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River discharge and flood inundation over the Amazon based on IPCC AR5 scenarios

Rodrigo Paiva (1), Mino Sorribas (1), Charles Jones (2), Leila Carvalho (2), John Melack (3), Juan Martin Bravo (1), and Edward Beighley (4)

(1) Institute of Hydraulic Research, Federal University of Rio Grande do Sul, Porto Alegre, Brazil (rodrigo.paiva@ufrgs.br), (2) Geography Department, University of California Santa Barbara, USA, (3) Bren School of Environmental Science and Management, University of California Santa Barbara, USA, (4) Civil and Environmental Engineering, Northeastern University, Boston, USA

Climate change and related effects over the hydrologic regime of the Amazon River basin could have major impacts over human and ecological communities, including issues with transportation, flood vulnerability, fisheries and hydropower generation. We examined future changes in discharge and floodplain inundation within the Amazon River basin. We used the hydrological model MGB-IPH (Modelo de Grandes Bacias – Instituto de Pesquisas Hidráulicas) coupled with a 1D river hydrodynamic model simulating water storage over the floodplains. The model was forced using satellite based precipitation from the TRMM 3B42 dataset, and it had a good performance when validated against discharge and stage measurements as well as remotely sensed data, including radar altimetry-based water levels, gravity anomaly-based terrestrial water storage and flood inundation extent. Future scenarios of precipitation and other relevant climatic variables for the 2070 to 2100 time period were taken from five coupled atmosphere-ocean general circulation models (AOGCMs) from IPCC's Fifth Assessment Report (AR5) Coupled Model Intercomparison Project Phase 5 (CMIP5). The climate models were chosen based on their ability to represent the main aspects of recent (1970 to 2000) Amazon climate. A quantile-quantile bias removal procedure was applied to climate model precipitation to mitigate unreliable predictions. The hydrologic model was then forced using past observed climate data altered by delta change factors based on the past and future climate models aiming to estimate projected discharge and floodplain inundation in climate change scenario at several control points in the basin. The climate projections present large uncertainty, especially the precipitation rate, and predictions using different climate models do not agree on the sign of changes on total Amazon flood extent or discharge along the main stem of the Amazon River. However, analyses of results at different regions indicate an increase on flood inundation and discharge over the upper Amazon basin (west Amazon) and decreased discharges over the southeastern tributaries.