Tutorial

DISPLAYING

Displaying Geospatial Data

with

TNTmips®

TNTedit™

TNTview®

Before Getting Started

This tutorial booklet introduces you to the TNT products from MicroImages, Inc. You may be a professional with years of experience or you may be a student taking your first GIS or Image Processing course. Whatever your situation, this booklet will help you get started with the TNT products. We recommend that your next tutorial be *TNT Product Concepts*. Once you learn the basics of TNT with these first two booklets, you will be ready to branch off in any direction to explore the many powerful features TNT offers.

Sample Data The exercises presented in this booklet use sample data that is distributed with the TNT products. If you do not have access to a TNT products DVD, you can download the data from MicroImages' web site. In particular, this booklet uses objects in the CB_DATA, BLACKBRN, EDITRAST, and MAPLO data collections. Make a read-write copy of the sample data on your hard drive so changes can be saved when you use this data.

More Documentation This booklet is designed as the first in the tutorial series. Further general system information is provided in the *TNT Product Concepts* tutorial, which covers many TNT interface conventions. After you complete the exercises in these two booklets, you will have the basic skills you need to pick up any of the other tutorial booklets.

TNTmips® Pro and TNTmips Free TNTmips (the Map and Image Processing System) comes in three versions: the professional version of TNTmips (TNTmips Pro), the low cost TNTmips Basic version, and the TNTmips Free version. All versions run exactly the same code from the TNT products DVD and have exactly the same features. If you did not purchase the professional version (which requires a software license key) or TNTmips Basic then TNTmips operates in TNTmips Free mode.

This booklet refers to TNTmips, TNTedit, TNTmips Free, and TNTview as "TNT." Since the display features in all four products are essentially the same, you will be able to follow these exercises no matter which product you have with the exception of the exercises on adding web layers, which require the professional version of the TNT products (except for WMS and ArcIMS layers).

Merri P. Skrdla, Ph.D., 18 September 2010

It may be difficult to identify the important points in some illustrations without a color copy of this booklet. You can print or read this booklet in color from MicroImages' web site. The web site is also your source for the newest tutorial and application booklets on other topics. You can download an installation guide, sample data, and the latest version of any TNT product:

http://www.microimages.com

Install TNT

You can install the TNT products from a DVD or after downloading from MicroImages' web site. An *Installation and Setup Guide* in Adobe PDF format is provided in the root directory of the TNT products DVD. You can also download or view the installation booklet from MicroImages' web site.

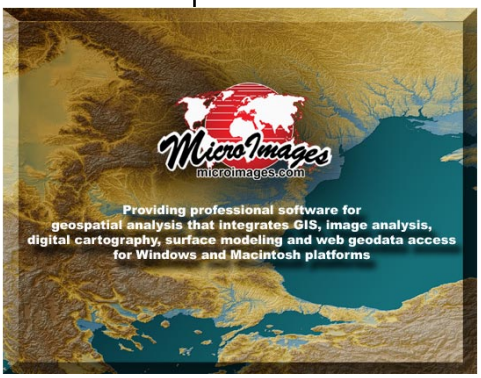
The exercises in this booklet use sample data available with the TNT products. Copy the sample data to your hard drive. Making a read/write copy enables display parameters and other information to be saved. The data and documentation can be downloaded from MicroImages' web site. A large collection of Technical Guides on individual features is also posted on MicroImages' web site. Consult the TechGuides for newer features that may not be included in this booklet. A collection of Quick Guides, which provide helpful hints for using the TNT products is also available.

The geospatial display process is common to TNTmips, TNTedit, and TNTview. It also is at the core of the free TNTatlas product.

- TNTview contains the display process, the SML scripting language, the import and export processes, and file maintenance procedures.
- TNTedit is TNTview plus the geodata editor, and georeferencing.
- TNTmips is the complete suite of TNT display, editing, manipulation, and support processes.

The exercises in this booklet describe the Display process as it appears in the TNTmips Pro, TNTmips Basic, and TNTmips Free products. Only slight differences in the way you launch the process appear in TNTedit and TNTview.

Windows computers begin each TNT session with the MicroImages splash screen.

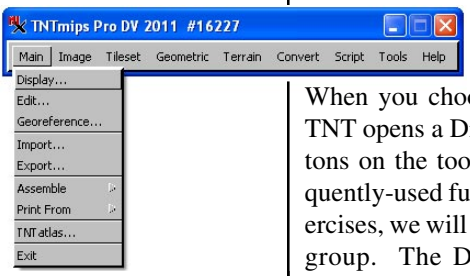


A new edition of TNTmips that includes the latest error fixes is posted weekly on MicroImages' web site (no software is error free, but MicroImages is very responsive to fixing errors). The posted development version also contains newly added features. You can install and run the development version and also run the current release version of TNTmips.

The exercises in this booklet on pages 4–10 introduce basic object and display concepts. Pages 11–21 introduce each type of internal spatial data object. More complex visualization and output features, including the types of Internet-based layers supported are covered on pages 22–42.

Start TNTmips

The tutorial booklets refer to menu choices with a **menu path** notation. For example, choosing Display from the Main menu is indicated with the menu path "Main / Display."



STEPS

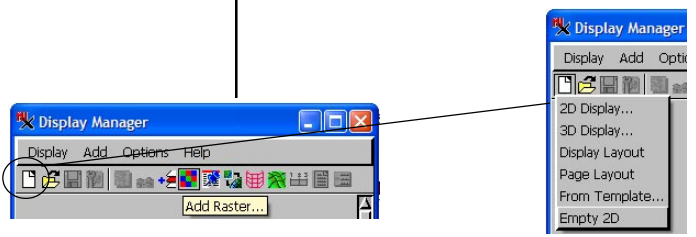
- ☑ launch TNT from the desktop
- ☑ select Main / Display
- ☑ expose the ToolTip for each icon button in turn on the Display Manager toolbar
- ☑ click the New icon button and select Empty 2D from its menu 

Launch TNT for Windows and Mac computers by double-clicking on the TNT program icon created during installation. The system also starts the X Server, which provides the operating environment for TNT (MI/X on Windows and X11 on the Mac).

TNT displays its main menu with the items Main, Image, Tileset, Geometric, Terrain, Convert, Script, Tools, and Help. This booklet uses the Display process to introduce the main types of geospatial objects used in the TNT products: raster, vector, CAD, TIN, shape, and database. The exercises show how to display both simple and multi-object / multi-layer views.

When you choose Display from the Main menu, TNT opens a Display Manager window. Icon buttons on the toolbar give you quick access to frequently-used functions. For these introductory exercises, we will use the simplest form: a 2D display group. The Display process also supports 3D groups, display layouts, and page layouts.

When you are finished with a TNT session, close each active TNT process. You exit Display by selecting Exit from the Display menu in the Display Manager. You exit TNTmips by selecting Exit from the Main menu on the main TNT menu bar. You can also exit a process using the close icon in the main window's title bar. The X Server automatically exits when the last TNT process is closed.



You can always tell what an icon button does by exposing its **ToolTip**: hold your cursor over an icon button for a moment to see a description of the button's function.

Display Group View and Manager

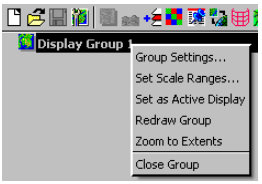
When you choose to open an empty group, the Display process opens a Display Group 1 View 1 window (hereafter called the View window) and lists Display Group 1 in the Display Manager window. Other choices in the Display Manager will result in a prompt for you to select an object. Object selection is discussed in the next exercise.

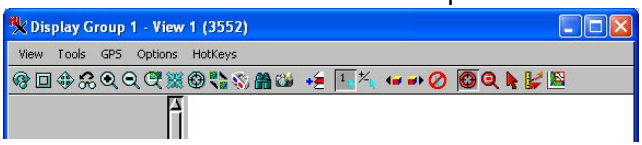
The Display Manager window lets you add and remove display groups and layers, and lets you examine the attributes associated with each object by manipulating the expandable list of objects in each group. Many of these functions are also available in the legend area of the sidebar.

The Display process lets you simultaneously open multiple View windows, plus 3D groups, display layouts, and page layouts. This booklet introduces display for 2D groups. Other tutorial booklets treat using page layout displays for map and poster design and 3D perspective and stereo visualization. There is a single Display Manager window to manage all of your views.

STEPS

- ☑ inspect the interface components of the Display Group View window
- ☑ click on the main menus in each window to survey the drop-down selections
- ☑ right-click on the Display Group 1 item in the Display Manager list and select Close Group from its menu (on a Mac, use ⌘ command-click for the right-click function)

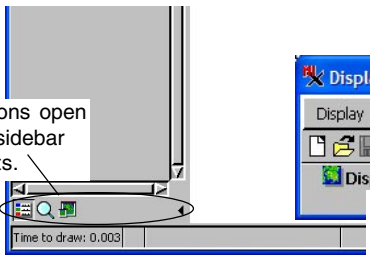




The **Sidebar** may contain the legend, a magnifier, and a locator for the geodata in the View canvas.

The **View** canvas of the **Group View** window shows a multilayer display of your geospatial project materials.

These buttons open and close sidebar components.



The companion **Display Manager** window provides tools to add, remove, and examine each layer in the view.

File and Object Selection

STEPS
- ☑ select 2D Display from the New icon menu
- ☑ examine the Select Object dialog that opens

Most processes open a standard Select Objects dialog so you can navigate through drives, directories, and Project Files to locate input and output project materials. In the exercises on this page and the next, you will select several objects for 2D display from the TNT sample data. For purposes of illustration, we assume your sample data is on drive C: in /DATA.

The TNT Project file has an RVC file extension. Many additional file types are supported for direct use or by linking to files in their original format. Shape objects have no corresponding internal object type and are supported by direct use or linking only. File types supported for direct use have a same-named file with an RLK extension when needed for ancillary information created in TNT, such as georeference, styles, and additional database tables.

A **Project File** is the TNT data structure for all raster, vector, CAD, TIN, database, and text materials, as well as associated subobjects (such as georeference control and display characteristics).

Switch between Web and local layers using this arrow.

Each arrow drops down a list of the contents of drive/directory/file to its left.

This arrow drops down a list of recently selected objects/files.

Click on the icon in this position to go up one level in the directory.

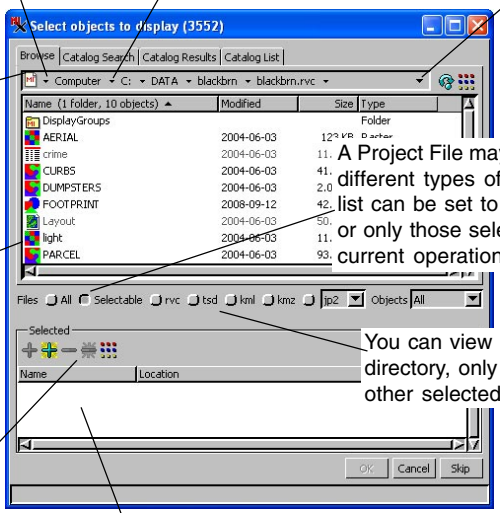
A Project File may contain many different types of objects; the list can be set to show all types or only those selectable in the current operation.

An icon shows the type of each item in the list.

You can view all files in a directory, only RVC files, or other selected file types.

Grayed-out interface elements are not active in the current context.

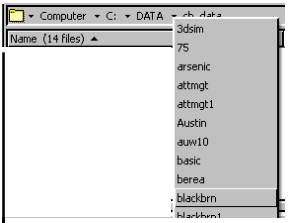
Already selected items appear in this list.



Select Display Objects

- ☑ Select the C:/DATA/BLACKBRN directory from the object list; TNT shows you the Project Files and other file types that can be directly displayed in that directory.
- ☑ Navigate into the BLACKBRN Project File from the object list (click on the icon that represents the file or double-click on the file name); TNT shows you a list of objects and folders inside the Project File.
- ☑ Click the Add All button to add all selectable objects to the selection list (note that the layout is not added to the list because it is not selectable in this case).
- ☑ Click the [OK] button to complete your selection and close the Select Objects dialog. TNT automatically displays the selected objects in the View window.

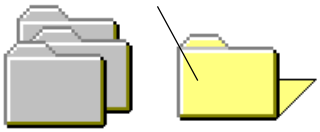
When you complete these steps, your View and Manager windows should look like those illustrated on pages 8 and 10, respectively.



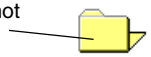
Keep this display group on the screen for the next exercise.

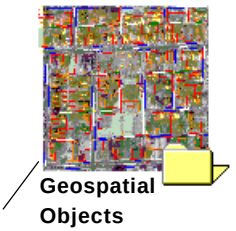
If you do not have the sample data on your computer, copy it from the TNT products DVD or download it from www.microimages.com. The sample data for all tutorial booklets is in a single .zip file.

1 Once you have selected the /DATA/BLACKBRN directory, select a **Project File** from the object list; in this example, BLACKBRN.



2 A Project File may be logically organized to include one or more **Folders**. Observe the DISPLAYGROUPS folder in the object list (but do not select it).

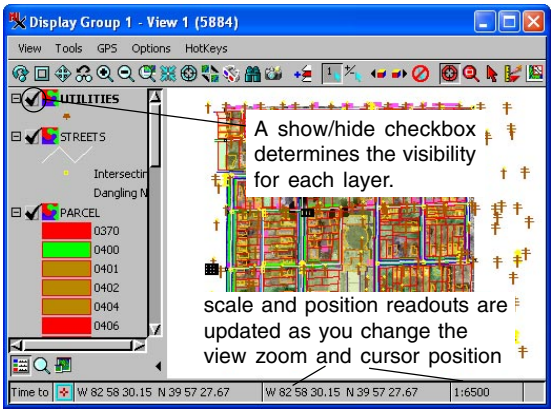




3 A Project File or a Folder may contain several **objects**. For this exercise, you will select all the selectable objects in the list.

