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Introduction

MicroImages is pleased to distribute **V6.70** of the **TNT** products, which is the 52nd release of **TNTmips** and adds 124 new features submitted by clients and MicroImages. All **TNT** products can use now use a native Windows desktop and create and use JPEG2000 files with images compressed 100 times. **TNTsim3D** has more than doubled in features and is now a free **TNT** geopublishing tool just like **TNTatlas**. Generating buffer zones and fitting polygons to point observations have many new, unique features. Polygon and line label placement and appearance is improved and coupled with new, interactive label editing. Even more attractive maps can be created with new legend design tools. **TNT** map layouts can be converted to the new web standard Scalable Vector Graphics. And, all of these are now available for use with Apple's latest Mac OS X. A summary of the new capabilities introduced in **V6.70** are listed below.

- **Native Windows Desktop:** Elect to see and manage every **TNT** window and dialog as a separate window on your Microsoft Windows' desktop. In this mode, **TNT** windows are not directly rendered by the X server. Now **TNT** windows and other software's windows are intermixed and operate similarly.
- **ISO Standard Wavelet Compression:** Be the first to directly use, import, and export georeferenced JPEG2000, the replacement for JPEG files. Compress still images to 1/100 of their original size, where appropriate, without introducing any image noise or other artifacts.
- **Better Label Placement:** New label placement for polygons finds the best place in the polygon or outside with a leader line. Multiple like line segments are automatically assembled into a virtual line and assigned 1 label. Other elements in a layer, including polygon fills, are prevented from drawing in label clipping boxes.
- **Interactive Label Editing:** Pan successively to every label to check it and edit it and its placement as needed. Select and move a polygon label outside its polygon and a leader line is automatically added. Slide line labels along the line. Use many new text styling features and labels of more than 1 line in length.
- **FREE Real-Time 3D Simulations: TNTsim3D** for Windows is now free and can be distributed for use with any Landscape File(s). Use layer controls during a simulation to select or switch between various surface texture layers, which can be offset, merged, mosaicked, and be locally transparent. Open and maintain multiple simulation views with different viewpoints: at fixed points, special map view, down, left, right, and others. New readout panels provide all position and orientation parameters for all open views. Move cursor in any view and track its surface and distance coordinates in any projection and units.
- **TNTatlas and TNTsim3D:** Automatically start up a **TNTsim3D** simulation from any position in a **TNTatlas** and automatically orbit about, pan, or stare at the starting point before moving on in the simulation. Start up a **TNTatlas** automatically zoomed in to view the position selected in a **TNTsim3D** view.
- **Landscape Builder:** Create or add multiple texture layers in a Landscape File.
- **Scalable Vector Graphics:** Convert **TNT** map layouts to the "new flash," the World Wide Web Consortium's standard layout, all expressed in open XML for use in browsers, page layout, Illustrator, and many other products.

- **Transfer Attributes:** Transfer attributes provides new convenience options and all operations are faster, especially for polygons with a very large number of vertices.
- **Buffer Zones:** A completely rewritten process providing a display window to preview buffer zone results. Many new options have been added to assist in preparing complex buffer zone layers.
- **Polygon Fitting:** Large databases can be mined in a single pass to produce many separate groups of polygons in a vector or CAD object. Records representing points with common attributes are grouped together and fit with polygons and their attributes attached. Many such groups of points defined by their attributes can be processed in a single pass and all written to a single CAD or vector object.
- **Harmonic Analysis:** This is a new process using Fourier analysis to extract time dependent changes from the common multi-temporal set of images.
- **HTML-based TNTclient:** Easily customized to control which features are presented to its end user and this, in turn, controls its size during its download.
- **HTML-based TNTbrowser:** Now uses same HTML code base as HTML-based **TNTbrowser** and, thus, provides the same features. Downloads now as a familiar Windows installable program.
- **QuickGuides:** 9 new QuickGuides are available.
- **Getting Started Booklets:** 5 new Tutorial booklets are available as well as revised and expanded versions of 6 earlier booklets.
- **MacOS X: TNTmips**, **TNTedit**, and **TNTview** are now fully supported in Apple's native Aqua interface and desktop for all features including moving about a network via a floating license.
- **Better USB Key Support:** A new USB software authorization key permits a fixed license **TNT** professional product to be immediately moved between Windows, Mac 9.x, Mac OS X, and Linux based computers with a USB connector.

Optimize Your Performance

Multi-Processor PCs?

Periodically questions are received about the advantages, if any, of dual processor PC's for use with **TNTmips**. By now it is common knowledge that the operating system manages and allocates tasks or portions of tasks on dual or higher multiple processor PCs. However, as processors are added, the efficiency of the utilization of each processor goes down as overhead to manage them increases. It is only very specialized application software that is being written to directly manage multiple processors at once, and generally it is not worth it for a small number, especially 2 or 4. If you think you may need dual processors, buy a machine equipped to handle them but with only 1 installed. You can then plug in a second processor later when you need it or when they are cheaper.

Creating multiple threads in a given process more effectively utilizes a single processor and gives the operating system discrete activities it can allocate to different processors in a multi-processor system. Gradually, multithreading is being introduced into **TNT** products where appropriate as major sections are being revised and updated or as new

products are designed. For example, **TNTsim3D** uses multiple threads in the terrain server and application. **TNTserver** is also multi-threaded.

Since Moore's law continues to be applicable, rapid advances in the speed and other PC system optimization features continue to outpace the advantages of dual main processors when the cost is considered. By the time a processor chip's price drops so it can be economically combined with 1 or more additional processors, Moore's law and Intel's market plan go into action. Intel then offers a new, single, higher speed processor at a cost of less than the sum of the 2 earlier slower chips. Intel does not want a multi-processor system on your desk. If Intel's cost structure / market plan promoted multi-processor designs using a stabilized processor speed and focused on multi-processor designs, their competition could catch up and supply multiple, functionally similar processors for this purpose at a lower cost.

What is being overlooked by many who ask about dual processor systems is that the area of your display system and its speed have the most impact on your efficiency in conducting geospatial analysis or playing a game. As a result, the processing associated with visualizing complex images can be offloaded to the powerful, but specialized processor on your display board if you are careful in its selection. Thus, from the viewpoint of geospatial analysis, the era of dual processors is already widespread and cheap due to the high demand and economy of scale provided by video game technology and its market. A buyer of a new computer or display board must be careful to select one of the current advanced game driven display boards from ATI, nVIDIA or Matrox. It is usually the most economical to accept the display board integrated into your computer. However, by investing in the latest game board, whose price may range from US$100 (for a little earlier model) to US$400 for the latest model, will gain much more for you at a lower cost than a dual processor computer. Granted, it is sometimes hard to convince the grownup with the money, be that you or someone else, that you need the latest PC game board. However, this is an important and most volatile component of your **TNTmips** workstation. It directly exploits dual processing and is evolving so rapidly that your display board should be upgraded about once a year considering that its cost is a fraction of your workstation and monitors. For example, features will continue to be added to **TNTsim3D**, and this can lower your frame rate. To use more and more of these features, you may need to annually upgrade your display board to keep pace with this, the most active development area of PCs. There has been a lot invested learning your geospatial analysis skills, your equipment, and your **TNT** software. Support these big investments by making at least the small additional purchases (display board and monitors) that will make measurable increases in your efficiency and productivity.

Latest Display Board.

Matrox has just fired another shot across the bow of nVIDIA and ATI, Matrox's Toronto neighbor, with the introduction of its new Parhelia graphics chip and boards. Please see Matrox.com for all the details on the chip and the advanced features of the initial Matrox board using it. For an independent review of their first board (US$399) using this new graphics chip see

> Matrox Aims for ATI and nVIDIA in 3-D Graphics. by Dave Salvator. PC Magazine, 1 August 2002 issue. page 44.
> or online at pcmag.com/article2/0,4149,381586,00.asp

MicroImages' previous recommendations for the best all around display board for the **TNT** products were the Matrox G400, G450, and G550 series of boards. These boards

were recommended for their 2 standard multisync connections for dual analog monitors and their fast operation, including the support of DirectX 8 and OpenGL. The Parhelia chip, and the first Matrox board based upon it provide triple monitor support and the following advanced video display options:

dual independent DVI-out at 1600 x 1200 resolution for each,
dual independent RGB-out at 400Mhz spanning a total of 2048 x 1536 pixels @ 85 Hz, and
triple independent RGB-out in extended desktop mode at 3840 x 1024 pixels and 32 bits per pixel.

The cables for these various configurations are provided with the display board.

Matrox is promoting the triple monitor support to game developers as the basis for introducing "Surround Gaming." But you do not need to wait. With this new Matrox board and 3 of S150 17" flat screen analog RGB tube monitors, you can immediately use **TNTmips** to "get into your work."

MicroImages has just received this display board and completed preliminary testing with triple monitors using Matrox's Windows driver to span all 3 monitors. At this time it is the recommended board for anyone who wants to use **TNTmips** in an "Immersive Geospace." The attached color plate entitled Immersive Geospatial Analysis illustrates several uses of 3 monitors with **TNTmips**.

TNTsim3D pilot's window was also tested spread over all 3 monitors (a single simulation view of 3840 by 1024 pixels). It ran at 10 frames-per-second (fps) or faster if the point of view was close to the ground and 70 fps at higher altitudes and was impressive. The test machine used was a 600 MHz Pentium of an older design. This was adequate for an impressive simulation, but, higher fps rates will occur with a current design PC (2.5 GHz, 400 MHz front side bus, more cache memory on the drive, and so on). With 3 monitors, the US$3000 to US$4000 new system outlined below takes on the appearance of a much more expensive simulator. The attached color plate entitled: Immersive TNTsim3D illustrates several arrangements for your simulations on 3 monitors.

Computers.

The last time MicroImages recommended a complete, top-of-the-line computer for your geospatial analysis system to you was in the **V6.10** Release Notes in early 1999. As a reference point, that configuration is reproduced below.

MicroImages Recommended Computer in Early 1999 (**V6.10**)

Gateway Performance 550XL — US$4000

Intel 550 MHz Pentium III Xeon
128 Mb SRAM
512 Kb internal cache
18 Gb 9.5 ms ultra ATA 66 7200 rpm hard drive
19" VX900 color monitor (.26 dp)
AGP display board with 16Mb memory
4.8X DVD-ROM drive with MPEG2 Decoder
Philips CD-RW CD-Rewritable Drive
3.5" diskette drive
TV/FM tuner card
SoundBlaster sound card and 3-piece speaker system
56K modem

Tower case
Keyboard and MS Intellimouse
W98, MS Office 97 (w/o Access)

This is still a good low end platform for **TNTmips** for those who are not professional users. Note that it is approximately the computer used for the Matrox triple monitor display board testing of **TNTsim3D** described above. Many students still run **TNTlite** on slower computers with 64 Mb of memory. **TNT** processes are modularized for a small memory footprint, and processing lite sized data sets does not use much memory. In fact, students and the instructor in MicroImages' last training program used 200 and 333 MHz Pentium computers with 32 Mb of memory (unless they brought their own portables). Using these slower machines has partly been to insure that the training proceeded at an even pace. Fast training machines mean the action is merely over in a second without time to think about what is taking place. Working examples at a methodical pace also provides focus to those who get concepts immediately, or think they do, and then get distracted and begin to ask about other things. During teaching, instant results mean that underlying concepts may flash past.

Until recently the downward spiral of computer prices meant there was little choice and complexity in the computer to use for **TNTmips**. Everything had become standardized for the previous 3+ years. You simply bought the fastest machine with the lowest price and added memory as needed. About the only opportunity you had in that period was to add a CD writer. Now the price of a new machine with 3 to 4 times the processor MHz and many other standard features is US$600. Now Wal-Mart has a 850 MHz computer, 128 Mb memory, CD, and so on for US$299 (without monitor), which will run **TNTmips**. This "low ball" approach has lead again to healthy stratification with upper end design choices. One choice is to buy a self contained high end portable computer if mobility is important. The other is to design the best, state of the art geospatial analysis workstation for a professional. Both of these are outlined below.

Why spend US$3000 when you could spend US$600? What is the total annual opportunity cost for you to maintain yourself or someone else as a professional geospatial analyst: annual salary, training, office space, benefits (vacation, health, …) and so on, and the intangible cost of not doing it better, cheaper and faster than your competition. Compare this to the cost of using the best software available, keeping it current, and operating it in the most efficient fashion on a US$3000 computer, which will actually cost US$1500 per annum if upgraded biannually? The cost of your tools with which you actually produce work are only a fraction of your total cost. Ask your boss (we all have 1 or more) how much your wasted time is costing if you do not have the best tools available. If you are a consultant, you can not get more hours into the work day or get someone else to do it as well as you, but you can buy back some time by doing tasks faster (for example, best computer) and even better (multiple displays, latest software version, …).

Power Portable Workstation.

Sony VAIO GRX570 (8.4 pounds) US$2500
Pentium 4 at 1.60 GHz 512 Kb cache memory and 400 MHz bus
16.1" UXGA (1600 x 1200) TFT display
4X AGP ATI RADEON 7500
w/ 32 Mb VRAM (via 128-bit DDR SDRAM)
512 Mb DDR SDRAM

Removable (but included) 40 GB hard drive
Removable (but included) CD-RW/DVD-ROM
Ethernet 10/100 base
Jog dial and touch pad
2 PC Card slots
Sony memory stick slot
Integrated I/O connectors: firewire, 3 USB, TV out, Modem, Ethernet, VGA out, parallel, headphone, and port replicator.

While this portable has more of everything than other portables, it does not have wireless networking built in. However, a wireless network connection, if needed, is best added via the PC Card slot where it can be upgraded, as this is at the moment a very volatile and geographically determined technology. Sony has also recently announced memory stick cards for GPS, wireless, and other expansion features, which are interchangeable with their other products (base computers, cameras, and so on).

There are more and less expensive Sony VAIO's in this GRX series. This GRX570 model is designed for multimedia users and has a faster graphics board for things like **TNTsim3D** than the other GRX models. This multimedia GRX570 also has dual monitor support. Another analog monitor can be connected to the portable. As with other portables this can provide for a mirror (demo) monitor or for projecting the built in monitor's image.

This Sony model portable will also span your desktop across both monitors if you plan to use it as your base computer. This is available on very few portables most of which simply mirror the built in display.

Power Desktop Workstation.

This recommended US$3000 base station configuration is designed around 3 monitors to provide for immersive geospatial analysis. Using this system, **TNTmips** will provide your geospatial analysis on a desktop of 3840 pixels wide and 1024 pixels high). Tilting your left and right monitors at an angle to the center monitor will immerse you in that analysis.

Pentium 4 or AMD of at least 2.5 GHz or AMD equivalent. make sure: internal bus is 400 MHz PCI bus is 133 MHz AGP video is not built into the motherboard or can be disabled AGP4X slot is available	US$750
512 Mb of DDR memory make sure its expandable later to at least 1 Gb without replacement of first 512 MB	
Matrox triple headed Parhelia Display Board (see above section)	US$400
3 matched Flat Panel 15" inch monitors (analog multisync)	US$1200
DVD read/writer (not DVD-RAM) also capable of CD-RW	US$400
120 Gb Western Digital HD make sure it's the new one with 8Mb buffer, not 2Mb	US$200
Ethernet 10/100 base	US$50
Integrated I/O connectors: firewire and USB 2.0 cheaply added via combo PCI card	US$50

total US$3050

Design Notes.

To get the best buy for your money you may want to buy a bare bones computer (processor, memory, built-in Ethernet, IDE drive controller, I/O card, and WXP or W2000). With this in mind, most of the components of this base system are not specified by brand name. The Matrox Parhelia board is a must even if you use only 1 monitor (monitors can always be added later). Add your hard drive via a US$20 removable tray and add a second empty tray. Alternately, accept the built in lowest cost hard drive in the package (probably 40 Gb) and use it for your software drive. Then add the 120 Gb drive using a removable tray for easy swapping in and out with other hard drives providing more storage or various operating systems (which means, Windows and Linux).

If you need to reduce the cost of the above system to US$2400 use 3 matched 17" analog, flat screen CRT monitors at about US$150 each. If you can increase your workstation's cost to US$3600, then move up from 15" to 17" flat panels (Samsung is currently rated best for both sizes). Some clients are already planning to use double and triple 18" flat panel monitor systems, which provide very high quality images.

How many hours a day would you tolerate watching less than the best television picture before doing something about? You spend at least twice as many hours a day in front of your computer monitor! It's the quality of the display system and its speed that most impacts the efficiency of your work, especially in how long you can tolerate work day eyestrain and the long term outlook for your eyesight. Your display system is not the place you want to save money.

You can now purchase 4.7 Gb DVDR and DVDRW media at about US$1 each in 100 unit quantities, so its use is now practical (see rima.com).

Product Licenses

Large Format Printing.

By popular request the P15 large format printer option can now be ordered for **TNTview** and **TNTedit**. Previously, this option was only available for **TNTmips**. **TNTview** and **TNTedit** have already provided access to all the **TNT** map layout features. Now with the P15 option, they can print any map size larger than the standard 11" by 17" page and use "print to" to convert a **TNT** map layout to any resolution of TIFF, SVG, PDF, EPS, and Illustrator file. The price for P15 with **TNTview** and **TNTedit** is the same as the price for P15 with **TNTmips**.

New Universal USB Keys.

Why Add Another New Key?

V6.70 adds support for an additional type of USB Software Authorization Key manufactured by Aladdin and called a HASP key. It does not look very different from the earlier USB key manufactured by Rainbow and used for **V6.60** and earlier. It is slightly smaller in size and, unfortunately, is only available in the same drab purple color, so you will have to look closely to tell these 2 brands apart. The important difference is that Aladdin is much more progressive and responsive to changes in the marketplace and provides software drivers for new operating systems when they are released rather than years later or never.

How Universal Is It?

The new Hasp USB Software Authorization Key is supported in **V6.70** for use with the **TNT** products on systems running Windows, Mac OS X, Mac OS 8.6 & 9.x, and Linux. The only operating system it can not be used with are workstation UNIX's, since these platforms do not support USB ports.

How About an Exchange to Get It?

If you want to exchange any **TNT** product key for a new HASP USB key, that **TNT** product must be the current version at the time of the exchange (which means, **V6.70** at this time). The cost will be US$100, which just covers the cost of this new key and its average shipment anywhere in the world by fastest air express. The used keys that you return can not be reused for new products by US law.

Can It Be Moved Between Computers?

If you have this new USB HASP key, it is your **TNT** product and MicroImages' license permits you to move it freely between Windows, Mac, and Linux platforms. If you have a **TNT** fixed product license, simply plug this key into that computer, and go. If you are using this new HASP key to authorize a floating license, its virtual licenses can float to any platform including Windows, Mac OS X, Linux, or UNIX (but not Mac 9.x).

Think of moving the key for your fixed **TNT** license between platforms and the locations, such as the home and office, just as many are now moving data using the new USB memory keys. The difference is that the **TNT** key does not provide memory, but the authorization to start up and use the **TNT** products. As you know, **TNTlite** can be freely installed and run from the **TNT** product CDs or mircroimages.com on any supported platform. Plug in the USB HASP key to a computer with a **TNTlite** and it will run as your professional product, remove it and you are back to **TNTlite**. Choose **TNTlite**, **TNT** professional products, and any operating system: same interface, same features, same geodata resident somewhere on the network or moved about via your network or the Internet. If you want **TNTmips** software (which means, **TNTlite**) for other platforms, all you have to do is ask, and MicroImages will send you CD's for installation on additional different platforms, or you can immediately download any version from microimages.com.

Will TNT Project Files Move as Well?

It is also probably worthwhile to remind you that the Project Files you prepare while your USB HASP key is plugged into a Windows, Mac, or Linux platform can automatically be used between platforms – no conversion required (also includes UNIX when a floating license is used). And, of course, the functionality, operation, and user interface is the same it you move from one operating system to another.

Updated Floating License Manager.

The FlexLM license manager used for the floating license version of the **TNT** professional products has been upgraded in **V6.70** of the **TNT** products from the earlier version 6 to the current version 8. This was done to support Mac OS X, improve reliability, and license server stability.

No changes are needed on the machine where **TNTmips**, **TNTedit**, or **TNTview** will run. The license file will be automatically adjusted as needed.

Before installing the license server itself, you should

1) Shut down the existing license server.

2) Uninstall the old license manager.
3) Install the new license manager. This will go through the steps needed to restart the license server.

Free Upgrades Only By Downloading.

MicroImages discontinued providing new purchasers with a single, first free upgrade to its commercial products in late 2001 in connection with the announcement that MicroImages' new upgrade schedule would be at 6-month intervals instead of the 3- to 4.5-month intervals used over the previous 15 years. However, any client authorized to use the currently shipping version of MicroImages products, such as a new buyer, can obtain patches containing additional changes, improvements, and corrections to the MicroImages' products they own from www.microimages.com/freestuf/tntpatch/ under the following conditions.

Patches to MicroImages products are usually posted on Tuesday and Thursday of each week. Any client authorized to use the current version of a MicroImages' product can download and install these patches to that same version. However, when a new, replacement version of MicroImages products is officially shipped, any new updates released after that date can only be applied to that new version. In other words, updates to a purchased version are still available without cost only by download for about 6 months after that version first ships.

MicroImages does reserve the right to withhold any major new feature from the free patches to the currently authorized version. This may occur for a major new feature being prepared for the next release, which has probably not been released in the current version.

Mac OS X

Mac 10.1.5 Direct Support.

V6.70 introduces full support of **TNTmips**, **TNTedit**, and **TNTview** for the Mac OS X platform. The attached color plate entitled Geospatial Analysis is being distributed as a introduction to this product. These new **TNT** products use the same Apple Aqua windows motif as any other product. Just as with the new **TNT** Windows desktop for Microsoft Windows, you can not directly visually tell that the **TNT** products are running as derivatives of the Linux and UNIX versions.

TNTmips' performance on a Mac OS X platform is more or less the same as on any Windows platform, perhaps a bit faster in interface and processing than a Windows-based platform with a processor of the same megahertz rating. Its appearance is very pleasing, as is the Mac OS X interface in general.

This new version of the **TNT** products uses the same UNIX / C++ code simply compiled separately for each of the other operating systems. Almost all of the product code operated correctly the first time it was compiled under Mac OS X. The few errors that did occur were always there in the **TNT** versions for other operating systems but were more obvious in the Mac OS X implementation. However, the scourge of software developers was the same on this new platform – support of legacy devices (printers, GPS units, and so on). Even more complex and frustrating is the task of properly packaging the large **TNT** software package for trouble free installation on a Mac computer that might already have just about anything else installed on it. This might include several brands and previous versions of X servers, different versions of the window manager, at least 4 ver-

sions of Mac OS X, key drivers, several earlier **TNT** components, just to name a the few variables of direct concern.

As usual, the **TNT** products use an X server hidden in the background. This Darwin X server is open source, so its source code was compiled by MicroImages, and it can be modified in the future if needed. This X server is converted to look and operate exactly like the native Mac OS X Aqua windows using an X window manager named Orobor-OSX, which is the open software creation of Adrian Umpleby in Great Britain (see //julia.et.ic.ac.uk/adrian/). Samples of these attractive **TNT** Aqua windows can be seen on the attached color plate entitled Built for Mac OS X.

Installation is a bit more complicated than for the **TNT** products for Mac 9.x where you could simply copy them onto your drive. You can still simply copy all of this new **TNT** product code by dragging it to any directory, but now you must install the driver for the Software Authorization Key, the X server, and OroborOSX in separate installation steps, and the Apple installer package is a bit awkward.

Since all the familiar features of **TNTmips** are available in this new version, it has no close comparison on this Mac OS X platform. Just 1 example, **SML** scripts can now be developed on any platform, including this Mac, and run without alterations on it or any other **TNT** platform. There is nothing else vaguely like **SML** for custom geospatial applications available on the Mac. The various forms of **SML** scripts for use on this Mac are illustrated on the attached color plate entitled Use Powerful SML Scripts in Mac OS X. But, all the new **V6.70** features just being introduced now are also automatically available as well: JPEG2000 wavelet compression, Scalable Vector Graphics, label placement and editing, map layouts, advanced buffer zone and polygon fitting, even building Landscape Files.

Beta Testing.

A number of beta testers helped perfect the **TNT** products for release for Mac OS X as it evolved from **V6.6.1** to **6.6.7**. MicroImages appreciates their help, which has made **V6.70** a product ready for professional use with all of its features available. They identified printing, GPS access, coverage file import, installation, and other problems as we moved this version forward. May email (**V6.6.3**) from one of these beta tester is attached entitled TNTmips for Mac OS X: How good is it? providing his opinion as of that date.

Mac 9.x.

Contrary to an earlier announcement, **V6.70** of the **TNT** products **will not be** the last upgrade for this Mac OS 9.x.

Many Mac users have not yet switched to Mac OS X due to their legacy Mac products that just keep on working. As a result and by popular request, this will not be the last release of the **TNT** products for the earlier Mac 9.x operating system.

Editorial and Associated News [by Dr. Lee D. Miller, President]

And Yet Another Release.

This is the 52nd consecutive total release of **TNTmips** over the past 16 years. Yes, that's a lot of lines of code and hard work from the software engineers. Yes that's a lot of new features introduced and errors solved. Yes, that's a lot of pages of tutorials, manuals, and illustrations by our writers. And, yes that's me writing and assembling a lot of these MEMOs, (4000 to 5000 pages). Yes, we always seem to be chronically late in getting that next release out (remember, each single day's delay costs MicroImages a lot of money, since we have guaranteed you 2 releases in your annual maintenance). And yes, we may never seem to get to that specific feature of interest to you. However, with your input, support, and patience and our decisions, we are still striving to provide you with up-to-date software at a reasonable price. **TNTmips** is powerful software that defines geospatial analysis by its integration of GIS, IPS, surface modeling, visualization and publishing tools, and so on. However, we have been at this so long that some of our clients are beginning to "retire out" and say goodbye to us as documented in the attached color plate entitled TNTmips: 16 Years And Still On Top.

Things have progressed a little differently during this release cycle as the new features, which the brave could download early, test, and use, were introduced by placing their descriptive color plates prominently on microimages.com. This followed quite naturally from the considerable effort made here to locate all the color plates from previous MEMOs and resurrect them wherever possible. The attached color plate entitled Color Plates on the Web provides additional details on this completed project. Now the 400+ color plates introducing new features in these MEMOs are available for your easy review, access, downloading, and translation as map layouts with data where appropriate or as PageMaker files. A PDF version of all plates is also available for download. Monitor microimages.com for additional color plates on features you can try out as they are added to **V6.80**, especially for **TNTsim3D**. The next project is to provide you a cross-index by application to all the previous MEMO's contents, these color plates, Quick-Guides, Tutorial booklets, and miscellaneous **TNT** reference materials.

For your convenience you can now proceed directly to the microimages.com home page using any of these aliases:

microimages.us	microimages. biz	tntatlas.com
microimages.info	tntmips.com	tntsim3d.com
microimages.net	tntedit.com	tntsim.com
microimages.org	tntview.com	

Let's Get Powered Up.

Okay, lets powerup your geospatial analysis to a new level. This need is summarized in this portion of a recent email to MicroImages.

> *… [A name] and his staff did satisfy our concepts very much and all officers had seen our TNTmips presentation with surprising on how fast of TNTmips displaying to handle the whole country's geodatabase – while they also saw TNTmips could handle both GIS and remote sensing in single product.* …

Yes, **TNTmips**, **TNTatlas**, **TNTsim3D**, and so on, can efficiently handle these large geodata sets. But the project size you tackle and then challenge us with continues to grow: whole nations, whole states, and whole counties with high level of detail. We must keep redesigning and adding features to meet your expanding expectations for the

TNT products. You must help us by investing in the latest equipment for your larger and larger projects.

In the technical sections of this MEMO, I present several new opportunities provided by **TNTmips 6.7** and new economical equipment to conduct large scale, powerful geospatial analysis. Let me review them here.

With New Equipment.

Use the new Matrox based triple monitor system to expand your Windows desktop to 3840 by 1024 pixels for all those windows you will be juggling. It is also a game driven board that will give you top performance from your rapidly expanding **TNTsim3D** simulations. A powerful, multitasking processor of 2.5 GHz or more will keep all these multiple tasks humming and/or rapidly form 3840 pixel wide geospatial views if that is what you are about. Next add a 4.2 Gb DVD writer to move big geodata sets about and fast 120 Gb drives via a removable carrier to exchange as needed.

The typical international geodata assets of whole states, provinces, or smaller nations, or businesses can be organized and utilized in **TNTmips**. More results and utilization means scaling up the number of floating licenses and those trained in professional or opportunistic applications. However, geodata richness, resolution, and precision keeps expanding, and we all must keep running to keep up with the size of this geodata and the new applications it enables. For example we are all now beginning to cope with sub meter satellite images, a state/country wide DEM raster, large complex vector objects for large areas or complex map layouts with smart attributes, and a nation wide database. It is now proposed that for “homeland security” we need to assemble a standardized, high resolution geodatabase of 400 different data layers.

And the Latest **TNT** Features.

Using the new Windows Desktop option, each **TNT** window is now independently exposed, and these windows can be manipulated in the familiar Microsoft motif along with other concurrent products operating at that time. This native windows approach is also used for the new Mac OS X release of **TNTmips** and has always been an option for Linux and UNIX workstations.

Now couple this with some of the other new features available to you from **TNTmips** before any competing mainline GIS or IPS product and included as standard features without any additional cost as part of your **V6.70** upgrade. Use ISO standard JPEG2000 for compressing, storing, and moving huge images where appropriate and SVG for compressing and moving around W3C standardized complex layouts. A FREE, distributable **TNTsim3D** with an expanding set of features and local analysis tools now joins **TNTatlas** and **TNTserver** so that you can publish your geospatial results with an expanding set of local tools.

Why a FREE TNTsim3D.

How do others do it?

Other GIS and IPS developers offer simulation products. Like MicroImages, they also provide a process in their basic product or as an option to organize and streamline geodata to represent a particular landscape in an optimal format. This format is needed to support realistic simulation on low-cost desktop computers. It exploits the desktop computer display board and rendering software whose development is now driven by the game industry.

Unlike MicroImages, they may charge extra to add the capability to build this landscape model and extra to use it in conjunction with one of their "paid for" products. For example, ERDAS charges a substantial optional fee for the capability to assemble a landscape model. In addition, you must then have their standard system to "fly" this landscape. ESRI continues to follow its "a-la-cart" marketing model requiring an optional product to view their simulations.

Last minute information: It has just been brought to my attention by a client that they have had **TNTsim3D** working in stereo with an NVIDIA GeForce4 board and US$100 stereo glasses called "Another I's" (www.stereo3d.com/anotheris.htm). Since the NVIDIA drivers provide this stereo capability it should work with any of the stereo devices they support. For more nVIDIA information on this support of stereo and the viewing devices their drivers support, which range in price from US$100 to US$5000, please start with the short article entitled : Featured Technology: NVIDIA 3D Stereo at www.nvidia.com/ view.asp?IO= IO_20010614_4380. Preliminary investigations also indicate that any board that features support for a stereo device will show **TNTsim3D** in stereo including those from ATI and Matrox.

What was the initial approach?

The Landscape Builder process, which provides you with the ability to build landscapes, was first included as standard in every **TNTmips 6.6**. Many of you are now using it as part of your use of **TNTsim3D**. In **V6.60** your landscape model could be assembled free of additional charges, but its use was limited to your or any other **TNTmips 6.6** system. As an introduction to this marketing strategy, **TNTsim3D 6.6** was also concurrently released in a free introductory "keyless" version with identical features to the same version included and installed as part of **V6.60**. Rapid development then proceeded on the "keyed" version of **TNTsim3D**. Some features of this keyed version were initially made available in the free version after **V6.60** via new postings on microimages.com. But, development rapidly continued and new and useful features were added to the keyed version every week or two. Gradually it became complicated to determine what was to be free and what was not.

It also became apparent that **TNTsim3D** was beginning to parallel **TNTatlas** in concept and your potential use of it. It surprised us how many of you had appropriate geodata and immediately used it in geospatial simulations. Finally, new design objectives for **TNTsim3D**, other than simply responding to your requests for a simulation capability, also became clearer to us. What you did not need was another flight simulator – the prime objective of other competing products. What you need is another mechanism to freely publish and distribute the rich geospatial materials you develop in **TNTmips** accompanied by tools for their local use in quantitative fashion.

What is the revised approach?

