Geophysical Research Abstracts
Vol. 19, EGU2017-8182, 2017
EGU General Assembly 2017

Informing a hydrological model of the Ogooué with multi-mission remote sensing data

Cecile Kittel (1), Peter Bauer-Gottwein (1), Karina Nielsen (2), and Christian Tøttrup (3)

(1) Department of Environmental Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark, (2) National Space Institute, Technical University of Denmark, Kgs. Lyngby, Denmark, (3) DHI-GRAS, Hørsholm, Denmark

Knowledge on hydrological regimes of river basins is crucial for water management. However, data requirements often limit the applicability of hydrological models in basins with scarce in-situ data. Remote sensing provides a unique possibility to acquire information on hydrological variables in these basins. This study explores how multi-mission remote sensing data can inform a hydrological model. The Ogooué basin in Gabon is used as study area. No previous modelling efforts have been conducted for the basin and only historical flow and precipitation observations are available.

Publicly available remote sensing observations are used to parametrize, force, calibrate and validate a hydrological model of the Ogooué. The modelling framework used in the study, is a lumped conceptual rainfall-runoff model based on the Budyko framework coupled to a Muskingum routing scheme. Precipitation is a crucial driver of the land-surface water balance, therefore two satellite-based rainfall estimates, Tropical Rainfall Measuring Mission (TRMM) product 3B42 version 7 and Famine Early Warning System - Rainfall Estimate (FEWS-RFE), are compared. The comparison shows good seasonal and spatial agreement between the products; however, TRMM consistently predicts significantly more precipitation: 1726 mm on average per year against 1556 mm for FEWS-RFE. Best modeling results are obtained with the TRMM precipitation forcing.

Model calibration combines historical in-situ flow observations and GRACE total water storage observations using the Jet Propulsion Laboratory (JPL) mascon solution in a multi-objective approach. The two models are calibrated using flow duration curves and climatology benchmarks to overcome the lack of simultaneity between simulated and observed discharge. The objectives are aggregated into a global objective function, and the models are calibrated using the Shuffled Complex Evolution Algorithm.

Water height observations from drifting orbit altimetry missions are extracted along the river line, using a detailed water mask based on Sentinel-1 SAR imagery. 1399 single CryoSat-2 altimetry observations and 48 ICESat observations are acquired. Additionally, water heights have been measured by the repeat-orbit satellite missions Envisat and Jason-2 at 12 virtual stations along the river. The four missions show generally good agreement in terms of mean annual water height amplitudes. The altimetry observations are used to validate the hydrological model of the Ogooué River.

By combining hydrological modelling and remote sensing, new information on an otherwise unstudied basin is obtained. The study shows the potential of using remote sensing observations to parameterize, force, calibrate and validate models of poorly gauged river basins. Specifically, the study shows how Sentinel-1 SAR imagery supports the extraction of satellite altimetry data over rivers. The model can be used to assess climate change scenarios, evaluate hydraulic infrastructure development projects and predict the impact of irrigation diversions.