ALADIN PhD:
"Evaluation of assimilation cycles in a mesoscale limited area model"

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1. Formalism: a very brief reminder

More details in the Newsletter 26 issue.

To input an information about the larger scales of the ARPEGE analysis in the ALADIN 3D-Var, a new term is added in the cost function:

$$J(\delta x)=J_b(\delta x)+J_o(\delta x)+\tfrac{1}{2}(d^k-\boldsymbol{H_2}\ \delta x)^T V^{-1}(d^k-\boldsymbol{H_2}\ \delta x)\ ,$$

where $d^k=H_1(x^{AA})-H_2(x^b)$ is the innovation vector with respect to the larger scales of the ARPEGE analysis, and V the error covariance matrix related to this source of information.

2. Evaluation over a 15-day period

2.1 Experimental framework

The evaluation is performed over a period from the 1st to the 15th of June 2004.

2.1.1 Datasets

In order not to use the same observations in ALADIN 3D-Var as in ARPEGE 4D-Var, two datasets have been prepared. The first one is composed of all the observations outside the ALADIN-France domain plus a random half of the observations inside the ALADIN-France domain. The other half of the observations inside the ALADIN-France domain is the second dataset. Thus an ARPEGE assimilation cycle and its subsequent coupling files have been recomputed.

2.1.2 Error Covariances Statistics

The "lagged NMC" statistics are used for B (Široka *et al.*, *Meteor. Atmos. Phys.*, 2003).

The ensemble evaluation described in the previous Newsletter is used for V.

2.1.3 Experiments

Our reference experiment is a "classical" ALADIN 3D-Var, i.e. a "J_b+J_o" 3D-Var, hereafter called BO. The experiment that we want to evaluate is "J_b+J_o+J_k" 3D-Var, hereafter called BOK.

2.1.4 Score computation

The scores are computed on the forecasts of our 2 experiments, with respect to the TEMP observations valid for that time. 6-hour forecasts have been computed for each analysis time, 48-hour forecasts have been performed for the 00 UTC and 12 UTC analysis time.

