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The impact of assimilating microwave surface sensitive observations over land on the representation of humidity in the ARPEGE 4D-VAR system

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Observations from satellite sensors such as the advanced microwave sounding unit-A (AMSU-A) and -B are very useful in Numerical Weather Prediction (NWP) since they are informative about temperature and humidity at different levels of the atmosphere. The use of these measurements in NWP has made substantial progress but more efforts need to be devoted to assimilate many more observations over a variety of surface conditions (ocean, land, snow, ...). Feasibility studies have been undertaken at Météo-France in order to assimilate low level humidity and temperature observations from AMSU-A and AMSU-B over land. For instance, AMSU-B observations from channels 2 and 5 are systematically rejected over land. Although, these observations are relevant to describe humidity in the low troposphere. A comprehensive set of 4 global 4D-Var assimilation and forecast experiments has been performed during the summer 2006. In addition to a control experiment, three two-month experiments have been run. The later make use of land surface emissivities dynamically retrieved at selected window channels and assimilate a selection of low level temperature and humidity observations from AMSU-A and AMSU-B over land.
The assimilation of surface sensitive observations impacts key parameters of water cycle. Comparisons made using outputs of the assimilation experiments with those of the control have revealed an important change of analyzed atmospheric fields and of precipitation forecasts over parts of the Tropics and especially over West Africa. Our experiments seem to emphasize the atmosphere moistening in India, South America and in West Africa together with an atmosphere drying over Arabia and North-East Africa. The humidity change not only concerns the surface but also many levels of the atmosphere up to 500 hPa. The effect for temperature is important with cooling at surface in zones with moistening at the surface.
The drying or moistening of the atmosphere have been successfully evaluated using independent TCWV measurements from the GPS AMMA network.