Characteristics of $PM_{2.5}$ aerosol particles during a heat wave in an urban atmosphere in southwest Germany

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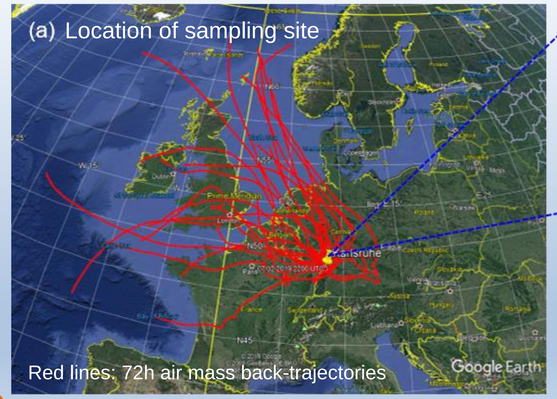
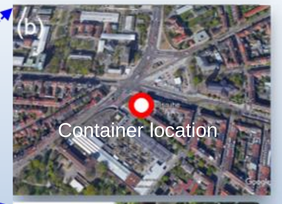
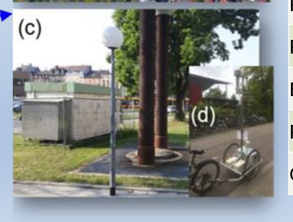
Introduction

Aerosol particles have significant impacts on climate, air quality, and human health[1]. Their characteristics are especially important in urban atmospheres during special meteorological conditions like heatwaves[2]. Here we conducted a 4-week measurement campaign at an urban kerbside in the city of Karlsruhe in southwest Germany from June 28th to July 29th, 2019. A high resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS) was used to measure non-refractory aerosol compositions of $PM_{2.5}$ online. An optical particle counter (OPC) and an aethalometer (AE51) were simultaneously co-located to measure $PM_{2.5}$ particle mass and black carbon (BC), respectively. Filter samples were also collected for the characterization of oxygenated organic molecular compounds using a chemical ionization mass spectrometer (FIGAERO-CIMS)[3].

