

Meteorological Operations in Weddell Sea, Antarctica, 1989-90

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Abstract

Marine meteorological data was collected round the clock during the passage from Goa (India) to Antarctica and during the stay in the Weddell Sea. Installation of APT on board was of immense help in monitoring weather systems throughout the expedition. Some of the prominent meteorological conditions encountered and parameters recorded in the Weddell Sea during this period, have been dealt with in the paper.

Introduction

The First Indian Scientific Expedition to the Weddell Sea, Antarctica, on board MV Polarbjorn, sailed off from Goa on 04 December, 1989 and returned to Marmugoa harbour on 08 March, 1990. During the passage and stay in the Weddell Sea, following prominent meteorological conditions were experienced :-

- (a) Intense low pressure systems from 19 December to 22 December, 1989 around 40°S.
- (b) Thick pack ice around 68°S in Weddell Sea.
- (c) Fast deterioration of weather in the Weddell Sea.
- (d) Formation of ice ridges in pack ice.

Alteration of Ship's Course on 20 Dec. '89

On 19 December 1989 an intense low pressure system was observed on surface chart in position 40°S, 20°E (Fig.1) WSW of ship's position, moving in a SSE-SE direction. The ship, on course 220, would have entered the centre of this system within next 24-36 hrs and hence was advised to alter course to 200 to move ahead of this system.

Once again the ship had to face two low pressure systems at 46°S. Two more low pressure systems, at about 58°S, were fast moving eastward i.e. towards the ship (Fig.2). With head winds of 45 Kts on course 200/220, navigation of the ship was likely to be very difficult. The average speed of these cyclones was of the order of 24-29 Kts in zone 40-60°S and 30-35 Kts along 45- 50°S. With course 200 the ship was bound to experience very rough weather and winds of the order of 80-100 Kts. Such high speed winds, swell and rough seas could besides making the members on board uncomfortable, cause considerable damage to the ships's cargo particularly the helicopters which were parked in a very compact hold.

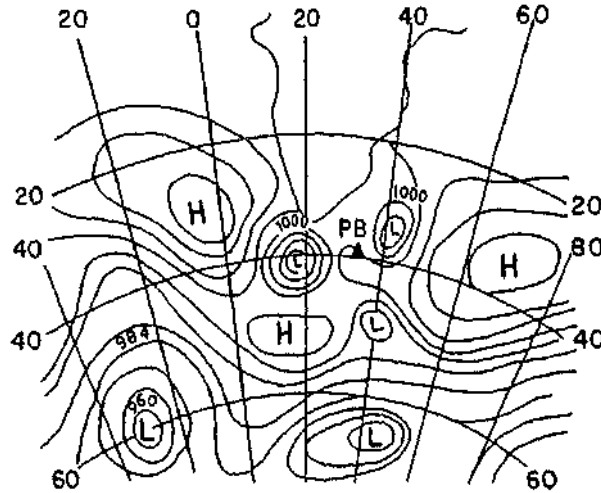


Fig. 1, Surface chart of 190600Z/DEC.

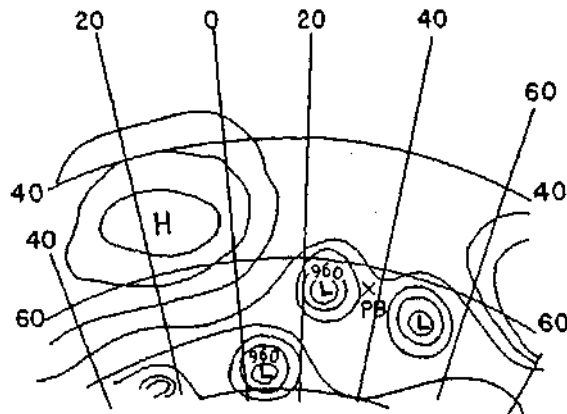


Fig.2. Surface chart of 210000Z/DEC.

Keeping this in view, the situation was explained to the ship's captain and the Expedition Leader who, as advised, decided to sail on course 180 and let pass all the systems and at the same time take advantage of tail winds, at about 60°S.

On 22 December '89, the low pressure system, at 58°S, 8°W (Fig.3) gave enough indications of clearing away in the next two to three days. The ship sailed westward in a relatively calm sea. This course was then maintained till 26th when first pack ice was encountered in the Weddell Sea.

