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Chemical characterization and source apportionment of size-segregated aerosol collected at a urban site in Sicily

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Twelve aerosol samples were collected in Catania, on the Eastern coast of Sicily (Italy), from 16 March to 13 June 2005. The sampling was performed using an 80 L/min five-stages Berner cascade impactor with the following dimensional intervals: 0.05 – 0.14 μm, 0.14 – 0.42 μm, 0.42 – 1.2 μm, 1.2 – 3.5 μm, 3.5 – 10 μm. The samples were analysed for total aerosol mass, Water Soluble Organic Carbon (WSOC), Total Carbon (TC) and the main inorganic ionic species. The Water-Insoluble Carbon (WINC) is derived by difference: TC – WSOC. The samples share some common features: Ammonium sulphate and carbon-containing species (both soluble and insoluble) are the largest contributors of fine particle mass, while coarse particles are essentially made of sea-salt, sodium nitrate and unaccounted PM (probably crustal material). The WINC/WSOC ratio decreases from the smallest size range to the large accumulation mode range (0.42 – 1.2 μm), while nssSO_4^{-2} and NH_4^+ contribution raises. The water-insoluble carbonaceous matter is the dominant component (70 % of PM) in smallest particles (0.05-0.14 μm), but its contribution to particle mass sharply decreases towards larger diameters: 13% in large accumulation mode particles and 7% in coarse particles. By contrast, WSOC median air concentration and PM fraction both peak in the large accumulation mode size range (0.42 – 1.2 μm), therefore showing a size distribution which overlaps with those of non-volatile inorganic secondary species (ammonium sulphate). In conclusion, we identified four different aerosol types, corresponding to different sources, contributing to the total particles load of the investigated urban environment. The first source identified is vehicular traffic, producing

primary carbonaceous insoluble particles with maximum air concentration in Aitken particles and in the smallest accumulation mode particles. Secondary aerosols dominate, instead, the composition of accumulation mode particles (aerodynamic diameters between 0.14 and 1.2 μm) with main components such as WSOC and ammonium sulphate. Organic matter in this mode is more soluble indicating the presence of more oxidized functional groups, likely due to condensation of photo-oxidized gaseous organic compounds. Finally, modified (nitrate-containing) seasalt particles and mineral dust are the dominant component of coarse particles in the investigated urban environment. While the insoluble carbon particles emitted by local traffic emissions constantly occur in the samples, the concentrations of the secondary organic and inorganic components, as well as that of sea-salt particles vary between samples according to different wind regimes and occurrence of regional pollution episodes in the central Mediterranean Basin.