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Release of V5.60 TNT products

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Introduction

Microlimages is pleased to distribute **V5.60** of the **TNT** products and the 41st "quarterly" release of **TNTmips**. During the past quarter, there were no special problems in the **TNT** products. Everyone at Microlimages did enjoy a Holiday season, which was the first in nine years that did not have to be devoted to preparation for the Annual Users' Workshop.

V5.60 software development proceeded more or less on schedule. Even more importantly, most of this software effort was concentrated upon advancing the geospatial analysis tools in the **TNT** products. Each successive quarter, Microlimages is able to concentrate more and more energy on adapting, and occasionally even inventing, new analysis tools.

Summary of New Features.

The Project File now supports importing and saving raster objects in compressed form. **RLE** lossless compression is available for binary rasters; **DPCM** lossless compression is available for all except color compressed rasters; and **JPEG** compression is available for lossless and lossy compression.

The drawing tools in the object editor, display, and elsewhere now allow the creation and editing of multi-points, multi-lines, and multi-polygons. This is specially valuable in direct editing, in directly drawing regions, or in selecting complex areas.

Vector and **TIN** layers can now be viewed in **3-D** and stereo separately or in superposition over a draped raster layer. When a **TIN** object is selected for viewing in **2-D** or **3-D**, it can be displayed as a **TIN** or converted and displayed as contours (isolines), or a combination of both.

The six different types of Element Selection dialogs in various processes have been standardized into one. This composite dialog has been simplified in appearance, and several new global tools have been added.

The Spatial Data Display and the Object Editing processes have a powerful new vector extraction capability. Any region created in these processes can be used to immediately extract a vector layer. Clipping to the inside or outside of a region can now be applied as part of this extraction (added to existing for modes of completely inside, completely outside, partially inside, and partially outside). The new extracted layer will have corrected attribute tables, including a recomputed standard attribute table (e.g. areas, perimeters, etc.). The editor will then allow immediate editing or saving of this layer as a new vector object.

Prototype regions can be interactively generated in Spatial Data Display, Object Editor, and new Raster Extract processes by eleven interactive methods: selected polygons, polygon fitting, buffer zones, viewsheds, raster thresholding, Voronoi polygons, basin growing, flooding with a dam, raster cells, texture growth, and point clustering. Once the prototype has been adjusted to fit the requirements, it can be immediately made into the active region for immediate application for selection, extraction, etc. from other layers.

TNTlite can extract a subarea ("lite-sized" object) when importing any vector format supported. Similarly, **TNTlite** can apply a query to an external database table when importing it in order to reduce the portion actually imported to a lite-sized object.

The Import process now supports **ERDAS** Imagine 8.x, compressed **JPEG**, **NLAPS**, **ERS (RADAR)**, **IRS** (Indian), **DISIMP**, latest modifications to the **ESRI** coverage format, **3-D MOSS**, and **ODBC** data sources. Compressed **JPEG** can now be exported.

All object types can now be edited directly in place. Unattached records can be filtered out of attribute tables during editing. As noted above, a new vector object can be extracted with any region, even when the clipping operation is selected. The new object will have correct attribute tables.

A new Raster Extraction process replaces the Copy Raster and Manual Resampling processes. It provides all the region generation tools and applies regions (cookie cuts) when extracting and creating new raster objects. All projection changes and attribute adjustments are completed during extraction.

The concept of the Wallis filter has now been expanded to apply to color images using a Locally Adaptive Contrast Enhancement approach. This procedure enhances a color image to bring out shapes in low or high contrast areas without significantly altering its color balance.

A more accurate iterative method is used in the Surface Modeling process for the conversion of an elevation raster object to a **TIN** object. The new method allows the input of the accuracy with which the **TIN** must approximate the elevation surface. It then iterates on the conversion until the difference between the **TIN** and the surface is everywhere equal to or less than this input value.

Surface modeling can now create stacked or parallel surface profiles and save them as a **CAD** object from which they can be displayed in **2-D** or **3-D**. A raster object can now also be optionally smoothed to provide smoother contours in the process.

The tabular view of selected database records or attributes now provides several important new features in Spatial Data Display, Object Editor, and other processes. The sum, mean, standard deviation, minimum, maximum, and a record count of fields can now be inserted into the table window. Records in the table window can be sorted by a selected field. The same kind of statistical information can be inserted into the sorted view for each group of records that has the same value in the sorted field. Colors can be assigned to style the table view to better identify these new table components. The records in the table view can be directly saved into a Project File or into a **dBASE** format, **CSV** (Comma Separated Values) format, or into an **ODBC** data source. Any two fields in the table can be selected and plotted in a new window.

The **DEM/Ortho** process has been restructured into four new procedures: Interior Orientation (Step A); Relative Orientation (Step B); **DEM** Extraction (Step C); and Orthorectification (Step D). These new procedures share a common general control panel, and each has a completely new highly interactive control interface. All have been redesigned primarily with the objective of insuring and checking the reliability of the control data which is being entered. This will not necessarily make these complex photogrammetric concepts simpler to learn to use, but will increase the quality of the results achieved. Portions of the steps are also significantly faster. Orthorectification (Step D) is not available but is equivalent to Restitution (Step 3) in **V5.50** and is still available on the menu to produce the final orthoimage from the **DEM** generated with steps A, B, and C. This old step C can now perform the restitution at once on all three raster objects making up a color image with identical input parameters.

The Grid Generation process can now create and save various patterns of sample points from the cells it creates. The Polygon Fitting process now has interactive prototype preview for the polygons it creates. The Distance Raster process can now compute distances from the elements selected in a separate vector object.

New Platform.

V5.60 of all the **TNT** products is now available for **LINUX** for computers using the Intel 486, Pentium, and Pentium-Pro chips (on the “**B**” **CD**). **LINUX** is the free, public domain version of **UNIX** initially developed by Linus Torvalds (**LINus UniX**) in Finland. **LINUX** comes with its own **X** Server (**Xfree86**) by which it can be used directly with the **TNT** products. Since this is a **UNIX** variant, it does require the use of the serial version of the **TNT** software authorization key. Unfortunately this means that those using the gray key on a parallel port for the Windows based systems cannot use **LINUX** without converting to the red, blue, or green serial key. The serial key could be used on an empty serial port for operation of both the **LINUX** and Windows versions of the **TNT** products.

Planned Features for V5.70.

The following is a summary of the additional new features which will be demonstrated at the Advanced Users' Workshop in May and released in **V5.70**. They are grouped into two priorities: first or highest priority and a second or “as time allows” after the first priorities are met. You will find that this list is a full “dance card”, and obviously everything will not get done. However, this quarter the development focus is upon things which need to be explained, demonstrated, discussed, and expanded upon at **AUW9**.

First Priorities.

Design a new graphical interface for controlling layers and other features while viewing in **2-D** or **3-D**. This interface will be something like the Element Selection dialog.

Directly read live geopoints from **GPS** units via the **NMEA** (National Marine Electronics Association) communication standard and also from saved geodata collected by a **GPS**. Reposition the view based upon the coordinates of the live geopoints or other coordinate inputs. Support **GPS** collection of geopoints to describe elements in the Object Edit process in a fashion paralleling that for **X-Y** digitizers.

Support locking together a **2-D** view and a **3-D** view. Provide new navigation tools for positioning view point, view direction, ... directly on the **2-D** view to control the parameters of the locked **3-D** view.

Use the pop-in ToolTip concept to interactively display the attribute of the nearest element in the active layer in the **2-D** and **3-D** view.

Allow the selection and execution of an **SML** script as a layer in any **2-D** or **3-D** view in any process. This will use an **SML** script to determine and recreate this layer at the time of the redraw.

Automatically generate and display labels in a view from a selected attribute field.

During editing and elsewhere, draw solid lines of selectable color and width for new prototype elements instead of the current hard-to-see complement lines.

Provide tools for combining saved regions or between the active region and a saved region (e.g. **AND**, **OR**, **XOR**, ...).

Allow regions to be created from raster objects using expressions (i.e. equations).

Provide for cut and paste of any selected areas and elements between layers of varying geodata types (vector to raster, **CAD** to vector, ...).

Where appropriate, use the right button to pop-in a small list of frequently used edit functions. This provides a faster and quicker method of switching between simple choices such as edit, delete, ... than hunting for them in a dialog with many other, but less commonly used choices.

Add additional requested features into the raster editor (e.g. better **WYSIWYG** editing when zoomed in).

Add improved, easier, and expanded legend generation in both the screen and print layouts.

Add another more direct means for designing the link from an attribute table to an object.

Provide expanded and additional means to graphically display a single field selected in any table (e.g. a Profile window for a single field). Insert the tabular or graphical view of a table into a layout to be printed as part of it.

Sort tables on more than one field for easier reading, adding substatistic lines, and creating virtual records.

Add tools for creating and/or populating tables, such as inserting latitude and longitude fields from other tables or from vector elements (e.g. centroids of polygons), from an expression, with a default value, etc.

Add improved and expanded interactive controls into the image classification processes. Allow more control and flexibility for merging classes and labeling clusters.

Completely rewrite the mosaic process, adding new functionality requested by clients and perhaps automating some of the features.

Design a completely new element styles creation subsystem. This will expand the kinds of styles which can be used and allow creation of many new styles which have been requested. For example, geologists need asymmetric line styles (strike and dip lines, characters and symbols in lines, depression contour lines, ...), and other disciplines have similar complex requirements. To accommodate these and anticipated future needs, a totally new style definition scripting approach is being designed and will be supported by new interactive style design tools and new rendering (drawing) functions.

Complete the conversion of the on-line reference manual (formerly the on-line documentation) to **HTML**. Redesign the quick help structure to make it more convenient to create it, so that the software engineers can add into it as they go. Make it easy to translate the quick help files for two-byte languages. Add a means to get from quick help windows into the proper section of the expanded materials provided in the reference manual.

Significantly expand the **SML** function library. For example, add functions for: surface modeling, classification, region applications, **TIN** operations, vector combinations, and so on. Allow selected major processes to be called in **SML** scripts with limited control parameters.

Second Priority.

Support "near real time" flybys and drive through modes from previously merged or prepared elevation and draped geodata. Provide tools to be used to design the path of motion in **2-D** view to control the concurrent **3-D** view. Add interactive control of the movement of a **3-D** view from mouse or joystick.

Add a hierarchical type legend display window providing similar functionality to that found in ArcView and MapInfo displays.

Add filter preview window into AutoTrace process. Integrate color binarization and color pattern mapping procedures into this process.

Create a new simplified process for resolution enhancement by the direct merger of multisensor data of various images of differing resolution, projection, etc. This might eventually become a procedure directly available in the **2-D** and **3-D** viewing on fast machines.

Prompt for attribute assignment when new elements are being created (e.g. when a line is added or a polygon is divided).

Modify the vector extraction process to use regions and the region generation tools.

Support the inclusion of "hard edges" in **TIN** objects (fixed known ridges, drainages, coast lines, ...) and modify the necessary processes to use them.

Support the use of two-byte file names for languages such as Japanese, Chinese, etc. and clients using them.

MI/X (Microlimages' X Server)

Modifications.

A compatibility problem was found between Microlimages' products and ArtiSoft's Lantastic 7.0 on **W95**. This incompatibility causes the Lantastic code to dial the modem when the **MI/X** server is started. To avoid dialing the modem, it is necessary to disable the remote connection feature of **MI/X**. All other Microlimages applications have been modified to use remote connections only when required. The method to disable the **MI/X** server from establishing remote connections is in the tnthost.ini file. Change the entry in **[TCPIP]/InitTcplp** to be 'No'. If you have the old tntmips.ini file, the entry can be placed there as well.

Public Release.

At the beginning of January, Microlimages officially placed the **MI/X** servers for Mac, PMac, **W95**, and **NT** in the public domain. This was done by putting them up on www.microimages.com with appropriate downloading and installation procedures. After a couple of weeks, these free and very useful items were discovered by the Web crawling engines and newsgroups and publicized widely. This caused a "raid" on www.microimages.com with thousands of attempted accesses and hundreds of downloads from around the world each day. This brought www.microimages.com to a crawl for several days until we added memory and more machines to our external Internet network. A number of mirror sites also spontaneously sprung up to transfer the **MI/X** access to other servers in other nations.

The chronology of the successful downloads from www.microimages.com provides interesting insight into how such a procedure works on the Internet.

end of successful

week	downloads	
1	10	
2	140	
3	200	
4	393	
5	2632	
6	538	server overloads for several days (memory/machines added)
7	1633	2 requests for mirror sites okayed informally by email
8	1154	8 more mirror sites registered by automatic procedure
9	399	6 more mirror sites registered
10	221	4 more mirror sites registered
11	538	2 more mirror sites registered
12	679	2 more mirror sites registered
total	8537	(Mac = 1553, PMac = 3755, and W95/NT = 3229)

Interpretations. There were twice as many Mac and PMac downloads as for **W95/NT**. Part of the explanation for this is the same reason Microlimages had to develop the Mac/PMac **MI/X**. Apple had a poor **X** Server for the Mac and stopped developing it when the PMacs were first released. They actually turned the Mac version over to a private company who could not handle its development and has recently dropped it. In mid-March 1997, Apple also announced they were no longer going to develop their **AIX UNIX** product for the PMac (they have **NEXT** now). There are still two commercial companies (White Pine and Tenon) developing **X** Servers for the PMac, both of which should work with the **TNT** products. Microlimages cannot compare their performance with the **TNT** products with that of **MI/X**, as we do not have their latest versions.

Mirror Sites. During the fifth week of the posting, information about it began circulate worldwide, and there were about 2632 completed downloads. The next week, www.microimages.com became overloaded with attempts that basically shut it down. As a result, mirror sites became available to shunt the load progressively more and more away from www.microimages.com. The current distribution of the mirror sites is: 6 Japan, 4 USA, 2 Australia, 2 Sweden, 2 Great Britain, 1 France, 1 China, 1 Spain, 1 Korea, 1 Kuwait, and 1 unknown. Access to **MI/X** has now taken on a life of its own. Microlimages is no longer the preferred source of these products, which now circulate freely, using registered mirror sites and many other locations where people just post it (university nets, etc.). Through this kind of multiplication effect, it might be reasonable to guess that perhaps 20,000 people have now experimented with **MI/X**. Mirror sites relieve the access problem but defeat the whole concept of getting people to visit and review the "paying" products at www.microimages.com. So the question remains of how to get 20,000 people to try **TNTlite**.

Feedback. If you search the Web or monitor the newsgroups, you will now find hundreds of messages about **MI/X** (or **MIX**) among other parties: some of them questions, many compliments, and some complaints requesting broader features. A sampling of the many thank you's received occur below at the end of this section. Microlimages has also received a lot of short requests for assistance on using **MI/X**, has answered many, and set up an **FAQ** on the public use of the **MI/X** servers. Most of the requests are for features for which the **MI/X**'s were not designed and are not needed in connection with their use with the **TNT** products. However, in response, there were some minor **MI/X** errors corrected, and downloading and installation procedures were improved.

TNT Mirror Sites. MicroImages has had requests from Dealers to set up mirror sites for **TNTlite** access and for in-country access to **TNTpatch**. This sounds useful but is not yet easily accomplished with their communication rates, drive capacities, and the necessity of keeping things current. The current problems are as follows: Dealers do not have Web sites on-line 24 hours per day. Only slow modem access is available. Providing storage for all the versions of **TNTlite** requires one gigabyte of drive space. There are a lot of pieces and parts to keep straight for the **TNT** products. All of the **TNT** products and **TNTpatch** are completely upgraded on www.microimages.com on each Tuesday and Thursday. However, managing these and other difficulties may be resolved in time as Dealers establish robust Web sites. For example, mirror sites for just the **W95/NT** version would satisfy many existing needs.

Typical Positive MI/X Feedback.

email from Germany on 11 February 1997.

*"I've solved the problem. Now it works. _very_ fine product. And easy to use. Has been just **RTFM** [Read That Fine Manual] problem in my case. Sorry, if I caused unnecessary work. I apologize."*

email from Japan on 13 February 1997.

*"I've been using your free **MIX** server -great work! I haven't had any problems running anything on it. You say in the documentation that you can use Windows as the desktop manager instead of **TWM**. How exactly is this done? I'm sure it's something painfully obvious, but I can't figure it out. Thanks!"*

email from **NASA** Headquarters on 15 February 1997.

*"Thank you so much for making **MIX** publicly available! I've been hoping someone would release something like this for a long time!"*

email from a U.S. university on 21 February 1997.

"Thanks for making your excellent product freely available. The latest version is quite stable and very useful."

email from a business site in California on 21 February 1997.

*"Hi my name is [name] and I have downloaded the demo version of **MIX** for windows 95 and I was wondering if it comes on **CD?**, and if so are there any programs that come with it, what are they, and how much does it cost and where can I get the **CD?**" [What demo **MIX** program? And, all the information on **TNTlite**, how to get the **CD**, etc. is on the same page on www.microimages.com as the **X** Server download information.]*

email from a U.S. university on 25 February 1997.

*"Great **X** windows program, very stable too. But would like to be able to copy an image (**3-D** finite element mesh) from the **X** window environment."*

email from Cray Research on 28 February 1997.

"MIX is a cool product, and fills a real need in the freeware community. Thanks!"

New Sample Geodata

Crow Butte Directory.

Both the **TNT** professional and **TNTlite** versions of the Crow Butte soil vector object are being reissued. Make sure to use this new object (by reinstalling the entire Crow Butte geodata set). MicroImages has used the new geodata maintenance tools being added to close up some leaking polygons, check and correct attribute errors, and recompute the standard attribute tables. In addition, some new **TIN** geodata has been added under CB_ELEV.RVC.

BEREA Directory.

The Berea geodata set distributed on the **V5.50 CDs** has the following additional Project Files added to it: BEREATRN.RVC, which contains the training sets for supervised classification; BERMNDV.RVC, which contains Modified Normalized Difference Vegetation Index raster objects for each of the six dates of the BEREAMSS raster multispectral image sets. These additional project Files contain additional data for use in the tutorials in the new Getting Started: *Image Classification* booklet.

CROPDATA Directory.

This RGBCROP.RVC Project File contains color airphoto raster objects also for use in the Getting Started: *Image Classification* booklet.

HAWAII Directory.

This contains varied Project Files with geodata for Maui and Hawaii for general use. The Project File MAUISURF.RVC provides the objects used for the tutorials in the new Getting Started: *Surface Modeling* booklet.

SURFMODL Directory.

This contains the Project File SURFACE.RVC also used in the Getting Started: *Surface Modeling* booklet.

EDITRAST Directory.

The Project File UNLPHOTO.RVC contains a grayscale raster object of 512 by 512 cells. It was cut out of a Digital Ortho Quarter Quad (**DOQQ**) for Lancaster County (i.e. for an area of Lincoln, Nebraska). This raster object is used throughout the tutorials in the new Getting Started: *Editing Raster Geodata* booklet.

The Project File LANCSOIL contains SHEET_45LITE which is a 512 by 512 cell cutout from a scanned Lancaster County **NRCS** printed soil survey sheet. It can be used in experimenting with the AutoTrace process in **TNTlite**. This Project File also contains SOILMASK which is a 512 by 512 cell cutout coregistered with SHEET_45LITE and contains null values used for transparent raster overlay in the tutorials in the new Getting Started: *Editing Raster Geodata* booklet.

FEATMAP Directory.

This directory contains the SECT27R Project File, which is used in the Getting Started: *Feature Mapping* booklet. The raster objects in this Project File are the separate red, green, and blue bands of frame-grabbed air video taken of a Small Unit Management Project (**SUMP**) site by the USF&WS. An 8-bit composite color raster generated from

these three raster objects is also included. Other rasters used in the Getting Started: *Feature Mapping* booklet are found in the BEREA Directory.

THEMEMAP Directory.

This directory contains the geodata used in the Getting Started: *Theme Mapping* booklet. The points in the artifact vector object are a subset of the data collected for the Sayil Archaeological Project (Michael P. Symth and Christopher D. Dore, Principal Investigators). The points represent locations where ten or more slipped ware shards were found in a comprehensive survey of a prehistoric archaeological site in the eastern Puuc region of Yucatan, Mexico.

USA Directory.

The Nebraska Project File added to this **V5.50** directory contains a modified county outlines object that has a new table with 1990 county populations in its polygon database. This object is used for the exercises in the Getting Started: *Theme Mapping* booklet.

FARMLITE Directory.

This Project File FARMLITE.RVC contains a collection of images, vectors, and other geodata from Otoe County, Nebraska. It can be used in connection with experimenting in some of the steps used in precision farming. There is no other written material available in connection with this geodata.

Installation

TNTstart.

A new Microlimages start-up "splash" logo was implemented on Windows 3.x and Windows **95/NT** (stays up for five seconds when any **TNT** product is started.)

