Geophysical Research Abstracts
Vol. 15, EGU2013-5379-1, 2013
EGU General Assembly 2013

Multivariate forecasting of total water storage anomalies over West Africa from multi-satellite data

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For West Africa, large-scale weather-related extreme hydrological conditions such as droughts or floods may persist over several months and usually have devastating environmental, social and economic impacts. Assessing and forecasting these conditions is therefore an important activity, in which data from the Gravity Recovery and Climate Experiment (GRACE) mission has been shown to be very useful. In this study, we describe a new statistical, data-driven approach to predict total water storage anomalies over West Africa from gravity data obtained from of GRACE, rainfall data from the Tropical Rainfall Measuring Mission (TRMM), and sea surface temperature data products over the Atlantic, Pacific and Indian oceans. Major teleconnections within these data sets were identified by independent component analysis, and linked via low-degree autoregressive models to build a predictive framework for forecasting total water storage, a quantity which is hard to observe in the field but important for agricultural and water resource management. After a learning phase of 80 months, our approach predicts water storage from rainfall and sea surface temperature data alone that fits to observed GRACE data at 79% after one year and 62% after two years. This means, our approach should be able to bridge the present GRACE data gaps of one month about each 162 days as well as a - hopefully - limited gap between GRACE and the GRACE-FO mission for West Africa.
Keywords: Forecasting GRACE-TWS, West-Africa, ICA; AR model