

# **Item 6. Progress in activities in 2010 and future work**

*a) Measurements and modelling*

*(Persistent Organic Pollutants)*

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on behalf of CCC and MSC-E

# Main CCC/MSCE activities on POPs in 2010

## ➤ Routine activities

- ✓ Preparation of POP emissions inventories
- ✓ Preparation of monitoring networks
- ✓ Preparation of meteorological data
- ✓ Calculations of contaminant concentrations (including country-to-country transport)
- ✓ Comparison of calculation results with monitoring data

## ➤ New developments

- ✓ Elaboration of integrated risk assessments
- ✓ Evaluation of influence of POPs on climate change links
- ✓ Development of global monitoring systems
- ✓ Start of implementation of the POPs Convention
- ✓ ...

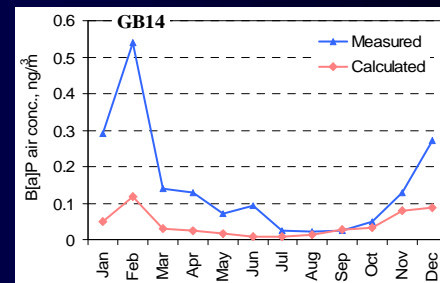
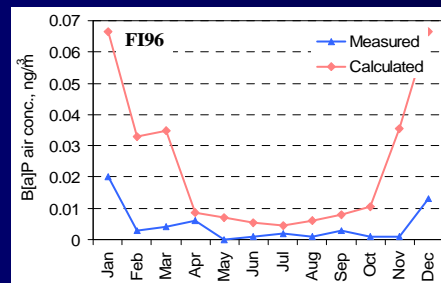
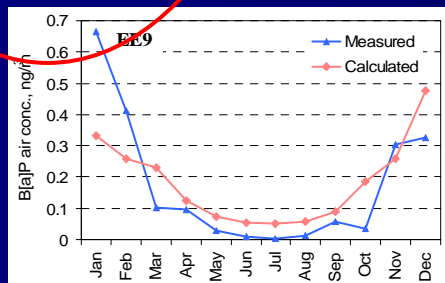
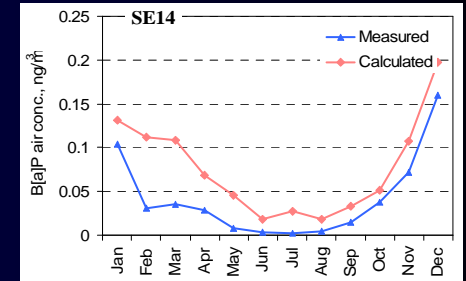
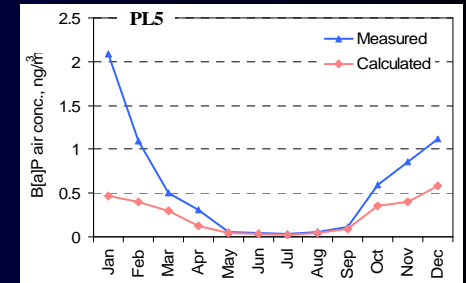
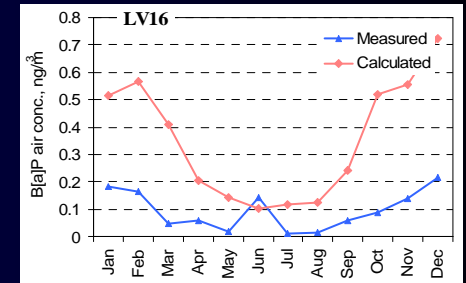
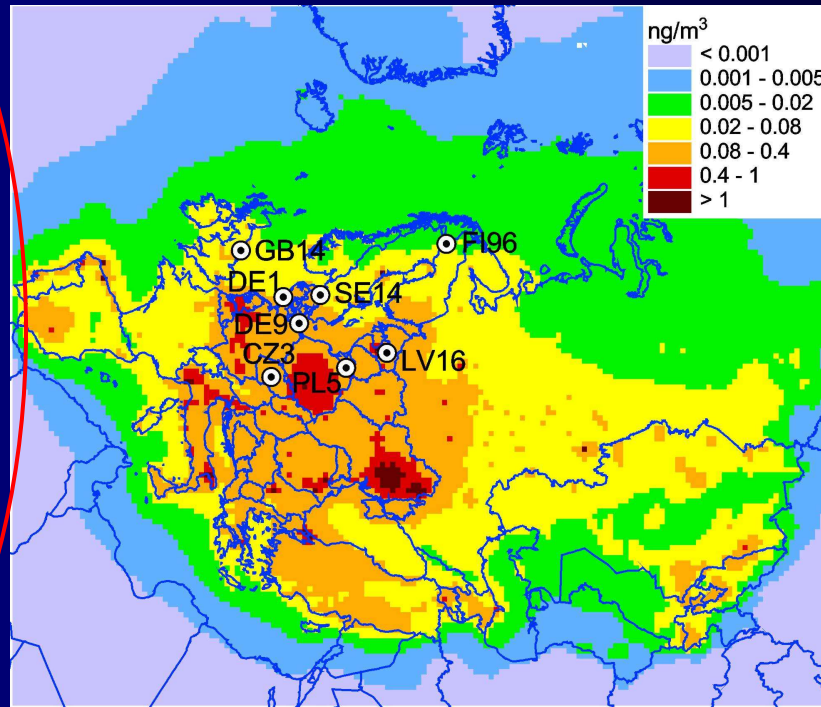
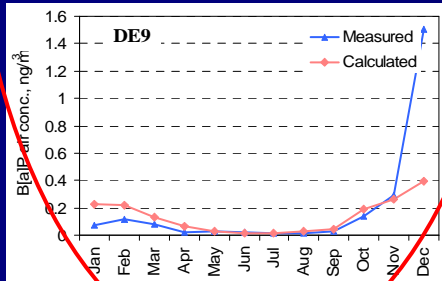
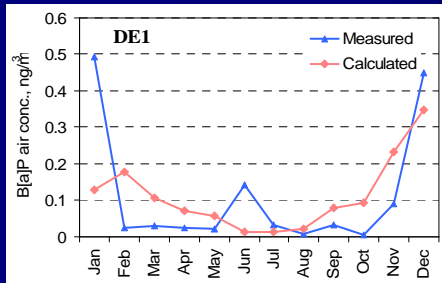
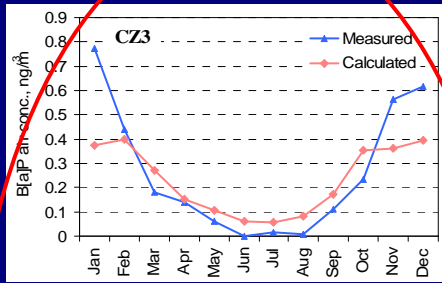


Steering Body to EMEP (September 13 – 15, 2010)



