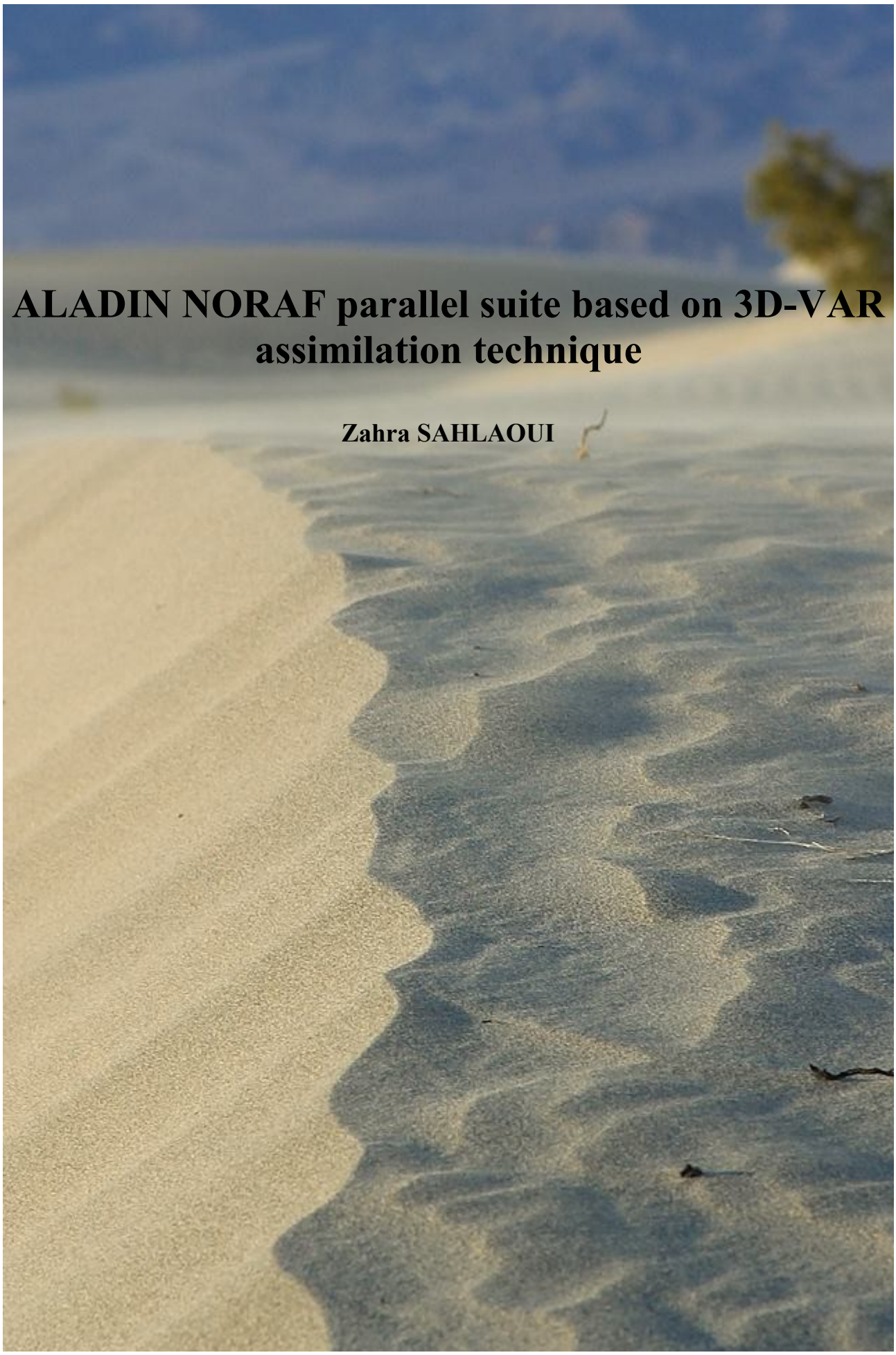

ALADIN NORAF parallel suite based on 3D-VAR assimilation technique

Zahra SAHLAOUI

1.Data assimilation in the Moroccan numerical prediction model.

Morocco is among the pioneers in the ALADIN consortium who use data assimilation in a limited area model. It was valid for the ALBACHIR model and we try to keep the same interest for data assimilation methods with the ALADIN NORAF model. An optimal interpolation analysis (called CANARI) was used in the operational suite. Observations are provided by the local observation data base. However, the lack of a good conventional observation coverage directs us to the use of satellite observations. In this context, 3D-VAR seems to be a more appropriate data assimilation method than CANARI. Research work was carried out in this direction and finalized in a parallel suite with 3D-VAR data assimilation.

