Probabilistic forecasts based on the HIRLAM INM deterministic model

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INTRODUCTION

Introduction

The high resolution deterministic model HIRLAM at INM is used to produce probabilistic forecasts applying the neighbourhood method ([1], [2]). Deterministic models have errors both in space and time directions. Part of these errors is related with a displacement of the forecast event.

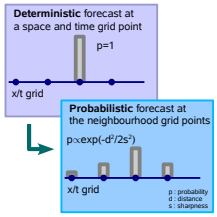
This diffusive method spreads the deterministic forecast both in space and time using some *a priori* probability distribution, providing probabilistic forecasts.

In this poster the attention is focused on the 24 hours rain accumulated forecast. Nevertheless, the method has been applied to other variables, like wind speed at 10 meters.

Deterministic HIRLAM INM

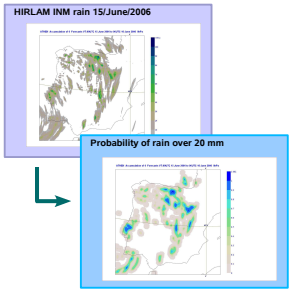
The operational HIRLAM INM model runs four times a day at two different horizontal resolutions, 0.16º and 0.05º, out to 72 and 36 hours respectively.

HIRLAM INM forecasts from April to June 2006 are used to produce probabilistic forecasts of precipitation. The probabilistic forecasts are verified using rain gauge data.



The probability distribution chosen to spread the deterministic forecast is the normal distribution in space and time. Doing so, at any grid point there is a set of pairs of forecast values and probabilities from the neighbourhood, that is, a discrete probability density function.

The size of the circle which defines the neighbourhood and the sharpness of the distribution are parameters that can be selected.



In the example, above HIRLAM INM at 0.05º resolution, deterministic total precipitation accumulated in 24 hours from 6 hours 15/June/2006. Below, the probability of precipitation over 20 mm in 24 hours. The size of the neighbourhood is 35 km in this case.

METHOD

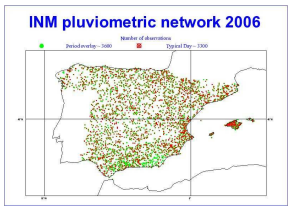
Set of experiments

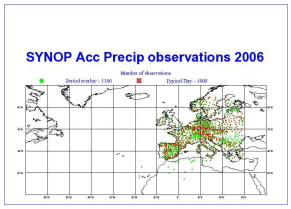
In order to test the method, different sets of probabilistic forecasts with different size of neighbourhood and sharpness of the normal are performed for each deterministic model. In the table below there is a summary of the experiments.

Set name	Resolution	Size (km)	Time
R16S17T1	0.16º	17	1
R16S35T1	0.16º	35	1
R16S35T3	0.16º	35	3
R16S53T1	0.16º	53	1
R05S09T1	0.05º	9	1
R05S09T3	0.05º	9	3
R05S18T1	0.05º	18	1

Rain gauge observations

INM rain gauge network and the SYNOPS available observations are used for the verification. The INM network is a dense set of observations of 24 hours rain accumulation, the SYNOPS set is less dense but covers a bigger area.





Verification method

The verification method is the same used for SREPS [3]. Forecast values are interpolated to the rain gauge site by a bilinear procedure and then compared to the observation.

In the neighbourhood method there is a probability density function, instead of the members in the usual ensemble systems. The verification is done from these probability density functions by taking into account the percentiles from 0% to 100% every 5%.

