American Water Resources Association
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GIS & Water Resources VI
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Tuesday, March 30
8:30 AM – 10:00 AM
SESSION 10: Basins

BASINS 4.0 - Overview and Recent Developments - Paul Duda, AQUA TERRA Consultants, Decatur, GA (co-authors: Daniel P. Ames, James N. Carleton)

The U.S. Environmental Protection Agency's (EPA's) Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) is a multipurpose environmental analysis system designed for use by regional, state, and local agencies performing watershed and water quality-based studies. It was developed by the EPA's Office of Water to facilitate examination of environmental information, to support analysis of environmental systems, and to provide a framework for examining management alternatives. BASINS integrates environmental data, analytical tools, and modeling programs under a Geographic Information System (GIS) environment to support development of solutions to watershed management problems and environmental protection issues, including development of Total Maximum Daily Loads (TMDLs). The current release of BASINS, version 4.0, is the first to be based primarily on a non-proprietary, open-source GIS foundation. By using open-source GIS tools and non-proprietary data formats, the core of BASINS is now independent of any proprietary GIS platform while still accommodating users of several different GIS software platforms. The use of open source software provides BASINS with greater stability and transparency because the source code for all components is available to developers and end users. The open-source framework of BASINS is designed around an extensible architecture that readily allows for the addition of new capabilities. BASINS encompasses a growing suite of watershed and water quality models, from sophisticated broad-spectrum watershed models to agricultural models to planning and management level models. New data types and analysis tools also continue to be added to BASINS. Most of these additions are in the form of plug-ins, allowing BASINS capabilities to expand without issuing a new release each time a new feature is added. This flexibility enables BASINS to continue evolving to meet the changing needs of the watershed management community.

HydroForecaster: An Open Source GIS-Enabled Hydrologic Data Time Series Forecasting Framework and Artificial Neural Network Implementation - Tevaganthan Veluppillai, Idaho State University, Idaho Falls, ID (co-authors: Daniel P. Ames, Harold Dunsford)

Object oriented programming advances in computer science - including concepts of object inheritance, interface implementation, and object attributing - present opportunities to overcome certain challenges associated with developing, testing, and deploying hydrologic data time series forecasting methodologies. Indeed, a graduate student or research scientist can implement and test new forecasting methods using rapid prototyping and modeling tools such as MATLAB, however when the requirement arises to deploy forecasting algorithms and tools to end-users - either in an operational or research context - the challenge becomes one of implementing the required code either as a standalone application (which may result in extensive and potentially time intensive GUI and data/file management development efforts) or one can simply code the methodology in a proprietary software package and require users to purchase associated licenses. In these cases, users are still required to perform basic data management tasks to ingest and prepare the hydrologic data. To overcome some of these issues and enable future developers of hydrologic data forecasting tools, we have created an object oriented, interface driven "extension" architecture specifically for hydrologic forecasting methodologies. This architecture works tightly with the open source, GIS-based HydroDesktop software application for data management and display, and allows users to access a number of forecasting methodologies and approaches within a consistent map-based environment. Forecasting results are stored in the HydroDesktop relational database structure and are hence able to be integrated with the broader CUAHSI Hydrologic Information System and HIS Servers. Most importantly, the architecture has been developed and documented on a community coding web portal such that future developers can build new forecasting algorithms by simply implementing the appropriate interfaces in their own code, compiling an associated DLL binary file, and placing it in a specified directory on the users' computers. This results in the new algorithm or method becoming

immediately available for use by end users. This presentation includes an overview of the HydroForecaster tool and demonstration of the framework through an extension that provides artificial neural network training and streamflow forecasting.

Development and Demonstration of a Hybrid Modeling Capability within the Fort Benning HSPF Watershed Model: Refinement of Unpaved Road Simulation Using WEPP:Road - John Imhoff, AQUA TERRA Consultants, Ouray, CO (co-authors: John L. Kittle, Jr., Brandon B. Gonzales, Anthony S. Donigian, Jr., Patrick N. Deliman, William J. Elliot, Dennis C. Flanagan)

A four-year project funded by the Strategic Environmental Research Program is in progress to develop a comprehensive watershed management model (using EPA's BASINS modeling system and HSPF watershed model) for Fort Benning, Georgia that addresses impacts on watershed hydrology, water quality and related ecosystems resulting from military activities and natural resources management. An additional objective of the project is to enhance the baseline Fort Benning HSPF watershed model developed during the first two project years to better reflect impacts from military land management. Watershed models and modeling efforts need improved ability to assess management-scale impacts within a larger watershed-scale context. Accordingly, a generalized capability has been developed to perform hybrid model applications in which HSPF can be used for modeling catchment-scale phenomena, while one or more field- or hillslope-scale models featuring more detailed process formulations for specific activities, sources, or land uses are run in parallel to HSPF. Using this hybrid modeling capability, the smaller-scale models provide time series flow and loadings for smaller areas with potentially large runoff or water quality impacts. It is a repeated message throughout forestry literature that road erosion is commonly the largest contributor to sediment production within forest watersheds such those that encompass Fort Benning. Proper understanding, design, construction and management of unpaved roads at Fort Benning require the use of credible methods and models for estimating sediment erosion and its impacts, and these models require a higher level of detail that surpasses the capabilities currently provided by HSPF and similar watershed-scale models. The forestry community considers USDA's WEPP:Road model as the state-of-the art model for estimating runoff and sediment yield from unpaved forest roads. To make available a more robust set of formulations for simulating sediment washoff from Fort Benning's unpaved forest roads, a WEPP:Road application will be presented as a demonstration of the hybrid modeling capability that has been developed for HSPF. This oral presentation will describe the HSPF hybrid model enhancement; describe improvements in representation enabled in WEPP:Road simulation; and compare and discuss results that were achieved by the preliminary HSPF baseline model and the hybrid HSPF/WEPP:Road application.

Towards Virtual Watersheds: Integrated Data Mining, Management, Mapping, and Modeling using Standards Based Web Services and an Open Source Software Stack - Yang Cao, Idaho State University, Idaho Falls, ID (co-author: Daniel P. Ames)

With the increased deployment of satellite telemetry, remote sensing and other automated data collection systems, a great quantity of geospatial data is being accumulated in online spatial databases and spatial information repositories and served using standards based web services such as those defined by the Open Geospatial Consortium (OGC). Additionally, a growing quantity of climate and hydrologic point observation data is being stored and distributed in standards-based web systems and services such as defined by the Consortium of Universities for the Advancement of Hydrologic Sciences (CUAHSI). These developments together with the rapidly increasing availability of open source GIS and modeling software tools represent the nascent requirements for a truly open and accessible standards-based virtual watershed system which could be used for education, research, and management purposes. This presentation/poster explores the fundamental requirements of such a system including data mining through on-line analytical processing (OLAP); data management using well defined server side and client side data management tools and standards for both spatial and temporal data; visualization through both web-based and client side open source mapping systems; and modeling using OpenMI as a model interoperability standard.