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Modelling of an ungauged basin by means of remotely sensed rainfall and evaporation

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The Luangwa river basin is one of the largest tributaries to the Zambezi and, unlike the upper Zambezi, responds quite fast on rainfall. It is a typically ungauged basin, since runoff records are only collected at the basins outlet, the runoff coefficient is about 10% and runoff cannot be measured when discharge exceeds about 3000 m^3/s. Daily rainfall records are collected but are not available near-real time and are not adequate enough to capture the daily spatial distribution of rainfall. Directly downstream of the confluence of the Luangwa and Zambezi, a major reservoir, Cahora Bassa, is being operated by Mocambique. During flood periods, the Luangwa River is responsible for about 50% of the inflow in this reservoir.

This study aims at the understanding and modelling of the Luangwa basin to support flood forecasting within the Luangwa, and decision making downstream of Luangwa (i.e. the Cahora Bassa reservoir). The ungauged character of the Luangwa is challenging us to adopt remote sensing techniques to both force and evaluate such a model. A bottom-up modelling approach is used. First the governing runoff responses and their temporal frequency within the basin are retrieved and simulated by running a lumped model with historical rainfall data. Then, the model is run in a distributed mode with a shorter time series of remotely sensed rainfall from the Tropical Rainfall Measuring Mission (TRMM), to further elaborate on the high frequency processes. Finally, the model performance and identifiability of (distributed) parameters, related to land surface processes, is elaborated in a multi-criteria framework, by using distributed actual evaporation estimates, prepared with the Surface Energy Balance Algorithm for Land (SEBAL). Land surface model parameters are in this framework estimated in a semi-distributed manner based on land surface classes.

Outcome of this research will be a semi-distributed model, of which the parameter uncertainty is more constrained than in a traditional model, because an independent source of information, the actual evaporation estimates, is used to estimate these parameters. Moreover, the daily rainfall distribution is adequately represented by the use of TRMM rainfall.