EMEP/MSC-W activities 2017/2018

H. Fagerli and co-workers at MSC-W

4th joint session to EMEP Steering Body and WGE 10-14th September 2018
Overview

• Reporting model runs and analysis
  • Countries that reported in 0.1x0.1 for the first time
  • Status and episode analysis (complementary to CAMS)
  • Modelled timeseries 2000-2016(17) and the new trend interface
  • SR in different resolutions
• The effects of international shipping
• Cooperation with WGE
• Plans: Uncertainties in SR due to SOA
Consistent modelled concentration and deposition data for 2000-2016 (17)

• For countries to follow the development in their country
  • Re-reported emissions by countries
  • Finer resolution
  • Consistent model version/meteorology
  • Presented in country reports
    • Also comparison to AirBase data for individual countries
EMEP Trend Interface
http://aerocom.met.no/trends/EMEP/

- Build on interface developed for ACTRIS
Frontpage
- choose parameter (only PM$_{10}$ now)
- trends marked
- analyze sites or countries
- zoom on a period

http://aerocom.met.no/trends/EMEP/
Future:
- Other parameters
- Sector contributions 2000-2016
- Include observations
- Country contributions?
Source-receptor (SR) calculations in the new EMEP grid

- For the first time, reported emissions in 0.1° x 0.1° are used in SR
- Different resolutions (0.4° x 0.3° 0.3° x 0.2° and 0.1° x 0.1°) tested for 5 countries: BG, IT, NL, NO, PL – which resolution should be used operationally?
- New, more detailed, country border data. How does it affect results?

- Changes wrt old SR also due to improved model version, updated emissions (especially ‘expert estimates’ for EECCA countries have changed)
PM$_{2.5}^\text{:}$ Relative contribution from the country to itself and to the top5 receptors
Choice of SR resolution

- Overall difference for depositions within a few percent, larger for ozone and PM (up to 11% for country-to-itself)
- Differences in individual transboundary contributions can be larger, especially when pollution is transported across mountain areas and/or is small
- The differences caused by using an improved country border data set is as large as differences due to different resolutions

SR in 0.3°x 0.2°, as these results are closer to 0.1°x 0.1°
Effect of international shipping on European ozone

• Paper focused on Europe based on HTAP2:

The effects of intercontinental emission sources on European air pollution levels. Jonson et al., accepted
• Why is shipping more important in the HTAP2 calculations than in our regional calculations?
  • Choice of indicator (mean ozone, POD, SOMO35)
  • Importance of ship emissions outside the EMEP domain
  • Scale
Choice of ozone metric is important…

• …but did not matter much for the total effect of international ship emissions. But the Europe-to-Europe effect is larger with POD/SOMO35

Ozone metrics
How does ship emissions in different areas, and especially outside the EMEP domain, affect European ozone? SOMO35

Countries around Baltic Sea/North Sea

ROW outside the EMEP area is important!

Percentage contribution compared to all global anthropogenic emissions

ROW=Shipping outside the EMEP area is important!
Summary

• Choice of ozone metrics important; POD and SOMO35 put a larger weight on European emissions
• Ship emissions outside the EMEP domain are important
Cooperation with ICP Vegetation
- global scale summaries of ozone metrics and impacts on crops
(EMEP/MSC-W model used to provide Phyto-toxic Ozone Dose, POD)

Cooperation with ICP-Forests

• Spatial variation of modelled total, dry and wet deposition to forests at global scale. D. B. Schwede, D. Simpson, J. Tan, J. S. Fu, F. Dentener, E. Du and W. de Wries. In revision

• Assessment of ozone flux for Swiss Level II plots. (Schaub et al)

• Comparison of ICP-Forests dep and EMEP/MSC-W model (A. Marchetto)

• Continental-scale forest growth in Europe is driven by management and further modulated by nitrogen deposition. In prep. Etzold et al
Plans

- Uncertainty in SR due to SOA, incl ‘Condensables’
- Bidirectional exchange of ammonia
  ++
Impacts of uncertainties in SOA modelling for source-receptor matrices, progress

• Illustrate and quantify the likely uncertainties in the source receptor matrices for PM as a result of current knowledge and data gaps for SOA modelling
  • Summer: BVOC modelling
  • Winter: ‘Condensables’

