

Ice navigator – part 2



Captain Duke Snider
FNI, Vice President,
The Nautical Institute

Mid-September in the Arctic is the time of seasonal change when it comes to ice. It is the change from melt and retreat, to freezing and advance. With that change, the Ice Navigator’s role begins to change too, from constantly looking for the next new opening and asking where can we get to now, to watching for what is no longer open to the ship.

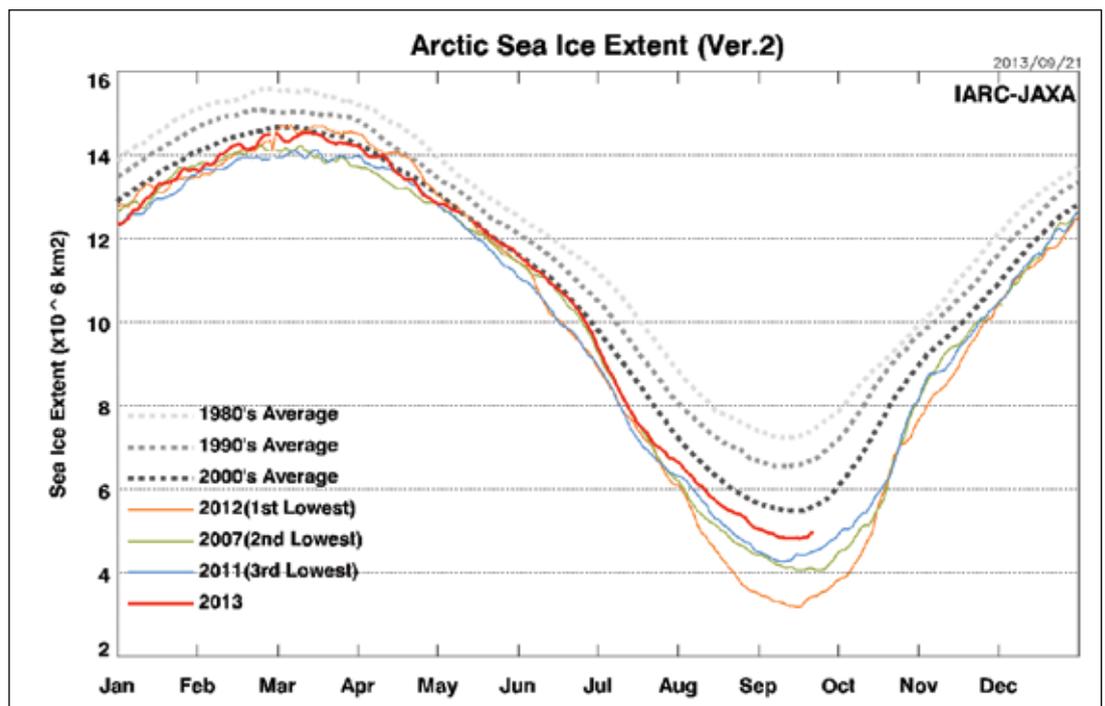
The advancing ice

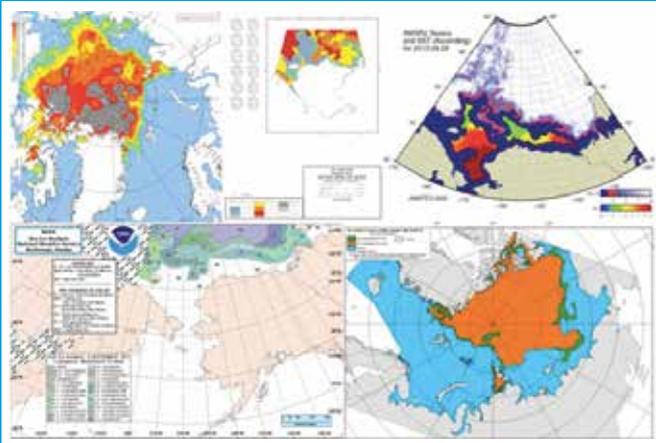
Since joining *Mirai* in August, as expected we have witnessed the usual retreat of the ice edge and continued melt of open water ice. Now, in the third week of September, ice charts are showing consolidation of ice within the pack, and in some areas there is a gradual advance of ice southward. Arctic Sea Ice Extent graphs are now indicating a levelling off in the seasonal loss of ice, and will soon begin to show the gradual increase in overall sea ice area for the Arctic as winter takes hold.

