Use of radar observations of small reservoirs for calibration of a simple hydrological model in the West African savanna

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Throughout the West African savanna, as well as in most other semi-arid areas of the world, thousands of small reservoirs (<100 ha) can be found. These reservoirs serve to provide the rural population with water for irrigation, households, cattle, and fishing during the dry season. The areas of these reservoirs can be observed most of the year with the aid of radar satellites, such as Envisat. Areas can be converted into stored volumes through regionally validated correlations. By comparing areas (volumes) over time, estimates can be made of total runoff amounts over the period between satellite overpasses. These estimates are coarse and infrequent but are available over large areas due to the large number of these reservoirs.

Clearly, the number of data points over time is limited and only useful during the period that the reservoirs are filling up and not yet spilling. From a hydrological point of view, this onset of the runoff season is the most interesting period. As a result, it was possible to calibrate a simple Thornthwaite-Mather model. The model structure was determined on the basis of hydrological field observations over a multi-year period and other studies in the region. The radar-based runoff estimates were used to calibrate the model for six watersheds in Ghana's Upper East Region over 2005. Parameter values were successfully validated over 2006, which had a completely different rainfall distribution over time. Although we expected low information content of the observed time series, the results turned out to be relatively accurate.