

## Arctic Observing Summit 2022

### **SATELLITE OBSERVATIONS OF MARITIME SHIP TRAFFIC TO ENHANCE IMPLEMENTATION OF BINDING AGREEMENTS IN THE ARCTIC OCEAN**

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### **Short Statement**

The objective of this statement is to contribute to Working Group 5 on Utility and Benefits in view of *“observing systems aim to provide data that are relevant in decision making contexts, such as adaptation and mitigation planning or resource management. This Working Group will build on past work to explore frameworks, mechanisms, and good practice that help ensure utility and societal benefits associated with observations.”*

This statement briefly addresses practical elements of satellite observations (Table 1), especially regarding maritime ship traffic to enhance the five binding agreements with application to the Arctic Ocean that have entered into force since 2009 (Table 2), when there were substantive changes in the operation of the Arctic Council. In particular, this statement focuses on the 2018

Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean that entered into force on 25 June 2021, requiring the integration of biogeophysical and socioeconomic assessments to implement its “precautionary approach” in this area beyond national jurisdictions.

ATTRIBUTE	ARCTIC MARINE SHIPPING ASSESSMENTS (AMSA)	
	AMSA (2009)	Next-Generation
Sampling Period	2004	2009-present
Data Sources	Arctic States Individually and with the Arctic Council	Diverse Government and Commercial Automatic Identification System (AIS) Sources
Observation Coverage	Point, Regional	Point, Regional and Pan-Arctic
Observation Scope	Ground-Based	Ground-Based and Satellite
Observation Frequency	Inconsistent over Space and Time	Synoptic and Continuous (from minutes to decades)
Ship-Type Designations	Variable National Designations	Standardized International Designations
Individual Ship Attributes	Inconsistent and Incomplete	Consistent and Comprehensive
Analytical Capacity	Limited Granularity and Questions	Open-Ended Granularity and Questions
Science-Diplomacy Contributions	Scenarios and Negotiated Recommendations	Holistic Evidence and Options (without advocacy)
Informed Decisionmaking <sup>2</sup>	Governance Mechanisms	Operations, Built Infrastructure and Governance Mechanisms

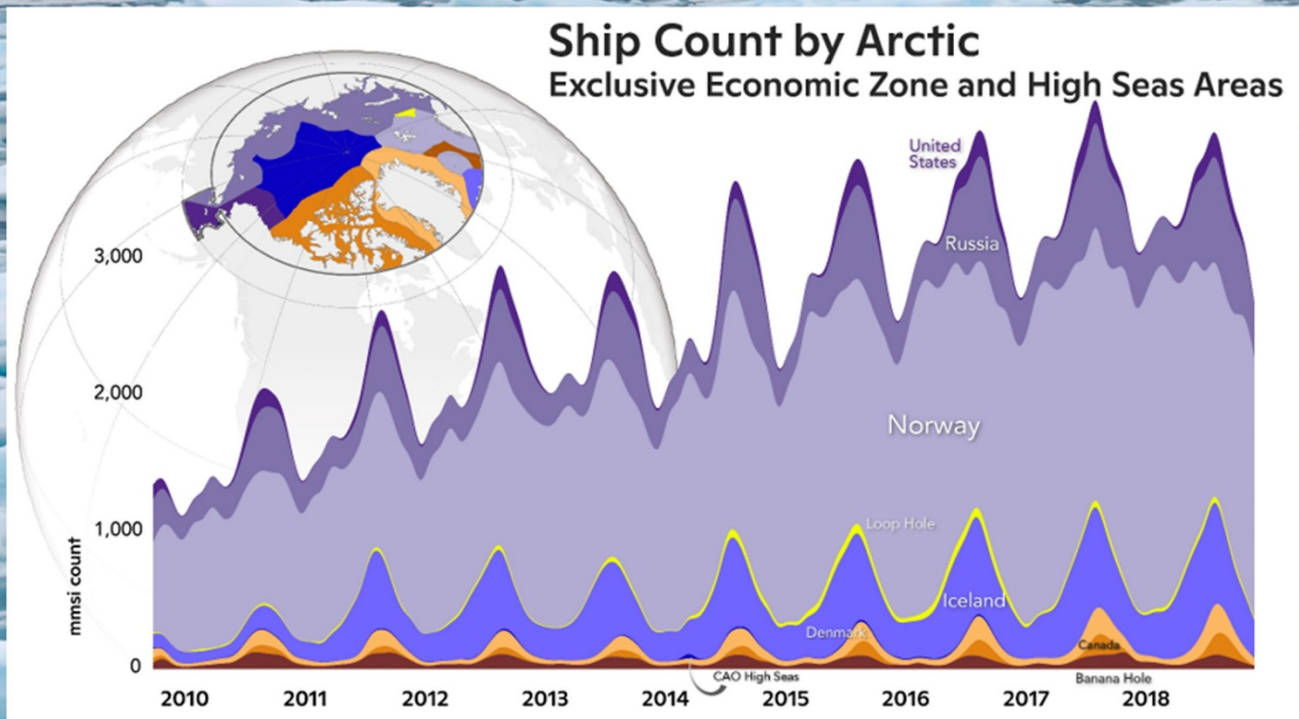
<sup>1</sup> Updated from Berkman et al. (2020, 2022), involving Automatic Identification System (AIS) data collected by polar-orbiting satellites. <sup>2</sup> Informed decisions operate across a ‘continuum of urgencies’ short-to-long term (Berkman et al. 2017), as elaborated subsequently in the Springer book series on INFORMED DECISIONMAKING FOR SUSTAINABILITY.

