A comparison of modal and sectional approach in aerosol modeling in the Milan area

A. Pederzoli, F. Monforti
ENEA, Bologna e Casaccia.

C. Silibello
ARIANET, Milano.
The MINNI project

Meteo sub-system
- ECMWF fields
- Local data
- RAMS
- Reference meteo year
- EMEP B.C.

Chemical-transport sub-system
- Concentration and deposition fields
- FARM

Emission sub-system
- Ref. inventory
- Emission scenario
- Space, time, species info
- Transfer matrices
- RAINS

The MINNI project is a comprehensive system for simulating atmospheric processes. It consists of three main subsystems:

1. **Meteo sub-system**
   - ECMWF fields
   - Local data
   - RAMS
   - Reference meteo year
   - EMEP B.C.

2. **Chemical-transport sub-system**
   - Concentration and deposition fields
   - FARM

3. **Emission sub-system**
   - Ref. inventory
   - Emission scenario
   - Space, time, species info
   - Transfer matrices
   - RAINS

The system integrates data from various sources, including meteorological and emission data, to simulate atmospheric processes accurately.
The MINNI project

Grid systems

EMEP 50 km

MINNI 20 km

9th Harmonisation Conference Garmisch-Partenkirchen
Example of FARM model output:
SO$_2$ concentrations on 1-2 Oct 1999, 20 km res.

1 and 10 ppb isosurfaces

10/01/1999 h 00:00:00
The MINNI project

Transfer matrix demo

Region 08: Emilia-Romagna
% change on total deposition, due to 25% change in emissions

Other details: poster 2.14

Calculation period: 1 winter week
PM in the MINNI system: AERO-3 (modal)

Scheduled 2005

Preliminary tests: now

PM in AERBOX (sectional)

Emissions in a workday - h 12:00

emission [kg/h/ha]

particle dimension [micrometers]
Comparing models in a Box around Milan

Check planned MINNI PM evolution algorithms in “typical” Italian conditions.

Looking for weak points and possible improvements

AERBOX full validation
Comparing models in a Box around Milan

50 km × 50 km

BC for gases:
EMEP

BC for PM:
Remote station
Comparing models on a Box around Milan

Emissions: CITY-DELTA
Comparison results: January – PM10 daily average
January – Relative Humidity

Relative humidity (%) vs. hours
Comparison results: January – PM10 2-hourly

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Sigma</th>
<th>bias</th>
<th>nmse</th>
<th>cor</th>
<th>fa2</th>
<th>fb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Via Juvara</td>
<td>68.95</td>
<td>37.32</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Aero-3</td>
<td>149.58</td>
<td>114.73</td>
<td>-80.62</td>
<td>1.86</td>
<td>0.224</td>
<td>0.455</td>
<td>-0.738</td>
</tr>
<tr>
<td>AERBOX</td>
<td>89.28</td>
<td>92.17</td>
<td>-20.33</td>
<td>1.37</td>
<td>0.268</td>
<td>0.581</td>
<td>-0.847</td>
</tr>
</tbody>
</table>
Comparison results: April – PM10 daily average

Days

concentration (mg/m³)

Via Juvara
Aero-3
AERBOX

9th Harmonisation Conference Garmisch-Partenkirchen
Comparison results: April – PM10 2-hourly

<table>
<thead>
<tr>
<th></th>
<th>N=174</th>
<th>Average</th>
<th>Sigma</th>
<th>bias</th>
<th>nmse</th>
<th>cor</th>
<th>fa2</th>
<th>fb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Via Juvara</td>
<td></td>
<td>31.06</td>
<td>19.78</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Aero-3</td>
<td></td>
<td>55.18</td>
<td>42.18</td>
<td>-24.11</td>
<td>1.87</td>
<td>-0.276</td>
<td>0.443</td>
<td>-0.723</td>
</tr>
<tr>
<td>AERBOX</td>
<td></td>
<td>28.75</td>
<td>23.50</td>
<td>2.32</td>
<td>0.81</td>
<td>0.238</td>
<td>0.741</td>
<td>-0.172</td>
</tr>
</tbody>
</table>
Aero-3 residual analysis: Relative humidity
Conclusions

• The complex sectional model AERBOX performs better than the modal model Aero-3

• AERBOX is likely to be validated (full year running)

• Computation times are enormously different

• Aero-3 should be tested and hopefully improved before starting long-term simulations for the MINNI project.