AEROCLOUD

How do aerosols and clouds affect the East Antarctic climate?

DURATION
15/12/2014 – 15/03/2019

BUDGET
628.346 €

PROJECT DESCRIPTION

Context

The role of clouds in the climate system, their interaction with radiation, the coupling between aerosols and clouds and the atmospheric branch of the hydrological cycle are recognized as key elements in the climate system by several international consortia, such as the Joint Programming Initiative Connecting Climate Change Knowledge for Europe (JPI Climate) and the Intergovernmental Panel on Climate Change (IPCC). Although these research topics are high on the international research agenda, hardly anything is known about the interaction between clouds, precipitation and aerosols in the Antarctic. This is unfortunate, as the Antarctic ice sheet is expected to become a dominant contributor to sea level rise in the 21^{sr} century. Since precipitation is the only source of mass to the ice sheet, and precipitation and cloud processes are closely connected, an improved insight in these processes is essential.

General objectives and underlying research questions:

The project ultimately aims at answering the following research questions:

- What is the role of clouds and aerosols in the East Antarctic climate system?
- What is the relation between aerosols and clouds in East Antarctica?

Clouds are known to exert a strong influence on the temporal and spatial variability of Antarctic surface energy and mass balance. However, the exact role of cloud properties, such as cloud base height and cloud phase, is uncertain. Aerosols, mostly brought to Antarctica via long-range atmospheric pathways, strongly affect cloud formation and properties (such as cloud particle phase and size) and their ability to produce precipitation. AEROCLOUD will study sensitivity of different cloud types to aerosols and their effect on the surface energy budget. Snowfall measurements and analysis together with other components of the surface mass balance will address a long-standing question on the processes controlling regional snow accumulation in Antarctica.

Methodology

The starting point of the project is the comprehensive meteorological-cloud-precipitation-aerosol observatory that has been established during 2009-2012 at the Belgian Antarctic station Princess Elisabeth (PE) in the framework of two BELSPO projects (HYDRANT and BELATMOS). Detailed measurements from the observatory will be used to evaluate and improve the regional climate model CCLM. An important advantage of the CCLM is the inclusion of a detailed parametrization scheme that takes into account the effect of aerosols on cloud microphysics. A multi-year assessment of the Antarctic aerosol-cloud-precipitation interaction will be performed based on a combination of observations and modelling, particularly studying the sensitivity of cloud and precipitation properties to the amount of cloud condensation and ice nuclei. This approach makes it possible to quantify the indirect aerosol effect on the radiation budget and hydrological cycle in East Antarctica.

Nature of the interdisciplinary

The KU Leuven group brings in expertise in regional climate modelling, specializing in cloud and precipitation processes and microphysical schemes in climate models. KU Leuven also collaborates with the Institute for Marine and Atmospheric Research Utrecht (The Netherlands) - one of the world experts on polar atmospheric weather stations. The Royal Meteorological Institute of Belgium brings expertise in atmospheric chemistry, aerosols and backward trajectories. The Belgian Institute for Space Aeronomy specializes on radiative transfer modelling and ground-based remote sensing of atmospheric composition. In-kind contributions will be delivered by the Institute for Geophysics and Meteorology Köln (Germany) in developing radar retrieval algorithms and by Leibniz Institute for Tropospheric research (Germany), providing a Cloud Condensation Nuclei counter.

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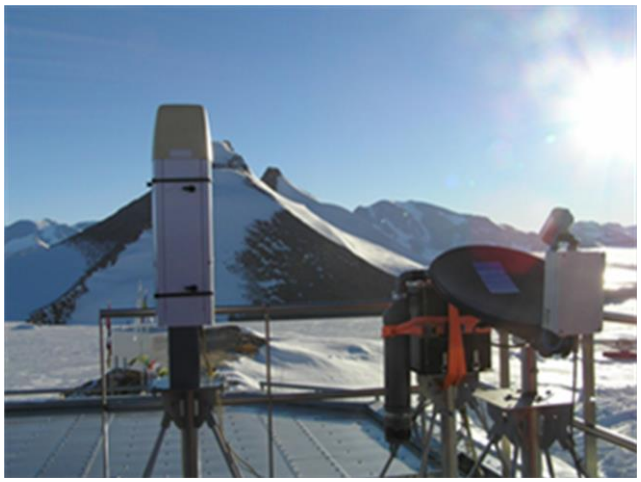

Potential impact of the research on science, society and/or on decision-making

AEROCLOUD outcomes will include:

- Comprehensive database available via the project website;
- Peer-reviewed publications;
- A workshop on polar atmospheric aerosols and polar clouds;
- Relevant contributions to several international programs and networks: European research framework of the JPI - Climate module 1 'Moving towards reliable decadal climate predictions'; World Climate Research Programmes GEWEX, CliC and CORDEX, Climate Limited-area Modelling-Community, Global Atmosphere Watch, and various observational networks such as NDACC, AERONET and AWS;
- Communication with policy via the Scientific Committee on Antarctic Research (SCAR) and IPCC;
- Lectures at schools and outreach activities for the general public.

Description of finished products of research (model, scenario, report, workshop, publication, etc…) at short and medium term.

The AEROCLOUD project builds upon two BELSPO projects (HYDRANT and BELATMOS), and the following peer-reviewed publications:

- Gorodetskaya et al. (2015): Cloud and precipitation properties from ground-based remote sensing instruments in East Antarctica, *Cryosphere*, 9, 285-304.
- Van Tricht et al. (2014): An improved algorithm for polar cloud-base detection by ceilometer over the ice sheets, *Atmos. Meas. Tech.,* 7, 1153-1167.
- Gorodetskaya et al. (2014): The role of atmospheric rivers in anomalous snow accumulation in East Antarctica*, Geophys. Res. Lett.,* 41, 6199-6206.
- Maahn et al. (2014): How does the space-borne radar blind-zone affect derived surface snowfall statistics in polar regions? *J. Geophys. Res.,* 119, 1-17.
- Gorodetskaya et al. (2013): Meteorological regimes and accumulation patterns at Utsteinen, Dronning Maud Land, East Antarctica: Analysis of two contrasting years, *J. Geophys. Res.,* 118, 1700-1715.
- Thiery et al. (2012): Surface and snowdrift sublimation at Princess Elisabeth station, East Antarctica, *Cryosphere*, 6, 841-857.
- Bromwich et al. (2012): Tropospheric clouds in Antarctica, *Rev. Geophys.,* 50, RG1004.

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LINKS

http://ozone.meteo.be/meteo/view/en/1550481-AEROCLOUD.html

Information on the HYDRANT project website:
http://ees.kuleuven.be/hydrant/

Information on the BELATMOS project:
http://ozone.meteo.be/meteo/view/en/1550481-BELATMOS.html

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