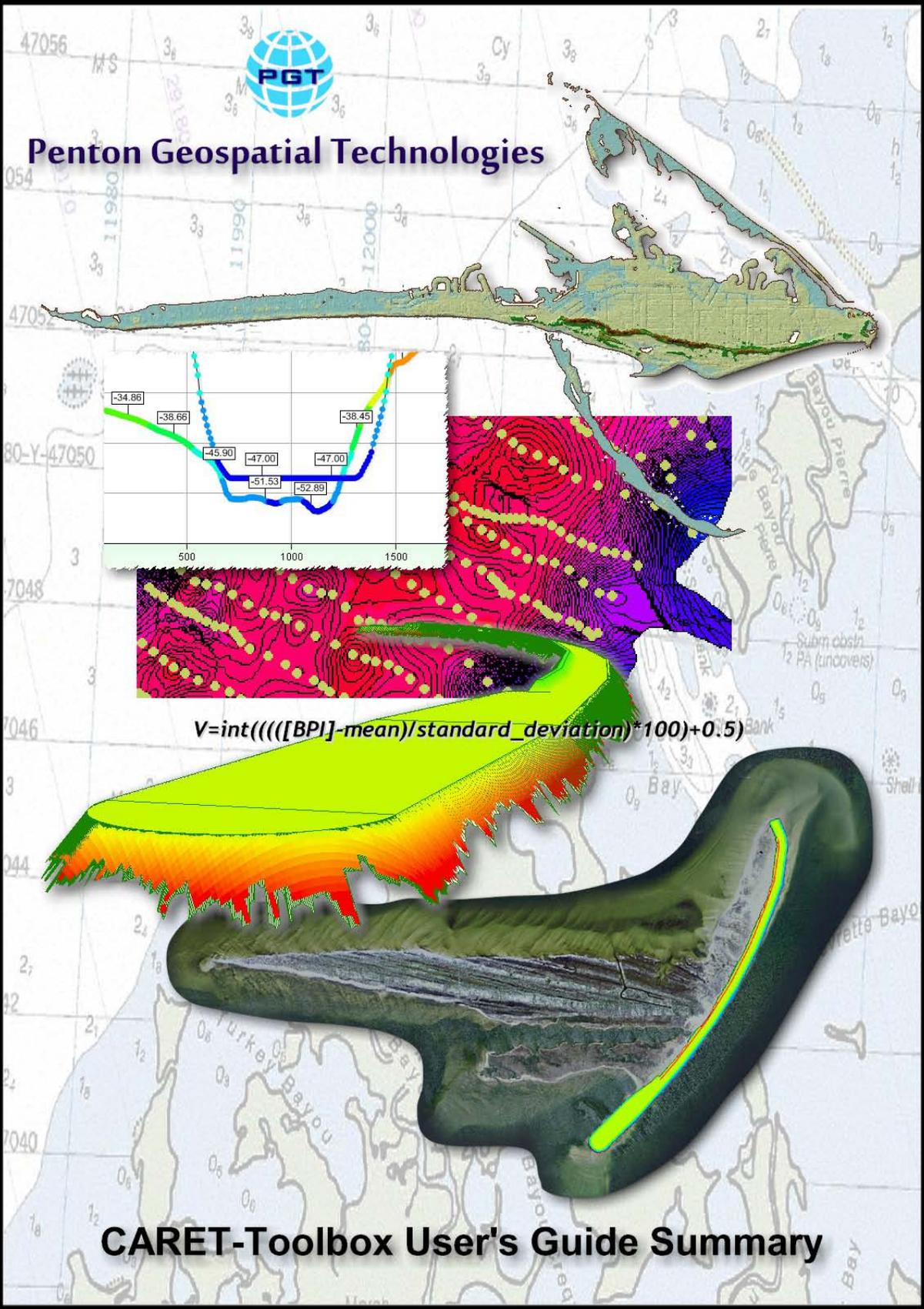




Penton Geospatial Technologies



$$V = \text{int}(\frac{([BPI] - \text{mean})}{\text{standard_deviation}} * 100) + 0.5$$

CARET-Toolbox User's Guide Summary

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1. Introduction

The Coastal Analysis, Research, and Engineering Toolbox for ArcGIS Desktop, hereinafter referred to as the CARET-Toolbox is an ArcGIS extension that is a set of tools geared towards end users who are involved with coastal and ocean related design and management issues. It was created as a comprehensive set of applications that enable stakeholders in management decisions to explore the broad spatial and temporal impacts of potential management actions. These tools have been designed as components for effective planning and prediction of regional and local coastal processes. The toolbox consists of several toolbars each providing a broad range of data creation, analysis, and graphing capability, with the idea of simplification of complex geographic information system analysis procedures. A brief functional summary are described in the tables immediately following the introduction. Others users not involved with coastal related work should find most of the functions useful in other areas of endeavor.