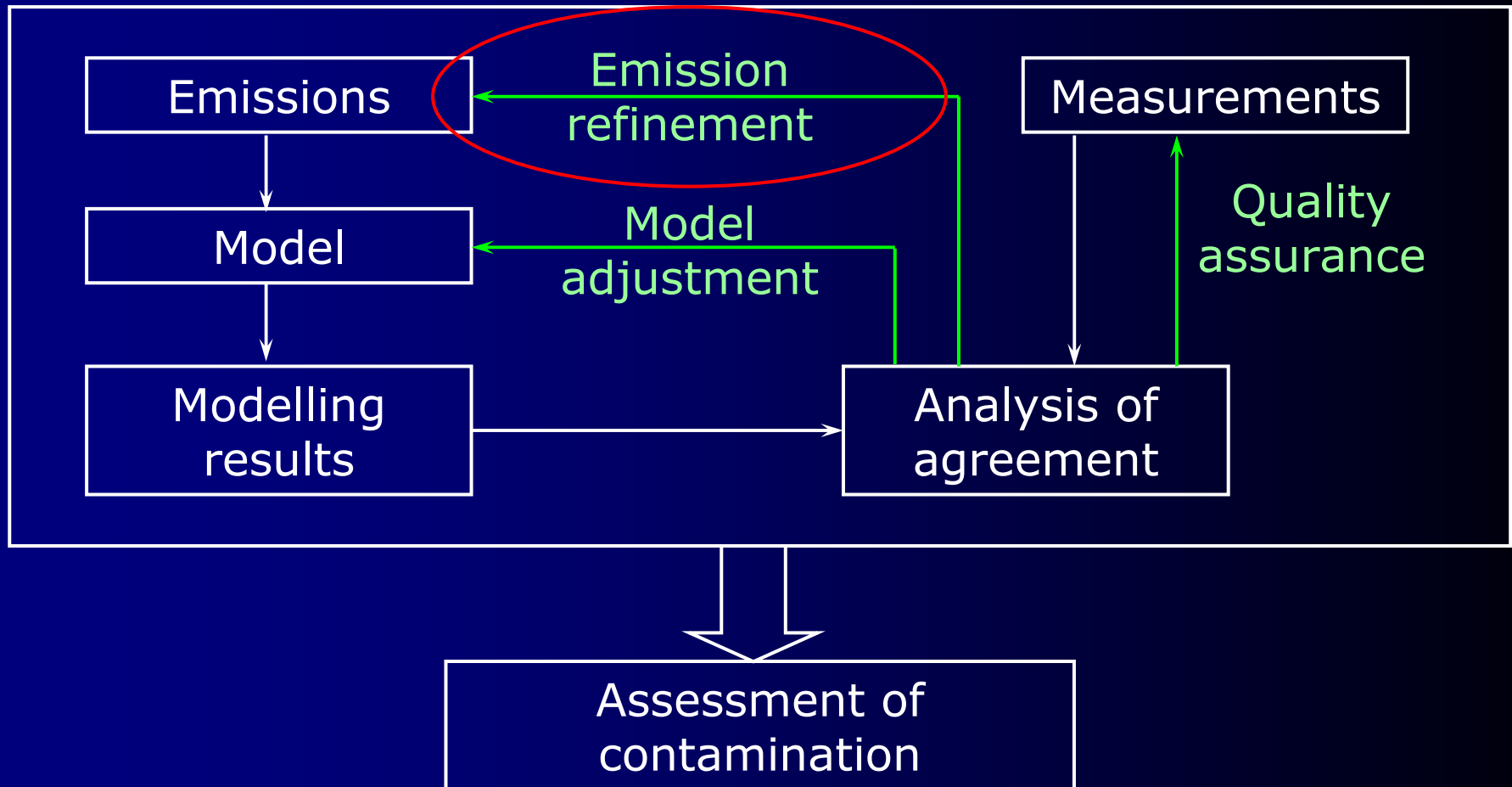
# Comparison with measurements

## B[a]P air concentrations, 2008



Steering Body to EMEP (September 13 – 15, 2010)

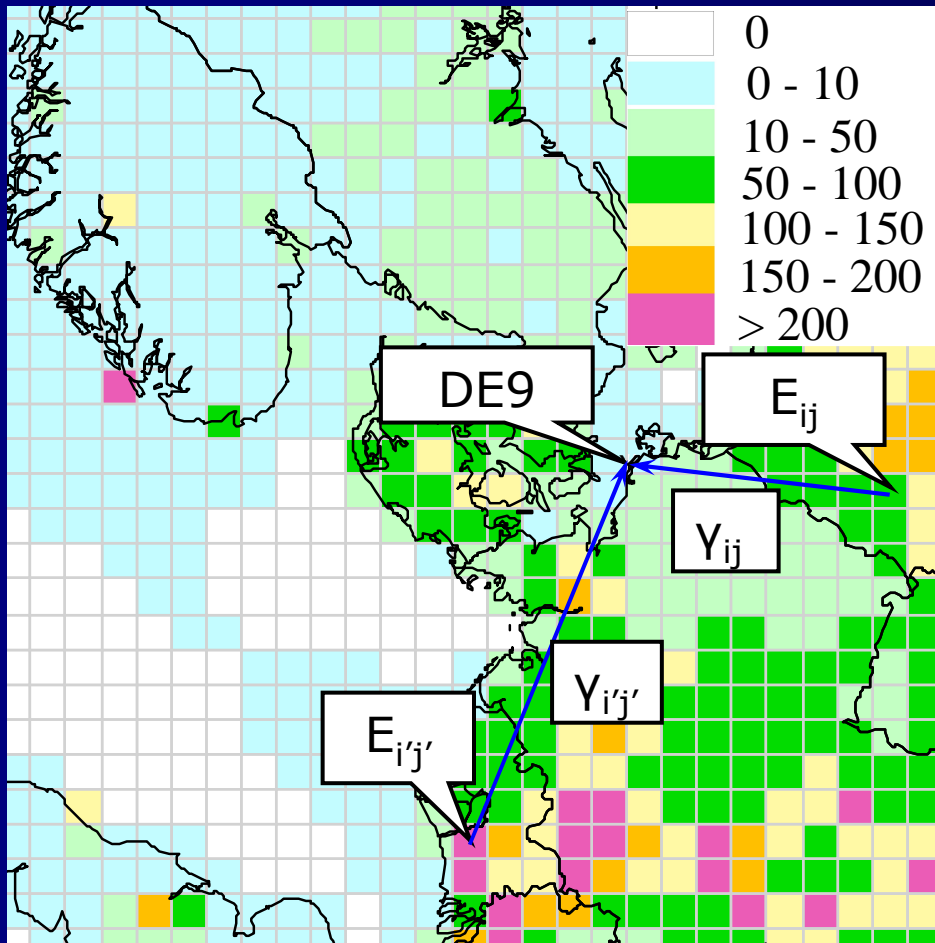
# Integrated monitoring/modelling /emission approach



