MSC-W: progress of activities 19/20

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Overview

Some major activities 2019/2020:

- ‘Condensables’ - model evaluation and source receptor matrices for 2018 + workshop (Session on condensables)
- EC - model evaluation and source receptor matrices for 2018
- Downscaling of EMEP-MSC model results for NO$_2$, PM$_{2.5}$ and PM$_{10}$ for all of Europe

- Further plans
EC - source receptor and model evaluation for 2018

- Related to condensables through the use of EC/PM fractions for emissions
- Large difference between different emission estimates (e.g. EU Action on BC\(^1\) review)
- Comparing model runs with reported EC emissions and EC from the inventory which use TNO Ref2 for GNFR C (small combustion) plus EC/OC fractions from TNO (EMEP and EMEPwRef2C)
- Compared to EMEP EC measurements (EBC last year - to be continued in TFMM EuroCarb)

Comparison of EC in EMEP and EMEPwRef2C

National total EC emissions

EC emissions from GNFR sector C (small scale combustion)

Countries with reported EC in 2020

[Graph showing EC emissions across countries with bars for each country, indicating the comparison between different emission scenarios.]
Figure 7.3: Annual mean concentrations of EC in PM$_{2.5}$ in 2018, calculated with the EMEP MSC-W model (colour contours) and observed at EMEP monitoring network (colour triangles) from EMEPwRef2C run (upper panel) and ECgrided run (lower panel).
Country to country itself contribution (C2C) and import from all other countries (IMPORT2C) for EC$_{2.5}$ using EC emissions from EMEP and EMEPwRef2C, respectively. Units: ng m$^{-3}$

Difference in country-to-itself contribution and import up to factor 2-4
Summary ‘black carbon’

• Large difference in emission estimates leads to large differences in source receptor matrices... (up to factor of 2-4 differences in country-to-itself and import-to-country contributions to EC concentrations) - here ‘only’ due to inclusion of a consistent set of condensables (Ref2 for GNFR C)
• Not possible to judge from the work here which emission estimates are ‘best’ (work last year pointed to substantial difference in ff/bb)
• Further work on comparison to observations (e.g. bb/ff in EIMP) will be performed in TFMM EuroCarb
Multi-scale modelling: uEMEP for Europe

Downscaling for all of Europe (100-250 m) for traffic, residential heating and shipping emissions (EMEP & EMEPwRef2C)

Figure 8.5: Calculated NO₂ concentrations in the 100 km tile (nr. 328) for 2018, part of the all European calculation at 100 m resolution. Left the EMEP calculation at 0.1° and right the uEMEP calculation at 100 m resolution. The city in this tile is Milan. Airbase stations are shown as circles.
Comparison to all EEA Airbase obs. data

In the majority of countries the spatial correlation is doubled

$NO_2$ is dominated by traffic emissions and this is spatially very well defined using OSM as a proxy.

Figure 8.7: Annual mean $NO_2$ concentrations and spatial correlation ($r^2$) per country for 2018 calculated with EMEP and uEMEP compared to Airbase observations. Only countries with more than 10 stations are shown but all stations are included in the final EU result.
- Bias improves
- Why not improved correlation for PM$_{2.5}$?
- Smaller ‘delta’
- The largest contributor to PM is residential heating which uses population as a downscaling proxy (‘within the grid’).
- Tests for Norway show better results when using better proxy data
- Options: use TNO proxies directly, other proxies

Figure 8.8: Annual mean PM$_{2.5}$ concentrations and spatial correlation ($r^2$) per country for 2018 calculated with EMEP and uEMEP compared to Airbase observations. Only countries with more than 10 stations are shown but all stations are included in the final EU result.
Exposure PM$_{2.5}$, EMEP & EMEPwRef2C

- Higher RWC emissions hits hard for exposure
- Caveats: population proxy, erroneous country gridding, PM water

