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Cloud Condensation Nuclei (CCN) and Ice Nucleating Particles (INP) conversion factors based on Thessaloniki AERONET station

Eleni Giannakaki, Karageorgopoulou Archontoula, Georgoulias Aristeidis, and Koutounidis Ioannis
Department of Environmental Physics and Meteorology, Faculty of Physics, University of Athens

Several studies [1,2] have shown the potential of polarization lidar to provide vertical profiles of aerosol parameters from which cloud condensation nuclei (CCN) and ice-nucleating particles (INP) number concentrations can be retrieved. The results are based on reliable of conversion factors between aerosol optical thickness and column-integrated particle size distribution based on Aerosol Robotic Network (AERONET) photometer observations. A crucial point regarding the efficacy of aerosol particles to act as CCN or INP depends on aerosol type.

AERONET Inversion Data (Level 1.5) for Thessaloniki station were analyzed over the period 2006-2021. Following [1,2], the Ångström exponent was used to separate the particles into pollution (AE > 1.6) and dust (AE < 0.5) dominated cases. To obtain a better classification of aerosols we utilize aerosol typing from CALIPSO. Only cases which are classified as either purely dust or polluted continental aerosols within 100km from Thessaloniki are selected. The Aerosol Optical Depth (AOD) at 440 nm and the Ångström exponent (AE) 440-870 were used to calculate the AOD at 532 nm, while the AOD at 1020 nm and the AE between 870-1020 nm were used to estimate the AOD at 1064 nm. The particle volume size distribution is derived for 22 discrete radius points, spaced logarithmically at equidistant intervals. The particle number concentration (n) for each radius interval is calculated by dividing the volume concentration by the particle volume and multiplying by the spectral integral width of 0.2716. The column value of n60 is the sum of number concentrations for radius classes 2 to 22 (>57 nm), while n100 is the sum for radius classes 4 to 22 (>98 nm). The INP-relevant column n250 is the sum of intervals 8–22 plus the mean of intervals 7 and 8, while n290 the sum of 8-22. To obtain particle extinction coefficient σ (or sigma) and n60, the AOD at 532 nm and the column n60 are divided by 1000 m. For urban particles, n60 (reservoir of CCN) and n250 (reservoir of INP) were used, while n100 (CCN) and n250 (INP) were used for dust particles. Following CALIPSO aerosol typing dust conversion factors was found equal to c_{100}= 24.3±7.0 Mm cm^{-3}, x_d=0.78 ± 0.13 and c_{250}= 0.30±0.03 Mm cm^{-3}, while for polluted continental particles, were c_{60}= 31.4 ± 9.0 Mm cm^{-3}, x_c= 0.94 ± 0.12 and c_{290}= 0.089±0.002 Mm cm^{-3}.

References:

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