What's New in RiverTools 3.0.1 ?

RiverTools 3.0 is a powerful and yet easy-to-use GIS application that specializes in the analysis and visualization of digital terrain, watersheds and river networks. RiverTools makes it easy to import digital elevation data in a wide variety of formats and to extract geometric and hydrologic information.

RiverTools includes many specialized algorithms for the analysis of DEMs and watersheds, including the **D8**, **D-Infinity** and new **Mass Flux** algorithms for contributing continuous flow angles and watershed contributing areas, plus state-of-the-art methods for dealing with pits and flats. It can quickly measure stream attributes such as length, drop, slope, curvature, upstream area, sinuosity, drainage density, longitudinal profiles, longest channel length, Horton-Strahler order and many more, for single channels or entire river networks. All of these measurements are made integrating on the surface of the currently selected ellipsoid model of the Earth, with built-in support for 52 different ellipsoids. Displays of Geographic data can be made in 17 different map projections.

While many GIS applications have a simple scripting language for extending their functionality, RiverTools can be extended with the full power of IDL, the Interactive Data Language, and hundreds of low-level RiverTools commands. RiverTools also runs identically on Windows, Mac, and UNIX platforms.

You can choose a topic from this list to go directly to a discussion on that topic.

Major New Features in this Release

Mass Flux Algorithms for Divergent Hillslopes

In RiverTools 3.0, a new method for computing continuous flow angles and watershed contributing areas has been introduced, called the **Mass Flux Method**. This method partitions flow between neighbor pixels by treating each pixel as a control volume. Unlike the supported **D-Infinity Method**, which is superior to the **D8 Method** but does not provide a rigorous solution to the problem of divergent flow on hillslopes, the mass flux method uses a rigorous mass balance approach that:

1. divides each pixel into four quarter-pixels,
2. computes a continuous flow angle for each using 3 neighbor elevations, and then
3. computes contributing area and specific area using the actual fraction of flow that would pass through each of a pixel's four edges if subjected to a spatially uniform rainrate.

The references to flows and rainrates here are conceptual constructs; the objective of the method is to compute contributing areas on divergent (as well as convergent) surfaces as accurately as possible. As with the D-Infinity method, flow from a given pixel will typically be partitioned between two neighbor pixels, except in the case of pixels that are single-pixel peaks or that lie on drainage divides. The new Mass Flux algorithms are available via the **Extract** → **Mass Flux Grid** menu. Grids based on quarter-pixels are created and saved (with QP for quarter-pixel in their name, along with their own RTI files), but they are also averaged to create flow angle and area grids that have the same dimensions as the DEM. Continuous angle grids from the D-Infinity and Mass Flux methods look quite similar, but the Mass Flux method shows significant improvements in the calculation of contributing areas. Both the D-Infinity and Mass Flux multiple flow direction algorithms outperform the single-direction D8 Method, but they use a D8 flow grid to resolve ambiguous flow situations in flats and pits.

You can experiment with these different algorithms by using DEMs in the Test_Surfaces folder on the RiverTools Data CD. These surfaces include a regular saddle, a monkey-saddle, a four-saddle, a cone, a Gaussian hill, a pyramic, inclined planes and others. While they can give significantly different results on a hillslope or other divergent surface, they all give similar values for the contributing areas of larger, channelized watersheds.

Finite Difference Curvature Grids

The new **Extract → Finite Difference Grid** menu has dialogs that use the method described by Zevenbergen and Thorne (1987) to compute morphometric parameters such as slope, aspect, partial derivatives and five different types of curvature, namely: plan, profile, tangential, mean and Gaussian curvature. This method fits a quadratic surface to the (3 x 3) neighborhood of each pixel in the input DEM file as a preprocessing step to computing partial derivatives. You can still create a grid of D8-based slopes or profile curvatures via dialogs in the **Extract → D8-based Grid** menu.

