ICE FORECASTING IN CANADA

The History of Ice Forecasting Central

From its inception in 1958,
its growth and transformation
into three divisions
in 1982

A. P. Beaton

with input from

W. E. Markham

Ottawa, Ontario

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This document sets the stage for the expansion of Ice Central into the world of electronic and digital analysis and processing of ice data as it developped in the 1980`s and subsequent years. This involves both sea and freshwater ice as well as iceberg programs. The addition of remote sensing systems to reconnaissance aircraft and later to earth-orbiting satellites generated volumes of data at such rates that highly computerized systems were necessary to receive and analyze the data and to generate forecasts and other products for clients. Staff expansion and training, and working with commercial organizatons to develop the required systems, involved considerable time, travel, and resources. Staff were also involved with Space Agencies and other international groups to ensure that systems being developped were compatible, and would be of optimal benefit to Canada.

Documentation of these later evolved technologies should be done by more contemporary users of these systems.

ICE FORECASTING IN CANADA

1. Background

The ice forecasting service in Canada, responsible for forecasting the presence, growth, and movement of sea ice along Canada`s coastal and northern waters, and ice in the St. Lawrence River basin, was established by the Royal Canadian Navy (RCN) at its HMCS Shearwater weather forecast office in the spring of 1958. This was an assignment from the Department of Transport (DoT) which earlier had begun regular aerial and ship-based ice surveillance, but did not yet have the facility to commence forecasting ice conditions to support shipping and other marine activities.

Arctic North America has always been affected by ice cover. Following the retreat of the great ice sheet over central North America several thousand years ago, ice remained a factor over the Arctic Basin, around the Canadian arctic islands and, on a seasonal basis, along Canada`s east coast and inland waterways. Although climatic variations over the centuries resulted in years with lesser or greater cover and thickness of the pack ice, little or no commercial activity being conducted meant that it mattered little. Over subsequent centuries, animal and sea life spread into the region, to be followed centuries later by human migration. It was the curiosity of traders and sailors to find a 'northwest passage' to the Orient that brought Europeans to the region in the 1700s and 1800s, and encroached on the life and serenity of the inhabitants and their environment. The most intrusive of these were the Sir John Franklin expeditions and the efforts in subsequent the years to locate any remnants of his last, ill-fated voyage.

2. Arctic Ice, National Security and Sovereignty

Another 'intrusion' into Arctic life and the environment occurred during the Cold War period following World War II. The potential threat to eastern and central U.S. and Canadian cities and industries from long-range Soviet bombers flying across the Arctic Basin raised the idea of a warning system to prevent this possibility. After meetings, discussions and consultations between U.S. and Canadian government and industry officials, a contract was awarded in 1954 to begin construction of a radar warning system across the Arctic from northern Alaska to eastern Baffin Island. This became known as the Distant Early Warning (or DEW) line, and set in motion an influx of ships in 1955 carrying all kinds of heavy construction equipment assisted by strong icebreaker support. In the western Arctic sector shipping came in through Bering Strait, accompanied USCG icebreakers with their ice observing and forecasting personnel to accelerate ship movement and construction.

In the eastern Arctic transport was through Canadian waters, and although much of the construction material was carried on U.S.N auxiliary ships it was deemed that for sovereignty reasons, a Canadian flag icebreaker should lead the operation. Since the U.S. ships were assisted by quasi-military icebreakers, it was also deemed appropriate that the Canadian icebreaking support operation be militarily operated. Canada's capability to operate in heavily ice covered waters at that time was quite limited, and the RCN had none. On the other hand, the Department of Transport had a new, heavy icebreaker under construction so, when it was launched in 1954, the ship was transferred to the RCN and christened HMCS Labrador. She became the symbol of our Arctic sovereignty and a workhorse of the eastern Arctic DEWline construction phase.

