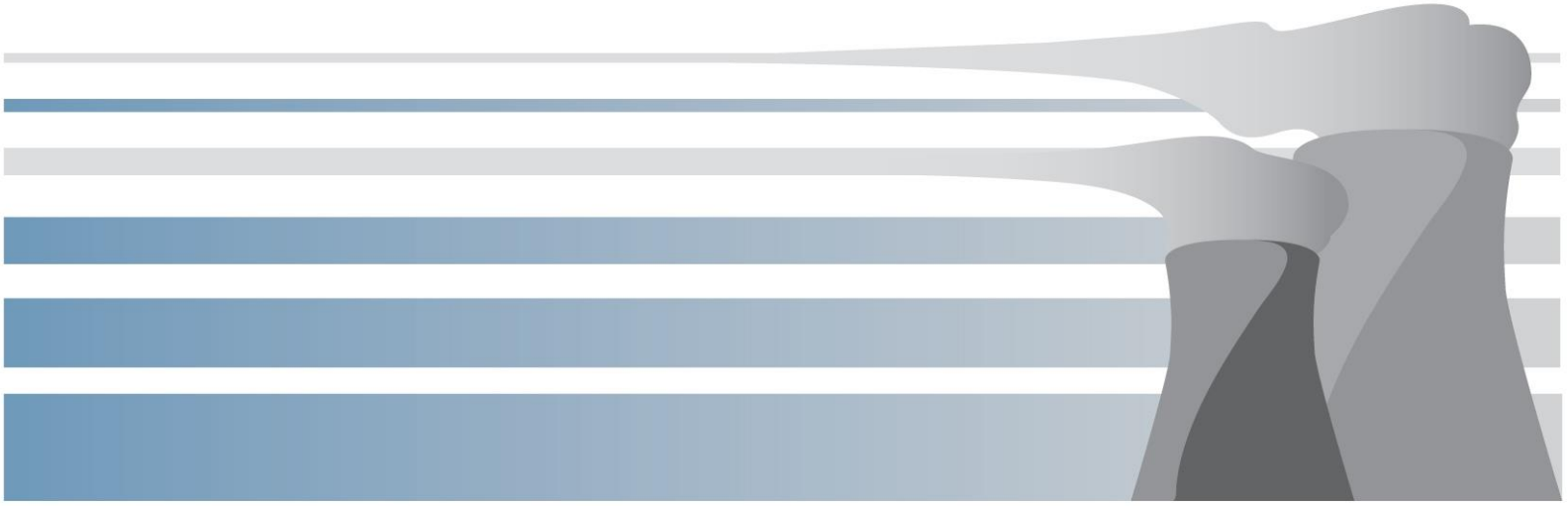


GlobEmission (ESA DUE program)

Project by KNMI, BIRA-IASB, FMI, TNO, VITO

presented by Ronald van der A

Royal Netherlands Meteorological Institute

The Washington Post

November 25, 2013

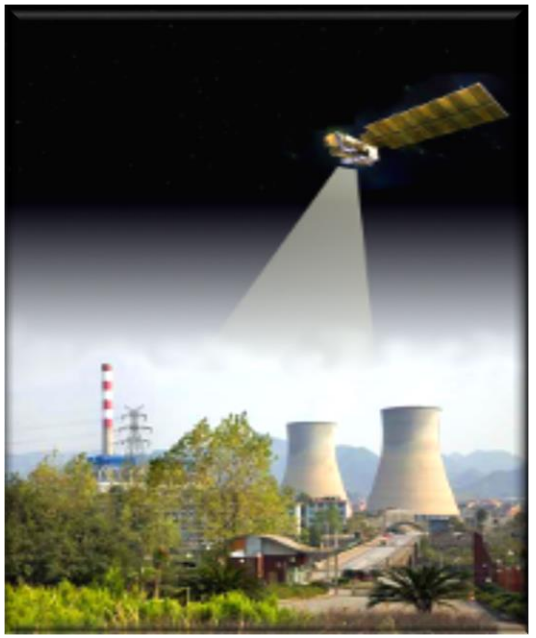
Study: US spewing 50% more methane than EPA says

"The study estimates that in 2008, the U.S. poured 49 million tons of methane into the air. That means U.S. methane emissions trapped about as much heat as all the carbon dioxide pollution coming from cars, trucks, and planes in the country in six months. That's more than the 32 million tons estimated by the U.S. Environmental Protection Administration"

"Something is very much off in the inventories," said study co-author Anna Michalak, an Earth scientist at the Carnegie Institution for Science in Stanford, Calif. "The total U.S. impact on the world's energy budget is different than we thought, and it's worse."

Scope of GlobEmission

- Within the GlobEmission project emission estimates derived from satellite observations are developed.
- Main advantages:
  - spatial consistency and high temporal resolution
  - pointing out/identifying flaws in bottom-up inventories
  - monitoring of emission changes, trends & new spots
  - rapid availability to users
- They provide complimentary information to bottom-up emission inventories



DUE project in 2011-2016

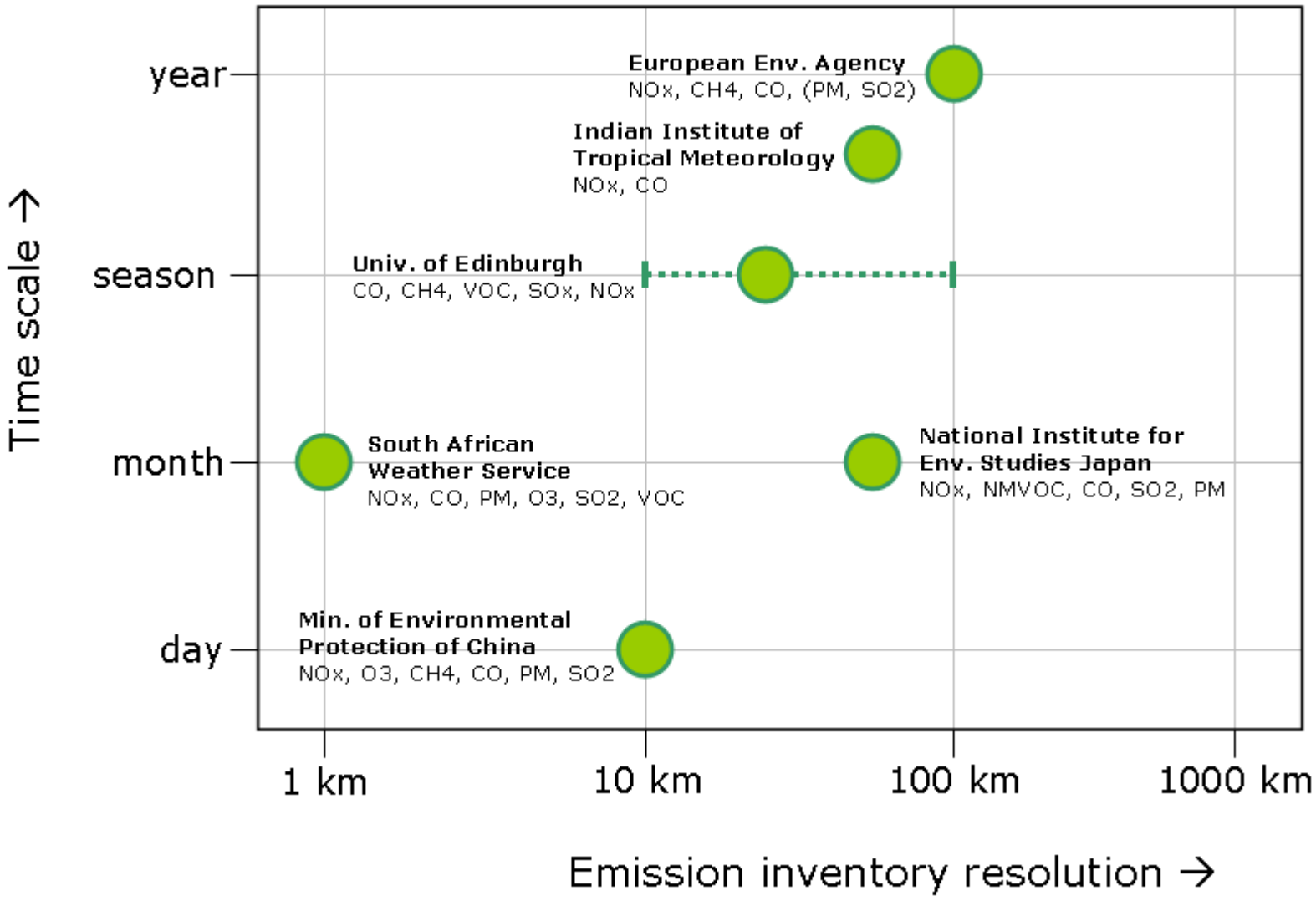
Committed end users

- European Environmental Agency
- LATMOS, France
- Satellite Environment Center of the Chinese Ministry of Environmental Protection
- Indian Institute of Tropical Meteorology
- South National Space Agency + South African Weather Service
- National Institute for Environmental Studies, Japan
- Qatar Environmental & Energy Research Institute

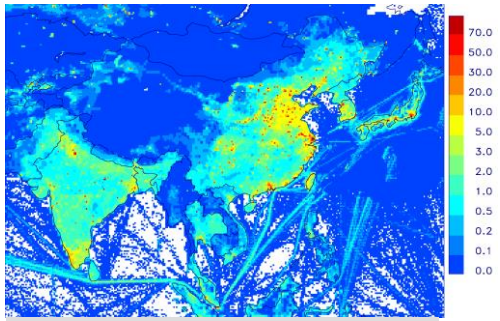
Specific user requirements:

- Species: NOx, CH_4, CO, NMVOC, SO_2, PM, O_3
- Accuracy: better than 30% - 80 %
- Spatial resolution: 1 km - 50 km
- Time resolution: daily – annual
- Regional and Global