Installed Sizes.

Loading a full installation of **TNTmips 5.6** onto your hard drive (exclusive of any other products, data sets, illustrations, Word files, etc.) requires the following storage space in megabytes.

PC using W31	76 MB
PC using W95	103 MB
PC using NT (Intel)	103 MB
PC using LINUX (Intel)	80 MB
DEC using NT (Alpha)	104 MB
Mac using MacOS 7.6 (680xx)	72 MB
Power Mac using MacOS 7.6 (PPC 60x)	81 MB
Hewlett Packard workstation using HPUX	104 MB
SGI workstation via IRIX	127 MB
Sun workstation via Solaris 1.x	92 MB
Sun workstation via Solaris 2.x	89 MB
IBM workstation via AIX 3.x (RS/6000)	175 MB
IBM workstation via AIX 4.x (PPC)	115 MB
DEC workstation via UNIX=OSF/1 (Alpha)	143 MB

V5.60 of the illustrations for the on-line reference manual requires an additional 28 megabytes. Installing all the sample geodata sets for **TNTlite** and **TNTmips** requires an additional 87 megabytes.

V5.60 of the **TNT** products for the **DEC** Ultrix, **IBM** PowerRISC RS/6000, and the Data General Avion platforms is available upon special request for which a special **CD** will be produced.

Upgrading.

If you did not order an upgrade of your **TNT** professional product and wish to do so now, please contact Microlimages by **FAX**, phone, or email to arrange to purchase your annual maintenance and obtain the use of **V5.60**. Upon receipt of your order and processing, Microlimages will supply you with an authorization code by return **FAX** only. Entering this code when running the installation process allows you to complete the installation and immediately start to use **TNTmips 5.60** and the other **TNT** professional products.

If you do not have an annual maintenance for **TNTmips**, you can purchase it to gain access to **V5.60** under the elective upgrade plan at the cost in the tables below. Please remember that new features have been added to **TNTmips** each quarter. Thus, the more quarters you are behind **V5.60**, the higher your upgrade cost will be. As usual, there is no additional charge for the upgrade of your special peripheral support features, **TNTlink**, or **TNTsdk**, which you may have added to your basic **TNTmips** system.

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

<u>TNTmips Product Code</u>	<u>Price to upgrade from TNTmips:</u>					<u>V5.00</u>
	V5.50	V5.40	V5.30	V5.20	V5.10	and earlier
D30 to D60 (CDs)	\$250	450	600	750	900	+150/each
D80	\$375	675	900	1050	1200	+150/each
M50	\$250	450	600	750	900	+150/each
L50	\$250	450	600	750	900	+150/each
U100	\$450	800	1000	1200	1400	+200/each
U150	\$615	1100	1450	1700	1950	+250/each
U200	\$780	1400	1875	2175	2475	+300/each

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

<u>TNTmips Product Code</u>	<u>Price to upgrade from TNTmips:</u>					<u>V5.00</u>
	V5.50	V5.40	V5.30	V5.20	V5.10	and earlier
D30 to D60 (CDs)	\$300	560	750	900	1050	+150/each
D80	\$425	800	1050	1200	1350	+150/each
M50	\$300	560	750	900	1050	+150/each
L50	\$300	560	750	900	1050	+150/each
U100	\$500	850	1050	1250	1450	+200/each
U150	\$665	1150	1500	1750	2000	+250/each
U200	\$830	1450	1925	2225	2525	+300/each

TNTview® 5.6

The following is a summary of the new features added to **V5.60** of the **TNT** products which are now available in **TNTview 5.6**. Detailed descriptions of these new features can be found in the appropriate section below on New TNT Features.

- Compressed raster objects can be viewed and imported.
- Raster, vector, and **TIN** objects can be viewed separately or superposed in **3-D** and stereo. Contours can also be viewed for **TIN** objects.
- Eleven powerful new interactive region creation tools are now provided for interactive **GIS** analysis of vector and raster layers. These tools allow the direct creation and saving of database tables in other formats (**dBASE**, Access, **ODBC**) for immediate use in other systems.
- Multi-polygon, multi-line, and multi-point selection tools are available along with an improved Element Selection dialog.
- **ERDAS** Imagine 8.x, compressed **JPEG**, **NLAPS**, **ERS (RADAR)**, **IRS (Indian)**, **DISIMP**, **3-D MOSS**, and **ODBC** data sources can be imported.
- A window from an external vector file and a query on a database table can be used to create smaller objects during import.
- Tabular database views are improved: color, statistics row, substatistic rows, and an **X-Y** field plotter.
- Support for **LINUX** on the Intel platform has been added.

Upgrades.

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

<u>TNTview Product</u>	<u>Price to upgrade from TNTview:</u>					<u>V5.00</u> and earlier
	V5.50	V5.40	V5.30	V5.20	V5.10	
W31, W95, and NT	\$95	170	225	275	325	+50/each
Mac and PMac	\$95	170	225	275	325	+50/each
LINUX	\$95	170	225	275	325	+50/each
DEC/Alpha via NT	\$125	225	300	350	400	+50/each
UNIX single user	\$155	280	375	425	475	+50/each

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

<u>TNTview Product</u>	<u>Price to upgrade from TNTview:</u>					<u>V5.00</u> and earlier
	V5.50	V5.40	V5.30	V5.20	V5.10	
W31, W95, and NT	\$115	205	270	320	370	+50/each
Mac and PMac	\$115	205	270	320	370	+50/each
LINUX	\$115	205	270	320	370	+50/each
DEC/Alpha via NT	\$150	270	360	410	460	+50/each
UNIX single user	\$185	335	450	500	550	+50/each

TNTatlas™ 5.6

Summary of New Features.

The process will now default to using the entire screen for the view window when the process is started. The back, home, and previous icon buttons are now available in a

group at the right side of the menu bar in addition to the Navigator window. This means that the Navigator window (which is always being obscured on small screens) is needed only when selecting and moving to an adjacent view.

Upgrades.

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

<u>TNTAtlas Product</u>	<u>Price to upgrade from TNTAtlas:</u>					<u>V5.00</u> and earlier
	V5.50	V5.40	V5.30	V5.20	V5.10	
W31, W95, and NT	\$65	115	150	200	250	+50/each
Mac and PMac	\$65	115	150	200	250	+50/each
LINUX	\$65	115	150	200	250	+50/each
DEC/Alpha via NT	\$80	140	190	240	290	+50/each
UNIX single user	\$95	170	225	275	325	+50/each

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

<u>TNTAtlas Product</u>	<u>Price to upgrade from TNTAtlas:</u>					<u>V5.00</u> and earlier
	V5.50	V5.40	V5.30	V5.20	V5.10	
W31, W95, and NT	\$80	135	180	230	280	+50/each
Mac and PMac	\$80	135	180	230	280	+50/each
LINUX	\$80	135	180	230	280	+50/each
DEC/Alpha via NT	\$95	170	225	275	325	+50/each
UNIX single user	\$115	205	270	320	370	+50/each

TNTlite™ 5.6

General.

A total of 2000 copies of **TNTlite 5.5** kits have been distributed directly and via Dealers, bringing the total **TNTlite CDs** shipped to 7000. Currently, completed downloads of **TNTlite** range between 20 to 40 per week. Many others start a download but get discouraged when they grasp the time required.

A copy of the standard **V5.60** of the "A" or "B" **CD** will be shipped to each party who has registered their copy of the **V5.50 CD**. These copies will be shipped when all shipments to professional clients are complete.

Registration Discontinued.

TNTlite 5.60 kits will no longer contain registration forms, and MicroImages will no longer keep a record of registered **TNTlite** users. Correspondingly, the purchaser of a **TNTlite 5.6** kit will not be able to register to receive the next version of **TNTlite** free of charge. The principal reason for this is that the **TNTlite 5.6** kits will contain a minimum of 12 printed Getting Started booklets, and this number will continue to grow as the quarter progresses. The additional expense of printing and shipping these booklets as part of the kit will preclude shipping a second set for the next version.

Within a month, the **TNTlite 5.6** kit will begin shipping in a box instead of an envelope to accommodate the expanding amount of material. It is also likely that the price of a single **TNTlite** kit will increase to \$35 sometime later in this quarter, as the number of Getting Started booklets increases.

Summary of New Features.

The following is a summary of the new features added to the **TNT** products to improve their usability in general and for **TNTlite 5.6** in particular. Detailed descriptions of these new features can be found in the appropriate section on **TNTmips**.

- A least ten Getting Starting tutorial booklets will be shipping in the **TNTlite 5.6** kits.
- The additional sample data sets for these booklets are included on the **V5.60 TNT** product **CDs**. Additional **TNTlite** booklets will be added during the quarter as outlined below. Their sample data can be downloaded as it becomes available.
- **TNTlite** now allows raster objects ranging from between 512 cells by 512 cells to 256 cells by 1024 cells (with a product not to exceed 512 times 512).
- All external "foreign" vector geodata can be windowed down in geographic area to fit into "lite-sized" vector objects as it is imported.
- All external "foreign" database tables can be reduced in size to fit within the 1500 records per table limit for a "lite-sized" database table.
- Now all imported geodata can be windowed as imported into raster, vector, **CAD**, or database objects. A user of **TNTlite** no longer has to go back to or use the product which produced the source geodata in order to introduce it, or a portion of it, into **TNTlite**.

Getting Started Booklets

The Plan.

Version **5.50** of the **TNT** products provided you with the first trial Getting Started tutorial booklet entitled: *Displaying Geospatial Data* and the associated geodata sets. MicroImages has decided to turn this into a unique series of tutorial booklets that you can use to learn about geospatial analysis on your own using the free **TNTlite** product at home or your professional **TNTmips** products. These booklets are also useful for laboratory references and exercises for those using the **TNT** products to train others in geospatial analysis or one or more of its components: **GIS**, image analysis, desktop mapping, surface modeling, ...

V5.60 contains nine of these booklets in final or draft format. There are now about 40 Getting Started color illustrated booklets planned with between 16 and 32 pages each. Almost all the exercises in these booklets can be completed in **TNTlite**. The sample geodata sets used in these exercises are included on the **TNT** products **CD** and can be downloaded from the MicroImages Web site. The list below provides the current status and availability of all the booklets. At any time you can check at www.microimages.com for an update on this schedule. Preparing the 500 to 1000 pages of such heavily illustrated materials takes time for our professional writers. They can produce between six and nine booklets per quarter. However, as the quarter passes, they will have to spend more and more time updating the existing booklets for newly released changes in the processes covered. As a result, the goal of completing the series becomes progressively harder to reach. Please consider the dates of availability presented in this schedule as tentative and optimistic, as good things always seem to take longer than anticipated.

Additional Getting Started booklets will be provided in black and white printed form with each new quarterly release as they are completed. All Getting Started booklets completed will also be provided in black and white printed format with each new **TNTmips**

professional product. The printed versions are also included in the \$25 **TNTlite CD** kit. Sorry, earlier and newly released booklets are available in printed form only as part of the latest **TNTlite** kit or with new products.

The original Getting Started booklets are completely illustrated in color. Their authors have attempted to make sure that the salient features of each illustration are visible in the black and white printed versions. Images of the original color versions of each completed booklet can be viewed or downloaded via Internet Explorer or Netscape at www.microimages.com under Documentation and Support. They can also be printed in color on your printer using these browsers from www.microimages.com or after they have been downloaded to your drive. MicroImages will place all the available booklets on the **V5.70 CDs** (probably in Adobe Acrobat format and with the Acrobat reader for their viewing and color printing).

The covers of the Getting Started booklets introduce Ptolemy, a character who is symbolic of the purpose of these booklets. Ptolemy's tutoring tasks are to help newcomers and students learn more about geospatial analysis and the way it has been implemented in the **TNT** products.

Ptolemy (A.D. 127 -151) was a Greek teacher, mathematician, astronomer, and geographer in Alexandria. His treatise called "Geography" was the basis for his map which recognized the world was round and employed a system of latitude and longitude based upon a spherical earth which influenced mapmakers for hundreds of years. However, his map and system suffered from a lack of reliable observations and became lost knowledge that had to be rediscovered by empirical means by other, much later European cultures.

Completed Booklets. [10 units]

Announcing TNTlite	Surface Modeling
Displaying Geospatial Data	Georeferencing
Feature Mapping	Theme Mapping
Editing Vector Geodata	Image Classification
Editing Raster Geodata	
Style Manual (the reference guide for creating uniform booklets)	

Partially Completed Booklets. [3 units--late March or early April availability]

Navigating	Interactive Region Analysis
Importing Geodata	

Scheduled Next. [9 units--late April to mid May availability]

Using 3-D Perspective	Laying Out Maps
Spatial Manipulation Language	Building and Using Queries
Sketching and Measuring	Acquiring Geodata
Assigning Attributes	Editing CAD Geodata
Pin Mapping	

Later. [8 units]

Editing **TIN** Geodata
Exporting Geodata
Getting Good Color
Filtering Images

Vector Analysis Operations
Raster Analysis Operations
Making **DEM**s and Orthoimages
Constructing a HyperIndex®

Final Group. [8 units]

Vectorizing Scans
Mosaicking
Scanning
Creating and Using Styles

Mapping Watersheds and Viewsheds
Using the Electronic Reference Manual
Changing Languages (Localization)
Map Projections

Reference Manual

Old Version.

With the distribution of the initial collection of Getting Started booklets, the on-line documentation begins to assume its correct role--that of a reference manual. As usual, it is also available in several forms on-line, on **CD**, printed, and eventually via **HTML** on-line and on the Internet. As a result, the on-line documentation is hereby renamed the **TNT Reference Manual**.

The Reference Manual this quarter has 2510 single spaced pages. Last minute supplemental sections which do not occur in the on-line or Microsoft Word versions were created for new processes and features. These sections were completed for **V5.60** after the master **CD**s were created for the reproduction process. These 55 additional pages are included in supplemental, printed form as follows.

Object Editor (11 pages)

Extract Raster Objects (25 pages)

SML Version **5.6** (Revision to Appendix for **V5.50**--19 pages)

HTML Version.

MicroImages has been able to successfully test convert a portion of the on-line reference manual into **HTML** format for direct use in browsers. This works out the general procedures. Now there remains only the mechanics of passing all the existing pages through the conversion software and making minor corrections. The Display section of the reference manual is available on the **V5.60 CD**s for your experimentation. If you do not already have Microsoft Internet Explorer 3 installed (or Netscape), it can be installed from the **TNT products CD** and used to browse this initial volume of the reference manual.

New TNT Features

* Paragraphs or main sections preceded by this symbol "*" introduce significant new processes, or features in existing processes, released for the first time in **TNTmips 5.6**.

> Paragraphs or main sections preceded by this symbol ">" introduce modifications in the **TNT** professional products which have additional, special significance to the users of the **TNTlite** products.

System Level Features.

*** Project Files.**

Raster Compression. Raster objects can now be stored as compressed (lossy or lossless) or not compressed. The compressed raster object is still pyramided and tiled, so these advantages for speed of access are not lost. Whenever and however a raster object is compressed, all its pyramid layers are also automatically compressed. The types of compression available for your selection include **RLE** (Run-Length Encoding) for binary rasters; **DPCM** (Differential Pulse Code Modulation) for 8-, 16-, 32-bit integer raster objects and 32-bit and 64-bit floating point raster objects; and **JPEG** (Joint Photographic Expert Group) for 8-bit grayscale and 24-bit color composite rasters.

RLE and **DPCM** compression are lossless compression methods. They reduce the stored size of the raster object in the Project File without changing the raster object's content in any way. Any subsequent analysis of the raster object will not be affected by the use of these compression methods. Of course, compression requires additional computation.

DPCM Compression. **DPCM** compression has been selected as optimal for use in the **TNT** products. It will be the most frequently used, and it significantly outperforms commercially available general compression programs such as pkzip or arj. It provides good compression ratios (2.2 - 2.5 to 1 for typical aerial or satellite images of 8-bits per pixel).

DPCM is optimized for speed during decompression. A typical user of the **TNT** products will, on the average, display (i.e. read) from a raster object many more times than they will save (i.e. write) to a raster object. **DPCM** compression method requires more time compressing the raster object when it is saved than decompressing the raster object during reads. As a result, you will find that saving an image to a **DPCM** compressed raster object will take a little longer than saving it uncompressed. However, the subsequent viewing of the **DPCM** raster object may not be noticeably different from viewing its uncompressed equivalent.

All compression methods can now also be directly applied when other raster formats are imported. Since importing a raster object takes time anyway, this is a good place to add a bit more time to compress with **DPCM** if viewing portions of the image several times is your initial objective (which is almost always the situation). The new Raster Extract process introduced in **V5.60** (see below) can be used to move rasters back and forth between their compressed and uncompressed forms.

RLE Compression. Run-Length Encoding will be available only if you have binary rasters and is best applied when you have scans of line drawings, binary masks, and so on. How much compression you can expect varies greatly with the contents of the raster. For example, **RLE** compression can reduce a raster object containing a soil polygon map or a mask of larger polygons by a factor of 20 to 1 or greater (i.e. to a few percent of its original size). This means that much less data is being read or written to your hard drive, which is faster and offsets some of the time needed to **RLE** compress or decompress these raster objects.

JPEG Compression. When you choose to store a raster object in compressed fashion, please carefully consider its future use by you or someone else. Compression into **JPEG** can be lossless and behaves as outlined above. However, you may also choose to compress a raster object of an image 20 to 1 (to 5% of its original size). This image may look almost identical to its original uncompressed equivalent. **JPEG** achieves this

large compression by slightly altering the data values in the raster so that they are identical in a local group to their neighbors. To achieve a 5% size, the data value may only be changed by 3 counts in 256 counts (i.e. from 222 to 225). This level of change is hard for the human eye to detect at first inspection. You may think of it as only removing "image noise" or reducing image detail and content, depending upon your viewpoint and image analysis objectives.

If all you or any subsequent user of the raster object wants is to see the pretty picture, then this **JPEG** compression to 5% is significant, and the visual effect is negligible. It may even be reasonable to subsequently do direct photo-interpretation of such raster objects. But, remember that if you **JPEG** compress with losses, this subtle information is lost forever from any subsequent use of this raster object! For many uses of images and scans of other materials, you will not want to use lossy compression. Thus, you will need to give the impact of the use of lossy compression on subsequent operations very careful consideration.

Never use lossy **JPEG** compression on images destined for multispectral/multitemporal classification, feature mapping, and so on. Similarly, scans of color maps destined for raster to vector conversion should not use lossy **JPEG**. Even scans of grayscale soil maps from low grade printed matter should not be subjected to losses. When in doubt, do not use lossy compression. MicroImages will put warning windows in the appropriate image analysis processes to identify that somewhere previously in a **TNT** product, the raster object being selected has "lost" information by lossy compression. However, even when this is in place, it will not help you when you have to go back and rescan a bunch of color airphotos which you have subsequently passed through a lossy compression and decompression cycle.

IMPORTANT: Give careful consideration to any possible subsequent use of a raster object compressed with the **JPEG** lossy option. Remember, these losses in image quality cannot be recovered except by starting over with the never-compressed form. However, raster objects of 5% of their original size can be very useful if you can easily return to the source materials by reimporting, using the original never-compressed form, or rescanning the photos.

> **TNTlite Raster Size Limits.** The overall raster object size limit in **TNTlite** has not been changed from the product of 512 by 512 cells. However, for increased utility, **TNTlite** now allows raster objects ranging from between 512 cells by 512 cells to 256 cells by 1024 cells. Rectangular raster objects are useful in many situations--for example, if you wanted to experiment with mosaicking several small video images of 200 by 200 cells. Another application would be to use three 1024 by 256 geographically adjacent "lite" raster objects in layout to make a 1024 by 768 base for a map or a vector overlay on the screen.

SPOT Header Information. Support/Maintenance/Project File can now display the detailed information in the **SPOT** Header subobject. This feature was added in connection with improving the planned use of **SPOT** imagery in the **DEM/Orthophoto** process. The information displayed includes: satellite and instrument names, spectral mode, pre-processing level (along with explanation in plain English), coordinates in **SPOT** Grid Reference System, viewing date and time, satellite revolution number inside 26-day cycle, sun azimuth and elevation, angle of incidence, true east rotation angle, position of

scene center and corners in Lat/Lon coordinates, Map projection and map coordinates of the upper left image corner (for 2B processing level), absolute calibration coefficients, look directions of **CCD** detectors, satellite angular rates during acquisition (73 records), and satellite ephemeris data (9 records).

* Graphical Tools.

General. The separate manual dialogs for the graphical tools are now integrated into main tool dialogs. This follows MicroImages' policy of continually striving to reduce the number of dialogs on the screen at one time (they multiply easily, especially in new processes).