You can experiment with these new curvature grids by using DEMs in the Test_Surfaces folder on the RiverTools Data CD. These surfaces include a regular saddle, a monkey-saddle, a four-saddle, a cone, a Gaussian hill, a pyramic, inclined planes and others.

Point-and-Click Grid Calculator

This user-friendly dialog operates in much the same way as a scientific calculator, except that it associates the variables X, Y and Z with 3 RTG (RiverTools Grid) files. You can leave the Y and Z grid entries blank if you want to create a new grid from a single input grid. You can choose the data type of the output grid from a droplist at the bottom. This much more general dialog replaces three older dialogs in this menu called: Product of 2 Grids, Difference of 2 Grids and Area-Slope Power Law.

Example Applications

(1) In the idealized case of unit excess rainrate, the product of a slope grid and a specific area grid is proportional to the flow or stream power per unit of contour line length.

(2) The depths of depressions in a DEM can be computed as the difference of the filled DEM (*_DEM.rtg) and the original DEM (*_rawDEM.rtg).

(3) A grid for pruning a flow grid to identify heads of channels (via the **Extract → River Network** dialog) can be computed from a slope and area grid as f = (Slope^a) * (Area^b), where a and b are constants. Various topographic indices can also be computed from slope, area and curvature grids.

Grid Sequence Visualization Tool

This new **Display → Grid Sequence** visualization tool allows you to plot the frames in an RTS (RiverTools Sequence) file as an animation. The arrow buttons at the bottom allow you to view frames one by one. You can also jump to a particular frame by typing its number beside the **Frame** button and pressing Return on your keyboard or

by clicking on the **Frame** button. To show all frames as an animation, you specify a wait time between frames, **DT**, and then click on the **Start** button. Additional options can be selected by clicking on the **Options** button and choosing from the menu.

RiverTools Sequence (RTS) files are a simple extension of the RTG file format that allow a sequence of RTG files to be stored in a single file. That is, an RTS file is a simple concatenation of RTG files that each have the same data type. The main purpose of this format is to provide support for **landscape evolution models** and spatially-**distributed hydrologic models** in the RiverTools environment. For example, a landscape evolution model produces a sequence of DEMs, each of which represents the topography of the landscape at a particular time in its evolution. Similarly, a spatially-distributed hydrologic model may produce a sequence of grids, each of which shows how water depths are distributed spatially at a particular time during a storm. One way to create an RTS file is to merge several RTG files with a data type of FLOAT with the **Prepare** → **Merge Files** dialog. The RTS file format is explained in Appendix A, RiverTools Files and Formats, in the User's Guide.

Scrolling Master Windows

This new preference in the **Graphics Windows** panel of the **File** → **Set Preferences** dialog changes the behavior of the "master" windows (as opposed to tool windows) that are created with many of the tools in the **Display** menu. Instead of automatically rescaling up or down by an integer factor, the image is displayed at the full resolution of the DEM and scroll bars are added to the edges of the window. Any of the window tools in the **Tools** menu of the new, scrolling window can be used. This can be a very useful feature, but it can be memory (RAM) intensive when you are working with a very large DEM.

Four New DEM Formats, Including MOLA DEMs for Mars

Support for four new DEM formats has been added to the **File** → **Import DEM** dialog, namely **GRD98 Raster**, **MOLA DEM for Mars, SRTM (HGT format)** and **ARC Gridded ASCII**. The GRD98 format is used by the NGDC (National Geophysical Data Center) for the distribution of bathymetric and topographic data. The MOLA (Mars Orbiter Laser Altimeter) instrument is currently in orbit around Mars on the Mars Global Surveyor spacecraft. It collects high-resolution topographic data for Mars which is distributed as binary data files together with georeferencing data in a text file that has the extension (*.LBL). New DEMs from the Shuttle Radar Topography Mission (SRTM) are distributed as binary files with the extension (*.HGT). The ARC Gridded ASCII format is a text file format that has georeferencing information in a header, followed by data values as text.

