8th Joint Session of the EMEP Steering Body and the Working Group on Effects
12-16 September, 2022

POP pollution assessment on national, regional, and global scales with focus on PAHs

MSC-E: A. Gusev, N. Batrakova, M. Kleimenov, O. Rozovskaya, V. Shatalov, N. Vulykh, I. Ilyin

CCC: K. Breivik, P. B. Nizzetto, K. A. Pfaffuffer, W. Aas

**CEIP**: S. Poupa, R. Wankmueller, B. Ullrich

Eurodelta-Carb B(a)P: M.G. Vivanco, M.R. Theobald, J.L. Garrido, V. Gil, F. Couvidat, A. Collette, M. Mircea, M. Adani, I. Delia, R. D. Kouznetsov, E. V. Kadancev

Operational and research activities on POPs in 2022

Main topics :

- **Operational activities**

  - Emissions of POPs in the EMEP region (CEIP)

  - POP monitoring in the EMEP region (CCC)

  - Model assessment of POPs (PAH, PCDD/F, PCB, HCB) pollution for 2020 (MSC-E)

- **Research activities and co-operation**

  - PAH pollution assessment:
    Eurodelta-Carb BaP (TFMM),
    Case study for Poland (TFMM),
    A pilot study of B(a)P pollution from wildfires

  - Analysis of temporal changes of POP pollution (WGE)

  - Assessment of global-scale POP pollution (TFHTAP)

  - Contaminants of Emerging Concern (TFMM, HELCOM)

- **Plans on further activities**

  www.msceast.org (MSC-E), **www.ceip.at** (CEIP), **www.nilu.no/projects/ccc/** (CCC)
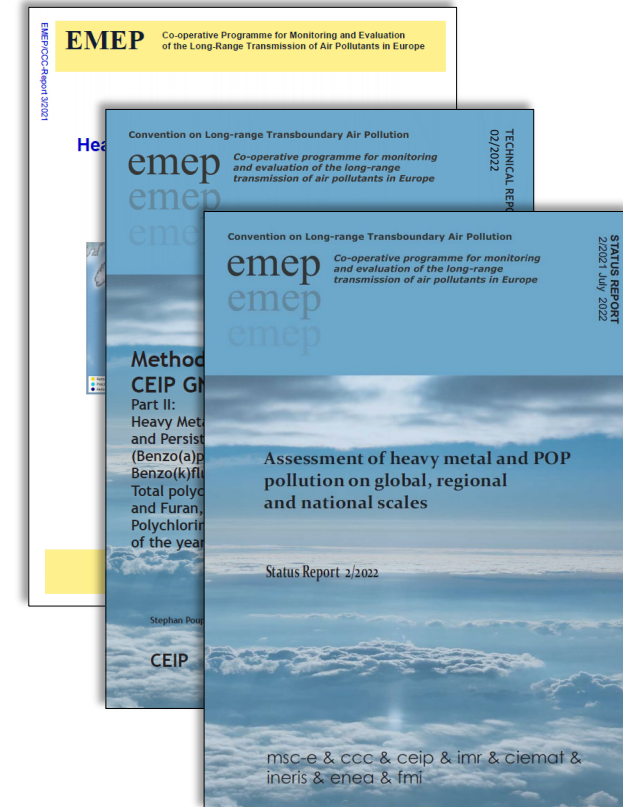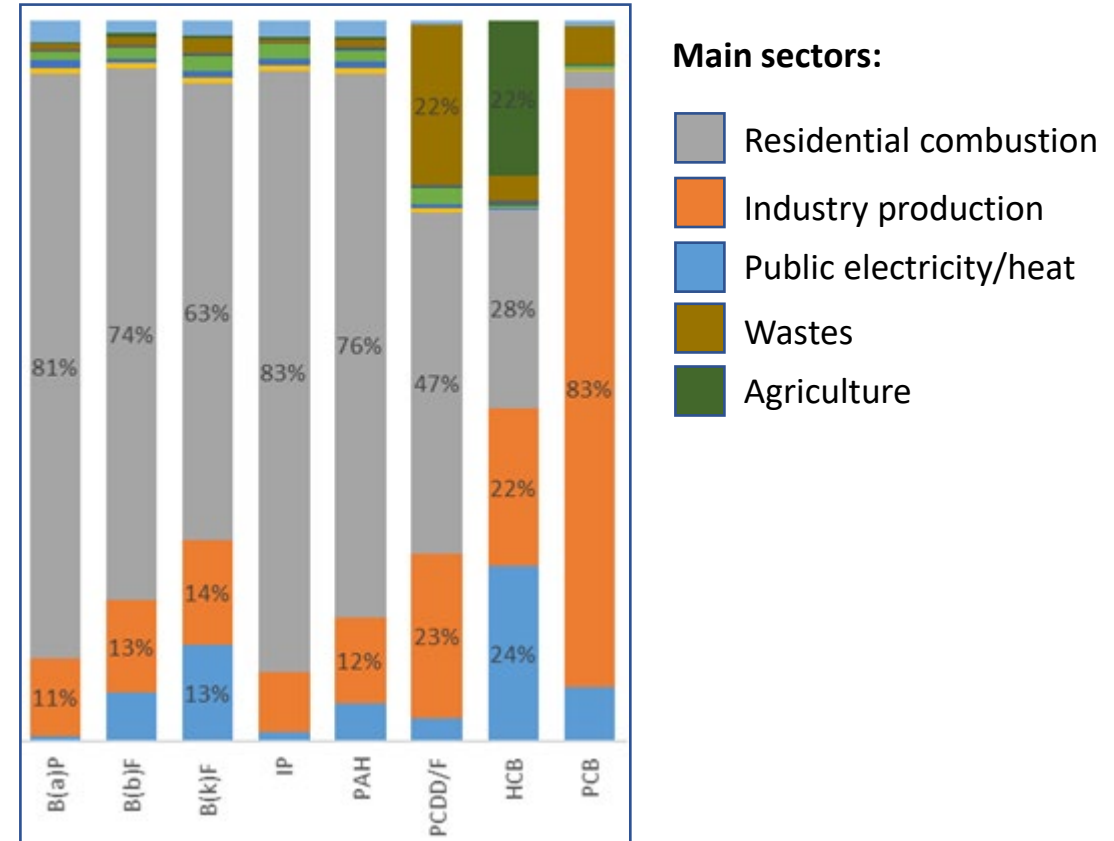
EMEP Status Reports 2022