The manual subsection is implemented as a pop-down panel if there are other controls on the dialog and is dropped via a "Manual Entry" toggle button. If there are no other controls for the dialog (e.g. in most of the vector add tools in various processes), the manual section becomes the tool dialog, and no toggle button will exist to remove it.

Rectangle Tool. A manual editing section has been added to precisely position the rectangle tool. There are three different manual entry dialogs which are accessed via tab pages. The three are 1) enter center point, height, and width; 2) enter corner, height, and width; and 3) enter extents.

Line/Polygon Tool. The controls for the line/polygon tool are now icon buttons. The line generated on screen has new graphical markers to easily identify the start and end of the line. The start of the line has a square, and the end of the line has a circle. These two shapes correspond to the "Add Start" and "Add End" icons on the tool dialog. The tool mode ("Draw" and "Stretch") is now retained between editing sessions.

Multi-Point Tool. A new power tool called the multi-point tool has been created. This tool is currently used in the tool region generation section in the "Element Selection" dialog for the Spatial Data Display process (in both **TNTmips** and **TNTview**) and in the Object Editor process. This tool allows the manipulation of multiple points including adding, moving, deleting, and manual editing. Previously you could add and delete single points only. Now you can add a series of points and "back up" through them.

Multi-line/Polygon Tool. New power tools called the multi-line and multi-polygon tool have been created. These tools are currently used in the tool region generation in the "Element Selection" dialog in Spatial Data Display process (in both **TNTmips** and **TNTview**) and in the Object Editor process. They allow the manipulation of multiple lines and/or polygons including adding, moving, deleting, and manual editing.

An example use of the multi-polygon tool would be to draw a series of polygons, one after another, around an image or other features which can then immediately be made a region. When drawing these polygons, you can back up through them to alter any one of them. When combined with the regions concept in the editor, this is a very powerful, interactive way to draw a series of polygons around features in an image, make them a region, and then immediately apply the region to another layer (e.g. to extract with clipping from a vector layer)! This is just one example of this powerful "draw" and "click" kind of interactive geospatial analysis which can be done with these new tools. These same kind of powerful interactive tricks can be performed with any of the improved drawing tools outlined above.

Element Selection Dialog.

The Element Selection dialog has been standardized throughout the processes. Now you will have to remember how to use only this single dialog. The options it presents

vary somewhat from location to location depending upon the features required for the process which calls it. Most of the changes to this dialog have been graphical with a few new buttons added.

Simplifications.

- 1) In **V5.50**, opening the element selection dialog caused all element types (lines, nodes, polygons, ...) in all viewable layers to be selectable. This presented too many choices and was confusing. In **V5.60**, only the element types in the "active layer" are initially selectable. The "active layer" is the layer highlighted in the main control panel.
- 2) The color of the selection icon button and symbol on each element type changes from red to cyan if the element type is made selectable. In **V5.50**, the icon selection button was simply grayed out as is standard for most "off" icon buttons. This new color change makes it easier to quickly visually detect which element types are on or off.
- 3) Two icon buttons have been added for fast global selection actions. The first is the "Unselect All" icon button which will unselect all elements in all layers for the display window. The second is a "Clear Selectable Set" icon button which will turn off all selection buttons for all the layers. This icon button is useful if you have element types selected in layers that you no longer want to select from.
- 4) An icon "Control..." button has been added for each layer. Use it to directly open the Layer Controls dialog for that type of layer. This allows you to directly change the display characteristics of any layer. You no longer have to open the Layer Controls window, open the Layer Control dialog, change the layer's characteristics, close the dialog, and reopen the Element Selection dialog.
- 5) In **V5.50**, the rows of icon buttons for element types which were not being displayed for a layer were shown in gray. Nothing could be directly done with these rows. Now if the element type is not selected for display, the icon row will not show. This significantly reduces the number of rows of icons to those actually being used. To expose an element control row for a particular layer, use the new Control icon button for the layer, and add that element type to the display.

* Interactive Vector Extraction. Extracting vector elements from a layer using any region has been added to Display Spatial Data and the Object Editor processes via the Element Selection dialog. Think of this powerful tool as an interactive vector extraction procedure. The elements selected in this fashion create a temporary vector object. The attribute tables of the original vector layer will automatically be filtered and new tables created for the temporary vector layer that contains only the records attached to the vector elements extracted. The source vector layer is then automatically hidden, and the new temporary layer is displayed. This new temporary layer can also be saved in the Object Editor process as a new object in a Project File.

Six methods are now available for defining how the region will extract or "cookie cut" the source vector layer. They are "Completely Inside", "Partially Inside", "Clip Inside", "Completely Outside", "Partially Outside" and "Clip Outside". The two new methods which 'clip' the source vector elements at the edge of the region alter the topology of the elements. Topology will automatically be recomputed for the new temporary vector layer. These 'clips' also alter the standard attribute tables (e.g. smaller polygon areas), so these tables are also recomputed.

In the Object Editor process, this temporary vector layer functions as a normal editable layer and can immediately be used for any additional editing and analysis. It can also

be saved and then immediately added as an edit layer to avoid directly altering its contents. Obviously, a great deal of computational effort is being performed in this new region procedure. Its use as an 'interactive' tool will thus be a function of the speed of your computer and its drives and the complexity of the source vector layer.

* Region Generation.

Several color plates are attached to illustrate the new interactive region generation tools, procedures, and features. Please consult them to clarify the discussion of regions in the following subsections.

Prototyping Regions. New, powerful methods are now available for creating regions in Display Spatial Data, the Object Editor, and the new Raster Extract process. Eleven methods are introduced in **V5.60**, and all are similar in general operation. They each present a similar Region Generation Preview dialog. This dialog provides you with simple sliders and buttons to design a prototype region. Since you are only creating a prototype region, it can be immediately altered by changing one of the sliders or buttons.

For example, the "Buffer Zone" region generation method provides a slider to interactively adjust and change the width of the buffer zone around the selected or drawn point, line, and polygon elements. Changing this slider causes new buffer zone regions to be displayed (i.e. changes the prototype region). A 'color' button allows you to change the color of the line defining the buffer zones (i.e. prototype region). The line width of the boundary can be changed as well.

All the Region Generation Preview dialogs have sliders for the principal control parameter(s), line color and width buttons, and so on. All dialogs also provide an "Advanced Options" pop-down panel. It provides additional sliders and controls to filter the size of the individual polygons making up the prototype region. For example, buffer zones which are formed around small linear features can be eliminated (i.e. filtered) from the prototype region. These area filters allow you to control the minimum size for a polygon to be included in the current region prototype, the minimum size of the island polygons, and a 'no-islands' option. These area filters are only applied when the pop-down panel is exposed.

An "Apply" button is also provided. It is used when you do complex region design activities on large and/or complex layers which may not be very interactive. It allows you to change several features in the Region Generation Control dialog and then indicate that you are ready for the prototype regions to be computed and displayed. When you are finally satisfied with the design of the prototype region, it can be made into the active region for additional use with the "OK" button (e.g. to extract and show a temporary vector layer from a source vector layer as outlined above).

Interactive Methods.

1) Selecting Polygons. This method was available in **V5.50** and is used to generate a region by selecting a set of vector polygons. Any selection method can be used such as drawing, querying, using another region, and so on. But now you can use the new multi-point, multi-line, and multi-polygon drawing tools to select or create and erase a whole suite of prototype polygons. There are no specific control options to generate this region, just the normal drawing and selection tools and advanced options.

2) Polygon Fitting. (alias Home Range). This method generates a prototype region around a selected set of vector points. It was available in **V5.50** but is now interactively controlled via a Region Generation Control dialog. You can select the fitting method

(Minimum Polygon, Harmonic, Fourier, or Tessellation), use a slider to adjust the most important control parameter for the selected method, and apply the advanced options.

3) Buffer Zones. Use the sliders in this Region Generation Control dialog to independently control the width of the buffer zones being displayed. Separate sliders are provided for the buffer width for the points, lines, and/or polygons you have selected. This is the only region generation tool which provides more than one slider, and each slider is totally independent, as it separately controls the buffer zones for its respective element types.

4) Viewshed. Use this method to compute viewsheds which correspond to a selected point or set of points. This Region Generation Control dialog will permit you to independently select the raster object containing the elevation to be used to compute the viewshed. The polygons in the prototype viewshed region will encompass all the cells in the elevation raster which can be viewed from the selected set of points.

A slider in the viewshed dialog box controls the height of the viewer's observation point above the selected cell(s). Its default is 0.0.

Another slider is provided to specify the maximum distance from each point that the viewshed will include, because the further you search for "viewable cells", the longer the computational time. Its default is the length of the diagonal of the elevation raster. Thus all elevation cells will be tested.

The third slider is used to set the 'importance factor', which is the percentage of the total possible observations (starting points) from which a remote cell must be viewed to be counted as in the viewshed region. For example, a setting of 30% means that for any remote surface cell to be included in the prototype region, it must be visible from 30 cells when 100 original observation cells are selected. This slider defaults to 0% which means it can be seen from at least one selected view-point.

5) Thresholding. Regions can be generated with this method for the cell values thresholded from raster objects. Only single variable raster objects can be used, such as a graytoned image or an elevation raster. The Region Generation Control dialog will permit you to separately select and display the raster object. Two sliders are provided to control the upper and lower values for the inclusive range of values whose locations will define the polygons in the regions. Since an image can be noisy, use the polygon area and island filter controls in the advanced options to control errors of omission and commission. A typical use of this tool might be to threshold out a range of elevation and then use the region to extract a new vector object from a vegetation type map in another vector layer.

6) Voronoi Polygons. This method generates Voronoi polygons for every vector point present in the vector layer, regardless of which are selected. The prototype region is then formed and displayed from the outside edges of the Voronoi polygons for the selected points. There are no interactive sliders needed in this method. A sample application of this region would be to determine the area available to the selected points (e.g. specific stores, bird species, etc.) among the total distribution of points (e.g. all stores, all birds, etc.). The next step in the use of such a region might be to examine the distribution of some other factor (e.g. income, nesting habitat, etc.) in another layer.

7) Basin Growing. This is an interesting combination of several TNT processes into an interactive tool. Its Region Generation Control dialog will permit you to select the raster object containing the elevation to be used to compute the necessary watershed

properties. The prototype region will then be mapped from these properties and represent the basins in the elevation which flow into the selected points, lines, and polygons. There are no interactive sliders needed in this method. These basin regions might then be immediately used to extract their areas from a soil map or geologic map. The standard attributes of this new vector object can then be used to determine the area of each soil or geologic unit present within the basin above the originally selected points at which water quality or geochemical samples were obtained.

8) Flooding. Using the same general approach as for obtaining a basin region, you can use the line drawing tool (or other selection methods) to create lines representing dams on the elevation raster selected in this Region Generation Control dialog. A slider is provided to set the height of the dam above the lowest elevation under the line which defines it. The prototype region will be the area flooded. Remember that a dam can also be built to protect an area (e.g. a side dam). The button labeled Change Flood Side can be used to change the area to be flooded to the opposite side of the dam.

As this tool was created, two separate, totally independent requests were received for a feature to compute the volume of water which would be held in a dam as a function of its height (i.e. a graph of water stage versus volume). This kind of feature can now be added via this tool where it will be possible to expose another window containing a plot of the volume of the water and surface area plotted as a function of the increasing height from the lowest elevation under the prototype dam.

9) Raster Cells. You can use this tool to create a region from a single raster for individual cells which exactly match a collection of specific cell values. You can choose any single raster object from within the tool. A slider is provided to set the range around the selected raster values for cells to be included to the output region. Simply use any procedure to select the "training" elements from a layer or draw points, lines, or polygon. The prototype region is all the cells in the image which match those defined by the selected or drawn elements.

This simple tool (as well as the others) can actually be used in complex applications. For example, first cluster a multispectral/multitemporal set of images into 256 clusters stored in a single 8-bit color raster (any existing simple color composite raster made from an **RGB** image will do). Select this 8-bit raster in this tool. Add a vector layer which has a map of some polygon surface features of interest, or draw them (e.g. a vegetation map, surface geology, a training set map, ...). Select polygons from this layer representing a surface material type. The prototype region is immediately the cells in the image which match those in the polygons in color or cluster value. Use the advanced tool sliders to control the "noise" of omission and commission in the prototype region by their real areas (e.g. to suppress areas and islands of less than ten acres). Use this region or map of the material to immediately extract from some other image or vector layer. This is merely a sample application of what can be done in a truly interactive raster-vector based geospatial analysis system with a few mouse clicks!

10) Texture Growth. A prototype region can be obtained from the areas in an image of a selected texture. The Region Generation Control dialog will permit you to select the raster object. The texture sought in the image is defined by the raster cells located inside the selected vector polygons, under the selected vector lines, or inside circular areas surrounding selected points.

A measure of texture must be provided by more than a single image cell from single selected points. Therefore, there is a slider available to define the radius of the circle at

each selected point (i.e. training areas) from which the texture will be defined and grown. Also remember for use here that **V5.60** allows you to directly create (e.g. draw on the image) multiple selected elements by directly drawing them.

Texture is defined for this initial implementation separately from the cells inside each training area using their mean and standard deviation. A slider is provided to select the upper/lower limit of the standard deviation of the cells in the training area. This slider defaults to zero so that only the cells with the training area are in the prototype region. As you increase the slider value above zero, each training area grows or expands. The tool tests adjacent cells to determine if they can be added to the training area using the criteria defined by the setting of the slider (i.e. if their value is within the specified standard deviation range). If this test is met, the adjacent cell is added to the area, and the process continues and grows outward to areas bounded by cells which do not meet the test. The prototype region is the composite of all the areas grown in this fashion.

11) Cluster. All six of the cluster methods used elsewhere in unsupervised image classification are available via panels in this Region Generation Control dialog to cluster selected points based upon their **X** and **Y** separations. The methods include **K**-Means, Fuzzy **C** Means, Minimum Distance Angle, Self Organizing, Adaptive Resonance, and Isodata classifications. A single relative distance slider is provided in the method where it is logical. It allows control of the cluster tightness and therefore the number of the clusters which will be formed to make the polygons in the region which results.

Direct Regions. Points, lines, and polygons can now be directly drawn, in place of selection, to provide the elements for the creation of regions. At the top of the "Element Selection Dialog" there are now three icon buttons providing access to tools in the "Region" portion of the dialog, which are multi-point, multi-line, and multi-polygon.

All three tools allow multiple points, lines, or polygons to be considered as one entity for generating regions. Pressing the right mouse button after drawing your features will expose a pop-up menu with the appropriate list of operations to generate a region with. This is the same list used for vector lines, points, and polygons. See above for the list of region generation methods. After your selection, the same "Region Preview Dialog" will be brought up with the options for viewing and manipulating the region.

Some sample application ideas clarify how these direct drawing tools can be used for fast region generation. Use the multi-line tool to trace a series of drainage lines from an orthophoto. Then use the right button to select the buffer zone region generation method, and immediately design the buffer zones for these drainage lines. In another example, draw polygons around wetlands or lakes in an orthophoto, and then use the right button to select the basin region generation method. Use the basin polygon areas created around the water polygons to determine which one might be a sink for a chemical spill.

Your Region Ideas. MicroImages is made up of software oriented professionals. We do not have staff who employ the **TNT** products in contract or other professional applications to do geospatial analysis. Since its founding, MicroImages has relied on its clients to request meaningful adaptations of our technological skills to their special disciplines.

At this point, or as you use these region tools, you may have ideas for new region generation methods which can be added to **TNTmips** and **TNTview**. Please submit these ideas for possible implementation. Some ground rules are in order regarding what is appropriate and inappropriate. Region tools, and the application of regions, are deliberately designed to be simple, with few and easily understood inputs and controls. They

are designed to provide a more easily understood, interactive geospatial (i.e. **GIS**, **IPS**, ...) analysis paradigm for newcomers and for increasing your fast and routine productive use of existing geodata.

Remember, all these interactive region generation tools and their uses are available in **TNTview** via the display process. **TNTview** is designed to support this kind of quick visual geospatial analysis by professionals who need only simpler part-time geospatial visualization and analysis tools when working with existing geodata.

Any new region tools you propose must be capable of being controlled by a few simple inputs! In general, they will contain at most two principal sliders or less and a few simple additional controls. Each slider should control an independent variable if possible. Part of the problem with geospatial analysis which the region tools are designed to overcome is that newcomers are intimidated by processes which provide too many initial parameters which they do not understand and have no idea how to select or set. If you are proposing a region generation tool, it will need to produce a spatial result related to the display, and may require the selection of one object not currently displayed (e.g. elevation or image objects that are directly selected in the region generation tools in **V5.60**). In other words, a region generation can be capable of a complex activity as long as it makes sense to its user to operate it with a few simple controls.

If you propose a new region generation tool, please give a detailed idea of its design together with the required models equations. It was relatively easy for MicroImages to add the basin and flood tools this quarter. But it took years and hundreds of hours to add and improve the watershed analysis process which supplied the software functions reused in these tools. There may be several repeated, important spatial analysis activities in your profession which might be very useful if implemented as region generation tools. For example, region generation tools could map the dispersion of a fluid or a gas over a surface as a function of time in an environmental spill. But you will need to supply the model for how this dispersion can be modeled. Regions can also be built from linear concepts related to connectivity, such as the flow of species between isolated sites (e.g. **GAP** analysis).

Most of the activities the region generation tools and region analysis perform could already be done elsewhere in the **TNT** products by a series of Object-In Object-Out (**OI/OO**) steps. This **OI/OO** approach to the same kind of activity is more appropriate for professionals with more experience in the **TNT** products and to the more complex analyses. The **OI/OO** steps give you many, many more controls on the steps in the process. This means that you must have a lot more knowledge and experience with the results that all these interacting control parameters will produce.

So far, the way in which powerful but simple to use region generation tools are created is to start by implementing an **OI/OO** process with all the many input parameters needed to try to control all aspects of the process. When this process has been perfected, it can then be abstracted into a simpler to use region generation tool. This was certainly the case with regard to the ease with which the watershed, unsupervised classification, buffer zones, polygon fitting, and Voronoi tools were quickly created this quarter in a few days each. For example, buffer zone region prototyping was not possible until a fast and accurate buffer zone procedure was available in the **OI/OO** process.

Certainly the new region tools you envision will be most expediently added if you explain to us how they can be built up out of the concepts already implemented in our existing

OI/OO processes. A request for a region tool which first requires a complete new **OI/OO** process to be built is going to get less attention and/or take a lot longer.

Display/Spatial Data.

Some complex layouts will now open faster. The amount of speedup depends on the number of **RVC** files used in the layout. Layouts using a small number of Project Files can open as much as 50% faster.

When displaying **TIN** objects, the user now has the option to draw contour lines instead of, or in addition to, the other **TIN** elements. Two different contour intervals may be set (one must be an integer multiple of the other) with different line styles for each. For example, the first interval might be set to 100 with a heavy line style and the second interval to 20 with a lighter line style, as is common on topographic maps.

Display/3-D Perspective. *(prototype process)*

* A totally new **3-D** rendering algorithm has been substituted to display the perspective image on the screen. As a result, the time required to render oblique raster views has been greatly reduced. On a Pentium 133 with **W95**, it now takes less than ten seconds to render a **3-D** perspective view of the Crow Butte sample geodata. This test used the Photo **IR** band draped over the elevation raster. On a Power Mac computer using a 200 MHz model 604e processor, this same test rendering takes less than two seconds, even when the hydrology and road vector layers from the sample geodata are also draped over the surface being rendered.

Vector and **TIN** objects which have **3-D** coordinates can now be displayed separately in **3-D** and stereo with the selected lines styles, offsets, and other controls. Vector and **TIN** objects with **2-D** or **3-D** coordinates can be viewed in **3-D** or stereo over an elevation raster or an image draped upon an elevation raster. When only **2-D** coordinates are available in vector objects, the **Z** value of every vertex in the elements is derived from the elevation raster as they are rendered. Multiple stacked **3-D** views of these types can be rendered (e.g. use Crow Butte hydrology and roads over a **3-D LANDSAT** image, soils over the elevation image, and so on in a vertical stack for comparison).

When a **TIN** object is available, you have the option to draw contour lines instead of, or in addition to, the other **TIN** elements. Overlaying contour lines on a perspective **3-D** view of an image can be especially effective. Simply choose the **TIN** object for a surface overlay on the image, and select to draw it as contour lines rather than a net of triangles. If you have an elevation raster object for use in your **3-D** view, you can always overlay a contour map on the surface. Simply prepare for this by creating an accurate **TIN** object from the elevation raster object using the new **V5.60** elevation to **TIN** conversion procedure (see the surface modeling process discussed below).