Project FIles are read or write locked during usage to protect your data. A read-locked file can be opened by another process for reading but not for writing. The WIndows OS manages most file locking but if your files are on a networked drive or you are using a Mac, file locking is handled by TNT. If your computer shuts down abnormally while a Project File is locked by TNT, you can unlock it by deleting the .LOK file (such as BLACKBRN.LOK) located in the same directory. For additional information on file locking, see the Understanding and Maintaing Project Files *booklet.*

Using the View Window



In the previous exercise, you selected all the displayable objects in the root of a Project File. Now your group contains eight layers, including: AERIAL (a raster object airphoto), FOOTPRINT (CAD outlines of buildings), and PARCEL (vector polygons) among others. After layer selection is complete, TNT updates the layer list in the Display Manager window and the Legend (if open) and displays the group in the View window.

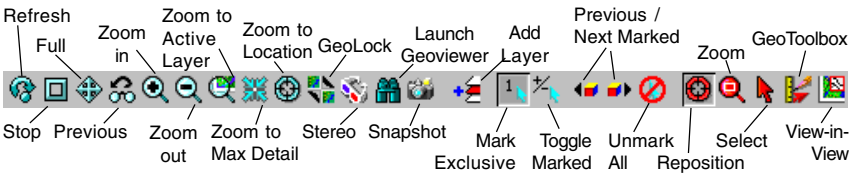
STEPS

- ☑ the Reposition tool is active by default; hold the left mouse button and drag to reposition the view or roll the scroll wheel away from or toward you to zoom in/out
- ☑ click the Zoom box to draw a zoom area
- ☑ Zoom to Maximum Detail matches raster cells to screen pixels

Your preference for whether the zoom box tool requires a right mouse click to initiate the zoom or simply zooms when you release the mouse is set with the View Options opened from the Display Manager.

Icon buttons across the top of the View window present many display control features. Use the default reposition tool to drag the view in any direction (hold left mouse button) or zoom in and out with the scroll wheel. Click the Zoom In button to enlarge the contents of the view. Click Zoom Out to reduce the scale of the view. Select the Zoom box and draw an elastic box on the display image. When you finish drawing the box, the display zooms to the extents of the box. Click the Maximum Detail icon to see a "1X" view (1:1 raster cell to display pixel). Click on Full to fit the whole group to the current window size.

The default layer name used in the Manager and Legend can be the object name, object description, or file and object name. This option is set on the Layer tabbed panel of the Options window opened by choosing Options/View Options in the Manager.



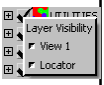
Legend, Magnifier, and Locator

The sidebar on the left side of your View window may contain three optional components: the Legend, Magnifier, and Locator. The sidebar as a whole and each of its components can be resized. On the preceding page only the Legend is shown.

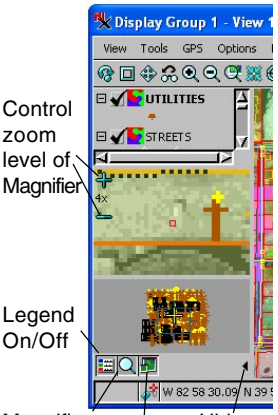
The Legend provides many of the same features as the Display Manager directly in the View window. You can turn layers on and off and open the Layer Controls by clicking on the associated icons. Layer order can be changed by dragging. A right mouse button menu also provides access to these functions and others.

The Magnifier provides a 4X zoom (by default) of the layers in the view centered on the cursor location. The current zoom level of the Magnifier is shown between the control buttons for increasing and decreasing the Magnifier's zoom level.

The Locator provides an overview of all selected layers with a rectangle that represents the current extents showing in the view window. You can move this rectangle to change the area being viewed and/or resize it to change the zoom level of the main View. You can turn layers off in the Locator from the right-click menu for the Show/Hide checkbox.

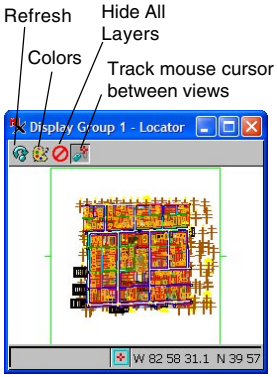


You can also open a separate Locator window (Display/Open Locator View in the Display Manager). A single Locator window is used to manage all of the open views of the same display. A rectangle is used to represent the extents of each open View. You can change the colors used by changing the primary and secondary graphic tool colors in the GeoToolbox (Options/Graphic Tools). The primary color is used to indicate the view extents for the view the cursor is over. All other view extents boxes are shown in the secondary color. You can also change the background color for both versions of the Locator.



STEPS

- ☑ use the icons at the bottom of the sidebar to turn optional components on/off (note that the icon to reopen the sidebar moves to the left margin of the View)
- ☑ with the Locator on, turn off several of the vector overlays
- ☑ choose Display/Open Locator View in the Display Manager window

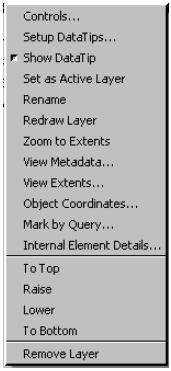


Using the Manager Window

STEPS

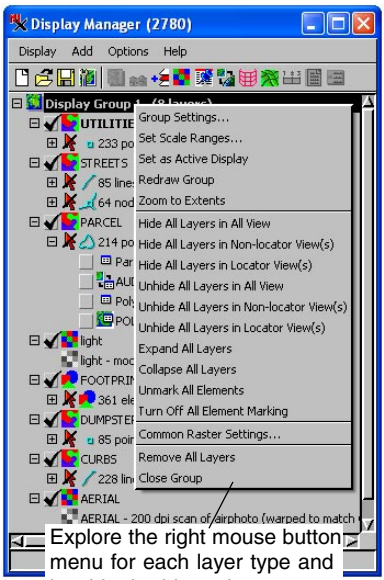
- ☑ click the expand/ collapse boxes for the Parcel layer and again for its 214 polygons
- ☑ turn on the show/ hide checkbox for the AUDITOR table
- ☑ select Expand All Layers from the right-button menu for Display Group 1
- ☑ click the object icon for the Parcel layer and survey the Vector Layer Controls dialog that opens
- ☑ inspect the right-button menu for several layer types
- ☑ select Remove All Layers from the right-button menu for Display Group 1 to prepare for the next exercise

Each primary row in the Manager window corresponds to one layer in the View window and gives you access to features related to the display layers. The layer list is presented with expandable tree controls. You can access secondary rows of subordinate information and controls for a layer by clicking its expand/collapse box. You can expand the entire list for a group by selecting Expand All Layers from the right mouse button menu for the group.

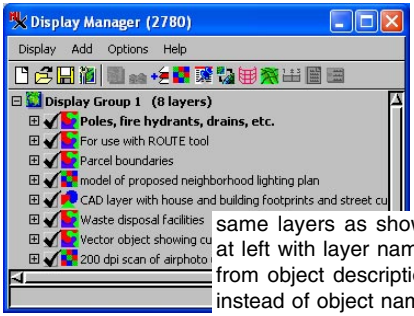


An object icon for each layer shows the object type (raster, vector, shape, CAD, TIN, ... more on object types later). Click on an object icon to open a Layer Controls dialog that offers display controls and options for that layer.

A right mouse button menu for each layer offers functions appropriate for that layer. Compare the right-button menus for a raster and vector layer in the list. Also note that every level in the Manager has an associated right-button menu not just those representing display layers.



Explore the right mouse button menu for each layer type and level in the hierarchy.



same layers as shown at left with layer name from object description instead of object name

Above: one row for each layer. Left: the layer tree has been expanded to reveal the hierarchical presentation of features and information.

Add a Single Raster

A **raster** is a geospatial data object that may contain an image, such as a digital photo, a satellite image, or a scanned map or it may contain other numeric data, such as elevation. A raster is a two-dimensional array of cells. If you have ever used a paint program, you may be familiar with common raster formats, such as TIFF, PNG, JPEG, and GIF.

An 8-bit "composite color" raster uses a color table to map each raster cell value into one of 256 discrete display colors. Each display color in the color map generally represents a compromise to represent a collection of similar colors that occur within the image when the separate red, green, and blue components are combined. 8-bit rasters that lack a color map are displayed in grayscale.

16- and 24-bit rasters provide truer colors because the image is represented by 65,536 or 16,777,216 possible colors, respectively, instead of a mere 256. 24-bit imagery is more common but cannot be distinguished from 16-bit by the human eye unless all the colors in an image fall within a very narrow range of the spectrum.

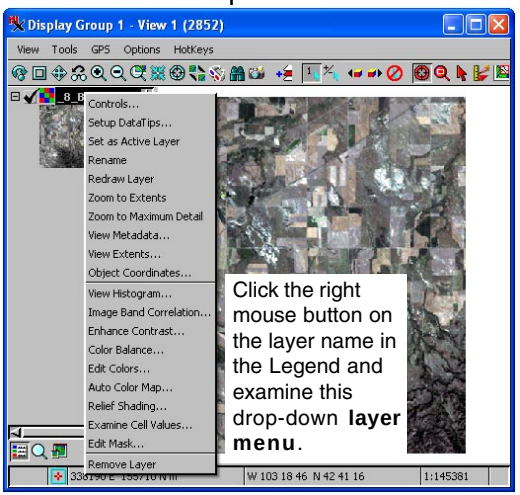
The TNT products support the use of a wide range of raster types including 1-bit binary rasters to 128-bit complex number rasters. Grayscale, color composite, and hyperspectral rasters are supported.

_8_BIT is a composite color TM (Thematic Mapper) satellite image of the Crow Butte 7.5-minute map quadrangle in Nebraska. 8-bit color was more common in the early days of digital imagery when display memory and file storage were very expensive.

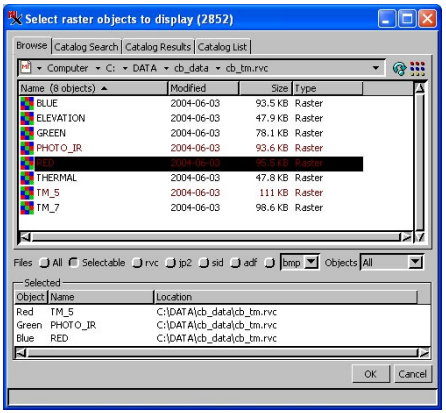
STEPS

- ☑ click the Add Objects icon in the Display Manager 
- ☑ select CB_DATA / CB_COMP / _8_BIT
- ☑ right-click the layer name in the Legend to see the layer menu for _8_BIT
- ☑ click on the object icon then on the Edit button for the Color Palette and note the available colors 
- ☑ choose File/Close in the Color Palette Editor window
- ☑ select Remove Layer from _8_BIT's Legend layer menu

Note: you could also click on the Add Raster icon and choose Single from its menu.



Select a Three-Raster RGB Set



To select rasters to display as red, green and blue, click on the object icon or double-click on its name to add in red-green-blue order.

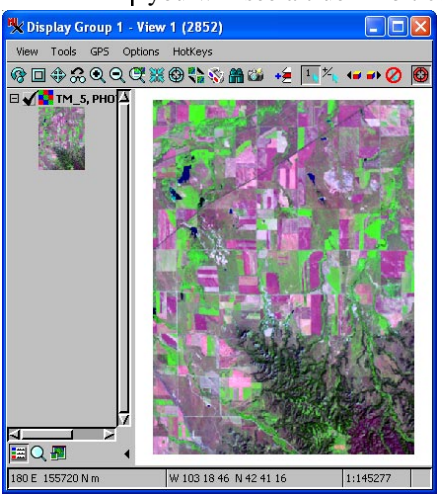
STEPS

- ☑ click on the Add Raster icon, and choose Red-Green-Blue
- ☑ select TM_5, PHOTO_IR, and RED from CB_DATA / CB_TM in the order specified
- ☑ select Remove Layer from the layer menu in the Display Manager

A color image can be created from three separate raster objects when each raster object is used to control one color component: one raster object provides the red component, one the green, and one blue. Use component color raster display for viewing selected bands from multispectral image sources, such as 7-band TM satellite images. By assigning various bands to the RGB components, you can view and analyze false-color images, such as illustrated below. [Other multiple-component raster display modes use input rasters for hue, intensity, and saturation (HIS), or as hue, brightness, and saturation (HBS) components.]

You can also add a set of raster objects as a single RGB layer by clicking on the same icon used to add any type of single-object layer. If you select three coregistered, coextensive raster objects with red, green, or blue in their object name, they will be added as a single RGB layer.

If your computer is in a 24-bit color display mode, you will see a true 24-bit color image (each of the component raster objects provides 8 bits of information). If your computer is in a 16-bit or 8-bit display mode (not recommended), Display automatically reduces the 24-bit color information from the RGB raster objects into an optimally chosen palette with the appropriate number of colors.



Quick-Add an RGB Set

In addition to adding RGB sets as described in the previous exercise, you can add RGB sets using the Add Objects icon if the layers in the set are coregistered (with the same orientation and geometry), coextensive (having the same extents), and appropriately named*. Coregistered, coextensive rasters have a 1-to-1 cell correspondence with the same ground area represented by the corresponding cells in each raster.

