Geophysical Research Abstracts
Vol. 17, EGU2015-4749, 2015
EGU General Assembly 2015


# Assimilation of SMOS observations to improve soil moisture and streamflow simulations in the Murray Darling Basin, Australia

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Soil Moisture and Ocean Salinity (SMOS) retrievals hold a large potential for improving hydrologic model simulations through data assimilation. However, the soil moisture retrievals are often provided at coarser spatial resolution than the model grid. To resolve the mismatch in spatial resolution between SMOS retrievals and simulations by VIC (i.e. the Variable Infiltration Capacity model), two approaches are investigated. The first approach is to downscale the remote sensing data prior to their use in the model. This renders the development of the data assimilation algorithm more straightforward, but requires a significant amount of satellite data processing. In the second approach, this processing is circumvented by directly assimilating the coarse scale satellite soil moisture retrievals into the model through the use of the observation operator. Recently, an increasing interest has also been drawn to the assimilation of level 1 data, i.e. the satellite-observed brightness temperatures. To accommodate for the assimilation of SMOS brightness temperature data, VIC is coupled with the Community Microwave Emission Model (CMEM), which allows the forward simulation of TOA brightness temperatures observed by SMOS. The main advantage of this approach is that it allows for using consistent parameter sets in the land surface and radiative transfer model.

The objectives of this study are to investigate the potential of assimilating SMOS data, either as downscaled soil moisture, coarse scale soil moisture or brightness temperature products, into a coupled land surface and radiative transfer model for improving flood forecasts, and to provide recommendations on the optimal assimilation strategy. The merit of SMOS data assimilation for water management applications is studied by comparing simulated soil moisture and streamflow predictions with in situ measurements of soil moisture from OzNet and stream gauge data from 169 stations across the Murray Darling Basin. The study shows a better performance with the assimilation of coarse scale soil moisture retrievals, whereas an a priori downscaling of the data does not add much skill to the open loop prediction. Notwithstanding the increased complexity in implementation, the assimilation of brightness temperatures is a promising alternative and leads to improvements in soil moisture and streamflow predictions comparable to those of the coarse-scale soil moisture retrieval assimilation.