The Ice Navigator now closely watches weather patterns and temperatures for systems and signs of weather that will contribute to increased freeze up and further advance of the pack. In our present area of operation sea surface temperatures remain resolutely above zero, while air temperatures are gradually dropping day to day and are now consistently below zero. Remote from the gradual southward march of the growing polar pack, for the time being we are not at risk of ice formation around us.

The main polar pack ice edge has not retreated as far as in previous years. In 2008, the *Mirai* crossed the Canada Basin, and on 24 September 2010, she reached the furthest north for a non-icebreaking research ship at 79°11.4’N. This year, the Canada Basin is completely covered with ice and the furthest north we reached was 74°50’N on 7 September. The first two decades of this century have experienced some of the greatest loss in overall ice cover since reasonably accurate measurement began. After the huge loss in 2007 that shocked many and turned global attention to the Arctic, we witnessed years of even greater overall loss in 2011 and 2012. This year, however, is clearly not in that league. On 17 September the total estimated area of sea ice was 4.8 million km², well above that of the last years, but still less than the average ice cover in the decades before the turn of the millennium.

News from the National Ice Centre this past weekend that this is the ‘6th lowest year on record’ for Arctic sea ice has prompted another flurry of media hype. But in our area of operation the ice has remained resolutely further south than in previous years, making original plans for passage and research unachievable, as we are unable to occupy science





Examples of ice charts in use onboard *RV Mirai*

stations that had been clear of ice in previous years.

In the media hype the overall variability of ice conditions is most often ignored or played down. There is no doubt that we have been experiencing a gradual and measurable reduction in overall ice cover that is most likely attributable to global climate change. But we must not forget that within that change, there are still cycles where the amount of sea ice waxes and wanes and its location changes back and forth. Even in a good ice year, the mobility of Arctic ice still requires caution in those that choose to operate here.

A viable commercial route?

News has reached us of the voyage of Nordic Bulk Carriers *Nordic Orion* with a cargo of metallurgical coal from Vancouver, BC to Finland through the Northwest Passage (NWP). It is claimed that this is the first commercial bulk carrier voyage via the NWP. I certainly could not argue whether that is actual fact or not, but I do know, having sailed extensively on one of the highest ice-class cargo ships in the world, the *MV Arctic* (then owned and operated by Canarctic Shipping, now by Fednav), that bulk ships have been coming and going from the Northwest Passage for decades. Is this the beginnings of the highway across the top of the world via the Northwest Passage? Not likely. Regardless of the reports of successful one-off voyages, this ocean is not yet fully open for business and it is far from 'ice free'.

The Northern Sea and Northwest Passage routes can be a very promising proposition when one thinks in terms of distance only, but what of the other variables? Fuel costs may well be lower due to the reduced distance in *some* voyages, but the additional costs are less often discussed:

- Ice remains a possibility even during the three to four month navigation season when the ice cover is reduced (*not* eliminated). The ship must be built at least to minimum ice strengthening standards.
- Circuitous routes through draft-limited waters necessitate course and speed changes that combine with the delays and diversions due to ice to add voyage time to the calculations; particularly in the Northwest Passage. That rules out anything like a regular liner service or a voyage tied to on-time delivery.
- Both routes remain coastal and require carefully planned and executed voyage plans, in areas that remain poorly charted and with limited support infrastructure.
- Insurance rates climb dramatically for vessels operating 'north of