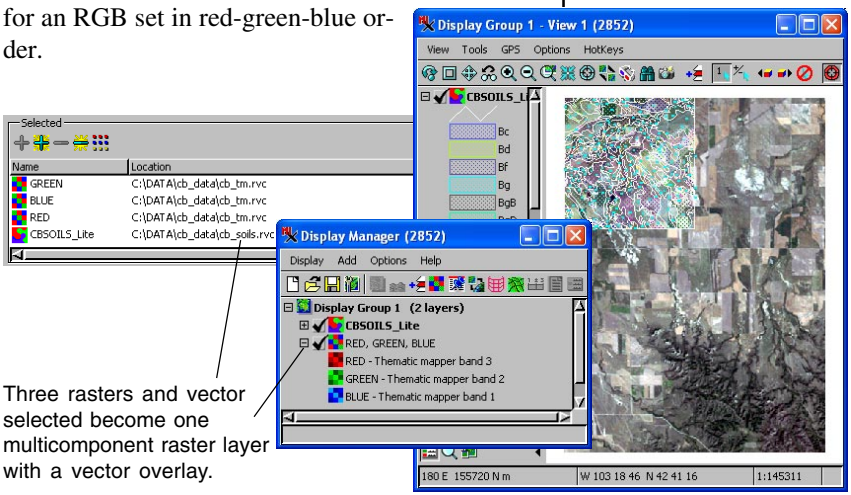
This quick-add lets you use the same Add Objects icon used for single rasters and other single objects to create a multicomponent raster layer alone or in combination with other layers. Multiple RGB sets can be added with a single use of the Add Objects button as long as they have different extents. If multiple sets with the same extents are selected, all are added as separate, single-raster layers.

If red, green, or blue is included in the object name, it is appropriately named for use with this quick-add feature. Color name identification is case insenstive and will utilize localized color names if your TNT product interface is in a language other than English. Because the multicomponent band identification is made by name, you do not need to select the rasters for an RGB set in red-green-blue order.

STEPS

- ☑ click on the Add Objects icon in the Display Manager 
- ☑ select GREEN, BLUE, and RED from CB_DATA / CB_TM in any order, then select CBSOILS_LITE from the CB_SOILS Project File
- ☑ select Remove All Layers from the right-click group menu in the Manager window

* Different null specifications will prevent coregistered, coextensive raster sets from being added as a single, multicomponent layer. Having the same null specification means that all three rasters have an individual null value, all three have a null mask, or all lack a null value or null mask. To read more about null values and null masks, consult the *Working with Massive Geodata Objects* booklet.



Three rasters and vector selected become one multicomponent raster layer with a vector overlay.

Vector Object Display

A **vector** is a spatial data object containing point, line, and polygon data. Vector objects often contain features with associated database values, such as

- agricultural fields and crop information,
- political districts and population data,
- well locations and pumping capacity, and
- highway segments and paving type.

STEPS

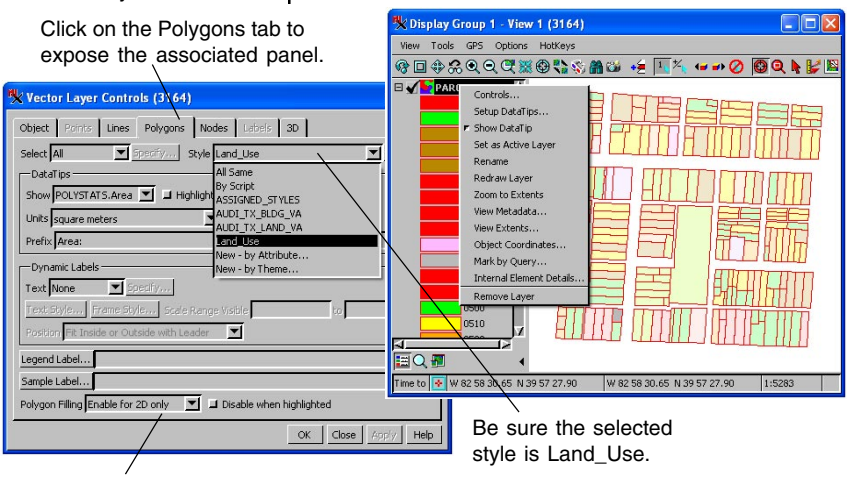
- ☑ click on the Add Objects icon in the Display Manager 
- ☑ select the /TNTDATA/BLACKBRN directory, the BLACKBRN Project File, and the PARCEL vector object
- ☑ click on the vector icon or select Controls from PARCEL's right mouse button layer menu in the Display Manager or Legend 
- ☑ on the Polygons panel, select Style Land_Use

This exercise introduces the second major type of geospatial data object: the vector object. Vector objects may contain point, line, and/or polygon elements with associated database records. A sample vector object from the Blackburn neighborhood in Columbus, Ohio shows property parcels and associated tabular data from the County Assessor.

The right mouse button menu for a layer provides most of the same choices in the Legend and Display Manager so you can use the menu in the window that is more convenient. The icon that represents the layer type provides a shortcut to open the Layer Controls for that object.

Vector objects have rigorous topology, which describes the relationships between the elements in the vector object. The three types of vector topology supported in the TNT products are polygonal, planar, and network topology. An additional element type (nodes) is important in topological descriptions. All lines start and end in nodes. Nodes are usually hidden for display purposes. For more information on vector topology see the *Vector Analysis Operations* tutorial booklet.

Click on the Polygons tab to expose the associated panel.



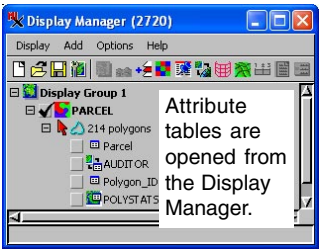
Be sure the selected style is Land_Use.

Enable Polygon Filling.

Keep the PARCEL object on screen for the next exercise.

Vector Attribute Display

You can select elements in the View to see the attached database records containing attributes of vector, shape, CAD, pinmap, TIN, and raster objects. Vector objects have a separate database for each element type (points, lines, and polygons). Each vector element type may have any number of different attribute tables. You can open as many tables as you want simultaneously by clicking each table's hide/show checkbox.

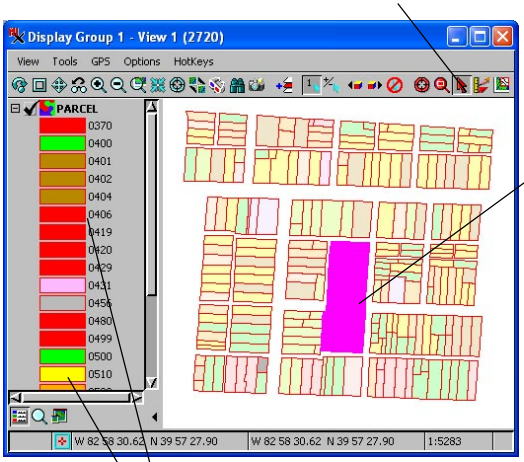


The TNT products provide two viewing modes for your database attributes: single record view (shown below) and tabular view. You switch between these viewing modes from the Table menu for an open database table or using an icon on the table's toolbar. When viewing attributes in tabular form, you can select records and mark all elements associated with those records in the View. Thus, you can select elements in the View and see which records are attached or select records in the table and see which elements are associated with them.

STEPS

- ☑ expand the Manager's tree list until it shows the tables for polygons in the Parcel layer
- ☑ open the AUDITOR table
- ☑ click on the Select tool in the View window
- ☑ click on a polygon in the View window
- ☑ examine the related database record in the table window

Click the Select tool.



Click on an element in the display to view its attached database record(s).

The Legend shows the drawing style for each type of polygon.

CAD Object Display

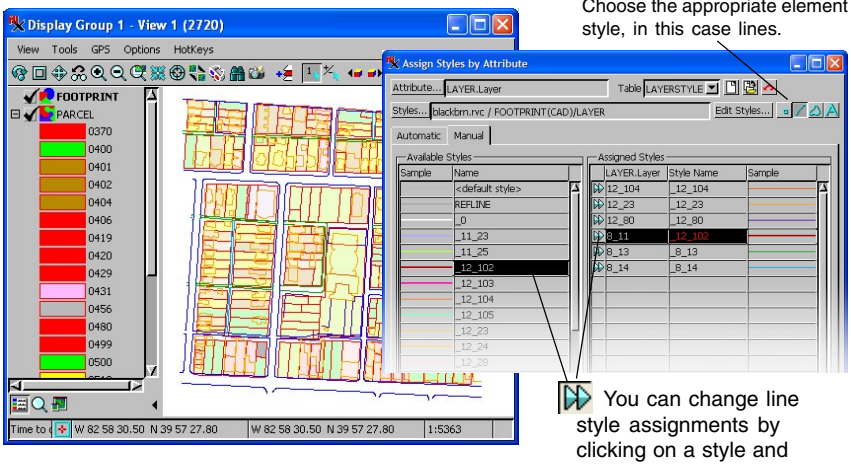
A **CAD object** contains point, line, polygon, geometric shape, and block elements with their associated database records. CAD objects have a single database to maintain attributes for all element types.

STEPS

- ☑ click the Add Objects icon button in the Manager window
- ☑ select the FOOTPRINT CAD object in the BLACKBRN Project File
- ☑ click the FOOTPRINT layer icon in the layer list of the Manager window
- ☑ select the Elements panel in the CAD Layer Controls dialog, change Style to By Element, and click on Apply
- ☑ after noting the difference in appearance, change Style to By Attribute and click on Apply

This exercise introduces another type of geometric object: the CAD object. CAD objects are used for interpretation and annotation layers, as well as for overlapping, layered spatial elements, such as overlapping polygons or lines that lie in front of or behind polygons. Overlapping polygons are not supported by any other object type. Another unique CAD property is that each element can have its own individual drawing style created at the time the element is added. This "by element" drawing style can be modified in TNT's Editor.

The FOOTPRINT CAD object in the BLACKBRN Project File contains outlines of the buildings in the study site. The building footprints may display in a single color (drawing style All Same). To use additional line styles, open the CAD Layer Controls dialog (click on the FOOTPRINT layer icon in the Display Manager or the Legend or use the right-click menu in either), and then change the Style option button from [All Same] to [By Attribute] or [By Element]. When TNT redraws the display, the lines show in different colored styles. If you click on Specify in the CAD Layer Controls dialog when the style is set to By Attribute, you can change the styles assigned.



Database Pinmap Display

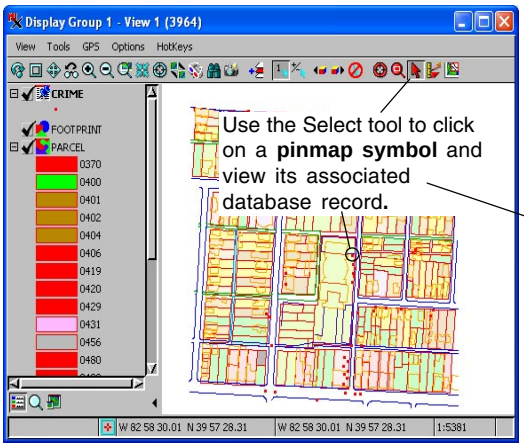
This exercise introduces database objects. Database objects may contain records of numeric, text, and logical fields that have some spatial quality. A database record may be related to a spatial coordinate system in two ways: 1) each record may contain explicit coordinate values, and/or 2) each record may contain attributes that are related to geospatial elements or act as key fields that are related to other attribute tables.

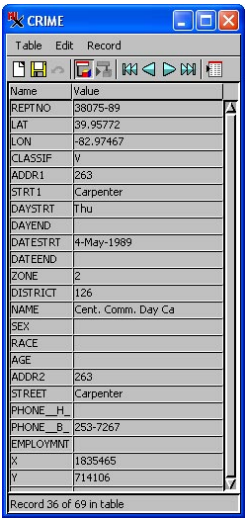
When database records contain map coordinate values, TNT can create a "pinmap" from the database records. The BLACKBRN Project File includes a database of police calls with such map coordinates. Unlike other geometric object types, pinmaps can have new elements added in the Display process when you add new records to the table with coordinates for a new pinmap "point." You can also move points by editing the coordinate fields. Like points in other geometric object types, you can style pinmap points to use predefined symbol shapes or custom symbols and styling can be the same for all points or vary by attribute. A more complex option that varies the style by script is also available.

TNT can link to external database files in several formats or use its own internal database format.

STEPS

- ☑ click the Add Database Table Pinmap icon in the Manager window 
- ☑ select the CRIME table under the CRIME database object in the BLACKBRN Project File
- ☑ click [OK] to accept default display controls in the Pinmap Layer Controls dialog
- ☑ open the CRIME table for the pinmap layer after expanding the pinmap layer in the Manager as you did on page 15 
- ☑ use the Select tool in the View window to click on a pinmap symbol 





Theme Mapping

Theme Mapping applies selected values in a database to the drawing styles used for elements in vector and TIN objects.

STEPS

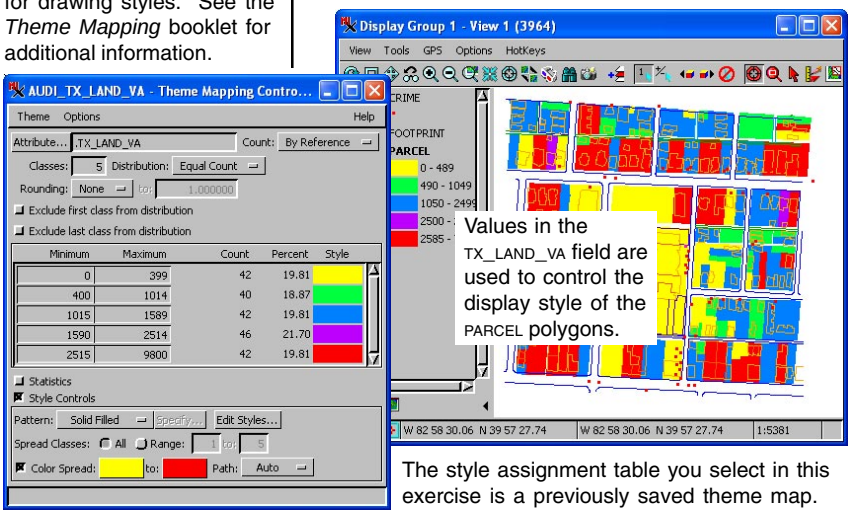
- ☑ click the PARCEL object icon to open the Vector Layer Controls dialog
- ☑ select the Polygon tab and change Style to AUDI_TX_LAND_VA
- ☑ click [OK] to initiate a redisplay
- ☑ close this display Group by selecting Close Group from the right-button menu for Group 1 in the Display Manager

If you click [Edit] next to Style in the Vector Layer Controls when a theme map style object is selected, TNT opens the Theme Mapping Controls window. You can select the database table, theme field, number of themes, and color spread for drawing styles. See the *Theme Mapping* booklet for additional information.