BINDING AGREEMENT			
Number	Name	Done At	Entry into Force
1	<i>Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic</i> ( <a href="https://oaarchive.arctic-council.org/handle/11374/531">https://oaarchive.arctic-council.org/handle/11374/531</a> )	Nuuk May 12, 2011	January 19, 2013
2	<i>Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic</i> ( <a href="https://oaarchive.arctic-council.org/handle/11374/529">https://oaarchive.arctic-council.org/handle/11374/529</a> )	Kiruna May 15, 2013	March 25, 2016
3	<i>Agreement on Enhancing International Arctic Scientific Cooperation</i> <a href="https://oaarchive.arctic-council.org/handle/11374/1916">https://oaarchive.arctic-council.org/handle/11374/1916</a>	Fairbanks May 11, 2017	May 23, 2018
4	<i>International Code for Ships Operating in Polar Waters (Polar Code)</i> ( <a href="http://www.imo.org/en/MediaCentre/HotTopics/polar/Pages/default.aspx">http://www.imo.org/en/MediaCentre/HotTopics/polar/Pages/default.aspx</a> )	appending IMO Conventions	January 1, 2017
5	<i>Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean</i> ( <a href="https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:453:FIN">https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:453:FIN</a> )	Ilulissat October 3, 2018	25 June, 2021

Building on earlier regional analyses with the space-time cube in the Arctic Ocean (Berkman et al. 2020), the scalability of the satellite record of maritime ship traffic is illustrated best in relation to governance mechanisms within the “*framework of the Law of the Sea*”, to which all Arctic states and Indigenous Peoples’ Organizations “*remain committed*” for the purposes of “*informed decision-making in the Arctic*” (Arctic Council 2013). The Pan-Arctic ecosystem of maritime ship traffic north of the Arctic Circle is shown comprehensively with Figure 1 in relation to Exclusive Economic Zones of Arctic coastal states surrounding High Seas areas beyond national jurisdictions, as defined under international law of the sea.

