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Supplement of

Composition, size distribution, optical properties, and radiative effects of laboratory-resuspended PM_{10} from geological dust of the Rome area, by electron microscopy and radiative transfer modelling

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Supplementary materials

Section S1

Internal standard approach to quantification of particle elemental composition from SEM XEDS microanalysis

First, high-count spectra of particles analyzed manually in the dust sample matrix (as described in Sect. 2.2) were quantified by the standard-based routine available from EDAX control v. 3.3 package (Newbury and Ritchie, 2013); to this aim, the pure minerals available from EDAX Library have been used as standards. Long acquisition time and high counts of these spectra are expected to minimize the statistical error of quantification (Goldstein et al., 1986). From the EDAX quantification routine, the element Z (atomic number), A (absorption) and F (fluorescence) correction factors, related to the influence of the particulate matrix on X-ray losses of individual particles, are obtained for each analyzed particle of a sample.

Element ZAF mean values, differentiated by dust sample, were then obtained by averaging, within each sample, ZAF values of all analyzed particles. Finally, the sample-specific mean ZAF values were used in the quantification of particle spectra obtained by automated microanalysis. The conventional standard-based ZAF-corrected Castaingôs method was used also in this case; however, the standard element concentration and ZAF were those of the manually-analyzed particles. By this procedure, indeed, manually analyzed particles could be assumed as internal particle standard, on a sample-specific base. The reliability of quantification of manually analyzed particles, by Castaingôs first approximation approach, was evaluated in terms of accuracy with respect to mineral standards available from the EDAX Library. Results are discussed in Sect. 3.1.

Particles showing total percent weight (%wt) of the particle that could be identified below 50 (including oxygen estimated by element oxides) were not further considered in the rest of the study.

Reference XEDS spectra and elemental composition of pure minerals, to be used for particle allocation, were obtained either from the EDAX Library (biotite, clorite, calcite, diopside, kaersutite, olivine, plagioclase and quartz) or by the RRUFF project (Downs, 2006) and GEOROC (Sarbas and Nohl, 2008) open-source databases, available on the web. Minerals collected from Central Italy were preferred where possible.

Spectral matching was performed by the chi-square test for spectral goodness of fit included in the Library matching v.3.3 application (EDAX Inc., 2000). In cases where spectral matching couldn't be performed, allocation of particles to mineral species was obtained on the basis of the best fit of dust particle %wt element composition versus the composition of pure minerals, by single linear regression analysis (SLR). The reliability of the internal standard approach has been evaluated by assessing the consistency of the allocation to mineral species (which directly depends on results of quantification by internal standard approach) with XRD analysis.