Integrated approach

# Sensitivity analysis for emission refinement

Emission density for B[a]P in 2008, g/km<sup>2</sup>/year



$c_m$  – monthly averages of air concentrations at measurement site (DE9)

$E_{ij}$  – emission density in grid cell (i,j)

$$c_m = \sum_{i,j} E_{ij} \gamma_{ij}$$

$\gamma_{ij}$  – sensitivity of  $c_m$  with respect to  $E_{ij}$

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Independence of  $\gamma_{ij}$  on emissions

Steering Body to EMEP (September 13 – 15, 2010)

*Integrated approach*

## **Simplified approach to sensitivity calculations**

Sensitivities  $\gamma_{ij}$  of concentrations to emissions in grid cells can be approximately evaluated using back trajectories taking into account:

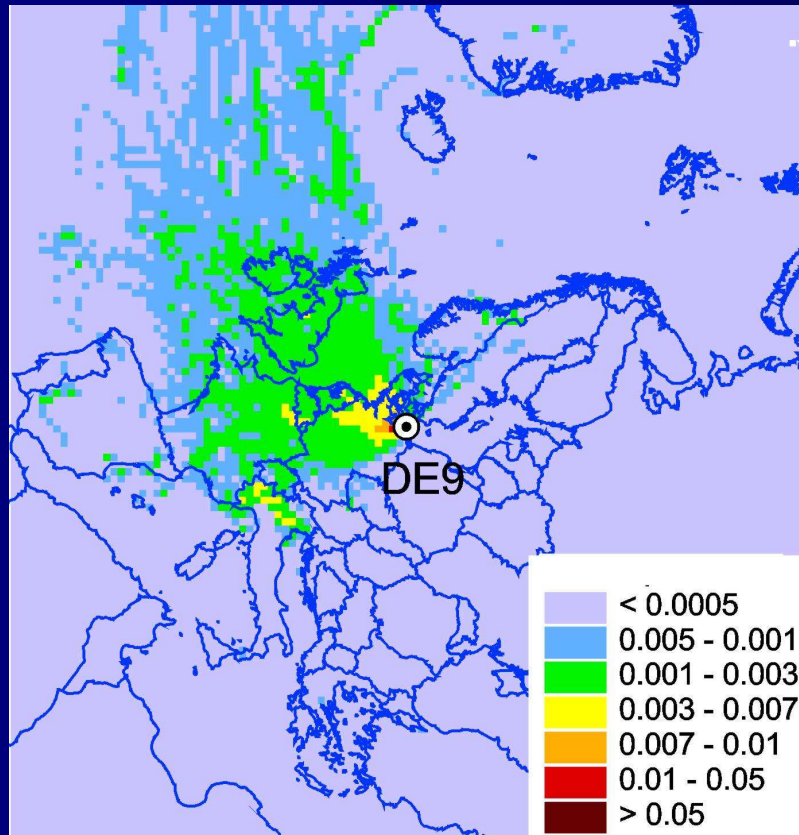
- transport in the atmosphere
- removal processes (degradation, deposition, ...)



