

[OVOC analysis for Total Observed Organic Carbon determination, OVOC-TOOC]

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- **Introduction and motivation**

In the Total Observed Organic Carbon (TOOC) concept as many as possible gaseous and particulate organic substances are measured at a site (Heald et al., 2008). This gives an indication about the importance of different species for aerosol formation and other air quality issues. The novelty of the concept is that not only gaseous or particulate compounds are looked at, as done normally, but that both types of air pollutants are evaluated in a common experiment. At the SMEAR II stations a first measurement campaign was performed in Europe to test the concept. Within OVOC-TOOC Empa provided an in-situ GCMS system, which is customized for oxygenated volatile organic compound (OVOC) (Legreid et al., 2008) measurements to the spring campaign in SMEAR II (Finland).

- **Scientific objectives**

The performance of mass closure experiments of atmospheric organic carbon at different European environments is an excellent tool for validating the importance of gaseous and particulate organic compounds in the atmosphere. The TNA proposed within this project will test the concept of Total Observed Organic Carbon (TOOC). The concept of TOOC is based on the analysis of ideally all gaseous and particulate organic species at a certain site. This has already been performed in the USA but will be tested for the first time in Europe in spring 2012 at SMEAR II,

- **Reason for choosing station**

The SMEAR II site is an excellent station for the research performed under the OVOC-TOOC project. First, it is located in a relatively pristine environment in Northern Europe. This is a very favorable position for first testing the concept of TOOC measurements in absence of local anthropogenic sources of VOCs and OVOCs. Furthermore, several instruments for measurement of OVOCs and VOCs were already present at the site. One GC-FID for the measurements of VOCs and two PTR-MS for the measurements of VOCs and OVOCs. Furthermore, the good reachability and the very experienced staff made it a nearly optimal site for our purposes.

- **Method and experimental set-up**

As the concept of TOOC measurement includes the analysis of the whole range of suite of gaseous and particulate organic carbon VOCs, OVOCs and organic particles were measured using the following instruments during the campaign in spring 2012:

GC-MS (Empa) for measurements of OVOCs and VOCs (Legreid et al., 2008)

GC-FID (Finnish Meteorological Institute) for measurements of VOCs (Hakkola, 2012)

PTR-TOF-MS (University of Helsinki)

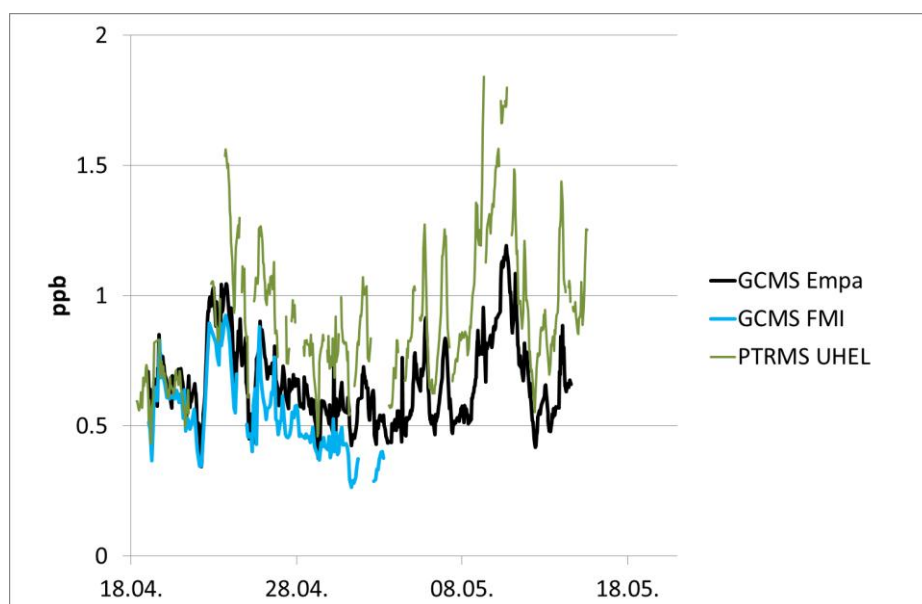
PTR-MS (University of Helsinki) (Rinne et al., 2007)

AMS (University of Helsinki)

Furthermore, measurements of other air pollutants (e.g. CO) and meteorological observations were available for origin of air masses and potential filtering of local sources.

- **Preliminary results and conclusions**

Measurements of GC-MS, GC-FID and PTR-MS showed a very consistent picture for the gaseous compounds. As an example for the VOC measurement the dataset for benzene measured by 3 independent instruments is given below. Remarkably concentrations exhibit the same pattern of pollution events and clean periods. Differences in concentrations are due to preliminary calibration, but will disappear after full quality assurance of the data has been performed. Also the more complicated OVOCs (as shown for acetone measurements shows a very good comparability between GC-MS and PTR-MS measurements.



Concentrations of acetone/propanal measured with 3 different instruments

- **Outcome and future studies**

The measurement campaign at the SMEAR II station was a successful in proving that the concept of TOOC measurements can be performed by using different instruments for the measurement of gaseous and particulate organic compounds. The location in Northern Europe will be an important station in providing a general picture of TOOC in Europe with its diverse landscapes and climate zones. The TOOC concept will be further tested during the EMEP intensive campaign in 2012/13 and within the ACTRIS JRA 5.

- **References**

Legreid, G., D. Folini, J. Staehelin, J. Balzani Lööv, M. Steinbacher, S. Reimann, Measurements of organic trace gases including oxygenated volatile organic compounds at the high alpine site Jungfrauoch (Switzerland): Seasonal variation and source allocations, J. Geophys. Res., 113, D05307, doi:10.1029/2007JD008653, 2008.

Rinne, J.; Taipale, R.; Markkanen, T.; Ruuskanen, T. M.; Hellen, H.; Kajos, M. K.; Vesala, T.; Kulmala, M. Atmos. Chem. Phys. 2007, 7, 3361.

Hakola H., Hellén H., Henriksson M., Rinne J., Kulmala M. In situ measurements of volatile organic compounds in a Boreal Forest. Submitted to Atmospheric Chemistry and Physics, 2012.

Heald, C.L., A.H. Goldstein, J.D. Allan, A.C. Aiken, E. Apel et al., Total observed organic carbon (TOOC) in the atmosphere: a synthesis of North American observations, Atmos. Chem. Phys., 8, 2007–2025, 2008.