Vector, shape, and TIN objects can be displayed "By Theme" so that selected values in associated database tables control the display style of the elements. For example, a "Flow_Capacity" field associated with pipeline line elements could be used to determine the display color and style for all the pipeline elements in a vector object. Raster objects can also be displayed by theme using cell value ranges to define the theme classes.

In this exercise the TX_LAND_VA (land tax value) field from the county AUDITOR database is used to control the display style of the PARCEL polygons. A color spread from yellow to red has been created so that churches, public buildings, and parcels with no buildings (zero tax value) display in yellow, and parcels with the highest tax values display in red. Intermediate tax values are green, blue, and purple.

The Theme Mapping Controls let you decide how to count the elements being theme mapped (by database reference, by element size, or using all records) and whether to include all classes in the distribution. Other parameters set in this window are described at the right and illustrated below.



The style assignment table you select in this exercise is a previously saved theme map.

Shape Object Display

Shape objects are one of the geometric object types supported by the TNT products. Shape objects are unique in that they have no internal object representation and exist only in external formats that are either utilized directly (shapefiles and LiDAR LAS) or linked to using the Import process (Oracle Spatial, MySQL Spatial, ESRI Personal Geodatabase, and PostGIS). Thus, shape objects exist in their original, external format and can be manipulated by both TNT and their native software.

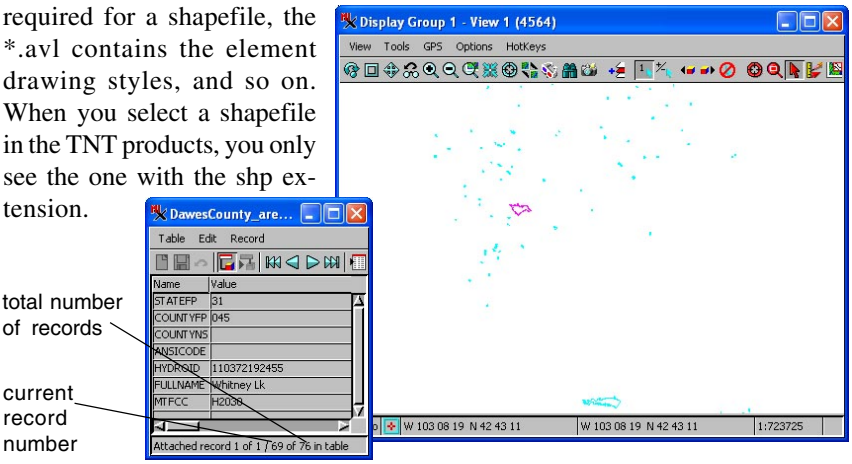
Shape objects can have only one element type (point, line, or polygon) and, as represented externally, only one database table that has a single record directly attached to each element with a record for every element. When viewed within the TNT products, additional tables (including relational tables) can be added. Additional database tables and other subobjects added using TNT, such as style objects and display parameters, are maintained in a linked Project File that is automatically selected along with the external shape object in the TNT products.

A "shapefile" is actually a collection of files with the same name and different extensions. The *.shp file contains the elements, the *.prj file provides the georeference, the *.dbf file is the single database table required for a shapefile, the *.avl contains the element drawing styles, and so on. When you select a shapefile in the TNT products, you only see the one with the shp extension.

STEPS

- ☑ click on the New icon and select 2D Display
- ☑ navigate to the Crow Butte data collection and select the Dawes County_areawater.shp file
- ☑ click on the Select icon, then click on a polygon 
- ☑ right-click on the group name in the Display Manager window and choose Close Group

Because shapefiles can only contain one element type, lakes (polygons) and rivers (lines) must be in different objects. The shapefile used in this exercise contains lakes.



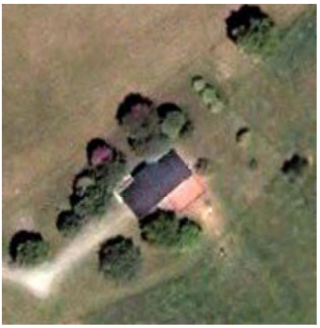
LiDAR Display

STEPS

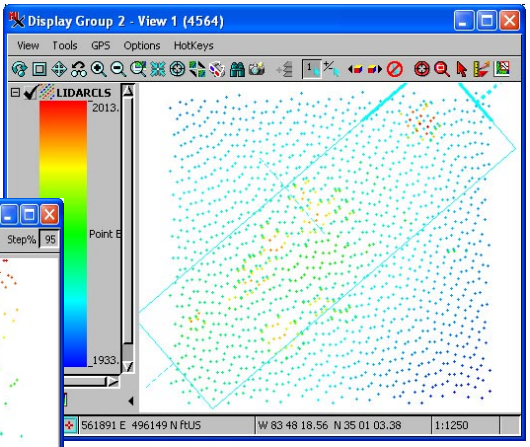
- ☑ open a new display group and select the LIDARCLS.LAS file from the SML data collection
- ☑ choose Tools/Point Profile (View window)
- ☑ resize and reposition the box that appears and note the effect on the profile shown
- ☑ click on the LAS layer icon to open the Layer Controls and explore the various options
- ☑ right-click on the layer name and choose Reclassify
- ☑ note the options available

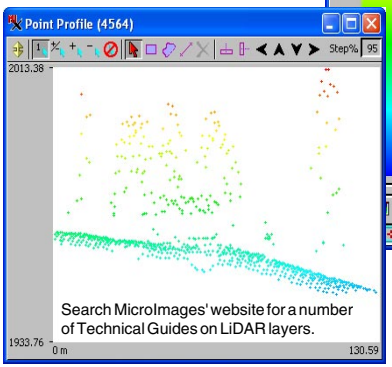
LAS is a public format for LiDAR (Light Detection and Ranging) data that can be directly used in the TNT products. LAS files typically contain tens of millions of points that provide high resolution elevation information acquired by optical remote sensing. These points may have associated classification information from a standard classification table for this data type. This information is presented as a TNT database table. A tool for classifying/reclassifying points is provided in the Display process for LAS layers. You use this tool in conjunction with the selection tools in the GeoToolbox.

A number of styling choices are available for LAS points (e.g., by elevation, by class, by intensity). LAS layers can also be displayed as a surface generated from the point classes you select. The Point Profile tool, which can be used with 3D vector and shape objects as well as LAS files, provides a vertical view of the points within a selected area. A number of Technical Guides concerning the use of LAS files in the TNT products are posted on MicroImages' web site.



A natural color orthoimage of the area covered by the sample LiDAR points.





The dashed lines that extend from the edges of the elastic rectangle are used for rotating the rectangle. The dashed line in the middle extends in the direction of the profile view.

TIN Object Display and DataTips

This exercise introduces the TIN (Triangulated Irregular Network) object. TIN objects consist of a network of *triangles* formed from a set of x,y,z coordinate *nodes* in 3D space connected by *edge* (line) segments. TIN objects provide benefits of speed and efficiency for processes that deal with 3D surfaces.

The TINGROUP object has three layers: USGS_DEM, RIGHTLITE, and TINLITE. USGS_DEM was extracted from a full-quadrangle elevation raster. RIGHTLITE is a reduced section of an airphoto. TINLITE was extracted from a stereo pair of airphotos in the Photogrammetric Modeling process and represents the derived elevation surface.

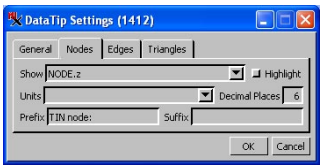
TINGROUP is defined so that a DataTip shows values from two of the three layers in the group. Compare the DataTip you see when your cursor pauses over the image with the DataTip definitions for each layer (select Setup DataTips from each layer's right-button menu in the Legend or Display Manager).

A **TIN** object defines a 3D surface with a network of node, edge, and triangle elements.

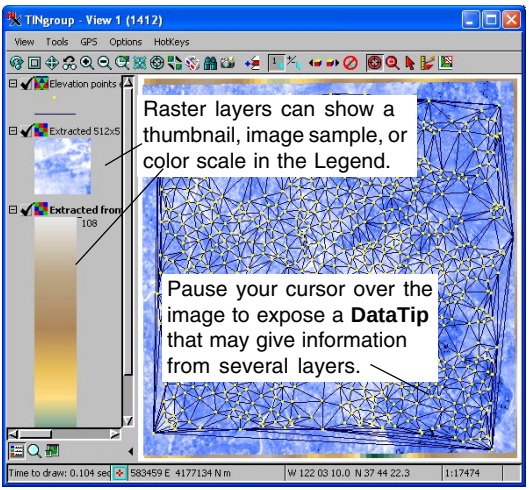
STEPS

- ☑ click the Open Display icon in the Manager 
- ☑ select the the TINGROUP object from the SF_DATA data collection and the TINLITE Project File
- ☑ select the View window's Options / DataTips menu cascade and turn on the Maximum toggle
- ☑ pause your cursor over a TIN node to expose a DataTip
- ☑ select Setup DataTips from the right-button menu for a layer in the Legend
- ☑ choose Display/Close

A **DEM** (Digital Elevation Model) is a raster object with cells that contain elevation values for a surface.



Define a DataTip by selecting a data attribute, prefix, and suffix for each layer.



For information on the 3D display of TINs, see the tutorial booklet *3D Perspective Visualization*. To see how TINs are used in Stereo-to-DEM and surface modeling, see the booklets, *Making DEMs and Orthophotos* and *Surface Modeling*.

Multi-Layer Display

One of the most powerful visualization features of TNT is the way it so easily integrates geospatial data objects of all types and map projections.

STEPS

- ☑ in the Manager window, click Add Objects and select the first four objects listed
- ☑ click on Add Database Table Pinmap and select the CRIME table listed
- ☑ click on parcel Layer Controls icon in the Manager window and adjust its polygon display controls (change the Style: to ASSIGNED_STYLES)

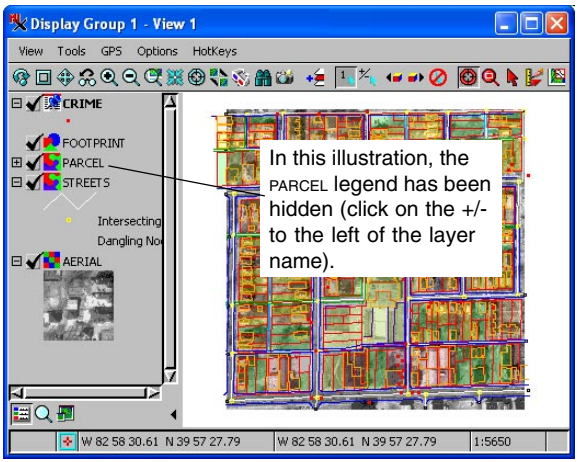
Several multi-object **layout objects** are included with the TNTmips Free sample data. Click Open Display in the Manager and browse through the LAYOUTS Project Files in /BEREA, /BLACKBRN, /CB_DATA, and /SF_DATA.

This exercise builds a complex display from raster, vector, CAD, and database objects. Add these layers to a new group:

Raster:	BLACKBRN / AERIAL
Vector:	BLACKBRN / STREETS
Vector:	BLACKBRN / PARCEL
CAD:	BLACKBRN / FOOTPRINT
Database:	BLACKBRN / CRIME

When you select multiple objects for display, be sure each one is registered to some spatial coordinate reference system, as they are in this sample data. TNT automatically reconciles different map projections and coordinate systems, but if one object has no map registration, then you will get unpredictable display results. (To add map registration to an object that has none, refer to the *Georeferencing* tutorial.) You receive a warning message if you try to mix georeferenced and nongeoreferenced objects in the same display group.

Objects must also share a reasonable spatial proximity. A raster in Texas and a vector in Japan may be selected together, but a full display would zoom out so far that the objects would be too small to see.



The transparency effect for the polygons in the PARCEL layer is achieved in the Polygons tab of the Vector Layer Controls dialog. Set Style to ASSIGNED_STYLES (the predefined styles for these polygons specify 90% transparency in this style assignment table), and select one of the Enable options in the Polygon Filling option button.

Web Layers: KML and My Maps*

My Maps layers are KML layers hosted by Google Maps. Google Maps lets you create a My Maps layer from directions you get, locations you find, or points, lines, or areas you draw. In order to save a My Maps layer, you need to have a Gmail email address.