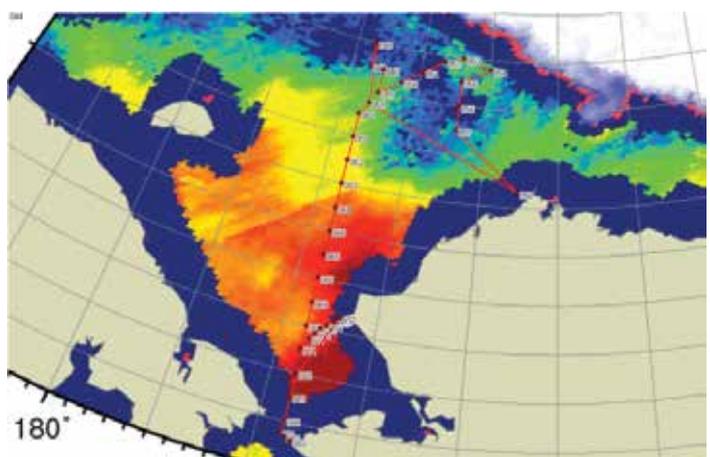
sixty'. In addition, the 'icebreaker' fees charged by the Northern Sea Route can approach \$400,000.

- Additional personnel are needed, with adequate knowledge of operating in ice to ensure as safe and economical passage as possible.
- Though much has been made of the 'huge increase' in applications for transit permits for the Northern Sea Route for the 2013 navigation season, the vast majority are destination (in and out, or in support of Russian hydrocarbon exploration/exploitation). Transits of each passage are counted in the tens, not the thousands. Traffic will increase in the Arctic, of that there is no doubt. But let's be realistic; neither route will ever replace the Suez and the Panama canals. At most, they will be seasonal additions to those two traditional routes.

Watching the weather

Uncertainty about the position and movement of the ice gives an added dimension to passage planning in the Arctic. This morning was one of those days when ice was a primary factor in developing the next cruise plan. After last night's ice briefing, the chief scientist worked on developing three possible scenarios for the cruise plan after Fixed Point, where we have been operating for the past two weeks. The Captain, chief officer, chief scientist, assistant chief scientist and I then went over the three plans, considering current ice conditions and forecast ice.

The chief scientist had hoped to be able to recover and redeploy the sediment trap mooring placed on a subsurface mooring at the Chukchi



AMSR2 snapshot with chief scientist's proposed plan B

Abyssal Plain (CAP) last year. However, the mooring position is already encumbered by ice on the edge of the polar pack ice edge. With the NOAA and TOPAZ forecasts indicating even further advance southward of the ice edge and likely coverage by at least 6-8/10ths old ice by 25/26 September, we are unlikely to be able to reach it. Plan B allows for appraisal of the conditions as we head north towards a position which is presently predicted to be in open water but may be north of some ice of 1-3/10ths coverage. Southerly winds expected over much of the next week would help keep the more open ice clear of our target. If necessary, we could simply cancel that northern station and head south to open water, then head back towards the stations at 74°N, which are presently in open water and likely to remain so. Plan C, leaving the stations at 74°N 162°W till after Barrow, means a greater likelihood that those stations will then be denied to us by ice cover by the time we get to them.

At the end of the discussions it was decided that Plan A was highly unlikely and was shelved. My recommendation was straightforward. Plan B would be the plan of choice at present, but conditions of course would be monitored over the coming days before final decision. The feedback loop will continue in the coming days as conditions change and new data is received. Things change in the Arctic.

Moving on

The two weeks of observations and data collection at the Fixed Point centred on 72°45'N 168°15'W were completed on 25 September. The researchers onboard are very happy with the results. During our stay in this area several cyclone centres have passed directly over our position, ensuring the Senior Met Officer's project was more than successful. With the dozens of CTD rosette, plankton net hauls and other casts a fascinating in depth sequence of changes has been noted. Shigeto Nishino's group have been very excited with the results. A number of theories on sea water distribution of the Pacific and East Siberian surface water may have been confirmed – if not, they have at least been provided with more supporting evidence. Other new theories have been postulated.

