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The Automated Geospatial Watershed Assessment (AGWA) tool – Enhanced Capabilities of just released Version 1.4

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Planning and assessment in land and water resource management are evolving from simple, local-scale problems toward complex, spatially explicit regional ones. Many of the hydrologic aspects of water resource managers are better addressed with distributed models that can compute runoff and erosion at different spatial and temporal scales. The extensive data requirements and the difficult task of building input parameter files, however, have long represented an obstacle to the timely and cost-effective use of such complex models by resource managers. The USDA-ARS Southwest Watershed Research Center and the U.S. EPA Office of Research and Development, has developed a Geographic Information System (GIS) based tool to facilitate this process. A GIS provides the framework within which spatially-distributed data are collected and used to prepare model input files and evaluate model results. The Automated Geospatial Watershed Assessment (AGWA) tool uses widely available standardized spatial datasets that can be obtained via the Internet. The data are used to develop input parameter files for two watershed runoff and erosion models: the Kinematic Runoff and Erosion Model, KINEROS2 (http://www.tucson.ars.ag.gov/kineros/), and the Soil and Water Assessment Tool, SWAT (http://www.brc.tamus.edu/swat/).

The latest release of AGWA, version 1.4, is available as a stand-alone extension for ArcView 3.x, and as one designed to be fully integrated with Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) version 3.1, released in August 2004. The new version offers the same ease and automation as the original AGWA, with new features designed to increase the flexibility and power of the tool. The integration of AGWA and BASINS has additional benefits for both BASINS and AGWA users alike. BASINS users will now have additional modeling and visualization tools at their disposal and AGWA users will find required input data much more accessible via the BASINS Data Download Tool.

AGWA version 1.4, stand-alone and for BASINS, has many new features. The Land-Cover Modification Tool (LCMT) increases the utility of AGWA by facilitating scenario development for alternative futures simulations. Improvements to SWAT rainfall modeling with the implementation of elevation bands offer better precipitation estimates, which are crucial to model performance. The ability to customize hydraulic-geometry relationships significantly improves channel network representation, and facilitates model applications in diverse geographies. The ability to rerun existing simulations gives the user the power and flexibility to customize input files, thus facilitating model calibration and the implementation of additional model features while still allowing simulation results to be viewed and compared with the GIS. The implementation of the baseflow feature in KINEROS allows users to better represent

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hydrologic processes in a wider range of geographies. The inclusion of ponds for KINEROS and reservoirs for SWAT facilitates their application in more intensely managed watersheds. The ability to use SSURGO soils to parameterize SWAT provides more flexibility in selecting from available data sources.

Examples

Initial model runs indicate using the new features of AGWA version 1.4 can have a significant impact on model results. As such, care should be taken when applying new features to assure they are used appropriately. Differences shown here are intended only to illustrate the potential benefit of implementing the new features.

The LCMT was used to develop an urban-growth scenario for Sierra Vista, Arizona. To simulate urban growth, the LCMT was used to change land cover in a user-defined area to the North American Landscape Characterization (NALC) Urban class. Significant changes with respect to areal coverage were made for the urban scenario in the following classes: Oak Woodland decreased from 12% to 11% of the watershed area; Mesquite Woodland decreased from 14% to 7%; Grassland decreased from 17% to 12%; Desert Scrub decreased from 20% to 15%; and Urban increased from 19% to 37%. The relative change in total runoff between the original land cover and urban-development scenario using the same precipitation input file is illustrated in figure 1.

