Status of surface assimilation in Harmonie

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Introduction

CANARI_OIMAIN

The soil analysis was done for four control variables, soil water content and temperature of the two first layers of the soil.

The formulation of the analysis for WG2 is:

$$WG_2^a = WG_2^b + k_1\left(T_{2m}^o - T_{2m}^b\right) + k_2\left(RH_{2m}^o - RH_{2m}^b\right)$$

Where k_1 and k_2 were calculated in order to minimize the mean square error. They depend on VEG, LAI/RSMIN, the soil texture, local time and other variables like cloudiness, wind, precipitation and snow cover.

After the analysis, the code control the increments in order to maintain the WG2 between the field capacity and the wilting point.

CANARI_EKF_SURFEX

It's already coupled with Harmonie.

The soil analysis was done only for WG2 (soil water content of the second layer of the soil).

In this case k1 and k2 are the elements of Kalman Gain Matrix.

$$K = BH^T\left(HBH^T + R\right)^{-1}$$

H is given by the Jacobians elements.

$$H_{ij} = \frac{y_i\left(x + \delta x_j\right) - y_i(x)}{\delta x_j}$$

For the calculation of H we use SURFEX (OFF LINE version) The forcing fields come from the forecast files of the previous run.

Harmonie Setup

Harmonie version: 36h1.1

Non-hydrostatic dynamics

Arome physics

SURFEX surface with 3 layers of the soil.

The area is focused in the Iberian Peninsula.

The central points of the domain are: LATC = 40.0° and LONC =-2.5°.

Lat x Lon = 480 x 576

Grid size = 2500

Dynamics time step = 60 sec

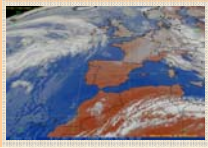
CANARI was used for analysis of T_{2m} & RH_{2m} observations.

The experiment run two days with the soil assimilation scheme in order to achieve a better balance of the fields.

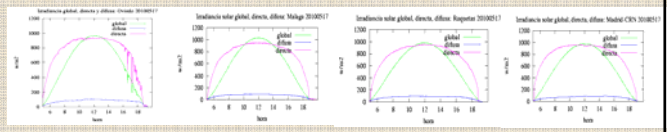
Date of the experiment: 2010051712

Synoptical situation.

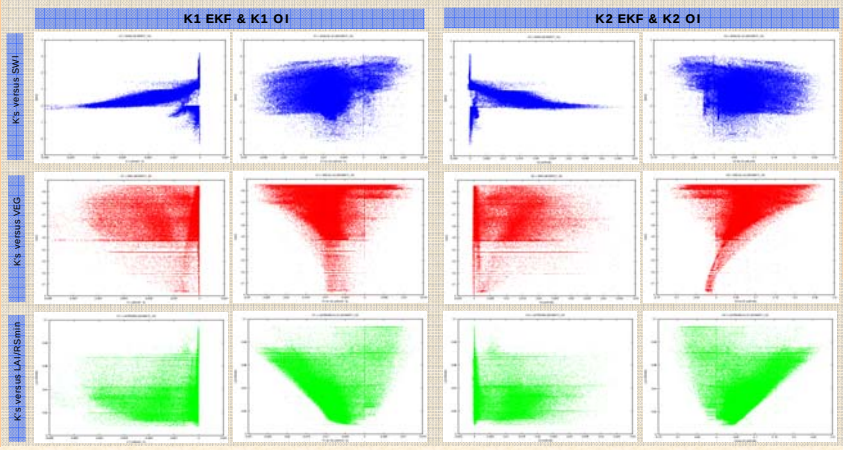
No cloudiness and weak wind over our area of interest. Some observations of direct and diffuse radiation for this day are:



Observation of Solar Ratiation



Comparision of the elements of Kalman Gain Matrix and the equivalent of OI.



k¹ VALUES ARE BIGGER FOR OI THAN FOR EKF AT 12 UTC

We can observe great differences between the dependences of k1 and k2 with SWI:

For EKF all the values of k1 are negative and k2 positive.

In EKF the analysis have no effect for points with SWI below 0, neither for values bigger than 1.

Another important fact is that the values of K are bigger near SWI=0 and the dependence is not constant for the interval.

In OI there isn't any dependences.

In both cases there are very few points below 0.5.

In OI we can see the parabolic form of the function.

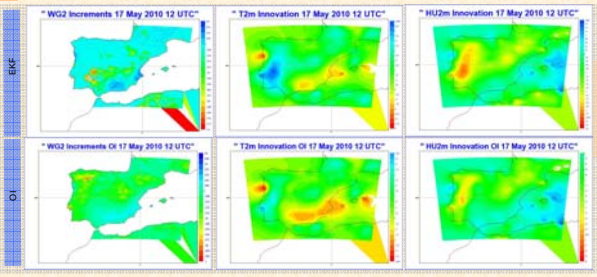
There are points with positive values for K1 and negative for K2 in the OI scheme when the fraction of vegetation is close to 1!!!

Both methods also have very different performance.

In EKF, the k's of most of the points are in the area where LAI/RSmin is less than 0.4.

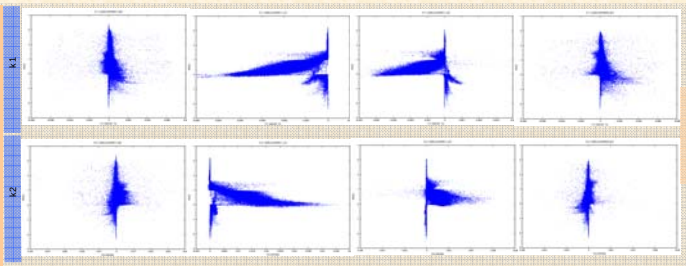
On the other hand in OI the points with high value of k have LAI/RSmin also high (near 0.8) and the dependence is lineal.

Increments and Innovations.



As we expected, the increments of Soil Water Content for EKF are lower than for OI. More time is needed in order to achieve a better balance of the fields.

Evolution of k versus SWI during the day.



The values of k during the night are much bigger than OI ones.

CONCLUSIONS

In order to improve the knowledge of the new method a comparison between the OI method and EKF method has been done.

1. During the day the size of the elements of Kalman Gain Matrix are smaller for EKF than for OI. This fact makes that the balance between the initial fields and the physics of the model will be slower.
2. During the night the k's values are much bigger than the OI ones, although much smaller than the diurnal ones.
3. The dependence of k with Veg and LAI/RSmin is more realistic for EKF than for OI.
4. The sensibility is dependent of the soil water content for EKF:
   1. The bigger sensibility is when SWI > 0 and less than 0.1.
   2. The relationship is not constant in the interval.
   3. It is negligible for soils with SWI > 1and SWI < 0.

      This fact will be a problem if the soil in the initial condition is too dry, thus the analysis won't increase the humidity in the soil.
   4. It is not necessary more controls for the size of the increments like OI does.

More studies are needed for the rest of control variables, the next one should be temperature in the second layer of the soil.

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