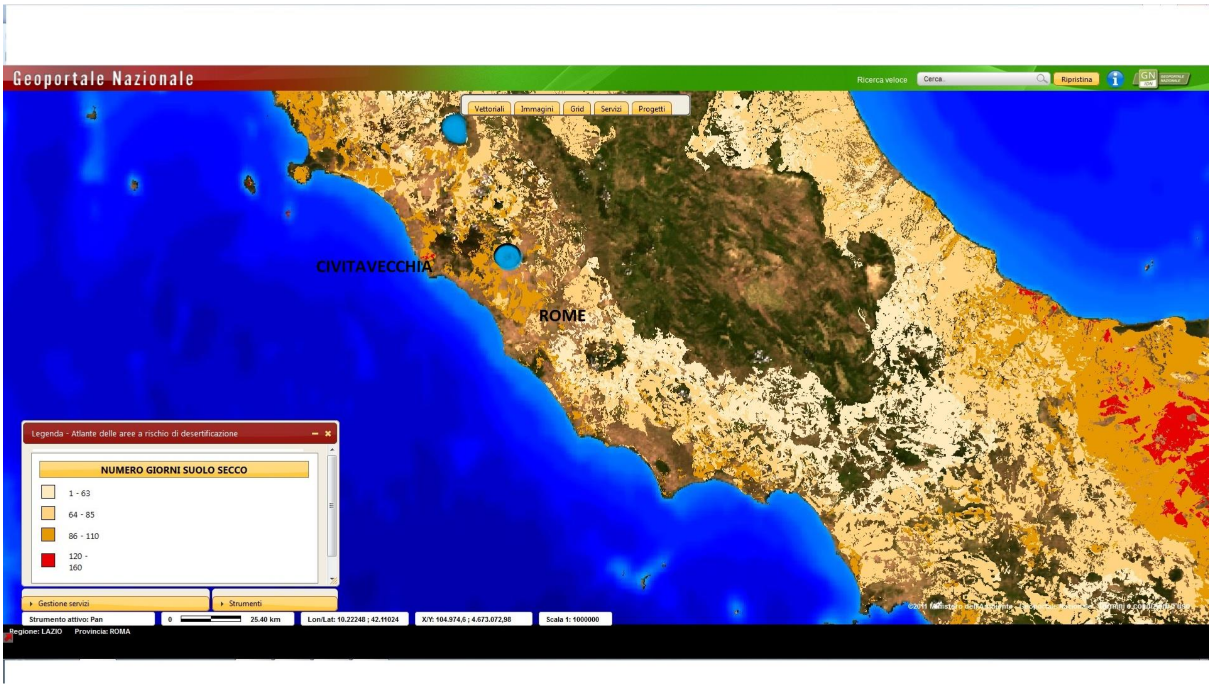

Figure S1. Map of the annual average number of dry soil days in the area of study of this work (Geoportale Nazionale MATTM, 2011). Highest number of dry soil days (86 ÷ 110) is observed in the northern zone of the study area of this work.