• SR calculations with different model configurations and input data
POA (inert) from MACCIII emissions

\[ \text{POA (inert)} + \text{SVOC} + \text{IVOC} = 3 \times (\text{POA} + \text{SVOC}) \]

\[ \text{POA (inert)} + \text{IVOC} = 0.25 \times \text{NMVOC} \]

Fairly good agreement to OC observations when introducing SVOC and IVOC plus SOA chemistry
The End
Yearly average of daily max $O_3$: Contribution from the country to itself and to the top5 receptors due to NO$_x$ (ppb per 15% reduction)
How does ship emissions in different areas, and especially outside the EMEP domain, affect European ozone? Annual ozone

ROW is important!

Percentage contribution compared to all global anthropogenic emissions
LARGE-SCALE (IAM) OZONE RISK ASSESSMENT IN SOIL MOISTURE LIMITED AREAS

- Why? Ozone uptake is driven by stomatal conductance:

\[ g_s = g_{\text{max}} \times f_{\text{phen}} \times f_{\text{light}} \times \max\{f_{\text{min}}, (f_{\text{temp}} \times f_{\text{VPD}} \times f_{\text{SWP}})\} \]

- fSWP (now fSMI) is a key driver
- SMI = soil moisture index:
  - 1 = fully moist, 0 = fully dry
LARGE-SCALE (IAM) OZONE RISK ASSESSMENT IN SOIL MOISTURE LIMITED AREAS

- SMI data sent for 12 Mediterranean sites, 45 Swiss sites, 25 Swedish sites
- 1990-2012

### Switzerland

[Graph 1: Site: CH_1464 Alt: 395 Year: 2012]

### Spain

[Graph 2: Site: Las Majadas Alt: 258 Year: 2012]

[Graph 3: Site: Las Majadas Alt: 258 Year: 2005]
Cooperation with ICP-vegetation
Modelled $\text{O}_3$ uptake data (POD) – EMEP MSC-W
Mapping global impacts of ozone on crops

(Slide from: Katrina Sharps – katshar@ceh.ac.uk)

Modelled O3 AND Crop production data (spatial) AND Dose response relationships

Global production loss - wheat

Mills et al., Global Change Biology, 2018.
Wheat production loss due to ozone (mean 2010 – 2012)

Highest quantity of losses are in the high wheat producing countries, especially in:
- warm temperate dry and tropical dry climates (blue colours) where irrigation is used
- temperate moist climates (yellow and green) where soil moisture is not limiting to ozone uptake

Overall, a mean global annual yield loss of 9.4% and 85 Tg (million tonnes) of grain, worth $24.2 billion at global market price
LARGE-SCALE (IAM) OZONE RISK ASSESSMENT IN SOIL MOISTURE LIMITED AREAS

Main goal:

Collaboration between ICP-Vegetation and EMEP MSC-W for improving current flux-based ozone risk assessment applications for large scales (IAM), especially for soil moisture limited areas such as the Mediterranean, Central and Eastern Europe, and in most of Europe under future scenarios of climate change.

Objectives:

1. Check Soil Moisture Index (SMI) performance in soil moisture limited areas (2017-2018)

2. Parameterize SMI limitations to ozone flux for common European vegetation species from soil moisture limited areas (2018-2019)

3. Update for parameterizations for large scale ozone flux estimation in European soil moisture limited areas (2018-2019)

- Led by CIEMAT, also with Sabine Braun
- Status: EMEP soil water estimates data for.... sent to CIEMAT for 1st comparisons
Other work

• Status run analysis in 0.1x0.1 degree, episode analysis etc.
• Bidirectional exchange of ammonia
• OA modelling – SR preparation. SVOC/IVOC
• O3 flux – cooperation with WGE
• TFHTAP: hosting web server & model calculation. Paper on European O3
• TFMM twin site study
• EMEP/MSC-W Model updates/improvements
• Country report updates
• Local fraction tests
Proposed workplan elements

1. Large-scale (IAM) ozone risk assessment in soil moisture limited areas
2. Impacts of uncertainties in SOA modelling for source-receptor matrices
3. Impacts of bi-directional exchange of NH3 on source-receptor relationships for nitrogen and PM2.5
4. Contribution of international ship traffic emissions to ozone in Europe – cooperation with TFHTAP