Note: logarithmic scale

PM$_{2.5}$, uEMEP: 132 million above 10 ug/m$^3$, 31 million above 15 ug/m$^3$

PM$_{2.5}$, uEMEPwRef2C: 231 million above 10 ug/m$^3$, 51 million above 15 ug/m$^3$
Summary multi-scale EMEP modelling

- Works excellent for NO$_2$, better bias for PM (but not improved spatial correlation). More work on spatial distribution/proxies are needed for PM
- Add national contribution, combine with SR

Table 8.3: Source contribution to all air quality stations in Europe calculated with uEMEP. uEMEP local contributions are from emissions within an region of $\pm 0.1^\circ$ in both latitude and longitude. Non-local EMEP contributions are all emissions from outside this region for the downscaled sources as well as other sources within this region that are not downscaled.

<table>
<thead>
<tr>
<th>Source</th>
<th>NO$_X$ ($\mu g/m^3$)</th>
<th>PM$_{2.5}$ ($\mu g/m^3$)</th>
<th>PM$_{10}$ ($\mu g/m^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic (GNFR6)</td>
<td>13.9 (58%)</td>
<td>0.71 (6%)</td>
<td>1.1 (7%)</td>
</tr>
<tr>
<td>Residential heating (GNFR3)</td>
<td>1.8 (8%)</td>
<td>2.2 (19%)</td>
<td>2.6 (16%)</td>
</tr>
<tr>
<td>Shipping (GNFR7)</td>
<td>0.30 (1%)</td>
<td>0.01 (0.1%)</td>
<td>0.01 (0.1%)</td>
</tr>
<tr>
<td>Non-local EMEP</td>
<td>7.9 (33%)</td>
<td>8.4 (75%)</td>
<td>12.3 (77%)</td>
</tr>
<tr>
<td>Total</td>
<td>23.9 (100%)</td>
<td>11.3 (100%)</td>
<td>16.0 (100%)</td>
</tr>
</tbody>
</table>
The Trend interface
https://aerocom-trends.met.no/EMEP/

- Added more parameters + 2017
• 2018 to be added (‘with Condensables’). Source/sector information
• Work together with CCC on defining obs. data set relevant for trends
• Deposition, more parameters

Data from trend interface also used by ETC/ATNI in cooperation with EMEP: main drivers of long term trends
Cooperation with ICP-Vegetation

- Modelling ozone flux in soil moisture limited area (lead: CIEMAT)
- Parametrization for semi-natural vegetation in the EMEP model (POD$_1$IAM)
- Modelling ozone flux for other parts of the world (impacts on yield)
- Ozone flux-based risk assessment for vegetation at various air pollution scenarios (for review of the GP).
Further work

- Participate in the **EPCAC activity** with uEMEP: Estimate the effects of local/regional/(inter)national emission reductions on concentrations in the selected cities.
- Include the ‘national contribution’ to uEMEP results (based on SR)
- **TFHTAP exercise**: importance of shipping emissions in other regions of the world - impact on ozone
- EC: TFMM EuroDelta, solid vs liquid fuel sources
- Continued work on EMEP Trend interface, with CCC
Further work II

- GP review: e.g. new modelled trend series (1990 ->2030(?)), updated historical emissions for modelling (for exceedance calculations) + O₃ flux (ICP-veg)
- Nordic Council of Ministers - project application (with TNO, IIASA, SYKE, NILU):
  - Revising historical PM$_{2.5}$ emissions from residential combustion to consistently include condensable organics and assess the implication for the review of Gothenburg Protocol
    - 2005-2018 emissions
    - New model calculations of PM trends (and SR matrices)
    - Comparison to observations

Relevant for GP review question 4.4, if funded
Utskifting av bakgrunnbilde:
- Høyreklikk på lysbildet og velg "Formater bakgrunn".
- Under "Fyll", velg "Bilde eller tekstur".
- Velg ønsket bakgrunnbilde og klikk "Åpne".
- Avslutt med å velge "Lukk".