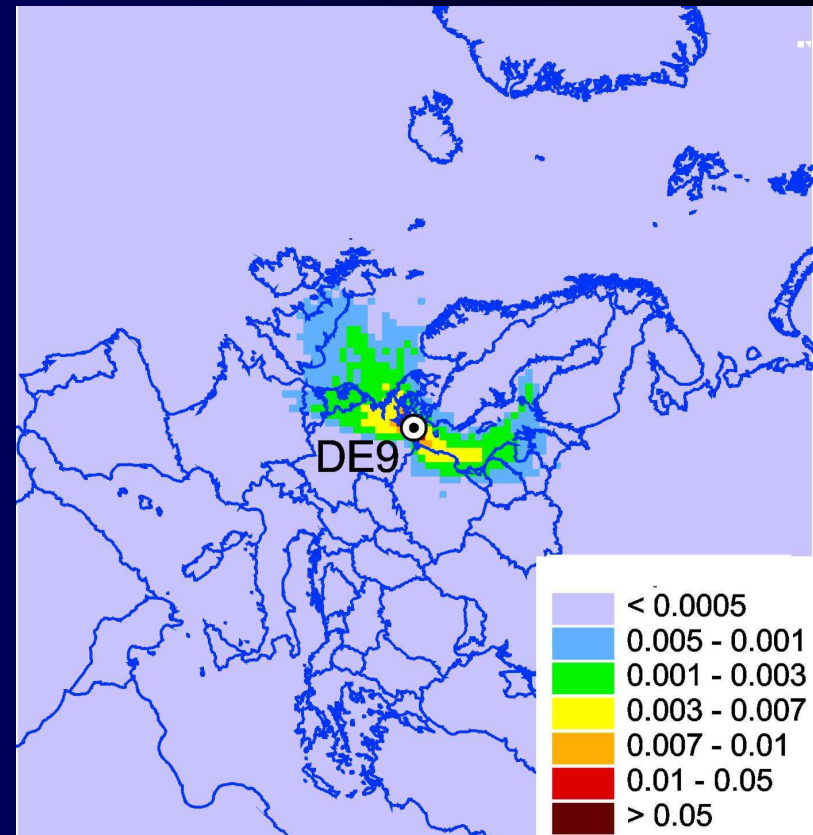
*Integrated approach*

# Calculated sensitivities

Sensitivities  $\gamma_{ij}$  of  $c_m$  to  $E_{ij}$  at DE9



January



July

B[a]P, 2008



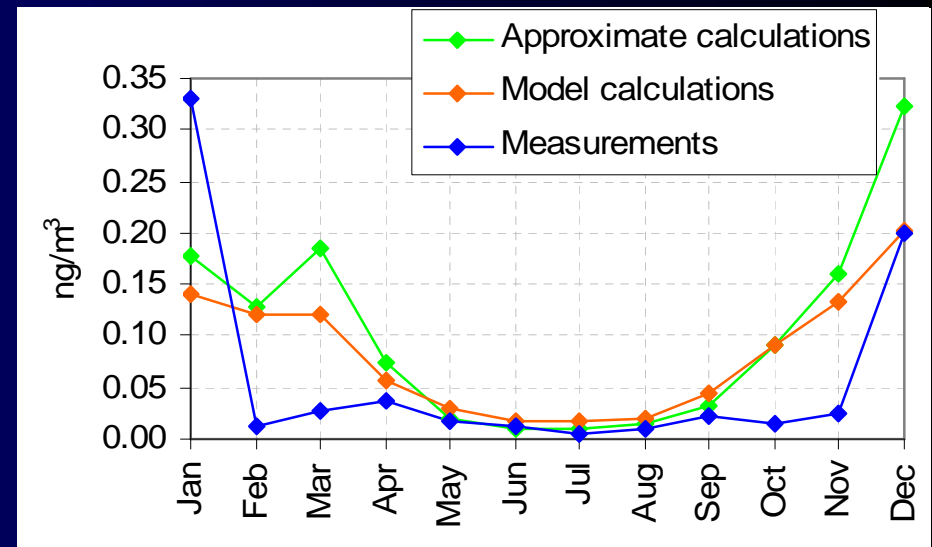
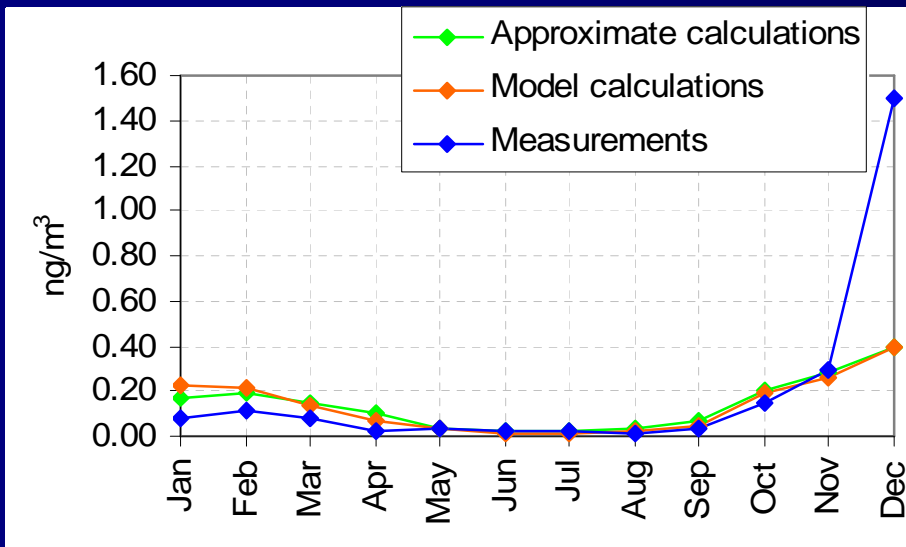
Steering Body to EMEP (September 13 – 15, 2010)

*Integrated approach*

# Agreement of approximate evaluation with model results

DE9

SE12



B[a]P air concentrations in 2008



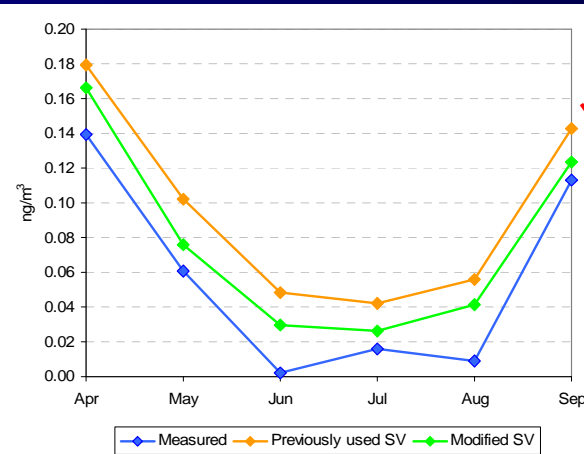
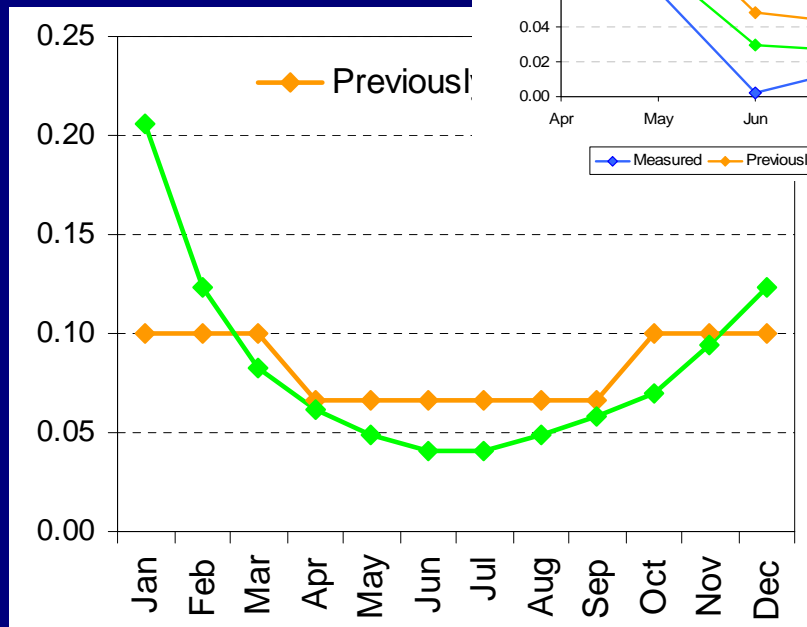
Steering Body to EMEP (September 13 – 15, 2010)

Integrated approach

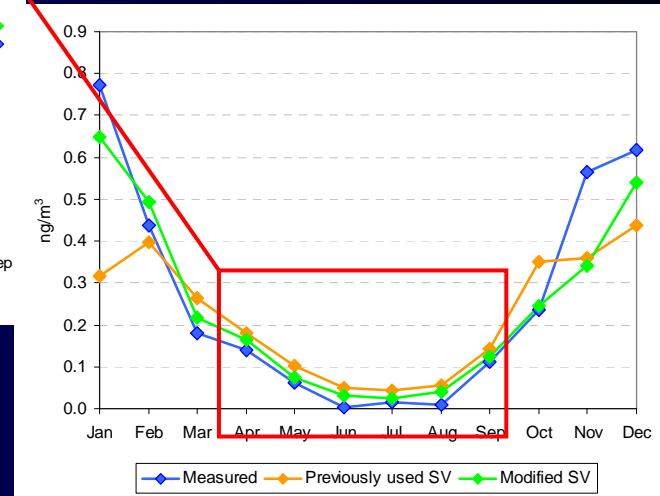
# Applications: Seasonal variations of emissions

