

Mass concentration and mineralogical composition of the boundary layer aerosol at Tinfou, Morocco and at Praia, Island of Santiago, Cape Verde



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Umweltmineralogie

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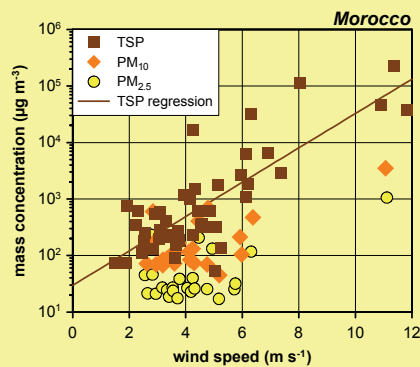
Introduction

The Saharan Mineral Dust Experiment (SAMUM) is dedicated to the understanding of the radiative effects of mineral dust. A joint field campaign focused on the investigation of fresh Saharan dust was carried out in the region of Tinfou, south east Morocco. A second field campaign was performed at the Cape Verde Islands to address the changes of the mineral dust by aging and admixture of marine and biomass burning aerosols. Ground-based and airborne measurements were performed in the early summer season in Morocco, where mineral dust from the central Sahara is transported towards the measurement region. At Cape Verde Islands, measurements were performed in winter, when mineral dust transport occurs in the boundary layer and biomass burning material is transported aloft.

Methods

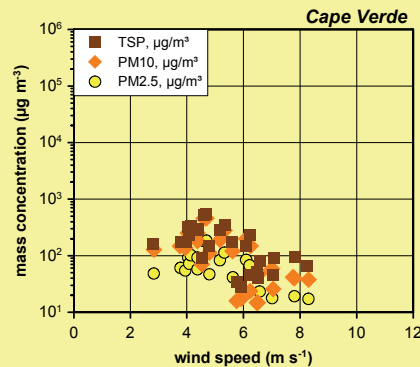
The samples were collected with an isokinetic and isoaxial filter sampler (total suspended particles) and with two filter samplers following a rotating-drum pre-impactor with cut-offs of 2.5 µm and 10 µm aerodynamic diameter. The sampling equipment at Tinfou, Morocco, was installed 4 m above ground (30°14'15" N, 5°36'29" W, 684 m asl.) on the Drâa river flood plain; at Cape Verde it was installed 3 m above ground (14°56'51" N, 23°29'4" W, 109 m asl.) on the airport of Praia, Island of Santiago. The particle mass was measured by filter gravimetry. The sampled air volume was determined by gas mass flow meters and corrected for ambient temperature and pressure. Mineralogical composition was determined by X-ray diffraction.

Dependency of aerosol mass concentrations on wind speed



For Morocco, the graph above shows the dependency of the aerosol mass concentrations on the average wind speed during the sampling period. A correlation exists mainly for the TSP concentrations indicating the local production of the large particles which dominate the TSP. For PM₁₀ and PM_{2.5} concentrations the dependency is less significant. From the regression line a background TSP concentration at zero wind speed of 30 µg m⁻³ can be estimated.

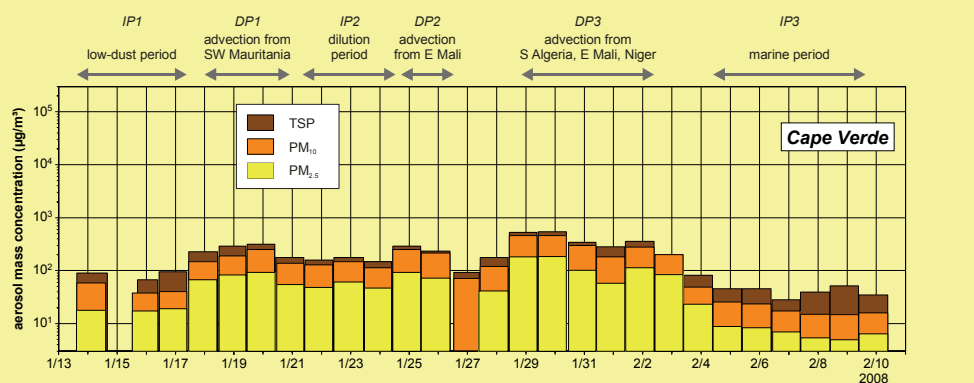
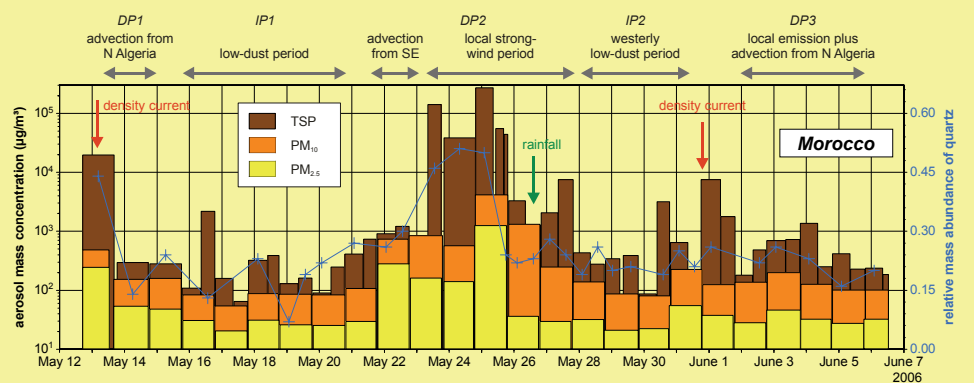
At Cape Verde an anticorrelation exists between mass concentrations and wind speed (see graph below), which is expression of the meteorological situation – weak easterly winds – associated with mineral dust transport. As to be expected, the strong northerly and westerly winds observed didn't carry mineral dust.



Acknowledgments

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Aerosol mass concentrations at Morocco and at Cape Verde Islands with characteristic synoptic situations



While the minima of the TSP concentrations in Morocco and the Cape Verde Islands are in the same order of magnitude, the maxima in Morocco are higher by a factor of 500. For PM₁₀ and PM_{2.5} the differences are much less pronounced. The mass concentrations at Morocco show a much higher short-term temporal variability, mainly for the TSP values, which is caused by the vicinity of the dust sources. While the geometric mean ratio of TSP to PM₁₀ in Morocco is 5.7, the value of 1.5 at Cape Verde illustrates the sedimentation loss of the largest particles during transport.

Mineralogical composition

For Morocco (graph on the right), two main meteorological situations can be distinguished in terms of aerosol mineralogical composition: dust storm and low-dust conditions. During dust storms the quartz content is strongly enhanced. Otherwise the mineralogical composition shows only minor temporal variability. The most abundant components in Morocco are quartz, illite and K-feldspar.

For Cape Verde, only preliminary results are available. During the dilution period of the last dust event on February 4th/5th, the presence of quartz, muscovite, kaolinite, gypsum and sodium chloride could be detected with an abundance of each of more than 10 %, indicating a clay mineral composition differing from the Moroccan one.