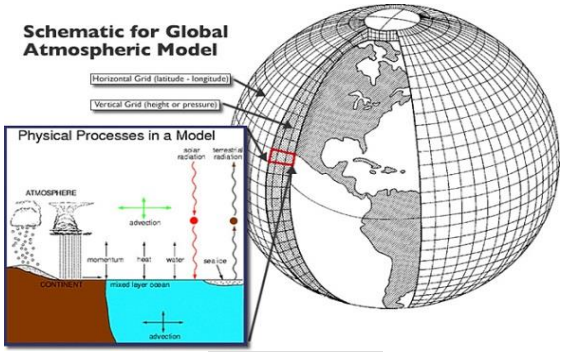
User Requirements: Temporal/Spatial



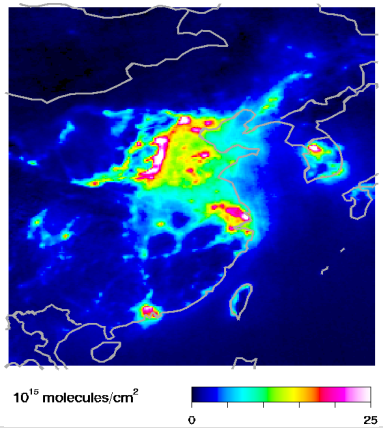
Inversion of satellite observations



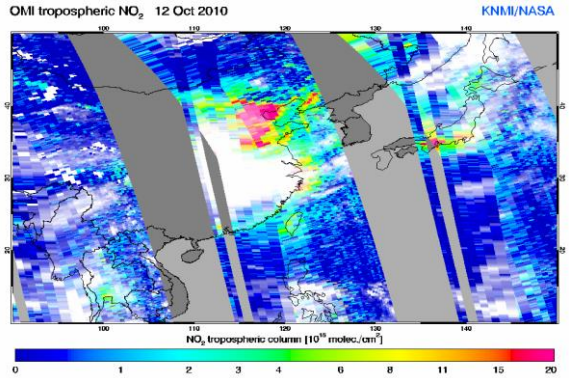
A priori emissions



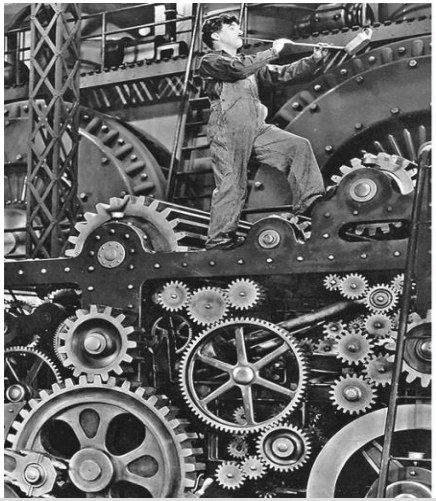
CTM



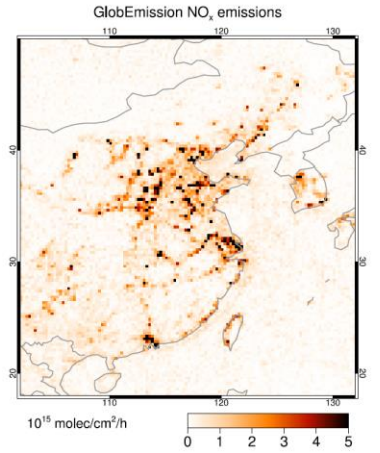
Concentrations



Satellite observations



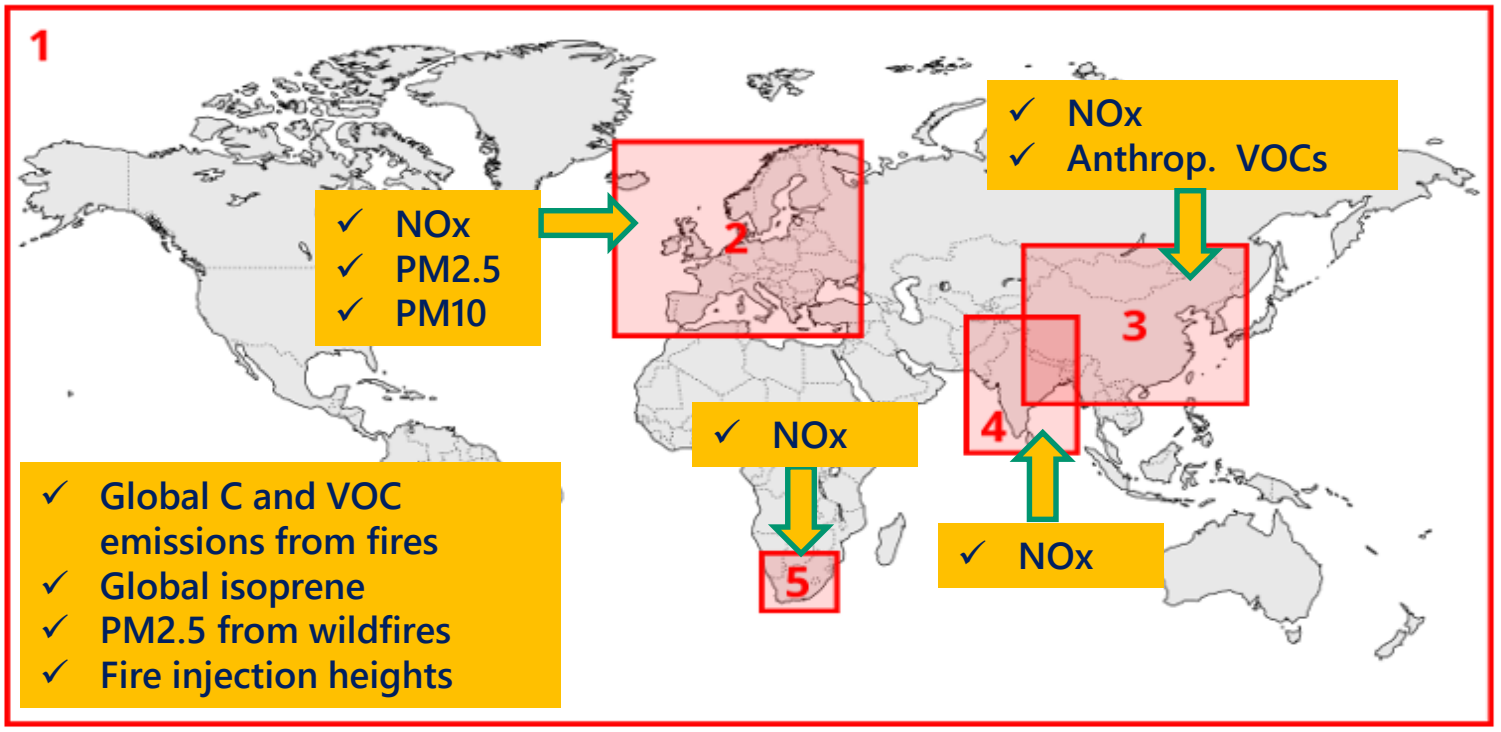
Inversion algorithm



Updated Emissions

Select emission data area:

View all datasets



World
fire-related emissions, NMVOC, biogenic isoprene

Europe
NO_x, PM2.5, PM10

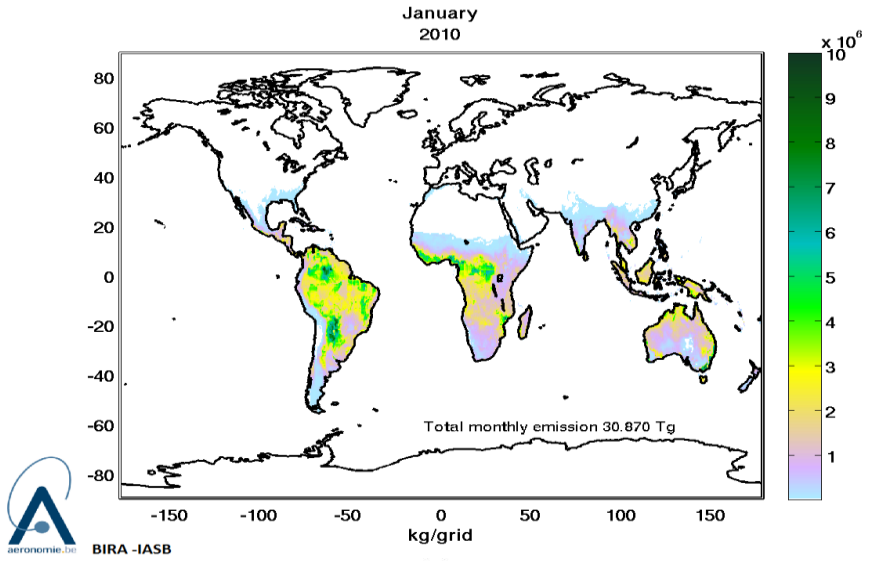
East China
NO_x, VOC

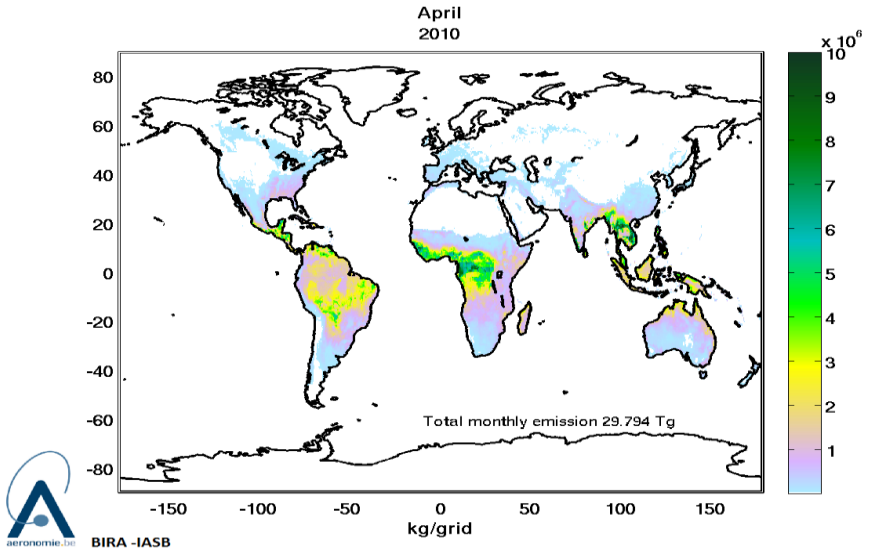
India
NO_x, aerosol

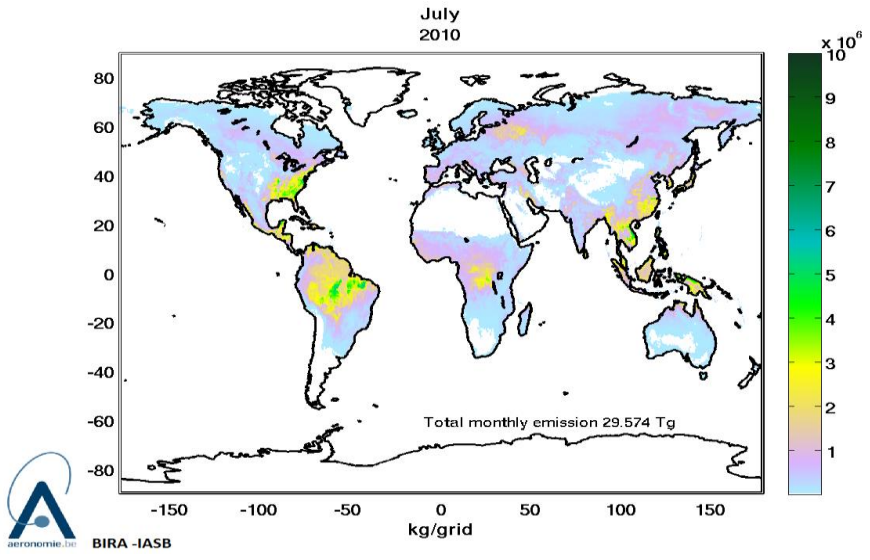
South Africa
NO_x, aerosol

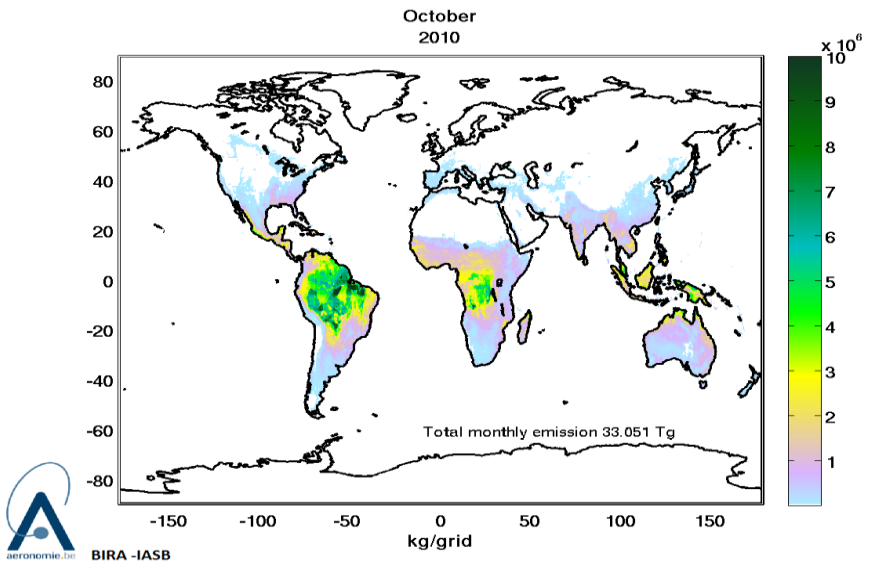
More products soon @ http://www.globemission.eu

Global: Isoprene emissions



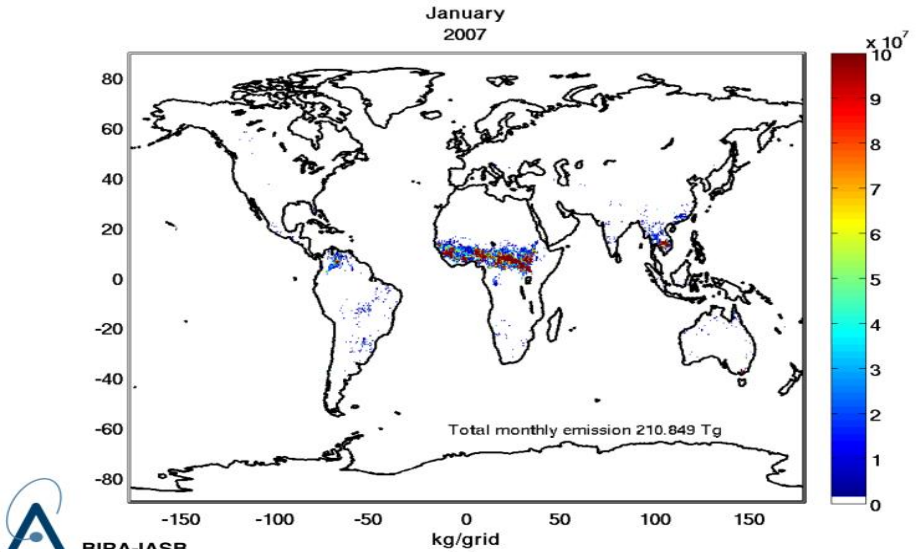


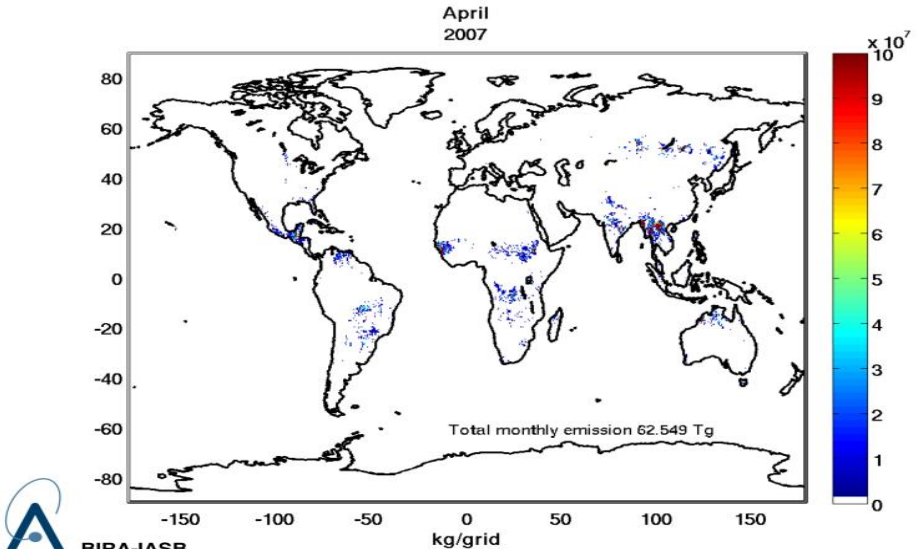


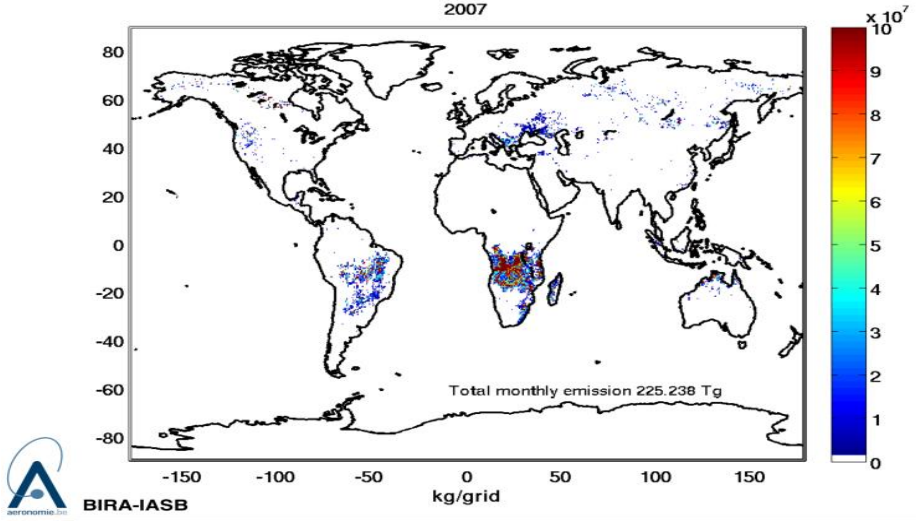


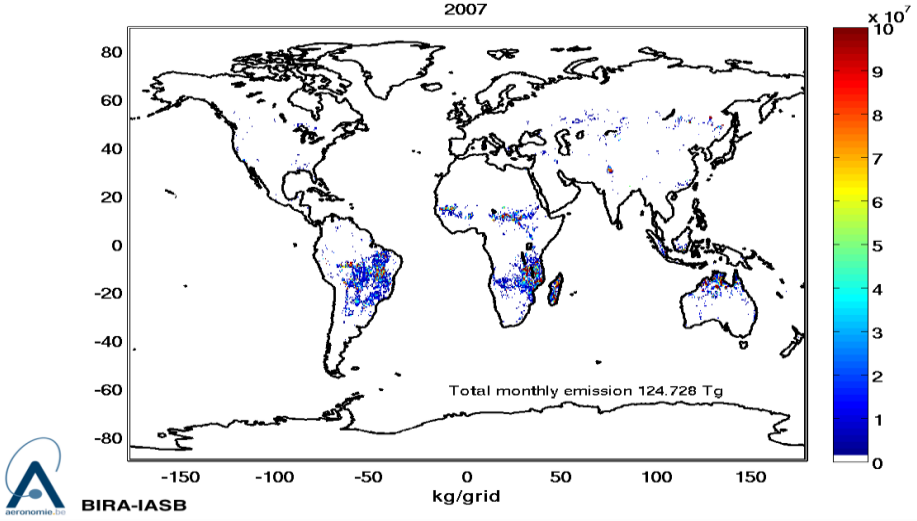
Monthly NetCdf files for 2007-2012 , 0.5x0.5 deg.