1.1 Technical Requirements

Required software to run the CARET-Toolbox consists of ArcGIS 10 with service pack 5 or newer. The installation of 3D and Spatial Analyst extensions are also required. The CARET-Toolbox was compiled as a 32-bit application but should run normally on 64-bit CPU computers.

1.2 Summary

The following tables and figures contained hereinafter provide a brief summarization of the current capabilities of the extension. There are several other sophisticated applications under development that will be added to the extension depending on the commercial viability of the extension (ultimately). A detailed user's guide providing details of every aspect of the extension is also available for download.

1.3 DataViewer Toolbar Functional Summary

	<p>Toolbar: CARET DataViewer Tool: Working Folder</p> <p>Function: This form allows a user to set working “scratch” location on a user’s local computer.</p>		<p>Toolbar: CARET DataViewer Tool: Zoom To Layer</p> <p>Function: Allows a user to quickly zoom to the extents of a layer in the table of contents honoring the spatial extent of the definition query used in the layer file.</p>
	<p>Toolbar: CARET DataViewer Tool: Ad Hoc Coordinate Tool</p> <p>Function: Allows a click on a map and gather a list of XY coordinate pairs onto a list. The coordinates can also be reprojected on the fly if required while they are added to the list. A KML file can also be generated from the coordinate list.</p>		<p>Toolbar: CARET DataViewer Tool: Create Map Layout</p> <p>Function: Allows a user to quickly and efficiently create a map layout suitable for printing and or plotting. This tool simplifies map printing by providing a user the option to select a printing device and then select a paper size. Pre-defined map scales are also available for choosing. Each change updates the map layout.</p>
	<p>Toolbar: CARET DataViewer Tool: Find By Attribute</p> <p>Function: Allows a user to search attributes contained in a vector feature layer by selecting from a list of distinct attribute values queried from the selected layer. Double-clicking on a value from the search list locates to the first feature by that value.</p>		<p>Toolbar: CARET DataViewer Tool: Sort Layers</p> <p>Function: Allows a user to sort all the layers in the table of contents alphabetically. The tool will honor grouped layers of any level.</p>
	<p>Toolbar: CARET DataViewer Tool: Move Layer(s) to Top</p> <p>Function: Allows a user to move any selected layers to the top of the table of contents.</p>		<p>Toolbar: CARET DataViewer Tool: Move Layer(s) to Bottom</p> <p>Function: Allows a user to move any selected layers to the bottom of the table of contents.</p>
	<p>Toolbar: CARET DataViewer Tool: Remove Invalid Layers</p> <p>Function: Allows a user to remove all invalid layers from their table of contents, typically layers with broken data sources.</p>		<p>Toolbar: CARET DataViewer Tool: Delete Multiple Fields</p> <p>Function: Allows a user to select a shape file on their computer. Once selected, a list of attribute fields is created from the shape file for final selection. All selected fields in the shape file are then deleted.</p>
	<p>Toolbar: CARET DataViewer Tool: Imagery Manager</p> <p>Function: Manages multiple raster images by locating and adding images into the Table of Contents of an ArcMap session. Management is performed by creating an index polygon feature for each image in the selected location – TOC or file directory.</p>		<p>Toolbar: CARET DataViewer Tool: (Future)</p>

