Geophysical Research Abstracts
Vol. 20, EGU2018-18711, 2018
EGU General Assembly 2018

The use of GRACE satellite data to validate the global hydrological cycle as simulated by a global climate model

Carmen Boening (1) and Marie-Estelle Demory (2,3)

(1) Jet Propulsion Laboratory, Pasadena, United States (carmen.boening@jpl.nasa.gov), (2) University of Reading, (3) University of Bern

This study investigates the use of the Gravity Recovery and Climate Experiment (GRACE) data to validate the global hydrological cycle as simulated by an atmospheric General Circulation Model (GCM), particularly the transport of water from the ocean to the land and vice-versa. Until GRACE, no other observational data were available for such a robust assessment. Usually, moisture transport is calculated by using the water balance equations (e.g. Precipitation-Evaporation), or by using reanalysis data, which are known to have major issues related to the hydrological cycle. By comparing the decade-long record of Earth's gravity field variations measured by GRACE with the terrestrial water storage simulated by GCMs, we can compare the amplitude of the variability in water transport at inter-annual to decadal time scales at global and regional scales. This is an innovative approach to assess GCMs and understand the processes underlying changes in the water cycle. It is by improving our understanding of the mechanisms involved in the hydrological cycle that we will be able to build confidence in model simulations of the evolution of the hydrological cycle with climate change.

We make use of the UPSCALE (UK on PRACE: weather resolving Simulations of Climate for globAL Environmental risk) campaign, a traceable hierarchy of global atmospheric simulations (based on the Met Office Unified Model, GA3 formulation), with mesh sizes ranging from 130 km to 25 km, for which five-member ensembles of 27-year, atmosphere-only integrations are available, using present-day forcing. We show here the ability of this climate model, at any resolution, to simulate the inter-annual variability of terrestrial water storage, compared to GRACE. We particularly find that the model is able to capture the regional distribution of changes in terrestrial water transport during El Nino Southern Oscillation events, implying its ability to import more or less water over land during a La Nina or an El Nino event.