Forecast and Real time modeling air quality system:

• As provided by the air quality Directive 2008/50/EC, modelling is considered a powerful tool to assess and manage air quality (AQ).

• In Italy, to date, only few Regional Environmental Protection Agencies (ARPAs) have implemented models to integrate information coming from air quality monitoring networks and support the definition of measures to reduce health impact of air pollution.

Would Forecast and Real time air quality modeling become an important support instrument to Environmental Protection Agencies (ARPAs)?

Forecast system:

• Emission pre-processing system: EMMA

• Prognostic non-hydrostatic meteorological model RAMS

• Interface module for the estimation of dispersion parameters: GAP/SurfPro

• Chemical Transport Model (CTM) : FARM

• Produces a 12 hours forward prediction on a daily basis

Comparison Model Systems and Measurements

The AQ System verification lasts the period from August to December 2009 and is mainly devoted to verify the modelling system capability to reproduce the observed concentration of major pollutants, their time variations and to forecast relevant air pollution episodes. The comparison with observations has been extended to the regional-background and metropolitan domains (Figure 1) to identify resolution effects and possible influence of emissions.

Table 1. Discrete Statistic for November – December 2009, PM10, Forecast System, Resolution 1 Km

<table>
<thead>
<tr>
<th>Station</th>
<th>Accuracy</th>
<th>FAR (%)</th>
<th>POE (%)</th>
<th>CSI (%)</th>
<th>RMSE</th>
<th>NME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Province</td>
<td>78</td>
<td>60</td>
<td>105</td>
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Table 2. Comparison Forecast and Real time: November – December 2009.

The statistics refer to stations located inside the observed ones. This feature is shown by the observed values very close to the threshold values can be exceeded locally when concentration limits are exceeded only in some of the monitoring stations. These conditions are quite hard to forecast because the threshold value can be exceeded locally for a few μg/m³ of concentration. Moreover, when exceedances are forecasted in wrong position, the forecast can still be considered positively. Its contribution to FAR and CSI will decrease performance indicators.

The system is characterized by an elevated Accuracy in every considered month. This parameter is influenced by the high number of correctly forecasted non exceedances and for this reason, it is important to pay attention to the interpretation of this index in the evaluation of a forecasting system performances. The POE values are very high, but in many cases the FAR index too; this is the reason for what the CSI is low. It can also be noticed the variation of some parameters in FAR and CSI among the different considered stations. This behaviour can be attributed partially to the moderate polluted situations when concentration limits are exceeded only in some of the monitoring stations. The conditions are quite hard to forecast because the threshold values can be exceeded locally for a few μg/m³ of concentration. Moreover, when exceedances are foreasted in wrong position, the forecast can still be considered positively. Its contribution to FAR and CSI will decrease performance indicators.

Both Forecast and Nowcast well reproduce the pollutants trends . (Fig.2)

Comparison Model Systems and Measurements

The monthly mean concentrations maps of NO2 (Lazio region) and PM10 (Rome urban area) produced by the NRT system for November 2009 are shown in Figure 4. For NO2, the NRT system qualitatively describes the areas where higher concentrations are observed and provides values very close to the observed ones. This feature is shown by PM10 map too for Rome urban area, even if PM observed data have been assimilated.

Near Real Time:

• Emission pre-processing system: PREMA

• Prognostic non-hydrostatic meteorological model RAMS

• Interface module for the estimation of dispersion parameters: GAP/SurfPro

• Chemical Transport Model (CTM) : FARM

• Assimilation performed with the Successive Correction Method, that takes into account O3, NO2, Benzene, CO and SO2 measurements from 34 regional monitoring stations

• Produces air quality analyses every 3 hours

Table 3. Categorical Statistic for November – December 2009, NO2, Forecast System, Resolution 1 Km

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Table 4. Discrete Statistic for November –December 2009, NO2.

The values of RMSE for NO2 confirm the large discrepancies already observed for the forecast system and the relevant improvement provided by data assimilation.

Conclusion

• At high resolution (1 km) over Rome urban conglomeration, the quality of the Forecast and Nowcast results are comparable and both well reproduce pollutants trends for the considered period.

• During wintertime, very good results have been obtained for PM10 and PM2.5 daily average values.

• At resolution of 4 Km over Lazio Region domain, the forecast system predictions underestimate the observations, while the NRT system maintains a very good concordance with experimental data for NO2, whose measurements are directly assimilated, but not for PM10, which is not assimilated.

These results highlight the importance to improve emissions characterization outside Rome area.