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Introduction

MicroImages is pleased to distribute **V6.60** of the **TNT** products, which is the 51st release of **TNTmips**. It provides new capabilities for direct use of external files in views and other analyses, building landscape files for real-time 3D viewing, and mapping point densities into a raster. **TNTatlas** for Windows has been completed. **TNTsim3D** for Windows and the Mosaic process have had major additions and 193 new feature requests submitted by clients and MicroImages' staff were implemented. A summary of the new capabilities provided in **V6.60** are listed below.

- **Automatically Use External Files:** Directly select and use, without conversion, shapefiles, TAB, MrSID, ECW, TIFF, or GeoTIFF external files as layers in a composite view, as input to an analysis process, or for import. Intermix these external geodata files in these activities with objects from a Project File.
- **Large Display Windows:** Select that the large virtual view window should automatically scale to the maximum extent of all layers or the active layer or that it should scale 1:1 to show every pixel in the active layer.
- **Faster Views:** A 2 by 2 pyramid layer for rasters can now be created to accelerate views that will select this layer. All processes now optimize vector objects for zoomed in views. Optimization has been extended to accelerate label location in zoomed in views. Filling islands is much faster.
- **Real-Time 3D Simulation:** **TNTsim3D** for Windows can be used with DirectX or OpenGL. It is now much more robust, and individual frames are equal in quality to static 3D views and better than movies. Image smoothing can be used to smooth big pixels in the foreground. Smoothing and the application of fog and haze reduce sparkle at the horizon. Use keys to toggle view from pilot (forward), to passenger (left and right), bombardier (nadir or straight down), or rear gunner (rear) views. 3D compass provides orientation.
- **Landscape Builder:** A new **TNTmips** process to produce a Project File optimized for real-time use in **TNTsim3D**. Choose any raster object of any data type for the surface, or terrain, raster object. Choose any combination of raster, vector, CAD, TIN, and supported external files for combination into the texture, or drape, raster object. This process uses the familiar selection, query, symbol, style, projection reconciliation, attributes, and other powerful geospatial management features in similar fashion to those in the static 3D viewer.
- **TNTatlas for Windows:** FREE **TNTatlas** for Windows is now equivalent in functionality to **TNTatlas** for X. An installation program is provided using the familiar InstallShield.
- **Improved Mosaicking:** Automatically, cosmetically repair narrow under-lapping seams or small holes (gap filling). Use a reference raster to set the cell size, contrast, and georeferencing. Georeferencing and control of contrast are improved.
- **Tracing while Editing:** When vector elements are being drawn or edited, they can be extended by tracing portions of elements from other layers.
- **Reference Views while Editing:** Open additional GeoLocked views in the Spatial Data Editor for reference purposes.

- **Hough Transform:** Application of the Hough Transform and its inverse are now much more interactive and include viewing the results over a reference raster.
- **Point Density Mapping:** This new process maps the occurrence of all points or points selected by query from a vector object into a continuous raster object of their density distribution.
- **Mattes:** Select many different border types and colors for a group, such as a legend group. Fill these boxes with a color matte. Add a neat line or border around the whole map (layout). Use CartoScripts to draw custom borders.
- **HTML-based TNTclient:** This client now provides an interface panel through which end users can draw points, lines, or polygons on a view, complete a form for their attributes, save them locally, and insert them into a vector layer in the atlas being used by the **TNTserver**.
- **TNTserver: TNTserver** is now **V3.00**, which accepts and manages the remote entry of elements and attributes into a vector object.
- **Easy Windows Installation:** All **TNT** products for Windows (except **TNTserver**) now use the familiar InstallShield wizard product.
- **Global Searching:** The Online Reference Manual and all the Getting Started Booklets have a composite index and can all be globally searched and then accessed from the Help menu using Adobe Acrobat Reader.
- **QuickGuides:** 9 new QuickGuides are available.
- **Getting Started Booklets:** 7 new Getting Started Booklets are available as well as expanded versions of 5 existing booklets.
- **Mac OS X: TNTmips**, **TNTedit**, and **TNTview** are supported for Mac OS 10.1 using Apple's Aqua interface and will be shipped in January as **V6.60** when software authorization key support is implemented.

Installation for Windows

MicroImages has licensed and now uses InstallShield for the installation of **V6.60** for all **TNT** products on Windows based platforms (all **TNT** X server and Windows versions except **TNTserver**). Installation via InstallShield is commonly used for most products for any version of Microsoft Windows. Some of the advantages of this new procedure are:

- installation uses the common and familiar wizard procedures,
- **TNT** components are automatically installed into the Microsoft approved locations,
- uninstall via the Add/Remove Programs icon on the Control Panel, and
- Microsoft libraries (DLLs) required by the **TNT** products are updated automatically.

From a technical viewpoint the DLL management issue is very important. In 2 prior **TNT** releases, difficulties were experienced on older versions of Windows that resulted from MicroImages' assumption that your system DLLs would be current. In one case, every single person at MicroImages, at home, and elsewhere who tested the prerelease software used a system that also had the latest version of Microsoft Internet Explorer installed. Installing this version of Explorer updated system DLLs that were used in the preparation of that release and were required to operate it. Alas, some clients were not using Explorer, were not keeping it current, and were using an older version of Win-

dows. As a result, these clients could not run that version of the **TNT** products until they obtained the revised DLL and used it to patch their version of Microsoft Windows.

InstallShield is closely coupled with the operation of all versions of Windows. Its installation preparation kit contains all the various past and present DLLs and other required modifications for various versions of Windows. When MicroImages use this kit to prepare the **TNT** products for installation, it determines which versions of DLLs and other upgrades have been used and adds them to the CD. Subsequently, when you install the **TNT** products or any other product with InstallShield, it first scans your system to see which DLLs and other upgrades are required and automatically makes these modifications. InstallShield relies upon Microsoft to insure that all these modifications are backward compatible with all the other applications you have previously installed.

Product Licenses

Types Available.

A new MicroImages MEMO entitled TNT Licenses and dated 1 December 2001 is enclosed to describe the types of licenses available for the operation of MicroImages' commercial **TNT** geospatial analysis products: **TNTmips**, **TNTedit**, and **TNTview**. Attached to that MEMO to clarify how these licenses operate and are controlled are the 5 color diagrams entitled:

Your Complete Geomedia Solution,

FIXED LICENSE: for 1 direct user,

FLOATING LICENSE: for 1 concurrent user,

FLOATING LICENSE: for 5 concurrent users, and

FLOATING LICENSE: for UNLIMITED concurrent users.

As always, prices for MicroImages products can be checked at microimages.com.

Please note that a floating license is not, and will not become, available for the **TNTserver** product. **TNTserver** requires a software authorization key to be attached directly to the Windows platform upon which it is operating.

License Configuration.

MicroImages now uses InstallShield to automatically install an additional small License Configuration program for the management of any licenses to all the **TNT** products on Windows based platforms (all **TNT** X server and Windows versions except **TNTserver**). This program appears on the same Windows menu as your **TNT** product (see Start/Programs/MicroImages/TNT Products 6.6/License Configuration). This program will open the **TNT** Products License Configuration window providing the following options for selecting the control device for the license you are using:

- Free TNTlite license,
- License key on parallel (LPT) or USB port,
- License key on serial port [choose your COM],
- Floating license from FLEXlm server [specify your server name], and
- Apply feature option codes.

Toggle Between **TNTpro** and **TNTlite** Products.

For various reasons you may occasionally want to start up the **TNTlite** version of your professional **TNT** product. For example, if you are preparing geodata for someone else

to use in **TNTlite**, you will want to check to see how it operates. Or, you have removed your software authorization license key to take it home or elsewhere. Prior to **V6.60**, removing the key would simply produce an error message when you attempted to start the lite version of your products. You had to find and alter the appropriate line in your tnthost.ini file to start your **TNT** products in lite mode. Then, later when the key was re-attached, you would have to edit the tnthost.ini file again. All this was very inconvenient. Now you can simply use this new License Configuration window to toggle on the "Free TNTlite license" option and from that time onward, you can start any **TNT** product in lite mode whether the key remains attached or is removed. To switch back to starting up into your professional **TNT** product, simply reopen this License Configuration window and select the option that identifies the port where your software authorization key is attached.

Setting Up a Fixed License.

If you are setting up a Windows platform with a fixed license use either the "License key on parallel (LPT) or USB port" or the "License key on serial port" options depending upon the kind of software authorization key you have chosen. This program detects which COM ports are active (COM1, COM2, COM3, …) and presents them in a list for your selection. Remember, the recommended USB key can be moved between Windows and Mac 9.x platforms and simply selected in this panel to immediately convert the **TNTlite** version of a product to run in the **TNTpro** mode. Using this new program and options, a fixed license, and a USB key makes it very easy to move a **TNT** professional product around in a classroom equipped with many **TNTlites** for routine practice.

Setting Up a Client for a Floating License.

Use this new License Configuration window to set up a networked Windows platform to run the **TNT** products as a concurrent user of a floating license. First install the **TNT** products from the **V6.60** CD onto the local machine. Then use this window on the local machine to specify the name of the network server that is dispensing the virtual software license keys for the **TNT** products (see virtual key concept on the color plates attached to the MicroImages MEMO entitled TNT Licenses). When a **TNT** product is started, it will then connect to the floating license server to obtain a virtual key. Since the **TNT** software has been installed locally, if no virtual key is available, the machine can use this same panel as described above to switch to lite mode to run the product.

More advanced automated network approaches can be set up to bypass the need to use a CD to install the **TNT** products on a client machine via a concurrent license. A network administrator can set up copies of the **TNT** products for each platform (Windows, LINUX, UNIX, and soon Mac OS X). When it is decided to install (or update) the **TNT** products on a client machine, the appropriate version for that platform can be downloaded and installed locally. The advantages of this approach are that all types of platforms can be more easily served (you don't have to hunt around for the appropriate CD) and upgrades can be much more easily handled. You are already familiar with this approach for programs you obtain via the Internet.

Changing a License.

Modifying your software authorization key (fixed or floating) uses the License Configuration window. Use it when you have ordered any of the following changes:

- updating to a new version of a **TNT** product,

- adding optional large format printer support,
- converting from **TNTview** to **TNTedit** or **TNTedit** to **TNTmips**, and
- increasing the number of concurrent users on a floating license.

Simply select “Apply feature option code” from this window, which will present the Apply option code window where you can fill in the authorization code provided by MicroImages. The program will then use this code to program your software authorization key to permit the operation of your new features or products.

IMPORTANT: If you order upgrades of any **TNT** product (except **TNTserver**) before the CDs are mastered for that version, do not request an authorization code. The CD for that version will automatically reprogram your key when you install from it.

Possible New Keys.

MicroImages is evaluating new HASP parallel and USB software authorization keys from Aladdin (see illustrations at ealaddin.com) for all **TNT** products. These keys look similar to the parallel and USB keys currently purchased from Rainbow Technologies (rainbow.com). They would also be used and supported in the same fashion as the current keys. One advantage of these HASP keys is that they come with improved design and software drivers, which would provide the basis for better cross platform movement of your **TNT** products. Furthermore, Rainbow is consistently slow and late in providing drivers to support new developments in hardware and operating systems, such as Mac OS X (via its underlying UNIX base) or for USB on LINUX. To maintain backward compatibility, MicroImages will add support for the new keys in parallel to that which is used for the current keys. However, if these new keys perform as advertised, it will be possible to move your **TNT** professional products freely between Windows, Mac OS X, and LINUX platforms using a USB key and with a parallel key between Windows and LINUX (the legacy parallel port is not available on Macs). Since the price of the **TNT** products is the same for all these platforms, MicroImages is planning to implement this flexibility for you.

Mac OS X

Mac 10.1 Direct Support.

V6.60 of the **TNT** products will be released for Mac 10.1 platforms in January 2002.

The Competitive Situation.

No major image processing or GIS product is available for use with Mac OS X. Kodak (alias ENVI) has announced that the IDL language is not being ported to Mac OS X (see http://www.rsinc.com/pr/lettertomac.asp). Since IDL is the cross platform support for the ENVI product, this means that ENVI will not be available for Mac OS X except when run in the Classic 9.x mode. With the exit of ENVI, no other vendor of the major components of geospatial analysis currently offers support of the Mac OS X platform. As a result, when released in January, the **TNT** products will be the only complete geospatial analysis product available for use with Mac OS X.

Why the Delay?

When Mac OS X (V10.0) was released, MicroImages was able, with minor modifications, to compile all the **TNT** library and processing functions. This posed no special requirements as Mac OS X is built on a UNIX base, as are the **TNT** products. Unfortunately, Mac 10.0 was not complete, robust, fast, or sufficiently widely installed to warrant the release of the **TNT** products for direct operation in this new operating system. Furthermore, an earlier release would have necessitated that MicroImages devote software engineering time to creating an X server for this purpose when it was clear that several other X server development efforts were underway, including 1 from the Open Source community. Finally, Rainbow, the manufacturer of USB software authorization key used with the **TNT** products, still has not released the required UNIX/LINUX support of their USB key.

X Server.

The underlying UNIX derivation of Mac OS X implied that good X servers would be much more important than for use with Mac 9.x and would probably be created in the public domain by the Open Source community. Concurrent with the release of Mac 10.1, the Darwin Open Source X server has matured into a free, reliable X server that has been compiled and tested for use with the **TNT** products. It is free and can be given away for use with **TNTlite**, which was another important consideration. Since its source is available and MicroImages is familiar with coding X servers, it can be maintained and even modified in the future if necessary.

Window Manager.

An attractive window manager called OroborOSX is also available as Open Source and presents each X window and dialog (including each in the **TNT** interface) as a separate window. Using this window manager, the **TNT** interface automatically looks and operates as if it is a native Mac 10.1 application directly using the native Aqua window manager. In other words, even though an X server is being used, the **TNT** user interface looks and functions like a native Mac 10.1 application. Also the Mac OS X is now multitasking and can run the **TNT** products at the same time as other applications. As a result, the operation of the **TNT** products can be concurrent with other applications and all these products' system and interface components intermixed and accessed as expected.

Language Support.

Mac OS X uses Unicode encoded fonts. Thus, the **TNT** products for Mac OS 10.1 used in your language will automatically use the same resource files as the Windows platforms to convert the TNT interface into your language. So far Apple has released Mac 10.1 in Simplified Chinese, Traditional Chinese, Hangul Korean, Finnish, Norwegian, Swedish, French, German, Italian, Dutch, and Spanish. Since Adobe Acrobat Reader 5 is also available for Mac 10.1, the Getting Started Booklets, the Online Reference Manual, and the new indexes to them will also automatically be available in English. The use of the available translated versions of the Getting Started Booklets via Acrobat Reader has not yet been investigated.

Software Authorization Key.

Aladdin's HASP USB key has been selected for use with the Mac 10.1 product (see illustrations at ealaddin.com). It can be programmed to control **TNT** operations on Micro-

soft Windows and LINUX platforms. Thus, this single USB key permits the interchange and operation of your **TNT** product on Mac OS 10.1, Windows, and LINUX.

Floating License Available.

MicroImages' floating license, like almost every other floating license, uses a FLEXlm license manager purchased from GLOBEtrotter software. FLEXlm was never made available for Mac 9.x or earlier Mac systems as it operates in the background on multi-tasking systems, which these were not. Thus, MicroImages' floating license does not permit a concurrent user to work from Mac 9.x stations. Mac OS X is a multi-tasking UNIX based operating system and is fully supported by FLEXlm. As a result, a **TNT** floating license can be used from a Mac 10.1 platform on that network. It is now even possible for a Mac 10.1 station to host the FLEXlm license manager and the **TNT** software authorization key associated with it.

Prices.

Prices for the **TNT** products for Mac 10.1 will be the same as for Windows, Mac 9.x and other platforms. Those who purchased a **TNT** product for use with Windows or Mac 9.x can subsequently change to a USB key that will permit their software authorization key and **TNT** product to be moved between Mac 10.x, Windows, and LINUX. The charge for this key exchange will be $100, which includes shipment to you by DHL air express.

Mac 9.x

V6.60 of the **TNT** products will operate in the 9.x classic mode under Mac OS X or directly in 9.x. Be sure to use the latest Mac OS 9.2.1 if you are using the classic mode with Mac 10.1.

MicroImages recommends booting directly into Mac OS 9.x to use **V6.60** of the **TNT** products on a Mac OS X platform.

V6.60 will also operate if you are using a Mac equipped only with Mac 8.x or 9.x. If you are using these versions we recommend updating to Mac 8.6 or Mac 9.2.1.

V6.70 of the **TNT** products will be the last update released for Mac 8.x or 9.x.

Advances in the **TNT** products will be frozen for the older legacy versions of Mac with the release of **V6.70**. At that time MicroImages' software development efforts will be focused upon operation of the **TNT** products directly in Mac 10.1. After that, only **V6.70** and corrections for the **TNT** products will be available for the older Mac 8.x and 9.x.

If you are using **V6.60** or **V6.70** directly in Mac 8.x and 9.x, you will be able to move your license and operation of the **TNT** products to Mac 10.1. There will be no change in your **TNT** product price or license. However, as noted above, Mac 10.1 will require a change in the manufacturer and model of the USB software authorization key. This key exchange will be at no charge for the new key for those using the current USB key with Mac 9.x. MicroImages will ship this new key to you or your dealer in advance of the return of your current key with it authorized for 15 days of operation. This limitation will be removed with a code number supplied by MicroImages when your original key is re-

turned to MicroImages. This overlap period will permit you to avoid gaps in your operation of the **TNT** products.

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

Integrated Geospatial Analysis Versus Piecing It Together.

The Piecemeal Approach.

Any organization, large or small, that is seriously involved in time-critical geospatial analysis and geodata mining is making a large commitment of time and money. Over the past 20 to 30 years, GIS, remote sensing, data mining, computer cartography, spatial RDBMS, Internet delivery, personal computers, and other components have been adopted piecemeal. Today all these pieces of the technological puzzle are required in a successful program. As a result, almost all organizations are using systems that were not engineered into place, they were assembled piecemeal often by various individual's initiative, skills, or alas, only by their authority. A good review of how this happed in one organization can be found in the following scientific paper. This paper critically reviews the piecemeal evolution of the management of geospatial analysis systems using New South Wales Department of Natural Resources as a model.

Long Term Management of a Corporate GIS. Tai O. Chan and Ian P. Williamson. International Journal of Geographical Information Science. 2000. Vol. 14, No. 3. pp. 283-303.

Abstract: *The GIS literature abounds with strategies to guide the development of a corporate GIS as a single project but lacks discussion on the long term management of the GIS. This paper documents a recent study into GIS development in a state department over an 18-year period. It applies the productional perspective of GIS to model long term GIS development diagrammatically and identifies five patterns of GIS development. The outcomes reveal some long term characteristics of a corporate GIS, based on which a three-stage approach is developed to guide the long term development of an ideal corporate GIS.*

A reprint of this paper can be ordered in PDF format from http://rosina.catchword.com/vl=29983727/cl=50/nw=1/rpsv/catchword/tandf/13658816/v14n3/s5/p283

The Risk in Continuing It.

Gradually, all these pieces begin to show up in the organization's "technology" budget, often second only in magnitude to the central database oriented IT budget. In larger organizations, the piecemeal activities gradually coalesce into separate service oriented remote sensing and GIS departments, which begin to compete with corporate IT departments for serious funds. Eventually, top management takes note of this, especially when a merger takes place or during a recession when corporate or national budgets shrink. When they finally critically review the cost of these operations versus their perceived worth, they are found wanting because they are expensive and not yet perceived as essential, strategic, or contributing to their profits. Their decision is then simple and easy, close down these groups and departments and outsource essential services of this type. Typical examples of this process are the almost complete demise of the large oil companies remote sensing departments in the 1980s and the disappearance of the remote sensing and GIS departments from major mining companies starting in the mid 1990s and just running now to completion. Alas, there are still many organizations, especially in governments and their militaries, that are headed down this same path. Unfortunately, it is not easy to eliminate or even change these kinds of institutionalized ac-

tivities even if they are clearly proven to be ineffective and inefficient. For example, I have had numerous accurate reports of national government mapping organizations that have had major commitments to computer map production programs for 20 years and have never produced a single map or serious computer mapping project. The value of these programs is easy to judge.

System Review Shows All.

The effectiveness of groups who are producing geospatial products can also be systematically examined to determine their efficiency and cost effectiveness. These programs should be well aware that in a future time of financial duress or reorganization, they may be subjected to careful analysis from the outside. They would benefit, as would those contemplating involvement in geospatial analysis for the first time, from performing a careful systems analysis of the most cost effective approach. Unfortunately, due to the many special interests involved, a fair analysis is difficult to conduct if done internally or even if contracted out.

What follows is a report based upon a careful system analysis review of the software procedures of a government agency already heavily involved in the time-critical production of paper maps and beginning to produce companion CD products. This study was conducted by a major international engineering contractor to that agency. This contractor is responsible for the assembly of the Windows based systems and software currently being used, the systems level control procedures for the activity, and the design of future improved solutions. The contractor is concerned with all aspects of the process, but since this is a complex, mission critical program, their focus is more on the time than the cost. Also important is the reduction of the complexity of the process as this has a serious indirect cost in the availability of skilled operators, the time to train them, their retention, and the quality of their products—all of which significantly impact on the ability of this agency who directly employs the analysts to react to changes in demand by scaling the production up or down.

The contractor conducting the review below already uses its own specialized image processing software modules in the existing workflows, which require software from 10 additional outside commercial software vendors. The results of their system analysis of the existing workflow shows that without changing their modules an improved workflow has been achieved and additional products produced using only 5 software products from other vendors. I have used bracketed changes [changes] to make this review anonymous and to add my clarifications. Also, to maintain the sources anonymity, it is not possible to include the color workflow diagram referred to in this communication. As noted, the existing system, referred to here as the [E&E system], uses 11 software products made up of 4 primary software collections from ESRI, ERDAS, this contractor, and a workflow management package with 7 minor specialized software products from other vendors. The proposed system, referred to here as the [**TNT** system], uses 6 software products made up of 3 primary software components consisting of **TNTmips**, this contractor's components, and the workflow management package with 3 minor specialized software products from other vendors. In both approaches the minor software products are for such activities as writing out a CD, network software, and data management.

Full text of email from a **TNTmips** client dated 1 December 2001.