# CIRCUMPOLAR DISTRIBUTION OF ARCTIC MARITIME SHIP TRAFFIC

Biogeophysical

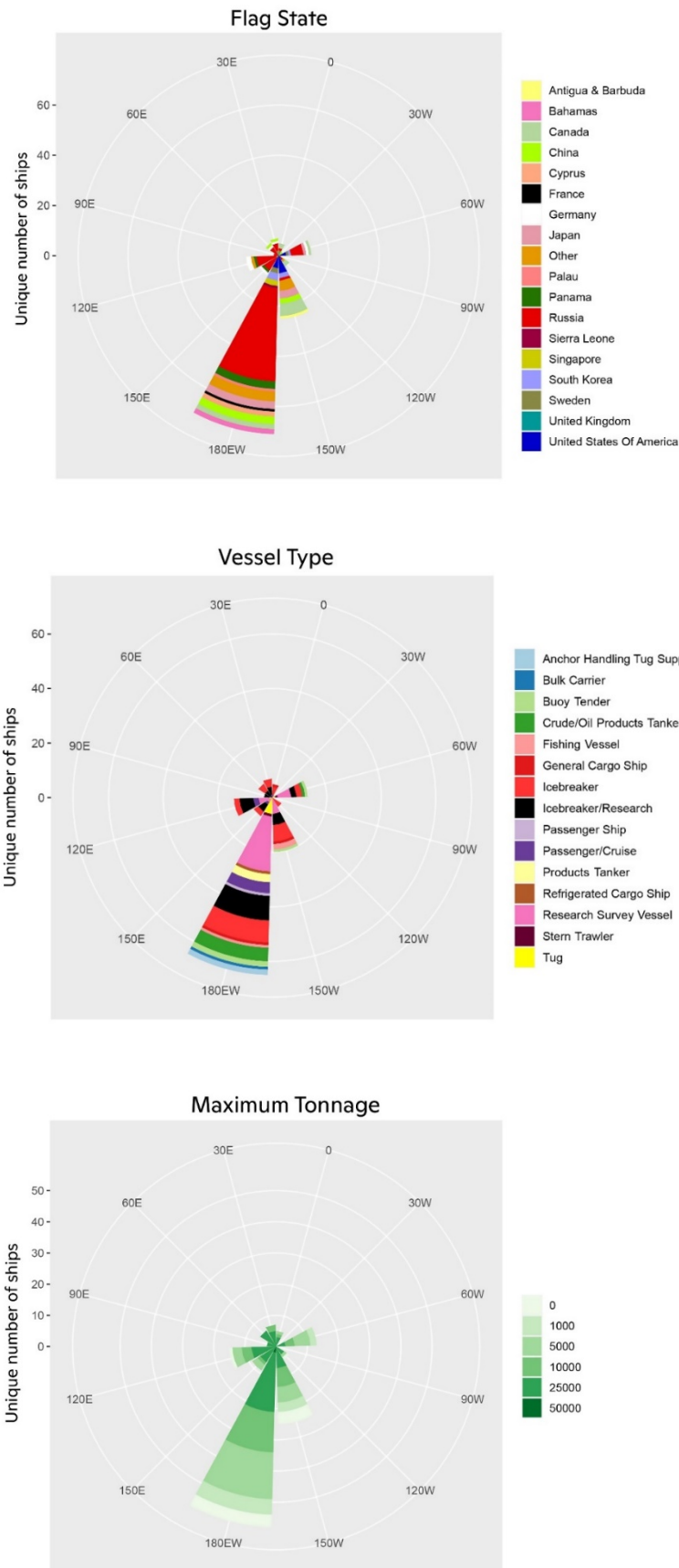


Socio-Economic

**FIGURE 1: PAN-ARCTIC ECOSYSTEM OF MARITIME SHIP TRAFFIC AMONG LAW OF THE SEA ZONES IN THE ARCTIC OCEAN** derived from satellite Automatic Identification System (AIS) big-data. From Berkman et al. (2022).

Integration between socioeconomic data from Arctic maritime ship traffic and biogeophysical data from the Arctic Ocean are illustrated with the “ship-ice hypothesis” (Berkman et al 2020, 2022) that ship traffic is increasing as sea ice is diminishing in the Arctic Ocean. As test of this hypothesis is based on directionality of ship traffic into the Central Arctic Ocean High Seas (Fig. 2), which reveals predominant flow from the Pacific Ocean, underscoring risks and requirements for appropriate emergency response capacities in view of the binding agreements (Table 2). This research is formally contributing to the ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean (WGICA 2021) to help implement the *Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean* (Table 2)

In addition to the big-data analyses with the oldest and longest continuous satellite record of maritime ship traffic north of the Arctic Circle (Figs. 1 and 2), this statement introduces KnoHow™ (<https://knohow.co>) for the purposes of knowledge discovery with “unstructured data” to reveal their objective relationships, as illustrated with the Arctic Observing Summit 2013 (<https://aos2013.knohow.co>) and the Arctic Council Ministerial Declarations from 1996-2021 (<https://arcticcouncil.knohow.co>).



**FIGURE 5: ‘SHIP-ICE HYPOTHESIS’ TEST WITH MARITIME SHIP TRAFFIC POPULATIONS IN THE CAO HIGH SEAS** based on distribution of ship entry points across 30° meridional sectors surrounding the North Pole: (TOP) ship flag states; (MIDDLE) ship types; and (LOWER) ship sizes. From Berkman et al. (2022).

This brief statement highlights observing systems as core features of built infrastructure, involving technology plus capitalization, that are coupled with governance mechanisms to achieve progress with sustainable development in the Arctic. This maritime ship-traffic research (above) could contribute to *Sustaining Arctic Observing Networks (SAON) Roadmap for Arctic Observing and Data Systems (ROADS)* initiatives (Arctic Council 2020).

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