

# Desktop GIS Software for Hydrological Applications

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Geographic Information Systems have become important tools for hydrologists. The following listing describes many of the GIS software desktop products commonly used in the environmental sciences. The products have varying degrees of vector and raster capabilities and range in price from free to very expensive. They are listed alphabetically. Some of the information was taken from product Web sites; neither the author nor *Southwest Hydrology* guarantees the accuracy of the product descriptions or endorses any of the products listed.

## Autodesk – Envision 8

[usa.autodesk.com](http://usa.autodesk.com)

Autodesk Envision integrates GIS spatial data and AutoCad design data from a

variety of formats, making it easy to visualize, query, analyze, and present information within a single desktop application. Envision can perform civil engineering tasks such as calculating elevations and cut/fill volumes and running flood analyses. AutoDesk Raster Design is the raster data complement to Envision used to edit, modify, and enhance raster data for integrating maps, scanned documents, satellite imagery, and aerial photos into the workflow.

## Bentley Systems PowerMap

[www.bentley.com](http://www.bentley.com)

Bentley PowerMap provides engineers an easy-to-use, 2-D light-editing environment to complement geospatial projects built on Bentley Systems' Microstation and Microstation GeoGraphics. PowerMap is an effective solution for production mapping in an engineering environment and offers the capability to extend this work into geospatial applications. The product has solid and extensive mapping and map-production functionality, including a range of topological operations and thematic mapping capabilities.

## Clark Labs – IDRISI: The Kilimanjaro Edition

[www.idrisi.clarku.edu/](http://www.idrisi.clarku.edu/)

IDRISI Kilimanjaro is a geographic modeling technology that includes raster analytical functionality covering the full spectrum of GIS and remote sensing needs, from database query, to spatial modeling, to image enhancement and classification. Special facilities are included for environmental modeling and natural resource management, including change and time series analysis, land change prediction, multi-criteria and multi-objective decision support, uncertainty analysis, and simulation modeling. IDRISI Kilimanjaro also offers special tools for computing watershed boundaries, viewsheds, and surface flow patterns.

## Earth Resource Mapping – ER Mapper 6.4

[www.ermapper.com](http://www.ermapper.com)

Earth Resource Mapping produces a suite of imaging solutions for the processing, display, and serving of digital raster imagery. Digital image technology allows up-to-date information to be processed and interpreted quickly to identify, measure, and monitor aquatic natural resources. ER Mapper can develop models of water circulation and sediment transport using the interactive spatial modeling features. The software can create quantitative measurements of acres of water and model changes in water flow, lowered water levels, and changing erosion patterns.

## ESRI – ArcView

[www.esri.com](http://www.esri.com)

ArcView provides raster and vector data visualization, query, and analysis, along with the ability to create and edit geographic data. The ArcView Spatial Analyst Extension is a raster analysis package that includes a Hydrologic Modeling Sample Extension. Using this sample extension, watershed and stream networks can be created using DEM data; the physical and geometric properties of watersheds can be calculated; and these properties can be aggregated into a single attribute table. ESRI also created Arc Hydro, a geodatabase design template, and a set of accompanying tools geared for support of water resources applications in the ArcGIS environment (see page 18).

## Geographic Resources Analysis Support System 5.0.3 (GRASS)

[grass.baylor.edu](http://grass.baylor.edu)

GRASS GIS is a free, open source geographical information system with raster, topological vector, image processing, and graphics-production functionality that operates on various platforms through a graphical user

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interface and shell in X-Windows. GRASS was developed by a worldwide network of developers who continue to release new versions regularly. GRASS includes modules for erosion modeling, landscape structure analysis, solution transport, and watershed analysis.

### Intergraph – GeoMedia 5.1

[www.intergraph.com](http://www.intergraph.com)

Intergraph was one of the first GIS software companies to acknowledge that enterprise databases are the best means of storing large amounts of geospatial data. All GeoMedia products scale well from desktops to enterprise-wide systems. The product includes “on-the-fly” data integration, “feature-centric” data management within a unified data model, use of industry-standard relational databases, a complete set of spatial analysis tools, and an open Microsoft Windows-compliant platform for developing custom applications. GeoMedia Grid is a third party add-on from Keigan Systems that installs a complete suite of grid processing tools within GeoMedia for 3-D viewing, raster-to-vector conversion, grid reprojections, and other new functions.