It appears that our process model efforts to compare the production workflow using ERDAS Imagine and ESRI ArcInfo vs. ***TNTmips*** *is paying off. We have won support from key* [government personnel] *who were impressed with our ability to create "vector with attributes" maps. In the past, all digital maps were annotated graphics with no attribute information nor actual vector data in real world coordinates. We were able to show the customer not only an improvement in the production process but also an advancement in data delivery.*

… [paragraph related only to quantity of units and timing omitted here]…

The results of our efforts and recent confirmations should be an actual order for ***TNTmips*** *from* [our company]*, with a corresponding deployment order to* [replace all E&E systems] *(a potential order of ~100 licenses). This will take ~18 months to accomplish but I thought you would like to know everything is a go.*

I am pushing to get a draft of our process comparison methodology published because of the innovative way we were able to compare "apples" to "apples" in the geospatial software selections.

Attached is a windows bitmap [not included here] *of the two procedures; the alternative* [**TNT** system] *is in the top section and the existing* [E&E system] *in the bottom. It is zoomed out intentionally to obscure the details. The process model diagram is characterized by colored horizontal "swim lanes" each representing a software product needed during map production. Vertical dotted lines across the top represent "phases" or functions of the production process such as feature extraction, attribution, map composition, etc.*

Notice that there are 10 phases for both workflows, representing that the functional concepts have remained identical. However, a count of the swim lanes reveals that alternative has 6 software packages vs. 11 needed in the existing process [E&E system]*. Next, count the flowchart boxes and find 72 on the alternative* [**TNT** system] *but 87 flowchart boxes on the existing* [E&E system]*. That means the alternative process eliminated several steps and software packages in the new process. But more significantly, each flowchart box in the existing process* [E&E system] *has a duration associated with it documented from actual cartographers experience; and thus we are able to compare how long each flowchart step takes to complete. By simulating the process model and running several thousand simulations we can see if the normal distribution of our simulated process roughly matched the experience of the map makers.*

With the existing production simulated, we turned to prototyping the alternative and recorded the amount of time needed for each flowchart step. We were able to focus on real bottlenecks to production and recommend alternatives that produced huge reductions in map production time. [This writer has verbally noted that the existing process required 1100 work hours while the streamlined process requires 110 work hours.]

These comparisons were the first time the customer has looked at how they make maps and how the software choice they make affects their production and delivery ability. The method of comparison was so radical many did not believe our comparison. Others are trying to shoot down the comparison because of the embarrassing realty that the existing process was never really engineered. It was just made up by cartographers with skills in [the existing] *software.*

There are limitations to the depth of our comparison, but we have successfully demonstrated for the first time in over several years of my involvement that engineering analysis, when done fairly and openly, produces compelling indications that the biggest brand name software doesn't mean you have the best process.

It has been shown that many of the customers so-called map making gurus are simply exceptionally skilled "GIS" types whose breadth of experience is really limited by the collection of software tools at their disposal. Their attempts at processes may or may not be engineered well.

By designing process models that can directly compare identical functional phases against software steps needed to complete it, we are able to take an "apples" to "apples" look at judging software.

This analysis provides a clear example of the benefits that result from replacing a loosely assembled, multi-vendor collection of software with an integrated geospatial analysis product supplemented by special purpose software. In this example, each product set will be produced in 3 weeks by 1 operator (110 hours) instead of 10 operators (1100 hours). This will produce an order of magnitude increase in production or a major reduction in costs. The number of software products involved is reduced by 1/2, thus correspondingly increasing the reliability of the system while decreasing system installation, maintenance, and operator training time.

Geomedia?

What Is It?

All our efforts in geospatial analysis are eventually focused upon the production of geomedia. We all have some end user to reach, such as a client, supervisor, professor, board, or … sometimes its just ourselves as we plan our next step or make a final decision. What good are all these analyses if others can not access and understand them? Only recently have articles appeared that acknowledge that those involved in geospatial analysis are in the media business as we "sell" our results and ideas. We may "sell" using PowerPoint presentations, paper maps, reports with plates, CDs, web sites, or on-screen simulations in 2D, 3D static, or 3D real time simulations.

GIS as media? Daniel Z. Sui and Michael F. Goodchild. Guest Editorial. International Journal of Geographical Information Science. 2001. Vol. 15, No. 5. pp. 387-390.

A reprint of this paper can be ordered in PDF format from http://alidoro.catchword.com/vl=3170614/cl=15/nw=1/rpsv/catchword/tandf/13658816/v15n5/s1/p387

Forty years ago as a student member of the American Society of Photogrammetry (now American Society of Photogrammetry and Remote Sensing [ASPRS]), I was proud of the quality of their Photogrammetric Engineering publication (now Photogrammetric Engineering and Remote Sensing). However, I recall wondering why they put so much money into producing a high quality monthly publication relative to those of other professional societies. Gradually I came to the awareness that this was because they had something to sell—the content of the high quality images that made up this publication. These editors realized that they were not going to convince anyone of the usefulness of photo interpretation by publishing low quality reproductions of the images that accompanied their articles.

It has taken the first 15+ years of the operation of MicroImages to realize that we are ultimately in the business of producing tools that put you into the media business. Initially,

we (and still some of our new buyers of today) focused upon the implementation of low-cost, desktop image interpretation, GIS, and map production tools. Gradually these evolved into a broad-based, comprehensive package for geospatial analysis. As **TNT** technical applications and implementation strategies improved, you, by your requests for new features, defined the media aspects of the **TNT** products. Certainly you still ask for a wide variety of specific analysis features and improved performance, but your common theme is for improved support for the production of geomedia.

Many new media components have been added to your desktop computer environment and provide new opportunities for the distribution of our geomedia. These include large format printers, fast display boards, dual/multiple displays, huge drives, ubiquitous fast CD units coupled with personal CD writers, high speed Internet access, projectors… All of these are now readily available worldwide at low cost. Many of you now use several or all of these media technologies to distribute the results of your geospatial analysis. It is often the quality of your geomedia presentation that distinguishes your results from those of others. Your access to these new and improved technologies has prompted MicroImages to try to satisfy your expectations for their operation in the **TNT** products. As a result, a significant portion of our current efforts is focused upon satisfying your requirements for superior media distribution of your superior project results.

The realization that MicroImages and you are in the geomedia business and the need to show the relationships that exist in the several fine **TNT** products are illustrated in the diagram entitled Your Complete Geomedia Solution, which is attached to the enclosed MicroImages MEMO entitled TNT Licenses. This diagram illustrates the current relationships between the **TNT** geospatial analysis and geomedia products. Perhaps this diagram will help you review the many excellent, free, end user media options that are available for the publication of your results.

Satisfying This Need.

Earlier versions of the **TNT** products addressed your geomedia publishing needs by moving the results of your geospatial analysis into other media by exporting your results, for example, export to PDF, Illustrator, TIFF, GIF, VRML, … formats and the creation of MPEG, and AVI movies and other standard media formats. Let us review the progress over the last year in **V6.50** and **V6.60** toward directly meeting your special geomedia requirements as a function of the desktop devices that enable each opportunity.

Language Support.

You have limited or no geomedia options if your language can not be used in your geomedia. By its very nature, media is for public consumption and requires the use of your public's language.

V6.50. All **TNT** products were converted to use TrueType. This provided for your access to the widest selection of fonts in your language for the operation of the **TNT** products, for **TNTatlas** distribution, and for map production.

V6.60. Provides continous incremental improvements in the support of your language and adds new languages.

Competitive Status. The **TNT** products support more languages at no extra cost than any other similar product in any price range.

CDRW Drives.

CDs are the principal media by which large geodata sets can be created for distribution. **TNTatlas** is unique in that without cost it provides an organized structure for distribution of geodata together with quantitative geospatial analysis tools.

V6.50. You were first introduced to **TNTatlas** for Windows as a standalone prototype (no X server required). Since this is a free geomedia product, it can be prepared for distribution using **TNTmips** on any platform. You created and distributed various prototype atlases with this product.

V6.60. **TNTatlas** for Windows is now fully featured and can be used to create one or many CDs containing your FREE **TNTatlas** for Windows. You or your user can run these in a familiar Windows fashion completely from the CD, use the familiar Windows installation procedure to install the **TNTatlas** program only, or install everything—the program and geodata—to a hard drive.

Competitive Status. **TNTatlas** is not a geodata viewer but a FREE quantitative GIS and image interpretation product that is relatively easily used in your language. There is no other product with which **TNTatlas** can even be compared!

CD Drives.

Fast CD readers are now required standard equipment so that anyone with a computer can use your **TNTatlas**.

V6.60. The new **TNTatlas** for Windows can be operated completely from your CD without any installation. Simply select its icon on the CD to start it up from the CD.

Competitive Status. You do not even have to install **TNTatlas** for Windows to use it from the CD.

Larger and Larger Hard Drives.

Viewing ever larger geodata sets is the most basic geomedia application. Many now build up very large geodata sets so they can provide “any view, anywhere, anytime.” Efficiently handling such massive geodata has long been a **TNT** specialty, since our products were originally designed for high performance on limited desktop computers.

V6.50. Video recording has recently become the driving force in the development of larger, low-cost hard drives. SML now permits the frame-by-frame production of the content of MPEG and AVI movies from your geodata. Applications include the collection of external data from sensors or changing databases for use in controlling what will appear in a frame and how it will appear.

V6.60. Large rasters, primarily images, are being distributed in MrSID and ECW format. Even compressed GeoTIFF images are getting large. To avoid duplicating these materials within a Project File, they can now be directly viewed and used in **TNT** products and processes. Only a few-second time penalty occurs the first time a raster in this format is viewed. Very large geographical data sets are also being created in **TNT** or elsewhere and, thus, ESRI’s shapefiles and MapInfo TAB files can now also be directly viewed and used. However, due to the simple structures of these files, under some circumstances their direct viewing in their source product’s format or as linked in the **TNT** products can be very slow.

Competitive Status. The **TNT** products provide more import/export capabilities than any other general-purpose product. Now widely used formats can even be directly used. However, at least 1 other product directly uses more external formats.

Large Format Printers.

Most of you now have access to a large format color printer in your office, on your network, or via a service bureau. It has become commonplace to bring geodata into **TNTmips** to produce large maps in your language.

V6.50. You are preparing progressively more complex legends for your maps, which was improved in this version.

V6.60. Now you can easily apply borders and matte backgrounds to any group in a map, such as a legend block, and add a variety of neat lines around your map's content.

Competitive Status. This is hard to judge as its more a matter of how easy it is to prepare an acceptable map product than what it looks like. **TNTmips** is used to finish large maps created in other products and the reverse is not reported. However, Adobe Illustrator is also used to finish more elaborate maps started in the **TNT** products.

Fast Display Boards.

The PC game industry has promoted the use of fast display boards with independent memory and bypasses most of the operating system using DirectX or OpenGL (Open Graphics Language). As the use of these features for games becomes standard in PCs, your geospatial results can be presented in realistic simulations. The most important aspect of your use of the simulations (versus playing games or movies) is their geographic control since they are using georeference materials.

V6.50. Large virtual displays were introduced by means of the X server permitting rapid views of any size at the specified scale.

This version also first introduced the standalone **TNTsim3D** product for use on Windows platforms. It supported only DirectX for your display board.

V6.60. **TNTsim3D** for Windows now uses a new Landscape Builder process to build a texture layer and a surface layer. These layers are loaded by **TNTsim3D,** and you can fly over them using your board's DirectX or OpenGL support. This Landscape Builder uses the same powerful **TNT** Geospatial Rendering Engine (**GRE**) and, thus, provides all the features you already use in constructing your 2D or static 3D views: all objects, projection reconciliation, resampling, contrast improvement, queries on vector elements, …

Competitive Status. Large virtual displays appear to be unique to the **TNT** products. Alas, we are behind others in preparing simulations. However, **TNTsim3D** is not an expensive option and is included as a standard component of every **TNTmips**, **TNTedit**, and **TNTview**. The new Landscape Builder provides powerful, efficient access to the geodata used since it is based upon the **TNT** Geospatial Rendering Engine.

High Speed Internet Web Sites.

Access to the Internet using a connection faster than a modem is gradually becoming common in urban areas around the world. This means that publishing your geospatial materials on your own web site is another geomedia option.

V6.60. **TNTserver 3.0** now provides support for remote clients to draw point, line, and polygon features on any view and complete the database record associated with them. These elements are added by **TNTserver** to the vector object associated with them.

Competitive Status. There are excellent competing commercial and public domain products that are widely used. Key features of **TNTserver** are that it is based upon materials produced in the **TNT** products, data is introduced in the same **TNTatlas** structure, and the price is lower than competing commercial products.

Low Speed Public Access.

Worldwide public access continues to expand but often uses low speed modems. Delivering geomedia views to everyone requires careful crafting of the client software they must use.

V6.60. The new HTML-based **TNTclient** and standalone HTML-based **TNTbrowser** provide the same features as their Java-based **TNT** equivalents. However, they are much smaller and, thus, download in an acceptable period via a modem or cell phone device. Furthermore, for security reasons, many organizations will not permit their staff to access the network using Java or other network protocols. They restrict their users to simple HTML access. Users from these sites can now access and use **TNTserver** sites with the new HTML-based **TNTclient** or **TNTbrowser**.

Competitive Status. There are a myriad of clients, tools, approaches, and strategies available on the Internet, so comparisons are difficult—who is the client, what kind of network access do they have, how patient are they, and on and on. However, keeping a map client simple in appearance while providing many features is the challenge. HTML is familiar to everyone and all standard browsers and firewalls. Our HTML-based **TNTclient** and **TNTbrowser** can be easily modified by those familiar with HTML. Our **TNTclients** leave no cookies or other alterations on the client's computer. They are small and download quickly via a modem.

Too Frequent Upgrades.

Occasionally, MicroImages has been criticized for providing too frequent upgrades. Some believe this leads to too little checking and too many errors. There is some relationship between errors and the frequency of releases, but not much. There are a million possible paths through **TNTmips**, and it is only possible to check the major ones. Adding features or correcting existing errors that change many subsystems causes errors. Thus, longer intervals between software updates and releases do not necessarily equate to fewer errors. Adding fewer features to a product in a given time interval will reduce errors. However, few of you are willing to forego your particular new requirements, your favorite platform, and MicroImages must also react to changes in competitive technology.

After 16 years of frequent MicroImages upgrades, other software developers are being forced to adopt a similar strategy for similar purposes. Microsoft offers periodic service packs (NT has 6) and upgrades such as with Internet Explorer. Now they plan to automatically patch XP and their other products when your unpatched versions are detected via the Internet. Closer to home, ERDAS has issued at least 6 upgrades to their V8.x since it was released. Now, as outlined in the following items, ESRI has also been forced to adopt this same policy, primarily to manage errors.

Posted on a public list server on 26 July 2001.

At the ESRI conference a few weeks ago, Jack announced that ESRI is going to be offering service packs every 3 months or so for download and then, when they have released ~4 SP's, they will bundle them up and do a new software version release. So, the first service pack is available for download.

From ArcOnline at arconline.esri.co/arconline/download/ao_/SP1.cfm.

ArcGIS Service Pack 1. Posted: July 3, 2001

Service Pack 1 is an optional upgrade to ArcGIS 8.1. It addresses specific issues that were discovered in ArcGIS Desktop 8.1 (ArcView, ArcInfo, and ArcEditor), ArcInfo Workstation 8.1, and ArcSDE 8.1. The service pack contains performance improvements, maintenance fixes, and a few new features.

ESRI highly recommends that customers download and install Service Pack 1 at their earliest convenience. For a complete list of the issues addressed for Service Pack 1, please review the List of Updates.

Get Service Pack 1 now. There are two ways to get Service Pack 1. You can download it directly from this web site, or you can order the CD(s) you need for nominal fee. Click on the link below to find out more information about each available Service Pack download.

Naiveté.

Many years ago those of us who started MicroImages had the naive outlook that our innovative windows approach to desktop software made written documentation superfluous. This was in the days of CPM and the Z80 chip, DOS and the Intel 8080 chip, and the introduction of the Mac when any software that used a few windows seemed vastly easier to learn and use. This is still true for the simple, single purpose software that displays an image or controls a scanner. For example, most users of a web browser do not consult any documentation. However, complex, broad scope products such as **TNTmips** must continually advance and introduce new ideas. It requires extensive written materials to explain these new objectives, guide their operation, and illustrate potential applications. As more and more capabilities are added, this written information base grows larger and larger. Far from those expectations of "no documentation," the professional version of **TNTmips** comes with 4200 pages of references and tutorials. Furthermore, I have written 1000s of pages in 51 of these MEMOs with almost 400 accompanying illustrations from others to introduce these changes. MicroImage's web site contains literally over 10,000 pages of materials. While it is all written down somewhere, finding specific materials can be difficult. **V6.60** introduces the first cross-document indexing of the Online Reference Manual and all the Getting Started tutorials to help you locate materials on any **TNT** topic.

Wavelet Compression.

MrSID versus ECW Legal Issues Revisited.

False Start on Legal Settlement.

The MicroImages MEMO accompanying **V6.50** reported that the legal contest between LizardTech (MrSID compression) and Earth Resource Mapper (ECW compression) was settled. The following is a portion of a report on this topic: ERM, LizardTech – Summary Judgment as reported in Geospatial Solutions, January 2001, page 12.

"The legal wrangling between Earth Resource Mapping (www.ermapper.com) came to an abrupt end in December when a federal court issued a partial summary judgment rul-

ing that Earth Resource Mapping's Enhanced Compression Wavelet (ECW) technology does not infringe on LizardTech's MrSID (multiresolution seamless image database) patent.

"The United States District Court for the Western District in Seattle, Washington, granted ERM's motion for the ruling. The ruling follows the October issuing of a Notice of Allowance – an indication of patent approval – for ECW technology by the United States Patent and Trademark Office."

LizardTech Appeals.

LizardTech was not satisfied with this judgment and is appealing the decision. The following was extracted from a press release on LizardTech versus Earth Resource Mapping wavelet compression issues published in Photogrammetric Engineering & Remote Sensing, Industry News. June 2001, V67, N6, page 673.

"On April 18, 2001, the U.S. District Court in Seattle granted LizardTech's request for an immediate appeal of the court's December 11, 2000, ruling that Earth Resource Mapping's ECW technology does not infringe. LizardTech will now appeal the patent ruling to the Court of Appeals for the Federal Circuit, in Washington, D.C. While the appeal is pending, all other claims in the litigation between LizardTech and Earth Resource Mapping (ERM) are stayed. The appeal can be expected to take a year or more. LizardTech had initially filed suit against ERM in October 1999, for breach of contract – maintaining ERM failed to abide by the terms of a software licensing agreement between ERM and LizardTech; copyright infringement – maintaining ERM included computer code owned by LizardTech in ERM's products in the absence of any right or license to do so; trademark infringement – maintaining ERM used LizardTech trademarks as metatags and keywords on its Web site; false advertising – maintaining ERM published a white paper containing false statements about MrSID products; and patent infringement – maintaining that ERM's ECW compression technology infringes LizardTech's licensed patent for MrSID (US Patent No. 5,710,835).

"On December 11, 2000, without a hearing, the court ruled that ECW did not infringe the MrSID patent. LizardTech maintains that the court applied an incorrect legal standard and reached an erroneous conclusion in this ruling. Trial on the remaining non-patent claims has been scheduled for January 22, 2001, but the court struck the date three weeks before trial. LizardTech filed a motion asking the court to certify its patent ruling for immediate appeal, rather than waiting for final judgment on the non-patent claims before appellate review of the non-patent issues. LizardTech also argued that it would be more efficient to resolve the patent appeal first so that, if successful on it's appeal, there would need be only a single trial on both the non-patent and patent claims."

MicroImages Remains Neutral.

The courts take so long to settle technological disputes that their rulings are meaningless in each particular case in the face of technological advances. The only merit to such suits is to set legal precedent for the next similar technological issue. Further delays waiting for the court to understand the pace of technological advancements is no longer warranted. As a result, **V6.60** fully supports both LizardTech's MrSID and ER Mapper's ECW wavelet compression methodology as licensed by both these companies. Supporting both approaches, and one of the few that has done so, has provided MicroImages with a basis for comparing their strengths, weaknesses, and similarities. In general, we find that their market, objectives, and approach are dissimilar.

JPEG 2000.

A suitable general JPEG 2000 function library is now available for public use. MicroImages will add JPEG 2000 wavelet compression support in **V6.70** of the **TNT** products.

Almost .5 Meter Imagery.

Earth Watch has changed its name to Digital Globe. It is rumored that this change was made as others already had all the Internet names associated with terms related to Earth Watch. This points out that it is your web name that you are known by and its representation and availability must receive careful consideration—it may even be the determining factor if you wish to be easily located in the global market.

QuickBird 2 reached its proper orbit in good health and most recently responded to its check out by removing its lens cover. Imagery from this platform is expected to become available early in 2002.

X Server (alias MI/X)

There were no significant changes in the X server having any impact on its use in the **TNT** products. A series of minor improvements in the standalone version sold separately by MicroImages under the name MI/X have raised its version number to 3.09. These changes are all related to improvements in handling the installation and protection of this product for trial use and purchase.

TNTlite® 6.6

Increasing Activity.

Approximately 400 different individuals around the world complete the online form each month and attempt to download **TNTlite** from microimages.com. Their success varies as a **TNTlite** download ranges in size from 37 Mb for the **TNTmips**/**TNTedit**/**TNTview** software up to a complete package of 267 Mb including all programs, reference manual, tutorials, and SML scripts. Another group of more than 400 start a download without completing the visitor's form. At this time, a total of 60 to 70 gigabytes of **TNTlite** and the associated tutorials and sample geodata are downloaded each month from microimages.com.

Image Analysis in Geology.

The 3rd edition of Dr. Steve Drury's popular hardcover book entitled Image Interpretation in Geology was finally published by Nelson Thornes. **V6.40** of **TNTlite** is included on a CD in a pocket in this book along with the sample geodata used by the special geologic exercises used in the book. The complete table of contents and extensive other information about the contents of this book can be reviewed at http://www.microimages.com/documentation/drury.htm. This textbook can be ordered from Blackwells via blackwell.com for £30, Barnes and Noble via bn.com for $75, or Amazon from amazon.com for $75. Make sure that you clearly specify the 3rd edition and a 2001 publication date as some vendors are still trying to clear inventories of the older 2nd edition.

Toggling Between TNTpro and TNTlite Products.

