GEBRUIK VAN NATIONALE EMISSIE DATA VOOR EUROPESE LUCHTKWALITEIT STUDIES EN VERSCHILLEN TUSSEN LANDEN

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OUTLINE

› Why make an inventory?
  • Air quality models – as all models – depend on the quality of the input data. Emission input - which should be complete, includes all sources and is consistent in time and space - partly controls the quality of the products (forecasts, reanalysis of AQ)
  • Who needs it?

› From national reported to a consistent European data set
› Insight in reported emission data
› Emission database and trends
› Comparison between countries (examples)
› In-depth analysis of wood combustion emissions in Europe
› Conclusions
MACC – MACC-II
Monitoring Atmospheric Composition and Climate

Delivering the pre-operational regional and global GMES atmospheric services

V.-H. Peuch, A. Simmons (ECMWF) and the MACC/MACC-II consortia
Envisaged funding period: 2015 - 2022

http://www.ecmwf.int/en/about/what-we-do/copernicus/copernicus-atmosphere-monitoring-service
http://www.gmes-atmosphere.eu

- Air-quality forecast
- Stratospheric ozone records
- UV index
- Monthly methane emissions
- Aerosol forecast
USE OF EMISSIONS DATA: INPUT FOR AIR QUALITY FORECASTS

HTTP://MACC-RAQ.COPERNICUS-ATMOSPHERE.EU/INDEX.PHP?CATEGORY=ENSEMBLE

MACC-III is a Coordination & Support Action (2014-2015) funded by the European Union under the Horizon 2020 Programme. It is coordinated by the European Centre for Medium-Range Weather Forecasts and operated by a 36-member consortium.
WHY IS “EXTRA” WORK NEEDED?

- In Europe Countries **shall** make their own inventories and **shall** provide these to EMEP (The European Monitoring and Evaluation Programme EMEP) (& also in gridded form for modelling).

- But......

- Some countries do not comply (or only partly)!

- Time series may be incomplete

- The spatial distribution is not consistent between countries

- ....
IS THERE A PROBLEM?

- Gapfilling
- Check for completeness
- “repair” time series
ALSO....DIFFICULTIES FROM A USER PERSPECTIVE
Important consequences:

• Need to “freeze” the data set at a chosen moment because the emissions for a given year are not static.
• If the time series is extended, all years need to be updated
• Needs good communication and explanation!

Thanks to EMEP- CEIP for keeping the data and making it available!
We make liberal use of country reported emissions (EMEP-CEIP) and IIASA GAINS but cater for the AQ models and user specific needs:

- Pollutants covered:
  - NOx, SO2, NMVOC, NH3, CH4, CO, PM10, PM2.5 (and components)
- Add or “do” components that are not or incompletely reported like EC
- High resolution (~ 7x 7 km), consistent distribution patterns for road transport, agriculture, power plants, industry, etc.
- UNECE-EUROPE… not limited to EU27
- Collaborate in interpretation and provide description of input.

See J. Kuenen et al., ACP, 2014
http://www.atmos-chem-phys.net/14/10963/2014/acp-14-10963-2014.pdf
TNO-MACC_III PM10 TRENDS 2000-2011
CONSISTENT EMISSIONS DATA BROKEN DOWN BY SOURCE SECTOR BY COUNTRY. EXAMPLE SO2 FOR SPAIN AND POLAND.

Switch to low-S coal and/or desulphurisation in power plants
RESULTING EMISSION MAPS

NOx in 2009

- NH
- RESULTING
- EMISSION
- MAPS

y2009_all
NOx tons/cell
- < 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 75
- 75 - 100
- 100 - 125
- 125 - 150
- 150 - 200
- 200 - 250
- 250 - 500
- 500 - 750
- 750 - 1000
- 1000 - 1500
- 1500 - 2000
- 2000 - 2500
- 2500 - 5000
- 5000 - 10000
- > 10000
- no data