With an icebreaker in the fleet, the RCN now needed a support team to enable it to carry out its newly assigned operational duties in ice-encumbered waters. The immediate question was whether Oceanographers or Meteorologists were the most appropriate specialists to be the team foundation. Assessing the effects of wind induced drift, temperatures, melting/freezing effects, albedo of ice and water, etc., against the effects of sea temperatures, salinity, vertical mixing and water currents, among other factors, the recommendation of appropriate authorities favoured the Meteorologists .

3. Developing a Forecast Capability

Now began the task of actually assembling the team. The Meteorological Branch of DoT seconded two Meteorologists with arctic weather experience to the RCN. Both W. E. (Bill) Markham and M. G. (Mel) Hagglund were commissioned with the rank of Lieutenant Commander (Special Branch) and went to Washington, D. C., for a comprehensive course in Oceanography and its interaction with Meteorology on ice growth, properties, movement, effects on ships and other structures. On return to Canada Lcdr Markham was assigned to the icebreaker HMCS Labrador, and Lcdr Hagglund was assigned to the aircraft carrier HMCS Magnificent. (Mr. A. B. Low, a civilian meteorologist from the Winnipeg Weather Office served on HMCS Labrador during the 1954 arctic summer as an advisor on meteorology and its effect on the ice in the vicinity of the icebreaker.) Later another meteorologist at HMCS Shearwater, Mr. A. P. (Alex) Beaton went to the US Naval Air Station at Lakehurst, N. J. for an introductory course in Ice Observing, some properties of ice and its growth, and communication support to ships (October – December 1957).

DEWline construction, begun in 1955 was largely completed by 1958, but ongoing resupply shipping was a requirement. In addition, new and increasing commercial shipping, both in the Gulf of St Lawrence and Newfoundland area, greater activity on the Hudson Bay Shipping Route and in the Arctic in summer, demanded a continuing ice forecast service. The small nucleus of ice forecasters and technicians at HMCS Shearwater was gradually increased to the level of a full service operation under the direction of Lcdr Markham. Hence the inauguration of the first Canadian ice forecast office - Sea Ice Central – at HMCS Shearwater in the spring of 1958.

During the summer Arctic navigation season field forecast units were set up at Frobisher Bay (now Iqaluit), at Churchill, and at Cambridge Bay. These field units were close to the shipping routes and worked closely with local Canadian Coast Guard (CCG) personnel who were in contact with the ships and icebreakers. This support setup was deemed effective as there was not yet a well developed communication system to relay the ice data to the Ice Central for processing, and getting the ice forecasts back to the ships as quickly as possible. Initially incoming ice data and relays to ships were in plain language or coded messages. Later, these were supplemented or replaced by facsimile relays over landline circuits (to Ice Central), and radio facsimile broadcasts of ice charts available to all ships and icebreakers equipped to copy these broadcasts. In the longer term, high powered VHF radio broadcasts of ice data from transmitters in Halifax and Edmonton covered all of the Canadian navigable waters. The development of analog facsimile to replace earlier facsimile transmission methods resulted in faster, more legible, and more reliable reception of all charts.

4. Transfer to the Department of Transport

Toward the end of 1958 the Royal Canadian Navy saw its 'sovereignty role' nearing an end and was preparing to return HMCS Labrador and the ice forecast service back to the Department of Transport. The icebreaker was returned to the Canadian Coast Guard and the ice forecast service became part of the Meteorological Branch of DoT. In early 1959 the Ice Central was relocated from HMCS Shearwater to offices adjacent to the Halifax Weather Office, with Mr. Markham as the Officer-in-charge. The advantage of this location was the ability to use the communications and the weather charts and forecast facilities of the weather office.

A gradual increase in staff - meteorologists as ice forecasters and civilian support technicians to replace the RCN naval technicians - took place, with B. H. (Bernard) Sproule becoming the first non-naval technician in the ice forecasting office. An increase in the forecaster complement permitted the continuation of the summer field forecast units at Frobisher Bay and Cambridge Bay for a number of years. The Cambridge Bay ice forecast operation was redeployed to Edmonton in 1967 to take advantage of the local high powered VHF radio broadcast facility for the ice and weather charts, and the weather forecast experience and guidance in the Arctic Weather Office. Winter ice forecast operations in the Newfoundland and St Lawrence Gulf and River basin were always carried out from the Halifax office.