2.Descriptionof the parallel suite:

The operational suite is described in the previous N27 ALADIN Newsletter.

Since November 2004, a parallel suite for ALADIN NORAF, based on 3D-VAR data assimilation technique, is running in Casablanca too. Four daily updates towards observations are performed at (00UTC, 06UTC, 12UTC, 18UTC) with an assimilation window of 6hours (long cut-off).A production run is performed once a day at 00UTC (called rAN). Observations used in this run are from a time window of 4.5 hours (short cut-off). Analysis steps are presented in figure 1.

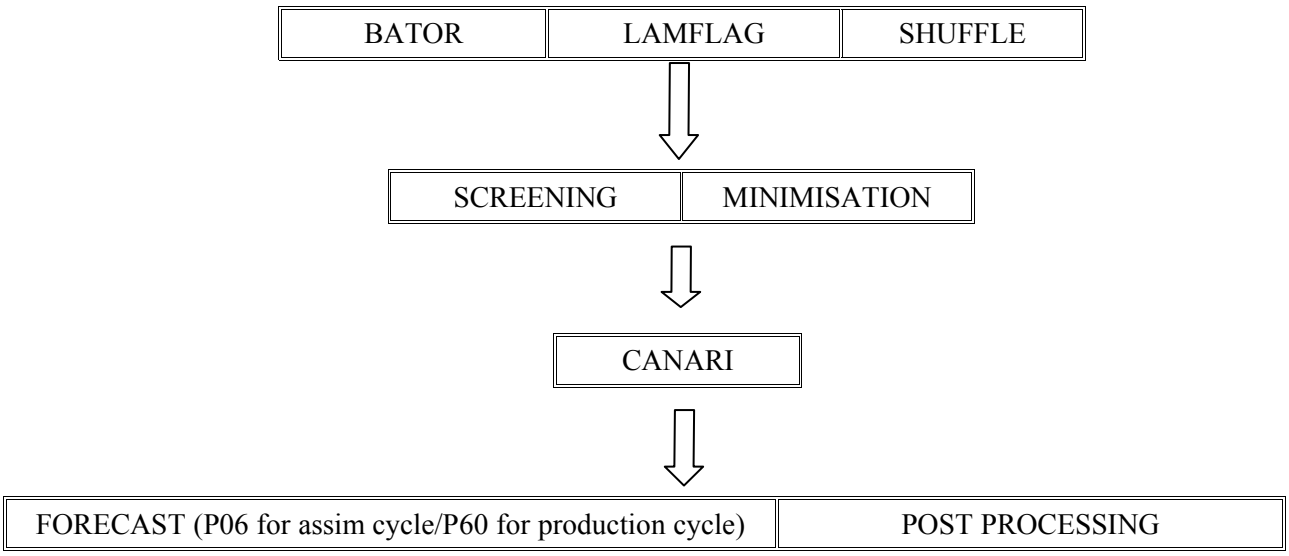

Figure 1. Steps of the parallel suite

Observation preparation : the ascii file of observations, provided by the local data base, is converted to ODB form by the script BATOR. Then LAMFLAG chooses observations inside of the model area and gives them a flag. SHUFFLE selects the flagged observations and splits the data base on many pools.

Upper air analysis: the observation control is performed by the screening to select observations in consistence with each other and with the guess. After this selection, we proceed to the minimisation of the cost function measuring the distance between observations and model.

Surface analysis: the surface analysis is done with an optimal interpolation method called CANARI. The guess is the upper air analysis. The model fields produced by this step are the initial state for the forecast process.

As is shown in figure 1, the analysis is followed by an integration of the model. Forecast range

is 6 hours for the assimilation cycle, to provide the guess for the next anlysis. The production cycle has a forecast range of 60 hours.

2.1.Validation

Scores don't show a great impact of 3D-VAR compared to dynamical adaptation (4D-VAR ARPEGE analysis interpolated to the ALADIN grid). This is a result of the poor observation cover over the NORAF domain (see table below). Most of theses observations are located in the Northern part of the domain, a large part of which covers the Atlantic Ocean and the Sahara.