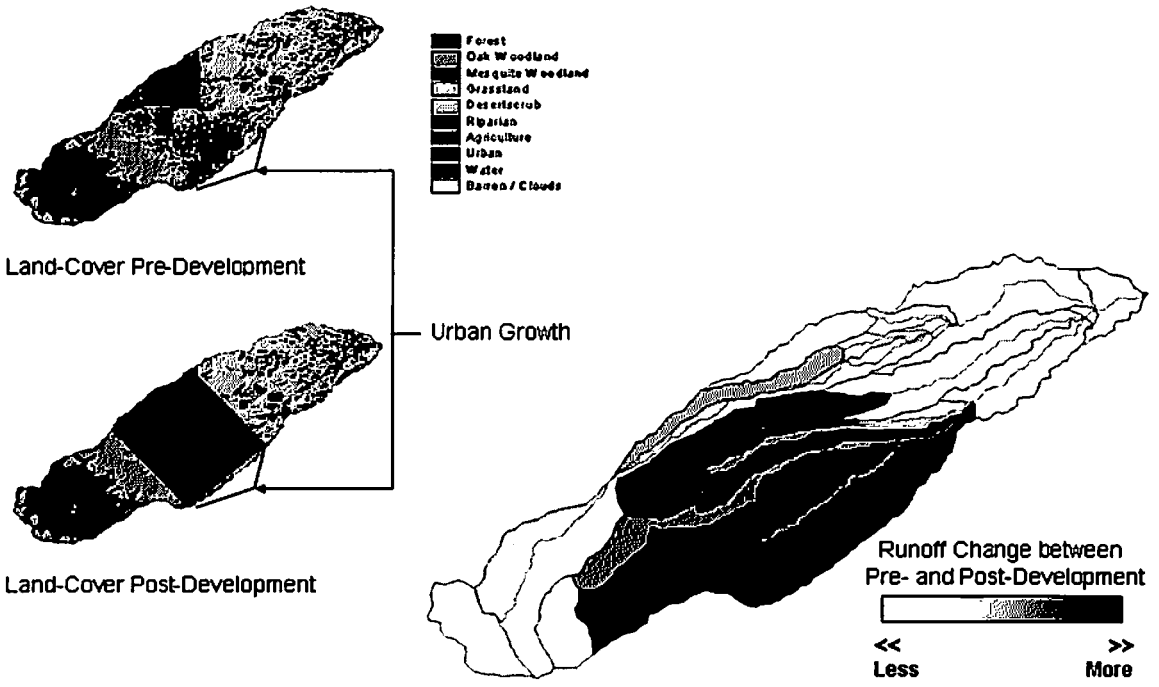

Figure 1. Observed (1997) and hypothetical future land-cover grids (left) and mapped AGWA output showing the relative change in total runoff between KINEROS simulations based on the two land-cover inputs.

The SWAT elevation bands feature was used to illustrate the effects of accounting for precipitation and temperature lapse rates in the San Pedro River Basin, a watershed characterized by high relief with elevations ranging from 900 to 2600 meters. Thiessen precipitation weighting was used with and without elevation bands to illustrate the effect precipitation data can have on surface runoff and channel discharge. Elevation bands were used with a 200m band interval and precipitation and temperature lapse rates of 3 mm/km and -6 °C/km, respectively. The watershed was subject to 12 percent decreases to 15 percent increases in precipitation in the subwatersheds depending on the gage elevation relative to the subwatershed's average elevation. The varied precipitation resulted in 43 percent decreases to 28 percent increases in surface runoff across the subwatersheds. The change in surface runoff was evident in the channel discharge, which varied from 9% decreases to 29 percent increases in different channel reaches.

Discussion

Although requiring additional input from AGWA users, the new features described herein provide the means to significantly improve model results for both KINEROS and SWAT in a range of geographies. The LCMT provides the added ability to generate land-cover/use scenarios, or alternative futures, for evaluation using the models.

Applications of the new features are not limited to the examples shown here. SWAT elevation bands may be used with uniform or distributed rainfall inputs. The LCMT may also be used to facilitate pre- and post-fire assessment, and in future versions it will facilitate the application of best management practice (BMP) scenarios. The LCMT includes three different means to modify existing land-cover grids:

- Changing an entire user-defined area to a single land-cover type;
- Changing just one land-cover type to another in a user-defined area;
- Changing an entire user-defined area to a random pattern of up to three user-defined land-cover types.

Future Directions

Development of AGWA and related products is ongoing. A future AGWA release, version 1.42, is planned with support for global FAO soils in KINEROS and SWAT, and with enhanced temporal output visualization for SWAT. Additionally, the integration of AGWA and the Analytical Tools Interface for Landscape Assessment (ATtILA - http://www.epa.gov/nerlesd1/land-sci/attila/) extension will be formalized to improve parameterization of SWAT by taking advantage of its hydrologic response unit (HRU) feature. Development of DotAGWA, an Internet-delivered version of AGWA, and AGWA 2.0 for ArcGIS, will begin this fall, with planned Beta releases for both in the fall of 2005. To find up-to-date documentation and software and read about our current and future research, please visit our updated website at http://www.tucson.ars.ag.gov/agwa/.