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Modeling and monitoring of a system of small reservoirs in a semi-arid catchment: data integration from remote sensing

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The hydrology of semi-arid rivers poses a great challenge for modelers. River discharge, the variable through which hydrological models are calibrated/validated, is most of the time close to zero in these regions. The models are therefore better evaluated with the volume of water stored in man-made reservoirs. The semi-arid catchment of the Benguê reservoir in the state of Ceará, northeastern Brazil, is no exception to the above mentioned characterization, with about 240 small to medium sized reservoirs in a catchment area of 1000 km2.

The WASA-SED model (Güntner et al. 2004a,b; Müller et al. 2010), a physically based hydrological model, especially designed to cope with reservoir operation and small-scale dams, has been successfully applied to this catchment. The model had been previously manually calibrated by Medeiros (2009). The resulting parameter set could represent the Benguê reservoir storage dynamics very well (Nash-Sutcliffe of 0.98). However, it is still difficult to understand how the model captures the total water storage in the catchment, since until recently there had been no measure of the total dam and impoundment storage.

The objective of this study is to use a recently derived dataset of watermasks obtained from TerraSAR-X which, combined with ground validation and bathymetry (Klein, 2012), describes the state of the catchment with approx. monthly resolution. The size of the artificial water bodies included in this dataset range from 900 m2 and 3 km2. The model was therefore optimized taking into consideration different objectives: the representation of the Benguê reservoir actual storage and a general criterium that takes into consideration the whole storage in the catchment.

By examining model results of actual dam storage in each subcatchment and comparing it to this novel dataset, it was possible to obtain a semi-distributed measure for the skill of WASA-SED in representing water storage in a highly humanized landscape. This is a significant step for managing distributed demand in a water stressed region.