Effective with the release of **V6.70** all **TNTsim3D** code has been disconnected from the **TNTmips** software license key. **TNTsim3D 6.7** is now FREE and, as a result, your new use of it will closely parallel that of **TNTatlas**. You build up your 3D terrain model within **TNTmips** and publish and distribute it however you choose in whatever quantity you choose along with a free copy of **TNTsim3D**. You can put **TNTsim3D** on a CD or DVD with a standard installation program for use with your Landscape Files. With a little planning and compromise, you can even put **TNTsim3D** and **TNTatlas** on the same CD/DVD and use the same landscape objects embedded and shared in a **TNTatlas** Project File(s). You or your client can also download a complete, current version of

TNTsim3D packaged with the standard Windows installation program from microimages.com. Sample Landscape Files demonstrating some of **TNTsim3D**s features can also be downloaded from microimages.com. Remember that while **TNTsim3D** is compact and easily downloaded, Landscape Files can be large for areas other than local examples. You can even host an installable **TNTsim3D** on your intranet or Internet site along with your models in Landscape Files.

How about an X version?

TNTsim3D has been designed from the onset to potentially operate across all popular platforms by being built for operation with either DirectX (for Windows) or OpenGL (for Windows, Mac, UNIX, and Linux). To date we are only providing you with access to the Windows version of **TNTsim3D**. **TNTsim3D** for all other platforms will require that its user interface (dialogs and views) be redeveloped for use in the X window structure. This will require effort even though we have a mechanism in place for designing a GUI once that works on both the Windows and X platforms (as is now done for **TNTatlas**). Most of the development work would actually be required to work out the packaging (for example, perfecting language support, assembly, installation, …) for reliable distribution by all means for each platform. As a result, while **TNTsim3D** could be released for these other platforms, this will occur when the economics, which means, the sale of related **TNTmips** units for those platforms, justifies the effort involved in releasing and maintaining other non-Windows versions. Of course, you can already build your Landscape Files on any **TNTmips** supported platform (for example, on the Mac) for distribution and use with the Windows version of **TNTsim3D**. Thus you can use the platform of your choice for your geospatial analysis, and yet 95% of the people who might be interested in using your simulation can do so using the free **TNTsim3D** for Windows.

Wavelet Compression Via JPEG2000.

Summary of Initial Implementation.

V6.70 of the **TNT** products now supports the direct use, import, and export of rasters using ISO standard JPEG2000 compression in the ISO standard JP2 still image format (*.jp2). As you know, **TNT** permits you to work with a wide variety of raster data types ranging from 1-bit binary to 128-bit complex numbers and from grayscale images to hyperspectral images. Sorry, the JPEG2000 standard does not support images using floating point numbers. But, you can now export any signed or unsigned **TNT** integer or color composite raster object(s) to JP2 files for use in any other system that can use a JP2 file of that data type. For example, images or other rasters that are signed or unsigned integers or color composites can be imported from any external format supported by **TNTmips** into raster objects in a Project File and then immediately exported to JPEG2000 compressed JP2 files. It is even easier if the external format is supported for direct use by the TNT products, such as GeoTIFF, ECW, or MrSID, as they can be directly exported to JP2 files with JPEG2000 compression (no import is required). Images or other rasters created in **TNT** products in this fashion, or created in some other commercial product can immediately be directly used in **TNT** products (linking to JP2 files is automatic and transparent). For example, **TNTatlas** can use linked JPEG2000 compressed JP2 files. A JP2 file exported from a georeferenced raster object in a Project File or via a link to a georeferenced external file format (for example, GeoTIFF or MrSID) will automatically be georeferenced when directly used by any **TNT** process.

An ISO Standard, Not a Proprietary Product.

Is it JPEG2000 or JPEG 2000? This seems to be a confusing point. For JPEG2000 Google gets 16,300 hits. For "JPEG 2000" Google gets 12,700 hits and asks "Did you mean "JPEG2000"?" So, at this time MicroImages is following Google rules and using JPEG2000, which also relates to and contracts better to JP2, which is how everyone is referring to JPEG2000 compressed still image files.

If you review JPEG2000 compression on the WWW you will find the names and affiliations of those involved in its creation and technical exploitation are widely scattered around the world. It is not some United States convention, but a widely developed and supported ISO standard based on an international initiative. The few technical articles sited later in this MEMO represent individuals who are in Greece, Australia, Switzerland, Germany, … Clearly the wide international adoption of the ISO JPEG2000 standard is very significant to the future use of image materials of all types and, in particular, to remote sensing, which creates the most massive still images. JPEG2000 encoding and decoding chips have already been implemented by the Chinese for use in television and recording devices. Of course, it will take considerable time for JPEG2000 to gradually replace the widely used JPEG. Similarly, while immediately useful in **TNTmips**, it will take some time to fully integrate JPEG2000 concepts seamlessly into all aspects of the **TNT** products such as **TNTsim3D**, apply it directly in raster objects, and so on.

Another MicroImages First.

I have carefully reviewed the WWW and believe that this may be the first integration of JPEG2000 support into a full scale geospatial analysis system and a remote sensing image processing system in particular. In fact, for tests during our initial development we could find only 2 JPEG2000 still images files (*.jp2 files) posted on the WWW. As a result, microimages.com will soon host a variety of *.jp2 files representing images of varying types for possible test use by others.

Last minute information: It has come to my attention that MapInfo Professional and MapBasic v7.0 have just begun shipping with "JPEG 2000 support – JPEG 2000 format is supported in raster files, as well as Save Window As menu options" (see www.mapinfo.com/products/mipro/beta_70.cfm).

When applied properly, JPEG2000 has significant benefits in geospatial analysis and geopublishing. However, you can not choose to create lossy still images to save storage, to decrease web bandwidth requirements, and so on without giving up something! Your applications of lossy compression should carefully consider what is happening to your images or rasters and what this will do, if anything, in any possible future application of them. We certainly do not want a repeat of the past few years where 10s of thousands of orthoimages were heavily compressed via MrSID to save drive space and to speed downloading. This provided "good to look at" pictures. But, inexperienced staff and organizations, in an effort to save a few dollars in storage media, often did not archive the lossless source materials and purged them. Even when the lossless images are archived, they are not easily accessible for more precise applications, such as change detection compared with current images. Even more insidious are client inquiries as to why multispectral images that have been imported into **TNTmips** from lossy formats give such strange results when used in the automatic multispectral image clas-

sification schemes. Obviously you can not lossy compress multispectral or hyperspectral images without skewing their statistics.

SVG or Not to Be!

It's Not a 1-Act Play.

"Yes raster is faster, but raster is vaster, and vector just seems more correcter." (Tomlin, 1990). *"Unless instead you plan ahead, use true geospatial analysis to avoid paralysis, and become ambitechuous"* (Miller, 2002 or 1992, 1982, …, I forget which it is).

Tomlin, Dana (1990). Geographic information Systems and Cartographic Modeling, Prentice Hall, Englewood Cliffs, New Jersey.

Miller, Lee D. (2002). Created on the spur of the moment in reaction to reading this statement and after 15 years of trying to prove that neither alone is better.

All this reminds me of the often quoted statement that the "best GIS is one which will represent every raster cell as a vector polygon."

Or, the newly exposed position being taken by the IT czars responsible for major corporate databases who insist that everything has to be embedded in their database for security reasons.

Setting the Stage.

There is a very good 19 page, succinct, layman's discussion entitled
Vector-based Web Cartography: Enabler SVG in German, French, and English with follow-up contributions (alas only in German) at carto.net/papers/.
This synoptic paper by Andre M. Winter, Institute for Geography and Regional Studies, University of Vienna and Andreas Neumann, Institute of Cartography, Swiss Federal Institute of Technology, Zurich summarizes the many competing WWW vector formats: Flash, DWF, PDF, VRML, HGML, WebCGM, and others. This is a preamble for their explanation of why the SVG subset of XML is the most current and suitable format for cartography and web cartography in particular including animation, metadata, and extensibility. This review, published in November of 2001 (9 months ago) finishes with a discussion of the export to SVG from other products as follows:

"Exporting from a graphical or DTP program is a way to directly obtain displayable results. You need a program supporting SVG export; to this day, that is the case with the latest versions of Adobe Illustrator and CorelDRAW, and with a number of drawing programs for the open source domain (Sketch, Killustrator, etc.). Adobe is planning to integrate SVG into its whole range of products. Macromedia, whose Freehand is widely spread amongst cartographs, does not follow this lead yet. In this context we must mention that Macromedia supports the Flash format described above, which is a concurrence product to SVG. Macromedia nevertheless participates in the SVG specification, which lets us suppose that sooner or later it will be supported.

"Just as the case with every export out of a graphical program, if you save a file, it is written out in the target format, SVG. At this occasion, details are asked as to modi wished (e.g. embedding fonts, resolution of the drawing grid or mode of depositing style data). Names of drawing levels and objects are preserved. With Illustrator, there is an option to assign links to SVG objects, and to include simple JavaScript functions. As we know from similar export possibilities for image maps, this will not be enough for demanding applications. Therefore, 'manual' editing of the code will be necessary.

"Frequently, data is directly available in GIS. There, too, you have the possibility to generate SVG data. Since at present there is no export option implemented, you will need to export the data (usually vector data) into a readable text format. Thus you have to rewrite the data using pattern matching (e.g. PERL) to get SVG capable code. Finally, the SVG objects thus created will be surrounded by the remaining information (attribute data) essential to a cartographic SVG project.

"As we have stated, SVG supports Bezier curves. GIS applications frequently won't [as it seriously complicates maintaining topology]. *Given that SVG was created with the Internet in mind, file size needs to be limited. Complicated curves, which are over defined for SVG, can be converted to Bezier curves quite easily in a graphical program, resp. number of vertices can be reduced. For this reason, at times using a common graphics software is preferable to generating directly in GIS.*

"In order to work with optimal file size, it is possible to compress an entire SVG file before sending it to the WWW browser. In this case it must be correctly referenced and embedded into the HTML file."

For the Current Act.

V6.70 of the **TNT** analysis products now sets the stage for the next act in the GIS rollout of SVG. Based on the statement of the GIS versus common graphics software situation outlined in the paragraphs above by Andre and Andreas, **TNT** is the first commercial geospatial analysis system (call it GIS if you are old-fashioned or narrow-minded) to convert complete, complex GIS derived cartographic layouts into an SVG format for use elsewhere.

As usual, converting **TNT** layouts to SVG is available as an identical operation on all common platforms: Windows, Mac, UNIX, and Linux. At the moment, **TNTmips** seems to be standing alone as the only advanced topologically vector oriented GIS for Mac OS X – even though it is the platform preferred by many cartographers. Assembling complex map layouts from all kinds of source materials and converting them to SVG, PDF, EPS, TIFF, and others provides a significant new capability for cartographers using Mac OS X.

Overall, from my chair, this capability has been added to the **TNT** analysis products on all platforms with some hard work, but without particular difficulty. What was key to this was the 18 years of effort MicroImages has already invested in gradually adding many features into the **TNT** products to make complex maps combining all kinds of cartographic, CAD, GIS, and image data on all platforms. Converting a **TNT** layout to SVG (export is really too weak a term to apply to converting layouts) including specialized content, such as CartoScripts, TrueType fonts, linked rasters, and relational attributes was primarily a long series of questions of where to put everything in the SVG XML format.

As always, when developing a complete new **TNT** process, a couple of pesky artifacts in our earlier design of **TNTmips** surfaced that do not interface well with SVG (or previously with Illustrator or PDF). These are being addressed now (post **V6.70**) and include the need to support embedded fonts and to save hatch patterns as styles using line descriptions. Embedded fonts can now be used (post **V6.70**) during conversions of a **TNT** map layout to a PDF file. This is a precursor to providing an embedded font approach for conversion of a **TNT** map layout to an SVG file. Better support of hatch patterns is also being designed now. The corresponding technical sections below discuss the ap-

proach and status of these improvements in more detail and you can obtain them as patches to **V6.70**.

The Next Act.

A hint of where SVG leads is revealed in PCWeek news magazine July 1, 2002, page 7. Canada's Research in Motion Ltd. sequel product to the BlackBerry wireless device is reviewed under the title RIM Takes Global Route. See the full article at www.eweek.com/article2/0,3959,322251,00.asp for more information on this new GSM/GPRS wireless smart phone due this fall with PDA, full keyboard, and web access capabilities. For SVG use in other PDAs see http://research.bitflash.com/sdvg/ SVGBDemoRep.html.

Nothing is said in this article about the OS being used, any browser, or any other software specifics. However, the 1 thing that the RIM CEO revealed is that *"By the end of the year, RIM's BlackBerry devices will also feature color screens and an enhanced media engine that supports scalable vector graphics, officials said."* A cursory internet search reveals that there is now something called "SVG Tiny" and "SVG Basic," which are designed for cell phone (Tiny) and PDA (Basic) applications (www.w3.org/TR/SVGMobile/). How SVG relates to SVG Tiny and Basic and MicroImages' conversions to SVG is yet to be determined. However, as we have already experienced, Tiny usually means some features are not supported as in the use of "Pocket Explorer 3.0" (for example, no dynamic HTML).

Clearly, as will be discussed in the **TNTmips** section of this MEMO entitled Scalable Vector Graphics (SVG), the delivery of complex electronic maps over the web will use SVG in standard browsers, specialized devices, self contained programs, and other approaches. MicroImages is again pleased to equip you in this upgrade with the first known system to combine its many advanced geospatial analysis capabilities with the ability to create complex SVG products for subsequent use in many diverse applications.

National Mapping Programs.

We have gradually implemented, via several releases, your requests for more complex map layout tools, especially for legends. This release provides more in the form of improved label placement and position editing, interactive insertion of samples into legends, and legends for your unique features rendered by CartoScripts (requested by many of you). While we still have more ideas and improvements in store, **TNTmips** layout capabilities, backed up by our spatial data editor, have matured into full scale paper and electronic map production and publishing tools.

To illustrate how these tools can be used, I have initiated a new booklet series showing how **TNTmips** can be used to make high quality maps of various types. Two preliminary booklets on Making Geological Maps and Making Topographic Maps are available as part of **V6.70**. It is our plan to expand these booklets and prepare others related to making other types of maps such as planimetric, highway, image, tourist, and so on.

Coincidentally, after this series of booklets was initiated, several new map making activities using **TNTmips** have emerged and some aspects of these can be discussed here.

NIMA.

Background.

The following was extracted from a short CIA summary about the creation of NIMA at www.cia.gov/ic/nima.html.

"NIMA was established on October 1, 1996 as a Department of Defense (DOD) combat support agency. It is a member of the Intelligence Community and has been assigned, by statute, the additional mission of providing support to national-level customers and other government agencies. NIMA provides ready access to the best-available imagery and geospatial information, supports national decision making, and contributes to the operational readiness of America's military forces.

"Since its standup, NIMA has emerged the previously separate disciplines of imagery and mapping has assumed leadership of the imagery and geospatial community. Through its management of the U.S. Imagery and Geospatial Information System (USIGS), NIMA provides customers the critical data necessary to achieve a dominant awareness of the mission space in which they operate.

"NIMA is committed to attaining information superiority in the mission space of the next century, as well as to addressing civil issues critical to U.S. national interest, and improving the decision and cycle times for those who make and execute national security policy. The Agency's focus is on providing high-value information and laying the foundation for the more efficient exchange of data and integration of products and services."

After 6 years, the existence of and mandate of NIMA is not yet commonly known to the public in the United States or elsewhere (it does not have a high profile mission like NASA). However, NIMA was assembled by this legislation from some previously well known, and some not so well known, components of other departments and agencies as follows:

- Department of Defense's (DOD) big Defense Mapping Agency (makes all military maps),
- Central Intelligence Agency's (CIA's) Central Imagery Office (CIO), which was their National Photographic Interpretation Center,
- DOD's Defense Dissemination Program Office (DDPO), and the
- CIA's National Photographic Interpretation Center.

To these the law added in the imagery exploitation and dissemination elements of the:

- DOD's Defense Intelligence Agency (DIA),
- National Reconnaissance Office (NRO),
- DOD's Defense Airborne Reconnaissance Office (DARO), and
- other smaller Central Intelligence Agency (CIA) components.

You can imagine the complexity of melding together the bureaucracies and culture of these various secretive groups. As with all new U.S. Government entities assembled from other agencies, it takes time and prodding to get things properly rolling together. Thus, to support this complex undertaking, Congress requested that an Independent Commission be formed to review the startup of NIMA and its needs and objectives. This Commission's report was published in December of 2000 (18 months ago and prior to 11 September). This investigation and its report was managed by a 9 member commission made up from appointees from the CIA, NRO, Defense Science Board, and others. It may also be of interest to note that 1 of these 9 Commission members was Jack Dangermond, President and owner of ESRI (Environmental Systems Research, Inc.) the source of the ArcINFO ArcGIS, ArcView, and so on.

This Independent Commission's external review of the tasks and needs of NIMA is entitled The Information Edge: Imagery Intelligence and Geospatial information in an Evolving National Security Environment. This complete 163 page Commission report has been made publicly available at www.fas.org/irp/agency/nima/commission/toc.htm by

the Federation of American Scientists. The FAS was founded by the scientists of the Manhattan Project, creators of the atom bomb, acts as a United States national science conscience, and is endorsed by 60 Nobel Laureates. Their web publication of this Independent Commission's Report provides a good overview of NIMA and its activities and future needs.

I believe you will find from their report that this Commission primarily concludes in 163 pages that what is needed is a single, well integrated geospatial analysis system for image and GIS analysis coupled with motivated professionals who know how to use it.

The commission's clearest observation of our national initiatives in mapping and image use is on the first page of the Executive Summary and Key Judgments and is repeated in many ways and themes throughout the report.

"The Commission validates the charge that the Intelligence Community is 'collection centric,' thinking first of developing and operating sophisticated technical collection systems such as reconnaissance satellites, and only as an afterthought preparing to properly task the systems and to process, exploit, and disseminate the collected products."

Throughout the body of the report you will find many very clear observations that this exploitation will require much closer integration between NIMA's Image Analysts (IAs) and Photointerpreters (PIs) and its smaller group of GISers.

Just a few samples of a theme that is widely expanded upon in this report:

"By whatever name, IAs and PIs historically have seen themselves as distinct from geographers and cartographers – the stuff of Geospatial Information Systems (GIS).

"Despite some encouraging experiments with collocation of the two disciplines, and encouraging examples such as recounted below in the Tale of Two Cities*, the Commission has looked largely in vain for real convergence."*

The Tale of Two Cities is a caustic review showing how an IA team and a GIS team would quite differently approach a battlefield intelligence collection activity and outlines the synergism that would result if they closely collaborated and integrated their efforts. Referring again later to the Tale of Two Cities is the bottom line.

"Or, does it presage the next generation of intelligence professional, schooled in both imagery and geospatial analysis disciplines."

The report's terminology varies a bit here as throughout the entire report the term geospatial analysis is widely used to refer to the objective of integrating IA and GIS activities. However, it is clear that those well versed in the use of **TNTmips** would already fit this requirement.

The latest news on this subject is in this Northrup Grumman Press Release, which can be read in its entirety at www.irconnect.com/noc/pages/news_releases.mhtml?d=29398.

"HERNDON, Va. -- July 9, 2002 -- A team led by Northrop Grumman Corporation (NYSE: NOC) has been selected by the National Imagery and Mapping Agency (NIMA) to develop its Commercial Joint Mapping Toolkit (C/JMTK). The contract is worth $72 million to Northrop Grumman's Information Technology (IT) sector, and will add approximately 30 jobs to the company's offices in Chantilly, Va." …

"The program will focus on the development of a commercial version of NIMA's Joint Mapping Toolkit, which provides military and intelligence agencies with a common suite of imagery software versus independent versions produced by various organizations.

"The C/JMTK program will insert COTS geographic information systems (GIS) components into the DII COE and associated Joint and Service C4ISR systems using ESRI's ArcGIS software as a foundation. This system will provide the warfighter with a comprehensive range of mapping utilities, analysis tools, and visualization to support real-time situational awareness, track management, terrain analysis, multi-intelligence fusion, and other important geographically based functions. The C/JMTK program will use a common spatial information infrastructure and open software application framework." …

"In addition to ESRI, other members of the Northrop Grumman IT team for C/JTMK include Analytical Graphics, Inc., Malvern, Pa., and ERDAS/Leica Geosystems, Atlanta, Ga." …

For more information on this subject see the NIMA Press Release, which can be read in its entirety at www.nima.mil/ocrn/nima/hot/jmtk.html.

IEC

Imagery Exploitation Capabilities (IEC) is a major production program of NIMA, which creates highly accurate digital terrain models using British Aerospace Electronics' (BAE) Socet Set soft photogrammetry product, RemoteView for image interpretation, and so on. The NIMA IEC staff uses a mix of UNIX and Windows 2000 analyst stations. These stations draw upon imagery in a huge centralized classified image base.

A fixed number of carefully orchestrated, qualified software products make up the IEC station's production tools and must all be carefully tested to work together. About 25 products in all are involved and 85% of them are unclassified Commercial-Off-The-Shelf (COTS) products and 15% of them are Government-Off-The-Shelf products (GOTS), which usually have narrow, specialized classified objectives. Many of these products have a specific purpose – for example, one COTS software product is used just to make the color CD labels, another COTS to interface to a specific printing plant format. One GOTS package de-resolves (degrades) image resolution from classified to unclassified for use in situations where the product that contains the image may be compromised.

The current V2.x software mix for the IEC workstations makes several major products available to the analyst's. These include BAE's Socet Set for subpixel soft photogrammetry, some specialized 2D and 3D image viewing and mensuration tools, Leica's ERDAS Imagine for more specialized image interpretation, and a suite of ERSI's Arc products for GIS operations. MicroImages is pleased to announce that **TNTmips 6.8** will be a new addition to V3.0 of the IEC software collection scheduled for release in 2003. **TNTmips 6.6** and **6.7** are already in use at BAE, Lockheed, and NIMA sites for their tedious qualification procedures to insure that all 25 software products are reliable and can be used on the IEC station in any combination.

Lockheed is the prime contractor on the current 7 year IEC equipment, software, and training program initiated in 2000. Additionally, they are responsible for the Image Analyst (IA) software on these stations. BAE is a major subcontractor responsible for the soft photogrammetry via Socet Set now sold by Taliesin, a BAE wholly owned commercial subsidiary. They are also responsible for the GIS oriented activities on the IEC station. The IEC workstation is used to produce about 100 NIMA products. It is through BAE, and to meet requirements to rapidly produce new specific Image Map Products that **TNTmips** will be deployed. Once authorized and deployed, **TNTmips** can float to any IEC station for whatever other uses of it may be discovered. The Image City Map product is unclassified but restricted in its distribution. It has previously been distributed

as a very large format paper map, but will now also be made available as an electronic "smart" map using a **TNTatlas** CD or DVD.

This MicroImages activity in connection with BAE and NIMA is totally unclassified as is all our facility and all our activities. The IEC program will be using our standard **TNTmips** product and we have not contracted to anyone for any special modifications to any **TNT** product for this IEC release. Any software features that might be added to **TNTmips** to support this client's activities, will be generic in nature, of use to you, and available to all as part of our normal annual maintenance contract.

Providing further information here about NIMA's objectives, the IEC station, the Image City Map, Lockheed's and BAE's contract activities might be touchy subjects. So, for more information, I would like to refer you to the public world wide web to learn more about NIMA and their current IEC program and ICM products in particular.

I will conclude here by noting that at present there is great pressure from congress on NIMA, with roots in the highly classified world, to expand the of use commercial unclassified image sources, primarily from satellite since it maps the world, for many of its map products. This would remove the principle reason that such activities are classified. The Directors of NIMA and Homeland Security agreed in public statements with this idea several months ago. However, it is not clear how this will actually resolve itself in the light of our United States and your nations' homeland security. Using public, low bidder production of these electronically based, unclassified materials can mean they can be easily moved out from any control in electronic form into the public domain via the Internet and be available to anyone. As discussed elsewhere in this MEMO the W3C's open Scalable Vector Graphics XML structure is an excellent means of moving complete maps anywhere, anytime, and quickly.

However, there is now already considerable movement in the direction of contracting out this unclassified map production (outsourcing this work) to unclassified vendors for many of the standard product map making operations of NIMA. Some of this started in 1999 and later with classified contractors: see Agency outsources imaging and mapping duties via US$600 million omnibus project (www.gcn.com/archives/gcn/1999/February8/44b.htm). This has now moved on to a new level of outsourcing via the special status of American Native organizations as follows:

NIMA, Alaskan Firms to Sign Controversial Deal. Washington Technology, 9 September, Vol. 16, No. 12, 2001.

"The National Imagery and Mapping Agency this month is expected to sign a controversial 15-year, $2 billion outsourcing deal designed to help Alaskan Native companies.

"The project, which will outsource some 600 jobs to the private sector, has aroused opposition in the information technology industry and among government employee unions. They question whether the government or Alaskan Natives themselves are benefiting from a special program that allows the Defense Department to bypass normal acquisition procedures in order to award contracts to designated Alaskan Native Regional or Village Corporations. …

"Alaskan Native corporations are regional and village corporations owned by the indigenous people of Alaska. The corporations were formed under a 1971 federal law giving them preferred procurement status in exchange for federal rights to traditional Native land."

To further complicate things the actual work under this contract will not be done in Alaska by these native corporations, but by a corporation they have set up in McLean, Virginia to be close by the NIMA offices and potentially employ former NIMA employees displaced by this outsourcing. (For the complete article on this very controversial contract see www.washingtontechnology.com/news/16_12/federal/17120-1.html)

There is now considerable "below the radar" discussion of what would happen if this kind of work were to be allowed to move outside the United States to the lowest bidders.

NIMA Topology.

While we are visiting the subject of NIMA a technical item may be of interest. NIMA's GIS side is in the forefront of defining the various topologies of vector geodata and in turn their potential applications. MicroImages vector objects adhere to their definitions for Levels 0, 1, 2, and 3 and the **TNT** products maintain and can convert between these topological levels during editing and analysis. Of particular note is that NIMA is now defining topology Levels 4 and 5 for full 3D and even multi-temporal geospatial data creation, storage, and analysis.

Level 0: (**TNT** non-topological or spaghetti vector object)

Name:	Boundary Representation (2D or 3D coordinates)
Primitives	Entity nodes & edges.
Relationships	none
Description	A set of entity nodes and edges

Level 1: (**TNT** network topology vector object)

Name:	Non-planar Graph (2D or 3D coordinates)
Primitives:	Entity nodes, connected nodes, and edges
Relationships:	Start and end nodes, connected edges
Description:	A set of entity nodes and edges that meet at nodes

Level 2: (**TNT** planar topology vector object)

Name:	Planar graph (2D or 3D coordinates)
Primitives:	Entity nodes, connected nodes, and edges
Relationships:	Start and end nodes, connected edges
Description:	A set of edges and nodes where, when projected onto a planar surface, the edges meet only at nodes.

Level 3: (**TNT** fully topological vector object)

Name:	Full planar topology (2D and 3D coordinates)
Primitives:	Connected nodes, entity nodes, edges, and faces (including universe face)
Relationship:	Start and end nodes, connected edges, containing face, contained nodes, left and right faces, outer and inner rings
Description:	The surface is partitioned by a set of mutually exclusive and collectively exhaustive faces. Faces meet only at edges, and edges meet only at nodes.

Level 4

Name:	3D face topology (3D coordinates only)
Primitives:	Connected nodes, space nodes, edges, and faces (no universe face)
Relationship:	Start and end nodes, connected edges, containing face, contained entity nodes, bordered faces, outer and inner rings.

Description: A set of faces, edges and nodes where the faces meet only at edges meet only at nodes

Level 5

Name: Full spatial topology (3D coordinates)
Primitives: Start and end nodes, entity nodes, space nodes, edges, volumes
Relationships: Start and end nodes, connected edges, containing face, containing volume, contained entry and space nodes, contained entity edges, bordered faces, bordered volumes, outer and inner rings, outer and inner shells
Description: The space is partitioned by a set of mutually exclusive and collectively exhaustive volumes. Volumes meet only at faces, faces meet only at edges, and edges meet only at nodes

For diagrams and more descriptive information about these levels of topology please see www.geovista.psu.edu/sites/geocomp99/Gc99/037/gc_037.htm.

Topographic Maps on a Shoestring.

A MicroImages' client in a small nation recently reported they used 7 **TNTmips 6.5** systems part-time for a year to prepare 160 of 1:50,000 topographic maps to replace the nation's original 60 to 70 year old printed British or US Army Map Service maps. MicroImages has reviewed an electronic sample of these maps and they have very complex legends, and these maps are very close in appearance, design, and quality to the older printed maps.

This production of new printed and electronic maps completes about 10% of the 1:50,000 scale maps of this nation. It involved using the **TNT** Spatial Data Editor and other **TNT** tools to digitize the contours and older cartographic features from the old topographic maps for most areas where there are no changes in topography. These could then be overlaid and matched in the Editor to large sections of raw satellite images that "were not orthophotos." This allowed accurate transfer of new features in that matching area to the revised cartographic layers. The **TNT** map layout and templating procedure was then used to prepare the print plates for this revised map series. These mapmakers indicated that additional national topographic map upgrading will be conducted in this fashion. They also pointed out that a government organization had funded a $500,000 project in 1998 using a competitive product "in house," which to date has produced no maps.

Hand Made Globes.

A well-known manufacturer of globes has always designed their globe skins with Mac software. You probably have 1 of their hand assembled globes in your home. Now they will be updating their maps, especially place name features, with the Mac OS X version of **TNTmips**. They hand wrap their globes with a map printed with a unique non-mathematical projection. The northern and southern hemispheres of the map are printed separately in 2 hemispherical parts, which look like orange peels pulled up from the equator to the pole in equal longitude strips – sort of the "flattened pinwheel" projection. This manufacturer also wished to have the capabilities at hand via **TNTmips** to produce and market other kinds of globe and 2D map products.

X Server (alias MI/X)

A series of minor improvements in the standalone version sold separately by MicroImages under the name **MI/X** have raised its version number to 3.11. These changes are all related to improvements in handling the installation and protection of this product for trial use and purchase. The user of **MI/X** does not yet have access to the new Windows desktop, which will be released as part of **MI/X 4.0**.

TNTsim3D™ for Windows

Background.

There are numerous low-cost products that can ingest standard raster and/or graphics files and produce realistic qualitative simulations. The ubiquitous availability of DirectX and OpenGL, fostered by the game industry, has provided a code base upon which to rapidly build many different qualitative simulation viewers. Most of the programming effort in creating these low-cost products is expended in developing the product's user interface around these rendering libraries.

Simulation products specifically directed toward GIS and image processing systems are more expensive. They are primarily providing a means of transforming their, or someone else's, ill-designed mess of geodata in various other formats into a format suitable for rapid rendering or, as in some, directly into real memory. Typically the geodata is assembled into a landscape directly in their geospatial analysis package or in an expensive optional module for that package. Their proprietary viewer is then used to run the simulation within the geospatial analysis system used to assemble it, or by buying a copy of their optional viewer.

Landscape Files (which means, Project Files) are assembled in **TNTmips** using a standard feature provided with every system at no additional cost. With the release of **TNTsim3D 6.7**, these files can be used for simulations by anyone who is provided or downloads a free copy of **TNTsim3D 6.7**. **TNTsim3D** can now be distributed freely with your Landscape Files assembled for **TNTatlas**. This approach follows the same preparation/distribution model as used with **TNTatlas**. In fact, an initial level of interprocess communication has been established between a free **TNTatlas** and a free **TNTsim3D** so that each can start up the other to view the common image = texture and DEM = terrain objects occurring only once in the accompanying Project File(s).

What it is not.

TNTsim3D was conceptualized from the onset, like **TNTatlas**, to be a geospatial visualization and local analysis tool. It can provide a wide area simulation flying over a real world. However, a simulation for a geospatial application will often have little to do with how the real world looks or might look to an observer. **TNTsim3D** is not provided to teach us how to fly and, thus, is not another flight simulator striving for realism. It does not provide any cockpit appearance (for example, control panels), operation characteristics (for example, flight dynamics), guns, other aircraft, and so on. Its design objectives are not focused upon simulating an air battle, planning a route to a strike zone, driving a tank, or planning an architectural project.

What it is.

TNTsim3D's current capabilities and continuing development focus on providing a geopublishing and local geoanalysis tool for professional geospatial analysts using

TNTmips. This means that it will strive to use complex geospatial objects prepared in **TNTmips** in quantitative ways while supporting your choice of map projections, geodata types, attributes, and so on. Some initial features oriented toward these objectives are being released in **V6.70** such as:

- readouts of many viewing characteristics,
- real time display of map coordinates in any projection,
- multiple texture overlays with offsets,
- selection of texture layers during the simulation,
- merging and mosaicking of textures during simulation,
- map reference views, and others.

Current plans for **TNTsim3D** will continue to proceed along these development lines toward supporting:

- JPEG2000 compression to permit the distribution of very large landscapes,
- static and interactive pin mapping,
- offsetting multiple terrain surfaces,
- direct use of vector overlays including polygon extrusions,
- dynamic pin mapping, and so on.

