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Construction of an Elevation Model Using Multiple Sources of Data in a Data Poor Environment for Hydraulic Flood Modeling; A Case Study from Naga City, the Philippines

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Developing countries suffer disproportionally from floods in terms of damage and in loss of human lives. This makes proper flood hazard assessment very important for instance by using a 2D-hydraulic flood propagation models. These models require accurate elevation data. The main problem is the frequent changes of land use in major cities, where frequent updating of the digital terrain model (DTM) for flood modeling might be needed. Moreover, limited terrain data is one of the major problems in constructing a good DTM in order to get satisfying flood model results. This paper presents an example of integrating elevation data available from various sources to generate a DTM for Naga City, the Philippines. The elevation data is derived from topographical maps, drainage construction plan, building height data, road construction plans, recent and future development plans and geodetic leveling. Flood modeling in an urban environment put constraints on the accuracy (horizontal and vertical) and the resolution of the DTM. The challenge is to meet these requirements by integrating data from multiple sources. In the DTM construction the natural terrain is separated from the man-made terrain. For the natural terrain it can be assumed that points that are closer together tend to be more alike than points that are farther apart. Therefore, experimental variogram plot is used to investigate the effect of integrating multi-sources of elevation data by evaluating the nugget values. High nugget value may be caused by the edge effect as data of different scales are added together. Therefore, the data sources are prioritized based on the data collection approach, scales, form of data and contour line interval. In this paper, there are 4 interpolation methods used, namely ANUDEM, Kriging, Polynomial and Triangulated Irregular Network (TIN). The assessments are based on percentile vertical accuracy assessment, error point's distribution and visual assessment. The kriging interpolation method has produced the best DTM and it full-filled the requirement for hydrological flood modeling purpose. Finally the DSM of the study area was constructed by integrating both man-made and natural terrain. This DSM is used for modeling with a 2D hydraulic model (SOBEK) for scenarios studies to assess the effect of major changes in the DSM on the flood characteristics.