CAALC

Characterization of the Antarctic Atmosphere and Low Clouds

http://www.antarctica.cl/Home/Home.html

Principal investigator

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Areas of contribution

Polar atmospheric processes

Modelling and forecasting

Education

Summary

The West Antarctic Ice Sheet (WAIS) and the Antarctic Peninsula (AP) have been among the most rapidly warming regions on Earth, although the AP has more recently experienced a halt in warming. Despite the rapid change experienced in the WAIS and AP, knowledge of clouds is severely limited. In addition, clouds over the Southern Ocean are not reproduced accurately in climate models, with important implications for global climate modeling. We plan to measure atmospheric and low-cloud properties over the AP during Austral summers 2016/2017 (complete), 2017/2018, and 2018/2019, and over the WAIS during a short field campaign during Austral summer 2018/2019. Our goals are to improve our understanding of low-cloud properties, their impact on warming and sea ice concentration, and their representation in models. We are particularly interested in the frequency and effects of supercooled liquid cloud.

Measurements: Standard radiosoundings will be made, measuring atmospheric pressure, temperature, humidity and winds up to 20 km. To extend the time span of soundings, we are collaborating with scientists at the Korean
and Chinese stations on King George Island. In addition, several soundings will include cloud sensors capable of determining cloud height, thermodynamic phase, and droplet or ice crystal size distribution. Surface-based instruments (pyrgeometer and pyranometer) will measure broadband ultraviolet/visible and infrared radiation. Furthermore, our measurements will be complemented by additional measurements made by the Antarctic Research Group of the Universidad de Santiago de Chile (USACH), including a mini-micropulse lidar, which will remotely sense cloud height and thermodynamic phase, and spectroradiometer measurements of ultraviolet and visible radiation.

**Description**

The West Antarctic Ice Sheet (WAIS) and the Antarctic Peninsula (AP) have been among the most rapidly warming regions on Earth, although the AP has more recently experienced a halt in warming. Despite the rapid change experienced in the WAIS and AP, knowledge of clouds is severely limited. In addition, clouds over the Southern Ocean are not reproduced accurately in climate models, with important implications for global climate modeling.

Located just north of the terminus of the Antarctic Peninsula, King George Island is well situated to observe clouds from the AP as well as the Southern Ocean. However, due to cost and labor requirements, radiosonde measurements are not routinely made at King George Island, despite that a number of countries have stations on the island.

We will measure atmospheric and low-cloud properties at Escudero station to during Austral summers 2016/2017 (complete), 2017/2018, and 2018/2019, and over the WAIS (at Union Glacier) during a short field campaign during Austral summer 2018/2019. Our goals are to improve our understanding of the atmosphere as well as low-cloud properties, their impact on warming and sea ice concentration, and their representation in models. We are particularly interested in the frequency and effects of supercooled liquid cloud.

Field experiments include the following measurements:
1) Standard radiosoundings will measure atmospheric pressure, temperature, humidity and winds up to 20 km.
2) Several soundings will include cloud sensors capable of determining cloud height, thermodynamic phase, and droplet or ice crystal size distribution.
3) Surface-based instruments (pyrgeometer and pyranometer) will measure broadband ultraviolet/visible and infrared radiation. (Escudero only).
4) These measurements will be complemented by additional measurements made by the Antarctic Research Group of the Universidad de Santiago de Chile (USACH), including a mini-micropulse lidar, which will remotely sense cloud height and thermodynamic phase, and spectroradiometer measurements of ultraviolet and visible radiation. (Escudero only).

In addition, the following collaborations are underway:
1) To extend the time span over which radiosondes measurements can be made, we are collaborating with scientists at the Korean and Chinese stations on King George Island. We hope to coordinate assisting them in acquiring Helium for their radiosoundings.
2) The British Antarctic Survey plans to fly their twin otter, equipped with a variety of cloud sensors, over King George Island at the start of our Austral summer 2017/2018 campaign (possibly late November 2017). These measurements will provide an important complement to our data.
3) We are also collaborating with Marta Caballero, who is working toward her Ph.D. thesis with Matthias Braun at the university of Erlangen in Germany. Marta’s work will include comparison of surface-based and satellite-derived cloud properties as well as Polar Weather Research Forecast (Polar WRF) modeling over the Antarctic Peninsula.

Compliance with Guidelines for Endorsement

We plan to integrate and share radiosoundings acquired by our group as well as other measurements made on King George Island. Radiosounding measurements will also be sent to GTS to improve weather prediction. Radiosounding and cloud measurements will be compared to satellite-based measurements. Polar WRF runs are expected to improve modeling of clouds over the King George Island and surrounding region. Our overarching goal is to improve our understanding of mixed-phase clouds over the Southern Ocean, Antarctic Peninsula, and WAIS. Thus this project will contribute to the following YOPP objectives.

2. Gather additional observations through field programmes aimed at improving understanding of key polar processes.

3. Develop improved representation of key polar processes in uncoupled and coupled models used for prediction, including those which are particular hindrances to high-quality prediction for the polar regions, such as those relating to stable boundary layer representation, surface exchange, permafrost, mixed phase clouds, winds, extreme thermal contrasts, and steep orography.

7. Improve verification of polar weather and environmental predictions to obtain quantitative knowledge on model performance, and on the skill of operational forecasting systems for user-relevant parameters; and efficiently monitor progress.

We acknowledge the importance of close coordination of all planned YOPP activities. We will coordinate activities such as the radiosounding and will coordinate with the larger YOPP group as needed, including attendance at YOPP conferences (starting with the conference this June).

Measurements will be made available to the broader community in keeping with the YOPP data strategy. We further agree to make available a summary of planned activities of endorsed projects through, e.g., the website of the International Coordination Office and agree to support the work of the PPP-SERA subcommittee, and be available for contact. Finally, we agree to inform the ICO about plans for changes in the project.

Timeline

2016-03-01 - 2019-02-28

Regional emphasis

Northern hemisphere: No
Southern hemisphere: Yes

**Further specification**

Our field experiments will occur at Escudero station, on King George Island at the northern terminus of the Antarctic Peninsula. In addition, a small experiment is planned for Union Glacier, on the West Antarctic Ice Sheet.

**Key project deliverables**

- Radiosonde measurements (height, pressure, temperature, humidity)
- Surface-based radiometry measurements (e.g. pyrgeometer/pyranometer)
- Balloon-borne in situ cloud property measurements (thermodynamic phase and particle size; 3-10 per year)
- Lidar cloud property measurements (Austral summers 2017/2018 and 2018/2019 only)

Union Glacier, Antarctica, during Austral summer 2018/2019 (10 day field season; measurements less certain):
- Radiosonde measurements (height, pressure, temperature, humidity)
- Surface-based radiometry measurements (e.g. pyrgeometer/pyranometer)
- Balloon-borne in situ cloud property measurements (thermodynamic phase and particle size; 3-10 per year)

**Data management**

We plan to archive all data on a website hosted by the University of Santiago of Chile (antarctica.cl). Radiosoundings will also be shared with the Integrated Global Radiosonde Archive.

**Is data provided to WMO Global Telecommunication System**

Yes

**Real-time provision**

We will send each radiosounding to GTS. We will also coordinate with other stations on King George Island to assist them as needed in sending their radiosondes to GTS.