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The respective roles of the aerosol size distribution and chemical composition in CCN activation

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We performed measurements of size resolved cloud condensation nuclei (CCN) activation spectra at a non-urban field site in Germany (Kleiner Feldberg, situated near Frankfurt a. Main). These showed that total CCN concentrations were mainly determined by the aerosol number size distribution. Distinct variations of CCN activation with particle chemical composition were observed. For particles of the same size the critical supersaturation decreased with increasing mass fraction of inorganic ions. However, since the critical supersaturation for activation is very sensitive to particle size, the influence of the chemical composition was found to play a secondary role. An increase in inorganic ion content by more than a factor of two decreased the critical supersaturation less than a 20 nm increase in particle size. Thus, total CCN concentrations and the fraction of activated particles at a certain supersaturation are very sensitive to changes in the particle size distribution. When the temporal variation of all chemical effects on CCN activation is neglected, variations in the size distribution alone can explain 84% to 96% of the variation in CCN concentrations at various supersaturations.