These are all fundamental features that need our focus and effort so they can be added to this product. Viewing characteristics, such as:

- display gadgetry for realistic control panels, dials, and sliders;
- sky types, including clouds, sun position, sunsets;
- water surfaces;
- rendering realistic buildings, trees, and cars; and similar features

are details that can be added as needed. If you request these cosmetic features, please justify why we should interrupt our baseline development of **TNTsim3D** into a geospatial analysis and publishing tool in order to provide them.

Additional Background Materials.

As usual, this MEMO introduces the features that are new in **V6.70**. However, since it is now free, first time users of **TNTsim3D 6.7** need to review this same section in the MicroImages' MEMO shipped with your **V6.60** or posted at www.microimages.com/relnotes/v66/ for additional introductory materials not duplicated here. Also, the most recent Using TNTsim3D for Windows tutorial booklet can be downloaded now from www.microimages.com/product/tntsim.htm. Please also consult the attached color plates illustrating **TNTsim3D** while reading this section as they, more than words, attempt to illustrate the dynamic actions of **TNTsim3D**.

Caution: Some of the attached color plates do not show minor changes and improvements added after their printing to **TNTsim3D 6.7** provided on the CD.

Development work continued on **TNTsim3D 6.7** after several of the attached color plates were printed. Thus, some of their illustrations may no longer conform to the exact appearance and operation of **TNTsim3D**. These descriptions in this MEMO were written later to conform to the version of **TNTsim3D** on the **V6.70** CD.

Easy Download and Install.

The Windows application program SetupTNTsim3D.exe on your **V6.70** CD can be copied to your web site or onto any other CD or media type and freely distributed. No other files are needed as this is a complete Windows program. Simply add the Landscape Files you prepare or the sample landscapes provided on the CD or at www.microimages.com/product/tntsim.htm. This SetupTNTsim3D program file is compressed and packaged with the common windows InstallShield. Do not zip this file in any way, as it is already fully compressed. Wherever this program is made available, it can be selected by the mouse and InstallShield will decompress the program and install it to the designated hard drive. It can also be installed using the Window's Add/Remove Programs utility.

Please keep in mind that by the time you get SetupTNTsim3D on the **V6.70** CD, it is likely that a newer version with additional features will be available from www.microimages.com/product/tntsim.htm. Get used to this idea, and keep up. You can determine the date of the **TNTsim3D** version you are running by using its menu option Help / About TNTsim3D…. This date is inserted when the program is compiled. When a new **TNTsim3D** is available, the description where you download it will show the date of that version.

At this time each new version of **TNTsim3D** will be about 10 Mb and will download packaged into the same compressed, single SetupTNTsim3D installable file, just as the one on the CD. Thus, if you are satisfied with the newer version of **TNTsim3D**, you can simply substitute and distribute it as you choose. It is advisable to use Window's Add/Remove Programs utility to officially delete an older version before installing a new version.

Landscape Builder.

Since they are Project Files, the Landscape Files you prepared in **TNTmips 6.6** will still work in **TNTsim3D 6.7** and any other **TNT** product. However, to use some of the new simulation features (for example, multiple texture layers), your existing Landscape Files must be expanded. Simply add the new objects to them in the **V6.70** Landscape Builder. Please see the technical section on new **TNTmips** features for an explanation of the alterations that were made to the Landscape Builder to expand your Landscape Files to use new features in **TNTsim3D 6.7**. These additional features can also be reviewed in the attached color plates entitled Preparing Multiple Textures for TNTsim3D and the tutorial booklet entitled Building 3D Landscapes, which is current with **V6.70**.

Multiple View Windows.

Simultaneous use of more than one 2D display window is an important aspect of your efficient use of the **TNT** geospatial analysis products (for example, geolocked 2D views, image plus map views, related 2D with 3D views, and so on). The need for a similar multi-view strategy can be extrapolated to the development and application of **TNTsim3D**. First, a review of 3 ways your **TNT** product's desktop can be used for viewing and interacting with your geodata. Variations on these 3 arrangements are illustrated for 3 monitors on the attached color plates entitled Immersive Geospatial Analysis and Immersive TNTsim3D, and they apply as well to how you layout the display area of 1 or 2 monitors. Please also keep in mind that a 2nd 17" monitor would cost less than US$200 and a replacement Matrox dual monitor display board about US$100.

Make One Big View.

For demonstrations and direct visual interpretations you can set up 1 big 2D display window or static 3D simulation covering all your monitor(s) display area. If you use the virtual X desktop option, the 2D display in **TNTmips** can even be much larger than the area of your monitor(s). **TNTsim3D** provides a parallel effect to the virtual X desktop when you have a large landscape available and use your control device to interactively change your viewpoint. In this "big view" approach you show the maximum image or map area. Control dialogs and other windows must be brought forward and backward as needed. When multiple monitors are used, their display board's driver makes these monitors appear as 1 larger display to application software. Thus **TNTsim3D** and **TNTmips** can immediately use 2 or 3 monitors to show 1 large "wrap-around" desktop over which you can enlarge your display window or simulation view.

Use a View and Controls.

You can choose to use a smaller **TNTmips** display window or **TNTsim3D** simulation view and use the rest of the display area on 1, 2, or 3 monitors for control information in several control panels and dialogs.

Take Multiple Viewpoints.

For intense analysis you can open several **TNT** display windows and position them across your monitor(s). In **TNTmips** these might be some combination of a 2D view, a static 3D view, a geolocked 2nd map or image view, and so. Since it is geospatial tool, **TNTsim3D** also supports this concept by allowing you to open multiple interrelated simulation views, all related in some way to your main (pilot) view. These additional views of your geodata all move in tandem as you move around through new landscape areas. Furthermore, as will be discussed below, each view can show the same or a different texture layer as the main view all chosen from the multiple textures you can now add to your Landscape File.

Displaying and maintaining simultaneous separate views in a flight simulator product is not particularly useful. A flight simulation wants to put everything in just 1 view, which looks like a cockpit with a window(s), control panel, embedded recon sensor views, and so on. In a geospatial simulation tool, this realism is not paramount as often the analysis does not deal with a real view of the world, but with geologic, soil, infrastructure, historical images, panchromatic images, symbolized elements, and so on. Often you will be visually portraying the interrelationship between various diverse geodata types. **TNTsim3D** now provides you the opportunity to open a variety of interrelated specialized simulation windows. Each window represents a different viewpoint. Each window can use 1 or more separate textures. **TNTsim3D** maintains all these simulations at the same time while preserving their preset orientations and interrelations.

Georeferenced Views.

The geodata objects (both texture and terrain) assembled in a Landscape File are standard objects in a Project File. Thus, if they are georeferenced, this georeference data is available during their use in **TNTsim3D**. **TNTsim3D** shares many standard **TNT** library functions with the other **TNT** products and uses these functions to process the geodata objects up to the final rendering of each simulation view, which is the responsibility of DirectX or OpenGL and your display board. **TNTsim3D 6.7** can therefore provide some

of the quantitative features and behavior needed in a geospatial simulation and analysis tool, thus moving beyond a simple simulator.

Using the georeferences of the objects in the Landscape File, **TNTsim3D** provides the basis for continuous readout out of the real world map coordinates of many positions of interest in the simulation. For example, you can point in any view with the mouse and get a continuous readout of the coordinates of that position on the terrain surface. The map projection and datum can be selected or changed during a simulation, and all real time readouts will report these new coordinates. The units for reported measurements such as altitude, surface elevation, and distance to the indicated point can be selected from any of those provided in **TNTmips**. The 3D Compass gadget now uses the georeference to indicate true north. Multiple textures covering only part of the terrain can be draped over or merged into a larger texture in the correct geographic position. Multiple textures each covering part of the terrain raster (for example, orthoimages) can be virtually mosaicked during a simulation. These new features resulting from using georeferenced texture and terrain objects in the Landscape File will be discussed in the sections that follow. The attached color plate entitled Georeferenced Views in TNTsim3D illustrates some of them.

Observer Views.

The main **TNTsim3D** view window shows a view forward along the current line-of-forward-motion (pilot's view). Several standard observer windows can be opened to provide additional simulation views. Several are illustrated in the attached color plate entitled Simultaneous Views in TNTsim3D. These views present what an observer, free to turn their head, could view from the same viewing position as the main (pilot) view. Each observer view will use the same terrain layer and viewing position as the main (pilot) view. However, within each observer view you may choose any texture layer(s) from those you have added to the Landscape File. For example, you may want the vertically down nadir view to show a different texture than the main (pilot) view, such as a map. Different combinations of textures can be selected in each of these views and will use the offset and embedded texture effects discussed below.

Left View.

This is the view of an observer looking out a left window 90 degrees to the left of the center-line or line-of-forward-motion.

Right View.

This is the view of an observer looking out a right window 90 degrees to the right of the center-line or line-of-forward-motion.

Down View.

This is the view of an observer looking down 90 degrees from the center-line or line-of-forward-motion.

Rear View.

This is the view of an observer looking 180 degrees from the center-line or line-of-forward-motion. It is the view looking directly back along the current line-of-forward-motion.

Vertical View.

This is the view of the nadir point beneath the current viewer position and may be on or off the texture layers. It is the view perpendicular to the X-Y plane. If the main (pilot)

view is below the surface, then the vertical view is at the zenith point above the viewer position and is still perpendicular to the X-Y plane. The contents of this Vertical View rotate with changes in the main (pilot) view so as to maintain the line-of-forward-motion always pointing to the top.

Map View.

Use this Map View to keep track of where you are and what you are looking at within the landscape in the main (pilot) view projected onto the X-Y surface of the texture(s) it displays. The Map View is an ortho view of the texture layer(s) selected within this view from the textures in the Landscape File. This texture might be that of a map, an aeronautical chart, or simply the same image that is in the pilot view. If this Map View is zoomed in so that it shows only part of the extent of the terrain layer, it will automatically roam the texture as you move the position of the main (pilot) view relative to the X-Y plane, keeping the viewer position centered in the window. Changing only the orientation of the main (pilot) view such as its pitch, roll, altitude, never causes the Map View to roam. If the entire texture is showing in the Map View, its content will not move and remain unchanged for any change in the main (pilot) view. The attached color plate entitled Map View in TNTsim3D illustrates this special view.

Locator Gadgets.

Two optional Locator gadgets show the position and orientation of the main (pilot) view in the Map View.

Arrowhead.

The simplest Locator gadget is a simple, color arrowhead. The base of this arrowhead is at the nadir position of the main (pilot) view. The arrowhead points in the direction of the line-of-forward-motion. If the Map View is zoomed in and therefore roams, the base of this arrowhead is always at the center of the view as this will always be the nadir of the main (pilot) view. If the Map View is viewing the entire extent of the terrain layer and does not roam, then the arrowhead moves about as the nadir position in the main (pilot) view moves around over the terrain.

View-Center.

This Locator gadget shows the nadir position of the main (pilot) view as a cross with an arrowhead on one limb always pointing north. The position of the center of this same view projected to the terrain surface is indicated by a circle. In other words, this circle indicates what is being viewed at the center of the main (pilot) view. It changes position in the Map View with changes in the pitch and heading of the main (pilot) view. A colored dashed line between the cross and the circle indicates the direction from the nadir position to the center of the main (pilot) view. The length of this dashed line between the cross and circle indicates the distance from the viewer to the center in the X-Y plane. This is a very simple, but useful gadget to determine where your main (pilot) view is at on the terrain and where you are currently looking in it. For example, if you are looking straight down in the main (pilot) view perpendicular to the X-Y plane, the cross and the circle will be coincident.

Dragging the Nadir Position. This gadget also provides a very direct way to use the mouse to change your main (pilot) view position and the center-line of that view and all other windows slaved to it. If, in the Map View, you position the cursor over the nadir point cross and press and hold down the left button, you can drag this end of the gadget anywhere within the extent of the terrain showing in the Map View. As you do this, the

nadir point in the main (pilot) view will track the change in this nadir position while remaining at the same elevation and rotating so as to remain centered on the same point on the terrain. Using this maneuver, you can instantly position your main (pilot) view over a landscape feature (for example, a mountain top, a proposed scenic overlook, a building site, and so on).

Repositioning the View Center. If you use the mouse to click on any other feature in the Map View the circle end of the gadget will move there. This will recenter the main (pilot) view on that point in the terrain (for example, a house, a proposed forest clear-cut, and so on) without changing its nadir position or elevation. You can also hold down the left button in the circle and drag it slowly to the new position so that the main (pilot) view will rotate gradually to center on that new point in the terrain.

Using the mouse on this gadget provides the easiest and fastest possible way to reposition your main (pilot) view to a particular point above the terrain and then view a specific feature from that position. Note that clicking the left mouse button on the terrain in any view also recenters it on that position on the surface just as if you moved the circle gadget to that point.

Scrolling the Altitude.

After working awhile with this gadget, it was determined that 1 more additional feature would be very useful in moving your position around. The altitude of the main (pilot) view can now be moved up or down with the scroll wheel on your mouse. The rate of movement is one wheel notch equal to the distance specified for Speed Up/Down.

Since the **V6.70** CDs.

The altitude scrolling feature is not in **TNTsim3D** on the **V6.70** CDs but is available now in the latest version at www.microimages.com/product/tntsim.htm. The following additional improvements to the operation of this gadget are in the latest version. 1) This gadget is much more useful than the arrowhead and is now the default gadget. 2) Any roll you have created in your main (pilot) view by some other control, (for example, via the joystick) will be fixed and maintained as you move the nadir point in the main (pilot) view (crosshair) around. In other words, if your horizon is level (or at some angle) it will be maintained at that orientation as you move your main (pilot) view—you will no longer roll over. 3) Both ends of the gadget now move more reliably.

You may at first experience what you think is spurious behavior in the operation of this gadget. Remember that you are manipulating a 3D control. For example, a change in the altitude or nadir position of your main (pilot) view may automatically and correctly change the position of the circle and the dashed line. If you lower your altitude, the circle may jump toward the nadir point as a hill in the foreground suddenly obstructs the view to the previously distant intersection of your viewline with the terrain. In a similar fashion, for a fixed nadir and altitude you may drag the circle to a position behind a mountain obstructing your view of that position. This will cause the circle to snap to a new position on the near face of the mountain with a shorter dashed line.

Zoom Icons.

Zoom In and Zoom Out icons in the Map View zoom its contents in and out in 2X increments. A Full icon zooms out until the full extent of the terrain layer is exposed

Options Icon.

This icon opens a Map Options dialog. Use it to select the particular Locator gadget and its color. It also indicates in percent how much of the total geographic extent of the ter-

rain layer used as the basis for this landscape is currently displayed in the Map View providing an indication of how far it is zoomed into the area of the total landscape. It is not the percent of the texture being viewed as this might cover only a small portion of this landscape. For example, the texture you have selected in the Map View might be a single orthophoto or topographic map texture from many adjacent textures in the Landscape File.

The Map Options dialog also provides the option to shift between a fixed north orientation at the top of the Map View to/from a Viewer orientation. When the Viewer orientation is selected, the contents of the Map View rotates so that its up is always the direction of forward motion in the X-Y plane. In other words it behaves just as if you are rotating a map in your car to keep your direction of travel up at the top to assist in watching for left or right turns. In the Viewer orientation mode the Arrowhead Locator gadget that points in the direction of the main (pilot) view will always point to the top of the window and the dashed line for the View-Center Locator gadget will always be vertical.

Point-of-Interest Views.

Since **TNTsim3D** is a geospatial tool, it is likely that you, as a geospatial specialist, will need to demonstrate how a particular landscape and set of textures look from a variety of viewpoints. You will maneuver around in the landscape you have prepared and view it through the main (pilot) view. However, you wish your observer to focus on how a particular area looks from any position above it (for example, how a proposed forest clear-cut will look from a variety of viewpoints, how it relates to the drainages, and so on).

A total of 8 Point-of-Interest (POI) views can be designated and opened, each of which provides a fixed view of a specific point selected on the terrain in the pilot view by the mouse, by the entry of map coordinates, or in advance in the Landscape Builder. The interactive creation of a POI view is illustrated sequentially in the attached color plate entitled TNTsim3D Point-of-Interest Views. Select Window / Point-of-Interest from the menu in the main (pilot) view. This exposes a Point-of-Interest dialog box. With this box open simply select any point on the terrain in any view. This position on the terrain will be immediately marked with a vertical color bar in every open view and with a matching color arrowhead in the Map View. A Point-of-Interest 1 view will open centered on that view and will remain centered there for wherever you move the main (pilot) view. You can now repeat Window / Point-of-Interest and add a 2nd POI and view and so on.

Point-of-Interest Dialog.

When you are designating a new POI, this dialog box will allow you to enter a name for that new POI view. It also provides you with the ground coordinates of the position you select in any view with the mouse for a possible POI. You can keep clicking the mouse around in your views and each time these coordinates will change. You can also simply fill in the actual values you want in these coordinate boxes, then choose Apply to set that POI. The POI marker will then jump exactly to this manually entered position.

Each POI view provides a toolbar with 2 icons.

Texture Icon.

This icon permits you to select the texture(s) to show in this POI view from all those in the Landscape File.

Edit Icon.

This icon will reopen the Point-of-Interest dialog for that POI view. When this dialog box is reopened for any POI view, its coordinates can be manually edited and its name changed. As long as this dialog is open, you can also click the mouse in any view and that POI and its marker will move to that position in all views and the POI view will redraw centered on the new position.

Multiple Textures.

As has been noted above, a Landscape File can now have multiple texture layers. All these textures are still referenced to the same single terrain layer and match it in geographic extents. The technical section on **TNTmips** reviews how to use the Landscape Builder to add multiple textures into a Landscape File. This is also illustrated in an attached color plate entitled Preparing Multiple Textures for TNTsim3D. If you have already created some single texture Landscape Files using **V6.60**, you can now add additional textures to them. The order in which you add the textures is not critical at present to their subsequent use. Creating and using multiple terrain layers will be introduced in a future version of the Landscape Builder and **TNTsim3D**.

Each simulation view you have exposed permits you to choose any combination of the textures in the current Landscape File for that view. Be careful about selecting more than 1 texture for use in a simulation view until you have defined offsets for the textures in **TNTsim3D** as discussed below. If you select more than 1 texture for draping on the terrain, each with a zero offset, you may get spurious features (triangles) popping in and out of your simulation. This occurs because there is computational indecision for some surface elements at some view angles with regard to which of the textures should be used since they are both at the same elevation relative to the terrain.

Stacking Textures with an Offset.

During the operation of **TNTsim3D** you can vertically offset texture layers above or below the terrain surface. Typically these offset layers will be different texture layers each with different information about the landscape. All simulation views will show these textures in their vertically stacked arrangement and offsets if they have been selected to show in that view. This is illustrated in the attached color plate entitled Multiple Textures in TNTsim3D. You can move a viewpoint around outside the stacked texture layers or move into and through them. For example, if you move between offset textures 1 will be seen above you and 1 below. If the vertical offset between two different textures is small (say 1 meter), then 1 will be visible from a viewpoint above that terrain (on top) and the other can be seen from a viewpoint below the terrain (the bottom of the surface).

Using Transparency.

The layers you added as textures from Project Files in **TNTmips** may not have complete coverage of the terrain area in your Landscape File. However, for this version, each texture layer covers the total terrain area. Any holes and irregular areas are filled with nulls. Null areas in a texture are 100% transparent in a simulation view. Thus several texture layers can be used together for some very useful effects.

You could use a low resolution monochrome image and DEM of a large area and a high resolution color image of a small, interior portion of this area (for example, a city, special site, …). A Landscape File can be built for the large area of the DEM with a higher reso-

lution color image texture and lower-resolution monochrome texture. If the offset for the color image is set to be 1 meter higher than that of the grayscale image, your simulation will visually merge the color into the grayscale texture and permit moving over the larger area to and from the monochrome area into the higher resolution color area. An illustration of a combination of 2 layers in this fashion can be seen in the lower right corner of the attached color plate entitled Multiple Textures in TNTsim3D.

The current result of this strategy for virtually merging textures of varying resolutions and geographic extents is that it produces a large Landscape File. This is why, as mentioned in the section on JPEG2000 and repeated below, JPEG2000 compressed, linked images will be tried in **TNTsim3D**. Other applications of the use of merging textures would be to overlay (which means, insert) a color orthoimage onto a larger map area, a piece of a geologic map into a Landsat image. Since you now have texture layer selection in **TNTsim3D**, these textures can be viewed together or separately in each view. A shoreline image and a color coded bathymetry DEM could be combined for viewing their respective areas. Several vector objects (for example, drainage, roads, watershed basins,…) could be converted to rasters with nulls everywhere except for their features and used as textures. These feature texture layers can then be merged in **TNTsim3D** with a color image texture draped on a terrain and turned off an on as desired.

Setting Offsets.

Offsets can be set for each texture layer using Texture / Offsets from the menu in the main (pilot) view. This will open a Texture Offsets dialog showing each texture in the Landscape File and its current vertical offset value (initially set to 0, which will drape all the textures directly onto the terrain). Fill in the vertical offset values for each texture layer relative to the terrain. You can use +/- and zero offsets, and these will set the order of use of all these textures in every simultaneous simulation view. Remember that if you want to combine several layers, each must have a non-zero offset to set up their order. These rendering order offsets can be small and will not show up in the simulations. You can bring up the Texture Offsets dialog at any time to edit these offsets.

Note: Textures at the same offset (for example, 0) should instead have a small difference in offset value to establish their rendering order.

Readout Panels.

The Position Status bar used in **TNTsim3D 6.6** has been replaced with the Readouts dialog. This change was made because only a limited amount of quantitative data could be displayed in the bar. This new dialog box is not dockable as was the position status bar. It presents many different tabbed panels that can be selected to readout the current status information of the simulation. The color plate entitled Georeferenced Views in TNTsim3D contains illustrations of this dialog. Each panel provides numerical information about some aspect of your simulation activity. This dialog box can be kept open during a simulation. At any time during your simulation you can open the Readout dialog and/or switch to a new tabbed panel. Any tabbed panel you expose will be updated in real time throughout the operation of the simulation.

Changing Coordinate Systems and Units.

At the bottom of the Readout dialog is a Projection button. Use it during your simulation to access and use the Coordinate System / Projection Parameters dialog. Use this dialog as in **TNTmips** to choose the system, zone, projection, datum and other parameters to define coordinates presented in the readout panels. Use this same dialog to select the units for distance, elevation, angle, and velocity. These settings are applied not only to the Readouts dialog, but also where appropriate on the Options dialog, such as speeds and max / min height. In all locations where units are needed, the symbol for the current selected unit is displayed.

The availability of this kind of option shows how some of the geospatial analysis capabilities developed over many years in **TNTmips** can be incorporated in **TNTsim3D**. **TNTsim3D** uses georeferenced objects in Project Files with known coordinate system parameters. Complete libraries (now classes) are available in the **TNTsdk** to perform these transformations in any **TNT** product (either Windows or X server based) including **TNTsim3D**.

Terrain Panel.

The Terrain tabbed panel reports general information about the geographical extent of the Landscape File you are using in your current simulation as follows:

- extents in the coordinate system you have designated for the east, west, north, south, E-W, N-S geographic span of the landscape,
- the vertical extents of the terrain layer as maximum and minimum elevations,
- the terrain quality as set in View / Options / Terrain, and
- your current frame rate (this and terrain quality are the only parameters in this panel that change as you move in the simulation).

Viewer Panel.

The Viewer tab panel refers to the current viewpoint and provides continuous readouts as follows:

- position for the nadir point for the current viewpoint in the coordinate system you have specified;
- altitude above mean sea level at the nadir;
- elevation above the terrain at the nadir;
- height of the terrain at the nadir;
- pitch, roll, and heading of the viewpoint; and
- velocity of the viewpoint.

This panel is illustrated in the attached color plate entitled Georeferenced Views in TNTsim3D.

Mouse Panel.

The Mouse tabbed panel provides continuous readouts of the map coordinates of the cursor at any position on the terrain surface within any open view. It will also readout the elevation at the cursor position and the distance from the viewpoint to the surface at the cursor's position. It is illustrated in the attached color plate entitled Georeferenced Views in TNTsim3D.

Typically you will use a joystick in your writing hand to manipulate the viewpoint of your main (pilot) view. The other hand can, as needed, use the mouse to indicate a feature in the view. You can also stop moving the simulation with the joystick to change to the

mouse to readout a specific feature's map position. However, stopping the motion is not necessary, so you can track a target and readout its coordinates with the mouse in real time as you manipulate the simulation with the joystick.

The cursor position on the screen is expressed as a specific screen pixel position. This pixel is then mapped to some point on the terrain and the distance to that point and its coordinates are estimated and displayed. This panel also shows the change in distance in the same measurement units from the center cell to each of the neighboring screen pixels in the 4 cardinal positions. How these distances vary provides an indication of how the terrain varies at that position. For example, if the top cell's distance is much larger than all the other 3, the cursor has selected a pixel at the top of a hill. Thus, moving the cursor just 1 screen pixel upward would provide a much different distance for it as it passes over the hill to a more distant position.

Forward Panel.

The Forward panel reports information about the intersection of the centerline of the main (pilot) view projected to the terrain surface as follows:

- terrain position,
- elevation of the terrain above mean sea level,
- distance from viewer to projected point,
- the number of surface triangles used in rendering the view as an indication of its 3D detail, and
- 4 adjacent pixels' distances.

This panel is illustrated in the attached color plate entitled Georeferenced Views in TNTsim3D.

Observer View Panels.

The Left, Right, Up, Rear, Down, and Vertical tabbed panels readout the same information as the Forward panel for the intersection of each of these observer views (if open) projected to the terrain surface.

Point-of-Interest Panels.

Each POI tabbed panel also reads out the same information as the Forward panel for the fixed POI. The coordinates reported are those of this fixed POI and do not change. The elevation of the POI oscillates a tiny fraction and only appears to change as it is constantly being recomputed from differing view angles. The distance to the POI does change as the main (pilot) view changes. Although the POI and its coordinates are fixed, the 4 adjacent pixels' distances will change as the POI is viewed from varying angles, thus changing the 4 pixels used.

Map View Panel.

The Map View panel reads out the same general information as the Forward panel but for the center of the Map View. If you are zoomed out in the Map View to view the entire extent of the terrain in your landscape, these coordinates will not change. If you are zoomed in so the Map View roams, then its center coordinates will change. The View-Center position gadget was just added to **TNTsim3D** and perhaps information about its positions may be added to this panel. If you want information now about these positions in the Map View, use the Viewer tabbed panel for information about the viewpoint of the main (pilot) view indicated by the cross in the gadget. Use the Forward panel for infor-

mation about the projected centerline of the main (pilot) view indicated by the circle and dashed line in the gadget.

Vertical Exaggeration.

A vertical exaggeration can now be set using the Terrain panel in the Options dialog (View / Options / Terrain). It is set by default to 1, and to increase or decrease vertical exaggeration simply edit the value. This is illustrated in the attached color plate entitled Set Vertical Exaggeration. The value to select is a constant multiplier for all the elevations in the simulations in so far as viewing terrain relief is concerned. This elevation multiplier will not affect any of the X-Y coordinate readouts. However, when this value is changed, the viewpoint location is proportionally changed in all views to maintain the same position relative to the terrain. If your viewpoint was not adjusted in this manner, increasing the exaggeration could place the viewpoint main (pilot) view below the terrain surface in 1 or more views, a disorienting effect at best.

Using TNTsim3D with TNTatlas.

TNTatlas and **TNTsim3D** are complementary geopublishing tools. They can use common raster geodata when this sharing is carefully planned in advance. Each is optimized around visualizing geodata, and each has distinct but related advantages.

The dynamic 3D views in **TNTsim3D** provide better insight into the 3D relationships of the available geodata and a new means to locate the areas of interest. For example, a simulation provides a better means to orient any observer of your geospatial analysis results in an atlas to any location of your or their interest. Using this approach, the simulation becomes a new navigation tool for a **TNTatlas**. The use of several appropriate simulation viewpoints can further illustrate the 3D relationships of interest, such as any obstruction to a line of site view.

TNTatlas is more cartographic in nature and provides more quantitative means of carefully studying the 2D relationships of many complex geodata layers. For example, **TNTatlas** is a more appropriate means for accurately comparing layers, such as comparing recorded property ownership with a new color image of local land use. Accurate measurements and sketches are local GIS capabilities more appropriate for **TNTatlas**.

V6.70 provides the first opportunity to run both these free products together to digitally publish the results of your geospatial analysis. While each of these free programs is unique in its own right, it is anticipated that used together they will synergistically yield new visualization, geopublishing, and local analysis opportunities. MicroImages plans further integration of these tools in future releases, such as improved sharing of compressed rasters objects and other atlas components. Please review the **TNTatlas** section of this MEMO for more details on the initial interactions that can be established now between **TNTatlas** and **TNTsim3D**. The attached color plates entitled Launching TNTsim3D from TNTatlas and Using TNTsim3D to Launch TNTatlas illustrate these interrelated operations.

Add Points and Styles in Landscape Builder.

The prototype capability to create relational point and style tables in a Landscape File has already been incorporated into **V6.70** of the Landscape Builder. This permits the building of a relational point/symbol database in any new or existing Landscape File from the points in vector objects and their attributes and styles. A relational database structure is used, as it is easily extended to add new controls as to how each point is

rendered and behaves. You can create more than 1 set of points and add points to an existing table in an existing Landscape File. Since this is a **TNT** relational table, all the existing **TNT** tools can be used on these tables in a Landscape File to create, modify, and edit its content (for example, the database table editor, the database tree view, and so on).

During the creation of this point table structure in Landscape Builder from a vector object, you can use all the **TNT** selection procedures including select all, by query, and so on. You can also map how attributes will be used to control the size and color of the stalk of the pin and appearance of the billboard on top of it in **TNTsim3D**. You may decide to extrude the **TNT** style of the point up from the surface. You may choose to stack color geologic cores atop each other above or below the terrain. Each core would be defined by multiple records in a related table for each point. These records would define the base position above/below the terrain surface, the length of the segment, and the color. You can define a 3D shape, such as a sphere or prohibited air space or threat dome, to be drawn in by DirectX or OpenGL.

Bill Boarded and Stalked Point Symbols.

The first iteration permitting you to use points in a vector object in your simulation is nearly complete, but the release of **V6.70** of the **TNT** products could not be delayed for this latest **TNTsim3D** feature. Watch the special **TNTsim3D** pages at www.microimages.com/product/tntsim.htm for information about the release of an updated **TNTsim3D** that can then be downloaded from that same page.

When these tables can be used in **TNTsim3D**, you will select them from a Landscape File and add them to your views as predetermined in the Builder. It has not yet been determined when, if, and how pins might be added, moved, or edited during a simulation either interactively, by editing the table, or dynamically.

Sample Landscape Files.

The following sample Landscape Files are provided on the **V6.70** CD to illustrate some of the new **TNTsim3D** features. Landscape Files are large, so only 3 new ones would fit on this CD. Other Landscape Files showing earlier and other features are on your **V6.60** CD and can be downloaded from microimages.com/products/tntsimLandscapeFiles.htm. Additional new Landscape Files will be added at this download site as they are created to test and demonstrate new post-**V6.70** features.

BigPine3.sim (38 Mb).

This landscape file covers the same area as the BigPine and BigPine2 files created previously and still available from microimages.com/products/tntsimLandscapeFiles.htm. Its area is centered on the Owens Valley of eastern California, with the town of Big Pine at the northern edge. This new file has three texture layers that include a satellite image, an image of the terrain data, and topographic map data. The *LandsatTM* texture is identical to the single texture in the previous files—an RGBI image that uses the 15-meter Landsat 7 panchromatic band to sharpen a 30-meter natural color image (bands 3-2-1). The *ColorShade* texture is a color shaded relief image created by displaying an elevation raster (with color palette and with partial transparency) over a shaded relief raster computed from the elevation raster. The *DRG* texture was created from a mosaic of USGS 1:100,000-scale Digital Raster Graphic (DRG) topographic map images for several quadrangles.

YM67.sim (29 Mb).

This Landscape File covers the same area as the downloadable YuccaMtn.sim file, a desert region in southwest Nevada that is the location of a proposed national high-level nuclear waste repository. There are three texture layers in the file, including geologic map data and several types of imagery with varying levels of detail. The *SPOTpan* texture is a panchromatic SPOT image with 10-meter resolution. The *GeologyShade* texture is similar to the texture in YuccaMtn.sim; it combines geologic map data (rock-unit polygons with transparency fill, contacts, and faults) with a shaded relief raster. The *ColorDOQ* texture shows an extract of a color Digital Orthophoto Quadrangle covering part of the landscape area with a horizontal resolution of about 2 meters. (This image is dominated by Mars-like reddish tones due to the lack of vegetation in the area, rock, and soil color, and the processing of the original image.) The portion of the texture outside the limits of the image (null values in the texture raster) are transparent when viewed in **TNTsim3D**, so that the underlying SPOTpan texture remains visible around its edge when both are selected for viewing. This example illustrates that the same Landscape File can include low-resolution imagery for the entire landscape as well as more-detailed imagery for limited areas.

