Publication

# Chemical and physical influences on aerosol activation in liquid clouds: a study based on observations from the Jungfraujoch, Switzerland

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A simple statistical model to predict the number of aerosols which activate to form cloud droplets in warm clouds has been established, based on regression analysis of data from four summertime Cloud and Aerosol Characterisation Experiments (CLACE) at the high-altitude site Jungfraujoch (JFJ). It is shown that 79aEuro-% of the observed variance in droplet numbers can be represented by a model accounting only for the number of potential cloud condensation nuclei (defined as number of particles larger than 80aEuro-nm in diameter), while the mean errors in the model representation may be reduced by the addition of further explanatory variables, such as the mixing ratios of O-3, CO, and the height of the measurements above cloud base. The statistical model has a similar ability to represent the observed droplet numbers in each of the individual years, as well as for the two predominant local wind directions at the JFJ (northwest and southeast). Given the central European location of the JFJ, with air masses in summer being representative of the free troposphere with regular boundary layer in-mixing via convection, we expect that this statistical model is generally applicable to warm clouds under conditions where droplet formation is aerosol limited (i.e. at relatively high updraught velocities and/or relatively low aerosol number concentrations). A comparison between the statistical model and an established microphysical parametrization shows good agreement between the two and supports the conclusion that cloud droplet formation at the JFJ is predominantly controlled by the number concentration of aerosol particles.
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