A Dynamic One-Dimensional Model of Hydrodynamics and Water Quality (EPDRiv1)

Introduction

The EPDRiv1 package contains user-friendly programs designed to model one-dimensional waterbodies with special emphasis on the needs of regulatory decision making including TMDLs and conventional wasteload allocations. Initially based on CE-QUAL-RIV1 (developed by the U.S. Army Engineers Waterways Experiment Station) EPDRiv1 now contains both hydro-dynamic and water quality models, managed by a robust preprocessor, supported by a capable post processor, each integrated with the Water Resources Database (which is also a stand alone part of the Tool Kit).

The current version of EPDRiv1 was developed for the Georgia Environ-mental Protection Division directed by Dr. Roy Burke III, and the U.S. Environmental Protection Agency, Region IV, supervised by Mr. Jim Greenfield. The model, support software, and documentation were prepared by AScI Corporation, Natural Resource Engineering, Inc., and Clayton Engineering Inc. EPDRiv1 has been successfully applied to complex water quality issues including the Chattahoochee River near Atlanta and the Coosa River Basin also in Georgia.

Enhancements and Extensions

Extensive modifications were made to the original hydrodynamic and water quality codes to improve performance and add capabilities for performing waste load allocations in complex systems incorporating wastewater discharges, tributary inflows, water withdrawals, and power plant heat loads. In addition, three user-friendly tools were developed from scratch to provided an integrated modeling-analytical system. These include the preprocessor for input file development and overall project management, the postprocessor for analysis of model results, and the Water Resources Database which supports and interacts with the other two.

Computational Components

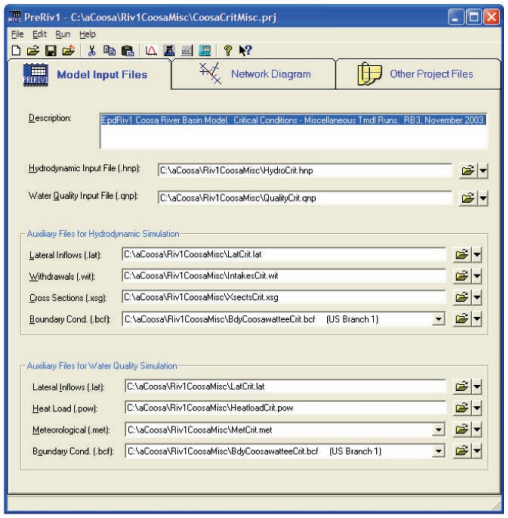
There are two computational components: a one-dimensional, cross-sectionally averaged, hydrodynamic model EPDRiv1H and the water quality model EPDRiv1Q. (The two models run separately.) EPDRiv1H can successfully represent dendritic or branching river systems and can handle downstream tidal influences, downstream lake effects, dynamic water withdrawals, dam spillway operations and storm events. EPDRiv1H can provide hydraulic output or linkage files for use by either EPDRiv1Q or WASP.

EPDRiv1Q can simulate 16 state variables, including water temperature, dissolved oxygen, carbonaceous oxygen demand, nitrogen species (organic nitrogen, ammonia, and nitrate), phosphorus species (organic phosphorus and orthophosphate), algae, iron, manganese, bacteria and two arbitrary constituents. In addition, the model includes the impacts of attached macrophytes on dissolved oxygen and head loads from power plants on river temperature and water quality kinetics. Temperature simulations, using the full heat balance method, have been notably successful.

User-Friendly Utilities

Much effort and testing have been invested to ensure that the EPDRiv1 package is intuitive and easy to use, particularly for less experienced modelers in regulatory agencies. This includes a unique set of tools for management and analysis of raw data, development of all model input files, and graphing, analyzing, and reporting model results.

The **preprocessor** (PreRiv1) is the EPDRiv1 master control center. Through the preprocessor the user can: create new models; build, view, and edit all model input files in simple user-friendly forms; execute hydrodynamic and water quality simulations; launch other utilities like the postprocessor and Water Resources Database; and, perform other standard chores. When models are running, real-time results are displayed on screen either in graphical form or in an Excel-type grid at the user's choosing, helping the modeler observe the river system behavior during computations.



EPA United States Environmental Protection Agency

The preprocessor is organized around the *project* concept, in which all the files associated with a hydrodynamic and water quality simulation are identified and listed in a project file (*.prj). PreRiv1 also provides: file integrity checks, input data validity checks, and generous on-line modeling help that explains inputs and offers suggestions for kinetic parameter values.

In PreRiv1 time series data can be manually input, or imported from the Water Resources Database or other data sources and file formats. PreRiv1 has the capability to interpolate missing values if appropriate, apply scale and conversion factors during the "build" operation, and graph the input data for visual examination.

The **postprocessor** is capable of graphically displaying very large files (100s of Mb) of various types, comparing simulation results with observed data stored in a variety of data sources (usually WRDB), subtracting two curves to assess differences, and performing other useful analyses. Several graph types are available including: time series; longitudinal, depth, and width profiles; frequency histograms and probability plots, and scatter plots. Select graph types can be viewed in an animation mode. Statistical and mathematical curve fits are available when needed, and statistics can be instantly displayed to help the modeler compare various modeling runs or observed data. PostRiv1 also provides robust export options and excellent reporting capabilities.

Summary

For complex one-dimensional river systems with issues that do not involve sediment transport, toxics, or metals, EPDRiv1 would be the model of choice. It uses state-of-the-art solution routines and provides defensible results for regulatory decision making.

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Watershed & Water Quality Modeling
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