

Developments in data assimilation for ALADIN at Météo-France

Dominique Giard. Météo-France/CNRM/GMAP . February 2004

First assimilation experiments at very high resolution

Introduction

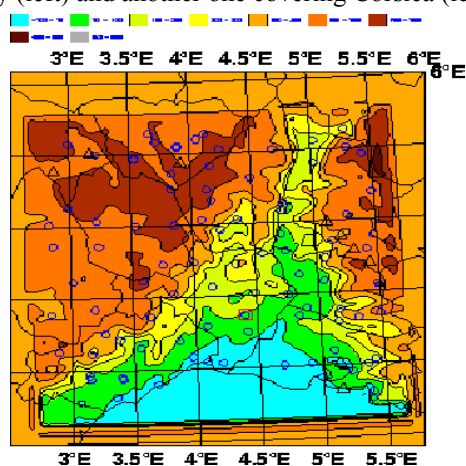
An assimilation suite at very high resolution was designed quite early for AROME. However this complex and intermediate prototype is mainly used by the Meso-NH team for preliminary studies and will differ significantly from the final NWP choice.

Model setup

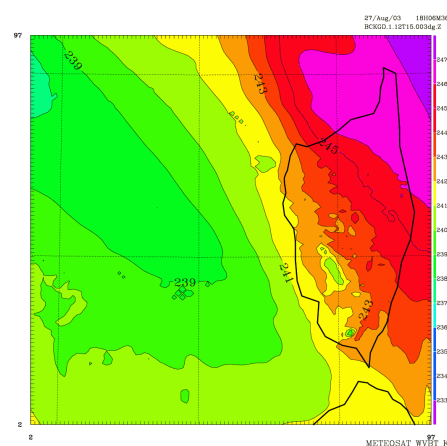
The present assimilation suite is using 2 different models : ALADIN for 3d-var analysis, Meso-NH for forecast, and several converters in-between. It is very expensive and complicated, but allows to benefit from a more detailed physics.

The horizontal resolution is 2.5 km for both models, but with only 41 vertical levels. So this is an hybrid non-incremental assimilation (as far as resolution is concerned).

Two small domains have been considered up to now : the one chosen for the AROME prototype, covering the Southern Rhône valley (left) and another one covering Corsica (left).



"prototype"
"occasional"

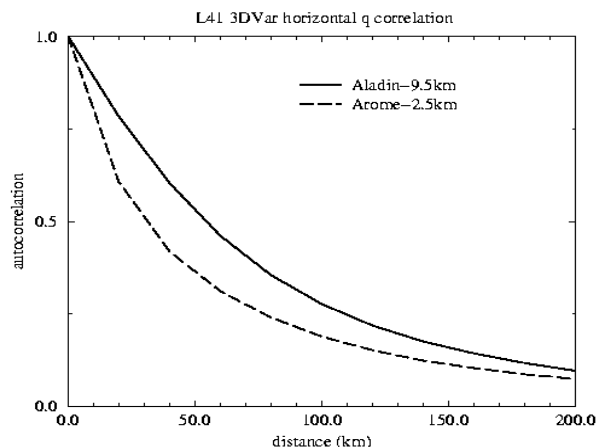


Domains for data assimilation experiments

Background error statistics

The B-matrix used for such experiments is obtained by downscaling from the ALADIN-France one (resolution 9 km, lagged-NMC statistics), using an "automatic" tool. This avoids recomputing statistics from scratch, but works only for an horizontal resolution of 2.5 km and sub-domains of ALADIN-France. A documentation should be available on the new public AROME web site (search for *arotools*).

The changes in spectra are illustrated hereafter :



Observations

Single-observation experiments were performed first, as usual. The next ones focussed either on the use of surface (SYNOP) observations, or on MSG SEVIRI data.

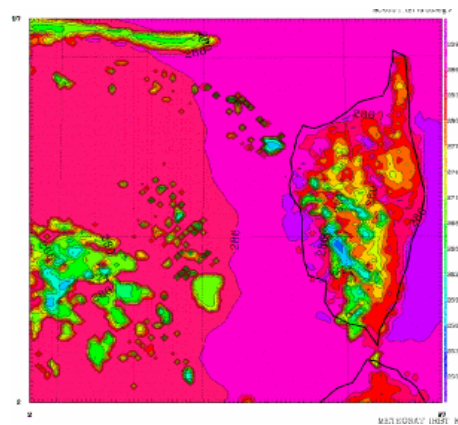
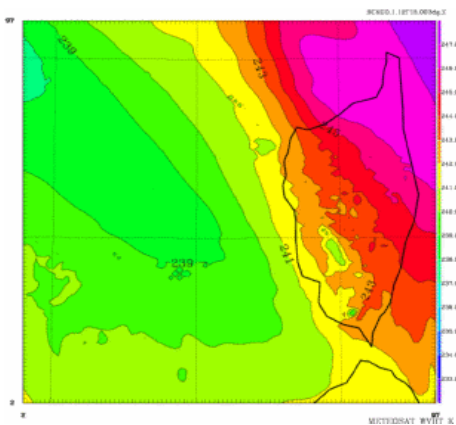
Exemple

The experiment illustrated hereafter helped demonstrating the positive impact of the assimilation of MSG-SEVIRI data, even at very small scales. Though information on both temperature and humidity is available, the improvement is mainly on humidity and cloudiness fields.

