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Is nucleation important for regional and global modelling: box model studies

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Formation of atmospheric fine particles has recently received growing experimental and theoretical interest due to their climate and health effects. The increased aerosol concentrations are largely due to secondary particle production i.e. nucleation and subsequent growth from vapours in the atmosphere. The nucleated particles, typically of the size of 1 nm, have no significance unless they grow to detectable sizes ($>$ 3 nm) and further. The growth, in turn, depends on the amount of condensable vapours present (Kulmala et al., 2000), however, at the same time the nucleated particle number concentration decreases due to coagulation. A faster growth means less time for scavenging, implying a larger survived fraction of the nucleated particles. On the other hand, the higher the condensable vapour concentration the larger the condensation sink and competition nucleation becomes less efficient. Modelling nucleation and subsequent growth is a difficult task especially in global and regional models. Therefore it is important to know under which conditions the freshly nucleated particles are able grow to the Aitken mode sizes and further to cloud condensation nuclei thus affecting climate. By using a sectional aerosol dynamics model AEROFOR at various conditions, the regions of parameter space in which nucleation plays an important role are identified and the contour plots are presented (Pirjola et al., 2004). Sulphuric acid is assumed to participate in both nucleation and condensation processes, additionally there is present some other condensable vapour. Our simulations show that nucleation is an important process in the atmosphere excluding the cases when condensable vapour concentration is not high enough so that the nucleated particles have time to coagulate away before reaching the Aitken mode sizes. Thus it is well established to include

nucleation in regional/global models.

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