Modification of seasonal variations of emissions

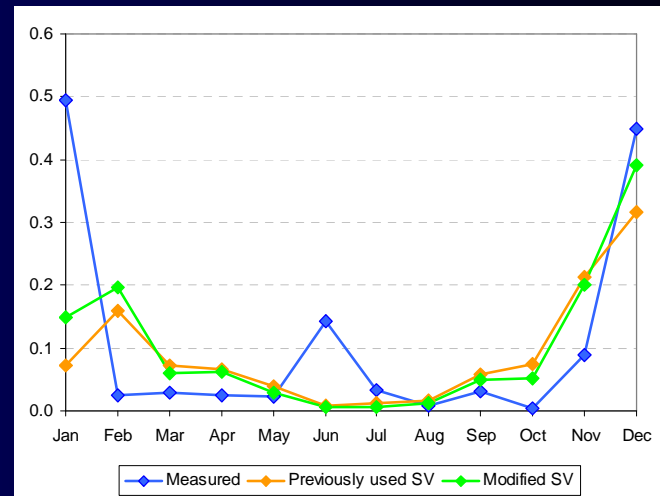
**B[a]P**



Comparison with measurements of air concentrations in 2008



DE1



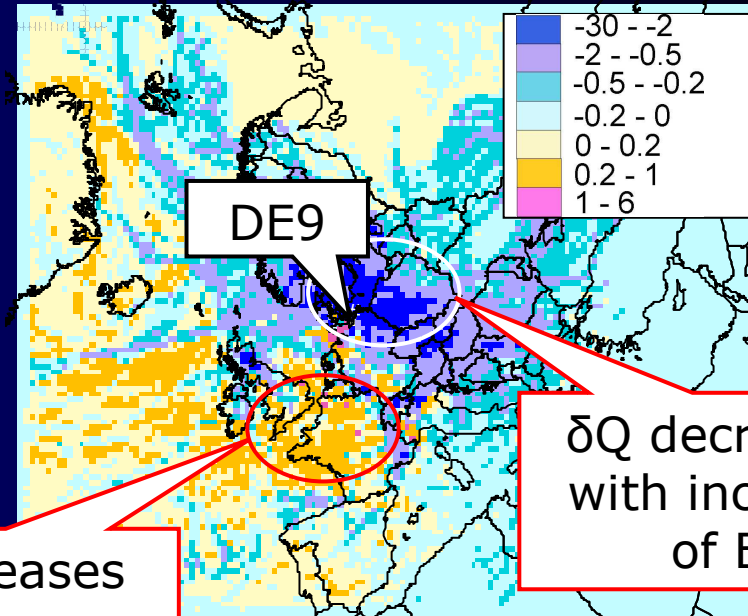
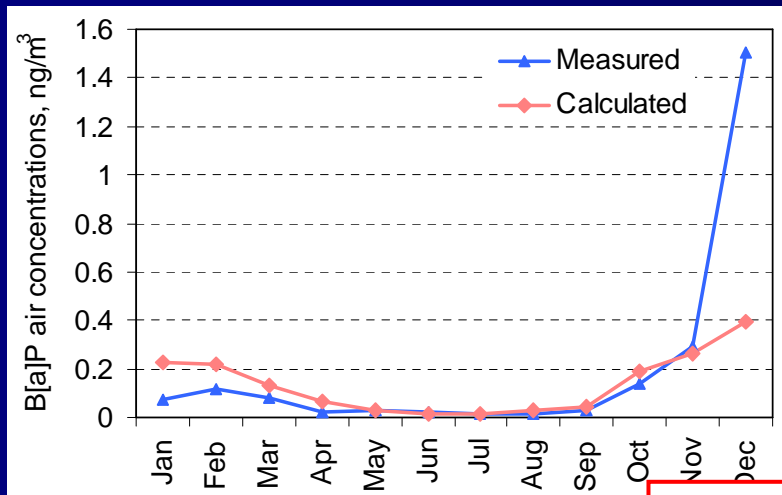
Steering Body to EMEP (September 13 – 15, 2010)



# Applications: Spatial distribution of emissions

Characterization of deviations: 
$$\delta Q = \sum_{m=1}^{12} (c_m^{\text{meas}} - c_m^{\text{calc}})^2$$

DE9



$\delta Q$  decreases with increase of  $E_{ij}$

$\delta Q$  increases with increase of  $E_{ij}$

Comparison of calculations against measurements for B[a]P, air conc., ng/m<sup>3</sup>

Zones of maximum emission influence ( $dQ/dE_{ij}$ )

## Results

The tool for **rapid calculations** of concentrations/deposition fluxes at particular locations for various emission spatial distributions is developed.

It can be applied to:

- Evaluation of various emission scenarios.
- Selection of emission sources having high influence to concentrations/deposition fluxes at particular locations (zones).
- ...

The application of the tool was tested at the comparison of calculated and measured air concentrations of B[a]P.

# Influence of environmental factors: links to climate change

## Environmental factors:

➤ Temperature

➤ Precipitation intensity

➤ Forest \*)

➤ Grass \*)

➤ Water\*)

➤ Soil \*)

➤ Ice \*)

➤ Wind speed

➤ ...

\*) Fractions of coverage by various land use types

## Target parameters (TP):

➤ Transport distance

➤ Depositions to particular countries

➤ Ecosystem-dependent concentrations/deposition fluxes

➤ ...

**Transport distance (TD):** the distance from a source at which concentration drops 1000 times (information for evaluation of new substances)

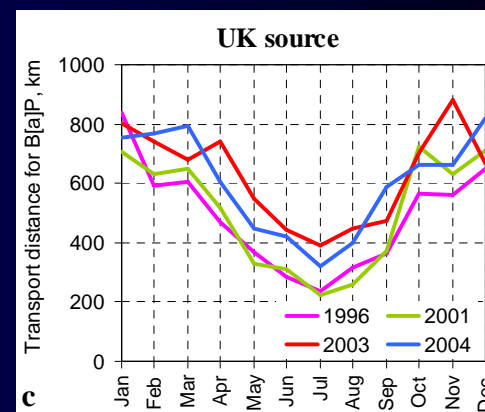
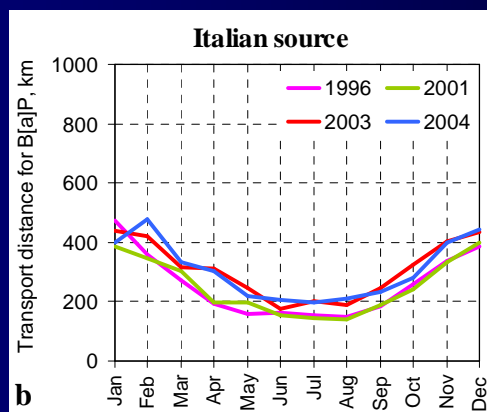
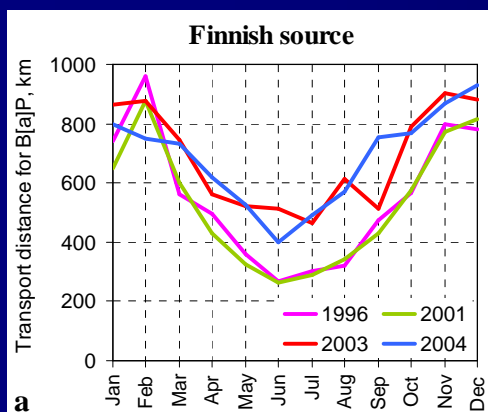
# Influence of environmental factors

