Polar operational challenges and solutions

West Greenland 2024

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Survey location

The journey and work area

Depart Galway Ireland for Nuuk 24th July 2024

Survey site from 1st to 20th August 2024

Returned to Galway 1st September 2024

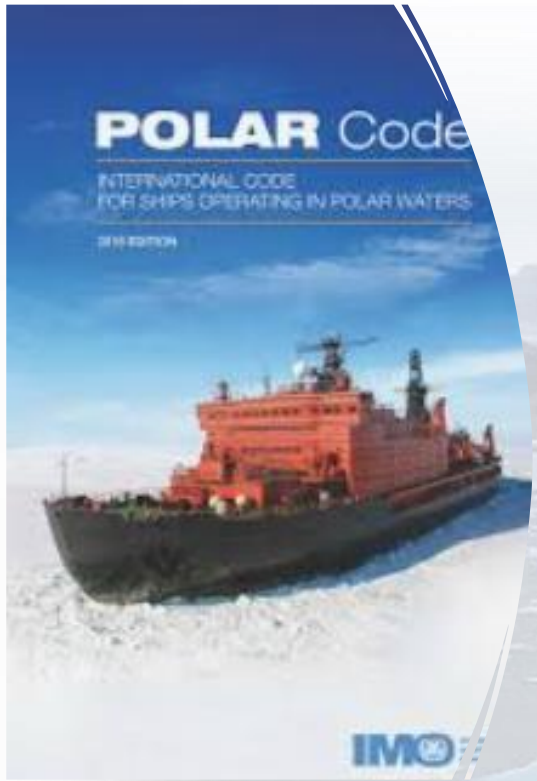
The Mission

University of Texas, Institute for Geophysics (team lead by Professor Ginny Catania) set out to study ice sheet change and stability through focusing on seabed sediment. The researchers central hypothesis was that morainal bank sedimentation can stabilise or delay retreat for some glacier systems.

This strategy was to compare past observations with oceanographic observations along with in situ seabed samples taken using the ROV Nereid under Ice.

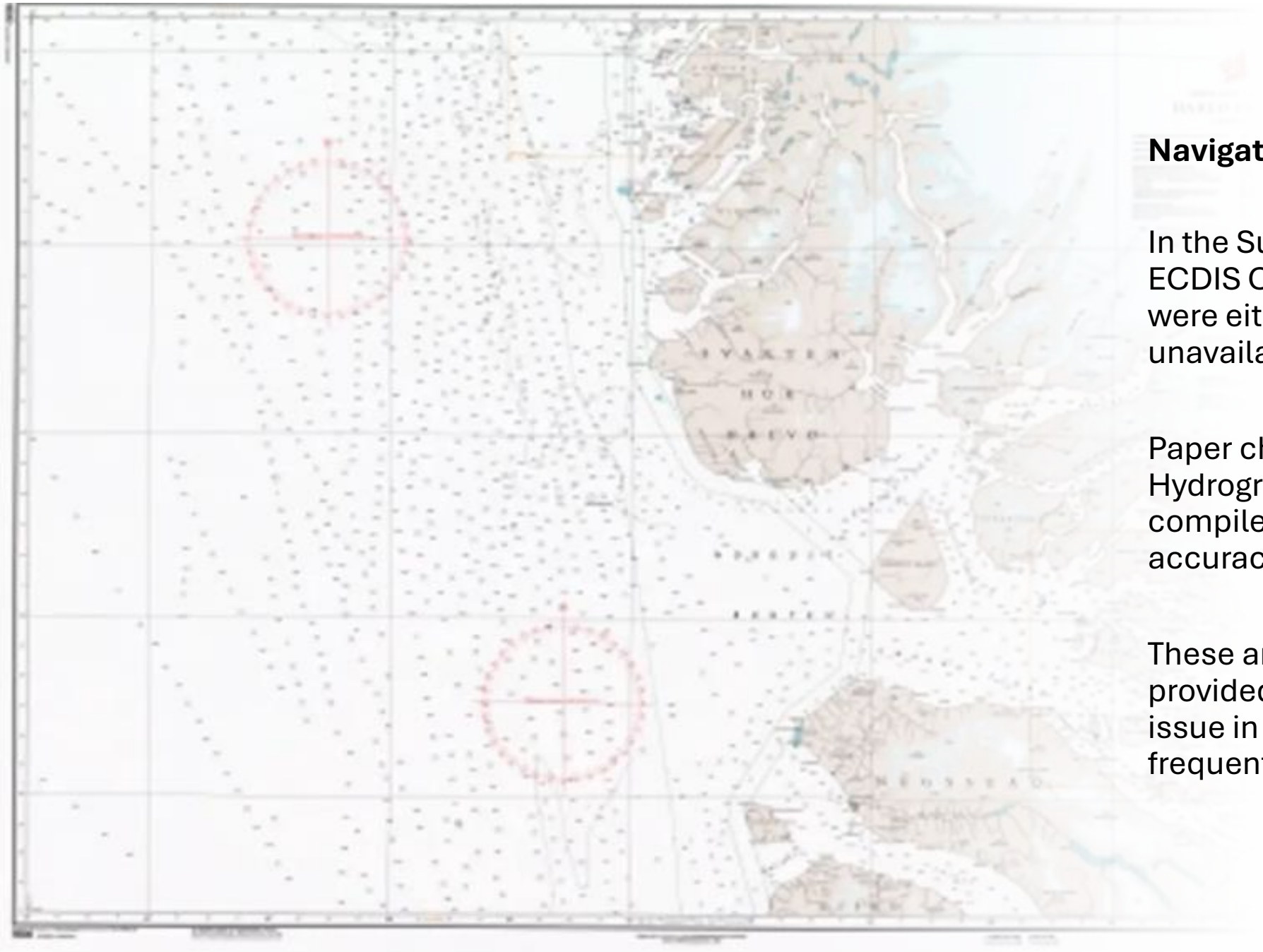
Operational Issues, challenges and solutions

