Snapshots of Results and Improvements of Atmospheric Observations at Birkenes and Zeppelin

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Measurement Programmes

- Particle number size distribution fine
- Particle number size distribution coarse
- Aerosol scattering coefficient 3-λ
- Aerosol absorption coefficient 1-λ
- Aerosol optical depth
- Aerosol chemical main components
- PM2.5, PM10 mass concentration
- CH_4, CO_2, O_3, H_2, SO_2, NO_2, NH_3, HNO_3, Hg

- Particle number size distribution fine
- Aerosol scattering coefficient 3-λ
- Aerosol absorption coefficient 1-λ
- Aerosol optical depth
- Aerosol chemical main components
- CCN number concentration
- CH_4, N_2O, CO, CO_2, O_3, H_2, SO_2, NH_3, HNO_3
- CFCs, HCFCs, HFCs, halons, halogenated compounds

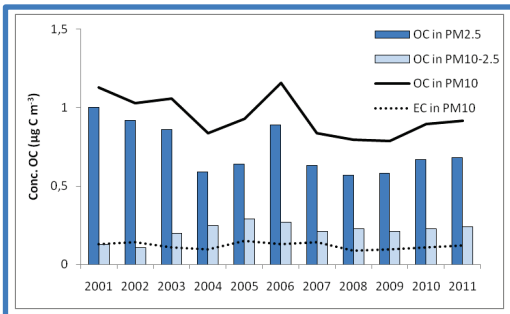


Figure 1: OC in PM_{10}, $PM_{2.5}$ and $PM_{10\text{-}2.5}$, and EC in PM_{10} at Birkenes (2001 – 2011).

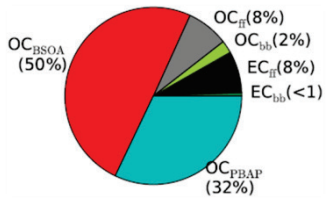
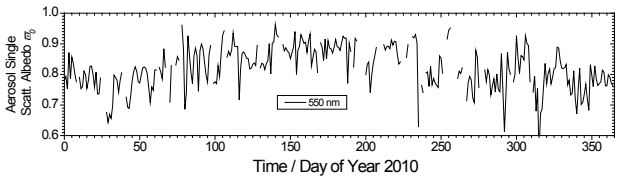


Figure 2: Best estimate (median), fractional contributions of different carbonaceous particle fractions to TCp for Birkenes PM_{10} filter samples collected during August 2009 from LHS analysis.

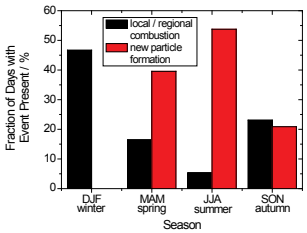
Figure 1: TOA analysis of EC/OC at Birkenes goes back to 2001, thus being the longest time series in Europe. Annual means are among the lowest in Europe; 0.95±0.13 µg C m^{-3} (OC in PM_{10}); 0.73±0.16 µg C m^{-3} (OC in $PM_{2.5}$); 0.22±0.05 µg C m^{-3} (OC in $PM_{10\text{-}2.5}$); 0.12±0.02 µg C m^{-3} (EC in PM_{10}). No trend has been observed over the 2001 – 2011 time period. The 25-30% annual contribution of OC in $PM_{10\text{-}2.5}$ to OC in PM_{10}, and occasionally 50%< contribution on a monthly basis during the vegetative season, is likely due to primary Biological Aerosol Particles (PBAP) (Yttri et al, 2007).

Figure 2: Source apportionment of the summer time carbonaceous aerosol (TCp in PM_{10}) at Birkenes, using concentrations of source specific organic tracers and their emission ratios as input to LHS statistical treatment, provided quantitative estimates of OC and EC from biomass burning (OCbb; ECbb) and fossil fuel (OCff; ECff), as well as OC attributed to biogenic SOA and PBAP. The carbonaceous aerosol was found to be totally dominated by natural sources (82%), with BSOA (50%) being the single most important source, whereas PBAP (32%) was the second most important source (Yttri et al., 2011).



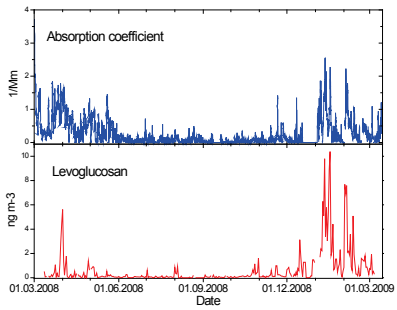
Left: 2010 time series of aerosol single scattering albedo (SSA) at Birkenes derived from filter absorption and integ. nephelometer. A distinct annual cycle with smaller SSA in winter can be detected.

Right: In an attempt to attribute the annual cycle seen in the single scattering albedo (SSA), this figure shows the seasonal frequency of occurence of local / regional combustion events (distinct Aitken-mode in particle size distribution, SSA < 0.85) and new particle formation events (occurence of "nucleation banana" in particle size distribution). It is obvious that new particle formation occurs most often in summer, together with the peak in biogenic activity, whereas local / regional combustion events occur most often in winter, likely explaining the annual cycle of the SSA.



Snapshot of Atmospheric Research at Zeppelin

Improved understanding of processes and sources of absorbing aerosols in the Arctic is crucial in order to predict future climate development and implement effective mitigation steps. Recent studies have argued that agricultural and boreal wild fires with their high emissions and proximity to the Arctic could be the most important source of Arctic BC in years of high wild fire activity (Stohl, 2006; Warneke et al., 2009). Additionally, countries bordering the Arctic are known to use substantial amounts of wood for residential heating (Yttri et al, 2009).The current study presents the first one-year time series of the wood burning tracer levoglucosan in the Arctic, measured at the Zeppelin observatory. 24 hours mean concentrations of levoglucosan were obtained from filter samples .Collocated measurements of EC (Thermal-Optical Analysis), light absorbing particles (Particle Soot/Absorption Photometer) and CO are used to interpret the results.



The results show that the mean concentration of levoglucosan observed at the Zeppelin observatory in winter is typically 2 - 3 orders of magnitude less than that reported for European urban areas in winter and 1 – 2 orders of magnitude less than that of the European rural background environment. Elevated concentrations in winter (mean ± SD; 1019 ± 1769 pg m^{-3}) compared to summer (mean ± SD; 108 ± 180 pg m^{-3}) were observed.

Outlook Birkenes

- Upgrade of aerosol absorption measurement to 3 wavelengths (Birkenes).
- Cloud Condensation Nucleus Counter (Birkenes)
- Aerosol Chemistry Speciation Monitor (ACSM) (Birkenes)
- VOC and NO_x measurements (Zeppelin).

Links to ACTRIS Partner Networks

EMEP: European Monitoring and Eval. Programme, in Convention on Long-range Transboundary Air Poll. (CLRTAP) since 1970's (Birkenes) and 1989 (Zeppelin).
ICOS: Integrated carbon observation system
InGOS: Integrated non-CO2 greenhouse gas observing system (**only Zeppelin)**
AGAGE: Advanced Global Atmospheric Gases Experiment (**only Zeppelin)**

References

Yttri, K. E., et al. (2007) :Elemental and organic carbon in PM10: A one year measurement campaign within the European Monitoring and Evaluation Programme EMEP.*Atmos. Chem. Phys.*, *7*, 5711-5725. doi:10.5194/acp-7-5711-2007.

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