



Polaris: What's Next Industry Perspective

James Bond, ABS, Director Polar Operations Research & Ice Class Ships
Rob Hindley, Aker Arctic, Head of Machinery & Structural Design



Aker Arctic
The Ice Technology Partner

POLARIS

- Links ice class to actual ice conditions
- ABS & LR (IACS) with Arctic states did most of the development and validation work
- Important because it is an international instrument
- Adoption is apparent, it is the choice for operators on their Polar Ship Certificate for stating limitations for operating in ice
- Invaluable as an awareness building tool
- Can it be improved – Yes!
- Update: Is time is running out?

GUIDANCE ON METHODOLOGIES FOR ASSESSING OPERATIONAL CAPABILITIES AND LIMITATIONS IN ICE

1 The Maritime Safety Committee, at its ninety-fourth session (17 to 21 November 2014), adopted the new chapter XIV of SOLAS and the International Code for Ships Operating in Polar Waters (Polar Code), by resolutions MSC.386(94) and MSC.385(94), respectively. In accordance with the Polar Code, new and existing ships operating in polar waters shall have on board a valid Polar Ship Certificate establishing operational limitations, including limitations related to ship structural ice capabilities.

2 The Polar Code also requires that information on ship-specific capabilities and limitations in relation to the assessment required under section 1.5 of the Polar Code be included in the Polar Water Operational Manual (PWOM).

3 The annexed guidance addresses the development of methodologies for the assessment of operational limitations in ice which may be referenced on the Polar Ship Certificate and which may form part of information on ship-specific capabilities and limitations included in the PWOM.

4 This guidance has been issued as "interim guidance" in order to gain experience in its use. It should be reviewed four years after the entry into force of the Polar Code in order to make any necessary amendments based on experience gained.

5 In the meantime, Member States and international organizations are invited to report on their experience with the use of the guidance to the Maritime Safety Committee under the agenda item "Any other business".

6 Member States are invited to bring the annexed guidance to the attention of all parties concerned.



POLARIS

- Risk evaluated based on Ice Class & ice regime encountered
- Outcome is a ***single value*** Risk Index
- $RIO = (C_1 \times RV_1) + (C_2 \times RV_2) + (C_3 \times RV_3) + (C_4 \times RV_4)$
 - $C_1 \dots C_4$ concentrations of ice types within ice regime (mixture of different ice types and ice free water)
 - $RV_1 \dots RV_4$ Risk Values (RV) for each ice class

| RIO _{SHIP} | Ice classes PC1-PC7 | Ice classes below PC 7 | Color Code |
|---------------------|--|--|------------|
| 20 ≤ RIO | Normal operation | Normal operation | |
| 10 ≤ RIO < 20 | | | |
| 0 ≤ RIO < 10 | | | |
| -10 ≤ RIO < 0 | Elevated operational risk | Operation subject to special consideration | |
| -20 ≤ RIO < -10 | Operation subject to special consideration | Operation subject to special consideration | |
| -30 ≤ RIO < -20 | | | |

Increasing ice thickness (severity)

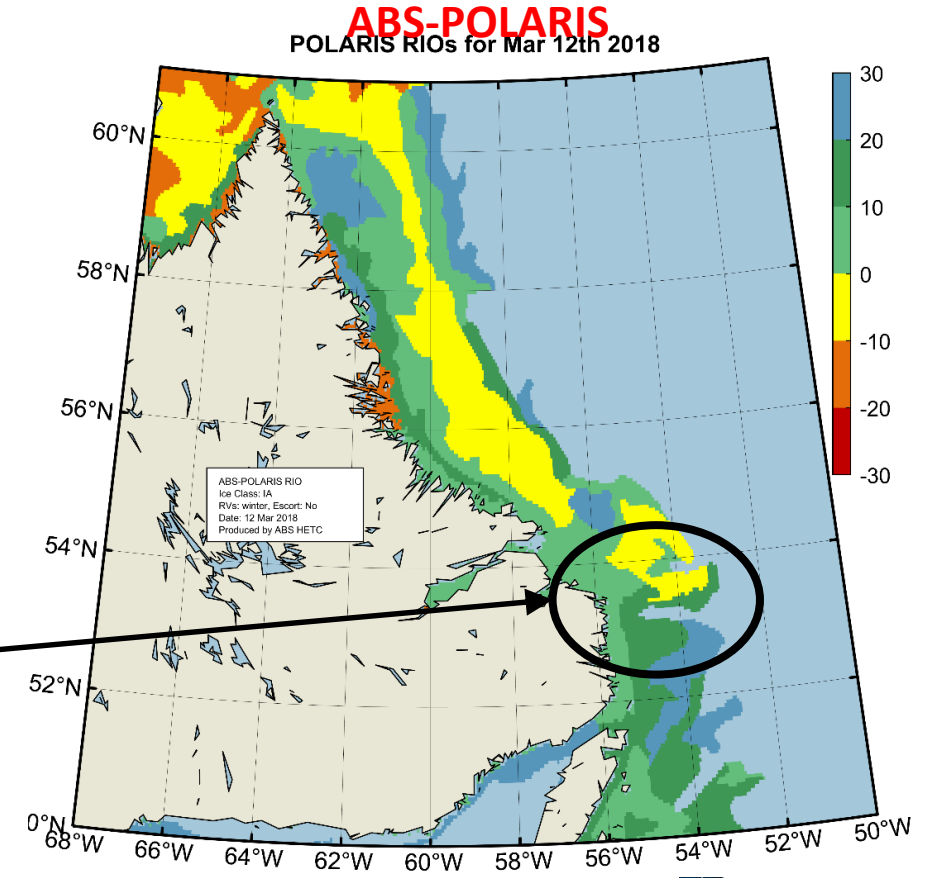
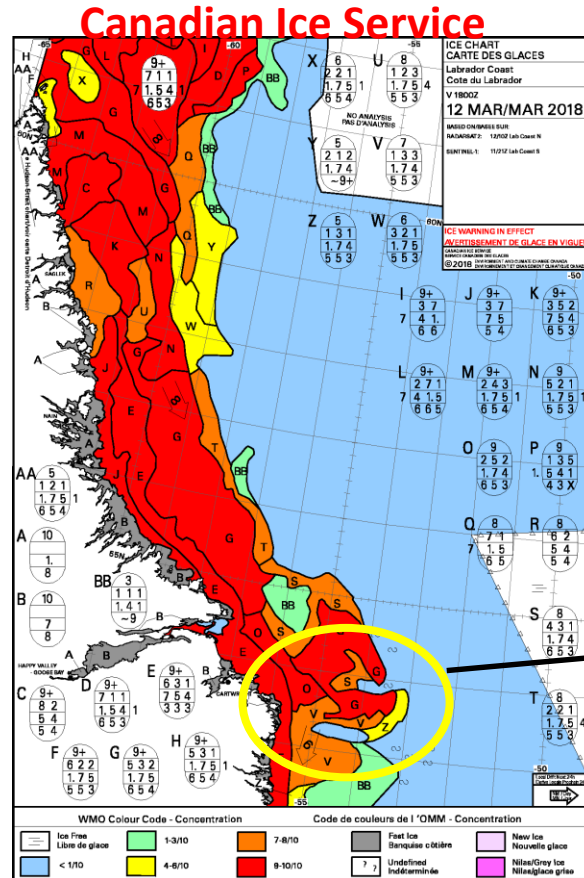
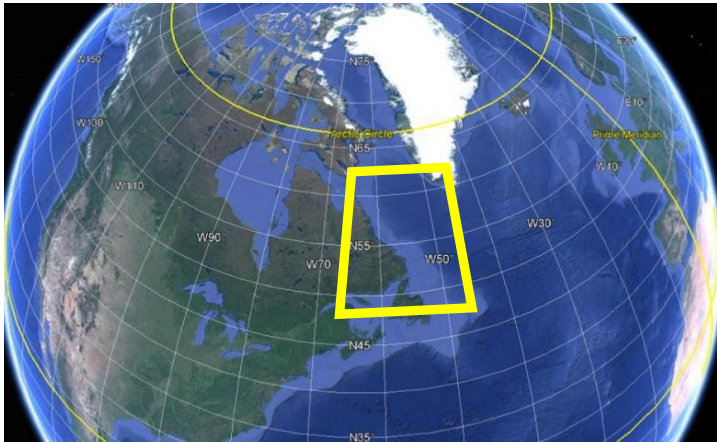
| Polar Ship Category | ICE CLASS | Winter Risk Values (RVs) | | | | | | | | | | | |
|---------------------|--------------|--------------------------|---------|----------|----------------|---------------------------|---------------------------|-----------------------------|-----------------------------|------------------|-------------|------------------|------------------|
| | | ICE FREE | NEW ICE | GREY ICE | GREY WHITE ICE | THIN FIRST YEAR 1ST STAGE | THIN FIRST YEAR 2ND STAGE | MEDIUM FIRST YEAR 1ST STAGE | MEDIUM FIRST YEAR 2ND STAGE | THICK FIRST YEAR | SECOND YEAR | LIGHT MULTI YEAR | HEAVY MULTI YEAR |
| | | -- | 0-10 cm | 10-15 cm | 15-30 cm | 30-50 cm | 50-70 cm | 70-95 cm | 95-120 cm | 120-200 cm | 200-250 cm | 250-300 cm | 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 | 0 | -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 |

