Assessment of POP pollution in EMEP region

Alexey Gusev on behalf of
MSC-E and CCC

Main directions of activities on POPs in 2016/2017

2016/2017 workplan (ECE/EB.AIR/133/Add.1)

Item	*Activity description*
1.1.1.4	Evaluation of HM and POP background levels in selected cities of the EMEP domain
1.1.1.6	Ecosystem-dependant deposition fluxes of HMs and POPs to different land use types in the new EMEP grid
1.1.1.22	Design source receptor studies in the ECE region for benzo[a]pyrene
1.1.2.5	Review and assess data, methodologies and competences available to deal with POP and HM issues in the ECE region and propose a strategy to improve emission inventories
1.2.4	Assessment of HM and POP pollution levels with fine spatial resolution generated in cooperation with national experts (EMEP case studies on HMs)
1.3.1	Explore possible use of EMEP/WGE tools, data and infrastructure to support AMAP activities
1.3.2	Support UNEP Stockholm Convention in relation to atmospheric observations and data management within the ECE region
1.3.3	Continue collaboration with OSPARCOM and HELCOM related to atmospheric monitoring and modelling and data management
1.3.5	Contribute to air quality assessments in newly industrialized countries

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Main outcome of MSC-E and CCC activities in 2017

- POP monitoring activities
- Assessment of POP transboundary pollution (with focus on PAHs)
- Transition of operational modelling to the new EMEP grid
- Country-scale pollution assessment – Case study on B(a)P pollution in Spain
- Review and improvement of POP emissions data for modelling
- Co-operation with subsidiary bodies, international organizations and national experts

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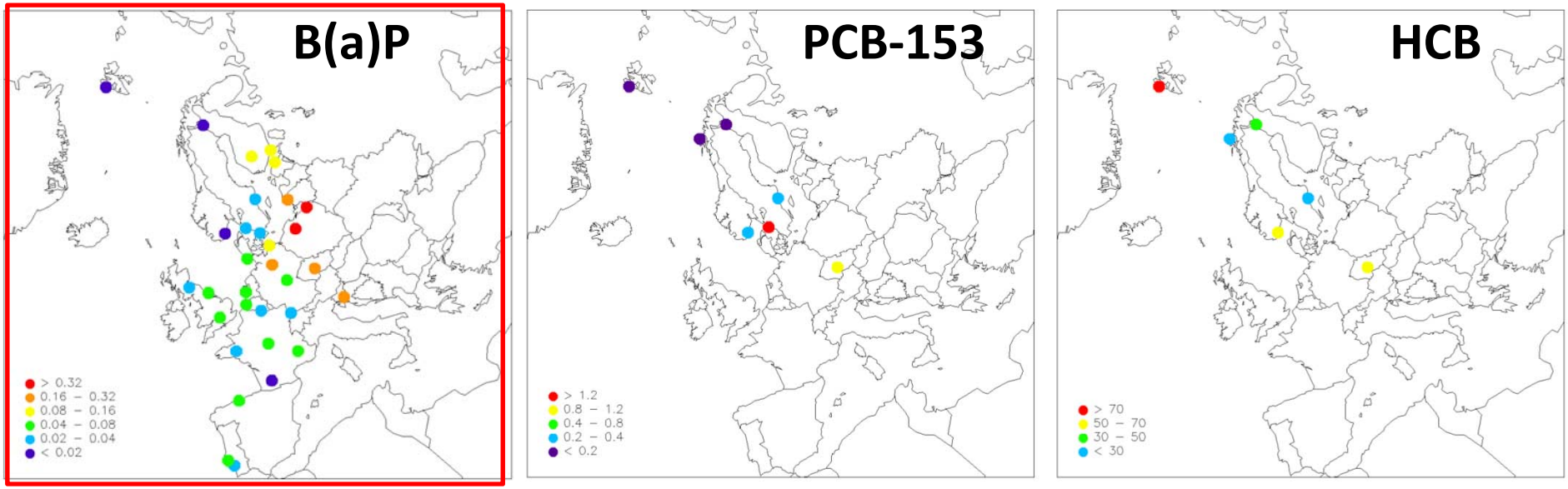
EMEP POP monitoring activities

Measurements of POPs at the EMEP monitoring network (2015)



EMEP monitoring network for POPs:

- PAHs were reported by 34 sites
- PCBs and HCB were reported by 7 sites
- No measurements for PCDD/Fs

Important issues for analysis:

- Coverage of EMEP domain
- Comparability of data of different sites
- Parallel measurements of 4 PAHs (14 sites)

