

Canadian Ice Island Drift, Deterioration and Detection (CI2D3) Database

Requirements Specification Document V1.0

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Collated by Ron Saper and Anna Crawford

Water and Ice Research Lab
Department of Geography and Environmental Studies
Carleton University
1125 Colonel By Drive
Ottawa, ON K1S 5B6

Contents

- Contents 2
- Introduction and Background 3
- How to Use This Document 3
- Scope and Structure of this Document 4
- Potential Issues 5
- High Level Requirements 5
- Database Management and Design Requirements 8
- Other Requirements 11

Introduction and Background

Ice islands (large tabular icebergs) are becoming increasingly prevalent in both the Eastern and Western Arctic as a direct result of climate-induced break-up of Arctic ice shelves and glaciers. Ice islands form when extremely extensive coastal ice calves away from the shore. This creates large expanses of drifting ice that can break-up as they transit south. Ice islands pose a hazard to offshore activities (i.e., natural resource extraction and shipping) in the Arctic and along the East Coast of Canada. Our project aims to address the need for quantitative information on where ice islands are drifting and how rapidly they are deteriorating.

A geospatial ice island database is under development using mainly Radarsat-2 imagery from the CIS image archive. This database has the potential to contribute to at least four areas of ongoing active research, including: drift analyses (statistical approach), deterioration analyses, remote-sensing detection and, drift and deterioration model calibration and validation.

In order to define what is required of the finished CI2D3 database, this requirements document was created.

How to Use This Document

The purpose of this document is primarily to guide project development internally, but also to explain what public users can expect from CI2D3 both before and after release. The development we seek to guide is not only software and database implementation, but also data selection, scoping, digitization, quality assurance, documentation etc. In short all the activities necessary to create the CI2D3 database.

This document is intended to be revised frequently as the scope is changed, as problems and opportunities are identified, and as key decisions are made. The version numbers that end in a zero fraction part (i.e. 1.0, 2.0, 3.0 etc) are to be considered definitive. Intermediate versions such as 0.1 or 2.7 are considered working versions used to communicate draft ideas. It is intended that more than one person should participate in revising this document, and the release versions (e.g. 1.0) represent the current definitive view of what we need CI2D3 to be.

It is expected that the document will get somewhat longer and more detailed as we progress in development and implementation.

Scope and Structure of this Document

This document is not a design document, and should not contain detailed information on how the database is structured. It is also not a status report, user's guide, or technical reference. These can be documented elsewhere in other forms as needed.

The document contains different sections which cover different qualitative categories of requirements. The most basic requirements are called high level requirements. Low level requirements provide more detail. Database management and design requirements describe CI2D3 database design and management considerations to allow for specific data query and manipulation operations (internal project use only). Data requirements deal with the input imagery used to build the database. IT requirements cover what software platforms and tools are to be used where it is necessary to specify. Other requirements include reporting and documentation.

Not all requirements are equally important. Mandatory requirements are the first requirements to satisfy because they represent the minimum needed to support research currently planned. Desirable requirements will permit additional research to be done, and would be pursued if time and budgets permit or if they can be accomplished without significant additional effort or cost in the course of satisfying Mandatory requirements. Nice-to-have requirements are at a lower priority and can be pursued only if it does not compromise meeting of Mandatory and Desirable requirements.

Potential Issues

There are some unknowns regarding whether these specifications can be maintained for the 2008 calving event due to the more limited availability of SAR data in that era. Some problems also exist in terms of retrieving 2008 SAR data from archives, and some alternatives need to be investigated in the short term.

High Level Requirements

High level requirements define the scope and intent of the CI2D3 database (CI2D3 dB). Table 1 contains these requirements which can be referred to by identifier.

