Using Sentinel-5P Data to Improve Air Quality Maps

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The presented work is a part of the SAMIRA (Satellite based Monitoring Initiative for Regional Air quality) project – an ESA-funded project which aims at improving air quality monitoring in the regions of collaborating countries: Norway, Poland, Romania and the Czech Republic.

Data fusion in air quality mapping

The fusion of in-situ measurements, outputs from chemical transport models and other supplementary data (altitude, population density, land use etc.) was already tested in previous research and is also used routinely[3]. Within the SAMIRA project, the added value of satellite data was examined. Here we focus on daily maps created with Sentinel-5P/TROPOMI data and compare them with maps created with OMI data and without any satellite data at all. The next step in the project will be to produce the maps on a near real-time basis.

Input data sources

The data fusion was run on a 1 x 1 km domain covering the Czech Republic for the period from 01/08/2018 to 30/09/2018.

- in-situ measurements of NO₂
  - CHMI air quality database - background stations
  - chemical transport model (CTM)
  - CAMx 4.7 x 4.7 km
  - satellite data
    - AURA/OMI: L3, daily overpasses with 24x13 km spatial resolution.
    - Sentinel-5P/TROPOMI: S5P L2, daily overpass with original 7x3.5 km spatial resolution.
    - Converted to L3 with the HARP[2] toolbox to 0.05x0.05 deg.
- supplementary data
  - altitude, population density

Results - cross-validation bias and RMSE

Table 1: Comparison of average and median RMSE and bias.

<table>
<thead>
<tr>
<th></th>
<th>S5P</th>
<th>OMI</th>
<th>base</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₂ - bias</td>
<td>3.19</td>
<td>3.32</td>
<td>0.02</td>
</tr>
<tr>
<td>NO₂ - RMSE</td>
<td>5.11</td>
<td>5.24</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Comparison and conclusions

- Robust methodology
- Reduced RMSE and bias of maps with the use of satellite data
- Possible influence of L2 to L3 conversion method of S5P data - necessary to examine and test
- Better spatial coverage of S5P data - big advantage

Example maps

Figure 6: Examples of air quality maps: base (top), OMI (middle) and S5P (bottom).

References