Item 7. Progress in activities in 2012 and future work

a) Measurements and modelling (Persistent Organic Pollutants)

> Sergey Dutchak on behalf of CCC and MSC-E

Main CCC/MSC-E activities on POPs in 2012

EMEP Work-Plan for 2012 – 2013 [ECE/EB.AIR/2011/5]

Operational activity

Assessment of POP pollution levels and transboundary transport

Research activity

- Interactions of POP with atmospheric reactants
- Seasonal changes of POP pollution (PAHs, PCDD/Fs, HCB)
- Long-range transport of complex chemical mixtures (PCDD/Fs)
- Accumulation of historical emissions (HCB, PCDD/Fs)
- Climate change and POP inter-linkages



Assessment of POP pollution, 2010

Monitoring/Modeling

Monitoring data



2012 publications

- □ EMEP Status Report on POPs 3/2012
- □ EMEP/CCC Technical Report 2012
- □ EMEP/MSC-E Technical Report 4/2011
- Tracing the origin of dioxins in Baltic air using an atmospheric modeling approach, V. Shatalov, J. Johansson, K. Wiberg, I. Cousins. *APR*, in press.
- Intercontinental Transport of Persistent Organic Pollutants: A Review of Key Findings and Recommendations of the Task Force on Hemispheric Transport of Air Pollutants and Directions for Future Research, A. Gusev, M. MacLeod, P. Bartlett. APR, in press.



HCB pollution

Objectives

Evaluation of long-range transport and fate of HCB for the long period of time (1945-2010)

Testing of Global EMEP Multi-media Modelling System (GLEMOS) and nesting of EMEP domain.





Emissions of HCB on regional and global scales

Official data (regional), 2010, CEIP

HCB emissions of EMEP countries for 2010:

- National total emissions 32 countries
- Gridded emissions 22 countries

Annual HCB emission within the EMEP domain for 2010



Expert estimates (global), 1945-2010, MSC-E

- European HCB emission for 2000-2010 (Expert estimates of TNO)
- European HCB emission for 1970-1995 (Expert estimates of POPCYCLING-Baltic project)
- □ FAO data on global scale emission of HCB
- Global HCB emission [Bailey et al., 2001]



HCB

Emissions of HCB on global scale





Steering Body to EMEP, September 17 – 19, 2012

Global and regional pollution, 2010



Air concentrations (initial and boundary conditions for EMEP region)



Soil concentrations



Air concentrations within EMEP (50km x 50km)



with monitoring data for 2010



HCB

Contribution of main emission sources to pollution levels of EMEP region



Dynamics of HCB contamination in different media (1945-2010)



Averaged contributions from different sources to HCB air concentrations in Europe



HCB



CONCLUDING REMARKS

- EMEP anthropogenic emission sources 5% of HCB concentrations in the EMEP domain
- ❑ Non-EMEP anthropogenic emission sources 30%
- □ and Global re-emission sources 65%
- Evaluation of HCB pollution requires the use of historical data on HCB emissions for sufficiently long period (from 1945 to present time)



Dioxins & Furans (D&F)

Main objective

Evaluation of pollution levels of total toxicity of **17 D&F** congeners in EMEP domain.

Input data

- □ Official emissions of D&F, CEIP:
 - totals 41 countries
 - spatial distribution 27 countries
- Boundary conditions:
 - hemispheric modelling with emissions of North America, China, and Japan

Missing information

- Regular EMEP monitoring data
- Congener composition of emission data





Measurements of dioxins and furans

Literature sources >750 measurements (compiled by MSC-E)

Country	Years	Monitoring sites	With congener composition	Range, fg TEQ/m ³
Italy	1990 - 2005	Urban	10	13 - 480
		Background	9	1.5 – 54
Poland	1995 – 2002	Urban	9	39 - 12000
		Background	3	71 - 3200
United Kingdom				
Sweden				



D/F Congener compositions in measurements

~ 140 background measurement data were used for model validation



NILU

Model calculations, based on official emission data



Spatial distribution of D&F air concentrations (total toxicity) in Europe in 2010



Measured and calculated toxicities at Thau Lagoon (France) in nine months

Measurements 5 time higher than calculated values



Congener compositions in emissions of various source categories





D/F

D/F Adjusted emission data for modelling of D&F

Adjustment of emissions is based on available measurements and emission expert estimates:



Adjusted total toxicity was enlarged about 5 times

Spatial distribution of emissions of each of 17 congeners, 2010



D/F Monitoring/Modelling Assessment of D&F Pollution, 2010 (adjusted emissions)

Annual totals





Spatial distribution of D&F air total toxicity in comparison with measurements

Seasonal variations



Råö – SE14 (Sweden)







CONCLUDING REMARKS

- Collection of measurement data from national and international networks and campaigns
- Data on congener composition and updated total toxicity of 17 congeners of D&F
- Calculated pollution levels of D&F, generated using adjusted emissions are in a good agreement with available measurements



Long-term trends of PAH of pollution levels, 1990-2010 (B[a]P)



Country/	Relative reduction, times			
region	Emissions	Concentrations		
EMEP	1.4	1.4		
France	2.2	2.1		
Denmark	Increase 2.5	1.0 - stable		



Transboundary transport of B[a]P, 2010



PAHs

Monitoring/Modelling assessment of B[a]P air concentration (annual averages) 2010



EU regulations (B[a]P)

EU threshold levels (Directive 2004/107/EC)

Target value

1 ng/m³

0.6 ng/m³

0.4 ng/m³

- Upper threshold (UAT)
- Lower threshold (LAT)

annual average annual average annual average







Maximum values of B[a]P air concentrations in some EMEP grid cells of countries

Steering Body to EMEP, September 17 – 19, 2012



PAHs



Seasonal variability of B[a]P air concentrations

Main reasons: degradation and temporal emission variability



Temporal variations of B[a]P air concentrations at PL5



POP degradation

Degradation of B[a]P in gaseous phase: reaction with OH radical

Comparison of trend of OH <u>mixing ratio</u> with trend of total solar radiation (TSP) (average over Europe)



Degradation of B[a]P lived on particles: reaction with ozone



PAHs

Temporal variability of B[a]P emissions



Temporal variability of B[a]P emissions - highly important



CONCLUDING REMARKS

- Country-specific information on temporal variations of emissions (monthly resolution)
- Heterogenic reactions between B[a]P and ozone and other reactants
- Assessment of pollution with finer spatial resolution for selected locations of EMEP domain



Climate change and POP inter-linkages

Main objective:

Analyze influence of changes in meteorological parameters and extreme weather events on variations of POP air concentrations

Effect of variability of air temperature on:

- □ changes in degradation intensity (B[a]P)
- changes of gaseous exchange with underlying surface (PCDD/Fs)

Effect of extreme weather events (heat wave in Russia in 2010):

□ increase of B[a]P content in air due to forest fires



Climate change Influence of changes of meteoparameters

Changes of air temperature



Increase of temperature in Aug 2010 in comparison with Aug 2009 (up to 6 °C)

Decrease of B[a]P in air up to 30%



Changes of air concentrations due to degradation of B[a]P



Increase of D&F in air up to 70%

Changes of air concentrations due to increase of re-emission of D&F

Climate change

Extreme weather events: effect of different factors

Temperature increase between Aug 2010 and Aug 2009 up to 6 °C





Forest fires (August, 2010): increase of B[a]P emissions Increase of B[a]P content in air by 2-5 times



Difference in B[a]P in air between 2010 and 2009, NPO Typhoon, RF

CONCLUDING REMARKS

- Due to interaction of concurrent processes (degradation and gaseous exchange with underlying surfaces) the influence of temperature increase can be different for different pollutants
- The influence of extreme weather events (e.g. forest fire) should be taken into account in evaluation of the affect of climate change to the environmental POP contamination



Future activities

Main directions of future activities:

Routine activities

- Review, store and make available EMEP monitoring data for 2011 for the modelling centres and Parties.
- ✓ Evaluate air concentrations, deposition fluxes and transboundary transport of PAHs, PCDD/Fs and HCB for 2011.

Research

- Continue elaboration of integrated monitoring/ modelling/emission approach including adjoint modelling.
- Perform preliminary model assessment of POP transport on country scale.
- Continue elaborating and testing GLEMOS modelling framework for POPs.
- ✓ Continue examination of the influence of climate change at POP behaviour in the environment.



Cooperation with countries





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