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Flood Risk and Climate Change in Negril, Jamaica: an assessment of combined terrestrial and coastal flood risk driven by projections of future climate

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Terrestrial flooding from extreme rainfall events and coastal flooding from storm surges are two of the major natural hazards affecting Jamaica as well as other small island states in the Caribbean. Hurricane systems bring both extreme rainfall and coastal storm surge, leading to both inland and coastal flooding. Between 2001 and 2010, the island experienced damage of over US $1.27 Bn due to severe weather systems including hurricanes and tropical cyclones (Planning Institute of Jamaica, 2011). In low-lying areas such as Negril, west Jamaica, storm surges may combine with heavy rainfall to lead to an increase in terrestrial flood risk inland. Flooding from hurricanes and storms has greatly affected the coastal region around Negril, particularly the tourism sector, causing substantial shoreline retreats over the last 50 years. Coastal flood models have previously been used for Negril to show the effects of sea level rise on coastal communities. However, inland flooding has not been studied previously and no flood risk map exists for the South Negril-Orange river watershed. In addition, the impacts of coastal storm-surge inundation on terrestrial flood-risk have not been assessed. This research considers the effects of extreme rainfall on the South Negril-Orange river watershed and its impact on local communities, and the relative impact of sea-level rise and storm surges to inland terrestrial flood risk. Work completed as part of this project is contributing to the ongoing *Partnership for Canadian-Caribbean Community Climate Canada Adaptation* (ParCA) project which supports community-based vulnerability assessment of coastal communities using GIS-based coastal flood mapping. In this research, flood models for the lower Orange and Negril Rivers were created with the aim of producing current and future flood hazard maps, using data from past extreme events and future climate projection scenarios. Intensity-Duration-Frequency (IDF) for the present day were calculated from measured rainfall data and used drive the HEC-HMS model of catchment hydrology to produce streamflow levels for a range of exceedance probabilities from the upper sections of th e catchments. Calculated streamflows were then used to drive the 2D hydraulic model code, LISFLOOD-FP, capable of flood wave routing and the calculation of overland flow and able to incorporate downstream boundary water-level effects. Storm surges for past events were incorporated in the model through tidal measurements. In this way, the relative importance of storm-surge vs. rainfall in causing flood inundation risk was assessed and mapped. IDF curves were then perturbed for future climate using the PRECIS regional climate model, with projections of future climate generated using multiple realizations from the PRECIS model for the 2080s forced with two Global Climate Models (HadCM and ECHAM) at its lateral boundaries and run under different emmisions scenarios. Changes in rainfall levels predicted by PRECIS were used to update IDF curves for future climates, which were then used to drive the HEC-HMS model to generate future streamflows. These were then used in the LISFLOOD-FP model, together with projections of future sea-level, enabling the prediction of future flood hazard maps incorporating both terrestrial and coastal flooding.