Assessing the Capacity of the Existing Arctic Observing System for Identifying Marine Traffic-Related Pollution Events in Arctic waters

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ABSTRACT: In this study, we consider changes in sea ice extent, marine traffic, and shipping incidents over the period 1990-2019 and the varied observational approaches for detection of shipping related hydrocarbon spills and other pollution Incidents. Although the shipping data is challenging to use due to differences in reporting among organizations and nations, we can begin to put together a picture that allows us to make suggestions about needs for new observational infrastructure, supplements to existing infrastructures and pathways to improving response to incidents through open data and information sharing. This work speaks to efforts currently underway to develop Shared Arctic Variables for Sea Ice (SAON and Arctic Passion), to WG 4 of the Arctic Observing Summit, and to ongoing efforts among observing communities to improve observations and share useable observations in near real-time, and to responding communities that manage hazards and risks resulting from incidents to mitigate and minimize ecological and human impacts.

Background

- The Arctic is unique both because of its strategic location as well as its natural resource potential.
- A major consequence of the rapid increases in sea surface and air temperatures in this region is the accelerated loss of summer sea ice.
- Arctic sea ice extent for September 19 2023, was 4.23 million square kilometers (1.63 million square miles). It was the sixth smallest summer minimum on record
- Between the years 1990 and 2015, maritime activity in the Canadian Arctic almost tripled

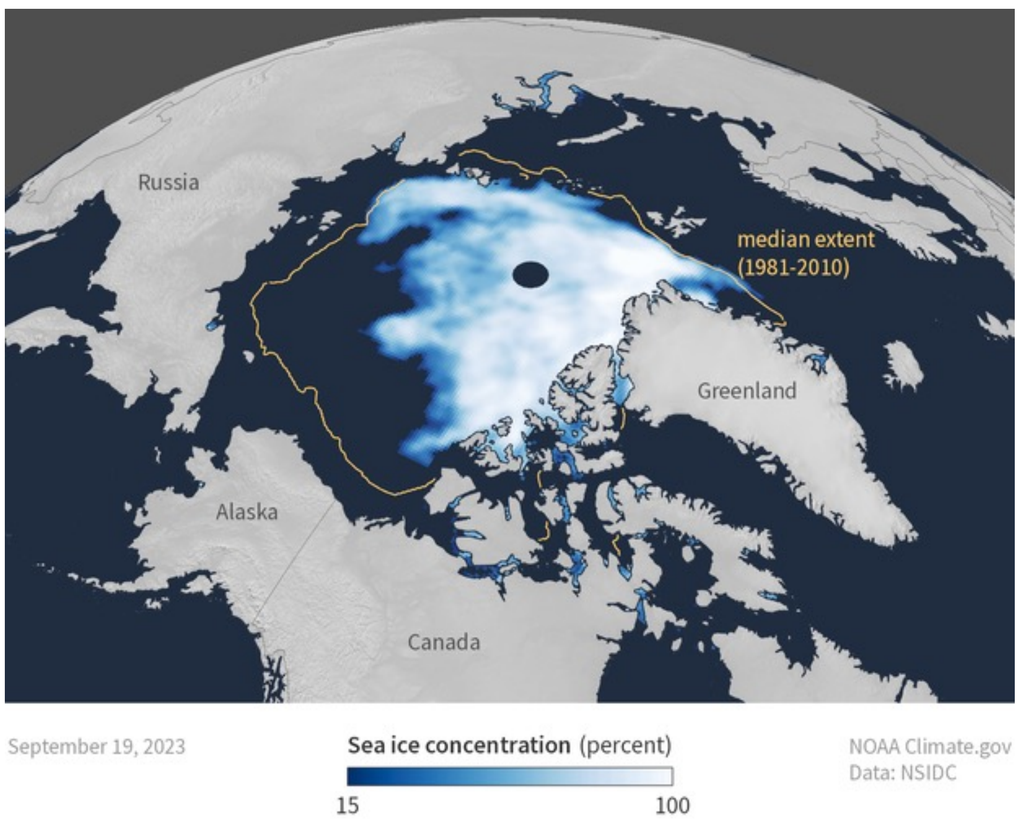

Figure 1. September 2023 Summer Sea Ice extent

Data

- Data was obtained from several sources:
  - Protection of the Arctic Marine Environment (PAME)
  - Transportation Safety Board of Canada
  - Lloyds of London (LLOYDS)
- Over the recent period (2005-2019), 618 pollution-related discharge incidents were recorded