- Polar Code compliance
- Navigation
- Ice risk
- Karrat’s Fjord Tsunami 2017
- Communication
- Other considerations



Polar Code Compliance

The Celtic Explorer is certified under the Polar Code as a Category C vessel (D1). Strategic planning had to consider the ship specific capabilities and limitations of a vessel in that category, essentially ice avoidance.



Navigation - the challenge

In the Survey Area, the availability of ECDIS Charts for the region of interest were either extremely limited or unavailable.

Paper charts available from the Danish Hydrographic office were originally compiled in the 1960s and come with accuracy warnings.

These are large scale, and the depths provided are spot depths. It is a common issue in these regions with vessels frequently encountering these situations

Navigation - mitigation

Other sources: C Map charts which have both depths and bathometric charts available for the areas of interest.

Multibeam data. Over the past 8 years extensive detailed multibeam data has been procured in the areas of interest through the Oceans Melting Greenland project commissioned by NASA.

Utilising this data, charts were prepared by Advance Mapping Services in the Marine Institute, both electronically and on hard copy to ensure the vessel has appropriate information to safely carry out the survey.

Navigation - Mitigation

The fjords in which the survey work took place were deep and obviously easy to navigate draught wise.

As a research vessel, it is also heavily equipped with acoustic sounders, such as multibeam sonars and a forward-looking Sonar which was employed as an extra measure.

The ship’s crew are experienced in this type of cautious navigation with experience in from participation in the INFOMAR seabed mapping programme, in waters of various and unknown depths.

Wide range of mitigation used and discussed formally with Flag, Class and Insurance prior to the survey at an early stage.

Ice Risk

Under Polar Code the vessel uses risk-based procedures to ensure the vessel is kept safe and compliant with its status as a CAT C vessel as defined by the Polar Code.

The formal method used in the ships Polar Code Manual is the POLARIS Assessment System

The Polaris System

Polaris (Polar Operational Limit Assessment Risk Indexing System) using the Egg Code format for assessing ice conditions.

Different Countries use slight variations of this system in their Ice Forecasts but in principle all are very similar.

Use of the egg code allowed for the vessel to calculate the Risk Index. As can be seen from the table, a CAT C vessel is restricted, accordingly awareness of the risk is vital

Increasing ice thickness (severity)

