Co-operation between EMEP/MSC-E and WGE

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Outline

• Wind re-suspension of heavy metals
• Heavy metals in mosses
• Future cooperation
Wind erosion and dust suspension

Mineral dust suspension:

- Aerodynamic entrainment
  Lift of dust from the surface due to aerodynamic forces

- Saltation bombardment (sandblasting)
  Collisions of saltating soil particles with the surface resulting in dust emission

- Aggregates disintegration
  Destruction of large soil aggregates due to collision with the surface

Source: Shao et al., 2011
Model parameterizations (MSCE-HM):

- Suspension of mineral dust from soil (saltation, sandblasting)
  [Marticorena and Bergametti, 1995; Alfaro and Gomes, 2001; Gomes et al., 2003]

- Soil properties data (texture, composition, size distribution)
  [ISLSCP (Initiative II), http://islscp2.sesda.com]

- Production of sea salt aerosol
  [Monahan et al., 1986; Gong, 2003]
Simulation of wind-blown dust

Mean annual mineral dust suspension from soil

- Deserts, bare soils
- Arable lands (during cultivation period)
- Urban and roadside areas

Simulated annual dust suspension flux

PM2.5 (d<2.5 μm)  PM10 (d<10 μm)
Wind-blown dust in Europe

Does wind suspension of mineral dust occur in Europe?

PM10 measurements in Germany, Czechia, Slovakia and Poland

Back trajectories from measurement sites (for 24 March 2007)

Analysis of meteorological conditions and dust composition revealed the origin of the plume as dust suspension in southern Ukraine

Birmili et al., ACP (2008)

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Wind-blown dust in Europe

Simulation of dust suspension event from Ukraine, March 2007

Simulated PM10 suspension flux in Europe

Total PM10 suspension from Ukraine and southern Russia

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Wind-blown dust in Europe

Simulation of dust suspension event from Ukraine, March 2007

Simulated PM10 suspension flux in Europe

Source: Bessagnet et al., 2008

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Re-suspension of heavy metals

High Cd concentration event in the end of March 2007

Concentrations in air, ng/m³

Rudolice v Horach

Concentrations in air, ng/m³

Syvatouch

Concentrations in air, ng/m³

Kosetice

Concentrations in air, ng/m³

Cervena
Re-suspension of heavy metals

High Cd concentration event in the end of March 2007
Re-suspension of heavy metals

High Cd concentration event in the end of March 2007

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Re-suspension of heavy metals

High Cd concentration event in the end of March 2007

**Rudolice v Horach**

- Model (anthrop)
- Model (re-susp)
- Observed

**Svratouch**

- Model (anthrop)
- Model (re-susp)
- Observed

**Kosetice**

- Model (anthrop)
- Model (re-susp)
- Observed

**Cervena**

- Model (anthrop)
- Model (re-susp)
- Observed

Re-suspension of heavy metals

High Cd concentration event in the end of March 2007
Re-suspension of heavy metals

Annual re-suspension flux of Cd in Europe

Re-suspension  Anthropogenic emissions

Total emission and re-suspension of Cd in Europe (1990-2005)

Anthropogenic  Re-suspension
Re-suspension of heavy metals

Annual re-suspension flux of Pb in Europe

Re-suspension

Anthropogenic emissions

Total emission and re-suspension of Pb in Europe (1990-2005)

- Anthropogenic
- Re-suspension

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Uncertainties

- Dust suspension parameterisations (suspension from urban areas, roadsides etc.)
- Soil properties data (spatial distribution of soil types, size distribution of soil grains)
- Local meteorological conditions (wind stress, soil wetness, etc.)
- Heavy metal concentration in soils and urban/road dust (vertical profiles, enrichment of the upper soil layer)
- Temporal dynamics and processes of heavy metal cycling in soil
Uncertainties

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Supplementary measurements data

Heavy metal concentration in mosses

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Benefits of moss data:
- Wide spatial coverage
- Large number of sites
- Characterization of total deposition in air, precip., and c. HM monitoring in EMEP (67 sites), HM in mosses (~5600 sites)

Heavy metal concentration in mosses:
- Finland
- Germany

Concentration in moss and modelled deposition over the years 1990 to 2005.
Evaluation of spatial distribution using moss measurement data

Modelled total deposition flux of Cd in 2007 (5x5 km)

Concentrations of Cd in mosses (survey of 2005)

Results were discussed at the WGE/ICP-vegetation meeting (February 2011)
Country-specific character of the analysis

HM deposition vs. moss concentration

**Czech Republic**
- $R_c = 0.79$

**Norway**
- $R_c = 0.74$

**France**
- $R_c = 0.51$

**Sweden**
- $R_c = 0.73$

**Finland**
- $R_c = 0.88$

**Germany**
- $R_c = 0.47$

**Bulgaria**
- $R_c = 0.45$

**Sweden**

**Norway**

**France**

**Germany**

**Bulgaria**

**Finland**

**Sweden**

**Norway**

**France**

**Germany**

**Bulgaria**

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Future co-operation

- Joint research and discussion of air-surface exchange of particle-bound heavy metals (deposition/re-suspension)

- Dynamic modelling of heavy metal cycling and accumulation in soil

- Further work on application of measurements in mosses and other ICP data for the model evaluation and pollution assessment of HMs (and POPs)

- Information exchange and joint analysis of critical loads exceedances for heavy metals