The Automated Geospatial Watershed Assessment Tool

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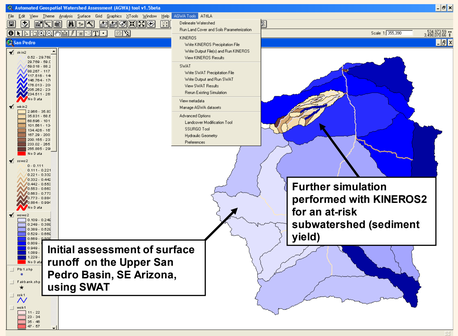
Problem Statement

Global climate change and water shortage are just two looming threats to our way of life in the Southwest. The need to plan and account for changing conditions in our landscapes and watersheds is critical so that we can better manage our resources to ensure they endure into the future. With the advent of spatially distributed hydrologic models, we can model hydrologic and related processes and their interactions with topography, vegetation, soils and climate to better model our environment; however the models typically have extensive data requirements and complex inputs that limit their usability.

Introduction

Planning and assessment needs in land and water resources management are evolving from simple, local-scale problems towards complex, spatially explicit regional ones.

The USDA-ARS Southwest Watershed Research Center, in cooperation with the U.S. EPA Office of Research and Development, has developed a GIS tool to facilitate this process. A geographic information system (GIS) provides the framework within which spatially-distributed data are collected and used to prepare model input files and to evaluate model results.



AGWA was developed under the following guidelines:

- Provide simple, direct, and repeatable method for hydrologic model parameterization
- Use only basic, obtainable GIS data
- Be compatible with other geospatial watershed-based environmental analysis software
- Be useful for scenario and alternative futures simulation work at multiple scales

KINEROS

The KINematic Runoff and EROSion model, KINEROS2, is an event-oriented, physically-based model developed by the USDA-ARS to describe the processes of interception, infiltration, surface runoff and erosion from small watersheds (< 100km^2). Watersheds are represented by a network of planes and channels, allowing rainfall, infiltration, runoff, and erosion parameters to vary spatially.

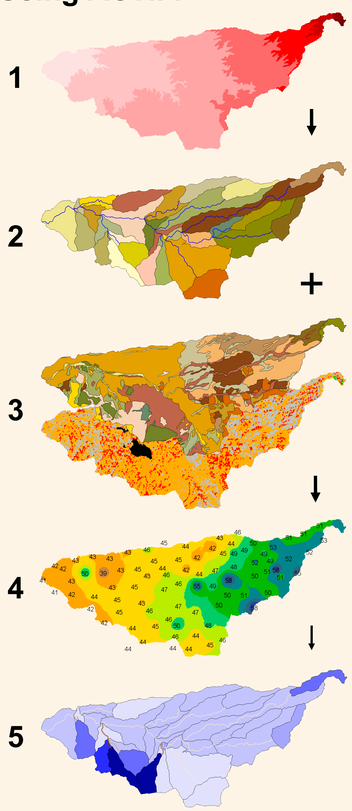
KINEROS2 can be used to determine the effects of various artificial features such as urban developments, small detention reservoirs, or lined channels on flood hydrographs and sediment yield.

SWAT

The Soil Water Assessment Tool is a quasi-distributed model developed at the USDA-ARS to predict the impact of land management practices on water, sediment, and agricultural chemical yields in large (basin scale), complex watersheds with varying soils, land use and management conditions over long periods of time (> 1 year).

SWAT is a continuous, i.e. a long-term yield model, using daily average input values; it is not designed to simulate detailed, single-event flood routing. Major components include hydrology, erosion and sedimentation, crop growth, soil temperature, weather, nutrients, pesticides, and agricultural management.

Using AGWA



Prepare the raster inputs. AGWA uses Digital Elevation Models (DEMs), flow direction and flow accumulation grids.

Delineate and discretize the watershed. Using a user-specified outlet and contributing source area, AGWA determines the outline and subdivides it into elements required for the selected model. Internal breakpoints can be used.

Parameterize the watershed for soils and land cover. The watershed is intersected with the soil coverage and land cover raster to determine model parameters.

Generate precipitation files for the selected model. AGWA can create properly formatted files for uniform or spatially distributed rainfall inputs.

Run the model and view results. AGWA creates all of the necessary input files and executes the model. Users can then import the results and select from several available outputs. Simulations can be compared by examining percent or absolute change.