	<p>Toolbar: CARET DataViewer Tool: Add X,Y Coordinates</p> <p>Function: Automatically creates and populates an X and Y value column(s) in the attribute table of a selected vector layer using the coordinate system of the Data Frame properties.</p>		<p>Toolbar: CARET DataViewer Tool: Import Excel as Points</p> <p>Function: This tool imports from a selected Excel spreadsheet a worksheet that contains columns of data that can be queried as X and Y point data. The tool imports the data and creates a point feature layer into the map.</p>
	<p>Toolbar: CARET DataViewer Tool: Export to Text File</p> <p>Function: Allows users to easily export the feature attributes of a feature map layer to an ASCII comma-delimited text file. The tool can also be used to export the XY vertices of a polygon or polyline feature class to a text file. If the feature class is 3D, the Z value of the geometry is also included.</p>		<p>Toolbar: CARET DataViewer Tool: Polygon Area Tool</p> <p>Function: Allows users to calculate the area, perimeter, and centroid of features in a polygon feature layer. The tool will also work with data that is in a geographic coordinate system.</p>
	<p>Toolbar: CARET DataViewer Tool: Graphics to Features</p> <p>Function: This tool allows users to convert graphic elements (polygon, polyline, or point types) in the map to permanent feature classes of the same type of geometry.</p>		<p>Toolbar: CARET DataViewer Tool: Bounding Polygon Tool</p> <p>Function: This tool allows the user to create a boundary based on a feature point selection, and it creates a polygon graphic that surrounds the feature selection. The bounding polygon is a convex hull polygon.</p>
	<p>Toolbar: CARET DataViewer Tool: Compare Tool</p> <p>Function: The main function of this tool, although not the only function, is to search the specified feature class for duplicate geometry. Any duplicate features are marked as duplicate with a Duplicate column that is added to the attribute table.</p>		<p>Toolbar: CARET DataViewer Tool: Make PointZ Shape</p> <p>Function: Allows a user to select an ASCII comma-delimited text file that contains as minimum X, Y, and Z values that typically represent a location and an elevation. The resultant point shape file is z-aware, meaning it has 3D geometry.</p>
	<p>Toolbar: CARET DataViewer Tool: Make PolylineZ Shape</p> <p>Function: Allows a user to select an ASCII comma-delimited text file that contains as minimum X, Y, and Z values that typically represent a location and an elevation. The X and Y values are used to create the polyline vertices. The resultant shape file is z-aware, meaning it has 3D geometry.</p>		<p>Toolbar: CARET DataViewer Tool: Polyline Tools</p> <p>Function: The polyline tools are a collection of tools that modify polylines in a shape file or create new features from existing features.</p>

	<p>Toolbar: CARET DataViewer Tool: Shape to Multipoint Shape</p> <p>Function: Combines one or more point shape files into a single multipoint shape file.</p>		<p>Toolbar: CARET DataViewer Tool: Nearest Neighbor Tool</p> <p>Function: This tool is used to calculate the nearest point to every point contained in a point feature layer and provide the resulting average distance between points as a final result.</p>
	<p>Toolbar: CARET DataViewer Tool: Pixels 2 ASCII File Tool</p> <p>Function: This tool permits you to select a raster dataset and export the raster pixel values to a formatted ASCII text file.</p>		<p>Toolbar: CARET DataViewer Tool: KML Import Tool</p> <p>Function: The KML import tool will read a KML file and build shape files, one for each set of point, polyline, and polygon data (for a total of 3) that is contained in the KML file.</p>
	<p>Toolbar: CARET DataViewer Tool: Import Geo-Tagged Images</p> <p>Function: This tool imports GPS stamped digital photos building both shape file and KML file with hyperlinked references to the photos.</p>		<p>Toolbar: CARET DataViewer Tool: Polyline to Polygon Tool</p> <p>Function: This tool converts the selected polyline feature to a polygon shape file.</p>
	<p>Toolbar: CARET DataViewer Tool: Polygon to Polyline Tool</p> <p>Function: This tool converts the selected polygon feature to a polyline feature.</p>		<p>Toolbar: CARET DataViewer Tool: Common Distance Tool</p> <p>Function: The common distance tool computes the linear distances between a selected anchor point and a set of secondary points.</p>

