Geophysical Research Abstracts
Vol. 18, EGU2016-8951, 2016
EGU General Assembly 2016

Global synthesis of long-term cloud condensation nuclei observations

Julia Schmale (1), Silvia Henning (2), Frank Stratmann (2), Bas Henzing (3), Patrick Schlag (4,5), Pasi Aalto (6), Helmi Keskinen (6,7), Karine Sellegri (8), Jurgita Ovadnevaite (9), Mira Krüger (10), Anne Jefferson (11), James Whitehead (12), Ken Carslaw (13), Seong Soo Yum (14), Adam Kristensson (15), Urs Baltensperger (1), Martin Gysel (1), and the CCN Team (16,17,18) Team

(1) Paul Scherrer Institute, Villigen, Switzerland (julia.schmale@psi.ch), (2) Leibniz Institute for Tropospheric Research, Leipzig, Germany, (3) Netherlands Organisation for Applied Scientific Research, Utrecht, The Netherlands, (4) Forschungszentrum Jülich, Germany, (5) University of Utrecht, The Netherlands, (6) University of Helsinki, Finland, (7) Hyytia¨la¨ Forestry Field Station, Korkeakoski, Finland, (8) Observatoire de Physique du Globe de Clermont-Ferrand, University of Clermont-Ferrand, France, (9) National University of Ireland Galway, Ireland, (10) Max Planck Institute for Chemistry, Mainz, Germany, (11) National Oceanic and Atmospheric Administration, Boulder, US, (12) University of Manchester, Manchester, UK, (13) University of Leeds, Leeds, UK, (14) Yonsei University, Seoul, South Korea, (15) University of Lund, Sweden, (16) University of Sao Paulo, Sao Paulo, Brazil, (17) University of Crete, Heraklion, Greece, (18) Energy Research Centre of the Netherlands, Petten, The Netherlands

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).

Numerous intensive field campaigns have already explored detailed characteristics of CCN in many locations around the world. However, these rather short-term observations can generally not address seasonal or inter-annual variations and a comparison between campaign sites is difficult due to the higher influence of specific environmental circumstances on short-term measurements results. Here, we present results of more long-term CCN and aerosol number concentrations as well as size distribution data covering at least one full year between 2006 and 2014. The 12 locations include ACTRIS stations (http://www.actris.net/) in Europe, and further sites in North America, Brazil and Korea.

The sites are located in different environments allowing for temporal and spatial characterization of CCN variability in different atmospheric regimes. Those include marine, remote-continental, boreal forest, rain forest, Arctic and monsoon-influenced environments, as well as boundary layer and free tropospheric conditions.

The aerosol populations and their activation behavior show significant differences across the stations. While peak concentrations of CCN are observed in summer at the high altitude sites, in the Arctic the highest concentrations occur during the Haze period in spring. The rural-marine and rural-continental sites exhibit similar CCN concentration characteristics with a relatively flat annual cycle. At some stations, e.g. in the boreal environment, the annual cycle is more pronounced for higher SS. Geometric mean diameters of aerosol populations as well as the activation ratios on the basis of particles > 50 nm vary strongly among sites and throughout the seasons.

Additionally, autocorrelation analysis is performed to investigate the persistence of variables over different timescales and to explore meaningful averaging periods for global modelling of CCN. In terms of CCN persistence, we find three different regimes: (1) CCN concentrations persist for a week or longer showing also seasonal patterns. (2) CCN concentrations persist for less than one week and there is little seasonal pattern. And (3) CCN concentrations are highly variable and do not persist longer than 2 days but show seasonal cycles. Several but not all sites show diurnal cycles. These different behaviors are influenced by environmental factors such as rainy seasons in the Amazon or Korea (monsoon) but also by anthropogenic pollution episodes such as during the Arctic Haze period.