For various reasons, you may occasionally want to start up the **TNTlite** version of your professional **TNT** product. For example, if you are preparing geodata for someone else

to use in **TNTlite**, you will want to check to see how it operates. Or, you have removed your software authorization license key to take it home or elsewhere. Prior to **V6.60**, removing the key would simply produce an error message when you attempted to start the lite version of your products. You had to find and alter the appropriate line in your tnthost.ini file to start your **TNT** products in lite mode. Then, later when the key was re-attached, you would have to edit the tnthost.ini file again. All this was very inconvenient. Now you can simply use the new License Configuration window to toggle on the "Free TNTlite license" option and from that time onward, you can start any **TNT** product in lite mode whether the key remains attached or is removed. To switch back to starting up into your professional **TNT** product, simply reopen this License Configuration window and select the option that identifies the port where your software authorization key is attached. For more details see the earlier Licenses section.

NOTE: TNTlite and corresponding supporting materials provided for downloading is the official release version and is not changed or updated between releases. Interim upgrades for **TNTlite** can be obtaining in the identical fashion as for the **TNTpro** products.

TNTatlas® 6.6 for Windows and X

Windows Version Complete!

TNTatlas is now available for both native Windows (**TNTatlas**/W) and X (**TNTatlas**/X) with similar features. When you build a **TNTatlas**, it can now be used and distributed with either version. The attached color plate entitled TNTatlas® for Windows® and X emphasizes the features in the completed TNTatlas for Windows.

Not Just a Viewer, A FREE Geospatial Analysis Product!

TNTatlas is a unique, FREE geospatial analysis product that has been available for many years. Yes, other companies have gradually released free viewers such as Arc Explorer from ESRI.

TNTatlas is not designed to be a free viewer!

TNTatlas is a quantitative analysis tool and can be used for complex feature measurements and region analysis. It can be used to perform the same complex geospatial queries as any **TNT** product. It supports direct input and use of GPS units. It can be used in the field or office to create point, line, or polygon features and identify them with attached database records. If your geodata is stored as objects within Project Files and you are using it from a fast CD, hard drive, or network connection, you get fast displays (not likely in most viewers). And, using SML Tool Scripts, you can extend all these capabilities in your atlas for free or for sale by adding your own interactive tools unique to your profession or application. You can also expand the analysis capabilities of **TNTatlas** using other kinds of SML scripts. The attached color plate entitled Be Creative with SML summarizes the types and objectives of SML scripts you can create for use in your **TNTatlas**.

You can freely distribute your atlas and its contents in a variety of formats or you can sell and protect your unique tools, geodata content, and even the operation of a specific

TNTatlas to 1 authorized user. No other FREE geospatial product offers even an approximation of the capabilities of this completely free approach to your geomedia needs.

Easier Use, Broader Appeal via Windows!

One of today's limitations in **TNTatlas** has been the decision of 10 years ago to give it cross-platform geomedia capabilities. It did and still does meet this criterion when the X server version (**TNTatlas**/X) is used. **TNTatlas**/W, with the release of parallel features for use directly with Windows, operates in a similar fashion to other Windows products. This Windows-only version also autostarts, installs, and starts from an icon using familiar Windows procedures. Now you can produce and distribute a **TNTatlas**/W that does not require any experimentation with its general operation.

Uses New Direct Linking!

This version of the **TNTmips** products introduces the direct use of MrSID, ECW, shapefiles, TAB files, and TIFF/GeoTIFF files. **TNTatlas** uses the same geospatial rendering engine as all the other **TNT** products and, thus, also uses the new direct linking option added to all **TNT** products. Thus, if you wish to leave your geodata exposed for use by other software, any of the objects used in the atlas can be kept in these original formats and only linked to the Project Files used in your atlas structure. This will result in slower access to some formats, such as linked shapefiles, due to their simple structures. Some formats, such as ECW and MrSID, will be just as fast as if they were imported into a raster object within a Project File due to their advanced structures.

Also Select and View any Supported Format.

TNTatlas can now also take advantage of the direct viewing in **TNT** of an increasing number of external geodata formats. As a concession to those who wish to use **TNTatlas** as a simple geodata viewer, both versions of **TNTatlas** now support the navigation to, selection of, direct linking, and immediate display of an internal object or external file, but only 1 at a time and not as overlays.

Setup Wizard.

Use the Assembly Wizard process to check the continuity of your **TNTatlas** structure. It now has an additional button to re-validate so you can fix a problem and continue on.

You can now select the installation package for Windows to conform to the use of self-contained installers for **TNTatlas**/W or **TNTatlas**/X.

The selection and naming of a .atl file is now integrated so you don't have to open a separate window to define it.

Adding Installation Programs.

Installation programs for **TNTatlas** for X and **TNTatlas** for Windows are on the **TNT** product CD in the **TNTatlas** directory. Use the atlas wizard to select either of these installation programs and it will be added to the set of files being prepared for your atlas.

Published Atlases

Two color plates are attached to illustrate some of the new **TNTatlases** prepared on CD and also posted on microimages.com. The color plate entitled New Sample Web Atlases illustrates examples from dealers in Turkey and Paraguay. The color plate entitled RANGES Electronic Atlas presents a sample of how range management data, derived

from Landsat 7 satellite images, can be provided in a timely fashion to remote ranch sites. This atlas is the product of a client participating in a project sponsored by NASA.

TNTsim3D™ for Windows

Games for Grownups?

This new process at first might appear to be just another of the "Games for Grownups." However, simulation in geospatial analysis is focused upon recreating an existing landscape or creating one that does not yet exist so that decisions can be made. More realistic and flexible presentations of your results increase your perception of the content of your geodata and help you present it to others. As **TNTsim3D** evolves and expands, it will not be another qualitative flight or 3D simulator but a quantitative analysis tool. It will provide the special tools for preparing quantitatively oriented simulations of and about GIS and image analyses and their visualization. Since all the geodata presented in the 3D view is georeferenced, the simplest example of a quantitative tool is the readout of the ground coordinates of any point selected by the mouse in the simulation. This has just been added—see section below entitled Modifications since V6.60 CDs**.**

Evolution of Geospatial Visualization Requirements.

Nearly a decade ago versions of **TNTmips** provided the capability on your desktop to produce multiple 2D views of various landscape features made up of composites of geodata in raster, vector, CAD, TIN, and database structures. An innovation of 7 or 8 years ago, only now being matched in other systems, provided automatic reconciliation of map projections, conversion of geodata types, GeoLocking between views, and many other time saving features. Now your desktop computer is fast and the display of views from massive composite geodata sets routinely takes only seconds. In fact, they typically take more time to set up for the first time than to display due to the many variables involved.

Surface modeling and the availability of digital elevation models provided the basis for the **TNT** products to incorporate these same innovative features into static 3D views of all these composite layers. You now interactively set up a viewpoint and produce a simulated view of your project's results in perspective view. This activity may simulate a realistic view of the area or illustrate the results of some classification or other mapping operation. Gradually, more representations of geospatial materials have been added to these views, such as stalked pinmaps introduced in **V6.50**.

The advent of compressed MPEG and AVI video formats and free viewers provided the opportunity for **TNT** products to turn static 3D views into movies. These movies are geospatial in nature and provide a more realistic means to present your project results. For example, a movie might orbit a particular landscape feature to focus viewer attention on it. **V6.50** added these movie frame orientation and creation functions to SML. This provided you with the opportunity and with sample scripts designed to follow a specified path through your geodata and to collect input as you proceed that alters each frame of the movie. The simplest application is to read time and geoencoded database records and add pinmap features into each frame. At least one advanced SML application has used these functions to alter the content of the frames as external sensors, read by the SML script, collect real time measurements.

Today geodata and its analysis can be used as the basis for real time 3D simulations. This requirement differs from the many video games that gave rise to current display

boards and the direct access function libraries encoded into them. Many games have modes where interactive 3D activities can be tracked in 2D map-like form. The most important difference is that these games are prepared for mass consumption and cost millions of dollars to create. Illustrating the results of geospatial analysis requires accurate quantitative control of a simulation that will often only be used once. Simulations with unique geodata are gradually becoming actual analysis tools, much like games where one tries to navigate through a series of constraints with a minimum of cost. Military organizations already use these concepts in training where a flight path is interactively selected with a minimum exposure to known risks. **TNTmips**, **TNTview** and **TNTedit** are now providing you these capabilities at no additional cost by adapting game technology and effective management of the geodata linked to or in your Project Files.

New Features.

A selection of these new features is illustrated in the attached color plates entitled New Features in TNTsim3D and TNTsim3D Effects and Extras.

Degrees of Freedom.

You can control movement in **V6.60** of **TNTsim3D** in many more ways. The application now defines and maintains 3D positions for the center of the view and the "plane" carrying the viewer, but also allows different attitudes (orientations) for the plane and viewer. Assign your input devices (see Input Controls section below) to control all these new motions during any simulation as follows:

with respect to the current position of the plane, move it

- forward or backward,
- left or right,
- up or down (perpendicular to the flight line), and
- altitude up or down.

with respect to the current attitude of the plane, rotate around the local axes

- pitch up or down,
- roll left or right (roll 0 relevels wings), and
- turn left or right.

Throttle up and throttle down controls let you set and adjust a sustained forward or backward velocity, and a throttle 0 control lets you instantly stop. An altitude lock input control acts as an on/off toggle to lock the plane at the current altitude while maintaining freedom to move in other directions.

The normal viewing direction is in the direction of the flight, but Look controls show the view in a specific direction (down, up, left, right) relative to the current plane attitude as long as the control is pressed. Thus you can move in one direction while viewing in another. It is helpful to lock the altitude control when doing this. Finally, when you get lost in the hills or sky, you can use the View menu options to Recenter the landscape while maintaining your current position, or Restore Initial Viewpoint, which jumps the viewer position and orientation back to the starting point.

Readouts.

By default, a Position Status bar is shown at the bottom of the screen. It can be pulled off with the mouse and docked at the top, left, or right of the scene or dragged entirely out of the view to create its own separate window. A Status bar is also presented at the bottom of the view by default to show the current program status and to provide descrip-

tions of any highlighted menu options. Both of these bars can be toggled on and off using View menu options. The following status information is displayed and refreshed for each frame in the Position Status bar: altitude, pitch, roll, heading, height above surface, and frame rate. The map coordinates of the plane/viewer position are also displayed at the left end of this bar.

Sky Color.

You can select any colors for the sky and background color.

Smoothing.

Texture smoothing/anti-aliasing is provided by DirectX and has important visual effects but little impact on frame rate as it is a hardware feature. It will markedly smooth out the distinct blockiness that would normally show up for individually resolved foreground pixels from low resolution images, such as Landsat, or for any images if you get exceptionally close to the ground. It also significantly anti-aliases the edges of features in the view. Finally, it drastically reduces background sparkle in distant portions of the scene. Alas, this smoothing function is not available in the standard V1.1 of OpenGL, which is installed as part of Microsoft Windows.

Haze, Fog, or Pollution.

Fog or haze in any color can be added as a function of distance from the viewer. Its distribution (accumulation or opacity) can be controlled to be linear or exponential with distance to each pixel in the scene. In linear mode, you specify the starting distance (0%) and ending distance (100%) while in the 2 exponential modes, you set a single density factor. Adding a light gray fog to a scene adds realism and also mitigates the last vestiges of pixel sparkle still present in the most distant areas of the scene after anti-aliasing and other improvements are added.

3D Compass.

A small, colored, compass-like, 3D skyball gadget can be inserted into the simulation. It will point parallel in each frame to the column axis of the DEM input for the Landscape Builder process. It is being modified now to use the georeference information in the landscape file to point to the north regardless of the orientation of the orginal DEM. Its orientation also provides an indication of the orientation of the plane of the view with respect to horizontal. The points on the compass always lie in the horizontal plane, and they and the central sphere are shaded as if illuminated from above (lighter on top, darker on the bottom). This shading helps to indicate whether the attitude of the plane is pitched down or up from the horizontal.

Minimum Altitude.

A “no crash” option is available that, when the minimum altitude you set is reached, will stop any further decrease in altitude. If the altitude is not increased, the plane will continue on at that fixed height above the surface. This will prevent passing through the surface but can cause a bumpy ride if the altitude is not increased from this minimum. You can also set a maximum altitude for the flight.

Multiple Views.

You can open more than 1 **TNTsim3D** process at a time for multiple views. Each will be a separate application and can use the same or a different landscape file. Your control device(s) will provide input only to that application (simulation window) that currently has

the focus selected by the mouse. At this time, these 2 **TNTsim3D** applications (separate windows) will not communicate, so only one moves with the controls unless the other has been set up for some automatic activity, such as flying in a straight line. A future version of **TNTsim3D** will provide for multiple views from the same plane position of different or the same landscape files. Views that are locked could each use the same input to permit tandem control for an image and map view, for 2D moving map and 3D flight views, pilot and observer views, and so on.

Input Controls.

Since this is a Windows application, the standard Microsoft game control utility and window are used to assign the controls provided in **TNTsim3D** to your joystick, keyboard, and/or mouse. If you have set up Microsoft Flight Simulator or other games, you will already be familiar with its operation. You can mix control devices. Your current control settings can be checked at any time for reference while you are flying by exposing the TNTsim3D Controls window from View/Show Controls on the menu. This window also provides a reference list of all the input controls that are available to assign to any input device. The attached color plate entitled New Features in TNTsim3D illustrates the contents of this window and which controls have been assigned during a particular simulation to each of the following input devices.

Learn to Fly with a Joystick.

Serious real time flyby applications require the use of a joystick. **TNTsim3D** permits you to assign a wide variety of joystick controls to manage simulation options. You will not be satisfied with operating **TNTsim3D** with the simplest, cheapest joystick you can find with only a few buttons. There are too many degrees of freedom involved. The following are good joysticks for use with **TNTsim3D**.

Logitech Wingman Extreme Digital 3D	$40
Logitech Wingman Force 3D	$70
Microsoft SideWinder	$30
Microsoft SideWinder Precision 2	$50
Microsoft SideWinder Force Feedback 2	$100

These models all come with a choice of input connectors. Be sure to buy one with a USB connector, so it can be easily moved between your portable and other computers.

Based upon trials with them, MicroImages strongly recommends the use of either of the Logitech joysticks. For example, both provide a rotating stick action that can be used to easily turn the view. The entry level Microsoft SideWinder does not provide for this and requires aircraft-like banking to turn the view.

Keyboard Control.

All the inputs to **TNTsim3D** can be assigned to keys. Good first results can be achieved with a keyboard only, however, dodging down canyons and over hills, a la Star Wars, is not as easy or smooth. Even with a fully featured joystick some actions must be assigned to keys simply because there are too many options and, in some cases, because it makes more sense to use both hands. For example, keys are conveniently used to switch the view to look 90 degrees left, right, or to the nadir as you fly forward with the joystick. You might also use keys with your free hand to toggle to lock to a fixed altitude above sea level then hold down another key to look straight down to see the aerial camera or bombardier's eyeview. For example, when the view you select is not in the direction of flight, locking the altitude to maintain level flight makes flying easier.

Mouse Control.

Most control functions can also be assigned to the mouse. However, it has a limited number of inputs, so it is best used by the hand not on the joystick to handle special effects. The cursor and its position are shown on the moving simulation. Thus, the mouse can also be used in your other hand to point out features in the simulation. Special GIS uses of this cursor position are planned. For example, the simplest would be to report the coordinates of the cursor's position on the surface. Another would be to point and hold the view oriented to its position on the surface while flying around it with the joystick.

Preparing a Landscape.

Building Landscape Files.

The Landscape Builder is a new process. It prepares a special "landscape" or simulation Project File with a .sim extension for use in **TNTsim3D**. It uses the same dialogs as the other **TNT** display processes to permit you to select the objects it processes for use in **TNTsim3D**. Use its familiar controls and features to select the elevation (terrain) layer and to select and composite together multiple objects for the image (texture) layer. Just as with 2D, 3D, and the Spatial Data Editor, this process uses the same **TNT** Graphical Rending Engine (**GRE**). It uses the same Project File geodata as any other **TNT** display process. You can navigate to, and select any combination of objects and data types for computation into the raster objects to be used for the terrain and the texture overlay in your simulation. The Landscape Builder is included as a conventional **TNT** process in every **TNTmips**. This new process is described in more detail in the Landscape Builder subsection below as part of the New Features section for **TNTmips**. Some aspects of it are also illustrated in the attached color plate entitled Landscape Builder for TNTsim3D.

Sample Landscape Files.

A small initial collection of landscape (*.sim) files is available for your maiden flights until you can get your own files built using the Landscape Builder. These simulations have been assembled from geodata that MicroImages had on hand. More and improved versions will be added to the download section at microimages.com as ideas occur and as the Landscape Builder and **TNTsim3D** evolve. Remember, a *.sim file is a Project File, so you can view its rasters in any **TNT** process. However, these landscape rasters have a special tiling and pyramid structure, so modifying them (editing, filtering, resampling...) in another **TNT** process will adversely affect their use in **TNTsim3D**.

Several sample *.sim files are on the **TNT products V6.6** CD, but they are not included in the installation procedures. You must locate these files on the CD (in a root-level directory "simdata") and copy them to your local drive. (Running simulations directly from the CD will produce slower performance in **TNTsim3D**). These and other larger files can be downloaded from microimages.com.

BigPine.sim (14 Mb on CD; a higher resolution version, BigPine2.sim, 46 Mb, is available at microimages.com)

Covers an area of about 940 square kilometers centered on the Owens Valley of eastern California, with the town of Big Pine at the northern (top) edge. The rugged crest of the Sierra Nevada Mountains flanks the valley on the southwest, and the Inyo Mountains lie along the eastern edge. The texture layer is a Landsat 7 RGBI image that uses

the 15-meter panchromatic band 8 to sharpen a 30-meter natural color image (bands 3-2-1). This is a desert landscape with only sparse natural vegetation; some irrigated cropland is found near the Owens River. The scene principally illustrates geologic features, such as the glacially-sculpted Sierra crest (with partial snow cover) and broad alluvial fans stretching eastward from the mountain front. Recent basalt lava flows and cinder cones (dark gray to red tones) cover parts of the down-faulted Owens valley. The large cinder cone just south of Big Pine (Crater Mountain) is cut by two fault scarps visible as dark lines or color changes. The western fault line stretches southward (marked on its upslope side by patches of dark green vegetation) to the smaller cinder cone Red Mountain at the center of the scene.

Eureka.sim (184 Mb from microimages.com)

This sample covers an area of about 22,000 square kilometers in eastern California and southwestern Nevada, including the area of the Big Pine simulation near the southwest corner. Like that simulation, the texture layer is a Landsat 7 RGBI image that uses the 15-meter panchromatic band 8 to sharpen a 30-meter natural color image (bands 3-2-1). The area stretches from the Sierra Nevada mountain crest and Owens Valley in the southwest, across the White-Inyo Mountains, to the basin-and-range topography of western Nevada (northeast half of the scene). Eureka Valley lies just southwest of the center of the scene, and northern Death Valley is in the southeast corner. This is a rugged desert landscape with many salt-encrusted dry lake basins (playas), which appear as bright white patches. Green irrigated fields can be seen in parts of the Owens and Fish Lake valleys in the western half of the scene.

YuccaMtn.sim (46 Mb from microimages.com)

This simulation illustrates the power of the Geospatial Rendering Engine used in the Landscape Builder to create complex texture images. The texture combines a geologic map with a relief-shaded raster image of the terrain (a desert region in southwest Nevada). The texture actually combines four different display layers, which from bottom to top were: 1) the shading raster (created from the terrain raster, but with subsequent bilinear resampling to a smaller cell size to produce a smoother image); 2) a vector layer with the map polygons and text labels, with each fill color set partially transparent so the colors merge visually with the underlying terrain-shading; 3) a vector layer with black map-unit contact lines with different line styles indicating the degree of certainty in the contact location; 4) a vector layer with red lines showing the numerous fault traces, with different line styles again indicating certainty in location. The Landscape Builder rendered these display layers into the single texture raster used in the simulation.

MtDiablo.sim (12 Mb on CD and from microimages.com)

At 3849 feet above sea level, Mount Diablo is the highest point in the region surrounding the San Francisco Bay in California. This simulation covers an area east of the bay, about 30 km on a side, with Mount Diablo in the north-central portion. The texture layer is a Landsat 7 RGBI pan-sharpened image from July 7, 1999 showing “natural” colors. The area includes extensive urban-suburban development in the broad valley floors, brown grasslands covering the surrounding hills, and greener chaparral and forest on the higher, more rugged slopes. The city of Concord merges southward into Walnut Creek in the northwest corner, with development continuing southeastward down the valley through Danville to Dublin at the southern edge of the simulation. The northeast corner includes the southern part of the town of Antioch.

Yosemite.sim (15 Mb on CD and from microimages.com)

Yosemite National Park in California is the focus for this sample simulation. The texture image is a natural-color RGB combination of Landsat TM bands. Yosemite Valley proper, along the Merced River, is in the southwest corner of the scene. The large lake in the west center is Hetch Hetchy Reservoir in the canyon of the Tuolumne River. The bare granite and snow of the Sierra Nevada mountain crest stretch from the northwest to the southeast corners of the scene. Dark coniferous forest mantles the lower slopes on the southwest side of the crest, while the northeast corner reveals a patch of the high desert east of the range.

Lancaster.sim (220 Mb from microimages.com)

Covers most of central Lancaster County including Lincoln, Nebraska, where MicroImages is located. The texture layer is part of a mosaic of 1-meter resolution, black-and-white orthophotos. The terrain layer was extracted from a mosaic of the 30-meter resolution DEMs used to produce the original 7.5'-quadrangle ortho images. Try landing at the Lincoln Airport or locating the Sharp Tower.

Purgat2.sim (24 Mb from microimages.com)

This sample uses all of the first sample 30-meter DEM from the Shuttle RADAR Topography Mission (SRTM). The area in southern Colorado reaches from the Spanish Peaks along the Rocky Mountain front in the southwest across the high plains to the east. The incised canyon network of the Purgatoire River dominates the northeastern part of the scene. The texture layer was created in the Landscape Builder by merging the elevation raster, color-coded by elevation and displayed with partial transparency, with an underlying relief-shaded view of the terrain. Although all data in the simulation were derived from the DEM, the combination of color coding, shading, and 3D display provides a very effective and realistic view of the terrain in **TNTsim3D**. Additional SRTM DEMs should soon be available. A security hold had been placed on the data following the September 11 attacks, but this hold has recently been lifted for data acquired over the United States. As of this writing, data for areas outside of the United States are still restricted and unavailable for security reasons.