Table 1 - DataViewer Functional Summary

1.4 Survey Toolbar Functional Summary

 <p>Toolbar: CARET Survey Tools Tool: Raster Profile Generator</p> <p>Function: The raster profile generator allows you to cut profiles through one or more raster surfaces. This operation will result in one or more profile point shape files, one for each surface, that represent elevation values calculated along the transect line.</p>	 <p>Toolbar: CARET Survey Tools Tool: TIN/Terrain Profile Generator</p> <p>Function: The TIN/Terrain profile generator allows you to cut profiles through one or more TIN or Terrain surfaces. This operation will result in one or more profile point shape files, one for each surface, that represent elevation values calculated along the transect line.</p>
 <p>Toolbar: CARET Survey Tools Tool: Auto-Profiler Generator</p> <p>Function: The auto-profiler generator allows you to create profiles through one or more raster surfaces using a centerline and stationing. The operation will result with one or more profile point shape files, one profile per station per surface that represents elevation values.</p>	 <p>Toolbar: CARET Survey Tools Tool: Depth Difference Calculator</p> <p>Function: The depth difference calculator is a tool that provides you the ability to subtract one raster grid surface from another. The result of this operation is a new raster grid surface that represents the resultant difference in terms of the elevation units of the grid cells.</p>
 <p>Toolbar: CARET Survey Tools Tool: Surface Generator</p> <p>Function: The surface generator is a tool that provides the ability to generate a raster surface or a tin surface from an input point feature layer with several options.</p>	 <p>Toolbar: CARET Survey Tools Tool: NetCDF Tools</p> <p>Function: Provides an interface for loading, querying, and displaying time series NetCDF data in the ArcGIS environment.</p>
 <p>Toolbar: CARET Survey Tools Tool: Beach Profile Importer</p> <p>Function: This application is designed to read the Florida Department of Environmental Protection (FLDEP) profile format and create the beach profile as a shape file. Beach profile data is available for downloading from the FLDEP.</p>	 <p>Toolbar: CARET Survey Tools Tool: Random Point Generator</p> <p>Function: The random point generator is a tool that provides the capability to create random points within specified criteria. The resulting random points created are used to automatically build a point shape file.</p>
 <p>Toolbar: CARET Survey Tools Tool: Surface Area-Volume Tool</p> <p>Function: The surface area-volume tool is a tool that is used to calculate planar and 3D surface areas and volumes for tin, terrain, or raster surfaces.</p>	 <p>Toolbar: CARET Survey Tools Tool: Ocean Volume Tool</p> <p>Function: The ocean volume tools performs a specifically configured cut and fill analysis to calculate water volume based on an elevation plane and area of interest.</p>

	<p>Toolbar: CARET Survey Tools Tool: Import LandXML Tool</p> <p>Function: The import landxml tool reads and creates several GIS features from an open source landxml export file.</p>		<p>Toolbar: CARET Survey Tools Tool: Shrink Wrap Tool</p> <p>Function: The shrink wrap tool is an application that synthesizes a data boundary from points that can be used to enforce a proper interpolation zone in the surface.</p>
	<p>Toolbar: CARET Survey Tools Tool: Shoreline Classification Tool</p> <p>Function: The shoreline classification tool is designed to attribute a shoreline shape file in accordance with the National Geodetic Survey's attribution scheme Coastal Cartographic Object Attribute Source Table (C-COAST).</p>		<p>Toolbar: CARET Survey Tools Tool: Shoreline Tortuosity Tool</p> <p>Function: The shoreline tortuosity tool is a tool to calculate the fractal dimension, typically of a shoreline, and the sinuosity, a measure of the "curviness" of the shoreline.</p>
	<p>Toolbar: CARET Shoreline Tools Tool: Sediment Allocation and Analysis Tool (SAAS)</p> <p>Function: A set of tools to manage sediment allocations (gains and losses) along broad swaths of coastline within a geographic context.</p>		<p>Toolbar: CARET Shoreline Tools Tool: Beach and Rapid Inlet Shoal Classifier (BRISC)</p> <p>Function: A set of tools to rapidly classify inlet areas, define beach areas, and build beach transects and create beach profile plots from the transects.</p>
	<p>Toolbar: CARET Oceanographic Tools Tool: Sea-Bird Data Tool</p> <p>Function: A set of tools to open, process, and visualize ASCII data generated by Sea-Bird Electronics software. Sea-Bird Electronics is the world's largest developer and manufacturer of products for the measurement of salinity, temperature, pressure, dissolved oxygen, and related oceanographic parameters in marine waters.</p>		<p>Toolbar: CARET Oceanographic Tools Tool: Great Circle Navigation Tool</p> <p>Function: A tool to calculate a great circle navigation track based on starting and ending longitudes and latitudes. Way points can be calculated based on a longitudinal step value and then printed, plotted in ArcGIS, or made into a Google Earth KML file.</p>
	<p>Toolbar: CARET Oceanographic Tools Tool: Undersea Terrain Builder</p> <p>Function: The Undersea Terrain Builder tool is used to characterize potential shallow marine benthic habitats. Using a concept called the Topographic Position Index (TPI) which compares the elevation of each cell in a DEM to the mean elevation of a specified neighborhood around that cell; a classified raster is created defining benthic structure in accordance with user-defined parameters.</p>		

