Investigation of Greenland temperature variability over the 6000 years using trapped air in ice cores

Berichterstattung

Projektinformationen

GREENTEMP

ID Finanzhilfevereinbarung: 624183

Projektwebsite

Projekt abgeschlossen

Startdatum
1 Mai 2014

Enddatum
30 April 2016

Finanziert unter
Specific programme "People" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013)

Gesamtkosten
€ 277 296,80

EU-Beitrag
€ 277 296,80

Koordiniert durch
UNIVERSITAET BERN
Switzerland

Final Report Summary - GREENTEMP (Investigation of Greenland temperature variability over the 6000 years using trapped air in ice cores)

Greenland temperature is one of the most important variables when considering future climate change, as

it has the potential to impact a significant percentage of the population through an increase of the global sea level resulting from the melting of the Greenland ice sheet. Therefore, it is critical to understand the mechanism of Greenland temperature variability over multidecadal to centennial time scales with societal relevance. A new method has been developed to reconstruct precise Greenland temperature variability using argon and nitrogen isotopes in occluded air in ice cores coupled with a firn densification heat diffusion model. The method is based upon the fact that gasses in the firn (unconsolidated snow layer) fractionate based on the depth and temperature gradient of the layer.

In this funded research, I successfully set up a gas extraction line and established a high precision analytic system for argon and nitrogen isotopes from ice cores at University of Bern. Argon and nitrogen data were obtained from occluded air within NGRIP ice cores for the period of 2100-4100 years working with a master student, Aurich Jeltsch-Thömmes. He conducted part of this project for his master thesis, and completed his thesis on April, 2016. Using the data obtained and a firn model, we calculated the Greenland temperatures over the past 4100 years, and identified highly significant anti-correlation between Greenland temperature and solar activity over the past 4100 years in a multidecadal to centennial time scale.

During the project, two papers were published in international peer-reviewed journals. The first publication discusses potential causes of anomalously cold Greenland temperature in the late 20th century estimated from reconstructed Greenland temperatures over the past 2100 years. Data indicated that Greenland temperature generally followed Northern Hemispheric temperature changes over the past 2100 years. However, Greenland temperature deviates from the hemispheric trend most probably bound to solar variability (stronger solar activity induces cooling in Greenland). This indicates that the modern solar maximum during the late 20th century should have had rather large cooling impacts on Greenland temperature, likely involving Atlantic meridional overturning circulation (AMOC). This paper was press-released by AGU, and several news outlets published articles on this paper. The second publication was about gas fractionation processes in the firn layer. We found that changes in accumulation rate at the surface have influences on gas fractionations (e.g argon and nitrogen) at the bubble close off depth. We developed a model to show that this fractionation occurs through the overloading pressure at the bubble close off depth.

In addition, a low resolution Greenland temperature history over the Holocene was reconstructed from GISP2 ice core data. We conducted temperature calculations using two firn models (i.e. Goujon and Schwander models) and compared the results. Also, I set up a climate model of intermediate complexity (LOVECLIM) on a server environment at University of Bern, and conducted climate model experiments for different sets of climate forcings. At present, I work on a paper for the Holocene Greenland temperature and its causes.

During the project, I supervised a master student for this project. He conducted ice sample analyses, firn modeling, and was involved in the interpretation of Greenland temperature. He completed his master thesis on April, 2016. In addition, I worked together with a Ph.D. student at the University of Bern. We compared the performances of two different firn models regarding temperature calculations. I co-taught the “Stable Isotopes lecture” with Prof. Markus Leuenberger at University of Bern in the fall 2014, including a presentation about project GREENTEMP. This information is also available on website that I have

developed for this project.

Project website:
https://sites.google.com/site/greenlandtemperature/home

Letzte Aktualisierung: 18 Juli 2016

Permalink: https://cordis.europa.eu/project/id/624183/reporting/de