Our last chance to occupy the CAP mooring site was finally put to rest today. We have been carefully studying the ice information coming in over the last few days to make the decision. The CAP location, almost half a day's steam from our present position, demanded high assurance that the site would be sufficiently ice free to spend 4-5 hours recovering the present mooring and deploying the replacement. Given the few days remaining in the cruise, wasting a day steaming to and from a station that was important but not vital, only to find it ice-covered could result in other stations being lost to the ice that is now advancing daily.

There remains plenty of work to do in the final two weeks. We will continue to move northward towards the ice pack to complete observations in stations along 74°N as yet still unencumbered by ice. We will return to the area of Point Barrow to attempt recovery of the moorings that remain there, then finally steam



Senior Met Office Jun Inoue calibrates a radiosonde before launch



Polar bear tracks across ice floe – but no bears



The Ice Navigator

to stations along the 168°45' meridian that were deferred at the beginning of the cruise.

In the event, the southerly winds over the last few days drove what ice there was south of the polar pack well clear of our last two most northerly stations. The chief scientist and the captain were both quite happy as it allowed for stress-free occupation of the two stations, one of which required position keeping for almost seven hours. Ice in the vicinity would have added an extra challenge that neither really wanted. Many of the crew were disappointed, hoping as they were for one last chance to be amongst the ice and possibly see a polar bear.

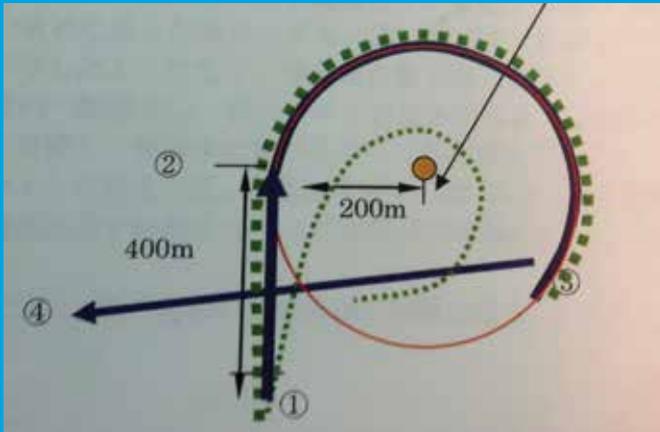
We have seen quite a number of walrus over the two weeks we maintained the Fixed Point observation point. They definitely looked well fed, and were very curious as to what we were up to. Often the biggest of a group would come within 50 metres, raise himself high out of the water, and grunt loudly, obviously concerned that we were either on his turf messing with his food supply or were a threat to his harem or family. We have seen an amazing diversity of life on this cruise, from masses of phyto and zooplankton, jelly fish, right up the food chain to signs of polar bears – although we never saw any actual bears. The Arctic remains a vibrant living but delicate ocean.

Dragging for a mooring

Today was the first time the *RV Mirai* has dragged for a mooring, which was necessary because, while the transponder on this particular mooring was still active, it simply refused to release on command. To conduct a dragging operation the ship initially takes position well downwind (~500m) and downcurrent of the mooring position while the drag line is rigged. The drag line is then deployed over the stern as the ship maintains position. To the outer end of the drag line is rigged a 100kg weight of chain clump, followed by 50 metres of chain and five grapple hooks, 500 metres of wire connected at a Y shackle which in turn is connected to another 100kg anchor and a 150 metre wire connected to the ship's piston wire. The entire anchor-to-anchor length is intended to stay on the bottom as the ship pulls the string along.

Once the piston wire is connected the ship begins to move ahead at ~1kt. The piston wire is paid out simultaneously at the same speed to ensure the dragging string stays on the bottom. As the ship passes 200m abeam of the mooring position ~400m of piston wire has been paid out, sufficient to provide enough angle that the drag string itself remains on the bottom. At this point the piston wire is then stopped off and the ship will commence its turn about the mooring position at 200m radius until two-thirds of the circle is completed. At that point the ship crosses her original track line, completing the circle and drawing the 'noose' tight.