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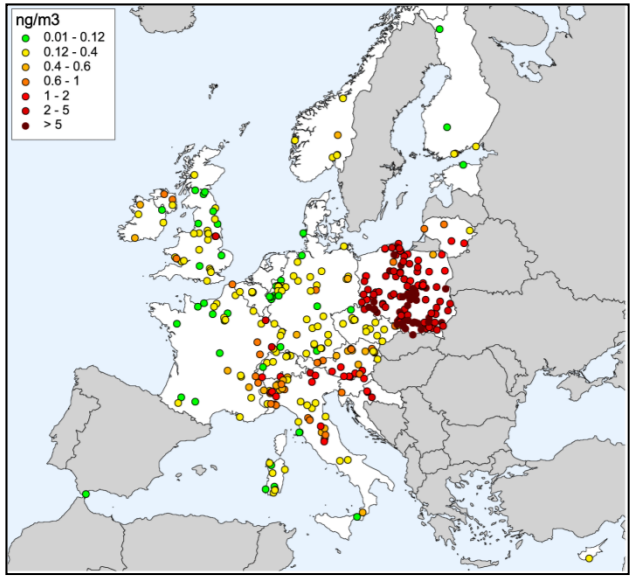
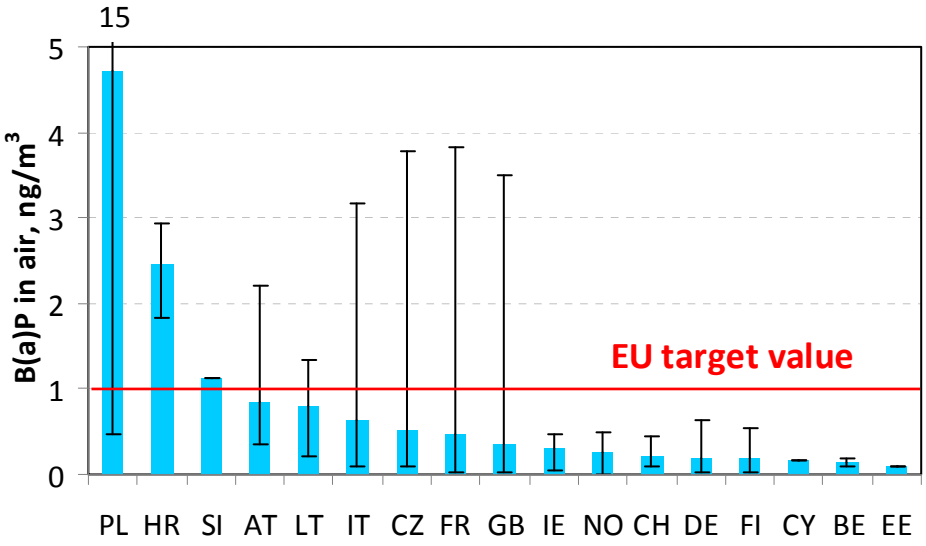
Monitoring of B(a)P in the EU countries (Airbase)





Observed B(a)P air concentrations in 2015 (EEA AirBase): **industrial, urban, suburban, traffic, and background** monitoring sites (>300 sites)

Analysis of B(a)P air concentrations for 2015:

- High levels of B(a)P (above 1 ng/m^3) in 2015 were observed in nine countries (mostly at urban and suburban)

Analysis of long-term trends in B(a)P air concentrations (2005-2015):

- About 35% of sites showed increasing concentrations in period 2005-2015
- About 10% of them showed statistically significant increase of B(a)P

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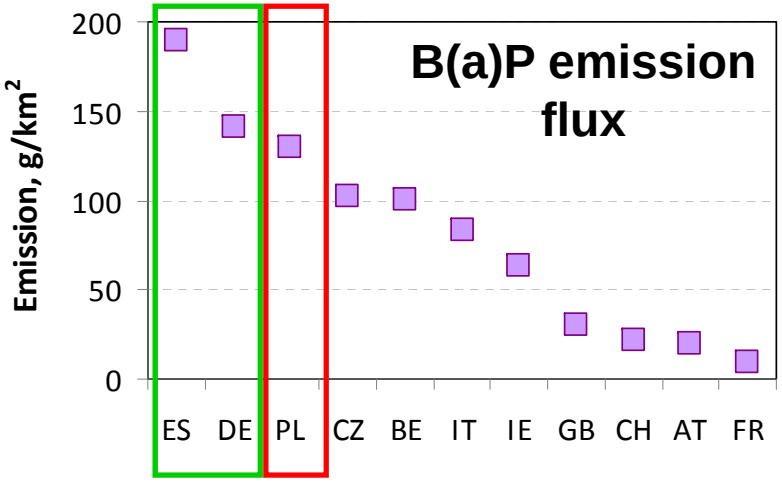
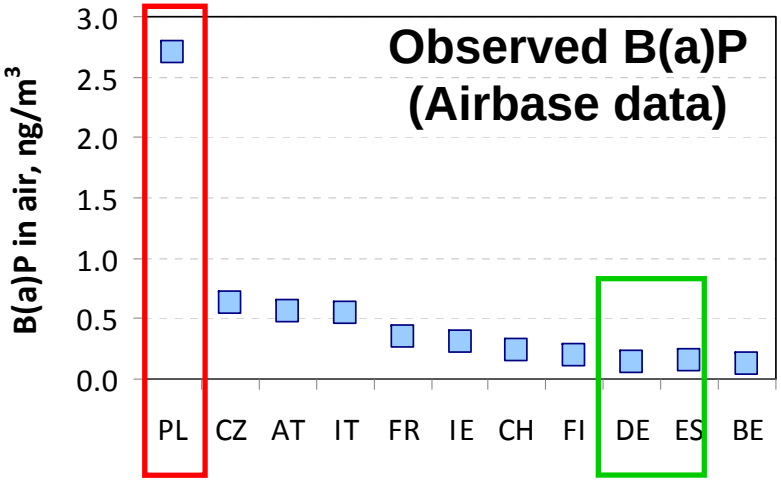
Uncertainties in reported PAH emissions

Inconsistencies between reported PAH emissions and measured concentrations





- High observed B(a)P levels, while B(a)P emission flux comparable to other countries (PL).
- High B(a)P emission flux, while observed B(a)P concentrations are low (DE, ES).

