

Application of POLARIS

The Polar Operational Limit Assessment Risk Indexing System (POLARIS) is an evaluation of the risks posed to a ship by ice conditions in relation to the ship's assigned ice class. POLARIS uses a Risk Index of Risk Values (RIVs) which are assigned to a ship based on the ice class and ice types.

RIO _{SHIP}	Ice classes PC1-PC7	Ice classes below PC7 and ships without 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

Figure 1. RIO evaluation criteria for ships operating independently. If a vessel has an icebreaker escort, the vessel's RIO is modified by +10. Source imo.org

For each ice regime encountered, the RIVs are used to determine a Risk Index Outcome (RIO) that forms the basis of the decision to operate or the limitation of operations. The RIO is determined by a summation of the RIVs for each ice type present in the ice regime multiplied by its concentration.

Practical method to assess safety

Aker Arctic has recently developed a practical method of applying the POLARIS approach for calculating RIO values, and assessing the possibility of navigation in the Northern Sea Route (NSR) water area. This method can help in understanding the severity of ice conditions in the intended area of operation, verifying the need for icebreaker support, and selecting an optimal ice class for designed vessels.

It is based on input from digital Sigrid-3 ice charts, which is an open vector file format with archive data available through the Arctic and Antarctic Research Institute (AARI) website. The research work was done

within the ePlcenter project funded by the European Horizon 2020 programme.

Calculations for November 2021

Sabina Idrisova, project engineer in the Aker Arctic consultancy team, applied this method to evaluate RIO values for the end of November 2021 in the NSR water area. AARI Sigrid-3 ice charts covering the Kara, Laptev, East-Siberian, and Chukchi Seas were used and the calculations were performed for IC, IA and PC6 ice classes. (See figures 3,4, and 5).

"As a conclusion of the figures, navigation of IC ice class ships at that period was absolutely unsafe and NSR transit navigation of IA ice class ships was safe only with icebreaking assistance," Alexey Shtrek comments. "Although these estimates do not take into account the individual characteristics of each vessel, they provide a more accurate indication of the level of risk for planning voyages along the NSR, compared to the official requirements of the NSR Administration."

Available safe mode of operation	PC1-PC7	IA Super - IA	IB, IC, no ice class
Independent operation	RIO ≥ 0	RIO ≥ 0	RIO ≥ 0
Independent operation with limited speed or icebreaker escorted operation	-10 ≤ RIO < 0		
Icebreaker escorted operation only		-10 ≤ RIO < 0	-10 ≤ RIO < 0
Icebreaker escorted operation with limited speed	-20 ≤ RIO < -10	-20 ≤ RIO < -10	
Operation is not safe	RIO < -20	RIO < -20	RIO < -10

Figure 2. Criteria used for application of POLARIS to determine safe modes of navigation for vessels on the Northern Sea Route.

Calculated RIO values for 30-Nov-2021, iceclass IC

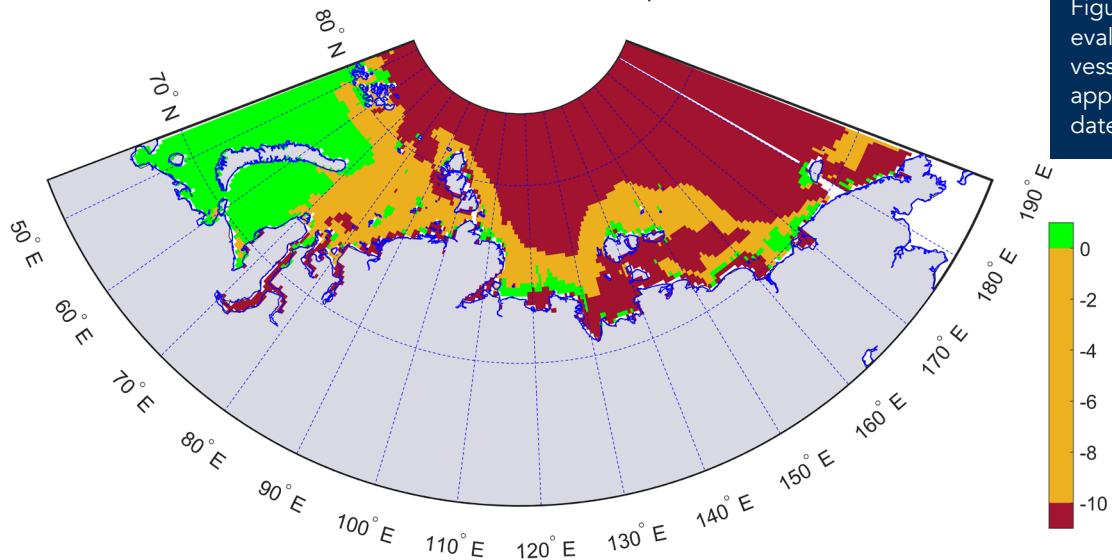


Figure 3. Risk index values evaluated for IC ice class vessel utilizing POLARIS approach and ice charts dated 30 Nov 2021.

