Geophysical Research Abstracts
Vol. 17, EGU2015-13652, 2015
EGU General Assembly 2015

Precipitation recycling in West Africa – regional modeling, evaporation tagging and atmospheric water budget analysis

Joel Arnault (1,2), Harald Kunstmann (1,2), and Hans-Richard Knoche (1)

(1) Karlsruhe Institute of Technology, Campus Alpin, Institute for Meteorology and Climate Research (IMK-IFU), Garmisch-Partenkirchen, Germany, (2) University of Augsburg, Augsburg, Germany

Many numerical studies have shown that the West African monsoon is highly sensitive to the state of the land surface. It is however questionable to which extend a local change of land surface properties would affect the local climate, especially with respect to precipitation. This issue is traditionally addressed with the concept of precipitation recycling, defined as the contribution of local surface evaporation to local precipitation.

For this study the West African monsoon has been simulated with the Weather Research and Forecasting (WRF) model using explicit convection, for the domain (1°S-21°N, 18°W-14°E) at a spatial resolution of 10 km, for the period January-October 2013, and using ERA-Interim reanalyses as driving data. This WRF configuration has been selected for its ability to simulate monthly precipitation amounts and daily histograms close to TRMM (Tropical Rainfall Measuring Mission) data.

In order to investigate precipitation recycling in this WRF simulation, surface evaporation tagging has been implemented in the WRF source code as well as the budget of total and tagged atmospheric water. Surface evaporation tagging consists in duplicating all water species and the respective prognostic equations in the source code. Then, tagged water species are set to zero at the lateral boundaries of the simulated domain (no inflow of tagged water vapor), and tagged surface evaporation is considered only in a specified region. All the source terms of the prognostic equations of total and tagged water species are finally saved in the outputs for the budget analysis. This allows quantifying the respective contribution of total and tagged atmospheric water to atmospheric precipitation processes. The WRF simulation with surface evaporation tagging and budgets has been conducted two times, first with a 100 km2 tagged region (11-12°N, 1-2°W), and second with a 1000 km2 tagged region (7-16°N, 6°W -3°E).

In this presentation we will investigate hydro-atmospheric processes involved in the atmospheric branch of the water cycle in West Africa, based on our WRF simulation. We will particularly focus on the respective contribution of local and remote water vapor to atmospheric processes involved in local precipitation, and compare the results at the 100 and 1000 km2 scales. The potential impact of local land use change on local precipitation will finally be discussed based on this quantitative analysis.