Chemical characterization of sub-micrometer aerosol particles in the tropical Atlantic Ocean: marine and biomass burning influences

Manuela van Pinxteren[1], Björn Fiedler[2], Dominik van Pinxteren[1], Yoshiteru Iinuma[1], Arne Körtzinger[2] and Hartmut Herrmann[1]

[1] Leibniz-Institut für Troposphärenforschung (TROPOS), Atmospheric Chemistry Department (ACD), Permoserstr. 15, 04318 Leipzig, Germany
[2] GEOMAR Helmholtz-Centre for Ocean Research Kiel, Department Chemical Oceanography, Düsternbrooker Weg 20, 24105 Kiel Germany

SOPRAN Surface Ocean Processes in the Anthropocene

TROPOS Leibniz Institute for Tropospheric Research

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Introduction

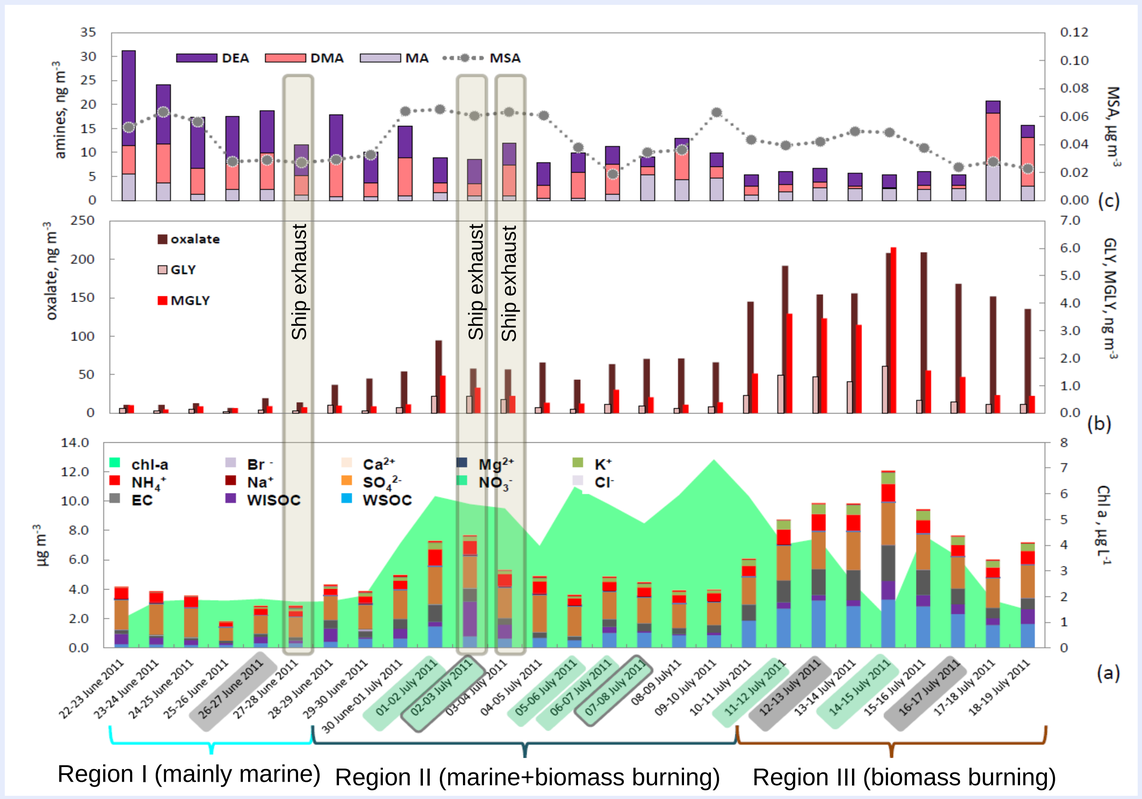
- Aerosol particles in the marine boundary layer are a complex mixture of different sources.
- Natural formed aerosol particles can be injected to the atmosphere via bubble bursting and the transfer of trace biogenic oceanic trace gases and their subsequent condensation on aerosol particles.
- These natural formed aerosol particle can be influenced by continental outflows (industry, ship emissions)
- The chemical nature and the origin of fine particles over the oceans are still largely unknown.
  ⇨ mainly due to insufficient spatio-temporal coverage of in-situ measurements and the lack of identification and quantification of organic compound groups and single organic species
- Especially in the southern hemisphere measurements are sparse.

