

Introduction

The Automated Geospatial Watershed Assessment (AGWA) Tool incorporates two watershed runoff and erosion models, KINEROS and SWAT, into a GIS framework (ArcView). The Land Cover Modification Tool adds functionality to ArcView by allowing the user to modify a land cover map. These two tools were combined into an ArcView extension and applied at Fort Huachuca, Arizona to simulate the impacts of various management activities on the local hydrology.

Fort Huachuca is located within the San Pedro River Basin and upstream of the San Pedro Riparian National Conservation Area (SPRNCA). The SPRNCA was designated by Congress in 1988 to "protect and enhance the desert riparian ecosystem, a rare remnant of what was once an extensive network of similar riparian systems throughout the Southwest". Fort Huachuca, west of Sierra Vista, houses the U.S. Army Intelligence Center and employs approximately 11,500 people. The 3060 ha base is situated in semi-desert grasslands at the base of the Huachuca Mountains. About 66,000 people live in the Sierra Vista Sub-watershed.

Explosive population growth in the area has stressed the San Pedro River system, requiring the Fort and other municipalities in the watershed to evaluate the hydrologic impacts of their management actions. This tool provides a powerful means of helping land managers reduce negative impacts to the SPRNCA.

Land Cover Modification Tool Description

The Land Cover Modification Tool was developed by the USDA-ARS/SWRC for use in the San Pedro River basin to evaluate the effect of land cover changes in various applications. Management personnel at Fort Huachuca desired a tool to evaluate impacts of their management actions on the hydrology of the area. A 1997 North American Land Cover (NALC) map was customized for use at Fort Huachuca by intersecting a roads coverage with the NALC map to classify roads as "barren" areas. This enables land managers to evaluate road restoration projects in addition to other projects.

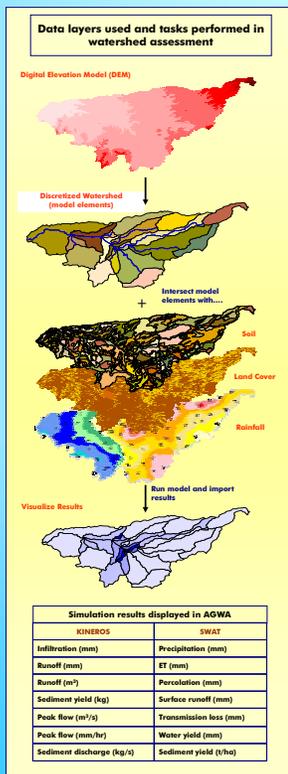
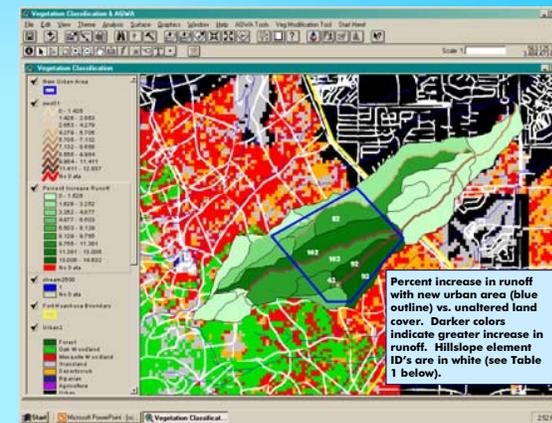
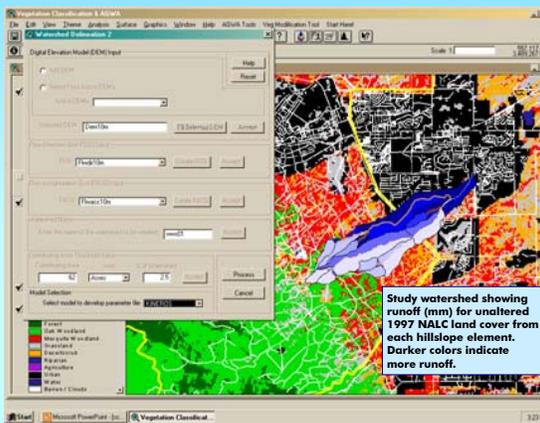
Through user-friendly interfaces, the Land Cover Modification Tool allows the user to modify the NALC map in one of three ways:

1. Change one land cover type to another within a user created polygon (i.e. change barren to grassland)
2. Change the entire user created polygon to one land cover type (i.e. change to all urban)
3. Change the areas within a user-supplied polygon coverage to one land cover type (i.e. analyze a prescribed burn by changing land cover type to grassland)

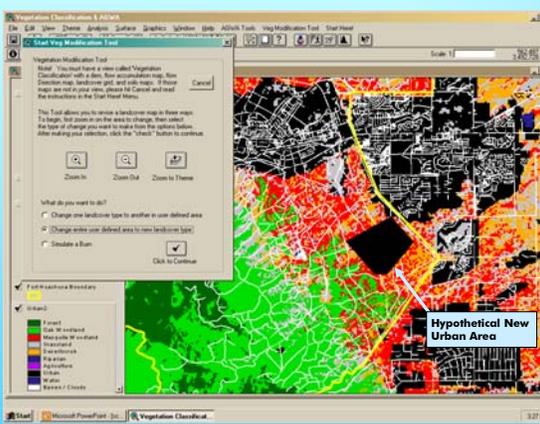
Once the new land cover map is created, AGWA may be run on both the new and original land cover configurations to evaluate the hydrologic impacts of the land cover change on a watershed scale.