## Seasonal variations of transport distance

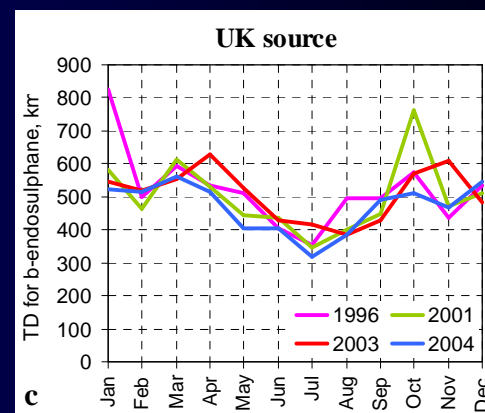
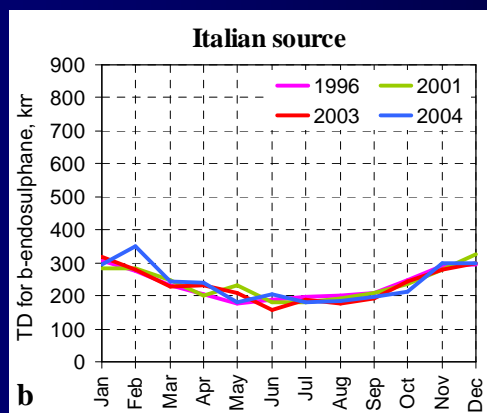
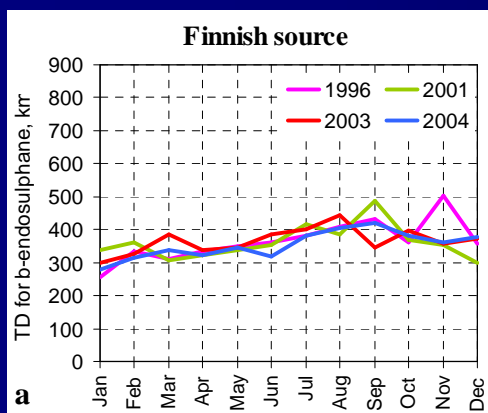
Finnish source

Italian source

the UK source



B[a]P



B-endosulphan



*Influence of environmental factors*

# Evaluation of sensitivity to environmental parameters (methodology)

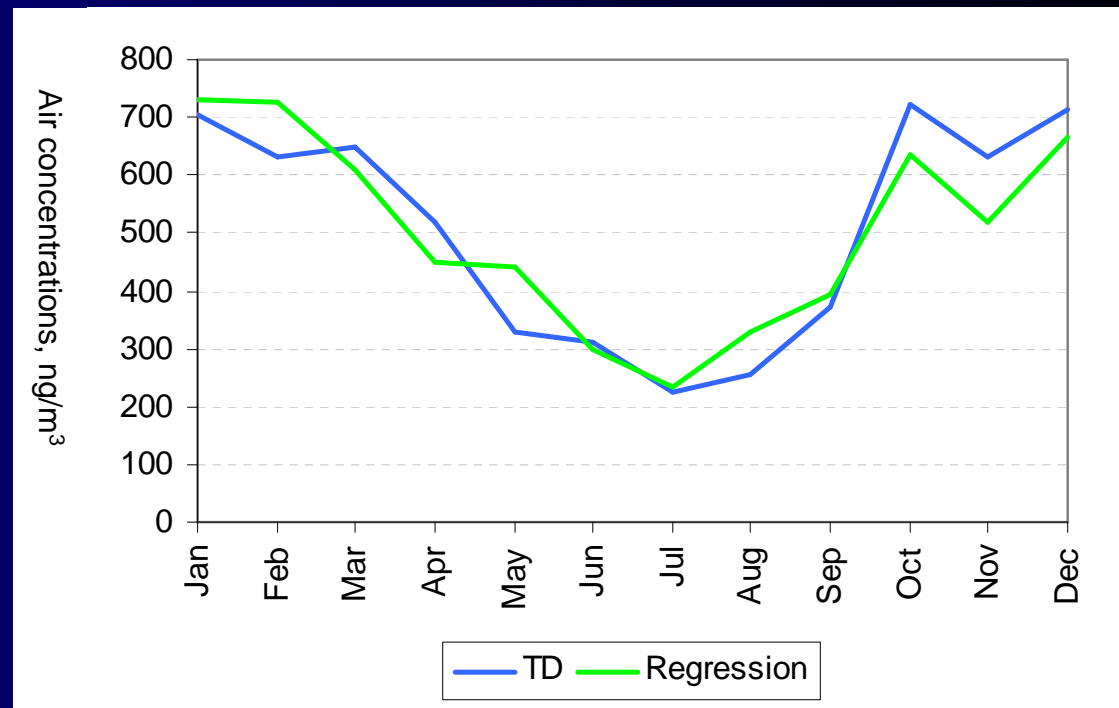
Mathematical approach: regression analysis

B[a]P, 2001

The UK source

Coefficient of multiple determination:

$$R^2 = 0.83$$



Step 4: four factors –  
temperature, forest fraction,  
precipitation, **water fraction**

Steering Body to EMEP (September 13 – 15, 2010)



*Influence of environmental factors: link to climate change*

## Evaluation of sensitivity (results for B[a]P)

the UK source

Italian source

2001

Temperature
Forest
Precipitation
Water
Grass

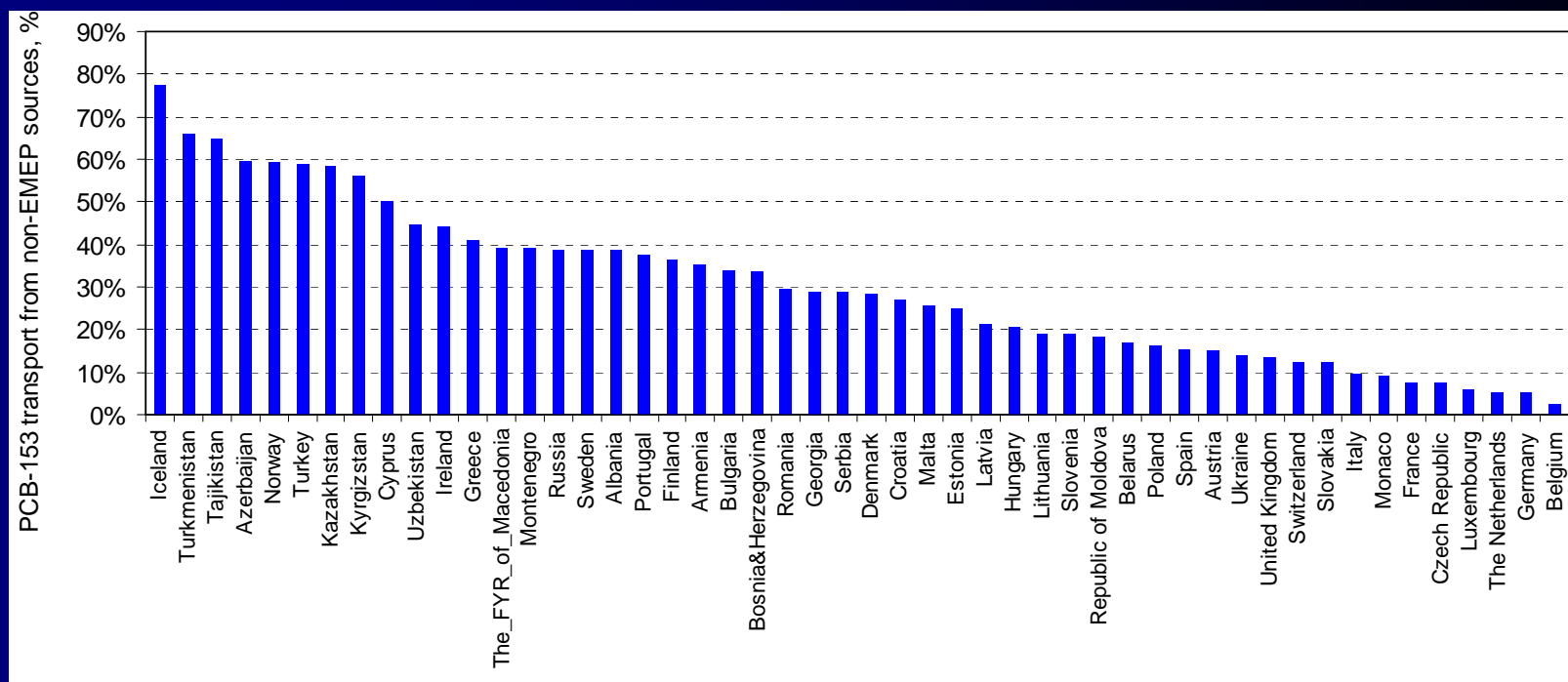
Grass
Temperature
Water
Precipitation
Forest