Decreasing ice class

Increased Risk

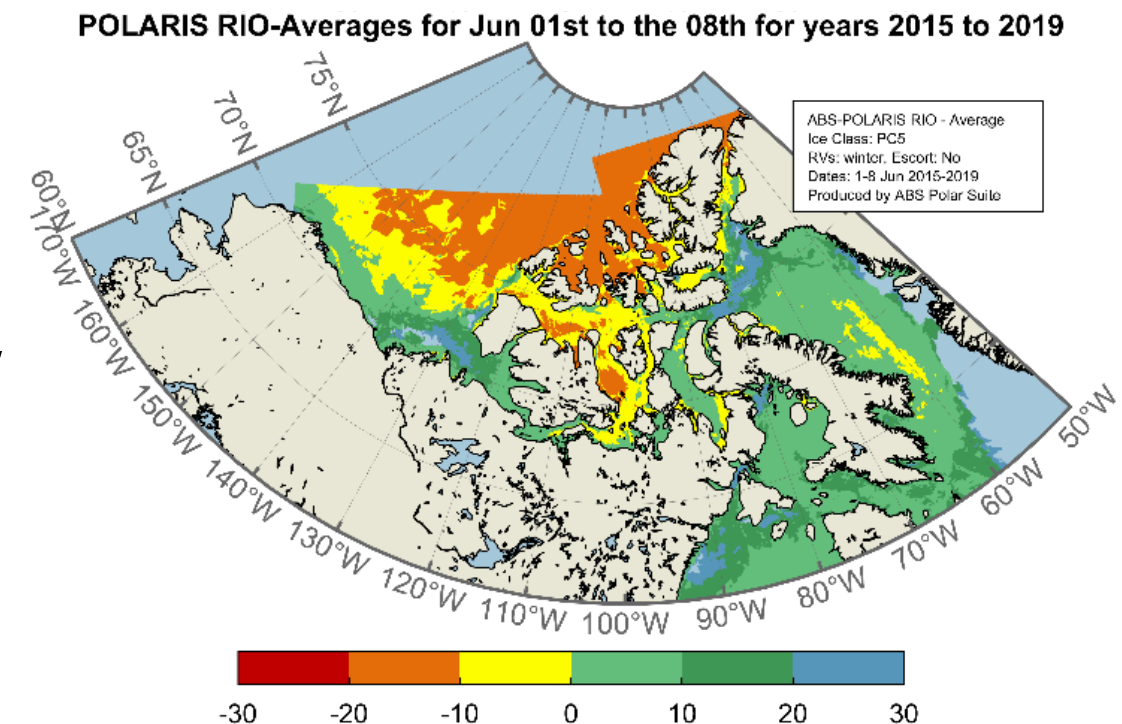
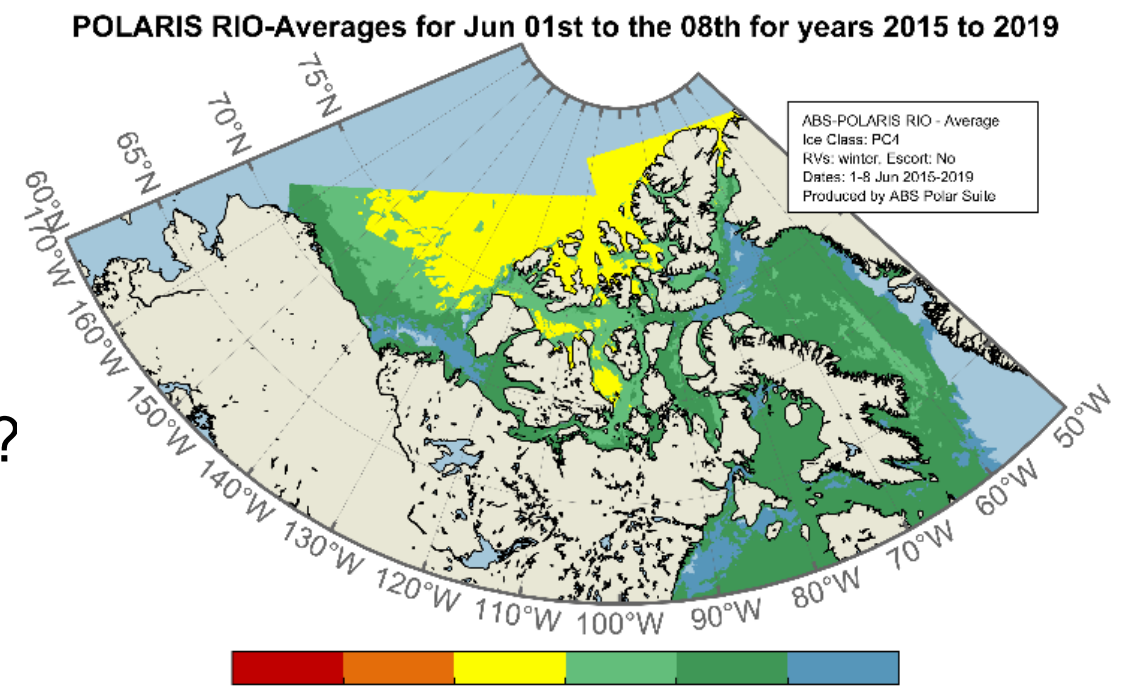
ABS: How we use POLARIS

