Geophysical Research Abstracts
Vol. 18, EGU2016-13303, 2016
EGU General Assembly 2016

GRACE-based validation of terrestrial water storage variations as simulated by 4 di[U+FB00]erent hydrological models under WFDEI atmospheric forcing

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Since its launch in 2002, the Gravity Recovery and Climate Experiment (GRACE) mission provides a unique way to monitor the terrestrial water storage (TWS) variations at large spatial scale (>300km) by measuring month-to-month changes of the Earth's gravity field. We apply TWS variations estimated from GRACE to assess the ability of four hydrological and land surface models to simulate the continental branch of the global water cycle.
Based on four different validation metrics that focus on variability on sub-seasonal to inter-annual time scales, we demonstrate that for the 31 largest discharge basins worldwide all model runs agree with the observations to a very limited degree only, together with large spreads among the models themselves. In particular, we focus on selected basins with very different climatic conditions and discuss time series of individual water storage components such as surface water, soil moisture, and snow depth. Since we are applying a common atmospheric forcing data-set to all models considered, we conclude that the discrepancies found are not due to differences in the forcing, but are mainly related to the model structure and parametrization. By investigating the relative performance of these different models, we attempt to give directions for further development of global numerical models in the areas of large-scale hydrology and land-atmosphere interactions.