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Performance of the multi-model SREPS precipitation probabilistic forecast over Mediterranean area

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The performance of the Short-Range Ensemble Prediction system (SREPS) probabilistic precipitation forecast over the Mediterranean area has been evaluated comparing with both, an Atlantic-European area excluding the first one, and a more general area including the two previous ones. The main aim is to assess whether the performance of the system due to its meso-alpha horizontal resolution of 25 kilometres is affected over the Mediterranean area, where the meteorological mesoscale events play a more important role than in an Atlantic-European area, more related to synoptic scale with an Atlantic influence. Furthermore, two different verification methods have been applied and compared for the three areas in order to assess its performance.

The SREPS is a daily experimental LAM EPS focused on the short range (up to 72 hours) which has been developed at the Spanish Meteorological Agency (AEMET). To take into account implicitly the model errors, five purely independent different limited area models are used (COSMO (COSMO), HIRLAM (HIRLAM Consortium), HRM (DWD), MM5 (NOAA) and UM-NAE (UKMO)), and in order to sample the initial and boundary condition uncertainties each model is integrated using data from four different global deterministic models (GFS (NCEP), GME (DWD), IFS (ECMWF) and UM (UKMO)). As a result, crossing models and initial conditions the EPS is composed by 20 members. The underlying idea is that the ensemble performance has to improve as far as each member has itself the better possible performance, i.e. the better operational configuration limited area models are combined with the better global deterministic model configurations initialized with the best analysis. Because of this neither global EPS as initial conditions nor different model settings as multi-parameterizations or multi-parameters are used to generate SREPS.

The performance over the three areas has been assessed focusing on 24 hour accumulation precipitation with four different usual forecasting thresholds: 1, 5 , 10 and 20 mm. A standard probabilistic verification exercise (following ECMWF recommendations) has been carried out, assessing quality with well known properties like reliability, resolution and discrimination, using usual performance measures: Reliability (Attributes) Diagram, Brier and Brier Skill Score Decomposition, Relative Operating Characteristic (ROC) and ROC area. The value of the forecasts w.r.t. sample climatology is shown with Relative value envelopes.

This exercise has been carried out for a one year period (May 2007 to May 2008). Observed precipitation data from High Resolution (HR) networks over Europe have been used as reference. To avoid the potential lack of statistical significance due to spatial dependence between close observations, up-scaling processed observations have been used, provided by ECMWF, who collects the raw data from different member and cooperating states over Europe.

This advanced up-scaling methodology has the feature to be more independent of the density of precipitation observations than the more classical simple methodology of interpolate the model outputs to the observation station points. In particular, the observations have been up-scaled to a 0.25ºx0.25º box taking each box as representative only when more than five observations are available in it. In the first one verifying method the box-average is taken, and for the second one a set of quantiles is considered, specifically 10, 25, 50 , 75 and 90 quantiles. The difference between both methods is that the first one takes over each box a single value as

representative of precipitation. Whereas the second one takes a probability density function as representation of precipitation over the box, thus introducing uncertainty (related with spatial distribution) in the observations.

The results are consistent, and show that in general SREPS is a reliable probabilistic forecasting system for the three selected areas. Concerning performance over different regions, the SREPS probabilistic precipitation forecasts over the selected Mediterranean area have a little less reliability and resolution than over the North Europe area, specially with the higher thresholds 10 and 20 mm. The latter results suggests that in SREPS the representation of the mesoscale meteorological events around the Mediterranean basin has to be improved, and probably also the orographic-related processes as the orographic enhancement of the precipitation. So it is suggested that the predictability skill of SREPS system around the Mediterranean could be expected to improve if the horizontal and vertical resolution of each limited area model of the system is increased in order to take into account the meso-beta scale. When comparing the two verification methods, one using up-scaled box average and the other using an up-scaled set of quantiles (i.e. a box PDF), it is shown that the validation of the probabilistic forecast is quite more consistent in the latter method when uncertainties in the observations are introduced and probably gives a more realistic idea of performance.