35 Years of Emission Trends in Europe

EDGARv4.0 and v4.1 Project team:

Ulrike Doering, Greet Janssens-Maenhout, John van Aardenne, Suvi Monni, Valerio Pagliari, Julian Wilson, Jos Olivier (PBL), Jeroen Peters (PBL), Laslo Szabo (IPTS Sevilla)

► Introduction & EDGAR Methodology
► Trends, Gridding & Projections
► Conclusions

http://edgar.jrc.ec.europa.eu
I EDGAR Emission Inventory

Goal:

Implementing a global emission inventory model, which should:

- Consider information about historical and actual emissions on a regional scale for all emission sources (complete time series) collected in a consistent way.
- Consider all main air pollutants and GHG.
- Consider all available national and international information of emissions.
- Calculate emissions and emission scenarios.
- Verify emissions by comparison with other available inventories.
I EDGAR Emission Inventory

- Compounds: GHGs ($\text{N}_2\text{O}$), CO, SO$_2$, NO$_2$, NMVOC, NH$_3$, (PM$_{2.5}$, PM$_{10}$, OC, BC, CFCs, HFCs, PFCs and SF$_6$)

- EDGAR database consists of the following factors:
  - AD: activity data, e.g. TJ of the National energy consumption of the International Energy Balance
  - TECH: technology, e.g. share of vehicle type (passenger cars, motorcycles)
  - EOP: end-of pipe, e.g. share of the specific emission control
  - EF: Uncontrolled emission factor: e.g. kg SO$_2$/TJ
  - RED: efficiency of end-of-pipe, e.g specific emission control (e.g. EURO 1)

$$EM_C(y, x) = \sum_{i,j,k} \left[ AD_{C,i}(y) \cdot TECH_{C,i,j}(y) \cdot EOP_{C,i,j,k}(y) \cdot EF_{C,i,j}(y, x) \cdot \left(1 - RED_{C,i,j,k}(y, x)\right) \right]$$
I EDGAR Emission Inventory

Information which is considered:

- National information which is available (statistics, technologies e.g. EURO standards or emission reduction scheme of power plants)

- Regional & global EF (EMEP/CORINAIR EI Guidebook 2009 and previous version, IPCC 2006 Guidelines & scientific literature)

Annex I vs. UNFCCC reporting & Non-Annex I countries, e.g. NO₂ emissions (including LULUCF sector)

- EDGARv4.1 Annex I Totals
- EDGARv4.1 Non-Annex I Totals
- UNFCCC Report2009 Annex I
- GAINS-Asia +REAS Inv Totals
- Internat. aviation & shipping, EDGARv4.1

Non-Annex I countries: +46%
Annex I countries: -25%

EU15 (& EIT) countries, here e.g. NO$_2$ as NO$_x$ emissions

from 1990 on
EU 15: -32%
EIT countries: -36%
II-1 Emission Trends 1970 - 2005

Some examples on country level, here e.g. NO$_2$ as NO$_x$ emissions
close results:

results with discrepancy
II-1 Emission Trends 1970 - 2005

EU15 (& EIT) countries, here e.g. NH$_3$ emissions

from 1990 on
EU 15: -8%
EIT countries: -55%
EU15 (& EIT) countries, here e.g. N$_2$O emissions

From 1990 on
EU 15: -23%
EIT countries: -41%
Il-2 Gridding

- National total emissions gridded to 0.1°x0.1° grid
- Maps from EDGARv4, for example
  - Human population
  - Animal density
  - Croplands and grasslands
  - Rice cultivation
  - Road (density considered by urban population)
  - Power plant point-sources
Combination of maps

emissions tons per cell

- >5000.000
- 1200.000..5000.000
- 800.000..1200.000
- 500.000..800.000
- 200.000..500.000
- 150.000..200.000
- 100.000..150.000
- 70.000..100.000
- 60.000..70.000
- 50.000..60.000
- 40.000..50.000
- 30.000..40.000
- 20.000..30.000
- 10.000..20.000
- 0.010..10.000
Results: Emission grid maps for N-species (sum of NOx-, NH3- and N2O-N)

Spatial allocation of total N emissions in the year 2005 per 0.1 degree grid cell for the countries, not considered here shipping and aviation
BAU + AP => BAP:
Combining BAU with the National Emission Ceiling (NEC) directive 2001/81/EC:
eop measures in EU-27
For each of the 27: country-specific scaling per SNAP sector of APs: NOₓ, NH₃,
NEC5 report of IIASA (2007)

Business as usual, BAU: continuing current (absence of) implemented GHG reduction measures

Assumptions:
• 2050: 2x 2005 world energy consumption
• Population grows to 9.1 E9 in 2050 (1.4x)
II-2 Methodology: Growth projection

\[ EM = \sum_i AD_i \times EF_i = EF_{\text{implied}} \times \sum_i AD_i \]

Activity Data (AD)
AD Growth rates:
- Energy + transport: POLES
- Industry: scaled as their combustion except solvent industry scaled with population density (IMAGE (ADAM))

Implied EF Growth rates:
0 (constant 2005 value)

Emissions follow AD Growth rates

Emission Data (EM)
Emission Growth rates:
- Agriculture: IMAGE (based on cattle population/crop cultivation) (ADAM baseline)
- Waste: IMAGE (idem ADAM)
- Solvent industry: based on population (IMAGE (ADAM))

Implied EF Growth rates: follow Emission growth rates

Activity data (aggregated): constant (2005 value)

1970  1990 Reported  2005  Projected  2050
Results Gridding BAU vs BAP for 2025 & 2050

Spatial allocation of changes (percentage ratio) of total N emissions in the year 2025 and 2050 to the base year 2005 per 0.1 degree grid cell for the countries due to the applied scenario

-21% for EU-15 & EIT countries

-10% for EU-15 & EIT countries

BAU

BAP

2025

2050
IV Conclusions

• The EDGAR inventory covers more than 200 countries for GHGs and Air pollutants.

• Differences between national inventories and the EDGAR national totals occur due to the applied international statistics, methodology on a regional scale and due to the different EFs applied (e.g. N\textsubscript{2}O and NH\textsubscript{3} EF from IPCC 2006 GL), which were considered for calculation!

• Global emissions of N species decrease in the Annex I world, not only based on improved technologies and reduced fuel consumption but also based on decreasing population and food demand. However, emissions of N species increase in the rest of the world based on the shift of increased production, fuel consumption and older technology!

• Emission trends (in particular for N species) can be influenced in the near future if abatements strategies will first focus on emissions reduction in the energy sector as a driving force.

Thank you!