

Ice navigator

Life aboard an Arctic research vessel



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The RV *Mirai* departed Dutch Harbor, Alaska on 27 August for a six week science mission in the Beaufort and Chukchi Seas. She is a 130 metre, 8600 GT research ship, with accommodation for 34 crew and 56 scientists and support staff, and according to the vessel owners Japan Agency for Marine-Earth Science and Technology (JAMSTEC), she is the world's largest oceanographic vessel. She was originally nuclear powered, but was converted to diesel electric propulsion in 1997. Amongst other equipment, she carries 13 oceanographic laboratories and three meteorological laboratories, all of which will come into their own in the weeks which follow.

Getting started

For me, the voyage really began the day I left my home port of Victoria on 22 August. In an attempt to beat the northern propensity to lose luggage, I checked my two bags into air freight, priority. They should have arrived the same day I did. Right? Silly me. No bags Saturday, or Sunday, or Monday. No bags the night before departure. By then I was really beginning to worry. By the time we got word they definitely wouldn't be arriving, at 0800 on the day of departure, it was a mad dash to re-supply before sailing. I spent about \$800 getting toiletries and clothing to get me through the next six weeks. Of course a few things were forgotten, and of course I will miss my kit; my binoculars, cold weather gear, knife – imagine a sailor without a knife on his belt – my good camera, my computer connections (thankfully they have wifi – but no GPS inputs directly to the laptop), and so on. Most of my books were on my iPad or kindle and I am glad I thought to bring chargers for all that kit on my carry on. But at least I am here and the voyage has started.

Site selection

We are heading north from Dutch Harbor, basic ship familiarisation and emergency drills behind us. Our first science station is several days away in the Bering Strait. Until then, we continue to watch the ice situation. Martech Polar staff are collecting and forwarding on ice charts from NOAA; the National Ice Centre; Canadian Ice Service; Russian Arctic

and Antarctic Research Institute; and Norwegian Met Office. Each has its own advantages and disadvantages, and not all will be of value on any given day.

We rely primarily on open source ice information, most of which is not real time. American NOAA and National Ice Centre charts are composite averages of past conditions issued three times and two times a week respectively. The scale permits reasonable strategic planning, but is not truly suitable for any tactical planning, and the dated nature of the data makes it less valuable for efficient route selection. Daily Japanese AMSR-2 sea ice and sea surface temperature and Norwegian TOPAZ sea ice charts have been proving to be more accurate when compared against actual conditions. The small scale/large areas and 'macro' view with no clear ice regime partial definition makes them suitable for broad scale strategic planning, but still fall short of ideal for more accurate route planning. Taken all together, reasonable decision making can be done as timing and routing are extremely flexible during a research cruise such as this.

As ice navigator, my primary task at this point is obtaining ice information that is suitable for long range planning. This is still more strategic than tactical, as science stations must be clear of appreciable ice. With ice data in hand, I work with the Master, Captain Yoshiharu Tsustsumi, the chief scientist Shigeto Nishino and senior meteorological officer Jun Inoue to determine the areas of focus for the coming days. Tactical ice operations – actually working within the ice – will only occur later in the voyage, when we push as far north as possible to conduct meteorological observations at increased intensity.

Right now our chances for covering the entire planned science programme are not good. The chief scientist has set a very comprehensive cruise plan that was based on previous year's ice situations. However, the ice melt this year has not been as rapid and extensive as in past years and so far many of the science stations are still covered by ice. At least the winds and seas have begun to moderate. That makes it easier for the science crews to set up for the busy weeks ahead.

First experiments

On 31 August, science begins in earnest. Under sunny skies, winds NE15 and a slight 1 metre swell four separate casts are conducted just outside the US three mile limit to the east of Little Diomedé Island.



Ship's crew and science crew trial rig science packages on stern mounted 22 ton A-Frame for upcoming science station

In relatively shallow depths of 52 metres, the casts go quickly. First a PRR (spectroradiometer) is cast from the stern, followed in turn by an HydroScat (spectral backscattering sensor), a plankton net cast and the full 36 Niskin bottle CTD (Conductivity Temperature Depth) rosette from the starboard side. The massive CTD rosette is the most impressive to watch, swung over the side by the purpose built Dynacon three ton articulated crane. It is sent to the planned depth, then on the way up specific bottles are triggered to close at certain depths, taking samples of the water at that depth. Once back onboard, the rosette is moved back into the #1 buoy shed water sampling room and is soon surrounded by technicians taking the required sample sets from each bottle.

The captain generally remains in charge of manoeuvring throughout the occupation of the stations, using the joy stick control linking the twin bow thrusters, single stern thruster and twin shafts. As an 'older' ship, *RV Mirai* is not DP rated, but enjoys at least the ease of single joy stick control. First officer Ken Matsuura MNI tells me the ship is very responsive with plenty of power at one's finger tips.

