

Evaluation of the global tropospheric chemistry model GEM-AQ for the surface ozone variability over Europe, based on measurements from the EMEP network.



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1. Introduction

Tropospheric ozone is one of the main pollutants, which have negative influence on human health, ecosystems and materials. During the last decades, the concentration of ground-level ozone increased and exceeds the thresholds established by EU every summer.

Ozone and its precursors are sufficiently long lived compounds, which are regarded as a long-range environmental issue, that is why very important to use global air quality models that can tackle all those problems.

The Global Environmental Multiscale Air Quality model (GEM-AQ) has been developed in order to accommodate various scales and processes. Air quality chemistry module, including the gas phase, aerosol and cloud particles, deposition and transport processes have been built into the Canadian operational weather prediction model GEM. GEM-AQ provides the integrate framework between meteorological and air quality aspects of the atmospheric systems.

Evaluation analysis has been carried out to investigate the model performance, as well as its weaknesses and strengths over different geographical regions in Europe.

2. Methodology

The GEM-AQ tropospheric chemistry model was run over 3-year period. As a part of model evaluation the comparison with surface ozone observation was undertaken.

Modeled concentrations were compared against the measurement obtained from the EMEP database for 49 stations. The criteria for stations selection was: completeness of measured data more than 90%, altitude below 500 m amsl and located distant from coastal areas.

The following averaging periods has been used:

- Daily average,
- Monthly average,
- Combined daily average,
- Combined monthly average.

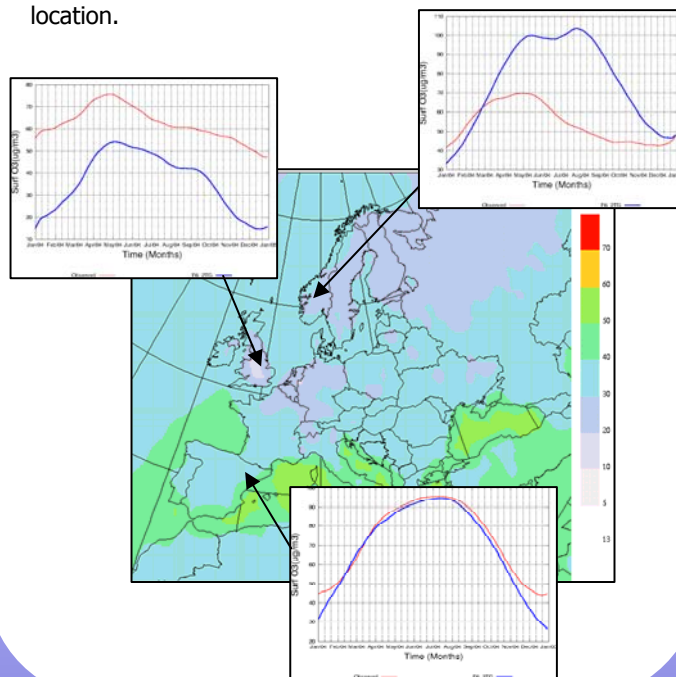
For each station statistical parameters such as: MBE (Mean Bias Error), NMBE (Normalized Mean Bias Error), MAGE (Mean Absolute Gross Error), NMAGE (Normalized Mean Absolute Gross Error) and correlation coefficient were calculated. Additionally analyses of the temporal and spatial variability were undertaken.

3. Analysis

Daily averaging for 2001-2004					
	MBE	NMBE	MAGE	NMAGE	corr. coef.
mean	-1,06	0,01	18,9	0,36	0,64
	-25,71	-0,43	28,93	0,75	0,31
the best	Aston Hill (GB31)		Iskrba (SI08)		Klrvatn (NO39)
	0,36	0	14,25	0,22	0,79
the worst	Tanikon (CH03)	Kosetice (CZ03)	Els Torms (ES14)	Estrange (SE12)	Pillersdorf (AT30)

4. Results

Comparison of measured data and the modeling results, shows that the model performance for ground-level ozone concentration over Europe depend on geographical location.



5. Conclusions

For time series the GEM-AQ model showed best performance for Central and Western Europe. Slightly worse agreement was noted for Southern Europe, but not sufficient density of the measurement network in this area did not allow for comprehensive analysis. The worst representation of measured time series was obtained for Northern Europe (including Great Britain). Problems connected with accurate representation of simulation results, particularly in the Northern Europe, might be due to:

- incomplete or not representative emission data,
- insufficient modeled exchange between stratosphere and troposphere,
- differences between real topography and the data used in a model,
- faster ozone removal in urbanized areas, stronger processes of vertical mixing in mountain areas and low speed of deposition over the water.

Differences between observed and modeled values may be caused also by incorrect flow direction due to low resolution of model grid.

Results of GEM-AQ model for the global scale are very promising and keep most features of time and spatial variation.

References:

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 - Borell P., Tropospheric Chemistry Encyclopedia of Ecology and Environmental Management, Blackwell Science, 1998
 - Dziewulska-Łosiowa A., Ozon w atmosferze, PWN, Warszawa 1991
- More references on request