Table 2 - Survey Functional Summary

1.5 Map Book Extension Functional Summary

	<p>Toolbar: Map Book Extension Tool: Create Map Series Wizard</p> <p>Function: The map series wizard tool creates a map series and is also used to change some map series properties of an existing map series.</p>		<p>Toolbar: Map Book Extension Tool: Add Identifier Grid</p> <p>Function: This tool allows you to place an identifier grid on your page layout. This identifier grid provides a visual representation of the active map page in a map series.</p>
	<p>Toolbar: Map Book Extension Tool: Create Grid Wizard</p> <p>Function: The index grid wizard tool creates a grid of squares whose size and number are based on the parameters selected while running the wizard. This index grid is used to build a map series.</p>		<p>Toolbar: Map Book Extension Tool: Create Strip Map Wizard</p> <p>Function: This tool creates a connected path of map grid polygons that follows some sort of logical path across data.</p>

Table 3 - Map Book Extension Functional Summary

2. DataViewer Toolbar Functions



Figure 1 - DataViewer Toolbar

2.1 Maps Menu

The maps menu section of the Data Viewer toolbar has two dialogs the Create Map and the find by Find by Attribute dialogs.

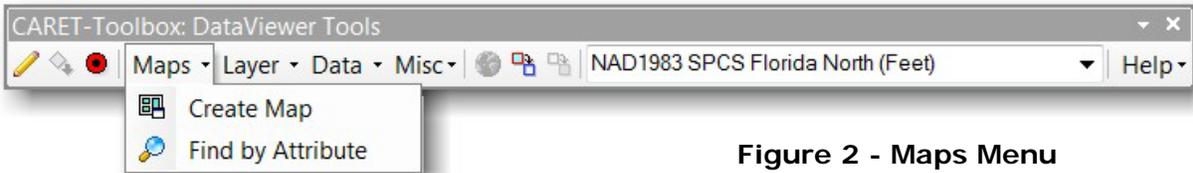


Figure 2 - Maps Menu

2.2 Layer Menu

This is a set of tools to manipulate layers in your table of contents.

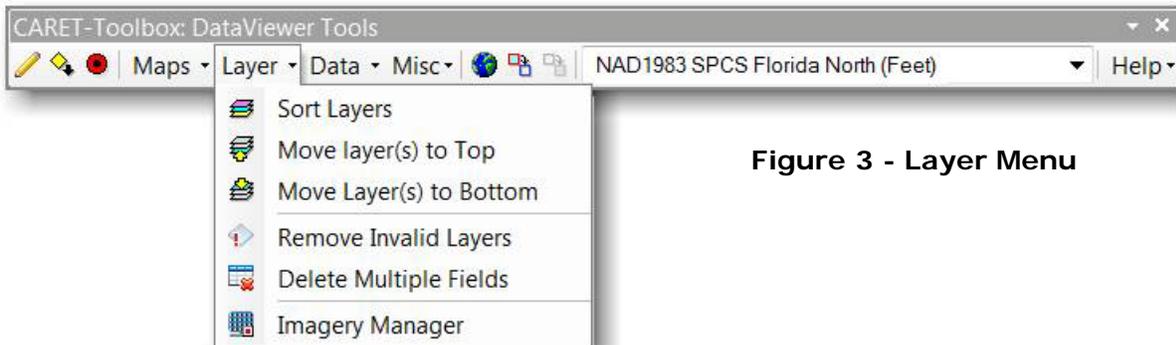


Figure 3 - Layer Menu

2.3 Data Menu

The data menu tools are a collection of applications that create or modify data, typically on features that already exists in your map.