Shipping traffic continued to grow in all areas, and new requirements arose for ice information and support for shipping activity in the St Lawrence River to Quebec and for off-shore oil drilling rigs. Initially drilling took place off the Labrador coast. Discussions were already being held with respect to potential drilling in southern Hudson Bay, in Davis Strait, east of Newfoundland, and further ahead, in the Beaufort Sea. Obviously ice was a serious problem for drill rigs at certain times a year in all these areas. The rescue of the USCG icebreaker Northwind in 1967 from the Arctic pack north of Alaska by CCGS John A MacDonald with Canadian aerial ice reconnaissance support, and the return voyage of the S.S. Manhattan from the eastern U. S. seaboard to Point Barrow, Alaska, in 1969 with full CCG and Ice Branch support, added to the diverse needs for ice forecast services.

5. Relocation of Ice Central to Ottawa

These ongoing and proposed activities were putting greater pressures on the Canadian Coast Guard, both for tactical support of all marine operations as well as their regulatory functions. Increasingly, inputs of ice data were becoming an important part of their decision making. Because CCG was providing much of the financial support for the whole ice program, they recommended that the Ice Central should be located where they could have daily or immediate access to the expertise and data available in this office. As a consequence they requested that the Ice Central be relocated to Ottawa, to facilitate interaction with their decision-making people.

The relocation took place in November 1971. Unfortunately some of the professional and technical staff were not willing to move to Ottawa so some expertise was lost in the move, but new staff were recruited and trained to meet the growing needs of the CCG and other commercial clients. A computer expert, A. K. (Awtar) Koonar was added to the office to look at ways to automate some ongoing activities. and another meteorologist, J. C (John) Falkingham to begin study of ice research related to operational forecasts. The growing accumulation of ice data from numerous sources – visual observations, satellite and radar imagery - dictated that an ice climatology function be set up. With these activities growing, space became a problem, and in 1982 the Ice Central moved a second time, to larger office facilities, still close to CCG headquarters.

Coincident with this move a division of functions was set up among the various activities in Ice Central, and the unit was split into three separate Divisions:

Ice Forecasting Central, led by A. P. (Alex) Beaton, carrying on much of the original analysis, forecast and support roles which it had been its mission since 1958;

Ice Climatology and Applications, under D. W. (Dave) Mudry, designed to take all existing ice data in their various forms, try to standardize them, prepare historical charts based on this standardization, and eventually proceed to the publication of Canadian ice summaries and atlases;

Ice Research, led by Dr. R. O. (Rene) Ramseier, focusing on remote sensing tools, like Sideways Looking Airborne Radar (from aircraft and satellites), infrared sensors in various spectra, and other tools could be used with appropriate ground-truthing to better identify and understand the properties of the various ice types.

An **Ice Reconnaissance Division** had existed since 1957, operating from Meteorological Branch (later Atmospheric Environment Service) headquarters in Toronto, under the guidance to T. B. (Tom) Kilpatrick. This division was responsible for collection of most of the ice data used by the Ice Central for its forecast and information products. Data was gathered from aerial reconnaissance (fixed wing and helicopter) flights, and by ice observers assigned to CCG icebreakers. In the beginning visual observation was the only data gathering option, but the later addition of radar systems to the reconnaissance aircraft had greatly increased the all-weather capability of the data gathering missions. The training of new ice observers was also the responsibility of this Division.