Two different contour intervals may be set for a contour display with different line styles for each (one must be an integer multiple of the other). For example, the first interval might be set to 100 with a heavy line style and the second interval to 20 with a lighter line style, as is common on topographic maps.

None of the objects used in this process need to have matching projections, cell sizes, and other similarities, as it functions similar to the Display Spatial Data process and dynamically resolves these differences when building a composite **3-D** view. In general, these kinds of computations for projection reconciliation and other data fusion do not

significantly impact the time to render the view. The principal factor which does affect the rendering time is the resolution of the elevation raster relative the view requested.

A pedestal can be designed for each **3-D** view or each model in a stack of views. The color of the pedestal can be designed for each layer in a stack on the layer control dialog when the elevation raster from that model is selected.

*** Import/Export.**

> Extraction During Vector Import.

This feature was added to eliminate the need for a **TNTlite** user to obtain access to some other vector based product. It allows the **TNTlite** user to extract a smaller ("lite-sized") portion of the other product's vector files. This feature will also have value to professional clients who wish to import only a specific geographic subsection of a larger vector file.

You can now specify the extents of the vector object to be imported in the control window and select one of the three edge handling methods: Completely Inside, Partially Inside, and Clipped Inside. During import, all the external attribute tables will be filtered to eliminate records attached to elements which are not extracted in whole or in part. Also, the standard attribute table will be built only for those elements transferred. If you select the "Clipped Inside" option, the standard attributes (e.g. area, ...) will be computed for the altered or clipped elements in the vector object.

Unfortunately, it is not possible for any topological vector import process to directly determine (in advance) the number of vector elements of each type which will be created during a clipped import. For example, a single wavy line element at the edge of the area to be clipped can create many new lines in the new clipped vector object. Also a single "snake-like" polygon at the edge of the extent being imported can create many new smaller polygons. Thus, **TNTlite** users cannot be warned in advance that the extent they are requesting will create a vector object which exceeds the **TNTlite** vector object size limit. As a result, the process must create a temporary vector file for the extent, assemble the topology, and then report that it is oversized. The **TNTlite** user must then reduce the extent and try again.

Compression During Raster Import.

The raster import processes now provide the option to create a compressed raster object. If the lossy option is selected for **JPEG** compression, the amount of compression corresponding to image degradation can be specified.

ERDAS Imagine 8.x Import.

By popular demand, any images in the various forms in the new project file format created in **ERDAS** Imagine 8.x can be imported into raster objects.

NLAPS Import.

Imagery in the National Landsat Archive Production System (**NLAPS**) can be imported. This is the format for the geometrically corrected **LANDSAT TM** and **MSS** imagery distributed primarily from the **EROS** Data Center archives on **CD-ROM**.

JPEG Import.

JPEG images (usually have extensions .jpg) can now be imported into raster objects. This is a common format for compressed images posted on the Internet, where most images are posted in **TIFF** (*.tif), **GIF** (*.gif), or **JPEG** (*.jpg) formats.

When importing from **JPEG**, you can specify that the raster object created be uncompressed or compressed to a specified level. Unfortunately, a **JPEG** compressed file carries no information about the level of compression previously applied. Thus, it is not possible to exactly match this compression in a **JPEG** compressed raster object. (i.e. When you import into a **JPEG** raster object, **JPEG** compression is automatically applied.) However, it is the nature of **JPEG** compression that if you choose to have less, even slightly less, **JPEG** compression in the imported raster object than in the source file, there will be no additional losses in the images.

JPEG Export.

Compressed or uncompressed raster objects can be exported to the **JPEG** format. You can set the "compression factor" (i.e. the lossy level) of the **JPEG** file being created. If the raster object is compressed in **JPEG**, the export will default to the same compression factors for the new file.

ArcWorld Import.

You can now specify the units for an ArcWorld file when importing it from **TIFF**.

DISIMP.

The **DISIMP** format used in Australia can now be imported into a raster object. This format comes in at least two variants, both of which are imported. There appears to be a standard format and a modified format (***.IPS**) in which rasters were created by **CRA** Exploration Pty. Ltd., Australia. This import will be adjusted as other variants and alterations of this format are encountered if sample data is provided to MicrolImages.

AVHRR-Biweekly Import.

The import for the **AVHRR**-Biweekly format has been updated to handle recent changes to the format.

MapInfo Import and Export.

By popular request, **MIF/MID** files can be imported and exported to/from vector objects. You can also still import and export them to/from **CAD** objects, as they do not necessarily contain topological geodata. When importing into a vector object, the topology will automatically be built.

ARC/INFO Coverage Import.

The new *.adf file in the coverage is now used during import. The import process also automatically determines and imports single or double precision coordinates according to their use in the coverage file. MicroImages has traced back several complaints about inaccuracies in the subsequent use of a vector object in the **TNT** products (e.g. in an overlay) to the single precision coordinates used in the source coverage.

3-D-MOSS Export.

Vector and **CAD** objects which have **3-D** coordinates can now be exported to **3-D** structures in the **MOSS** format. Remember, **MOSS** is a well documented and simple vector **ASCII** based format which can be used for input into your custom programs or as a means to transfer geodata into unsupported formats (i.e. where they have an import for **MOSS**).

> Database Import via Query.

This is a simple idea added to make **TNTlite** easier to use, but you will also find it very helpful in both **TNTmips** and **TNTview**. **TNTlite** is limited to a total of 1500 records in each table. In **V5.50**, if the table needed was larger, a **TNTlite** user would need to learn and use the source database product to reduce the records in each table. This made it complicated to simply get a selection of 1500 or fewer records from an existing large table to do a pin map onto an image, make a theme map, and so on. However, these are very useful beginning exercises for the new user of **TNTlite** (or in your professional product).

During the import of a database table, you will now find that there is an option menu labeled "Select" which provides the choices of "All" or "By Query". Next to the "Select" button there is now a button labeled "Edit Query...". Use this button to prepare a new query or edit an existing one. The syntax for your query will be just the same as that used when you select By Query in Display or other processes. Use this new feature to "filter" the records you wish to use as they are imported into a database object. For example, the **EASI** .dbf in the database object c_genpop has demographic records for 3141 U.S. cities: import by query "URBANPOP > 7500" selects 1498 records into a raster object for immediate use in **TNTlite**. If it is not obvious how to write this import query, use the external .dbf viewer in Access, Excel, **MS** Works, ... to inspect the external .dbf file and choose the values for your query.

ODBC Import and Export.

You can now create a new **ODBC** data source in both the import and export processes for Windows products. The "**ODBC** Control Panel..." button in either process exposes the **ODBC** import or export dialogs. These will allow you to configure an **ODBC** data source for Windows Excel and Access. The ability of the **TNT** products to directly create a new database is a function of the individual vendor's database management control policies and implementation of **ODBC**. The **ODBC** drivers for some database products will deliberately not allow this. For example, creating a new database in Oracle is non-trivial and can only be done by the administrator.

Object Editor.

All Objects.

General. The icon bar on the main editor control panel is now editor specific and no longer the same as the display process and provides icons "Create New Object...", "Edit Reference...", "Open Object for Editing...", and "Save As...".

A "Cancel" button has been added to all "add element" and "edit element" tools for vector, **CAD**, and **TIN** layers (not rasters). Pressing this button for "add element" tools switches you out of the current tool back to the zoom box tool. For the "edit element" tools, the cancel button will switch you back to the step before the edit element tool was invoked.

* Element Selection. The three different element selection dialogs used in **V5.50** have been replaced with the familiar and now universal Element Selection dialog from the Spatial Data Display process with a few modifications. The first modification is that the "Selection Parameters" toggle button is gone, and the layer/element view pull-down is automatically opened. The second modification is that the layer/element view only shows the current layer as defined by the main control panel. This change in element selection dialogs allowed the powerful region creation and element selection tools to be incorporated into the Object Editor.

Snap-to-Grid. A snap-to-grid capability is now supported for all editable layers of any type. The dialog to set up the snap grid is under "Setup/Snap Grid" on the main control panel menu.

Redraws. Options to redraw layers under certain conditions have been added. The options are under "Setup/Preferences.../View".

Edit in Place. Under the "file" menu in the object editor is an option to edit all object types in place. This power feature is for quick modifications to an object. Note that this feature directs the editor to modify the object directly. This entry appears only when the extended menu items are enabled in the main menu under "Setup/Preferences...". The save timer discussed below and the "File/Save..." options are not available for objects that are edited in place. You will also not be notified when closing the object or leaving the editor that changes have been made to the object. **CAD** objects are not editable in place. The raster editor "Undo" capability is disabled since the operation relied on the original object to undo from.

IMPORTANT: Give careful consideration to editing objects in place. It is the same decision you would make regarding editing a big report or a complex page layout in place. All software fails, even the latest version of Microsoft Word being used to write this **MEMO**. However, editing in place is very useful if you can readily recover the object being edited from some backup source such as reimporting it or from a backup. Use editing in place to make a few simple anticipated changes to an object. Do not edit in place when you cannot anticipate each step. With "unknown" needs, pay the time-price it takes for the Object Edit to make a temporary copy of the layer you plan to edit, and then subsequently and periodically save your progress into a new object.

Saving Options. You are now able to specify a time interval to prompt you to save a modified layer to an object. The timer is set in the editor under "Setup/Prefereces/Save" and is maintained separately for each layer. For example, if you set the save timer to 20 minutes and then modify a layer, 20 minutes after the timer was set,

you will receive a dialog prompting you to decide if you want to save this layer. At this point you can save the layer or skip it. Any new layers that are loaded or created also get a separate timer. If the specific layer is editable, but has not been modified, you will not be asked to save when the timer expires. The timer is reset per layer after the timer expires, therefore each layer has a continuous auto-save timer.

You are now able to "Save As..." from any editable layer to an object even though it has not been modified. Previously, it was required that the layer be modified to do a "Save As..." operation.

* Filtering Attributes. There is now an option to remove unattached records for the databases attached to the raster, vector, **CAD**, or **TIN** object. This option is under "File/Remove Unattached Records".

Vector Objects.

Snapping. A snap option has been added to avoid line crossing when snapping to nodes or points. Lines can now also snap to themselves in the snap operation.

* Filtering Attributes. Options are now available to remove excess nodes and remove unattached records when saving. This option is set under "Setup/Preferences.../Vector".

* Regions. The new "Extract Via Region" tool in Display Spatial Data does not exist for vectors in **TNTedit**. In its place is a similar, but even more powerful new procedure for use on either reference or editable vector layers called "Copy". Copy performs the same function as the "Extract Via Region" but has two additional important capabilities. The first allows you to specify that you want "all" elements or only the "selected" set of elements to be extracted. Second, the new extracted layer is directly created as a completely viable, editable layer, which can be modified and saved like any other editable layer. The display version of the operation creates a temporary vector layer that cannot be saved as an object and that exists only until the layer is removed or the process is closed.

When using the "Add Region" tool and the vector object is empty and set to an arbitrary projection, you will be asked if you want to change the georeference of the vector object to be the georeference of the region. This feature eliminates the inconvenient requirement in **V5.50** to first generate a new vector object with the correct georeference then add the region into it.

Raster Objects.

* Compression. New rasters which are created can now be saved as compressed raster objects using the "Create New Raster" dialog. Existing compressed raster objects can now be selected and used as a layer. You can control your default preferences for the use of raster compression when saving through the Setup/Preferences/Raster section. This panel also allows, when saving the raster, to change the compression type. See the section above on raster compression for more details on these new compression methods and their effects on raster objects.

Raster Color Conversions.

The process allows an existing color map to be used when the output type is 8-bit color composite. This is useful when the data is to be subsequently exported to some other system which does not automatically resolve color map differences when using multiple images.

The process can now create a 4-bit color-composite. This is useful when there are only a few colors in the raster.

The process permits one or more of the input components to be "skipped".

*** Raster Extract.** *(prototype process)*

General.

Raster Extract is a completely new process replacing the earlier Raster Copy and Manual Resampling processes. It has a completely new and more interactive user interface. For example, the new process now allows views using non-integer zoom/sampling values and rotation to any desired angle.

The resampling method used during the raster(s) transformation can be chosen as nearest-neighbor, bilinear, or cubic convolution interpolation. When copying "complex" rasters to "real" rasters, the component (real, imaginary, magnitude, or phase) can be selected. When inserting into an existing raster, the user now has the option to replace only "null" cells in the existing raster object with real values from the source raster object. You can also choose to create compressed output rasters and control the compression type and quality (for lossy compression types).

You now have more control over the output values if rescaling is to be performed. The value can be automatically rescaled over the allowed range for the selected raster type. Alternately, you can enter offset and scale factors to rescale to any desired range. If rescaling is done, the output raster will have the scale and offset set back to the original values stored in the raster header.

Defining Areas.

You can now control the area to be extracted by tab panels offering a choice of five area definition modes: all, by range, by mask, by region, and user defined.

By Range. The "range" extraction mode allows you to position and size an elastic box over a view of the source raster. The size and extents of the box are reported and can be set in either raster or map coordinates at your option. Setting the box size in this fashion is particularly useful in preparing data for **TNTlite**, as the box can be sized such that the raster will fit within the **TNTlite** limits and then positioned at the desired location.

By Mask. Choosing to extract by mask option allows you to select an existing binary raster to use to define portions of the raster(s) to be extracted. The area selected by the mask is highlighted in the raster view. After the mask has been selected, the user can modify the selected area by pressing the "Modify" button.

By Region. Extracting by region option allows selection of an existing (previously-saved) region to define the area to extract.

Manual. This method of extraction provides you complete control over the area to be extracted by using the rectangle, circle, ellipse, polygon, and region generation tools. Using the "manual entry" drop-down panel, the user can define the area to be extracted using any desired map coordinates. Regions can be directly created and used within

the process using the same methods, including the 11 new region generation tools, which are now available in the other display oriented processes as described above.

Raster Properties.

This process has now been separated from the process which computes surface properties and can be found at Interpret/Vector/Raster Properties... You can now select multiple raster objects and create the properties table for each.

Several optional methods are now available for the processing of the boundary cells which are intersected by the polygons defining the surface areas whose properties are being computed:

Include. You can choose to include all these boundary cells.

Exclude. You can choose to exclude all the boundary cells. This means the area of each polygon will be slightly smaller than for the include method.

Assign. This method adds each boundary cell into the polygon which has the largest portion of the cell.

Divide. This method will take the longest to execute and will proportion the fraction of each boundary cell to its respective polygon.

Locally Adaptive Contrast Enhancement. (Interpret/Raster/Filter/Local ...)

The Wallis Filter first released in **V5.50** has been expanded to operate in color and with several methods and has been renamed Locally Adaptive Contrast Enhancement (**LACE**). The process now has a revised user interface with tab panels to support the differing enhancement methods and groups of raster objects to which they are applied. An important new feature is that all **LACE** effects can be restricted to the area specified by a selected binary raster mask. For example, you can enhance land areas to bring out local contrast details while leaving the water bodies unchanged, or the reverse.

The basic Wallis enhancement method provided in **V5.50** is still available and operates on grayscale rasters.

You can choose either the **RTZ** or **HIS** method for application to an **RGB** set of rasters or color composite raster object. Either method will first transform the input color rasters to **HIS** (Hue, Intensity, and Saturation) rasters and apply the grayscale **LACE** to the Intensity component. The two methods then use different approaches to transform the **LACE** Intensity image back into **RGB** color space. These procedures also ensure that the color balance of the new enhanced color composite raster or set of **RGB** rasters is similar to that of the input. A color plate is attached to illustrate the results of the application of this method.

A principal component method is also available to apply to multiband raster objects of more than three bands. The process first converts the bands (i.e. raster objects) you select to principal component raster objects. **LACE** is then applied to the first principal component. The inverse principal components operation is then used to convert the rasters (including the enhanced first component) back to the original bands (raster objects).

Surface Modeling.

The interface of the process has been improved, and the integrated View window now includes functions for examining attributes and viewing raw raster data.

Profiling.

There is a new optional operation available in the Surface Modeling process which creates "stacked profiles" from a raster object and saves them in a new **CAD** object. This **CAD** profile object is intended primarily for display in **2-D** or **3-D** over other objects for surface visualization and visual analysis. An example of the display prepared by this new option can be found on page 18 of the enclosed Getting Started: Surface Modeling booklet.

This new profile option will allow you to specify in the raster object the distance separating the individual profiles, the cell sampling rate along a profile line, and the orientation (angle) of profiles. The displayed appearance of stack profiles is controlled by setting the maximum amplitude factor for all profiles and options to display the profile baselines and to show only the specified portion of each profile which is above the average level of the whole raster. You can also choose whether the profiles are to be smoothed using quadratic or Cubic **B-Spline** techniques. When all the profiles are saved in a **CAD** object, it will contain lines or polygons depending on the process settings.

Contouring.

A more advanced and more robust raster contouring method than was provided in **V5.50** is now used. You can choose to smooth the input raster before tracing the contours, which yields smoother contours. This improves the visual appearance of contours for your noisy, poor quality **DEMs**.

TINs.

You now have an option to match some other reference raster with the new raster surface object created from a **TIN** object.

* DEM/ortho. (*prototype process*)

Background.

Considerable effort was expended to improve the **DEM/ortho** process over the past several months. Most of this was concentrated on rewriting and reorganizing how you use the process based upon past observation of your applications of it. These changes have not fundamentally changed the way the process works, but take the form of improvements in the user interface and in the statistics reported for your inputs and the accuracy of the stereo model which they define. However, the goal still has not yet been achieved of providing the casual approach to its application as in the use of many other **TNT** processes.

The principal difficulty is still the accuracy of the inputs to the process. The concepts used in the **DEM/ortho** process are those developed in the science of Photogrammetry, which is the science of making precision measurements from photographs. It should be emphasized here that this is a whole science in and unto itself, and that the key words here are "precision measurements". At the present time, MicroImages find that the users of the **DEM/ortho** process are often unable to provide inputs to the process which are sufficiently accurate to achieve the results which they desire. There is a saying in old English that "it is difficult to make a silk purse out of a sow's [pig's] ear", which translated means that the results can only be as good as the inputs provided.

In the case of anyone's photogrammetric process and MicroImages' **DEM/ortho** approach in particular, there are dozens of factors which all must be right to achieve an accurate result. If any one is wrong, then the result is wrong and inaccurate. These factors range from: acquiring the best quality stereo imagery possible for the application,

preserving the image content and geometry through content through the digitization, and subsequent handling up to and including the entry of accurate ground control and precisely positioned tie-points. Errors or inaccuracies in any of these steps will degrade your final results, sometimes in unexpected ways.

To illustrate this in the extreme, every couple of weeks, MicrolImages will get this general type of question: "Can your **DEM**/ortho process produce a contour map with a one foot or one meter accuracy from say **SPOT** imagery or some kind of low quality stereo airphotos?" Obviously this is not going to be possible. However, one **TNTmips** user has worked together with MicrolImages to gradually develop the software and their image acquisition methods to handle a very difficult application. The application is to acquire scuba-video images a few meters above components of a ship wreck and produce a **DEM** and ortho image of these ship components. This archaeologist has had a lot of frustrations and certainly not found this to be a casual activity, but has persisted. He recently presented his as yet unpublished results at a marine archaeology conference at which they were widely accepted as useable. He is anxiously awaiting each new release with improvements in the **DEM** portion of the process and also the features needed in other processes. For example, the **3-D** viewing of his **TIN** and contours of the components released in **V5.60** will allow him to view his **DEM** results from varying angles.

Think of the problems he has encountered and at least partially surmounted: speckling in the images due to surface wavelet action, low quality video images of poor contrast and almost no color, low resolution video images, partial obstruction by moving sea-plants, very difficult to acquire control points (no **GPS** readings down there), and on and on. However, on the other hand, he was not daunted and was not trying to force his data acquisition and the **DEM**/ortho process to produce millimeter accuracy from five meter height under these conditions. His **DEMs** look like the wreck components, and his orthorectified video images were improved in geometry and "mosaicked" results.

The most common problem encountered to date in the application of the **DEM**/ortho process is in the expectation that the source images and control data can produce results greater than is photogrammetrically possible and the subsequent inaccurate entry of the ground control points and tie-points. All other things being correct (image quality, scanning, camera parameters, ...), the **DEM**/ortho process cannot help you create better stereo image and control data. However, effort has been expended this quarter and will continue to be expended periodically as feedback is received and you put time into controlling the accuracy of the data you enter. This takes the form of more accurate input methods and more and more checking systems to report to you when inaccuracies are encountered in your data and materials. However, it is still possible that you can even now enter data which will cause the process to refuse to run.

Introduction.

