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 paper the attention is focused on the 24 hours rainfall 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 2 different horizontal resolutions, 0.16° and 0.05°, 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.

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.

<table>
<thead>
<tr>
<th>Set name</th>
<th>Resolution (km)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>R16S1F7T1</td>
<td>0.16</td>
<td>17</td>
</tr>
<tr>
<td>R16S3F7T1</td>
<td>0.16</td>
<td>35</td>
</tr>
<tr>
<td>R3S5F7T1</td>
<td>0.16</td>
<td>53</td>
</tr>
<tr>
<td>R5S5F9E3T</td>
<td>0.05</td>
<td>9</td>
</tr>
<tr>
<td>R5S5F7E1T</td>
<td>0.05</td>
<td>18</td>
</tr>
</tbody>
</table>

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 rainfall accumulation, the SYNOP set is less dense but covers a bigger area.

INM pluviometric network 2006

Verification method
The verification method is the same used for SREPS [3]. Forecast values are interpolated to the rain gauge sites 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 for the HIRLAM 0.05° set of experiments and H+30 forecast.
There are smaller differences in the ROC curve 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
Neighbourhood method has been applied to HIRLAM INM high resolution model at 0.16° and 0.05° 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 one 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 spread 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. Use of other a priori probability distribution functions to spread the deterministic forecast, based in more realistic assumptions.

References

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