CraterLk.sim (14 Mb on CD and from microimages.com)

This sample for the area of Crater Lake National Park in Oregon illustrates the use of additional display features in the Landscape Builder to create effective texture layers, in this case involving the creative use of null value cells. The basic data is a DEM for the area that includes surface elevations for the lake floor as well as the surrounding land area. Like the Purgat2 simulation, the Crater Lake texture merges color-coded and relief-shaded renderings of this terrain, but you will see that separate color schemes are used for land areas (earth tones) and the lake floor (blue water tones). Two new versions of the DEM were created for use in building the texture layer: one with elevations for the land area but null values for the lake floor (with an earth tone color palette), and the other with elevations for the lake floor and null values for all other cells (with a blue-tone color palette). These two rasters were overlaid in the Landscape Builder with the nulls in each transparent to create the combined color-coded elevations. Both rasters were displayed with partial transparency over a third shading raster created from the original DEM to produce the complete color-shaded view.

CrLkMap.sim (14 Mb on CD and from microimages.com)

The second Crater Lake area simulation uses a terrain raster that shows the flat lake surface and a texture layer derived from a scanned tourist map of the park (downloaded from the National Park Service). This 8-bit scan showed all of the color line work against a white background, so it was first edited to fill the lake surface area with blue. In the Landscape Builder the color palette for the map raster was edited to turn the remaining white map background yellow, and this color alone was made partially transparent. The map raster with semi-transparent background was displayed over a relief-shaded view of the DEM, resulting in solid-color line work and labels appearing against a relief-shaded color background. Although the lines and labels are not in a vector overlay (though they could be), note that the line and label edges are nicely anti-aliased if the texture smoothing option for DirectX is turned on.

MonBay4.sim (28 Mb on CD and from microimages.com)

This sample covers Monterey Bay and the adjacent California coastline. It was created from an elevation model that included both topography and submarine bathymetry. The texture layer was created in a similar fashion to the first Crater Lake simulation. Two versions of the elevation model were created, one for the land area and one for the bathymetry (with nulls for the remaining area) with different color palettes. In the Landscape Builder these two layers were overlaid (with partial transparency) over a relief-shaded view of the original elevation model to produce a color shaded-relief texture with blue-toned bathymetry and earth-toned land elevations.

Getting Underway.

Installation Options.

TNTsim3D is a separate program that is installed automatically with your other **TNT** products using InstallShield. However, to operate, it requires a **V6.60** software authorization key for **TNTmips**, **TNTedit**, or **TNTview** to be attached to the computer or access to a virtual key from a floating license. If you use a Mac you can prepare your landscape files on the Mac and move them to a Windows computer, attach your **V6.60** authorized USB key, install **TNTsim3D**, and use it. If you have a **TNT** product for a LINUX or UNIX platform, you can use your **V6.60** software authorization key or virtual key in a similar fashion.

Cranking the Engine.

A **TNTsim3D** simulation can be started in the same ways as any other Windows application. Simply find a landscape file (*.sim) and double click it with the mouse. You can also start **TNTsim3D** from its icon or from the Start/Programs menu and then use File/Open to navigate to and select the landscape file. MicroImages has used **TNTsim3D** without problems or frame rate degradations with *.sim files located on a file server on the network. The menu also provides the option to select from the most recently used landscape files.

Warming Up.

TNTsim3D starts up fast and a landscape file loads rapidly, usually in less than 15 seconds regardless of its size. The texture server it provides is started and loads only those tiles needed for the first frame and some predicted frames. The terrain raster is small and is automatically loaded entirely into real memory. Virtual memory will be automatically used for the terrain by Windows if real memory is insufficient, and you will

not get acceptable frame rates. If this happens, close other competing applications. However, it will be hard to find detailed terrain rasters as big as 8000 by 8000 cells that will exceed even 64 Mb when loaded. Memory is very inexpensive and 512 megabytes of real memory is commonly available on professional computers. Under any circumstance, it is a good practice to close other applications to run **TNTsim3D** as they will steal processor time and, thus, frame rates. Another reason for closing other concurrent applications is that OpenGL and DirectX can operate directly with the processor and graphics chip at a lower level than the operating system. Thus, any game or program, such as **TNTsim3D**, that use them can hang the computer and its tasks causing a real crash.

Defaults.

Nearly all parameters defining the operation of **TNTsim3D** are now stored in the tntproc.ini file just as with other **TNT** applications. These include almost everything from window size and position to control device assignments to special effects settings. For example, the default position for the start of the simulation is always a view from above the upper left corner looking to the center of the landscape. The linear velocity defaults to the value that will take 120 seconds to cross the maximum extent of the terrain. Everything else has similar defaults stored or computed. If you want to change these parameters you can do so at any time as you use a landscape file in **TNTsim3D**. For example, your velocity and rotation rate can be set on the Options dialog and will be retained and used at the next start of the **TNTsim3D**. This will be fine if the landscape has the same ground cell size but these and other parameters must be changed for a landscape of a significantly different scale.

From the above you will note that at this time you do not have much control over how **TNTsim3D** will start up with landscape files that vary widely in size, scale, and orientation. In the future, the Landscape Builder will help you set up a .sim file that, via a new subobject, supplies the appropriate default values for these aspects of its use. If any of these are changed during its use in **TNTsim3D**, you will have the option of saving them to replace the original defaults in any future use of that landscape file. These will include the starting viewpoint, the starting window size, the starting velocity, your control settings if desired, and other defaults that should be associated with each unique landscape file.

Technical Considerations—Tuning the Engine

OpenGL or DirectX?

Both of these consist of low level libraries that bypass most operating system functionalities. In some ways they define a kind of new operating system and function library mobilizing and optimizing all system resources for high speed, real time, frame rendering. DirectX 8.1 (and a beta version of DirectX 9.0) is a Microsoft product. OpenGL V1.1 to 2.0 (and higher experimental versions) are Open Source developments and available for many platforms including most UNIX and LINUX, Mac OS 9.x and 10.1, and Windows through OpenGL V1.3. **TNTsim3D** at present only requires DirectX 8.x or OpenGL V1.1.

If you ask several young game players which is best (DirectX or OpenGL), you will get strong but mixed answers depending upon what display board they have and which works best with the games they prefer. As a result, MicroImages has no clear opinion on this and has supported both in **TNTsim3D**. Obviously, the one that works best for

you will be the one that has the best implementation for your display board hardware, driver, and auxiliary library. Thus, when starting **TNTsim3D**, you are presented a window to choose the graphic system you wish to use. After experimenting, you can settle on the one that works best on your platform, and set the default in this window to start in that mode for any future startup of **TNTsim3D**. At any time during your simulation, you can still use a menu option to toggle between DirectX and OpenGL.

Graphics chips are very competitive and changing. Intel, NVidia, and now ATI all provide their chips to many other firms who assemble the logic board, memory configuration, and driver. Matrox is one of the remaining small volume vendors still in the competition who use their own chips on their boards and with their own drivers. Microsoft's Xbox uses a standard NVidia graphics chip and DirectX. Nintendo's GameCube, released in November 2001, uses the latest Intel graphics chip. As a result of all this volatility, DirectX and OpenGL are in a constant state of flux. It will require effort on your part to tune your system for good frame rate performance with **TNTsim3D**.

DirectX 8.

(For your convenience this section is reproduced here in part from the **V6.50** memo.)

When you install a recent Windows operating system, DirectX is automatically installed. However, it may not be DirectX 8, which was first released earlier in 2001. If your machine is 2 to 3 years old, you probably have DirectX 7. If you do not have version 8 installed, **TNTsim3D** will detect this and notify you. If you need to get DirectX 8, go to microsoft.com and download and install it. You may then need to go to the manufacturer of your video card or microsoft.com and get a revised driver for the card that supports DirectX 8. MicroImages has found that most current video board manufacturers who supported DirectX 7 now have new drivers available to support version 8. These new drivers use the display hardware to implement most of the DirectX 8 functions in the graphics chip providing a good response.

NOTE! When you download DirectX 8, you will get a program called the Capability Viewer. Run it, and it will list each of the DirectX 8 capabilities of your display board. Send this file to MicroImages software support if you are having difficulties.

TNTsim3D will produce frame rates of 15 to 30 fps (frames per second) with average video cards and processors of at least 500 MHz. With a new game card or the dual display Matrox G400 and G450 and the latest computers, the frame rate can be as high as 60 fps. If your display card does not support DirectX 8, then Microsoft's software emulation of the missing hardware functions will automatically be used, and the frame rate will be unacceptably slow.

As you fly, DirectX converts your elevation raster to a triangular network, more or less a TIN. It then drapes the texture layer over it. Your board and its DirectX 8 support will control the level of detail you can use in a flyby by setting an upper limit on the number of triangles it can process to represent the surface view at any given time.

OpenGL.

OpenGL first started 20 years ago, a library and special graphics chips and functions used by SGI in its custom built, UNIX-based simulators. Gradually SGI has promoted and supported its evolution into an open source public approach for high speed simula-

tion that is platform OS independent. At this time it is available up to V2.0 for most UNIX, LINUX, and Mac platforms. V2.0 is shipped with the Mac OS 10.1.

Only OpenGL 1.1 is installed as part of most Microsoft Windows installations. **TNTsim3D** uses V1.1 for this reason and has not yet needed more advanced functions. As usual, Microsoft wants to make it difficult to use OpenGL over its own DirectX. Since V1.3 for Windows is widely available for download, it will probably be used in future **TNTsim3D** releases and will be installed from the **TNT** products CD.

Some of the obvious advantages of OpenGL are that it is available on many platforms, it has many extensions from the worldwide community, source code is available for modification, and it can be easily extended by adding new functions.

Just as with DirectX you want to check the web site of the manufacturer of your display board to see if you have the latest version of their driver and if your board supports OpenGL functions in hardware.

Recommended Display Board.

MicroImages still recommends the Matrox display board for all-around flexibility and performance, hardware support of both OpenGL and DirectX 8.0, and direct display on dual monitors via its 2 video connectors. The latest model of this board is the US$125 G550 which can be reviewed at matrox.com/mga/products. The G550 uses DDR (Double Data Rate memory). (The G450 also uses DDR but not the original G400.) Its AGP bus connection is the newer 4X. (The G450 is also 4X but not the original G400.) The G550 is supposed to come in a special model that has 2 digital connectors for the support of dual digital, not analog, flat panel monitors. So far we have not been able to locate this special model.

Modifications since **V6.60** CDs.

The following new features are being added at this time to **TNTsim3D**.

Vertical Exaggerations. This is an option to control vertical exaggeration while operating **TNTsim3D** *(completed)*.

Real Time Positions. While flying, point anywhere in the simulation window with the mouse, and read the map coordinates of and the distance to that point on the surface. These values will change dynamically as you continue to fly (*completed*). Additional information about this ground position is being added, such as the elevation of the position and the relative accuracy of its coordinates since it will decrease with increasing distance.

Multiple Views. Open a 2nd daughter simulation window such as the passenger's view of the point selected in the pilot's view by the mouse cursor *(underway)*.

To get these and other new features as they are added, go to the **TNTsim3D** page at microimages.com and download the latest version. New additions to **TNTsim3D** will be announced on this page as they become available. Periodically, a new Landscape Builder may also be needed to rebuild the landscape files for some future enhancement.

TNTserver 3.0

Are You Ready to Go Online?

The real expense in money and effort to implement a spatial data server (a geoserver) depends on the answer to many complex questions. For MicroImages' clients, **TNTat-**

las is a good technology benchmark to use to answer questions regarding the state of preparation of your materials for use with **TNTserver**. If you have prepared a FREE **TNTatlas** on CD from your materials, then you are prepared to assemble a small or very large spatial data server. You already know the effort involved in preparing all your map, image, document, and database materials for use on the intranet or Internet via **TNTserver**. Newcomers, beginners, or those just considering going online must carefully calculate the costs associated with answering yes to the following questions.

Are your maps, images, and documents ready?

Are all your geodata and paper documents in a digital format suitable for direct use in a spatial data server? If the answer is no, you are going to spend big money to scan, import, convert, edit, export, and otherwise handle 10s of thousands of files.

Are your databases ready?

Merely determining that ODBC link or Spatial Oracle can be used is meaningless. Are your associated relational databases clean and ready for use? Are you ready to expose your databases to public access? If not, are you ready to spend the money to clean them up and maintain them? In many cases, this is also a "political" expense as these databases belong to other departments or government agencies. Will they cooperate, especially when you begin to expose their problems first internally and then to the public?

A recent example of the magnitude of this problem for a single prosperous city was recently posted on the Internet from ethan@cityoforlando.net. *"I thought this would be of interest to many of you that work in the State of Florida. Florida Department of Revenue wants all cites and counties to update the DOR's communication tax address database. In Orlando, we found 1,000 mistakes and I have heard of much larger ones."*

The databases maintained by an organization's IT staff can be full of errors, which may be tolerated for the internal policy and record keeping of an organization. When these databases are exposed publicly via a spatial data server, errors take on a whole new meaning. For example, if a public user of a site can not find his house or street, then they are quite unhappy, will let you know, and will not come again or support your effort. Spatial data servers are designed to be tolerant of such errors but their users are not!

What does geoserver software cost?

Prices for various vendor's geoserver oriented software products vary but average around $5000. However, it is totally unrealistic to simply compare the prices of geoserver products from various vendors. This software is a minor cost component of the effort and money required to place a serious spatial data site online on the Internet or into your company via its intranet or virtual private network. The real cost of going online depends on where you already are in the development of your geospatial materials and the new technological skills required to make the next step. If you already have a centralized GIS and image processing program well underway, then you will know how to proceed. If you do not, then you probably need outside help from someone who can demonstrate that they can give you sound advice, plans, and realistic quotes.

Whose human and software resources will be used to go online?

If you are not familiar with ESRI's ArcIMS 3.0 and want to cut through the marketing hype, see a critical review at http://spatialnews.geocomm.com/newsletter/2000/22/arcims.html entitled ArcIMS 3.0 - An Application Developer's Perspective, by Andrew

Waxman, Chief Technology Officer, Telemorphic Inc. (1/6/00). This review may convince you that entering into the operation of a map server or an Internet GIS activity should not be undertaken casually and requires the availability of new technological skills. This is also the subject of the enclosed MicroImages MEMO entitled Considerations Before Buying a TNTserver dated 12 November 2001. Use this MEMO to determine if you are prepared to set up your own spatial data server or need the help of a consultant or a MicroImages dealer.

Remote Geodata Entry.

TNTserver now permits the remote entry of points, lines, and polygons and their attribute records into a vector layer established in your atlas layout. Each new view provided to any client by the **TNTserver** will show all the latest additions to this vector layer. With this feature your clients can create multiple elements of mixed types and they can also save these elements locally for other uses. This vector layer is included in the atlas layout for this specific purpose and can be of any of the vector topologies supported in the **TNT** products: polygonal, planar, or network with 2D or 3D coordinates. As elements are added, **TNTserver** maintains the specified topology for that layer.

This remote geodata entry capability has been added to allow public or local office entry of vector elements, such as lease boundaries, easement boundaries, observed point events, and so on. This new feature has not yet been extended to provide remote editing of this vector object. **TNTedit** is much more appropriate for editing complex vector objects!

It is possible that 2 remote clients will attempt to enter elements from this vector layer at the same time. **TNTserver** now supports the concept of “area locking” to manage this situation. The manager of the **TNTserver** sets up a maximum spatial area that can be used for reference in a view used for creating point, line, or polygon features. For example, a maximum reserved area of 1 square kilometer might be specified. Under this condition, all users must zoom in to view an area no larger than 1 km^2 before they can get an area lock on that view and remotely enter elements for that area. No one else can use that area while they have a lock on it, so conflicts and duplication are not possible. When they finish entering elements to that area, it is released. It is also automatically released after a time increment set by the manager if no access to the server has been detected.

Caching Layouts.

Many new technical improvements have been added to **TNTserver** for its management and reliability. Typical of these is layout caching on startup. Prior to this addition, the first client to access an atlas just restarted after maintenance would find their access to be slower than normal, perhaps by a factor of 10. This was caused by the need of the server to read the entire layout for the atlas and cache it in memory before that atlas was used. After the first use, this layout remains in memory for all other uses of the atlas. Now, when **TNTserver** is started, layouts can be automatically cached before any remote use.

Managing Multiple Atlases.

Since multiple atlases can be published via a single **TNTserver**, additional management tools are provided for controlling how each will behave. For example, **TNTserver** at startup now reads a designated text file that contains *.atl files and/or directories, which

in turn contain the *.atl files, or directly searches a designated directory. Each of these *.atl files is set up by the atlas designer and is used by **TNTserver** to determine where the layout for that atlas is stored, what title to give to it, whether to automatically cache the layout, if the atlas should be included in the published list of available atlases for use by any standalone **TNTbrowser**, and so on.

TNTclients.

At the present time, there are 5 different **TNT** sample clients available for use with **TNTserver** 3.0 or as models and source code for your client: 2 use Java, and 3 use HTML.

Java Clients.

The Java-based **TNTclient** and the Java-based **TNTbrowser** use a common set of code in Java 1.1 and are stable and relatively unchanged and do not provide the remote geodata entry panel. As of this date, the penalty assignment judge in the Microsoft anti-trust case is being lobbied to force them to continue to support Java in addition to their .NET approach. Perhaps this will lead to the release of at least Java 1.x, if not Java 2.x as part of Windows XP and Internet Explorer. Mac OS X and the LINUX and UNIX platforms now all install and support Java 2.x.

HTML Clients.

There are now 3 different modes of operation of the HTML-based client, which are summarized below. All 3 use a single code base with options built into it to determine which of these modes the client should operate in. This causes minor bloating of this client but is well worth it to minimize the effort to keep them all concurrent. This client uses only Dynamic HTML and JavaScript and is much smaller to download than the Java-based clients. The alteration of this client by the site manager is also easier as HTML and JavaScript are more commonly used for web clients.

HTML-based **TNTclient**.

This **TNTclient** was introduced in the **V6.50** MEMO. It has now been modified to be compliant with **TNTserver** 3.0 and is also used as a base for the HTML-based **TNTbrowsers**. These additions include providing the new Remote Data Entry panel and the Reference panel and their associated features. Many additional enhancements have been added, some of which are discussed in the sections below.

HTML-based **TNTbrowser**.

This is a standalone browser, which can be downloaded from a **TNTserver** site and started up as a local application. It will connect to any **TNTserver** that has published a list of atlases (see the Managing Multiple Atlases section above). Since it is the same code as the HTML-based **TNTclient,** it is small as it uses many components from the DLLs required for the operation of your web browser. It takes about the same amount of time to download this standalone browser as to start the HTML-based **TNTclient** if it is not already in your local cache. However, for any additional use, it takes only a couple of seconds to start it from your hard drive as a local application regardless of your network access rate.

Since this client is a local program, it is not operating inside your general web browser. This means that it, and your modifications to it, can automatically access and create local files and run other programs. For example, your modifications to this standalone program can bypass a firewall, bookmark a view, save measurements and elements lo-

cally, and so on just as with any other program without changing your web browser's security.

HTML-based Thin **TNTclient**.

This is a new facet of this client that is being incorporated to enable its possible future use via small screen devices, such as Microsoft based Pocket PC hand held units. In these applications, the client should probably be stored locally as a standalone browser as the bandwidth of the device is limited by current cell phone access. Since the units display screen is also small (typically 200 by 320 pixels), the user interface has to be much more "serial" in nature, wherein user interactions require a results view and a series of overlay tool access and control views similar to the panels in the larger format client.

New Features.

The HTML-based **TNTclients** have many new features. These are easily tried by simply visiting microimages.com. The following is a brief summary of some of them.

Launch Queries via Forms.

The manager of a **TNTserver** can now use HTML and the **TNT** query language to create forms that the end client simply fills in to retrieve a specific view from a **TNTatlas**. Your form for a launch query can control how the end user completes the query using defaults, constraints, pick lists derived from the atlas's attributes, or use no input all. Your design of the HTML of the web site hosting the **TNTserver** can provide access to many different custom atlas launch queries. Each form presented by this host site can call a different query to retrieve views from 1 **TNTserver** and 1 **TNTatlas** or different **TNTatlases**. MicroImages sample Nebraska Statewide atlas at microimages.com illustrates the use of 7 different forms and associated launch queries to retrieve specific results by address, ZIP code, township and range, city, latitude and longitude, state capitol building, and county name. The entry form for each of these is illustrated on the attached color plated entitled TNTclient Launch Queries.

Enhanced Query Builder Panel.

TNTserver is also being used on intranet sites in an application similar to data mining where very large geodata bases are queried to locate views with specific characteristics. These clients construct their own queries, which are often used only once within the query building panel of the **TNTclient**. Some of the recent enhancements to this panel are illustrated in the attached color plate entitled TNTclient Query Builder.

Remote Data Entry Panel.

The section above entitled Remote Geodata Entry outlined the use of the **TNTserver** 3.0 to permit an end user to add elements to an atlas layer created for this purpose. A new panel provides the user access to the features needed to create and submit these elements or save them locally. The attached color plate entitled TNTclient Remote Data Entry illustrates this panel and its operation.

Drawing Elements.

This new panel and the measurement tools panel both use HTML and JavaScript to create vector elements. Creating these tools in HTML still seems to be a unique capability. Other products use Java for drawing tools, which means delays in downloading a Java client. Java based drawing can be more sophisticated but also means slower cli-

ent access via modems. Elements and measurements of them can be saved to a file for local use. An HTML data entry form is part of the remote geodata entry process. This form can use defaults, pick lists, constraints, and other control features.

Select Drawing Color.

Often it is difficult to see where you are drawing on color computer views. This new panel provides a selection of colors to use for its drawing operation. If you still have trouble seeing the line you are drawing the color view can be toggled in and out of grayscale using the menu presented by the right mouse button on the color view.

Split Screen Reference View Panel.

A new split screen tab panel now provides for dual related views. Its use is illustrated in the attached color plate entitled TNTclient Reference View. Selecting it converts the entire panel area at the left into a reference view for the main or principle view at the right. The entire panel area and, thus, the area of the reference view can be enlarged or reduced by using the mouse to grab the separating boundary or the icon provided for this purpose and move the boundary left or right. The relationship between what is shown in the reference view and the right view can be controlled by the end user by the right mouse button as described below. The area or extent of the main, or right, view is shown by a red box outline on the reference view. This is a zoom box that can be enlarged or repositioned and will automatically request a new view for the right view.