Global: Fire emissions



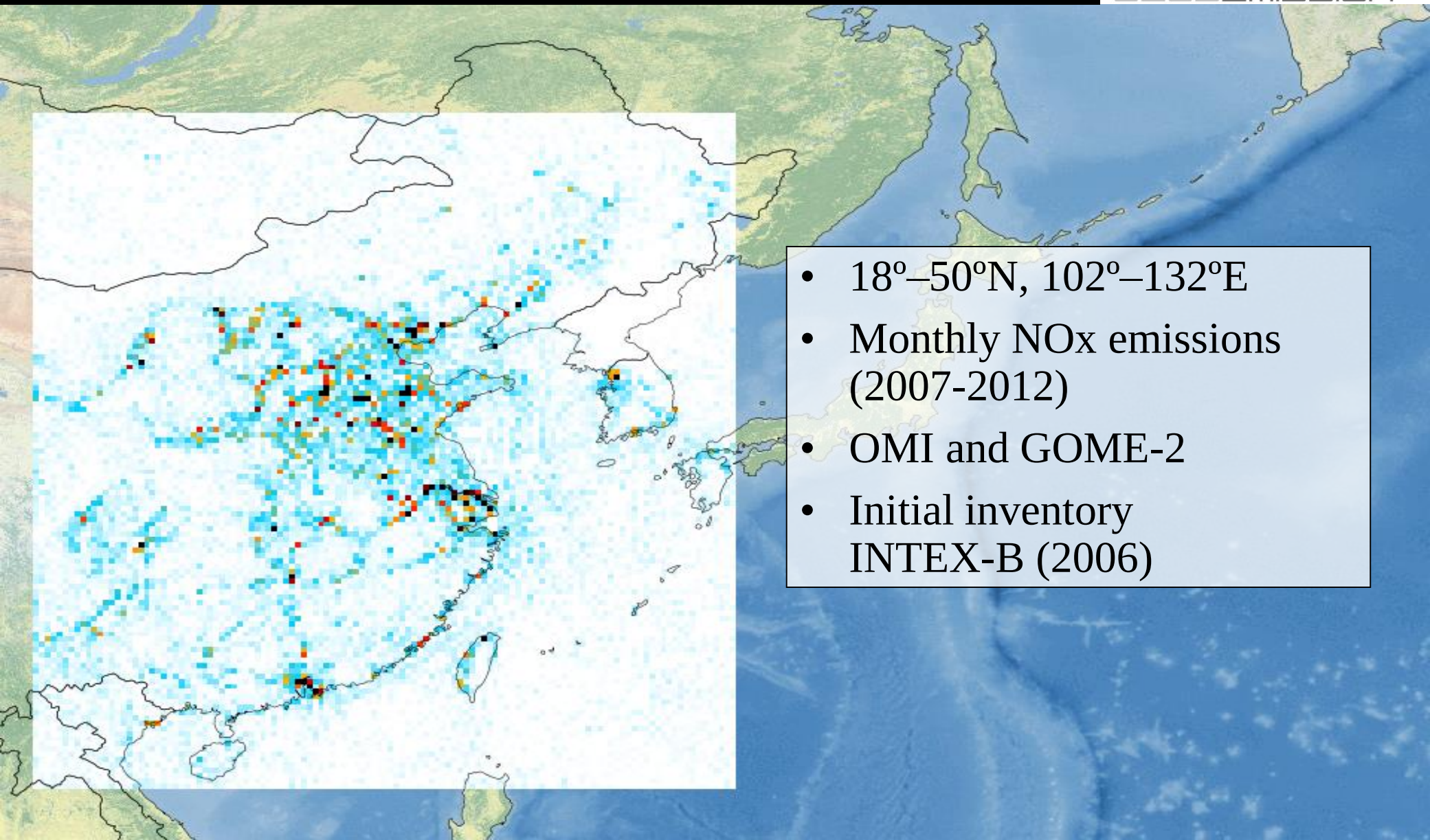






Monthly NetCdf files for 2007-2012, 0.5x0.5 deg.

East China: NOx



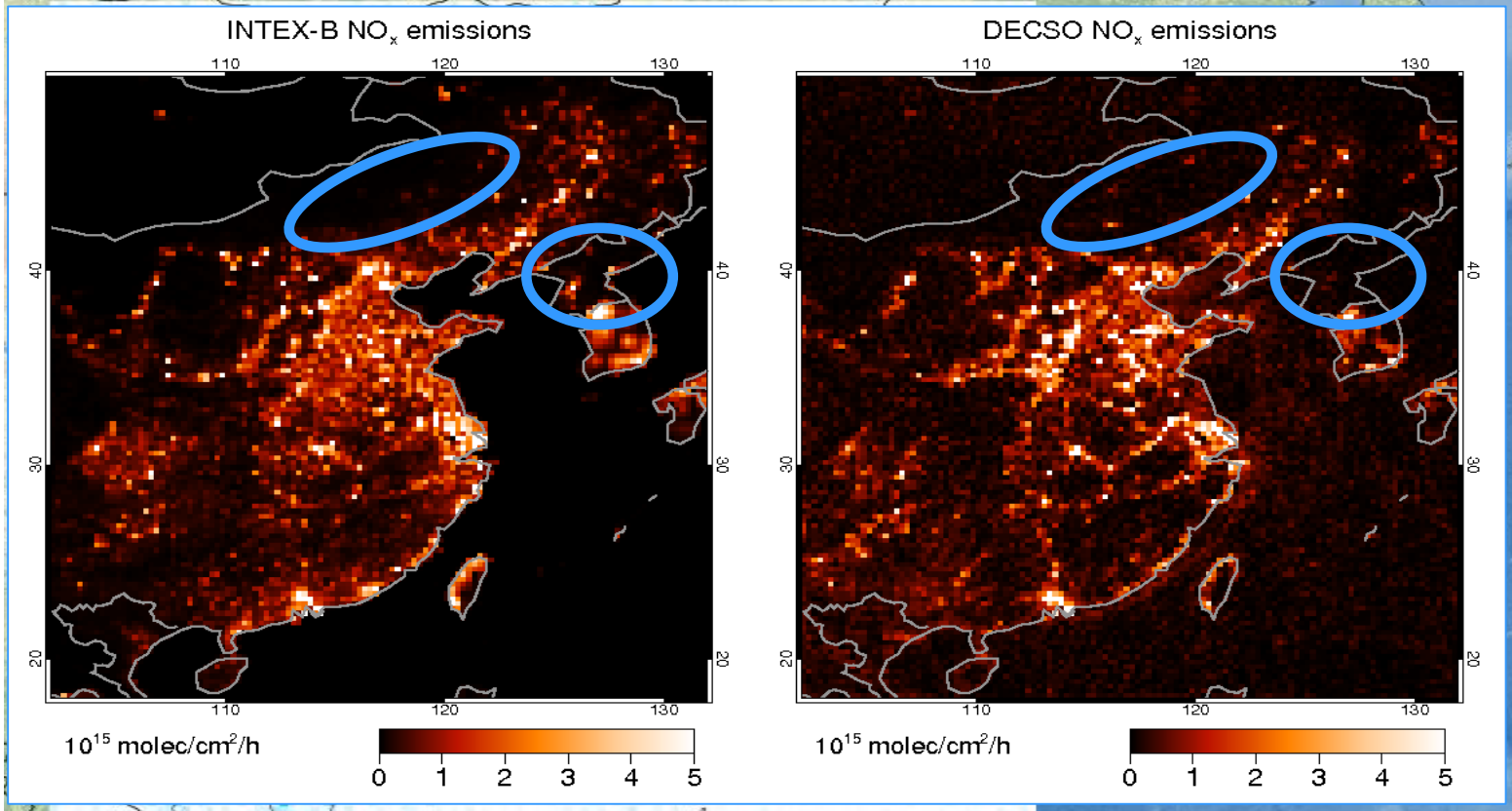
- 18º–50ºN, 102º–132ºE
- Monthly NOx emissions (2007-2012)
- OMI and GOME-2
- Initial inventory INTEX-B (2006)

CHINA

❑ NOx emissions

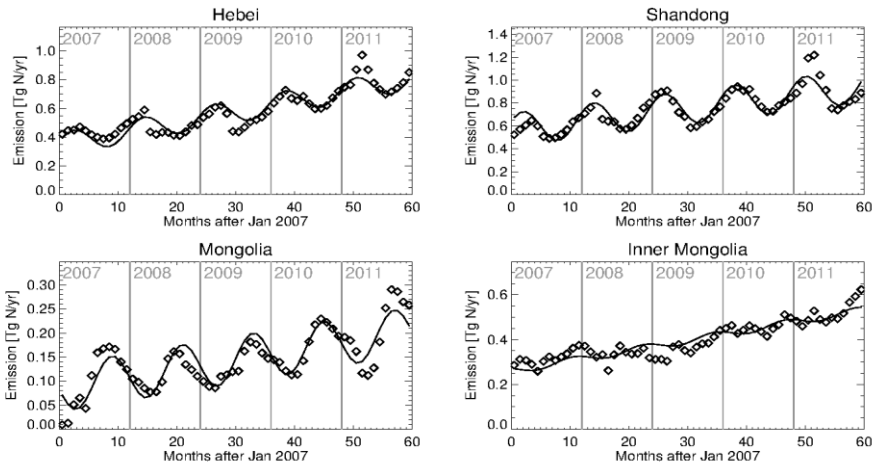
Service provider : KNMI (R. van der A and B. Mijling)
Main user: SEC-MEP (China)

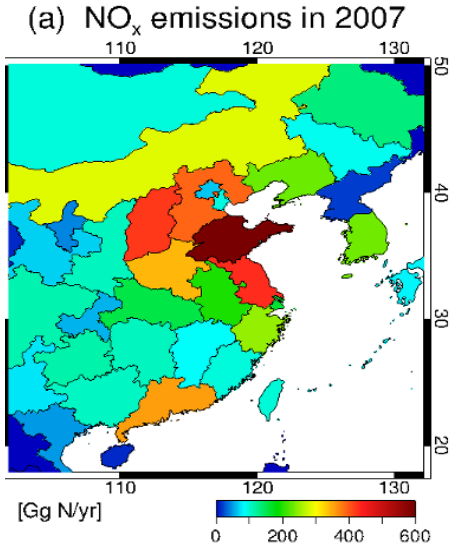
DESCO inversion algorithm enables estimation at high resolution (10-25 km)