Major issues of reported PAH emissions:

- Total PAH emissions not equal to the sum of speciated emissions (DE, PT, RS)
- Missing speciation of PAH emissions (AT, ES, FI, IT)
- Spatial distribution of emissions contradicts with observed concentrations (DE)

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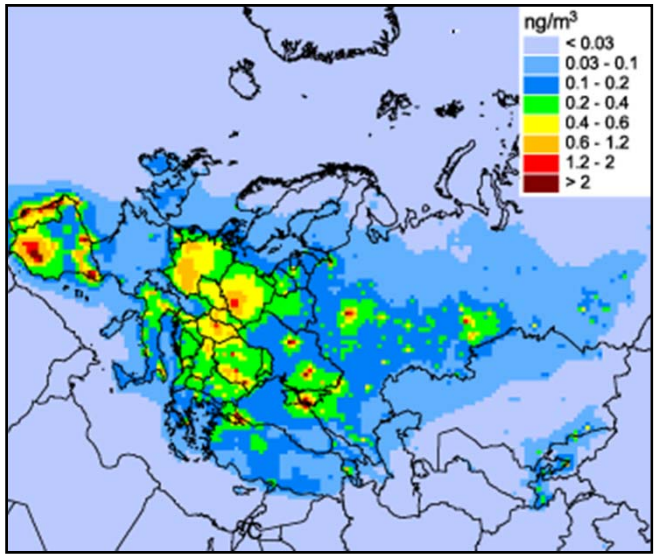
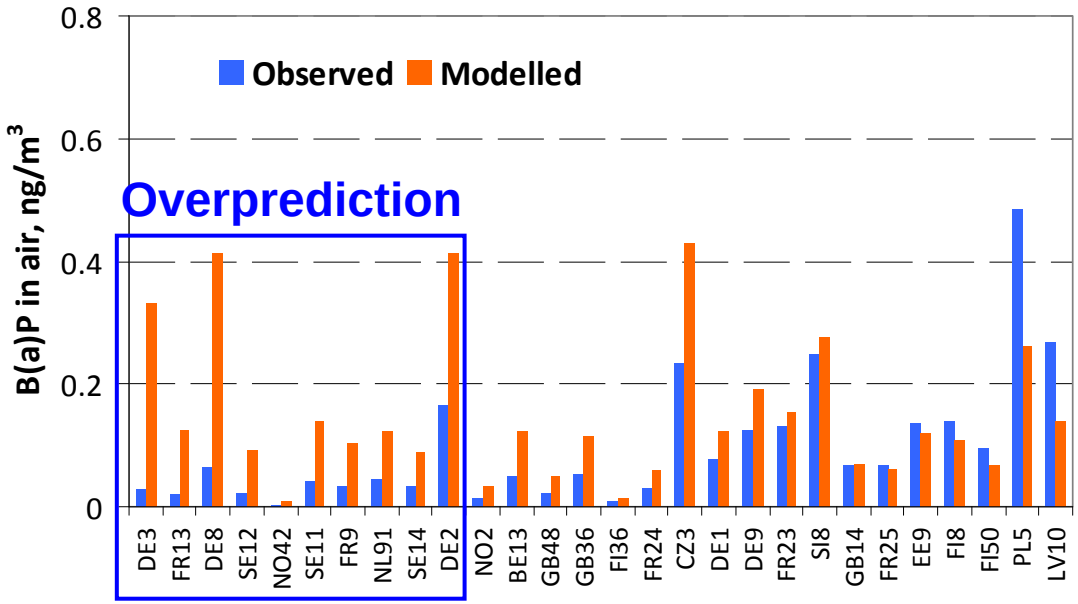
Evaluation of PAH pollution in the EMEP countries



Modelled B(a)P air concentrations (2015)



Modelled vs observed B(a)P air concentrations for 2015

Analysis of modelled and measured B(a)P air concentrations:

- For ~50% of EMEP monitoring sites agreement is within a factor 2, for ~80% - within a factor 3.
- Spatial distribution is captured by the model (correlation 0.63).
- However, model overpredicts air concentrations, measured at some monitoring sites (DE, SE, FR, ES, BE, NL).

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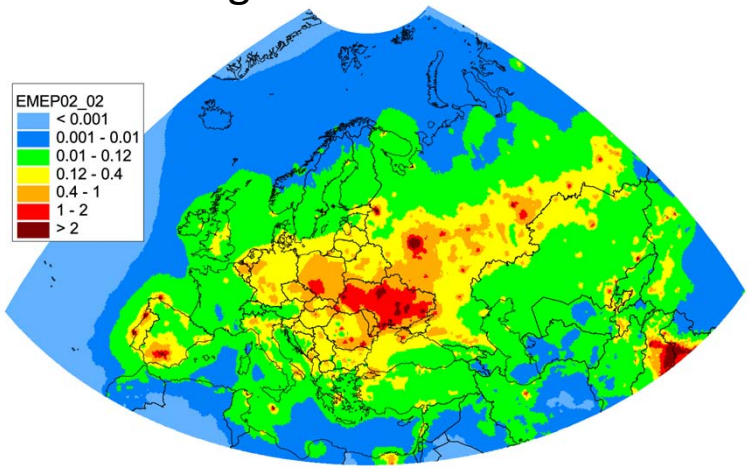
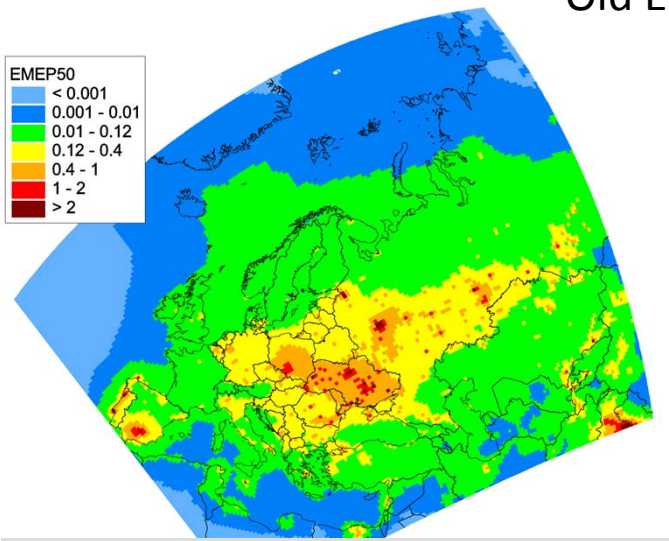
Transition to the New EMEP grid