Right Mouse Button Controls.

The right mouse button can be used at any time to pop in menus to gain quick and convenient access to commonly used client operations. Some of these right button menus are illustrated in the attached color plate entitled TNTclient Reference View. These operations can be the same as presented elsewhere in the client using icons, drop-down menus, and other more formal interface components. They can also be accessed by this approach simply for convenience. However, unique functions can also be found on these menus. Since the site manager and the atlas designer both control which aspects of atlas/server are available, the contents of these right mouse button menus will automatically vary to reflect these choices. For example, if the atlas designer does not use navigation levels, then the navigation tool will not appear in the client or on a right button menu.

Main or Principle View (right view).

The right mouse button typically presents these options on the main, or right, view: Zoom Out, Re-center, Zoom In, Full View, Full Resolution, Get InfoTip, Navigate, Home, Last View, Next View, Add to Favorites, Copy Shortcut, Copy URL, Grayscale/Restore Color, Relief Shaded, Show Picture, and View Image. The purpose of most of these operations is clear from their use elsewhere in the client but some are only available via this menu. For example, toggling the view into grayscale (and back to color) is a local client operation and is useful when elements drawn on a color view are hard to see even though you can select the drawing color. Relief shading is a local client operation which demonstrates that raster and image processing operations can be provided by a JavaScript embedded in the HTML client.

Reference View (left view).

The menu presented for a panel by the right mouse button is associated with the panel and, thus, can vary with the panel. When the panel providing the reference view is ex-

posed using the right mouse button, it typically presents these options: Zoom Out, Zoom In, Update Now, Update from Main, On Demand (only), Auto (by zoom), Maximum Overview, and Show Picture. These choices all control how this reference view will relate to the main, or principle, view. By default, this view comes from the same atlas as the main view. However, it is presented at a different relative scale set by the server manager. For example, it presents the same layers as the main view but lags its scale changes by a factor of 4X and 12X to provide a more macro view. This scale relationship is set in the HTML script and, thus, can be changed.

The right button menu choices for the reference view change only the reference, or left, view as follows.

Update Now will redisplay the reference view to match the main view, and it will not change until the main view changes by the preset relative scale factor.

Update from Main copies the image from the right, or main, view into the reference view.

On Demand (only) freezes the reference view "as it is" until changed via this menu.

Auto (by zoom) resets the default scale relationship between the reference and main views and redisplays the reference view.

Maximum Overview displays the full view (the full extents) of this atlas layout in the reference view.

Show Picture requests a redisplay of the image in the reference view in case it does not load correctly.

Outside of View.

Using the right mouse button on the browser frame presents its standard popin menu controlling its features. Using the right mouse button inside the browser frame but outside the views will present a menu of **TNTclient**-oriented utility functions such as: Save Background As, Set As Background, Copy Background, Set as Desktop Item, Select All, Paste, Create Shortcut, Add to Favorites, View Source, Encoding, Print Refresh, NeoTrace It!, and Properties. For example, NeoTrace is a shareware program that, if it is installed on the local machine, can be started from this menu to trace and display all the Internet links and their bandwidths from the computer running the **TNTclient** to microimages.com.

Hot Key Controls.

Keyboard controls or hot keys can now be used to control the main, or right, view in the HTML-based **TNTclient** and **TNTbrowser** as follows:

[*1*] = full view [+] = zoom in [-] = zoom out [*0*] zooms to full resolution

[*2*] thru [*9*] = accelerated zooms toward center of view

[*h*] or [*F1*] show help.

The following Arrow and Page keys control panning within the same atlas. When a layout edge is reached, these controls will automatically navigate to adjacent layouts in the direction selected.

[*up arrow*] = north [*down arrow*] = south [*right arrow*] = east [*left arrow*] = west

[*page up*] = go back to last view

[*page down*] = go forward to next view (if any backup was performed)

[*home*] = return to atlas entry point

TNTview® 6.6

Planned Windows Version.

With the completion of **TNTatlas**/W, MicroImages has now begun the implementation of a native version of **TNTview** for Windows with the same features as **TNTview** for X for release in **V6.70** of the **TNT** products. Those authorized to operate **V6.70** of **TNTview**/X will also be able to use **TNTview**/W.

Autolinking to Popular Formats.

The following external formats can now be directly used in **TNTview**:

- ESRI's shapefile (line work and table),
- MapInfo's TAB file (line work, tables, and rasters),
- ER Mapper's ECW file (Enhanced Compressed Wavelet),
- LizardTech's MrSID file (wavelet compressed), and
- TIFF/GeoTIFF file (all types).

Inherited New Features.

The following general improvements in all **TNT** product operations were automatically added to **TNTview 6.6**. These improvements are detailed below in the major section on New Features for **TNTmips** and include:

- familiar Windows installation using InstallShield with improved license configuration;
- use autoscaling to numeric scale, active layer, and pixel size with the virtual desktop;
- conduct global searches of reference manual and all tutorial booklets;
- faster vector rendering of labels and polygon fills of islands;
- faster raster rendering at some important scales by using full binary pyramiding;
- import MrSID, ECW, GeoSPOT, IDRISI32, NTF vectors and rasters; …,
- for increased Z resolution, use DEMs of any data type including real numbers;
- make more attractive layouts using color mattes, borders, and neat lines; and
- use a full suite of import functions in SML scripts.

Upgrading.

If you did not order **V6.60** 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 6.6**.

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 current version of **TNTview** relative to **V6.60**, 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**:					**V6.00**
	V6.50	**V6.40**	**V6.30**	**V6.20**	**V6.10**	and earlier

Windows/Mac/LINUX	$175	275	400	500	555	+50/each
for 1-user floating	$210	330	480	600	667	+60/each
UNIX for 1-fixed license	$300	475	600	675	725	+50/each
for 1-user floating	$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**:					**V6.00**
	V6.50	**V6.40**	**V6.30**	**V6.20**	**V6.10**	and earlier
Windows/Mac/LINUX	$240	365	465	545	605	+50/each
for 1-user floating	$288	438	558	654	726	+60/each
UNIX for 1-fixed license	$350	550	700	800	850	+50/each
for 1-user floating	$420	660	840	960	1020	+60/each

Installed Sizes.

Loading **TNTview 6.6** processes onto your hard drive (exclusive of any other products, data sets, illustrations, documentation files, …) requires the following storage space in megabytes.

	for **V6.50**	for **V6.60**
PC using W95, W98, WME, NT, W2000, or XP	35 Mb	43 Mb
PC using LINUX (with Intel) kernel 2.0.36–2.4	28 Mb	29 Mb
Mac using Mac OS 8.x or 9.x	43 Mb	47 Mb
SGI workstation via IRIX	34 Mb	34 Mb
Sun workstation via Solaris 2.x	30 Mb	31 Mb
IBM workstation via AIX 4.x (with PPC)	35 Mb	36 Mb

TNTedit™ 6.6

Autolinking to Popular Formats.

The following external formats can now be directly used in **TNTedit**:

- ESRI's shapefile (line work and table),
- MapInfo's TAB file (line work, tables, and rasters),
- ER Mapper's ECW file (Enhanced Compressed Wavelet),
- LizardTech's MrSID file (wavelet compressed), and
- TIFF/GeoTIFF file (all types).

AutoTracing.

While adding an element to the active layer, you can now add to it a continuous segment of vector elements traced in another vector layer in the view. Simply toggle into the autotracing mode, select the reference layer, autotrace the desired portion of the existing elements, and exit the tracing mode, which inserts this as a new element or appends it to the element being created.

Reference Views.

Additional 2D and 3D GeoLocked reference views can be opened to consult while editing in the primary view. These additional views could present other color combinations and enhancements, images of some other date, a topographic map, or any other georeferenced or arbitrarily locked materials.

Inherited New Features.

The following general improvements in all **TNT** product operations were automatically added to **TNTedit 6.6**. These improvements are detailed below in the major section on New Features for **TNTmips** and include:

- familiar Windows installation using InstallShield with improved license configuration;
- use autoscaling to numeric scale, active layer, and pixel size with the virtual desktop;
- conduct global searches of reference manual and all tutorial booklets;
- faster vector rendering of labels and polygon fills of islands;
- faster raster rendering at some important scales by using full binary pyramiding;
- import MrSID, ECW, GeoSPOT, IDRISI32, NTF vectors and rasters, and others;
- export to ECW, NTF vectors and rasters, and others;
- for increased Z resolution, use DEMs of any data type including real numbers;
- make more attractive layouts using color mattes, borders, and neat lines; and
- use a full suite of import and export functions in SML scripts.

Upgrading.

If you did not order **V6.60** 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 6.6**.

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 current version of **TNTedit** relative to **V6.60**, 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:**					**V6.00**
	V6.50	**V6.40**	**V6.30**	**V6.20**	**V6.10**	and earlier
Windows/Mac/LINUX	$350	550	700	800	875	+50/each
for 1-user floating	$420	660	840	960	1050	+60/each
UNIX for 1-fixed license	$650	1000	1350	1600	1750	+50/each
for 1-user floating	$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:**					**V6.00**
	V6.50	**V6.40**	**V6.30**	**V6.20**	**V6.10**	and earlier
Windows/Mac/LINUX	$500	750	950	1100	1200	+50/each
for 1-user floating	$600	900	1140	1320	1440	+60/each
UNIX for 1-fixed license	$750	1200	1550	1850	2000	+50/each
for 1-user floating	$900	1440	1860	2220	2400	+60/each

Installed Sizes.

Loading **TNTedit 6.6** 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 **V6.50**	for **V6.60**
PC using W95, W98, WME, NT, W2000, or XP	53 Mb	55 Mb
PC using LINUX (with Intel) kernel 2.0.36 to 2.4	50 Mb	52 Mb
Mac using Mac OS 8.x or 9.x	57 Mb	61 Mb
SGI workstation via IRIX	63 Mb	68 Mb
Sun workstation via Solaris 2.x	54 Mb	57 Mb
IBM workstation via AIX 4.x (with PPC)	68 Mb	72 Mb

Free Training

The free training sessions have been of considerable value to those who have attended. The MicroImages' staff has enjoyed meeting a variety of clients during these sessions. One free training session has been scheduled for the beginning of 2002: 14-18 January. A color flier is enclosed to describe this free training and includes a registration form. You can find the contents of this flier and the registration form at http://www.microimages.com/announce/freetrain.htm.

NOTE! MicroImages has no further free training sessions scheduled beyond this January 2002. If any other free training is offered in 2002, it will be publicized months in advance on microimages.com.

QuickGuides

9 new 1-page QuickGuides listed below are enclosed with **V6.60**, bringing to 35 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.

- GeoToolbox
- Tool Scripts
- Profile Views
- Custom Toolbars
- Database Constraints
- Color Scale Range Legends
- Macro Scripts
- Line Style Libraries
- Automatic Projection Reconciliation

All 35 QuickGuides can be downloaded in Adobe Acrobat Reader PDF form from http://www.microimages.com/didyouknow/.

Getting Started Booklets

There are now 65 Getting Started Booklets. These tutorial and reference booklets provide 1700 pages and over 3700 color illustrations. They are up-to-date with the features in **V6.60** of the **TNT** products. Remember that each new professional **TNTmips** now comes with 2 thick notebooks containing a color printed copy of every booklet. Those of you receiving your **V6.60** 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 / Getting Started.

An online, searchable, cross index covering all the booklets and online documentation is now available from the Help menu. See the section below entitled Global Searching for more details.

New Booklets Available.

7 new GSBs are being released for the first time with **TNT V6.60** and are shown in the attached color plate entitled New Getting Started Tutorials. They are:

- Using TNTatlas for Windows,
- Using TNTatlas for X Windows,
- Analyzing Terrain and Surfaces,
- Geospatial Analysis in Precision Farming,
- Modeling Watershed Geomorphology,
- Translating Tutorials, and
- Using TNTsim3D for Windows [not on CD, please download].

Expanded Booklets.

5 GSBs have had significant upgrades or additions for use with **V6.60** of the **TNT** products and are shown in the attached color plate entitled Expanded Getting Started Tutorials. They are:

- Writing Scripts with SML (major revisions),
- Managing Geoattributes (updated and 4 new pages),
- Analyzing Hyperspectral Images (updated and 4 new pages),
- Designing Electronic Atlases (updated and 4 new pages), and
- Creating a Tutorial (updated).

Translated Booklets.

Various experienced MicroImages clients are now participating in a program to make initial translations of the Getting Started booklets available to their nations. The attached color plate entitled Translated Getting Started Tutorials illustrates the covers of typical translations. There are currently 21 **TNT** languages and 65 booklets, so this is a major effort. However, many of the booklets have already been translated during previous years in complete or in abridged form into Japanese, Turkish, Thai, and Korean. A few of the most important booklets have recently been translated into Spanish, Italian, Finnish, German, French, and Dutch. Negotiations are underway for the possible translation of selected booklets into Chinese, Arabic, and Croatian. You can determine which booklets are available in your language and obtain them from the “Downloads” listings at microimages.com.

Online Reference Manual

Now in PDF Format.

The **TNT** reference manual is written in Microsoft Word but is now converted to PDF format and installed in that format for use in Adobe Acrobat Reader. The PDF online presentation of the manual in the **TNT** products is more attractive than the previous HTML presentation. The latest version of your browser is automatically equipped to view PDF documents over the Internet. Thus, this manual can even be accessed and used directly from microimages.com just as if it was locally available. Conversion of this manual to PDF format matches its format to that used for the Getting Started tutorials

and permits all these written materials to be searched at once as outlined in the section below.

Direct Topic Links.

When you access the Online Reference Manual directly from the menu, it opens up to the Volume Index page illustrated on the attached color plate entitled Reference Manual Online. From this title page you can select a chapter of interest and its table of contents will be found on the Bookmarks tab in Acrobat Reader. Each entry in this table is a bookmark link and, when selected, Reader will jump to the beginning of that subsection. Newcomers should use this table of contents approach to become familiar with how the **TNT** products are organized and to browse this material and read sections in the manual. Experienced users of **TNTmips** and other geospatial analysis products who are familiar with the terminology can now search for and jump directly to the pages of interest using the new global document searching introduced in **V6.60**.

Printed Copy.

You can use your Reader to print and bind a physical shelf reference copy of this **TNT** Reference manual on your color printer. You no longer need to obtain the separate Word version from MicroImages for this purpose. When printed via Reader, the manual's appearance is attractive and quite similar in layout and structure to that printed previously from the separate Word version. The following are the page counts for a single spaced printing of the sections in the **V6.60** manual.

- Basic System Operations 249 pages
- Display 684 pages
- Edit 282 pages
- Process 1087 pages
- Support 98 pages
- Appendices 20 pages
- Glossary 93 pages

2513 total

Global Searching

Objective.

A review article of popular desktop image processing systems published in GeoWorld contained the following comments regarding the **TNTmips** documentation.

[Extracted from Image Processing Software: System Selection Depends on User Needs by Fredrick Limp]

*"The documentation maximalist award winner was **TNTmips** - a small fork lift dropped off two large boxes of information. One box contained three large, three-ring binders (with an estimated 3,000 pages of text) and three small, three-ring binders (with an estimated 900 pages of documentation* [now 1700]*). I say "estimated," because each section of the manuals has its own numbering and table of contents, but there's no overall index or pagination. Users, however, can access and search the online versions.*

*"The larger manuals serve as the user's manual, providing specifics on each aspect of operation. The three smaller manuals explain concepts and process sequences. In addition, there are excellent color images that show operation results. The **TNTmips** documentation is thorough, and would be excellent if it weren't so difficult to find things (there are no indexes). The online versions make global searching and discovery somewhat easier."*

Since this was a valid criticism, an indexing approach was sought to remedy this situation. The task is non-trivial as the **TNT** written document base now contains

- 2500 pages in the 7 volumes of the Reference Manual,
- 1700 pages in 65 separate Getting Started and related booklets,
- 1000s of pages of technical reference material in the MicroImages MEMOs,
- 400 color plates that accompanied the MicroImages MEMOs, and
- a small collection of new single page Quick Guides.

Added to this are the other pages of materials created specifically for access only from microimages.com.

Approach.

Fortunately the new version 5 of Adobe Acrobat introduced the capability for automatically cross-indexing many PDF files. Accompanying this is the capability in V5 of the FREE Adobe Acrobat Reader to search for a term in a composite index of all documents. It then opens a window showing the title of each document that contains that term arranged in the order of their relevancy ranking, which depends on the number of its occurrences, proximity of its occurrences, and other control settings. If you select any of these document titles from this window, Reader will open that document to the first page that contains the term and highlight all its occurrences. You can then toggle through each occurrence of the term in the document using the Next Highlight button or pick another document from the list in the window. More details on this new global search feature can be found on the attached color plated entitled Online Search Capabilities. You can open the search window in your Reader from within the **TNT** products using the Search option on the Help menu.

Adobe Acrobat Reader 5.0.5 is a required upgrade for all Reader operations on Windows XP and Mac OS (5.0.0 is provided on the **TNT** CD).

Future Scope.

MicroImages will expand the scope of this PDF indexing/searching to cover all MicroImages MEMOs and the color plates attached to them to illustrate new **TNT** features. The MicroImages MEMOs have already been converted to PDF format and are available on microimages.com. However, they are not yet on the **V6.60** CD or included in its master index. At present many of the color plates used in these MEMOs to introduce new features have been reviewed, revised, and organized into a feature illustration gallery in PDF format. Including these in the master index, and thus in the search path, was impossible as they total hundreds of megabytes and will not fit on the **TNT** products CD. Eventually they can be indexed and included in your global search, which then opens your browser to view a color plate stored at microimages.com. As an alternative you could download all the plates once after each new release for direct local use. Reliable procedures for the use of these materials are the next goal in this global indexing strategy.

New TNTmips Features

Paragraphs or main sections preceded by the asterisk "*****" symbol introduce significant new processes or features in existing processes released for the first time in **TNTmips 6.6**.

System Level Changes.

Auto Linking to Other Formats.

In **V6.50** and earlier **TNT** products, you could first make a link to and then use other external geodata file formats (for example TIFF and GeoTIFF files). In **V6.60**, when you select a supported external geodata file in any process, these links are now automatically made. You simply navigate to the external file using the Object Selection dialogs and then display, edit, and analyze the geodata in that original format, just as you would any other object in a **TNT** Project File. Projection, datum, data type, histograms, and other on-the-fly changes will also be handled transparently, just as for a **TNT** object contained entirely within a Project File.

When you select one of the supported external geodata files for direct use in this fashion for the first time, the **TNT** process being used will automatically create a "stub," or link, Project File for it. The original external file is not altered in any way and still maintains its name, extension, original structure, and location. The link Project File contains all the other things that the **TNT** products need to make direct use of the external file. For example, if the external file is a raster, then the pyramid layers, histogram, georeference, and other subobjects will be created for it as necessary.

Creating this Project File to define the link when you select the external geodata file for the first time usually takes only a few seconds. Thus, using an external file in a **TNT** process is a transparent operation. The next time you use the file in any process, it finds and uses the previously created Project File that defines the link. This link file is a Project File that is saved in the same directory as the external geodata file. It will have the same name as the external file but with the extension *.rlk (for RVC link) instead of the usual Project File extension of *.rvc. If the media containing the external file is read-only, such as a CD or a read only network source, then the link file will be created in the cache directory on your local drive.

The following external formats can now be transparently linked and used in **TNTmips**, **TNTedit**, **TNTview**, **TNTatlas**, and **TNTserver**:

- ESRI's shapefile (line work and table),
- MapInfo's TAB file (line work, tables, and rasters),
- ER-Mapper's ECW file (Enhanced Compressed Wavelet),
- Lizard Tech's MrSID file (wavelet compressed), and
- TIFF/GeoTIFF file (all types).

Now that this procedure is in place, other supported external geodata formats with appropriate structures could be added: ERDAS .img, NITF 2.x, CADRG, and so on.

Cautions.

Wavelet, as well as other technologies, can compress your images to very small sizes but with significant losses in detail. Care should be used in applying these approaches to images that require further processing and interpretation. However, when you reach your geomedia production step, these quality losses may be quite acceptable. Your **TNT** products can use many kinds of rasters and also provide different kinds of compression and formats, and care should be used in their selection. Special caution should be used with rasters that are not images. For example, DEMs might be acceptable in wavelet compressed format if the loss of some surface detail is acceptable. Categorical rasters containing solid polygons should not use lossy compression but can be greatly compressed by run length encoding and other lossless compression schemes. For many

years MicroImages refused to support lossy compression in the Project Files for fear that such rasters would be misused in most image processing applications. However, your pressure and evolving geomedia needs forced support of these formats. Now MicroImages must rely upon you to know when to use compression, which to use, and when to avoid it.

When you get images in a highly compressed format, you have little choice but to use them. Unfortunately, the tendency of those supplying images in wavelet compressed formats is to make it easy on themselves by compressing the image to a small size. Make sure that you understand the impact of using these compression formats at high compression ratios on the images you acquire. Often, when the owner of the very large images is asked for a copy they will, for their convenience, choose to deliver it in MrSID format. For example, it has become common for state agencies to meet their public access regulations by making their black and white 7.5' orthophotos available for download or on CD in MrSID format. Typically they will compress a single 7.5' orthoimage from 40 Mb to 2 to 3 Mb. This is convenient for them in terms of web storage and for the party acquiring copies of these free images in terms of bandwidth requirements. However, a comparison of the original image to the compressed image will illustrate that this is acceptable for direct visual use of the image, but perhaps not for other more exacting applications.

MrSID has been designed to be a highly compressed lossy format for the convenient final delivery of pretty pictures that are very large or where media space is limiting. You will find as you acquire images in MrSID format that it is not designed as a transport or storage media for images destined for image processing. It supports only 8-bit and 24-bit composite color images. Furthermore, these limited image types can be compressed so drastically that they are unsuitable for any computer analysis. Also, it is not possible to save MrSID images unless you license their expensive compressor and its application would be limited to saving only 8- and 24-bit images (and not other rasters) whose final results were for viewing only. The one aspect of MrSID images that makes them popular is that they decompress fast and many products support viewing them.