Observation type	rAN	r00	r06	r12	r18
SYNOP	667	707	827	964	798
AIREP	143	196	1114	1271	1127
SATOB	296	296	303	379	149
DRIBU	45	181	124	135	155
TEMP	37	37	7	37	6

TABLE 1. Observation statistics over the ALADIN-NORAF domain (2005-08-12)

Because of their high spatial resolution and temporal frequency, satellite data should be very useful and will be a good complement for conventional observation systems. A case study shows that AMSU-A[1] radiances from ATOVS have positive impact on temperature and geopotentiel forecasts.

Differences of bias (vs ARPEGE analysis) between simulation with and without AMSU-A radiances are shown in figure 2.

We can see a positive impact on the temperature field over the Sahara and an other positive centre over Atlantic Ocean in front of western African coasts.

Regarding the geopotential field, there is a large reduction of forecast bias (12 mgp) due to the assimilation of AMSU-A data.

The injection of AMSU-A raw radiances in the assimilation system have also an impact on humidity forecast (not shown). In fact, the tropical moisture is better simulated, whereas there is an overestimation of the humidity over Portuguese western coasts associated to a synoptic perturbation.

More OSE[2] experiments should be realised to better undestand the effect of satellite date on the model performance, but we can already suggest that AMSU-A raw radiances seem to be beneficial over areas where there is a lack of conventional observations (ocean and Sahara).

Concerning surface analysis, a study was realised to qualify the impact of CANARI. Results (see figure 3) show that for both cycles with and without CANARI for surface analysis, the forecast scores are very similar. So it was concluded that the step of surface analysis could be avoided (reduce the computation time) without real harm to the forecast quality.

[1] ATOVS Microwave Sounder Unit-A
[2] Observing System Experiment

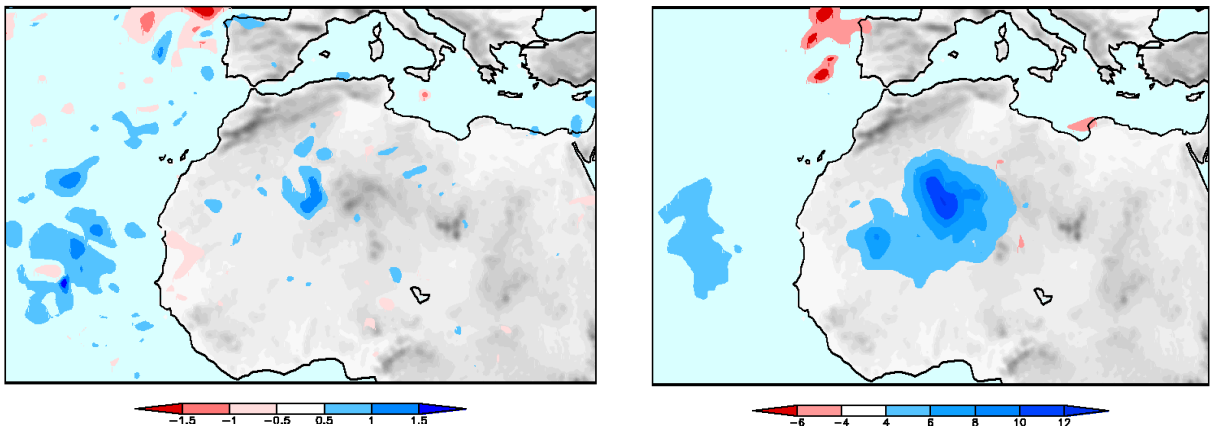

Figure 2. 24 hour forecast scores for temperature (left) and geopotentiel (right) at 700hPa level. Blue areas mean positive impact and red ones correspond to negative impact