Passage through the Pack Ice

Ice conditions in the Weddell Sea and in its approach from NE are generally unfavourable. The Weddell Sea pack ice is heavily hummocked with northern boundary varying upto

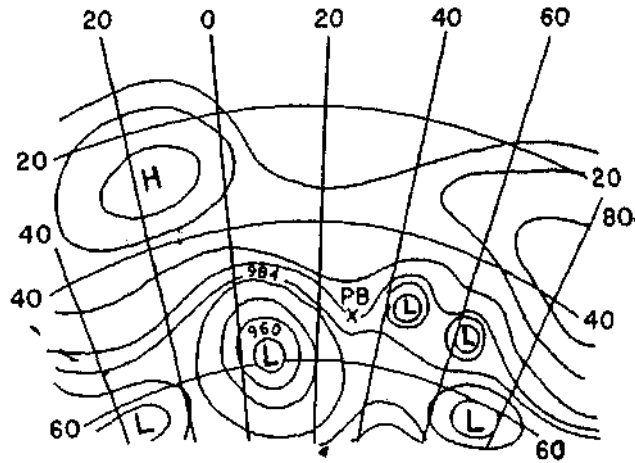


Fig.3. Surface chart of 221800Z/DEC.

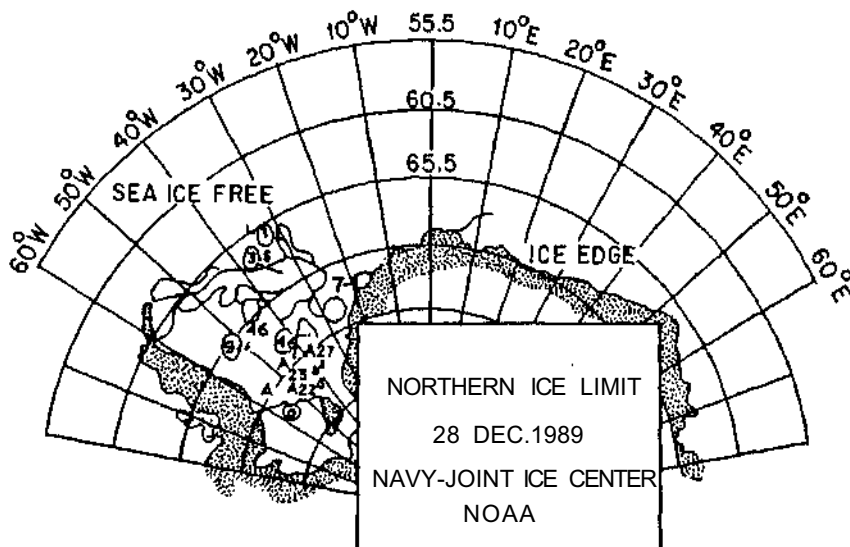


Fig.4. Ice chart of 28 th December, 1989.

300 NM in different years. Under the influence of easterly winds and westerly ocean currents, the ice drifts westward and south westerly shores become unapproachable by ships in any season. During summer months, the northeastern and east-central parts of the sea are found to be navigable but conditions vary from year to year. Ice condition records of the Weddell Sea indicate that the 1989-90 Summer Season has been probably the best year after 1979-80 from the navigation point of view.

The ice chart received from Molodezhnaya on 24 December '89 and later confirmed from the ice chart received from Joint (JIC) NOAA, USA, had indicated a pack ice condition of 3-5/10 in position 68°S, 20°W, where Polarbjorn was expected to reach by 29 December, 1989. However, the ice chart of 28 December (Fig.4) from NOAA revealed that the ship