Digital Photogrammetric Modeling in **V5.60** is now a single integrated process that combines all previously separated technological steps for stereoscopic modeling. It consists of four parts or steps: Interior Orientation (modeling the interior geometry of each image), Relative Orientation (relating the acquisition geometry of the two images), **DEM** Extraction, and Orthorectification. All four steps are now tightly integrated together in one process. You can now easily switch back and forth between these steps when it is necessary to adjust some specific parameters or perform additional data entry tasks (e.g. more tie-points). This new integrated design provides immediate access to all information and operations available in the **DEM/ortho** process for your photogrammetric project.

Overall Design.

The new process uses two principal visual interface components: dual integrated, locked together View windows (one for each image) and the Digital Photogrammetric Modeling control window. This control window provides access to the four process parts or steps using four tab panels. You can also switch between tab-panels (steps) using the tab icons or pull-down menu options. The control window also provides the means of selecting the input stereo images for each step in the process. Once selected in the first step, these rasters by default will now automatically be used in each successive step. However, you can also still select different inputs for direct entry into a specific step. You are also presented with options for saving the intermediate raster object prepared by one step before proceeding on to another.

Interior Orientation Step (Step A).

Interior Orientation provides the interface for entering information about camera parameters and input rasters. It consists of three parts: Camera Parameters, Fiducial Marks (not yet implemented), and Distortion (not yet implemented). The Camera Parameters form provides for the inputs specifying camera focal length, scanner resolution, and position of the principal point on the left and right rasters. It also has two buttons for loading and saving camera parameters in **RVC** files as a new camera sub-object so that these parameters can be reused. The Fiducial Marks form will provide visual semi-interactive interface for finding and measuring position of fiducial marks on the input rasters in order to compute location of the principal point. The Distortion form will provide interface for removing distortion from the images using camera calibration information. There are also plans to provide geometrical correction for the Level 1 **SPOT** images.

Relative Orientation (Step B).

Relative Orientation has an extensive user interface for selecting, editing, and manipulating tie-points and generating epipolar images that are necessary as an input to the **DEM** Extraction step. This interface provides three parts: Tie-Points, Auto Generate, and Parameters. The Tie-Points form provides the interface you use to view the stereo images and to enter and manipulate the tie-points. It has two small image magnifier windows (one for left and one for right stereo image) with arrow icon buttons to accurately position their cursors. The form also provides a scrolling list of data on each of the current tie-points set.

Tie-Points. The two small magnifier windows are tightly integrated with the two locked together dual image view windows. When the cross-hair tool is moved in either of the

two image view windows, the small magnifier window shows the selected zoom of the small area at the intersection of each cross-hair tool. This approach eliminates the previous need to zoom in and out of each image view to accurately co-locate the tie-points. Simply move either cross-hair tool in the image view windows, and the magnifiers will follow. Then switch your attention over to either magnified view to accurately position the tie-point in either image using the arrow keys provided (and the cross-hairs will correspondingly follow).

There are two numeric displays right under the magnifier windows which show the current image parallax (in x and y direction) for current cursor locations in each image. Another numeric display under the magnifiers shows the current correlation coefficient between left and right images at current cursor locations. Observing this correlation coefficient is very helpful to determine the accuracy and reliability with which you are able to position a new a tie-point at this location.

The scrolling list at the bottom of the form displays standard information about each tie-point in the current working set: number, **X-Y** locations on both the left and right images, and parallax information in both directions. However, the list is also directly connected to the display part of the interface: clicking on a specific tie-point will result in moving cursor position to the location of this tie-point in both View windows and updating both magnifier windows to it. This allows quick and easy navigation to, and inspection of, any existing tie-points. Correspondingly, you can also click on the tie-point in either image view window, and this tie-point will be highlighted in the tie-point list and positioned into the magnifiers. Each tie-point can also be optionally shown with a numeric label tying it to that point in the numeric list.

After you have selected and repositioned to an existing tie-point, an Action button icon provides a dialog to perform the following operations on that tie-point: Adjust, Add, Update, Delete, Delete All, Open, and Save buttons. Adding or adjusting any tie-points results in the immediate recalculation of the current epipolar solution. Based upon the current solution, a red outline box is drawn on both the left and right images showing the current computed overlap between images. Your initial georeference points for the left raster are also displayed as a small rectangle with the crossing lines on it. The georeference on the right image is not used in this process.

Autogenerate. This form provides controls for the auto-generation of additional tie-points and/or readjusting positions of existing points. This auto-generation procedure can often generate thousands of additional tie-points in minutes and may or may not be suitable for gathering tie-points before running the Area Correlation procedure in **DEM** Extraction process (old one, separate process). It saves all the points it finds in the tie-points subobject under the left raster and optionally loads them into the process, replacing any current working tie-point set. If this current working set of tie-points was not saved, you will be prompted for its possible save. There is also an option to save all these computed tie-points as a **TIN** object. The Adjust All Tie-Points button starts the analysis of all currently loaded tie-points, and it tries to automatically recorrelate and re-adjust them. It might be helpful when trying different settings for correlation and search window sizes.

Parameters. This form provides access to all options and settings for this step. It provides the controls for this step's display and appearance. You can select to show or hide the numeric tie-point labels on the view windows, the rectangle controlling the area of overlap in the images, and the original georeference points. The default tie-point la-

bels show a white background, and the currently selected point would have a red background. You can optionally choose two alternate label display styles: by correlation and by residuals. These are activated by "Show Color Coded Correlation" and "Show Color-Coded Residuals" toggle buttons. The Show Color Coded Correlation will assign a color to each numeric label according to its correlation with the other tie-points. Highly reliable points with a correlation coefficient of .75 to 1.0 will have green labels. Acceptable but possibly suspicious points with correlation coefficient of .5 to .75 will be yellow. Unreliable points with a correlation coefficient of less than .5 will be blue.

The same green-yellow-blue label color scheme is used if you toggle on the Show Color-Coded Residuals option and represent a test of the residual in the y-direction (i.e. perpendicular to the flight direction). This y-direction residual is a good indicator of the quality of your current epipolar solution or model with your current collection of tie-points. Low residuals with a parallax in the y-direction less than or equal to one cell will have green labels. Acceptable residuals with a parallax in the y-direction between one and three pixels will be yellow. Unacceptably high residuals with a parallax in the y-direction greater than three cells will be blue. The residual parallax in the y-direction should be less than three raster cells.

This form also provides option menus for setting the magnifier windows' zoom level; the sizes of the image search and correlation windows used in the autogeneration of tie-points; the image resampling method of nearest neighbor, bilinear, and cubic convolution (default); to compress and not-compress (default) the output rasters; and whether or not (default) to replace the current raw input views with the epipolar ones after generating them.

DEM Extraction (Step C).

DEM Extraction creates the **DEM** raster from epipolar images. **V5.60** provides a more accurate **TIN** densification procedure which is also ten to 20 times faster than the one used in **V5.50**. This of course significantly improves the practical applications to the whole **DEM**/ortho process. This new interface provides two parts: Extraction and Options.

Extraction. The Extraction form provides standard controls over the stereo image cross-correlation and the **TIN** densification algorithm:

- minimum cross correlation;
- minimum **TIN** triangle area;
- maximum number of nodes in the **TIN**;
- maximum number of iterations during **TIN** densification;
- image Correlation window size;
- output **DEM** raster object sampling rate; and
- output **DEM** raster data type.

There is also an option to save the result as a **TIN** object. This allows you to immediately view it in the **3-D** process as well as use it for a contour overlay.

In **V5.60**, this **TIN** densification approach builds a **TIN** based on input tie-points and then runs Quintic surface fitting procedure to fit a surface on it. A minimum curvature surface fit will subsequently be added as the default method for **DEM** generation. After the **DEM** is computed, and if the Save Result As **TIN** option was selected, this **TIN** layer will be overlaid on the image in the left display window. **TIN** overlay can also be overlaid as contours on the left image so you can inspect the results.

Options. The Options form provides control over appearance of an output **TIN** object and other display parameters.

Orthorectification (Step D).

Step D is not yet available in this new process. The **V5.50 DEM/Ortho** process of three steps is still available on the menu. Simply use Step 3 of this process to perform the restitution to provide an orthoimage. Step 3 will subsequently be replaced, but in **V5.60** it has been improved by a new user interface. It will now simultaneously process multiple rasters (e.g. **RGB** objects) using the same orientation parameters derived from your setup with one base raster. All additional raster objects selected for identical processing should be the same size and match the base raster (as would be the case in a set of color rasters), but they do not need to be georeferenced or have camera parameters. All orthoimages generated in this fashion will have the same georeference transferred from the base raster.

Vector Filtering.

The AutoTrace process introduced in **V5.50** provided a new bubble filter for cleaning up vectors. By popular request, this new filter is now available for selection in the Vector Filtering process. To refresh your memory, repeated below is the brief description from the **V5.50** Features **MEMO** of how bubble filtering functions.

“The process now also removes ‘bubble’ polygons. Bubble polygons are those which are made of only two or three lines. Bubbles can occur in the binary raster in wide lines or where a line gets thick and bubbles out. Where this occurs, the thresholding step has put holes inside these wider lines which ultimately produce spurious bubble polygons. The bubble filter tests the size of a bubble polygon set by a slider. If a bubble polygon is under the specified size, the bubble polygon is deleted by removing the longest line making up the bubble. If a bubble is removed, then the lines removed can generate new bubbles which are in turn tested for and removed. This will then delete a ‘nest’ of bubbles which can occur when a complicated ‘blob’ appears in the binary raster.”

Directional Analysis.

The rose diagram dialog was changed to permit saving the rose diagram as a raster object. Modifications were made to make the rose diagram faster. You can now choose to show labels in degrees.

Interactive Line Following.

Minor adjustments were made to the user interface in order to make it similar to the one used in the color raster binarization process. These changes affect only mouse manipulation in display and in zooming windows.

Grid Cells.

Generating Sample Points.

The Grid Generation process (Prepare/Vector/Generate/Grid...) can now create point samples and navigation points inside each grid cell it creates. A variety of options are available as follows.

Grid cells structures designed with triangle, hexagon, rectangle, or square cell shapes can create point samples by three methods.

Centers. The regular method locates the sample point in the center of each grid cell.

Systematic Unaligned. The systematic unaligned method locates the sample point in each grid cell so that it is not aligned with the sample points placed in all four adjacent cells. It is also highly unlikely that any two cells in the entire grid would be aligned. Alignment of a pair of sample points would mean that a line between them was parallel to the grid. This avoids aligned, adjacent sample points in a grid placed in a rectangular agricultural field, forest stand, ... which line-up in and sample a previous crop row, tree row, treatment practice, ... and subsequently provide biased results.

Random. The random cluster method locates the sample point in a randomly selected position in the grid cell. It also provides a constraint percentage parameter which restricts the area of the possible location in each cell. The percentage entered determines, from the center of the cell, the portion of the total cell area which is used in the random position selection. No sample point will be placed outside this area near or on the edge of the cell. For example, you can choose a rectangular cell design and set the constraint percentage to 80%. The only possible sample points which can be randomly generated will be inside a rectangle centered in the original grid cell rectangle but only 80% of its width and height.

Parallel Lanes. Grid lines designed by the parallel lane method can also have sample points located along the lanes. These sample points are inserted at the selected interval and provide navigation points. An optional offset percentage can be entered to move these points off of the center of the lane by that percentage.

Adding Attributes.

When grid cells are saved as polygons in a vector object, they can automatically generate an attribute table attached to the polygons. Similarly, saving the sample points as point elements in a vector object can create their attached attribute table. These attribute tables are the means by which data fields from other sources (e.g. soil samples or geochemical samples) can subsequently be attached to the matrix-like arrangement of vector elements.

There are now six options for how the grid cells polygon elements and the sample point elements can be labeled when created in these attached attribute tables. You can choose only one of the following cell/point enumeration methods or any combination of the six for each table.

Separate rows and columns. This places one alpha field and one numeric field in the table. The first field is a letter designation (e.g. A, B, C, ... AA, ...) of the rows of cells/points starting at the bottom and continuing upward. The second field is the numeric designation (e.g. 1, 2, 3) of the columns of cells/points from left to right.

Combined rows and columns. This places one alphanumeric field in the table. The field combines a letter and a number into a single identification for the cell and the sample point matrix positions. For example, A1 is the lower left cell/point, A2 is the next cell/point to the right of A1, B1 is the first cell/point in the second row from the bottom, and so on.

Separate numeric rows and columns. This places two numeric fields in the table. The first field is a numeric count for the rows of cells/points. The rows are counted from the bottom up. The second field is the numeric count of the columns cells/points starting at the left.

Combined numeric rows and columns. This places one numeric field in the table. It contains the row number multiplied by 10,000 and added to the column number. Rows and columns of cells and points are again numbered up and from the left respectively.

Sequential numeric. This places one numeric field in the table. It is a sequential numeric count started at integer 1 and counted 1, 2, 3, ... from the upper left cell/sample. The count proceeds sequentially down the first column of cells/points. After the first column is finished, the count continues down from the top of the second column of cells/points from the left and so on.

Serpentine numeric. This places one numeric field in the table. It is a sequential numeric count started at integer 1 and counted 1, 2, 3, ... from the upper left cell/sample. The count proceeds sequentially down the first column of cells/points. After the first column is finished, the count continues up from the bottom of the second column from the left. Then the count continues down in the third column from the left and so on in a serpentine fashion from left to right.

Polygon Fitting.

The polygon fitting process (Interpret/Vector/Polygon Fitting...) now has an interactive preview. The most important parameter can also be changed by a slider. When you change this slider, the process now automatically recalculates and redraws output prototype polygons. When you have designed the best solution with the slider and changes in the other numeric control parameters, the polygons can be saved into a new **CAD** or vector object.

Distance Process.

The distance process (Interpret/Raster/Distances...) can now calculate a distance raster for the selected elements in a vector object. The dialog also has additional options for setting cell resolution and data type of the distance raster object it creates.

*** Databases.**

MicroImages has attempted to obtain the server version of Oracle **NT** to test support for its **ODBC** for more than four months. We have the personal version of Oracle **NT**, but this cannot function as a server in our tests. Oracle finally admitted that the server version had not shipped to anyone until about six weeks ago. Hope you are having better luck obtaining and using your Oracle products and getting support than we are as developers!

When reading the following database sections, the material they contain will be easier to understand if you consult the attached color plate entitled: "Database Statistics and Plots" which illustrates these new features.

Color Forms.

The background color of normal records can now be set in the Tabular View window by selecting Colors... from the Table menu. The display of these normal records can alternate between two colors (which you can select): every row, every Nth row, or every time the value changes in the field being sorted. Separate background colors for the new total statistic and substatistic rows now optionally inserted into the Tabular View window can also be similarly selected. The procedure for inserting these new rows into your Tabular View window will be explained below. Use these color arrangements to provide a pleasing color display format to make your table easier to read and to visually distinguish the original rows of real records from the temporary inserted statistical rows.

Once a color scheme is set up for a table, it is stored with the table and reused until it is altered.

Sorting.

Records in a Tabular View window can now be sorted on a selected field to allow viewing groups of similar records. Sorting also permits substatistic or "virtual records" to be created and automatically inserted between the records grouped together by the sorted field. **V5.60** permits choosing one field for the sort in the table via the Field/Sort menu. Deeper sorting on additional fields is on the list of features to be added. If you do not choose a field, the sorting will automatically default to the key field if the table has one. If there is no key field, then the sort will be by the first field at the left. The attached color plate illustrates the results of sorting on a selected field.

Summary Statistic Rows.

Optional total, or summary, statistics rows can now be inserted into the bottom of a Tabular View window. Each row will show a computed property for all the non-null, numeric values in each vertical field in the table. You can toggle these summary statistics rows on or off using Statistics from the Table menu.

A separate summary statistic row can be inserted for six properties: sum, mean, standard deviation, minimum, maximum, and a record count. These vertical or field statistics are computed for all the non-null, numeric records in the Tabular View window (visible or visible by scrolling). However, the rows are not inserted at the bottom of the table where you might have to scroll to find them. They are stuck in, and stuck to, the bottom of the Tabular View window regardless of how it is scrolled or resized. A mathematical symbol occurs in the first column of these rows to identify the kind of property it presents. However, as noted earlier, you should also pick a unique background color for these rows to readily distinguish them from all the other real records displayed in the table.

These statistics will be computed only for all the records which are viewable by scrolling in the current Tabular View window. For example, if you've selected "View All Records", the statistics rows will be for all records. If you've selected "View Selected Element Records", the statistics will be computed for these records only. Statistics are not computed for string fields. There is also an option to omit the statistic in a row for any categorical numeric fields you select (i.e. to omit the sum of all the ZIP codes in the United States, as this is not a meaningful statistic). To omit a field from a summary row, select the field, choose the Field/Options menu, and use the toggle button "Do Not Compute Statistics" from the Field Options window.

Substatistics Rows.

You can also add "substatistics" rows (i.e. computed or virtual records) into Tabular View windows by using the toggle button "Substatistics" from the Table menu. These rows look just like total statistic rows at the bottom of the table but represent statistics for a vertically adjacent set of records. These rows are automatically inserted after, and apply to, each grouping of records which have equal values in the sorted field. These substatistics records will scroll up, down, and out of the Tabular View window along with their associated group of real records so that all sorted groups of records and their substatistics rows can be viewed. As noted earlier, you should also pick a unique background color for these substatistic rows to readily distinguish them from all the other real records and statistic rows displayed in the table.

In the example of sorting by soil type noted above, the standard attribute table for polygons was sorted by polygon soil type. A substatistic row can then be requested for the sums of the numeric fields. These new rows will appear below each group of records representing polygons of a common soil type. The value in each row in the field for the area of the polygons will then contain the total area of the soil for that type.

Remember that a table and its Tabular View window may not contain a field or a combination of fields of interest. They may exist only in a related table. Use a computed field to temporarily (or permanently) insert these fields into the current Tabular View window and then see their statistics and substatistics as well. The values of all computed fields in the Tabular View are evaluated before the statistics and substatistics for these fields are computed.

Saving Tables.

Concept. There is now a "Save As..." option under the Table menu in the Tabular View window. This will allow you to save selected records, the records for the currently selected elements, or all records. This table can be saved into an **RVC** database object, **dBASE** format, **CSV** (Comma Separated Values) format, or into an **ODBC** data source (which can be a direct link to Access, Oracle, Excel, etc.). This is a very powerful and useful new feature when combined with the new region selection and table filtering tools also introduced in **V5.60** and explained earlier. You might begin to consider this suite of new tools as a means of "Graphical or Visual Database Editing".

The new "Save As..." option is also available in **TNTview**, and thus can also be used there in the **2-D** display process with these new region selection and attribute table extraction tools. Thus, both **TNTmips** and **TNTview** can be used to graphically select, edit, and filter map-oriented database tables and then directly save them in the appropriate format for direct use in other software such as a statistics package, the enterprise database system, a spreadsheet, and so on.

Converting Virtual Records to Real Records. When creating a new table by the Save As option, you can choose to save just the actual records for the currently selected element or all records. You can also choose to save just the actual records or the "virtual records" generated by substatistics rows. This save step can be used to make these substatistics rows, or virtual records, into real records. When the table is saved in **RVC** format and is saved to the same database as the original (e.g. under the same vector), key field relationships will be maintained, and the new records will automatically be related to their source table (i.e. to the table in the Tabular View window).

Under these conditions, these substatistic records are automatically related back to the graphical elements for which they were computed. In the example presented earlier, the substatistics records were computed for sorted, similar soil type records. The new table under this soil map vector object will thus relate the fields in these new records back to each soil polygon of that type (i.e. a one to many relationship where one new record links through the source table back to multiple soil polygons). For example, the new record containing a field for the total area of all soil polygons of a specific type is now related back to each soil polygon of that type.

Options. By default, any fields which are currently hidden in the Tabular View window will not be included in the saved table. To include them, you can unhide them or use an option to include all hidden fields. When saving just substatistics rows, fields for which statistics are not computed are omitted, but the field on which the table is sorted is always included regardless of its type (numeric or string).

> **TNTlite** users can only save into a Project File. Saving into other formats would allow this feature to be used to export database tables. **TNTlite** is designed for self contained projects and does not support exporting geodata.

To select a range of records in the Tabular View window for any purpose, click on the record selection button for the first record, scroll to the last record in the range, and click its record selection button while holding down the Shift key. All records in between will be selected as well.

NOTE: Choose a first record with the record select button. With the Shift key down, choose a second record selection button, and get all the records between it and the first record.

X-Y Plots of Fields.

Operation. An **X-Y** Plot window is now available to graphically present the relationship between any two numeric fields in a Tabular View window. Use the mouse to select a field for the **X** axis by clicking on its title or label box. Hold down the shift key and use the mouse again to select the second field for the **Y** axis. Then expose the **X-Y** Plot window by selecting Plot/**XY**Plot from the Field menu. This window will then automatically plot the relationship between the two selected fields. Note, the **X-Y** plot option is not active until you have selected both the fields.

