AGWA
The Automated Geospatial Watershed Assessment Tool

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TMDL Analysis

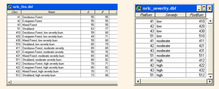
AGWA now supports TMDL analysis for nutrient loading through nitrogen and phosphorus modeling in SWAT. Different scenarios can be defined by modifying the land management parameters. AGWA provides two methods of doing this—setting the management parameter for a subwatershed based on the dominant land cover type or by manually entering a management parameter value for each subwatershed. Nitrogen and phosphorus outputs are available through the results dialog. 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

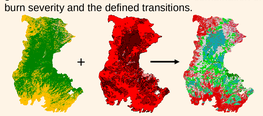
Burn Severity Landcover Change

The Landcover Modification Tool now provides an option to create new land cover grids to study the impacts of fire. Using the Burn Severity component, AGWA users can create a new surface with land covers based on explicit transitions from one land cover type to another based on burn severity.

First, a custom land cover lookup table is created containing pre- and post-burn land cover characteristics. Then, using burn severity descriptors, i.e. low, moderate or high, a change table is created defining the transitions from pre-burn land cover type to post-burn land cover type.



These tables and the burn severity polygon map are used as inputs in the Landcover Modification Tool to generate a new land cover based on the combination of burn severity and the defined transitions.



Original Land cover Burn Severity map New Land cover

Metadata

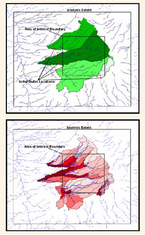
These files contain information regarding the creation and current state of the watershed. This allows watersheds to be transferred between projects, users or machines easily.

AGWA v1.5

Watershed Groups

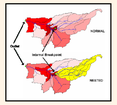
A watershed group is a collection of AGWA watersheds, for either KINEROS or SWAT, that is discretized, parameterized, and simulated as a unit. The group can be defined explicitly using multiple, existing outlet locations or through AGWA with Area of Interest outlet location.

Potential outlets are identified using the stream network and boundary of the area of interest. These outlets are adjusted until the entire area is contained within a watershed. AGWA locates outlets so that the area is contained in the fewest number of watersheds without creating excessively large watersheds.



Nested Watersheds

Nested watersheds use internal breakpoints to identify areas of different complexity, as specified by the user. AGWA then generates a single watershed that can be simulated using SWAT or KINEROS.



Riparian Buffers

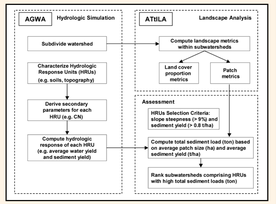
The most common best management practice, riparian buffer strips, can now be discretized and simulated using AGWA and KINEROS. Buffers can be added to any channel segment; users specify the width, length and location on the watershed.

Above, the basic steps for creating riparian buffers are illustrated. First, select the lateral elements of the channels to be buffered. Then, for each lateral element selected, enter a width value. Finally, identify the endpoints for each buffer segment. The lateral elements for the channel are rediscretized using the specified endpoints as internal breakpoints. These new elements are placed in a new watershed.

AGWA can simulate pre- and post-installation watersheds. Land cover characteristics can be set for each buffer element using pre-defined land covers or custom land covers. Slope can also be set for each buffer.

SWAT Hydrologic Response Units

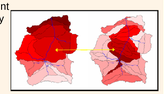
AGWA automatically defines HRUs for each subwatershed based on the unique characteristics of the selected land cover.



AGWA-SWAT with HRUS can be utilized in conjunction with the Analytical Tools Interface for Landscape Assessment (ATtiLA) to integrate landscape ecology with hydrologic modeling. Simulations performed with HRUs can be used to evaluate the impact of land cover/land use on water yield and erosion; landscape analyses can then be performed with ATtiLA to calculate a variety of metrics.

CSA Enforcement

A new internal breakpoint option that automatically inserts breakpoints to ensure that all lateral plane elements correspond to the specified CSA.



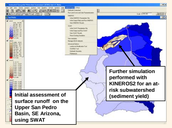
Additional Features

- SSURGO Tool: a collection of functions to facilitate the use of SSURGO soils datasets in AGWA. The tool allows users to merge spatial and tabular datasets, correct internal voids and extend the edges of a dataset beyond the boundaries of a specified watershed.
- Support for spatially distributed precipitation files for KINEROS using recorded time-depth pairs.
- Additional display options: view results with a stored classification based on select simulations or display the results as a time series for KINEROS hydrographs or a specified range for SWAT.
- Improved handling of internal breakpoints, outlet location and discretization to create a more robust watershed discretization process.
- Improved user interface: adjust the stream grid for more accurate outlet placement for high resolution DEMs; select the weather generator file from a point theme; and enter XY coordinates for outlet location.

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.

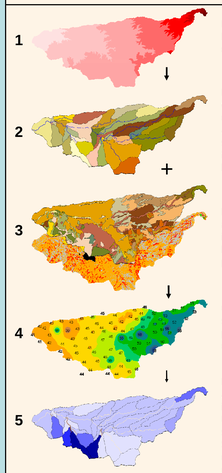


AGWA was developed under the following guidelines:

- 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

The utility of AGWA in joint hydrologic and ecological investigations has been demonstrated on such diverse landscapes as southeastern Arizona, southern Nevada, central Colorado and upstate New York.

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.

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 (< 100km²). 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, sedimentation, crop growth, nutrients, pesticides, and agricultural management.