Emissions of POPs for modelling (CEIP)

Activities:

- Analysis of reported POP emissions (gridded data, long-term changes) and gap-filling (CEIP)

- Expert estimates of POP emissions and gridding for 2020 (CEIP)

- Preparation of intra-annual changes and vertical distribution of emissions (MSC-E)

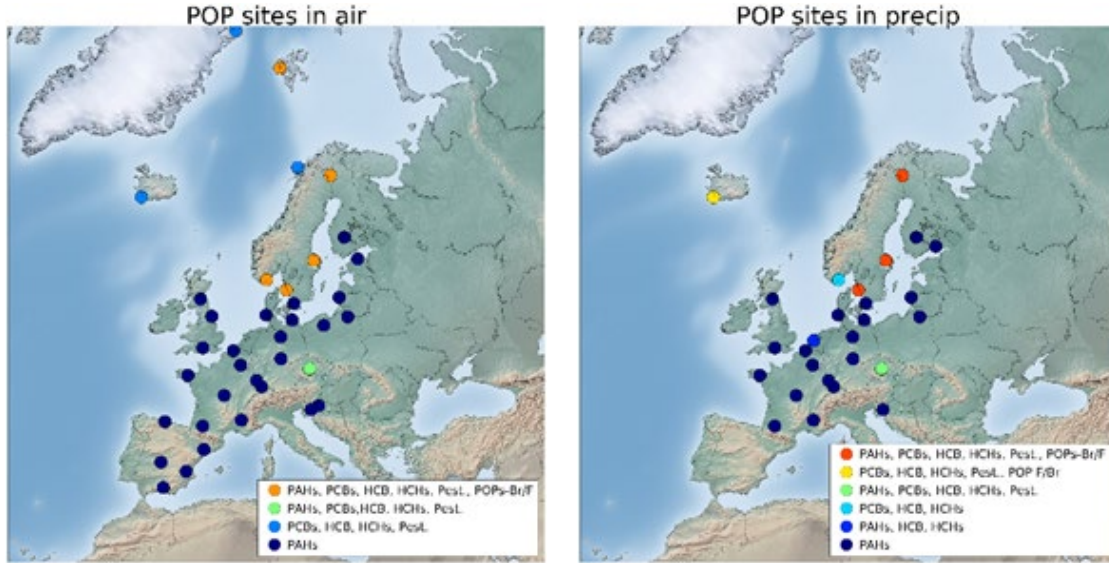- Compilation of global emission data (MSC-E)

Challenges:

- Reduction of uncertainties in reported spatial distribution of POP emissions

- Refinement of POP emission inventories for eastern part of EMEP domain

- Emission factors and inventories for wider list of POPs

Main sectors:

- Residential combustion
- Industry production
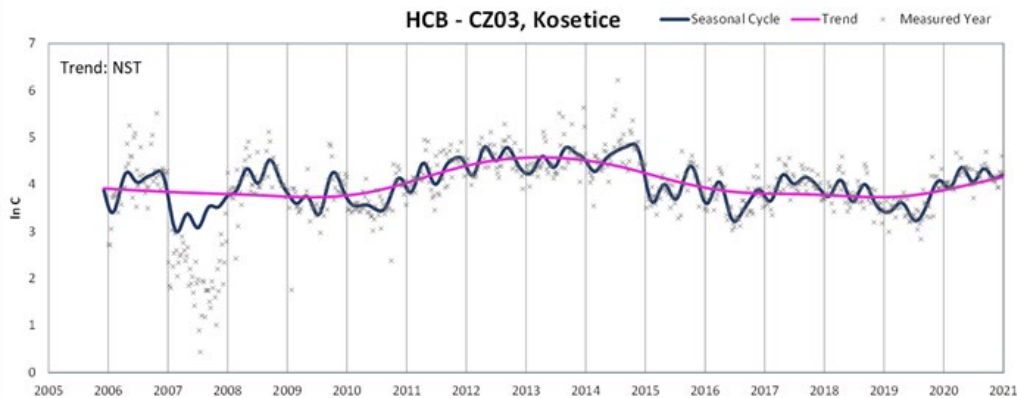- Public electricity/heat
- Wastes
- Agriculture

GNFR sectors contribution to total POP emissions in EMEP domain (2020)

Monitoring of POPs (CCC)

POP measurements in air (2020)

POP measurements in precipitation (2020)

Trends in observed HCB in air (2005-2021)

Activities:

- Collection and analysis of POP measurements of the EMEP network for 2020 (CCC)

- Analysis of long-term and seasonal changes in observed HCB concentrations (CCC) [*Platt et al.*, 2022, ACP]

- Compilation of POP measurements from other databases/networks, e.g. EEA (MSC-E)

Challenges/recommendations:

- Laboratory intercomparisons for POP measurements

- Difficulty of direct comparison between measurements obtained from various EMEP sites (different sampling strategies)