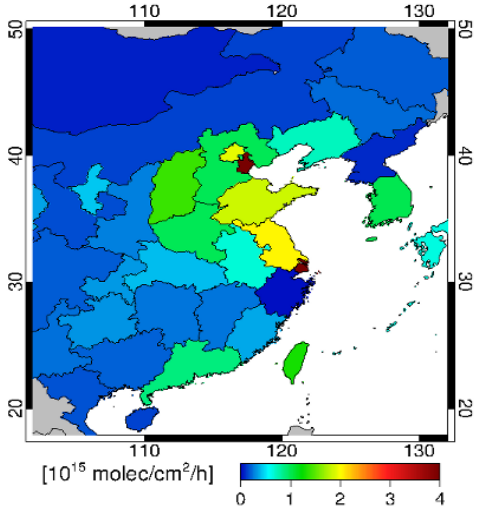


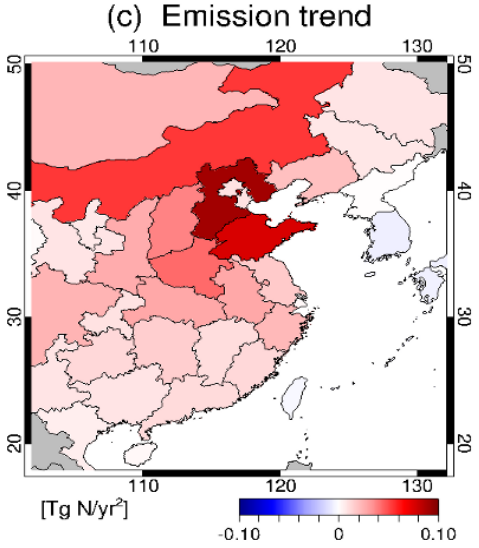
- New power plants in Inner Mongolia
- Distinct emissions along great rivers
- Low emissions in North Korea
- Ship emissions

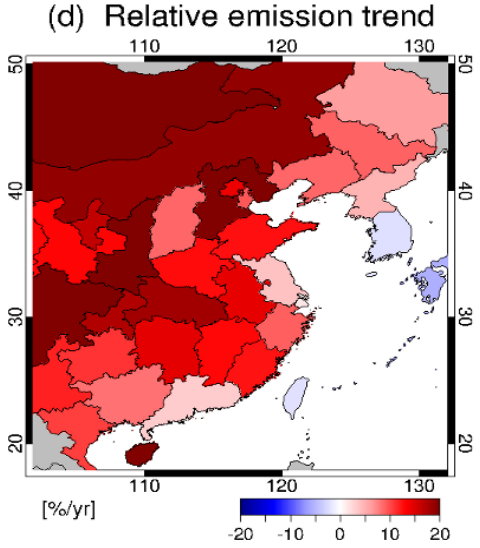
Emission trends







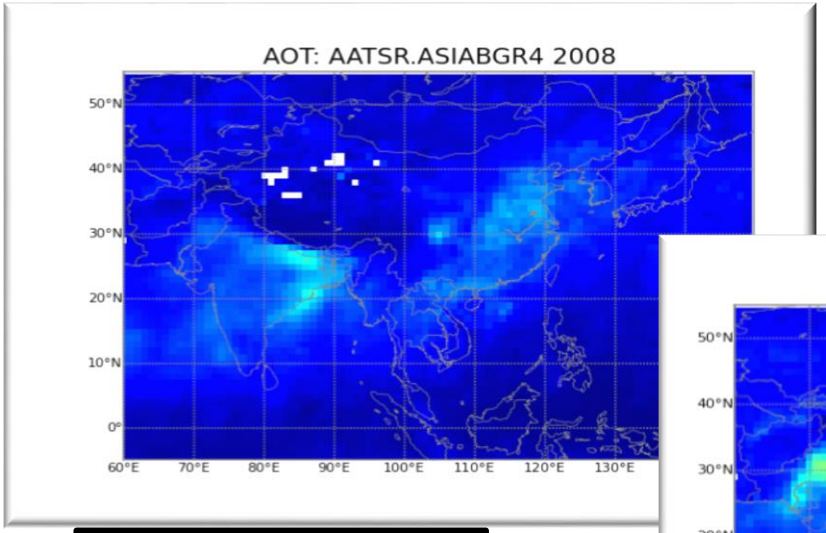




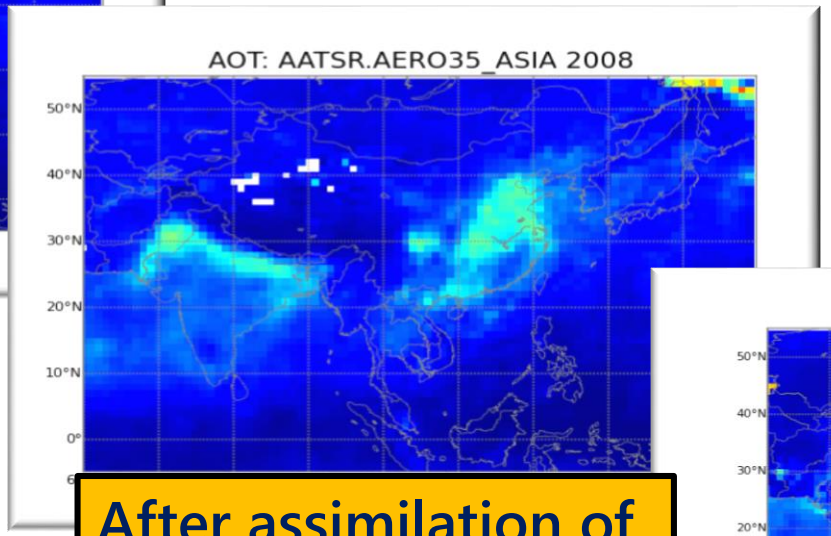
41% growth in 2007-2011

Mijling et al. (2013) *Regional nitrogen oxides emission trends in East Asia observed from space*, Atmos. Chem. Phys.

China: Aerosol emissions

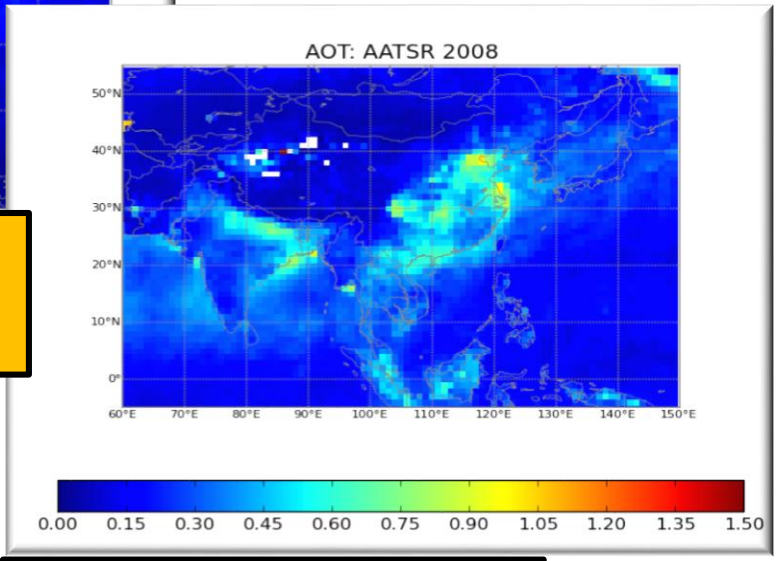


A priori model



After assimilation of MODIS AOD data

Service provider : FMI (J. Vira, M. Sofiev, E. Rodriguez, G. de Leeuw)
Main users: MEP, SAWS, NIES, EEA



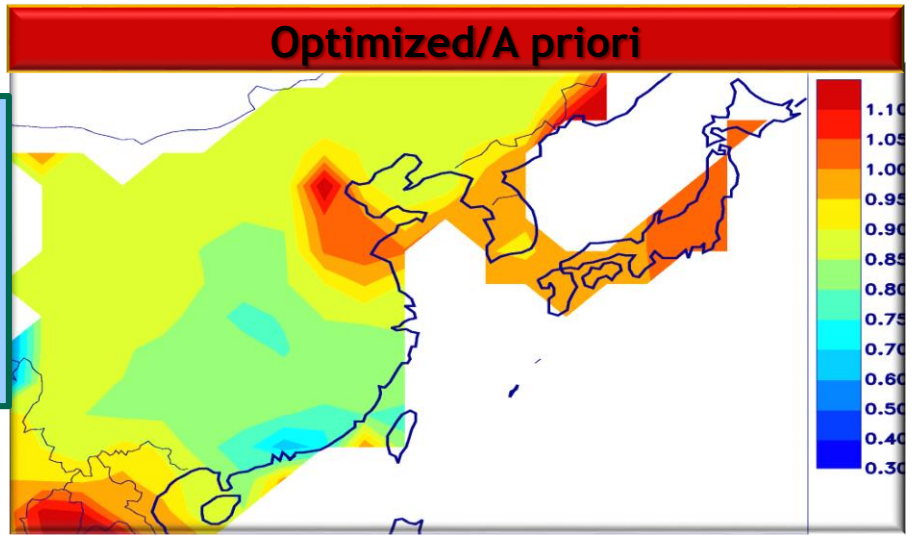
AATSR AOD data

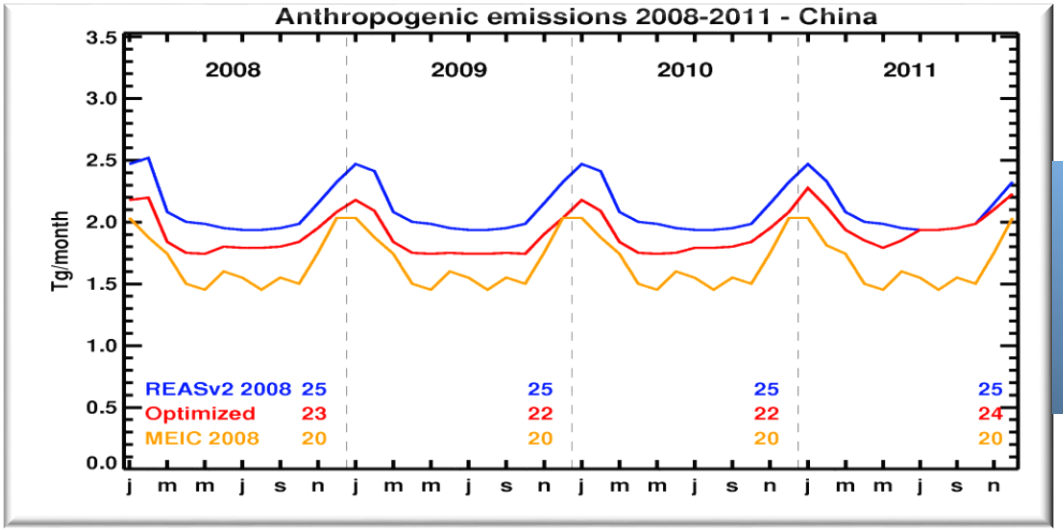
Assimilation of MODIS AOD improves agreement also with AATSR AOD and AERONET ground-based data