Objectives

- This work presents the results of aerosol sampling during the *RV MARIA S. MERIAN cruise MSM 18/3*, which travelled from Cape Verde to Gabon from 22nd June – 21st July 2011.
- The main aim was to study marine aerosol chemical composition in the tropical Atlantic region, with a special focus on the influence of equatorial upwelling.
- It should be elucidated if oceanic productivity in upwelling areas would influence aerosol composition.
- Detailed chemical analysis of marine aerosol composition was combined with information regarding air mass origin and meteorological and biogeochemical parameters to elucidate the characteristics of marine aerosols and to reveal their sources.

Results

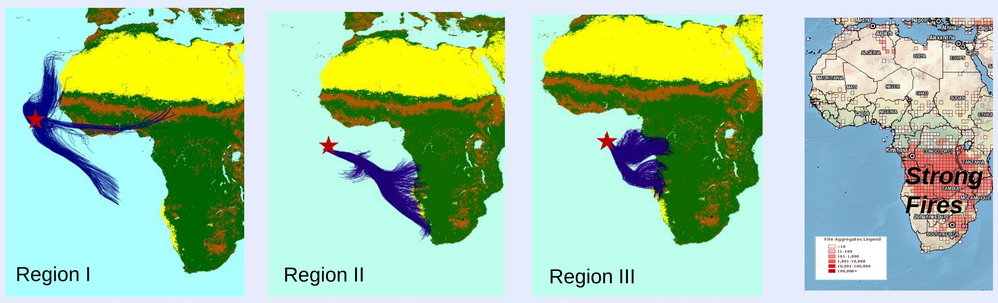
Chemical composition of aerosol particles and backwards trajectories



n-alkanes

0.81 ng m^{-3} 1.85 ng m^{-3} 4.57 ng m^{-3}

- PM_1 concentrations reached a maximum in Region III.
- Strong correlation between OC, EC and potassium.
- High WISOC concentration along the entire cruise.
- Increasing n-alkane concentrations along the cruise.
- Such high concentrations are unlikely to be of solely marine origin.
- Point to additional sources.



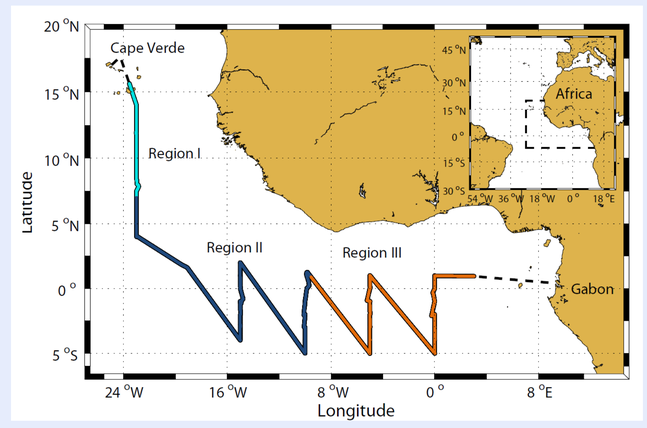
Concentration of inorganic and organic parameters (sum and single compounds) together with air mass back trajectories (http://www.arl.noaa.gov/ready/hysplit4.html) and fire maps (http://firms.modaps.eosdis.nasa.gov/firemap)

Acknowledgement

The authors acknowledge the Bundesministerium fuer Bildung und Forschung (BMBF) for funding within the SOPRAN phase II project (FK:03F0662J).