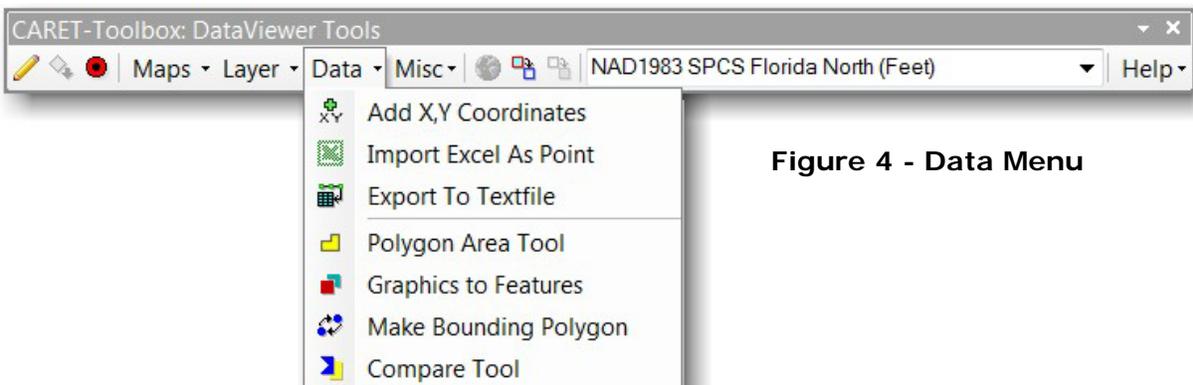


Figure 4 - Data Menu

2.4 Miscellaneous Tools

The miscellaneous tools are a collection of applications that create or modify data, typically on features that already exist in the map.

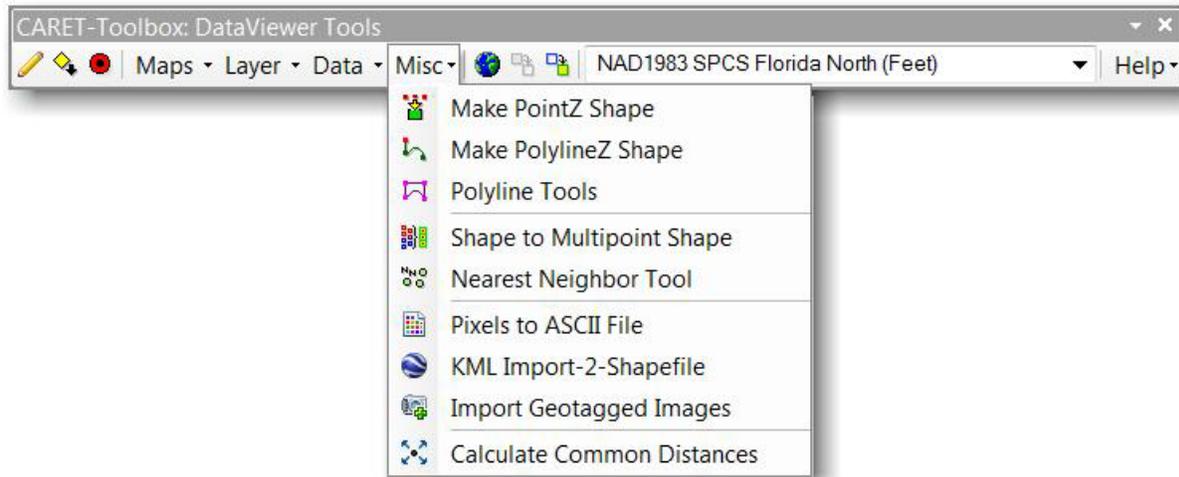


Figure 5 - Miscellaneous Menu

3. Survey and Analysis Toolbar Functions

The survey and analysis tools are a collection of tools that allow for the design and analysis of raster grids, TIN surfaces, terrain surfaces, landxml exchange files, and NetCDF time series data files. The tools require the use of the 3D Analyst and Spatial Analyst extensions for ArcMap.

