Cross evaluation of in-situ, synthetic and remotely sensed surface soil moisture in southwestern France

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A long term data acquisition effort of profile soil moisture is currently underway at 12 automatic weather stations located in southwestern France. The SMOSMANIA profile soil moisture network has several objectives including: (i) the validation of the operational soil moisture products of Météo-France, produced by the hydrometeorological model SIM, (ii) the validation of new versions of the land surface model of Météo-France (ISBA), and (iii) ground-truthing of future airborne Cal/Val campaigns in support of the SMOS mission and in a more general way the verification of remotely sensed soil moisture products. Soil moisture observed at SMOSMANIA constitutes a unique data set as for the first time in Europe, automatic measurements of soil moisture are integrated in an operational meteorological network. Twelve stations of the existing automatic weather station network of Météo-France (RADOME) in southwestern France were upgraded to measure soil moisture at different depths (5, 10, 20, 30 cm) with a twelve minute time step. The network is operational since January 2007.

These data permit to evaluate the surface soil moisture (SSM) from the operational SIM suite of model (SAFRAN-ISBA-MODCOU) used at Météo-France and also remotely sensed METOP/ASCAT (Advanced SCATterometer) surface soil moisture estimates over a two year period (2007-2008). In-situ SSM measurements are necessary to validate remotely sensed SSM estimates. Land surface models can be used to upscale the in situ SSM observations and complete the evaluation of satellite products. The comparison of the SIM and SMOSMANIA data shows a good temporal correlation with an average of r = 0.70 for the twelve stations with a positive mean bias = 0.031 m3m-3 and a mean error RMSE = 0.085 m3m-3. The good correlation shows that the SIM predictions may be used as a credible SSM data set to evaluate the seasonal and interannual variability of the remotely sensed SSM. Regarding the comparison between rescaled in-situ (or SIM) and ASCAT SSM, an average error of the soil moisture retrieval is about 0.06 m3m-3. However, the correlation for each station is always better for SIM. A new ASCAT SSM data set downscaled at one km scale is also presented in this study.

Finally, a last SSM data set is evaluated, the ECMWF soil moisture analysis system updated with an Extended Kalman Filter (EKF) permits to assimilate the METOP/ASCAT SSM into the Integrated Forecasting System (IFS). Over a 6 month period in 2008, the IFS SSM correlates very well with the in situ observations (r = 0.84).