First results from the new JRC greenhouse gas monitoring site at Ispra, Italy

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Summary

We present measurements results from a new continuous greenhouse gas (GHG) monitoring station located at the EU Joint Research Centre in Ispra, Italy. The monitoring site is located at the northern border of the Po valley which is one of the most polluted regions in Western Europe. CO₂, CH₄, N₂O, and SF₆ have been monitored continuously by gas chromatography (GC-FID/EC) since November of 2007. In September 2008 we included an ANSTO dual fast Radon monitor which allows us to estimate GHG surface fluxes using the ²²²Radon reference method. In addition, we apply a proton transfer mass spectrometer (PTR-MS) instrument during dedicated periods to monitor fossil fuel related VOCs (benzene, toluene and xylenes) and the biomass burning tracer acetonitrile. Additional air quality measurements (e.g. carbon monoxide) and meteorological data are available from the co-located Ispra EMEP-station.

Results

On the role of woodfuel emissions in the Ispra area

Table: Anthropogenic emissions in the Po Valley, Italy

<table>
<thead>
<tr>
<th>Species</th>
<th>CO₂</th>
<th>CH₄</th>
<th>N₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2005</td>
<td>0.2% ± 0.2%</td>
<td>1.0 ± 1.0%</td>
<td>0.2 ± 0.2%</td>
</tr>
</tbody>
</table>

On the role of traffic and industrial emissions in the Ispra area

Toluene and benzene were measured by PTR-MS to investigate the role of traffic and industrial emissions in the Ispra area. Main sources for benzene are industrial use (petrol) and traffic emissions, for benzene traffic and to a lesser extent biomass burning. Emissions of benzene and toluene are generally coinciding with CO₂, CH₄, and N₂O. Here we compare annual concentrations measured between 11:00 and 16:00 h (winter 2008/2009) with concentrations measured between 11:00 and 16:00 h (spring 2009). We find that the annual average concentrations of benzene, toluene, and N₂O are higher than the annual average concentrations of CO₂, CH₄, and N₂O.

Calculating atmospheric emissions with EDGAR v4

We compare estimated CO₂ and CH₄ with EDGAR v4 database which provides anthropogenic emissions on a 0.1 x 0.1 degree grid scale for the year 2005 (http://edgar.jrc.ec.europa.eu/). We find that the annual average concentrations of benzene, toluene, and N₂O are higher than the annual average concentrations of CO₂, CH₄, and N₂O.

On the role of woodfuel emissions in the Ispra area

The current 15 m sampling mast at the JRC Ispra, to be replaced by a 45 m tower.

Estimating GHG surface fluxes at Ispra

The mean surface flux Jₛ of species X over the source region influencing the measurement station, assuming a well-mixed PBL can be expressed by:

\[ Jₛ = \frac{\Delta X(t) \cdot \Delta t}{A} \]

We refer to the mean Radon emission rate in the measurement domain (kBq·m⁻²·s⁻¹) as a correction factor for the Radon radiative decay, and \( \Delta X(t) \) is the slope of the linear regression between hourly observations of species X and Radon, shown here for CO₂, CH₄, N₂O and SF₆ for October-November 2008 (all hourly mean data).

Comparing calculated emissions with EDGAR v4

Using a mean Radon surface flux of 76 Bq·m⁻²·h⁻¹ from the TMS model (reduced by 25% for winter conditions) and a mean residence time of 2 days we can estimate a surface flux of 2.7 x 10⁻³ kg CO₂·m⁻²·h⁻¹, 3.3 x 10⁻³ kg CH₄·m⁻²·h⁻¹, 5.7 x 10⁻³ kg N₂O·m⁻²·h⁻¹.

Outlook

At the Ispra site the sampling mast of 15 m will be exchanged for a 48 m mast by the end of 2009. From the second half of 2009 we plan to activate a complementary GHG monitoring station at Monte Orsina near Varese using a Picarro Cavity Ring-Down Spectroscopy monitor for CO₂, CH₄, and N₂O. Our data analysis and (TM5) inverse modelling activity will focus on improving the emissions budgets of CH₄ and N₂O of Northern Italy (Po valley).

References

[3] Deuste Steininger (Germany) are calibrated against 5 high precision primary standards
[5] ANSTO Radon analyzer