### Keigan Systems - MFWorks 3.0

[www.keigansystems.com](http://www.keigansystems.com)

MFWorks 3.0 is descended from a long line of popular raster GIS packages previously marketed as MAP II and MapFactory. This stand-alone application is a complement to vector-based applications. MFWorks includes hydrological tools to compute flow direction, fill sinks, fill digital elevation models, flow accumulation, watershed delineation, stream segmentation, and reverse paths.

### Manifold System 5.5 Professional Edition

[www.manifold.net](http://www.manifold.net)

Manifold System 5.5 is an integrated system that simultaneously works with vector drawings, satellite and aerial photos, raster data, remote sensing images, 2-D and 3-D surfaces and terrain simulations, and a wide range of database table formats. Manifold System includes substantial functionality, including an integrated Internet map server, for less than the price of many other desktop GIS software products. Surface Tools is an optional extension to Manifold System 5.5 that provides additional functionality for working with raster surfaces.

*See Software, page 33*

## GLOSSARY OF GIS TERMS

**Data model** – the result of a conceptual design process in which a user defines how data are to be structured to facilitate their use within an application, and to create an approximate representation of real world objects and relationships.

**Data portal** – an Internet site that organizes and provides access to diverse data sources, search tools, support resources, data, and applications.

**Enterprise platform** – a linked technology network of software, hardware, and data.

**Geospatial data** – data containing a geographic or spatial element defined by x, y, and z coordinates such as latitude, longitude, and altitude.

**Interoperability** – the capacity for different computers, databases, and technologies running on different software and hardware platforms to work together in an integrated fashion.

**Metadata** – information about a dataset, such as content, author, creation date, quality and accuracy, methodology and projection used, or other attributes.

**NAD83, NAD27** – North American Datum of 1983 (or 1927); a reference point that defines the origin and orientation of lines of latitude and longitude. The 1927 datum was updated in 1983, resulting in location shifts of up to 500 feet; thus, the datum used must be specified.

**Raster data** – data that are grid-based and comprised of cells or pixels, as in jpg or tif files. Examples include satellite images, scanned aerial photography and maps, and digital elevation models.

**State plane coordinate system** – a coordinate system unique to a state, used to define positions in terms of plane rectangular (x,y) coordinates. As many separate zones as necessary are used to limit scale distortion to less than one part in 10,000. Such systems are four times more accurate than the UTM system, but unsuitable for regional-scale projects.

**UTM (Universal Transverse Mercator)** – a coordinate system that divides the Earth into 120 zones, 60 each in the northern and southern hemispheres. Each zone is 6 degrees of longitude wide at the equator. Coordinates are expressed as a distance in meters to the east (“easting”) and meters to the north (“northing”) from the reference point of the particular zone. Most appropriate for scales of 1:250,000 and larger.

**Vector data** – data that are comprised of points, lines, and polygons. Examples include well locations, roads, water bodies, and stream gauge locations.

*Thanks to Cheryl Karrer Thurman and Howard Ward (TerraSystems Southwest) and Jamie Harding for their reviews. See also [www.mentorsoftwareinc.com/resource/glossary.htm](http://www.mentorsoftwareinc.com/resource/glossary.htm).*

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## **MapInfo Professional 7.0**

*www.mapinfo.com*

MapInfo Professional 7.0 is a full-featured desktop geospatial solution. The company provides easy-to-use software for novice users and powerful programming tools for accomplished users. It provides a rich set of spatial capabilities, including integration with enterprise databases. Vertical Mapper is a third party add-on to MapInfo that provides modeling tools and interpolators for grid analysis and visualization of raster datasources.

## **PCI Geomatica – Geomatica 9.1**

*www.pcigeomatics.com*

Geomatica 9.1 provides an all-in-one geospatial software solution for remote sensing, photogrammetry, GIS, and cartography. PCI Geomatica previously sold individual software components for image-processing (EASI), raster GIS (SPANS) and vector GIS (PAMAP) solutions. The ease of movement of spatial information between highly integrated applications is a key part of the PCI Geomatica design philosophy, as is meeting the widest possible range of dynamic processing requirements within a single geospatial solution.

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