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Effect of land surface elevation data availability on river hydraulic model output

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River hydraulic models are useful tools in watershed management. They are critical components of flood planning studies, and are prerequisites for pollution transport modeling. One of the critical parameters in modeling river hydraulics is the river channel slope. When the river system of a large watershed is of concern, the land surface elevation data can be used to create the river network and to determine the slopes of the river channels. Digital elevation maps (DEMs) created by using remote observations, together with GIS tools provide an easy way to delineate the river network and to determine the river channel slopes. However, the validity of the resultant model parameterization is very much dependent on the resolution and the accuracy of the DEM data. The alternative to using DEM data based on remote sensing is to use actual site elevation measurements throughout the river network. Although this alternative has the potential to provide more accurate results, collecting and compiling measurement data in the adequate resolution may not be economically feasible if the data is not already available, especially in case of developing countries.

This study is part of a research project titled “Development of a geographical information system based decision-making tool for water quality management of Ergene Watershed using pollutant fingerprints” funded by Turkish Scientific and Technological Research Council (TUBITAK). A hydraulic model is being developed to be used in water quality management of the Ergene Watershed, which has a drainage area of 12,438 m^2. The hydraulic model will cover the main branches of Ergene River with a total length of more than 300 km.

Two different approaches have been adopted in describing the river network and river channel slopes. In the first approach, DEM data obtained from the European Environment Agency (EU-DEM) has been used. EU-DEM is a high resolution elevation data set that is publicly available. The resolution of EU-DEM data is 1 arc second or about 30 metres. In the second approach, a data set of actual elevation measurements at 38 locations throughout the river channel network collected as a part of the research project has been used. Different hydraulic model simulations were carried out using river channel data obtained through these two approaches. The simulation results were analyzed to obtain insights on the contribution of using actual site measurements on the model accuracy as opposed to using remotely sensed DEM data.

Ergene River mostly runs through plain areas with low slopes. Further simulation experiments were carried out to analyze if the added value from actual site measurements may be more significant where the river channel slopes are low.

The results from this study may guide future hydraulic modeling studies for large watersheds with low slopes where river channel slope data is not readily available. It may provide guidance on developing cost-effective elevation data collection schemes for hydraulic modeling purposes for large watersheds.

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