SEFIGO

Seasonal Forecast of the Ice-Mass Balance of Greenland using Earth Observation Data

Principal investigator

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Areas of contribution

Polar atmospheric processes
Oceanic processes
Modelling and forecasting
Polar-lower latitude linkages
Observations
Land processes
Outreach
Policy-relevant / cultural aspects
Societal and/or behavioural aspects

Summary

Aim of this project is to pioneer the development of a statistical forecast system for the seasonal prediction of monthly mass flux of the Greenland Ice Sheet. The data-driven approach uses robust teleconnections between melt production in Greenland and preceding mid-latitude atmospheric/oceanic anomalies recovered in Earth
observation and meteorological data sets. The skillful approach transforms existing data collected in ESA’s Climate Change Initiative and from meteorological agencies into a new product of high societal relevance (e.g. Greenland flood risk prediction, expedition planning, understanding mid-latitude/Arctic linkages).

Description

The status of the project is: proposal to be submitted on 28 February 2019.
Submission to European Space Agency ESA in response to invitation to tender ESA/AO/1-9101/17/I-NB, EO SCIENCE FOR SOCIETY PERMANENTLY OPEN CALL, Activity Line 1: Scientific Data Exploitation
Team:
AWI: Alfred Wegener Institute, Bremerhaven, Climate Sciences Department
DTU: DTU Space, Technical University of Denmark, Geodynamics Department
Dr. Ingo Sasgen (PI, AWI), Dr. Monica Ionita-Scholz (co-PI, AWI), Dr. Louise Sandberg Soerensen (co-PI, DTU; CCI+ Greenland).
Fixed price conditions of ESA: 150.000 EUR for 12 months

Aim of this project is to pioneer the development of a statistical forecast system for the seasonal prediction of monthly mass flux of the Greenland Ice Sheet. The data-driven approach uses robust teleconnections between Greenland’s melt production and preceding mid-latitude atmospheric/oceanic anomalies recovered in Earth observation and meteorological data sets. The approach transforms existing data collected in ESA’s Climate Change Initiative (CCIs) and from meteorological agencies into a new product of high societal relevance (e.g. Greenland flood risk prediction, expedition planning, understanding mid-latitude / Arctic linkages). The Scientific Readiness Level (SRL) aimed for is Phase A “End-to-End Performance Simulations”.

In our statistical approach, the stationarity and lags of a suite of climate drivers (e.g. mid-latitude sea-surface temperature, geopotential height, local temperature, a.o.) relevant for the surface-mass balance in Greenland are analysed and statistically modelled. The robust (significant and stationary) teleconnections are then used together with pre-conditioning fields of the ice sheet (e.g. ice-sheet surface albedo, winter snow accumulation), as predictors for the summer surface-mass balance (predictand) in Greenland three months in advance. Hindcast analyses of output of regional climate models allow internal assessment the skill of the forecast. To close the budget of net monthly mass flux for Greenland, we analyse and extrapolate time variations (seasonal to decadal) of ice discharge using Earth observation data and include it into our prediction. We estimate the forecast skill of our approach by comparing in hindcast analysis the seasonal forecasts to monthly or sub-monthly mass fluxes derived from GRACE/GRACE-FO (2003-2017/2018-present), supported by CryoSat-2 data. As a final part, the project develops strategies of knowledge transfer and assessment of its future political and economic potential.

The overall objective breaks down into six main aims:
• Adaptation of the statistical prediction system to forecast surface-mass balance in Greenland
• Extension of forecast for accumulation in Greenland
• Develop empirical ice-discharge prediction (based on ESA’s Climate Change Initiative CCI+ data)
• Improvement of the prediction skill by including pre-conditioning fields, such as surface-ice albedo (based on CCI data)
• Skill analysis of the forecast system based on GRACE/GRACE-FO net mass fluxes
• Dissemination and research for further applications
Although seasonal forecasts of the Greenland ice sheet mass balance have negligible direct economic impact, we anticipate breakthroughs by a) an improved understanding of the links in the climate system and Greenland melt conditions based on ESA’s Earth observation data, b) demonstrating the use of satellite data in climate prediction services, and c) testing future applications of societal importance.

**Timeline**

2020-02-03 - 2021-01-29

**User relevant aspects**

Seasonal forecast of summer melt conditions in Greenland have implications for the protection of infrastructure, expedition planning, and back-country accessibility. Increasing importance is expected with increasing use of hydropower in Greenland.

**Provider relevant aspects**

Reliable seasonal forecasts of the Greenland ice sheet mass balance will enhance confidence of the society in the climate system experts. For example, a pre-warning of an upcoming strong melt year in Greenland issued via dedicated platforms, bulletins and press releases will build trust of the society in the understanding of the climate system and the usefulness of related Earth observation data.

**Regional emphasis**

Northern hemisphere: Yes

Southern hemisphere: No

**Further specification**

The project focusses on the Greenland ice sheet as a whole.

**Key project deliverables**

D1: Prototype seasonal forecast system for the Greenland ice sheet
D2: Skill assessment of forecast system  
D3: Scientific roadmap for future development

Data management

https://www.pangaea.de/  
and project website

Is data provided to WMO Global Telecommunication System

No

Other information

It is possible that some aspects of the data sharing guidelines of YOPP may not comply with contract conditions imposed by ESA. These could be related to publication of exclusive ESA data or a ban on dissemination of results before project closure. However, at this stage it is too early to identify possible contractual conflicts. Typically, after successful bidding, negotiations will start with ESA in which possible conflicts can be resolved.