- Reduction of uncertainties of POP air/precipitation measurements
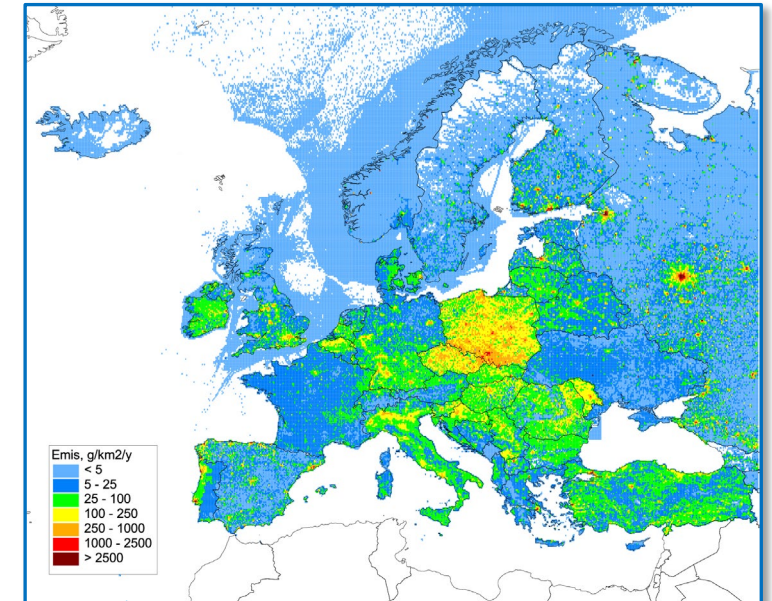
PAH assessment: multi-model study of B(a)P pollution

Contribution to Eurodelta-Carb model intercomparison project (TFMM)

Objectives:

- Assessment of B(a)P pollution levels and exceedances of air quality guidelines

- Analysis of model predictions and reasons of differences between the models

- Evaluation of B(a)P/PM emissions from 'residential combustion' sector

- Analysis of links of B(a)P and PM components (OC, EC)

- Contribute to further development of B(a)P modelling approach

Annual B(a)P emissions within
Eurodelta-Carb modelling domain (2018)

Participating models:

Model	Institution	Uploaded to FTP server
CHIMERE	CIEMAT (Spain), INERIS (France)	B(a)P
GLEMOS	EMEP/MSC-E	B(a)P
MINNI	ENEA (Italy)	B(a)P, O_3, OC, EC, PM2.5, …
SILAM	FMI (Finland)	B(a)P, O_3, OC, EC, PM2.5, …

Modelled vs observed B(a)P concentrations (EMEP stations)

Annual mean modelled B(a)P concentrations (2018) vs data of 29 EMEP stations
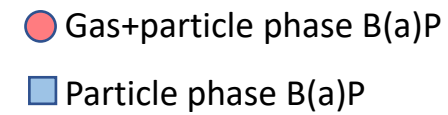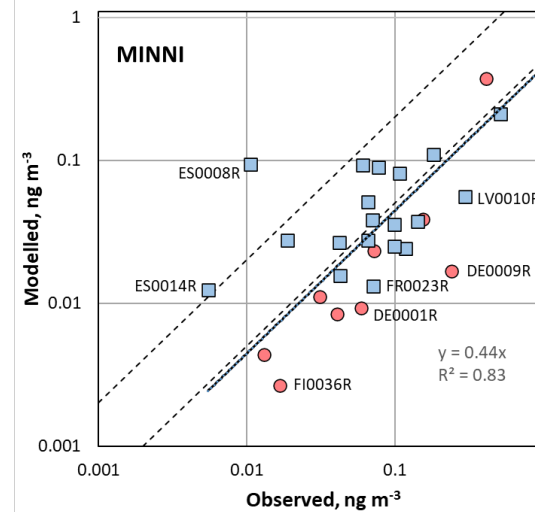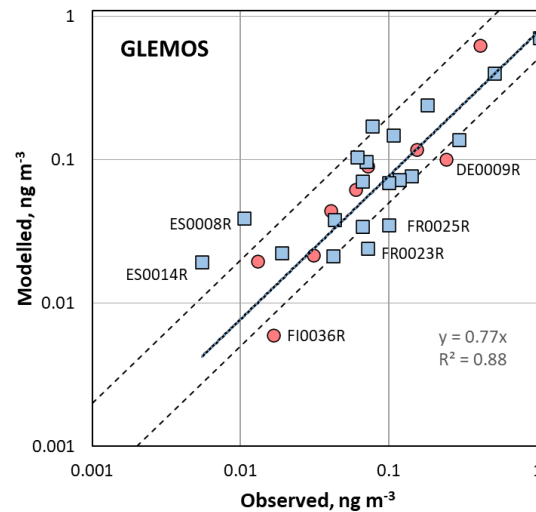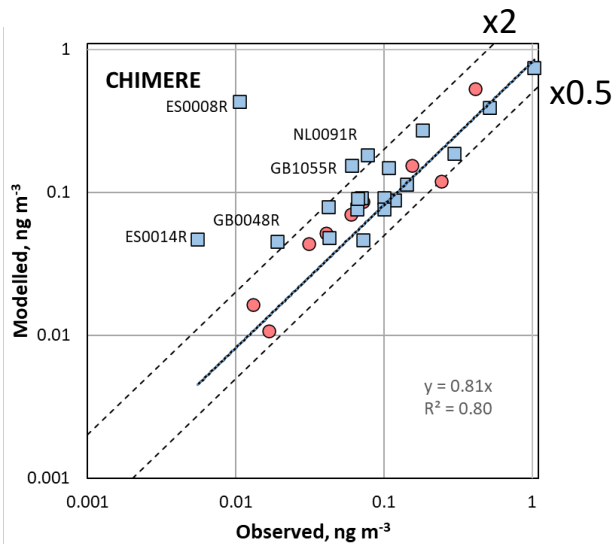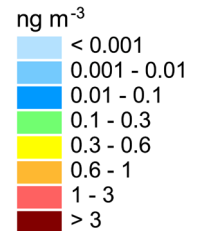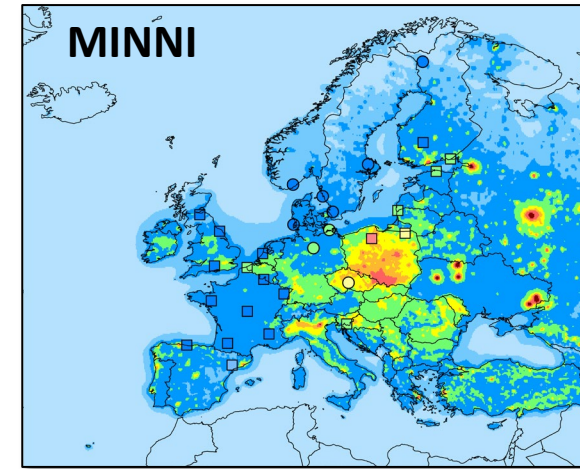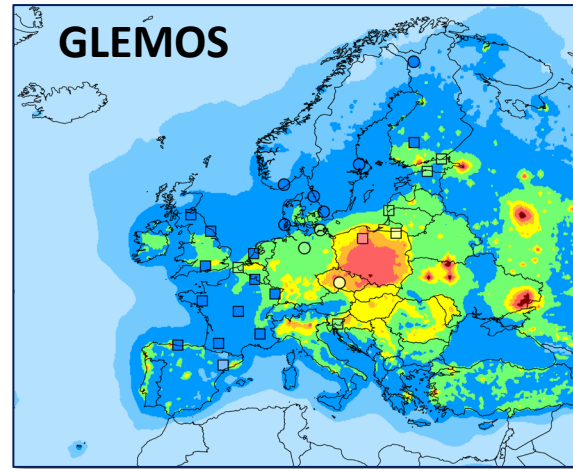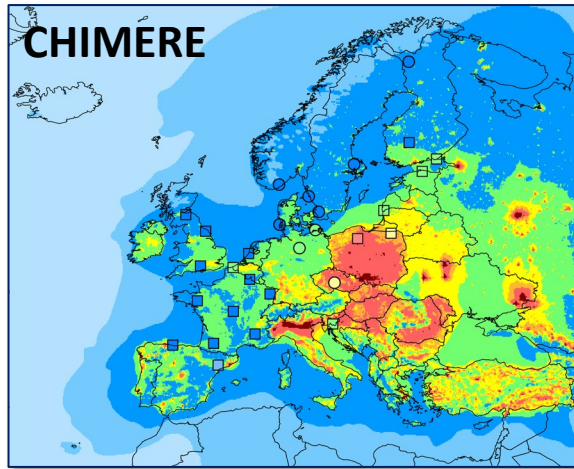
Eurodelta-Carb: current progress and further activities