$R^2$ : 0.7 – 0.8  
depending on year

$R^2$ : 0.7 – 0.9  
depending on year



# Contributions of non-EMEP sources



Relative contribution of non-EMEP sources to the contamination of European countries by PCB-153 anthropogenic sources in 2008, %

## **Development of EMEP modelling framework for POPs (GLEMOS)**

Status of the development of POP-specific GLEMOS modules

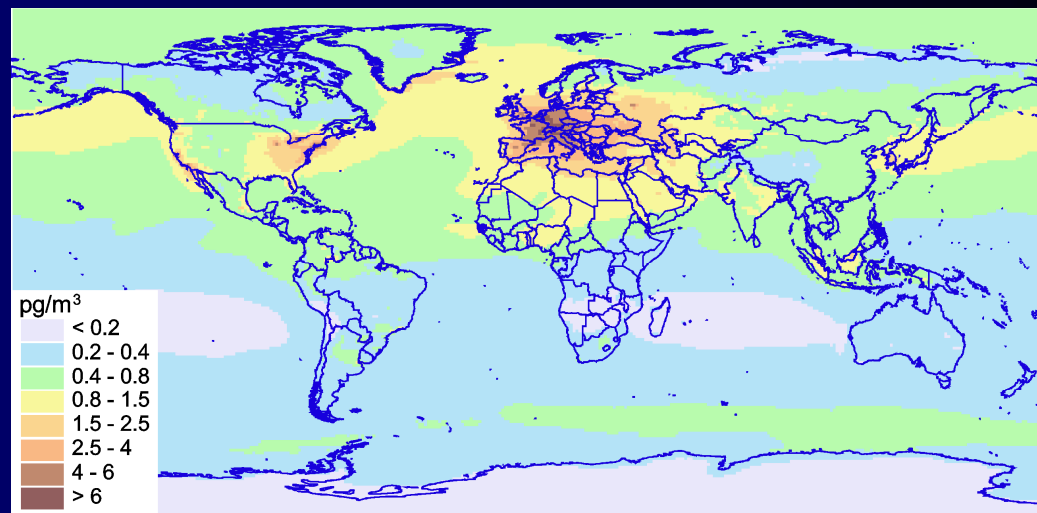
<b>Modules</b>	<b>Status</b>
Atmospheric processes	Ready
Inter-media exchange	Ready
Soil processes	Ready
Oceanic processes	Simplified version; further development in 2011
Vegetation processes	To be developed in 2011

EMEP global modelling framework

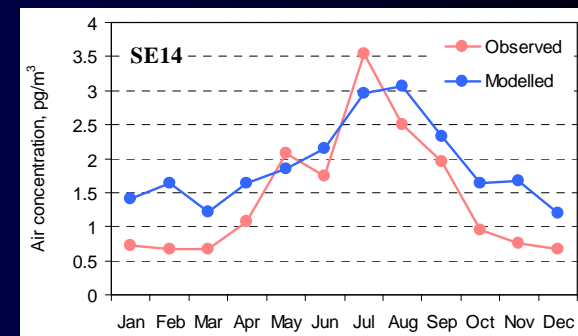
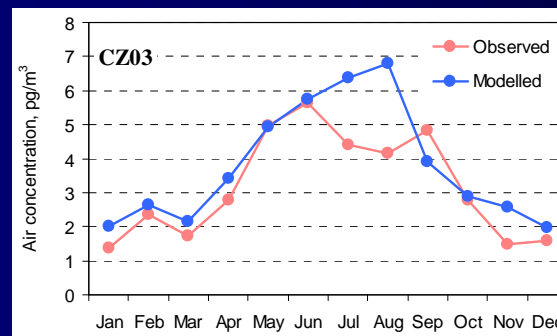
# Pilot evaluation of environmental pollution at global scale

Calculations of PCB transport and accumulation by GLEMOS model with resolution  $1^{\circ} \times 1^{\circ}$  for 2008

Air concentrations of PCB-153 in 2008



Comparison with measurements (air concentrations)

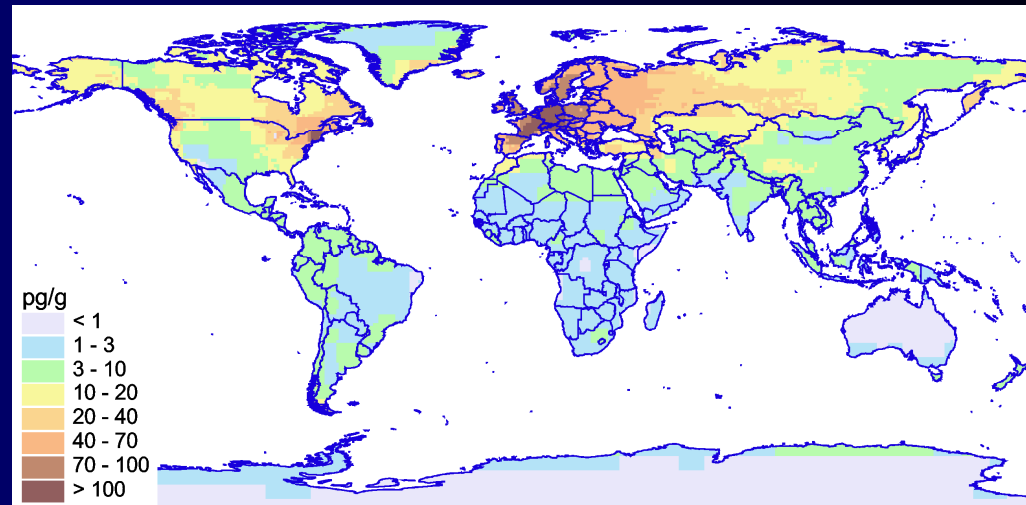


Steering Body to EMEP (September 13 – 15, 2010)