Six New Tools in the Extract → D8-based Grid Menu

Six new tools have been added to the **Extract** → **D8-based Grid** menu, namely:

- **Flow Widths**
- **Specific Areas**
- **Grid Increments**
- **Upstream Relief**
- **Longest Channel Length**
- **Basin Averages**

These tools are described in *Chapter 2,* How to Use the RiverTools Dialogs, in the RiverTools User's Guide.

Ability to Start RiverTools from an IDL Session

If you purchase IDL (Interactive Data Language) separately from RSI (Research Systems, Inc.), then you can start RiverTools from an IDL session and use low-level RiverTools commands and IDL commands in a command-line window for batch processing and adding extensions to RiverTools via the User menu.

Road Map of New Features by Menu Location

This section is meant to serve as a roadmap for finding the new features in RiverTools 3.0. A description of each new feature can be found in Chapter 2, How to Use the RiverTools Dialogs, of the RiverTools 3.0 User's Guide.

File Menu

Import DEM → GRD98 Raster (NGDC)

Import DEM → MOLA DEM for Mars

Import DEM → SRTM DEM

Import DEM → ARC Gridded ASCII

Set Colors (5 new color tables & lightness factor option)

Set Preferences

Preference type: Graphics Windows (Scrolling master windows)

Preference type: Plotting Options (Ability to set Nodata and NaN color)

Window Tools: 3 new cursor types

Prepare Menu

Convert Grid (Now creates RTI files automatically)

Replace Bad Values (replaces bad values with neighbor average)

Replace Values

Extract Menu

RT Treefile (Added "All basins draining to RTM mask" option)

River Network (Added "Prune by Specified grid file" option)

D8-based Grid → Flow Widths

D8-based Grid → Specific Areas

D8-based Grid → Grid Increments

D8-based Grid → Upstream Relief

D8-based Grid → Longest Channel Length

D8-based Grid → Basin Averages

Mass Flux Grid → Flow Angles

Mass Flux Grid → Upslope Areas

Mass Flux Grid → Upslope Specific Areas

Finite Difference Grid → Slope

Finite Difference Grid → Aspect

Finite Difference Grid → Profile Curvature

Finite Difference Grid → Tangential Curvature

Finite Difference Grid → Plan Curvature

Finite Difference Grid → Gaussian Curvature

Finite Difference Grid → Mean Curvature

Finite Difference Grid → Laplacian

Finite Difference Grid → df/dx

Finite Difference Grid → df/dy

Finite Difference Grid → d(df/dx)/dx

Finite Difference Grid → d(df/dy)/dy

Finite Difference Grid → d(df/dx)/dy

Derived Grid → Grid Calculator

Mask → Land Mask

Mask → Ocean Mask

Display Menu

Grid Sequence

Map Projection Info (Added several options to the dialog)

User Menu

There is a new method for adding extensions, as explained in the section, Adding Extensions in Chapter 1 of the RiverTools 3.0 User's Guide.

Help Menu

Enter License

Window Tools: Channel Profile

Options → Show Raw DEM Profile,

Options → Fit Curve to Profile

Window Tools: Vector Zoom

Options → Configure

Options → Contours

Options → Flow lines

Options → Grid lines

Options → Background

Options → Start Channel Profile

Click in window, use keyboard arrow keys to navigate.

Window Tools: Value Zoom

Options → Change Coordinates → to Col/Row

Window Tools: Surface Zoom

Options → Style

Options → Background

Options → Colors

Options → Axes

Options → Skirt

Click in window, use keyboard arrow keys to navigate.

Window Tools: Density Zoom

Options → Change Colors

Options → Stretch

Window Tools: Add Text

New feature

Supported Platforms

Windows NT 4.0, 2000, XP

Macintosh, OS X (10.2.x)

Solaris 8, 9

Ask about Linux & other Unix platforms.