Data Set Citation

When using this data, please cite the data package

Amaral T , Bartholomaus T , and Enderlin E. 2019.
Iceberg calving model evaluation data products and observations, Greenland Ice Sheet, 2011 - 2017
urn:uuid:d66d5b62-7655-4c92-a5e9-303ca221dd6d (https://arcticdata.io/metacat/metacat/urn:uuid:d66d5b62-7655-4c92-a5e9-303ca221dd6d/default)

General Information

Title:	**Iceberg calving model evaluation data products and observations, Greenland Ice Sheet, 2011 - 2017**
Identifier:	autogen.2019110710495960725.1
Abstract:	These data comprise observations and derived data products from 50 marine-terminating glaciers in Greenland that were used models. These data include publicly-available, spatially-referenced, near-coincident observations of ice elevation and ice surfa estimates, vectorized glacier terminus margins, estimated ice strain rates and calving rates, and associated observational erro profiles up the centers of 50 different outlet glaciers in Greenland, spanning spring, summer, and fall seasons from 2011 to 201 original, publicly-available formats into data sets that are quicker to ingest and analyze. We expect that this data archive will be calving and the dynamics of marine-terminating glaciers.
Keywords:	GCMD: ◦ ICEBERGS ◦ GLACIER MOTION/ICE SHEET MOTION
Publication Date:	2019

Data Table, Image, and Other Data Details:

Metadata download

Other Entity:

Name:	**calvingObservations.hdf5**
Data Object Type:	application/octet-stream
Description:	All glacier observations from 50 sample glaciers used to evaluate iceberg calving models

Attribute(s) Info:

Name	Column Label	Definition	Type of Value	Measurement Type	Measurement Domain	Missin Value Code
centerline	glacier center profile line vertex coordinates	center profile line consisting of vertices spaced 10 m apart, generally following centerline of each glacier trunk. All 1-D data sets are interpolated onto centerline vertices. First column is x coordinate, second column is y coordinate in in North Polar Stereographic Projection; EPSG: 3413.		ratio	**Unit** meter **Type** real	
bed_profile	bed elevation 1-D profile	bed elevation estimates from BedMachine v3 (https://nsidc.org/data/IDBMG4) linearly interpolated onto glacier center profile points. Units are meters above mean sea level.		ratio	**Unit** meter **Type** real	

Other Entity:

Name:	**calvingObservations.hdf5**
Data Object Type:	application/octet-stream

Description:	Nested data structure encompassing all observations and derived data products from all 50 glaciers used in calving model ev

Other Entity:

Name:	**calvingObservations.hdf5**
Data Object Type:	application/octet-stream

Other Entity:

Name:	**calvingObservations.hdf5**
Data Object Type:	application/octet-stream
Description:	All glacier observations and data products for 50 glaciers used to test calving model performance

Attribute(s) Info:

Name	Column Label	Definition	Type of Value	Measurement Type	Measurement Domain	Miss Valu Code
obspt	glacier terminus location reference point	x,y coordinate of glacier terminus used for plotting purposes. Coordinates in North Polar Stereographic Projection; EPSG: 3413.		ratio	Unit meter Type real	
centerline	glacier center profile line vertex coordinates	center profile line consisting of vertices spaced 10 m apart, generally following centerline of each glacier trunk. All 1-D data sets are interpolated onto centerline vertices. First column is x coordinate, second column is y coordinate in in North Polar Stereographic Projection; EPSG: 3413.		ratio	Unit meter Type real	
bed_profile	bed elevation 1-D profile	bed elevation estimates from BedMachine v3 (https://nsidc.org/data/IDBMG4) linearly interpolated onto glacier center profile points. Units are meters above mean sea level.		ratio	Unit meter Type real	
errorBed_profile	bed elevation error 1-D profile	estimated measurement uncertainties on bed elevation estimates from BedMachine v3 (https://nsidc.org/data/IDBMG4) linearly interpolated onto glacier center profile points. Units are meters above mean sea level.		ratio	Unit meter Type real	
geoid_profile	geoid height above WGS84 ellipsoid 1-D profile	Geoid heights above WGS84 Ellipsoid from from BedMachine v3 (https://nsidc.org/data/IDBMG4) linearly interpolated onto glacier center profile points.		ratio	Unit meter Type real	
ATM_profile	Operation Icebridge Airborne Topographic Mapper (ATM) LiDAR, 1-D ice elevation profile	Ice elevation measurements from NASA's Operation Icebridge ATM LiDAR (https://nsidc.org/data/icebridge/) corrected to meters above mean sea level and linearly interpolated onto glacier center profile points.		ratio	Unit meter Type real	
spatialDate	Date of ATM ice elevation measurements	YYYY.MM.DD format date of ATM ice elevation measurements.		dateTime		
WV_profile	Ice elevation 1-D profile from WorldView satellite stereo image pairs	High resolution (2 m) DEMs constructed from DigitalGlobe's WV-1 and WV-2 satellite images as part of the ArcticDEM project (http://data.pgc.umn.edu/elev/dem/setsm/ArcticDEM/geocell/v3.0/2m/) capture the lower ~5-10 km of outlet glaciers with approximately 3 m vertical uncertainty. These DEM elevations are linearly interpolated on each glacier center profile points for Jakobshavn Isbrae, Kangerlussuaq Glacier, Daugaard-Jensen Glacier, and Illullip Sermia. Units are meters above mean sea level.		ratio	Unit meter Type real	
temporalDates	Nominal dates of WorldView stereo image ice elevation data	YYYY.MM.DD format date of WorldView stereo image ice elevation data for Jakobshavn Isbrae, Kangerlussuaq Glacier, Daugaard-Jensen Glacier, and Illullip Sermia. Defined as midpoint between the date of each satellite image in the stereo image pair.		dateTime		

temporalVelDates	Dates of velocity maps that correspond with WorldView ice elevation data for Jakobshavn Isbrae, Kangerlussuaq Glacier, Daugaard-Jensen Glacier, and Illullip Sermia.	YYYY.MM.DD format dates calculated as midpoint date between two satellite radar images and as 15th day of month for optical sensor velocity maps.		dateTime	
velocity_profile	ice surface velocity 1-D profile	Ice surface velocity measurements from feature-tracking of repeat satellite image pairs from optical (http://nsidc.org/data/nsidc-0481) and radar (http://nsidc.org/data/nsidc-0646) sensors linearly interpolated onto glacier center profile points. Units are meters per year.		ratio	**Unit** dimensionless **Type** real
eigenvalues_profile	strain rate eigenvalues 1-D profile	First and second strain rate eigenvalues calculated from derivative of ice velocities using NumPy module numpy.linalg.eig function and linearly interpolated onto glacier center profile points. Units are per year (1/yr)		ratio	**Unit** dimensionless **Type** real
Rxx_profile	Longitudinal resistive stress 1-D profile	Longitudinal resistive stress calculated from 2-D ice velocity maps using stress exponent n=3, ice viscosity of -5 degree Celsius ice, and ice density of 920 kilogram/cubic meter linearly interpolated onto glacier center profile points.		ratio	**Unit** pascal **Type** real
observedTerminusIndex	centerline index of observed glacier terminus location	centerline index of glacier terminus determined from manual inspection of corresponding ice elevation 1-D profile. Glacier terminus defined as the most-seaward location of calving cliff crest as opposed to the intersection point of the calving cliff and the waterline.		ratio	**Unit** dimensionless **Type** real
calvingRate	Frontal ablation rate (iceberg calving + submarine melting)	We calculate observed frontal ablation rates as the difference between glacier length change over time and ice velocity, â(u_f=u_i-l/t,#(16)) where l/t is the distance between two traced terminus margins from satellite images divided by the time between satellite images and u_i is the ice velocity. We define u_f as a positive quantity oriented up-glacier for historical reasons, opposite the convention for positive u_i and l/t. The two satellite images for terminus traces are coincident with or fall within the dates of the two satellite images employed in the generation of the corresponding ice velocity map. Terminus margins are digitized by hand from Landsat and Sentinel satellite images using the Google Earth Engine digitization tool developed by James Lea (https://liverpoolgee.wordpress.com/geedit-geedit-reviewer). The change in time between terminus traces is typically 11-35 days, depending on the corresponding velocity observation period and the availability of suitable satellite imagery. We calculate length change rate and ice velocity along a series of 20 parallel profiles oriented with ice flow and spaced 100 m apart that span the center 2000 m of the terminus width. By averaging frontal ablation rates across the middle 2000 m of the glacier, we reduce the effect of large individual calving events that only impact part of the terminus and instead obtain a frontal ablation rate that represents the behavior of the glacier where it is thickest and fastest.		ratio	**Unit** metersPerDay **Type** real
errorCalvingRate	Error in calving rate measurement	Estimated error associated with calving rate measurements. Quantified sources of error include digitization errors (~30 m) and ice velocity map errors.		ratio	**Unit** metersPerDay **Type** real

