Variational analysis of surface parameters in meteorological models.

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Short summary

The analysis of soil temperature and humidity is important in the meteorological models to forecast accurately the evolution of the atmospheric fields near the surface and in the mid-troposphere. A variational analysis taking into account the temporal dimension and uncoupled with the upper-air analysis is developed to assimilate 2m observations of temperature and relative humidity in a single column model.

A sensitivity study of 2m forecasts has confirmed the importance of the total water content analysis in situation of strong solar radiation and the importance of initializing the other prognostic variables of the ISBA land-surface scheme has been assessed. The topology of the cost function has been studied using simulated observations. The uncertainty in the distribution of water between the two surface reservoirs and the influence of various parameters (water stress, fraction of vegetation, solar radiation intensity, frequency of 2m observations, length of the assimilation period) on the quality of the analyzed surface fields have been evaluated. The covariances of background errors used both for the optimal interpolation and the variational surface analyses were estimated on the experimental site MUREX with a direct method (using observations) and a Monte-Carlo one. These two analysis schemes have been tested over a full annual cycle with simulated and real observations. It has been useful to define different assimilation windows according to the associated time scales of the analyzed surface fields in the variational analysis. This method gave better results than the optimal interpolation because of the temporal consistency of the observations on the assimilation period for the total water content analysis and the assimilation of asynoptic observations for the fields with short time scales evolutions. Both methods are however very sensitive to the presence of 2m biases which are not caused by surface errors, pointing out the importance of the model quality in terms of radiative and hydrological forcings.