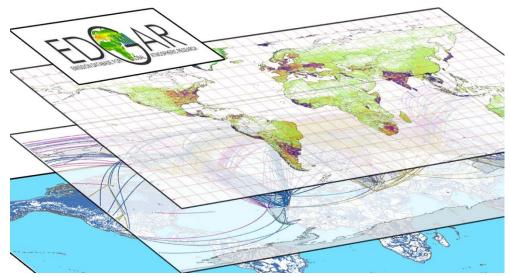


HTAP Emission inventory: Status and Discussion

G. Janssens-Maenhout, F. Dentener, T. Keating, D. Guizzardi, M. Crippa, M. Muntean, G. Pouliot, Q. Zhang, J. Kurokawa, T. Ohara, R. Wankmüller, H. Denier van der Gon



WP objectives & steps
Going beyond HTAP_v1
Results of HTAP_v2.1
Outlook

http://edgar.jrc.ec.europa.eu/htap_v2/index.php?SECURE=123

Objectives



- to develop HTAP_v2 harmonized emissions database for use in global and regional modeling for 2008 and for 2010.
- 1. collecting emission gridmaps of CO, NMVOC, NOx, SO2, NH3, PM10, PM2.5, BC and OC for 2008 and for 2010 per sector and per region using: - US EPA covering North America,
 - TNO/ EMEP covering Europe,
 - MICS-Asia (covering East Asia)
 - EDGAR4.3 (gapfilling Rest of countries)
- 2. aggregating gridmaps to one global map of 0.1°x 0.1°
- 3. repeating 1. and 2. but for monthly gridmaps or after having applied the EDGAR monthly profile on the annual regional map
- 4. Possible extensions: including agricultural waste burning
- 5. For other pollutants (CH4, Hg, POPs)/ other sources we refer to
 - **v4.2FT2010** for **CH4**
 - **GFED3** for **fire** emissions
 - GMOS for Hg and MSC-East for POPs
 - T. Diehl for volcanic emissions of SO2

Objectives





Years:

2008, 2010

Monthly time series available for US, MICS-Asia, EDGAR, not for EMEP



Emission sources:

Anthropogenic activities except Savannah burning and LULUCF and Agricultural waste burning (not in MICS)



Chemical substances:

Air pollutants: CO, NMVOC, NO_x, NH₃, SO₂

Aerosols: PM₁₀, PM_{2.5}, OC, BC



Spatial allocation at resolution:

0.1° x 0.1° available for US and EDGAR,

0.125°x0.0625° of TNO aggregated at 0.1°x 0.1°

0.1°x 0.1° for MICS-Asia but, some (e.g.India) at 0.25° x 0.25°

Step 1:



Regional inventories

| Data source | EMEP-TNO (MACC) | US EPA | MICS-ASIA | EDGARv4.3 (Rest) | |
|------------------|--------------------|-------------------------|------------------|---------------------|--|
| со | grid /yr | grid /m /height | grid /m (no AWB) | grid /m | |
| NMVOC | grid /yr | grid /m /height/species | grid /m | grid /m | |
| NOx | grid /yr | grid /m /height | grid /m (no AWB) | grid /m | |
| <i>SO2</i> | grid /yr | grid /m /height | grid /m (no AWB) | grid /m | |
| NH3 | grid /yr | grid /m /height | grid /m | grid /m | |
| PM10 | grid /yr | grid /m /height | grid /m (no AWB) | grid /m | |
| PM2.5 | grid /yr | grid /m /height | grid /m (no AWB) | grid /m | |
| ВС | grid /yr | grid /m /height | grid /m (no AWB) | grid /m | |
| ос | grid /yr | grid /m /height | grid /m (no AWB) | grid /m | |
| geo- coverage | | | | | |

Purpose: to make use of official emission inventories for the different regions that are already gridded.

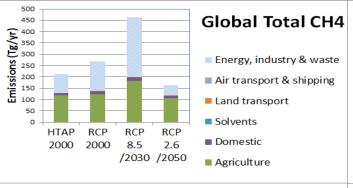
Step 2:

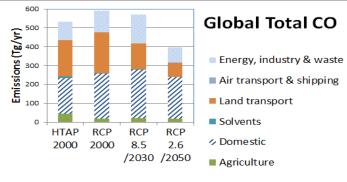


Sector specification

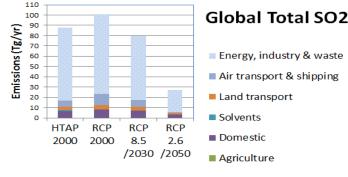
| HTAP (def. US EPA/ MICS/ | IPCC level 1 | EMEP-TNO | MICS_ASIA | | | | | |
|------------------------------|----------------|--------------------|-------------|--|--|--|--|--|
| EDGAR) | (NFR code) | (MACC) | | | | | | |
| htap_1_air (aviation) | 1A3a(i) + (ii) | | | | | | | |
| htap_2_ships (int. shipping) | 1A3d(ii) | | | | | | | |
| htap_3_energy | 1A1a | S1_ind.comb | power | | | | | |
| | 1A1b-c, 1A2, | S3_manuf.comb., | | | | | | |
| | 1B1-2, | S4_prod.processes, | | | | | | |
| | 2A-B-C-D-G | S5_fossil.fuel, | | | | | | |
| htap_4_industry | 3 | S6_solvents | industry | | | | | |
| | | S7_road.transport, | | | | | | |
| htap_5_transport | 1A3b-c-e | S8_mobile_sources | transport | | | | | |
| | 1A4-5, | S2_non-ind.comb, | | | | | | |
| htap_6_buildings | 6A-B-C-D | S9_waste | residential | | | | | |
| htap_8_agriculture | 4A-B-C-D | S10_agriculture | agriculture | | | | | |

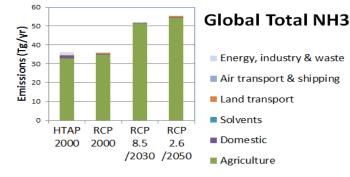
- Aggregation level ≥ most detailed common level of sectors (MICS)
- We follow IPCC with extensive combustion sector, and large industry group
- Issue with inland waterways (1A3d(i)): in S8, so only int. ships under 2_ships
- <u>Crude oil evaporation in tankers</u> (1B2a(iv) -S5): under 4_industry (not 5_transport)

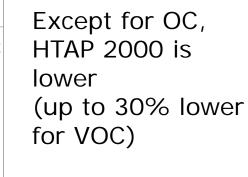




HTAP_v1



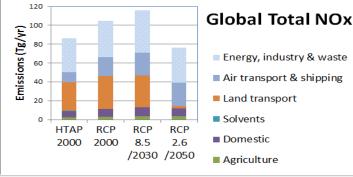


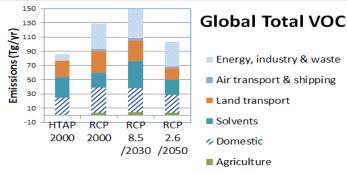


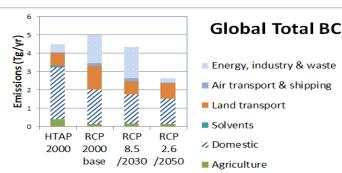
HTAP 2000

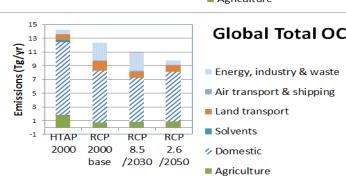
to RCP 2000

reasonably close





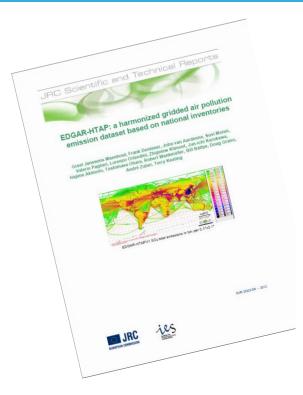




Lessons learned



HTAP_v1



Wishlist of the HTAP modellers community:

- VOC speciation
- ✓ Carbonaceous particle speciation
- Height distribution
- Recent year
- Multipollutant point source has single location

Which spatial and temporal resolutions?

- Monthly?
- ✓ 0.1 ° x 0.1 ° ?

Important is the localisation of point sources (requiring sector-specific details)

Which level of inconsistency is important?

- Multipollutant emission sources spatially smeared out
- Mass balance of PM (in danger if BC/OC from other datasource)
- Country totals: boundaries, partial coverage of country area (e.g. Russia)
- Time-series consistency?

