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Ageing of aerosol and their radiative properties in the Mediterranean Basin

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The VESSAER campaign (VErtical Structure and Sources of AERosols in the Mediterranean Region) identified different sources of aerosol in the Mediterranean Basin and assessed the regional impact of aerosol on cloud microphysical and radiative properties. The airborne aspect of VESSAER was conducted on an ultra-light aircraft in summer 2012. Ground-based activities included observations in the central and northern regions of Corsica, as well as aerosol LIDAR and sun photometer measurements on the eastern coast. The main scientific goals were to investigate local versus long-range sources of aerosol and cloud condensation nuclei (CCN) and their vertical structure in the lower troposphere, study evolution and ageing related to atmospheric processes, and determine aerosol direct radiative impacts over a larger spatial scale in the Mediterranean Basin.

Even though Corsica is separated by from the European continent by ca. 100 km with no immediate sources of urban aerosol, the background concentrations in Corsica were similar to those in the continental European boundary layer. The background total aerosol concentrations within the boundary layer in Corsica are nearly 2000 cm-3. Nearly all of the particles in the boundary layer (> 90%) are CCN-active at 0.37% supersaturation as they had become hygroscopic during their transport. Ageing (with respect to CCN-activity) of European emissions occurred exclusively in the boundary layer and not in aerosol layers aloft. In contrast, aerosol hygroscopicity did not change as a function of transport time in elevated aerosol layers, suggesting that photochemical ageing of less hygroscopic material is relatively slow compared to ageing processes in the boundary layer.

The vertical profiles clearly show the long-range transport of dust from the Saharan Desert and pollution from the European continent – which were the two major sources of aerosol during the campaign. Two of the research flights coincided with CALIPSO overpasses, when Saharan Dust layers are transported within the lower 5 km. Concentrations of submicron particles (Dp > 0.3 um) and aerosol optical depth showed a corresponding increase throughout the troposphere. Results of satellite overpasses, ground-based remote sensing, airborne in-situ observations and regional-scale models have been combined to assess the radiative impact of dust over the Mediterranean Basin.