IMPORTANT: After selecting the field for **X** axis, use the shift key to select the second field for **Y** axis.

A single Tabular View window may contain only one of the fields you wish to plot in this new window. Perhaps the second field only exists in a related table. Use a computed field to temporarily (or permanently) insert the second field into the current Tabular View window where the two fields can then be selected for **X-Y** plotting. Both fields being plotted can be computed fields as long as they are being evaluated in the same Tabular View window. The values of the computed fields in the current Tabular View window are evaluated before the **X-Y** plot is displayed.

Options. The **X-Y** Plot Window can be resized in the normal manner to present the points in more detail. A subsection of the plot window can be selected for viewing and zoomed in and out. The points can be represented in a variety of shapes: crosses, rectangles, triangles, circles, diamonds. The **X-Y** axes can be identified with the names of the variables which are being plotted.

The **X-Y** plot can be further enhanced by adding plotting labels (point numbers), showing grids, connecting all points with a line, fitting the points using **B**-splines, and/or displaying the centroid location and a linear regression line. The data points can also be redisplayed in principal component space (Principal Component Analysis), by nearest-neighbor cluster analysis, and via a Hough transform.

Transfer Attributes.

Transfer attributes has been modified to work between vector objects of different projections.

Map Projections.

The Cassini-Solder projection commonly used for maps in the Middle East is now available. If you need other projections added, you need to provide complete references for them. Please contact MicrolImages for data which you will need to provide to add your special projection.

SML.

Core Changes.

Structural. As projected in the **V5.50** release **MEMO**, the underlying structure of the Spatial Manipulation Language has been restructured to allow its significant expansion to support more of the geospatial functionality of **TNTmips**. Most of these alterations relate to the ability of **SML** to function better with the line type Vector and **CAD** objects. This will allow more functions to be added in the future to deal with these types of objects. These structural changes are transparent and will not affect **SML** scripts you have already created.

Keywords. There are a few new keywords in **SML** used to declare variable types. "raster", "vector", "cad", "tin", and "regions" are reserved words now. The use of these keywords will be documented in a future release, once there are some **SML** functions that can deal with these object types. They are being mentioned here because attempting to use them as variable names will cause a Syntax Error in **SML**.

Keywords are now case insensitive. Until now all keywords were in all lowercase. This means that "for" was a keyword, but "For" was interpreted as the name of a raster variable. There have been a number of software support calls from people who are concerned by this. With the addition of "cad" and "tin" keywords (which should logically be in all caps anyway) it was decided to change this.

New Functions.

Very few of the many **SML** functions which are needed for your expanding geospatial analysis activities could be created for **V5.60**. Addition of a significant number of functions will be an objective of the preparation for **V5.70**. MicrolImages can now begin to be more responsive in adding new functionality related to the use and combination of all object types.

DispAddRaster(dispnum,filename\$,objectnum)

Adds a raster layer to display window referenced by dispnum and displays standard control dialog. This allows you to turn off the autonormalize display function.

DispAddRasterVar(dispnum,Rvar)

Same as DispAddRaster() except it uses **SML** raster variable.

GetOutputVector(Vector)

Opens a standard **TNTmips** File/Object selection dialog to select a vector object.

GetVectorLinePointList(Vvar,xarray,yarray [,node])

Returns, (via arrays xarray and yarray), a list of points in a line.

SetStatusBar([[value],max])

Displays a status bar at the bottom of the console window.

SetStatusMessage(message\$)

Displays a status message at the bottom of the console window.

FocalMedian(Rvar,lins,cols,[centerlin,centercol[,rate]])

Median--(middle element of sorted list), of values in focal area.

FocalMode(Rvar,lins,cols,[centerlin,centercol[,rate]])

Most frequently occurring value in focal area. This is a renaming of the FocalMajority () function.

* Merging Vector Objects. One example of the new kind of features in the new **SML** is that a script can now easily merge multiple vectors. This is a simple merge. If the vectors overlap, it will split lines and polygons and resolve database record attachments. For the moment, this only works for vector objects. Given vector variables V1, V2, V3 and Vout, the following line of **SML** will merge the three...Vout = V1 + V2 + V3.

Sample Scripts.

The following Sample **SML** Scripts can be installed to provide examples for you to examine to see how they were implemented.

vecfocal.sml. *Objective: Compute Focal Mean of a Raster Around Corresponding Point in a Vector Layer.* It demonstrates using a vector object to delineate important points in a raster object. The mean value of the raster cells surrounding the point are then calculated and written to a text file.

gamma.sml. *Objective: Adjust Gamma of a Raster Object.* This correction can be applied to selected ranges or the entire image. This function is useful for altering the mid-tones of an image without adversely affecting the highlights or dark areas. Gamma is also used to refer to the transfer function between input **CRT** voltages and output intensity of the phosphors. This power law non-linearity is caused by the electrostatics of the cathode and grid of the electron gun, nothing inherent in the phosphors. Any image you are given may or may not have gamma corrections applied, so it is sometimes useful to be able to modify it if needed.

demogama.sml. *Objective: Demo Gamma Adjustment on Gray Scale Gradient.* It demonstrates the effect of gamma adjustment by creating a gray scale gradient and applying the adjustment to the top half of it.

multrang.sml. *Objective: Quantize Multiple Raster Object Ranges.* It allows the quantizing of values of an input raster object to specified output values. The ranges may be written to disk as a text file and reloaded for future use.

scaleras.sml. *Objective: Scale Raster to Range.* It demonstrates the simple scaling of an input raster object to a user defined output range.

stddisp.sml. *Objective: Standard Display Interface.* It presents a standard interface that makes user friendly interaction. In addition to the simultaneous display of before and after views of the raster object, it makes use of the programmable buttons and popup dialogs for user input. It also uses the status line to keep you informed of progress when doing long calculations. The script demonstrates loading and saving raster objects, creating and displaying temporary raster objects, and implementing a simple undo function. This script and all other samples that display raster objects use the new **SML** display function DispAddRasterVar(). This function along with DispAddRaster() allow a standard dialog to be presented to the user. The dialog can be used to turn off auto-normalize mode so that the effects applied to the raster objects can be properly evaluated.

smlmatrix.sml. *Objective: Using Custom Matrix Functions: SML Example.* This **SML** script is intended to demonstrate the use of the custom matrix functions. It includes support functions that utilize **SML** string handling functions to allow the initialization of matrices with string variables and formatted printing of values.

smlmatrix.c. *Objective: Matrix Functions: "C" Source Code.* This is a sample of how **SML** can be extended by adding custom functions written in "C". Some of the matrix functions built into **TNTmips** are made available for use in **SML** scripts. These include creating matrices, initializing their values, setting and reading individual elements, multiplication of matrices, and calculating matrix inverses. Any additional matrix functions that are needed could easily be added by following the examples in this script. See the **SML** script smlmatrix.sml for a sample of using these functions.

Easy Menu Selection.

During installation, **V5.60** provides the option to install all the **SML** sample scripts. Completing this installation option places all the sample **SML** scripts in a "Custom" subdirectory under **TNTmips** directory. All **SML** scripts installed in this fashion or others placed by you into this Custom subdirectory immediately and automatically become available on the menu for execution under the new "Custom" main menu choice.

Supplement to Appendix.

A supplement to the **SML** function appendix distributed in printed form with **V5.50** is enclosed. The **CDs** for **V5.60** also have the descriptions for the complete, current **SML** function list available in **HTML** format. They can be installed along with the new sample scripts and a copy of Microsoft Internet Explorer 3.0. Internet Explorer can then be used for viewing the latest **SML** function-use reference list and the new example reference scripts (as well as the Spatial Data Display section of the reference manual). Start by viewing "HTML\SML\SMLSTART.HTM", which can be found on the **CDs** for **V5.60** or in your **TNTmips** installation folder. Since **SML** is scheduled for major extensions and expansions in the next quarters, Internet Explorer and **HTML** will enable you to have quarterly access to up-to-date function-use lists and example scripts.

Internationalization.

The MESSAGES.TXT file now supports the localizing of user interface messages like "Select file to open:" for Japanese, Chinese, Korean, and other two-byte languages.

Some **W95** input difficulties for Japanese and Thai are now corrected.

Microlimages Advanced Users' Workshop (AUW9)

By popular request from clients and Microlimages' staff, the 9th annual Advanced Users' Workshop (**AUW9**) will be delayed until May in Lincoln. The cold weather, proximity to the holiday season, complications of winter travel, lack of adjunct warm-weather vacation opportunities, and related difficulties are behind this change. More information on the exact dates and details for **AUW9** have been mailed and are enclosed again with **V5.60**.

Microlimages Authorized Dealers

The following seven new dealers have been added during the past quarter.

India--Electronics Corporation of India Ltd.

Microlimages is pleased to present Electronics Corporation of India Ltd. (**ECIL**) as a new Microlimages Authorized Dealer. **ECIL** is a private company based in Hyderabad, employing 7500 staff, and owned wholly by the government of India. The Business Systems Division of the Computer Group, managed by T.V. Subrahmanyam is the point of

contact at **ECIL** for MicrolImages' products. He can be reached at the **ECIL** Computer Group, **ECIL** Post Office, Hyderabad 500762, India.

ECIL is involved in electronic and computer projects of all sizes throughout India. These range from super computer construction, satellite communication antennae, spectrometers, automated fingerprint identification analysis, airport security devices, vehicle routing, banking, and many other high technology products and systems. Mr. Subrahmanyam can be reached at voice (914)0782-0131 and **FAX** (914)0712-1897. MicrolImages is pleased that **ECIL** has selected the **TNT** products to market to its clients for image processing and **GIS** applications.

India--Physical Planning Consultants (India), Ltd.

MicrolImages is pleased to present Physical Planning Consultants (India) Ltd. as a new MicrolImages Authorized Dealer. **PPC** is directed by Dilip Kumar Paul and is located at 57/D Beltola Road, Calcutta 700025, India.

Mr. Paul can be reached at voice (9133)475-0116 and **FAX** (9133)474-8860. MicrolImages appreciates the confidence **PPC** has placed in us and our products.

Ecuador--aeromapa Cia. Ltda.

MicrolImages is pleased to present aeromapa Cia. Ltda. as a MicrolImages Authorized Dealer. aeromapa is managed by Gonzalo Lopez Jacome and is located at Calle Carrion 1253 y Versalles, Quito, Ecuador. aeromapa has been operating as a surveying, mapping, photogrammetry, and consulting firm in Ecuador since 1979. Its clients are primarily located in Ecuador in the oil, mining, and government sectors. aeromapa also markets the Trimble **GPS**, Vision International, and ERMMapper products. Gonzalo Lopez Jacome and aeromapa can be reached at voice (593)256-9052 and **FAX** (593)256-9315. MicrolImages is pleased that aeromapa has chosen the **TNT** products to market to the **GIS** community in Ecuador and neighboring nations.

Egypt--FOCUS Integrated Systems S.A.E.

MicrolImages is pleased to present FOCUS Integrated Systems S.A.E. as a MicrolImages Authorized Dealer. FOCUS is managed by Tamer Fahmy and can be reached at 1, Midan Mossa Galal, Suite 1, Mohandessine 12411, Cairo, Egypt. FOCUS is one of three jointly held companies including CITE (Apple, **IBM**, and media oriented solutions) and POINT (**HP**, Sun, **TI**, and Xerox equipment) which market computer solutions in the Egyptian and Middle Eastern nations. FOCUS specializes in network and system oriented **GIS** and related solutions in the government and petroleum industries. FOCUS also markets **IBM GPG** and Geovision **GIS** products. Mr. Fahmy and FOCUS can be reached at voice (202)304-8886 and **FAX** (202)304-8545. MicrolImages appreciates the confidence FOCUS has placed in us by becoming our first dealer for the Arab nations.

Brazil--Geosat Levantamentos Topograficos S/C Ltda.

MicrolImages is pleased to present Geosat Levantamentos Topograficos S/C Ltda. as a MicrolImages Authorized Dealer. Geosat is owned by Patrick Sigrist and Alexandre P.B. Franco and is located at Rua David Pimentel 84 in Sao Paulo 05657-010, Brazil. The primary activity of Geosat is in contract services in forest and agricultural mensuration. Patrick is known to some of you for his attendance at the **AUW**, and he has been a user of **TNTmips** for several years. Patrick has just finished two years at Purdue University

completing an advanced degree in forestry while maintaining their Forestry Department's **ERDAS** and Arc/Info systems.

Colorado--Furst Light GeoTechnologies.

MicrolImages is pleased to present Furst Light GeoTechnologies as a MicrolImages Authorized Dealer. Furst Light is a new company just formed by Dr. Tom Furst at 2295 Dexter Drive, Longmont, CO 80501-1515. Furst Light will specialize in consulting on the application of **GIS** and remote sensing technologies in the environmental industry. Tom has been an active user of the **TNTmips** products for nine years on many types of projects since he was a graduate student. He is well known to many of the MicrolImages clients through his active participation in our previous workshops. He has also traveled and demonstrated the **TNT** products in China, South America, and Southern Africa. Among its varied consulting services, Furst Light GeoTechnologies will be offering design, sale, and training for the **TNT** products. Tom and Furst Light GeoTechnologies can be reached at voice (303)682-3046 and **FAX** (303)682-3157. MicrolImages wishes Tom Furst a prosperous voyage and appreciates the enthusiasm and confidence he has always shown in the **TNT** products.

Washington--Cartafina Geographic Systems.

MicrolImages is pleased to present Cartafina Geographic Systems as a MicrolImages Authorized Dealer. Cartafina is a new company just formed and directed by Rob Kolosvary at 7902 NE Saint Johns Road, Suite 105, Vancouver, WA 98665. Rob has been a client using **TNTmips** for several years in forestry projects in the Western United States, Argentina, and Chile. Cartafina will specialize in a full range of geospatial consulting services in forestry and agriculture. As part of these services, Cartafina will offer the **TNT** products as well as their integration and training. Rob and Cartafina can be reached at voice (360)571-0409 and **FAX** (360)571-0382. MicrolImages wishes those at Cartafina a prosperous voyage and appreciates the confidence they have shown in the incorporation of the **TNT** products into their business plans.

The following dealers are no longer authorized to sell the **TNT** products.

Colorado--Walsh, Inc.

Walsh Environmental Scientists and Engineers, Inc. located in Colorado is no longer a MicrolImages Authorized Dealer.

Peru--Walsh Peru S.A.

Walsh Peru S.A. located in Lima, Peru is no longer a MicrolImages Authorized Dealer.

New Image Printers/Plotters Supported

Printing.

Canon.

Canon now has a low-cost model **BJC-4550** color printer at 360 by 720 dpi for the 11 by 17 inch size. It costs between \$400 and \$500 from discount vendors (Best Buy, Office Depot, mail order, ...). It is equivalent in general performance to the old, expensive, and no longer available **HP XL300** printer of approximately the same format. This size printer is very useful for many applications in engineering and geology to illustrate reports with a folded image or vector plot where a larger print from a much more expensive printer would also be cumbersome. Also, you could plot a U.S. standard soil map sheet out to match its original published format. This allows you to overlay this plot onto the original sheet for immediate checking and pencil notation of differences between an AutoTrace conversion and the original sheet.

V5.60 properly supports the communication with this printer via its Windows driver to achieve the large format printing. Even **TNTlite** can print map layouts of its limited objects to these larger print formats via the Windows drivers. Use special higher quality papers for best results. For color prints up to 11 by 17 inches, this printer support is now free in all the **TNT** products since the **P5** printing option is now standard in the **TNT** professional products.

This Canon printer is Mac and Windows compatible. It has optional Postscript. It claims to print at five ppm in B&W and one ppm in color. It uses the typical dinky Canon ink cartridges. It has both parallel and serial connectors. It prints on standard and a variety of more expensive papers including an expensive CANON glossy surface stock.

Epson.

Epson has released a line of low cost and very high resolution color printers--Epson Stylus COLOR 400, 600, and 800 (\$200, \$300, and \$400 respectively). All are 8.5 by 11 inch format printers. The model 400 has a resolution of 720 by 1440 dpi, while the 600 and 800 have a resolution of 1440 by 1440 dpi. The model 600 has been tested successfully by MicroImages with its Windows driver for use with **TNTmips**.

HP.

HP 693C printer prints with two color cartridges or six different ink colors or with three color and one black and white. Using this unique six color approach, this \$250 printer can produce near photoprint quality on a good paper. This printer has been tested successfully with **TNTmips**.

Computers

Pentiums.

There were no significant computer price decreases this quarter, but hard drive capacity and other features improved within the same price. Gateways can be designed and ordered via Internet at www.gw2k.com from anywhere in the world at their South Dakota prices.

This quarter, one Gateway 'best for your money' computer is recommended if you are ready to upgrade your hardware now. The recommended machine is the same as six units which MicroImages has purchased during the last quarter except for some periph-

erals. Yes, you can now afford and should buy a Pentium Pro (**P6** processor) for **TNTmips**.

Gateway **G6-200XL** (\$3749)

Intel 200 MHz Pentium Pro

64 **MB EDO DRAM** (expandable on motherboard to 128 **MB**)

256 **KB** internal cache

5.1 **GB** 10 ms **EIDE** hard drive

17" CrystalScan color monitor (.28 dp)*

3-D 64-bit **PCI** bus based display board with 8 **MB** memory

12X **CD-ROM** drive

1.44 **MB** 3.5" diskette drive

CD-Recordable Drive with **SCSI** controller (very useful in **GIS/IPS** applications)

Wavetable sound card and Lansing speakers

33.6 modem with **FAX** and speakerphone

Mini tower case

keyboard and **MS** Intellimouse

W95, **MS** Office 97 Standard business edition (w/o Access)

3 year parts warranty

*change Crystal Scan Monitor to a Vivitron monitor (.26 dp) for \$130

add internal Iomega JAZ hard drive for \$429 (1 **MB removable media)

Prices

Price Changes.

Price changes in the annual maintenance of the **TNT** products were covered in a Micro-Images **MEMO** mailed to all clients during the last quarter.

Reference Materials

General.

This book has a good introduction to Kriging and other surface fitting.

Introduction to Geological Data Analysis. A.R.H. Swan and M. Sandilands. 1995. Blackwell Science Ltd. ISBN 0-632-03224-3.

Chapter 7: Geographically Distributed Data, pages 266 to 327.

USA Blackwell Science, Inc., 238 Main Street, Cambridge, MA 02142

UK Marston Book Services Ltd., PO Box 87, Oxford OX2 0DT

Australia Blackwell Science, 54 University St., Carlton, VIC, 3053

Rewarded Papers.

Rewarded.

The following paper was rewarded \$2000.

A Spatial Analysis of Mosquito Distribution. *To fight mosquitoes effectively, one must know where they are.* by Tony Sweeney. **GIS User** No. 21, February-March 1997. pages 20-21.

Rule Changes.

A separate Microlimages **MEMO** is included to slightly modify the published paper \$2000 reward rules.

IMPORTANT: From this time forward, the rules for the reward of published papers may change from time to time. These rules and changes will not be distributed again to all in Microlimages MEMO printed form, as Microlimages cannot be sure that everyone who received an earlier MEMO receives a subsequent altered MEMO. If you want the current, up-to-date rules for rewarded papers, check for the version currently posted on www.microimages.com.

Staff Additions

Patricia A. Snover.

Patti has joined Microlimages as an office assistant. Patti completed BA degrees in German and also in International Studies in 1995 at Bradley University in Peoria, Illinois. As part of these preparations, she also attended Schiller International University in Heidelberg, Germany and the University of Nebraska at Kearney. Her previous working experience was as an aide in the Washington Office of now retired Nebraska Senator James Exon. More recently, she has been traveling as an Au Pair with a family in Milan, Italy. Patti's initial duties with Microlimages will be to assist in promotional mailings and product assembly and shipments.

Gregg R. Hutchison.

Gregg has joined Microlimages as a software support engineer. Gregg completed his BS degree in Science Education at the University of Nebraska. After graduation he taught a year at an International School in Seoul, Korea. His personal avocation has been microcomputers, starting with the early Ataris and progressing through the Intel 286, 486, and 586 machines. He will start out at Microlimages learning the **TNT** products and preparing geodata sets. After some months of this kind of utility work and training, you will begin to find Gregg answering your "how to" questions.

Testimonials *[and other interesting tidbits]*

Following are some of the positive, written comments to Microlimages during the last quarter exactly as written except for the [edit] alterations in [brackets] to keep them anonymous. Many more comments are received by Microlimages by voice but cannot be reproduced here verbatim as quotes. Please note that these quotations are not edited from their original form in spelling, grammar, punctuation, etc.

extracted from a **FAX** from an International Dealer on 7 November 1996.