China: Anthrop. VOC emissions

Service provider : BIRA-IASB
(J. Stavrakou, J.-F. Muller, M. Bauwens)
Main user: NIES (Japan)

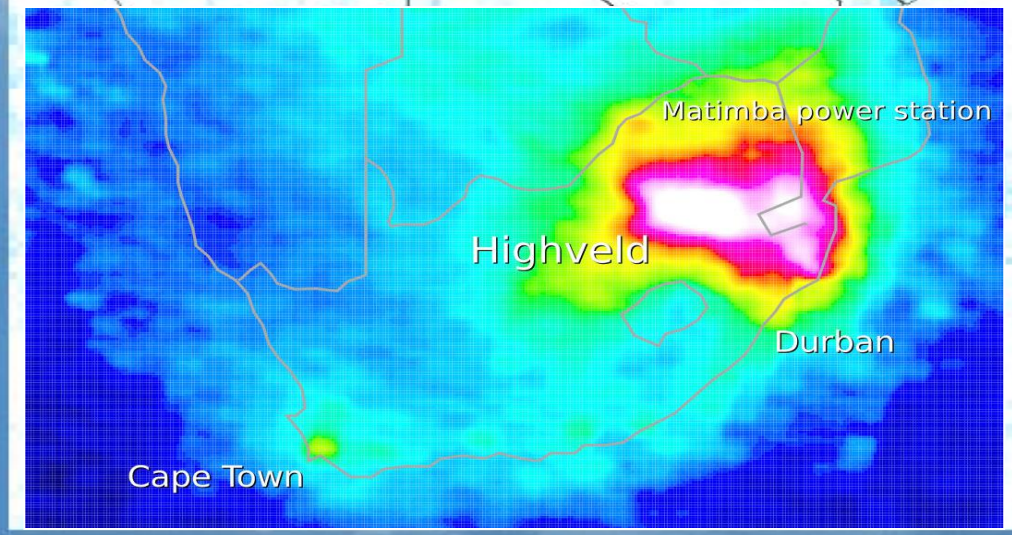
Moderate increase in Beijing region, and almost no change in the rest of NCP, decreases in the South-East China and especially in PRD region





✓ Optimized emissions are lower than estimated in REASv2, especially in 2009 and 2010, GlobEmission products are between the two bottom-up estimates

South Africa: NOx

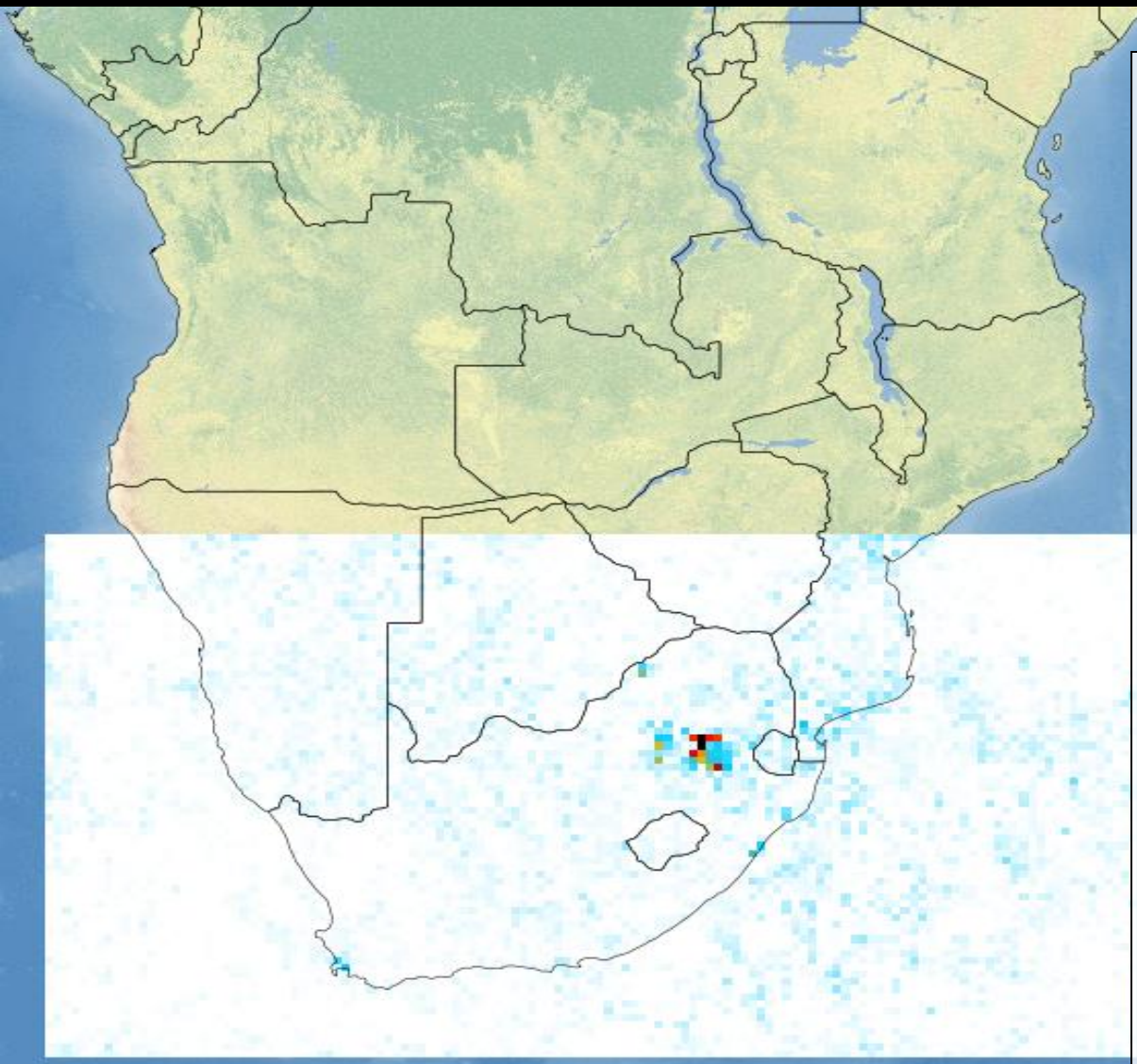


- 19º–37ºS, 10º–42ºE
- Monthly NOx emissions (2009-2010)
- Based on OMI
- Initial inventory EDGAR v4.2

Implementation issues:

- Low emissions, except for a few hot spots located close to each other.
- EDGAR: wrong initial hot spot positions

South Africa: NOx



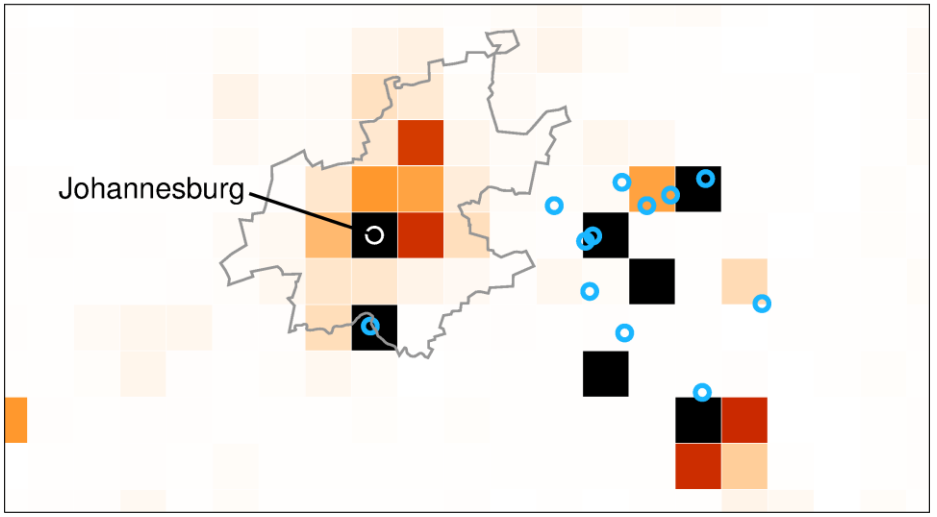
- 19º–37ºS, 10º–42ºE
- Monthly NOx emissions (2009-2010)
- Based on OMI
- Initial inventory EDGAR v4.2

Implementation issues:

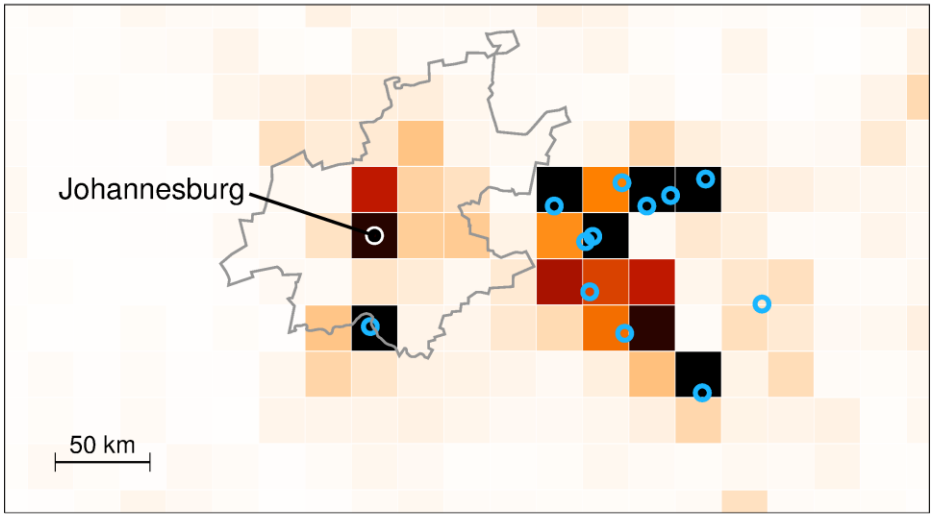
- Low emissions, except for a few hot spots located close to each other.
- EDGAR: wrong initial hot spot positions