- Based on an IMO POLARIS methodology, it expands from a single Risk Index Outcome value to compilation plot, ABS POLARIS
- Uses published, publicly available ice charts (Arctic and Antarctic)



Understanding Operational Reach / Limits

- Planning: In the simplest terms where can a ship of specific ice class go at a specified time?
- Example plots:
 - Averaged data 2015-2019 (five years)
 - First week of June
 - Can a PC4 go through the Northwest Passage?
 - PC5 make the same voyage?
- Use average over several years for planning and ice class decision purposes
- Compare individual years and compare to how current year is developing for more tactical nearer term planning

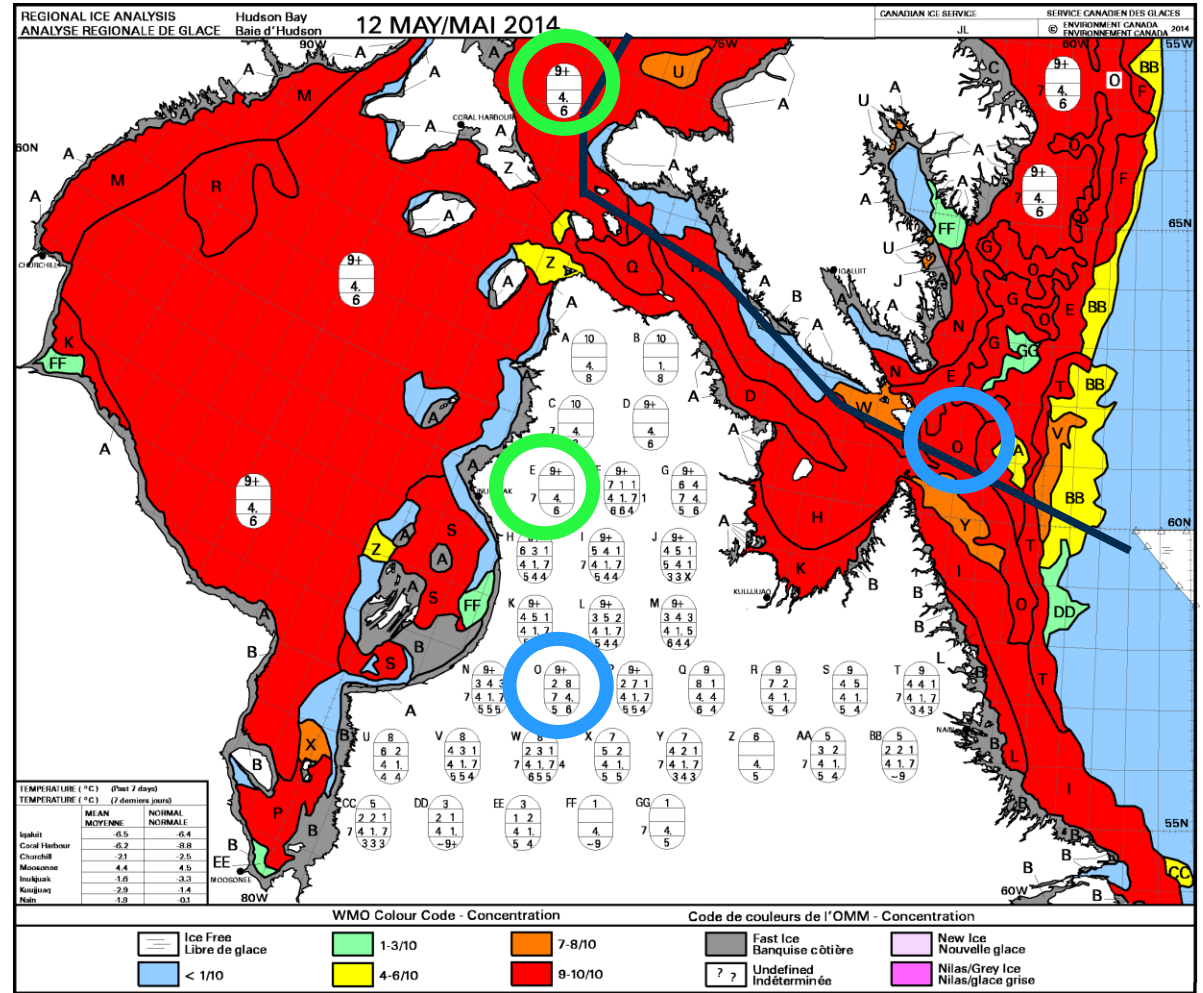


Aker Arctic: How we use POLARIS for Ice Class Evaluation

Early-stage transit analysis (example):

1. Select Route
2. Review multiple ice charts
3. Identify heavy, average, mild years
4. Find choke point ice conditions
5. Run POLARIS
6. Deep dive into choke points in different years
7. Take limiting ice conditions
8. Evaluate with AAT internal ice load models
9. Confirm suitability of ice class

| RIO for "Average" Season Conditions - Ice Regime "O" | | | | | | | | | | | | |
|--|---------|----------|-------|-------|-----|------|------|--------|-----------|---------|----------|----------|
| ICE CLASS | January | February | March | April | May | June | July | August | September | October | November | December |
| PC 1 | 20 | 20 | 41 | 21 | 18 | 23 | 20 | 30 | 30 | 30 | 30 | 24 |
| PC 2 | 20 | 20 | 41 | 21 | 16 | 23 | 20 | 30 | 30 | 30 | 30 | 24 |
| PC 3 | 20 | 20 | 41 | 21 | 14 | 23 | 20 | 30 | 30 | 30 | 30 | 24 |
| PC 4 | 20 | 20 | 39 | 12 | 4 | 13 | 10 | 30 | 30 | 30 | 30 | 24 |
| PC 5 | 17 | 11 | 31 | 12 | 4 | 13 | 20 | 30 | 30 | 30 | 30 | 24 |
| PC 6 | 10 | 10 | 24 | 11 | 2 | 12 | 20 | 20 | 20 | 20 | 20 | 14 |
| PC 7 | 7 | 1 | 14 | 2 | -6 | 2 | 10 | 20 | 20 | 20 | 20 | 14 |
| IAS | 7 | 1 | 14 | 2 | -8 | 2 | 10 | 20 | 20 | 20 | 20 | 14 |
| 1A | -3 | -9 | 4 | -7 | -18 | -8 | 0 | 20 | 20 | 20 | 20 | 8 |
| 1B | -13 | -19 | -6 | -16 | -28 | -18 | -10 | 20 | 20 | 20 | 20 | -2 |
| 1C | -23 | -29 | -16 | -25 | -40 | -28 | -20 | 20 | 20 | 20 | 20 | -12 |
| None | -33 | -39 | -33 | -35 | -48 | -39 | -30 | 10 | 10 | 10 | 10 | -22 |
| | IAS | IAS | IAS | IAS | PC6 | IAS | IA | None | None | None | None | 1A |