ECW wavelet compression should be used with the same cautions as MrSID—most important, do not over compress. However, ECW is a product of ER Mapper that is well versed in image processing and, thus, an ECW file can act as a container for many different collections of 8-bit images. For example, a single ECW file may contain many 8-bit images. It is important to note that each image in an ECW file is restricted to 8-bits per pixel. All of the 8-bit images in an ECW file can be directly used or imported into the **TNT** products. However, ECW images can be exported as well.

JPEG 2000 Planned.

A suitable general JPEG 2000 function library is now available for public use. MicroImages will add JPEG 2000 wavelet compression support early in the evolution of **V6.70** of the **TNT** products. Please check with MicroImages' support or at microimages.com for the status of this important addition. It appears that this library will permit the direct use of auto-linked files, multiple data types, greater than 3 image bands, and other important features, and support its import and export to/from raster objects of any size. In addition to these expanded features, it should provide the same compression as other wavelet based approaches free of legal entanglements. It also will be widely used in many image-oriented applications starting with video storage and transmission products.

It is the agreed upon replacement for JPEG and has already been implemented in the first silicon chips for use in TVs, recorders, and other consumer equipment.

Faster Rendering.

"To avoid criticism do nothing, say nothing, be nothing." A quote from Elbert Hubbard, an independent thinker and very prolific early 20th century American author who wrote more than 10,000 magazine articles and who died on the sinking Lusitania May 7, 1915. It seems that prolific authors, like software authors, are subject to plenty of feedback. But, over the years self criticism and your feedback have resulted in many important improvements in the rendering and other uses of geodata, such as raster tiling and tile compression, raster pyramiding, sampled histograms, optimization of vector structures, and others. These are important strategies as objects become huge and are rendered over and over.

Some of you now import, edit, or create single vector objects with full topology of hundreds of megabytes, even approaching a gigabyte in size. The **TNT** products recently introduced optimized vector structure makes large scale displays of your very large vector objects fast and relatively independent of their total size. However, further improvement in performance is possible by analyzing examples of how these large vector objects with special characteristics perform in your actual projects.

For some time, raster objects of any size have been rendered in seconds in the **TNT** products. Recently some of you have been using single raster objects that are each many gigabytes. Improvements in the mosaic process, continued increased capacity in low-price hard drives, operation of **TNTsim3D** over large landscapes, and other "enabling technologies" mean more and even larger raster objects. At the moment the most critical technical issue is how to move and backup these raster objects that greatly exceed CD capacity and saturate network resources when moved around. The available media capacity is the only thing that places a practical limit on the size of a raster object used in the **TNT** products. Again, however, slower performance detected in special cases and applications have occurred and have been resolved.

Quantitative Analysis.

Careful quantitative analysis of the performance of the **TNTatlases** and other sample geodata you provide has led to further significant improvement in their rendering. MicroImages can repeat your application on your large geodata set while concurrently running as another task a special commercial package called Quantify from Rational Software Corporation. This software reports how much time is used to complete each step within the concurrently running **TNT** process. For example, it reports step by step timing of the operations needed to render vector layers into a view. MicroImages can review this report to pinpoint activities that are slow and then devise optimizations to continue to improve performance.

The time to complete all the **TNT** code subsections in a particular **TNT** process may be quite acceptable in the general case. A slow code section may not show up or even be used for typical vector objects but becomes a problem under special conditions when used or simply used very repetitively. For example, a vector object is described below that has many polygons with many islands. Having more islands than basic polygons and filling them is not a typical condition. Careful review of each slow operation on an object is a particularly important strategy as objects become huge and are rendered over and over in large scale (zoomed in views). As previously noted, this has led to the

development of many important approaches in rendering and using geodata such as raster tiling and tile compression, raster pyramiding, sample histograms, vector structure optimization, and others. The most critical demands are now being encountered in rendering from **TNT** objects in **TNTsim3D** where new views are automatically rendered and frame rate is important. The strategy for this will be discussed in the section below entitled Landscape Builder.

Faster Raster Operations.

Full Binary Pyramid Layers.

As an option in **V6.60**, a **TNT** raster object or the Project File linked to an external raster now contains every pyramid tier starting at a 2 by 2 averaged sample and ranging in binary steps (2 by 2, 4 by 4, 8 by 8, …) until a tier is created that is less than 64 cells in 1 dimension. By default **V6.50** of the **TNT** products omitted the 2 by 2 sampled and averaged pyramid layer from a raster object as it contributed to a 25% increase in file size above the base raster size. This was important when hard drive capacity was expensive. Now **TNT** applications are emerging that need this 2 by 2 layer for faster displays and processing. Since hard drive space is no longer a critical factor, **V6.70** will probably make the creation of this 2 by 2 layer the default condition.

Application in Large Area Processing.

Recently those conducting large area geologic applications pointed out that their visual interpretations of satellite images were repeated over and over and at varying scales. Since large rasters are involved, it is convenient to view them at a pixel scale less than 1:1 but not as small as 16:1 (the first 4 by 4 pyramid layer available in **V6.50**). The viewing scale range varying around a 2 by 2 pyramid layer (ranging from 1:1.5 to approximately 1:10) was commonly called for and ideal. Without the 2 by 2 pyramid layer, viewing at these intermediate scales required reading, sampling, averaging from the full 1 by 1 raster object and this was slower than necessary.

Application in **TNTsim3D**.

TNTsim3D loads only the specific tiles it needs as your viewpoint moves forward or changes. It does not use the tiles from the 1 by 1 raster object if the pixels on the screen represent large, indistinct, distant cells on the ground. It automatically uses tiles from the pyramid layer containing cells of a size required by the ground size of the pixel viewed at that distance in that position in the view. In other words, it uses the tile from the pyramid layer whose cells will fill the pixel at that position in the 3D view. All the binary pyramid tiers and tiles are needed in this application, especially the 2 by 2 pyramid layer, and the Landscape Builder described below automatically creates them.

Application in Direct Linked Files.

Some external file types such as MrSID and ECW already contain all binary pyramid layers, including the 2 by 2 layer. Since this pyramid layer is already included in the size requirements of these external files, it is available via the direct link and no pyramid layers occur in the small linked Project File. If these files are imported into a raster object for some reason, all binary pyramid layers will be created. If external files are selected in the Landscape Builder, all these pyramid layers are extracted and used. Exporting any suitable raster object into one of these formats will create all the required pyramids including the 2 by 2 pyramid layer.

Sampled Histograms.

Some of you download new prototypes of the **TNT** products weekly to track and evaluate new features and to guide their development. This requires a lot of patience on your part as features come and go and can change detrimentally, even affecting other areas of the product. However, your feedback is especially useful in helping MicroImages get it practical and right. By this activity, you become part of the development team and have significant impact on what is done. Those who participate in this way often do so as they have application needs and problems to solve in the area being worked on.

The direct linking to MrSID and ECW files was first released several months ago. MicroImages then claimed that a direct link could be made in a couple of seconds. Several clients tried this direct link approach and reported that it was quite slow on their files. Neither of these qualitative image formats included a histogram. Since their file sizes were large, it was taking too long to decompress while auto linking in order to compute a histogram for every pixel. This histogram is computed and saved in the small raster object associated with this external file to make it available to subsequent **TNT** processing of this linked file. Their feedback resulted in modifications to the **TNT** processes to use a pyramid layer to compute the histogram for large raster objects or linked rasters that have pyramids such as MrSID and ECW. This reduced the time needed for computing and storing the histogram during the direct link to 1 to 2 seconds for any size of large raster. Using this same sampling approach throughout the **TNT** processes provides the same improvements in performance when you create, import, or analyze a large raster object. It can also decrease the time for viewing a raster created in a GeoFormula or other interactive raster creation.

Some special applications require viewing a full histogram with every cell included. The new histogram display uses the sampled histogram and shows the sampling interval. An option is available to compute and display the unsampled full histogram should accurate statistics be required.

Faster Queries.

In **V6.50** each time a query was evaluated (one per element), it had to read the record related to the element and compare the field value. In **V6.60**, if the field is indexed, the query uses the index, which is usually in real memory, to determine which records match the query, which eliminates the need to read the records. Thus, any query involving a database field that is indexed is evaluated much faster. If there is no index, the query will still read the record for each element.

In situations where the same query is evaluated over and over, such as in a **TNTserver** or any frequently used selection operation, indexing has a dramatic effect on performance. Any field you expect to be used frequently in a query should be indexed. To index a field, open the table in the Database Editor window. Use Table/Edit Definition and select the field and the Indexed toggle button. Once a field is marked as indexed in this fashion, its index will be maintained even if the database table is edited.

Faster Vector Operations.

Universal Vector Optimization.

The optimized element structure introduced in **V6.40** of the **TNT** products is now automatically created and maintained by all processes in **V6.60**. For example, vector validate will now automatically optimize the vector object. This structure makes large scale

views of vector objects fast and the time for this close-up display relatively independent of their total size.

Faster Labels.

HAT, MicroImages dealer in Turkey, provided a new sample atlas illustrated in the attached color plate entitled New Sample Web Atlases: Turkey for experimental use on microimages.com. Upon installation on **TNTserver**, it was noted that the street map of Istanbul it contained took 45 seconds to render a close up view of several city blocks. At this scale the view shows a few city streets identified by several street name labels from about 100,000 street lines and 26,600 labels in that vector object. Since **TNTserver** uses the same Geographical Rendering Engine (**GRE**) as the other **TNT** products, it was analyzed in the Quantify program. This pinpointed a section of code that was inefficient when used repetitively, but not problematic in smaller data sets or in the smaller scale views of this atlas where most of the labels were suppressed by scale control anyway. Improving this code section improved performance for this kind of operation in all the **TNT** products including **TNTatlas**, **TNTserver**, **TNTmips**, … by a factor of 20. The rendering of points (including nodes as points) in all cases is increased by a factor of 2. Furthermore, it has led to a design, not yet implemented, to index point elements in vector objects to decrease the time needed to retrieve the selected points for most operations in all processes.

Faster Polygon Filling.

This same Turkish atlas has an Istanbul map vector layer with 30,000 polygons almost all containing islands, some with many. This resulted from converting the original Istanbul vector object of the center lines of streets to a new vector object of the 2 street edges using the buffer zones process. This yielded many large grid-like polygon structures containing many interior street blocks as islands. The attached color plate entitled New Sample Web Atlases: Turkey illustrates this city block, island-like, street pattern. This unusual condition, with many blocks as islands also pointed out code inefficiencies in rendering a view of this vector layer. Improving this code section in the **GRE** improved island filling by a factor of 6 throughout the **TNT** products.

The Vector Challenge!

Periodically you report upon how long it takes to display a vector data set in a competitive product and how much faster it displays in your **TNT** product after importing it into a vector object. Based on these reports, MicroImages believes that the **TNT** rendering of topological vector objects is faster than any other product using the same object for the same purpose. If this is not what you find, then identify the condition and it will be our next challenge.

GeoTool Box.

3D Surface Measurements.

V6.50 reported various 3D surface properties for any raster layer in a composite view for the area inscribed by a polygon or region you drew or selected. Usually you would choose the elevation as the surface while drawing the polygon on an overlaying image layer. **V6.60** now also displays the actual surface area for the raster inside the polygon in addition to its flat (projected) area. It is now easy to determine the true surface area and its ratio to the flat area.

Tools now report true maximum, minimum, and other Z values for the selected surface after automatically applying any scale and offset value associated with the data values in that raster object. All Z coordinate values also default to the same units selected for the view.

Geospatial Display.

Big Display Windows.

If you are using the large, virtual display window in **V6.50**, you can now take advantage of the following new supporting features.

Scale to Maximum Extent.

Enter a scale and choose the check box Entire Extent at Scale, and the display window will resize to fit the extent of all the layers at the scale shown. The largest scale you can enter is the default value (smallest base number for the representative fraction). It is the scale of your view if the View window fills your entire large workspace. If you enter a smaller number than this to obtain a larger display window, it will be rejected and the smallest allowed number will be shown. If you enter a smaller scale (a larger number) that can be accommodated, it will be accepted, and when you enter OK, the display window will resize and redisplay your composite view at that scale, and it will contain all the extents of all layers in your composite view.

Scale to Active Layer.

Enter a scale and choose the check box Active Layer At Scale and the display window will resize to fit the extent of the active layer at the scale shown. The largest scale you can enter (smallest base number for the representative fraction) is the scale of your view if the View window fills your entire large workspace. If you enter a smaller number than this to obtain a larger display window, it will be rejected and the smallest allowed number will be shown. If you enter a smaller scale (a larger number) that can be accommodated, it will be accepted, and when you enter OK, the display window will resize and redisplay your composite view at that scale, and it will contain all the extent of the active layer in the composite view.

Scale to Active Layer's Pixel Size.

The Active Layer At option provides some convenient choices for resizing your display window relative to the pixel size of the active layer when it's a raster. Typical choices are 1X, 2X, 1/2X, 1/3X, and 1/4X. Choosing 1X will zoom the active raster layer 1 to 1 (1 cell per display pixel). Choosing 2X will zoom the display so that each cell in the active raster layer becomes 2 by 2 display pixels. Choosing 1/4X dezooms the display window to a 4 by 4 sampling of the cells in the raster layer. These number options can only be selected if the active layer is a raster and will fit your workspace at the numbers presented.

Miscellaneous.

View-in-View. When the view-in-view tool is selected, it now automatically shows a visible box in the center of the view. This makes it obvious that the tool is active and what it does.

GeoLocking. Views with "arbitrary user-defined" georeference can now be locked. GeoLocking 2 such views assumes that their contents use the same coordinate system (axes, scale, …). You can not lock a georeferenced view to an arbitrary view.

Landscape Builder (a prototype process).

A Display Process?

At first glance it may seem strange to find a new process by this name available as a type of **TNT** display process. However, this new process is built using the same Geospatial Rendering Engine (**GRE**) and permits you to choose objects in any Project Files as well as to specify how they are modified, controlled, composited, and displayed. Like many **TNT** processes, it can render 2D displays based upon your selections and settings. These views permit you to preview the results of the application of the Landscape Builder just as in many other **TNT** processes. However, the specific purpose of this new process is to provide all the familiar display controls to setup and create the geospatial objects used for an entirely new display, namely **TNTsim3D**. The attached color plate entitled Landscape Builder for TNTsim3D illustrates its basic operation.

TNTsim3D was first introduced in **V6.50** and used input texture and surface raster objects that had to meet specific requirements. You had to create these texture and surface rasters separately using various processes (color compositing, extraction, resampling...) to create the desired texture image while ensuring that both rasters had the same orientation and geographic extents and the required raster types. Now the Landscape Builder in **TNTmips** automates the preprocessing of texture and terrain rasters, allowing you much greater ease and flexibility in building simulated landscapes used in the separate **TNTsim3D** for Windows.

TNTsim3D runs separately from any other **TNT** product as it bypasses many specific operating system limitations by using DirectX or OpenGL. These call and use special high speed graphics functions executed directly in the graphics chip on your display board. For example, polygon rendering and texture buffering are built into modern graphics chips and are often used to compare their value. These display boards also provide separate, high speed memory to buffer and render 3D images at high frame rates. Since these activities are key ingredients in the PC video game industry, the most powerful boards are available at low cost.

Combining the **TNT** product's unmatched capabilities for preparing and rendering views and the low-cost direct display technologies driven by the game industry provides the basis for powerful new geospatial viewing tools. This 2-part strategy means that any additions to the conventional 2D and 3D **TNT** viewing via the Geospatial Rendering Engine (**GRE**) that are appropriate can be passed through for use in **TNTsim3D**. Already many of the powerful features of the **TNT GRE** are immediately available in the Landscape Builder such as:

- selection and direct use of other file formats (MrSID, ECW, GeoTIFF, shapefiles,…);
- projection reconciliation;
- using rasters of any numerical data type;
- combining raster, vector, CAD, and RDBM features into a raster;
- contrast enhancement and management;
- irregularly shaped objects with different extents; and so on.

These and many other features used to define a 2D or 3D view can already be used in preparing the landscape to be used in **TNTsim3D**. However, some features, such as polygon extrusion and scale controlled pin mapping, are not yet supported by **TNTsim3D** and, thus, are not yet used in the Landscape Builder. However, as soon

as **TNTsim3D** is modified to recreate these features, the Landscape Builder will be modified to present these options and controls.

What Is It?

Effective use of a simulation in geospatial analysis requires a convenient and familiar means of using all your current geodata available in or linked to Project Files while retaining its "geo" nature—this is the Landscape Builder. Current video board and main processor computer power are not yet sufficient to allow the same flexibility provided in the **TNT** non-real time 2D and 3D views of combinations of many objects and linked objects of various types. At this time, **TNTsim3D** must trade off video frame rate against features. Thus, some of the flexibility in the general use geodata in Project Files must be omitted from a Project File used to simulate a landscape. Computing this specialized Project File in the Landscape Builder on a fast machine is reasonable (for example, a minute for a 20 Mb landscape file or less than an hour for a 600 Mb landscape file). However, once you have computed a Landscape Project File, you can start it up in **TNTsim3D** in less than 15 seconds, regardless of its size, and fly anywhere in this landscape with a reasonable frame rate. Within **TNTsim3D** you can then select/delete simulation features that may increase/decrease your frame rate, for example: smoothing and anti-aliasing; rate of change in pitch, roll, and other viewer orientations; scene quality and size; velocity and acceleration; and so on.

What Does It Do?

The Landscape Builder will create a normal Project File but with the identifying extension of *.sim and containing 2 raster objects that meet a specialized set of criteria for their use in a rapid simulation in **TNTsim3D**. Giving this Project File the extension *.sim, instead of the usual *.rvc extension, permits it to be associated uniquely with and to automatically start **TNTsim3D** when any *.sim file is selected with the mouse. Although these are special purpose raster objects, they are still valid raster objects from the viewpoint of any other **TNT** process. In all other **TNT** processes, you can simply select and navigate into the *.sim file just as you would any *.rvc Project File. For example, these raster can be viewed in 2D or 3D. While they can also be used in other **TNT** processes, saving any changes to them may prevent their proper use by **TNTsim3D**.

One of these raster objects represents the vertical dimension in the simulation and is referred to as the terrain raster object or simply the terrain. It will be a 16-bit signed raster object. The second raster object contains the composite of the images, vectors, pins, and other features to be draped over this surface and is called the texture raster object, or simply the texture. It will be a 24-bit or 16-bit color composite raster object if color is part of the input objects selected. It will be an 8-bit raster object if only a grayscale image is available (for example, you are using a black and white orthoimage for the texture).

Limitations It Enforces.

A fixed set of relationships between the terrain and texture objects is required for their fast use in **TNTsim3D**. These properties and relationships are created by the Landscape Builder and provide the basis for achieving high frame rates. If **TNTsim3D** had to reconcile projections, composite objects, resample, and perform similar computations, it would take several seconds for each frame, which would not provide a realistic simulation. The first compromise relative to the normal **TNT** display is to limit the acceptable

data types as noted above. The terrain and texture objects differ slightly from other raster objects as they will automatically have their 2X pyramid subobject created adding 25% to their size. This eliminates some resampling activity when they are used in a simulation. Prior to **V6.60** the first pyramid subobject was 4X because the 2X layer added 25% to a raster object's size. Optional 2X pyramid support was added in **V6.60** to all processes for other totally different objectives, but as a result the surface and texture objects can still be used in all **TNT** processes. Additional information with regard to the addition of the 2X pyramid layer is provided in the Full Binary Pyramid Layers section above.

Flexibility It Permits.

The purpose of the Landscape Builder is to give you maximum flexibility to create the 3D simulation you want while automatically ensuring that the texture and terrain objects you produce meet the requirements noted above. The full capabilities of the Geospatial Rendering Engine used throughout the **TNT** products are also available to you in the Landscape Builder to produce the texture layer for your simulation. The texture you create can be as simple as a rendered image of the terrain itself (with color map or relief shading) or a complex view using any type of raster image (grayscale, RGB, RGBI, ...) with any number of overlays (other raster or vector layers with or without transparency, pinmaps, ...). As in other processes, texture layers with differing map projections are automatically registered and reprojected for display and processing. The Landscape Builder's View window displays the texture image and allows you to make any necessary adjustments to refine the image (contrast enhancement, color palettes, vector styles, ...). When you run the process, the Landscape Builder merges all of the layers in the View just as you see them into a single texture raster for use in **TNTsim3D**.

The objects you select for texture and terrain do not have to have matching extents and map projections. The Landscape Builder allows you to reconcile differing extents, orientations, and cell sizes for your candidate terrain and texture objects. You can automatically orient and clip the simulation objects based on the input data or reorient all objects to any map projection, and perform manual clipping in either case.

Using It.

Designing the Terrain.

To use the Landscape Builder to prepare a *.sim Project File, begin by selecting a raster object to represent the vertical dimension (terrain surface) for the simulation. In most cases you would choose a raster object containing a Digital Elevation Model, but any raster depicting a spatially-varying quantity (chemical concentration, annual precipitation, temperature, population density, ...) can be used to create the terrain layer. Simply navigate to and preview the available raster objects of any data type in any Project File or any linked raster object (for example, GeoTIFF). The Landscape Builder automatically converts the selected surface data to 16-bit signed integer format for use as the terrain object in **TNTsim3D**. Your selected raster is loaded as a surface layer in the accompanying geospatial view. The raster is not displayed, but a rectangular box outlines its extents.

Designing the Texture.

Continue to build your simulation by selecting any combination of objects to create the texture overlay. All of these objects are displayed in full in the View window just as they would be in the Spatial Data Display process, and all of the usual display control and

enhancement tools are available to allow you to refine the image. The sample landscape files that have been prepared by MicroImages, which were described in an earlier section, illustrate some of the range of possibilities for creating dynamic, data-rich textures for 3D simulations.

Relating Texture and Terrain.

Once you have the candidate terrain and texture layers loaded and refined, you can determine the orientation and extents of the output landscape layers. Push-buttons on the Landscape Builder window allow you to automatically orient and clip the objects to the selected terrain object or to the active layer in the View of the texture layers (set in the Landscape Builder Layer Controls window). You can also use standard dialogs to reorient all objects to any map projection, with the results shown automatically in the View. You can use the Output Extents graphic tool to resize the extents box to include exactly the desired area in the simulation.