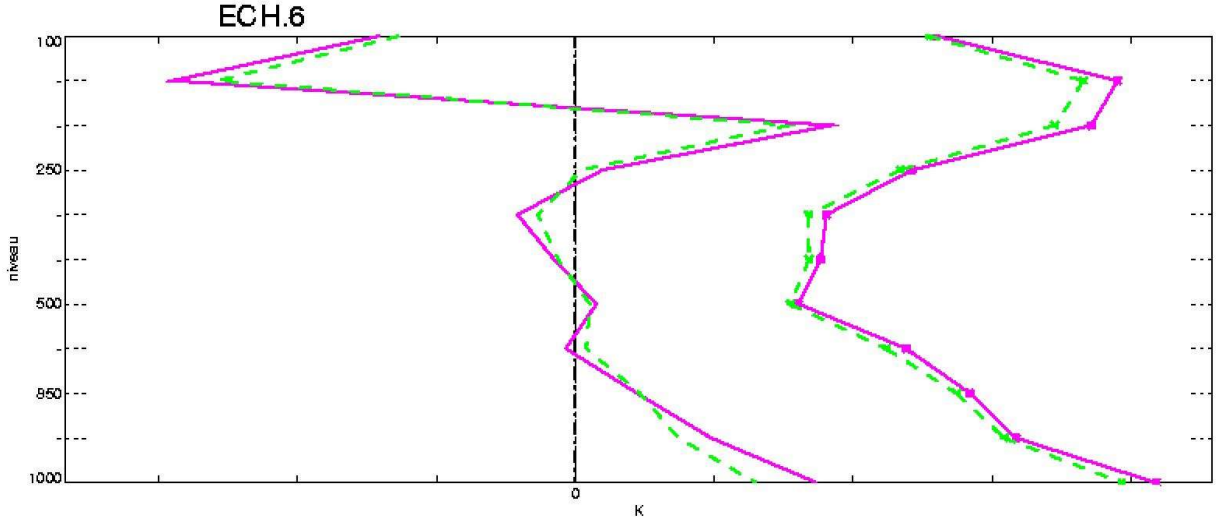
2.2 Results

2.2.1 6-hour forecasts

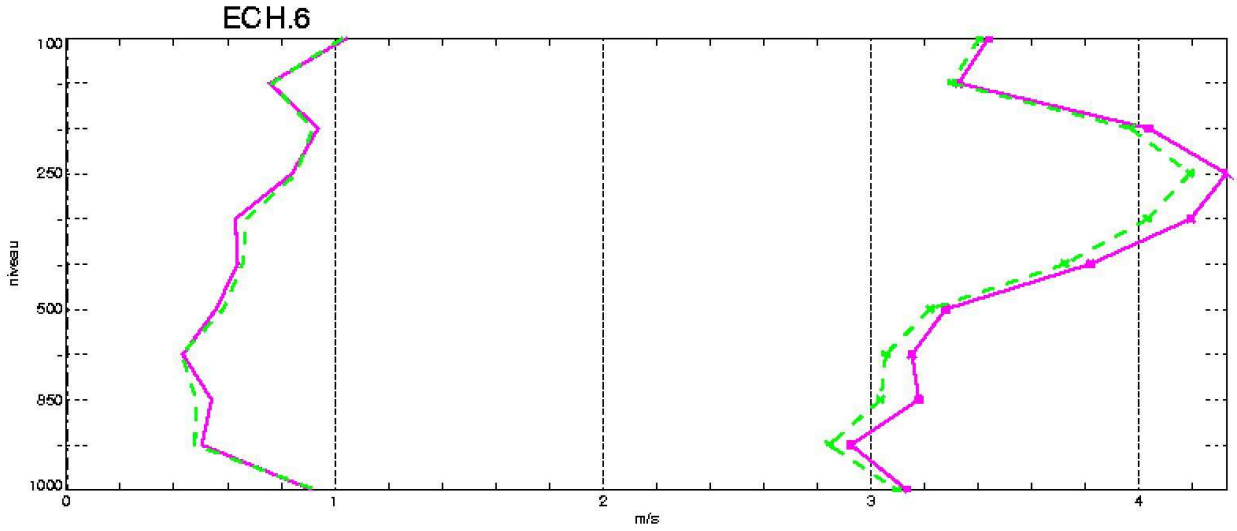
BO is in solid magenta, BOK in dashed green. Biases are plotted without symbols, RMS are with symbols.

The BOK experiment is clearly better than the BO one for temperature RMS. There is also an improvement for temperature bias, but the peaks at the tropopause and in the stratosphere are not significantly reduced. The wind RMS is nicely reduced. No other clear and visible conclusions can be drawn from these scores.

