Atmospheric Dry Deposition in the Central Mediterranean Seen from a Single-Particle Perspective

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Aerosol dry deposition, a primary mechanism for atmospheric particle removal and environmental transfer, remains incompletely understood. Among other effects, the a priori unknown size distribution of the aerosol in general and the deposition in particular in conjunction with missing statistics hampers the progress, for example with respect to a better model representation of the dry deposition cycle.

In the frame of a dry deposition network – names XMed-Dry – we have measured aerosol dry deposition in several locations across the Mediterranean from Spain to Cyprus. Here, we will present data from time series obtained at Lecce (Italy) and San Lawrenz (Malta). While for Lecce information is available from 2017–2025, we will focus here on the period spring 2017 – spring 2018, for which data is available at both stations.

Dry deposition was collected with a simple sampler consisting of two parallel plates, where the acceptor surface, a 25 mm electron microscopy stub with a pure carbon adhesive as surface, is positioned level with the lower plate. The sampler features a rain protection, which is triggered by an optical rain sensor to close the system in case of rain. Samples were exposed 48 – 72 hours to the atmosphere, before they were stored in a dry environment. For the given period, all samples were analyzed in a scanning electron microscope with energy-dispersive X-ray fluorescence, yielding size, shape parameters and elemental composition (elements with Z > 10) of each single particle. The system is controlled in a semi-automated way, allowing for a statistically significant number of particles to be analyzed. For the present work, around 660,000 particles have been analyzed.

As an example, Figure 1 shows time series of dust and sea-salt mass deposition rates for the two locations. Strong dust events can be observed for both locations, e.g. May 2017 and March and April 2018. Similarly, strong-wind periods yield a clear signal in the sea-salt deposition, e.g. June and July 2017. Generally, San Lawrenz has a higher and coarser sea-salt deposition, owing to its lower distance to the shores. Similarly, San Lawrenz shows also slightly higher dust coarse particle fractions, probably due to the shorter travel distance for Saharan dust. We observe different seasonal patterns with more dust and sea-salt between February and May, less sea-salt from June-August, more sea-salt again from August and less dust from November to January. While the sea-salt can drop nearly to zero for single time periods, dust is practically present in all samples. We will report also on other aerosol compounds like sulfate and detail the dust compositional aspects, as well as internal particle mixture.

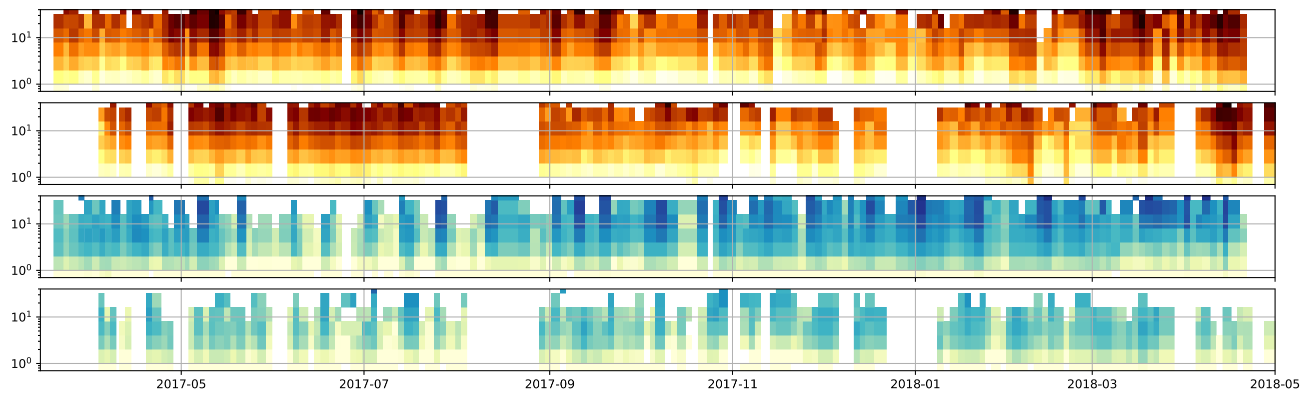

Figure 1: Time series of mineral dust (brownish) and sea-salt (blueish) mass deposition rates as function of particle volume-average diameter in µm. Colors for dM/dlogd are given on log scale covering 0.01 to 378 mg/(m²d) for dust and 0.01 to 196 mg/(m²d) for sea-salt. The upper of the same-colored plots refers to San Lawrenz, the lower one to Lecce.