2. Gianpaolo BALSAMO : "Mesoscale variational assimilation for land surface variables"

Optimization of the soil moisture perturbation for the 2d-var surface analysis

Introduction

The forecast of screen-level variables T2m, RH2m is studied with relation to soil moisture initialization. A set of simple experiments allows to assess the sensitivity of 2m forecast fields to a perturbation of the initial mean soil moisture Wp. The perturbation of the guess is used to evaluate the observation matrix H in the 2d-var assimilation.

The screen-level sensitivity to the soil moisture perturbation is varying with the meteorological situation and the soil state, which is the most desirable feature of the variational soil moisture analysis. This variability has also consequences on the validity of an "horizontal decoupling" hypothesis and on the clear evaluation of the gain matrix K. In fact, where the soil has lower vertical influence, the lateral influence of adjacent gridpoint, as well as the occurrence of noise, may become important. Different perturbations of the control variable Wp have been tried. A satisfactory evaluation is obtained with a double chess-like perturbation to increase the horizontal decoupling between gridpoints. The use of a Laplacian smoothing on the coefficients is sufficient to filter out the noisy patterns without varying the main structures of K.

This study is necessary to design a perturbation strategy for 2d-var assimilation of screen-level parameters for mean soil moisture analysis. The gain matrix K resulting from the linear variational method is examined on the ALADIN-France domain.

The perturbation of the control variable Wp

The importance of the initial perturbation comes from the use of 2d-var in the full 3d Aladin model, and the multiple interactions not simply related to the vertical soil-atmosphere feedback. Anyway, it has to be stressed that even for the Single Column Model (SCM), the perturbation of Wp has to be carefully chosen in order to take into account the sensitivity zone, especially the range between field capacity and wilting point (Mahfouf, 1991 and Bouttier, 1993).

The magnitude of the perturbation is also an important issue : it has to be small in order to satisfy the linear hypothesis but large enough to prevent the occurrence of large noisy patterns.

Particularly to this latter point, the occurrence of noise in screen-level forecast under cyclonic conditions can be shown in the "horizontal decoupling" experiment performed on the ALADIN-France domain (see also the previous Newsletter report for details), in figures 1 and 2.