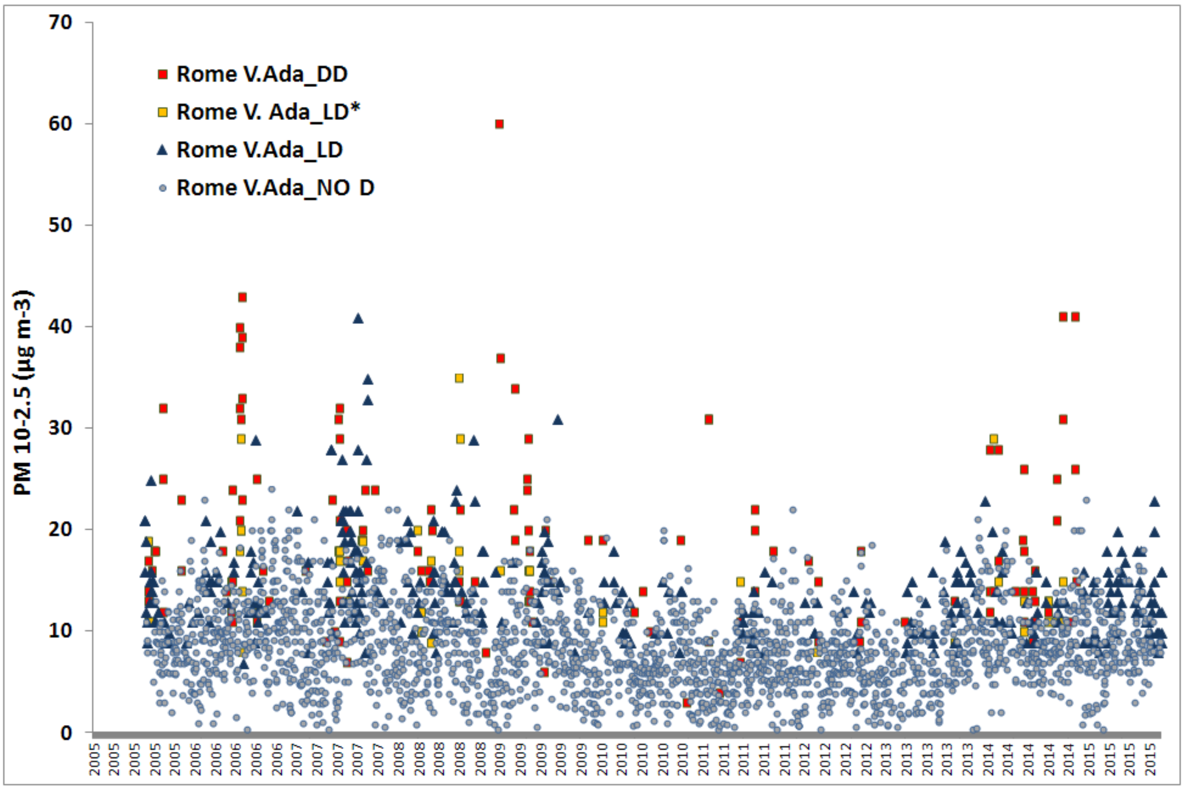

Figure S2. Daily coarse PM at Villa Ada site (urban background) in Rome, along the 2005 ï 2015 period (ARPA Lazio, 2015). Data in the plot refer to days of: desert dust intrusion at-ground (DD), local crustal contribution occurring next a DD intrusion event (LD*), local crustal contribution distant from DD events (LD) and low crustal contribution (NO D).

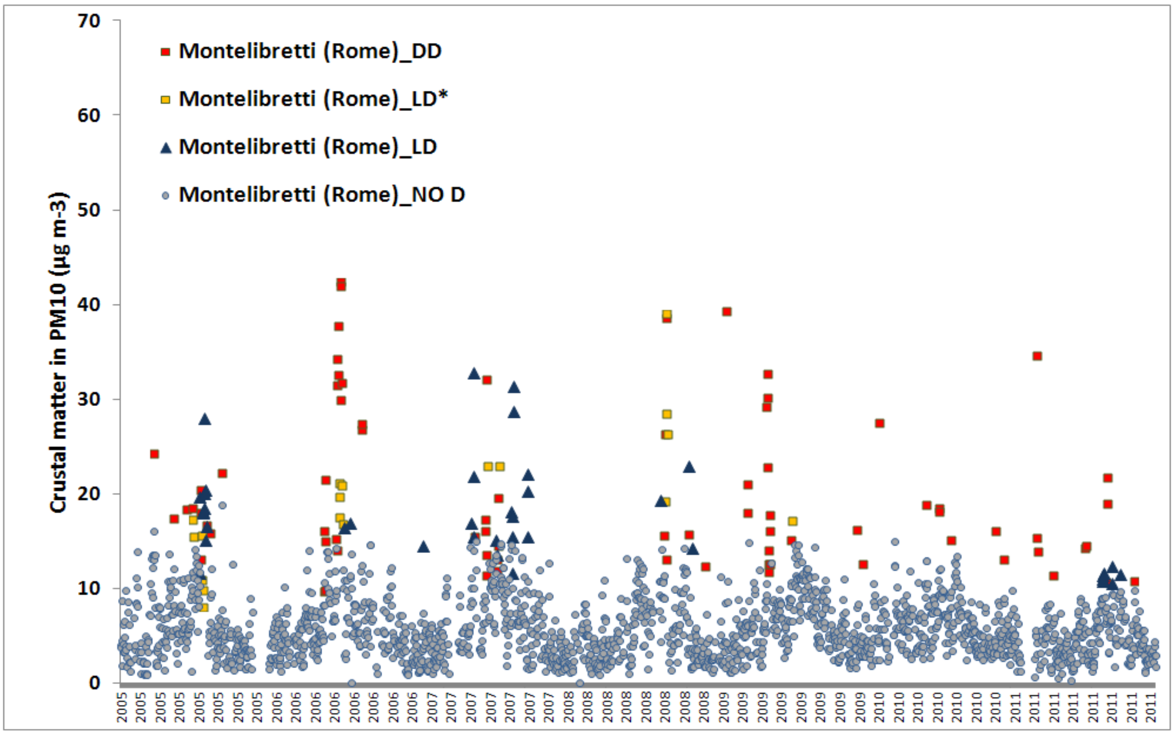

Figure S3. Daily crustal matter in the PM10 at Montelibretti (EMEP site), in Rome skirts, along the 2005 ï 2011 period (Perrino et al., 2015). Data in the plot refer to days of: desert dust intrusion at-ground (DD), local crustal contribution occurring next a DD intrusion event (LD*), local crustal contribution distant from DD events (LD) and low crustal contribution (NO D).

