Anthropogenic emission modelling for Europe at different spatial and temporal scales


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1. Introduction
2. Spatial Resolution
3. Temporal Resolution
4. Results
5. Conclusions and Outlook
Why are high resolved emissions needed?

- Identification of emission sources: high resolved emissions can be used to analyse and identify regional anthropogenic key drivers
- Development of efficient emission control options
- As input data for atmospheric transport models to calculate concentrations
- Future trends and possible developments of ambient concentrations of pollutants
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Different spatial scales of grids

EMEP: 50km x 50 km (black)
IER Europe: 0,05° x 0,05° (green)
IER Germany: 0,01° x 0,01° (yellow)
Methodology for spatial resolution
Point source distribution parameters for Europe
Proxy data for the road traffic in Europe
Distribution parameters for Germany

Point sources

Line sources

Area sources
Lead emissions in a 50 km x 50 km grid for the year 2020
NOx in 0.05° x 0.05° Resolution for the year 2005
PM 10 in 0.01° x 0.01° Resolution for the year 2020
CO2 in 0,01° x 0,01° Resolution for 2005
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Methodology for temporal resolution

- **Annual emissions per grid**
- **Yearly profile**
- **Weekly profile**
- **Daily profile**
- **Hourly emissions per grid**

Specific profiles for each sector e.g. road traffic
## Indicators for time profiles

<table>
<thead>
<tr>
<th>Sector</th>
<th>Indicator data for monthly resolution</th>
<th>Indicator data for daily resolution</th>
<th>Indicator data for hourly resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power plants</td>
<td>fuel use</td>
<td>load curves</td>
<td>load curves</td>
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<tr>
<td>Industrial combustion</td>
<td>fuel use, temperature, degree days,</td>
<td>working times, holidays</td>
<td>working times</td>
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<td></td>
<td>production</td>
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<tr>
<td>Commercial, institutional and residential combustion</td>
<td>fuel use, degree days</td>
<td>user behaviour</td>
<td>user behaviour</td>
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<tr>
<td>Refineries</td>
<td>oil throughput, fuel use</td>
<td>working times, holidays</td>
<td>working times, shift times</td>
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<tr>
<td>Industrial processes</td>
<td>production</td>
<td>working times, holidays</td>
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<tr>
<td>Road transport</td>
<td>traffic counts</td>
<td>traffic counts</td>
<td>hourly traffic counts</td>
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<tr>
<td>Air transport</td>
<td>LTO cycles, passenger and freight</td>
<td>LTO cycles, passenger and freight numbers</td>
<td>LTO cycles, passenger and freight numbers</td>
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<td></td>
<td>numbers</td>
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</tbody>
</table>
Correlation between fossil fuel use in power plants and ambient temperature

Germany - Hard coal

Lithuania - Natural gas

Finland - Lignite

Austria - Oil
Temperature dependency of the lignite use in power plants for Europe

Use of lignite in power plants and the dependency from the ambient temperature in Europe

Annual mean temperature of lignite using counties in Europe

Correlation between the annual mean temperature and the coefficient of determination for lignite
Temperature dependent monthly fuel use time profiles for power plants
Temperature dependent monthly time profiles for power plants in Germany
Weekly time profiles for power plants in Europe
Hourly time profiles for different European countries
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Reduction potential of NO$_2$ mean values in µg/m$^3$: 2005-2010, 2005-2015, 2005-2020 (RCG-calculation)

2005 - 2010
1-8 µg/m$^3$

2005 - 2015
-2-16 µg/m$^3$

2005 - 2020
2-20 µg/m$^3$

R. Stern, et. al.
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Conclusion and outlook

- **Spatial resolution:**
  1. Results for emission modelling at different spatial scales (50 km x 50 km, 0.05° x 0.05° and 0.01° x 0.01°)
  2. Besides anthropogenic air pollutants and greenhouse gases also other pollutants like heavy metals can be considered with the developed models

- **Temporal resolution:**
  1. Generation of a new set of time profiles for monthly, daily and hourly distribution for Europe
  2. Further improvements: consideration of new data sources and correlations

- **Sensitivity analysis and uncertainty assessment**
Thank you for your attention!