Status: HTAP_v2

Fundamental difference in approach: PATCHWORK of gridmaps

EDGAR-HTAP_v1 was gridded with EDGAR proxy datasets HTAP_v2 is a compilation of gridmaps from other datasources, only spatially gapfilled with EDGARv4.3 gridmaps

Challenges: different resolution, different projections, partial coverage of some countries, double coverage of some other countries Choice for EMEP-TNO because of grid and consistent C speciation



EMEP particulate matter:

PM10, PM2.5 no BC, no OC

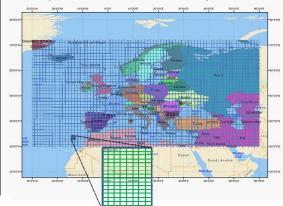


EMEP gridmaps (50kmx50km)





TNO gridmaps (0.0625°x0.125°) (12.5kmx6.25km)





TNO particulate matter:

PM10, PM2.5 BC, OC(+resuspended)

Status: HTAP_v2

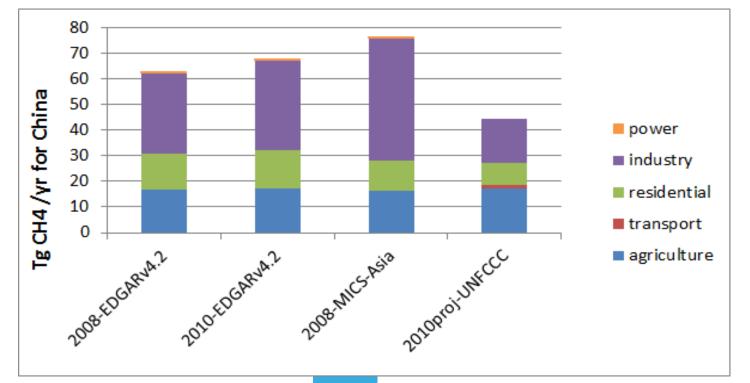


CH4 2008

1. Check completeness of regional emission datasets via CO2

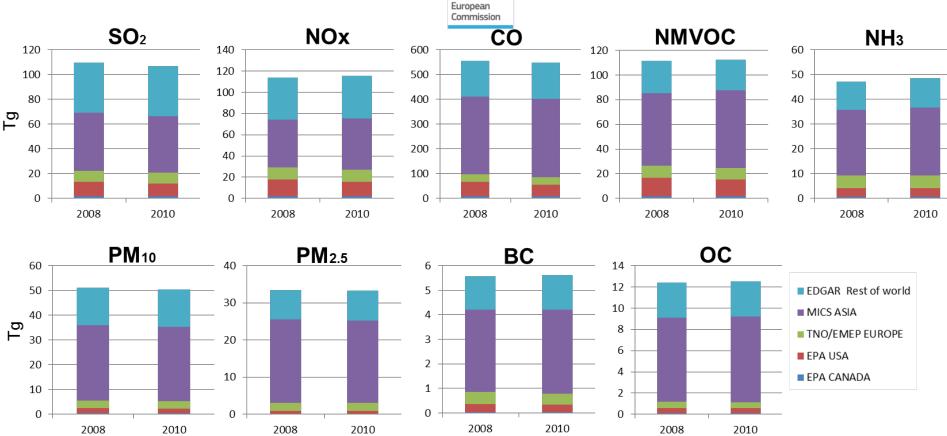
| Tg CO2 | | | | | | | |
|---------|-------------|----------|-------|-----------|-------------|-------|-------|
| in 2008 | RESIDENTIAL | INDUSTRY | POWER | TRANSPORT | AGRICULTURE | TOTAL | EDGAR |
| CHN | 1175 | 4136 | 2637 | 575 | 0 | 8524 | 7739 |
| JPN | 165 | 380 | 376 | 226 | 0 | 1147 | 1252 |
| KOR | 62 | 169 | 226 | 81 | 0 | 537 | 540 |