Preliminary conclusions:

- High spatial correlation of modelled and measured concentrations

- Significant differences between model biases (different parameterizations of B(a)P degradation in particulate phase)

- Models overpredict observed concentrations in Spain and underpredict in Finland, Latvia, Estonia (uncertainties in emissions)

- High correlation with observed intra-annual B(a)P variations

- Differences between models for particular months (different factors of emission temporalization)

Further activities:

- Detailed analysis of model-to-measurements and model-to-model differences and factors controlling them

- Presentation of the progress at the HARMO21 conference, Sept 27-30 (Portugal)

- Technical meeting to discuss progress of Eurodelta-Carb study (Nov 2022)

- Presentation of results at the TFMM meeting in May 2023
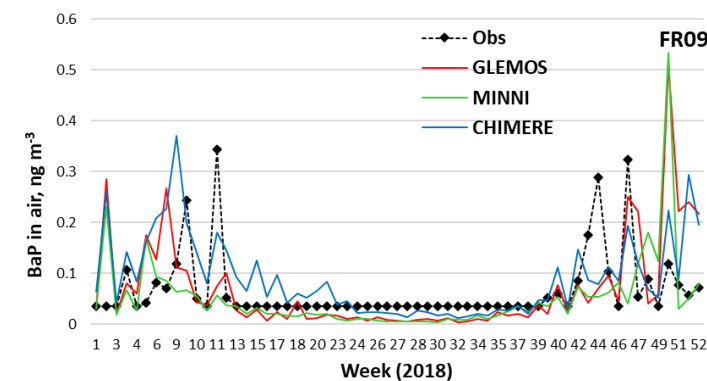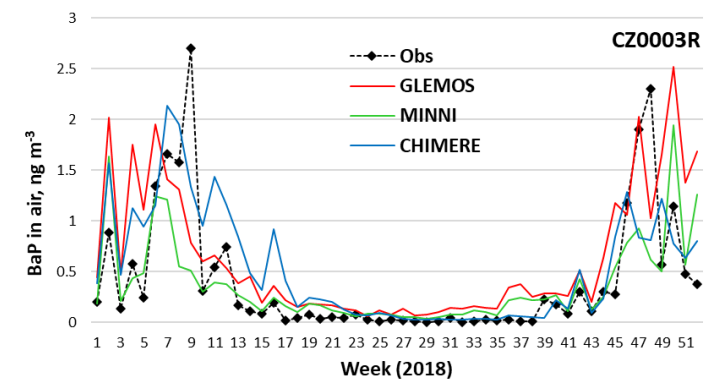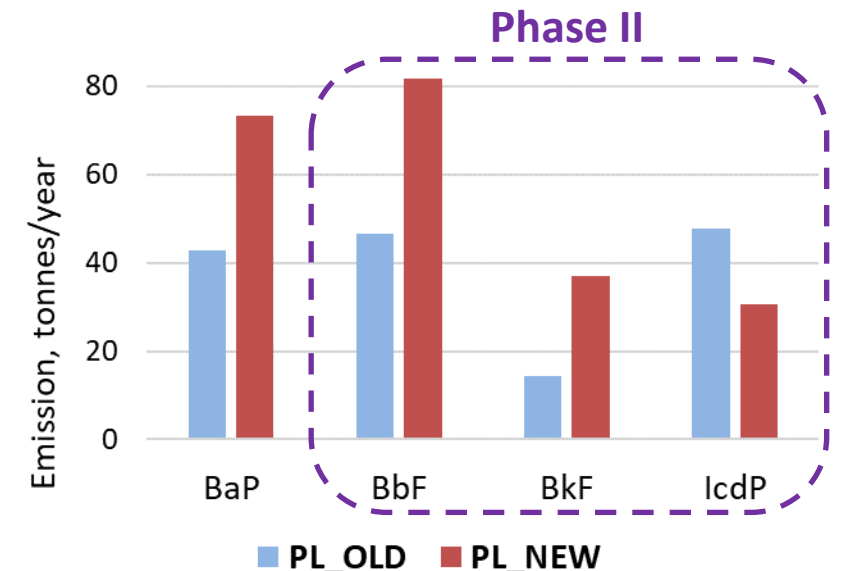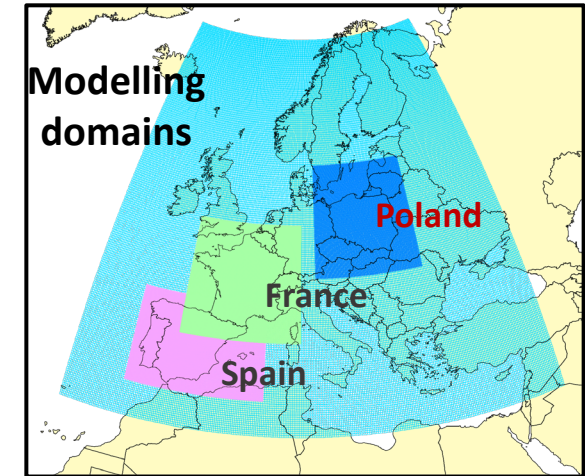