Determine the relative sizes of output texture and terrain objects by setting the Texture/Terrain Raster Size Ratio (1, 2, 4, 8, 16, 32, or 64). You can also specify which cell size should be held constant when the ratio setting is changed and the method used to resample cell values to create the output terrain object (Nearest Neighbor, Bilinear Interpolation, or Cubic Convolution). Currently the texture raster is created using only Nearest Neighbor resampling, but future versions will allow bilinear resampling as well. This change will allow you to hold the terrain cell size constant and use interpolation to resample the texture to a much smaller cell size, producing a smoother texture image.

You can manually edit the output line and column dimensions and cell sizes, but values you enter are automatically adjusted to maintain the selected ratio and to ensure that the output texture and terrain objects have dimensions suitable for the simulator. Each dimension of the texture raster (in cells) is maintained as a power of 2 multiple of 256 (for example, 256, 512, 1024, 2048). This restriction is related to the special texture-tiling scheme used in **TNTsim3D**'s texture server, which uses tiles that are 256 by 256 cells in size. The dimensions of the terrain raster are computed as the texture dimension divided by the selected size ratio, plus 1 cell. For example, with output texture dimensions of 1024 by 4096 and a texture/terrain ratio of 4, the terrain raster will be assigned dimensions of 257 by 1025. You can also choose the color-depth of the output texture image (24-bit, 16-bit, or 8-bit with color palette).

Minimizing File Size.

When building a simulation, keep in mind that your choices for cell sizes, texture/terrain size ratio, and raster sizes will impact the appearance of the simulation and the performance of the simulator. A highly-detailed terrain layer is not required for a realistic-looking simulation, so consider using a relatively high texture/terrain size ratio and holding the texture cell size constant (producing a smaller, coarser terrain raster). This strategy will maximize the detail of your texture layer while maintaining smaller sizes for both objects. Using a high ratio and holding the terrain cell size constant introduces no additional detail in the texture layer, but may increase the object sizes enough to impact the performance of the simulator, introducing pauses in the moving image at higher flight speeds.

Modifications since **V6.60** CDs.

Since the CDs were mastered the Landscape Builder has been modified in several ways to better handle "no data" areas in terrain objects and to correct minor errors.

If your terrain data does not cover the full extents you select for the simulation, the release version of the Landscape Builder assigned a null value for the no-data areas in the output terrain raster. These null value areas cause significant rendering problems when the simulation is run in **TNTsim3D**. 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 render smoothly over the entire area. 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).

In both the release and current versions of the Landscape Builder, if the texture data does not cover the full simulation extents, the no-data areas are assigned a null value in the output texture raster. In the release version of **TNTsim3D**, these texture nulls were displayed in black, but the simulator has since been modified to make texture null areas transparent. Nothing is rendered in these areas except your selected background color.

In the release version of the Landscape Builder, the cell value designated as null for the output texture raster is the minimum value for the raster type ([R=0, G=0, B=0] for 16-bit and 24-bit texture rasters). But this meant that areas of pure black color in any of the layers used to create the texture object in the Landscape Builder would inadvertently end up with the same texture cell value that had been designated as null. These valid black areas would now appear transparent in **TNTsim3D**. To avoid this situation, the Landscape Builder now makes a slight adjustment to the color of any black texture areas so that they are assigned a texture cell value that is different than the null value.

Other recent modifications to the Landscape Builder correct problems in converting floating-point values for terrain rasters, rendering transparency effects to 16-bit texture rasters, and in rendering the output extents box in the View window.

Map Projections and Coordinate Systems.

A "3-degree Gauss-Kruger" system is commonly used in Europe and is now supported. This coordinate system should not be confused with the 6-degree Gauss-Kruger system previously and still available. The 3-degree system consists of 8 overlapping zones at 3 degree spacing based on the Gauss-Kruger projection. Zone 1 is centered at East 3 degrees and zone numbers increase in an eastward direction. Zones are 4 degrees wide providing a 1-degree overlap between adjacent zones.

For Austria the Lambert coordinate system is supported for nationwide mapping. Local coordinate zones M28, M31, and M34 are also supported.

The "Ghana National Grid" coordinate system is supported.

Japan-19 Plane Orthogonal coordinate system is supported.

Swiss Conformal Cylindrical projection and Swiss LV03/LV95 coordinates are supported.

Amersfoort (The Netherlands) datum parameters have been updated.

Raster Correlation Histogram.

This histogram now uses all numeric data types including signed integer and floating point raster objects.

Georeferencing.

Now saves elevation values when control points are saved as text.

Hough Transform.

A new Inverse Hough Transform option is provided that uses the raster created by the Hough Transform to produce raster and vector objects containing the dominant lines detected in the input raster. A global threshold can be set to control the number of lines detected, or a graphic tool can be used to identify specific local Hough raster maxima corresponding to individual lines. The attached color plate entitled Inverse Hough Transform illustrates the operation of this process. It is important to remember that the Hough Transform is usually applied to an image that has first been subjected to careful filtering to retain edges of some sort.

Directional Analysis.

Directional analysis now provides for the display of reference layers, and the rose diagram defaults to showing and can be optionally hidden.

Mosaic.

Larger hard drives make it practical to use ever larger rasters. Both images and elevation rasters are now widely mosaicked for use in map web servers such as **TNTserver**, for large area simulations, such as in **TNTsim3D**, or simply city-, county-, or province-wide projects. Effective management and use of large rasters by the **TNT** Project File structure permit the visualization of large rasters just as fast as for small rasters.

The mosaic process has undergone an overhaul to support its expanding use, to add various features you have requested, and resolve minor errors that accumulated in it. The attached color plated entitled Mosaic Gap-Filling illustrates several of these new features. Yes, mosaic will directly use automatically linked, compressed raster formats such as MrSID, ECW, and GeoTIFF. The **TNTmips** Mosaic process is probably the only one that will directly ingest and mosaic mixed rasters (imported, linked, or auto-linked) in one operation regardless of internal or external format, cell size, map projection, … Please remember, as is true to a varying degree in many **TNT** processes, reading your source rasters from 1 physical hard drive and writing your output raster (your mosaic) to a different physical drive will improve performance.

Gap Filling.

When a mosaic is created from non-overlapping raster objects, gaps (seams) with no image content may be embedded in the mosaic. These seams can cause undesirable effects in subsequent applications. You can now minimize the impact of such seams by using the new gap-filling option. It interpolates new values for any narrow strips or clusters of null cells left within the interior of a mosaic because of non-overlapping input rasters (null cells around the outer edges are ignored). You have the choice of using the average of the neighboring 4 or 8 raster cells to fill the gap (excluding other null cells). If the gaps consist of small clusters of isolated cells along the seam, they disappear as shown in the attached color plate entitled Mosaic Gap-Filling. For more continuous gaps of 1 or 2 columns or rows of cells, an image mismatch may still be visible along the seam, but its impact will be much less than if null values were left in the mosaic. The gap-filling option is activated when you choose to set a null value for the mosaic.

Preview in Desired Projection.

The View window used in mosaic now automatically reprojects input rasters (if necessary) to the selected output coordinate system. As a result this view provides an accurate preview of the reprojected orientation of the mosaic. In the simplest case, input rasters with control point georeference to the same map coordinate system are now automatically displayed oriented to that map coordinate system rather than with raster lines horizontal and raster columns vertical.

Set Preview Projection.

As before, if the input rasters are georeferenced to different map coordinate systems, all these coordinate systems are listed on the Output Projection menu (Output panel). You can select any of these input coordinate systems and now the preview of the mosaic in the View window, as well as the mosaicked raster object, will be in this projection.

DataTips Added.

As an option, you can now see a DataTip in the View window for each pixel of your mosaic.

Set Cell Size with Reference Raster.

A new Auto-Update menu for cell size allows you to select any input raster as a reference raster to define the cell size in the mosaic. Unless this reference raster is specified, the default cell size for the mosaic is the minimum cell size for the set of input rasters. As before, you can also select any other new cell size for your mosaicked raster object.

Improved Georeferencing.

The method for saving georeference information for the mosaic has changed for instances in which input objects already have control point georeferencing. Previously, the control point information for the first object was copied to the mosaic, even though these control points apply to only a portion of the mosaicked area. Now the best-fit transformation parameters are computed from the entire set of input control points for all input rasters and these results are saved in the georeference subobject created for the mosaic raster. Individual control points are NOT transferred to the mosaic's georeference subobject.

Improved Contrast Enhancement.

Set Same for All Input.

A single automatic contrast enhancement can be applied to all input rasters using the Set Contrast All Layers icon button on the Input panel. This button opens a dropdown menu with all standard automatic enhancement methods (Auto Linear, Auto Normalize, ...).

Make Linear Contrast Table for Output.

Earlier versions of mosaic provided several procedures that transfer contrast-enhanced values into the mosaic—contrast-matching to an ideal Equalize or Normalize histogram, or using the Apply Contrast toggle button. These operations transform the cell values in the individual input rasters to new, adjusted cell values in the mosaicked raster object. Now, when you use any of these procedures, a new Linear contrast table is automatically created for these altered values in mosaic to insure that the applied contrast is cor-

rectly displayed. This new contrast table is saved and used as the default when the mosaic is displayed in the Mosaic Result window, the **TNTmips** Spatial Data Display process, or other processes that use the display interface. The existence of this new Linear contrast table prevents displays of this mosaic raster from applying an additional automatic enhancement, such as Auto Normalize, that might alter the intended appearance of the mosaic.

Set Contrast with a Reference Raster.

If you contrast-match to a reference raster that has a contrast table and choose not to apply a new contrast, the reference contrast table is copied automatically to the mosaic, insuring proper contrast-enhanced display of the mosaic.

More Tie Point Options.

Manual Positioning.

Mosaic can combine rasters that are not georeferenced. Improvements have been made to assist you in properly placing tie points in the overlap area of each input raster. For example, you can now manually enter or edit the line and column positions of the points you select in the Tie Points window.

Snap to Cell Center.

An option is now available to automatically snap each tie point to the center of the cell in which it falls. Use the Snap Tie Points to Cell Center toggle on the Options panel of the Tie Points window.

Saving RMS Adjustments.

The Root Mean Square (RMS) errors computed during the bundle adjustment of tie points and georeference control points can be optionally saved to a text file for further analysis.

Snapshot Option.

An option has been added to the View menu to save a snapshot of the View window.

Import/Export.

Raster Import/Export.

LizardTech's MrSID.

A MrSID file can contain either an 8-bit grayscale image or a 24-bit color composite RGB image. No other data types or multiband images are supported. Please understand that these limitations on data types and the associated wavelet compression strategy limits its use to the compression, movement, and storage of pictures.

Import.

MrSID files can be imported into an internal raster object in a Project File even though **TNTmips**, **TNTedit**, **TNTview**, **TNTatlas**, and **TNTserver** can now directly use MrSID files. The detail in the imported raster object will be that which was specified when it was compressed into the MrSID file, but its size will be larger. Any raster created by a **TNT** procedure using MrSID files, whether imported or not, will be saved as an internal raster object and can not be exported to MrSID.

Export.

LizardTech, the developer of MrSID image compression format, provides licenses and libraries without charge for other software developers to use to incorporate into their products the capability of reading files in the MrSID formats. They make their money by charging for their "compressor" software to compress raster files into MrSID format from GeoTIFF and several other public domain formats. You must license the compression software for these raster formats directly from LizardTech, and it is expensive. To compress files of 3 megapixels or less (typical for a digital camera) you can download a free program from their site at www.lizardtech.com.

MicroImages has been informed by LizardTech that they do not have libraries that developers can license or any documentation of same to permit direct export into MrSID format. Even if they did, this would only result in an expensive optional module for this export only. The only products we know of that appear to directly export into the MrSID formats are ERDAS Imagine and Adobe Photoshop and you must obtain an optional module from these developers to do this export. ERDAS sells this option in 3 levels based upon input file sizes: up to 50 Mb of pixels, 50 Mb to 500 Mb of pixels, and no pixel limit. From this grading one might assume that the unlimited pixel conversion is expensive.

ER Mapper's ECW.

A single ECW file can contain any number of 8-bit integer images. Thus, an ECW file can contain a single grayscale image, 3 coincident RGB images making up a color composite, multiband images, or any other set of images with a common extent, cell size, ... No other data types (16-bit, real, …) are supported.

Import.

ECW files can be imported into an internal raster object in a Project File even though **TNTmips**, **TNTedit**, **TNTview**, **TNTatlas**, and **TNTserver** can now directly use ECW files. The detail in the imported raster object will be that which was specified when it was compressed into the ECW file, but its size will be larger. Any raster created by a **TNT** procedure using ECW files, whether imported or not, will be saved as an internal raster object.

Export.

ER Mapper provides a library without charge for the compression into a single ECW file of rasters totaling up to 500 megapixels in size (before ECW compression). This library has been incorporated into **TNTmips** and **TNTedit** to export an ECW formatted file. Appropriate raster objects (8-bit per pixel) can be exported into a single ECW file. For example, a 24-bit color composite raster object can be exported in a single operation since it is actually 8-bit RGB images. Options are also provided to export contrast tables and color palettes if they are available.

This 500 megapixels size limits by counting the total pixels of all the uncompressed **TNT** raster objects exported to a single ECW file. For example, If you export separate RGB rasters of 1-byte per pixel, then each must be less than 500/3 megabytes. If you export a single 8-bit DEM raster object it must be no bigger than 500 megacells. To compress raster objects greater than 500 megapixels requires the use of ER Mapper's commercial image processing product.

JPEG 2000 Planned.

A suitable, general JPEG 2000 function library is now available for public use. MicroImages will add JPEG 2000 wavelet compression support early in the evolution of **V6.70** of the **TNT** products. Please check with MicroImages' support or at microimages.com for the status of this important addition. It appears that this library for JPEG 2000 will permit the direct use of auto-linked files, multiple data types, greater than 3 image bands, and other important features, and support its import and export to/from raster objects of any size. In addition to these expanded features, JPEG 2000 should provide the same compression as other wavelet based approaches free of legal entanglements. It will also be widely used in many image-oriented applications, starting with video storage and transmission products. It is the agreed upon replacement for JPEG and has already been implemented in the first silicon chips for use in TVs, recorders, and other consumer equipment.

SML.

When an SML script is used to import any supported raster format, the raster object it creates can now be compressed using the **TNT** supported compression methods. All SML import functions now have parameters to use to control compression or no compression.

DEMs and SDTS in Particular.

Previously **TNT** applications using Digital Elevation Models (DEMs) were limited to 8-bit integer raster objects with an offset or 16-bit signed integer rasters. The signed 16-bit version permitted any real earth surface elevation or ocean depth to be preserved without offset to the nearest 1 foot or meter relative to mean sea level. Other **TNT** processes that operated upon rasters containing only elevation models (for example, 3D perspective views or GeoToolbox region operations) expected them to be only in these integer formats and rejected any other data types.

Rasters containing DEMs are increasing in accuracy due to more accurate GPS signals, LIDAR mapping, laser and other custom mapping operations in individual agricultural fields, and other operations. Recently several different rasters were encountered that contained real mean sea level elevation values in decimeters and as decimals of feet and meters. For example, a revised SDTS format for USGS recorded elevations in decimeters and a locally produced DEM made to model microdrainage in a single crop field claimed accuracy to the nearest inch. Now the processes that import DEMs, and the SDTS import in particular, determine and use the appropriate numerical data type for the DEM raster object being created including floating point. Processes used only with elevation raster objects were also modified to accept and process these expanded DEM data types.

ESRI's BIL/BIP.

During import a separate Arc "World" file will be automatically located, if available, and used to provide georeference information when this information can not be located within the header for the BIL/BIP file.

ERS-2. ERS-2 Raster format.

European RADAR Satellite-2 raster format can now be imported.

ADRG - Save Georeference for “Overview” Image.

When NIMA’s ADRG (Advanced Digital Raster Graphics) files are imported, a 2nd raster object containing an overview image is also created. Now the georeference information for this reference image is also retained.

GeoSPOT.

The GeoSPOT image format can now be imported

IDRISI32.

The IDRISI32 raster format can now be imported (for Clark University’s IDRISI system).

ILWIS.

The MPR raster format is imported (for the ILWIS package from ITC in Delft).

NTF-DTM 2.0.

The National Transfer Format for Digital Terrain Data (NTF-DTM 2.0) raster format can now be imported. This is the Digital National Framework format in which the U.K. Ordnance Survey sells data.

ENVI.

ENVI image files may contain empty spectral bands. When they represent missing hyperspectral images, skipping them on import can cause complications in the **TNTmips** hyperspectral analysis processes. Now deleting the empty bands is optional during import.

ER Mapper.

If a new projection is encountered during the import of ER Mapper images, you are now prompted to enter its defining parameters. This happens when ER Mapper adds support for new projections.

TIFF.

The added information that expands a TIFF file into a GeoTIFF file can be ignored, and it will be imported as a simple TIFF file.

MODIS.

NASA’s MODIS HDF raster format can now be imported.

Vector Import/Export.

ESRI’s Shapefiles.

The import and export of shapefiles will now handle 3D coordinates.

If a projection file (*.prj) accompanies the shapefile (*.shp), the projection information it contains will be imported.

When a **TNT** vector object is exported to a shapefile, a projection file (*.prj) is automatically created with the associated projection information.

When setting up the import of a shapefile you are provided an option to explode the multi-part elements. If this option is used, each multi-part element will be converted in the **TNT** CAD object into multiple single part elements. A typical multipart element in a shapefile would be multiple polygons of the same identical type. Using this new option for importing them would separate these polygons in the CAD object into separate polygons with the same attributes. This would permit their separate selection and editing within the Spatial Data Editor where a typical activity would be to change or add to their

attributes to update or otherwise separate them. For example, to change the land cover identity of a polygon whose use has been found to be altered from an orthophoto upon which it is overlaid.

At the conclusion of the import of a shapefile, you will be warned if the number of elements does not equal the number of database records.

ESRI's Coverage.

A new and more intuitive directory selection procedure is provided for the creation of a coverage and the export of files into it.

NTF-VECT 2.0.

The National Transfer Format vector format (NTF-VECT 2.0) can now be imported. This is the Digital National Framework vector format in which the U.K. Ordnance Survey sells data.

CAD Import/Export.

AutoCAD DXF Internationalization.

AutoCAD DXF import will now correctly determine the code pages the document was saved in and convert the string information it contains to Unicode so that the original language used in the DXF file is preserved in the **TNT** CAD object. It will also automatically assign the "Arial Unicode MS" font to the style information for this CAD object so that the database tables and text labels show up correctly in the original language. (This Arial Unicode font contains characters for almost every language.)

AutoCAD DXF export will now allow the selection of a character encoding for the DXF file. The setting for the character encoding is placed into the DXF file during its export. Database information and text elements are converted and saved in the selected encoding. In this fashion, CAD objects created or used in a **TNT** product in your language can be transferred to AutoCAD in your language.

Surface Modeling.

The name of the option Optimize TIN structure available in the TIN generation process was changed to "Simplify TIN Structure." This minor change was made so that it is clear that this option removes some extraneous points from the TIN object that it created.

Transfer Attributes.

The attributes of source lines selected by any method in a vector object can optionally be automatically transferred to all lines in the destination vector object that fall within a specified distance of each source line. The default is to transfer attributes from the source line only to the nearest destination line.

CAD to Vector Conversion.

During conversion of a CAD object to a vector object, by default the vector object's structure is optimized.

Merge Vector Objects.

When multiple vector objects are merged, by default the new vector object is optimized.

Point Density Mapping (a prototype process).

Not Surface Fitting.

Surface fitting is applied to georeferenced swarms of irregularly spaced points to convert a value associated with them to a raster object. The Z value of the selected points or any other value associated with them that is selected from their attribute record can be used. This converts them to a regularly spaced grid of points, the value of the raster cells, that best preserves the position and value of the original points and interpolates values for every other cell in the grid. However, in all cases the value of the points selected to be fit with the surface is assumed to be at least relative. That is to say, all values used will lie somewhere along a common numeric scale. Typical examples of these would be Z values collected to represent elevations or fields in attribute records such as gross sales.

Mapping Occurrence Only.

Many kinds of surveys conducted with a GPS unit result in swarms of georeferenced points that have no Z value, or it is of no significance to the spatial analysis proposed. If the points have records attached, the records may have fields of interest that have no relative value and contain only nonparametric information. In the simplest case, you may have only the X-Y locations of events such as a disease occurrence, a plant occurrence, or a store location. Many kinds of useful additional true/false or categorical information may occur in the attribute record, such as the presence of a pottery shard, the presence of a particular plant species, a store that sells a particular brand, or the kind of dwelling in which a disease occurred. These kinds of nonparametric values can also be converted into surfaces that can then be included in spatial analysis, such as multiple stepwise linear regression to determine the cause of their presence or absence from other spatial variables.

Selecting Input Points.

A new point density process is provided to convert non-parametric values associated with georeferenced points in a vector object into a raster object. The attached color plate entitled Point Density Rasters illustrates the application of this new process. A query of their attributes can be used to select the specific points to be used from all the points in the selected vector object. Also, remember that you can use a computed field in any **TNT** query. By using computed fields, parametric values associated with each point in their attribute record can be combined and used in a query to determine if a point is to be used. For example, suppose you only want to include stores that have sales of a particular product but only sales of that product in a narrow range of values per square foot of total floor space. However, the sales of that product and the total floor space are provided as separate fields. Rather than manipulate the attributes to form new fields, simply define a computed or virtual field for the sales of that product by square foot and select the points based upon the desired range of this computed field. This same kind of result could also be accomplished from these attributes by a properly structured query. Once computed fields are defined, they are available for all processes and can sometimes be easier to construct than complicated queries.

Defining the Output Raster.

Once the input points have been defined, the location and the cell size of the output raster object and its data type are specified. The extent of the new raster object will

match that of the source vector object. You then select a radius that will specify how far to search around the center of each raster cell to count input points. That value representing the density of the input points at that position is then recorded for that cell. Those cells with a radius containing no input points can optionally be filled with 0 or with a null value.

Some of the considerations needed when using this procedure are outlined in more detail in the color plate entitled Point Density Rasters. Some point surface modeling procedures weight the value of each point by its distance from the raster cell being created. This point density function merely counts the points that meet the query criteria. Further modifications of this point density function could be made to permit the value returned to be weighted by the distance from the point within the radius to control its contribution to the density. In other words distant points contribute less according to the inverse of their distance from the cell center, the inverse square, or other options.

Layouts.

More Attractive Legends.

