Geophysical Research Abstracts
Vol. 21, EGU2019-14313, 2019
EGU General Assembly 2019

Sensitivity of convection-permitting atmospheric-hydrological modeling to PBL parameterization in simulating land-atmosphere interaction over Heihe river basin, northwest China

Zhenyu Zhang (1,2), Joel Arnault (1), Patrick Laux (1,2), Harald Kunstmann (1,2)

(1) Institute of Meteorology and Climate Research (IMK-IFU), Karlsruhe Institute of Technology, Campus Alpin, Garmisch-Partenkirchen, Germany (zhenyu.zhang@kit.edu), (2) Institute of Geography, University of Augsburg, Augsburg, Germany

Lateral terrestrial water flow contributes to the Earth system dynamics by redistributing the moisture fluxes at the land surface. Fully coupled atmospheric-hydrological modeling, which considers the lateral hydrological processes, is increasingly used to investigate the land-atmosphere interactions. Planetary boundary layer (PBL) parameterizations which depict vertical energy and mass exchanges from the surface to lower atmosphere are pivotal to atmosphere modeling applications. This study aims at quantitatively evaluating to what extend the PBL scheme influences land-atmosphere interactions and how it impacts the regional climate modeling by coupled atmospheric-hydrological modeling approach. In this case study, the hydrologically enhanced version of the Weather Research and Forecasting modeling WRF-Hydro is used as fully coupled atmospheric-hydrological modeling experiment, and the standard WRF modeling is used as the control experiment. The regional simulation is applied to the Heihe river basin, an endorheic basin located in northwest China. The atmospheric modeling is configured at convection permitting scale 3 km, and the lateral terrestrial water processes are resolved at 300 m fine hydrological sub-grid. An ensemble of WRF/WRF-Hydro simulations is produced by varying the PBL scheme (YSU, MYJ, ACM2) for three continuous years from 2008-2010. The sensitivity of land-atmosphere interactions is evaluated with a regional precipitation recycling analysis and a three-dimensional atmospheric moisture tracing method (E-tagging). The interannual variability of the regional water budgets and land-atmosphere interactions are quantified with the model ensemble. We find a low precipitation recycling and a clearly positive soil moisture-precipitation feedback triggered by lateral terrestrial water flow in the study area. Lateral terrestrial water flow increases the local precipitation recycling irrespective of the modeling variability obtained with the different PBL parameterizations. The robust impact of lateral terrestrial water flow on local precipitation recycling indicates that the fully coupled modeling should be applied for climate projections.