Priority symbols : M=Mandatory, D = desirable = N = Nice to have

ID	Name	Description	Comment	Priority
H-1	Drift, fragmentation, and extinction history: Petermann calvings (eastern Canadian Arctic)	CI2D3 DB shall support ice island drift modelling by tracking calving events from Petermann from the years 2008, 2010 and 2012 and tracing the fracture and drift of fragments as far as possible in time to their extinction, but only up until the end of 2014 for the 2012 calving event.	A threshold size under which it is unreasonable to continue tracking a fragment will be determined.	M
H-2	Accurate Shape	Where resolution permits, CI2D3 DB will capture the detailed 2-D shape of the ice island fragments seen in the imagery.	Detailed shape over time hoped to allow some measure of deterioration.	M
H-3	Adequate Temporal Resolution	CI2D3 DB will be able to provide a snapshot of locations of ice island > 5 km ² in the eastern Canadian Arctic at a minimum resolution of 2 weeks for the 2010 calving event, TBC for other Petermann calvings.	See D-4	M
H-4	Other glaciers, eastern Canadian Arctic	As a secondary priority, and when it does not require additional data sets, fragments from unknown or non-Petermann sources will also be captured if they are greater than 3 km² when first sighted and only if they are found south of 81.5° North . Full history is not expected. This is mainly to help reduce	For instance fragments from Ryder are known to be visible in certain places at certain times. The limitation to below 81.5°N latitude is added to to avoid the need to monitor other North Greenland fjords.	D

		confusion regarding Petermann v. fragments from other sources.		
H-5	Drift, fragmentation, and extinction history: Ellesmere Island calvings	CI2D3 DB shall support ice island drift modelling by tracking calving events from the Ellesmere Island ice shelves (e.g., Markham, Ayles, Ward Hunt ice shelves) and tracing the fracture and drift of fragments as far as possible in time to their extinction.	This is a possible extension of the CI2D3 DB project after the Petermann Glacier events are traced.	D
H-6	Good temporal resolution	CI2D3 DB may allow a detailed snapshot of locations of ice islands > 5 km ² in the Eastern Canadian Arctic at a resolution of 1 week	On a best efforts basis, better temporal resolution of 1 week versus 2 weeks may provide additional information. See D-5	D
H-7	Update to current timeframe	CI2D3 DB may permit update of 2012 calving event past 2014	This would allow complete characterization of the 2012 Petermann calving.	N

Low-Level Requirements

ID	Name	Description	Comment	Priority
L-1	Trackable minimum size	Ice island fragments being tracked should be maintained until their surface area is less than or equal to 0.25 km ² and their lineage documented where possible.	Fragments smaller than 0.25 km ² are harder to spot and identify and also can less easily be recognized as resightings of specific pieces with discernable shape.	M
L-2	Enhanced temporal resolution for initial calving	The temporal resolution for the initial pieces and their offspring fragments which are larger than 5 km ² within the first 30 days should be the maximum practical, using all available and accessible images.	The relatively confined drift within the initial 30 days makes this tractable, and the calving dynamics are of special interest.	M
L-3	Enhanced temporal resolution for spinning ice islands	The temporal resolution should be increased to the maximum practical (use all available images) for at least one contiguous 15 day interval when an ice island fragment bigger than 5 sq km is spinning in any one of Jones Sound, Lancaster Sound or Hudson Strait.	This will support drift modelling work.	M
L-4	Additional cases: Enhanced temporal resolution for spinning ice islands	As for L-3 but for additional cases and/or a longer period of time	This will support additional modelling work	D
L-5	Image reference	Each polygon that is digitized shall be linked in the database to the raster data source (satellite remote-sensing image)	This will allow detectability studies to gather descriptive statistics and validate algorithms	D

Database Management and Design Requirements

CI2D3 database design and management requirements allow for specific data query and manipulation operations. These tools will be for use within the project team. Table 2 contains these requirements which can be referred to by identifier. M = Mandatory, D = Desirable, N=Nice to have.