Decreasing ice class

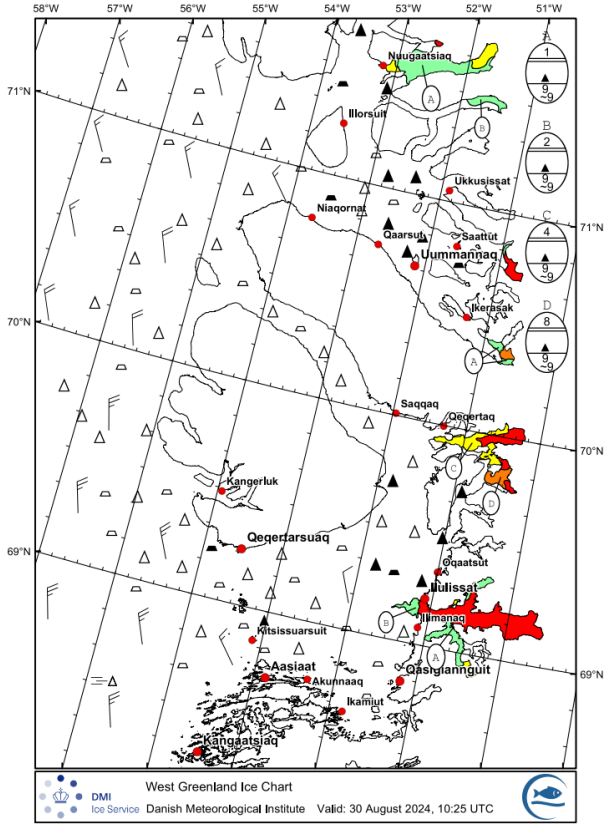
Increased Risk

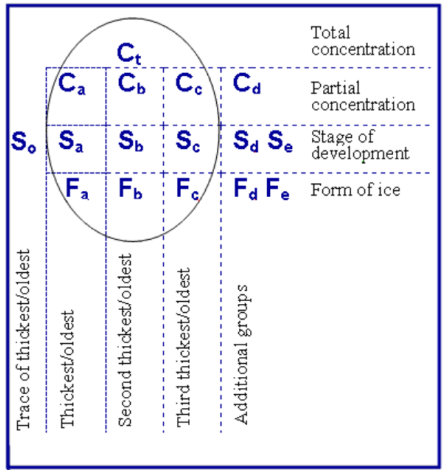
Polar Ship Category	ICE CLASS	ICE FREE --	NEW ICE 0-10 cm	GREY ICE 10-15 cm	GREY WHITE ICE 15-30 cm	THIN FIRST YEAR 1ST STAGE 30-50 cm	THIN FIRST YEAR 2ND STAGE 50-70 cm	MEDIUM FIRST YEAR 1ST STAGE 70-95 cm	MEDIUM FIRST YEAR 2ND STAGE 95-120 cm	THICK FIRST YEAR 120-200 cm	SECOND YEAR 200-250 cm	LIGHT MULTI YEAR 250-300 cm	HEAVY MULTI YEAR 300+ cm
A	PC1	3	3	3	3	2	2	2	2	2	2	1	1
	PC2	3	3	3	3	2	2	2	2	2	1	1	0
	PC3	3	3	3	3	2	2	2	2	2	1	0	-1
	PC4	3	3	3	3	2	2	2	2	1	0	-1	-2
	PC5	3	3	3	3	2	2	1	1	0	-1	-2	-2
B	PC6	3	2	2	2	2	1	1	0	-1	-2	-3	-3
	PC7	3	2	2	2	1	0	0	-1	-2	-3	-3	-3
C	IAA	3	2	2	2	2	1	-1	-1	-2	-3	-4	-4
	IA	3	2	2	2	1	0	-2	-2	-3	-4	-5	-5
	IB	3	2	2	1	0	-1	-2	-3	-4	-5	-6	-6
	IC	3	2	1	0	-1	-2	-3	-4	-5	-6	-7	-8
	No Ice Class	3	1	0	-1	-2	-3	-4	-5	-6	-7	-8	-8

RIO = (C1xRV1)+(C2xRV2)+(C3xRV3)+(C4xRV4)

C1…C4 concentrations of ice types within ice regime (mixture of different ice types and ice free water)
RV1…RV4 Risk Values (RV) for each ice class

RIO_{SHIP}	*Ice classes PC1-PC7*	*Ice classes below PC 7 and ships not assigned an ice class*
RIO ≥ 0	Normal operation	Normal operation
-10 ≤ RIO < 0	Elevated operational risk*	Operation subject to special consideration**
RIO < -10	Operation subject to special consideration**	Operation subject to special consideration**





Other applications

IcySea APP - An ice information app for navigation in polar regions providing various combined information in Polar Code complaint fashion.

Providing near real time sea ice information from various sources in interactive software that can be run on a low bandwith connection. This includes data from ice charts, satellite and radar imagery.

Various supporting information and descriptions and application can be tailored to vessel’s ice class.

Celtic Explorer used IcySea to supplement the approved systems on board.