Operations this morning commenced at 0850 as the deck crew began the deployment of the drag line. About 1130, when the circuit around was completed and no mooring broke the surface, the Captain decided to retrieve the string and start again after lunch. The last anchor was sighted at the surface



Ship manoeuvring plan for conducting a dragline recovery of a sub-surface mooring



Masatake Hori, Chief Scientist Shigeto Nishino and Ice Navigator Captain Duke Snider discuss changes to research plan required by changing ice conditions

about 1245, and as it came clear, tangled in the mass of chain was the mooring cable. Just before 1300 the valuable instrument package was onboard and shortly thereafter the transponder and top float. A successful morning!

Back to shore

RV Mirai's 2013 Arctic deployment is coming to a close. During the cruise, over 220 images and ice charts from American, Canadian, Japanese, Norwegian and Russian sources were obtained and used by the navigation and research teams onboard. These included analyses completed in the form of ice charts, as well as visual, radar and thermal satellite imagery. The ship and crew were able to complete a rigorous science programme with the input and guidance of an experienced ice navigator that provided further onboard analysis of information received from external sources combined with the assessment of actual conditions in the area of operation, weather forecasts and knowledge of ice dynamics. With the Ice Navigator's recommendations, plans were revised, sometimes daily, to take advantage of changing ice conditions or to avoid unproductive days where ice would have precluded effective sampling. More effective routing was selected and tactical manoeuvring completed safely under the guidance of the experienced Ice Navigator.

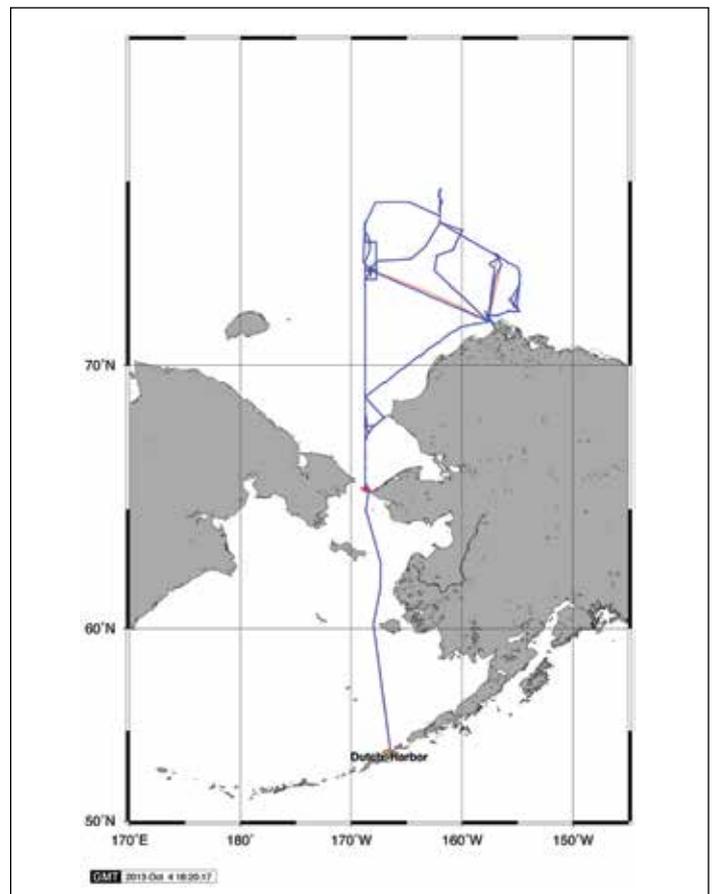
During this voyage, 86 observation stations were occupied, another 100 observation stations occupied at and around the fixed point station, 67 expendable bathy-thermograph sensors launched, 250 radiosondes deployed, five subsurface moorings were recovered and four deployed, and many miles of bathymetry recorded. *RV Mirai* cruised 4,500 miles during the 42 day Arctic Cruise 2013. Without doubt, this has been a successful research cruise in which a vast array of valuable data has been collected which will be used for research and study over many years to come.