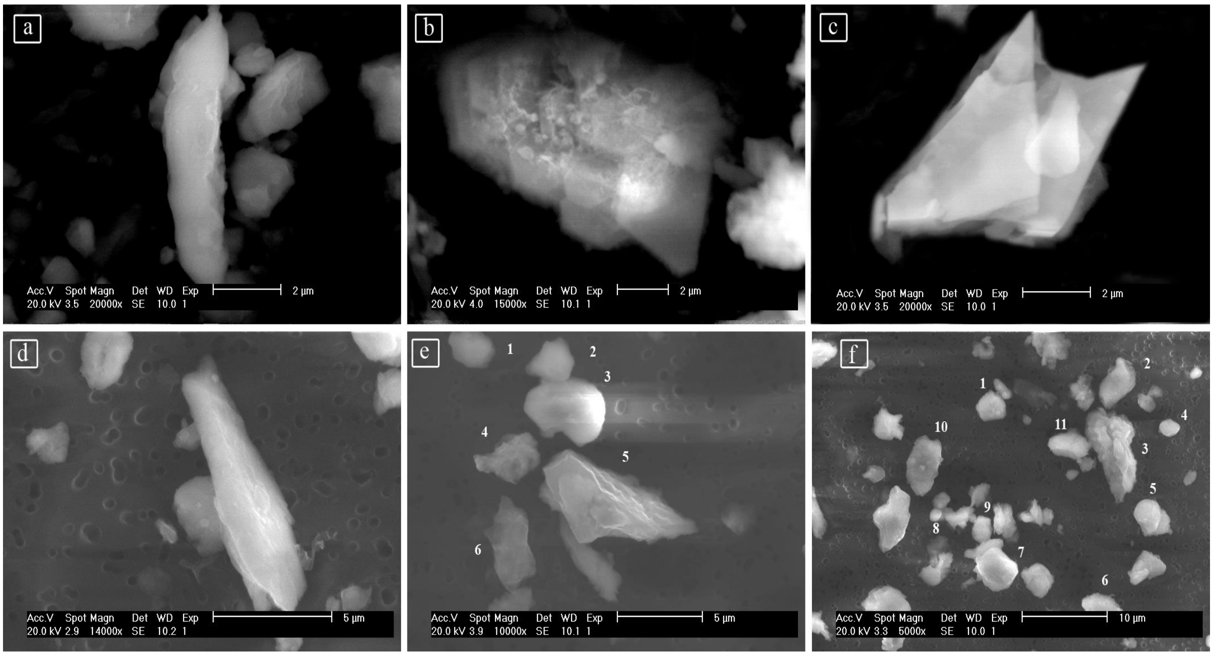

Figure S4. SEM micrographs of mineral particles identified in the study area.

Instrumental conditions are reported on each micrograph. a: Diopside; b: Mica; c: Montmorillonite; d: Muscovite; e: Calcite (particle #: 1, 2, 3), Talc, K-feldspar and Quartz (respectively, particle #: 4, 5, 6); f: Calcite (particle #: 1, 6, 7, 9), Quartz (particle #: 3, 5, 8, 10), Chabazite (particle #: 4, 11), Muscovite (particle # 2).

