Machine learning and HEC-RAS integrated models for flood inundation mapping in Baro River Basin, Ethiopia

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Abstract

This paper presents the integrated machine learning and HEC-RAS models for flood inundation mapping in Baro River Basin, Ethiopia. A predictive rainfall-runoff and spatially distributed river simulation models were developed using Artificial Neural Networks (ANNs) and HEC-RAS respectively. Daily rainfall and temperature data of 7-yrs and Topographical Wetness Index (TWI) with a spatial resolution of 50 x 50m were used to train the ANN in R studio. The integration of the spatial and temporal variability in this paper improved the accuracy of the predictive models integrated with ANN and HEC-RAS. The predictive ANN model was tested with the observed daily discharge of the same temporal resolution and the rainfall-runoff result obtained from the tested ANN model was used as input for the HEC-RAS. The flood event of 2005 was used to verify the accuracy of flood generated in the HEC-RAS model by implementing the Normal Difference Water Index (NDWI). The comparison was made between the flood inundation map generated by HEC-RAS and flood events of different periods based on coverage percentage areas and a good agreement was reached with 96 % overlapped areas. The performance of ANN and HEC-RAS models were evaluated with 0.86 and 0.88 values at the training and testing period respectively. Finally, it was concluded that the integration of a machine learning approach with the HEC-RAS model in developing a flood inundation mapping is an appropriate tool to warn residents in this river basin.

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