Stochastic Physics for Model Error Scheme in PEARP

Marie Boisserie*, Carole Labadie*, Laurent Descamps*, Philippe Arbogast

CNRM-GAME (Météo-France, CNRS)

*Correspondence to : marie.boisserie.labadie@meteo.fr

1. Introduction

The two basic ingredients for an accurate global weather forecast are perfect initial conditions and a perfect numerical weather prediction (NWP) model. During the past decades, more attention has been given to the estimation of errors rising from the production of initial condition. Because Less attention has been given to the model error estimation. Although NWP models have tremendously increased in complexity over the years, a model is by definition only an approximation of reality. Model errors result for instance from approximations in the dynamics formulation, physical parameterizations, or numerical schemes. Therefore, a weather forecast will always be associated with an error that scientists strive to reduce.

2. Motivation

In the past decade, different methods have been proposed to represent model error contributions in ensemble forecasting:

- Multi-model/multi-physics approaches Houtekamer1996,Stensrud2000
- Additive and multiplicative inflations Constantinescu2007, Anderson2001
- Stochastic physics (Stochastic Kinetic Energy Backscatter [SKEB,][]Shutts2005 Stochastically Perturbed Parameterization Tendencies [SPPT,][]Palmer2009)
-

3. Objectif

In this study, we compare the multiphysics approach with that of a stochastic physics approach. The stochastic physics method used here is the Stochastic Kinetic Energy Backscatter [SKEB,][]Shutts2005

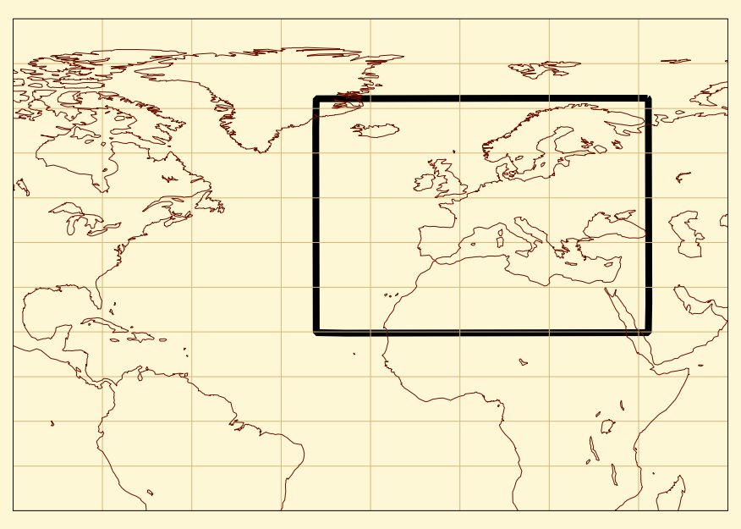
4. Experimental Setup

4 ensembles with different model error representations:

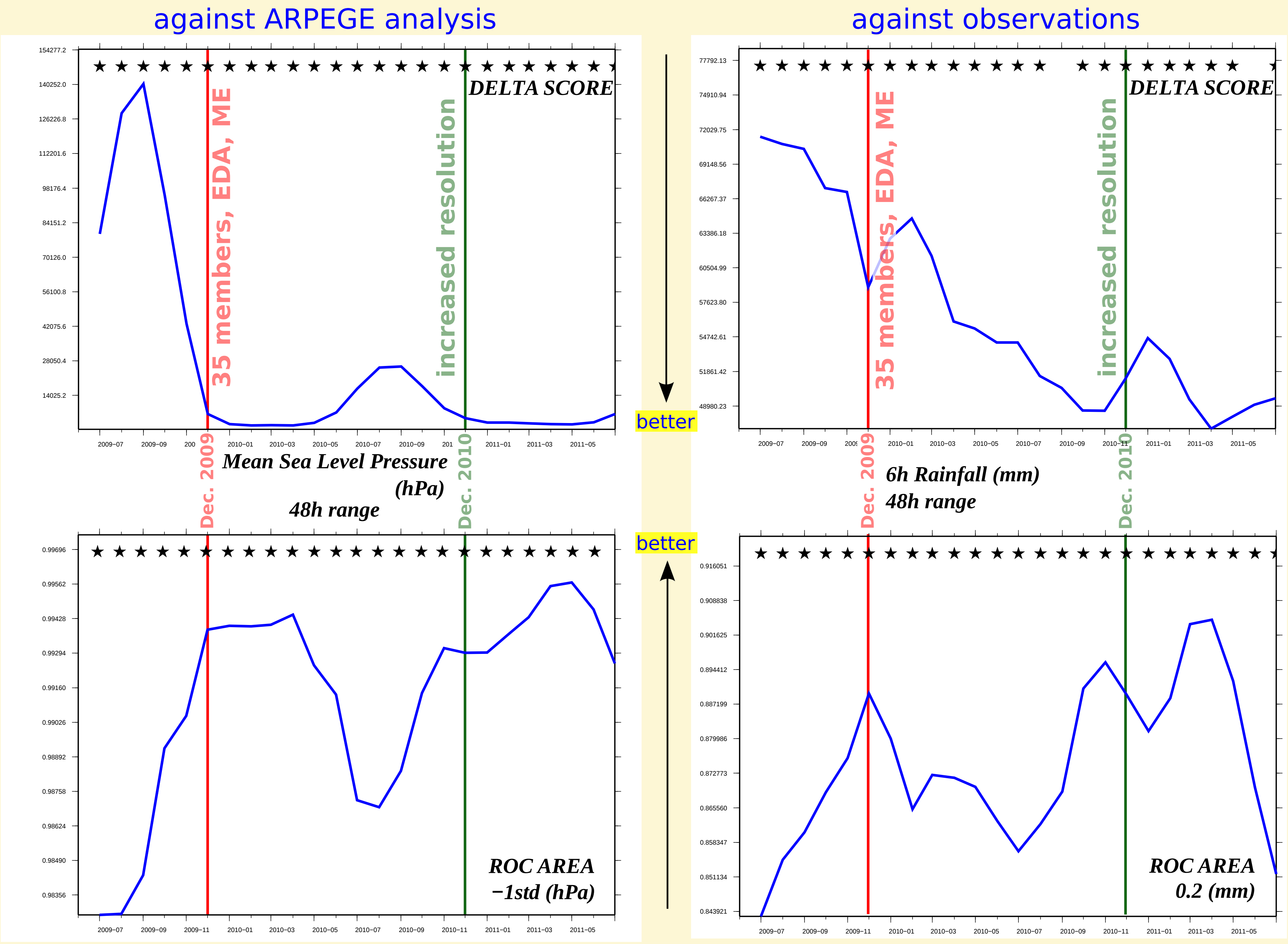
- CONTROL: model error is not taken into account
- PEARP: using 10 physical packages including that of operational ARPEGE model.
- PEARP: using 1 physics with the .
- 35 members including the control member;
- Forecast resolution : T538C2.4L65 (∼15km over France, 90km on the opposite side of the globe) ;
- Running at : 18UTC (108h range) ;
- Analysis perturbations :
  - using the 6 background states and the mean from the ensemble data assimilation of Météo-France (AEARP, Berre et al. 2007) ;
  - singular vectors computed over 7 areas ;
  - perturbations are rescaled by σ_b (background error variance of the day estimated by AEARP).

5. Results: scores

- The graphs below present the time evolution of two probabilistic scores of PEARP from july 2009 to july 2011. At a given date, the scores correspond to a 3 months period over Europe (see the figure to the right).



- DELTA (reliability measure = statistical consistence between the forecasted probability and the observed occurence, 0 for a perfect score)
- ROC area or ROC Area Under the Curve (resolution measure = ability of an ensemble to distinguish different forecasted probability categories, 1 for a perfect score)



6. Persepctives

Several future improvements in the development of PEARP are currently under investigation:

- Implementation of stochastic physics (replacing or completing the multi-physics approach) to represent model errors in the ensemble forecasting system. The approach consists in introducing systematic random perturbations associated with a magnitude that corresponds to an estimation of the model error magnitude (ANR Prevassemble project) ;
- Calibrating PEARP using a reforecast data set ;
- Perturbing some aspects of the surface physics.

PEARO : A convective resolving scale EPS is under development using the AROME model (PEARO). PEARP will be used to provide the boundary conditions to this model.

Toulouse, February 2012