6. Data Dissemination, Code Development, and Satellite Technology

Prior to the 1950's, navigation into the Gulf and River St. Lawrence was limited or restricted during the winter ice season. By the early 1950's, as world and Canadian trade increased, the need to extend the shipping season into the Gulf of St. Lawrence became economically necessary, in large part, to facilitate export of some commodities on a year round basis from ports like Sept Iles, Cornerbrook, and ports in the Chaleur Bay area. Also, because the cost of shipping into central Canada was lower than handling and land shipment of cargo from east coast ports, this was an added impetus. Supplying information to ship masters and shipping companies in a useable and efficient format required the development of an easy to understand depiction method. Similarly, exchanging ice data with other national services entailed the same difficulty.

Since its formation in 1947 the World Meteorological Organization has been working toward an international standard of ice terminology. Initially the USSR, Germany, and Denmark were the participants, but later, with increased interest and more marine activity, Canada, the United Kingdom, Finland and Argentina were invited to participate in a **Working Group on Sea Ice**. After a series of regular meetings this Working Group developped and circulated an illustrated ice nomenclature document. Then a method to portray the ice data on transmitted charts was attempted. Ultimately a diagrammatic system to represent ice conditions and their hindrance to navigation, known as the "EGG CODE", developed in the Canadian Ice Service, was tested and accepted by most of the countries where ice covered waters interfered with commercial shipping , fishing and other marine operations. The code depicts numerically the types and amount of ice in each category along with floe size, and other distinguishing features, and facilitates the relay of ice information in visual format to all marine interests.

Earth-orbting satellites opened a new frontier in the world of data gathering. Early satellites recorded data only in the visible spectrum, restricting their ability to acquire ice data during nighttime or over cloud covered areas. Ice Central first received the TIROS satellite images in the 1960s. The low resolution power of these early sensors limited their usefulness to showing presence of ice, general ice edge/limit when ice was very diffuse, indications of general concentration within the pack area, and not much more. But they showed promise of a bright future for this data gathering facility when sensor resolving power would improve.

Later generation satellites in the Landsat/ERTS series added infra-red sensors able to acquire nighttime data but were still unable to 'see' through cloud cover. Some improvement in defining ice concentrations and type was then possible with this satellite series. The Canadian RADARSAT satellite series added cloud penetrating synthetic aperture radar systems, similar to those on our ice reconnaissnce aircraft, thus greatly adding to the data quality and quantity, and supplementing our aircraft data. The aircraft data and observatons from ships aided greatly in 'ground truthing' the data from spacecraft.

Early receipt of ice images was by mail from both U. S. sources and from the Prince Albert satelitte receiving station. As technology improved, reception from the latter source was through the dial-up phone system, hence more immediate for inclusion in daily ice forecasts and other products. With the establishment of the Canadian-Danish satellite receiving station at Sondre Stromfjord in_Greenland in the 1980s, receipt of the satellite data was routed direct to Ice Central by high speed link, with a great increase in data quantity, quality and timeliness. These high data rates expedited the development of digital systems to receive and process the ice data and generate more useful and timely information and forecasts. Development of these systems placed Canada in the forefront of enhanced programs to acquire, process and disseminate ice and iceberg information to our clients, and for internatinal distribution.

These activities and the ongoing domestic and international meetings, workshops, conferences, etc. are typical of the involvement of Ice Central (and Ice Branch) personnel in many of the technological advances in the ice and iceberg environment since its inception in 1958.

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SEA ICE CENTRAL—Canada's first ice-forecasting service is now in operation at the RCN air station at Shearwater. At work in their new office, called Sea Ice Central, are Lt.-Cdr. William E. Markham, Edmonton, meteorological officer in charge, and Alexander P. Beaton, St. Ninian, Inverness County, N.S., his assistant.

Shearwater Watching The Ice

Canada's first ice-forecasting service, providing information on ice conditions in various coastal waters, went into operation this spring at Shearwater. The service is being operated this year by the Navy on behalf of the Department of Transport, which will take it over in 1959.

The service is part of an arrangement for provision of information on ice-infested areas around the coast of North America, for the benefit of commercial and government shipping. The areas covered by the RCN ice forecasts include the Gulf of St. Lawrence, Hudson Bay, Hudson Strait and the northern coast of continental Canada.