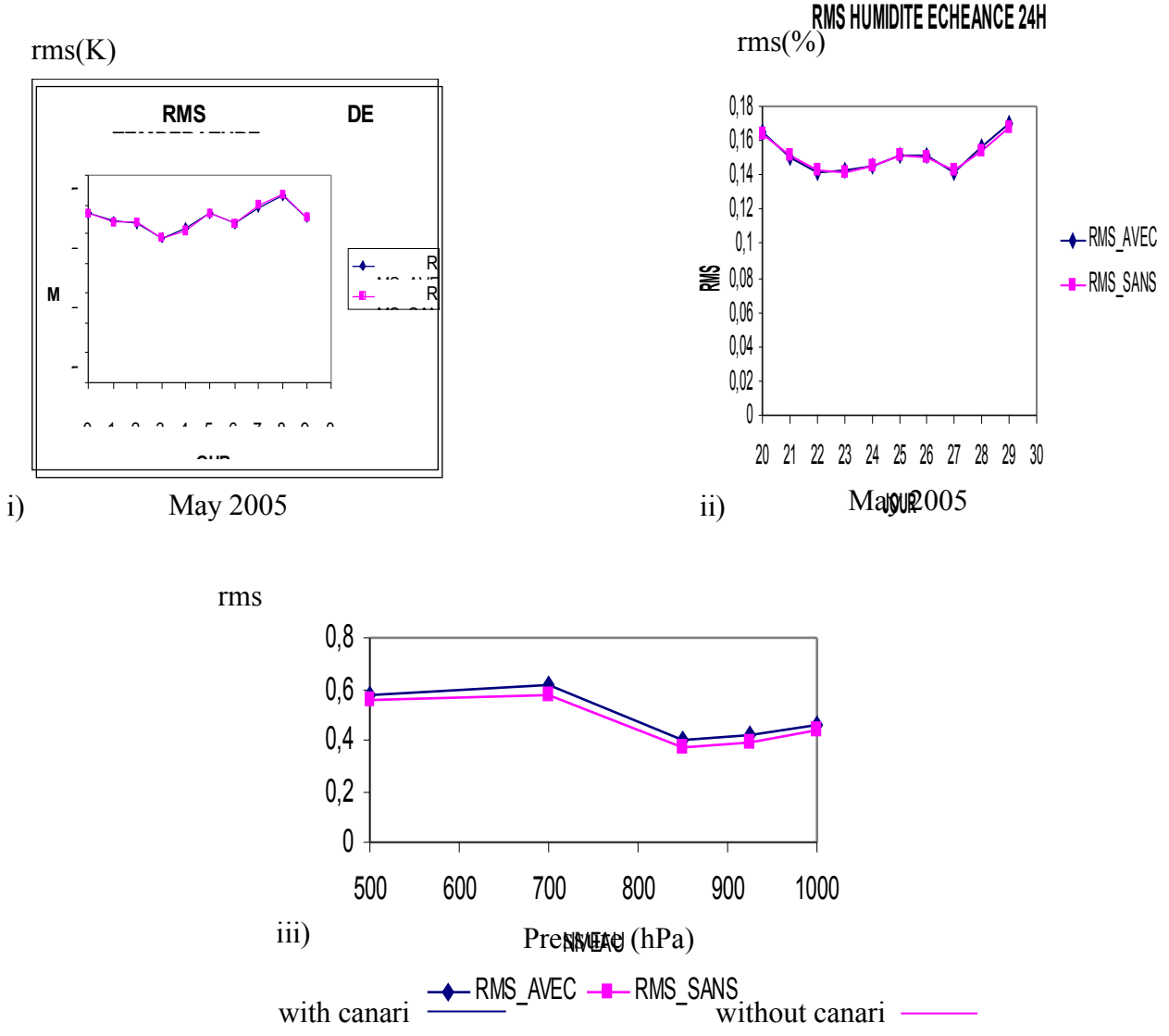

Figure 3. Temporal evolution of root mean square error (rms) of 24 forecast for i)T2m and ii)HU2m versus synoptic observations and iii)vertical profile of geopotential rms versus ARPEGE analysis. Blue line for experiment with CANARI and red line for experiment without CANARI

3.Conclusions and future work

The 3D-VAR parallel suite is the achievement of an earlier work on variational data assimilation methods for LAM models. Before a 3D-VAR operational suite, more tests and validations should be performed.

First, we need to carry out more OSE experiments with radiances (AMSU-A, AMSU-B, SSMI...). Running 3D-VAR without satellite data will just cost more with no real improvement on model quality.

On the other hand, there are some on going studies about the background error covariance matrix (f-plane, ensemble-based Jb). The most appropriate method will be chosen for the operational suite.

Some of ALADIN countries use a blending technique to create the initial state for the model. In ALADIN NORAF, it is planned to use the blended field as a guess for 3D-VAR analysis. This method is called blendvar and preliminary studies shows that this will be beneficial.

4.References

Hdidou.F, Sahlaoui.Z, 2004 : WMO Progress Report on Numerical Weather Prediction 2003.
Rajel, Tilioui, Hdidou.F, Sahlaoui.Z , 2005 : Analyse de surface dans ALADIN NORAF. Internal report.

CONTENTS