PAH assessment: case studies on PAH pollution

**Series of joint research for Spain, France, and Poland to improve PAH pollution assessment
(since 2017 in co-operation with TFMM)**

Objectives of case study for Poland:

- Evaluation of updated national PAH emission inventory of Poland reported to EMEP (phase I – B(a)P, phase II – other 3 PAHs)

- Analysis of PAH pollution levels and exceedances of air quality guidelines in co-operation with national experts

Phase II activities:

- Analysis and update of model parameterization for B(b)F, B(k)F, and I(cd)P

- Modelling with updated national B(b)F, B(k)F, I(cd)P inventory (PL_NEW) and previous inventory (PL_OLD) for 2018

- Analysis of agreement between modelled and observed PAH concentrations using EMEP and EU EEA measurements

Modelling domains (map showing Poland, France, Spain)

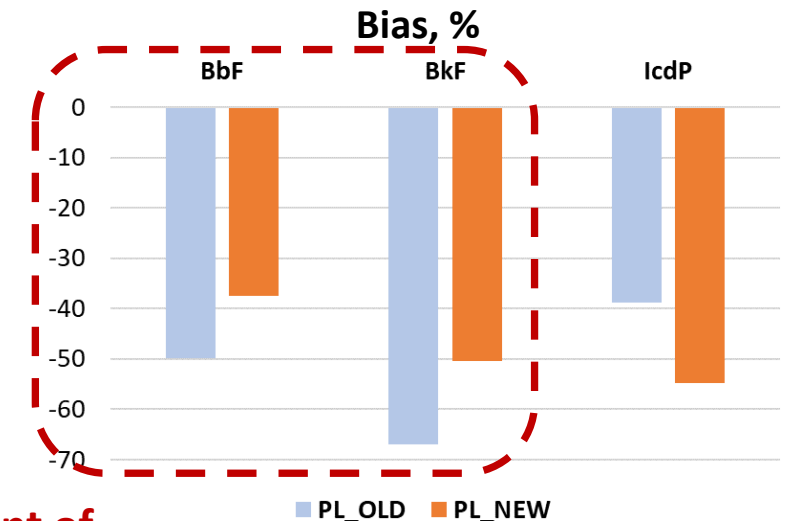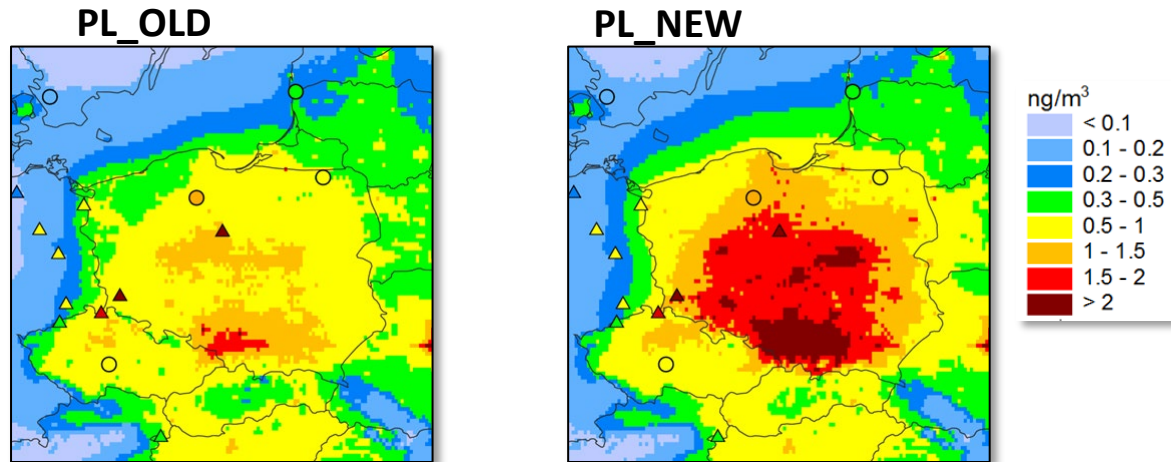Phase II — Emission, tonnes/year bar chart for BaP, BbF, BkF, IcdP (PL_OLD, PL_NEW)