	A	B	C	D	E	F	G	H
1	Data Source	Latitude	Longitude	Month	Year	Vessel Type	Vessel Name	Vessel Age
292	PAME	61.12473	-146.3464	3	2006	FIshing Vessel	Steven Daniel	48
293	PAME	59.63251	-151.5328	5	2006	FIshing Vessel	Stillwater	27
294	PAME	58.8	-138.11833	5	2006	Towing Vessel	Tiger	52
295	PAME	58.3157	-134.3518	3	2006	Towing Vessel	Togiak	73
296	PAME	60.83583	-149.0025	6	2006	Barge (Liquid)	Yukon	37
297	TSBC	67.8627778	-115.11889	8	2006		ALOAK TEWARI	
298	IR LLOYDS	68.2333	14.7833	12	2007	fishing (general)	Anna-Sofie	1996
299	IR LLOYDS	59.9078	10.7567	11	2007	product tanker	Ekfors	2003
300	IR LLOYDS	58.9667	5.7333	5	2007	anchor handling tug/supply	Far Sovereign	1999
301	IR LLOYDS	62	35	11	2007	barge	GHT-02	
302	IR LLOYDS	63.0355	7.2839	1	2007	fishing (general)	Heroy	1995
303	IR LLOYDS	68.9667	33.0833	3	2007	bulk carrier	Lian Hua	1984
304	IR LLOYDS	58.2	62.6	10	2007	barge	Mcnally Olympic	1951
305	IR LLOYDS	61.6	5.0333	11	2007	general cargo	Moonray	2001
306	IR LLOYDS	59.2	62.7667	10	2007	tug	R.J. Ballott	1956
307	IR LLOYDS	60.75	4.7	1	2007	bulk carrier	Server	1985
308	IR LLOYDS	60.1405	21.6764	4	2007	general cargo with container capacity	Sinegorsk	1991

Figure 2: Subset of Pollution dataset

Major Findings

- Arctic Maritime activity (north of 58^0 latitude) has increased in recent years
  - 2013 – 1298 vessels (total distance sailed by all vessels was ~6.5 million nautical miles)
  - 2019 – 1628 vessels mapped in this area with a cumulative sailing distance of 9.5 million nautical miles
- The greater volume of vessels increase the likelihood of accidents, such as oil spills or other pollutants being released into the marine environment.

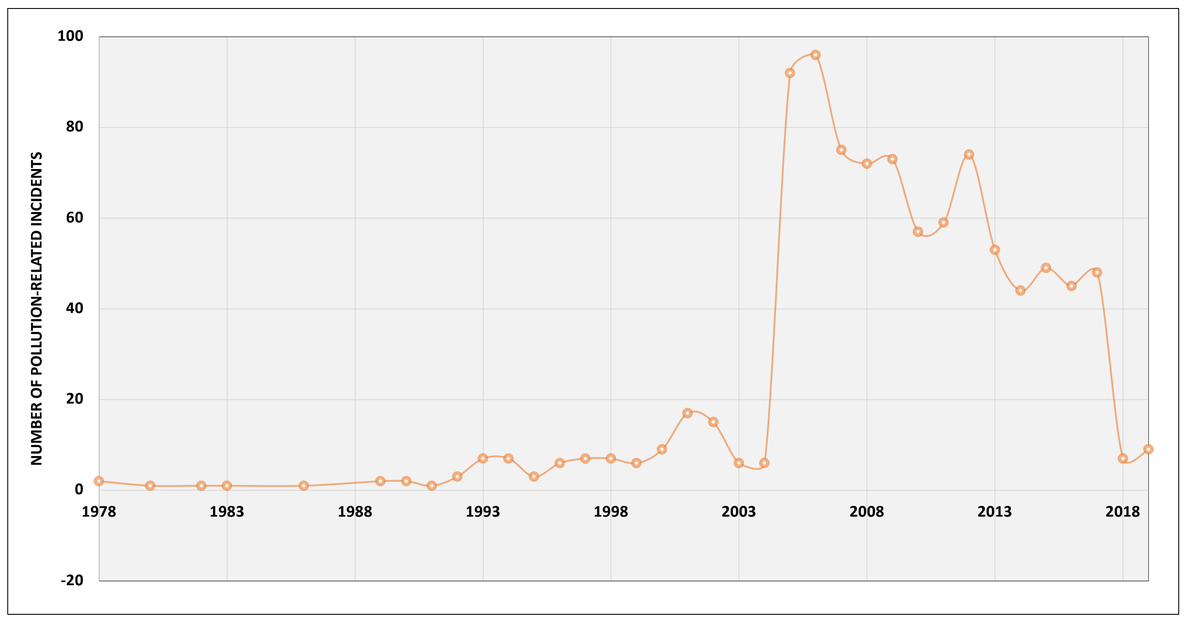

Figure 3. Number of Pollution-related incidents in the Arctic over the period 1978-2019