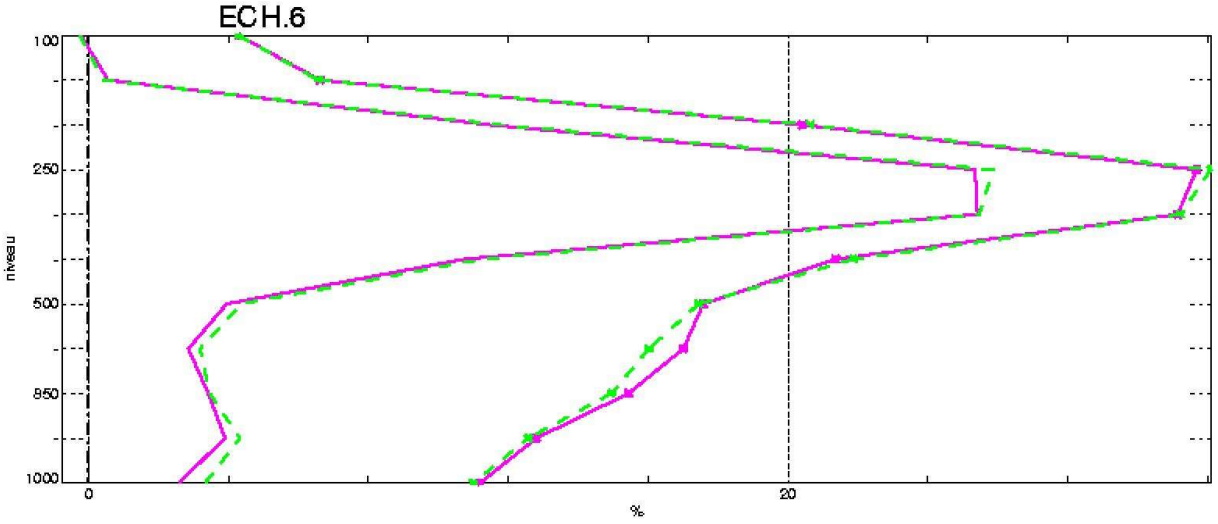
Temperature



Wind



Humidity

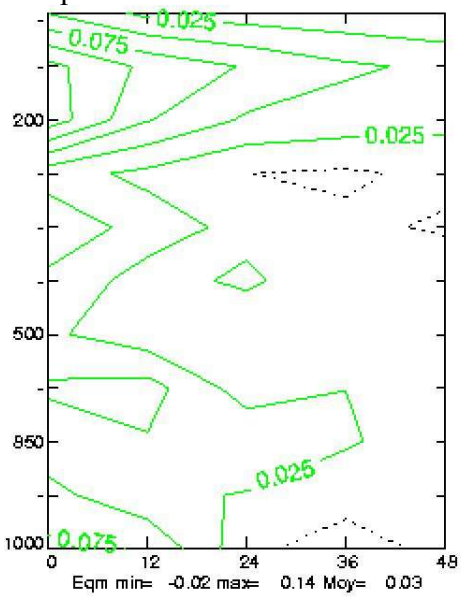


2.2.2 Time evolution of the scores

Vertical levels in ordinates, forecast range in abscissa.

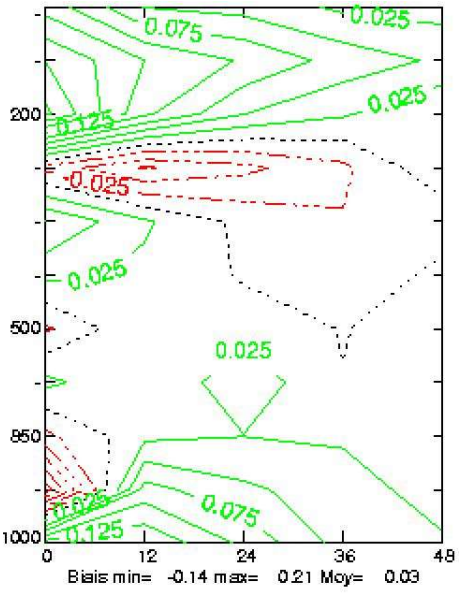
Green: BOK better than BO, Red: BOK worse than BO

