Test of an assimilation suite for ALBACHIR based on the variational technique

1. Introduction

The operational version of ALADIN-Morocco (ALBACHIR) is running routinely in data assimilation mode using the CANARI analysis, based on the Optimal Interpolation scheme. This technique is more and more obsolescent. It is progressively replaced by a variational algorithm.

Among the particularities of the variational method compared to optimal interpolation :

- It avoids the computation of the gain matrix (so the inversion of a big matrix) by taking the analysis as an approximate solution to an equivalent minimisation problem.
- It allows the use of non-conventional observations by the use of nonlinear observation operators.

The aim of this study is to realize a data assimilation cycle based on 3d-var for ALBACHIR. Two cycling types were tested during this study : one similar to the operational assimilation with only two differences : no coupling and CANARI replaced by 3d-var ; another one, called BlendVar, begins first by creating a suitable first guess with the blending method.

The idea of blending the guess is taken from ALADIN-LACE. The goal of this technique is to create an initial state combining the «large scales» resolved by the ARPEGE analysis to the «mesoscale» features provided by the short-range ALADIN forecast. Blending is considered as a mesoscale data assimilation "without using observations".

2. Experimental design

To evaluate the impact of 3d-var we performed at first a data assimilation cycle using the Optimal Interpolation scheme over a period of 10 days, starting on the 5th November 2001. This experiment (EXP_Ref) is considered as a reference for the following ones. Before setting up the 3d-var cycle, a first validation was made via a single-observation experiment (EXP_single). The other experiments: EXP_3dvar, EXP_blending, EXP_blendvar correspond respectively to the assimilation cycles performed with 3d-var, blending and BlendVar, over the same period. Table 1 describes these experiments.

Experiment	Assimilation scheme
EXP_Ref	Optimal Interpolation
EXP_single	3d-var with a single observation
EXP_3dvar	3d-var with full observation
EXP_blending	Blending of the first guess without analysis
EXP_blendvar	Blending of the first guess with 3d-var analysis

Table 1: Description of the experiment runs

The background error statistics used in Jb (model part of cost function) were computed using the «lagged NMC» method, i.e. obtained by statistics on the differences of forecasts (P36h - P12h) valid at the same time. The forecast P12h uses the same lateral boundary conditions as P36h, in order to decrease the impact of «large-scale» features introduced by a fresher ARPEGE analysis. The statistics were calculated over a period of 30 days.

To perform blending we must first compute characteristic truncations for the ALBACHIR context. The truncation that had been calculated for «low» resolution is E26xE26, and the resolution ratio between «high» and «low» spectral resolution is 2.26. The corresponding ratios are 2.66 for ALADIN-LACE and 3.01 for ALADIN-France.

3. Results

The single observation experiments showed that 3d-var analysis is running correctly in ALBACHIR. Figure 1 shows the averaged forecast scores, over all the period of assimilation and over the domain. We choose to present the relative humidity of SYNOP and TEMP because of the great sensitivity of this parameter to different assimilation methods. Forecast scores correspond to the root-mean-square (rms) error when comparing the forecast fields to the observations.

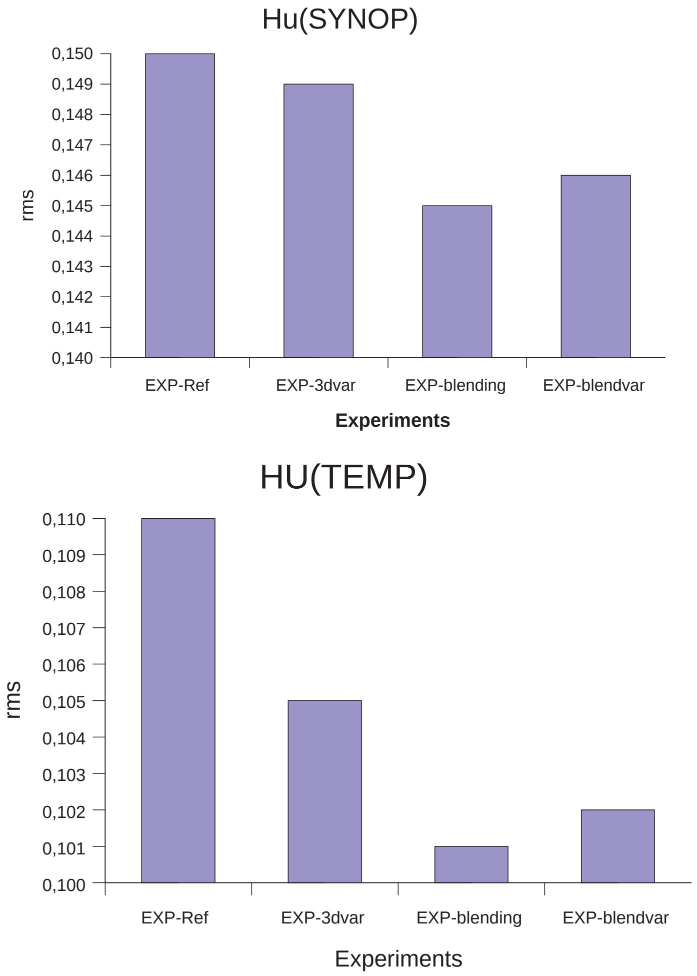

Figure 1 : Forecast scores average for relative humidity compared to SYNOP and TEMP

From this figure it can be seen that the blending and the BlendVar suites have the smallest forecast error against both SYNOP and TEMP. We notice also that the corresponding forecast scores are slightly identical.

In 3d-var cycle we assimilated only the conventional observations (here SYNOP, TEMP, DRIBU and PILOT), so the ability of this technique to use non-conventional observations is not exploited in this study. The use of such observations would certainly improve the forecast. That is why it is foreseen to use satellite observations (TOVS/ATOVS) in ALBACHIR. We intend also to test the use of vertical pseudo-profiles for humidity, produced from a satellite-based cloud classification (in research mode at Météo-France/CNRM/GMME).

It is also foreseen to extend the domain for ALBACHIR in order to cover the north African region. The tuning of BlendVar over this new domain will be done very soon.