Highveld , SOUTH AFRICA

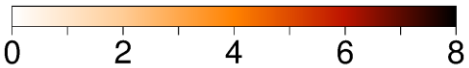
EDGAR v4.2 NO_x emission inventory (2008)



NO_x emission estimates by OMI (2010)



Nitrogen emission [kton N/yr]

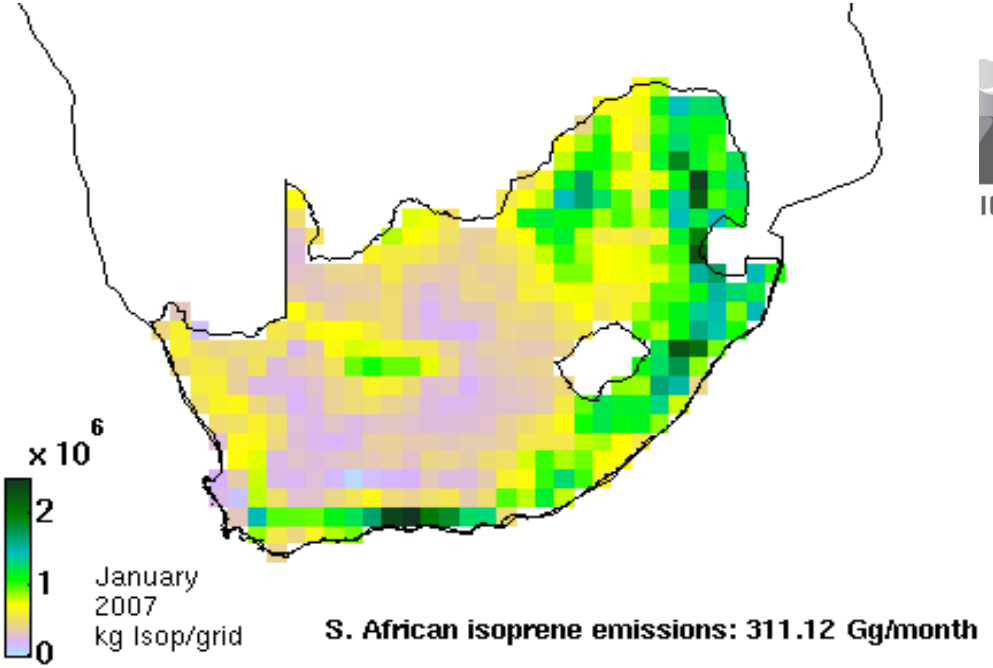


Service provider : KNMI
Main user: SAWS (South Africa)

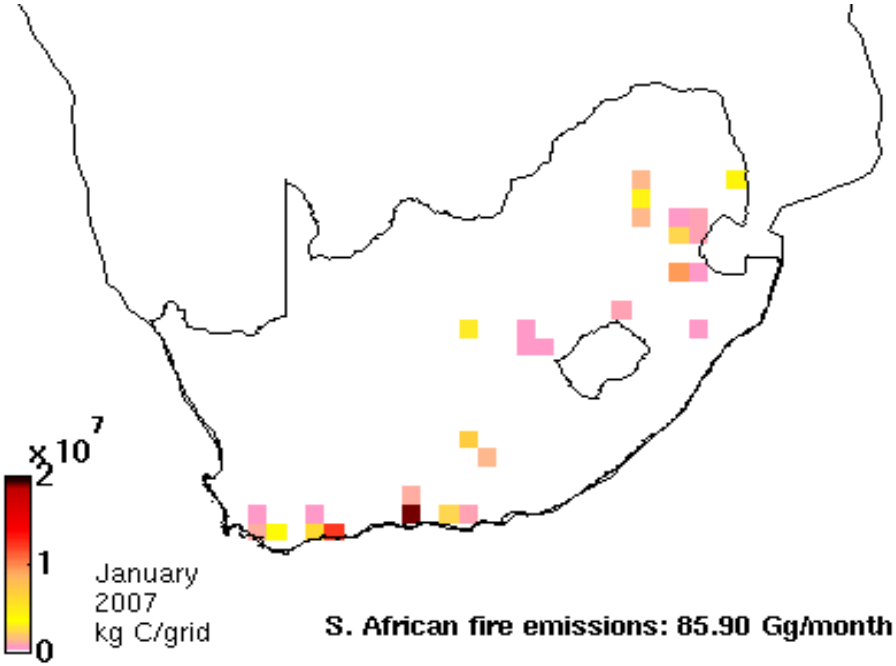
- NOx emission hotspots due to power plants and heavy industry
- Grey outline : densely populated Gauteng province
- Blue circles : coal-fired power stations, important hot spots of NOx emissions
- Upper panel : EDGARv4.2 based on 2008 data
- Lower panel : emission estimates based on OMI NO_2 for 2010.
- Errors in the location of emissions in EDGAR are improved with satellite data

- ✓ GOME-2 HCHO data
- ✓ IMAGES CTM and adjoint

- ✓ VOC emissions from fires
- ✓ Biogenic isoprene emissions



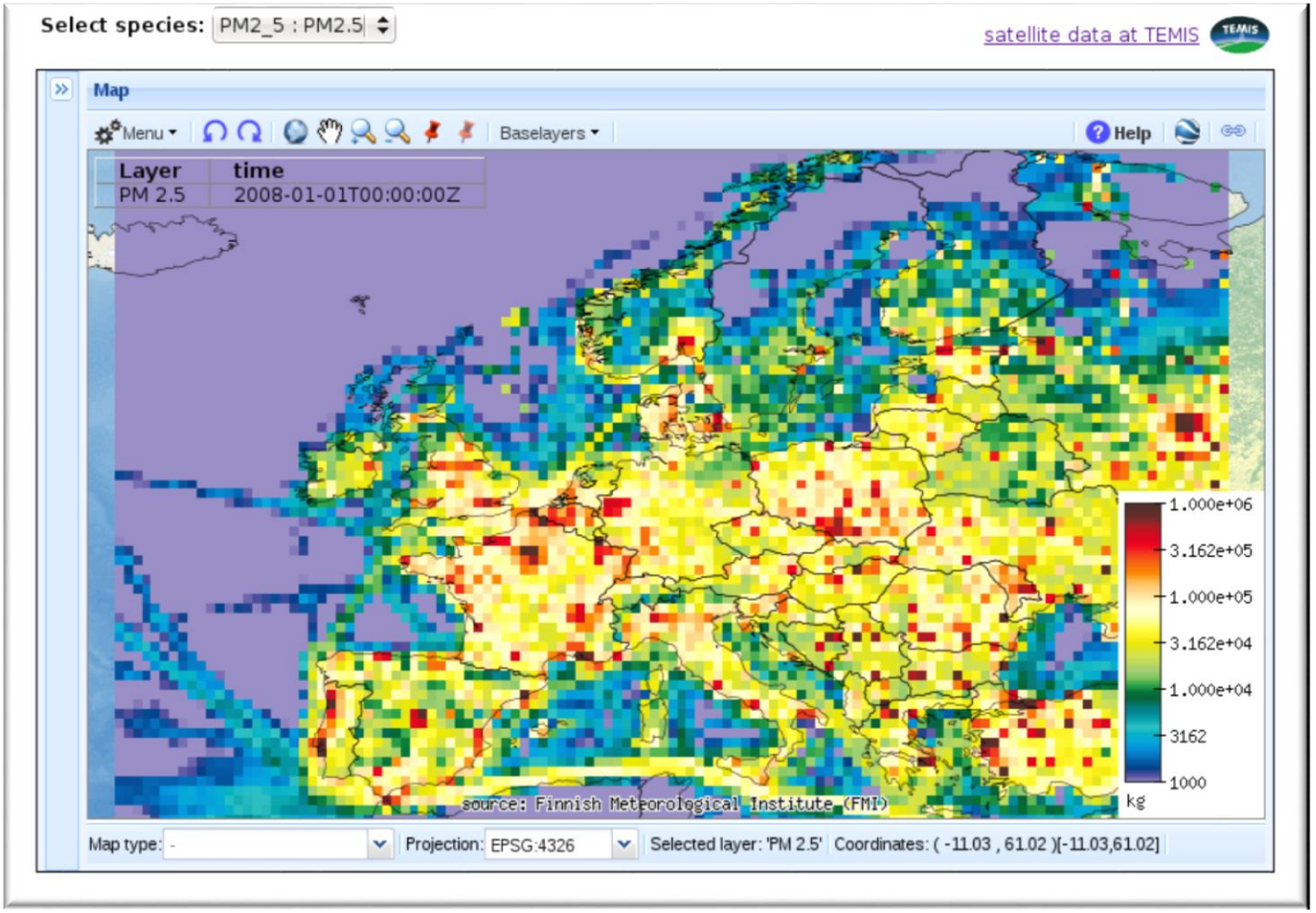
S. African isoprene emissions: 311.12 Gg/month