Assessment of the ice conditions ahead continues daily and the strategic plan for the science programme is amended as information on ice conditions changes. Informal evening discussions with the chief scientist tend to discuss broad possibilities for selection of stations to occupy over the coming days, while morning briefings with the captain are more specifically on routeing between the chief scientist's preferred station positions.

Moorings

After completing the first three stations across the Bering Strait from Little Diomed Island to Cape Prince of Wales, the ship turns back to her northbound track, working stations every 30 minutes of latitude along the 168°45' meridian.

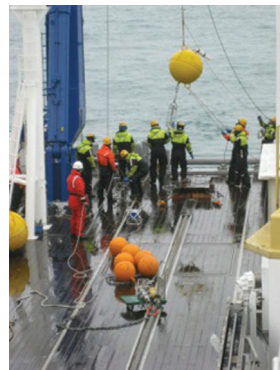
But this is the Arctic. Everything changes constantly. Most often it is the variability in ice conditions that cause plans to change. This time, it is weather. Having passed the Arctic Circle and into the Chukchi Sea on the morning of the 31st, *RV Mirai* begins a transect line along longitude 168°45'W, stopping to occupy science stations every 30' of latitude. But with brisk easterly winds forecast for the day that we were scheduled to recover current sensor moorings, the *Mirai* alters course to sail directly for Point Barrow to work the mooring a day ahead of the expected high winds.

However, things don't always go according to plan – even revised plans. Of the two moorings, only one is successfully recovered; a subsurface hydrophone placed to record whale sound and activity over the last 12 months. The second, a current recording mooring, responds to transponder pings but does not release. By late afternoon winds have freshened above the limits for recovery and snow squalls are blowing through, so *Mirai* turns back to occupying observation stations, planning to return later to again attempt recovery of the mooring when conditions moderated.

The final two days in the vicinity of Point Barrow



Captain Yoshiharu Tsutsumi maintains position using joystick control during occupation of Bering Strait science station



The top float of Barrow Canyon East mooring goes over the stern of *RV Mirai*

are also about moorings. Three sub-surface moorings are placed along the Barrow Canyon from about 26nm offshore in the north westerly line. BCE, BCC and BCW are in place to monitor variations of volume, heat and fresh water fluxes from Pacific Water entering the Arctic Ocean. The head of the Barrow Canyon is a prime area for biological activity, so sensors are also added to measure temperature, salinity and dissolved oxygen. In some cases whale 'voices' are recorded as well.

Generally the moorings stay in place for 12 months, but can remain viable for much longer. The three moorings recovered on 5 September were placed about the same time last year, and all things being well, will be recovered next year about the same time. For now, we turn north for the ice edge and to work the Northwind Abyssal Plain.

Ships that pass

We have a bit of a traffic surge off the North Slope of Alaska. A few days ago, the tug *Island Tugger* with a barge in tow and research ship *Aquila* were close by, Tuesday morning the *MY Octopus* was east bound, and Wednesday the Korean icebreaker *Araon* passed by heading SE. Though the number of vessels in the area over the last few days seems to be plentiful, it is uncommon and we are very aware that there are no dedicated search and rescue, salvage or repair resources nearby. In that regard we are alone.

Conditions remain positive for continued melt and retreat of the ice through the month of September. But for anyone that believes for a second that the Arctic ice is melting away faster than we can measure and is somehow no longer an impediment to shipping, we can attest that it is not quite so. Certainly, there is indisputable evidence that overall ice cover has been reducing, but the ice is still here. And it has kept us working along the Alaskan coast longer than originally planned.

Earlier this year the media made big headlines over an intensive cyclonic system that 'beat up the ice,' further reducing the polar pack. But right now the ice is further south in the Chukchi Sea than it has been for several years now. It proves that as long as there is ice, it moves, and it doesn't always go where one might want it to.

The greatest problem with the Arctic is not the Arctic itself, it is the incredible ignorance of many people of what it truly is like up here. It starts with media hype about global warming, and the 'ice free Northwest Passage', and it sometimes ends with adventurers leaping to 'experience' the Arctic without real preparation or understanding. Anyone venturing into the polar regions must be aware that these areas are still extremely remote, not within reach of rapid rescue or support, and that ice remains an issue regardless of what the latest headlines are in the media. Only well prepared voyages will succeed and even then may be subject to impenetrable walls of ice. A passage is never guaranteed and even the most powerful icebreakers can be held up for days by multi-year ice that still penetrates deep into the Canadian Archipelago.