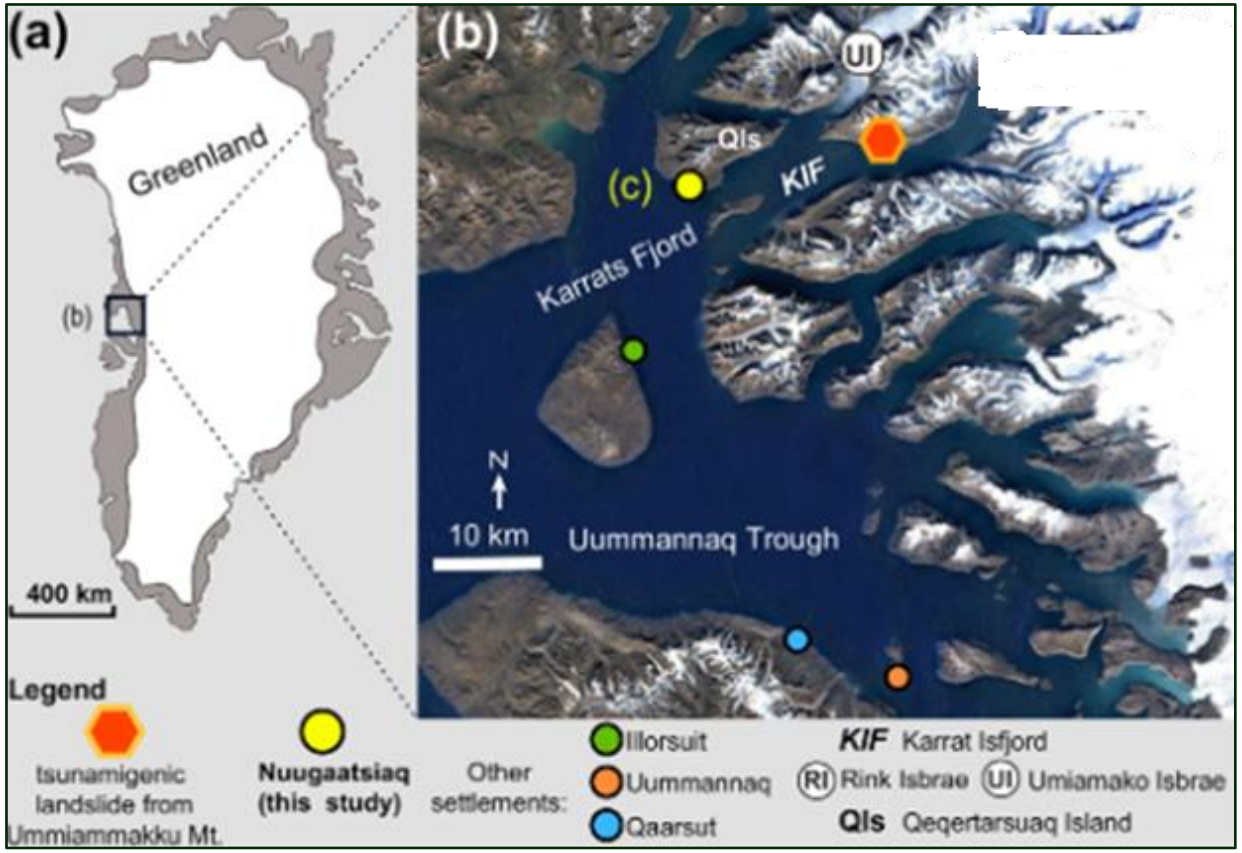


Image – International Tsunami Information Centre.

(a) Location of fjord **(b)** General position of Karrat Fjord in western Greenland. Nuugaatsiaq shown in yellow

Karrat's Fjord Tsunami 2017 and implications

On 17 June 2017, a significant tsunami occurred in the Karrat Fjord, resulting in severe property damage and casualties in the fishing village of Nuugaatsiaq.

The seismic energy detected prior to the tsunami was so significant it was first thought to have been the result of a magnitude 4.1 earthquake.

However, the cause was a landslide on a steep slope of the fjord where a significant amount of rock plunged into the water below, 32 kilometers northeast of the village. Forty-five structures, including eleven houses, were washed away or destroyed, and four people were killed.

At the time of Survey, a resultant Navigation Warning remained in place.

Tsunami Risk – Mitigation

Greenland publish a monthly Situation Assessment on the risk of further landsides in the region.

The fjord is monitored by CCTV.

The information was available online which allowed the ship to be aware of current risks.

Communication

Western Greenland North of Nuuk is remote, more so the further north. Survey area 71 degrees north.

Conventional Satellite overage was going to be a challenge due the low elevation of those Satellites at the high latitude combined with the subject Fjords being surrounded by mountains with heights reaching 2000M +.

Alternative services installed on the vessel, however, as untested it was of concern. Nevertheless, Starlink for example provided excellent coverage for the duration of the Survey.

Other considerations

Fresh water

Logistics and agents

Crewing

Over the side operations

Thank you

Takk fyri

Questions?

Foras na Mara
Marine Institute