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Identification of statistically independent climatic pattern in GRACE and hydrological model data over West-Africa

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West-African countries have been exposed to changes in rainfall patterns over the last decades, including a significant negative trend. This causes adverse effects on water resources, for instance reduced freshwater availability, and changes in the frequency, duration and magnitude of droughts and floods. Extracting the main patterns of water storage change in West Africa from remote sensing and linking them to climate variability, is therefore an essential step to understand the hydrological aspects of the region.
In this study, the higher order statistical method of Independent Component Analysis (ICA) is employed to extract statistically independent water storage patterns from monthly Gravity Recovery And Climate Experiment (GRACE), from the WaterGAP Global Hydrology Model (WGHM) and from Tropical Rainfall Measuring Mission (TRMM) products over West Africa, for the period 2002-2012. Then, to reveal the influences of climatic teleconnections on the individual patterns, these results were correlated to the El Nino-Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) indices. To study the predictability of water storage changes, advanced statistical methods were applied on the main independent Sea Surface Temperature (SST) patterns over the Atlantic and Indian Oceans for the period 2002-2012 and the ICA results. Our results show a water storage decrease over the coastal regions of West Africa (including Sierra Leone, Liberia, Togo and Nigeria), associated with rainfall decrease. The comparison between GRACE estimations and WGHM results indicates some inconsistencies that underline the importance of forcing data for hydrological modeling of West Africa.
Keywords: West Africa; GRACE-derived water storage; ICA; ENSO; IOD