To the ice edge

After completing work along the Alaskan coast, *RV Mirai* turns north to challenge the ice edge. Up till now the polar pack has remained resolutely closer to shore than previous years, but in the last few days has retreated sufficiently for us to attempt to occupy the Northwind Abyssal Plain mooring NAP-12 at 75°N 162°W. Given her relatively light 1A ice class, the *Mirai* generally avoids ice, and we prefer not to enter ice regimes of more than 1-3/10ths concentration.

We encounter our first ice at midday on 7 September, strips and patches of rotten old and thick first-year ice along latitude 74°30'N. From that point on I remain on the bridge as an active member of the bridge team. We are able to continue north, threading through the open patches between the very rotten strips and infrequent patches till we reach 74°50'N where 2.8nm ahead, ice coverage of 6-8/10ths old ice blocked further passage. We are ten miles short of our destination, but discretion is the better part of valour.

It is not a total loss. The mooring sensors and data collection equipment can comfortably remain another year until recovery during the 2014 voyage. And the new NAP-12 mooring is successfully deployed 8 September at a depth of 600 metres.

Transiting the ice

While transiting south on 10 September, we pass through 20 miles of old and thick first-year ice in our closest encounter with ice to date. Though the concentration was never more than 3/10ths overall, most of the ice was multi-year floes some up to 30 metres. For a lightly ice-strengthened ship such as *Mirai*, that is challenging. Not at all impassable, but challenging nonetheless.

Whenever transiting near or in ice, the ice navigator is on the bridge providing input to the captain and his bridge team on tactical manoeuvring based on visual, radar and other sensor information. I explain to the young bridge officers, new to sailing in ice, that the radar makes the ice look more concentrated than it is, and as we get closer and look out the windows, it's not all that bad. Nods of understanding and sighs of relief result.

Operating light-skinned ships in any ice is far more of a challenge in many ways than having a heavy purpose build icebreaker under your command. It's like using finesse versus brute strength to get the job done. Admittedly, sometimes only brute strength will get you some places, but for *RV Mirai*, we only go where we can gently waltz, not where we have to breakdance.

'Heads up' is the key advice as the conning officer carefully picks his way around the ice. Often speeds are dead slow ahead; less than 3kts. Sometimes we even stop as a floe is pushed gently aside. It is slow going, but Captain Tsutsumi knows his ship very well and adroitly manoeuvres through and around the ice. The captain and ice navigator confer in selecting best tracks through the ice, always bearing in mind the base course that we want to make good, but fully aware that we may have to go way over there to get back to over here.



Automated launch of radiosonde balloon from *RV Mirai* met lab. Doppler weather radar dome to right.



Third officer Kobayashi on his second Arctic voyage

Ballooning

RV Mirai now sails well south of the ice edge and takes up station at 72°45'N 168°15'W for approximately two weeks of concentration observations below and above the surface. One of the research points of focus is senior met officer Jun Inoue's study of Arctic cyclones. The ultimate goal is to develop more accurate forecasting models that can better predict the often rapid growth and high intensity of Polar Lows.

To gather the data, every three hours the *Mirai* alters heading to get relative winds off the port bow. Starting about one hour before the observation time, Jun and his team begin to inflate the balloon and prepare the disposable radiosonde. The quantity of helium is calculated for each launch based on true winds and temperatures to ensure that the balloon has sufficient lift to clear the eddy currents around the ship as it leaves the automated launcher, but not too much to rise too quickly. The radiosonde itself is calibrated against 'true' sea level pressure and temperature as well as true launch latitude and longitude. The balloon is inflated inside an automatic launch tube in the portable met lab secured on the mid bridge deck. The launch tube will rise clear of the lab on command, then swivel and tilt to allow the balloon to come free and move clear of the ship downwind. Thirty minutes before the observation hour the ship alters course if necessary and the balloon is sent on its way, transmitting its valuable data.

Halfway there

For this 42 day cruise, 17 September is the midpoint of the research voyage. Some of the crew, including myself, will leave on our return to Dutch Harbor on 7 October, but the majority will remain onboard till the ship returns to Japan on 20 October. Some of the team that arrived in Dutch Harbor will be replaced by a group focused on North Pacific research.

The GODI ship's officers and crews (the deckhands, the engine room oilers, and the galley and steward staff) work on four month on two month off rotation, a rotation that is very common on many deep sea fleets today. Thus on any given date, individuals are at different stages of their cycle. Some may leave in Japan in October, others will remain for the next voyage.

