WaterFALL™—Watershed Flow and ALLocation Modeling System Using NHDPlus

RTI International's watershed modeling tool and decision-support platform, WaterFALL, enables interactive, quantitative investigation of water availability at multiple geographic scales. WaterFALL employs a well-established hydrologic model, the Generalized Water Loading Function (GWLF), that has been modified to run on the U.S. Environmental Protection Agency's enhanced National Hydrography Dataset (NHDPlus) network. Scenario features built into WaterFALL's Web-based user interface provide an easy-to-use assessment tool for answering a variety of water quantity–based questions across the continental United States quickly and with limited user input.

System Architecture

WaterFALL's distributed model architecture is designed to be scalable and portable. The model can be run anywhere on the NHDPlus network for a single catchment or for any watershed upstream of a user-selected catchment with minimal model set-up, calibration, or additional data inputs. RTI has indexed data layers, including 46 years of daily climate data (1960–2006), onto each NHDPlus catchment. This enables WaterFALL to provide all of the input data needed for users to parameterize and run the GWLF model within each catchment and to quantify the cumulative water resource impacts across catchments. In addition, the system's front and back ends have been designed with accessibility and usability in mind, allowing users to perform modeling and conduct analyses from almost any Internet-connected computer in real time. Finally, WaterFALL provides granularity in its outputs through its distribution across many small NHDPlus catchments, which offers localized sensitivity to geographic variations in land cover and climate variables across a study region.

How It Works

Beginning with a map view of the contiguous United States, WaterFALL allows users to select from several different map views and navigate the map interface. The interface includes a variety of functions for identifying a selected study area and for viewing and modifying the default model input data. No additional model set-up or parameterization is required because all of the input data are georeferenced to each NHDPlus catchment.

WaterFALL's user interface provides navigation, modeling, and scenario management features over a standard Internet connection.

WaterFALL addresses five primary needs:

- **Land Use and Climate Change Adaptation.** Employing GWLF, the system calculates runoff based on precipitation rate, ambient temperature, and land use. Down-scaled climate modeling of future changes in precipitation or temperature and changes in land use can be incorporated to determine how predicted changes may shift the availability of water and the characteristics of the flow regime at any user-designated geographic location.

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- **Ecological Flow Development.** WaterFALL produces a complete hydrograph for each NHDPlus catchment included in the user-selected study area. As a result, flow, velocity, and water depth are profiled for small stream reaches, often one kilometer or less in length, on a daily time step. The model performs independently of stream gage data, eliminating the need for extrapolation of historical flow data. WaterFALL output can be examined easily with the Index of Hydrologic Alteration software (IHA) to develop flow regime metrics needed for input in the Ecological Limits of Hydrologic Alteration framework.
- **Water Supply Risk and Impact Assessment.** WaterFALL is an efficient tool for large consumers of water to assess site-specific vulnerability of water supplies, support plant siting studies, better target water conservation investments, and satisfy sustainability measurement and reporting requirements such as those included within the Global Reporting Initiative framework.
- **Water Allocation and Management.** WaterFALL enables water resource planners and managers to systematically evaluate the impacts of proposed water allocation strategies on water availability throughout an entire watershed. State and regional water resources managers can employ the model to quantify the available daily yield of local watersheds and to better understand how those yields would be altered as a consequence of either temporary or permanent changes in rainfall amounts, air temperatures, water withdrawal or consumptive use rates, or land use patterns.
- **Reservoir Storage-Yield-Reliability Analysis.** WaterFALL can be employed to generate a time series of stream inflows to reservoirs under both historical and anticipated climate and hydrologic conditions. These data are critical in calculating the likelihood that a reservoir will be able to satisfy demands or yields, especially under changed, or "non-stationary," fluctuations in inflow rates.

WaterFALL can be used by people of all skill levels. Because it is already parameterized and built in a spatially explicit network, users without any modeling experience can simply choose a location and dates and run the model. For users with more advanced skills, WaterFALL provides the ability to modify model input parameters, make comparisons to measured flows, and run different scenarios. Export of the hydrologic output from WaterFALL occurs as a standard time series text file, allowing it to be manipulated or further analyzed in a variety of external software packages, such as the IHA, or even input into an additional modeling algorithm, such as a reservoir operations model. Finally, validation metrics for WaterFALL simulations compared to monitored streamflow records are also output at all available locations (e.g., U.S. Geological Survey streamflow gages) for assurance of model performance.

More Information

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