*"We are dealing with the highest levels within the Forest [an agency] and think we have a better than even chance to help them establish an effective national forest management system. You will be pleased to hear that when the second in charge dropped in on its way to see a major [a city] based consulting firm, he was so impressed with **TNTmips** that he stayed two extra days and didn't visit the firm in [the city] who were trying to sell a \$500,000 package based on ARC/INFO, ERMapper, we-know-better-than-you style consulting and very little training."*

from a student in Germany on 1 December 1996.

"I am studying landscape engineering in Freising near Munich - Germany (University FH Weihenstephan). In our school, we are learning to work with computer aided design. A few months ago I took a course using the ARCINFO program and I think I can speak for most of the course members when say we would appreciate a windows interface, since it is much more user friendly."

*"A few days ago, I visited [a client] in Munich and he gave me an short overview about your **GIS** system. I am amazed at the abilities of your system and how easy it seems to be to work with it."*

*"[The client] told me that it is possible to get the **TNTlite** learning program for free, so it would be great if you could send me your program. (**PC 486 Windows for Workgroups**)"*

*"Right now, at the end of my study I am doing my final exam work and I want to do it with a computer aided program because it is a typical application of superposition of areas. Until now I thought I will do it with **AUTOCAD**, because for me the **GIS** on ARCINFO is too involved. However, working with **AUTOCAD** would also be a compromise. Being able to use **TNTlite** would make the project much easier."*

*"Another possibility would be to use your **TNTmips** program, however, I cannot receive support from the school for the purchase of this software. I don't know if it is possible, but would your company be willing to supply a full, or time-limited version of the **TNTmips** program for my final exam work? My work is only for my diploma and is not a commercial project. Up until now, the ARCINFO program is very sidely used in Germany. This would be an opportunity to introduce **TNT** to our department in the FH Weihenstephen."*

*"Even if it isn't possible to supply a copy of the **TNTmips** program, I would very much appreciate receiving a copy of the **TNTlite** version. Thank you in advance for your help."*

on a **TNTlite** Registration Card from Colorado on 10 December 1996.

*"Thank you for you prompt response and patience with my anxiousness. Though I am working on making **TNTlite** working on my machine [a PMac]: your program appears to be of high quality and capabilities."*

[The organization of this **TNTlite** client has subsequently purchased a professional version of **TNTmips**.]

from a **FAX** followup from a demo of **TNTmips** to a major Australian consulting firm on 9 December 1996.

*"The **TNTmips** software was very impressive, especially from the way it is designed and how it operates. Functionally, we see nothing from a **CAD**/Cartographic mapping point of view that cannot be done in either ArcInfo or Intergraph."*

*"Where it is obviously ahead of its competitors is in its ability to derive knowledge or support decision making from **GIS** data sets. It very much does what ArcInfo (vector) and **ERDAS** (raster) do in the one system, but obviously has many advantages over trying to use both these systems. From our preliminary overview, the cost benefit of **TNTmips** would be well ahead of the configuration."*

[The nature of the work of this firm and the writer are known to have in depth experience with the use of many other **GIS** and image analysis products. They are not a Microlmages client but were reviewing **TNTmips** for possible use in a proposal.]

extracted from email from a U.S. student on 5 December 1996.

"The response time of the MicroImages technical staff never ceases to amaze me. Kudos to you and the whole staff."

from email from a student in California on 8 December 1996.

*"I am a graduate student at the [a university]. I use ARC/INFO, IDRISI, MultiSpec, and SpaceState (From **RRI**)."*

*"I recently downloaded **TNTlite**. I loved the product -- I could do everything on **TNT** that I now use four packages to do poorly -- but it lacks the capacity to actually work on my research."*

*"Who would I talk to about getting a graduate student type discount on **TNTmips**?"*

extracted from email from a mining exploration client on 5 December 1996.

*"I tried **TNT** on a Pentium the other day - what a difference - fallen in love with the product all over again. Apparently [another client] use **DEC** Alphas that literally scream with **TNT**. Hmm, I understand clones are coming out - keep us posted."*

[The other mining exploration client referenced is using several of the 64-bit versions of **TNTmips** on clones of the **DEC** Alpha, which have been around for about two to three years.]

on a **TNTlite** Registration Card from Chile on 10 December 1996.

"I am just now trying to do a photogrammetric restitution of a series of photographys I took of a very rocky piece of ground my parents bought at Los Molles Beach. Wish me luck."

email from a **TNTmips** client in China on 17 December 1996.

*"Today I have received the packing for release of **TNTmips 5.5**, and installed to my computer. It is wonderful software and better than that I have ever used, thanks a lot!"*

extracted from a **FAX** from a client in Germany on 17 December 1996.

"There are a number of new items that will make this fabulous System even more helpful to us. Nevertheless, two items we were longing for since September are still missing. These are:"

[One of the two items just happened to be added the day the **FAX** was received. The second is on the request list.]

"Finally we would like to thank you for the ongoing support that you provided during the now ending year."

from email from a U.S. Dealer on 14 December 1996.

*"Good News! I installed Version **5.5** on the PowerMac that I have on my desk at [a location]. This is a Model 7600 with 80 **MB** of **RAM** (133 Mhz clock speed). The installation was flawless (no special precautions taken except to close all applications before installing). The speed of the program (**TNTlite** without key -- of course runs like **TNTmips** with a key) is about the same as it is on my Pentium 133 Mhz 32 **MB RAM** machine."*

[The 7600 PMac uses 132 MHz Motorola **PPC** 604 chip. **RAM** Doubler 2 is not needed on this system as this machine has 80 **MB** of memory. It would have run just as well if the machine had 32 **MB** of memory. Speed Doubler should still be used, as it will speed up file read/write independent of memory availability. Speed Doubler 2 will be released

in January and claims even better file access speed equal to two times what it would be if not used.]

email from a U.S. Dealer on 16 December 1996.

*"Thank you for v.5.5 of **TNTmips** and outstanding new features. I am busy with my delayed **TNTatlas** projects, but all of them are still actual and getting their form slowly but surely. Reasons for delays are expanding needs of customers and expanding needs for demonstrations."*

[Continues on to describe an error.]

extracted from an email from a German client on 16 December 1996.

*"Version **5.50** of **TNTmips** has arrived on Friday. After 'playing' around for a while (I spent half a weekend) I want to express my compliments to everyone at Microlmages for having done a pretty good job once again."*

"I want to mention some of my favorites:

- **ODBC**
- **ROIs** (very important for us) [Region-of-Interest]
- Surface /Raster Properties (tremendously important for us)"

*"I also appreciate your efforts towards including metadata with objects, and, in my opinion, clinging to the **FGDC** standard (or a subset, may be organized in profiles) would not be worst choice."*

email from a Dealer on 17 December 1996.

*"Thanks for the (somewhat long awaited) release of **TNTmips 5.5** which arrived here, last Friday. Although I know, that we're a bit behind or plans (at least in terms of sales) regarding **TNTmips**, we still take Microlmages effort and impressive development dynamics as the driving force to broaden our knowledge base of **TNTmips**. I specifically enjoyed (both being entertained and educated at the same time) reading through the ARC/INFO related Memos and the really valuable Microlmages-periodical 'Grapevine'. I certainly take the chance hereby to ask for some compiled form of the material presented in these memos (as suggested)."*

*"We also have sent numerous **TNTlite** packages out (exclusively **PC-Users** under Windows). I don't know actually how many of them registered the package. [Some Dealer comments skipped here.] But it's still our conviction, that **TNTlite** is the way to make specifically other system's users at least have a look at **TNTmips**, while providing real newbies with a complete system to learn what **GIS** is all about. The latter will be the people then who stop throwing money in the 'dinosaur's throat'."*

[Additional Dealer questions skipped.]

*"Finally, just for the case that I won't be able to get back to you prior to the Christmas Holidays, I'd like to thank you and your colleagues at **MI** for your cooperation, but mainly for throwing real expertise rather than marketing tricks into the future development of **TNTmips**. To all at Microlmages happy holidays season and our best wishes for a good 1997."*

extracted from an email from an Angolan client on 17 December 1996.

*"As for the rest of **TNTmips 5.50** I can only say that it's been worth the wait. I'll need about a month to try out all the new features. Thanks."*

extracted from an email from a non-U.S. student on 20 December 1996.

[This student did not download **TNTlite**. He only obtained the **MI/X** Server. He contacted MicroImages' software support as follows requesting help.]

[First email] *"I have downloaded a copy of **MI/X**, **X** server from the internet. It was installed properly, I guess, as it didn't give any error message." [He would have used install routine downloaded as part of **MI/X**.]*

*"I am using dial up modem connection to go online. It's a university dial up line. Now I try to connect to a different **unix** system using telnet. I change the display variable as **rqd** [required] but still I am not able to get display on my computer. Gives error message 'Can't open display on...'" [This message is coming from the remote **UNIX** machines, which at this point do not know who this is, as he is not on their Domain Name Server.]*

*"HOW CAN I SET UP **MI/X** so that I can use my system as **X** emulator and run **unix** applications to the remote machine.. and display comes up on my machine."*

"Please help me out.."

*"Using Windows **NT 4.0** Pentium Pro 200 MHz. Connecting to the University of [a name] thru a dialup connection. Telneting to another unix machine."*

"How can I get display on my machine???"

[Software support responded. He then came back saying it now worked but slowly. Software support then asked him how well since a slow modem connection was used.]

[Last email] *"As such I am trying to run programs like ARC/Info & ArcView, Matlab, IDEAS."*

"I guess these programs send back and forth lot of graphics data so they are slow over modem connection."

*"I tried **EXCEED** from Hummingbird corporation too, its same performance wise except few things here and there." [EXCEED is the top ranked commercial **X** Server for Windows platforms--cost \$300 per seat.]*

*"Kevin, as such I am interested in **GIS**. Is it possible for me to get a hard copy manual for **TNT** and a paper or something which tells how things are being implemented internally. Also, if u need anybody for review/testing of software, I'll like to do that. I am pretty good at **GIS** softwares like ARC/Info (all modules), Map/Info."*

*"Also is there any programming module for **TNT**."*

"Thanks, for ur reply and support. I really appreciate that."

[He was referred back to microimages.com to **TNTlite**!]

extracted from a FAX from an International Dealer on 19 December 1996.

*"Just received version **5.50** and I am busy wading through the memos and other documents. Looks like some great new features and improvements have been added. Worth waiting the extra month or two for these."*

a letter from a professional United States user of **TNTlite** dated 31 December 1997.

*"On October 14, 1996, you responded to my posting about **GIS** software on the Internet. Subsequently, you sent a copy of **TNTlite** on version **5.4** along with other information to me. I would like to order the latest version (December/Jan release). Enclosed is a check for \$25.00 to cover the costs of the new **CD**."*

"I understand from our telephone discussion this morning that this is not necessary [i.e. could have one free upgrade], however, I would like to support your company's approach to introducing products to people that want to learn about the capabilities of the software without a major outlay of capital in a small way. [?] I have also passed the information along to several other interested parties."

extracted from an email from a German client on 2 January 1997.

*"Congratulations to all members of the MicrolImages team for the new features. Especially concerning the new filters and the **3-D**-applications."*

extracted from an email from a German **TNTlite** user on 3 January 1997.

*"PS: **TNTlite** is great - forget ARCVIEW."*

extracted from an email from a United States **TNTlite** user on 11 January 1997.

"Congrats to all at MicrolImages on the good looking HomePage!!"

"I enjoyed bopping around it tonight. Inspirational."

"Major upgrade from what I saw last month."

extracted from an email from a United States client on 7 January 1997.

*"p.s. congratulations on **TNTmips 5.5**, the product is really coming along well."*

email from a Hungarian university on 16 January 1997.

*"I have a lot of leaflets about the **TNTmips**, **TNTview**, **TNTatlas** and **TNTlite**. Some of my colleagues got those when they were at the University of Debrecen, Hungary. they use the **TNTlite** under Win95 there but this is unuseful for us because we don't use this platform."*

*"We would like to try the **TNTlite** program but we use SUNs with Solaris 2.3 and Solaris 2.5 operating system so we need the sparsol2.tar file from your ftp-server."*

"I was able to reach the server yesterday night and downloaded only a part of the 41,691,523 bytes during 6 hours. (Exactly: 41,116,672 bytes) Then the connection was interrupted. So..."

"Thank you for your help again, I am going to try it in the future again."

[Since the **UNIX** versions are compressed, he was 500,000 bytes short and interrupted! He gets a free **CD** kit for effort.]

extracted from an email from a Canadian client on 17 January 1997.

"I have received the last documentation [MEMOs, etc.] on version 4.5 [He means 5.5]. Congratulation for all your efforts in improving database functionalities and much more on the overall interface."

email from a Congo site on 19 January 1997.

"Last week arrived the version 5.5. Every quarter it is getting better and better!!!!"

from an email exchange with an International Dealer starting 22 January 1997.

[Dealer Statement] *"Things here are as hectic as ever, we're in the final stages of [a] research project. For project reasons we had a demo of PC ERDAS Imagine 8.2 the other day, and 'frightening' is the only word I can use, it does a small fraction of what TNT can do, it cannot create or edit vectors! All the database capabilities are flat file! 8.3 is due out second quarter which may add some vector capabilities (They are getting the arcview DLLs from ESRI apparently). On the plus side the interface is very very fast and the modeller (which is functionally the same as SML) uses drag and drop flowcharting to define the algorithm and you then click on each box to populate it with a process or some data, very slick. We hit a slight vocabulary problem during the demo, what they call geo-referenced, I/we'd call geo-rectified or simply 'resampled to fit the projection'. Of resampling on the fly there is virtually none in any meaningful sense. The client for this job has specified Imagine, we're going to try to talk them into TNT of course. This may be old news to you folks but its nice to have a decision reinforced once in a while. Bear in mind this is all after a 2 hour demo and then an hour of unsupervised playing (1 App error) while the salesman was at lunch with someone else."*

[My observations on the speed of the ERDAS user interface (without first-hand experimental results) are as follows: 1) It is likely the salesman brought in the fastest PC available with a lot of memory in comparison to the working TNTmips systems in this shop. 2) As is noted, ERDAS requires common cell size and projections for images combined in a single display. Automatic resampling, map projection reconciliation, differential zooming, and other power features in TNTmips do place time tax on the execution of its interface and displays.]

[MicrolImages' Response] *"One question does arise on the Imagine demo, was the software installed on your machine or was a computer brought by the ERDAS dealer specifically for this purpose? What were the characteristics of the PC involved (RAM, hard drive space, etc.)? Could the software be run from CD?"*

[Dealer Response] *"To answer your question, Imagine was demo'd on one of our own *standard* TNT PC's, 166Mhz Pentium triton II motherboard, 32mb EDO ram, 2MB diamond stealth graphics, Fast Ethernet and 2x2GB disks, running Windows 95. As is typical with almost all image processing demos no image was bigger than 512x512 [demoed by every TNTlite], but they do have tiling and pyramiding so i'd expect display times to be rapid."*

[MicrolImages' Response] *"Regarding your email of 24 January. Thanks for the information on the ERDAS Imagine demo. It was interesting to note your comment on the raster size being only 512x512 and the overall speed of the display. As you are aware, using this small of imagery will always be pretty fast. TNTlite will display rasters that are this size quite fast as well as it's free. It was mentioned that while the person was away to lunch that you had the opportunity to 'play' with the software even more. Did you*

have the chance to bring in some of the large [a name] imagery that is always around [your shop]? If so, how were the display times then?"

[Dealer Response] "We didn't get to import any large imagery to Imagine during the demo or playtime, although I assume we now have, since a [name] here is evaluating it on a 12 day demo (this seems to be the standard evaluation time). I'm afraid I've been concentrating on other areas recently, but it's on my list to catch up with the Imagine trial."

"On the 512 raster thing, bear in mind, this was their standard demo dataset, equivalent to Crow Butte. Since they have raster tiling/pyramiding I assume display times should be comparable, if I get some time, I'll try and do some comparative timings. The thing that really sped up their display for interactive work, was that when you pan or zoom a window, only the bit that needs updating is redrawn, so you issue say a pan command (or slide the slider bars on the window), the whole display window then instantaneously jumps by the appropriate amount (I assume they're just copying a portion of the display bitmap), the software then fills in the required areas/layers from disk. I guess they've done some research into optimizing the display process further, by redrawing the necessary bits."

*"BTW another question you asked, during the demo, they didn't run directly from the **CD**, but installed to the hard disk. Interestingly it is standard practice here at [a name] to set windows temporary directory to be the root of the **C** disk on a machine (so people notice a buildup of the unneeded temporary files) The **TEMP** and **TMP** environments both point to this location. The Imagine install ignored these variables, put some files into the \windows\temp directory and then couldn't find them again!"*

extracted from a **FAX** from a client in Lao on 21 January 1997.

*"I am pleased to inform you that we had received **TNTmips** from version **5.2** to **5.5** and until **5.9** [i.e. a subscription through **V5.90**]. These products had ordered from **UNDDSMS** New York [a United Nations agency]. **TNTmips** was running quite well and last month we sent our staff to train at [a Dealer site]."*

extracted from an email from a professor in the USA on 23 January 1997.

[The course discussed below is a required freshman/sophomore course in environmental science. This particular full semester course was being given for the first time during the month break between regular sessions. During the three weeks noted, the full 15 week semester's work was covered by working only on this course all day.]

*"The course went very well. Students were able to complete very complex **GIS** projects in a week of work [third week was devoted to a project]. Just 3 weeks ago, they did not know what **GIS** meant. We needed another week to get more into analysis and styling of vector elements and into turning **3-D** point data into rasters, etc. They all feel empowered. We are thinking of addition of **TNTlite** to our Tech Tools II class soon (preparatory to the first **GIS** class so we can make more progress in the [this] introductory **GIS** class). **TNTlite** would be taught aside of stat Tools and advanced spreadsheet tools. Tech Tools I (pre-req for Tech Tools II) covers basic computer, word processing, introduction to spreadsheets, presentation software, photo processing software, and Web building and use."*

*[Conclusion: geospatial analysis concepts can be appropriately taught at the freshman/sophomore university level using **TNTlite**.]*

extracted from an email from a South African university on 24 January 1997.

*"I am currently the manager of the **GIS** Lab at the Department of Geography at [a university]. We recently received a **CD** copy of **TNTlite**. I must admit that it is a wonderful product with many possibilities. To this point I have been able to perform some actions in **TNTlite** with great success. Unfortunately I have a problem in understanding some of the terminology used for some actions. The on-line help is not always available."*

[The party was made aware of the on-line documentation.]

extracted from an email from a client in Ecuador on 24 January 1997.

*"ps. the Remote Sensing with **TNT-Lite** course went great--I have orders for 8 copies of the **CD** and haven't talked to the department head yet about their copies--we'll deal with this later!"*

an email exchange with a Hungarian university using only **TNTlite** on 28 January 1997.

[This is not a **TNT** professional user, but one who downloaded the **TNTlite** product. He could not install it, so he came into technical support by email. It was turned over to the Microlimages software engineer who manages our installation processes including those used for network downloaded products. He pursued this with vigor since he had gotten similar feedback in prior months from three or four sites while hundred of others were downloaded and installed okay. He could not duplicate the problem here, primarily because the previous reports did not have sufficient detail, and we simply sent them a **CD**. Finally, someone in Hungary was willing to go back and forth as frequently as was necessary by email to be given the interrogation needed to find out what he was actually doing. The final exchange of email succinctly summarizes it all. And, how many software companies do you know that would stick to solving this kind of problem for a free product, especially when it turns out to be a problem in somebody else's software? As a problem solving company, Microlimages does not like unsolved problems. So we will stay on them with willing clients until they are eventually solved--days, weeks, or years!]

[from Microlimages] *"My first idea of what went wrong isn't the cause of this problem. I figured out today that your use of 'D:\install\Microimages' for your source directory causes PKUNZIP to fail. 'Microimages' has more than 8 characters."*

[from Hungary] *"Oh my God, I have thought that the problem will be a triviality, but such a triviality ... I have the highest regard for you, because when somebody has a problem in his brain profoundly, it is very difficult to realize a triviality. While I am writing this mail, **TNTlite** has installed, so you tip was right. Thanks."*

email from an international client on 28 January 1997.

*"Thanks alot for your immediate action and help in this matter [a problem in customs]. What happened is that we quite frankly have a crazy president. I'm not sure how much [the nation's] news you get in Nebraska, but let me just get you oriented. National and international policies change every day.. The first week he was in office, President [a name] (after recording a **CD**) announced that long hair, rock and roll, and leather jackets (a national product) were against the [nation's] way of life or something.. Anyway the next day the police were going around arresting young men at a rock concert that had ponytails! So what I'm getting at here is that all of a sudden they have decided to be extremely strict with incoming items in terms of fines etc. The president also has just put his 20 year old son in charge of customs, and no of course he has no experience in these matters! But at least it keeps things interesting around here, I mean he's not*

really dangerous per se, but quite loony. So I have no idea if the second copy will make it through, maybe they will forget about their upped protection on imports tomorrow! I'll let you know what happens."