Temperature

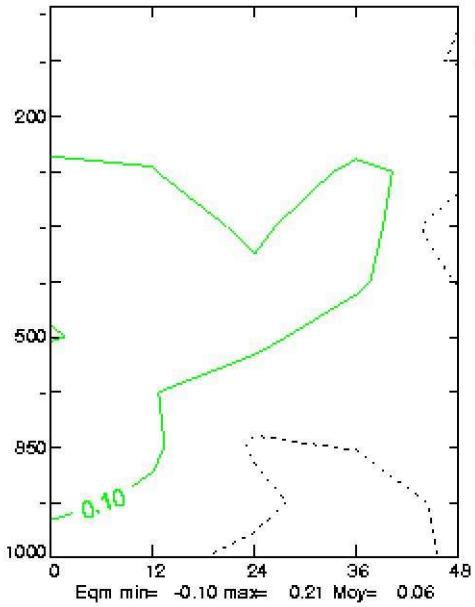


RMS

BIAS

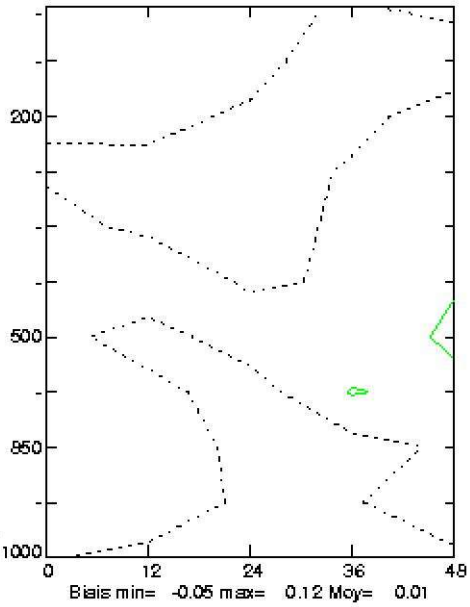


Wind

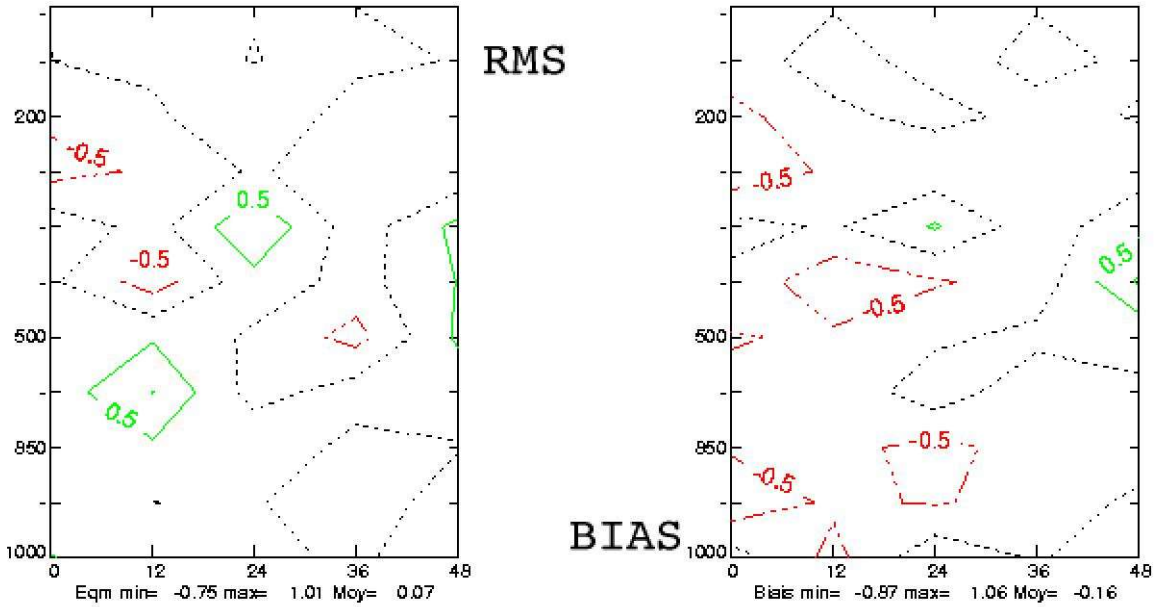


RMS

BIAS



Humidity



No significant conclusions can be drawn for the wind and humidity scores. Nevertheless, the improvements on the temperature field are pretty encouraging, especially in the stratosphere and in the lower troposphere, both for bias and RMS.

3. Conclusion

The objective evaluation of the BOK experiment leads to neutral or significantly positive scores, depending on the variable we focus on. No specific improvements were expected for the humidity field, as there is no constraint for this field in the J_k term. The reduction of the RMS for the temperature and wind fields is a clear signal that we modify the description of the atmosphere in the right way. The temperature bias is not sufficiently improved, especially in the upper troposphere.

The truncation at wavenumber 12 applied to the information from the global model may be a bit too drastic. A higher truncation (e.g. 20-25, closer to the one used in DFI-blending) may improve the description of the larger scales of the global analysis, and thus the quality of the BOK ALADIN analysis.

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