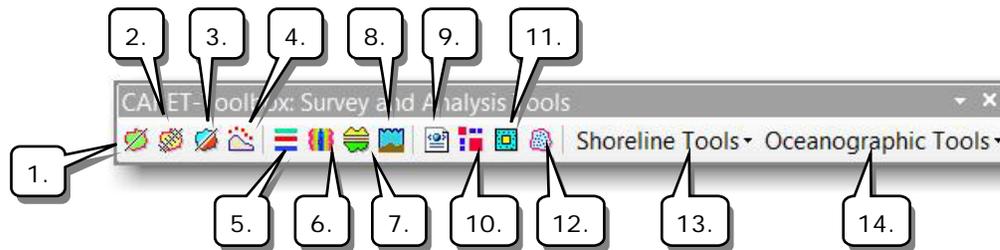


Figure 6 - Survey and Analysis Toolbar

1. **Raster Profile Tool:** The raster profile generator allows you to cut profiles through raster surfaces. This operation will result in one or more profile point shape files being built and added to your map. Allowable raster formats are ESRI GRID, TIFF, FGDBR, SDR, and IMAGINE IMAGE. Profiles are viewed in x-y graph format.
2. **Auto-Profiler Tool:** The auto-profiler allows you to layout a centerline and then place station lines along the centerline at a specified spacing and width. The stations are then used to generate a profile shape file that contains at least one profile for each station along the centerline. Allowable raster formats are ESRI GRID, TIFF, FGDBR, SDR, and IMAGINE IMAGE. Profiles are viewed in x-y graph format.

3. **TIN/Terrain Profile Tool:** The TIN/Terrain profile tool allows you to cut profiles through a TIN or a Terrain feature surface. This operation will result in one or more profile point shape files being built and added to your map. Profiles are viewed in x-y graph format.
4. **FLDEP Beach Profile Tool:** The Florida Department of Environmental Protection maintains a historic shoreline database that contains many directories of related types of information about beach changes in Florida over the past 150 or so years. The main focus of the database is historic mean high water (MHW) locations from digitized maps and field profile surveys. Beach profile data is available for downloading from the FLDEP. This application is designed to read the FLDEP profile format and create beach profiles as shape files.
5. **Depth Difference Tool:** The depth difference calculator is a tool that provides you the ability to subtract one raster grid surface from another. Supported raster formats are ESRI GRID, TIFF, FGDBR, SDR, and IMAGINE IMAGE. The result of this operation is a new raster grid surface that represents the resultant difference in terms of the elevation units of the grid cells.
6. **Make Surface Tool:** The surface generator is a tool that provides the ability to generate a raster GRID surface or a TIN surface from an input point feature layer with several options for managing analysis masks. The Spatial and 3D Analyst extensions are required in order to use this tool
7. **Surface Area-Volume Tool:** The surface area-volume tool is a tool that is used to calculate planar and 3D surface areas and volumes for tin, terrain, or raster surfaces at user-specified elevation intervals. Allowable raster formats are ESRI GRID, TIFF, FGDBR, SDR, and IMAGINE IMAGE. This tool is very useful for creating reservoir capacity charts.
8. **Ocean Volume Tool:** The ocean volume tool performs a specifically configured cut and fill operation to calculate ocean volume beneath a specified reference plane and confined area of interest. The output report is automatically created based upon the volume units selected.
9. **LandXML Import Tool:** LandXML is an ASCII data exchange format based on XML (Extensible Markup Language) used to save project data from mostly civil and surveying software packages. It's similar to a DXF™ file, which is a generic file format for vector-based drawing information. This tool reads the LandXML file and converts several of the more useful features, such as parcels, cogo points, surfaces, and alignments into gis features.
10. **NETCDF Time Series Analysis Tool:** NetCDF (network Common Data Form) is a file format for storing multi-dimensional scientific data (variables) such as temperature, humidity, pressure, wind speed, and direction. NetCDF was created by Unidata, an organization funded primarily by the National Science Foundation. This tool was designed to interact with NetCDF libraries to facilitate the extraction and visualization of NetCDF multi-dimensional data in the ArcGIS environment.
11. **Random Point Generator Tool:** The random point generator is a tool that provides the capability to create random points within specified criteria. The resulting random points created are used to automatically build a point shape file.

12. **Shrink Wrap Tool:** The shrink wrap tool is a workflow that uses several of the geo-processing commands found in the ArcGIS Toolbox to synthesize a data boundary from points that can be used to enforce a proper interpolation zone in the surface.