ID	Name	Description	Comment	Priority
F-1	Search all children	The database shall support retrieval of all children to any desired depth D given an identified polygon		M
F-2	Search all ancestors	The database shall support retrieval of the lineage of ice islands which gave birth to an identified polygon, given a desired depth D and an identified polygon		M
F-3	Retrieve by spatial extent	The database shall allow extraction of all ice islands by spatial extent give a polygon or latitude/longitude range		M
F-4	Retrieve by time period	The database shall allow extraction of all ice islands by temporal extent give a date range	This needs to be possible in conjunction with F-3	M
F-5	Export shapefile subsets	Shapefile subset export will be possible keeping lineages intact	To be conducted after F1-4.	M
F-6	New shapefile generation	Generate and export point shapefiles from centroid locations		N
F-7	Calculations with attribute fields	Calculations within the database can be conducted and form the basis of an update query to modify or add fields.	E.g., Calculate the % or magnitude of deterioration between ice islands connected within a lineage and categorize these as deterioration types or as 'new fragments' vs. 'same ice island'.	D
F-8	Generate New Fields	Geospatial analysis within the database can be conducted and form the basis of an update query to modify or add fields.	E.g., Finding aspect ratios of ice islands	D
F-9	Insert new data	The ability to incorporate new ice island observations between times that have already been digitized	This insertion will not break lineages	M

Data Requirements

Data requirements refer to the sources of information utilized by CI2D3 DB. Table 3 contains these requirements which can be referred to by identifier. M = Mandatory, D = Desirable, N=Nice to have.

ID	Name	Description	Comment	Priority
D-1	RADARSAT	CI2D3 DB will use as primary data RADARSAT-1 and RADARSAT-2 data in their original format as delivered by the processing facility.		M
D-2	ENVISAT	CI2D3 DB will use ENVISAT ASAR data in their original format as delivered by the processing facility where data from D-1 does not suffice		D
D-3	ALI and other optical imagery	Advanced Line Imager data can be used where appropriate as well as optical data of opportunity.		D

IT Requirements

IT requirements refer to the software platforms and tools used by CI2D3 DB. Table 4 contains these requirements which can be referred to by identifier. M = Mandatory, D = Desirable, N=Nice to have.

ID	Name	Description	Comment	Priority
I-1	PostgreSQL	Uses open source Postgres/PostGIS database to store the geodatabase		M
I-2	ArcGIS	Information contained within the database needs to be compatible with ArcGIS v10.3 or higher. This software is also used by the operational digitizers to create/collect the data ingested to CI2D3 DB.	Query in the database and export for mapping in ArcGIS. Should be able to go in both directions (i.e., extract bathymetry depths of ice islands in ArcGIS and add this to CI2D3 DB)	M
I-3	Python/Arc Tools	Customizeed tools for this project are desirable for generating attribute fields of digitized shapefiles and tracking an ice island's lineage.		M
I-4	Backups	Backups of the database and associated files to be conducted at least weekly	Currently incremental backups occur daily, weekly and monthly for most files. The database files are backed up weekly. Archiving occurs occasionally	M
I-5	Version Control	All programs, scripts and protocols to be version controlled or versioned	This will avoid confusion, allow rollback and show the evolution of protocols throughout the project	M

Other Requirements

Other requirements can refer to any additional objectives of the project or needs of current and future users of the database. Table 5 contains these requirements which can be referred to by identifier. M = Mandatory, D = Desirable, N=Nice to have.

ID	Name	Description	Comment	Priority
O-1	Webpage	CI2D3 DB shall include a webpage so that users can discover, learn about, acquire and use CI2D3 DB	Aids in discovery and dissemination	M
O-2	Searchable	Metadata to be posted on the Polar Data Catalogue so it can be found by those searching for this information	PDC/CCIN number 12678	M
O-3	Downloadable	A sample dataset will be made available on the PDC website and on the CI2D3 webpage. A full copy of of the CI2D3 DB and designated user support files will be made available in time.		M
O-4	User Manual	The User Manual will support using CI2D3 DB to query CI2D3 DB and also visualize within ArcGIS.	This shall be useable by people outside of WIRL	M
O-5	Project Documentation	A file containing operators' procedures regarding ice island digitization shall be available to provide context/answer questions for future users regarding CI2D3 DB's creation		M
O-6	Raw Data	The original image data will be retained and organized throughout the project lifetime for easy retrieval of remote sensing data.	In the event that there is 'something of interest' that comes to attention during data processing and a visual inspection would be useful	D
O-7	Streamlined Image Processing	The workflow for processing raw data, obtained by O-5, will be easy for any future user		N