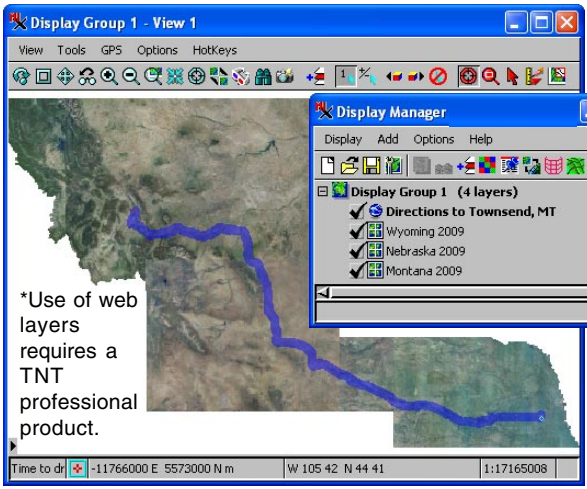
Google Earth also provides sketching tools and lets you save your drawing as a KML or KMZ file. Either of these can be used directly in the TNT products. You can add a placemark (point), polygon, or path (line) and it is automatically remembered and re-loaded as a My Places layer. To use it in the TNT products, you need to choose File/Save/Save Place As. You can also choose to save any layer that appears in your My Places list as a KML or KMZ file.

MicroImages provides sample data in both My Maps and KML format. If you do not have and do not want to set up a Gmail account, you can use MicroImages' sample My Maps layers with the email address sample.mymaps@gmail.com and password samplemymaps. The path shown in the illustration below is one of these samples. A path generally needs a background image to make it relevant. The background images for the illustration are discussed in the next exercise.

STEPS

- ☑ go to http://maps.google.com
- ☑ click on Get Directions
- ☑ enter two locations of interest to you
- ☑ click on Get Directions
- ☑ scroll to the bottom of the directions
- ☑ click on Save to My Maps
- ☑ enter your Gmail email address and password
- ☑ choose Create a new map and click on Save
- ☑ you can then click on Edit and change the name of the map, add a description, and choose whether you want it to be unlisted rather than public
- ☑ open the Display process, click on  the Add Web Layer icon
- ☑ click on the My Maps folder and carefully enter your authentication (Gmail address and password)
- ☑ select the map you made above and click OK

Keep this display open for the next exercise.



*Use of web layers requires a TNT professional product.

Directions from Lincoln, Nebraska to Townsend, Montana generated by Google Maps were saved as a My Maps kml file and displayed in TNTmips together with Internet tilesets for the states the path crosses.

Web Layers: Tilesets and Preview*

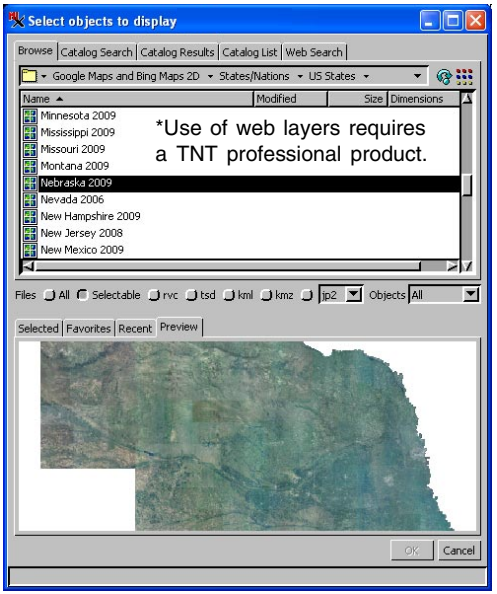
STEPS

- ☑ with your My Maps layer still in the Display, click on the Add Web Layer icon 
- ☑ click on the Micro-Images' Sample Tilesets folder, then on the Google Maps and Bing Maps folder and highlight the name of a tileset after you choose from the category that would provide an appropriate background for your My Maps layer (in the States/Nations folder within the USA and in the Global folder or Public TIlesets folder for all other countries)
- ☑ click on the Preview tab to view it before selecting it
- ☑ click on the tileset icon to add it to the selected layers, then click [OK]

A tileset is a collection of small image files, called tiles, in a predefined file size, format, and directory structure. It is designed for efficient viewing of very large images or maps over the Internet. Google Maps, Bing Maps, Google Earth, and World Wind have each defined their own tileset structure.

MicroImages has posted tilesets for each state in the USA, most with 1-meter resolution collected as recently as 2009, and global data with a variety of resolutions from 500-meter to 10-meter resolution. The imagery for a few cities is also posted with the highest resolution of four inches.

When you navigate to MicroImages' Sample Tilesets, you will find that the majority of the tilesets are in a tileset structure that can be used by both Google Maps and Bing Maps. These and the other tileset structures can also be used directly in the TNT products provided there is an associated tileset description file (*.tsd) that provides information about the structure of the file and location of the tiles.



You can preview any layer that is highlighted in the list in the Browse panel whether it is local (on your computer or intranet) or remote (located on the Intranet). Click once on the tileset name to highlight it for previewing without selecting it.

The statewide coverages available as MicroImages' Sample Tilesets were assembled from the imagery collected annually by the USDA as a joint project of the FSA (Farm Services Administration), NRCS (Natural Resources Conservation Service) and RD (Rural Development). For more information on these tilesets see http://www.microimages.com/geodata/us-orthophotos/index.htm.

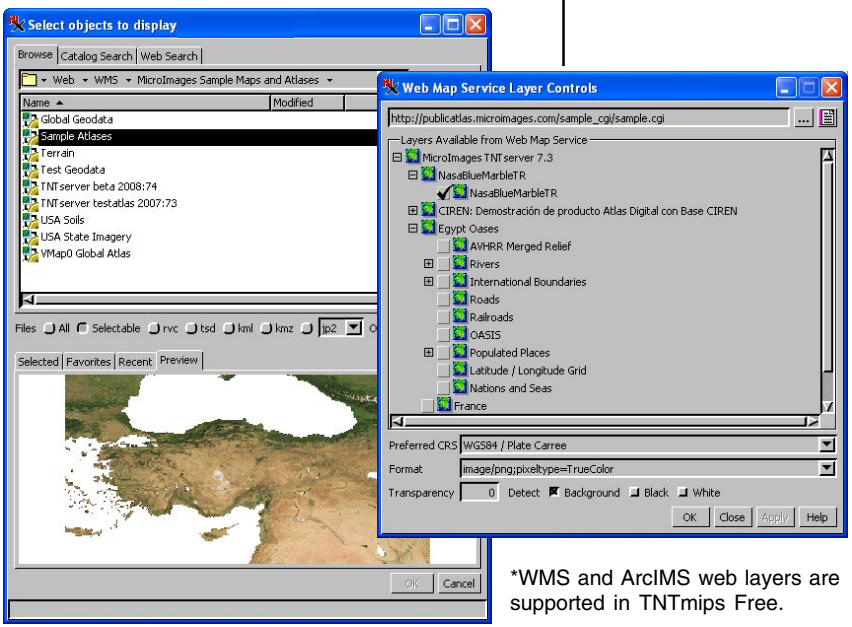
Web Layers: WMS and ArcIMS*

MicroImages has compiled catalogs of known WMS and ArcIMS services. When you elect to add either of these types of web layer, you can select a service from the catalog or search the web for services by using entered text, by place name (using the GeoNames or Google Maps place database), or by geographic extents (see the Technical Guide entitled *Spatial Display: Searching MicroImages' Catalog of WMS Layers*).

When you choose more than one WMS or ArcIMS service or choose them in combination with other layer types, the first layer offered by each service is selected for display, which can be changed by opening the Layer Controls. When you choose only a single service, the corresponding Layer Controls window automatically opens so you can choose which layer(s) to display. The first layer offered by the service is the one shown in the Preview panel.

STEPS

- ☑ in a new 2D Display, click on the Add Web Layer icon 
- ☑ click on the WMS folder, then MicroImages Sample Maps and Atlases, and Sample Atlases
- ☑ click on Apply
- ☑ choose New 2D Display and switch to web layer selection (click on leftmost arrow head in the address bar of the Select Objects window)
- ☑ click on the Web Search tab and enter some text relevant to a WMS layer you would like to select



*WMS and ArcIMS web layers are supported in TNTmips Free.

Integrated Layer Selection*

STEPS

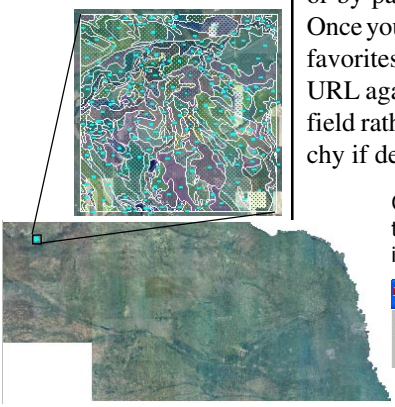
- ☑ click on New, and select 2D Display
- ☑ click on the arrow to the right of the Up One Level icon, choose Web, and note that you now have the same set of choices you had after clicking on the Add Web Layers icon in the previous exercises
- ☑ choose MicroImages' Sample Tilesets/Google Maps and Bing Maps/States/Nations/US States and select Nebraska 2009
- ☑ click on the same icon as in step 2 but choose Computer, navigate to your cb_data directory and choose CB_SOILS.RVC/CBSOILS_LITE
- ☑ click [OK]
- ☑ right-click on CBSOILS_LITE in the Display Manager or the View legend and choose Zoom to Extents

*Use of web layers requires a TNT professional product.

The TNT products offer integrated selection of local (your computer or intranet) and remote (Web [Internet-based]) layers with the ability to include multiple layers of both types in a single selection operation. You can switch between local and remote layers at any point in the selection process.

There are a number of ways to initiate the selection process (for example, from the New, Add Objects, and Add Web Layers icons in the Display Manager). Whether selection defaults to local or web layer selection is determined by how selection is initiated. In any case, it only takes a simple menu selection within the Select Objects window to switch between the two. There are two places recent selections can be reviewed and selected: from the rightmost arrow in the field that shows the path and on the Recent panel at the bottom of the Select Objects window. The former shows locations from which layers were selected and the latter shows the layers selected. Both include recent remote and local locations.

You can also select geodata layers of interest to you located on the Internet by clicking to the right of any entries in the field that shows the path and entering its URL. The URL may be entered by direct typing or by pasting the URL copied from your browser. Once you have entered a URL, it can be added to your favorites if desired so you do not need to enter the URL again. You can also type a local path into this field rather than navigating your computer's hierarchy if desired.



Click on this icon to enter a URL or local path to select from, which you then type or paste into the field at the left.

Recent arrow

Rendering to Various Formats

TNTmips supports rendering of all the layers in any display to a raster in Project File format, GeoJP2, GeoTiff, and PNG (also JP2, JPEG, and TIFF). Rendering to KML, SVG, PDF, and tilesets is also supported. Rendering to tilesets is not supported in TNTmips Free and rendered raster size is limited to the TNTmips Free size limit of 314,368 total cells with a maximum of 1024 cells in either dimension.

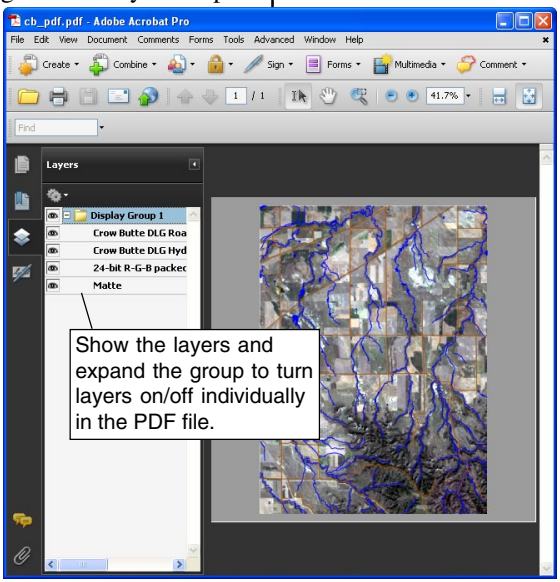
Some of the formats rendered can be directly used in the TNT products (GeoJP2, JP2, GeoTIFF, TIFF, PNG, JPEG, and KML) while others require other viewers (SVG and PDF). The Render to Raster and Render to Tileset options render the full extents of the object(s) in the active View to a raster in the specified format. The Render to KML, SVG, and PDF options let you choose between rendering the full extents or matching the extents shown in one of your open View windows.

Geometric layers in your open Views are rendered to the single raster produced when rendering to raster. When rendering to SVG, all geometric layers are part of the SVG file and any raster layers in the view are saved in JPEG or PNG format. The same is true when rendring to KML, however, the KMZ format option packages them all in a single file. You retain the ability to turn individual layers on and off when viewing your rendered PDF output in Acrobat Reader if you have the Include Layer Controls option on when rendering.

STEPS

- ☑ click on New, and select 2D Display
- ☑ choose one of the composite color rasters from the CB_COMP Project File and the HYDROLOGY and ROADS layers from the CB_DLG Project File
- ☑ choose Display/Render to/PDF
- ☑ check to see that the Include Layer Controls toggle is on
- ☑ accept the other defaults or change them as desired, then click [OK]

PDF files can be viewed in your browser or in the free Adobe Reader you can download from www.adobe.com.



Quick Snapshots

STEPS

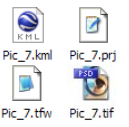
- ☑ zoom in on an area of interest in the View from the previous exercise
- ☑ click on the Quick Snapshot icon in the View window 
- ☑ make the desired choices in the Quick Snapshot Settings window if this is your first Quick Snapshot
- ☑ review your settings by choosing Options/View Options* in the Display Manager if this is not your first snapshot
- ☑ click on New, choose 2D Display, and select your newly created snapshot (all external formats listed are supported for direct display) 
- ☑ zoom out in the View you created a snapshot of and in the View with the snapshot raster

* If you forget where your snapshots are being saved or want to change other parameters, you can open this window at any time.

You can create a new raster in your choice of formats that captures the canvas area of any View window by clicking on its Quick Snapshot icon. Your preferences for the format of this raster, whether to save georeference information in auxiliary files, and where to save the raster can all be specified on the Snapshot panel of the Options window opened from the Display Manager (Options/View Options). If you have not set up these parameters prior to clicking on the Quick Snapshot icon for the first time, a Quick Snapshot Settings window will open that provides the same choices found on the Snapshot panel of the Options window.