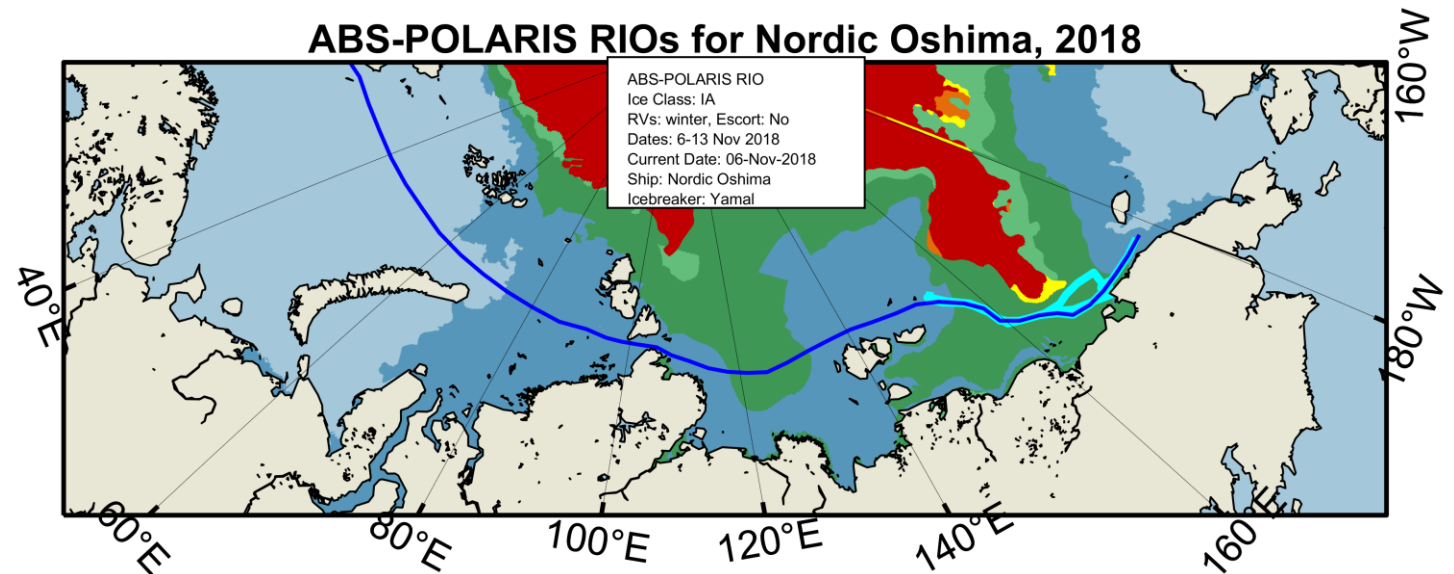
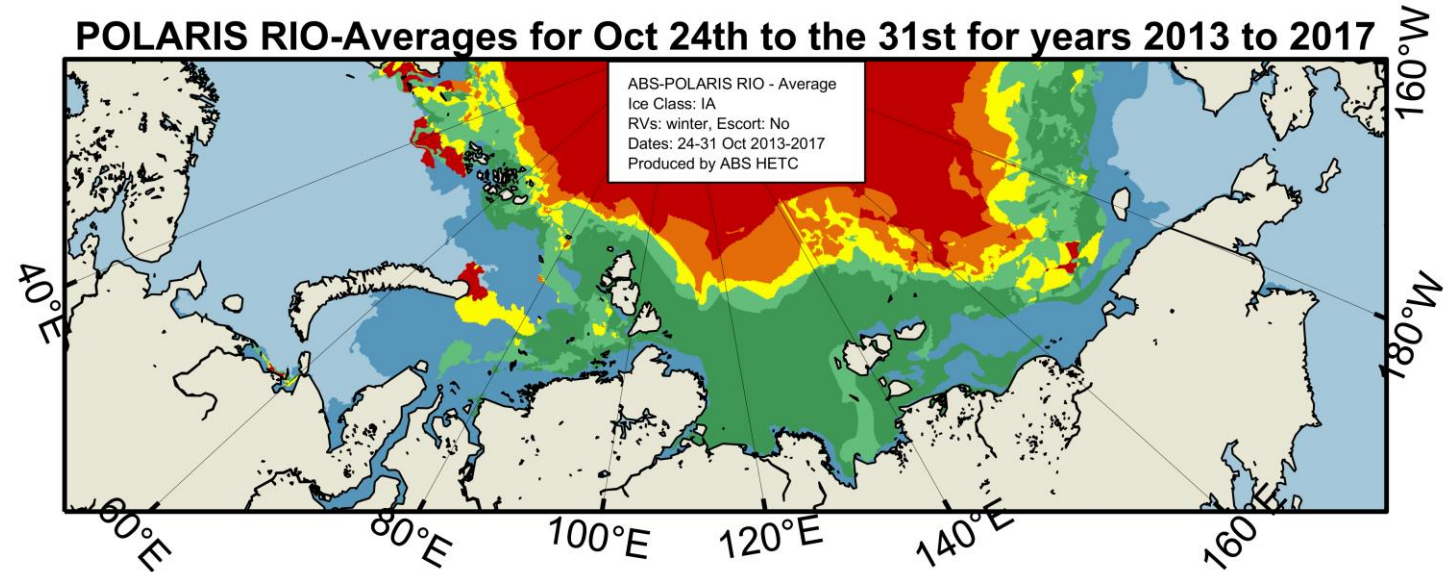
Aker Arctic: How we use POLARIS and How we Don't

- POLARIS is a generic starting point to understand ice risks
- We don't make decisions only on POLARIS when selecting ice strengthening, it is used to screen routes, conditions etc.
- Screening helps us select limiting or most difficult ice conditions
 - ...this helps us consider in more detail the risks for a better understanding of trafficability
- Also need to look at local ice conditions and more extreme events
- Especially the case where traces or low concentrations of Multi-Year ice are part of the ice regime