AGWA Outputs

KINEROS	SWAT
Channel Infiltration (m^3/km)	**Precipitation (mm)**
Plane Infiltration (mm)	**Evapotranspiration (mm)**
Runoff (mm or m^3)	**Percolation (mm)**
Sediment Yield (kg)	**Surface Runoff (mm)**
Peak Flow (m^3/s or mm/hr)	**Transmission Loss (mm)**
Channel Scour (mm)	**Water Yield (mm)**
Sediment Discharge (kg/s)	**Sediment Yield (t/ha)**
Peak Sediment Discharge (kg/s)	
Percent Error	

System Requirements

AGWA 1.5 requires ESRI's ArcView 3.x software and the Spatial Analyst 2.0 extension.

AGWA 2 requires ESRI's ArcGIS 9.x software and the Spatial Analyst extension.

It is designed to run on Microsoft Windows versions 98, NT 4.0, 2000, ME, and XP. Processor speed does have a significant impact on the time required to perform many of the tasks.

References

Arnold, J.G., J.R. Williams, R. Srinivasan, K.W. King, and R.H. Griggs, 1994. SWAT-Soil Water Assessment Tool. USDA, Agricultural Research Service, Grassland, Soil and Water Research Laboratory, Temple, Texas.

Scott, S.N., I.S. Burns, D.J. Semmens, L. Levick, S.N. Miller, M. Hernandez, D.C. Goodrich, W.G. Kepner , 2006, Automated Geospatial Watershed Assessment (AGWA) - A GIS-Based Hydrologic Modeling Tool: Documentation and User Manual: USDA, Agricultural Research Service, ARS-1446. www.tucson.ars.ag.gov/agwa

Woolhiser, D.A., R.E. Smith, and D.C. Goodrich, 1990. KINEROS: a kinematic runoff and erosion model. USDA, Agricultural Research Service, ARS-77, 130p.

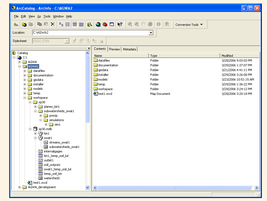
AGWA2 and dotAGWA Software Background

AGWA2 and dotAGWA utilize ESRI software products. For the user interface and data management, AGWA2 uses ArcGIS 9 Desktop while dotAGWA uses ArcGIS Server and ArcSDE. Both products rely on ArcObjects from the ArcGIS 9 software suite for their core functionality. The core geoprocessing and model components are coded in VB.NET.

File Management

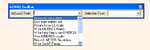
The figure below depicts AGWA2 file management and a typical workspace with several delineations and discretizations. Geodatabases provide a logical organizational structure to store output data. AGWA2 creates a unique geodatabase for each delineation and stores subsequent discretizations in that geodatabase. Discretizations are stored as two feature classes (polygon and polyline) within a feature dataset.

Geodatabases do not store flat ASCII files well, so model inputs and outputs for simulations are stored in subfolders of the same folder as the geodatabase. Each discretization contains its own precipitation folder and simulations folder. This logically organizes inputs and outputs to help prevent inadvertently mixing them up, and also allows more flexibility in naming precipitation inputs and model simulations.

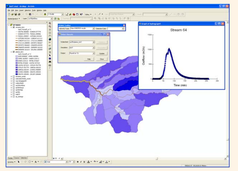


AGWA2

AGWA2 Interface

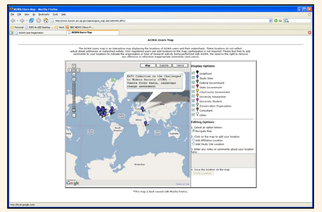


The above image shows the AGWA2 toolbar displayed in ArcMap and some of the functions and tools available. The user interface is designed to mimic the easy to use interface in AGWA v1.5, though improvements offered by VB.NET have been taken advantage of to simplify the interface whenever possible.
The image below depicts the results visualization available in AGWA2. Using the graphs available in ArcMap, users can now view stream hydrographs for individual events (KINEROS) or for average yearly flows (SWAT).

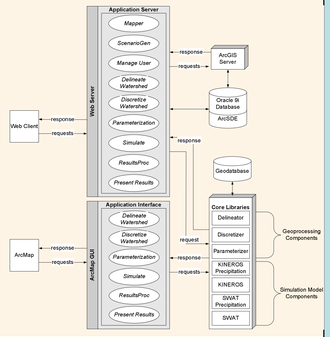


The example at left shows one geodatabase representing one delineation: sp30. The sp30 delineation is expanded to show two feature datasets representing two discretizations: kin1 and swat1. The swat1 feature dataset is expanded to show the polygon and polyline feature classes that compose it: streams_swat1 and subwatersheds_swat1. The workspace folder contains the sp30 delineation and sp30 workspace. The sp30 workspace is organized by discretization, where each discretization has a precipitation and simulation folder.

AGWA Users Map

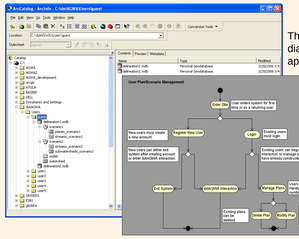


AGWA2 and dotAGWA Design



dotAGWA Interface and User Management

The ArcCatalog frame and corresponding user activity diagram depict the structural organization of the dotAGWA application's user database and user project management.



dotAGWA users will be presented with an interface similar to the one pictured at right after logging in and selecting a scenario. Scenarios can be compared to evaluate differences between management plans. In addition, users will be able to download scenarios for more advanced analysis.

The map interface shown is the primary means of creating management plans, scenarios, and simulations. Model execution and results viewing will also be available via the shown map interface.