Methods

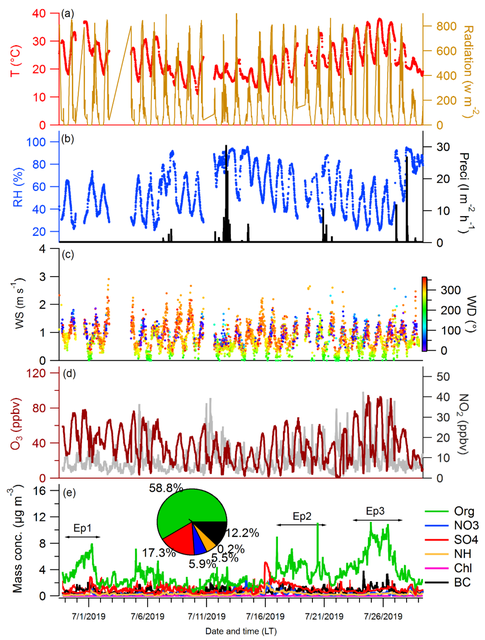


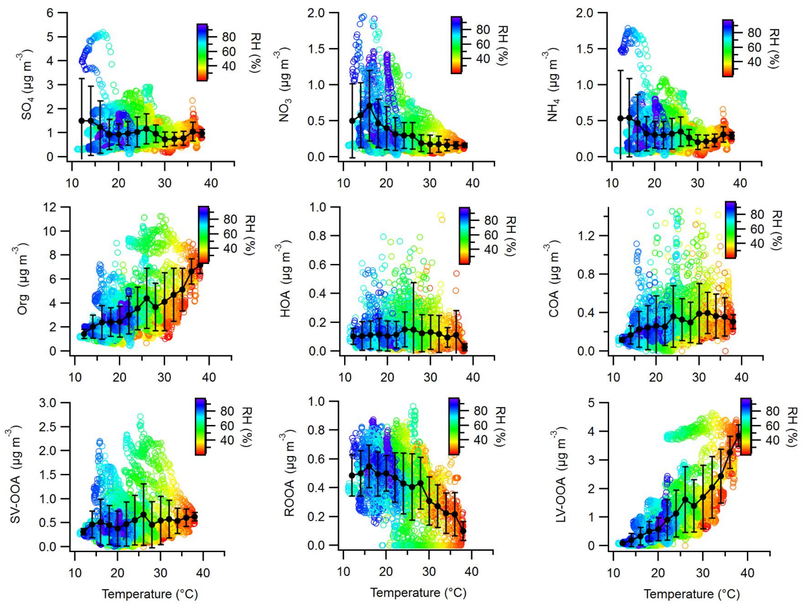


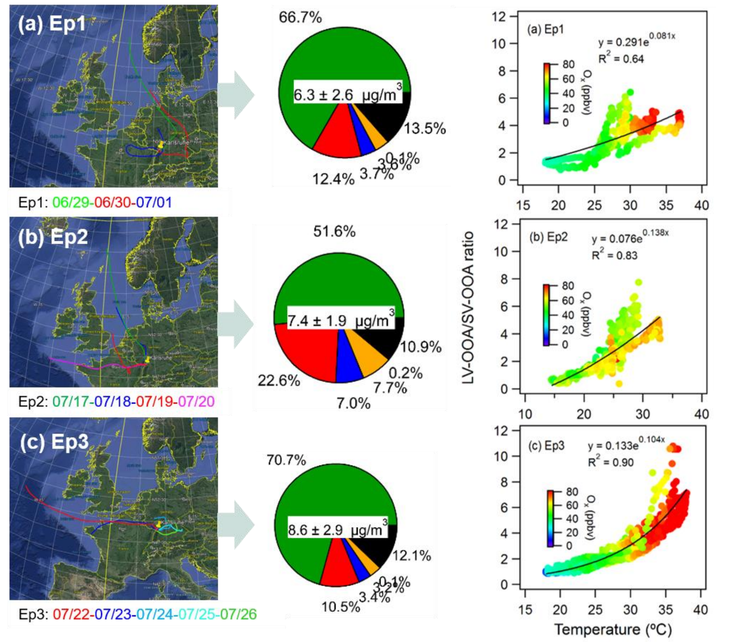


Container measurement	Instruments
Meteorology (RH, T,WS, WD, Radiation and rain)	WS700
Trace gases (O3 and NO2)	O341M/AS32M
Particle number concentration	CPC3776
Particle optical concentration and size	FIDAS200
Particle size and number concentration	NanoScan-SMPS
Black carbon (BC)	AE51
Particle mass and size of non-refractory PM2.5	HR-ToF-AMS
Offline filters	FIGAERO-CIMS

Results and discussion







- Non-refractory $PM_{2.5}$ average concentrations of (4.9 ± 2.3) µg m^{-3} dominated by organic components (Org).
- Three organic-rich episodes coincided with high temperatures and O_3 concentrations.
- PMF analysis resolved five OA factors: HOA, COA, SV-OOA, ROOA, LV-OOA
- Higher concentrations of SOA than POA indicate strong photochemical oxidation
- High temperatures facilitated the production of organics, especially of low volatile OOA, while secondary inorganic components were reduced in the particle phase
- Ep2 mainly influenced by westerly air masses and showed higher fraction of SO_4.
- Ep1 and Ep3 influenced by easterly air masses and showed higher fractions of Org.
- Ratios of LV-OOA/SV-OOA correlated exponentially with temperature, implying the importance of biogenic SOA enhancement during heatwaves

Conclusions and future work

- **Organics were the dominant component in non-refractory $PM_{2.5}$ and positively correlated with temperature.**
- **Exponential relationship between LV-OOA/SV-OOA ratios and temperature implies an important contribution of biogenic SOA formation even at an urban kerbside.**
- **Future work will focus on the link between AMS OA factors and specific oxygenated organic molecules.**

References

[1] García-Herrera et al., (2010) Crit. Rev. Env. Sci. Tec., **40**, 267-306.
[2] IPCC (2013) Climate Change, Cambridge University Press.
[3] Huang et al., (2019) Atmos Chem. Phys, **19**, (18) 11687-11700.

Acknowledgements

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