Geophysical Research Abstracts,
Vol. 11, EGU2009-9231, 2009
EGU General Assembly 2009

Building a Coherent River Network for Hydrologic and Hydraulic Simulations

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The river network is the natural link between hydrological and hydraulic studies. In a physically based and spatially distributed model, the hydrological part uses the rivers as an outlet for the runoff and baseflow, while the hydraulic studies pay a particular attention to the propagation of these inputs through the river, taking into account the real cross-sections properties and the presence of hydraulic structures along the river. In the hydrologic studies, the river network is computed on the basis of the Digital Elevation Model (DEM), and therefore covers the whole basin, but with very few informations on the rivers characteristics. On the other hand, hydraulic studies often need a much more detailed description of the river geometry, and rely on accurate data from on-site surveys, such as river cross-sections or engineering structures descriptions. However, this kind of data is generally only available on a reduced part of the bassin. A methodology is therefore proposed to generate a river network coherent with both hydrologic and hydraulic approaches.

The DEM is modified using a “stream burning” algorithm to force the topography-based river paths to follow the real river course where sufficient data is available. Specific engineering structures which modifies the flowpaths (such as an important railway) can be taken into account in this process at this stage. A first 1D river network is then generated with this new DEM. At the same time, a second 1D network is created using the cross sections data, including every hydraulic structure such as sluice, footbridges, and pipes. Both networks are then merged using the following procedure. First, the river branches are split into multiple parts at each characteristic point (confluences and ends) of both networks. Second, the DEM-based river parts are replaced by the corresponding parts from the other (more accurate) network, where available. Special treatments are applied to deal with the inconsistencies between both networks, such as the bed level discontinuities at the junctions. Eventually, the split river parts are merged back to form the complete river network. When necessary, other additionnal networks, such as the sewage system (when computed explicitedly in the hydrological model) can easily be added in the overall merging procedure.

The above method was tested on two Belgian catchments (with catchment areas of 40km^2 and 130km^2) in the framework of combined hydrologic and hydraulic studies, and proved to be very convenient and efficient to build the river networks.