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Aerosol and CCN properties at Princess Elisabeth station, East Antarctica: seasonality, new particle formation events and properties around precipitation events

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Since 2010, several complementary ground-based instruments for measuring the aerosol composition of the Antarctic atmosphere have been operated at the Belgian Antarctic research station Princess Elisabeth, in Dronning Maud Land, East Antarctica (71.95° S, 23.35° E, 1390 m asl.). In addition, three ground-based remote sensing instruments for cloud and precipitation observations have been installed for continuous operation, including a ceilometer (cloud base height, type, vertical extent), a 24 Ghz micro-rain radar (vertical profiles of radar effective reflectivity and Doppler velocity), and a pyrometer (cloud base temperature). The station is inhabited from November to end of February and operates under remote control during the other months.

In this contribution, the general aerosol and cloud condensation nuclei (CCN) properties will be described with a special focus on new particle formation events and around precipitation events. New particle formation events are important for the atmospheric aerosol budget and they also show that aerosols are not only transported to Antarctica but are also produced there, also inland. Aerosols are essential for cloud formation and therefore also for precipitation, which is the only source for mass gain of the Antarctic ice sheet.

Measured aerosol properties comprise size distribution, total number, total mass concentration, mass concentration of light-absorbing aerosol and absorption coefficient and total scattering coefficient. In addition, a CCN counter has been operated during austral summers 2013/14, 2014/15 and 2015/16. The baseline total number concentration N-total was around some hundreds of particles/cm3. During new particle formation events N-total increased to some thousands of particles/cm3. Simultaneous measurements of N-total, size distribution and CCN number revealed that mostly the number of particles smaller than 100 nm increased and that the concentration of cloud condensation nuclei increased only very weakly, respectively. Further analysis of the CCN data indicate that the aerosol measured at Princess Elisabeth station consisted mainly of material with a hygroscopicity close to that of sulfate. The measured wavelength-dependent aerosol absorption and scattering coefficients give further insight on the aerosol type, showing that mainly strongly scattering aerosol dominates. However, the fraction of light-absorbing aerosol increased during the passage of some extra-tropical cyclones or frontal systems, indicating the presence of aged, long-range transported aerosol. The characterisation of the atmospheric aerosol at Princess Elisabeth station will be used in this contribution to compare it with simultaneously measured precipitation observations.