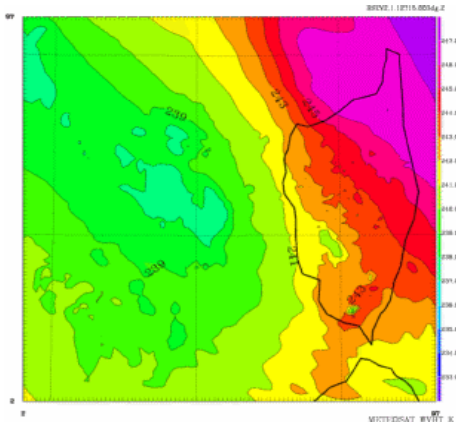
The domain covers part of the Mediterranean sea, near Corsica, so few conventional observations are available. The first guess is 6 h Meso-NH forecast, moved to the ALADIN grid. The result, a 6 h Meso-NH forecast starting from the ALADIN analysis once moved to the Meso-NH grid, is compared to the reference 12 h Meso-NH forecast. Only MSG SEVIRI observations are used in ALADIN 3d-var.

The analysis is valid at 12 h UTC, on 12 February 2003. The simulated satellite pictures show that assimilation enables the capture of observed small-scale features.

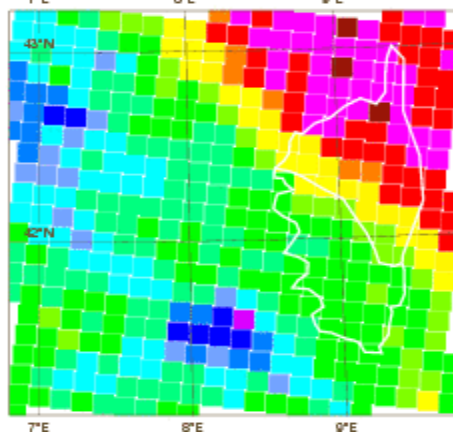
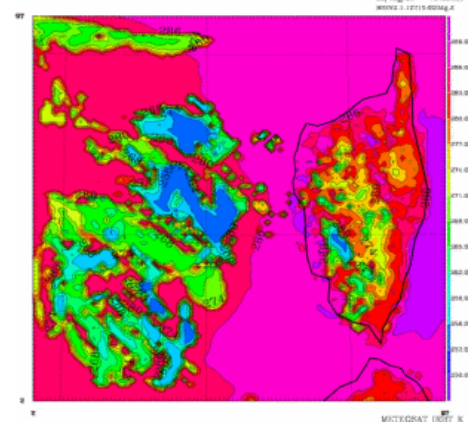
simulated brightness temperatures
Water Vapour Infra-Red



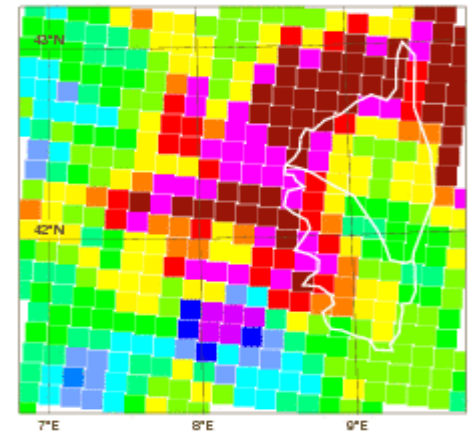
reference 12h forecast



with a 3d-var analysis at 6h



observations



Towards an operational 3d-var assimilation for ALADIN-France

Introduction

The design of an operational 3d-var assimilation suite for ALADIN has just started at Météo-France. It should be implemented in 2004, starting with the simplest framework and improving it afterwards.

First design

OBSERVATIONS :

- SYNOP et al. (mslp, 10 m wind over sea) using the highest available resolution
- AMDAR et al.
- Geowinds
- ATOVS
- MSG
- reduced thinning distances

BACKGROUND ERROR STATISTICS :

- NMC-lagged
- retuning according to "a posteriori" estimation

CYCLING :

- cycling period : 6 h
- coupling frequency : 3h
- preliminary evaluation of a simple solution : restoring towards large scales only through forecasts, and time-consistency of coupling files, to be compared to other methods (blendvar, update of coupling files and surface fields, ...)

INITIALIZATION :

- none, first (let's try !)
- finalization tried if noise problems in the assimilation cycle ??
- DFI with a short cut-off period tried if noise problems in forecasts

SURFACE

- fields interpolated from the ARPEGE analysis (as for dynamical adaptation)

Second step

OBSERVATIONS : more !

- 10 m wind over land
- radar reflectivities (if ready)
- variational quality control

BACKGROUND ERROR STATISTICS :

- from an Ensemble method ?
- other refinements ?

CYCLING :

- use of Jk ?

The choice is still open !

Other plans (in cooperation with ALADIN visitors)

Background error modelling

Many projects, few persons ...

- further evaluation of the Ensemble method for limited-area models
- evaluation of the recent adaptation to a β -plane
- work on a non-diagonal B matrix if further help may be found
- further evaluation of the wavelet representation
- evaluation of new humidity variable from IFS ??

3d-FGAT

Significant changes must be brought to the code in order to make 3d-FGAT affordable. Work will use the new data-flow introduced recently in ARPEGE-IFS-ALADIN. Coding of the tangent-linear and adjoint versions of semi-Lagrangian advection in ALADIN is also considered, but only for hydrostatic dynamics.

Radar data

The work on radar reflectivities will start in March 2004.

Var-Pack

The use of observations of temperature and humidity at 2 m in 3d-var is under thorough investigation. The aim is to check whether 3d-var may replace optimal interpolation for all ALADIN applications, especially for diagnostic analyses (Diag-Pack, for nowcasting purposes) and to a less extent analysis of 2 m fields as input to the assimilation of soil moisture and temperature.