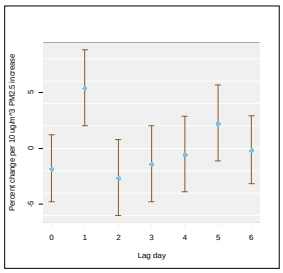
Variations in the concentrations of ultrafine particles and PM in relation to particle sources and meteorological conditions in Tartu, Estonia

Hans Orru[1], Marko Kaasik[1], Meelis Eller[1], Janek Uin[2], Sander Mirme[1], Aadu Mirme[1], Erik Teinemaa[3], Urmas Hõrrak[1]

[1]University of Tartu, [2]Brookhaven National Laboratory, [3]Estonian Environmental Research Centre

Introduction

- Fine particles have significant effect on Estonians' health
  - Ultrafine particles (UFP) of size <100 nm have been recently largely highlighted due to their high penetration level and health risks



Läll et al., 2013

Aim

- The aim of the study was to examine the impact of street traffic and domestic heating to particle concentration and to find out, how this impact is altered by other pollutants and weather, and micrometeorological parameters

Study sites and periods

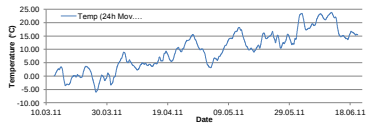
- Urban background air quality monitoring station in Tartu
  - 30 meters from the nearest street, Influenced by local heating district
- Regular monitoring of NO_2, SO_2 and O_3
- Particle concentrations were measured by Electrical Aerosol Spectrometer (EAS), with the size distribution 3.16 nm – 10 μm
- Measurements June 2011 – April 2012
- Meteorological data from Külitse station (near-by Tartu)

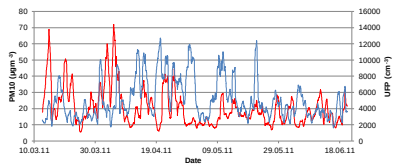
Measurement campaigns

- 11.03.2011 – 20.06.2011 (spring/summer)
- 10.10.2011 – 21.02.2012 (autumn/winter)

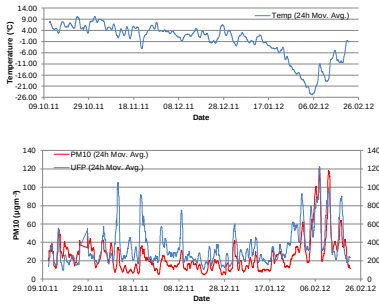
- 3 interesting periods from the campaigns
  - Early spring: 12.03.2011 – 20.04.2011
  - Late spring: 20.05.2011 – 19.06.2011
  - Winter: 27.01.2012 – 11.02.2012

Spring/summer campaign 12.03.2011-19.06.2011





Autumn/winter campaign
11.10.2011-21.02.2012

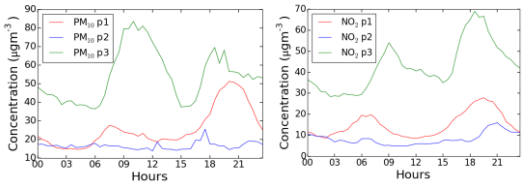


Daily averages
PM_{10}, NO_2

p1 marks the early spring period (12.03-20.04.2011)

p2 is the late spring period (20.05-19.06.2011)

p3 the winter measurements (27.01-11.02.2012)



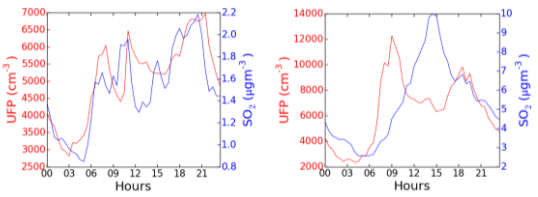
Daily averages
UFP, SO_2

Early spring period

(12.03-20.04.2011)

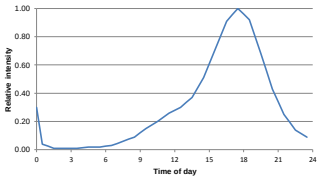
Winter measurements

(27.01-11.02.2012)

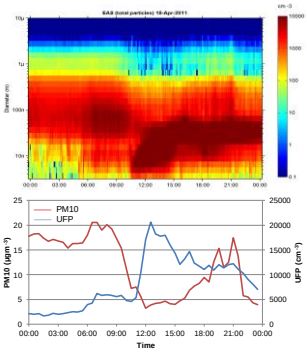


Residential heating intensity and morning inversions in Tartu

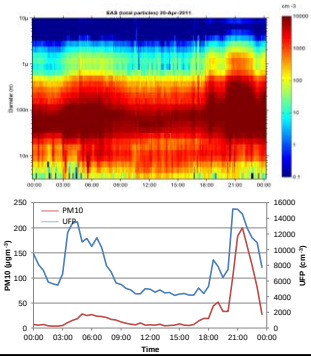
- Morning winter UFP peak largely caused by inversion
- Afternoon winter UFP peak caused by high intensity of burning fuels (mainly wood) in households
  - Questionnaire study in 2006–2007 (Kaasik et al., 2007)



UFP and PM_{10}
18.04.2011



UFP and PM_{10}
20.04.2011



Factor analysis

- In all periods first factor is dominated by nitrogen oxides and anti-correlated with O_3
  - More pronounced in autumn-winter campaign and reaching its extreme in cold period
- The UFP concentrations are following the same pattern, again more strictly in autumn and winter
- The solar radiation and wind are anti-correlated with the combustion pollution complex in spring, but almost no relation is seen in autumn and winter
- The strong diurnal cycle of radiation-induced turbulence in spring and early summer is obviously changing dramatically the dispersion conditions, whereas in colder season the difference is less pronounced

Conclusions

- Local heating especially important in the evening local heating peak in colder periods
- Traffic especially important during morning and afternoon rush hours
- Highest concentrations of UFPs during nucleation events at spring time
  - High concentrations on PM_{10} at spring time due to road dust resuspension (use of studded tires)
- Highest PM and trace gas concentrations in winter (particularly in high-pressure area)

Thank you!

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