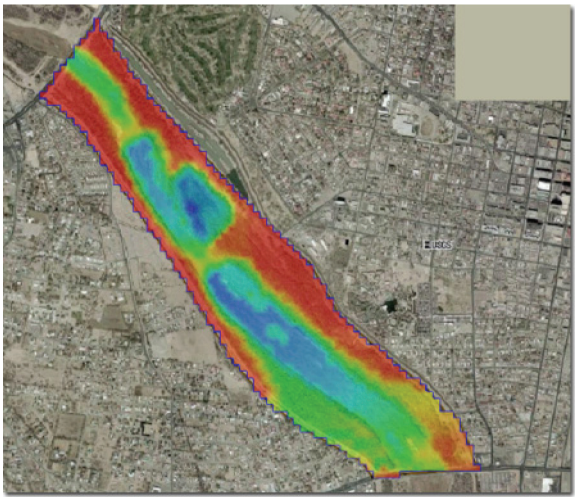
System-Wide Water SWWRP Resources Program

Gridded Surface Subsurface Hydrologic Analysis (GSSHA)



Description: Gridded Surface Subsurface Hydrologic Analysis (GSSHA) is a watershed analysis and management tool that has the ability to simulate the movement of water, sediment, and associated constituents across watershed-scale areas. The model is capable of simulating streamflow generated by excess runoff, saturated source areas, exfiltration, and groundwater discharge to streams. It is also capable of simulating soil moistures and groundwater levels at the grid scale as well as wetland hydraulics, storm drainage networks in urban areas, and tile drainage networks in agricultural areas.

Application: Current GSSHA applications include the Kishwaukee watershed in Illinois (just outside of Chicago) that is focusing on providing flooding and groundwater level information for a watershed management plan that includes removing tile drains and restoring native wetlands. Another application is in south Washington County, Minnesota, where an urbanizing area in glacially influenced terrain is being modeled to predict flooding. A third application involves modeling a portion of the Rio Grande River to predict local groundwater level changes due to a small dam being inserted in the river. The results of the GSSHA model will be tied to ecological models to predict ecological change based on changes in water levels.

Benefits: GSSHA adds the ability to simulate saturated and unsaturated groundwater, allowing use of the model in a variety of climates and watersheds. Because of its numerical formulations, GSSHA is able to be applied as a watershed model in coastal areas and in areas around large water bodies. GSSHA can predict flooding from rainfall events and also from storm surge events. GSSHA is also able to simulate the effects of localized projects, such as wetlands addition or the removal of tile drains that traditional hydrologic models cannot predict. It interfaces with the Watershed Modeling System (WMS). Using GSSHA and WMS will enable modelers to use greater levels of data detail, better models of physical processes, and reduce the data collection, model setup, and post-processing time from weeks to days.

Future Capabilities: Currently, water quality routines for in-stream, overland, and in-soil processes are being added to GSSHA. These routines will include basic carbon/nitrogen/phosphorous (C/N/P) processes as well as plant uptake and contaminant kinetics. It is anticipated that this capability will be in GSSHA by the end of FY07.

The sediment transport routines are in the final stages of testing.

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Future developments will see a regional three-dimensional groundwater model, improved snowmelt modeling, improved linkage to water quality and habitat models, and improved numerical schemes for decreased run-time and increased stability.

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