Geophysical Research Abstracts
Vol. 19, EGU2017-15896, 2017
EGU General Assembly 2017

A fjord-glacier coupled system model

Eva de Andrés (1), Jaime Otero (1), Francisco Navarro (1), Agnieszka Prominska (2), Javier Lapazaran (1), and Waldemar Walczowski (2)

(1) Universidad Politecnica de Madrid, Dept. Matematica Aplicada a las TIC, Madrid, Spain, (2) Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland

With the aim of studying the processes occurring at the front of marine-terminating glaciers, we couple a fjord circulation model with a flowline glacier dynamics model, with subglacial discharge and calving, which allows the calculation of submarine melt and its influence on calving processes.
For ocean modelling, we use a general circulation model, MITgcm, to simulate water circulation driven by both fjord conditions and subglacial discharge, and for calculating submarine melt rates at the glacier front. To constrain freshwater input to the fjord, we use estimations from European Arctic Reanalysis (EAR). To determine the optimal values for each run period, we perform a sensitivity analysis of the model to subglacial discharge variability, aimed to get the best fit of model results to observed temperature and salinity profiles in the fjord for each of these periods. Then, we establish initial and boundary fjord conditions, which we vary weekly-fortnightly, and calculate the submarine melt rate as a function of depth at the calving front. These data are entered into the glacier-flow model, Elmer/Ice, which has been added a crevasse-depth calving model, to estimate the glacier terminus position at a weekly time resolution.
We focus our study on the Hansbreen Glacier-Hansbukta Fjord system, in Southern Spitsbergen, Svalbard, where a large set of data are available for both glacier and fjord. The bathymetry of the entire system has been determined from ground penetrating radar and sonar data. In the fjord we have got temperature and salinity data from CTDs (May to September, 2010-2014) and from a mooring (September to May, 2011-2012). For Hansbreen, we use glacier surface topography data from the SPIRIT DEM, surface mass balance from EAR, centre line glacier velocities from stake measurements (May 2005-April 2011), weekly terminus positions from time-lapse photos (Sept. 2009-Sept. 2011), and sea-ice concentrations from time-lapse photos and Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data.
Results suggest submarine melt rates at Hansbreen terminus implying noticeable changes in the glacier front geometry, and hence the stress field, which favour the occurrence of calving events. In this way, submarine melt at the glacier front could be a first-order mechanism in determining the terminus position in late summer.