Ice forecasts for the central and eastern Arctic and for the shipping lanes along the east coast to Baffin Bay have been provided in the past by the United States Navy's hydrographic office. This year the hydrographic office will provide the usual full support to shipping along the east coast north to Baffin Bay and five and 30-day forecasts for the Eastern Arctic area. Other ice advisories and ice forecasts will be provided by Canada.

"SEA ICE CENTRAL"

The new Sea Ice Central, as it is called, is located at the Shearwater Naval air station, and is operated by personnel who have had practical experience with sea ice. The Department of Transport has organized an extensive system of surface and aerial ice observations, which are relayed to the Ice Central at Shearwater for use in issuing ice bulletins and ice forecasts. Both civilian and Air Force aircraft will be used in the aerial ice surveys.

By midsummer, three field forecast stations will be set up at Churchill, Man., and Cambridge on Victoria Island and Frobisher on Baffin Island in the Northwest Territories. While the Shearwater Ice Central will be manned the year round, the northern stations will be manned, two at a time, during the summer months only. The Shearwater unit will provide basic ice information to the northern stations, which will be equipped with radio facsimile recorders.

Much of the over-all organization and liaison for establishment of the ice forecasting service was carried out by William F. Ganong, director of naval weather service at Naval Headquarters, Ottawa. The forecasting program is under the immediate charge of Lieutenant-Commander (SB) William Markham, Dartmouth who was meteorlogical officer in the Arctic patrol ship Labrador for three years. Operating the main forecasting station at Shearwater, he will be assisted by A. P. Beaton, now serving as a civilian meteorological officer at the air station. They will be responsible for setting up the three field stations this summer. In addition to Lieutenant-Commander Markham and Mr. Beaton, three RCN meteorologist's mates are on the strength of the Shearwater unit. They are PO John L. Hebgin, Alliston, Ont., Leading Seaman R. G. McIvor, Toronto, and Leading Seaman S. J. Willis, St. Jean, P.Q.

The service is now providing forecasts for the Gulf of St. Lawrence area, to assist shipping in both the river and the gulf. Forecasts covering the Hudson Bay and Hudson Straight area will assist shipping operating to and from Churchill and the service will gather data to aid in planning shipping seasons in Ungava Bay.

First Move of Ice Central – 1959

This article describes (on pages 2 and 3, above) the transfer of ***Sea Ice Central*** from DND to DOT about 1959. At that time, LCdr **Bill Markham** returned to civilian life and was tasked by the Meteorological Branch to move the fledgling ice office from Shearwater to the Post Office Building in downtown Halifax, collocated on the same floor as the established regional weather office run by Rube Hornstein.

During 1959, the move took place and the staff of the new office increased. It was then named ***Ice Forecasting Central.***

In May 2021, Judy Hill, daughter of meteorologist Richard (Dick) Hill, discovered the photo below which is a window on the early staff of Ice Forecasting Central not long after the 1959 move. The photo was marked “1960” on the four corners. We don’t know who took the photo, but credit should go to Judy and Dick Hill.

l to r: Alex Beaton, Dick Hill, Ron Sumara, Bernie Sproule, Bill Markham.

This page added, June 2021
by CMOS Archivist
Bob Jones (former member of Ice Central staff)

Ice Central moves . . . *finally*

Contact
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The words: "This is it, folks!" stood out in bold letters across the new floor plan for Ice Forecasting Central, a section of Atmospheric Enviromnent Service. This was ironic even to **Alex Beaton**, chief, since the move from cramped quarters in one downtown Ottawa office building to a more spacious area several blocks away had been changed so many times, Mr. Beaton had almost lost count.

"But, we'd never gotten to this stage," says Mr. Beaton, as he and his small staff prepared to pack up charts, maps, desks, teletype machines and computers for the move.