[Just part of the fun of shipping and servicing products to some nations.]

extracted from an email from a client in Italy on 30 January 1997.

"This time MicrolImages is not busy with a meeting in a polar temperature and I have taken the occasion to fly in Thailand to dive. It was not so interesting as a MicrolImage's meeting but hotter."

[Fine, but we are still here in Lincoln, and it's still polar for us. During the approximate period the Advanced Users' Workshop would have been held in the past, the temperature in Lincoln reached -15F degrees and -60F degrees wind-chill. Yes, spring is a better time in Lincoln. January is a good time to get down and do work.]

email from a client in California on 3 February 1997.

*"Lee had asked me to try out the **MI/X** [MicrolImages' X Server] for Arc/Info. I am pleased to report that I am able to run **TNT** products on workstations from my home computer running **W95**. We have **PPP** accounts through [a location] and as long as I start **MI/X** and **TWM**, I can start **TNT** products from the [a location] workstations."*

"I am a bit disappointed in Arc/Info version 7.0. It does not like the xterm window I am using, and bombs out with a fatal error. I will try a few other approaches."

*"The rewarding achievement is being able to run **TNT** from home. This means that many students could avoid the parking problems and computer sign up sheets."*

extracted from an archaeological conference paper on 3 February 1997.

[The stereo video imagery used in this study was collected by swimming over components of a wrecked ship. The images were then framegrabbed into **TNTmips**. Geographic control points were "staked out" in the area of the components. We have air-video, so should this be seavideo or scubavideo?]

[from the Methods section] *"The **SIS** [Spatial Information System] package used for this project - **TNTmips** versions **4.5-5.5** [4.5 through 5.5], written and distributed by MicrolImages, Inc. (Lincoln, NE) - has the capability of grabbing video signal frames (primary and secondary fields) and creating rasters from them; registering the rasters to an arbitrary, user-defined coordinates; rectifying the registered rasters by applying various models of distortion; prospective projection of raster image pairs, and from these left-right pairs, generate elevation models, which may either be traditional Digital Elevation Models (**DEMs**) or the more efficient data structures called Triangulated Irregular Networks (**TINs**). No other software was required, and in fact the routines used in this project only comprise about 5 percent of all the routines available in the package."*

[from the Summary section] *"Commercial off-the-shelf hardware and software have been used to generate elevation models of parts of a wreck site in the Florida keys. The final product will be a 32-bit **TIN** model of the wreck that is the 'base image' for generating many other types of raster, vector, and **CAD** objects representing the same area. The technique presented here does not require a metric camera, nor custom software, nor a workstation. In 1993, all hardware and software used in this project was purchased for under \$10,000. No modifications have been made to either the hardware or the software in order to generate stereovideo models from the captures video imagery."*

email from a U.S. client on 4 February 1997.

"digitizer works just fine now, thanks for the help!"

[Getting digitizers to work is a pain in the neck for all **GIS** software vendors.]

extracted from email from an International Dealer on 11 February 1997.

*"Please pass on my congratulations to all the staff at MicroImages for their impressive effort on **v5.5**. We have used it consistently since its release and have found it extremely reliable and full of useful new features. It seems to me that **TNTmips** draws further ahead of its competition each quarter."*

extracted from email from a client in the Congo on 11 February 1997.

*"I hope you can help me solve a problem. I am installing a database with the locations and camps as part of our infosystem. Basis: locations (Lat/Long) as vector points. Primary [field] attached is a unique code for every village. I link now a database table to this object and set the relation to the attribute, the code of the village. In this linked table are stored the activities of the people, like **elephant hunting**, fishing, etc. ...and so on..."*

email from the U.S. from a prospective client on 20 February 1997.

*"I am currently evaluating **GIS** and image processing packages. I think highly of **TNTmips**, in fact, since it does offer everything I am looking for in one integrated package I am 99% sure it will be the software I choose. Please send me the latest pricing. Also, I am considering running it on Intergraph's **TDZ-410** (dual Pentium- Windows **NT**) which has **3-D** graphics, similar to Sun or **SGI's (Unix RISC) 3-D** hardware. Will this affect pricing. Thanks in advance for your prompt reply."*

[It is a pleasure to find that Intergraph has been put at least once in the position of providing fast hardware to run **TNTmips**! More! More!]

emergency email from a client visiting Botswana on 20 February 1997.

*"The **DLL** files seems to have cured all that was ailing us - we did indeed have version 'b' of windows 95. I want to thank you and [a staff name] for coming to the rescue so fast - the folks here in Dilbete [Botswana] (synonym for a place far away from the backbones of the Internet) were really quite impressed that a problem of this magnitude could or would be so quickly solved by a corporation in the States - you really need to congratulate yourself and take a pat on the back. Once again technical support at MicroImages not only were able to quickly source the problem from my confused and cryptic fax - but you handed me the solution from my confused and cryptic fax - but you handed me the solution in a way that I could help myself out quickly (posting the **DLL** on the server). My first attempt at downloading was successful for only about 5 minutes as 19b of the 64b file made it through before the rural Botswanan telephone lines thwarted us. However one quick call to Gaborone got someone to go by Info-Botswana (the local server) and they followed instructions I had faxed to them on where to look and how to download the file. By 3:00 PM today (20 February) we were up and running and back in business. Thanks for the great job on your end!"*

*"Happy **TNTmips**ing in the Botswana bush veld."*

extracted from email from a client in Ecuador on 21 February 1997.

*"Thanks for replying about the drives and the dates for the workshop. I have forwarded a copy to both [names], who started working on **TNTmips** in our Chile office late last year and has since got all the geologists in the office onto **TNTlite**. She keeps in close contact with [a MicroImages Dealer]."*

email from India on 21 February 1997.

*"In the Geotimes' October, 1996 issue I came across the news item about your **TNTlite** cross platform mapping/image processing/**GIS** software. We are planning to take up a pilot project on groundwater prospecting in hard rock areas using satellite imageries and field geophysical, geological and hydrogeological data. In this connection we are also trying for federal government funding for remote sensing applications in geophysics, coastal engineering and other areas. At our research station we only have **IDRISSI GIS** software, which also is not the latest version [as it is no longer free]. We have an image processing software which has been developed in house and as such is not very versatile and robust. We are however, planning to acquire image planning and **GIS** software for our remote sensing applications in the near future."*

*"I would appreciate if you could send me the details of how to obtain your **TNTlite** software free of cost for the time being for use in our pilot study. We are not hooked on to Internet as yet and as such are not able to down load your software from MicroImages. I would be thankful if you could answer my query through e-mail."*

extracted from a **FAX** from an International Dealer on 23 February 1997.

*"**ESRI**. What really annoys me [me too] is that every one thinks that the **A/I** methods and topology are, by definition perfect. However, we are sick of getting geology maps in **A/I** format that have been 'Cleaned' (i.e. Filtered and Validated in a largely uncontrollable process) such that the map borders do not match up. This happens because instead of moving nodes to make a new intersection, it also bend the line down to meet the node. Thus the borders are no longer straight and when the maps are joined, slivers have to be manually removed. Also, **ARC/INFO** can not have points and polygons in the same data set. **PAT** stands for Polygon Attribute Table or Point Attribute Table depending on which type of data is in the coverage." [***.PAT** is the extension of one to the many files making up a coverage.]*

*"The real advantage that **A/I** has, and the only reason consultants like us need it, is that the **e00** format is an industry standard and therefore any serious **GIS** packages should be able to produce **e00** files. We have a MapInfo to ArcInfo translator called **AIMI** but it converts polygon attributes to point attributes so the polygons have to be built using ArcInfo. Unfortunately neither **AIMI** nor **PC** ArcInfo can handle some of the larger data sets we produce."*

*"**LINUX**. I once installed **LINUX** on a **PC** and was very impressed with it. I often see requests on **GIS-L** for information on **GIS/IPS** for **LINUX**. It appears that **GRASS** is the only system available. It might be worth us running **TNTmips** under **LINUX** just to keep up [a name's] **UNIX** skills, so we can provide support. We can wait until **v5.7**."*

extracted from email from a client in Ecuador on 24 February 1997.

"I have interrupted my work to send you guys a huge THANK YOU ! for some great foresight."

*"Because my disk space is limited without access to my ?)!@# \$! **EO** drive. I have imported two **TM** scenes by linking to the data on the **CDs** and selected the create pyra-*

*mids option. I am now looking at a Full View of the two of them simultaneously because although the raw tmdata can't be accessed for on of them (separate **CDs**) the pyramids are on my hard disk. I took a chance that this would work and am so happy to see it does THANKSSSSSSS! Please pass on my exuberance to the software developer responsible."*

extracted from a FAX from an International Dealer on 24 February 1997.

[Discussing training given at a large university.]

*"This [training] went particularly well with all of the lecturers planning on how they are going to package **TNTlite** and external training documentation for distribution to students externally. [This university does a lot of courses by correspondence.] They are talking about anything from 60 to 100 students per year which will be excellent. They have plenty of ideas on what they want to do as far as teaching materials are concerned. They will probably communicate directly with you with how they manage all of this. They had a range of questions and concerns they wanted to address and I gave them the option of either communicating directly with you or via me to you. Most of their questions and concerns were on how they might distribute **TNTlite**. For example they were thinking that they might create their own **CDrom's** for distribution containing **TNTlite**, documentation, training data sets. They want to be able to customize **TNTlite** so that when a student first loads it up they are only presented with the relevant menu or toolboxes [i.e. toolbars] instead of the complete menu." [...continues on regarding details.]*

An Internet exchange on comp.infosystems.gis on 21 February 1997.

[Question from someone who subsequently ordered **TNTlite**] *"Hi there. What to think about **TNTlite** software. Sounds interesting for a beginner in **GIS**, but what experienced users think about it. Thank you for answering me."*

[Response from university professor in the U.S.] *"We are full blown users of **TNTmips**. As far as **TNTlite** is concerned it is just as good but with all the limitations described on the **CD**. It does have just about everything you could ever want for any application. **CAD**, raster, vector and **TIN**. Converts easily between all these applications and in the full version can convert to just about everything. It is very easy to use and has a nice interface. We run it on **NT** here at work and I have **TNTlite** at home on my 68LC40 Mac. We have almost stopped using Arc/Info since we purchased our second copy. Since **TNTlite** is free I would suggest getting a copy."*

[A very clear review of the situation.]

extracted from a FAX from an International Dealer on 24 February 1997.

*"Amazing how often you can tell people that having one or two expert ARC/info/**ERDAS** literate users in the company is putting your whole **GIS/RS** operation at risk of instantaneous collapse, and they won't listen till it happens, then help!"*

extracted from a letter to software support from a client on 24 February 1997.

[From a group of clients who visited MicrolImages for a week of training.]

*"I'm not sure I can find proper words to say thank you for everything. So, 'thank you for everything' will have to do the job. It was a long week, but very enjoyable, educational, and well worth the time and money. I have the feeling that you may have thought you didn't cover enough, but believe me, you did... and then some. I fully understand that **TNTmips** is a good package and I intend to begin using it much more than I have been able to in the past, and I want to continue to 'dig deeper' into some of the areas you covered. I'm going to work on a map/poster layout and may send it down to you for printing once [the boss] approves what I come up with."*

[A personal paragraph here contained information that two of this party became engaged during a break in the training. Now who said **TNTmips** wasn't dynamite and can't do everything!]

"I felt very welcome in your offices and really enjoyed talking with the different people in your company. [MicrolImages] have created a wonderful environment for you to work in and it really shows that [MicrolImages] care about their people. This is something [the boss] and I have discussed at length, and seeing some of our ideas work in reality is exciting to me."

*"After I catch up on everything back here, I plan to spend some solid time working with the data we created. Again, thank you so much for all your help and good information. I look forward to working more with **TNTmips** and to the possibility of future training."*

email from a MicrolImages International Dealer on 27 February 1997.

"It's a long time since I don't contact you."

"My new life as a husband is wonderful. I will try to send you a picture of my wedding."

"Things have been a little bit busy here."

"Among the last interesting projects we were involved in on the 'Maps of Environmental Study of Gasandes' was an interesting one. This implied to made 47 copies of 37 different maps (more than 1000 maps). This was done in November and December of the past year. The client was very happy with the quality of the maps."

*"I hope somebody may go to the new version of **AUW**."*

[Wow, two wedding deals in a row! Makes for happy users.]

extracted from a FAX from an International Dealer on 1 March 1997.

*"I visited some potential client site (forestry) for an explanation of **TNTmips**, [they] having two [**ERDAS**] Imagine and two Arc/Info used for making forestry maps based on classification of Landsat or others. They complained about Arc/Info and **ERDAS**, etc. Arc/Info's 'programmers' aspect and the buggy, and non-reproducible nature of several processes of Imagine, management problem of **UNIX**, not so fast compared with current **PC**, and high prices of the system."*

[Several feature questions followed with regard to **TNTmips**' features.]

extracted from email on 6 March 1997 from a party recently at MicroImages for training.

"I'd like to say thanks to all of you at MicroImages for the excellent visit I had to your place. It was well worth while."

"Well I would like to give a tentative big YEE HAAA. It looks like we'll get the contract from [a company]. So I'd like to repeat my thanks, because our ability to do quality soil mapping from your software played a big part in us getting it."

email to a MicroImages Dealer on 7 March 1997.

*"I have been able to use **TNTmips** as well as the old **dos mips** for longer than I used ArcInfo. For managing graphic data and translating several formats as well as outputting hardcopy I feel that **TNTmips** is one of the best packages out there. Unless it has changed since 1995 when I last used **TNTmips**, it wasn't database linkable or **ODBC** compliant. Has that changed?"*

incoming email from a **TNTlite** user in Estonia on 7 March 1997.

*"I'm very impressed about your **TNT** product line. May I have your price list and more detailed information about your software future versions."*

a posting on the Internet from Canada on 8 March 1997.

[This party ordered a **TNTlite** on 31 January 1997 but has had no other contact with MicroImages.]

*"I've been looking at **TNTmips** to use on the Mac Platform."*

*"Are there any list members that are using this software or does anyone know someone that is using **TNTmips** on the Mac?"*

"As far as I can tell it is the most powerful and comprehensive software available for the Mac Platform. Does anyone disagree with that?"

[No one disagreed! Dimple and **PCI** responded with an attempt to promote their image analysis products on the Mac. But the poster does not ask for alternatives or mention image processing.]

extracted from email from an International Dealer on 10 March 1997.

*"During [dates in] March we were on an exhibition about software in environmental protection field and we made an exiting [exciting] experience: All persons who visited our place are really surprised about **TNTmips**, especially about the price and possibilities of **TNTmips**. So we hope to get some new clients in the near future. A very great input of potential customers we get from [another client firm]. They also use **TNTmips** in landscape planning and had a really well prepared exhibition. (I don't know if they will tell you about it). Very impressive was a plot of an ortho-mosaik overlaid with some vector elements on high quality paper printed with **HP Designjet 750 C**. The plots looked like really photopositives and were about 3.5 to 2.5 meter in extension (very large!!!)."*

note printed on edge of order form from a U.S. professor ordering a second set of ten copies of **TNTlite 5.5** on 13 March 1997.

"Had ordered previously. Really a great program. Have a French version?" [He was referred to a Dealer in France.]

Sample TNTlite Demo INVITATION

This was broadcast 3 March 1997 via email to the faculty and graduate students of the University of Wisconsin at Madison by a very experienced, long time Ph.D. student user of **TNTmips** (and **TNTlite**)--not suggested, solicited, or arranged by MicroImages.

AN INVITATION TO A HANDS ON DEMO OF TNTlite

CONTENTS: THE PITCH, THE CATCH, THE BOTTOM LINE, and THE INVITATION

THE PITCH:

I am inviting you to a hands-on demonstration of **TNTlite**, a FREE version of the professional product **TNTmips**.

(Reference <http://www/microimages.com/www/html/tntlite/english.htm>)

TNTmips is a "hybrid" **GIS** developed by MicroImages, a software company based in Lincoln, Nebraska.

TNTmips is a "hybrid" **GIS** because it provides for

Raster,

Vector,

CAD,

TIN,

and Database

processing in a single package.

TNTmips provides the usual suite of processes but more interestingly, it offers some advanced geospatial analysis capabilities:

- Spatial Statistics

(Trend, Residuals, Autocovariance, and Semivariogram profiles, surface (e.g. kriging) and polygon fitting (e.g. tessellation) ground truth sample planning and reporting, etc.)

- A to B conversions

(where A and B equal Raster, Vector, **CAD**, or **TIN**)

- Raster to vector map conversion

(color raster binarization, automatic line thinning and following)

- Vector combinations

(**AND**, **OR**, **XOR**, Add, Subtract

Extract Completely Inside/Partially Inside/Outside and Clip, etc.)

- Vector properties

(Fuzzy properties, directional analysis, etc.)

- On the fly Region of Interest calculations

(Dynamic "cookie cutter" analysis)

- Thematic statistics and display

(Partition and color database field values by quartiles, etc.)

- Directional Analysis

(Line segment rose plots for "fracture" analysis, etc.)

- Digital Photogrammetry

- (Epipolar image creation, **DEM** Extraction, Restitution, Stereoscopic viewing, anaglyph display)
- Image processing
(Unusual filters and classifiers, morphology, mosaicking)
- **3-D** Visualization
(Rapid mesh display, anaglyph display, raster drapes, multiple raster offsets)
- Civil Engineering tools
(Route tracing, **COGO**, map projection tool and dynamic display and subobject functional datum, ellipsoid, and projection transformations)
- Cartography
(Dynamic abstraction by display scale, robust layout control, many different plotter and printer drivers)
- Database Management
(Attach by attribute, attach by coordinate, field population via field combination, report creation, Open DataBase Connectivity)
- Data Management
(Folder, object and subobject data file methodology, locked file edit protection, generous metadata capability)
- Platform Compatibility
(Interface, functionality, and data file access are independent of computer platform and operating system)

In short, this package tries to do it all.

A reference you might like to look at is the September 1996 issue of **GIS** World, in which the image processing components of **TNTmips** were recently compared to **EASI/PACE**, **ENVI**, **ERDAS** Imagine, ER Mapper, and **MBI/MAI**.

THE CATCH

What I gain - by offering this demo is the possibility of creating increased use of this software on campus (as far as I know, I am the only one making use of it). I empathize with the frustrations of my colleagues and classmates when grappling with the syntax and analysis limitations of various "standard" software packages. I believe this software enables one to more freely explore the semantics of geospatial analysis.

I have seen, and have personally experienced, the frustrations of **ESRI's** Arc/Info and **ERDAS' Imagine**. However, I do not view **TNTmips** as a replacement rather as a complement to them.

A toolbox has many tools, not just one.

Another catch is that **TNTlite** is not fully enabled. There are limits to the size of the objects which can be manipulated and the export capability has been turned off; HOWEVER, the FUNCTIONALITY of **TNTlite** is the same as the professional package. Therefore, **TNTlite** is best for pedagogical purposes; the purpose of this demo.

(Reference **TNTmips**. <http://www/microimages.com/www/html/tntlite/english.htm>).

THE BOTTOM LINE:

It is the number of options that I find intriguing and wish to share in the spirit of "constant sifting and winnowing".

THE INVITATION:

If you are interested in attending this demo, I will be offering it every evening of the week March 31 to April 4 from 5 till 6 PM at the Environmental Remote Sensing Center's Instructional Laboratory, Room 1253, 12th floor, AOSS Building.

Please tell me:

1. What day(s) of the week March 31 to April 4 is (are) most convenient for you to attend?
2. What single geospatial analysis would you like to try in a demo? (I can't be an expert on every aspect of this software, but I will try to address your particular interest in a demo you can try.)

If you are not interested or cannot attend, would you please consider forwarding this invitation to a faculty member or graduate student you think would be interested?

Thank you for your time.

Abbreviations.

For simplicity, the following abbreviations were used in this **MEMO**:

W31 = Microsoft Windows **3.1** or **3.11**.

NT or **NT4** = Microsoft **NT 3.1**, **3.5**, or **4.0** (**3.1** is error prone, and thus the **TNT** products require the use of **3.5** and its subsequent patches).

W95 = Microsoft Windows **95**.

Mac = Apple Macintosh using the 68xxx Motorola processor and **MacOS 6.x** or **7.x**.

PMac or **Power Mac** = Apple Macintosh using the 60x Motorola Power**PC** processor and **MacOS 7.x**.

MI/X = MicroImages' **X** server for Mac and **PC** microcomputer platform and operating system.