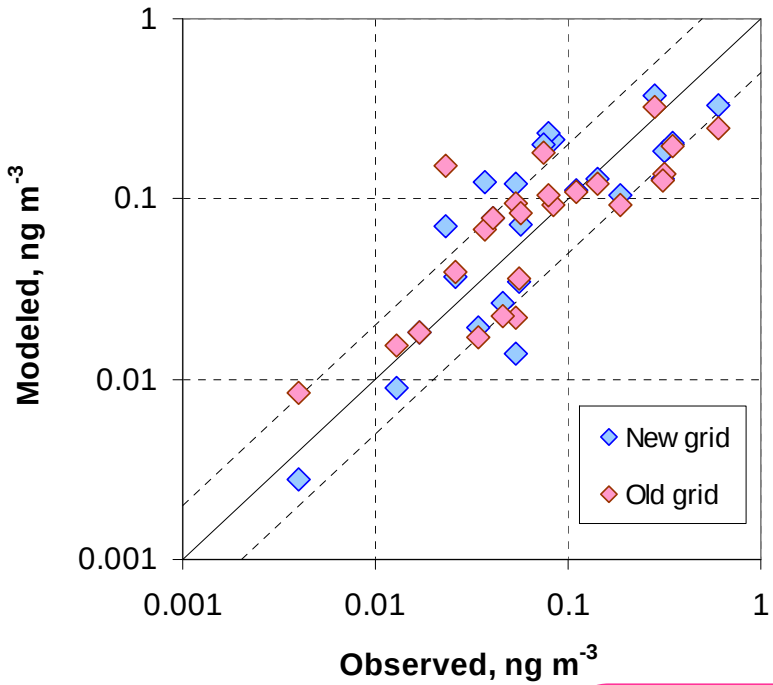
New EMEP grid



Old EMEP grid



Modelled vs measured B(a)P concentrations at background EMEP sites (2014)



