Trend analysis of the EDGARv4.2 greenhouse gas and air pollutant emissions

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1. EDGARv4.2 buildup and verification by intercomparison

2. Emission dataset validation by confrontation with measured concentrations

3. Lessons learned from trend analysis

4. Conclusion and outlook
Why EDGARv4?
Long-cycle greenhouse gas emissions per capita in 2008
Independent emissions estimates of EDGARv4.2 on CO2 (without agricultural waste and wood burning), CH4, N2O, HFCs, PFCs, SF6
How to use EDGARv4?

EOLO platform

Verification
- EDGARv4
- UNFCCC
- EPRTR
- PKU
- EMEP
- GAINS
- AQMEII
- HTAP_V1
- VULCAN
- REAS
- MICS-Asia

Validation
- Concentrations
- Inverse modeling

Lessons learned
- Trend analysis

Drivers?
- Intercomparing inventories
- Confronting to measurements

Decomposition
- Econometrics
- Decomposition
- Inverse modeling
**EDGAR-CIRCE** = $\text{ADxEFxgrowth}$
Tech-based calc. + POLES/ADAM growth

Pre-v4: ‘90–’50: GHG & AP & PM, BC, OC (trends, gridmaps monthly/sector)

**EDGARv4** = $\text{ADxE}$

Calculation of emission inventories
EDGARv4.2: ’70–’08: GHG & AP online (trends + gridmaps/sector); PM10

**EDGAR-HTAP** = $\Sigma EM_i$

Collection of official inventories
HTAP_V1: ’00–’05: CH4 & AP & aerosols
All but no Savannah, no LULUCF sectors

**EDGAR proxy data**

Spatial: Point-source + Diffusive proxies
74 datasets: e.g. UNEP BC emission scenarios
Temporal: Monthly distributions
13 distributions: Friedrich’04/Veldt’92/Asman’92

Verification by intercomparison

For all EU-27 member states the difference between UNFCCC data (cfr.ESTAT/EEA) and EDGAR is <3% for CO2 and is <4% for CO2eq. Uncertainty for CO2 in OECD: 8%, in EIT: 22% in Non-AnnexI: 40%
EDGARv4.2:

High fugitive emissions from fossil fuel production in EU & EA still

Lower emissions from rice paddies than in v4.1
Verification by intercomparison

Regional SO2
- Energy, industry & waste
- Air transport & shipping
- Land transport
- Solvents
- Domestic
- Agriculture

HTAPV1 = EDGAR-HTAP_v1
2000 dataset
RCPbase = RCP 2000 base dataset

Regional CO
- Energy, industry & waste
- Air transport & shipping
- Land transport
- Solvents
- Domestic
- Agriculture

HTAPV1 = EDGAR-HTAP_v1
2000 dataset
RCPbase = RCP 2000 base dataset

Regional NOx
- Energy, industry & waste
- Air transport & shipping
- Land transport
- Solvents
- Domestic
- Agriculture

HTAPV1 = EDGAR-HTAP_v1
2000 dataset
RCPbase = RCP 2000 base dataset

Regional NH3
- Energy, industry & waste
- Air transport & shipping
- Land transport
- Solvents
- Domestic
- Agriculture

HTAPV1 = EDGAR-HTAP_v1
2000 dataset
RCPbase = RCP 2000 base dataset
Verification by intercomparison

VOC speciation to be considered next

Carbonaceous particle speciation
Under progress
Validation with measurements

Inverse modeling

CH4: EDGARv4.2 apriori estimates: high in particular for UK & Ireland

CO: EDGARv4.2 apriori estimates: too low – as are the GFED

Bergamaschi et al (in prep, 2012)

Hooghiemstra et al (2012)
Validation with measurements

Source apportionment

**EDGAR** BC/PM2.5 ratio for 2 selected sectors over period 2000-2008 compared to:

**RM**: Receptor Models for PM apportionment in selected sites from 8 European countries, China, USA, India and Korea.

**FASST**: national average concentration estimated with TM5-FASST tool.

Globally for 1970-2002:

- **Power generation** ≈ constant
- **Road transport**

From 2002 onwards:

*Increased emission growth rate of power industry in China*

*Olivier, Janssens-Maenhout, Peters, Wilson (2011)
Lessons learned of trend analysis

Drivers? \[\rightarrow\] Decomposed indicators?

Kaya identity

\[\Delta \log(CO_{2t}) = \Delta \log(CI_t) + \Delta \log(EI_t) + \Delta \log(income_t) + \Delta \log(pop_t)\]
Lessons learned of trend analysis

Environmental Kuznets Curve (EKC):

Emissions = f(GDP)
Lessons learned of trend analysis

I(r) = 1: common trend

I(r) = 2: stationary around linear trend

USA

EKC: assumes I(r) = 1

However not with linear trend but with parabolic trend

<table>
<thead>
<tr>
<th>CO2</th>
<th>SO2</th>
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<tbody>
<tr>
<td>Greece</td>
<td>Belgium</td>
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<tr>
<td>Korea, Rep.</td>
<td>Mexico</td>
</tr>
<tr>
<td>other 151</td>
<td>other 143</td>
</tr>
</tbody>
</table>
Lessons learned of trend analysis

Under EKC, the slope $\beta_2$ in $e_t = \beta_1 + \beta_2 y_t + u_t$ should be a linear function of $y_t$. This is not found in our estimates of $\beta_2$:

Estimates of $\beta_2$ plotted versus average log GDP.

*Paruolo, P., Murphy, B., Janssens-Maenhout, G. (2012)*
Conclusion

- EDGARv4.2 emission time series 1970-2008 for GHG and AP and PM10 available on edgar.jrc.ec.europa.eu

- EOLO allows yearly updates: end 2012: EDGARv4.3, that includes:
  - Time series to 2010
  - Carbon stock changes (IPCC 5A - FL1)
  - Hg
  - To be compared to HTAP_V2 for 2006-2010

- Econometric analysis on sector and subsector level envisaged to test drivers of emissions and to evaluate the causality relationship

thanks you for interest