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Flood Mapping Using Height above the Nearest Drainage Model: A Case Study in Fredericton, NB, Canada

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Abstract : Flood is a severe issue in different places in the world as well as the city of Fredericton, New Brunswick, Canada. The downtown area of Fredericton is close to the Saint John River, which is susceptible to flood around May every year. Recently, the frequency of flooding seems to be increased, especially after the fact that the downtown area and surrounding urban/agricultural lands got flooded in two consecutive years in 2018 and 2019. In order to have an explicit vision of flood span and damage to affected areas, it is necessary to use either flood inundation modelling or satellite data. Due to contingent availability and weather dependency of optical satellites, and limited existing data for the high cost of hydrodynamic models, it is not always feasible to rely on these sources of data to generate quality flood maps after or during the catastrophe. Height Above the Nearest Drainage (HAND), a state-of-the-art topo-hydrological index, normalizes the height of a basin based on the relative elevation along with the stream network and specifies the gravitational or the relative drainage potential of an area. HAND is a relative height difference between the stream network and each cell on a Digital Terrain Model (DTM). The stream layer is provided through a multi-step, time-consuming process which does not always result in an optimal representation of the river centerline depending on the topographic complexity of that region. HAND is used in numerous case studies with quite acceptable and sometimes unexpected results because of natural and human-made features on the surface of the earth. Some of these features might cause a disturbance in the generated model, and consequently, the model might not be able to predict the flow simulation accurately. We propose to include a previously existing stream layer generated by the province of New Brunswick and benefit from culvert maps to improve the water flow simulation and accordingly the accuracy of HAND model. By considering these parameters in our processing, we were able to increase the accuracy of the model from nearly 74% to almost 92%. The improved model can be used for generating highly accurate flood maps, which is necessary for future urban planning and flood damage estimation without any need for satellite imagery or hydrodynamic computations.

Keywords : HAND, DTM, rapid floodplain, simplified conceptual models
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