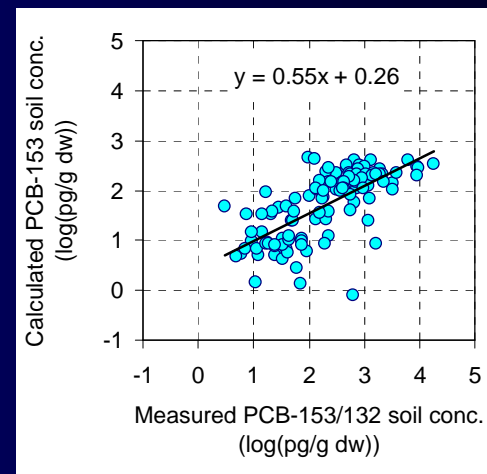


# Pilot evaluation of environmental pollution at global scale

Soil concentrations of PCB-153 in 2008 calculated by GLEMOS model with resolution  $1^{\circ} \times 1^{\circ}$



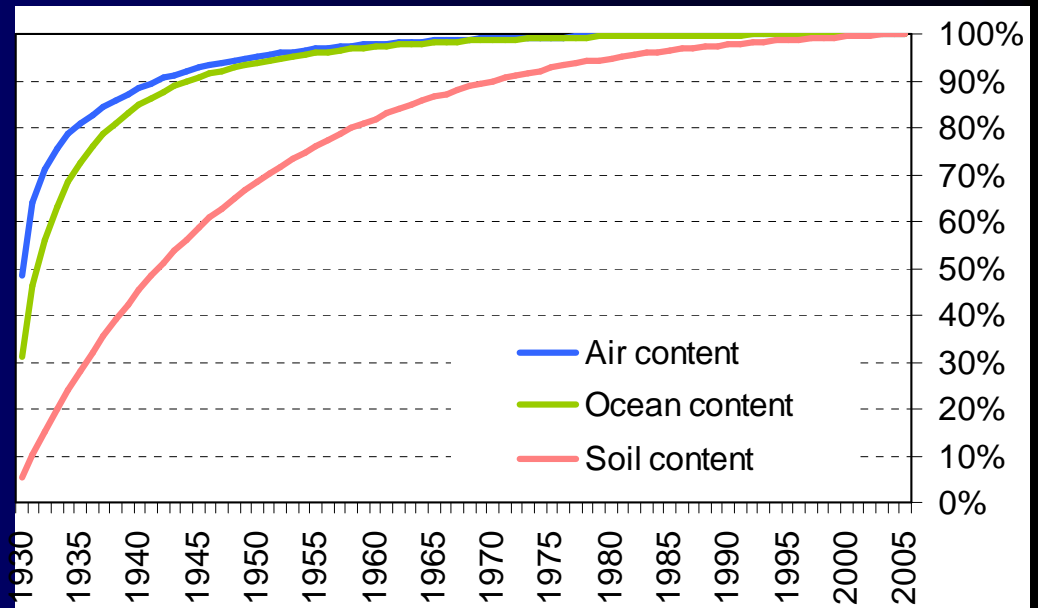
Comparison with measurements (soil concentrations)



# Investigation of accumulation in the environment

Calculations of PCB-153 transport and accumulation for 1930 – 2005 performed by GLEMOS model with resolution  $5^{\circ} \times 5^{\circ}$

Simulations with constant emissions (experimental calculations for accumulation evaluation)

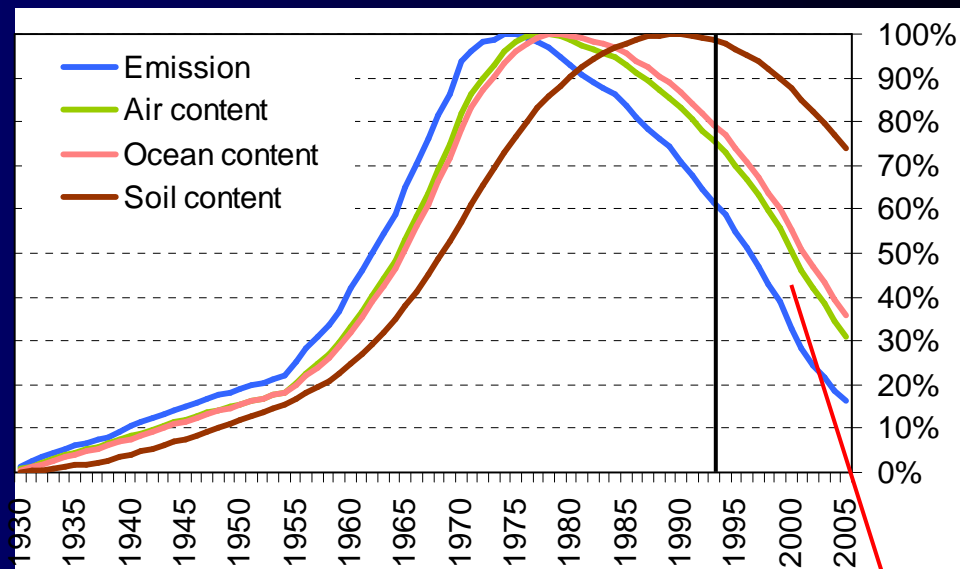


Normalized to maximum

# Investigation of accumulation in the environment

Calculations of PCB-153 transport and accumulation for 1930 – 2005 performed by GLEMOS model with resolution  $5^{\circ} \times 5^{\circ}$

Simulations with historical emissions



Normalized to maximum

Re-emission from soil

# Future activities

## CCC

- Review, store and make available the 2009 monitoring data;
- Use the results from the EMEP and AMAP laboratory intercomparison of POPs in 2010 together with field intercomparison between passive and active sampling to assess the uncertainties in the POP measurements;
- Explore the use of passive POP measurements;
- ...



# Future activities

## MSC-E

- Continue to develop the **integrated monitoring/modelling/emission approach** on the basis of back trajectory analysis and **simplified adjoint models**;
- Investigate **seasonal variations of emissions** for B[a]P and PCDD/Fs on the basis of calculations with different emission scenarios;
- Continue development of **global modelling framework** (elaboration of POP modules for **ocean and vegetation compartments**)
- ...



**Thank you for your  
attention!**