NERC EnvEast DTP – Research Experience Placement 2019

Comparison of three algorithms to calculate cloud base height from LIDAR backscatter signal

Supervisor: Dr Amélie Kirchgaessner

Ceilometers operated by the British Antarctic Survey employ pulsed diode laser LIDAR technology (LIght Detection And Ranging), where short, powerful laser pulses are sent out in a vertical or near-vertical direction. The backscatter caused by haze, fog, precipitation and clouds is measured as the laser pulses traverse the sky. The resulting backscatter profile is used to detect cloud bases. The ceilometer is able to detect up three cloud layers up to 7.5km simultaneously.

Stored data consists of the cloud base height and the full backscatter profile at about 15m vertical resolution and a temporal resolution between 15s and 60s. From two Antarctic stations these data are available since 2007. There is increased interest in these data sets from the national and international scientific communities as cloud properties in the Polar Regions remain one of the main uncertainties in the simulation of future climate scenarios.

We want the project student to compare the cloud base height as calculated by the manufacturer's algorithm with firstly that derived independently from the backscatter signal, and secondly cloud base height based on an algorithm developed by Van Tricht et al. (2014) especially for LIDAR measurements in Polar Regions. This will require the student to work on the following tasks:

- Pre-process backscatter data by performing auto-calibrating and reducing signal to noise ratio
- Derive cloud base height from backscatter signal
- Apply polar threshold algorithm.
- Compare manufacturer's cloud base height values with those derived independently from backscatter signal.

The student will have the opportunity to make synoptic cloud observations during the REP under guidance from an experienced observer in the team, and compare those with ceilometer output from an operational ceilometer on site.

The student will be given the opportunity to present the findings of their work as part of the Atmosphere, Ice and Climate seminar series.

This eight week placement will be at the Headquarters of the British Antarctic Survey in Cambridge. The student will be supervised by Dr Amélie Kirchgaessner of the Climate Processes group (part of Atmosphere, Ice and Climate Team); support will also be provided from other members of the team who work with the meteorological instruments. The student will be located within one of the student rooms, close to the Climate Processes group, alongside other PhD/REP students. They are welcome to attend any of our science seminars and will get to see research from the different areas of BAS.

During the course of this project the student will have a taste of what it is like to work in a research group environment and work on a research project with a practical element. They will learn about data processing and analysis and develop their programming skills on this project.

The AIC team has a strong relationship with the main manufacturers of commercially available ceilometer, Vaisala and Campbell Scientific Ltd. Both are very interested extending the use of ceilometer data beyond the purely operational.

The student should be doing a numerate degree and have basic physics knowledge. Knowledge of basic meteorology, data processing and statistical analysis would be preferred. They should have some programming experience.

Students must meet all of the following criteria to be eligible to apply for a REP:

- Be studying for an undergraduate degree in a quantitative discipline outside of NERC's scientific remit (eg mathematics, statistics, computing, engineering, physics).
- Be applying for a placement in a different department to their undergraduate degree.
- Be undertaking their first undergraduate degree studies (or integrated Masters).
- Be expected to obtain a first or upper second class UK honours degree.
- Be eligible for subsequent NERC PhD funding (ie UK, EU or right to remain in the UK).

References:

Van Tricht, K., I. V. Gorodetskaya, S. Lhermitte, D. D. Turner, J. H. Schween, and N. P. M. Van Lipzig, 2014: An improved algorithm for polar cloud-base detection by ceilometer over the ice sheets. *Atmos. Meas. Tech.*, **7,** 1153-1167.

Applications (no more than 2 sides A4) and enquiries should be sent directly to: Dr Amélie Kirchgaessner acrki@bas.ac.uk no later than noon, 15th May 2019.