13. **Shoreline Tools:**

- a. **Shoreline Classification Tool:** The shoreline classification is a tool that is designed to attribute a shoreline shape file in accordance with the National Geodetic Survey's attribution scheme 'Coastal Cartographic Object Attribute Source Table (C-COAST). CCOAST was developed to bring attribution of various National Geodetic Survey sources of shoreline data into one attribution catalog. C-COAST is not a recognized standard but was influenced by the International Hydrographic Organization's S-57 Object-Attribute standard so that the data would be more accurately translated into S-57.
- b. **Shoreline Tortuosity Tool:** The shoreline tortuosity is a tool that is designed to calculate the fractal dimension of a shoreline (or any curvy polyline for that matter). Determining the length of a country's coastline is not as simple as it seems at first. In fact, the answer depends on the length of the ruler you use for the measurements. A shorter ruler measures more of the sinuosity of bays and inlets than a larger one, so the estimated length continues to increase as the ruler length decreases. In fact, a coastline is an example of a fractal, and plotting the length of the ruler versus the measured length of the coastline on a log-log plot gives a straight line, the slope of which is the fractal dimension of the coastline (and will be a number between 1 and 2).
- c. **SAAS Tool:** Sediment Allocation and Analysis System tool provides a framework for formulating, documenting, and calculating allocations (budgets) of sediment, including estimation of uncertainty, along broad swaths of coastline. This application allows users to define conceptual allocations of sediment visually by creating a series of cells and arrows that represent sources, sinks, and flux rates. It then calculates quantitative "micro" (local) and "macro" (regional) sediment allocations, using a pre-defined sediment mass balance equation.
- d. **BRISC Tool:** The Beach and Rapid Inlet Shoal Classifier (BRISC) toolset provides for two fundamental capabilities integrated together in a complimentary fashion. The first component, generally referred to as the inlet tools, utilizes ArcGIS image analysis techniques, specifically an ISO unsupervised image classification that is used with an accompanying user-defined classification scheme for rapid characterization of near-shore water. The second BRISC component, referred to as the beach classification tool, provides for automated routines to quickly map the wet-dry line and the vegetation line of a beach and to generate transects from a common baseline to these features. These transects can be exported for inclusion into other analysis tools requiring transect data and also can be used to automate generation of beach profile data using raster surfaces of the beach proximity created from x, y, z data such as lidar.

14. Oceanographic Tools:

- a. **Sea-Bird Data Tool:** A set of tools to open, process, and visualize ASCII data generated by Sea-Bird Electronics software. Sea-Bird Electronics is the world's largest developer and manufacturer of products for the measurement of salinity, temperature, pressure, dissolved oxygen, and related oceanographic parameters in marine waters.
- b. **Great Circle Navigation Tool:** A tool to calculate a great circle navigation track based on starting and ending longitudes and latitudes. Way points can be calculated based on a longitudinal step value and then printed, plotted in ArcGIS, or made into a Google Earth KML file.
- c. **Undersea Terrain Builder Tool:** This tool is a modified version of the free Benthic Terrain Modeler available for download from ESRI. The Benthic Terrain Modeler is licensed under a Mozilla Public License Version 2.0 and as such, the source code for the Undersea Terrain Builder tool is required to be made freely available upon request. The Undersea Terrain Builder tool, hereinafter referred to as the UTB, is used to characterize potential shallow marine benthic habitats using a concept called the Topographic Position Index (TPI) which compares the elevation of each cell in a DEM to the mean elevation of a specified neighborhood around that cell.

4. Map Book Extension

The Map Book extension for ArcGIS 10 is an adaptation of the Map Book Developer's Sample that was made available for the ArcGIS 9.x version of ArcMap by ESRI. Map books are multi-page documents based on a dataset and an index grid representing the pages. The index grid for a map book represents how the dataset set should be divided up for plotting at a more workable scale. All of the original functionality has been retained and enhanced where opportunities for such existed. The most prominent improvement in this version of the tool is the ability to create and utilize multiple map series in a single map document. This did not exist in previous versions. The map book extension only requires version 10 of ArcGIS and does not need any other extensions.



Figure 7 - Map Book Toolbar