Calculated RIO values for 30-Nov-2021, iceclass IA

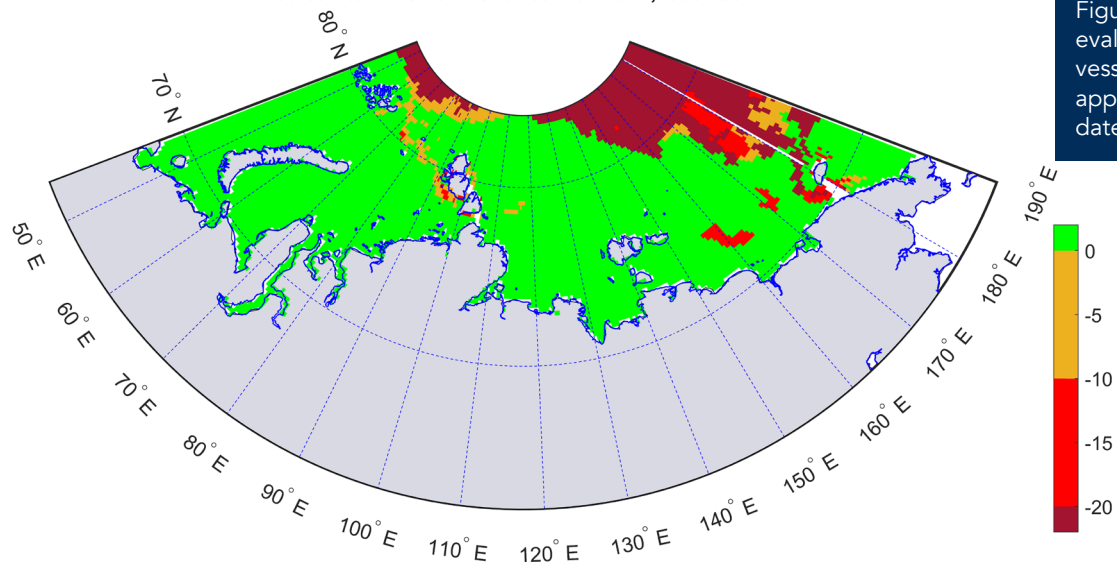


Figure 4. Risk index values evaluated for IA ice class vessel utilizing POLARIS approach and ice charts dated 30 Nov 2021.

Calculated RIO values for 30-Nov-2021, iceclass PC6

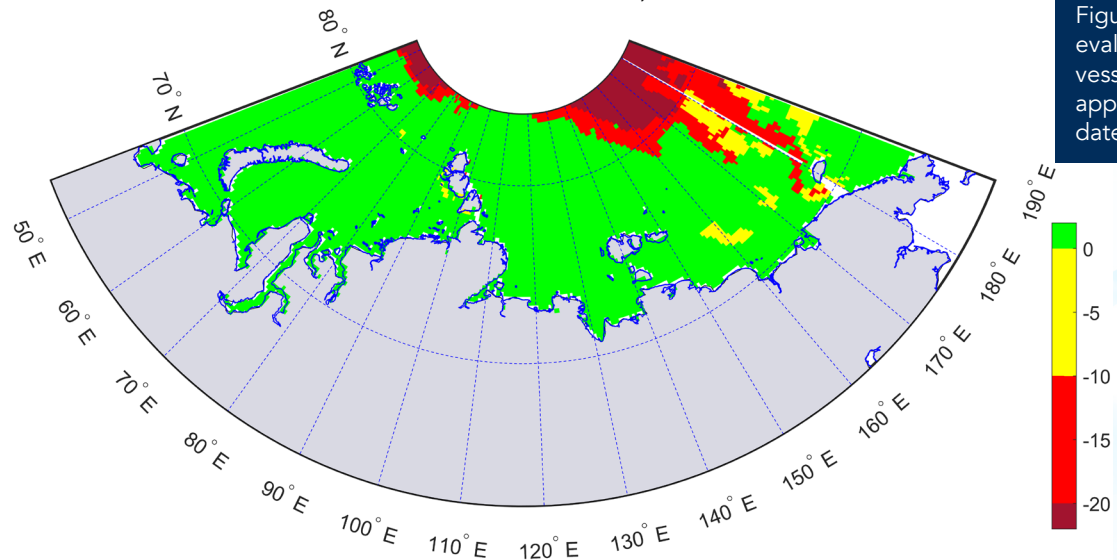


Figure 5. Risk index values evaluated for PC6 ice class vessel utilizing POLARIS approach and ice charts dated 30 Nov 2021.