Modelled vs observed PAH pollution levels in Poland

Comparison with data of Background Rural + Suburban stations for 2018 (about 19 stations):

- Decrease of model **bias** for B(b)F and B(k)F, but increase for I(cd)P

- Increase of **correlation** for B(b)F and B(k)F, but decrease for I(cd)P

- Increase of **Factor of 2** parameter by 30% for B(b)F and B(k)F, but decrease by 10% for I(cd)P

PL_OLD   PL_NEW

Modelled B(b)F annual mean air concentrations for 2018

Measurements of EMEP (●) & EEA AQ e-reporting (▲)

Improvement of model results
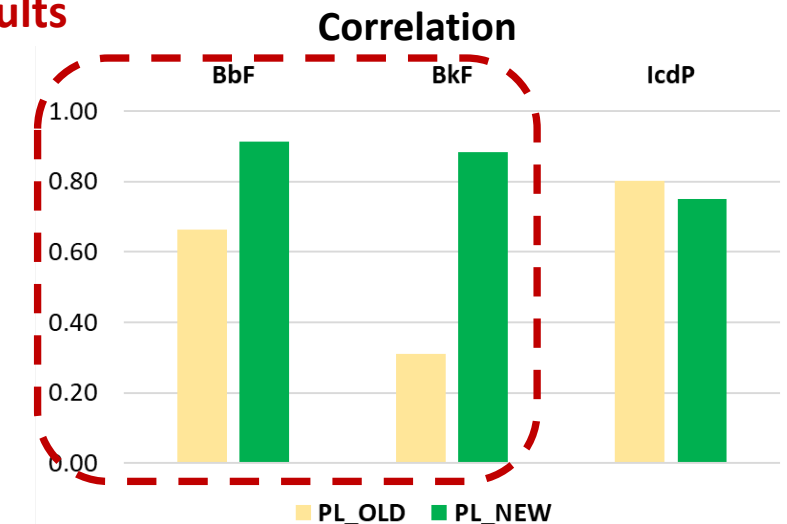
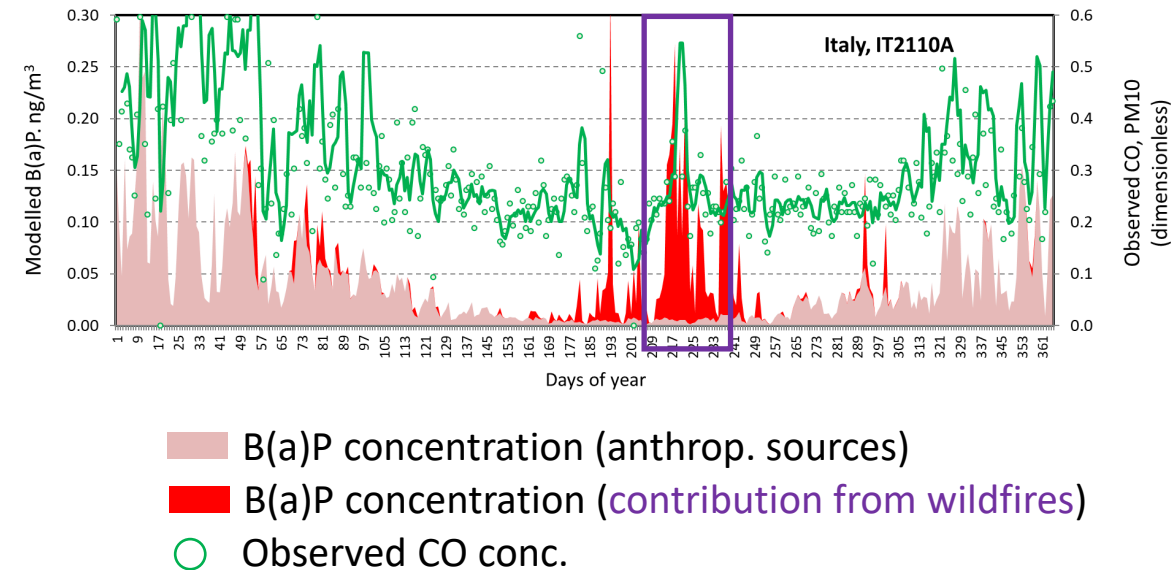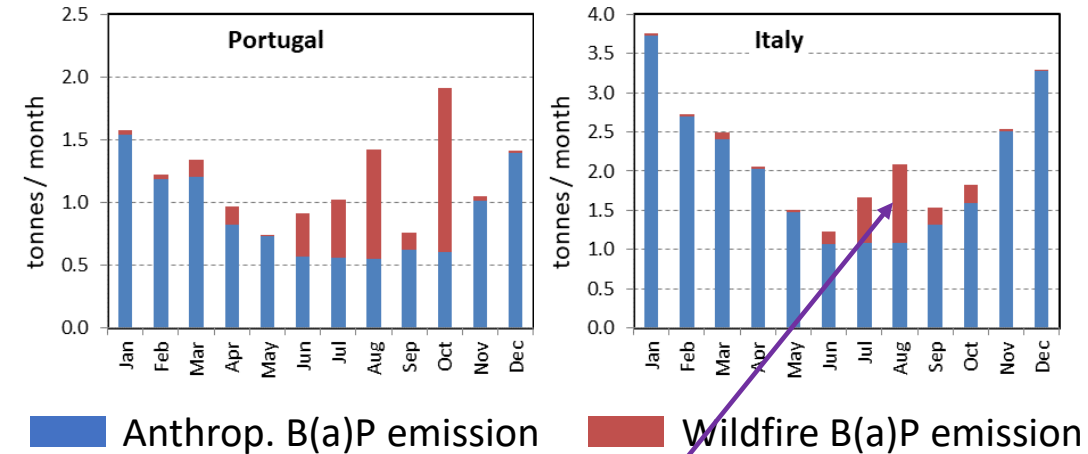# PAH assessment: effect of wildfires on B(a)P pollution