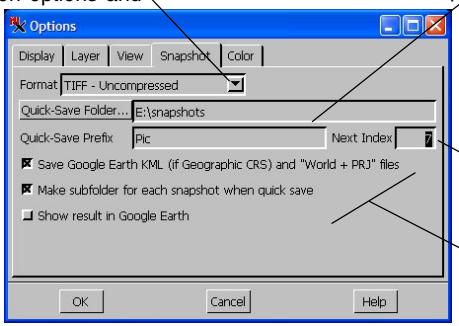
The options you set are used when you click on the Quick Snapshot icon so that no further input is needed from you. If you want to alter the saved location or the automatic name for an individual snapshot, choose View/Save Snapshot As in the View window you want to take a snapshot of. You need to revisit the Snapshot panel of the Options window to change other parameters.

A snapshot is a raster with a one-to-one correspondence between its cells and the display pixels on your View canvas. If background area is showing in your view, it will be captured as part of the snapshot.



You get these four files when you click on the Quick Snapshot icon with the options shown below.

Choose between a variety of compression options and formats including internal (RVC) and external (GeoJP2, JP2, GeoTIFF, TIFF, JPEG, and PNG) format files.



With the parameters shown, the next snapshot saved by clicking on the Quick Snapshot icon would be E:\snapshots\Pic7.tif.

This number increments automatically as quick snapshots are saved to the designated folder.

These options are not active if saving to internal format (RVC).

Layer and Detail Visibility

You can choose whether to devote some of your viewing area to provide a legend for the layers in that View. A part of the Legend area may be utilized for the Locator, which lets you reposition and zoom your view by moving and/or resizing the rectangle that represents the area currently in the view, and the Magnifier, which provides a zoomed view of the area around the cursor.

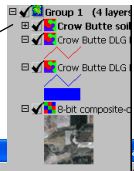
You decide how detailed you want your Legend to be using the expand/collapse icon to reveal or hide details about each layer. There are also right mouse button menu options at the display level (group or layout) to expand or collapse all layers in the Legend. When collapsed, only the layer names are shown in the legend.

The default layer name is determined by a View Options setting (see page 40) on the Layer tabbed panel. Your choices are Object Description, Object Name, and File and Object Name. You can also right-click on the layer name in either the Display Manager or Legend and choose Rename. Your newly entered layer name is remembered when the group or layout is saved.

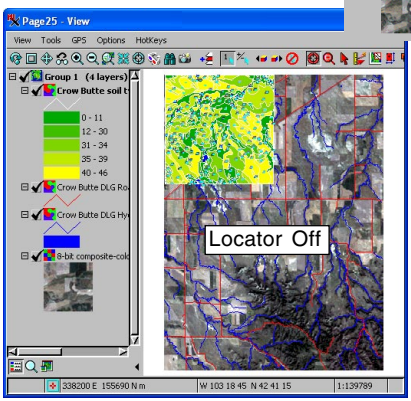
STEPS

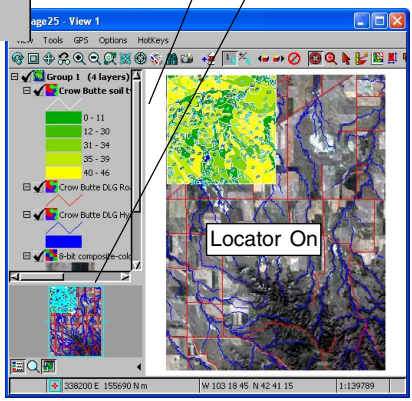
- ☑ open the layout CB_DATA / LAYOUTS / PAGE25 
- ☑ right-click on the checkbox for a vector layer in the Legend and turn off the Show Locator icon 
- ☑ drag the separator between the Legend and view canvas
- ☑ drag the separator between the Legend and Locator
- ☑ click the expand/collapse box for the soil layer to hide its legend 
- ☑ turn off the Show Legend toggle on the Options menu in the View window or use the Show Legend icon 

Legend for the Crow Butte soils vector layer has been collapsed.



Adjust the width of the Legend and the height of the Locator by dragging the separator between the panels.





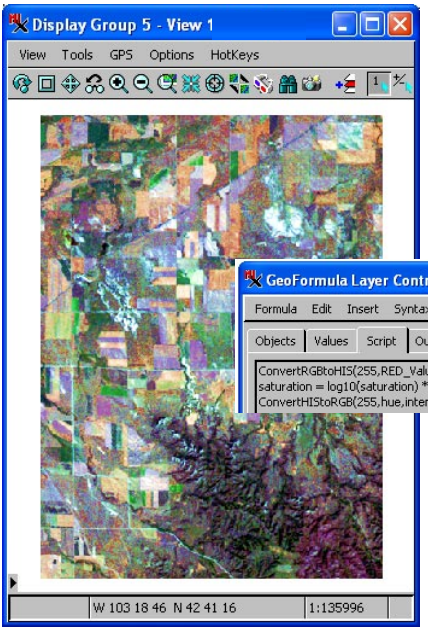
GeoFormula Layers

STEPS

- ☑ Select New / Empty 2D in the Manager
- ☑ select Add / Layer / GeoFormula / Add GeoFormula Layer in the Manager window
- ☑ select Formula / Open in the GeoFormula Layer Controls dialog
- ☑ use the standard Select File process to select GEOFRMLA / STRETCH2.GSF
- ☑ in the Select Objects dialog, select RED, GREEN, and BLUE from CB_DATA/ CB_TM
- ☑ click [OK] to close the GeoFormula Layer Controls dialog

A GeoFormula is a computed display layer that uses one or more input objects to derive a layer for display. It gives you a way to combine objects "on the fly" rather than preparing objects for display ahead of time with preliminary processing. A GeoFormula is a dynamic display layer that contains a "virtual object." The GeoFormula layer does not create an output object that is saved in a Project File. Instead, it creates a display layer that releases all its system resources (such as disk space and memory) when you are finished with it.

In the exercise on page 12, you used three raster objects for component color from CB_DATA / CB_TM. Here you will use the components that would create a natural color display if chosen as an RGB set. The GeoFormula creates another false-color image. If you are familiar with a programming language, such as C or BASIC, you should get a sense of how a GeoFormula works by examining the script illustrated below.



This GeoFormula applies a color transformation to increase color saturation. It translates the RGB components to Hue-Intensity-Saturation (HIS) equivalents and applies a saturation stretch.

Creating and applying GeoFormulas is an advanced skill in TNT. Begin by working through the tutorial booklets *Writing Scripts with SML* and *Using Geospatial Formulas*.

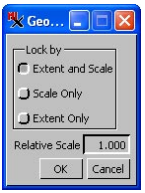
Multiple Views with GeoLocking

The GeoLock feature links the position and scale between multiple View windows so that scroll and zoom actions applied to one view automatically adjust the linked views. You can optionally turn off GeoLocking in one or more Views in order to adjust viewpoint and zoom levels independently. A tracking cursor echoes the position of your mouse cursor in all View windows that share some geospatial extents.

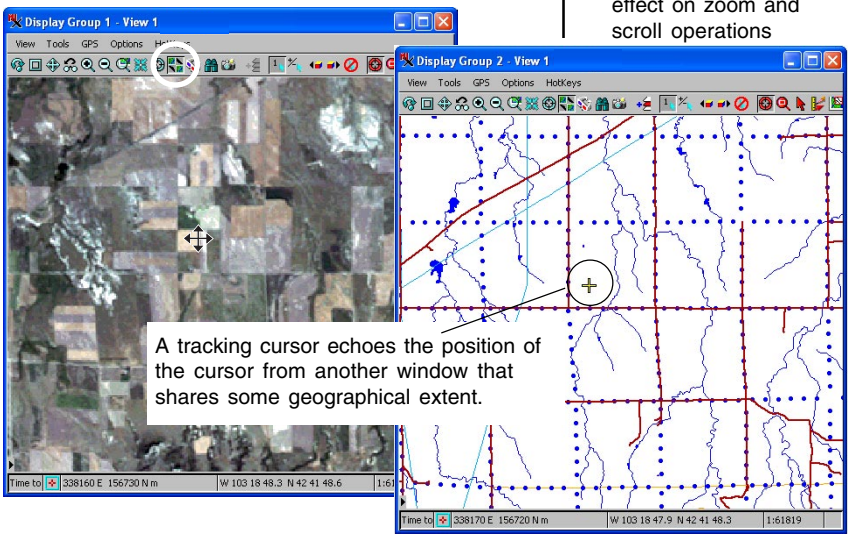
In this exercise you will view the GeoLock tool at work in two views of data from the cb_data collection. In this geodata, which has been prepared to work in the size limits of TNTmips Free, you can see how the GeoLock feature works. But the real value of using GeoLock with multiple views comes when you are using large-extent project materials in the professional versions of the TNT products. If one view contains a mosaic of several thousand airphotos and another view contains an array of scanned topographic maps of the same region, finding the same location in both views would be tedious without the GeoLock feature.

STEPS

- ☑ create a New / 2D Display and select CB_DATA / CB_COMP / _8_BIT
- ☑ create another New / 2D Display and select all the objects in CB_DATA / CB_DLG
- ☑ verify that the GeoLock feature is on in both Views
- ☑ apply zoom and scroll operations and observe the linked view behavior
- ☑ choose Options/ GeoLock Settings in one of the View windows and examine the choices



- ☑ turn off the GeoLock feature and observe the effect on zoom and scroll operations



View-in-View

STEPS

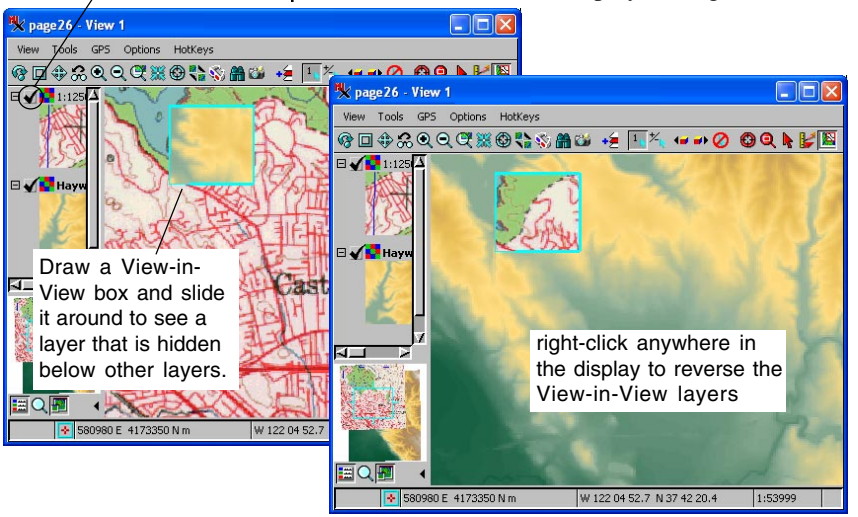
- ☑ open the group SF_DATA / LAYOUTS / PAGE26
- ☑ select the View-in-View tool in the View window
- ☑ notice that when the View-in-View tool is active, an additional choice appears on the visibility checkbox right button menu
- ☑ draw a View-in-View box on the image
- ☑ slide the box to a different place and use the elastic box resizing tools
- ☑ right-click anywhere on the image to reverse the inside/outside View-in-View rendering

When your display group contains several layers, the layers on top may sometimes completely hide the layers below. The View-in-View tool provides one way to hide one or more top layers in order to show the hidden layers. In a complex, multi-layer view, you can use the Show / Hide checkbox for each layer to select the layers you want the tool to expose. The View-in-View tool displays the "show" layers inside the box, and the original view elsewhere. The View-in-View tool gives you an excellent visualization method for comparing multiple layers of geodata.

The View-in-View tool is an elastic box that you can resize or move around as you compare different areas of the layers.

When you choose the View-in-View tool, the top layer is automatically turned off inside the View-in-View elastic box. You can toggle layers on and off inside and outside the View-in-View rectangle using the visibility checkbox in either the Legend of the View window or in the Display Manager. When a layer is toggled off in any open view, its check mark is dimmed in the Display Manager.

Right-click on the visibility checkbox to toggle on/off layers in a specific view.



Zooming with Hotkeys

The display process provides a set of keyboard shortcuts, or hotkeys, for quick display manipulations. These hotkeys apply center, zoom, and pan operations at the location of the mouse cursor.

For example, to zoom in on a feature, you could select the Zoom Box tool (see page 8), and draw a zoom box around the feature. But with the hotkey alternative, you simply move the mouse cursor to the feature and press the "+" key on the keyboard.

The hotkeys all center the view at the mouse cursor:

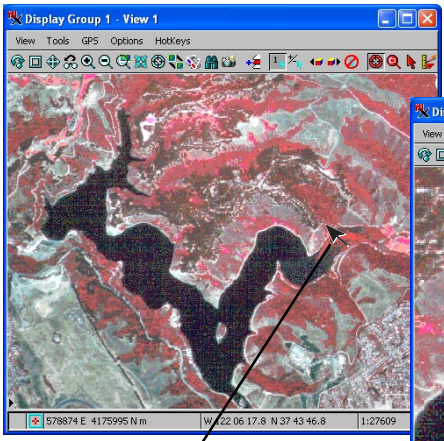
+	zoom in
-	zoom out
0	full view
1, 2, 3, 4	zoom 1X, 2X, 3X, 4X
spacebar	recenter (pan) at current zoom

If you have a complex layout with multiple rasters at different resolutions, you can indicate which one to use for the numeric hotkeys in the Raster Layer Controls by turning on the *Preferred for 1X zoom* toggle on the Options panel. That raster is then used so that one cell corresponds to one screen pixel at 1X, to two by two screen pixels at 2X, and so on.