Model Outputs

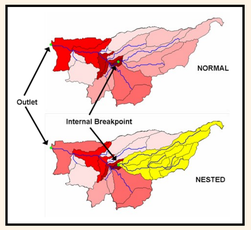
KINEROS	SWAT
Channel Infiltration	Precipitation
Plane Infiltration	Evapotranspiration
Runoff	Percolation
Sediment Yield	Surface Runoff
Peak Flow	Transmission Loss
Channel Scour	Water Yield
Sediment Discharge	Sediment Yield
Peak Sediment Discharge	
Percent Error	

AGWA, AGWA2, and dotAGWA

AGWA, AGWA2, and dotAGWA utilize ESRI software products. For the user interface and data management, AGWA uses ArcView 3.x, AGWA2 uses ArcGIS 9.x Desktop, while dotAGWA uses ArcGIS 9.x Server and ArcSDE. AGWA uses the native programming language to ArcView 3.x, Avenue, while both both AGWA2 and dotAGWA rely on ArcObjects from the ArcGIS 9.x software suite for their core functionality.

Features

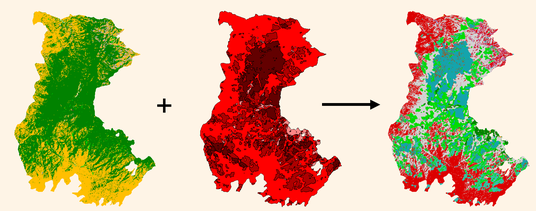
Nested Watersheds



Riparian Buffers

Land Cover Modification Tool

Types of land cover change
- Change one land cover type to another within a user defined area
- Change entire user defined area to new land cover type
- Apply a random land cover pattern to a polygon map
- Analyze a fire with a burn severity map

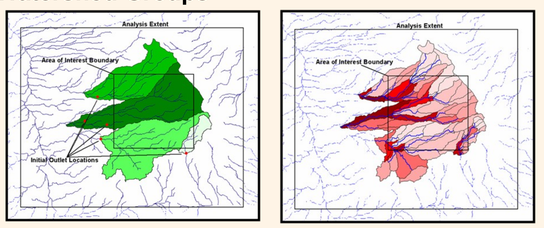


Original Land cover | Burn Severity map | New Land cover

SWAT TMDL Analysis

Available outputs include:
- Sediment Yield (t/ha)
- Organic Nitrogen (kg)
- Organic Phosphorus (kg)
- Mineral Phosphorus (kg)
- Surface NO_3 (kg/ha)
- Soluble Phosphorus (kg/ha)
- Nitrate, Nitrite and Ammonium concentrations

Watershed Groups



Additional Features

- SWAT Hydrologic Response Units
- CSA Enforcement
- Metadata
- SSURGO Tool
- Spatially distributed KINEROS precipitation
- Additional results visualization options

Southwest Applications

- Goodrich, D.C., Canfield, H.E., Burns, I.S., Semmens, D.J., Hernandez, M., Levick, L.R., Guertin, D.P., Kepner, W. 2005. Rapid post-fire hydrologic watershed assessment using the AGWA GIS-based hydrologic modeling tool. Proc. ASCE Watershed Manage. Conf., July 19-22, Williamsburg, VA., 12p., CD-ROM.
- Hernandez, M., S.N. Miller, D.C. Goodrich, B.F. Goff, W.G. Kepner, C.M. Edmonds, and K.B. Jones. 2000. **Modeling Runoff Response to Land Cover and Rainfall Spatial Variability in Semi-arid Watersheds**. *Journal of Environmental Monitoring and Assessment*, 64: 285-298. Kluwer Academic Publishers.
- Kepner, W.G., D.J. Semmens, S.D. Bassett, D.A. Mouat, and D.C. Goodrich. Scenario Analysis for the San Pedro River, Analyzing Hydrological Consequences of a Future Environment [PDF, 13 pp., 2.6 MB]. *Journal of Environmental Monitoring and Assessment*. 2004 94: 115-127. Kluwer Academic Publishers. http://dx.doi.org/10.1023/B:EMAS.0000016883.10110.15
- Levick, L. D.P. Guertin, S.N. Scott, D.J. Semmens, and D.C. Goodrich. 2006. **Automated Geospatial Watershed Assessment Tool (AGWA): Uncertainty analysis of common input data.** Proc. Third Federal Interagency Hydrologic Modeling Conference, April 2-6, Reno, NV.

(see http://www.tucson.ars.ag.gov/agwa for a comprehensive publication list and global applications)