2. Comparison of CH4 MICS-Asia for CHN & JPN with EDGARv4.2FT2010





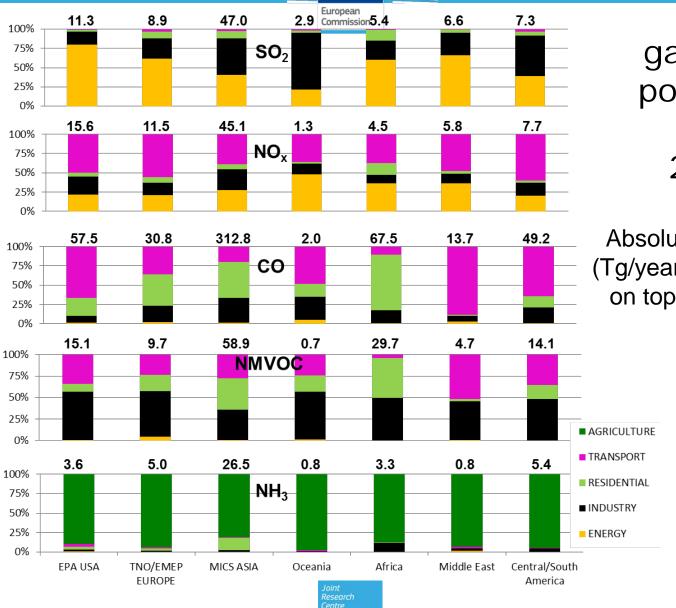
Global view



Regional anthropogenic emissions for 2008 and 2010 of primary gaseous pollutants (SO_2 , NO_x , CO, NMVOC, NH_3) and particulate matter components (PM_{10} , $PM_{2.5}$, BC, OC). Emissions are expressed in Tg of a specific pollutant per year.