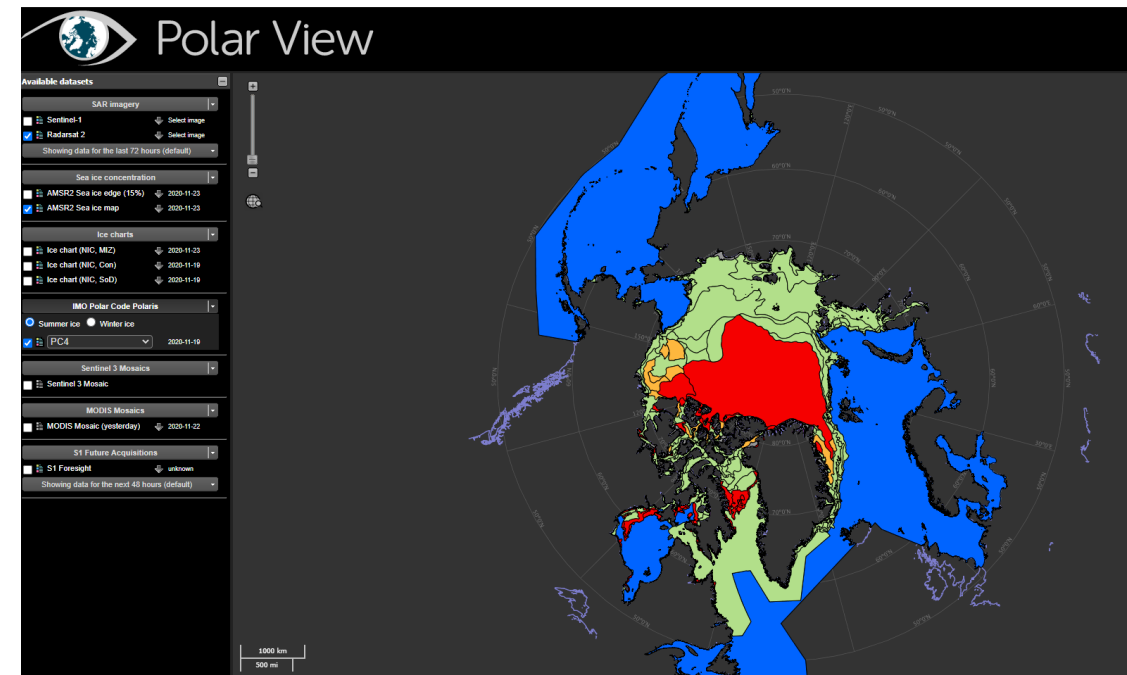
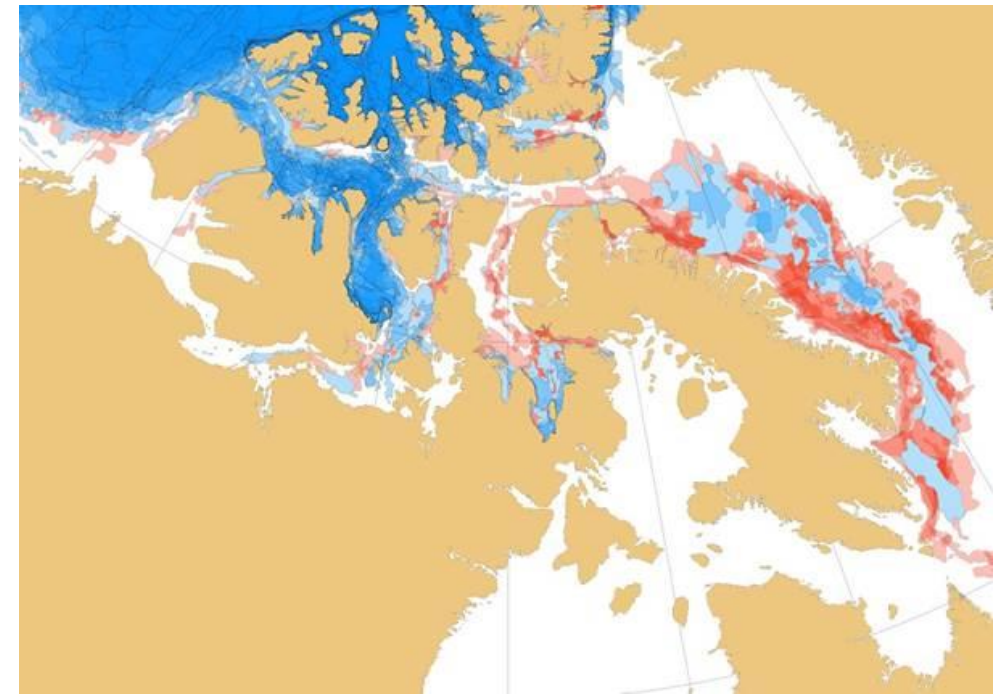
ABS Voyage Forensics

- Does POLARIS data analysis provide evidence of a sound planning?
- Example: Nordic Oshima and Nordic Olympic transit of the NSR in late Oct / early Nov 2018
 - Five year 2013-2017 data suggest a feasible voyage and that arranging icebreaker escort in the East Siberian sea would be prudent
 - 2018 actual data shows ice conditions quite different and icebreaker escort was a good plan



