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On the contribution of Aitken mode particles to cloud droplet populations at continental background areas – a parametric sensitivity study

T. Anttila and V.-M. Kerminen

Finnish Meteorological Institute, Research and Development, P.O. Box 503, 00101 Finland

Abstract. Aitken mode particles are potentially an important source of cloud droplets in continental background areas. In order to find out which physico-chemical properties of Aitken mode particles are most important regarding their cloud-nucleating ability, we calculated the number of cloud droplets formed on Aitken mode particles, CD_2 , with an adiabatic air parcel model. The model output was analyzed using a global sensitivity analysis method that quantifies and ranks the relative importance of the considered input parameters to the total variance of CD_2 . The results show that unless the particle surface tension or the mass accommodation coefficient of water is strongly reduced due to the presence of surface-active organics, the parameters describing the size distribution are generally more important than the particle chemical composition. In the absence of such compounds, the chemical composition may have roughly an equal importance with the size distribution only at low updraft velocities characterized by maximum supersaturations below 0.1%. Furthermore, the largest source of variability is generally the particle number concentration, followed by the particle size. The performed sensitivity analysis revealed that the variability of the particle chemical composition may dominate the total variation of CD_2 if: 1) the value of α varies at least one order of magnitude more than what is expected for pure water surfaces ($10^{-2}-1$), or 2) the particle surface tension varies more than roughly 30% under conditions close to reaching saturation.

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