Testing the capability of the MINNI atmospheric modelling system to simulate air pollution in Italy

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INTRODUCTION

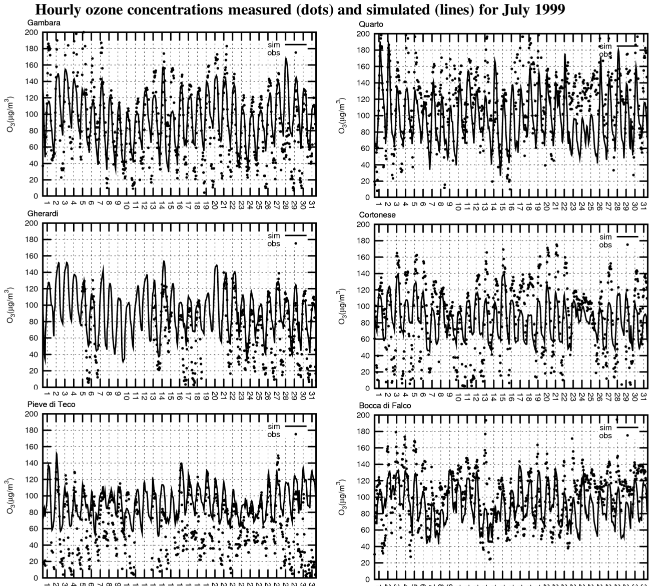
MINNI (Zanini et al., 2005) is the Italian Integrated Assessment Modelling System for supporting the International Negotiation Process on Air Pollution and assessing Air Quality Policies at national/local level sponsored by the Italian Ministry of the Environment. MINNI system is made up by two components: an Atmospheric Modelling System (AMS) and a Greenhouse Gas Air Pollution Interactions and Synergies model over Italy (GAINS – Italy). This presentation describe the AMS components: the emission processor (EMMA), the meteorological model (RAMS) and the air quality model (FARM), and shows some results from an extensive validation exercise over Italy.

The simulations were carried out for the year 1999, and the AMS ability to predict ozone formation and destruction under different conditions of sun light and temperature, for different seasons was evaluated. The modelled ozone concentrations were compared to surface measurements and statistical indicators such as mean normalized bias error (MNBE), mean absolute normalised gross error (MANGE) and unpaired peak estimation accuracy (UPA) were calculated for the all stations.

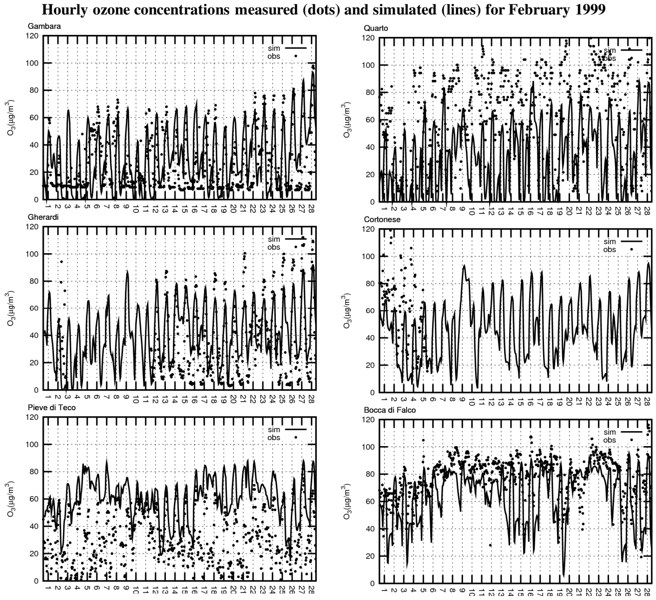
SIMULATED AND MEASURED TIME SERIES OZONE CONCENTRATIONS

The comparison of ozone concentrations simulated by MINNI and measured by main monitoring networks (BRACE national database) shows that the modelling system reproduces the maximum hourly ozone concentrations and the daily ozone cycle relatively well for both months, particularly at rural stations. The difference in the model performances at rural stations with respect to urban stations is explained by the low spatial resolution used in the simulation, which artificially creates a dilution of the ozone precursors NOx and VOC in the grid cell determining, thus, low ozone production rates. On the other hand, the measurements made at urban stations show high variability indicating that they are strongly influenced by traffic emissions, which can not be adequately described spatially and temporally in the provincial emission inventory.

Hourly ozone concentrations measured (dots) and simulated (lines) for July 1999



Hourly ozone concentrations measured (dots) and simulated (lines) for February 1999

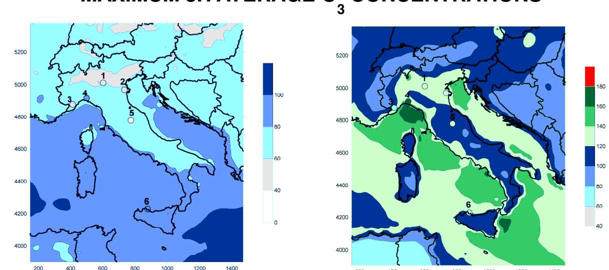


STATISTICAL EVALUATION OF MODEL PERFORMANCES

	Station name	Station type	July		February	
			MNBE	MANGE	MNBE	MANGE
1	Gambara	rural	-6.99	18.01	-1.92	5.18
2	Gherardi	rural	10.41	13.88	-22.96	23.06
3	Pieve di Teco	rural	7.66	14.02	1.57	1.57
4	Quarto	urban	-25.18	28.93	-50.81	50.85
5	Cortonese	urban	-19.96	22.45	-53.13	53.13
6	Bocca di Falco	suburban	-18.05	21.81	-17.42	17.99

MNBE (Mean Normalised Bias Error) e MANGE (Mean Absolute Normalised Gross Error) confirm that modelling system behaves better at rural stations than at urban ones for 20kmx20km model resolution, and it behaves better during summer than winter. At rural stations, the model fulfils the US-EPA (US-EPA, 2005) criteria: MNBE is lower than 15% and MANGE is lower than 30-35%.

OBSERVED AND SIMULATED MONTHLY MEAN SURFACE MAXIMUM 8H AVERAGE O_3 CONCENTRATIONS



FEBRUARY JULY

In February, the best agreement between model simulation and measurements is obtained at Bocca di Falco and Gambara. At Quarto, the simulated concentration is lower than the measured one of 20 $\mu g/m^3$ and, for the remaining stations, ozone concentrations are overestimated by 20 $\mu g/m^3$.

For July, model and measurements are in agreement at Bocca di Falco, Gambara and Quarto, and for the others stations, the differences between model and measurements are higher than 20 $\mu g/m^3$.

CONCLUSIONS

The results of this study show that the modelling system is able to simulate the daily ozone cycle and the maximum hourly ozone concentrations.

The statistical indicators show that AMS performs generally well, simulating the ozone concentrations better during summer than winter, and at rural stations rather than at urban ones.

The monthly mean surface maximum 8h-average O_3 concentrations are also reproduced by the modelling system: the differences between observed and simulated monthly mean surface maximum 8h average O_3 concentrations for both February and July are ca. 20 $\mu g/m^3$.

ACKNOWLEDGEMENTS

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