GIS-BASED DECISION SUPPORT SYSTEM FOR INTEGRATED TWO-DIMENSIONAL FLOOD ANALYSIS AND CONSEQUENCE ANALYSIS

Mustafa Altinakar, The University of Mississippi, 662-915-7788, altinakar@ncche.olemiss.edu

1. Mustafa S. Altinakar, NCCHE / The University of Mississippi
2. Marcus Z. McGrath, NCCHE / The University of Mississippi
3. Vijay P. Ramalingam, NCCHE / The University of Mississippi
4. Hamzeh Omari, NCCHE / The University of Mississippi

This paper describes the DSS-WISE™ software package, which is a GIS-based integrated decision support environment for two-dimensional flood simulation and consequence analysis. The DSS-WISE™ is comprised of three principal modules: (1) a GIS-based graphical user interface and pre-processor assists the user in preparing input data and in defining the simulation scenario; (2) a two-dimensional numerical model, called CCHe2D-FLOOD, which solves conservative form of two-dimensional shallow water equations using a shock capturing finite-volume scheme; (3) a GIS-based postprocessor with a series of modules for flood mapping, flood hazard risk mapping, and consequence analysis, such as loss-of-life, urban and agricultural damage. The entire decision support system is implemented as an extension of the ArcGIS, which is a commercially available, widely used geographic information system.

The numerical model CCHE2D-FLOOD is a multi-core multi-threaded parallel code that uses HLLC scheme to solve shallow water equations over complex natural topography. It can handle mixed flow regimes, wetting and drying, and preserves oscillation free sharp discontinuities. It offers many advanced features that allow the user to define realistic flood scenarios. Cut-cell immersed boundary technique is implemented to represent linear terrain features (such as road and railroad embankments) that are not captured by DEM, A special version of cut-cell immersed boundary technique is also used for defining rivers in coupled 1D-2D modeling. The user can define multiple dams, each with its own breaching sequence. Automatic local mesh refinement using quadtree method is implemented to resolve gradual dam breaching with sufficient resolution. Sources and sinks can be defined to model reservoir operations and flow through hydraulic structures (spillways, bottom outlets, bridges, etc.). Various boundary conditions can be specified along the model boundaries. Variation of Manning's roughness coefficient over the computational domain can be automatically computed using classified land-use data. By defining a series of observation points, lines and profiles the user can monitor simulation results in more detail at selected locations. The results can be directly read into ArcGIS for mapping and consequence analysis.

The paper describes the integrated system and discusses its capabilities. Examples of application to real-life cases are also provided.