Palmyra.sim (56 Mb)

The Palmyra Landscape File shows a rural, agricultural area surrounding the town of Palmyra in southeast Nebraska. Vertical relief in the area is only several tens of meters so you may want to increase your vertical exaggeration setting. The file contains two texture layers. The *FSAcolor* texture is a mosaic of orthorectified, natural-color aerial photographs. The *SoilDOQ* texture shows a vector soil map displayed with partially transparent color polygon fills over a mosaic of grayscale Digital Orthophoto Quadrangle images.

TNTatlas 6.7 for Windows and X

Introduction.

TNTatlas and **TNTsim3D** are complementary geopublishing tools. They can use common raster geodata when this sharing is carefully planned in advance. Each is optimized around visualizing geodata, but each has distinct but related advantages.

The dynamic 3D views in **TNTsim3D** provide better insight into the 3D relationships of the available geodata and a new means to locate the areas of interest. For example, a simulation provides a better means to orient any observer of your geospatial analysis results in an atlas to any location of your or their interest. Using this approach, the simulation becomes a new navigation tool for a **TNTatlas**. The use of several appropriate simulation viewpoints can further illustrate the 3D relationships of interest, such as any obstruction to a line of site view.

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V6.70 provides the first opportunity to run both these free products together to digitally publish the results of your geospatial analysis. While each of these free programs is unique in its own right, it is anticipated that used together they will synergistically yield

new visualization, geopublishing, and local analysis opportunities. MicroImages plans further integration of these tools in future releases such as improved sharing of compressed raster objects and other atlas components.

Sharing TNTatlas and TNTsim3D objects.

Expecting **TNTsim3D** to resample terrain and texture layers to a new projection and cell size would significantly slow down the simulation. Thus, a Landscape File prepared by the Landscape Builder in **TNTmips** for use in **TNTsim3D** has special fixed cell size relationships between its terrain and texture raster layers. This is the basis for achieving a usable simulation frame rate in multiple simulation views when these standard **TNT** objects are read by the multi-threaded texture server incorporated in every **TNTsim3D**.

Raster objects produced by the Landscape Builder are valid and complete with georeference information and all their other geospatial properties. Thus, they are completely usable in any other **TNT** product and process. The Landscape File with the extension *.sim is just like any other Project File. The designation Landscape File and *.sim extension are used merely to associate this Project File with its readiness for use in **TNTsim3D**.

A **TNTatlas** can be assembled from objects in multiple Project Files. All the raster objects (terrain and textures) in a Landscape File can be shared as layers in a **TNTatlas**. Thus, they may be your base or most detailed raster layers in the atlas and may be just a bit faster to use from a Landscape File since they have a common cell size and projection.

Remember also that you can hide layers in a **TNTatlas** and they will not show up in the View. For example, the terrain layer used in a **TNTatlas** from a Landscape File can be hidden in an atlas to provide only an elevation DataTip. However you assemble your atlas Project Files and Landscape Files, if they have a common geographic extent, they each can be used in interrelated **TNTatlas** and **TNTsim3D** operations.

If you plan ahead in the construction of your **TNTatlas**, its biggest components (for example, most detailed images) can be textures in a Landscape File for use in **TNTsim3D** and also used as common layers in the **TNTatlas**. At the other extreme, it is even possible that you create an application whose **TNTatlas** Project Files and your Landscape File are completely separate, contain completely different geodata, and can be used together merely because they cover some portion of a common geographic area.

Launching TNTsim3D from TNTatlas.

Macro Script Control.

Just as in previous **TNTatlas** for X operations an icon will appear on its tool bar for each Macro Script added, which should be placed in the same directory as the Landscape File (*.sim) to be launched. Selecting one these icons interprets its associated Macro Script, which can launch another program. This approach is used in **TNTatlas/X** to launch **TNTsim3D** for Windows with a combination of predetermined and concurrent **TNTatlas/X** viewing parameters. **TNTsim3D** will automatically load the Landscape File (which means, Project File) specified in the Macro Script and in the same directory as the Macro Script's **SML** file. Adding the capability of **TNTatlas** for Windows to use Macro Scripts is now a high priority for addition to **TNTatlas/W** (post **V6.70** shipment) but will take some time to accomplish.

A sample Macro Script is provided that places a Launch TNTsim3D icon on the tool bar of the associated **TNTatlas/X** when added. The icon and its launch action are illustrated on the attached color plate entitled Launching TNTsim3D from TNTatlas. The Macro Script is printed on the reverse side of this color plate. Your online Tutorial booklet entitled Writing Scripts with SML discusses the creation of Macro Scripts. It is recommended that you run in Windows desktop mode so the TNTsim3D window will be visible (not behind the X server) when it opens.

Startup Parameters.

The View window in a **TNTatlas/X** can be zoomed in or out to any scale when an icon is used to launch **TNTsim3D**. Thus, the sample Launch TNTsim3D Macro Script uses the extent of the current **TNTatlas/X** View window to compute the altitude above the terrain for the simulation in the main (pilot) view. The pitch of this view (up/down angle of the centerline) is set in the script (for example, –20 degrees). The start direction of the simulation is oriented to the top or up in the current **TNTatlas/X** View window. The nadir position of the main (pilot) view is determined from the coordinates of the current center of the **TNTatlas/X** View window. All these combine to open **TNTsim3D** with a main (pilot) view that is closely related to the scale and location of the current **TNTatlas/X** View window. For example, if the horizontal extent of your current **TNTatlas/X** window is large, then the altitude of your main (pilot) view will be high to provide a wide panoramic view at the pitch set in the script. When the **TNTatlas/X** window's horizontal extent is narrower, the altitude of the main (pilot) view will be proportionally lower, providing a "close in" view.

Startup Options.

When this icon is selected during the use of **TNTatlas**, the icon button presents a menu providing choices of Orbit, Pan, or Stationary. Select one and the separate **TNTsim3D** program will start up and load the associated landscape. After the landscape is loaded, **TNTsim3D** uses it, even if it is being used by **TNTatlas** as well, to create a separate main (pilot) view. This view will open at a position related to the center of the current **TNTatlas/X** window with the automatic movement defined by the option selected.

Stationary View.

If the Stationary startup option is selected, the main (pilot) view will open centered on the view in the **TNTatlas/X** window and oriented toward its top. Its pitch will be that set in the script and the altitude will be computed from the horizontal extent of the current **TNTatlas/X** window.

Orbiting or Panning Views.

Using **TNTatlas** to start **TNTsim3D** may imply that the user is more familiar with its operation and is less likely to be familiar with **TNTsim3D** and its operation. Thus, they may simply assume that **TNTatlas** has launched a static 3D view of the same area. For this reason, the Orbit and Pan options are provided so that a moving, useful, and automatic simulation of the same area can be selected.

If Orbit is selected the main (pilot) view will open the same as if the Stationary option was selected, but will immediately begin to orbit the center of the current **TNTatlas** view at an angular rate set in the script and at the constant computed altitude. If the Pan option was selected, the main (pilot) view is opened rotating looking outward at the pitch

and altitude determined in the script and positioned so that its nadir [the nadir point of the main (pilot) view] is the center of the current **TNTatlas** window.

Seizing Control.

At any time during these preprogrammed simulations as long as the executing program focus remains with **TNTsim3D**, any **TNTsim3D** navigation action via the joystick, mouse, or keyboard will seize control of the main (pilot) view, stop the Macro Script action, and proceed onward from the then current view in the main (pilot) view. This simulation is now operating just as if you started in **TNTsim3D** directly and navigated in **TNTsim3D** to that starting main (pilot) view.

Improvements for Startup Position.

It would be better if the position of the cursor on the **TNTatlas/X** View window, not its center, determined the nadir position that **TNTsim3D** uses to startup the main (pilot) view. For example, this would permit starting up **TNTsim3D** to orbit a specific point or feature such as a house, tower, forest clear-cut , …rather than a point in the general area. This is an interface procedural issue and will be part of an improved Macro Script and changes to **TNTsim3D** as needed.

Launching TNTatlases from TNTsim3D.

Navigating Using TNTsim3D.

A **TNTatlas** can present much more complex layer combinations in 2D than **TNTsim3D** and provide more accurate analysis tools such as those used for measuring or sketching. However, you may be more familiar with navigating in **TNTsim3D** or are geopublishing material for users who can not readily locate and orient themselves in a 2D visualization or easily understand the complex 2D relationships present. Use **TNTsim3D** as a navigation tool to take these observers to an area of interest and to view it from varying viewpoints. This will create and reinforce their understanding of where they are. Then you can start a **TNTatlas** centered upon the point of interest in the simulation and proceed on to a more detailed 2D analysis while keeping the 3D view open for reference. You can even move your focus or control back to **TNTsim3D** and move them around again to better explore and understand the location and 3D characteristics of the detailed area now showing in the **TNTatlas**. A color plate is attached entitled Using TNTsim3D to Launch TNTatlas illustrating a main (pilot) view and the **TNTatlas** View window it has automatically opened.

Creating an Atlas Menu.

Launching a **TNTatlas** for X or for Windows from within a **TNTsim3D** for Windows simulation is simpler to set up than the reverse launch described in the section above. **TNTsim3D**'s main (pilot) view now has an Atlas drop-down menu. When **TNTsim3D** loads a Landscape File (*.sim), it also adds to this Atlas menu the name of every **TNTatlas** whose startup file (*.atl) is located in that same directory. This menu item is not the cryptic name of the startup file, but the text name defined by you within the startup file.

Startup Parameters.

At any point during the simulation you can select an atlas by name from the Atlas menu in the main (pilot) view. The next mouse click in the main (pilot) view will launch the corresponding atlas if you have set up Windows to associate the *.atl startup file with either the **TNTatlas** for X or **TNTatlas** for Windows program. The atlas contents that first ap-

pear in the View window will center on the geographic position selected by the cursor in the main (pilot) view in **TNTsim3D**. This View window will also automatically zoom in to a scale determined by the current height above the terrain of the main (pilot) view. Using these startup parameters, the **TNTatlas** starts up with a reasonably representative view of the area around the point selected by the cursor.

Seizing Control.

Since the **TNTatlas** is now up and running, it automatically shows the same layers that would show if you had navigated in that atlas to that location and scale. If you retain focus on the **TNTatlas** program, you can now proceed forward in its normal operations (hide or show layers, make measurements, navigate up or down in levels, and so on). More than one atlas may show on the Atlas menu in the main (pilot) view; you can sequentially start up different or more than one **TNTatlas** in this fashion. You can also regain focus on the **TNTsim3D** program and move to a new position and restart an atlas to reposition its view.

Miscellaneous.

JPEG2000.

Rasters compressed with the new JPEG2000 wavelet compression can be used as linked raster objects in a **TNTatlas**. This will cause slower performance in a **TNTatlas** as these files are decompressed. However, the huge savings in storage space may more than compensate for this and makes even bigger atlases feasible. At this time if you want to use a JPEG2000 compressed raster in a **TNTatlas**, export it as a JP2 file, delete the RVC version from the Project File, and then link the JP2 file to that Project File (in other words, it must be external and linked).

TNTsim3D can also use JP2 files exported from the Landscape File for texture layers only and then linked back to it. However, at this time, this will cause jerky and unacceptable frame rates. Improving the performance in the use of JP2 files in these products is being investigated now.

Keep in mind that as you increase your processor's performance, reading raster data from a hard drive or CD begins to be the limiting factor controlling how fast that raster can be displayed in **TNTmips** or **TNTatlas**. Data compressed 100:1 requires less read time and a fast processor can keep up with the decompression required. This can be of particular importance in a **TNTatlas** run using data directly from a CD.

Changes to ATL File.

To support communications with **TNTsim3D** at startup, the **TNTatlas** ATL startup file (*.atl) has been expanded. Existing ATL files are still valid and can be edited to add these additional parameters. However, now when TNTsim3D is requested to startup a TNTatlas it computes and adds the following parameters into the ATL file which in turn starts a specific **TNTatlas** with the view they define:

Start Center Latitude to define a startup center latitude,
Start Center Longitude to define a startup center longitude,
Start Zoom Width (zoom to set width in meters).

Published Atlases

Quito, Ecuador.

The following is from a transmittal letter accompanying a printed color atlas in Spanish entitled ATLAS de la provincia de Pichincha, April 2002. This atlas is for the high Andean Ecuadorian province of Pichincha, which contains the city of Quito. Its legends employ many of the latest features issued in **V6.60**. Inquiries concerning the availability of this atlas should be directed to Direccion de Planificacion Y Ambiente at diplagpp@ pichincha.gov.ec.

"As per our previous contacts and as offered, please find enclosed a copy of the "ATLAS de la provincia de Picchincha," in which as you will notice the first 30 maps were prepared with TNTmips. With no doubt the software was of great help in getting accomplished the project, so I will thank all the people involved in the development of so good package, at the same time encourage you all to keep the high standard in the product, from which all of us will get some benefits."

SouthEast Asia.

An attractive CD based **TNTatlas** is illustrated in the attached color plate entitled Geotectonic Map of East and Southeast Asia: Sheets 1, 2, 3 and 8. The sheets in this atlas were prepared in **TNTmips 6.4**. A colorful 33" by 46" poster version of this map in PDF form can be downloaded and printed on your large format printer from www.microimages.com/documentation/CP67misc.htm.

TNTserver 3.0

TNTserver W2000 Only.

Microsoft's policy is to support their current operating system (XP) and the 1 prior version of their operating system (W2000). As a result, they have scheduled the close out of support for Windows NT, which they no longer sell. It is also widely accepted that Windows NT is not as reliable or secure as Windows 2000. For this reason MicroImages will only sell a **TNTserver** product for use with Microsoft Windows 2000. MicroImages will no longer sell new versions or produce new upgrades of **TNTserver** for use with Windows NT. To further guarantee this, all new orders of **TNTserver** will only be delivered with a USB key. This will insure that W2000 Server or the equivalent XP are used with **TNTserver** as they have support of USB. It will also insure that a reasonably current model computer will be used.

MicroImages will continue its support of many diverse platforms for **TNT** data collection and analysis products. As already covered elsewhere in this MEMO, **V6.70** provides them for the Mac OS X platforms. However, **TNTserver** is a totally different kind of product that is complex to setup and use. **TNTserver**, as we have already tried to convey by other means, is not an application product that is simply installed and used. There are many complex variables involved. MicroImages can best assist current and future users of the **TNTserver** by limiting the number of variables to be dealt with in managing a web server and **TNTserver** in particular. As a result, **TNTserver** is not going to be sold as a product that can be used on any platform under a wide variety of flexible circumstances. **TNTserver** is and will continue to be a narrowly confined and specified product.

Future Improvements.

JPEG2000 in Served Atlases?

TNTatlases can be prepared using linked JP2 files. It is not recommended that this approach be used at this time. It is slower to access linked JP2 files in your atlas via a **TNTserver**. Additional work underway now to speed up the display of linked JP2 files and, eventually, JPEG2000 compression may be incorporated directly into the structure of raster objects in a Project File. Hard drive space is the cheapest thing available to your **TNTserver**, so use it first, and avoid linking to JP2 files for the moment.

Decompression, after the data is read, is primarily a computation. Thus, with a fast processor, drive space access becomes the speed limiting factor. Ultimately, as discussed elsewhere in this MEMO, the drastically small size of a JPEG2000 compressed raster means they can potentially be read much faster from a drive and, in almost all systems, reading from the drive is the limiting factor in many **TNT** operations.

Sending JPEG2000 to **TNTclient**s?

Once the user is connected to and using an atlas, the primary activity determining the speed of its response is sending back a JPEG file of the image requested. This delay is almost totally determined by the network bandwidth of that user. **TNTserver**'s response in preparing this JPEG can always be increased by using faster or more computers for it. However, as a manager of a **TNTserver** you can not force its end user to move from a slow modem to a faster connection with higher bandwidth. They may not be able to do this even if they wanted and could afford it. One way to get results to them faster is to drastically reduce the size of what is sent by switching to sending a JPEG2000 compressed raster from the **TNTserver** to the end user. Another advantage of this is that the JPEG2000 raster can be streamed to the client so that it crystallizes in their view starting with a low resolution display almost immediately. Many times the user will see that this is not the right area and can then abort and instantly backup to the prior view, which is stored locally. This is a significant improvement but has the problem that their browser, without a special plug-in from and controlled by other companies, can not uncompress a JPEG2000 raster. This may change at any time by the anticipated release of Internet Explorer or Netscape with built in support for JPEG2000. It will be necessary to wait a little longer until JPEG2000 is used generically.

Serving SVG Layouts?

Other sections of this MEMO will give you the details on the W3C's Scalable Vector Graphics format in XML. This is clearly a way in which more complex results, layouts, and vectors and rasters can be sent from **TNTserver** to a requesting user of an atlas. MicroImages is researching how **TNTserver** could most efficiently create an SVG layout with images and vectors to send to a **TNTclient**. This would make the vector layer in **TNTclient** smart and interactive. It would be easy to add DataTips in this fashion. Again, there is another consideration that Adobe's SVG browser plug-in would also be needed. It could automatically be delivered with the **TNTclient** and **TNTbrowser**. However, this would slow down their initial access. Thus, SVG is something that is about to happen but is not quite there yet until its interpretation is included in the standard browsers.

TNTclients.

The HTML-based **TNTclient** and HTML-based **TNTbrowser** now share the same HTML code base. As a result, if you modify one with some of the built in customizations the changes will be reflected in both. Furthermore, when you add your own HTML modifications to one, they will work or can be easily adjusted to work in both versions.

You may not be aware that if you have saved measurements locally in the HTML clients, these files are stored in the SVG format discussed extensively in other sections of this MEMO.

HTML-based TNTclient.

Easy Customization of Features and Size.

Your HTML setup and control page used to provide access to the **TNTclient** also controls which features it will provide to your users. Virtually every component in the **TNTclient** or **TNTbrowser** can be "turned off" giving you control of not only which features are used but also the size of the **TNTclient** download. If your clients are in rural areas and only have slow modem access to the Internet, the **TNTclient** can be stripped down to a very small viewer only. If you do not want them to have measurement tools or remote data entry, then filter these tabbed panels out using your HTML control/access page. If you do not want them to have the drawing tools only, then filter them out to reduce the download size.

Edit Drawn Elements.

It can be hard to outline a complex shape using a mouse. Lines drawn in the remote data entry or measurement modes can now be adjusted in shape. If you wish to reshape and improve the fit of lines and polygons, they now have "handles." Simply use the left button near the line and a node will appear in the line that can be used to drag that point in the line to any new position.

Control Startup Window Size.

The size of the browser window you wish to have the **TNTclient** present can now be controlled by its launch parameters. Use this to insure that the **TNTclient** is started at a size you feel is appropriate for the means your client will use to gain access to it.

Can Be Localized.

You can now completely localize this **TNTclient** to present it to its user in their language. This is easily done by translating the text in the resource files that contain and supply all the text used by **TNTclient**. There are only about 150 short lines of text to translate. If you want to try a translated **TNTclient**, MicroImages will be happy to post your translated resource files on our **TNTserver** test site or instruct you how to do this for your site. A sample of a roughly translated Spanish **TNTclient** can be tried at http://alphaatlas.microimages.com/TNTservlet/Spanish/.

HTML-based **TNTbrowser**.

Duplicates Features in **TNTclient**.

Since the HTML-based **TNTbrowser** and HTML-based **TNTclient** have the same HTML code base, they now have the same features. Thus, the **TNTbrowser** now provides the remote data entry and several other features first introduced to the **TNTclient**.

Uses Windows Install Package.

The **TNTbrowser** is now automatically downloaded to a Windows platform as a standard, installable, compressed package (uses the ubiquitous InstallShield). It is no longer necessary to unzip it. It's now going to look and install just like any other Windows program to its users.

Locally Saves Atlas Startup Views.

The concept behind the standalone program version of the **TNTbrowser** is that its user is someone who makes regular and routine use of an atlas. It is especially appropriate when these applications are not public over the Internet but internal and routine to some large organization over a private intranet or over the Internet using a Virtual Private Network. When the atlas access is repeated and routine, the layout data and the legend images can now be locally stored at the machine using the **TNTbrowser**. Thus, at startup they do not have to be downloaded, which dramatically accelerates access to the initial view. For 2nd and subsequent accesses, these would have automatically been available in the temporary Windows cache. In the **TNTclient** this is automatically handled for 2nd and subsequent accesses by the browser's caching scheme.

Can be Localized.

You can now completely localize this **TNTbrowser** to present it to its user in their language. This is easily done by translating the text in the resource files that contain and supply all the text used by **TNTbrowser**. There are only about 150 short lines of text to translate.

TNTview® 6.7

Alas, **TNTview** for Windows is still only a promise. Work on it will be restarted, but it continues to be an elusive goal. It is not a hard goal to reach, its simply time consuming to redesign and rewrite 16 years worth of work and a million lines of code. Your and MicroImages' interest in adding new features of immediate interest and laying the foundation for future advanced features prevents spending the necessary, dedicated, larger blocks of time on this objective.

For the time being, if you choose to use the new optional native Windows desktop in **TNTview**, its user interface is indistinguishable from a Windows program in so far as user interaction with the windows and dialogs is concerned. However, please remember that it is still not a native Microsoft Windows application and is operating inside the same X server as if you choose the option to use the X desktop.

New Empowerments.

JPEG2000.

The support of JPEG2000 is of particular significance in **TNTview 6.7** for Windows, Mac, Linux, and UNIX combined with cross platform floating license support and conversionless use of geodata on all platforms. Now this advanced geospatial viewing and interactive analysis product can directly display and use all 3 popular wavelet compressed image formats: JPEG2000, MrSid, and ECW, as well as TIFF and GeoTIFF. Using JPEG2000, huge image sets and mosaics can be assembled on a CD, DVD, or hard drive. They can be directly overlaid with shapefiles and TAB files. **TNTview**'s extensive import capabilities can be used to add all kinds of other overlays from Project Files. All these geodata can be combined for direct visualization and interactive analysis

without regard to map projection or cell size and used for sketching with attributes (which means, photo interpretation), measuring, GeoFormulas, region analysis, GPS positioning, **SML** extensions, and so on.

Large map layouts also can be assembled from these geodata and printed using the P15 option (see below). If your map preparation does not require image analysis or any data editing, then **TNTview** now provides access to all of the **TNT** advanced map layout capabilities at a reasonable price.

Convert Map Layouts to Scalable Vector Graphics (SVG).

You can now convert map layouts prepared in **TNTview** to the W3C's Scalable Vector Graphics (SVG) layout file in an XML structure. The Editorial and **TNTmips** sections and several color plates in this MEMO discuss this new layout structure in considerable detail.

You can also print your map layouts to an SVG file(s) even if you do not have the P15 large format printing option for your **TNTview 6.7**. Just as in other "print to" formats previously available in **TNTview** (for example, PDF, Illustrator, EPS, and so on), this SVG file will have reduced coordinate values that have been rescaled to preserve only that accuracy needed to print to 11" by 17" size at 300 dpi. The rasters in the **TNT** layout will also be rescaled to fit into their position in the layout at the 300 dpi resolution.

Large Format Printing Option.

The P15 Printing option can now be purchased as an option, the only option, for **TNTview**. It provides for direct printing to any size greater than the basic maximum 11" by 17" printing included as standard in every **TNTview**. It also permits unrestricted conversion of **TNT** layouts via the "print to" capabilities into TIFF, EPS, Illustrator, PDF, and the new SVG layout files.

Inherited New Features.

The following general improvements in all **TNT** product operations are automatically available in **TNTview 6.7**. These improvements are detailed in this MEMO in the major section on New Features for **TNTmips** and include:

- use the new Windows desktop or the familiar X desktop,
- directly display georeferenced JP2 (JPEG2000 compressed lossy or lossless) rasters, …,
- import JP2 (JPEG2000 compressed lossy or lossless) rasters, …,
- convert a map layout to a Scalable Vector Graphics (SVG) XML layout,
- use transparency for 16-bit rasters (IKONOS, QuickBird, …)
- include legend samples for elements rendered via CartoScripts or other scripts in Legend Views and map layouts,
- use word wrap and justification in text blocks in map layouts,
- control advanced text features (italics angle, outline thickness, boldness, …),
- control labels by scale and pan to each label, and
- embed fonts into PDF files to improve their portability, scalability, and the rendering of tiny characters.

Upgrading.

If you did not order **V6.70** of **TNTview** in advance and wish to do so now, please contact MicroImages by FAX, phone, or email to arrange to purchase this version. When you

have completed your purchase, you will be provided an authorization code. Entering this authorization code while running the installation process allows you to complete the installation of **TNTview 6.7**.

The prices for upgrades from earlier versions of **TNTview** are outlined below. Please remember that new features have been added to **TNTview** with each new release. Thus, the older your version of **TNTview** relative to **V6.70**, the higher your upgrade cost will be.

Within the NAFTA point-of-use area (Canada, U.S., and Mexico) and with shipping by UPS ground. (+50/each means US$50 for each additional upgrade increment.)

TNTview Product	Price to upgrade from **TNTview**:					**V6.10**
	V6.60	**V6.50**	**V6.40**	**V6.30**	**V6.20**	and earlier
Windows/Mac/LINUX	US$175	275	400	500	555	+50/each
for 1-user floating	US$210	330	480	600	667	+60/each
UNIX for 1-fixed license	US$300	475	600	675	725	+50/each
for 1-user floating	US$360	570	720	810	870	+60/each

For a point-of-use in all other nations with shipping by air express. (+50/each means US$50 for each additional upgrade increment.)

TNTview Product	Price to upgrade from **TNTview**:					**V6.10**
	V6.60	**V6.50**	**V6.40**	**V6.30**	**V6.20**	and earlier
Windows/Mac/LINUX	US$240	365	465	545	605	+50/each
for 1-user floating	US$288	438	558	654	726	+60/each
UNIX for 1-fixed license	US$350	550	700	800	850	+50/each
for 1-user floating	US$420	660	840	960	1020	+60/each

Installed Sizes.

Loading **TNTview 6.7** processes onto your hard drive (exclusive of any other products, data sets, illustrations, documentation files, …) requires the following storage space in megabytes.

	for **V6.60**	for **V6.70**
PC using W95, W98, WME, NT, W2000, or XP	43 Mb	54 Mb
PC using LINUX (with Intel) kernel 2.0.36 - 2.4	29 Mb	36 Mb
Mac using Mac OS 8.x or 9.x	47 Mb	48 Mb
SGI workstation via IRIX	34 Mb	42 Mb
Sun workstation via Solaris 2.x	31 Mb	40 Mb
IBM workstation via AIX 4.x (with PPC)	36 Mb	44 Mb

TNTedit™ 6.6

Convert Map Layouts to Scalable Vector Graphics (SVG).

You can now convert map layouts prepared in **TNTedit** to the W3C's Scalable Vector Graphics (SVG) layout file in an XML structure. The Editorial and **TNTmips** sections and several color plates in this MEMO discuss this new layout structure in considerable detail.

You can also print your map layouts to an SVG file(s) even if you do not have the P15 large format printing option for your **TNTedit 6.7**. Just as in other "print to" formats previously available in **TNTedit** (for example, PDF, Illustrator, EPS, and so on), this SVG file will have reduced coordinate values that have been rescaled to preserve only that

accuracy needed to print to 11" by 17" size at 300 dpi. The rasters in the **TNT** layout will also be rescaled to fit into their position in the layout at the 300 dpi resolution.

Large Format Printing Option.

The P15 Printing option can now be purchased as an option, the only option, for **TNTedit**. It provides for direct printing to any size greater than the basic maximum 11" by 17" printing included as standard in every **TNTedit**. It also permits unrestricted conversion of **TNT** layouts via the "print to" capabilities into TIFF, EPS, Illustrator, PDF, and the new SVG layout files.

Advanced Label Placement.

Automatic Polygon Labeling.

Automatic label generation now attempts to fit the polygon label inside the polygon at the horizontal position wide enough to contain the label with preference given to the span that contains the centroid. If the label will not fit in the widest horizontal span, it selects one of the adjacent (common boundary) polygons for the label and adds a leader line. As a last resort, it will place the label over the center of the polygon regardless of its width (a common result for very small polygons). The polygon label placement dialog now also provides a Clip Under option. This will clip open a hole for the label text in the polygon fill and every other element in that layer.

Automatic Line Labeling.

Short individual lines can automatically be assembled into a single, longer virtual line by matching their attributes. A single label is then placed at the center of the virtual line. The way labels conform to an irregular line shape at the automatically located position can now be selected to follow the irregular line exactly, follow a spline, or an angled straight line. The vertical placement of the line's label can now be selected as Top, Bottom, or Centered on the line. When the label is centered on the line, it can be bisected by the line or the Clip Under option can be used to open a gap for the label in the line and any other lines in that object.

Advanced Label Editing.

Screen Labels.

You can now automatically pan to every label in a layer while zoomed in to locate labels that need to be repositioned.

Slide Line Labels.

A line label attached to a line can now be interactively slid along it in either direction to a new position. Its curved or straight alignment and above, in, or below baseline property will be maintained.

Drag and Drop Polygon Labels.

Individual polygon labels can now be interactively selected and dragged to a new position. If the label is dragged out of the associated polygon, a straight leader line will automatically appear leading back to its original position. You can select a position on this leader line and pull it out, rubber band fashion, so that it will have a dogleg. The free end of the leader line can also be grabbed and moved to some other position within the polygon.

Change a Label's Appearance.

A new interactive polygon text label size and orientation tool is available. It permits the position, orientation, and size of a label to be interactively adjusted. If a label is moved outside its polygon a leader line is automatically added. A single label can be restyled including its font and colors, by adding bold, italics, outline, or underline, which can also be controlled by the new italics angle, boldness, and other settings. Multiple line labels can also be created with the various alignment options (including justification) and word wrap.

Inherited New Features.

The following general improvements in all **TNT** product operations are automatically available in **TNTedit 6.7**. These improvements are detailed below in the major section on New Features for **TNTmips** and include:

- use the new Windows desktop or the familiar X desktop,
- directly display georeferenced JP2 (JPEG2000 compressed lossy or lossless) rasters, …,
- import JP2 (JPEG2000 compressed lossy or lossless) rasters, …,
- convert a map layout to a Scalable Vector Graphics (SVG) XML layout,
- use transparency for 16-bit rasters (IKONOS, QuickBird, …)
- include legend samples for elements rendered via CartoScripts or other scripts in Legend Views and map layouts,
- use word wrap and justification in text blocks in map layouts,
- control advanced text features (italics angle, outline thickness, boldness, …),
- control labels by scale and pan to each label, and
- embed fonts into PDF files to improve their portability, scalability, and the rendering of tiny characters.

Upgrading.

If you did not order **V6.70** of **TNTedit** in advance, and wish to do so now, please contact MicroImages by FAX, phone, or email to arrange to purchase this version. When you have completed your purchase, you will be provided an authorization code. Entering this authorization code while running the installation process allows you to complete the installation of **TNTedit 6.7**.

The prices for upgrades from earlier versions of **TNTedit** are outlined below. Please remember that new features have been added to **TNTedit** with each new release. Thus, the older your version of **TNTedit** relative to **V6.70**, the higher your upgrade cost will be.

Within the NAFTA point-of-use area (Canada, U.S., and Mexico) and with shipping by UPS ground. (+$50/each means US$50 for each additional upgrade increment.)

TNTedit Product	Price to upgrade from **TNTedit:**					**V6.10**
	V6.60	**V6.50**	**V6.40**	**V6.30**	**V6.20**	and earlier
Windows/Mac/LINUX	US$350	550	700	800	875	+50/each
for 1-user floating	US$420	660	840	960	1050	+60/each
UNIX for 1-fixed license	US$650	1000	1350	1600	1750	+50/each
for 1-user floating	US$780	1200	1620	1920	2100	+60/each

For a point-of-use in all other nations with shipping by air express. (+$50/each means US$50 for each additional upgrade increment.)

TNTedit Product	Price to upgrade from **TNTedit:**					**V6.10**
	V6.60	**V6.50**	**V6.40**	**V6.30**	**V6.20**	and earlier
Windows/Mac/LINUX	US$500	750	950	1100	1200	+50/each
for 1-user floating	US$600	900	1140	1320	1440	+60/each
UNIX for 1-fixed license	US$750	1200	1550	1850	2000	+50/each
for 1-user floating	US$900	1440	1860	2220	2400	+60/each

Installed Sizes.