Motivation:

- Wildfires are significant source of PM and POP emissions (e.g. PAHs, PCDD/Fs, …)

- Importance for the assessment of B(a)P adverse effects on human health

Activities:

- Evaluation of B(a)P emissions from wildfires in the EMEP region

- Model simulations of the effect of the wildfires on B(a)P pollution levels in the EMEP countries

Preliminary results of inclusion of wildfires:

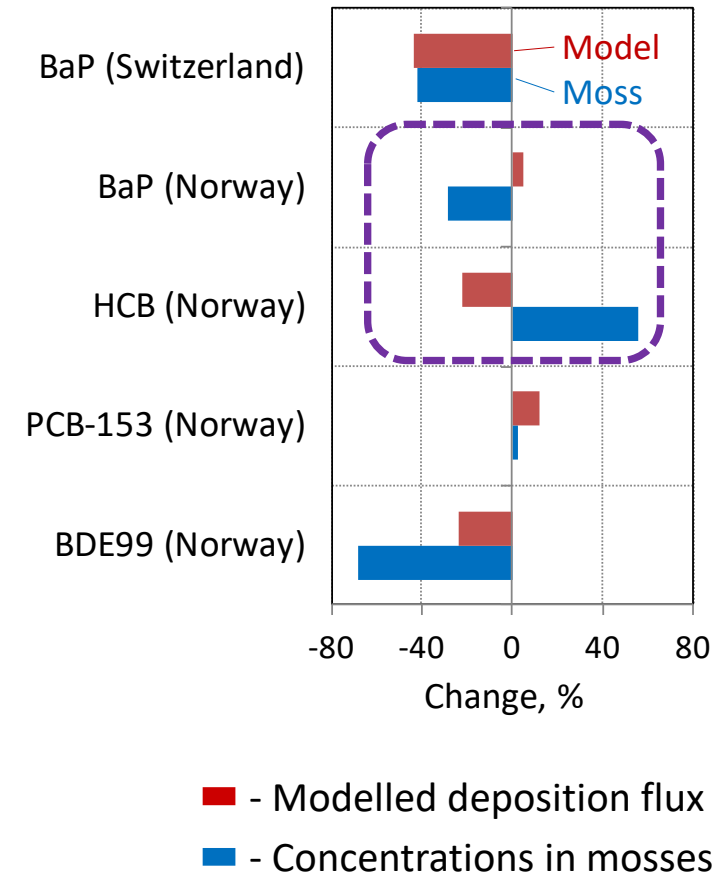- Increase of annual B(a)P concentrations in southern Europe (5-20%), in Eastern Europe/Central Asia (20-50%)

Anthrop. B(a)P emission   Wildfire B(a)P emission

B(a)P concentration (anthrop. sources)
B(a)P concentration (contribution from wildfires)
Observed CO conc.

Co-operation with working group on effects (WGE)

Analysis of long-term changes using data of EMEP (observations, modelling) and ICP-Vegetation (moss measurements)

Key features and results:

- Use of POP measurements in mosses (B(a)P, HCB, PCBs, PBDE, …) from 2010 and 2015 surveys

- Combination of ICP-Vegetation and EMEP data can provide more reliable estimates of pollution changes on local and regional scales

- Both moss data and modelled deposition show declining trends of B(a)P in Switzerland and BDE-99 in Norway

- Contradicting trends of B(a)P and HCB in Norway

- Analysis of discrepancies allows revealing assessment uncertainties (e.g. emission estimates, model parameterizations etc.)

Presented at the ICP-Vegetation Task Force meeting (21-23 Feb 2022)

Changes between 2010 and 2015 (%)

Change, %

■ - Modelled deposition flux
■ - Concentrations in mosses

# Scientific co-operation on global POP pollution assessment

Contributions to TF HTAP activities on POPs (2021-2022)

Recent and future activities:

- Preparatory work for compilation of mosaic emissions of POPs and multi-model experiments

    o Release of global scale JRC emission inventory EDGARv6.0_toxPOPs (4PAHs, PCDD/Fs, PCBs, HCB) in April 2022

    o Evaluation of JRC EDGARv6.0_toxPOPs emission inventory for B(a)P using GLEMOS model for 2018

- TF HTAP virtual meeting on POPs (25 May 2022) focused on global and regional POP/CEC emissions and modelling

    o Emissions and atmospheric modeling of PAH and other combustion related substances

    o Chemicals of Emerging Concern: sources and multi-media modelling (e.g. PFAS, microplastic)