	Old grid	New grid
Bias	-20 %	-5 %
Correlation	0.73	0.73

Results for new EMEP grid show better agreement with measurements

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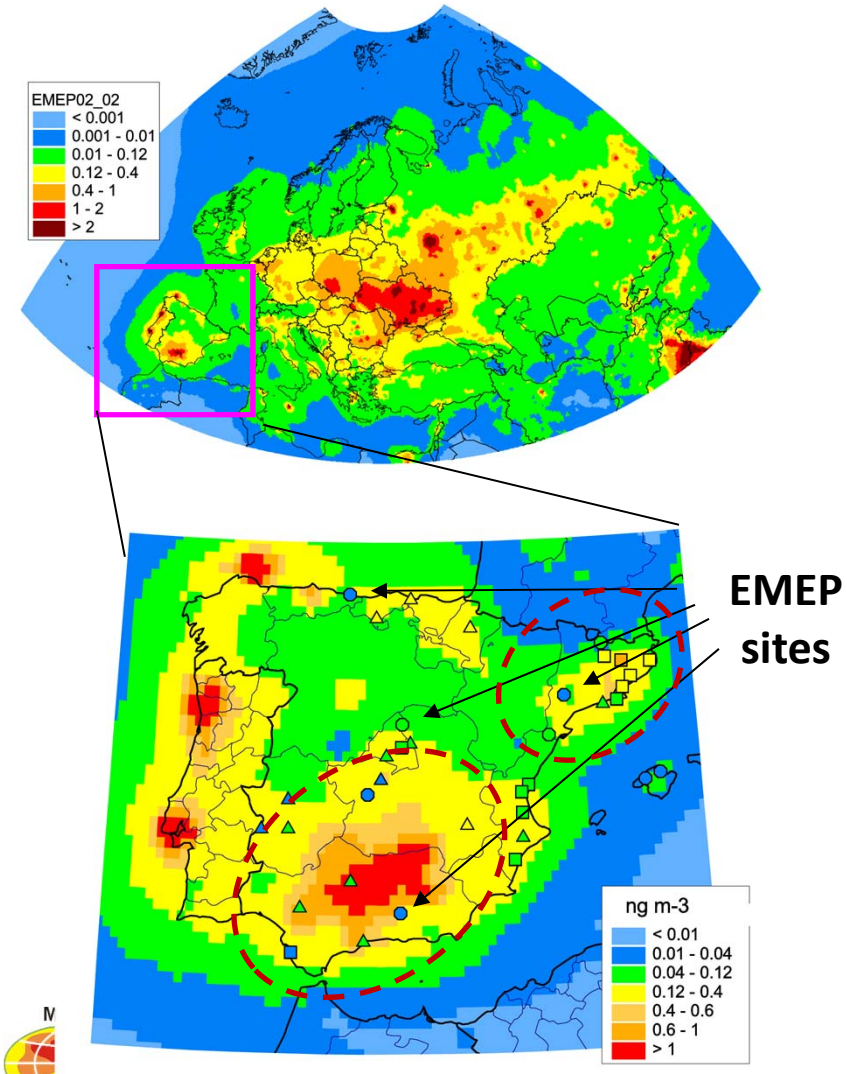
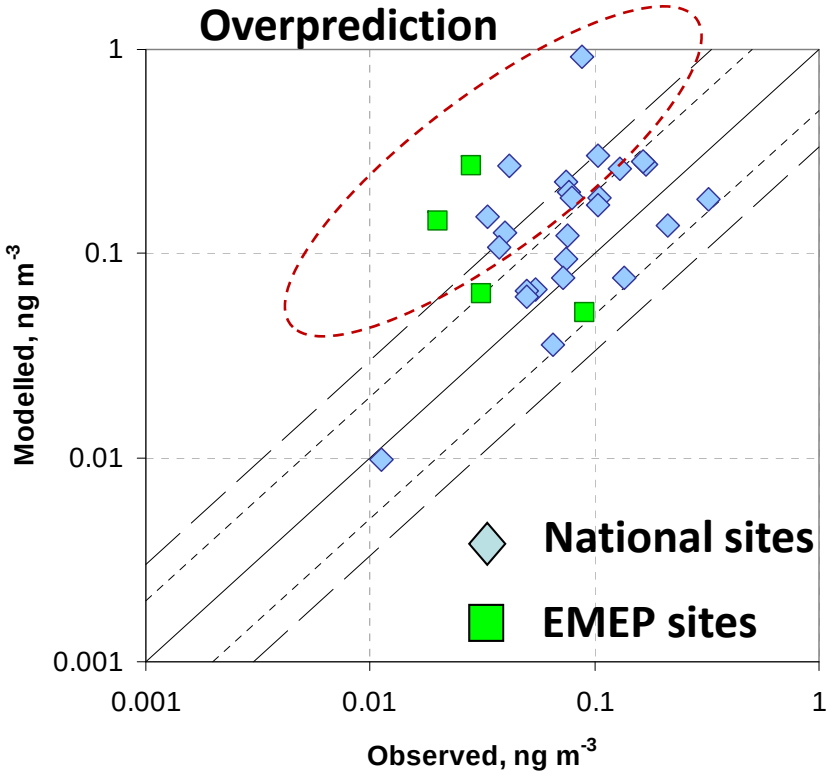
Model assessment of B(a)P pollution: case study for Spain

New EMEP grid



Modelled B(a)P concentrations vs. data of national and EMEP sites in Spain (2014)



For some of the sites in Spain the model overestimate observed B(a)P concentrations

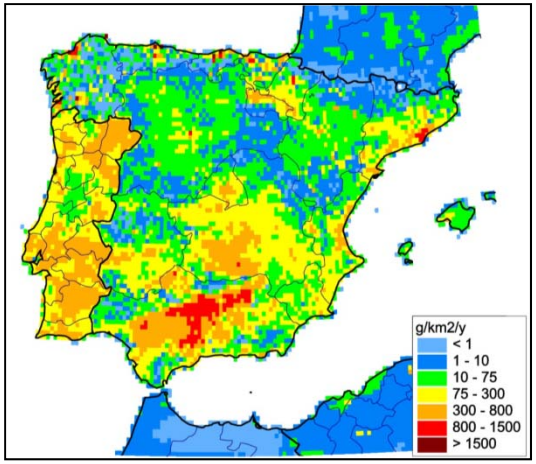
Country-scale POP pollution assessment for Spain

Objective of case study:

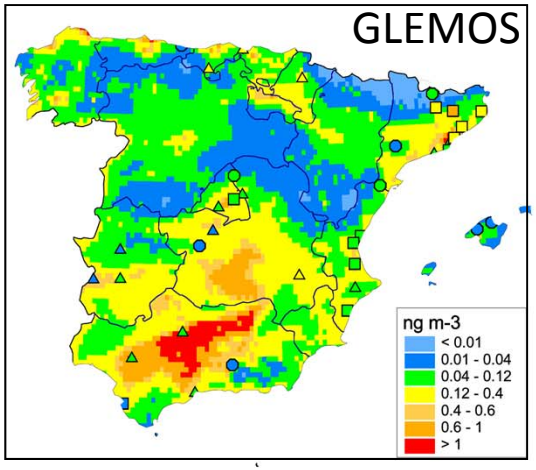
Assessment of B(a)P pollution levels in Spain with fine spatial resolution

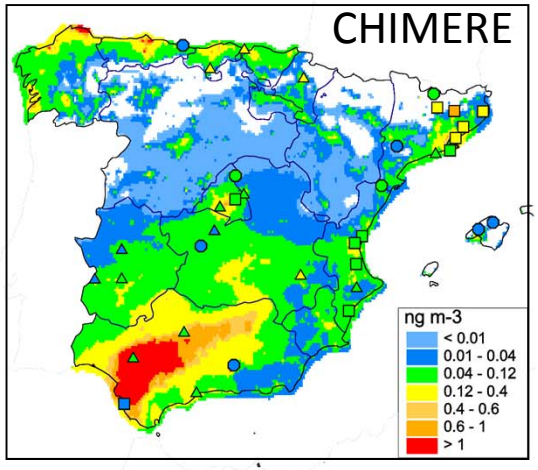
Preliminary results:

- Indication of possible uncertainties in the emissions (spatial and sectoral distribution, high emissions from agriculture)
- GLEMOS and CHIMERE (CIEMAT, Spain) model results overpredicted observed B(a)P concentrations
- Modelling using national emissions and experimental scenarios showed possible inconsistencies in PAH emission inventory



B(a)P emission fluxes (0.1°x0.1°), g/km²/y





Modelled and observed B(a)P air concentrations

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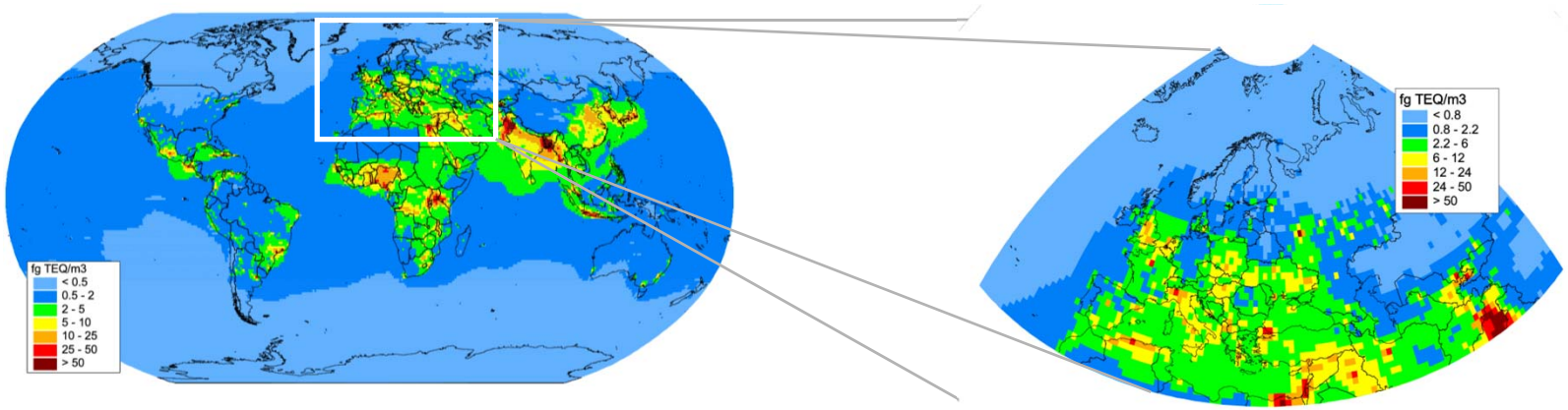
Assessment PCDD/F, HCB, and PCB pollution

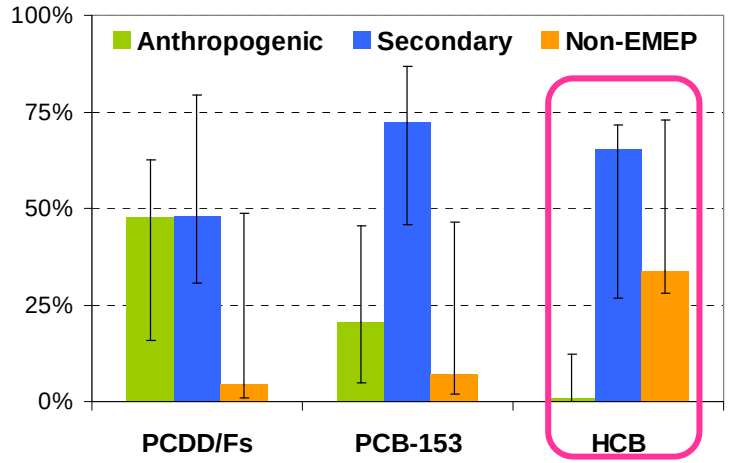
- Multi-media modelling over global and nested regional EMEP domains
- Transition to the new EMEP grid for these POPs is ongoing and requires further work on adaptation and testing



Modelled PCDD/F air concentrations (2015) over global lat-lon and new EMEP grids

Evaluation of contributions of various sources to the EMEP pollution (2015):

- EMEP anthropogenic emissions;
- Non-EMEP emission sources;
- Secondary emission sources.