Loading **TNTedit 6.7** processes onto your hard drive (exclusive of any other products, data sets, illustrations, Word files, and so on) requires the following storage space in megabytes.

	for **V6.60**	for **V6.70**
PC using W95, W98, WME, NT, W2000, or XP	55 Mb	70 Mb
PC using LINUX (with Intel) kernel 2.0.36 to 2.4	52 Mb	67 Mb
Mac using Mac OS 8.x or 9.x	61 Mb	64 Mb
SGI workstation via IRIX	68 Mb	86 Mb
Sun workstation via Solaris 2.x	57 Mb	72 Mb
IBM workstation via AIX 4.x (with PPC)	72 Mb	92 Mb

QuickGuides

9 new 1-page QuickGuides listed below are enclosed with **V6.70**, bringing to 42 the number provided in printed form with each new **TNTmips** product. If you have suggestions for QuickGuides that might help you or others as quick references to special features, please let us know.

- CartoScripts
- GeoCatalogs
- Windows or X Desktop
- Open Any Object Type
- Common File Extensions
- Unusual File Extensions
- Recenter and Zoom on Cursor Position
- TrueType Fonts for Localization
- Automatic Label Leader Lines
- Automatic Projection Reconciliation
- Database Constraints

All 42 QuickGuides can be downloaded in Adobe Acrobat Reader PDF from http://www.microimages.com/didyouknow/.

Tutorial and Reference Booklets

There are now 70 **TNT** Tutorial and Reference booklets (formerly called Getting Started Booklets). These booklets provide 1700 pages and over 3800 color illustrations. Many are up-to-date with the features in **V6.70** of the **TNT** products, some are not. Each new professional **TNTmips** ships with 3 thick notebooks containing a color printed copy of every booklet. Those of you receiving your **V6.70** upgrade on CD can view and refer to any booklet using Adobe Acrobat Reader. If you install all these booklets as part of any **TNTmips** product, you can directly access these booklets via Help / Tutorial Overview.

An online, searchable, cross index covering all the booklets and online documentation is now available from the help menu.

New Booklets Available.

Five new GSBs are being released for the first time with **TNT V6.70** and are shown in the attached color plate entitled New Tutorial and Application Booklets. They are:

- Advanced Vector Editing,

- Using TNTsim3D for Windows (latest version matching **TNTsim3D 6.7** is not on **V6.70** CD, please download),
- Building 3D Landscapes,
- Making Geologic Maps, and
- Making Topographic Maps

Expanded Booklets.

Seven TNT booklets have had significant upgrades for use with **V6.70** of the **TNT** products. They are:

- Displaying Geospatial Data,
- Navigating,
- Making Map Layouts,
- Feature Mapping,
- Building 3D Landscapes, and
- Pin Mapping.

Translated Booklets.

Additional translated tutorial booklets continue to be added to the list. A good portion of the booklets, some of the QuickGuides, and other materials are now available in Spanish. The first booklets are available in Russian and Bulgarian. You can determine which booklets are available in your language at any time and obtain them from the "Download" listings at microimages.com/getstart/. A color plate is attached entitled Translated Documentation to emphasize the availability of these materials.

New TNTmips Features

Main or subsections preceded by the asterisk "*****" symbol introduce significant new processes or features in existing processes released for the first time in **TNTmips 6.7**.

System Level Changes.

* Windows or X Desktop.

When you start up **TNTmips 6.7** within Microsoft Windows, you are now presented with a small Interface Type dialog to select the familiar **TNT** X desktop or the new **TNT** Windows desktop. The attached color plate entitled Windows Desktop or the X Desktop illustrates both of these desktops.

X Desktop.

If you choose the familiar X desktop option, you will be using the same full screen X window approach as in previous versions of the **TNT** products. One large X window appears providing your **TNT** desktop or work area and all other **TNT** visual interface components appear inside this large window. As you know, this X desktop can be set to any size you wish if your **TNTmips** is authorized to level M50 (the only version of **TNTmips** sold for the last 2.5 years—since **V6.30**).

There are sizing options for you to use to set up your X desktop.

1) The X desktop can be deliberately set smaller than your display screen to expose some of your normal Windows area outside the main X window. This will permit you to see other programs' windows and click on them to make them move to the front and become the active window for your input. Since you can also move any running program

to the foreground using its task bar representation, this smaller X window is seldom used.

2) The main X window size can be set to equal your screen(s) display area. This full screen X window will open to hide the windows of any other active programs. They can immediately be moved in front of this X window by selecting them from the task bar.

3) The third option, unique to the **TNT** products, is to set up a virtual X window, which is much larger than all the area of your display screen(s). This creates a virtual X desktop for large map size displays and instant access to any part of it and the many control windows used in **TNTmips**.

Windows Desktop.

The new **TNT** Windows desktop option makes the **TNTmips** interface components appear and function just like any other active windows. In this mode, MicroImages' X server projects each **TNTmips** window into the Microsoft Windows desktop using the same functions as native Windows. Thus, your **TNT** windows appear on your Windows desktop as separate windows and move, resize, close, and operate like any other open windows. All these **TNT** windows also appear on the task bar.

While you are not able to functionally distinguish these separate **TNT** windows from those of other native windows programs, you are still running MicroImages' X server in the background. You are not running a native Windows version of **TNTmips**, **TNTedit**, or **TNTview**, it just looks as if you are! Thus, even though you now have a native Windows desktop, it does not provide ActiveX components or permit communication with other Windows processes via OLE, COM, Visual Basic, and so on.

Making a Choice.

New users of **TNTmips** will find comfort in finding and using all the **TNT** windows and dialogs on the familiar Windows' desktop. Before the Windows desktop was available, the comment often heard from someone looking over your shoulder was "But, its not Windows!" Now, if you do not tell them, they may never realize that it is not. Those who become experienced in the operation of **TNTmips** will gradually discover and accept the differences (some good some not). Eventually, they will become sufficiently experienced to realize that **TNTmips** is not a single program, but a complex analysis system a bit like a simple, but specialized operating system. It has a common geodata file system and file management tools and performs many different but interrelated analysis operations on these files. Each of these operations may present several interrelated windows and dialogs. Thus, as you become an experienced user, you may choose the full or virtual screen X desktop mode that focuses all your attention on the integrated nature of geospatial analysis as you engage in progressively more complex activities.

The new Mac OS X versions of the **TNT** products function just like the new optional Windows desktop. Each **TNT** window appears and operates in a native Mac Aqua window, but is still formed from an X window. Switching between the X and Windows desktop on a Microsoft based platform is a matter of preference and is no different now than switching from a Windows desktop to a Mac desktop. There is no equivalent to the full screen X desktop option for Mac OS X. Linux and UNIX platforms can operate more or less like either of the Windows' desktop modes depending on the window manager selected. However, for all these different desktops and their windows' cosmetic differences, your **TNT** products will present the same windows, dialogs, options, and operations.

Changing Your Mind.

Unless you toggle it off, the Interface Type dialog will continue to provide you the opportunity to start either the Windows desktop or X desktop each time you start the X server. Leave it on for a few days until you have experimented thoroughly with each approach. If you have selected the Windows desktop mode and exit **TNTmips**, the X server is not closed and is treated as a suspended utility. Take careful note that there is a small X icon in your system tray (which means, at the right end of the task bar). This costs nothing and saves time when you restart a **TNT** product. However, if you restart **TNTmips**, it will not present the Interface Type dialog as you have not restarted the X server, so it appears that you can not switch modes. Simply use your right button on the small X icon on the toolbar to expose and use its Exit menu option. Now, if you restart **TNTmips** you will again get the Interface Type dialog box (unless you toggled it off previously).

Once you have toggled off the Interface Type dialog, use the following procedure to change between the desktop modes while running **TNTmips**. Use your left mouse button on the X icon in your system tray (which means, at the right end of the task bar) to expose the MicroImages X Server Preferences dialog. On this dialog select the Options tabbed panel, and scroll through the Extensions and Server Options. The check box for the option to Run in Rootless Mode switches the X server between desktop modes [Rootless Mode - see how programmer's jargon manages to creep in no matter how hard you try to stamp it out]. Remember that you then have to Exit the X server to get this change to take effect when **TNTmips** restarts it.

Customizing Menus and Running Your Programs.

There have been several recent inquiries that indicate it is not well understood how to customize your **TNT** menus. This is done by simply editing the file tntmips.mnu with WordPad or any other text editor. In this fashion, you can modify your **TNTmips** menus to move or delete **TNT** processes and to access **SML** scripts, processes you develop with **TNTsdk**, or programs developed with other tools such as Visual Basic. The procedures for modifying all **TNT** product menus (including **TNTatlas**) are outlined in the attached color plate entitled Customizing TNT Menus. Note that it illustrates how a Visual Basic program can be started from the menu. When it is run from the menu, it runs as a separate task with its own active window(s). If you are using the new **TNT** Windows desktop, you could now also see and access this program's windows. You are still running **TNTmips**, so when you quit this program, you can continue on with subsequent **TNT** processes.

Your Visual Basic program could incorporate the **TNTsdk** C++ functions to read and/or write objects to or from a Project File. Thus, this Visual Basic program could operate on **TNT** objects and modify them for use in subsequent **TNT** processes. Manipulating **TNT** database objects, such as collecting user input with a form, would be one example of this kind of operation. Of course, there are many other functions you could call in the **TNTsdk**. Alas, the powerful **TNT** Graphic Rendering Engine is not a function.

Miscellaneous.

In all object selection dialogs, the "Add All" button now adds objects in the order they are selected and shown rather than the order they are in the file. This allows control of the order by appropriate naming in cases where the order is significant such as the harmonic analysis process.

The message text formatting system was redesigned to permit changing the order of substitution parameters when translating messages. Previously these had to be retained in the original order. Translators may now arrange the values in their desired order to provide better readability in their language. For example the text

" 3D vector from raster '1 and vector $2' " can now be rearranged as

" 3D vector from vector '$2' and raster '$' 1".

Geospatial Display.

* Vector Element Selection.

When a query, script, or other control operation is used to select a subset of elements from a vector object for display, only the labels attached to those elements are drawn into the view.

The Table Editor dialog used for the selection by attributes of the element to render has been revised. This dialog now permits the selection of any attribute rather than being limited as in **V6.60** to a "primary key" attribute. The new dialog design is simpler to use with intuitive checkboxes for selecting/unselecting attribute records.

* Label Scale Control.

Add "scale range" option for label elements to suppress labels when they would be drawn too small or dense to be readable. Use this option to improve the appearance of vector objects with many dense labels.

Miscellaneous.

You can now manually add "representative elements" to legends (both in LegendView and a multi-object legend layer in a layout) for vector objects styled by script. This is done using the right mouse button after selecting an element in the GeoToolbox. These legend entries are stored in a database table associated with the elements, which can easily be edited later to change labels and text, remove legend items, and so on. This feature is discussed in more detail in the Legends section of this MEMO.

Transparency is now supported for any 16-bit rasters (for example, IKONOS and QuickBird)

The appearance of the relief shading of signed rasters was improved.

A user-specified color palette is stored with the group or layout if not saved as a palette object with a raster layer. This reduces the need to save the palette especially for cases where a layout-specific palette is desired or where the raster object is not writable such as on a CD or linked and set as read-only.

* JPEG2000 Compression Using Discrete Wavelet Transformation (DWT).

Background.

What is the Situation in Commercial Offerings?

Previous MicroImages' MEMOs have reported on the progress and legal entanglements of 2 other wavelet based still image compression methods: LizardTech's MrSID and Earth Resource Mapping's ECW. These earlier methods emerged to take advantage of wavelet concepts in the absence of an ISO approved JPEG2000 standard. They provide specific proprietary approaches to the application of wavelet compression concepts to grayscale and color picture compression (MrSID) and remote sensing applications (ECW). **V6.60** of the **TNT** products provides you with the ability to link to, or import im-

ages that you obtain in these proprietary compressed formats on the specific platforms their manufacturers support (generally limited to Windows). **V6.60** also provides the ability to produce ECW images up to the 500 Mb limit, which they permit other software vendors to provide without additional charges. Creating ECW files greater than 500 Mb is provided by the compressor included in the ER Mapper product. Creating MrSID files of any size requires the purchase of their "stand-alone compressor" product.

A careful search of the WWW in late June provided no information with regard to the implementation of JPEG2000 compression in PCI Geomatics, ENVI, or ERDAS products. A similar review of their web sites could not identify any capability of this type. In May Earth Resource Mapping released a marketing document part of which is devoted to comparing still image wavelet compression products and results.

> Accelerating WebGIS (ArcIMS® et al) with Image Web Server. Technical Overview and Performance Analysis. 17 May 2002. prepared by Earth Resource Mapping. 22 pages.

This is an important reference, which can be downloaded from

> http://www.ermapper.com/marktng/articles/pdf/accelerating%20webgis%20with%20image%20web%20server.pdf

While the map server portion of this document may be of interest, pages 15 to 21 present tables entitled Image Format Features Comparison, Compressed Image Technology Capabilities, and Compressed Image Technology SDK's. These comprehensive tables compare in considerable detail the ECW, MrSID, JPEG2000, JPEG, and compressed GeoTIFF formats. The tables also compare prices, limitations, efficiencies, and other aspects of using these formats.

In general, the entries in these tables for these competitive compression schemes appear correct. However, as noted in the footnotes to many entries, the JPEG2000 limitations reported represent limitations of LuraTech's JPEG2000 proprietary library implementation, not the JPEG2000 ISO standard. In comparison with these entries for the LuraTech approach, MicroImages' implementation of JPEG2000 compression uses a different library that overcomes these LuraTech imposed limitations. For example the **TNT** JP2 file size is unlimited (not the 2 Gb in this table), 16,384 spectral bands (not 255), data value precision is 38 bits (not 23 bits), and georeference information is provided. When these adjustments are made to the Image Format Features Comparison table, JPEG2000, an open standard ISO format equals or surpasses ECW, MrSID, and LuraTech's JPEG2000 in each category where each of our marketing and implementation strategies vary with regard to creating, buying, and using wavelet compression methods.

Finally, controlling compression and the efficiency of the end use of the file achieved also varies widely between these and the **TNT** products. For example, can the level of compression be controlled and how is it specified (for example, lossless, 18 to 1, …), how fast is the decompression in some other end user product (for example, a free geoviewer), does their display permit streaming only to the pixel resolution of the display (for example, stopping at the resolution of the display device), and so on. These Earth Resource Mapping tables do not cover these kinds of practical end user considerations as they are difficult to compare when you are providing files for use in a variety of other vendors' products.

What does the ISO Standard Encompass?

Please keep in mind that JPEG2000 has been designed for a wide variety of image applications such as streaming high resolution TV (for example, HDTV) to produce manageable band width requirements. To provide you with a better grasp of what objectives can be achieved by the JPEG2000 standard for use with still images, the following paragraphs in italics have been reproduced directly from the introductory portion of the article:

> The JPEG 2000 Still Image Compression Standard. IEEE Signal Processing Magazine. by Athanassios Skodras, Charilaos Christopoulis, and Touradj Ebrahimi. Sept 2001, V18, N5. pp. 36-58.

"Why Another Still Images Compression Standard?

"The JPEG standard has been in use for almost a decade now. It has proved a valuable tool during all these years, but it cannot fulfill the advanced requirements of today. Today's digital imagery is extremely demanding, not only from the quality point of view, but also from the image size aspect. Current image size covers orders of magnitude, ranging from web logos of size less than 100 Kbits to high quality scanned images of approximate size of 40 Gbits. The JPEG 2000 international standard represents advances in image compression technology where the image coding system is optimized not only for efficiency, but also for scalability and interoperability in network and mobile environments. Digital imaging has become an integral part of the Internet, and JPEG 2000 is a powerful new tool that provides power capabilities for designers and users of network image applications.

"The JPEG 2000 [ISO] standard provides a set of features that are of importance to many high-end and emerging applications by taking advantage of new technologies. It addresses areas where current standards fail to produce the best quality or performance and provides capabilities to markets that currently do not use compression. The markets and applications better served by the JPEG 2000 standard are Internet, color facsimile, printing, scanning (consumer and prepress), digital photography, remote sensing, mobile, medical imagery, digital libraries/archives, and E-commerce. Each application area imposes some requirements that the standard, up to a certain degree, should fulfill. Some of the most important features that this standard should possess are the following:

"Superior low bit-rate performance: This standard should offer performance superior to the current standards at low bit rates (e.g., below 0.25 bpp [bits per pixel] *for highly detailed gray scale images). This significantly improved low bit-rate performance should be achieved without sacrificing performance on the rest of the rate-distortion spectrum. Network image transmission and remote sensing are some of the applications that need this feature.*

"Continuous-tone and bilevel compression: It is desired to have a coding standard that is capable of compressing both continuous-tone and bilevel images. If feasible, this standard should strive to achieve this with similar system resources. The system should compress and decompress images with various dynamic ranges (e.g., 1 to 16 bits) for each color component. Examples of applications that can use this feature included compound documents with images and text, medical images with annotation overlays, and graphic and computer generated images with binary and near to binary regions, alpha and transparency planes, and facsimile.

"Lossless and lossy compression: It is desired to provide lossless compression naturally in the course of progressive decoding. Examples of applications that can use this feature include medical images, where loss is not always tolerated; image archival applications, where the highest quality is vital for preservation but not necessary for display; network applications that supply devices with different capabilities and resources; and prepress imagery. It is also desired that the standard should have the property of creating embedded bit stream and allow progressive lossy to lossless buildup.

"Progressive transmission by pixel accuracy and resolution: Progressive transmission that allows images to be reconstructed with increasing pixel accuracy or spatial resolution is essential for many applications such as web browsing, image archival and printing.

"Region-of-interest (ROI) coding: Often there are parts of an image that are of greater importance than others. This feature allows users to define certain ROIs in the image to be coded and transmitted in better quality and less distortion than the rest of the image." [Note, this is not the same use of the term ROI as used in the **TNT** products.]

"Open architecture: It is desirable to allow open architecture to optimize the system for different image types and applications. With this feature, a decoder is only required to implement the core tool set and the parser understands the code stream.

"Robustness to bit errors: It is desirable to consider robustness to bit errors while designing the code stream. One application, where this is important, is transmission over wireless communication channels. Portions of the code stream may be more important than others in determining decoded image quality. Proper design of the code stream can aid subsequent error correction systems in alleviating catastrophic decoding failures.

"Protective image security: Protection of a digital image can be achieved by means of different approaches such as watermarking, labeling, stamping, or encryption. JPEG 2000 image files should have provisions for such possibilities."

What is MicroImages' Approach?

As part of the JPEG2000 international design and ISO adoption process, all those companies participating in and contributing patented or copyrighted concepts into JPEG2000 agreed to abrogate or granted free licenses for use in this standard. This has permitted members of the standardization committee to develop libraries for the implementation of JPEG2000 support in other products that are free of legal entanglements at this time. After an examination of the available libraries, MicroImages purchased the unlimited and source code rights to use the Kakadu libraries (Kakadu is Australia's largest national park, see www.kakadusoftware.com). These libraries were developed by Dr. David Taubman, Senior Lecturer in Telecommunications, School of Electrical Engineering and Telecommunications at the University of New South Wales (www.ee.unsw.edu.au/staff/taubman/profile.htm).

Dr. Taubman is a central figure in the JPEG2000 standards movement and author of a new definitive 773 page book containing all the technical and mathematical details of JPEG2000.

JPEG2000: Image Compression Fundamentals, Standards and Practice. eds. David S. Taubman and Michael W. Mercellin. 2002. Kluwer Academic Publishers, The Netherlands. 773 pages. (ISBN 0-7923-7519-X)

For a synoptic technical introduction to JPEG2000 you can also see:

A Tutorial on Modern Lossy Wavelet Image Compression: Foundations of JPEG2000. IEEE Signal Processing Magazine. by Bryan E. Usevitch. Sept 2001, V18, N5. pp 22-35.

V6.70 of the **TNT** products uses the Kakadu library to implement almost all the meaningful JPEG2000 still image features in ISO Part 1 for all the **TNT** supported operating systems. Since JP2 files are in a standard format, they can also be moved between operating systems without alteration. ISO Part 2 is still under consideration at this time and will standardize some additional characteristics such as how to include image georeferencing (the **TNT V6.70** procedure is discussed below). However, most of what will be standardized in Part 2 concerns other kinds of images and will not be pertinent to still images and your use of them. MicroImages awaits the official publication of Part 2 and will extend JPEG2000 support to encompass its new features as soon as they are available.

Using JPEG2000.

JP2 files can be used in **TNT** products except in **TNTsim3D**. **TNTatlas**es can be drastically reduced in size, if appropriate, by using linked, compressed JP2 raster files. A plug-in is available for Adobe Photoshop to support its use of JP2 files. LuraTech at 194.231.34.35/index_e.html provides a plug-in for Internet Explorer to upgrade it to use JP2 files locally or via a web source. LuraTech also sells low cost JP2 plug-ins for Photoshop, Paint Shop, and browsers as well as extensions for other packages such as QuarkXPress. Please search the web or consult the manufacturer of your other software products to determine their support or plans to support JP2 files.

All of the different integer types that can be used in raster objects can be exported to the JP2 format (for example, binary, signed 16-bit or 32-bit integers). The conversion to JPEG automatically transforms color composite images of various types (RGB, HIS, …) into 3 RGB components. It is important to remember that **TNTmips** supports many integer raster data types, all of which can be exported to JP2 files. However, this does not insure that a particular data type in a JP2 file is supported or even useable by other commercial software products (for example, signed 16-bit integers). You may have to restrict or convert the data types in your **TNT** raster objects before exporting to JP2 for use in other software products.

Type of Compression.

Lossless Compression.

As you know, JPEG does not support lossless compression and the lossy level (compression ratio) of JPEG is hard to control. **TNT**'s JPEG2000 implementation provides lossless and better control over the level of lossy compression. However, lossless JPEG2000 is about the same as that used in GeoTIFF or other lossless compression schemes.

As pointed out in the table Image Format Features Compression (see source above), there are differences between proprietary wavelet compression and JPEG2000 implementations. Lossless compression ratios may increase significantly when images are provided in 16-bit integer files as often these images do not actually need that data type or they do not locally (in most subareas) range widely over the 16-bit data values—unless the image is highly noisy. Neither MrSID nor ECW provide 16-bit lossless support. **TNT** products now support lossless JPEG2000 compression for up to 32-bit integers.

Lossy Compression.

One of the main objectives of JPEG2000 is to provide vastly improved lossy compression. At first glance, its 50 to 1 or even 100 to 1 compression seems almost like magic. This very significant capability is illustrated in the color plate entitled JPEG2000: Compression Results. However, always keep in mind that if you apply any level and type of lossy compression to an image, you are creating a new image from it. You are not simply changing the format and size of your original image. The attached color plate entitled JPEG2000: Lossy or Lossless? lists some of the situations in which you can apply lossy compression to raster materials at your discretion. Lossy compression can be a powerful tool, but you must think about what it does to your image before you use it.

In concept, the wavelet compression used in JPEG2000 stratifies the content of an image by its frequency. As you increase the amount of lossy compression (increasing the compression ratio), image components with high frequencies are omitted from the new image and JP2 file. Eventually, as JPEG2000 compression increases, you can begin to visually detect that these kinds of components (high frequency features) are missing from your new image. This gradual loss of detail contrasts sharply with the visual 8 by 8 pixel artifacts that appear in highly compressed JPEG images. This is illustrated in the attached color plate entitled JPEG2000 versus JPEG "Classic".

At low lossy JPEG2000 compression ratios, it may be that image noise is discarded. However, as compression ratios are increased, the new image, when carefully examined, will show losses in detail. An example of the "fading detail" is illustrated in the attached color plate entitled JPEG2000: A Closer Look at Compression Artifacts. You must determine whether or not these losses are significant to your application. In the attached color plate entitled JPEG2000: Compression Results you do not detect these losses as the printer and scale of the reproductions do not maintain them. If the printer, display screen, the web application, and so on can not reproduce the detail lost at the desired resolution and scale, then the loss is meaningless. For these kind of applications, large compression can be very useful.

The level of compression and the amount of loss you wish to introduce into your JPEG2000 images is up to you. Lossy compression should never be used with multispectral or hyperspectral images that are going to have any subsequent analysis applied. DEM rasters (as discussed below) can have some losses introduced depending on how they were derived and what they are intended for. Images that are to be used for backgrounds in image maps can be very compressed when the details in the image will be lost in the printing process. Lossy JPEG2000 support, when included within the standard browsers, will find extensive application on the web where bandwidth and end user wait-time (which means, patience) is critical, and streaming of resolution detail is expected.

Almost Lossless Compression.

A "Lossy (best quality)" option is available as part of the **TNT** export to automatically achieve almost lossless compression for many kinds of source materials. Limiting your lossy compression to this level can provide significant compression in a new raster that is nearly indistinguishable in quality from the original. Choosing this option or specifying an even greater targeted lossy compression is a decision you are going to have to make.

The DWT process may itself can be lossless or lossy. In either case the source raster is converted to a Discrete Wavelet Transformation (DWT), which is encoded into a JP2

file. The difference between the lossless DWT and the lossy DWT is that the lossless DWT is performed using integer computation and uses 7 sequential cells at a time, while the lossy DWT uses floating-point computation and uses 9 sequential cells.

If the lossless integer DWT is performed, no additional information will be discarded later in the compression process resulting in completely lossless and reversible compression. The floating point DWT produces the "Lossy (best quality)" and all losses are those automatically minimized by the floating point DWT process. If you specify a target compression ratio greater than that produced by this initial DWT result, additional information will be selectively discarded from the floating point DWT to achieve your compression ratio.

Compressing only to the "Lossy (best quality)" level takes advantage of the DWT concept and usually causes only very small changes in numeric cell values. For relatively "smooth" data, such as elevation models, this setting can result in compression rations of 50:1 or greater with acceptable minor loss of precision. Compressing to a higher targeted ratio produces a JP2 file of known size whose additional losses in quality may be unimportant in your application.

Choosing A Compression Ratio.

Start from Lossy (best quality).

How should you proceed to select the lossy level. You could arbitrarily let the storage space on your media decide the level of compression to select without regard to what happens to the raster contents. If this is your choice, simply determine and enter the appropriate compression ratios. If you want to retain good quality in your images, choose "Lossy (best quality)" and plan to supply the required storage space. This is also the best choice for exploring new materials or for beginners with limited experience in using JPEG2000 compression on a wide variety of rasters. Closely compare the "Lossy (best quality)" JP2 raster with the original. If the results are satisfactory for your application, then rerun that comparison using incrementally higher "Targeted Compression" settings (for example, … 20:1, 25:1, 30:1 …) until you find the maximum lossy compression that retains the quality required for your application with this type of raster.

Sample Application to DEMs.

Compressing Nebraska.

Digital Elevation Models can be highly compressed to lossy JP2 files and the amount of compression can vary widely. The attached color plate entitled JPEG2000: Almost Lossless illustrates how "Lossy (best quality)" compression changes a 16-bit Digital Elevation Model (DEM) with a 1-meter vertical cell increment. This elevation map of Nebraska at this 90-meter cell size changes little from cell to cell. It was prepared by USGS from contour maps and the vertical accuracy has Root Mean Square Error (RMSE) of 15 meters. This makes it an excellent candidate for a small JP2 file for use in many applications.

As illustrated, almost 88% of the cells are changed only 0, 1, or 2 meters in elevation from neighboring cells while the RMSE of the cell elevation is 15 meters. On the other extreme, 1 cell in the whole area (46 million cells) was changed by 18 meters, 6 by 17 meters, 16 by 12 meters, and so on. Overall, 99.99% of all cells were changed by 10 meters or less.

Computing the Discrete Wavelet Transformation (DWT) during JPEG2000 compression is effectively fitting a mathematical surface to the whole state's DEM that exactly pre-

serves every cell's elevation. This description (DWT) is then altered just a little (thus becoming irreversible) to encode it into a much smaller JP2 file. The new surface in the JP2 file has a new elevation value for each cell that varies not at all, or only slightly, from each cell's original elevation. The new surface deviates the most in areas of rapid change in relief (2nd derivative of the elevation / 1st derivative of the slope). However, this new approximation of the Nebraska elevation model can be stored in 1/116 of the space and even a larger "targeted" JPEG2000 compression ratio could be applied.

A careful examination of this sample application illustrates a basic result in JPEG2000 still image compression. Very small changes, even 1 increment in data value, can result in large compression in the new raster with no visual degradation at any scale. A corollary to this is that the new image has to have some room to vary just a small amount in value. For example, a shift of 1 or 2 data values in a 16-bit raster is much less significant than a similar shift of 1 or 2 data values in the 8-bit version of the same raster. Converting a 16-bit DEM raster to an 8-bit raster gives a 2:1 compression but can have a serious impact on the DEM if the cell values are rescaled to fit in 8-bits. Further compression of this new 8-bit raster to a "Lossy (best quality)" JP2 raster will further degrade this DEM. However, going directly from a 16-bit DEM to a "Lossy (best quality)" may produce a much smaller file with little distortion.

USA DEM on a DVD.

The following is the latest announcement regarding the availability of the Shuttle SRTM derived DEMs: RADAR DATA RELEASE Aviation Week and Space Technology, 22 July 2002, page 51.

"NASA and the National Imagery and Mapping Agency (NIMA) are releasing 30-meter (98-ft.) radar topographic map data for the entire U.S. collected during the Shuttle Radar Topography Mission (SRTM) flown in 2000. The agencies also agreed to provide 90-meter (295-ft.) resolution SRTM terrain elevation data from non-U.S. sites to qualified researchers. Still in discussion is whether to provide the best 30-meter data of non-U.S. areas to the general public internationally. Those data, which are potentially militarily significant, are saddled with more restrictions. Data are being processed at the NASA Jet Propulsion Laboratory and NIMA. High-priority areas, like those in Afghanistan and Iraq, have been processed on an accelerated basis to provide critical terrain data to the Defense Dept."

These SRTM derived DEMs are generally similar in complexity to the Nebraska DEM used in this illustration. Their "Lossy (best quality)" compression of 100:1 would yield about a 1 Gb JP2 file for the 90-meter cell size for the United States (about 10 times greater for 30-meter cells). This size may be larger (2 or 3 Gb) since rugged terrain areas are not represented in Nebraska. However, it is still going to fit on a single DVD as a single JP2 file.

Georeferencing.

As noted earlier, the tentative Part 2 of the JPEG2000 standard covers georeferencing. Most of what is covered in Part 2 concerns other kinds of images and will not be pertinent to still images and your use of them. But without a georeference standard we must make do with work arounds for georeferencing images until Part 2 is approved. Needless to say, several different makeshift workarounds will appear from various sources and become part of the geospatial format quagmire, and we will all have to deal with these JP2 extensions for some years to come. The most logical of these temporary approaches is to adopt the same patched up method used for other formats that do not di-

rectly incorporate georeferencing. This is accomplished by creating and carrying along the georeferencing in an ArcWorld file of the same name as the JPEG2000 (*.jp2) file but with the extension of *.j2w. This follows the ESRI convention of a TIFF's *.tfw, MrSID's *.sdw, TAB's *.tbw, JPEG's *.jpw, and so on.

Last minute information: MapInfo Professional and MapBasic v7.0 have just begun shipping with JPEG2000 support. If you determine that they add or use a TBW file with the JP2 file contact MicroImages and the export and import of JP2 files will be modified to save and use this file.

V6.70 of the **TNT** products export the raster contents to a JP2 image file and create in the same directory a J2W georeference file using the ArcWorld format for the georeference. Only other programs that can read both these files will be able to use the **TNT** created JP2 file as georeferenced. If you select a JP2 file in a **TNT** product, its corresponding J2W file of the same name will be sought and used to georeference this raster. This J2W file may have been created earlier by the **TNT** product as part of an export or may be created by some other software that yields a JP2 file with a properly structured J2W file.

TNTmips' export of a JP2 file also creates an RVC Link File (*.rlk) in the same folder as the JP2 file. Just as with other directly used, linkable file formats, this RLK file contains information needed to treat an external raster file as if it is actually a raster object in the Project File. For example, the RLK file contains the pyramid layers for the external raster if it has none of its own. The RLK file created and associated with a linked JP2 contains the georeferencing for that JP2 file. Thus, a georeferenced raster object or linked external raster exported to JP2 can be immediately linked and is georeferenced.

Technical Characteristics.

Performance.

As noted earlier, a small RLK file is automatically created in the same folder as the exported JP2 file. This file contains the georeferencing since it can not yet be stored in the JP2 file. Since the RLK file is automatically available after exporting, it is automatically available for linking to the JP2 file. No pyramid objects have to be created and maintained as JP2 files automatically have Multiple Resolution Levels (see below). Thus, first time direct use of a JP2 file is almost as fast and efficient as using an uncompressed raster object of the same image. A JP2 compressed image and its internal levels can be highly compressed so that reading this smaller amount of data offsets the time needed to decompress it.

Unlimited File Size.