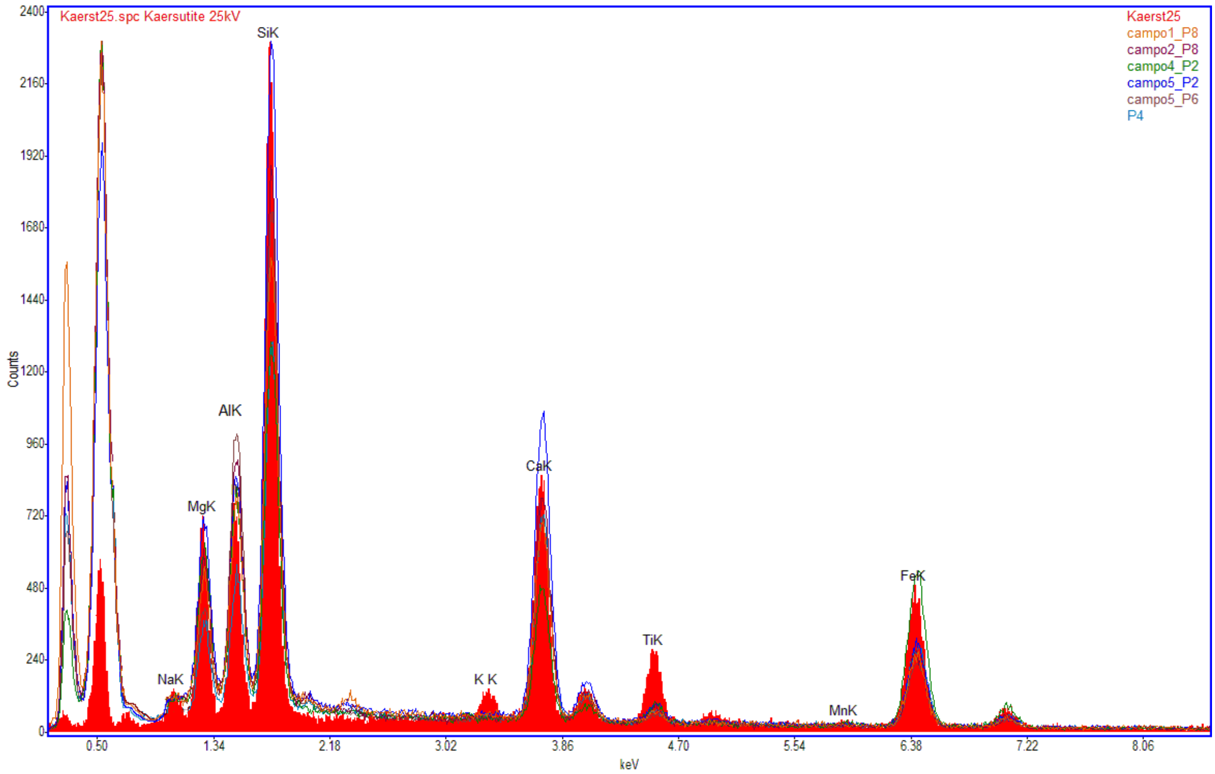

Figure S5. Overlap of high-count XEDS spectra of particles classified as Kaersutite, with respect to the EDAX spectrum of the bulk mineral standard.