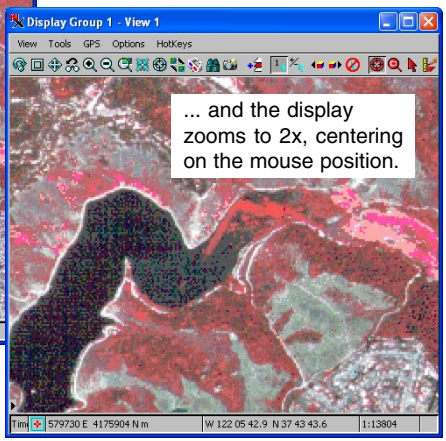
STEPS

- ☑ open a new 2D view with SF_DATA / AIRPHOTO / CIR146A
- ☑ position the mouse on a feature of interest and press the + hotkey
- ☑ position the mouse in the corner of the view and press the - hotkey
- ☑ experiment with the 0, 1, 2, 3, and 4 hotkeys
- ☑ recenter the view several times at the current zoom with the spacebar hotkey

The numeric hotkeys work at a set zoom level for raster layers. For example, from any other zoom factor, the 4 hotkey jumps to a 4X zoom level. But if the view is already at a 4X zoom, the 4 hotkey has the same effect as the spacebar hotkey—it recenters the view at the cursor position without changing the zoom level. If there are no raster layers in your view, 2, 3, and 4 continue to zoom in when used multiple times.



Position the mouse cursor at the east end of the lake and press the 2 hotkey ...



Complex Display Layouts

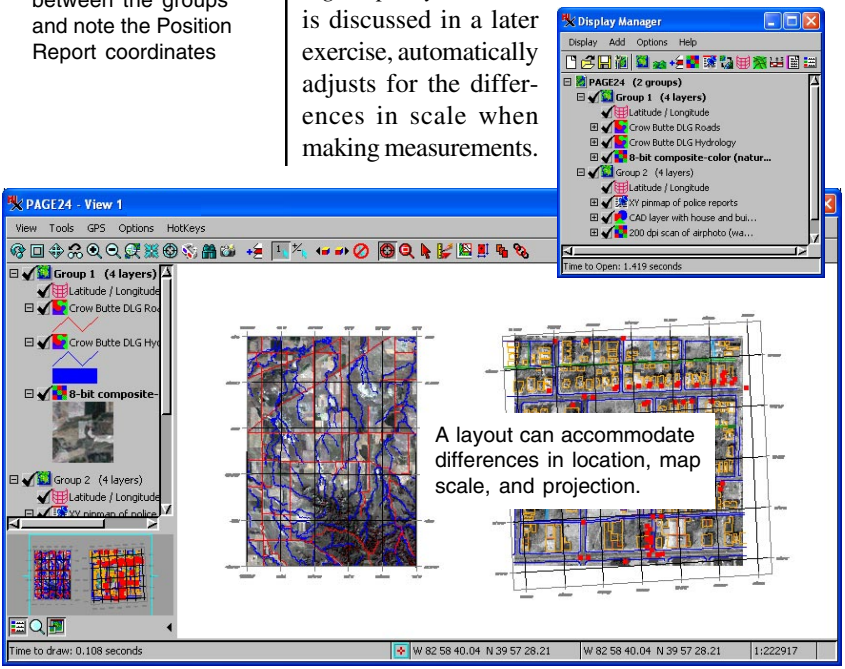
Vocabulary: A **group** can contain many layers with associated map grids and be presented in many View windows. A **layout** can contain multiple groups as well as legends, annotations, scale bars, and other complex layout elements.

STEPS

- ☑ click on Open Display in the Manager 
- ☑ select the BLACKBRN data collection, the LAYOUTS Project File, and the PAGE24 layout
- ☑ select Expand All Layers from the right-button menu of Group 1 in the Manager
- ☑ move the cursor between the groups and note the Position Report coordinates

The exercise on page 31 introduced the ability to use multiple, geolocked View windows for separate groups. You can also open multiple views of the same group and show different layers or locations in each. Another level of visualization complexity is offered by the layout feature. The Display / New / Display Layout and the Display / New / Page Layout menu choices let you combine multiple objects and groups in views of higher complexity.

A sample Display Layout with two groups has been prepared for this exercise. The layers in these two groups have sufficient geographic separation that they would not create a reasonable display if added to the same group. Also note that although these two groups are approximately the same size in the View, they represent very different ground areas. This effect is achieved by altering the relative zoom of one of the groups, which is described in the *Making Map Layouts* tutorial. The GeoToolbox, which is discussed in a later exercise, automatically adjusts for the differences in scale when making measurements.



Save Groups and Layouts

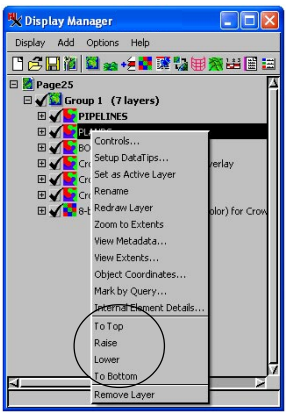
If you use the Display process to view the same spatial data many times during the life of a project, you should take advantage of saved groups and layouts. Layout and group definitions can be saved as objects in Project Files. They contain a record of all your layers, objects, and display options, so that you can return quickly to a complex view rather than adding each component, object by object, every time you want to view the materials. When objects are selected for a new group, the last used display parameters are used, such as color map, contrast table, geometric drawing style, and so on. These parameters are stored with your saved group or layout, which will appear the same as it did when saved even if these parameters for individual layers have been changed subsequently.

In addition to changing layer order using right button menu choices, you can drag layers to new positions with the left mouse button held down over the layer name. Layers can be repositioned by dragging in either the View window Legend or the Display Manager.

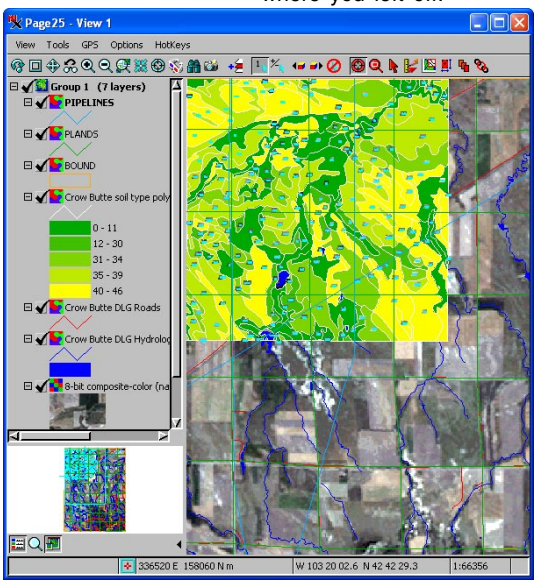
STEPS

- ☑ select Open Display in the Manager
- ☑ choose CB_DATA / LAYOUTS / PAGE25
- ☑ click Add Objects in the Manager and add BOUND, PLANDS, and PIPELINES from the CB_DLG Project File
- ☑ adjust the scale, layer order, styles, and other view controls
- ☑ select Display / Save As in the Manager and save your layout with a new name
- ☑ open your newly saved layout and the original to view the changes

Note that zoom level and position are retained with a saved layout. If you are working your way around a large image at 1X, you can save then later pick up where you left off.



A layer's right-mouse button menu lets you move it up or down in the drawing order.



Measuring with the GeoToolbox

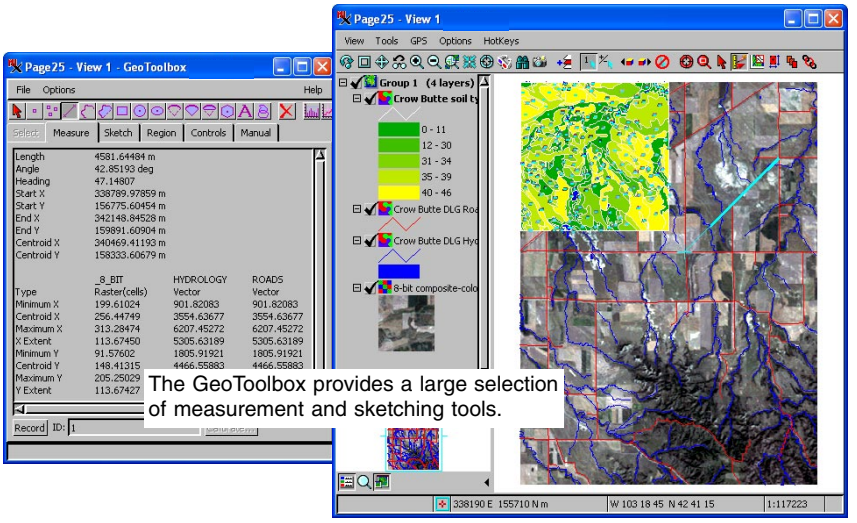
STEPS

- ☑ using the original CB_DATA / LAYOUTS / PAGE25 layout, select the GeoToobox in the View window
- ☑ click the Measure tab in the GeoToolbox window and select the Ruler tool
- ☑ draw an elastic measurement line on the image
- ☑ slide the line to a different place and use line resizing techniques to change its length
- ☑ inspect the measurement statistics in the Measure panel
- ☑ change the length units in the Measurement Units dialog that opens with the Options / Measure / Units menu cascade

This lesson introduces a powerful and richly featured tool in the display process: the GeoToolbox. For a much more complete survey of the tools in the GeoToolbox, refer to the companion tutorial booklet *Sketching and Measuring*.

The GeoToolbox window offers a row of tools and related tabbed panels. The measurement tools let you draw lines and shapes of all kinds and report a complete set of statistics for each measurement.

The simple, elastic measurement line you draw in the View window can be resized and dragged to a new position. The cursor shape indicates what will happen when you click and drag: the pointing hand repositions the segment as a whole, the crosshair repositions the closest end, and the left arrow draws a new line segment. Each time you manipulate the measurement line, the statistics in the Measure panel update. You can change the measurement units from the Measurement Units dialog by choosing Options / Measure / Units in the GeoToolbox window. You can record the measurement statistics to a text file by selecting File / Measurement Record in the GeoToolbox.



The GeoToolbox provides a large selection of measurement and sketching tools.

Selecting Elements with Regions

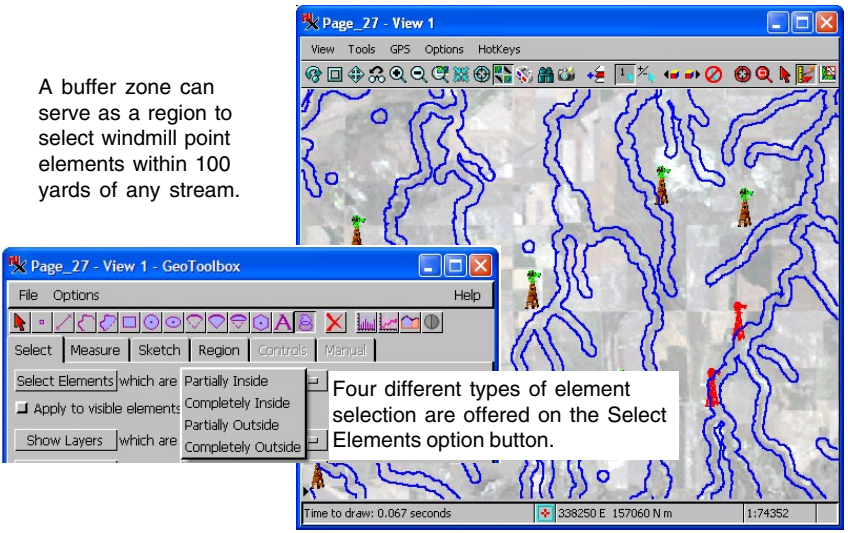
Region objects are composed of polygons and are used primarily for element selection operations. Region objects may also contain points and lines for storage and measurement purposes. Your regions may represent features like property boundaries, watersheds, or land use polygons. You can use regions to select point, line, or polygon elements that lie completely inside, completely outside, partially inside, or partially outside the active region (the region highlighted on the Region panel).

In this exercise, a region is used to find all windmills within 100 yards of any stream. The region object is a 100-yard buffer zone created around the Crow Butte hydrology. Buffer zone regions can be created directly in the Display process or using the separate Geometric/Compute/Buffer Zones process, which provides more options and allows other types of geometric output. This buffer zone is applied in an element selection operation on the WELLS object from CB_WELLS, which contains point elements. Since point elements have a location but no length or area, there is no possibility of a point element being partially inside or outside a selection region.

STEPS

- ☑ click on Open Display in the Display Manager and select CB_DATA / LAYOUTS / PAGE_27
- ☑ expand the vector layer in the Manager and click on the Enable/ Disable for Marking icon
- ☑ select the GeoToolbox, and click the Add button on the Region panel
- ☑ select the CB_WELLS / HYDROBUFFER region object
- ☑ select the Region tool in the GeoToolbox
- ☑ choose the Select tab in the GeoToolbox, and click Select Elements
- ☑ change the "which are" option button to Completely Outside and click Select Elements again

A buffer zone can serve as a region to select windmill point elements within 100 yards of any stream.



Printing Layouts and Snapshots

STEPS

- ☑ open BLACKBRN / LAYOUTS / PARKING and zoom up on part of the raster area
- ☑ select Display / Print in the Display Manager
- ☑ check your printing parameters and click on the Print button
- ☑ select View / Print Snapshot in the View window, and click on the Print button
- ☑ compare the two prints
- ☑ choose Display / Close in the Display Manager

When printing a snapshot, the extents of the layers shown on the canvas are enlarged or reduced to fill the printable area of the page for the printer you have selected.