Joint Research Centre

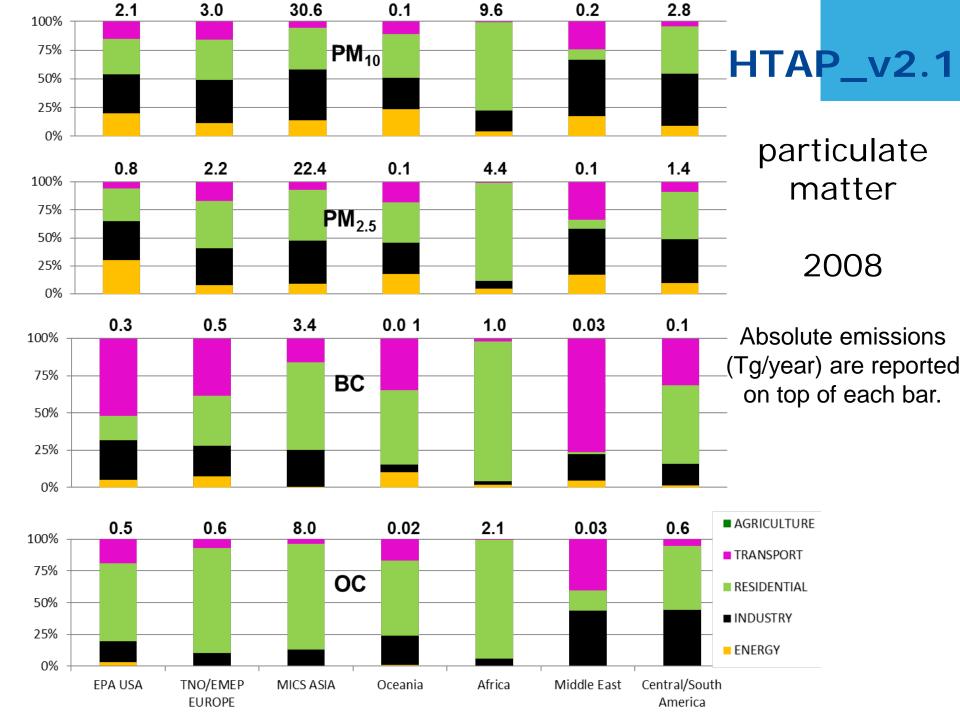
HTAP_v2.1



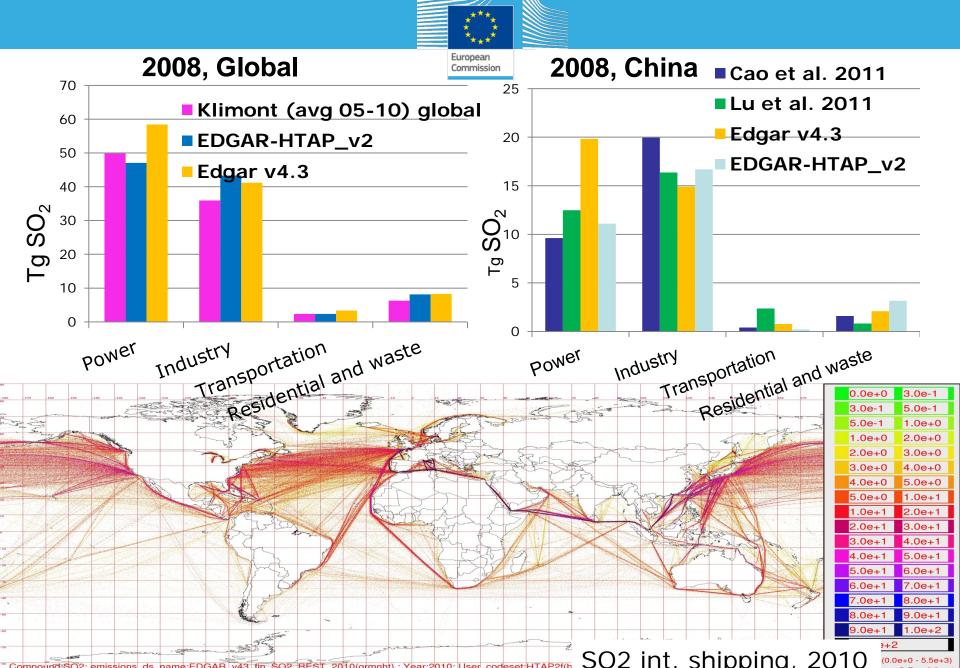
gaseous pollutant

2008

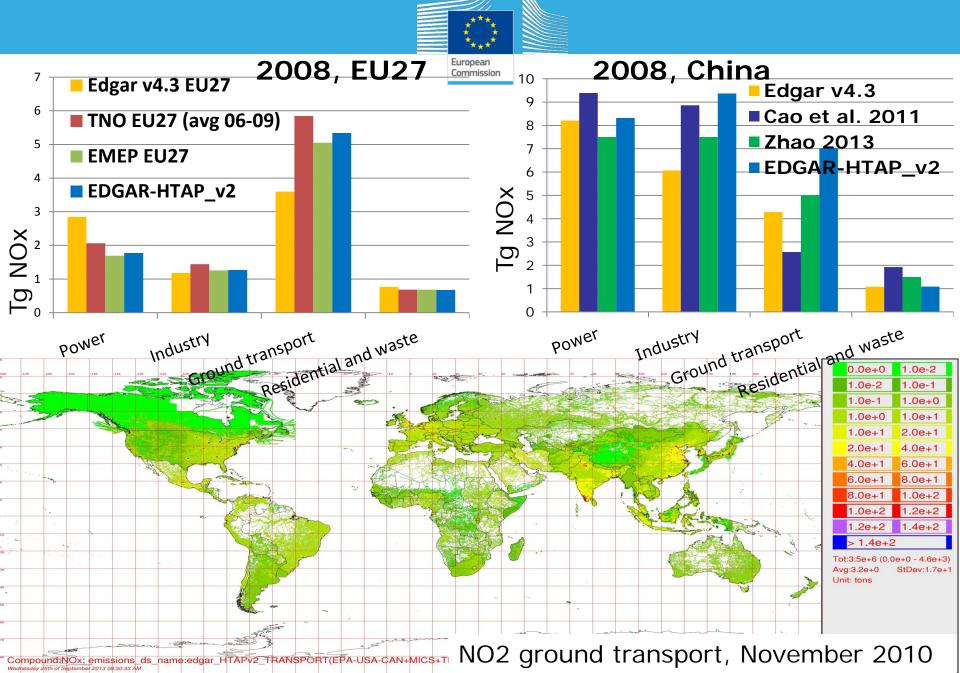
Absolute emissions (Tg/year) are reported on top of each bar.



