Texas A & M University and U.S. Bureau of Reclamation
Hydrologic Modeling Inventory
Model Description Form
July 18, 2007

Name of Model:
WISTOO - Mathematical Model of Rainfall-Runoff Transformation.

Model Type:
Integral distributed mathematical model. Based on digital GIS thematic layers.

Model Objective:
- runoff hydrograph simulation at arbitrary valley cross-section,
- spatial visualization of hydrological processes,
- determination of influence of water reservoirs on runoff hydrograph from watershed.

Agency and Office:
Cracow University of Technology
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Model Structure or Mathematical Basic:
Integral distributed model based on hydrodynamic equations describing processes: infiltration, surface runoff, subsurface runoff and water transformation in river network. Interception and groundwater runoff are described by simplified formulas. Evapotranspiration process is solved depending on meteorological input data, as Penman-Motheit equation, empirical function or tabular values.

Model Parameters:
- state of the terrain and land-use (ex. resistance coefficient – roughness, coverage height, permeability, coverage retention etc.),
- soil and sub-soil type: porosity coefficient, maximal soil conductivity, soil depth.

Parameters are estimated from digital thematic layers.

Spatial Scale Employed in the Model:
Optimal spatial scale varies between 10m x 10m and 25m x 25m for one cell (calculation element). Bigger cells for mountainous watersheds cause distortions in digital elevation model. In some cases bigger cells can be used.

Temporal Scale Employed in the Model:
Basic calculation time step is 1 hour. For small watersheds 10 min. time step can be applied.

Input Data Requirements:
Minimal data set consists of daily precipitation and runoff at watershed closing cross-section. Closing cross-section can be selected arbitrary.
Entire meteorological data set contains hourly data of precipitation, air temperature and humidity, wind velocity, and sun radiation.

Computer Requirements:
Minimum PC-type with Microsoft Windows 95/NT, Pentium 200MHz, 128 MB RAM. Display size and graphic card determine quality of results visualization.

Model Output:
Output from the model is determined by type of simulation. It can be:
- runoff hydrograph for 10 arbitrary selected cross-sections,
- spatial visualization of changes of selected hydrological process:
    - net precipitation (interception),
    - depth and velocity of water layer on watershed – surface runoff,
    - depth and velocity of water layer in soil – subsurface runoff,
    - volumetric soil humidity.
- runoff hydrograph in closing cross-section taking into account water reservoir with selected management policy.

Parameter Estimation/ Model Calibration:
Model parameters are estimated from digital thematic layers.
Fitting of simulated hydrographs to observed ones is done by soil parameter correction.

Model Testing and Verification:
Model testing and verification is based on fitting analysis of calculated and observed runoff hydrographs in selected cross-sections.

Model Sensitivity:
Model output hydrograph is sensitive to cell size. Cell size should be equal to mean river bed width.

Model Reliability:
Model is stable; lack of rapid variations in output with major changing parameter values.

Model Application/Case Studies:
Model was applied to several mountainous watersheds (from 20 to 500 km^2) in Tatra and Beskidy (Middle Karpatian) mountains. Model is useful in determination of high-risk flood plain, influence of land-use changes, water reservoir efficiency, and in visualization of hydrological processes.

Documentation:
Entire documentation is available at Cracow University of Technology.

Other Comments:
Model can be adopted for wide range of mountainous watersheds.