The small staff provides a constant stream of information on the condition of ice in Canada's coastal waters, in both winter and summer. This information is vital for offshore exploration, shipping, marine surveillance, fisheries, meteorological needs and coastal and harbour activities.

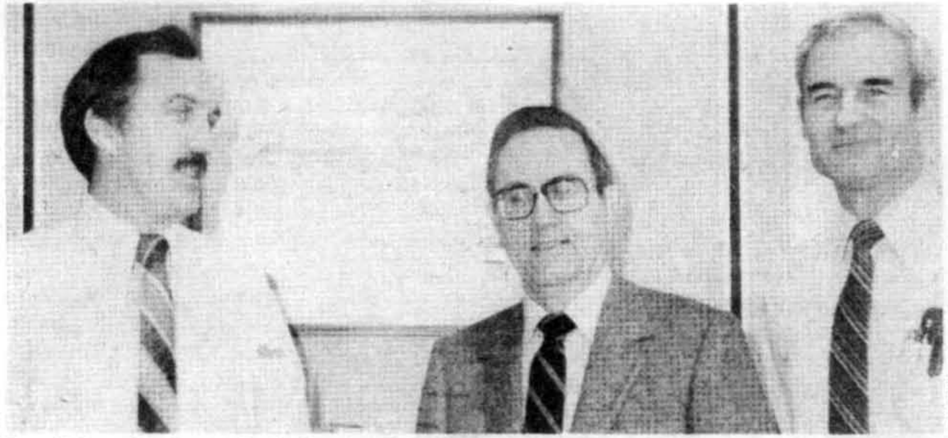
Daily charts are produced, describing ice types, floe sizes and other technical data. A computer system collects and displays data and develops guidance for generating ice forecasts. Ship and shore reports are received and interpreted.

A roomful of teletype machines serves as a back-up should the computer system break down. And what if the back-up system goes haywire?

"We'd be in big trouble," says Mr. Beaton.

The old location just couldn't hold any more equipment or people. When Ice Forecasting Central set up house in 1971, there were only 11 staff members. "Now we have 15 and there are more things going on," says Mr. Beaton.

Personnel besides Mr. Beaton include: **Phyllis Burge**, secretary; **Terry Mullane**, operations superintendent; **Bernie Sproule**, senior technician; **John Falkingham**, development of new methods; **Awtar Koonar**, systems analyst; **Angus Gillingham**, **Hugh McRuer**, **Bruce Ramsey**, **Normand Michaud**, forecasters; **Bob Baines**, **Ron Fawcett**, **Cec Saunders**, **Doug Hagen** and **Robert Tessier**, technicians.



GIBPIX

Terry Mullane, Alex Beaton, Bernie Sproule

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Angus Gillingham, Norm Michaud

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announces the establishment of

ICE CENTRE ENVIRONMENT CANADA

March 15, 1982

annonce l'établissement du

CENTRE DES GLACES D'ENVIRONNEMENT CANADA

15 mars 1982

Canada

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- ICE CLIMATOLOGY AND APPLICATIONS
- ICE RESEARCH

to

3rd Floor, Journal Tower South
365 Laurier Avenue West
OTTAWA, Canada K1A 0H3

Telephone (613) 995-6818
Telex 053-3761

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au

3ième Etage Immeuble Journal Sud
365 Laurier Ouest,
OTTAWA, Canada K1A 0H3

Téléphone (613) 995-6818
Télex 053-3761

Ice Centre Staff - May 1982

Open House on the Occasion of the Office Move

from the Trebla Building to the Journal Building, Ottawa

l to r: René Ramseier, Bernard Sproule, Phyllis Burge, Ron Fawcett, Awtar Koonar, John Falkingham, Hugh McRuer, Robert Tessier, Bill Markham, Normand Michaud, Angus Gillingham, Doug Hagen, Dave Mudry, Terry Mullane, Alex Beaton, Phil W Cote, Anne Owens (now Walker), Fred Geddes, Margaret Giroux.