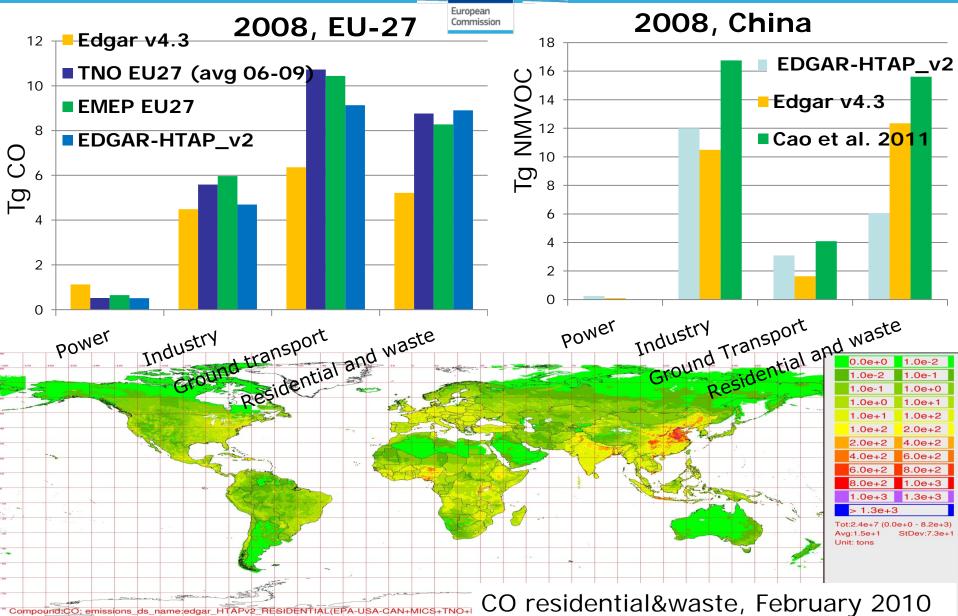
Emission inventories comparison: SO2



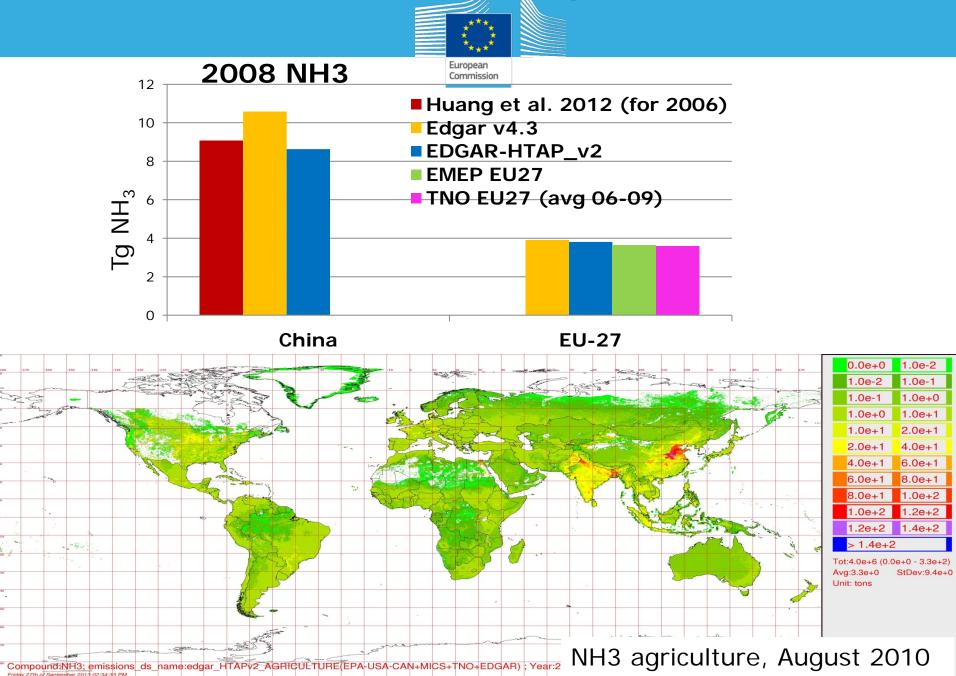
Emission inventories comparison: NOx



Emission inventory comparison: CO & NMVOC 2008, China 2008, EU-27 12 **Edgar v4.3** 18 EDGAR-HTAP_v2 ■ TNO EU27 (avg 06-09) 16 10 Edgar v4.3 **■ EMEP EU27** ■ Cao et al. 2<mark>011</mark> ■ EDGAR-HTAP_v2