Thirty-one researchers, technicians and I will depart the ship in Dutch Harbor on 7 October. The 34 crew and the remaining research group will remain onboard for the transit to their home port of Sekinohama Japan. But this is not the end. *RV Mirai* will return to the Arctic next year and the year after, continually adding to the many years of time-series data collected since she first came to the Arctic in 2000, and to combine that with Arctic research voyages from other nations.

Training for the ice

Whether any one year is measured least or greatest in terms of the extent of sea ice is not important to shipping. What is important is that the ice is still here most of the time.

The season in which navigation in the polar regions can be completed by ships other than ice breakers is measured in weeks, not months. Even during the brief navigation season, ice is still present and by virtue of its mobile nature remains a hazard to shipping. Ice can block routes that previously were open, forcing changes in plans and ETAs which can challenge even the best-planned commercial venture. Ice may force ships off well-planned tracks, sometimes into uncharted waters or may require extraordinary manoeuvring amongst ice floes that can cause severe damage with one lapse of attention of the officer



Cruise track – *RV Mirai* cruise MR13-06
Mirai's cruise track during the 2013 research voyage

of the watch. Mariners experienced and skilled in ice operations are required to safely operate in these ice infested regions.

Those who have operated for many years in these regions, and insurers that cover their ships and cargoes, recognise that it requires mariners with particular skills, knowledge and competence gained over many years to command and operate their vessels in polar ice regimes. Those who have cavalierly ventured into these regions without the experience and knowledge necessary have suffered the consequences, including ships damaged by ice, ships grounded in uncharted waters, ships trapped and beset for weeks when a simple diversion would have kept them clear of a deteriorating ice environment. It is not sufficient to throw a bridge officer into a weeklong training course, even with 20 hours in a simulator, and expect he will be able to tackle polar ice navigation safely or efficiently. That experience will clearly provide the mariner with a foundation, but it will not provide that mariner with the experience to identify hazardous conditions, anticipate situations strategically and tactically and make the best decisions for the safety of the ship, cargo and crew. Navigation in the polar regions is, and will remain for many years to come, a challenge to shipping requiring highly experienced Ice Navigators.

There is a need to consider ice navigation competency apart from routine operation. Much like what is required of crews operating tankers or dynamic positioning vessels, ice navigation requires mariners with additional skills, knowledge and competencies beyond those required of a bridge officer not trained in ice navigation. It is important to ensure that those who operate vessels in ice infested regions are sufficiently trained and experienced.

As the marine industry turns to the polar regions and looks to increasing movement of ships in these ice infested waters, it must consider these special skills and knowledge.

Though numerous local, regional and national requirements call for 'ice navigators' onboard vessels plying ice-infested waters, there is no common definition of an Ice Navigator or standard to measure their skill. Though the marine industry has clear global standards for navigation, engineering, and special skills such as tanker officers and dynamic position officers, we still lack a global standard for Ice Navigators or the skills, knowledge and competency they require.

The Nautical Institute's Ice Navigator Project aims to correct this shortcoming. As part of the project, the NI has led numerous face-to-face and virtual working groups. These working groups have examined the wide range of local requirements, the valuable work done by a variety of agencies, companies, classification societies and others including training institutions which have, in many cases, independently developed training courses. The intent is to build on the valuable depth of material and work already in existence, determine what, if any, gaps exist and then provide an overarching international standard. The end result will be a comprehensive Ice Navigator Competency table that outlines competencies, skills and knowledge required to conduct safe navigation in ice infested waters. The Ice Navigator standard may be incorporated within STCW, as part of compulsory Polar Code, or be made available as a Nautical Institute standard, as the Dynamic Positioning Officer scheme is presently. Regardless of the final disposition, such a global standard is required sooner rather than later.



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