JP2 library used in the **TNT** products supports the same unlimited file size as raster objects in all the **TNT** products. It is subject to the limits on single file size imposed by your operating system, which is 4 Tb for WNT and W2000 using NTFS (NT File System), 4 Gb for Mac OS 10.1.5, and 4 Tb for the most recent versions of Linux (for example, RedHat 7.30) and UNIX but 2 Gb for older versions of both. You may also be limited to an input raster object of 137 Gb by your 28-bit hard drive controller. However, 48-bit LBA (Logical Block Addressing) drive controllers (up to 144 Pb files) are beginning to appear on good quality motherboards and add-in controller boards. Temporarily your maximum output file size is limited (after compression) to about 2 times your real mem-

ory above which the process will go virtual and, thus, slowly. This real memory requirement is likely to be resolved by improved memory buffering in the next release of the Kakadu library.

Data Precision.

Each image raster color component compressed can range from 1- to 38-bit signed or unsigned integers. Floating point and complex rasters (dual floating point) must be converted to integer data values before JPEG2000 export can be applied.

Color Composites.

RGB color composites can be exported directly to a JP2. During the process the color components will be separated, compressed individually and then placed in a single JP2 file. Scanners, other image sources, and software are becoming available that produce and/or work with 48-bit color composites. Since these are broken down into 16-bit rasters for compression, they are well within the 38-bit precision of JPEG2000 compression process.

Other Standard Features.

Mixed Level of Detail.

Multiple levels of detail can be created during export for JP2 files destined for use in other software. These are not needed if their intended use is in the **TNT** products.

Progression Orders.

Progression order (lowest resolution first proceeding to highest resolution) is created in the JP2 file during export for use in other software. This order is not needed if their intended use is in the **TNT** products.

Multispectral and Hyperspectral Images.

Exports of multispectral and hyperspectral images are treated just like color composites as outlined above.

Multiple Resolution Levels.

The multiple resolution levels defined in the JPEG2000 still image specifications function like the pyramid structures in a **TNT** raster object. They are automatically created during export. As a result, **TNT** products use these directly from the JP2 file and no pyramid layers ever need to be created. This is similar to the way **TNT** products make direct use of ECW and MrSID files.

Not Supported.

Streaming.

This refers to the construction of JP2 files for controlling the order in which the image content is sent from a server. It does not necessarily refer to starting at low resolution and increasing the detail. It might mean to stream out spatially providing the face before the background or the advertisement before the content. It has no application in **TNTmips**.

Region of Interest.

This Region of Interest is not the same ROI concept used in the **TNT** products. It means varying the level of detail from 1 portion of the image to another. For example, the center of the image might have more detail or some other area where zooming in and more detail is expected.

Other.

The security features of JPEG2000 such as watermarking, labeling, stamping, and encryption are not implemented.

Landscape Builder.

Additional Background Materials.

As usual, this MEMO introduces the features that are new in **V6.70**. However, if you are using the Landscape Builder for the first time, please review this same section in the MicroImages' MEMO shipped with your **V6.60** or posted at www.microimages.com/relnotes/v66/ for additional introductory materials not duplicated here. The Tutorial booklet entitled Building 3D Landscapes provided for the first time in **V6.70** is current with this version of the Landscape Builder.

Multiple Textures.

The **TNTsim3D** / Multiple Textures section of this MEMO describes the various uses of several texture layers in a simulation. The Landscape Builder now provides the additional features needed to add multiple texture layers into a single Landscape File. The procedure operates similarly to that in **V6.60**, but after you have added a texture, it will prompt to determine if you want to add another texture layer. If you already have a Landscape File prepared in **V6.60** or **V6.70** you can now also select and open it in this process and add additional textures. This operation is illustrated in the attached color plate entitled Preparing Multiple Textures for TNTsim3D.

Handling Null and No-Data Areas.

The raster objects used in any **TNT** process can be any kind of irregular shape (for example, islands and coastlines) with any kind of interior holes (for example, lakes and masked out areas). Rasters can be used in processes even though their extents only partially overlap. **V6.60** of the Landscape Builder dutifully transferred these null areas into terrain and texture layers in a Landscape File and handled the areas of mismatched extents. However, the results of the Landscape Builder and **TNTsim3D** did not work properly together to render these no-data and null areas.

The Landscape Builder has now been modified to fill terrain no-data areas with the minimum real value from the terrain. The resulting simulation may show a "step" down to this minimum area at the original edge of the terrain but the texture overlay will now render over the entire area dropping into any null terrain areas. This change also would allow you to create a simulation from an image of an island with the surrounding sea and an elevation model covering only the island area. In **TNTsim3D** the island would appear to rise from the flat ocean surface (the ocean areas of the image rendered over the flat, minimum value areas of the output terrain raster).

If the raster object selected for the texture layer does not cover the full area of the simulation (which means, has any extent less than the terrain), its areas of no coverage were assigned in **V6.60** to be equal to the null value. But, the cell value designated as null in that raster object and, thus, in the texture layer could be the minimum data value for that raster data type (which means, R=0, G=0, and B=0 for 16-bit and 24-bit texture rasters). This meant that if such a raster object also had areas of this total black they would end up with the same texture cell value as designated for the nulls. Thus, these valid black areas would become transparent in **TNTsim3D**. To avoid this special condition, the Landscape Builder now makes a slight adjustment to the color of any total black texture

areas so they are assigned a texture cell value that is indistinguishable from total black (which means, not 0,0,0) and yet different than the null value.

Stalked and Bill Boarded Point Symbols (a post **V6.70** prototype feature).

The initial implementation permitting you to use points in a vector object in your simulation is nearly complete, but the release of **V6.70** of the **TNT** products could not be delayed for this latest **TNTsim3D** feature. Watch the special **TNTsim3D** pages at www.microimages.com/documentation/tntsim.htm for information about the release of a **TNTsim3D** with this feature, which can then be downloaded from that same page.

When these tables can be used in **TNTsim3D**, you will select the points, attributes, and styles from a vector object and add them to your views in the Landscape Builder. Thus, you will need to download the corresponding Landscape Builder that has already been modified to prepare these tables. Note, however, it has not yet been determined when, if, and how pins might be added, moved, or edited during a simulation either interactively, by editing the table, or dynamically.

Map Projections and Coordinate Systems.

"Michigan GeoRef" coordinate system used in Michigan statewide mapping is now supported.

"North Sahara" datum used in Algerian mapping is now supported.

"ELD-79" datum used in Libya and Tunisia is now supported.

"Hartebeesthoek 94" datum used in South Africa is now supported.

"New Zealand Geodetic Datum" is now supported.

Raster Extract.

Reinstate as an option the older pre-**V6.60** auto-naming system applied when performing extraction of multiple raster objects by vector polygons.

Raster Import/Export.

JPEG2000 (JP2).

JPEG2000 *.jp2 files can be imported and exported with georeferencing. This is discussed in detail in another section of this MEMO.

TIFF/GeoTIFF.

If a GeoTIFF file contains control points but no projection, use the projection set by the user as the default for import instead of "arbitrary."

Export to GeoTIFF will now automatically default to the closest available GeoTIFF datum rather than none at all. For example, GeoTIFF only specifies a single NAD27 datum code. **TNTmips** supports multiple versons of this datum with the various transformation parameters used in different geographic locations (nations, provinces, counties, …) to meet higher local accuracy requirements. Any of these custom versions of NAD27 will now revert to the single NAD27 datum during their export to GeoTIFF.

Import and export signed integer 16- and 32-bit TIFF/GeoTIFF files to/from raster objects.

Import TIFF/GeoTIFF files having more than three bands, such as 4-band multispectral QuickBird images, into raster objects.

During the import of CMYK (Cyan–Magenta–Yellow–Black) bands from a TIFF file, they are automatically converted to separate RGB raster objects.

ER Mappers' ECW.

An option is now provided for exporting to ER Mapper's ECW file using their "Optimize for Internet Display" setting.

ASTER-HDF.

Import the metadata for the ASTER-HDF file and use the georeference it contains as it is more accurate than the standard HDF georeference for ASTER images.

Vector Import/Export.

W3C's SVG.

Vector objects can be exported to Scalable Vector Graphics (SVG) files. SVG files and their pseudo export or conversion from **TNT** map layouts and all the different kinds of objects and groups they contain is discussed in detail in another section of this MEMO.

ESRI's Coverages.

The ARC/INFO coverage selection procedure has been improved. In **V6.70** and earlier it is used to select individual *.adf files in a coverage directory. It then assigned the name of this ADF file as the name of the new vector object. After **V6.70** was completed this import process was revised so that now you select only the coverage directory, the ADF files in it are automatically used, and the vector object is named to match the coverage directory. This change enables multiple coverages (which means., multiple directories) to be selected and then all imported at once. The "INFO" directory is not considered a "coverage" and can not be selected as an importable coverage file. These modification were made after the **V6.70** CDs were produced and you will need to obtain a patch from microimages.com to use it.

CAD Import/Export.

W3C's SVG.

CAD objects can be exported to Scalable Vector Graphics (SVG) files. SVG files and their pseudo export or conversion from **TNT** map layouts and all the different kinds of objects and groups they contain is discussed in detail in another section of this MEMO.

MapInfo's TAB.

The import and export of various MapInfo formats has been improved and exports can now be in either "feet" or "meters."

Surface Modeling.

Improved TIN Topology.

Delaunay triangles are the basis for the topology in a **TNT** TIN object. The 3 points making up a triangle form a Delaunay triangle if, and only if, the circle that passes through them contains no other vertex of any other triangle. Preserving Delaunay triangles insures a good representation of the surface with a minimum of triangles and other useful properties such as "fat triangles all striving to become equilateral." This topology also provides the basis for accurate operations in other related **TNT** processes. **V6.70** improves the TIN computation process to assure this topology is always maintained.

In **V6.60** some unusual local point distributions could cause local triangles to be formed that were not Delaunay triangles. For example, in an unusual scenario, lidar flight lines have very dense geopoints along the lidar lines and lines that are widely distributed. In this situation, there can be multiple points in the raw data that are very close to each other, fall nearly on a straight line, and yield very long sliver triangles in creating a TIN in **V6.60**. This required that the points be prethinned somewhat to eliminate this condition. However, this situation is now handled in **V6.70**. In typical data distributions, these sliver triangles were absent or few in **V6.60** and caused only very local anomalies in subsequent processing. For example, a local small point of inflection would occur in a contour line or slightly dimpled DEM. However, this in turn propagates into the watershed physiography computations. In the special cases where this topology was incorrect, the process computing Voronoi polygons would not finish, as they are formed by connecting the bisections of the Delaunay triangle edges.

Better Breaklines.

Breakline insertion and preservation in TIN objects has been improved. However, you must download and install the latest post **V6.70** patch to use this improvement.

Breaklines represent point, line, and polygon features of a surface whose elevation profile is known. Lake margins, island coasts, drainage lines, ridge lines, mountain peaks, and similar features are representative of breaklines. When a TIN is built from points and these breaklines are used in the process they become hard edges for the triangles making up the TIN. In other words, they must be preserved in the triangle edges of any TIN object and through any subsequent processing. When the TIN is used to represent a surface for contouring, displaying, Voronoi triangles, and so on, these hard edges must lie on the surface and force it to have the necessary inflection such as a drainage channel.

Hard edges can be created in a TIN object in **V6.70** and earlier from features in a vector object. However, some of the hard edges could be lost or violated in subsequent manipulation of that TIN object. This condition has been corrected. Also when a TIN object's topology is rebuilt after an edit or other modifying operation, there is a strong tendency for sliver polygons to form along the hard edge of existing triangles as these sides can not move in X-Y position. This tendency is now controlled so that hard edges are preserved if the TIN is rebuilt.

Harmonic Series Analysis of Multidate Rasters.

Background.

First of all, it must be clearly stated that this is an experimental procedure. Its addition to **TNTmips** was sponsored by a client who had already assembled an appropriate dataset. However, it has general interest in studying subtle ecological, climatic, land use, and other changes with imagery and other kinds of spatial data over seasonal, annual, or even longer time intervals. Its potential power is that it integrates together many successive sets of spatial observations to look for change or changes in the rate of change. It is not using simple gross change analysis between 2 dates. Its disadvantage is that assembling that kind of database can be expensive, time consuming, and tedious.

The sample data provided to MicroImages to test the development of this new process was a set of Project Files containing 55 NDVI (Normalized Difference Vegetation Index)

rasters. These were prepared from a collection of SPOT images processed to provide the NDVI rasters at 10-day intervals over a period of 2.5 years. Certainly this was a costly set of images to acquire, and it took some time for the client to assemble these Project Files in **TNTmips**. For brevity, the set of rasters made up of the property of interest for each image date will be referred to hereafter as a CMT (Calibrated Multi-Temporal data set). This new analysis procedure handled the computations on this 3 gigabyte CMT efficiently by both Fourier methods discussed below.

The following paper was used as a reference during the implementation of this new process.

Harmonic Analysis of Time-Series AVHRR NDVI Data. by Mark E. Jakubauskas, David R. Legates, and Jude H. Kastens. Photogrammetric Engineering and Remote Sensing. April 2001. Vol. 67, No. 4. pp. 461-470.

Abstract. Harmonic analysis of a one-year time series (26 periods) of NOAA AVHRR biweekly composite data was used to characterize seasonal changes for natural and agricultural land use/land cover in Finney County in southwest Kansas. Different crops (corn, soybeans, alfalfa) exhibit distinctive seasonal patterns of NDVI variation that have strong periodic characteristics. Harmonic analysis, also termed spectral analysis or Fourier analysis, decomposes a time-dependent periodic phenomenon into a series of sinusoidal functions, each defined by unique magnitude and phase values. The proportional variance in the original time-series data set accounted for by each term in the harmonic analysis can also be calculated. Magnitude and phase angle images were produced from analysis of the time-series NDVI data and correlated with information on crop type and extent for the region to develop a methodology for crop-type identification. Crop types occurring in southwest Kansas, including corn, winter wheat, alfalfa, pasture, and native prairie grasslands, were characterized and identified using this technique and biweekly AVHRR composite data for 1992. For crops with a simple phenology, such as corn, the majority of the variance was captured by the first and additive terms for the harmonic analysis, while winter wheat exhibited a bimodal NDVI periodicity with the majority of the variance accounted for by the second harmonic term.

Concept.

This procedure performs a 1-dimensional Fourier analysis of the irregular curve formed by many sequential time varying observations of some biophysical property of a single ground cell. It decomposes this irregular curve for that single cell into the many sine waves of differing magnitude and phase that would need to be combined together to reconstruct that irregular curve's shape. This process computes these properties independently for each cell in a 2D spatial array of ground cells, usually, but not necessarily, derived from a series of multi-temporal images. It outputs a series of rasters of matching cell size each of which contains the magnitude and phase of one matching period of this collection of sine functions.

This process, using either Fast Fourier Transform (FFT) or the slower Fourier Transform (FT) analysis discussed below, will create many, new raster objects. By default it will create 3 of these new raster objects. Optionally, it can create more output rasters, each for a sine function with frequencies increased by a power of 2. The maximum number of output raster objects is the number of input rasters in your CMT. Creating more than 3 does not effect the time to compute FFT or FT as they are always all computed anyway. It merely means you need more drive space and a little more time to write each to the drive.

Every output raster is a complex number raster object containing the magnitude and phase components of the sine wave for each cell. The first raster contains the average value for all the observed values for each cell as its magnitude component and its phase is zero. The second raster contains these properties for a sine wave of the largest period, the next has a period of 1/2 the first, the next 1/4 of the first, 1/8, 1/16 and so on (1/n to the power of 2 where n = 1, 2 ,3 , 4 …).

You are primarily interested in the displaying and interpreting the magnitude of these rasters. For a CMT spanning 1 year, the magnitude in the first raster is the average value for each cell for all of the time interval represented in the CMT. The second raster contains the magnitude/phase for the annual cycle. The third raster is the magnitude of 1/2 the annual cycle. The fourth is the magnitude of 1/4 the annual cycle, which might be of particular interest from a seasonal viewpoint, and so on. Things that cause changes in the ground cells during these cycles will control the relative magnitudes of the results for each cell.

Sources of Input Data.

Typical image sources that can be frequently and economically assembled for preparation of a CMT would be AVHRR, MODIS, or meteorological images since they are routinely collected everywhere. AVHRR images have been used by various research labs for these and related kinds of temporal analyses. AVHRR is collected daily and can be used to compute a vegetation index and assembled into a CMT. For example, many years of NDVI rasters can be assembled from AVHRR images for 10-day intervals. If a particular required date is cloudy, then use the image of the day before or after, adjusting the next interval to be longer or shorter to compensate. If a series of sequential days are partially cloudy, then images for several sequential days can be composited into 1 using a common AVHRR cloud identification procedure. If more frequent images can be assembled from aircraft or ground sensors for just one season, such as at 3-day intervals, they can also be used to prepare a CMT to study agricultural or climatological changes (apply only the FT method described below as the longest annual period is not complete).

Preparation of Input Data.

This process requires the collection and assembly of many raster objects in a CMT each of which represents 1 set of observations of a time calibrated variable that changes in a periodic fashion with time. A typical starting point would be to assemble a collection of multi-spectral satellite images of a site at frequent sequential dates throughout 1 or more annual cycles. Another criterion, which must be met in your CMT at this time in this process for computational reasons, is that the time interval between each image must be approximately equal. These images should be processed so as to be coregistered with a common extent, projection, and ground cell size. Next the multispectral image values for each cell in each image must be converted from image values to the biophysical property of the surface you wish to study.

Examples of biophysical properties of a surface that can be computed or at least reasonably estimated from multispectral satellite images are vegetation indices (for example, NDVI6, NDVI7, and various others), absolute reflectance in 1 band, surface albedo, real or radiant surface temperatures, and so on. Harmonic analysis permits you to study how these properties change over time.

It is important to understand that raw image pixel values, cell or pixel radiance, classified cell values, and similar uncalibrated rasters can not be used in a CMT or this analysis. These cell values may vary nicely within an image but they have no known relationship between images as a function of time. Or put another way, if a cell has a value of 100 for one of these properties today and a value of 200 tomorrow, this does not necessarily mean that the surface has changed at all, perhaps its only a change in the gain of the imaging device (for example, an aperture change) or some subsequent processing transformation. Attempting to use a CMT with these kinds of multi-date properties will produce totally meaningless results.

Choosing A Fourier Analysis Computational Method.

What's the Difference?

The Fast Fourier Transform has stringent requirements in the structure of the data whether it is applied in a 2D spatial, single image analysis or as in this case, to a one-dimensional analysis of the multi-temporal values for each cell. The Fourier Transform does not impose these special restrictions and is computed using trigonometric floating point computations. If these restrictions are met, and FFT can be applied, its computation is entirely by addition and subtraction, which is hundreds of times faster on any desktop computer.

Fast Fourier Transform (FFT).

The Fast Fourier Transform was developed by engineers as a practical implementation of the slow Fourier Transform for application in electronic signal processing and earlier image analysis. While an FFT is fast, it also places some more restrictions on any data sets to which it is applied. If it is applied in the spatial analysis (2D) of a raster (which means, using the Fourier Analysis process elsewhere in **TNTmips**) the rows and columns of that raster must be equal to a power of 2 and equal to each other. When FFT is applied in this multi-temporal or 1-dimensional analysis of a CMT for harmonic analysis these conditions must be met.

The number of multi-temporal values for each cell must be a power of 2. An option to create this condition in a CMT is discussed below. It resamples the time-variant real values for each cell to create a power of 2 new interpolated value.

The CMT must contain 1 or more complete periods for the longest periodicity present in the CMT. For many applications this will be 1 or more annual cycles, which start at any calendar date and must end at approximately the same calendar date in the final year. Do not include any partial periods of the largest periodicity included in the CMT. A linear trend in all the multi-temporal values for each cell represents an incomplete longer period cycle. Compensating for this is why the linear trend removal option discussed below is required for a FFT.

Fourier Transform (FT).

The FT is much more tolerant than the Fast Fourier Transform and does not require the restrictions outlined above for the FFT approach. FT does not require that the raster making up the CMT total to a power of 2. The FT also does not require that an integer number of the largest period be represented in the data range of the CMT. It can be applied to several complete annual cycles that do not begin on the same calendar date or season. It can also be applied to part of an annual cycle. Thus linear trend removal may or may not be useful in the FT approach. However, even the FT results will not be meaningful if applied to a CMT containing a small number of rasters.

Unfortunately, even on fastest desktop workstations the FT requires a significant amount of computation time for each cell in the CMT. For this reason it had not even been previously implemented as a function in the **TNTsdk** before this process was implemented. As a result, and depending upon the size of your CMT, do not start an FT process unless you can dedicate **TNTmips** to it for a few hours.

A practical approach to using this kind of analysis might be to combine the FFT and the FT. First experiment with your CMT in the FFT method and its various approximations if your CMT has enough temporal range so that it can be temporarily used to cover at least 1 complete annual cycle. The FFT method is fast enough so you can experiment with it and the makeup of your CMT. When the results are promising make a slow FT run without resampling required by the FFT to get the best cell by cell results for the entire multi-temporal range covered in your CMT.

Linear Trend Removal,

Your CMT may contain a long term linear trend that is longer than the principle periodicity of the CMT (which means, longer than an annual cycle). This trend appears to the FFT to represent an incomplete multi-temporal cycle, which is not permitted in the FFT process. If your CMT represents several annual cycles, the trend might be due to global warming, the sun spot cycle, a gradual change in average precipitation, or something else. A trend in a CMT representing a period of only 1 year might result from a gradual deterioration in the imaging system.

Use the Linear Trend Removal option to remove the trend from your CMT during the computation of the FFT. It will compute the average of all the multi-temporal observations available for a cell and then statistically determine the linear trend in all these values. Each original multi-temporal value for the cell is then adjusted by adding or subtracting the difference between the average value and linear trend value for that cell. If the trend value is greater than the average, this difference is added to that cell's original value. If the trend value is less than the average, this difference is subtracted from that cell's original value. This has the effect that the average for that cell does not change but the linear trend is no longer present.

Smoothing Filter.

Anomalous changes or noise may occur in the observation for any single cell on a specific date. For example, all images have some noise present even if it is not obvious. Smoke from a local fire might obscure some local cells on one of the available dates as would atypical, temporary areas of standing water just after a rainstorm.

In harmonic analysis you are not interested in these 1-date anomalies for each cell, which can occur anywhere on any date (which means, they represent numerous spurious high frequency events). This smoothing option fits a local sliding curve to the multi-temporal observations for each cell during the FT or FFT processing and uses this curve to recompute the adjusted value for each cell. Note that this approach to smoothing is another reason why the time intervals between values should be approximately equal.

Resampling in the Time Domain.

If the number of rasters in a CMT is not a power of 2, then these values must be created for each cell by interpolation between the real observations. This is accomplished during the FFT processing by choosing the option Linear or Cubic, which will fit a linear or cubic spline to the real observations spaced at the intervals needed to create a new interpolated set of multi-temporal values totaling the next power of 2 greater (for example,

58 real observations become 64 interpolated values). If the number of real values is equal to a power of 2, then selection of Linear or Cubic will be ignored. This interpolation process does not have any knowledge of how the multi-temporal observations for the cell might be spaced in time and assumes they have equal time intervals. This is another reason to make sure the time intervals between the rasters in your CMT are as close to equal as possible.

Results.

Using either the Fast Fourier Transform or the slower Fourier Transform, this process will by default create 3 new raster objects from the CMT. You may elect to create more output rasters; the computation time is the same, but a little more time is required for writing the additional rasters. Each of these new rasters is a complex raster object containing a magnitude and a phase component for every ground cell. The magnitude of these rasters is of the most interest and when displayed, show the changes taking place in the ground area in that property for an annual cycle, a seasonal cycle, or some other shorter cycle.

The first raster, usually referred to as the 0 component, has an magnitude for each cell equal to the average of all the values for that cell and a phase everywhere of zero. A display of the magnitude of this raster object would compare the accumulation or loss of the observed value over the time interval involved. For example, displaying the average of the NDVI would indicate how much green vegetation biomass each cell produced over the year relative to all other cells. Displaying the average temperature would indicate climatic differences in each cell.

The second raster object contains the magnitude/phase of the longest period sine wave in the observed values. If your CMT covers just 1 year, then displaying this magnitude shows the amount of variation in that observed parameter over 1 year. For example, did the temperature of each cell fluctuate more or less widely than all the other cells. If your CMT covers 3 or 4 years, this can be a longer period such as an 11 year sun spot period if it gradually effects the temperatures of all the cells values all the time in a subtle fashion. Alternately, you could make a CMT for each successive and equal annual period, analyze each separately, and then compare like magnitudes for the annual periods to examine change from year to year. For example, you could display 3 successive years magnitudes in red, green, and blue to enhance the changes from year to year.

The third raster contains the magnitude/phase of the sine wave that has a period of 1/2 that of the second raster. If the CMT covers just 1 year then the period of this sine wave is 1/2 a year. Its varying magnitude represents the variation in the observed property with a period of 1/2 year after the annual variation is removed.

The fourth raster's magnitude/phase are for the 1/4 annual cycle, the fifth for 1/8, the sixth for 1/16 and so on. The magnitude of the fourth (which means, period = 1/4 annual period) may be of particular interest related to changes in seasonal variability between the cells.

Possible Improvements.

Improvements could be made to this process by MicroImages if you can assemble a CMT that needs them and if you understand the general application enough to interpret your results. The most important would be to add a date and time to each raster in the CMT. This would permit improved time domain smoothing methods to be applied to the multi-temporal observations, such as splining each cell's observation spaced at their ac-

tual and unequal intervals. This would permit the creation of suitable CMTs from rasters that span a suitable period of time in sufficient frequency, but do not automatically have nearly equal time intervals. Assembling a CMT with nearly equal intervals is possible with low resolution satellite imagery, such as meteorological, AVHRR, or MODIS images. These are collected daily permitting shifts of 1 or 2 days for cloudy conditions. Such conditions can knock out a whole interval for less frequent orbital coverage devices, such as Landsat (for which there are many years of multi-seasonal imagery archived). When these unequal time periods are involved, the curve fitting could take into account the actual time interval and the curve interpolated to produce equal time intervals of a power of 2 for the FFT or without for the FT approaches.

*** Buffer Zones.**

You have reported that the **TNT** buffer zone process accomplishes tasks of a magnitude and complexity that could not be completed in competing products at all, let alone maintaining topology. As a result, this process is continually being challenged and tested where their buffer zone problem cases are imported into **TNTmips**, buffered, and exported back to them. Since the computation of buffer zones is a key process in many geospatial analyses, it has been rewritten for **V6.70** to make it even more powerful and flexible by the addition of many new, unique features.

New Interface.

Control Panel.

The Buffer Zone Analysis dialog has been completely revised. Tabbed panels are now used to present the control/selection options separately for Points, Lines, and Polygons as well as a Preferences panel. This provides a basis for controlling how the new features are applied to each element type while simplifying the appearance of this dialog.

Integrated View Window.

A standard View window is now opened in this process to preview the elements you have selected to buffer from a vector object by any method. As usual, this is a standard View so you can use all the visualization, multiple object overlay, interactive or query based tools, and other standard features to select elements for buffering. You can use this view to visually confirm that you have selected all the elements as you planned.

Next you can apply your buffer analysis to these elements and the buffer results will be displayed superimposed on the selected elements. In this fashion, you can immediately preview the results to determine how the buffer polygons fit the selected elements and how they inscribe or match features in any other layer in the view such as an orthophoto. Or you could use the attribute table inspection tools to view the new records, tables, and their relational tree-like structure.

Use this new View window and the new control dialog to interactively refine your selection and buffer zone operation, and fine turn your results. Each time you apply the changes in your procedure the view is refreshed and the computed buffer zones saved to a temporary file. When you are satisfied, you can save the temporary buffer zone object as a CAD or vector object.

Advanced Procedures.

None, All, or Selected are now options to select the elements to buffer. Buffer distances can be derived for each element as All Same or By Script. Using a script permits an independent distance to be computed or logically selected (for example, theme ranges)

independently for every individual element. Using a computed field to derive an attribute also provides a means of varying the distance by element. These are only a few of the many new ways in which buffer zones can now be specified. The color plate entitled New Buffer Zone Features illustrates and discusses additional options.

Selection of the elements to buffer by query or other methods can now use any of the attached attributes. **V6.60** permitted only the selection of elements by the key field, which often required a lot of unnecessary table manipulation. This also permits the creation of buffer zones for all elements attached to records with the same value for the selected attribute(s).

Buffer zones can be merged for all elements or kept as separate and overlapping polygons for elements with different attributes. Merging them will amalgamate overlapping polygons into single polygons regardless of their attributes. Separating individual element's buffer zones by attribute into independent polygons with different attributes is useful for CAD applications where topology is not wanted and separate, overlapping polygons are common. On the other hand, overlapping polygons saved to a vector object will have their topology formed. In other words, 2 overlapping polygons will become 3 with the new polygon representing the area of overlap. In all these cases a variety of record/table management capabilities are provided to control how attributes are transferred to the new vector or CAD objects. These and other combinations are illustrated in the attached color plate entitled Separating Buffer Zones by Attribute.

*** Polygon Fitting.**

Polygon Fitting, Buffer Zones, and Surface Modeling are all examples of important first steps in geospatial analysis and data mining. These processes and others convert point observation to areas that can then be tested for their association with other spatial objects (which means, images, maps, surfaces, …) by multivariable analysis, vector combinations, visual inspection, and other techniques.

Similar to the other **TNT** point-to-area conversion methods, the points used for fitting can now be selected by the select tool, the GeoToolbox, by query, or by record from an attribute table. This process can now, in a single pass, create sets of associated polygons in one or separate vector objects (one for each set) with attributes. In a single pass, it can also create sets of multiple polygons in a CAD object with attributes or be saved as separate CAD objects.

Topological Considerations.

The term "sets of associated polygons" means that each set of disjoint points assembled by a query or other means can be fit with one or more disjoint polygons. Since your query may assemble several sets of disjoint points you can get several sets of potentially overlapping polygons from one fitting operation. If these results are saved to a CAD object, the polygons making up each set are saved as a single element called a multi-polygon. In a CAD object, the multi-polygons can overlap but can subsequently be accessed by group or as individual polygons. If you choose to save all sets of associated polygons into a single topological vector object, all the individual polygons must be intersected together creating many new non-overlapping polygons in that object.

Fitting By Attribute.

A database may contain a complex relational structure associated with the point observations it represents. Polygon Fitting can now mine that database directly in a single

pass. The attribute selected for separating polygon groups can be a simple field or a computed field that makes use of complex queries to define the relationships that must exist between the points if they are to be included in forming each set of polygons. You can also use any means available, including complex queries, to select the points used for polygon fitting. The majority of the points tested can be completely omitted by the query. Thus, the polygons that do result represent a few sets of points with simple or complex interrelationships.

When you apply a fitting operation, the results are saved to a temporary file. These sets of polygons are also displayed immediately over all the original point positions (omitted or included) or any other image, vector, or other object, and you have access to the **TNT** visualization tools. Change your query or other standard point element selection procedure until you are satisfied with your results. Use Save As… to save the contents of the temporary file to a CAD or vector objects(s). The attached color plate entitled Polygon Fitting By Attribute illustrates a simple example of this kind of application.

Sample Application.

A simple example will illustrate how this works to mine a database. Suppose the relational database has 10,000 individual geopositions of where 100 different identified trucks have been (for example, from cell phone or GPS locations). The process will pass through this database once and create 100 sets of polygons (1 or more polygon in each set) based on the selected attribute (for example, license plate) that will separate each truck's position records by its identity and fit 1 or more polygons to that vehicles' locations. These sets of polygons represent the area(s) where each of these vehicles operate and can be saved to a vector or CAD object(s). This object(s) can then be combined with other spatial variables to determine why these vehicles operate in their respective areas.

If the polygons are written out to a CAD object, you will have 100 collections of multiple but disjoint polygons in that single object. They can overlap, since this is a CAD object. However, each group (multi-polygon) will have its own shared attribute associating it with the vehicle and whatever additional attributes were brought along for later use in a subsequent analysis. If you choose to save the result in a single topological vector object you may create many new polygons with multiple vehicle records attached to each for every area of overlap.

Transferring Attributes.

Attributes were not transferred in the Polygon Fitting process in **V6.60**. Thus, it required some tedious manipulations to get attributes organized and attached to these polygons in a vector object. **V6.70** now transfers these attributes to the new polygons. This is illustrated in the attached color plate entitled Transferring Attributes in Polygon Fitting. However, care should be taken or you can quickly create some complex sets of attributes when you create a single topological vector object. For example, if your polygon fitting yields many sets of polygons with common areas of overlap, then the many new overlap polygons formed in a vector object could have many records attached to each.

Saving a result into a single topological vector object is most effective when you select elements and attributes that tend to produce sets of polygons that isolate areas. This is why it is important to view the results of your choice of fitting algorithm and point selection before saving them. If you want to save sets with lots of areas of overlap, consider their future use and the possibility of saving them as a CAD object.

Transfer Attributes.

