

The impact of the surface and upper air analyses on the screen level temperature, a simple test

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1 Introduction

During the work with the "newsnow"-scheme in Hirlam, we have found that we sometimes get large errors in the screen level temperature at initial time. The data flow is as follows:

- The T2m-analysis is done starting from a first guess
- The analysis increment is spread to the surface temperatures of the different tiles
- The free atmosphere is analysed
- DFI is performed, and after that the surface temperatures of the surface analysis is put back again

Since the surface analysis is not done in a model variable, but in screen level parameters, a translation to the surface values has to be done. In the surface analysis (Rodríguez et.al.,2003), the T2m analysis increment is added to the surface temperatures for each land tile. The new scheme has up to 7 tiles, and moreover, the forest tile is physically rather different from the other. After that no check is done, whether the interpreted T2m are near the analysed values. The change in the surface temperatures, has a rapid impact on the lowest atmosphere due to the surface fluxes, and the further mixing in the vertical diffusion. Also the distribution of surface temperature changes between the tiles are arbitrary. These problems point towards a variational approach (Balsamo et.al.,2004).

Therefore we have made a simple test to look at the impact of these problems.

2 Modification of the analysis

This is a very simple 3D variational approach, based on the assumption, that the time scale of adjustment between the surface and the lowest atmosphere is of the order of about an hour or less. Starting from the T2m-analysis, and the analysed surface temperatures, from the standard surface analysis, we run four timesteps, only including the surface processes and the vertical diffusion, and calculate the screen level temperature, as a weighted value of the land tiles.

We then make a small perturbation (0.5 degrees) of the surface temperatures, and distribute that "reasonably" among the tiles (letting the dominating tile have most influence), and recalculate another screen-level temperature. This is repeated for a negative increment and the derivative of the (in balance) T2m, as a function of the increment is calculated. This derivative is then used to estimate the initial soil temperatures, and if the result show a better estimation of the screen level temperature, these temperatures are used.

3 An example

We have used this algorithm on a single case at 20060112 at 00Z. The error of T2m as compared to the analysed values are shown in the figures.

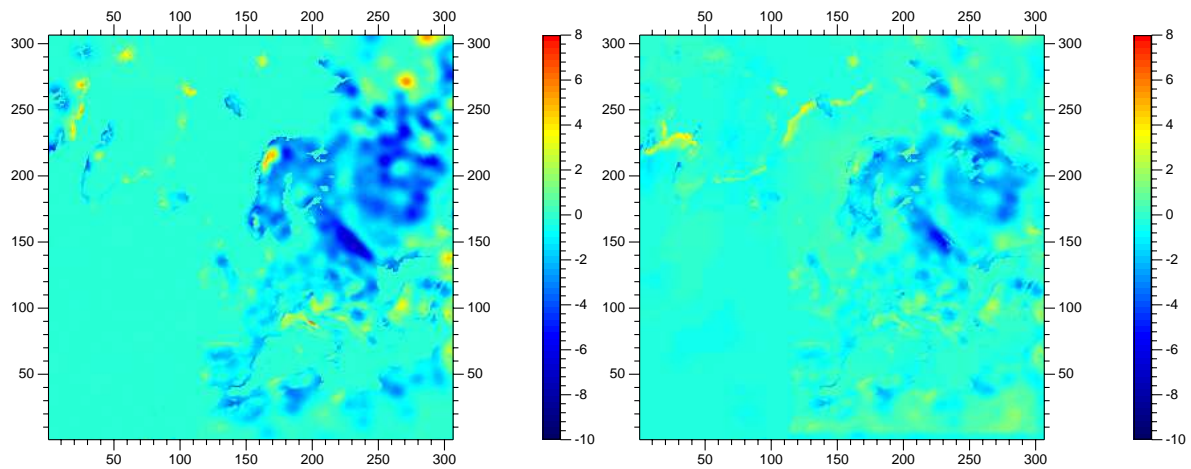


Figure 1: T2m error first guess (left) and after DFI, using surface analysis

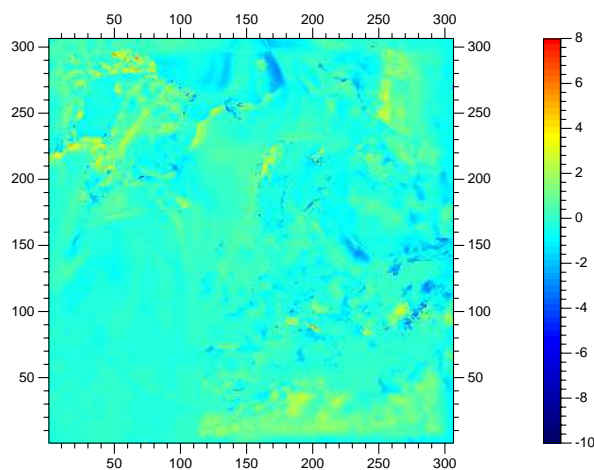


Figure 2: T2m error after the modification

4 Comments

This example is an indication that we should combine the surface analysis with that of the free atmosphere, since the lower atmosphere is strongly dependent on the surface characteristics. How this is going to be done, in connection with a 4D-VAR analysis is not clear for me, but I think that these issues should be addressed in the near future. From a surface modelling point of view, it seems that a more refined surface scheme, with many tiles is more sensitive to the initial conditions, than a simpler scheme.

5 References

Rodríguez, E., Navascués, B., Ayuso, J.J., Jrvenoja, S., 2003: Analysis of surface variables and parameterization of surface processes in HIRLAM. Part I: Approach and verification by parallel runs. *Hirlam Techn. Rep., No.58*

Balsamo,G.,Boysse,F.,Noilhan,J., 2004: A simplified bi-dimensional variational analysis of soil moisture from screen-level observations in a mesoscale numerical weather prediction model. *Q.J.R. Met. Soc.* 130A, 598, 895-916