Upgrade to 4D-Var of the operational ensemble variational assimilation at Météo-France

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Data assimilation is based on a statistical characterization of forecast errors. One needs to specify expected amplitudes of these errors (described by variances), which depend on the weather situation.

In this context, a real time ensemble variational assimilation system (AEARP) has been running operationally at Météo-France since July 2008 (Berre et al 2007, 2009), by using six perturbed 3D-Var FGAT assimilations. The spread of such an ensemble allows the space and time dynamics of background errors to be estimated, and resulting background error variances “of the day” are used as an input to the (unperturbed) 4D-Var system. Moreover, a 4D-Var version of this ensemble assimilation is experimented, in order to better simulate errors of the 4D-Var system.

This is illustrated by figures a, b and c, which correspond to a severe storm case over France (figure c), on 24 January 2009. The geographical distribution of variances is more realistic in the 4D-Var version (figure a) than in the 3D-Var version (figure b), with a maximum which is more pronounced and better located over France, in accordance with the strong uncertainty associated to this kind of intense weather system.

The superiority of the ensemble 4D-Var assimilation has been confirmed by comparisons with departures between observations and forecasts, and by impact studies of variances, provided by the ensemble, on the forecast quality. The associated increase of computation cost is moderate, and compatible with the ongoing computation power increase. This upgrade will become operational in the first half of 2010.

In terms of perspectives, it is planned to extend the use of departures between observations and forecasts, to estimate contributions of model errors (to be distinguished from errors induced by initial conditions). This will enable to estimate this error component objectively, as it is poorly known currently.

CAPTION OF THE FIGURE ON NEXT PAGE

Maps of standard deviations of background errors of zonal wind (unit : ms^{-1}) around 500 hPa, on 24 January 2009 at 03 UTC, estimated with two different versions of ensemble assimilation. (a) : standard deviations provided by an ensemble 4D-Var assimilation ; (b) : standard deviations provided by an ensemble 3D-Var assimilation. The mean sea level pressure field at 00 UTC is shown in panel (c).

REFERENCES

Berre, L., O. Pannekoucke, G. Desroziers, S.E. Stefanescu, B. Chapnik and L. Raynaud, 2007: A variational assimilation ensemble and the spatial filtering of its error covariances: increase of sample size by local spatial averaging. Proceedings of the ECMWF workshop on flow-dependent aspects of data assimilation, 11-13 June 2007, 151-168. (available on line at: http://www.ecmwf.int/publications/library/do/references/list/14092007)

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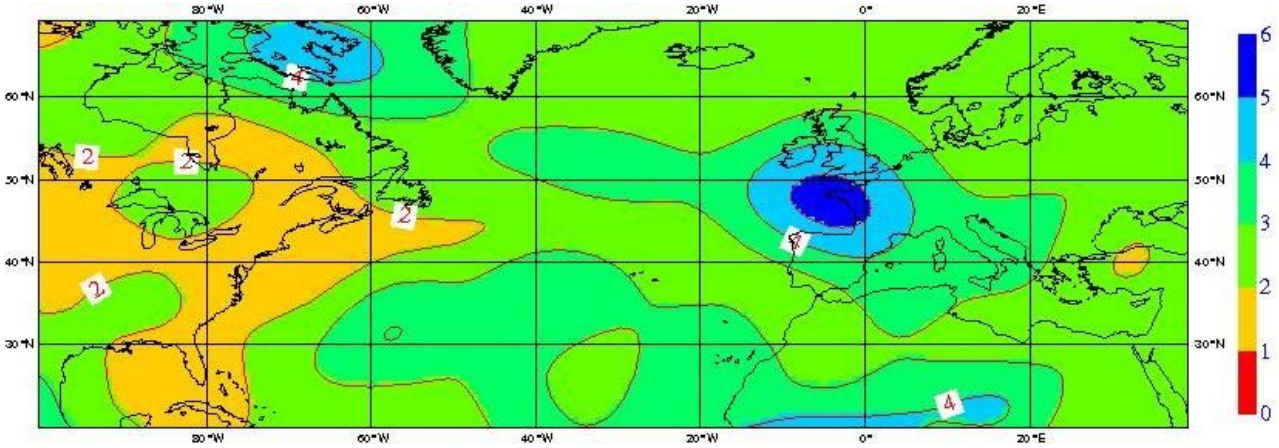
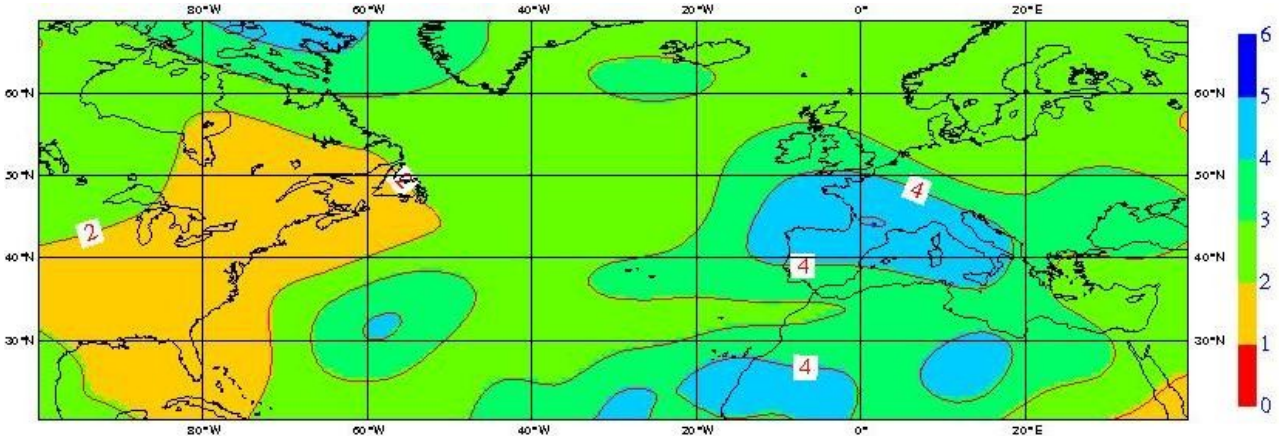
(a)



(b)



(c)

ANASYG du SAM 24/01/2009 00 UTC