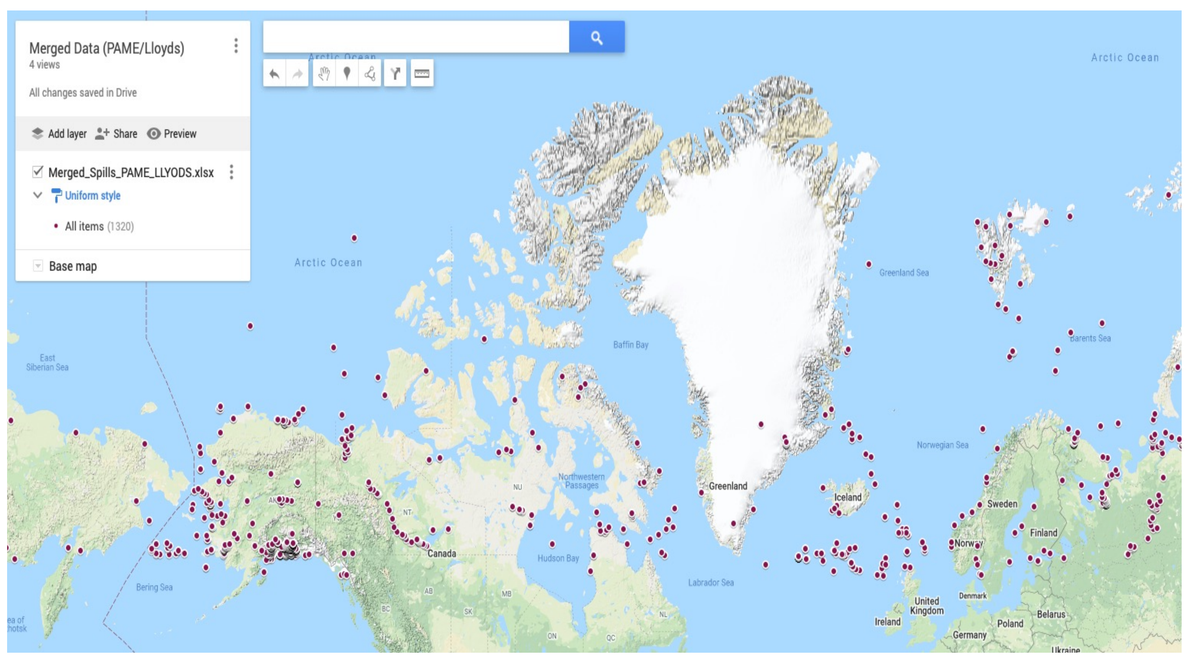

Figure 4: Locations of pollution-related incidents

Future Work

Can the network of Argo floats be integrated into a system of observing systems to facilitate pollution monitoring?

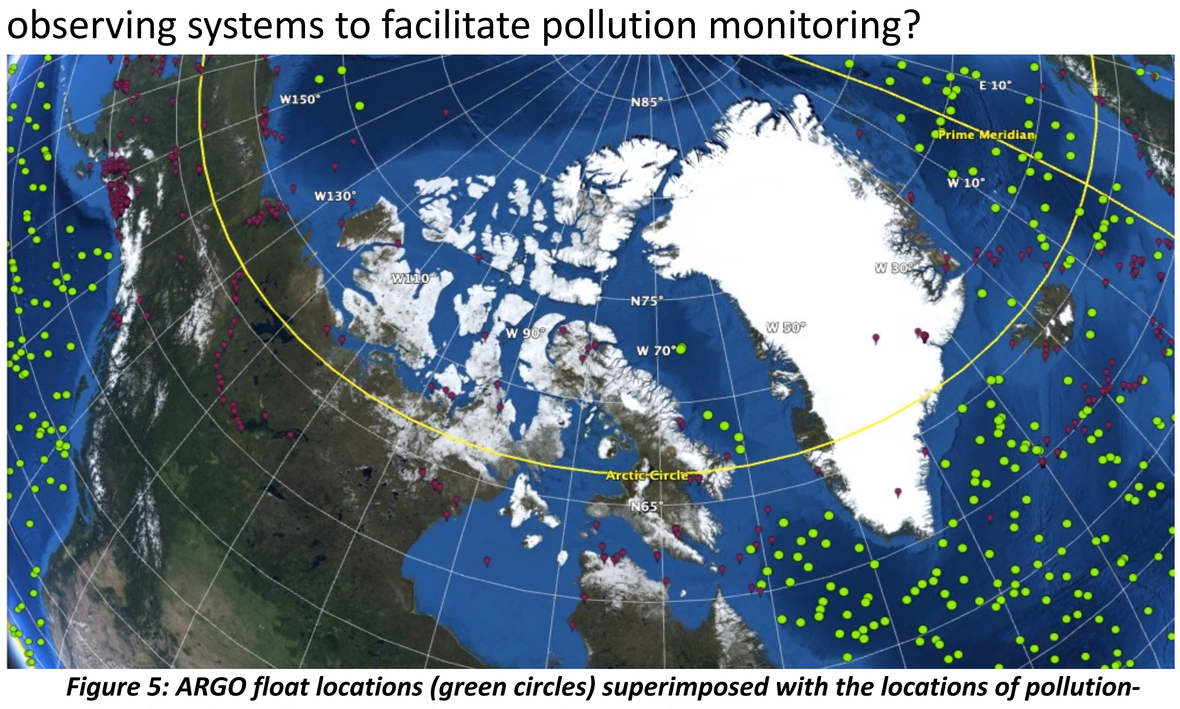

Figure 5: ARGO float locations (green circles) superimposed with the locations of pollution-related incidents shipping incidents over the period 1990-2019

Conclusions

- Continued declines in sea ice cover will act as a catalyst to increased ship traffic along trans-Arctic shipping routes which poses heightened risks for Arctic marine ecosystems and coastal communities as it increases the potential for accidents, oil spills, and pollution in the region.
- An integrated observing system is necessary to mitigate the environmental impact of heightened shipping activity and reduce the risk of pollution incidents.