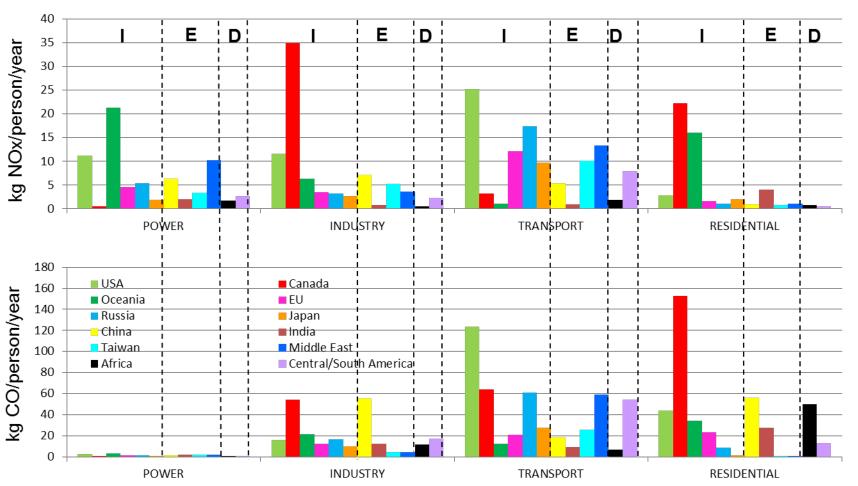
Emission inventories comparison: NH3



HTAP_v2.1 Air pollutant emissions per capita

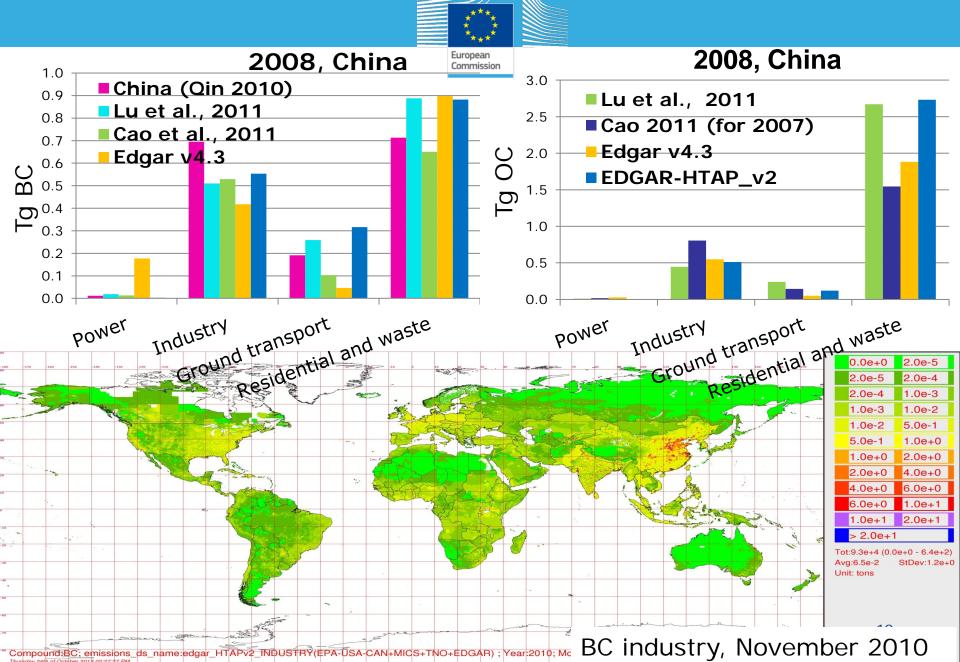
European Commission

Country Index: I= industrialised, E=emerging, D= developing



Emission inventory comparison: PM10 & PM2.5 2008, EU27 **EU-27** 0.9 0.70 Edgar v4.3 EU27 0.8 Edgar v4.3 EU27 0.60 ■TNO EU27 (avg 06-09) ■TNO EU27 (avg 06-09) மு 0.50 0.6 EMEP EU27 ■ EMEP EU27 PM_{10} 0.5 EDGAR-HTAP_v2 0.40 ■EDGAR-HTAP_v2 0.4 0.30 0.3 0.20 0.2 0.1 0.10 0.0 0.00 Residential and waste Ground transport Industry power Ground transport Residential and Waste Industry power 2.0e-5 2.0e-4 1.0e-3 1.0e-2 5.0e-1 1.0e-2 5.0e-1 1.0e + 02.0e+0 1.0e + 02.0e+0 4.0e+0 4.0e + 06.0e + 01.0e+1 2.0e+1 Unit: tons Compound PM10; emissions ds name: edgar HTAPV2 RESIDENTIAL (EPA-USA-CAN+MICS+TNC PM10 residential & waste, January 2010

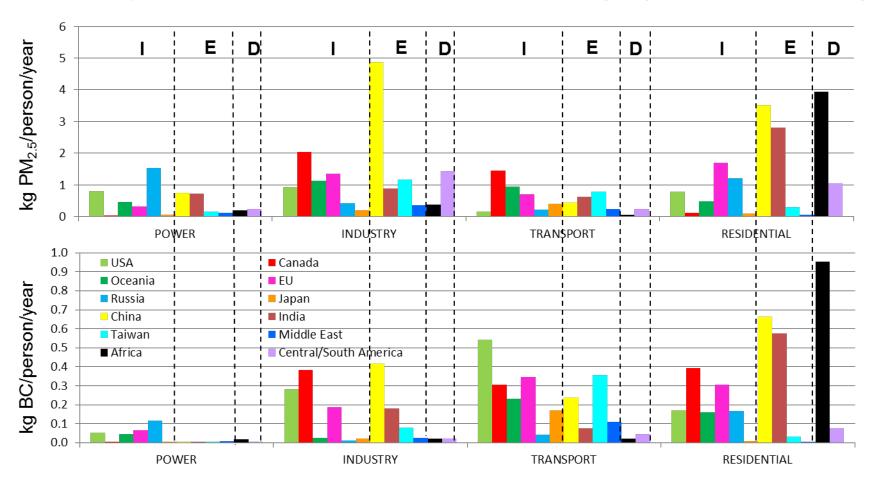
Emission inventories comparison: BC & OC



