Geophysical Research Abstracts
Vol. 20, EGU2018-11994, 2018
EGU General Assembly 2018

ACE-SPACE: Overview of Southern Ocean aerosols, CCN and INP from a recent circumnavigation of Antarctica

Julia Schmale (1), Silvia Henning (2), Andrea Baccarini (1), André Welti (2), Iris Thurnherr (3), Franziska Aemisegger (3), Daniel Rosenfeld (4), Leighton Regayre (5), Irina Gorodetskaya (6), Frank Stratmann (2), Josef Dommen (1), Martin Gysel (1), Urs Baltensperger (1), Ken Carslaw (5), and the ACE-Atmosphere Team

(1) Paul Scherrer Institute, Villigen, Switzerland (julia.schmale@psi.ch), (2) Leibniz-Institute for Tropospheric Research, Leipzig, Germany, (3) Institute of Atmospheric and Climate Science, ETH, Zürich, Switzerland, (4) Institute of Earth Sciences, Hebrew University of Jerusalem, Jerusalem, Israel, (5) Institute for Climate and Atmospheric Sciences, University of Leeds, Leeds, UK, (6) Centre for Environmental and Marine Sciences, Department of Physics, University of Aveiro, Portugal, (7) University of Tromso, Tromso, Norway, (8) Centre for Environmental and Agricultural Informatics, University of Cranfield, Cranfield, UK, (9) University of Helsinki, Helsinki, Finland, (10) Karlsruhe Institute ofKarlsruhe Institute of Technology, Institute for Meteorology and Climate Research, Karlsruhe, 76344, Germany Technology, (11) Centre for Atmospheric Science, University of Cambridge, Cambridge, UK

Aerosol-cloud interactions are the least understood anthropogenic influence on climate change. A major cause of this limited understanding is the poorly quantified state of aerosols in the pristine preindustrial atmosphere, which defines the baseline against which anthropogenic effects are calculated. Especially over the Southern Ocean, models grossly underestimate cloud albedo, resulting in biases as large as 30 W m-2 in reflected short wave radiation.

This contribution will provide an overview of the project 'Antarctic Circumnavigation Expedition: Study of Preindustrial-like-Aerosol Climate Effects' (ACE SPACE) whose main purpose was to conduct a comprehensive aerosol characterization in preindustrial-like conditions over the Southern Ocean. The campaign took place from December 2016 to March 2017 and covered the Indian, Pacific and Atlantic Oceans between Cape Town, Hobart, Punta Arenas, and Cape Town, recording aerosol data in some regions for the first time. The data set is not only of interest to understand atmospheric processes under pristine conditions, but also particularly useful to validate satellite retrievals of aerosol properties and model simulations, which are both essentially unconstrained over the Southern Ocean.

Here, we will present aerosol microphysical and chemical characteristics and discuss particle and cloud condensation nuclei (CCN) origin. Important factors influencing aerosol properties were meteorology, the thermodynamic structure of the boundary layer and ocean biological activity (phytoplankton blooms). For example, the leg between South Africa and Australia experienced a series of low-pressure systems characterized by a significant fraction of Aitken mode particles. Contrary to previous observations, the small mode dominated the size distribution under calmer conditions and was not necessarily associated with air mass trajectories arriving from higher altitudes. Near the West-Antarctic coast between Australia and South America, accumulation mode particles were found to dominate the size distributions that were associated with open ocean air masses and potentially cloud processing. The mode also contained methane-sulfonic acid, a product from phytoplankton related dimethyl sulfate emissions. These particles were found to activate between 90 and 100 % as CCN at a supersaturation of 0.3 %. Conversely, only 26 % of particles arriving with air masses from Antarctica activated as CCN, primarily because their dominant mode was < 30 nm. A small number of new particle formation events was observed as well. Preliminary analyses suggest that they were associated with coastal air masses and particles did not grow into the CCN size range. In addition, throughout the whole voyage, ice nucleating particles (INP) were measured with a filter-based method. Cumulative concentrations were low in the order of 1 m-3 at -15°C.