Geophysical Research Abstracts
Vol. 21, EGU2019-14311, 2019
EGU General Assembly 2019

Evaluation of ensemble simulations of a coupled atmosphere-land-surface-subsurface model for cross-compartmental data assimilation

Bernd Schalge (1), Harrie-Jan Hendricks Franssen (2,3), Stefan Kollet (2,3), Tobias Finn (4), Barbara Haese (5), Emilio Sánchez (6), and Clemens Simmer (1)

(1) Meteorological Institute, University of Bonn, Bonn, Germany, (2) Forschungszentrum Jülich GmbH, Institute of Bio- and Geosciences: Agrosphere (IBG-3), Jülich, Germany, (3) Centre for High-Performance Scientific Computing (HPSC-TerrSys), Geoverbund ABC/J, Jülich, Germany, (4) Meteorological Institute, University of Hamburg, Hamburg, Germany, (5) Institute of Geography, University of Augsburg, Augsburg, Germany, (6) Center for Applied Geoscience, University of Tübingen, Tübingen, Germany

The number of applications of coupled atmosphere-land-surface-subsurface models has increased considerably over the last years, arising the necessity of developing suitable coupled data assimilation methods. A primary concern is the definition of an adequate ensemble.

In this study we compare the simulations of an ensemble of fully coupled models on the catchment scale, to a higher resolution reference model. Both the ensemble of models and the reference use the Terrestrial Systems Modeling Platform (TerrSysMP) for their simulation. The ensemble has a resolution of 2.8km for the atmosphere and 800m for the land-surface and subsurface, whereas the reference model has a resolution of 1.1km for the atmosphere and 400m for the land-surface and subsurface. We used the Neckar river catchment and surrounding areas as the location for this experiment.

For data assimilation, the ensemble has to fulfill certain criteria with respect to the high resolution run such as a suitable spread and low or correctable bias. We find that an appropriate ensemble performance is very much dependent on how the considered variables are treated. For the atmosphere, it is essential to include variations of the forcing data as differences generated from the feedback to the land-surface alone are not enough to provide a suitable spread. Similarly, precipitation for non-convective events and cloud cover are often very similar on these scales. For the land-surface compartment variations in the plant settings, e.g. leaf area index, is most important to generate spread, while the soil setup can feedback on this via soil moisture. However, the region we have chosen is rarely in a water-limited state, and therefore the effects are dampened.

While a careful consideration of the ensemble setup can help overcome most of the problems that we found, there are some systematic differences between the ensemble and reference model runs arising just from the difference in resolution, that cannot be corrected by data assimilation alone. This is clearly observed in river discharge, which is affected by the drastic widening of rivers at the coarser resolution to the point where even scaling approaches to compensate for river widening that work at other resolutions have failed. We examine different possibilities to lessen the negative effects of model coarsening, and debate if these type of measurements are still suitable for data assimilation.