SNAP Description
1. Power plants & refineries
2. Residential combustion
3. Iron & steel industry
4. Oil, coal & gas production
5. Industrial, domestic & constructional solvents
6. Machinery, non-road transport & shipping
7. Landfills & waste incineration
8. Agriculture
9. Road transport - gasoline
10. Road transport - diesel
11. Road transport - LPG
12. Road transport - kerosene
CHANGE IN PM2.5 EMISSION BETWEEN 2000 AND 2011 (GREEN = REDUCTION; RED = INCREASE)
ALL SOLVED?

no more issues....?
SOLVENT SECTOR NMVOC EMISSIONS PER CAPITA
(SIZE OF COUNTRY NO LONGER MATTERS)

Note: solvent use is a dominant NMVOC source
National emission ceilings demand a level playing field
No country wants to be different… easier to adapt than to change
PER CAPITA, PER ANIMAL HEAD, PER TON PRODUCED ARE WAYS TO COMPARE COUNTRIES

PM10 emissions in 2010 per capita, all sectors
PM10 EMISSION PER CAPITA FOR RESIDENTIAL COMBUSTION IN 2010

PM10 emissions in 2010 per capita for SNAP 2

European emissions & country differences
Wood use in Sweden larger but different appliance

Countries use their own methods to calculate PM emissions
Large differences in “implied” emission factors
the US EPA defines particulate matter (PM) as consisting of a filterable fraction (FPM) and a condensable fraction (CPM).

Filterable PM is directly emitted:
- Solid or liquid
- Captured on filter
- PM$_{10}$ or PM$_{2.5}$

Condensable PM is in vapor:
- Reacts upon cooling and dilution
- Forms solid or liquid particle
- Always PM$_{2.5}$ or less

where should the PM mass be that forms almost instantaneously?
NORWAY & SWEDEN: TOTAL RESIDENTIAL WOOD COMBUSTION EMISSIONS IN 2005

(EC + OC ≈ PM2.5)
Vavihill OCbb and levoglucosan 2008-2009

- Measured levog. x 7.8-14 (Genberg et al., ACPD 2011)

- EMEP model OCbb EUCAARI emis
- EMEP Model OCbb (New DT-emis)
- EMEP Model OCbb (New SP-emis, only solid p.)

μg C / m³

25 European emissions & country differences 16-6-2015
Impact of consistent bottom-up calculation for wood combustion emission for selected countries

Indication of impact: 20% more PM2.5 emission over Europe

- Organic Carbon Emission (tonnes/yr)
  - EUCAARI
  - TNO-newRWC

Countries:
- Denmark
- Finland
- France
- Germany
- Italy
- Netherlands
- Norway
- Poland
- Portugal
- Spain
- Sweden
- Switzerland
- Ukraine

European emissions & country differences
MEASURED AND MODELLED OC CONCENTRATIONS WITH THE EMEP MSC-W MODEL (BERGSTROM ET AL., ACP 2012)
MEASURED AND MODELLED OC CONCENTRATIONS WITH THE EMEP MSC-W MODEL (BERGSTRÖM ET AL., ACP 2012)
SOME CONCLUDING REMARKS

- Emission inventory compilers work source by source, compiling the best Emission factor by source but do not compare across sources – differences in measurement protocols can be very important.
- We argue that PM2.5 from wood combustion in Europe is severely underestimated.
- National inventory compilers tend to report not to publish (task oriented) but more (peer-reviewed) emission publications would help the debate.
- Country reportings could improve by better and open comparisons but who to lead?
- Conflicting interests…not always good news

Documentation **TNO_MACC_II European emission data**: Kuenen et al., ACP, 2014
  [http://www.atmos-chem-phys.net/14/10963/2014/acp-14-10963-2014.pdf](http://www.atmos-chem-phys.net/14/10963/2014/acp-14-10963-2014.pdf)

**Particulate emissions from residential wood combustion in Europe**
H.A.C. Denier van der Gon et al. (2015) acp-2014-805
available for download at: [http://www.atmos-chem-phys.net/15/6503/2015/](http://www.atmos-chem-phys.net/15/6503/2015/)
THANK YOU FOR YOUR ATTENTION

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