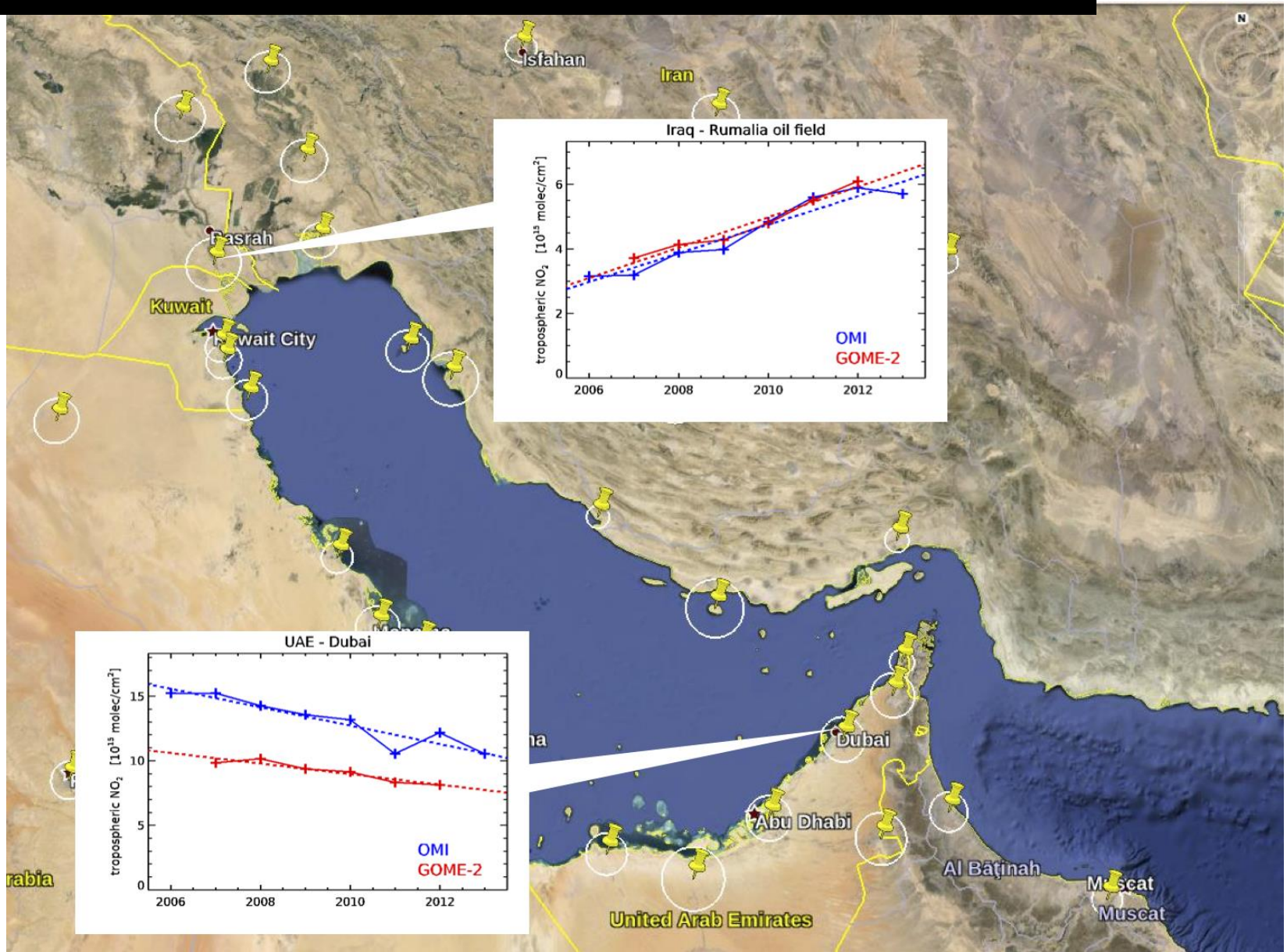
S. African fire emissions: 85.90 Gg/month

Europe: PM2.5 emissions

Service provider : FMI (J. Vira, M. Sofiev, E. Rodriguez, G. de Leeuw)
Main users: MEP, SAWS, NIES, EEA

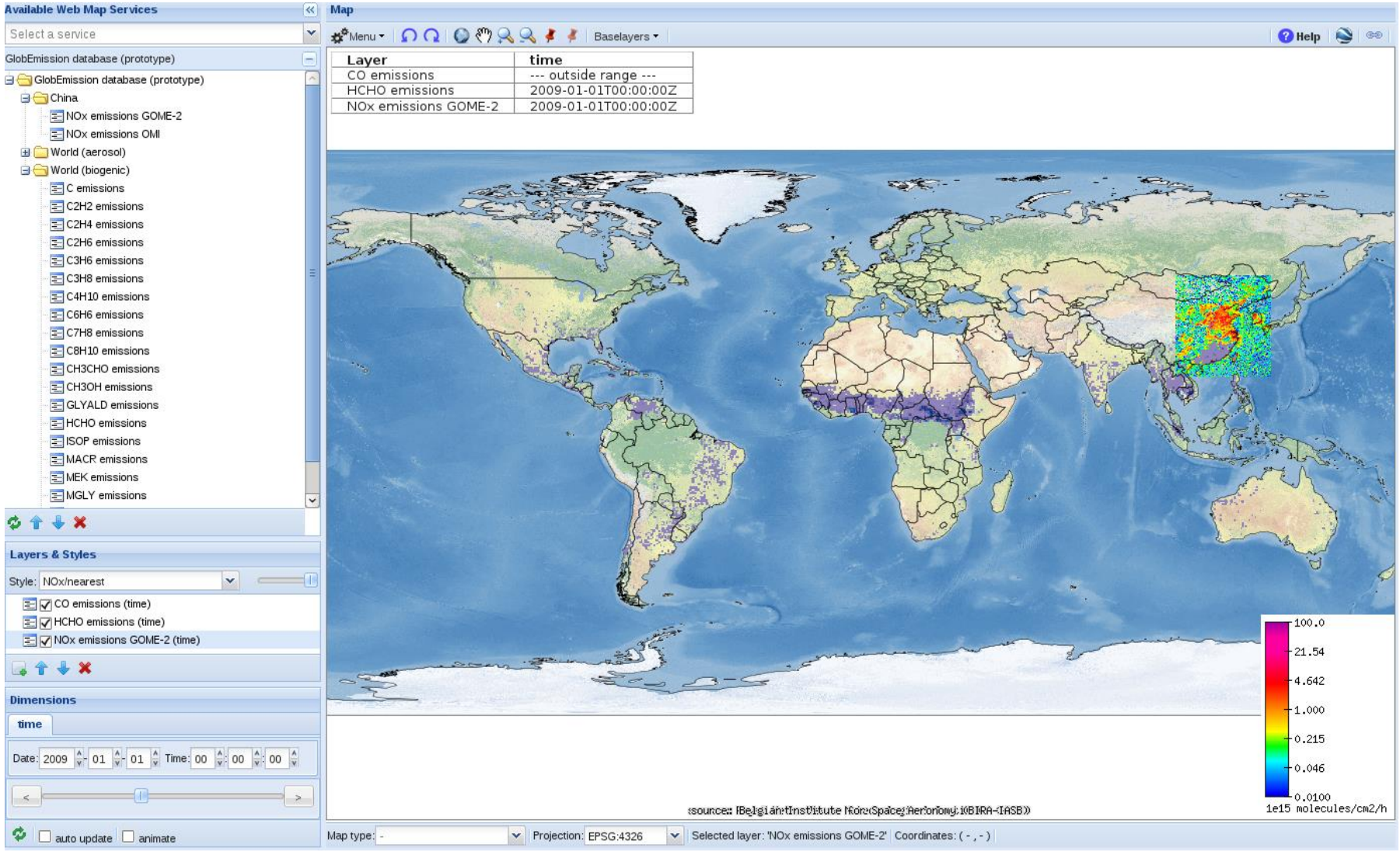


Middle East: NOx emissions

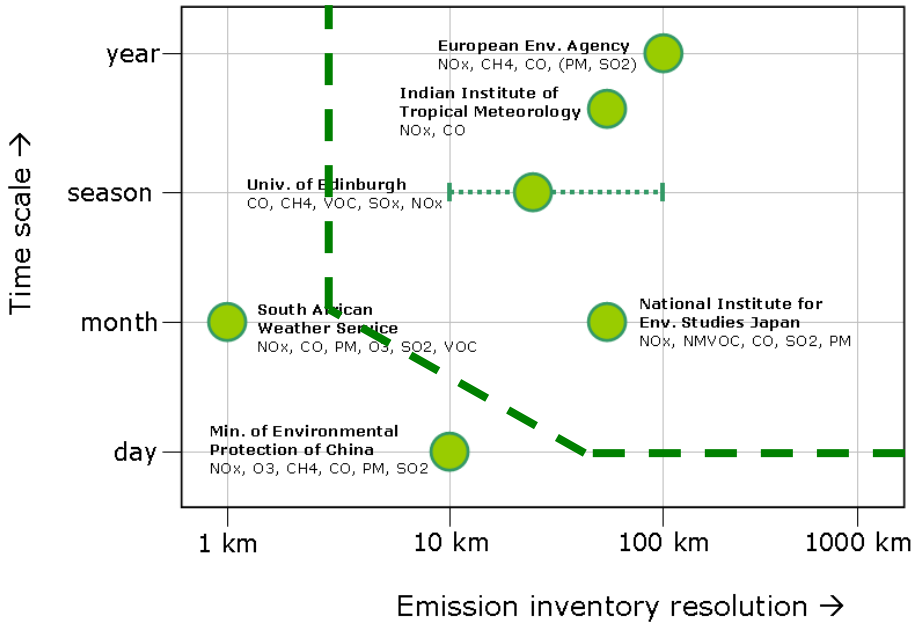


Visualisation tool

Data accessibility (NetCdf) + documentation



Are the user requirements met ?



Specific user requirements:	GlobEmission:
• Species: NOx, CH_4, CO, NMVOC, SO_2, PM	NOx, CO, NMVOC, PM
• Accuracy: better than 30% - 80 %	ok, more validation needed
• Spatial resolution: 1 km - 50 km	GlobEmission: 5 km – 50 km
• Time resolution: daily – annual	GlobEmission: daily - monthly
• Regional and Global	ok

Conclusions GlobEmission

- For several users/regions/species services are providing emission estimates constrained by satellite observations
- Validation with existing inventories and model results
- Strengths:
  - Fast updates,
  - Fair comparison between regions
  - Weaknesses in existing inventories identified
- Easy access via the web-portal: www.globemission.eu
- User feedback via workshops and Service Assessment Report
- Users need higher resolution emission maps => need for higher resolution satellite observations (S5p)