HTAP_v2.1 Aerosol emissions per capita

Country Index: I= industrialised, E=emerging, D= developing

European Commission



HTAP_v2.1



Where to find

http://edgar.jrc.ec.europa.eu/htap_v2/index.php?SECURE=123

Or ftp://edgar@edgar.jrc.ec.europa.eu (passwd has to be left blank)

HTAP V2



The EDGAR Team compiled the HTAP V2 inventory based on MICS-Asia, EPA-US/Canada and TNO.

HTAP_v2.1 online

For the project http://www.htap.org/

More details on: http://iek8wikis.iek.fz-juelich.de/HTAPWiki/WP1.1?highlight=%28%28WP Full documentation: report in draft

Remarks

18 November 2013: The HTAP_v2.0 dataset has been updated to HTAP_v2.1 to standardise all 3600 x 1800 longitude and latitude values for the global 0.1degree x 0.1 degree grid. (This impacted the TNO grid and therefore all files for the sectors 3_energy, 4_industry, 5_transport, 6_residential and 8_agriculture were replaced.) Please note that the gridmaps of the annual and the monthly .nc-files are expressed in fluxes with unit kg substance /m2 /s for all substances (also NO2 and SO2 and these are not in kg N/m2/s or kg S/m2/s). The title in the NOx files has been clarified as such. All files have the date of release indicated in order to provide the users full transparency on the updates.

OB November 2013: The HTAP_v2.0 dataset has been updated to correct the errors for the 2008 and 2010 monthly NMVOC 4_Industry data (evaporation of crude oil during tanker transport).

05 November 2013: The HTAP_v2.0 dataset has been updated to correct the errors for the 2010 NMVOC 6_residential data (125 - gridcells), the 2010 CO 4 industry data (2 - grid cells), the 2010 SO2 4 industry data (1 - grid cell) and the 2010 NOx 4 industry data (1 - grid cell).

Emission inventory

0. Gridmaps 0.1degx0.1deg for years 2008 and 2010 (yearly and monthly files) by sector vear: 2008 vear: 2010 Sector .txt [unit: ton species .nc [unit: kg species /m2 .txt [unit: ton species .nc [unit: kg species /m2 /0.1degx0.1deg] /s1 /0.1degx0.1deg] /s] 0.1×0.1 0.1×0.1 0.1x0.1 0.1×0.1 htap_1 Air [114.57 Mb (28/10/2013)] [44.34 Mb (28/10/2013)] [114.61 Mb (28/10/2013)] [44.35 Mb (28/10/2013)] 0.1×0.1 0.1×0.1 0.1×0.1 0.1×0.1 htap_2 Ships [25.91 Mb (28/10/2013)] [19.64 Mb (28/10/2013)] [25.91 Mb (28/10/2013)] [19.64 Mb (28/10/2013)] 0.1x0.1 0.1×0.1 0.1x0.1 0.1x0.1 htap_3 Energy [87.39 Mb (28/10/2013)] [159.17 Mb (28/10/2013)] [91.26 Mb (28/10/2013)] [150.97 Mb (28/10/2013)] 0.1×0.1 0.1×0.1 0.1×0.1 0.1×0.1 htap_4 Industry [874.36 Mb (08/11/2013)] [471.72 Mb (08/11/2013)] [903.71 Mb (08/11/2013)] [477.28 Mb (08/11/2013)] updated 08/11/2013 updated 08/11/2013 updated 08/11/2013 updated 08/11/2013

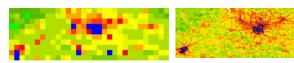
Outlook: HTAP_v2

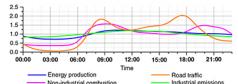


suggestions?

For next HTAP_v2.2 version:

- 1. We welcome all user feedback, in particular also from modellers (using inverse models)
- 2. Is the geospatial resolution 0.1°x0.1° and the monthly temporal resolution covering the needs of the HTAP modellers community?





- 3. Which speciations? In addition to the carbonaceous speciation also the NMVOC speciation?
- 4. Which further improvement: point sources data from e.g. EPRTR database, specification of height?
- 5. Which information on uncertainty? Magnitude/ spatial correlation?