A comparative analysis of atmospheric emission inventories available for Europe
J. Ferreira¹, M. Guevara², J.M. Baldasano³, O. Tchepeli³, M. Schaap¹, A. I. Miranda¹ and C. Borrego¹

¹ CESAM & Department of Environment and Planning, University of Aveiro, Aveiro, Portugal
² Earth Science Department, Barcelona Supercomputing Center, Barcelona, Spain
³ Environmental Modelling Laboratory, Technical University of Catalonia, Barcelona, Spain
* jferreira@ua.pt

ABSTRACT
A reliable emissions inventory is of extreme importance for air quality modelling applications, especially at regional or local scales, where high resolution is needed. This work aims at performing an inter-comparative analysis of different spatial disaggregation methodologies of atmospheric emission inventories. It is based on 2 different EU emission inventories: EMEP and an emission inventory developed by TNO.

These 2 inventories were converted into 3 distinct gridded emission datasets: (i) EMEP inventory disaggregated by area (EMEParea) and (ii) following a more complex methodology (HERMES-DIS); (iii) TNO gridded emissions, based on different emission data sources and different disaggregation methods. A predefined common grid with a spatial resolution of 12x12 km² was considered for spatial inter-comparison of the 3 datasets.

Results pointed out that HERMES-DIS and TNO are 2 distinct emission inventories, well discretized and detailed, suitable for air quality modelling. However, the different databases and distinct disaggregation methodologies certainly lead to different spatial emission patterns. This fact should be had in mind when applying regional atmospheric chemical transport models.

METHODOLOGY

Emission Inventories

Prior analysis

Emission totals by sector and by pollutant for each country for TNO and HERMES-DIS inventories. Differences for all sectors due to different spatial disaggregation (and associated criteria) and to inventories in their original version.

Methods for comparison

Intercomparative analysis

- Data Scanning
- Emission Maps + differences (HERMES-DIS - EMEParea, HERMES-DIS - TNO)
- Linear Regressions + scatter plots (coef. of determination R²)

RESULTS

Line charts for total emissions data series HERMES-DIS and TNO, for CO, NOx and PM10

Grid cells range from 0 (southwest corner of domain) to 191999 (northeastern cell of study area), i.e., from left to right latitude increases, and lines are “coloured” (grey scale) by longitude highlighting the meridional variation.

Emission Totals

Selected pollutants by SNAP sector for further analysis

TNO inventory presents maxima emissions two times higher than HERMES-DIS for most of the pollutants (except for CO)

Correlation obtained for the 3 linear regressions performed – EMEParea vs HERMES-DIS, EMEParea vs TNO and HERMES-DIS vs TNO.

Globally, correlation is low

SNAP 02 and 06 – coefficients of determination between HERMES-DIS and EMEParea are very similar, since the land uses types are practically the same. Nevertheless, HERMES-DIS vs TNO regression presents a higher correlation in SNAP06. The highest correlations were encountered for SNAP10 NH₃ emissions, due to the common use of CLC database for disaggregation.

CONCLUSIONS

- CO presents higher total emissions per cell than HERMES-DIS for most of the pollutants.
- Spatial analysis by SNAP sector pointed out that, for SNAP02 and 06, maxima emissions are generated in different areas of the study domain. TNO emissions more concentrated in big urban areas. HERMES-DIS emissions more homogenously distributed.
- Higher correlations verified for EMEParea vs HERMES-DIS regression (the latter is based on the first which does not happen with the TNO emissions). The highest correlations were encountered for SNAP10 NH₃ emissions, due to the common use of CLC database.
- Air quality modelling will benefit from the availability of fine resolution, consistent and reliable emission inventories.

REFERENCES


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