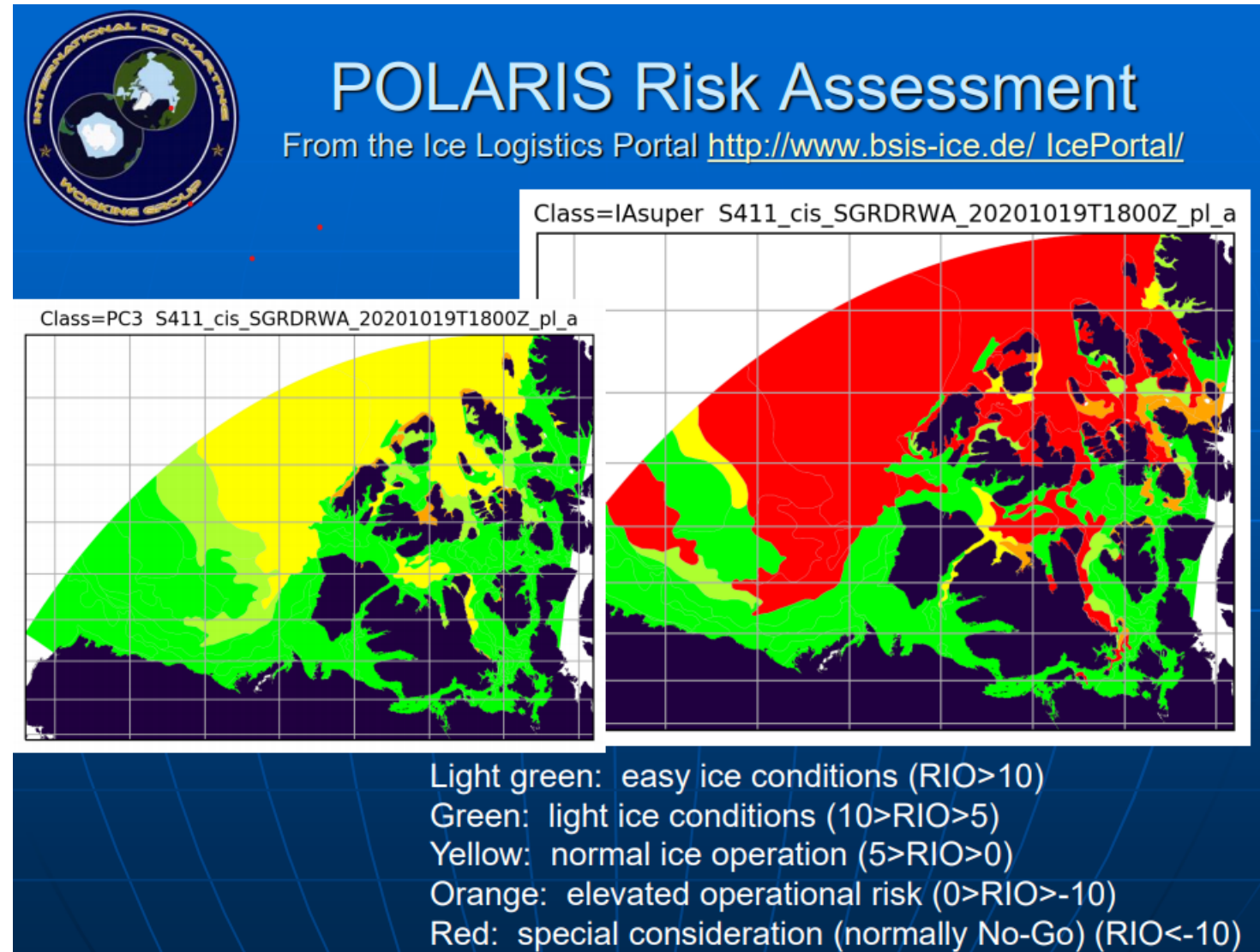
Other Organizations

- VARD Marine:
 - Heat map approach
 - Example: For 1 June and a 10 year time series
 - Colour intensity reflect number of years in which the RIO<0
 - PC5 shown in Red
 - PC4 shown in Blue
- POLARVIEW:
 - Data for last 72 hours is the default
 - Blue is open water
 - Red (RIO<-10)
 - Yellow (RIO>-10 and <0)
 - Green (RIO>0)



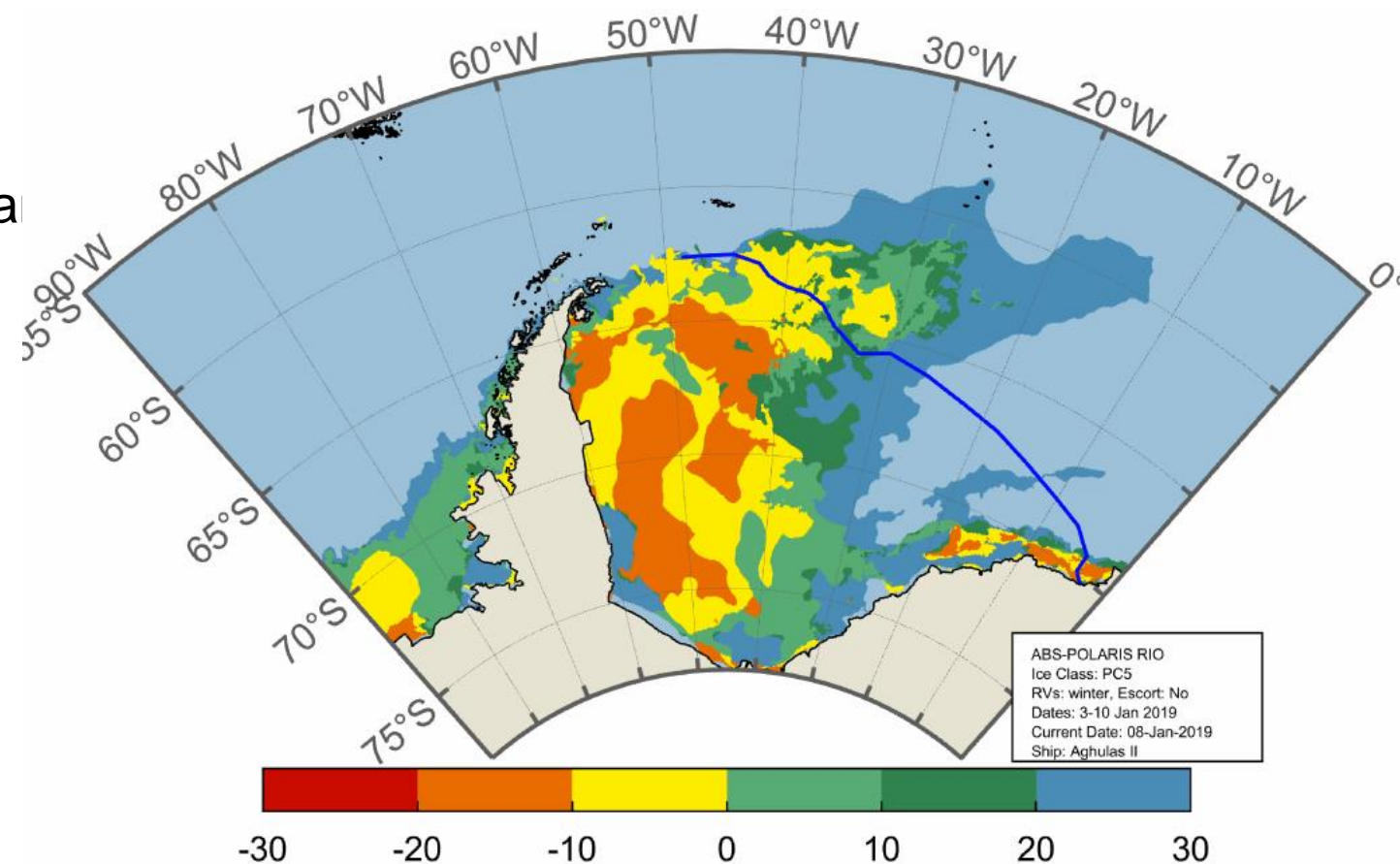
Other Organizations

- International Ice Charting Working Group
 - Being developed
- Researchers
 - One example used Copernicus data as input (extremely coarse input data)



Comparing to an Actual Voyage: Agulhas II

- 8 Jan 2019, Wendell Sea
 - Thickness about 130 cm
 - Concentration 50%
 - Floe size 15m² (median), 132m² (mean)
 - From above, RIO = 3x5 + 0x5 = +15



Points of Caution

- POLARIS helps evaluate risk, it is not a "this will be safe" operation tool. POLARIS is guidance!
- Ice Charts are coarse, and do not tell the whole story...if the input is coarse, the output is coarse
- Equivalency really does matter, you cannot assume that an Arc7 ship is a PC3 ship, because it is not
- POLARIS links ice class to actual ice conditions
 - (Obviously) it doesn't consider performance, or the capability of the vessel
 - Ice Class is about strength (hull and propulsion)
 - Ice transit *capability* is dependent upon hullform, propulsion power / characteristics and the crew