V6.50 provided new features for making layouts to assist you in managing the contents of groups, especially legend text and structure. **V6.60** follows this up by providing new controls to frame and matte groups and to more conveniently add neat lines and other borders to your layouts. These new layout options are provided on a new Matte tab panel on the Group Settings window for internal groups and under Layout/Options for the whole layout. A color plate entitled Matte Graphic Effects in Layouts is attached to illustrate these controls and some of these new border and matte features.

Borders.

Legend blocks and any other group can now have a variety of borders added around them of any width, color, and margin. Choose from the following line styles for the frame for each of your groups: solid, double, inset, outset, etched in, etched out, groove, ridge, or rounded. The appearance of each of these frames is illustrated in the attached color plate entitled Matte Graphic Effects in Layouts. Drop shadows can also be added to any frame or border. The color, width, angle, and a blending option can be controlled for the drop shadow. You can even use CartoScripts to create scalloped, curvilinear, or irregular frames and borders.

Matte Fills.

Now that you can frame your legends and other groups you may want to add a background matte to highlight their interior. For example, a pastel matte will accent the background of the legend and its style and background elements on a white map background. Or, when a legend or group is inserted in a solid color area, such as a blue ocean, a plain white legend background can often be too glaring and stark and should be toned down by the use of a color matte.

Any color or gray (hereafter referred to merely as color) can be selected for the group's matte using the new Matte tab panel. If 2 colors are selected the matte can spread, shade, or transition within the legend box between these 2 colors. This is called a gradient matte and can vary between these colors from 1 side of the group's area to the other or radially from the center outward to the edge. For a regular gradient, you merely specify the angle (0 to 360 degrees) of the gradient and this will automatically choose the most extreme positions in the legend box at this angle as the starting point

for color 1 and the ending point for color 2. When a radial gradient is selected, color 1 will occur in the center of the legend box and color 2 will be used at the corner. Choose from the following color models to control how color 1 will transition to color 2 in your gradient: RGB, HIS Clockwise, HBS Clockwise, and HBS Counterclockwise. The attached color plate entitled Matte Graphic Effects in Layouts illustrates a variety of mattes including gradient and radial.

Neat Lines.

Neat lines and other kinds of borders can now be drawn around the entire layout. The layout can also have a matte fill background for any area not contained in an embedded group. As noted above, these groups can have their own borders and matte fills or can be transparent, showing the overall layout's matte.

Spatial Data Editor.

Tracing Elements Between Layers.

V6.50 provided the ability to snap new lines being created in the active layer so that they terminate exactly on lines in some other layer, for example, to insure that property lines of a parcel terminated on a river or polygons already existing in some other layer. **V6.60** provides a complementary important feature to auto-trace and copy portions of lines and polygons from other layers into the editable layer. The portion of the elements traced and added to the active layer has new start and end points and may simply be added as part of some new element in the active layer. The traced portion common to the 2 layers has exactly the same vertices.

This new auto-trace option is illustrated in the attached color plate entitled Auto-Tracing Vector Line Segments. It can be used at any time during a line or polygon edit operation. For example, if you are drawing a new line that you snap to a feature in another vector layer, you can now simply continue on to add to your line by tracing part of the feature to which you have snapped. To add a traced portion to a line, enter the auto-tracing mode by choosing the new "Auto-Trace" icon in the "Mode" section of the "Line/Polygon Edit Controls" dialog. While in this mode, simply click somewhere on the line in the reference layer and the tool will "pick up" that section of the line between the snap point or any previous click in the tool and extend the trace to the new position. When you have finished tracing, or picking up, the portion of the feature of interest, simply choose another edit mode and continue drawing or otherwise extending your new line or polygon feature. You can toggle in and out of the tracing mode as many times as needed.

If you select a point to auto-trace to that provides more than 1 route through the reference vector object, it will not proceed (for example, around both sides of a polygon or bubble in the line). You will then have to select a new shorter segment that specifies the desired route (in other words, click on the leg you wish to take around the polygon and click again on the far side of the polygon). Sometimes you will think that auto-trace is not working as it will not proceed across a node to the point you have selected on the line on the far side. If you zoom up on this node, you will find that it is actually a polygon or bubble in the line and the trace is waiting for you to click on one route through it in your zoomed in view before it can proceed.

The attached color plate illustrates how in a single sequence of operations a parcel (which means, a polygon) can be created in a new vector layer using drawing together with snapping and tracing from a second layer. In this example, the north and south

boundaries of the property are drawn in, perhaps along visual boundaries in a reference orthophoto. The east and west edges are auto-traced and copied from a road layer and a river layer. This entire new polygon can be created in 1 continuous sequence of steps that go something like this: select drawing mode, select road layer, snap starting point to road, draw north edge, select river layer and snap to it, select trace mode and trace river boundary, select drawing mode and snap to end of river trace, draw south edge, select road layer, snap to road, select trace mode, trace road to north starting point, and close the polygon.

Multiple Reference Views.

The Editor can now open additional GeoLocked reference views of the area being edited. These views are for reference only and are automatically GeoLocked by default to the edit view for the same scale and center point. However, a reference view can provide some other arrangement of the layers in the edit view or other layers for the same area (for example, other images) that are not drawn in the edit window. These views are for reference purposes only and can not be used for editing. However, any time a feature is added by editing, the reference views can be redrawn and that new feature will be added to the reference view if it shows the edited layer.

The purpose of additional reference views in the Spatial Data Editor is to provide more information or to clarify the results of an editing operation. The partial color plate entitled GeoLocked Views in the Editor illustrates how a reference view can simplify the results of using multiple vector editing steps, including tracing, to assemble a land parcel from a multiple layered composite view. In this example the reference view presents only the new vector layer being created. Thus, it can be used to carefully inspect the parcel outlines that are being assembled in this new layer before proceeding or using undo. Another approach would be to present some other airphoto or reference image in a reference view to aid in identifying features being interpreted from the edit view. An even simpler application would be to use a grayscale version of a color image in the edit view while the reference view presents the identical color image. It is always hard to see what you are drawing on a color image, so edit on the grayscale version while deciding what boundaries to create (which means, what things are) using the matching color image in the reference view.

Spatial Manipulation Language (SML).

New SML Reference Booklet.

The attached color plate entitled Be Creative with SML summarizes the kinds of scripts you can create to extend the functionality of your **TNT** product for special applications. The SML reference booklet entitled Getting Started: Writing Scripts with SML has also been revised and updated. Sample scripts are reviewed in this booklet and illustrate each of these approaches to extending **TNTmips**, **TNTedit**, **TNTview**, and **TNTatlas**. Some of these are complete scripts with a specific purpose, and some are merely examples of how to approach various tasks in your script. However, they all provide sample script templates with approaches and segments that you can modify and/or incorporate into your unique script. For example, new sample scripts are provided to show how to set up an interface for selecting objects, how to interactively select the nearest point in a view, how to draw a line, and how to plot a profile of information associated with the line in any layer. Each of these and other new samples represent SML script segments that are common and for which help has been requested by some user learning how to

create a script containing these common operations. Tool Scripts permit you to create a script and add it as an icon to provide a special interactive tool or set of tools unique to your profession and needs. Typical Tool Script components are illustrated by the sample scripts introduced below. MicroImages is willing to provide similar public, generic SML sample scripts for commonly used operations for those who are capable of incorporating them in their own custom applications.

Sample Scripts.

Select Nearest Point *(included on CD)*.

A typical custom SML tool will often start by providing for the interactive selection of a vector element and/or its attributes from the active layer and then use it to act on some other layer(s) associated with it. Since this is a Tool Script, it will appear as an icon on the toolbar of the View window. An example of this kind of script is illustrated in the attached color plate entitled Sample SML Tool Script: Select Point. As a Tool Script, it becomes an integral part of the view. Thus, all of the powerful **TNT** visualization techniques become part of your tool as they can be used to create the composite multiple layer view and active layer that this tool will operate upon when selected. This sample script will find the nearest point element in the active layer if that layer is a vector object with points.

This short sample script merely locates and highlights the selected point element. Your extension of this script would use the geoposition of this interactively selected point to continue on to perform your custom operation for that point. This might be anything you wish to do with this point, its attributes, any other data at this position in another layer in the view or a layer not in the view. For example, you could save or display information about the point, move the point, delete it, edit its attributes, average raster values about this position in a raster layer in the view or one that is not displayed, and many, many other special operations. This sample script can also be very easily modified to allow interactive selection of the nearest line element and the nearest or the enclosing polygon.

Display a Raster Profile (included on CD).

Another typical operation at the startup of a Tool Script operation is to interactively draw a line on the view. Once this line has been created in the Tool Script, it can continue on to use the line in a wide variety of operations. The attached color plate entitled Sample SML Tool Script: Raster Profile illustrates a tool that creates a line and uses it to open a window with a profile of that line. In this example, the interactive line is created, the map coordinates of the positions it crosses are determined, and values determined from a coincident raster are plotted in a graphical profile window. A similar interactive profile tool is already provided in the **TNT** GeoToolbox, however, its use and properties are simple and fixed. This sample SML Tool Script is available to provide the basis for your implementation of profile analyses that are either more specialized to your needs or more complex.

The client who requested this sample tool has already refined this script for use in a military communication application requiring information about terrain clearance between 2 points. Their expanded tool provides additional profile data and displays it in a graphical window mimicking the layout and data provided by some other program already in use for this purpose but that is not as interactive or flexible. In their modified version of this script, other characteristics of the profile of an elevation raster are computed and displayed. These include such path information as maximum, minimum, minimum clear-

ance of the terrain between the end points, and other line-of-sight characteristics. These address questions related to the reliability of radio, laser, and other communications between the end points selected for the line. Since this Tool Script is started from an icon in a View window, multiple GeoLocked views can be open, one with the terrain, as shown in the plate, and one with a vegetation map. Their script could then be modified to create and maintain the line in each view. This would allow the user to interactively position the end points for suitable terrain clearance while placing them in an appropriate concealing vegetative cover.

This script could next be extended so that for any position of the line, push buttons in the profile window or some other dialog would use the viewshed functions in SML to compute the viewshed and exposure of the current end points of the line. The script could then plot the view or exposure in color (for example, in red and blue) around each end of the line in the elevation raster and the vegetation raster to determine their suitability for use as observation points. With these additions, the Tool Script could be used in cell tower network extension where one end of the line is fixed by an existing tower location and the next tower outward should be sited for maximum coverage and minimum visual impact. In this application, the viewshed and exposure for the new tower could be plotted in the 2nd window showing current land use and zoning instead of vegetation. Moving one end of the line around in the tool would interactively evaluate available potential high elevation positions that maximize present and future coverage (the viewshed of the position versus land use) with a minimum of scenic impact (the exposure of the point versus land use).

Many other modifications could be made to easily extend the use of this simple Tool Script for interactive analysis combining layers in the view with other raster and vector objects with a common extent. The simplest extension would be to add multiple color lines derived from other layers to the profile graph. For example, this script can be quickly modified to show a solid color profile line for several raster layers (elevation, slope, …) and a segmented vertical color bar for each vegetation polygon in a vector layer (with the colors matching the polygon colors). This provides a simple means of visually comparing vegetation, land use, and other attributes along any transect created with the line.

For those who want more than simple graphical results, complex statistical and geospatial analyses can be implemented in the script for the interactively selected position of the line. This kind of extension to the script can act on multiple variable profiles easily extracted from the layers in the view or other raster, vector, CAD, or TIN objects and their associated attributes. To include objects not in the view at the start up of this Tool Script, you would add the SML subsection needed to navigate to and select objects from Project Files. This subsection of SML script can be found in other sample scripts. Use this to select objects that are not viewed but are to be used in your profile analysis.

Modifications since **V6.60** CDs.

The Select Nearest Point script described above has been modified to show how to select the nearest point, nearest line, and/or a polygon. This revised Select Nearest Element script can be downloaded from microimages.com.

New Functions.

The 13 new functions and 12 new classes outlined below have been added to both **SML**/X and **SML**/W.

Raster functions. (1)

RasterApplyContrast2

Applies a contrast table to a raster.

Georeference functions. (1)

CreateControlPointGeorefDefaultAccuracy

Same as CreatedControlPointGeoref but without accuracy parameters.

CAD functions. (2)

CreateCAD

Create a CAD object.

OpenCAD

Open a CAD object given a filename and object name.

TIN functions. (1)

CloseTIN

Close an open TIN object.

Geodata Display View functions. (1)

ViewRedrawDirect

Draw view directly with draw flags.

Geodata Display functions. (4)

DispQuickAddCADVar

Quick -add a CAD object to a display window given a CAD variable.

DispQuickAddTINVar

Quick -add TIN object to a display window given a TIN variable.

GroupQuickAddCADVar

Quick- add a CAD layer to a group given a CAD variable.

GroupQuickAddTINVar

Quick -add a TIN layer to a group given a TIN variable.

Database functions. (1)

TableAddField

Append a field to a table.

Database Editor functions. (2)

DBEditorCreate

Creates a DBEDITOR handle for a given database. Note: if you have a layer, it's best to call DBEditorDestroy( ).

DBEditorDestroy.

Destroy a DBEditor handle created by DBEditorCreate( ).

New Classes.

SML scripts can now make use of arrays of classes. To do this, you just declare your class variable with a subscript like so…

```
Class POINT2D points[10];
```

This would declare an array of 10 points. Subscripts in SML always start at 1.

Import/Export classes.

The following Import/Export classes have been added to SML:

MieMrSID
for the MrSID wavelet compressed raster format of Lizard Tech

MieECW
for the ECW wavelet compressed raster format of ERMapper

MieHDFASTER
for the Hierarchical Data Format – ASTER

MieIDRISI32
for the IDRISI32 raster format

MieILWISR
for the ILWIS raster format

MieSRTM
for the SRTM elevation raster format

MieNTFR
for the NTF raster format of the British Ordinance Survey

MieNTFV
for the NTF vector format of the British Ordnance Survey

MieCTG
for the CTG raster format

MAPPROJ – Map Projection Parameters
This class is not new, but it now has methods for setting projection parameters. This makes the class easier to use and more self-documenting.

FFTID – Linear Fast Fourier Transform (FFT)
Forward: do a forward FFT
Inverse: do an inverse FFT

STRING – Text String
The STRING class is a more modern way to declare a string. In the past, the only way to declare a string was to end the variable name with a dollar sign. This was a convention lifted from the old BASIC language, that much of the original SML syntax was based on. Variables of both types may be passed to functions that require strings, but the new class has some added benefits. First, since it *is* a class, you can declare arrays of *class STRING*. String variables declared the old way do not allow for arrays of strings due to the way their internal storage is implemented. Second, as a class, it can have members and methods.

It has the following members and methods, that mimic the JavaScript String class:

Length
Returns the length of the string.

charAt (n)
Returns the nth character in a string.

charCodeAt (n)
Return the Unicode value of the nth character in a string.

indexOf (substr, start)
Return the 0-based index of a substring within a string (-1 if not found)

lastIndexOf (substr, start)
Return the 0-based index of a substring within a string starting at the end (-1 if not found)
toLowercase ( )
Returns a copy of the string in all lowercase. The string itself is not changed.
toUppercase ( )
Returns a copy of the string in all uppercase. The string itself is not changed.
slice (start, end)
Returns a part of a string.
substr (start, end)
Returns a part of a string.

Upgrading.

If you did not order **V6.60** 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 6.6**.

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 current version of **TNTmips** relative to **V6.60,** 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**:					**V6.00**
	V6.50	**V6.40**	**V6.30**	**V6.20**	**V6.10**	and earlier
Windows/Mac/LINUX	$500	750	950	1100	1250	+150/each
for 1-user floating	$600	900	1140	1320	1500	+180/each
UNIX for 1-fixed license	$800	1250	1650	2000	2250	+200/each
for 1-user floating	$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**:					**V6.00**
	V6.50	**V6.40**	**V6.30**	**V6.20**	**V6.10**	and earlier
Windows/Mac/LINUX	$600	900	1150	1400	1600	+150/each
for 1-user floating	$720	1080	1380	1680	1920	+80/each
UNIX for 1-fixed license	$900	1400	1850	2200	2500	+200/each
for 1-user floating	$1080	1680	2220	2640	3000	+240/each

Installed Sizes.

Loading **TNTmips 6.6** processes onto your hard drive (exclusive of any other products, data sets, illustrations, and so on) requires the following storage space in megabytes.

	for **V6.50**	for **V6.60**
PC using W95, W98, WME, NT, W2000, or XP	80 Mb	82 Mb

PC using LINUX (with Intel) kernel 2.0.36 to 2.4	107 Mb	114 Mb
Mac using Mac OS 8.x or 9.x	84 Mb	90 Mb
SGI workstation via IRIX	141 Mb	153 Mb
Sun workstation via Solaris 2.x	116 Mb	125 Mb
IBM workstation via AIX 4.x (with PPC)	164 Mb	176 Mb

V6.60 of the Online Reference Manual in PDF, including illustrations, requires 52 Mb. Installing all the sample geodata sets for **TNTlite** and **TNTmips** requires 202 Mb. The 65 Getting Started booklets require a total of 126 Mb. The sample TNTsim3D landscape files require a total of 69 Mb.

Internationalization and Localization

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

Translation of Booklets.

Various experienced MicroImages clients are now participating in a program to do the initial translations of the Getting Started booklets available to their nations. The attached color plate entitled Translated Getting Started Tutorials illustrates the covers of typical translations. There are currently 21 **TNT** languages and 65 booklets so this is a major effort. However, many of the booklets have already been translated previously in complete or in abridged form into Japanese, Turkish, Thai, and Korean. A few of the most important booklets have recently been translated into Spanish, Italian, Finnish, German, French, and Dutch. Negotiations are underway for the possible translation of selected booklets into Chinese, Arabic, and Croatian. You can determine which booklets are available in your language and obtain them from the “Downloads” listings at microimages.com.

Operating Languages.

New.

The **TNT** products can now be operated in Tagalog and Hungarian.

Significant Improvements.

A new translator has been selected to improve and bring up to date the Arabic operation of the **TNT** products.

The Italian interface for the operation of the **TNT** products has been substantially improved and updated.

Possible New.

Official translators for the **TNT** product interfaces have been selected for the following additional languages: Farsi, Serbian, Croatian, Bosnian, and Slovenian. Discussions are underway for the possible addition of Georgian and Icelandic.

Not Current.

The translation of the interface files for Indonesian operation can not currently be issued for **V6.60** and a new official translator is needed.

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Citradata Intersystem, PT. [Eko Rafia Iswantioro] located in Jakarta is discontinued.

Papers on Applications

Turkey Taps Diverse Processing Tools to Build Frequency Management Center. Kevin P. Corbley. EOM, V 10, No. 11, November 2001. pages 25-28.

[This article discusses and illustrates a product developed in Turkey using the **TNTsdk** (Software Develop Kit) by the Communications and Spectrum Management Research Center at Bilkent University in Ankara. This product integrates geospatial analysis with Oracle and Sybase for managing and monitoring frequency spectrum allocation and compliance. The complete text of this article can be found at http://www.eomonline.com/Common/currentissues/Nov01/corbley.htm but for some reason the useful illustrations are omitted from their online articles, silly, but perhaps they can not afford the drive space?]

Rates of Clearing of Native Woody Vegetation. 1997-2000. prepared for New South Wales Department of Land and Water Conservation. prepared by Environmental Research and Information Consortium (ERIC), Canberra, Australia. March 2001. 33 pages including color plates.

Rates of Clearing of Native Woody Vegetation. 1995-1997. prepared for New South Wales Department of Land and Water Conservation. prepared by Environmental Research and Information Consortium (ERIC), Canberra, Australia. December 1997. 50 pages including color plates.

Rates of Clearing of Native Woody Vegetation. 1995-2000. prepared for New South Wales Department of Land and Water Conservation, Centre for Natural Resources. prepared by Environmental Research and Information Consortium (ERIC), Canberra, Australia. May 2001. 11 page summary report including color plates.

[these reports can be found at http://www.dlwc.nsw.gov.au/care/veg/technical/eric/]

Rule-based Integration of Remotely-sensed Data and GIS for Land Cover Mapping in NE Costa Rica. by Kenneth L. Driese, William A. Reiners, and Robert C. Thurton. Dept of Botany, Univ. of Wyoming, Laramie, WY 92071-3165. Geocarto International, V 16, No. 1, March 2001 pages 35-44. email kdriese@uwyo.edu

Abstract: A classification method was developed for mapping land cover in NE Costa Rica at a regional scale for spatial input to a biogeochemical model (CENTURY). To distinguish heterogeneous cover types, unsupervised classifications of Landsat Thematic Mapper data were combined with ancillary and derived data in an iterative process. Spectral classes corresponding to ground cover types were segregated into a storage raster while ambiguous pixels were passed through a set of rules to the next stage of processing. Feature sets were used at each step to help sort spectral classes into land cover classes. The process enabled different feature sets to be used for different types while recognizing that spectral classification alone was not sufficient for separating cover types that were defined by heterogeneity. Spectral data included TNT

reflective bands, principle components and the NDVI. Ancillary data included GIS coverages of swamp extents, banana plantation boundaries and river courses. Derived data included neighborhood varieties and majority measures that captured texture. The final map depicts 18 land cover types and captures the general patterns found in the region. Some confusion still exists between closely related types such as pasture with different amounts of tree cover.

Extraction from section on methods: Although the scene was largely cloud-free, significant areas of cloud (5.5%) existed in the west-central and northern part of the area. A cloud and cloud shadow mask was developed using both TNTmips (MicroImages, Lincoln, Nebraska) and Arc/Info (ESRI, Redlands, California). The TNTmips Feature Mapping process and all reflective TM bands to automatically map the central portions of clouds with manually selected sample points as input. The cloud raster was converted to a polygon coverage (Arc/Info), and cloud polygons were buffered with a 57 m distance (2 pixels) to capture the cloud fringes. The resulting buffered cloud coverage and an offset coverage for cloud shadows was hand-edited to insure complete cloud and cloud shadow masking.

Specific processing steps are outlined in Table 2 and are listed by cover type in Table 3. All unsupervised classification was accomplished using TNTmips and all subsequent sorting of resulting spectral classes was performed using the Grid module in Arc/Info. … [Using old version of TNTmips before GIS capabilities were completed.]

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 present 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.]

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 (versions 3.1 and 3.5 are error prone, and thus 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 1 available but is not recommended unless you are having problems with your installation.

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 10.1 = Apple Macintosh using Mac X version 10.1.

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 for requests from either X/Motif or Windows.