RESULTS

24 hours precipitation from HIRLAM 0.16º, H+30 to H+54 forecast

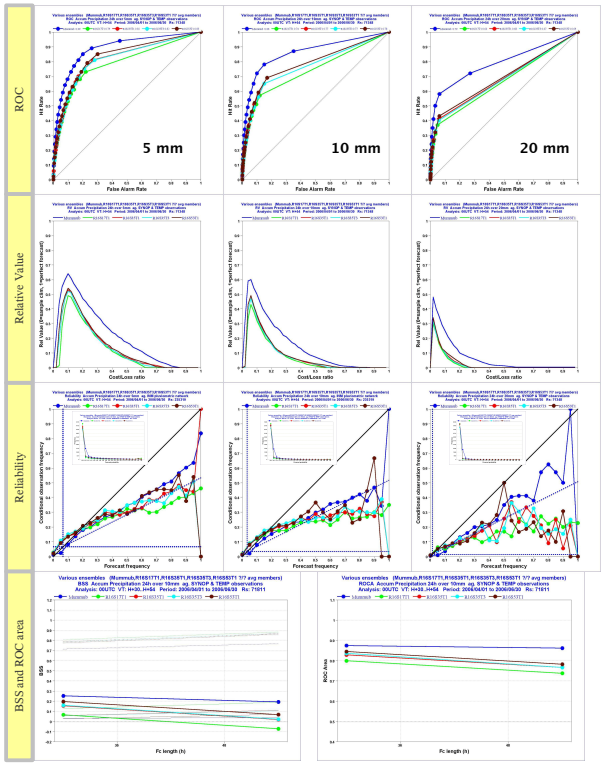
The relative operating characteristic (ROC), relative value (RV), reliability and Brier skill score (BSS) are all better in the Multimodel ensemble as expected.

The differences between different neighbourhood experiments are small compared to the difference of any of these experiments to the Multimodel ensemble, specially in the ROC and relative value curves.

Performances are better at 1 mm (ROC area 0.87) and get worse for 20 mm (ROC area 0.67).

The size of the neighbourhood has an important impact on the performance. Small size experiments results are similar to deterministic outputs having smaller probabilistic scores.

Verification is done with SYNOP observations, similar results are obtained with the INM network, although there are some differences.



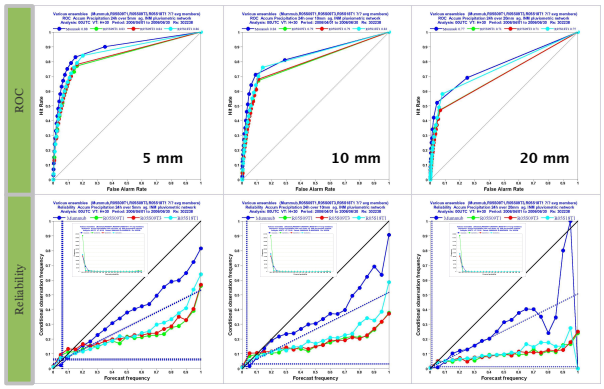
24 hours precipitation from HIRLAM 0.05º, H+06 to H+30 forecast

Results for the HIRLAM 0.05º set of experiments and H+30 forecast.

There are smaller differences in the ROC curves between Multimodel ensemble and diffusive method, although Multimodel ensemble shows much better reliability.

Relative values for Multimodel ensemble are clearly better than diffusive.

Verification is done with the INM observational network.



CONCLUSIONS

Conclusions

Neighbourhood method has been applied to HIRLAM INM high resolution model at 0.16º and 0.05º resolution and the probabilistic forecast of 24 hours accumulated rain has been verified with SYNOP and INM network.

Results are quite good, considering that the method is cheap in computational costs. Multimodel ensemble shows better performance as expected.

The size of the neighbourhood is an important parameter. Small sizes produce worse probabilistic performance because it get closer to the deterministic forecast, although big sizes spreads too much the forecast and the original high resolution is lost.

Future work

Application of the method to the hourly HIRLAM INM model output using more accurate treatment of the temporal spread of the deterministic forecast.

Verification of the 10 meters wind forecasts.

Upscaling verification procedure will be applied.

The use of other a priori probability distribution functions to spread the deterministic forecast, based in more realistic assumptions.

References

[1] Theis, S. & Hense, A. & Damrath, U. (2005) Probabilistic precipitation forecasts from a deterministic model: a pragmatic approach. Meteorological Applications.

[2] Theis, S. (2005) Deriving probabilistic short-range forecasts from a deterministic high-resolution model. Erlangung des Doktorgrades, Bonn University.

[3] Carlos Santos, Performance of the INM short range multi-model ensemble using high-resolution precipitation observations. Verification Workshop 2007, ECMWF, Reading.

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