MSc projects in Continuous Flow Analysis (CFA)

Five new master projects are offered at the Center for ice and climate. In the Ice and Climate group we work on analyzing past climate variability by means of ice core analysis. These particular master and bachelor projects involve chemical measurements of ice cores, for example informing on wind patterns, aridity, volcanic eruptions and sea ice variability.

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1) Climate signals in the Renland ice core

A 584 m ice core from Eastern Greenland has been analysed by means of CFA. Measurements of the ice core were made in Copenhagen and reveal a detailed history of the past climate reaching through the past glacial and into the last interglacial; the Eemian. A MSc project is available to conduct statistical analysis of the data obtained from Renland. This includes the investigation of past volcanic eruptions, reconstructions of past storm activity and reconstruction of past sea ice variability. This information is critical to improve the ice core chronology and link the climate data to a network of other Greenland ice cores.

2) Sea ice climate signal in the Renland ice core

In 2016 an ion chromatograph (IC) was installed at CIC as part of the ice core impurity lab in Copenhagen. In late 2015 discrete samples were obtained in 55 cm resolution for all of the 584 m ice core from Eastern Greenland; Renland. These samples hold all of the Holocene and can be analysed by means of IC. The IC measures several ion species that can provide information on the climate of the past; eg. Cl for sea salt, which relates to sea ice and wind speed, SO4 which relates to volcanic eruptions and Br-, which is a new proxy for sea ice. The student would measure Renland discrete samples and estimate changes in sea ice variability over the past 10.000 yrs. By investigating the discrete samples from Renland, hypothesis related to the large international ice2ice research proposal could be verified or discarded and thus it is likely that the student would also participate in international meetings.
3) Detecting volcanic eruptions in polar ice cores
Volcanic eruptions can be identified in ice cores from Antarctica and Greenland through the deposition of soluble acids as well as insoluble dust and tephra. Studying these volcanic events gives information regarding the climate changes produced by volcanic eruptions, impacts on society as well as offering a means to synchronise climate records distributed over a wide area. The detection of volcanic eruptions is often based on the identification of high acidity, sulphate or conductivity in the ice cores. Volcanic eruptions produce sulphate as well as halogen acid species such as chloride, fluoride and bromide. A MSc project is available to develop new techniques for the detection of volcanoes in ice cores. The projects include creating a record of volcanic eruptions from the Renland ice core over the past 4000 yrs, but also the opportunity to develop new techniques for the continuous measurement of fluoride in ice cores and to measurements by means of Ion Chromatography for sulphate.

4) Analysis of surface snow-cores from North Greenland
During a traverse in Northern Greenland in 2015, several short snow cores of between 8 and 16 meters were obtained, as well as discrete samples from several snow pits. These samples offer the opportunity to obtain a detailed record of atmospheric change over the past 20 years. The records further hold the 2012 melt event ice layers and can be studied for a spatial extent of the event, during which all of Greenland’s surface was above melting temperature for about a week in 2012. A MSc project is available to conduct analysis of the impurities in Greenland traverse snow samples and map the spatial and temporal extent of impurities, to enhance the knowledge on the geographical distribution of impurities across the Greenland ice sheet. This project offers laboratory-based instrumental measurements, data analysis and interpretation.

5) Climate chemistry record from the NEEM ice core
The NEEM ice core covers 130 thousand years of Arctic climate, but there is a 5000 years gap during the Holocene period, from 3000 to 8000 years ago. This gap is due to the ice being brittle and susceptible to damage during handling and processing. The goal of this project is to measure climate proxies in samples collected from the brittle ice, that have been previously measured for water isotopes. The project involves learning Ion Chromatography techniques, and filling in a crucial gap in the knowledge of the past 10 thousand years’ climate. The Ion Chromatograph measures several ion species that can provide information on the climate of the past; eg. Chlorine for sea salt, which relates to sea ice and wind speed, Fluoride and sulphate which relate to volcanic eruptions and Bromide which is a new proxy for sea ice. The NEEM record can inform on how climate has changed during a critical time in human agricultural and technological development, especially regarding the multiple waves of colonisation of Greenland.