Lines to Polygons,

A Split At Border operation has been added for use when transferring attributes from lines to polygons. The standard line attributes table that is attached to the polygons by the operation is modified so that the length reported is only the length of each line that falls within that polygon. For example, you make a grid cell vector object and transfer attributes from lines to polygons using the Split at Border operation to have the length of the roads in each grid polygon attached to that polygon. You must download and install the latest post-**V6.70** patch to use this improvement.

Handles High Vertex Polygons.

The transfer of attributes has been impractically slow when the process encountered individual polygons with 100s of thousands of vertices. Yes, it has even been applied to single polygons with millions of vertices. Under these circumstances, the process was not efficient and took hours. It has now been streamlined and is now practical to use on these messy polygons. However, you must download and install the latest post-**V6.70** patch to use this improvement.

*** Spatial Data Editor.**

Improved label positioning and editing are the principle new features added to the Spatial Data Editor. These new methods use a combination of an automated preliminary positioning followed by an easy inspection and manual repositioning by you. This 2-step procedure is the most efficient approach to high quality label placement with today's software tools. A new Tutorial booklet entitled Advanced Vector Editing has been provided to introduce these procedures in detail. As a result, they will only be outlined here in concept and their use is expanded upon in this booklet and in the attached, illustrative color plates.

Automatic Polygon Labeling.

Soil, geologic, vegetation, image classification, and similar vector objects can contain many polygons. Automatically positioning labels in these polygons for the various font size and display scales you might select is a complex undertaking. This is a task that you can manually accomplish, but it is tedious at best and very time consuming, as a single vector object for one map could have a thousand polygons. Current automatic label placement techniques can place many of the labels in a satisfactory position but can not provide for 100% quality placement for electronically generated products. There are simply too many conditions that can occur due to the wide variety of display layers, scales, fonts, polygon merging and dividing, and so on that might be used in a geospatial analysis system.

Automatic label generation now attempts to fit the polygon label inside the polygon at its widest horizontal position but with a bias toward the centroid. If the label will not fit in this width, it selects one of the adjacent (common boundary) polygons for the label and adds a leader line. As a last resort, it will place the label over the center of the polygon regardless of its width (a common result for very small polygons).

Your selection of label size can have a dramatic effect on the success of this preliminary automatic placement. Turn on the Preview option to experiment with label size and font type. After you have achieved the best automatic placement and appearance possible, save the placement with the vector object and move on to reviewing and repositioning

those labels that still have an unacceptable position. This automated step and some illustrated results are contained in the attached color plate entitled Auto-Generating Vector Polygon Labels.

The Auto Generate Label operation now also provides a Clip Under option. This will clip open a hole for the label text in the polygon fill and every other element in that layer. Be sure the text style used for the label has Vertical Alignment set to Center for correct placement of the clipping box.

Automatic Line Labeling.

The automatic labeling of lines also has some new features to improve the quality of your display and maps. All of these are illustrated in the attached color plate entitled Auto-Generating Vector Line Labels. Again you should think of this automated scheme as doing most of the work so that you can use the new line positioning features to refine and finalize your line labels.

Urban areas have many long streets that are broken by the nodes for crossing streets into many short line segments. Drainages also have many short reaches broken by nodes at connecting links. These are two of the many network-oriented vector objects that in **V6.60** would produce multiple labels along adjacent lines with the same attribute. The illustration at the top of the color plate shows this earlier result. Now you can assemble these into longer virtual lines by their attributes and treat them for the purposes of labeling as a single long line with the label placed near its center. This improved, new, thinned placement is illustrated on the same color plate.

The way labels conform to an irregular line shapes at the automatically located position can now be selected to be

- Exact, where the labels flow along the line's shape with tilting characters,
- Spline, where the reach of the line spanned by the label is fit with a spline, which the label follows with tilting characters, or
- Straight, where an inclined straight line is fit to the vertices in the line covered by the span of the label.

The vertical placement of the line's label can now be selected as Top, Bottom, or Center relative to the line. When the label is centered on the line, it can be bisected by the line or the Clip Under option used to open a gap for the label in the line and any other lines in that object. The size of the gap in the line before and after the label can be set by the Clip Distance entered in the new Advanced Options dialog used for setting text styles.

The Set Line Label tool assistant now allows the selection of a table and field for the 'Z' value, rather than assuming the internal 'Z' coordinate value. This and the new gap clipping for the label are particularly useful in preparing a contour map.

Screening Labels.

Collision or overlap errors can occur in automatic line and polygon label positions. Certainly it would be possible for the automatic placement process to identify label collisions in one object, but rectifying them is a difficult issue and multiple layers can be involved. Labels can also be positioned outside the extent of the vector, which you may or may not desire. These are simply some samples of the label positions you will want to manually adjust.

If you are preparing a professional map or view layer, you will want to conduct a quality control inspection of the placement of every label regardless of whether they are placed

automatically, by you, or someone else. You could do this by manually panning about and looking for problems. However, a more productive approach is to zoom in to a scale that focuses upon one label and its relationship to its feature. Next select this label and edit its appearance and position as desired. When this is complete, use the Select Next icon on the Active Element Information panel. This will pan you at that same zoom to center on the next label on the list for its inspection. In this fashion you can visit and give a very controlled inspection to every label in the layer and adjust those that need it. The attached color plate entitled Screening for Label Collisions outlines and illustrates this approach.

Sliding Line Labels.

The position of a line label attached to a line can now be easily changed via a new feature of the Edit Element tool. Simply select the label, keep the mouse button down, slide it in either direction along the line, and drop it at a new position. The curved or straight alignment and the top, center, or bottom baseline property will be maintained. This easy approach to editing the position of a line label is illustrated in the attached color plate entitled Interactive Editing of Line Labels.

Drag and Drop Polygon Labels.

Individual polygon labels can now be interactively selected and repositioned. Once a label has been selected, it can be dragged with the mouse button down to any new position in the polygon or out of it. If the label is dragged out of the associated polygon, a straight leader line will automatically appear leading back to its original position. For the most suitable new, external label position, this leader line may pass through some other label or feature. If you wish, you can select a position on this leader line and pull it out, rubber band fashion, so that it will have a dogleg around that location. You also have the option of grabbing the end of the leader line and moving it to some other position within the polygon. The attached color plate entitled Interactive Editing of Labels and Leader Lines illustrates and discusses these procedures.

Changing a Label's Appearance.

A new, interactive polygon text label size and orientation tool is available. When a label is selected, it now presents some "handles." Selecting with the left mouse button down within the label text will drag it to a new position. If this position is anywhere outside its polygon, a leader line appears as described above. Dragging the new (+) plus handle with the left button down resizes the label larger or smaller. Dragging the new ([]) box handle at either end of the baseline of the label will rotate it about the opposite end. These altered individual labels can be saved with these new properties. These elastic text operations are illustrated at the bottom of the attached color plate entitled Interactive Editing of Labels and Leader Lines.

A specific point, line, or polygon label can now be selected and custom restyled. You can change its font and colors. Its font characteristics can be changed to bold, italics, outline, or underline, which can also be controlled by the new italics angle, boldness, and other settings discussed in the Map and View Legends section of this MEMO. Multiple line labels can also be created with the various alignment options and word wrap.

Map Layouts.

Each release of **TNTmips** for the past 2 to 3 years has introduced new features to assist you in the preparation and publishing of professional and cartographically accurate

maps in paper and electronic form. Effort in this direction continues with this release by providing

- improved automatic label placement and interactive label position editing tools,
- better font management and font appearance in PDF files,
- completely new SVG electronic map distribution format,
- advanced text styling and text justification for legends, and
- legend samples for individual elements rendered by script.

Using all these features, including some only available in **V6.70**, the **TNT** map layout process can now prepare topographic and geologic maps that closely match those of the United States Geological Survey. The general procedures used to layout these sample maps have been documented in the 2 new Applications booklets entitled Making Geologic Maps and Making Topographic Maps. Several other geospatial analysis systems could layout similar maps from the geodata used for producing them in **TNTmips**. They will differ from **TNTmips** in the procedural approaches they use, how they access and analyze source materials, layout and templating procedures, the electronic publishing formats supported, and the number and integration of the products needed.

Preparing complex maps in any product is labor intensive and expensive. Thus, it will be the efficiency and interactive ease of use in preparing the map that can best distinguish **TNTmips** from competing products. Some additional cartographic tools are still needed in the preparation of **TNT** map layouts. However, MicroImages' development efforts are gradually shifting toward improving the process to reduce the complexity of completing a layout (for example, the improved label placement/editing in **V6.70**). Some examples of these possible future procedural improvements would be a graphical or WYSIWYG text editor and a schematic display of group relationships providing measurements and interactive group placement and positioning.

Reliability Testing.

Improvements and adjustments are made daily to some of the myriad components used in the **TNT** products, many of which are integrated into the **TNT** map layout process. Just one example is the continual modifications to the **TNT** Geospatial Rendering Engine (**GRE**). This has caused you frustrations when layouts and templates made in earlier versions of the **TNT** products can not be reused.

Another less obvious area of map layout activity for **V6.70** was the implementation of an automated map layout testing procedure soon after the release of **V6.60**. It works something like this. A growing group (currently 33) of complex and representative map layouts and the Project Files used in them were assembled. The sample geologic map and topographic map in the new Application booklets are part of this collection. Each layout was used to produce a raster object containing that map, which was carefully scrutinized for correctness and then saved. Starting several months ago and continuing, every one of these test map layouts is automatically recomputed several times a day to produce the same raster object. This recompilation uses the most recent compile, or build, of **TNTmips**. This new raster object is then automatically compared pixel by pixel with the original test raster. If any pixel is different, these differences are traced down and rectified.

This testing procedure has been effective through this **V6.70** development cycle in pinpointing changes and errors that affect complex map layouts. Since complex map layouts use many **TNT** component operations, this procedure also continually tests these

operations as well. However, it is not possible to design layouts that exercise all the features and approaches that you can use in a layout. MicroImages will add additional sample layouts to test other **TNT** components and will daily test any of the complex layouts you may wish to contribute to this activity.

Map and View Legends.

Most of these features were added at your request as you make ever more complex maps in a wider variety of your languages. These refinements are gradually making this a truly interactive and international map layout process.

CartoScript Styled Legends.

You can now interactively create legend samples and descriptions for vector elements you have styled using a script. The procedure described below applies whether you are using a simple style script (for points, lines, or polygons) or a CartoScript to create complex symbols for points or lines.

Background.

Line and point styles rendered by CartoScript depend upon the varying attributes associated with the elements. Their application is specifically designed to permit you to vary the style of element throughout a view or map to convey something about the element that also varies. For example, the varying flow rate of a river (or road or other network) could be attached to the line segments making up a river system. You could create a separate line width style and color for every different flow rate. However, with a single CartoScript you can draw all river segments in a width and color controlled by this flow rate attribute. Another application of CartoScripts is illustrated in the color plate entitled Orient Point Symbols Using CartoScripts. In this example, wind velocity vectors with varying orientations are created by a single CartoScript.

Selecting Legend Samples.

CartoScripts are not new and their use is described in detail in a Tutorial booklet entiled Using CartoScripts. However, in **V6.60** you could not fully exploit the power of custom styling with CartoScripts as the varying conditions they represent could not be defined in our LegendView or map legends. **V6.70** adds this important feature. However, creating a sample legend entry for a point or line type rendered by a CartoScript is not automatic. You must interactively choose the line element or the sample point from the view that you wish to represent that line or point style in the legend.

To add a representative element to LegendView, use the selection tools in the GeoToolbox to:

- select the representative element,
- expose the menu provided by the right mouse button,
- choose Add Active Polygon to Legend (or line, point, …),
- type in the text for this new legend sample in the Legend Element Label dialog box, which is automatically exposed, and
- the new legend element appears in the LegendView.

This procedure is illustrated in the attached color plate entitled Legend Samples for CartoScript Styles.

You would repeat this procedure to provide a sample for each different drawing style created by the style script. Each legend sample is drawn in LegendView by your script using the database attributes of the element you selected for it. If you change your mind

about a representative element you have added, simply reselect the element in the vector object and use the right mouse button menu to delete the sample from the LegendView. The sample descriptions and labels are stored in a database table associated with the elements, so you can select these elements easily or change the text if necessary. In the river flow example you could create several different legend samples for this one CartoScript, and label each with the flow rate it represents. This would provide a legend for the actual flow rates of all the rivers that are being rendered by this CartoScript in varying widths.

Dynamic Applications.

A powerful feature of styling with a CartoScript is that styles update automatically if the attributes of the line segments involved are periodically changed. In the river example, a new view or map can be prepared each time a new flow rate table is obtained due to a rainfall event. The wind vector map or view can be revised automatically using a map or display layout template substituting only each new hourly, daily, or monthly velocity/magnitude table. The CartoScript approach automatically uses these new attributes to adjust its rendering.

Your CartoScript legend sample is rendered by that actual CartoScript from the attributes for the element and position you selected. If either of these are changed, that legend element may or may not be appropriate depending on your intentions. For example, you may wish the width of the river legend sample to widen if the flow rate attribute for the sample position increases. On the other hand, you may have used several river width legend samples as noted earlier each with text denoting a specific flow rate. In this case you do not want the sample width to change because the associated interpretive text will be incorrect.

Example Maps.

Rendering lines and points by CartoScripts is important in the design a geologic map. Now you can now prepare appropriate legend entries for these lines. This is illustrated clearly in the attached color plate entitled Geologic Map of the Granite Gulch Study Area, Inyo County, California and also in the sample geologic map prepared in the new Applications booklet entitled Making Geologic Maps.

Inserting Text into Polygon Samples.

Soil, geologic, vegetation, and similar maps present many different types of polygons. Often there are so many that they can not be accurately identified in your legend by their fill color, hatching, or other symbology. For these complex situations, the text label in the polygon is also used in the legend to insure that each type of polygon can be uniquely identified in the legend.

V6.60 did not provide any means for inserting these text labels into the sample of each type of polygon displayed in the legend. You can now choose to have the text label for each polygon type inserted into its legend sample in LegendView or a map layout. The color plate entitled Text Labels for Polygon Legends illustrates this new procedure. **V6.70** also provides improved techniques for locating these labels within every polygon. This is discussed in detail in the Spatial Data Editor section of this MEMO.

Complex Legend Text.

The text with legends used for the complex polygon maps noted above and others can contain complex descriptions, text styles, and formatting. Meeting these requirements

creates a fully internationalized page layout capability embedded within the map layout process. **V6.70** provides you with more control and features to apply to text in these complex map legends.

New Text Styling.

New text styling features are available so that your legends can now be more attractive and cartographically precise in your language. The Text Layer Control dialog provides access to a new Advanced Options dialog. The text block width can now be entered in any of the **TNT** supported measurement units. This dialog also allows you to specify boldness for bold text, the angle for italic text, thickness for **TNT**'s special enhanced text, shadow offset distance and angle for shadowed text. The stroke width and offset can now be set for text underlines. The clip distance for labels inserted into lines and polygons can also be set. This is the distance before and after the label characters where the line or fill is clipped when the label is inserted. You can combine these special effects, but some are mutually exclusive such as the basic styles of bold, enhanced, outline, and shadow. The attached color plate entitled Advanced Text Features illustrates these special text styling options.

Text Alignment.

Alignment in text blocks can now be selected as Left, Right, Center, or Justify (which means, full justification) in the Text Style dialog. You must toggle on Word Wrap on the new Advanced Options dialog to select Justify for your text block. Word wrapping has to pick the best break positions using the spaces between whole words. To use word wrap, make sure you only use the line return or paragraph enter key at the end of a paragraph. You can insert hyphens or tabs as break points to refine the appearance of your word wrap. Word wrapping is automatically enabled for justified text in multi-object legends where you have inserted a vertical right column guide. The attached color plate entitled Alignment Control for Legend Text illustrates these new justification results.

At this time when you enter and edit your text in the Properties dialog it will always appear left aligned regardless of the alignment selected. It will only render the other alignment options when applied in the Legend Layer Controls window. This is due to the different customs required for entering the many languages the **TNT** products support (for example, those that are typed right to left).

Straight Versus ZigZag Lines.

Automatic imposition of zigzag line samples in line legends may be popular with some, but often it is not appropriate for complex line styles. Admittedly, it is a good marketing ploy as it certainly identifies the product as being created with ESRI's ArcView. However, cartographic applications, especially map layouts, are sometimes improved if straight lines are used for legend line samples so as to better represent the complex styles they contain, especially those styled by CartoScript. You now have the option of choosing either zigzag or straight for the line samples that appear in your LegendView or your layouts (the default is zigzag). This is also illustrated in the attached color plate entitled Legend Samples for CartoScript Styles.

Font Management.

Background.

Text can disappear or to be rendered in ugly substitute fonts in digitally published documents. This happens when the original creator of the document has used attractive

copyrighted fonts that have not been provided to you. In this situation, automatic font substitution will take place and you may not even know it. This is a particularly sensitive issue for cartographic and engineering materials converted to portable document formats, such as Adobe's PDF and W3C's SVG. It can also occur in transferring documents that have been prepared in other programs such as Word, Illustrator, PageMaker, and many others.

When you are provided an electronic document, more specifically a map, from someone else, you would like it to appear identical to the original on your computer screen or printed copy. An official government map is subjected to many microscopic, quality control inspections after it is completed but before it is printed in 1000s of copies. On the other hand, digitally published map products are not usually subjected to careful checking before distribution. This can be a critical oversight in cartographic applications. For example, suppose font substitution causes the annotated depth to an underwater hazard to be moved just a tiny amount. As a result, the decimal point in the annotated depth of water at mean low tide is obscured and appears to be 11 meters rather than 1.1 meters. This is merely an example of how a font substitution can have serious impact on the use of a digital map. Obviously, in this example it would be better to use some other form of expression such as $1^{\underline{1}}$ and $11^{\underline{0}}$.

When you use a **TNT** product to layout a map or other plate, you have the fonts you use installed on that local system or network. **TNT** products render your TrueType fonts into the X server using an open source FreeType library, which MicroImages has compiled for the Windows, Mac, Linux, and UNIX platforms. Regardless of how you acquired your TrueType fonts, if they are available on your computer or local network, you can use them in all the software on that computer. The problem occurs when you distribute digital products to someone else who may not be part of your local network. In particular, this impacts on how fonts are managed when **TNT** layouts are converted to SVG and PDF files in particular. It is important that the **TNT** products protect MicroImages and you from font substitution problems and accidentally distributing copyrighted fonts. You may not consider this serious until you want to widely distribute your digital products freely around the world and in large numbers.

Legal Issues.

The way a font such as TrueType stores the shape of its glyphs (which means, how it is formatted) is what is controlled by its copyright. But, the exact appearance of each glyph at any size is not covered by any copyright. You can see why this dichotomy is necessary and has been clearly established in the courts. If the exact appearance of a copyrighted font was covered by copyright law, then its accurate rendition on your printer would require permission of its owner, and you could be asked to pay a royalty for every character printed with that font. But the appearance is not protected, so printing 1 or 1000 maps from copyrighted fonts is permitted. What is not permitted is your transfer of a copyrighted font in its original format to another party without the permission of the copyright owner. So, you can print all the maps, posters, plates, and so on you choose with PageMaker or the **TNT** products using the copyrighted fonts you possess. However, the **TNT** products also provide you a means to publish your **TNT** map layouts in several portable digital formats such as PDF, SVG, Illustrator, and others. This is not equivalent to the use of fonts in a printed map where the glyphs are converted from the digital format to dots on a page. Providing legal access to fonts used in digital publications is an entirely different matter.

TNT Font Management.

At this point it should be clear that font copyrights have direct impact on the design of all page layout systems. Font substitution and poor appearance of your layouts leads back to a legal dilemma. Copyrighted fonts can not be distributed without permission and a royalty payment. MicroImages can not give you copyrighted fonts, and you can not legally give copyrighted fonts to others without permission. For map layouts created and used only in your **TNT** product, this is not a particular problem. You acquire the TrueType fonts you want in your language, use them in your layout, and print the layout to a printer or a raster. The problem occurs when a **TNT** layout is converted to some other digital layout, which also needs the same fonts for accurate rendering at its final point of use.

You have probably already experienced a situation where you obtain a document or page layout whose originator used a font that was not available on your system. This is particularly common in nations where limited fonts are available in their alphabet. When it happens, you either have to obtain the font or allow a substitution, which is not desirable in precise cartographic applications. A font can be missing because it was assumed to be present on every system, not included by accident or choice, the data format has no way to transfer or even identify the font, or the font is copyrighted and belongs to the document's originator and can not be legally provided.

You can buy the rights to use a copyrighted font or you can obtain it with a software package whose developer has secured the legal rights to distribute that font. If you have secured legal possession of a copyrighted font you can convert it to some other format from which it can then be identically rendered. In **TNT** map layouts you can use any TrueType font you have available. It is up to you to make sure that the party using the converted portable version of this map has access to all these fonts when using the attractive map products you provide.

PDF Font Management.

Adobe has extensive copyrighted and non-copyrighted font libraries and is also the owner of the ubiquitous Portable Document Format (PDF). Every TrueType font contains a code that identifies it as copyrighted or not. Adobe's strategy is to block the user of their Acrobat product from embedding any copyrighted font in the PDF file it creates. If you choose to use an embedded font when creating a PDF, you will be notified that the copyrighted font has been omitted. That copyrighted TrueType font is then automatically linked in the PDF file. If the end user of that PDF document (for example, you if you download it) does not have that linked font, a font substitution will be made every time that document is used until that font is secured and installed. In creating a PDF document, you also have the option to have all the fonts linked only as this will reduce the size of the PDF document. Usually this all-linked strategy is chosen if you use only the 14 standard Adobe fonts installed automatically by Adobe Reader and any additional fonts you know to be standard with Microsoft Windows in your language.

Polygon Characters.

MicroImages original conversion to PDF was designed as a compromise to overcome the font substitution issue. An approach is used that ensures your **TNT** produced PDF maps do not require substitution regardless of the language used and will render accurately at the scale for which they are designed for printing or viewing. During conversion, every character used is converted to polygons in the PDF file. Since every original

character used in the PDF file is converted to a new format (a polygon), it makes no difference if the font used was copyrighted or not. Furthermore, since every character is embedded, it can not be lost and preserves the exact shape of the glyph regardless of language. This approach has worked well as long as the PDF file was used at or close to the scale for which it was originally designed and as long as small fonts (less than 12 points) were not needed at that scale. When you zoom or print this PDF at a much bigger scale, the shape of the glyphs deteriorates. Small fonts used for map grid tick marks and fine legend printing appear blocky or aliased as this glyph-to-polygon approach bypasses all the tricks used in font rendering to overcome this effect, such as hinting, anti aliasing, and so on. Also this method may enlarge the PDF file if a substantial amount of text is included in the layout.

Embedded Fonts (a post **V6.70** prototype feature).

Recently, there have been some complaints about how small characters are rendered in a **TNT** layout "print to" PDF conversion. The polygon glyph method used in **V6.70** and earlier has valuable characteristics when employed for the situation for which it was designed. This "print to PDF" process will continue to be available as an option. However, a new **TNT** to PDF layout conversion is about to be released that follows the Adobe font management model. It embeds any non-copyrighted 1-byte or 2-byte Unicode TrueType fonts you have used in your **TNT** layout in any language into the PDF document. If the font used is copyrighted, then it will not be embedded and will be linked only. You decide if you wish to use copyrighted fonts and, if you do, then how you or the user of the PDF equivalent of your **TNT** layout acquires these linked fonts.

Please be aware that there are some subtle font expressions you could use now in a **V6.70 TNT** layout that are preserved in the polygon character method but are not rendered from embedded fonts in a PDF file. An example would be the new **V6.70** font setting that lets you enter a specific percentage to render something like bold or outline, or an angle for italic text, such as 23 degrees. PDF provides no means of storing this angle for a text character(s), and it will simply become the standard angle for italics in that font. Another example is that PDF will not define a weight for boldness (glyph stroke width), and this will simply become that font's standard boldness. If the target format for your distribution, in this case PDF, does not store advanced font controls, then do not use them in your layout.

Another minor improvement is that circles defined in a **TNT** layout as a geometric element are no longer converted to polygons in the PDF file. They are now also geometrically defined in the PDF file and will scale up and down properly.

Linked Fonts (a post **V6.70** prototype feature).

As an option you can now also specify that all fonts used in the conversion to PDF are to be linked only. This will minimize the size of your PDF document. You would use this option if you confine your use of fonts in your **TNT** map layout to operating system fonts, supply all the linked fonts separately from the PDF file, or are satisfied with automatic font substitution when it is used.

To use this new **TNT** to PDF layout conversion using embedded or linked fonts, obtain the appropriate updates from microimages.com after installing from the official **V6.70** CD.

*** Scalable Vector Graphics (SVG) (a prototype process).**

What is it?

Scalable Vector Graphics (SVG) is the newly adopted official World Wide Web Consortium (W3C) open format for the storage, modification, and transmission of "smart" documents ranging from page layouts to very complex map layouts. The complete documentation (over 600 pages) entitled Scalable Vector Graphics (SVG) 1.0 Specification: W3C Recommendation 4 September 2001 can be found at http://www.w3.org/TR/SVG/. German, Polish, and Japanese translations of these specifications are also linked at this URL.

The following are some of the organizations whose product development and/or W3C committee activities have contributed to and/or use SVG: Adobe, Apple, AutoDesk, BitFlash, Corel, HP, IBM, ILOG, INSO, Kodak, Macromedia, Microsoft, Netscape, Oasis, Open Text, Oxford University, Quark, RAL, Sun, and Xerox. Obviously this is a well thought out format that will become widely used as it moves into all types of products, not just web products.

SVG has been optimized for web use so layouts stored in an SVG file are more compact than when converted into PostScript, EPS, or PDF formats. This compactness is created in part by employing smaller, relative coordinates, rather than the larger, absolute coordinates used is these other formats. Compactness is a primary consideration for a layout format designed specifically for web use. However, since its general concept and utility parallel that of PostScript and PDF, it has many immediate and useful applications when used "off the web" because it has a much simpler structure than PostScript, and its contents are open and accessible for other use, while PDF is not.

The SVG file is structured in Extensible Markup Language (XML) where all line information is stored in coordinate form, not as graphical descriptions. Since it is a markup language extension of HTML, it is easily edited or modified by other software, even a text editor. Also XML is digitally "smart" so its components can be found and used by other processes. For example, a line can be selected in an SVG layout as a mouse-over, on-click, on-key press or other event to show a DataTip, a URL, … when viewed in a web browser. In other words, individual SVG graphic elements can behave in exactly the same way as traditional HTML elements.

SVG can embed rasters internally in the XML structure (which means, as modified PNG files), thus keeping the entire layout compacted into a single file. It can also link to other raster formats stored externally where they can be more easily altered, substituted, or modified by other software. PNG is currently the most common raster format used with SVG as it supports transparency, is an open format, and is compressed.

Since SVG might be viewed as second generation PostScript, smart printers could be developed that interpret and print it directly. This is less likely to happen today than 20 years ago with PostScript printers. Now more and more printers, except those of lowest cost, are network aware and use network resources [Internet Printing Protocol (IPP)] to convert (which means, RIP) the document's format into that printer's internal format.

SVG is also being called the "new flash," as it provides animation in web applications that compete with Macromedia's Flash. At present, just as with Flash, you must secure a plug-in from www.adobe.com/svg/viewer/install for your browser to make it SVG aware. Many web sites also coerce you into accepting these plug-ins so your web browser may already be Flash and/or SVG aware. It is highly likely that the next signifi-

cant release of Internet Explorer and Netscape's browser will include the capability to interpret SVG files. Once a browser is SVG aware and can display SVG content, it can print it to any printer supported by that browser. Photoshop, PageMaker, Illustrator and other commercial products either come with, or have plug-ins to use, modify, and print SVG files. A list of standalone SVG viewers can be obtained at www.w3.org/Graphics/SVG/SVG-Implementations. A news site for keeping tuned to SVG developments is www.oasis-open.org/cover/svg.html. If you want to delve into SVG in a physical book, try the new February 2002 O'Reilly book titled SVG Essentials by J. David Eisenberg (see a description at www.oreilly.com/catalog/svgess/desc.html).

Use in Geopublishing.

TNTmips, **TNTedit**, and **TNTview** now provide the capability to convert a **TNT** map layout into an SVG file. In **TNT** terminology, this means you can now "print to" an SVG file just as you have been able to "print to" PDF, Illustrator, EPS, and TIFF formats. Each of these converted layouts will contain subtle differences in the map that results. During this development, MicroImages has converted many available complex test map layouts to SVG. The resulting maps were compared to those rendered in **TNTmips** from the original layout to identify and resolve the handling of special **TNT** cartographic features that you might incorporate into your **TNT** map layouts.

Content and Size.

The proof is in the results. You can download the following comparative sample layouts from www.microimages.com/documentation/SVG.htm. You will find that each is posted there as a **TNT** layout with all its linked RVC Project File(s), its conversion to a layout in a PDF file, and its conversion to a layout in an SVG file. Additional sample layout comparisons will be posted to this web page from time to time and upgraded as changes are made to **TNT** layout conversion processes, such as the new font handling for PDF files. At the present time, these SVG files range from 1/6 to 1/15 of the size of the corresponding **TNT** layouts and associated data and PDF files. Part of this is because SVG has been carefully crafted to be as compact as possible using the worldwide experience of its many architects, some of whom have been working 25 to 30 years on page layout designs. Some of this size difference is also due to the embedded polygon characters still used in these **TNT** and PDF layouts.

Sample Geologic Map.

The complex geologic map layout illustrated on the color plate entitled Geologic Map of the Granite Gulch Study Area, Inyo County, California uses many complex map layout features. For example, it uses CartoScript line rendering and CartoScript legends as well as other new legend features. These TNT map legend features are being released for the first time in **V6.70** and yet they are accurately converted to SVG in **V6.70**. This layout and the objects needed to build it are available from microimages.com, all fit in the free **TNTlite**, and can be used as an exercise to learn how to layout a geologic map and then convert it into a compact W3C compliant SVG file. This set of sample map layouts can be used to compare for yourself this **TNT** geologic map layout (7056 Kb), its conversion to an SVG file (353 Kb) and to a PDF file (2785 Kb). Use your **TNTmips**, browser, Adobe Acrobat Reader, and/or Illustrator to view these layouts and compare them. Also note that at this time the SVG file is 1/8 the size of the PDF file and 1/20 the size of the **TNT** layout and associated data.

Sample Engineering Plate.

The 11" by 17" sample engineering plate illustration in the attached color plate entitled Introduction to Scalable Vector Graphics (SVG) contains several unusual layout components. For example, the database tables it uses for legends contain symbol fields that were captured just as shown in a geospatial analysis process as CAD objects, which were then simply positioned in this map layout. These tables convert very accurately to PDF and SVG. This set of sample layouts can be used to compare this **TNT** engineering plate layout (2576 Kb), its conversion to an SVG file (76 Kb) and to a PDF file (653 Kb). Use your **TNTmips** to print the plate at 11" by 17" and your browser to print the SVG and PDF files to the same scale and compare the results for yourself. At this time the SVG file is 1/9 to 1/35 the size of the other layouts. If your browser has the Adobe SVG plug-in installed, you can very quickly view this 76 Kb color plate in SVG format directly from www.microimages.com/documentation/SVG.htm illustrating the value of its compactness in web applications.

Sample 7.5' Topographic Map.

The topographic map layout explained in the new **V6.70** booklet entitled Making Topographic Maps was assembled into a map layout from USGS digital line graph files. It can also be viewed in the attached color plate entitled SVG Capabilities. Its area and scale were selected so that all the objects included with this booklet can be used in the free **TNTlite** to layout this map. This layout can be printed in color on 8.5" by 11" paper in **TNTlite** at a scale of 1:36,000 to provide a very close approximation of a subportion of the original USGS 7.5' printed map.

This layout contains almost every element you would expect in a typical topographic map of any nation. The attached color plate entitled Layouts Converted to SVG and PDF compare a small portion of this map rendered directly from the **TNT** layout and from a browser using its conversion to PDF and SVG layouts. While these results are similar at first glance, a few small differences in the cartographic details are present. MicroImages is continuing to work with conversion to PDF and SVG to remove these differences created during conversion from the original **TNT** map layout.

This set of files can be used to compare this **TNT** topographic map layout (6076 Kb), its conversion to an SVG file (275 Kb) and to a PDF file (4684 Kb). Use your **TNTmips** to print the plate at 8.5" by 11" and your browser to print the SVG and PDF files to the same scale and compare the results for yourself. At this time the SVG file is 1/15 the size of the PDF layout and 1/20 the size of the **TNT** layout.

Georeferencing.