Using AGWA and the Land Cover Modification Tool

AGWA may be used to parameterize two hydrologic models that predict runoff, infiltration, peak flow, and sediment yield from a watershed, and can be used to evaluate the impacts from land cover change. In this hypothetical scenario, AGWA/KINEROS and the Land Cover Modification tool are used to evaluate change in runoff and peak flows from a possible new urban area on Fort Huachuca to a small watershed terminating in the city of Sierra Vista. The watershed was delineated with AGWA, and the land cover map was revised with the Land Cover Modification tool. KINEROS was applied to both the unaltered map and the modified land cover map, and then AGWA was used to display the difference in runoff between the two simulations.



Step 1. Use the AGWA tool for watershed delineation and analysis. Display shows the NALC Land Cover map (showing roads classified as "barren") with Fort Huachuca boundary (yellow) and existing urban areas of Sierra Vista and Fort Huachuca (black). The study watershed generated by AGWA is shown in blues/purples. The watershed is divided into hillslope elements, or overland flow planes. In this example, AGWA is used to determine the contribution to runoff from the Fort to this small watershed using the KINEROS simulation model and the unaltered NALC land cover map.



Step 2. Use the Land Cover Modification Tool to change an entire user defined area to a new land cover type. Display shows the Fort Huachuca boundary (yellow) and urban areas of Sierra Vista and Fort Huachuca (black). The New Urban Area defined by the user (shown in solid black near Fort Huachuca's boundary), was used to create a new land cover map with the Land Cover Modification tool. AGWA will be applied to this new land cover map to evaluate the impact on the local hydrology from this potential new development.

Step 3. Use the AGWA tool to view the results. Display shows the difference in runoff (%) for the study watershed when analyzed with the original NALC land cover map and the modified land cover map (with new urban area).

Table 1. Comparison of runoff and peak flow for selected hillslope elements in the study watershed for the unaltered land cover configuration (base run) and the modified land cover configuration (Urban run; with new hypothetical urban area).

ID	Percent change (%)	
	Runoff	Peak flow
93	14.63	8.00
92	14.31	6.16
43	13.34	4.62
102	12.52	8.07
103	9.50	5.61
82	9.12	5.77

AGWA Description

Developed by the USDA-ARS Southwest Watershed Research Center, in cooperation with the U.S. EPA Office of Research and Development, AGWA is a GIS tool used to prepare inputs and display results from two watershed runoff and erosion models: KINEROS and SWAT.

The use of digital data in combination with the automated functionality of AGWA greatly reduces the time required to use these two watershed models. Through a robust and intuitive interface the user selects an outlet from which AGWA delineates and discretizes the watershed using a DEM. The watershed elements are then intersected with soil, land cover, and precipitation (uniform or distributed) data layers to derive the requisite model input parameters. The model is then run, and the results are imported back into AGWA for visual display.

Model results that can be displayed in AGWA are shown in the table to the right. This option allows managers to identify problem areas where management activities can be focused, or to anticipate sensitive areas in association with planning efforts.

AGWA is designed to evaluate relative change and can only provide qualitative estimates of runoff and erosion. It cannot provide reliable quantitative estimates of runoff and erosion without careful calibration. It is also subject to the assumptions and limitations of its component models, and should always be applied with these in mind.

Conclusions

AGWA and the Land Mod Tool were used to evaluate the hydrologic impacts of a land cover change in the Sierra Vista Sub-basin. For this example, runoff increased by up to 14.63%, and peak flow increased by up to 8.00% for the hillslope elements of the watershed affected by urbanization (see Step 3 and Table 1). Total runoff from the watershed increased from 9.58 mm to 10.22 mm, or 9.2%.

Additional Information

Both AGWA and the Land Cover Modification tool use readily available GIS data. The USGS DEM (10m or 30m), NRCS STATSGO or SSURGO soil data, and US-EPA MRLC or NALC land cover data are easily downloaded from the internet. Version 3.1 or later of ArcView and version 1.1 of the Spatial Analyst extension are required. The tools work with Windows 95, 98, 2000, ME, NT and XP environments.

AGWA, with supporting documentation and data layers, may be downloaded for free at <http://www.tucson.ars.ag.gov/AGWA>. Please note that AGWA is considered BETA software and does not have any technical support. The Land Cover Modification Tool is still under development and is not currently available for distribution.

Acknowledgements

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