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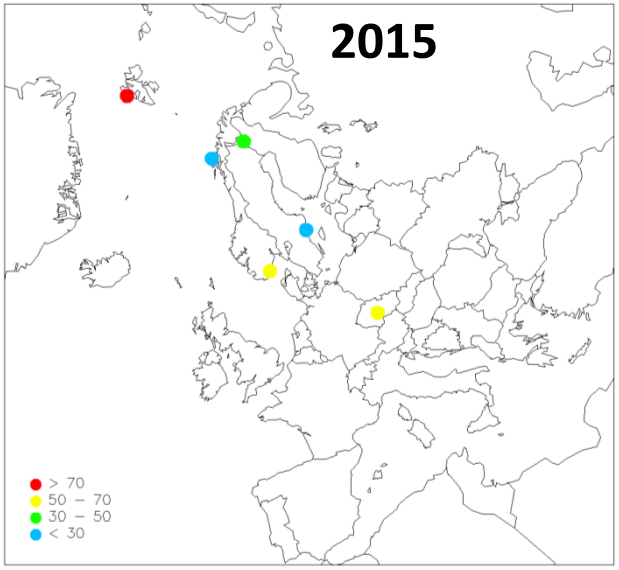
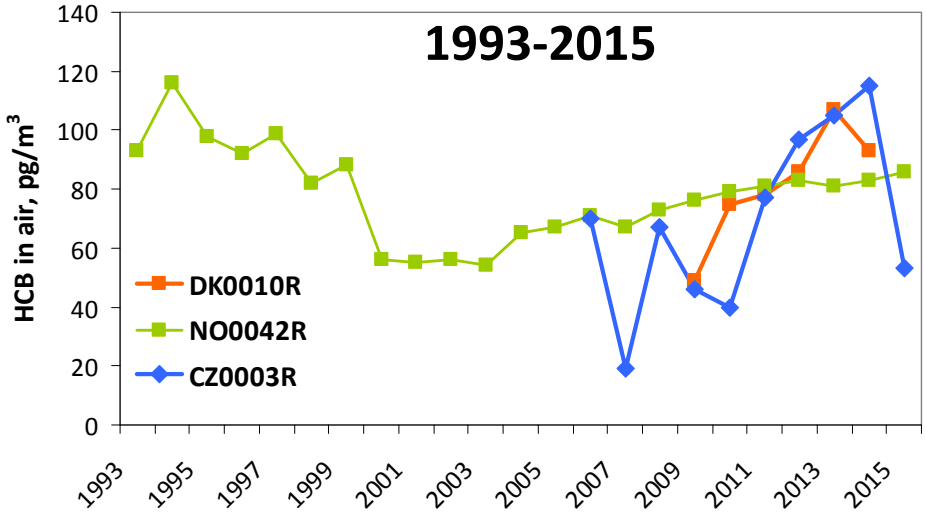
HCB pollution levels

Measurements of HCB at the EMEP monitoring network





HCB monitoring - challenges:

- Limited comparability of HCB data across the sites within the EMEP network (HCB undergoes breakthrough in high volume samplers).
- HCB in air is found to increase at some EMEP sites during the last five to ten years.
- This highlights the critical importance of continuous and consistent long-term monitoring of regulated POPs, even after periods of decline.
- Co-operation on POP monitoring with Stockholm Convention

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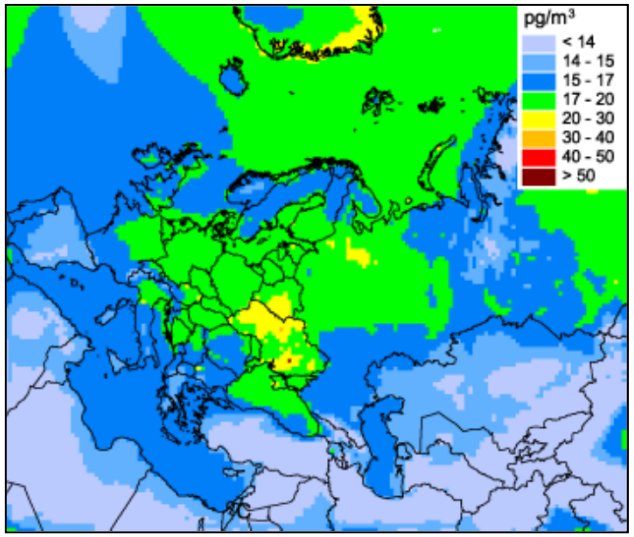
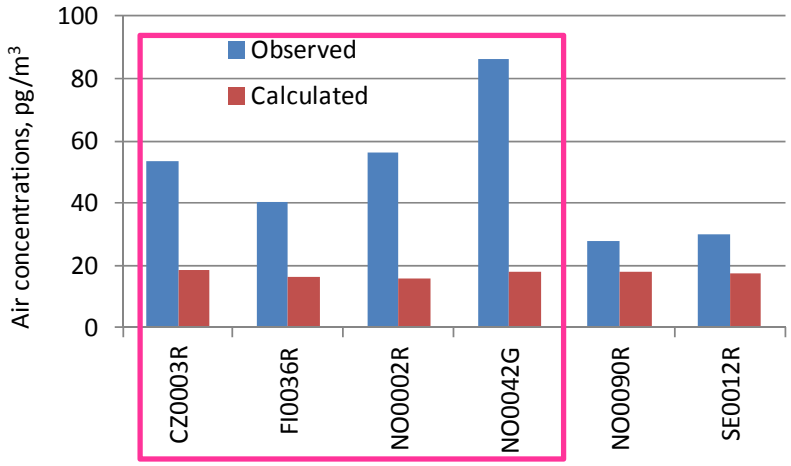
HCB pollution levels

Model assessment of HCB pollution of the EMEP region





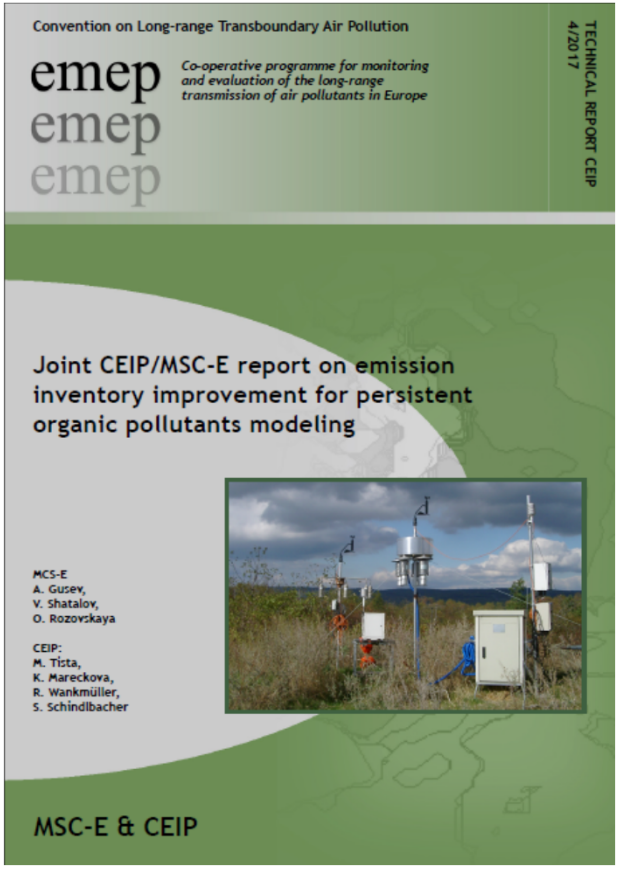
Modelled vs observed HCB air concentrations (2015)