To use the advanced composition and layout tools with the intention of printing, select Page Layout from the Manager's New icon menu. The Page Layout window offers the same tools and features as the Display Layout process (refer to pages 34–35). You can add map grids, scale bars, and annotations for color printers of any size and resolution.

For quick and simple printing tasks, you can use the Print Snapshot option on the View window's View menu. This option prints the current View contents scaled to fit your printer page. Of course printing screen shots limits your output to screen resolution and the current view canvas contents, but in some circumstances, that may be all you want. Printing a page layout creates a print over one or more pages at the map scale indicated on the Layout panel of the Group Settings window.

For more information on printing and layouts, see the tutorial booklets *Printing* and *Making Map Layouts*. For information on saving snapshots, see the exercise on page 28.

Using Styles

Point, line, and polygon elements can be rendered in a wide variety of drawing styles. In several previous exercises you have applied predefined styles to the vector and CAD objects you have displayed. In this exercise you will examine the selection of line styles associated with the RoadsandStreams CAD object in the millngtn Project File.

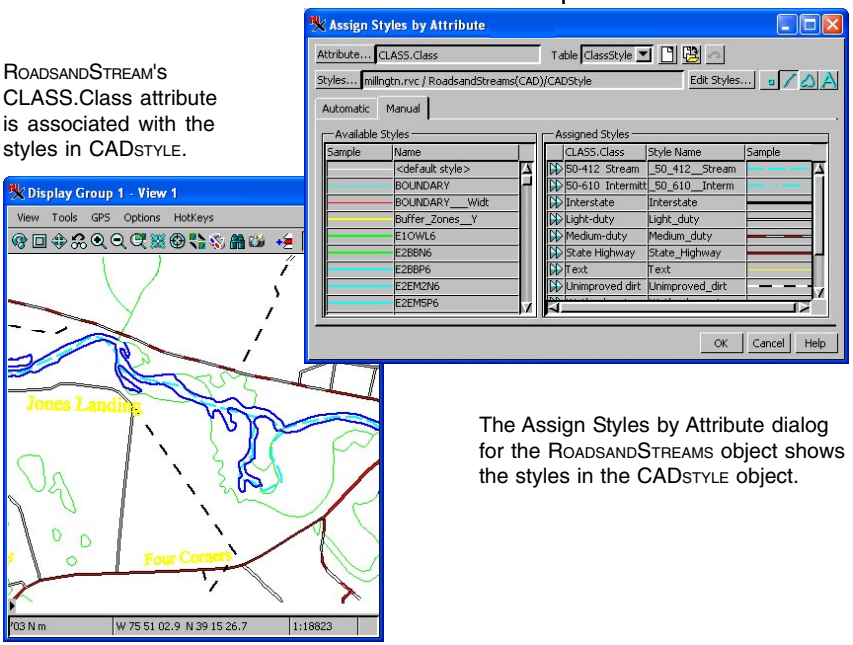
Style objects are independent from particular geodata objects, so one style object can be used by many different geodata objects. Using the same styles for many objects helps you standardize your symbology and ensure that all your project materials follow the same style rules.

Styles can be automatically selected according to the attributes of each geospatial element. At the simplest level that means "roads" will have a different drawing style than "rivers." But even more useful is the kind of differentiation between classes of roads and classes of rivers, as illustrated.

STEPS

- ☑ click Add Objects and select MAPLO / MILLNGTN / RoadsandStreams
- ☑ click the object icon in the Manager or Legend list to open the CAD Layer Controls
- ☑ select the Elements tab
- ☑ click the Specify button for Style
- ☑ click on the Line icon to the right of the Edit Styles button
- ☑ examine the Assign Styles by Attribute dialog (but do not make any changes)
- ☑ click [Cancel] to close the Assign Styles by Attribute dialog
- ☑ click [Cancel] to close the CAD Layer Controls dialog

RoadsandStream's CLASS.Class attribute is associated with the styles in CADStyle.



The Assign Styles by Attribute dialog for the RoadsandStreams object shows the styles in the CADStyle object.

Select Display Options

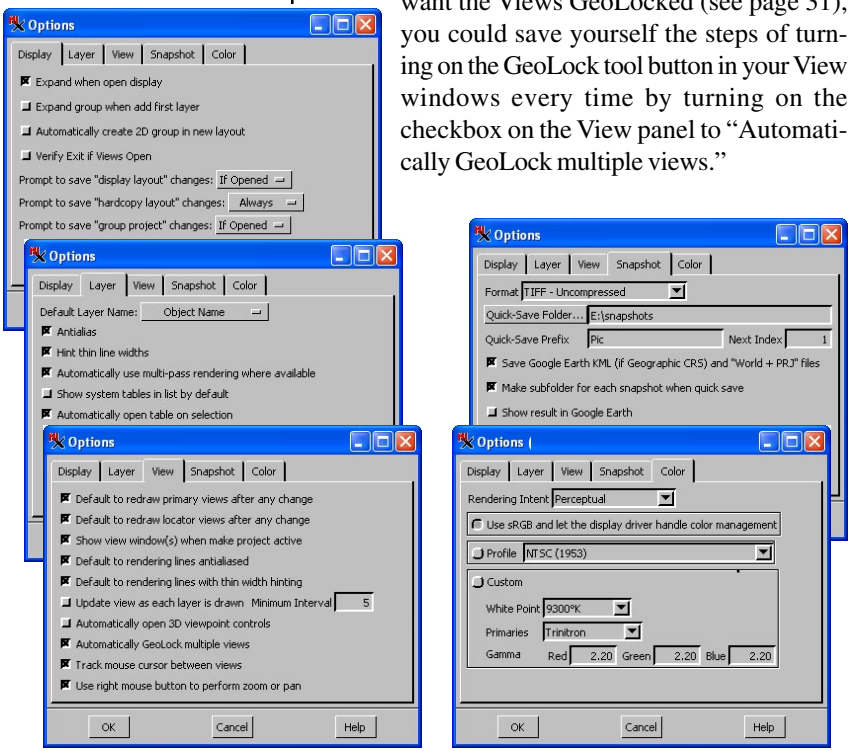
STEPS

- ☑ select Options / View Options in the Display Manager
- ☑ explore the tabbed panels for default program behaviors and alternatives
- ☑ click [OK] to close the Options dialog

Tabbed panels in the Options dialog let you set many default behaviors for the display process.

The display process offers a number of control settings that let you customize the behavior of the process including default choices for layer names, under what circumstances to prompt for confirmation when exiting the process and your snapshot preferences. If you share a TNT installation with others in your department or if your TNT installation is controlled by a system administrator, some of the default behavior you experience may be different than what you see in this booklet.

TNT opens the Options dialog illustrated below when you select View Options from the Options menu in the Display Manager. The tabbed panels in this window let you specify different default behaviors for the process. For example, if you do a lot of work with multiple View windows and characteristically want the Views GeoLocked (see page 31), you could save yourself the steps of turning on the GeoLock tool button in your View windows every time by turning on the checkbox on the View panel to "Automatically GeoLock multiple views."



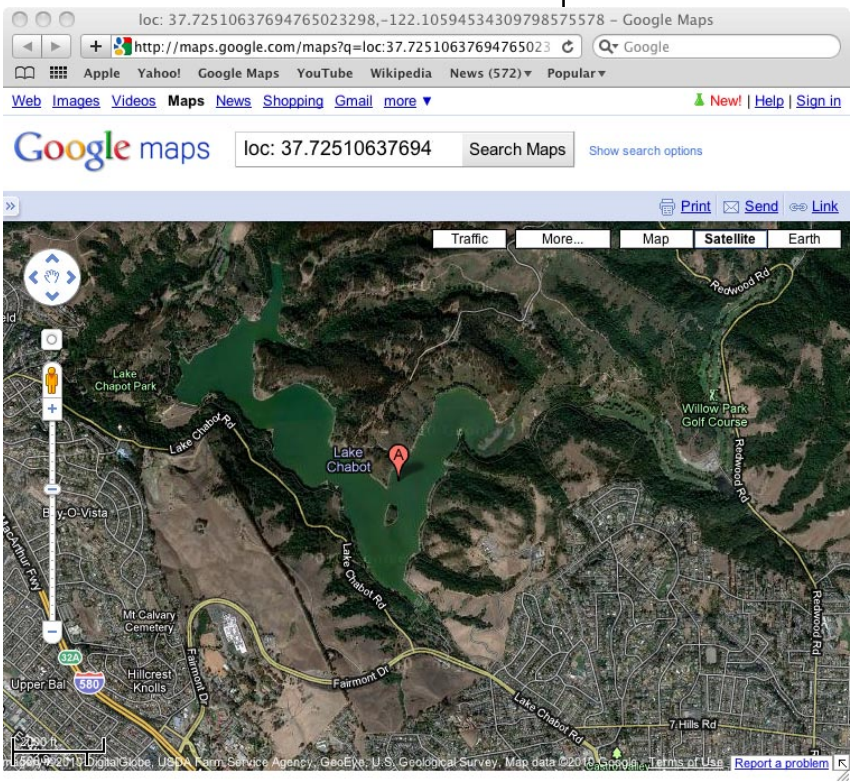
Launching Geoviewers to Match Extents

You can launch Google Maps, Bing Maps, or Google Earth with extents to match your current view from the Launch Geoviewer icon. When launching Google Earth, you have additional controls for showing the TNT view's centerpoint and an extents box as well as a box for the full group extents. The slider in the Google Earth Synchronization window determines the relative zoom between your TNT view and the Google Earth view of the same area. The TNT view centerpoint is also shown in Google Maps.

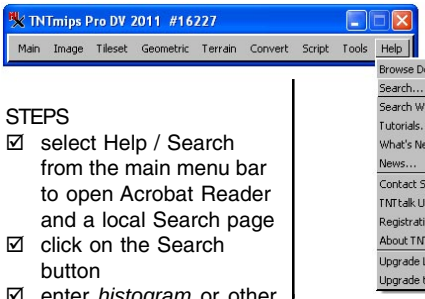
You need to install Google Earth to use that option. Opening a matching view in Google Maps and Bing Maps does not require any software installation (other than your browser).

STEPS

- ☑ open a new 2D group and choose a layer that you have used previously in this booklet
- ☑ click on the Launch Geoviewer icon in the View window and choose one of the three options



Online Reference Materials



The TNT products provide thousands of pages of reference materials. These materials include tutorial booklets, Quick Guides, and Technical Guides. You may have optionally installed the first two categories on your drive with your TNT product. All three categories and more can be found on MicroImages' web site. Install Acrobat Reader to view the documentation.

STEPS

- ☑ select Help / Search from the main menu bar to open Acrobat Reader and a local Search page
- ☑ click on the Search button
- ☑ enter *histogram* or other desired term for searching and click on the Search button in Acrobat

The reference-material-related Help menu choices have the following actions:

Browse Documentation: opens an installed html file that links to tutorials, Technical Guides, and Quick Guides from a topical list.

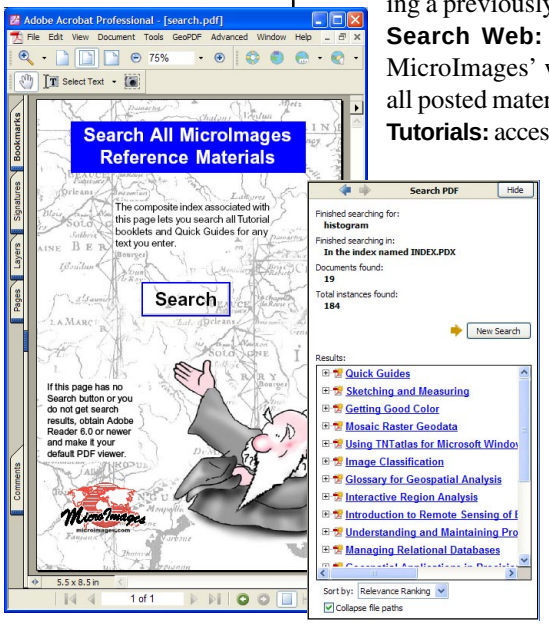
Search: opens the page shown below at the left to rapidly locate topics in the tutorials, Quick Guides, and Technical Guides installed on your drive using a previously prepared index.

Search Web: opens the search page at MicroImages' web site that lets you search all posted materials.

Tutorials: accesses a local tutorial index page and provides menus for selection of individual, locally installed tutorials.

What's New: opens an installed html page that lists the new features in the version of the TNT products you are running.

News: provides access to the News items at MicroImages' web site.



Search panel in Acrobat that automatically uses previously prepared index.

Notes

Advanced Software for Geospatial Analysis

MicroImages, Inc. publishes a complete line of professional software for advanced geospatial data visualization, analysis, and publishing. Contact us or visit our web site for detailed product information.

TNTmips Pro TNTmips is a professional system for fully integrated GIS, image analysis, CAD, TIN, desktop cartography, and geospatial database management.

TNTedit TNTedit provides interactive tools to create, georeference, and edit vector, image, CAD, TIN, and relational database project materials in a wide variety of formats.

TNTview TNTview has the same powerful display features as TNTmips and is perfect for those who do not need the technical processing and preparation features of TNTmips.

TNTatlas TNTatlas lets you publish and distribute your spatial project materials on CD-ROM at low cost. TNTatlas CDs can be used on any popular computing platform.

TNTmips Basic TNTmips Basic is a very low cost version of TNTmips for students and professionals with small projects with large object size limits than TNTmips Free.

TNTmips Free TNTmips Free is a free version of TNTmips for students and professionals with small projects. You can download TNTmips Free from MicroImages' web site.

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