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Investigating the impact of high resolution surface humidity on WRF PBL and microphysics fields

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In weather forecast models the representation of land-atmosphere interactions has a strong impact on the Planetary Boundary Layer (PBL) and, in turn, on the forecast. Soil moisture is one of the key variables in land surface modelling, and inadequate initial soil moisture field can introduce major biases in the surface heat and moisture fluxes. In previous studies, the soil moisture field derived from high spatial resolution ENVISAT/ASAR observations has shown significant biases and variability compared to the soil moisture field available from ECMWF analysis. In some cases, such as the Tanaro flood event of April 2009, the use of drier and highly resolved soil moisture field in the initial conditions of weather forecast model, lead to a significant impact on the precipitation forecast, particularly evident during the early phase of the event. The timing of the onset of the precipitation, as well as the intensity of rainfall and the location of rain/no rain areas, were better predicted using ASAR derived soil moisture field as initial condition in the forecast model. With the advent of future generation of SAR systems such as Sentinel-1, with an improved temporal resolution due to a revisiting time of few hours, it is important to investigate further on the usefulness of SAR derived soil moisture field on weather forecast, also for operational purposes. The effect of soil evaporation on the PBL structure is determined not only by the soil conditions, but also by a number of climatological parameters. Depending on the atmospheric conditions, a significant variation of land surface moisture can produce an increase, decrease or no change of cloud amount and precipitation. The sensitivity of a weather forecast model to initial soil moisture conditions depends not only on the thermodynamic structure of the atmosphere and on the role of synoptic forcing for a specific event, but also on the ability of the model to reproduce the large and small scale interactions, which, in turn, depends on a number of assumptions and parameterizations in the model.
In this study, the Advanced Research WRF (ARW) model is used to explore the response of both PBL and microphysics fields to initial high spatial resolution soil moisture data. Sensitivity studies are carried out using different PBL and microphysics schemes to investigate how specific parameterizations make the precipitation forecast more or less sensitive to the initial soil moisture field. Rain gauges and/or radar data available for selected case studies are used as ground truth.