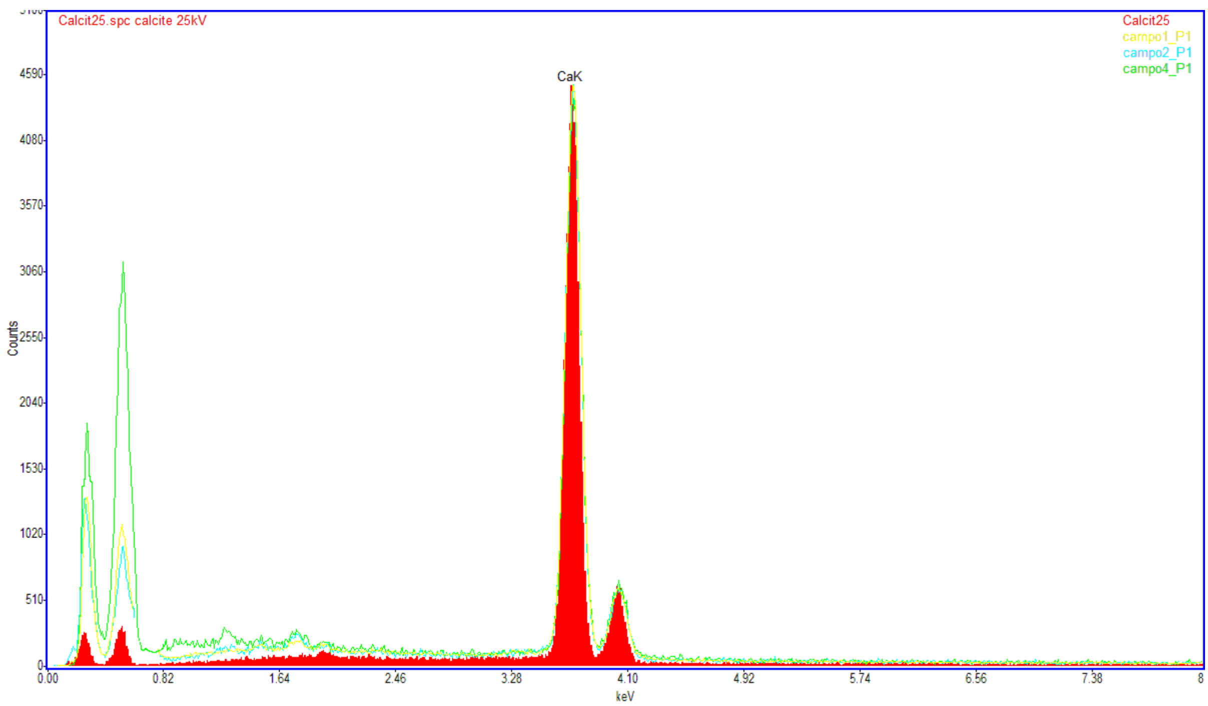

Figure S6. Overlap of high-count XEDS spectra of particles classified as Calcite, with respect to the EDAX spectrum of the bulk mineral standard.

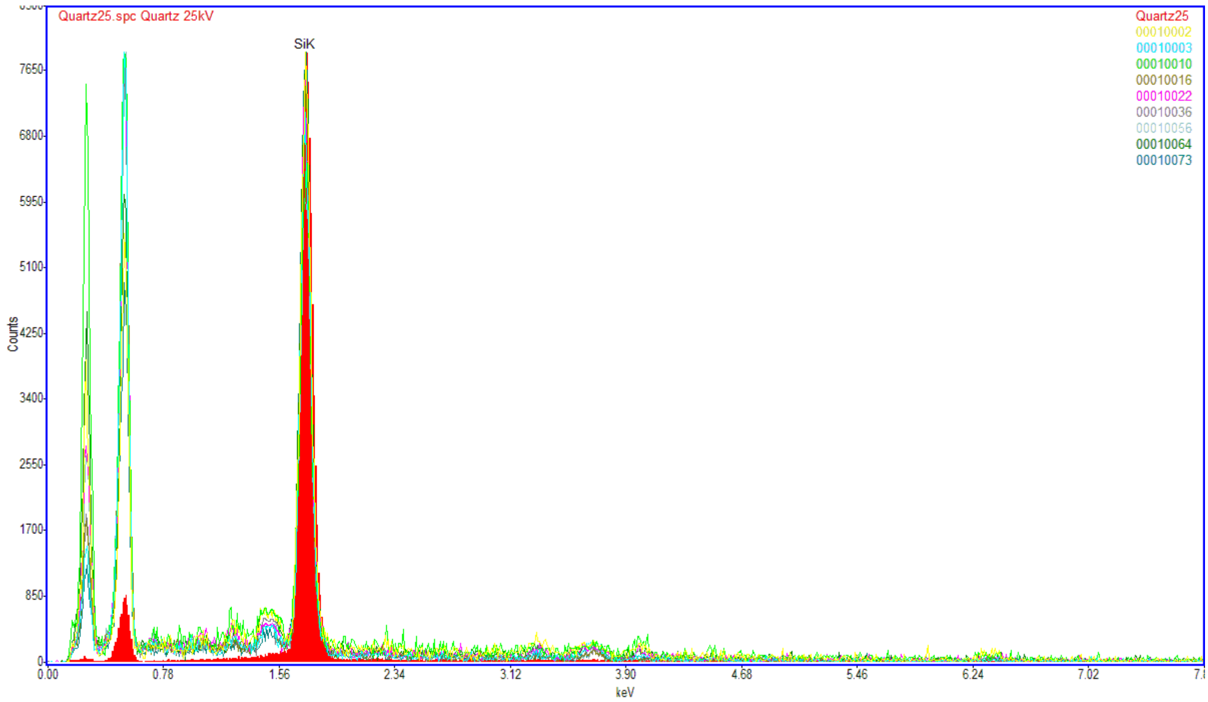

Figure S7. Overlap of high-count XEDS spectra of particles classified as Quartz, with respect to the EDAX spectrum of the bulk mineral standard.

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