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Characterization of PM10 chemical composition and its variability in relation to different sources in the central Mediterranean

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Atmospheric aerosols are estimated to play a relevant role in climate change, also in relation to global warming and to the hydrological cycle; information on aerosol sources and impact are among the data needed to constrain uncertainties in climate change models. This is particularly important in the Mediterranean basin, whose atmosphere is heavily polluted and characterized by strong influences from both natural and anthropogenic emissions. An investigation aimed at assessing the aerosol sources affecting the Central Mediterranean basin has been carried out by applying the Positive Matrix Factorization (PMF) model to a 2-year long data set of PM10 mass concentration and chemical composition of samples collected on the island of Lampedusa (35.5° N, 12.6° E, 45 m a.s.l.). Lampedusa is an ideal site for this kind of studies, as it is far from continental pollution sources (the nearest coast, in Tunisia, is more than 100 km away).
Samples were collected on a daily basis; after mass gravimetric measurements, different portions of the samples were analyzed for the ionic content by Ion Cromatography (IC), for soluble metals by Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES), and for the total (soluble + insoluble) elemental composition by Particle Induced X-ray Emission (PIXE). Data from years 2007 and 2008 are used in this study.
Seven sources were resolved: sea-salt, mineral dust, biogenic emissions, primary ship emissions, secondary sulphate, secondary nitrate, and biomass burning emissions. The chemical profiles of each source were identified and compared with literature data; the temporal evolution of each source was studied, in relation to seasonal changes and influence of different source regions. Air mass backward trajectories were also used in the analysis.
Daily absolute and relative contributions of the aerosol produced by each of the seven resolved sources to the PM10 in Lampedusa were also obtained. On average, each of the sources “primary ship emissions”, “biogenic emissions” and “biomass burning” contributes by about 5% to the total PM10 mass; “secondary nitrate” and “secondary sulphate” account for about 10% each; the “mineral dust” contribution is around 25%, while “sea-salt” constitutes about 40% of the PM10. Large variations in absolute and relative contributions are found and appear to depend on the season.