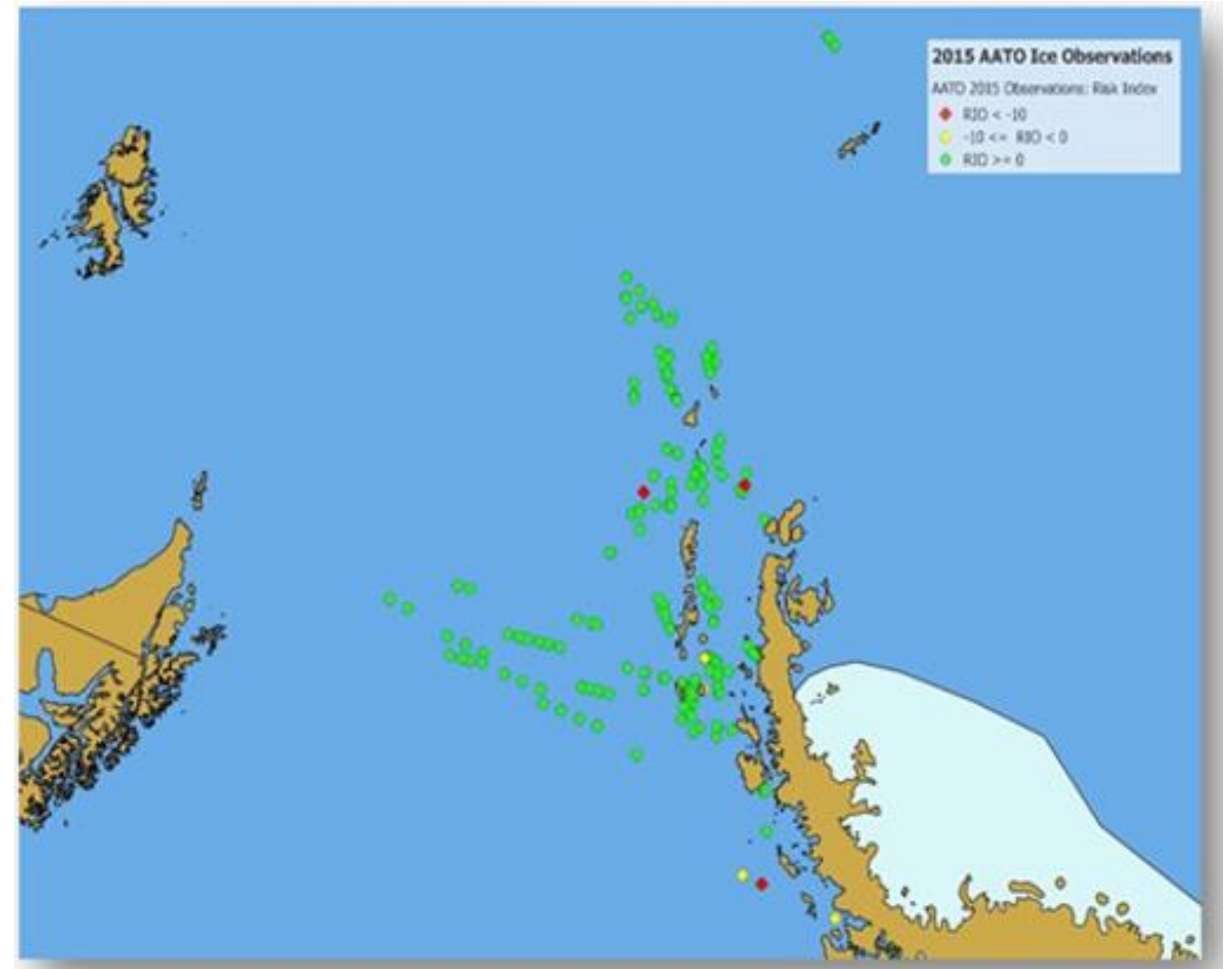


POLARIS Update Needs

- POLARIS incorporates several nuances that its predecessor methodology(s) did not include
 - Influence of icebreaker escort
 - Recognition of decayed ice strength (winter vs summer Risk Value tables)
- There is room for further refinement
 - Summer versus Winter RV table, guidance when these are to be applied
 - Icebreaker escort (better justification of the planning +10)
 - Linear dependency on ice concentration
 - Other older ice classes (guessing at equivalency is not good enough)
 - Transition from 1st to 2nd year ice on 1 Oct means that POLARIS RIOs jump just after midnight as October begins (ice regime did not change)
 - Tweaking Risk Values based on experience gained
- Means to Justify / Validate updates required
 - Need data, some more data and even more data

Previous Data Gathering (feedback) exercises

- Trialing of POLARIS in the Antarctic
- Prior to finalisation of POLARIS IAATO volunteered to trial the system in the Antarctic
 - Feedback on system
 - Gather ice condition data
 - 25 voyages, 10 ships
- Two follow-up seasons



Status of POLARIS updates ... Same as Last Year

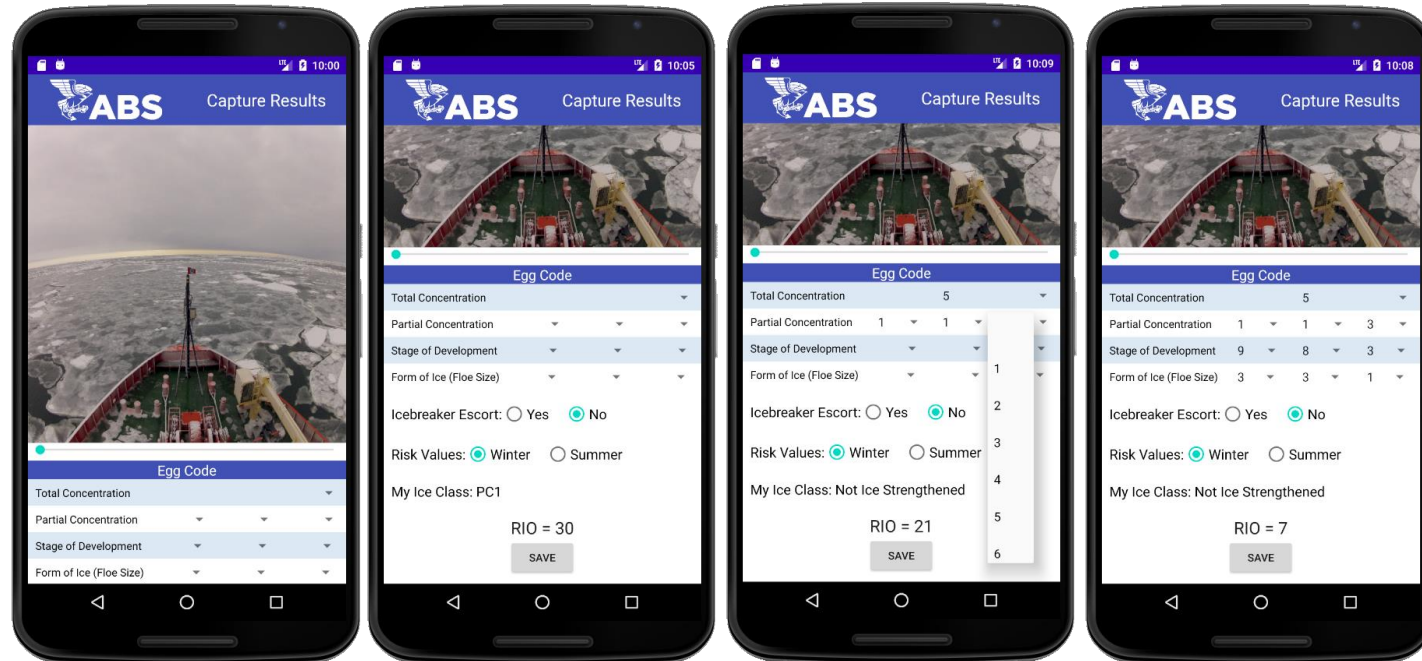
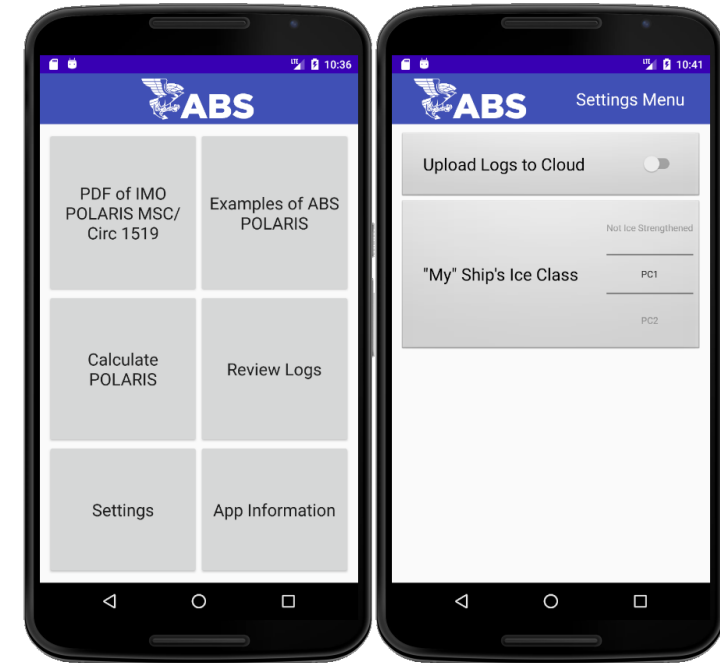
- No work is being done by IACS on updating POLARIS
- Technical team who worked on it are dispersed
- Limited work being done in academia to investigate POLARIS's validity
- ***This*** is the forum for feedback:
 - Could we (ASBPIF) develop standard logbooks and reporting?
 - Could the web portal be used to collect the logbooks / data?
 - Could we (ASBPIF) embark on a small amount of work to process the data so that it could be used by others to develop updates to POLARIS?

