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Uncertainty in the modelling of large scale flood events in the Barotse floodplain, Zambia

Tom Willis[1], Mark Smith[1], Donall Cross[2], Andrew Hardy[3], Georgina Ettritch[3], Happiness Malawo[4], Mweemba Sinkombo[4], Cosmas Chalo[4], and Chris Thomas[5]
[1]School of Geography, University of Leeds, Leeds, UK
[2]Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, Aberystwyth, UK
[3]Department of Geography and Earth Sciences, Aberystwyth University, Aberystwyth, UK
[4]Water Resource Management Authority, Mongu, Zambia
[5]College of Science, University of Lincoln, Lincoln, UK

The Barotse floodplain in the Western Province of Zambia, is a major feature of the Upper Zambezi River, covering an area of 11,000km^2, and is inundated annually by a flood cycle that ranges from minimum values in September, to peak levels in April. The annual flooding of the area provides a number of challenges, and critically is a significant component of the life cycle of mosquitos, the principle vector for the transmission of malaria. A research project, FLOODMAL, has been developed to apply process based modelling approaches to the life cycle of the mosquito in the floodplain. A significant component of this approach is the development of a 1D-2D model which can be used to predict the formation of water bodies that are essential to the mosquito breeding cycle. This research presents the uncertainties associated with developing the flood model, with an emphasis on model performance through simulation time. In a typical model exercise, the calibration of input parameters are associated with ensuring that model performance is optimised for representing the peak of a flood event. This can be at the cost of providing a consistent level of model performance throughout a simulation, which is essential in this research.

Using the LISFLOOD-FP computer code, and TanDEM-X1 terrain data, a baseline model of the Barotse floodplain was developed for the 2009 and 2018 events. A set of initial model runs identified key processes to be represented in the model, including evaporation and infiltration. The calibration of the model was focused on defining parameters for surface roughness, channel roughness, evaporation, infiltration, and defining channel topography. A number of datasets were available for model calibration, such as LandSAT imagery to compare observed and modelled extent at various points throughout the year, and downstream river gauge data. To further understand the uncertainties associated with the modelling, sensitivity analysis was undertaken using an emulator- based approach to define the contribution of the input parameters to overall model variance. The results indicate that parameters that control the movement of water across the floodplain (surface roughness) are generally the most significant of the inputs at all points in the year, although the level of this significance changes at different phases.