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Climate variability and flood risk in selected watersheds of Jamaica

Arpita Mandal (1), David Smith (1), Michael Taylor (1), Tannecia Stephenson (1), Jayaka Campbell (1), Matthew Wilson (2), Leonardo Clarke (1), Shavel Watson (1), Alrick Brown (1), and Junior Darsan (3)

(1) Department of Physics, Climate Studies Group Mona, The University of the West Indies, Mona Campus, Kingston, Jamaica. alrickab@gmail.com, (2) Geospatial Research Institute, University of Canterbury, New Zealand. mdwtnt@gmail.com, (3) Department of Geography, The University of the West Indies, St Augustine, Trinidad and Tobago.

Flooding from high intensity rainfall associated with or without tropical storms and hurricanes is a major hydrometerological hazard affecting Jamaica, the third largest island of the Caribbean. Analysis of extreme events ie hurricanes and tropical storms and associated flooding from 1900-2010 have shown a mean of 18 severe events per decade, and a strong increase in severe flooding since 1990 (103 events). The Planning Institute of Jamaica estimated that in ten years (2001-2010) the island experienced damage of over US $1.27 Bn due to severe weather systems including hurricanes and tropical cyclones. Flooding in Jamaica is a combined effect of rainfall, topography and lithology. Climate change models predict that, within the Caribbean basin, the intensity of tropical rainfall is likely to increase toward the end of this current century, even though the region is projected to be drier overall. This may affect the frequency and severity of floods in Jamaica as well as other Small Island Developing States (SIDS) of the Caribbean. The present research targets to create current and future flood hazard maps, using data from past extreme events and future climate projection scenarios. Hydrological and hydraulic models for Yallahs, Hope and South Orange Negril watersheds was carried out using the HEC HMS, HEC RAS and LISSFLOOD-FP. Intensity-Duration-Frequency (IDF) for the present day, past extreme events (TS Gustav) as well as future climate models (PRECIS) for the 2080s under two different Special Report on Emissions Scenarios (SRES scenarios. Discharge thus estimated from the hydrological model was used to drive the hydraulic model to estimate extent of innundation and flood depth under the above mentioned rainfall scenarios. Results showed that flood frequencies have increased in the last decade corresponding to increase in extreme events. Flood inundation maps created for the Yallahs and South Orange watershed for tropical storm Gustav show 12-14m of flood depth in the downstream end of the river with only 1 hour difference between the flood peak upstream and downstream. Climate projections suggest a decline in future flood frequency although inundation extend in valley does not reduce substantially. This paper further investigates how the flood hazard is affected by increases in global mean surface temperature by 1.5, 2.0 and 2.5 degrees C above preindustrial levels. Rainfall projections from the PRECIS regional climate model run over the Caribbean are examined. Six members from the Quantifying Uncertainty in Model Predictions (QUMP) (AENWH, AEXSA, AEXSK, AEXSL, AEXSM) are used as well as the model forced by the ECHAM5 global climate model. Rainfall data from these model runs were used to create 100-year flood inundation maps for the Hope watershed in Jamaica for the different global warming targets using catchment and flood inundation models. Results show that only two of the model runs result in peak discharges at 2.0 and a 2.5 degree warming that are higher than those in the available historical record of past extreme events which have caused damages to sections of the watershed