Primary researchers are based on specific research cruises, which can range from shorter two week cruises to longer six or eight week cruises depending on the primary research focus. Marine Works Japan technicians are often onboard for up to three months duration. Some in fact list *RV Mirai* as their primary residence, and during their periods ashore happily live almost a vagabond life. So does mid trip mean anything? Depending on where you are in your own cycle, with your own unique mid trip date it does, but to most the day that has the greatest importance is disembarkation day. For this ice navigator it is 7 October. 🌊

Follow Duke's voyage updates live and in full on <http://icenav57.tumblr.com/>

Rescue in the Arctic

RV Mirai's bridge crew are sombre today. We have just received the sad news of a crash of a Canadian Coast Guard helicopter in the Canadian Arctic in the area of McClure Strait north of Bank's Island. The reports we received here were that the helicopter with pilot, *CCGS Amundsens's* commanding officer and a scientist onboard went down while on an ice reconnaissance flight, and there were no survivors. I knew the captain and he was a good man. There but for the grace of God go I. Once many years ago, as chief officer onboard an icebreaker operating in the Beaufort Sea, the helicopter that I was flying in very nearly came to grief when struck with unexpected and very rapid aircraft icing that forced an emergency landing. It was about the same time of year. I still remember the pilot sitting there, breathing heavy after our rough landing on shore fast ice, turning to me and saying "That wasn't in the flight plan". These things never are.

This tragedy truly speaks to the remoteness of the Arctic regions. The nearest search and rescue resource was the icebreaker from which the helicopter launched. Devoid of the only asset that could have assisted, the *Amundsen* was almost ineffective. After that, *CCGS Henry Larsen* was the next closest – several hundred miles away. We in the Arctic are at the end of the lines for what others take for granted. And when the crews of the scant resources that are up here to provide support to others need it themselves, it's even tougher.

Recently, the Arctic Council nations bonded together and

declared a treaty for provision of Search and Rescue in the Arctic. Canada is responsible for ensuring communications in NAVAREAS XVII and XVIII, Norway for XIX and Russia for XX and XXI. We quickly knew about the crash, but the response was not as rapid. The new SAR declaration hasn't yet come up with new Arctic bases to launch from, or new equipment to launch for that matter.

It takes years to build that kind of infrastructure, even in more developed regions. The most vocal promises have come from the Russians, eager to see shipping frequent the Northern Sea Route and paying for the privilege. In 2012 the US Coast Guard ramped up a concentrated Arctic presence pre-positioning vessels and aircraft in the Arctic, but this year, it has scaled that effort back considerably due to cost. Canada has not yet spoken directly of increasing SAR presence and this year has been forced to scale back its Arctic icebreaker commitments as the ageing fleet must be cycled though life cycle extensions to hopefully last until new ships are built. But even then, only one new icebreaker is approved for construction and is not expected to be operational until after 2017 at the earliest.

On 4 September the tanker *Nordvik* was holed by sea ice with a risk of pollution. Only because she was in the more heavily travelled Kara Sea area was the *Nordvik* able to obtain support reasonably quickly. The challenges of preventing or cleaning up the resulting pollution for less fortunate vessels are daunting.

Accreditation Manager



The Nautical Institute (NI) is seeking a self-motivated maritime professional to lead a number of key projects in our Accreditation Service, which currently include Dynamic Positioning Operator (DPO) training, Oil Spill Response courses, Leadership & Management, and Ship's Welfare Visitor. Working with the Director, Accreditation & Services, the post will involve developing and managing NI's team of accreditation auditors, organising accreditation audits worldwide, and developing/maintaining/promoting the required standards in consultation with industry stakeholders. This work will be integrated with all aspects of NI activity including membership, the development of best practice, publications, input to the IMO, and other aspects of safety and efficiency within the industry. It will be wholly focused on providing a practical and efficient service to the industry with a professional ethos and it is envisaged that additional services will be developed in the accreditation or recognition of specialised training. The Institute is accredited under the ISO 9001:2008 standard.

The successful candidate will meet the following criteria:

- Lead Auditor qualification and experience.
- Membership of The Nautical Institute is very desirable, as is some management experience and a record of continuing professional development (CPD).
- Have a good knowledge of IMO Conventions and other regulations/guidance within the industry.
- NI DPO certified is desirable, as is sea-going experience generally.
- Good communication and negotiation skills, English and computer literacy, and proven writing ability.
- Be able to work within a small team as well as independently, in a multi-tasking environment, displaying the highest professional standards.
- Empathy with people of different nationalities.

The position, expected to be based at NIHQ in London, will entail some worldwide travel and will involve general promotion of the ethos and values of The Nautical Institute, as is the case for all staff.

This is envisaged to be a full time position and is offered with a salary in the range of £35,000 to £45,000 per annum depending on qualification and experience. Applicants should already be entitled to work within the UK.

To apply, send your CV and covering letter by the end of November to the Chief Executive as below, who may also be contacted for further information and a job description.

Philip Wake, MSc FNI

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