Involved Parties

Data Set Creators

Individual:	**Tristan Amaral**
Organization:	**University of Idaho**
Email Address:	tristan.amaral3@gmail.com
Id:	https://orcid.org/0000-0002-8153-1369

Individual:	**Timothy Bartholomaus**
Organization:	**University of Idaho**
Position:	Assistant Professor
Email Address:	tbartholomaus@uidaho.edu

Individual:	**Ellyn Enderlin**
Organization:	**Boise State University**
Position:	Assistant Professor
Email Address:	ellynenderlin@boisestate.edu

Data Set Contacts

Individual:	**Tristan Amaral**
Id:	https://orcid.org/0000-0002-8153-1369

Data Set Characteristics

Geographic Region:

Geographic Description:	50 outlet glaciers distributed around the Greenland Ice Sheet
Bounding Coordinates:	West: -80 degrees East: 10 degrees North: 90 degrees South: 60 degrees

Time Period:

Begin:	2011
End:	2017

Sampling, Processing and Quality Control Methods

Step by Step Procedures

Step 1:	
Description:	Data Organization: To test calving models against spatial and temporal variability in iceberg calving, we amasse measurement set from 50 individual glaciers and one temporally-distributed data set that consists of 15 measure Kangerlussuaq Glacier, Daugaard-Jensen Glacier, and Illullip Sermia). Data are organized in the hdf5 file using the glacier name, the second level is the variable name, and the third level (if applicable) is the date of variable Glacier is stored under calvingObservations['Tracy']['velocity_profile']['2013.04.18'] in Python dictionary or '/Trac

	50 glaciers have variable fields that pertain to the spatially-distributed observation data set, however only the fou that pertain to the temporally-distributed data set, such as "WV_profile", "temporalDates", and "temporalVelDate
Step 2:	
Description:	Data Manipulation: All 1-D profile data sets were downloaded from publicly data repository servers and interpola m apart using linear interpolation. Users are directed to data links for detailed information about data measurem resolution, authors contact, etc. Glacier centerlines were digitized by following NASA's Operation Icebridge Airb glacier trunks. Small gaps (< 1 km) in data profiles were filled using cubic spline interpolation. Metadata on proc including strain rate eigenvalues ("eigenvalues_profile", longitudinal resistive stress ("Rxx_profile"), estimated ca ("errorCalvingRate"), and observed terminus indices ("observedTerminusIndex") are included in the attribute me
Sampling Area And Frequency:	We selected 50 diverse marine-terminating glaciers that are distributed around the periphery of the Greenland Ic marine boundary as a whole. Of the approximately 200 marine-terminating glaciers in Greenland, only 50 fit our elevation and ice velocity and near-coincident observations of ice elevation and ice velocity.
Sampling Description:	We required observational inputs of coincident ice elevation, bed elevation, and ice velocity measurements to ev space and time. Of the roughly 200 outlet glaciers in Greenland, we identified 50 glaciers that had a complete se of glacier characteristics and environmental settings, exemplified by varying ice thicknesses, ice velocities, calvi temperatures, such that the 50 sample glaciers are broadly representative of the Greenland Ice Sheet marine bo set consists of a single set of bed elevation and coincident ice elevation and ice velocity observations from all 50 years 2009 to 2017. For four of 50 sample glaciers, we obtained 15 additional coincident observation sets at eac calving. These temporally-dense observations are from Jakobshavn Isbrae, Kangerdlussuaq Glacier, Daugaard- during the months of March through November from 2010 to 2017. The latter four glaciers exhibit some of the la rates and terminus position in Greenland.

Data Set Usage Rights