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Implementation and calibration of a ahort-range ensemble prediction system over Spain using HRM mesoscale model

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The irreparable technical limitation that exists when simulating the evolution of atmosphere makes the forecast to have an inherent error that grows with the forecast range. In the sinoptic scale this error is not significant untill the third day although it can affect the location of mesoscale extreme phenomena before 72 hours when high resolution models are used. Ensemble forecasting assumes an ensemble of plausible initial states that integrated individually conform the Probability Density Function (PDF) of the forecast. So that deterministic point of view in the forecast is changed for probabilistic one. In the short-range the generation techniques used for the medium-range have given too little spread and it has been found in the Multiplicity of Initial and Boundary Conditions (MIBC) and the Multiplicity of Models (MM) an easy an effective way to explain the uncertainty in the first hours of prediction.

In the present work a Short-Range Ensemble Prediction System (SREPS) using MIBC has been implemented. HRM mesoscale model (from DWD) has been adapted in order to read boundary conditions from AVN, ECMWF, GME, HIRLAM and UKMO. The uncertainty is then sampled in the initial state and the countours, leaving the uncertainty in model formulation out of study. Bayesian Model Averaging (BMA) for statistical postprocess has been applied for calibrating the ensemble. The PDF calculated with BMA is a weighted mean of the PDFs of each member, centered around the un biased forecasted value. The weights are a mesure of the skill of each member, and the variance can be split into the spread and the own variance of each model.

In order to minimize the effect of those sinoptic situations with large scale forcing and then more sensitive to model formulation, January 2004 has been selected as a study period. The variable of study has been mean sea level pressure, the forecast range 48 hours and ECMWF analysis has been used as verification. From the study of the non-calibrated ensemble it has been proved that ensemble mean verifies better than any of its members provided that they do not present significant errors or benefits. The ensemble is not calibrated (members not equiprobables), there is too much spread in the first hours and spread growth is slower than error growth. However, a significant spread-error linear correlation of 0.48 is achieved. After BMA bias correction and calibration the rms of the worst member was reduced by 50%, and the rest were significantly improved. Ensemble weighted mean verifies the best. The ensemble PDF approximates fairly well the actual forecast uncertainty, having an almost flat Talagrand diagram. BMA solves the problem of slow spread growth considering within member variance. After calibration spread-error linear correlation is 0.57, that is highly significant. Probabilistic forecasting also improves, having the ROC curve for 48 hours forecast a higher value of the area under the curve than in the non-calibrated case.