Overview on ACTRIS cloud condensation nuclei measurements results

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Cloud condensation nuclei (CCN) are aerosol particles with the ability to activate into droplets at a given super saturation and therefore influence the microphysical and optical properties of clouds. To predict cloud radiative properties understanding the spatial and temporal variability of CCN concentrations in different environments is important. However, currently, the effects of atmospheric particles on changes in cloud radiative forcing are still the largest contribution of uncertainty in climate forcing prediction (IPCC, 2013).

This study presents preliminary results of CCN measurements between 2012 and 2014 from several stations of the ACTRIS network (http://www.actris.net/). In addition, aerosol size distribution and chemical composition are analysed, as CCN activity also depends on particle size and chemistry. Stations operating CCN counters span the area between 9°W and 26°E, and 35 to 62°N. This enables temporal and spatial characterization and comparison of CCN variability in a number of different atmospheric regimes such as marine, continental, boreal and Mediterranean environments as well as boundary layer and free tropospheric conditions.

For example, the aerosol populations and their activation behaviour show significant differences at the following three stations: Cabauw, the Netherlands (rural background, maritime and continental influence, abbreviated as Cab); Hyytiälä, Finland (rural background, boreal environment, Hyy); Jungfraujoch, Switzerland (high alpine site, 40 % free troposphere, continental background, JFJ). While at Cab PM_1 ammonium nitrate dominates the bulk aerosol composition, organics prevail at the other sites (see Figure 1). The annual cycle of aerosol mass and composition is most pronounced at JFJ. In Hyy, peak mass concentrations are observed in June while concentrations are lower in spring and fall. In Cab, concentrations are higher during winter and spring than in summer and fall. The medians of total particle numbers are a factor 3 to 4 higher at Hyy and a factor 10 higher at Cab compared to JFJ. The monthly averages of geometric mean diameters of the particle number size distributions show a seasonal cycle at JFJ and are largest in summer. Also at Hyy a cycle is visible with larger diameters in winter and summer while at Cab no seasonal pattern is observed.

The annual cycles of geometric mean diameters and total aerosol number are reflected in the total number of activated aerosol particles at different supersaturations. Comparing the activated fraction of particles at 0.1 % SS with that at 1 %, we find that at JFJ around 90 % fewer particles activate, at Hyy between 80 and 90 % fewer and at Cab 60 to 70 %. This implies that the chemical composition might play a role at lower SS.

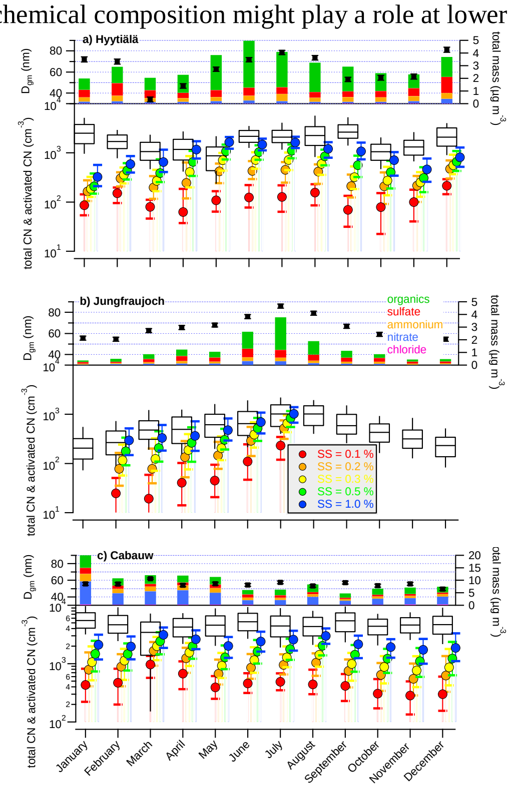

Figure 1: Annual cycle of various aerosol chemical and microphysical parameters at Hyytiälä, Jungfraujoch and Cabauw (all concentrations are in STP).

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IPCC (2013) *Summary for Policymakers in Climate Change 2013: The physical science basis*, Cambridge University Press.