Conversion to SVG in **V6.70** follows the W3C 1.0 Specification of 4 September 2001. The proposed Scalable Vector Graphics (SVG) 1.1 Specification: W3C Candidate Recommendation 30 April 2002 located at www.w3.org/TR/SVG11/ covers the incorporation of georeference information within the SVG file. Thus, **V6.70** does not convert the **TNT** georeference into the SVG file. Since the SVG file is open and will eventually include georeference information as text, it will be very easy to extract, alter, or use it in any program. However, an exhaustive list of map projection and datum parameters must be referenced in using the information in the georeference. In the V1.1 Candidate Recommendation the W3C recommends the following approach be adopted in the final V1.1 Recommendation.

"In order to allow interoperability between SVG content generators and user agents dealing with maps encoded in SVG, SVG encourages the use of a common metadata definition for describing the coordinate system used to generate SVG documents.

"Such metadata should be added under the 'metadata' element of the topmost 'svg' element describing the map. They consist of an RDF description of the Coordinate Reference System definition used to generate the SVG map.

"The definition should be conformant to the XML grammar described in the OpenGIS Recommendation on the Definition of Coordinate Reference Systems [OpenGIS Coordinate Systems]. In order to correctly map the 2-dimensional data used by SVG, the CRS must be of subtype ProjectedCRS or Geographic2dCRS. The first axis of the described CRS maps the SVG x-axis and the second axis maps the SVG y-axis. Optionally, an additional affine transformation is applied during this mapping, this additional transformation is described by an SVG transform attribute that can be added to the OpenGIS 'CoordinateReferenceSystem' element."

At present the **TNT** products can not use an SVG file in any process, so georeferencing is not needed in **V6.70**. Georeference information could be added temporarily at any time by creating an ArcWorld type file such as *.svw containing this information. However, it is doubtful that at this time there is any other application using SVG that employs an SVW georeference file. If you obtain or develop an SVG application requiring a georeferenced SVW file before V1.1 is adopted, this approach can be easily implemented for you. The first obvious application of georeferencing would be in geographically cataloging, merging, or mosaicking SVG files.

Editing.

The non-raster portion of your SVG file produced from a **TNT** layout is simply text. While viewing any of the sample SVG layouts at www.microimages.com/documentation/SVG.htm in your browser, use the right button menu and select View Source. A new window will open showing all the source text describing this SVG layout to your browser. Note that another choice on this menu is Save SVG As… to copy this SVG from within your browser into a file on your hard drive.

However you obtain an SVG file, it can be viewed as simple "marked up" text and modified in any simple text editor such as VIM or in Microsoft Word. The attached color plate entitled Editing SVG illustrates some SVG text. Like any markup language, it can be confusing to view it as simple text. Since it is XML, it can be logically organized, presented, and edited by free or shareware XML editors.

If you wish to interactively add and edit graphic and text components into an SVG file, then the Jasc WebDraw editor just introduced this year can be purchased for this purpose. It permits interaction with the graphical components of a view of the SVG file while presenting the corresponding editable XML text in another view. Jasc WebDraw can be downloaded for trial use or purchased for US$179 from www.jasc.com/products/webdraw.

Adobe Illustrator 10 directly creates, uses, and edits the SVG layouts produced from a **TNT** map layout as illustrated in the attached color plate entitled Editing SVG. So now you have 2 paths into Adobe Illustrator from a **TNT** map layout. Convert to the Illustrator format if you are going to stay within and make the final prints in Illustrator or some other product using that same format. Or, convert to SVG if you want to modify the SVG format and move it on to a browser or some other web oriented application.

Using JavaScripts.

Concept.

JavaScripts can be embedded in an SVG file. It will then be interpreted by the program reading the SVG file, such as your browser, to provide display, control, and analysis functionality to your SVG map. For example, every label on the map can be set up to link to a different URL. This is called "event-based scripting" and is illustrated by the JavaScript described below that is inserted into your **TNT** to SVG layout conversion to provide layer control. You can insert and edit your JavaScripts in your SVG file in your text editor or other tools. However, products like Jasc WebDraw make it much easier to create, insert, and test your event-based and other JavaScripts as they are inserted into an SVG file.

Direct Layer Control Example.

Standard Adobe Script.

The Adobe SVG plug-in for your browser adds its standard event-based JavaScript to any SVG file viewed in it. When your browser is showing an SVG source, pressing the right button of your mouse (control and mouse button on a Mac) on the view is an event that will run this JavaScript to pop in a right mouse button menu. If you want to see how this works use your browser to view the small SVG file (48 Kb) containing the MicroImages logo at www.microimages.com/svg/logo.svgz. This appended JavaScript allows you to select from several event-based options on the right-mouse button menu. Simply use your left button to select an optional operation on the SVG logo file, which is now temporarily resident on your local machine but confined within the browser's sandbox.

The redisplay options this JavaScript provides for selection from the right mouse button menu are Zoom In, Zoom Out, Original View, Higher Quality, Pause, Mute, Find…, Find Again. It also provides options that operate on the temporary SVG file: Copy SVG, View SVG, View Source, Save SVG As … As noted earlier, View Source permits you to directly view all the XML text making up this SVG file, including all of this JavaScript. The Save SVG As … option permits you to save the temporary file as an SVG file on your system. In this fashion you can capture the SVG file and the JavaScript it contains. This file can then be used later in the browser or some other program that understands SVG, such as Adobe Illustrator or the WebDraw editor.

Customizing the Adobe Script.

The original Adobe JavaScript was added to the temporary SVG file in the browser and saved in the local SVG file. You can now extract it in any text editor and modify or expand it. If this modified JavaScript is substituted for the Adobe standard script in the SVG file, it will redefine the right mouse button menu selections for the left button in your browser or other program.

To illustrate how to customize an SVG file, MicroImages' conversion from a **TNT** map layout to SVG file incorporates a modified JavaScript for the right button. If you view any of the 3 sample SVG maps introduced above from www.microimages.com/documentation/SVG.htm, you can try these new options added to the right mouse button menu. The modified selection panel for the sample engineering plate is illustrated in the attached color plate entitled Introduction to Scalable Vector Graphics (SVG). Note that all the standard Adobe options are retained and the following options are added: Layer Visibility, Save Current View, Change Color, and MicroImages Home. The added MicroImages Home option simply opens a new browser window at microimages.com. The

other options illustrate how the JavaScript you deliver with your SVG file (in other words, you add in) can add interactive geospatial functionality to your SVG map layouts.

Layer Selection Option.

Your original **TNT** map layout may use many groups, each with one or more layers (for example, the Quake Hazard map has 35 layers distributed in 26 groups). These are preserved in the XML structure in the SVG file. The custom Layer Visibility option exposes a new menu with a check off box in front of the name of each layer in the original **TNT** layout. This Layer Selection menu for the sample engineering plate is illustrated in the attached color plate entitled Introduction to Scalable Vector Graphics (SVG). By default all layers are initially checked to display (turned on) so everyone automatically views your complete map. Using the left mouse button you can toggle any layer to not display (turned off) and your browser will immediately redisplay the SVG file without showing this layer. The added Save Current View option on the menu saves the SVG file with the "off" layers marked so they are turned off if the SVG is redisplayed in the browser. However, all the turned off layers are still in the SVG file.

Change Color Option.

When you use the right button to show the modified Adobe right mouse button menu, the modified script stores that screen position of the mouse cursor. The Change Color option then allows you to change the color of the nearest line or surrounding filled polygon to blue, red, or yellow (uses the same original line or polygon element as in **TNT** map layout). In other words, you can select a line or filled polygon as you open the right mouse button menu, and then use this menu option to change its color.

Map Applications to Go.

A complete **TNT** geospatial analysis product is required to import, analyze, and layout the extensive variety of geodata sources and layout options available for use in a complex map meeting rigorous cartographic standards. However, once it is assembled and converted into an SVG format, it has many other subsequent uses by other software or software that you develop. For example, after trying the modified simple event-based right button JavaScript options added by MicroImages to your SVG file, it will become apparent to those inclined to do some scripting that other higher level interactive applications can be added relatively easily into an SVG file for interpretation in your browser or some other application. The following provide good tutorials and sample source scripts (always obtainable via your right mouse button) on how to add interactive, cartographically oriented features to your SVG map file for use via a browser or other program: www.carto.net/papers/svg/first_e.html and www.kevlindev.com/tutorials/basics/index.htm.

Hatch Patterns.

Hatch pattern fills for polygons can be used in a **TNT** map layout. They can not be transferred as scalable line descriptions for use in formats such as SVG, Illustrator, or PDF line/coordinate oriented layouts. **TNT** products render hatch patterns by converting each into a raster as a color bitmap at the scale desired for the resolution of the printer selected. This bitmap is then clipped into the polygon that contains it as the print file is created. This has been an adequate approach when used within the **TNT** products since pen plotters, which can only draw hatch lines, are no longer used, and print files are matched to the designated printer. However, it is not a suitable basis for conversion to line and coordinate oriented layout formats such as Adobe Illustrator and SVG, which

require graphical descriptions of the hatch lines and how they should be clipped. The current **TNT** method of hatching also causes complications in managing and retaining hatch patterns originally specified in national cartographic symbols sets as line descriptions. Line descriptions should be preserved in **TNT** products as styles and passed on as compact line descriptions to other layouts.

TNT products are being altered, post **V6.70**, to support hatch patterns so that they can be transferred as line descriptions into other formats.

Rasters as PNG.

When a **TNT** layout is converted to SVG you have the option to embed the Portable Network Graphics (PNG) files into the SVG file or create them as standard PNG files linked to the SVG file. Tools created by others to use SVG files will usually use these PNG rasters provided via either method. If you have no intentions to alter the PNG files once they are in SVG format, then embed them as this secures all the components of that layout in a single file. If you wish to alter the image contents of your layout, then keep the rasters as separate linked PNG files. An example of the use of this second approach would be to substitute the PNG file used in an SVG map layout created only as a framework for a series of image maps or to use the SVG file as a framework for even more dynamic image feeds (for example, weather radar images).

SVG Font Management.

W3C has an even bigger font issue than PDF, as SVG files ranging from tiny animations to large maps will zip around the world by the many millions each day. PDF is generally used for complete documents whereas SVG is designed to move around or gather up many XML components for a single view. Thus font copyright, availability, and substitution issues that vary by nation are of particular importance. For example, it would be desirable to produce multiple translations with an SVG map, and let the browser choose the language to render it in. This is entirely possible in the SVG XML structure where the font and language could be obtained as needed from some server on the web or multiple label layers in different languages embedded in the XML for the map and selected by the user. To accomplish this, the fonts used must be in the international public domain and available to anyone, anywhere. Heading toward this, SVG has its own open, public font description, and programs and libraries to convert fonts to this format are being created.

It is not yet clear to MicroImages how this conversion from TrueType to SVG font should be made. TrueType has features that are difficult to accommodate in SVG, and Microsoft is introducing an even more complex ClearType font and text rendering strategy. Therefore at this time during a conversion, all the fonts you used in your **TNT** layout will be linked, not embedded, in your SVG file. As a result, all the considerations in the sections above regarding the use of linked fonts with PDF files also apply here to SVG files (for example, automatic substitution, copyright considerations, and so on).

Controlled as a Printing Feature.

Just as with “print to” TIFF, “print to” PDF, “print to” Illustrator and others, some control is exercised over how “print to” SVG operates depending upon whether or not you have purchased the optional P15 large format printer support for your **TNTmips**, **TNTedit**, or

TNTview. If you have P15 support, the conversion preserves the full resolution of the coordinates and images in your XML component objects in the SVG file. This will permit enlarging (for example, scaling up) your subsequent application of the SVG file to any level commensurate with the coordinate accuracy of the original geodata imported into the **TNT** products.

You can print your map layouts to an SVG file(s) even if you do not have the P15 large format printing option. This SVG file will have reduced coordinate values, which have been rescaled to preserve only that accuracy needed to print to 11" by 17" size at 300 dpi. Also, just as in other "print to" formats, the rasters in the **TNT** layout will be scaled to fit into their positions in the layout at the 300 dpi resolution.

Export.

A vector object can be exported to SVG files with attributes. A matching raster object exported separately as a PNG file can be linked to an SVG file by editing its XML source. This produces a single SVG file with a raster and vector overlay for use in a browser or other SVG aware products. SVG can also be linked to other raster formats such as JPEG and GIF and used in some application, such as an Adobe modified browser.

Spatial Manipulation Language (SML).

Complex **SML** scripts have and continue to be written to automate large production processes, interactive applications, and visualizations. These are considered proprietary property by their owners who create them for some competitive advantage. As a result they are not available to MicroImages or any other. Also they are often created and used in the context of the problems and objectives of a specific user and thus are not of generic interest or use.

The following is a verbal description of a script written to rotate a complex 3D visualization of a section of a potential tunnel bore.

*Please find attached a zipped RVC with a 3D simulation. These 3D vectors are the result of several **SML**s and show a section of the subway in [a city]. It might be quite difficult to understand, but our geologists here like this result very much. The **SML**s facilitate the:*

a) preparation of reference layers for the geologist's interpretation, which is the drawing and attributising of strata lines along cross sections, which means, in 2D.

b) converting these various cross section lines into 3D-lines (the thicker lines) and eventually

c) interpolating those 3D-lines into surfaces, from which those wire mesh vectors are produced.

All attributes are created and attached automatically, as well as display parameters. So it is highly automated and corrections can be carried out easily, even though direct editing in the 3D model would be much more comfortable.

Reliability Testing.

MicroImages does not deliberately make changes to **SML** that would change or alter the operation of any possible existing scripts. If expanded capabilities are needed, they are added via new, not revised functions and components. However, improvements and adjustments are made daily to our **TNTsdk** library functions/classes that are the basis

for recompiling the **SML/X** and **SML/W** functions/classes. These can cause changes that cause problems in earlier **SML** components and, thus, in your scripts. It is simply not possible for MicroImages to continually check these thousands of **SML** components.

To help pinpoint these errors and inadvertent changes in **SML**, an automatic testing procedure was initiated several months ago. It is rather simplistic at this time and only a fewtest scripts are available to be evaluated in it. It simply runs the sample scripts we have every day with the latest daily build of **SML/W** and **SML/X**. If the script does not complete and produces errors, the reasons for this are investigated and errors corrected until the script runs again. This procedure works well for a first effort but is quite limited in scope due to the limited kind and complexity of the available test scripts.

Unfortunately, due to the proprietary nature of your **SML** scripts, few complex scripts are available to exercise and test the functions/classes in **SML**. Furthermore, only batch oriented **SML** scripts can be used at this time, since any user input required to run the script to completion is not available in this test. Any proprietary batch **SML** scripts you would care to supply would be kept confidential and used only for this testing purpose. For example, the visualization script described above does not require any input. Alternately, you can contribute test batch scripts that continually test features in **SML** that you consider fragile and of paramount importance to your efforts. If any of this is of interest, MicroImages can arrange a means for you to email or FTP your test scripts to be used with this test set.

New Functions.

The 5 new functions and 29 new classes introduced below have been added to both **SML/X** and **SML/W**.

Raster functions. (3)

PackRGB
: Takes a COLOR and packs it into the cell value for a 16 or 24-bit RGB raster.

UnpackRGB
: The inverse of PackRGB( )

ComputeReliefShading
: Computers the relief shading for an elevation raster.

Object functions. (1)

GetAllObjectNames
: Returns the names of all objects of a given type in an RVC file.

Object Conversion functions. (1)

VectorToBufferZoneExt( )
: Computes bufferzones.

New Classes.

DATETIME – To Check a File's Creation Date or to Time Events
: Represents a date/time value. Can be set to the "Current" system time. Has methods to return date/time as a printable string.

TIMEINTERVAL – Permits Time Interval Actions
: Represents the difference between two DATETIMEs. Has a method to return the value as a printable string.

FILEPATH – Represents a File Name

This class has methods to return the TimeLastModified and TimeCreated time (as a DATETIME), as well as methods to return a STRINGLIST of all the files and subdirectories if the filename represents a directory.

GUI_CTRL – Creates Components of a Graphical User Interface

Provides a suite of 20 classes for creating Graphical User Interfaces. This will eventually replace the Motif classes (Xm). The main advantage of GUI_CTRL is that they are implemented for both X and Windows-native.

GUI_DLG – Creates Dialogs

Used with the GUI_CTRL classes.

STATUSCONTEXT – For Status Information

Allows control over the status message and status bar in a STATUSDIALOG. A single STATUSDIALOG can have multiple STATUSCONTEXTs, each one representing a different line on the dialog.

STATUSDIALOG

Show a Status Dialog.

STRINGLIST

Get a list of STRINGs.

MieJP2

Import and export JP2 (JPEG2000 compressed) rasters.

MieHDF_LANDSAT7

Import and export Landsat 7 images in NASA's Hierarchical Data Format (HDF) file structure.

Modified Classes.

MieTIFF

Adds the option to export a simple georeference file for use in products that do not allow rotation of an image to north in the projection.

Upgrading.

If you did not order **V6.70** of **TNTmips** in advance and wish to do so now, please contact MicroImages by FAX, phone, or email to arrange to purchase this version. When you have completed your purchase you will be provided with an authorization code. Entering this authorization code while running the installation process lets you to complete the installation of **TNTmips 6.7**.

The prices for upgrades from earlier versions of **TNTmips** are outlined below. Please remember that new features have been added to **TNTmips** with each new release. Thus, the older your version of **TNTmips** relative to **V6.70,** the higher your upgrade cost will be.

Within the NAFTA point-of-use area (Canada, U.S., and Mexico) and with shipping by UPS ground. (+150/each means US$150 for each additional upgrade increment.)

TNTmips Product	Price to upgrade from **TNTmips**:					**V6.10**
	V6.60	**V6.50**	**V6.40**	**V6.30**	**V6.20**	and earlier
Windows/Mac/LINUX	US$500	750	950	1100	1250	+150/each
for 1-user floating	US$600	900	1140	1320	1500	+180/each
UNIX for 1-fixed license	US$800	1250	1650	2000	2250	+200/each
for 1-user floating	US$960	1500	1980	2220	2640	+240/each

For a point-of-use in all other nations with shipping by air express. (+150/each means US$150 for each additional upgrade increment.)

TNTmips Product	Price to upgrade from **TNTmips**:					**V6.10**
	V6.60	**V6.50**	**V6.40**	**V6.30**	**V6.20**	and earlier
Windows/Mac/LINUX	US$600	900	1150	1400	1600	+150/each
for 1-user floating	US$720	1080	1380	1680	1920	+80/each
UNIX for 1-fixed license	US$900	1400	1850	2200	2500	+200/each
for 1-user floating	US$1080	1680	2220	2640	3000	+240/each

Installed Sizes.

Loading **TNTmips 6.7** processes onto your hard drive (exclusive of any other products, data sets, illustrations, and so on) requires the following storage space in megabytes.

	for **V6.60**	for **V6.70**
PC using W95, W98, WME, NT, W2000, or XP	82 Mb	101 Mb
PC using LINUX (with Intel) kernel 2.0.36 to 2.4	114 Mb	150 Mb
Mac using Mac OS 10.x		132 Mb
Mac using Mac OS 8.x or 9.x	90 Mb	97 Mb
SGI workstation via IRIX	153 Mb	193 Mb
Sun workstation via Solaris 2.x	125 Mb	171 Mb
IBM workstation via AIX 4.x (with PPC)	176 Mb	223 Mb

V6.70 of the Online Reference Manual in PDF, including illustrations, requires 52 Mb. Installing all the sample geodata sets for **TNTlite** and **TNTmips** requires 235 Mb. The 70 Tutorial Booklets require a total of 133 Mb. The sample TNTsim3D landscape files require a total of 120 Mb.

Internationalization and Localization

New Manual Available in Thai.

The International Research Corporation (IRC) Ltd. in Bangkok, the translator of Microsoft products into the Thai language, is MicroImages' new dealer for Thailand. IRC has established a new GeoInformatics Business Department (GIBD) to sell services, equipment, and MicroImages' and related geoanalysis software. The staff of GIBD are the same excellent professionals with over 10 years of experience in using, marketing, training, and servicing all the **TNT** products, including the translation and perfection of these products in the Thai language.

IRC has just launched an aggressive campaign to introduce **TNT** products in Thai academic, agriculture, mapping, military, and other agencies. Part of the preparation for this activity has been the creation of color brochures in Thai for **TNTmips**, **TNTedit**, **TNTview**, and **TNTserver** (see microimages.com). Another is the preparation of an exhaustive instructional manual in Thai for **TNTmips 6.6**. This is not a translation of the reference manual or any of the tutorial booklets, but a unique undertaking, design, and approach with step by step instructions in Thai throughout.

This huge project was completed in July resulting in a beautifully illustrated **TNTmips** Thai manual with 13 chapters and over 900 pages in color. It will now be distributed widely by IRC/GIBD with **TNTlite 6.6** to academic, research, and other Thai agencies. It has also been provided to MicroImages in PDF form to distribute electronically. As a re-

sult, it now is available from www.microimages.com/i18n/_th_thai.htm to any Thai student or professional anywhere or anyone else who is curious.

Many of the example applications, maps, legends, database tables, and other illustrations throughout the manual have been prepared in **TNTlite** with data of Thailand or for the Chon Buri province just southeast of Bangkok, which contains the city of Pattaya and its beach resorts well known to tourists. It is hoped that it will be possible for IRC/GIBD to update this manual for **V6.70** and future **TNTmips** versions, as this is much less effort than the original undertaking.

GIBD is also the official translator of the interface for the **TNT** products into Thai. As a part of IRC and with their 10 years experience in using **TNTmips**, GIBD is the definitive reference source for the proper translation of the terms used in geospatial analysis to and from Thai and English. GIBD can be reached by email at narinb@irc.co.th and can be reached by mail at:

International Research Corporation Ltd.
Geoinformatics Business Department
23/106-108 Royal City Avenue – Block G
Soi Soonvijai, Praram 9 – Soonvijai Road
Bangkapi Subdistrict, Huay-Kwang District
Bangkok 10320 Thailand

New Reference Books in Turkish.

HAT Geographical Information Systems and Trade is a MicroImages dealer and the official translator of the interface for the **TNT** products into Turkish. HAT has just published 2 new, very attractive, bound books in the Turkish language on the application of **TNTmips**. These books are unique in that everything in them is in Turkish. This ranges from all the 100s of user interface illustrations to the complete descriptive text. Only a few proper names can be found in these books in English, such as **TNTmips**.

The book entitled COGRAFi BiLGi SiSTEMLERi, which translates as Geographic Information Systems, provides 260 pages in Turkish profusely illustrated on every page in full color (1000s of illustrations). Sample pages reproduced from this book can be viewed at www.microimages.com/i18n/_tr_Turkish.htm. This book is designed as a introductory class or self learning guide and reference on how to get started in geospatial analysis. It is divided into the following 15 sections each introducing a different **TNTmips** activity:

- Technical Characteristics
- Introduction to GIS
- Introduction to Remote Sensing of the Environment
- Acquiring Geodata
- Georeferencing
- Map Projections
- Displaying Geospatial Data
- Making Map Layouts
- Editing Vector Geodata
- Digitizing a Soil Map
- Pin Mapping
- Editing Raster Geodata
- Managing Geoattributes
- Building and Using Queries
- Vector Analysis Operations

The 2nd book that HAT has published is entitled UZAKTAN ALGILAMA, which translates as Remote Sensing, and provides 176 pages in Turkish and is also illustrated in color. This book is designed as an introduction to remote sensing image analysis with special emphasis on direct visual enhancement and manual interpretation. Sample pages reproduced from this book can be viewed at www.microimages.com/i18n/_tr_Turkish.htm.

With their many years of experience in using **TNTmips** and all this translation experience, HAT is now the definitive reference source for the proper translation of the terms used in geospatial analysis to and from Turkish and English. Please contact HAT for information with regard to the availability of these books and MicroImages products in Turkish by email at hatgis@hatgis.com.tr. HAT also maintains a very attractive and colorful web site at www.hatgis.com.tr and can be reached be mail at:

HAT Geographical Information Systems and Trade, Inc.
Koza Sokak No: 157
B. Esat
Ankara TURKEY

Operating Languages.

Note! If your language is missing, please contact MicroImages for information on plans to add it or to discuss becoming its official translator.

New.

The **TNT** products can now be operated in Bosnian, Croatian, and Serbian.

Not Current.

The translation of the interface files for Indonesian and Hungarian operation can not currently be issued for **V6.70** and new official translators are needed for these languages.

MicroImages Authorized Dealers / Geospatial Consultants

The following 11 new dealers and geospatial consultants in 11 nations were authorized to sell MicroImages' products since **V6.60** shipped.

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Calgary - *contact Geospatial Consultant:*

ENS Mapping

Laurie Matheson
C176, 4331 Sarcee Road SW
Calgary, Alberta T3E 6V9
Canada

voice: (403)217-1593
email: info@ensmapping.com
www.ensmapping.com

Ecuador.

Quito - *contact Geospatial Consultant:*

Alberto Andrade
Urbanizacion COFAVI
Calle Miguel I. Valdiviezo
N57-25 y Borrero
Quito
Ecuador

voice: (5932)240-1619
FAX: (5932)240-3451
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Latitude Geosystems

Arnaud Le Guellec

voice: (3313)964-5183

47, Av. de la Division Leclerc
Deuil la Barre F95170
France

FAX: (3313)964-4562
email: aleguellec@latitude-geosystems.com
www.latitude-geosystems.com

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Laud Alfred Dei
PO Box UC 180
University Post Office
Cape Coast
Ghana

voice: (2332)464-8945
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OKYALOS Ltd.

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email: info@okyalos.gr

Guatemala.

Guatemala City - *contact Authorized Dealer:*

SAESA

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Guatemala City 01010
Guatemala

voice: (502)337-1613
FAX: (502)337-0692
email: saesa@intelnet.net.gt

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Enter Technologies Pvt. Ltd.

Sekhar Lukose
244, Nila, Technopark Campus
Trivandrum 695581

voice: (9147)170-0106
FAX: (9147)172-1519
email: enter@vsnl.com

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Guanajuato - *contact Authorized Dealer:*

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Calle Profesora Maria Elena
Garcia Gutierrez #7
Colonia Cupulas, CP 36250
Guanjuarto, GTO
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FAX: (5247)3733-3130
email: sensrem@prodigy.net.mx

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Frontier Mapping

Bruce Bell

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Greenwoods Corner FAX: (649)623-2674
Auckland 1003 email: frontiermapping@frontiermapping.co.nz
New Zealand www.frontiermapping.co.nz

Thailand.

Bangkok - *contact Authorized Dealer:*

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GeoInformatics Business Department

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Global Environmental Solutions

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Paris and Associates [Jack Paris] located in Monterey, California is discontinued.

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Earth Intelligence Technologies Co., Ltd. [Wisuth Panyasubsin] located in Bangkok is discontinued.

Greece.

KLEOS S.A. [Anastasios Aloupis] located in Athens is discontinued.

Papers on Applications

Characterization of Enzootic Foci of Venezuelan Equine Encephalitis Viris in Western Venezuela. by Roberto Barrera, Nieves Torres, Jerome E. Freier, Juan C. Navarro, Carmen Z. Garcia, Rosalba Salas, Clovis Vasquez, and Scott C. Weaver. in Vector Borne and Zoonotic Diseases. Vol. 1, No. 3, Fall 2001. pp. 219-230.

Abstract: The distribution of the sylvatic subtype ID Venezuelan equine encephalitis (VEE) viruses in the lowland tropical forest of western Venezuela was investigated using remote sensing and geographic information system technologies. Landsat 5 Thematic Mapper satellite imagery was used to study the reflectance patterns of VEE endemic foci and to identify other locations with similar reflectance patterns. Enzootic VEE virus variants isolated during this study are the closest genetic relatives of the epizootic viruses that emerged in western Venezuela during 1992-19993. VEE virus surveillance was conducted by exposing sentinel hamsters to mosquito bites and trapping wild vertebrates in seven forests identified and located by means of the satellite image. We isolated VEE viruses from 48 of a total of 1,363 sentinel hamsters in two of the forests on six occasions, in both dry and wet seasons. None of the 12 small vertebrates captured in 8,190 trap-nights showed signs of previous VEE virus infection. The satellite image was classified into 13 validated classes of land use/vegetation using unsupervised and supervised techniques. Data derived from the image consisted of the raw digital values of near- and mid-infrared bands 4, 5, and 7, derived Tasseled Cap indices of wetness, greenness, and brightness, and the Normalized Difference Vegetation Index. Digitized maps provided ancillary data of elevation and soil geomorphology. Image enhancement was applied using Principal Component Analysis. A digital layer of roads together with georeferenced images was used to locate the study sites. A cluster analysis using the above data revealed two main groups of dense forest separated by spectral properties, altitude, and soil geomorphology. Virus was isolated more frequently from the forest type identified on flat flood plains of main rivers rather than the forest type found on the rolling hils of the area. The spatial analysis suggests that mosquitoes carrying the enzootic viruses would reach 82-97% of the total land area by flying only 1-3 km from forests. We hypothesize that humans within that area are at risk of severe disease caused by the enzootic ID VEE viruses. By contrast, equines could actually become naturally vaccinated, thus preventing the local emergence of epizootic IC VEE virus strains and protecting humans indirectly.

[Barrera, Torres, Navarro, and Garcia are with the Instituto de Zoologia Tropical, Facultad de Ciencias, Universidad Central de Venezuela, Caracus and uses **TNTmips**. Freier is with the USDA Center for Animal Disease Information and Analysis, Fort Collins, CO, which also uses **TNTmips**.]

Temporal Erosion-Induced Soil Degradation and Yield Loss. by Gerd Sparovek and Ewald Schnug. Soil Science Society of America Journal, 65:1479-1486 (2001).

Abstract. Intensification of tropical agricultural systems by increasing fertilizer input and technology is a current trend in developing regions. Under intensive management, erosion impacts on crop productivity may not be detected in the short term. However, long-term impacts are expected because erosion rates in tropical agroecosystems are usually greater than the rate of soil formation. A temporal function of soil-depth change was defined and named life time. Conceptually, soil's life time is the time until minimum soil depth needed for sustaining crop production is reached. The life time function was applied to the Cereiro watershed (1990 ha) located at the Southeastern part of Brazil, and compared with sugarcane (Saccharam officinarum L.) yield loss estimation. Soil erosion prediction was made employing the Water Erosion Prediction Project. The mean soil erosion rate for the area was 15 Mg ha^{-1} yr^{-1}, and sugarcane showed the highest mean value of 31 Mg ha^{-1} yr^{-1}. The half life time of the watershed, i.e., the time until 50% of the area reach the minimum soil depth, was estimated to +563 yr in relation to present time. The estimated time for sugarcane's productivity to be reduced to 50% of the pre-

sent value (half yield life time) was +361 yr. The life-time function was similar to the estimated long-term impacts of soil erosion on crop productivity. Therefore, the life-time function was considered as an integrative indicator for agricultural sustainability, useful for land-use planning and for the definition of tolerable soil erosion.

[This project made extensive use of **TNTmips** for data reduction, organization, surface modeling, and illustration.]

Comparison of Three Water Erosion Prediction Methods (137Cs, WEPP, USLE) in South-East Brazilian Sugarcane Production. by G. Sparovek, O.O.S. Bacchi, E. Schnug, S.B.L. Ranieri, and L.C. De Maria. Journal of Agriculture in the Tropics and Subtropics. Vol 101, October 2000. pages 107-118.

Earthquake: Imagery Sheds Light on Damage. by Lucian Chiroiu, Francoise Bahoken, and Giles Andre. Imaging Notes. Vol. 17, No. 3, May/June 2002. pages 28-29.

[authors are staff of GeoSciences Consultants, a MicroImages dealer in France]

Off-Street Paved Bike Paths in Oregon (Oregon's Multi-use Path Guide). by Rick Bronson 233 pages PedalPals Press. 5050 Donald Street, Eugene, OR 97405 www.pedalpals.com.

[assembled from many many maps made with TNTlite.]

Appendix: Abbreviations

For simplicity, the following abbreviations were used in this MEMO

W95 = Microsoft Windows 95.

W98 = Microsoft Windows 98.

WME = Windows Millennium Edition.

NT or NT4 = Microsoft NT 4.0 (the **TNT** products require the use of NT4.0 and its subsequent Service Packs). NT4 now has a Service Pack 6a available. Windows 2000 now has Service Pack 2 is recommended if you are working with large files.

W2000 = Microsoft Windows 2000.

XP = Microsoft Windows XP.

Mac 9.x = Apple Macintosh using the PowerPC G3 or G4 processors and Mac OS 9.x.

Mac 10.5 = Apple Macintosh using Mac X version 10.5.

MI/X = MicroImages' X Server for Mac and PC microcomputer platforms and operating systems.

GRE = MicroImages' Geospatial Rendering Engine, that is at the heart of most MicroImages products. The current **GRE** will respond and render requests from either X/Motif or Windows.

Gb = gigabyte (1000 megabytes) or 10^9 bytes

Tb = terabyte (1000 gigabytes) or 10^{12} bytes

Pb = petabyte (1000 terabytes) or 10^{15} bytes