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A fully coupled spatially distributed hydrologic-hydrodynamic model for the Barotse Floodplain, Upper Zambezi

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Floodplains play important roles in global hydrological and biogeochemical cycles, and many socioeconomic activities also depend on water resources in floodplains. Although considered as critical for the formation and preservation of floodplains, hydrology in floodplains has been hard to characterise. In recent years the demand for an understanding of the hydrological and hydrodynamic processes for the Barotse floodplains is ever increasing especially with the advent of climate change/variability, and expected upstream developments. Yet, the multi-way interactions between river flows, wetland inundation, and groundwater are complex, and poorly understood, compromising studying these changes. Most hydrological and hydrodynamic models applied for large-scale hydrological and inundation modelling lack an advanced floodplain-groundwater feedback mechanism, and thus may over predict or under predict inundation extent, depth, and downstream river flow. This is because groundwater re-infiltration and evaporation from the floodplains over a longer time scale than the flood process are not accounted for. Hence, the main objective of this current study is to show the very first attempt to a fully coupled model for the Barotse floodplain. The hypothesis is that a fully coupled model will result in larger groundwater dynamics, a slower rise of inundation, and possibly a longer recession tail. To test this hypothesis, we setup two experiments; (i) in the first experiment, WFLOW runs and feeds upstream flows into LISFLOOD. This is sort of the classic approach, and similar to earlier studies, and also does not necessarily require a time-step based coupling; (ii) in the second experiment, WFLOW runs and feeds into Lisflood_FP, and Lisflood_FP then returns water into the WFLOW model. This an experiment where we re-infiltrate water into wflow and by doing so, let groundwater levels adapt so that additional reinfiltrated water, decrease the amount of flood water, increase groundwater levels more during the wet season, and provide a higher recession

tail downstream. Our model environment and experiments are available through https://github.com/Innochomba/barotse.