HCB modelling problems – underestimated EMEP emissions, global and secondary sources:

- Chemical and metal industry, and cement production can be sources of HCB, but not included in the inventory (*Germany IIR, 2017*)
- Study of POP emissions from small scale combustion in Estonia indicated significant uncertainties in the available emission factors of HCB (*Maasikmets et al., 2016*).
- Refinement of data on global emission sources and historical HCB emissions.

POP emissions: co-operation with CEIP activities

Joint report of CEIP and MSC-E on the state of POP emissions (EMEP Technical Report 03/2017)



MSC-E contribution:

Overview of different POP emission parameters and their influence on quality of the assessment results

Key factors affecting quality of model estimates:

- Quality of gridded anthropogenic emissions
- Chemical composition (PAHs, PCDD/Fs, PCBs)
- Temporal variations (PAHs)
- Global emissions inventory (PCDD/Fs, HCB)
- Historical emissions (HCB)
- Emissions to surface media

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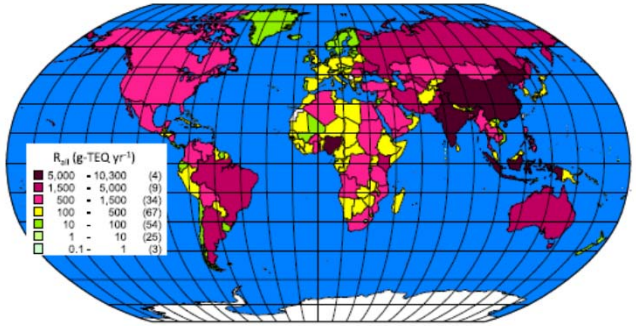
Co-operation with international organizations

Stockholm Convention on POPs (ongoing projects):

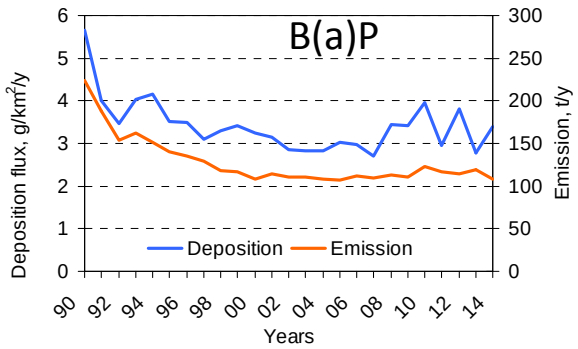
- Inventories of unintentional POPs (PCDD/Fs, PCBs, HCB emissions)
- Global Monitoring Plan on POPs (2016-2020) – monitoring of POPs in three UN regions (*Africa, Asia-Pacific and Latin America and the Caribbean*)



PCDD/F emissions (Wang et al., 2016)

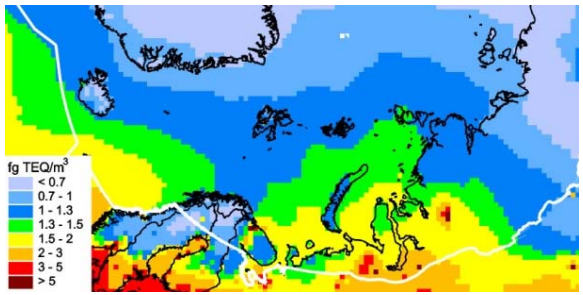
HELCOM:

- Source apportionment and long-term trends of the Baltic Sea pollution by POPs (1990-2014)



AMAP:

- Estimates of Arctic pollution (PCDD/F air conc., 2015)



WGE/ICP:

- Monitoring of PAHs in mosses in 2015/2016 (e.g. Norway, Sweden, Austria, Switzerland, Spain, etc.)

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Main directions of work in 2018-2019

1. **Country-scale assessment of POP pollution:**
   - *Assessment of country-specific B(a)P pollution for Spain, France, and Poland*
   - *Evaluation of pollution levels in high-emission and high-impact areas*
   - *Analysis of factors affecting quality of POP pollution modelling*

2. **Evaluation of multi-compartment intercontinental transport of POPs:**
   - *Assessment of PCDD/Fs and PCB pollution from regional and global sources*
   - *Analysis of the key factors affecting POP accumulation in and exchange between the environmental media*
   - *Evaluation of secondary emissions of selected POPs*

3. **Contribution to the analysis of effectiveness of implementation of Protocol on POPs:**
   - *Analysis of long-term trends of B(a)P pollution levels*
   - *Assessment of B(a)P pollution levels with focus on densely populated areas*
   - *Evaluation of the key source categories contribution to B(a)P pollution*
   - *Projections of future B(a)P pollution levels*

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