ASBPIF as a Means to Cooperate – Some Thoughts

- An opportunity for joint industry-administration cooperation to report ice conditions and POLARIS outcomes
- Could some agreement be made between the Arctic States for this?
- What is industry willing to contribute?
- Ideally:
 - Technical team or working group established to do this and to report to ASBPIF
 - Preparation of log books and reporting approach to be agreed
 - Reporting of log books uploaded to ASBPIF web portal
 - Data made available on the portal (in some kind of redacted format?)

POLARIS: Data, Data, Data

- ABS POLARIS Data Collection Tool (under development)
 - Are we ready for an App and a Cloud based data repository?
 - Take photo / calculate POLARIS RIO
 - Capture results (neural network, AI, ML under development)
 - Save to Log
 - Upload to Cloud
 - The Future?
 - Redacted Data hosted by PAME

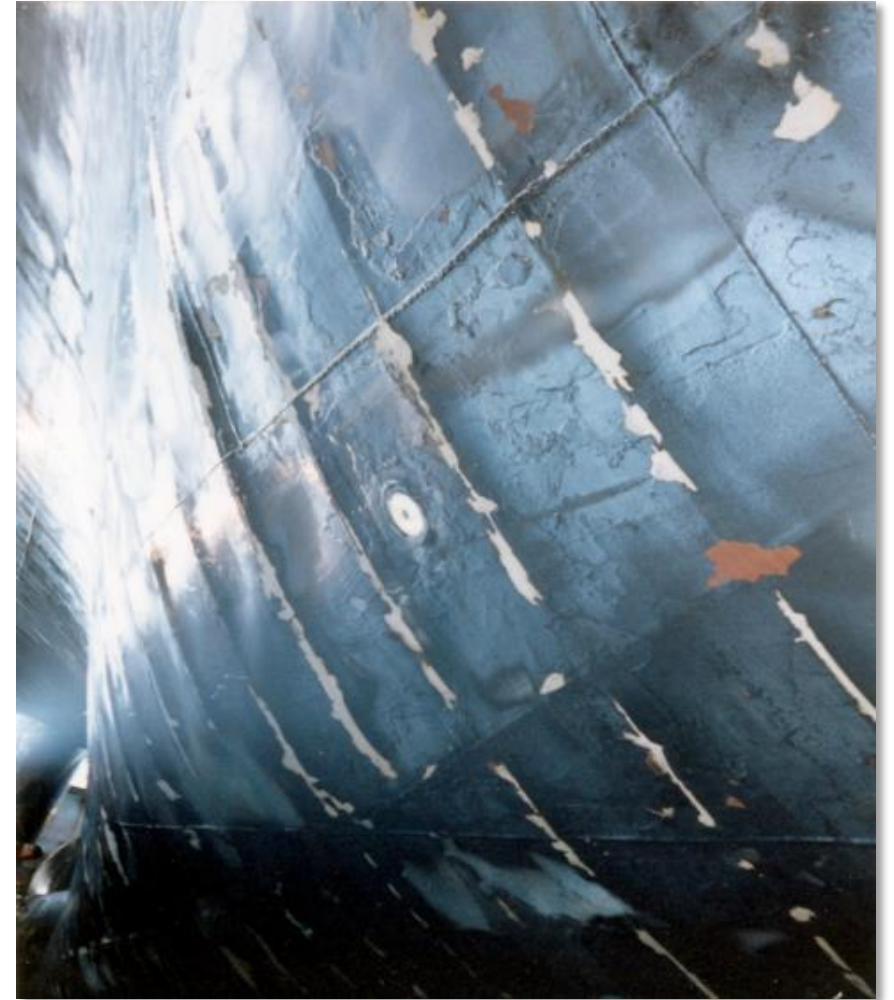


Role of PAME and POLARIS

- PAME = Protection of the Arctic Marine Environment
 - Policy, Achievable, Meaningful, Embrace
 - Policy, Actionable, Measurable, Enforceable
 - Procedures, Appropriate, Maintainable, Enhance Safety
- POLARIS is an important risk mitigation tool
 - It aligns with the P's, A's, M's and E's above
 - Know where and when the ship could go (planning)
 - What is happening off the bow (tactical decisions)
 - POLARIS can inform ice class selection, voyage broad view forensics
 - Refinement: YES

Final Message

- POLARIS is an important unified international instrument
- MSC1.Circ.1519 is interim guidance, work should be ongoing now to get updates ready for 2021 (2022?)... We don't think anything is happening
- Data is needed internationally if updates are to be made
- Is there a need? Judging by some uses of POLARIS we believe YES: there is a need for an update, and guidance on its limitations so there is a broader understanding of how it can be appropriately utilized



Question and Discussion

- Contacts

James Bond (Ottawa)
jbond@eagle.org

Rob Hindley (Helsinki)
rob.hindley@akerarctic.fi