Sampling:

- Aerosol particle sampling with a high-volume Digitel sampler (DHA-80)
- Sampler was on the top of the observation deck (15m height)
- Aerosol particles (PM1) were collected on preheated quartz fiber filters
- Sampling time was 24 h
- After sampling, filters were stored in aluminum boxes at -20° C and transported in dry ice to the TROPOS laboratories in Leipzig

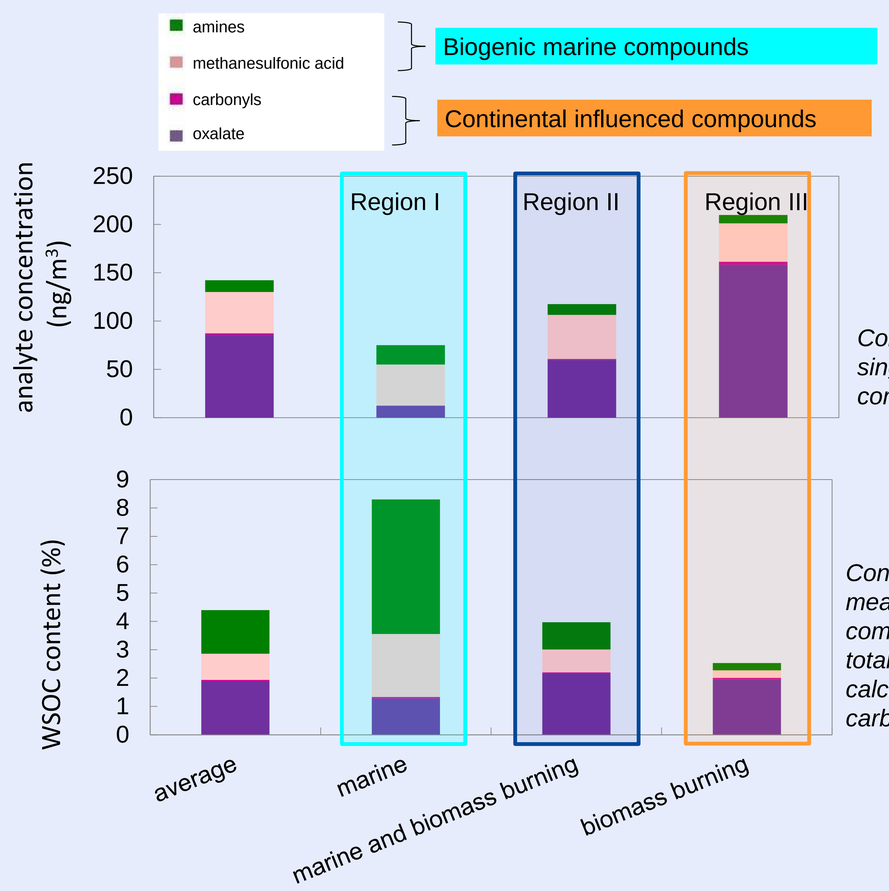


Cruise track with identified regions of the RV MARIA S. MERIAN cruise MSM 18/3.

Chemical Analysis:

- Sum parameters:
- OC/EC: thermal-optical method after the EUSAAR 2 protocol
- WSOC: non-dispersive infrared determination with a TOC-VCPH analyzer
- WISOC: calculated as the difference between OC and WSOC
- Single compounds:
- Amines, oxalic acid and inorganic ions: IC
- MSA : CE-DAD
- Sugars: HPAEC-PAD,
- Carbonyls: GC-MS
- PAHs, hopanes, alkanes: CPP-GC-MS
- Chlorophyll-a: FLD

WSOC compounds



Concentration of single organic compounds.

Contribution of the measured organic compounds to the total WSOC fraction calculated on a carbon basis.

Summary

➢ Three main Regions of the Cruise could be established.

➢ The high concentrations of water-insoluble organic carbon along the cruise suggest upwelling influences on the local aerosol composition.

➢ Due to strong external influences from biomass burning, a quantitative upewlling effect couldn´t be ascertained from these measurements.

Reference

These results are published in:
M. van Pinxteren , B. Fiedler, D. van Pinxteren ,Y. Iinuma , A. Körtzinger and H. Herrmann, J Atmos. Chem. 2015, *in press*