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Size-resolved aerosol pH over Europe during summer

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The dependence of aerosol acidity on particle size, location and altitude over Europe during a summertime period is investigated using the hybrid version of aerosol dynamics in the chemical transport model PMCAMx. The pH changes more with particle size in northern and southern Europe owing to the enhanced presence of non-volatile cations (Na, Ca, K, Mg) in the larger particles. Differences of up to 1-4 pH units are predicted between sub- and super-micron particles, while the average pH of $PM_{1\text{-}2.5}$ can be as much as 1 unit higher than that of PM_1. Most aerosol water over continental Europe is associated with PM_1, while $PM_{2.5\text{-}5}$ and $PM_{5\text{-}10}$ dominate the water content in the marine and coastal areas due to the relatively higher levels of hygroscopic sea salt. Particles of all sizes become increasingly acidic with altitude (0.5-2 units pH decrease over 2.5 km) primarily because of the decrease in aerosol liquid water content (driven by humidity changes) with height. Inorganic nitrate is strongly affected by aerosol pH with the highest average nitrate levels predicted for the $PM_{2.5\text{-}5}$ range and over locations where the pH exceeds 3. Dust tends to increase aerosol water levels, aerosol pH and nitrate concentrations for all particle sizes. This effect of dust is quite sensitive to its calcium content. The size-dependent pH differences carry important implications for pH-sensitive processes in the aerosol.

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