- Contribution to TF HTAP multi-pollutant, multi-model intercomparison exercise focused on the impacts of wild/agricultural fires (TF HTAP meeting in Nov 2022)
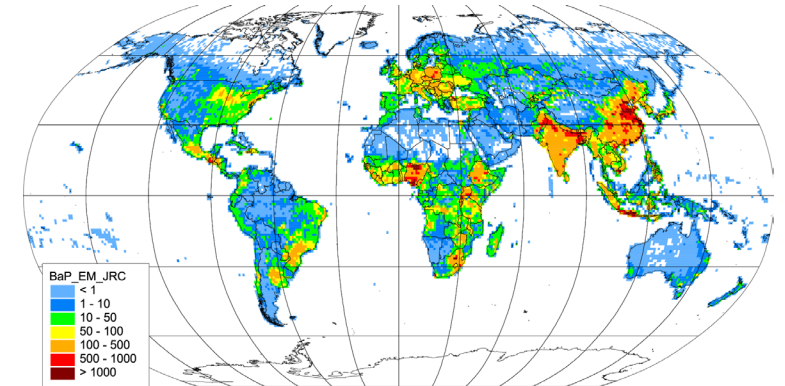
B(a)P emissions, 2018, EDGARv6.0_toxPOPs
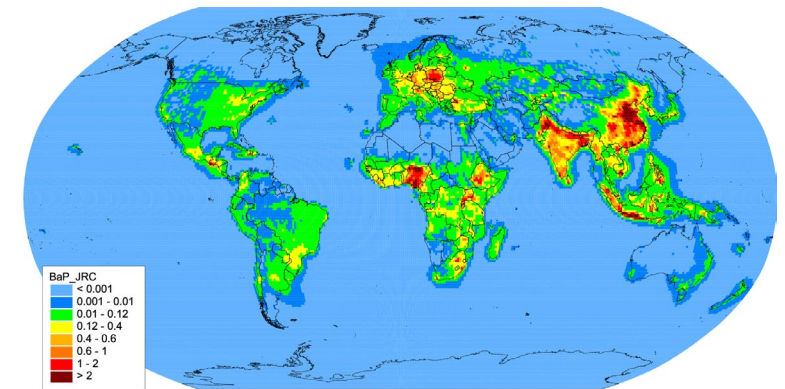
Modelled B(a)P based on EDGARv6.0_toxPOPs (2018)

More information on **www.htap.org** (TF HTAP)

Chemicals of Emerging Concern (CECs)

**Contributions to preparatory work for assessment of pollution by CECs (TFMM, TFHTAP)**

Motivation:

- CECs have confirmed toxicity for humans and ecosystems

- Some CECs (e.g. *HCBDD, PeCB, PBDEs, PFAS, PCNs and SCCPs*) were added to the POP Protocol in 2009

- CECs are of high interest of other international bodies (Stockholm Convention, AMAP, HELCOM, OSPAR)

Ongoing and future EMEP activities:

- Monitoring of CECs at EMEP stations (CCC, countries)

- Reviews of information (on emissions, properties, …) and pilot model assessment (MSC-E, HELCOM), included in the Joint EMEP reports for HELCOM (2020, 2021, 2022)

- Workshop on CECs measurements and modelling in 2023 (TFMM, TF HTAP, CCC, MSC-E)

Monitoring of BDE-99 within EMEP
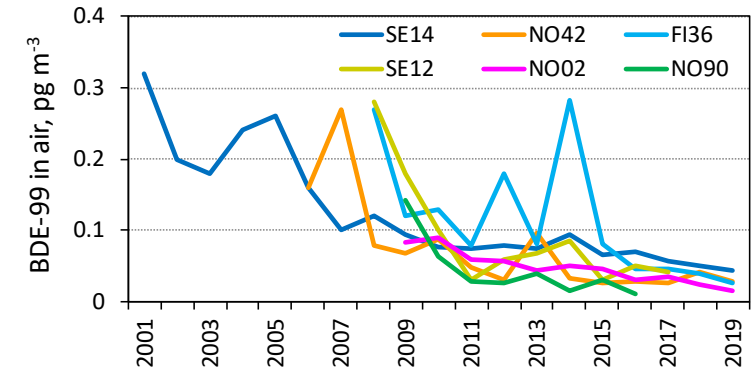
Modelled deposition of BDE-99
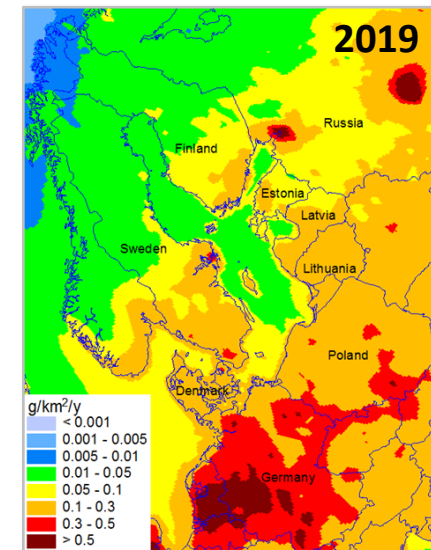
Future research directions

(Based on work-plan 2022-2023 and EMEP Strategy)

- Continuation of multi-model intercomparison study of BaP/PM pollution as a part of Eurodelta-Carb study (TFMM) (item 1.1.1.5)

- Collaboration with TF HTAP on development of global POP emissions inventories and model intercomparison studies for combustion related POPs (e.g. PAHs, PCDD/Fs) including effect of wildfires (TF HTAP meetings, Nov 2022) (items 1.1.4.3, 1.1.4.5, 1.1.4.6)

- Co-operation with the effect community on assessment of POP pollution and trends (WGE, ICP Vegetation) (items 1.1.1.13, 1.1.1.18)

- Preparatory work for assessment of Contaminants of Emerging Concern (CECs) (item 1.1.1.6)

- Research of atmospheric pollution of the marine environment by POPs and CECs (co-operation with HELCOM) (item 1.3.1)