The Risk of Synoptic-Scale Arctic Cyclones to Shipping

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This is an interesting and potentially important paper because of its creative integration with open-access data repositories, addressing transdisciplinary questions with societal relevance, and it should be published as an exemplar.

The integration of Satellite Automatic Identification System (S-AIS) data to interpret incidents with maritime ship traffic in relation to sea-ice distributions and cyclonic weather events is innovative with the intersecting dynamics of biogeophysical and socioeconomic systems north of the Arctic Circle.   The following comments are intended to enhance the publication with appreciation to the authors.

1. The Introduction presents well-reasoned conclusions about Arctic maritime ship traffic as a starting point to formulate the questions that stimulated this research.

2. The Methods includes five subsections that are fine. However, a cross-cutting subsection should be added to clarify the transdisciplinary integration approach. More specifically, this additional subsection should provide details about the mapping methodologies and geospatial analyses with Big Data.

3. In Methods subsection 2.1: The application of sea-ice data from the Hadley Centre in the United Kingdom complements previously published applications of sea-ice data from the National Snow and Ice Data Center in the United States. Noting the data integration includes the same S-AIS data in Berkman et al. (2020, 2022), how do ship-ice patterns or trends compare with data from the two sea-ice repositories?

4. In Methods subsection 2.2: *"Arctic cyclones are identified in hourly ERA-5 data."* As a data integration opportunity, it would seem helpful to mention the relative rates of S-AIS (e.g., satellite orbit) and sea-ice (e.g., daily) data production from the relevant repositories in relation to hourly ERA-5 data.

5. Ships and storms have tracks. It would seem helpful to be consistent with terminology throughout the paper about "ship tracks" and "storm tracks."

6. "The Arctic Circle (66.3°N) is incorrect." To be corrected throughout the paper: the Arctic Circle is either 66°33'47.5"N or 66.5°N?

7. In Methods subsection 2.3: "*The sensitivity of these thresholds is also assessed in this study, and the number of ships intersected by cyclones with 10 m wind speeds greater than 25 ms−1(Beaufort Wind Scale 10 and higher) and significant wave heights greater than 4 m (Douglas Sea State Scale 6 and higher) is also assessed.*" However, the details are in subsection 2.5. *"In this study, an intersection between a ship track and a cyclone occurs if the ship track is within 3◦ radius of the maximum 10 m wind (greater than 17 ms−1) or significant wave height (greater than 2.5 m)."* Additionally, what is a 3° radius in relation to distance?

8. In Methods subsection 2.5: "The number of past ship tracks intersected by an intense cyclone is quantified to determine the number of ship tracks impacted by past cyclones." How? This is the crux of the matter with the missing subsection that is noted above.

9. Tables and Figures:

   a. With the five or six Methods subsections, it would seem reasonable to create one synthesis figure for each subsection. Currently, there are 10 figures and this number should be reduced in the main paper and any ancillary figures could be part of the Supplement.

   b. Conversely, the Tables about shipping incidents in the Supplement are new and should be included in the main paper.

   c. Reducing the number of figures may require the Methods subsections to be reorganized in parallel to the story that will be woven through the discussion, introducing Arctic Shipping Data earlier, perhaps as subsection 2.1. The logic of the paper would be tightened by such symmetry.

   d. It would seem helpful to generate a single synthesis figure with seasonal (left to right and spell-out in the legend) December-January-February (DJF), March-April-May (MAM), June-July-August (JJA) and September-October-November (SON):
      i. "ship tracks";
      ii. "ship density" (noting "ship tracks" is based on individual ships per time and "ship density" is based on all ships per area per time);
      iii. Arctic cyclone wind speed;
      iv. Arctic cyclone wave height.

   e. In Figure 3: It is interesting that the annual ship-track trends for the Northwest Passage and Northern Sea Route are nearly parallel from 2010-2016, with relative increases in 2014 and 2016. This complements annual ship-ice interactions across latitudes shown in Berkman et al. (2020, 2022).

10. Discussion: A paragraph or two should be added about the specific creative applications in this paper as well as generalized utility of open-access data repositories to empower open-ended inquiry, notably in view of risk analyses that are the focus of the journal.

11. Discussion: Lastly, the audiences for this paper include the decisionmaking institutions that have remits to address maritime ship traffic in relation to the biogeophysical dynamics of the Arctic Ocean. It would seem relevant to mention or specify the binding international agreements that address safety of life at sea, search and rescue, pollution prevention, and marine ecosystem impacts.