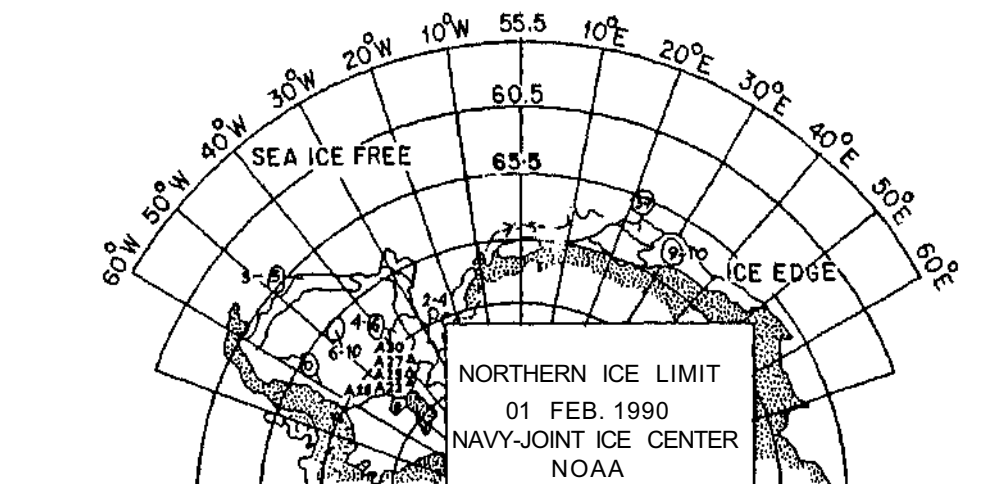


Fig.5. Ice chart of 1st February, 1990,

could navigate through open waters upto 77°S, 35°W by altering course to 190/180 which was done. On 01 Jan. '90 the ship once again entered into thick pack ice in position 77.7°S, 036.2°W. In the absence of updated ice chart, helicopter sortie had to be flown to locate the exact position of the polynya. Thereafter, the ice charts from JIC, NOAA, USA were received every Friday to monitor movement of pack ice in the Weddell Sea Area.

Weather Conditions in the Weddell Sea

Weddell Sea is one of the two great bays in Antarctica. The area is well known for its adverse weather conditions throughout the year. Most of the weather systems that move eastward between 60-70°S, originate in the Weddell Sea.

During 40 days of our stay in the Weddell Sea, only twelve clear weather days were observed. On most of the other days, weather was overcast, often with white-out conditions. Fast spreading *stratocumulus* and *stratus* clouds used to create full white-out within 2-3 hours. Lowest temperature recorded during the period was (-) 10°C. Winds were generally weak and the wind chill factor was rarely above 2/3. Pressure, as recorded in the area, was between 958 and 995 mbs without any significant variation.

Ice chart received from JIC, NOAA, USA on 01 Feb. '90 (Fig.5) indicated a considerable concentration of fast ice around the Filchner Ice Shelf. The trend of ice movement gave clear indication that the outward passage from the area is likely to be completely blocked within 10-12 days. Leader of the expedition and ship's captain were advised accordingly and on 03 Feb '90 the outward journey from the Weddell Sea area was commenced. Ice chart of 15 Feb. '90 subsequently showed a complete blockade of the southern limits of the area.

Formation of Ice Ridges

Formation of ice ridges in the pack ice is very frequent in the area. Pack ice moves fast with ocean currents and favourable wind and two blocks of pack ice merging together to form ice ridges upto 3m thick. Movement of pack ice has to be monitored regularly as formation of ice ridges around the ship may trap the ship in the area for long durations.

Meteorological Observations in the Weddell Sea

- (a) Surface winds are generally ESE'ly to SE'ly with speeds 10-15 Kts. During white-out, winds are generally calm. Winds start shifting to NE'ly-NNE'ly before white-out conditions are set in.
- (b) Snowfall is quite frequent in the area. About 3-4 hours prior to the commencement of snowfall, dark stratus / stratocumulus clouds are seen in NNE-NNW Sector. During snowfall, no significant change in pressure is observed but temperature shows increasing tendency. Dark streaks of clouds trailing down from low clouds, on the horizon, give very good indication of approaching snowfall overhead within 3-4 hours. Weather generally clears within 2-3 hours after the snowfall has ceased. Improvement in weather is indicated by lifting of cloud base in SE'ly direction and beginning of high winds from ESE'ly direction.
- (c) Rapid fall in pressure (10-15 mbs) in 24 hrs does not indicate deterioration of weather. However, rapid increase (8-10 mbs) indicates approach of a warm front of an ETC approaching from the west of the Weddell Sea.
- (d) Very often on clear sunny day, after the snow fall, weather was observed to be packing up again with very low clouds, which would clear up by about 1200 hrs. Observation revealed that these low clouds actually were sea fog which formed in the morning.
- (e) Katabatic winds, under the influence of a low pressure system, move/loosen the pack ice northward and provide safe opening for ship's movement.

Extreme Values of Meteorological Data Recorded during the Stay in Weddell Sea

During the overall stay of the ship within the providence of the Weddell Sea from 27 December '89 to 07 Feb. '90, the following extreme values of meteorological data have been recorded:

a)	Max. Surface Wind	30 Kts on 27 Jan.'90 at 0000Z
b)	Max. Temperature	+ 5.6°C on 12 Jan.'90 at 1200Z
c)	Min. Temperature	- 10°C on 20 Jan.'90 at 2100Z
d)	Min. visibility	50M on 07 Feb. '90 at 0300Z
e)	Max. Atmospheric Pressure	1008.1 mb on 15 Jan.'90 at 1500Z
f)	Min. Atmospheric Pressure	967 mb on 05 Feb.'90 at 600Z

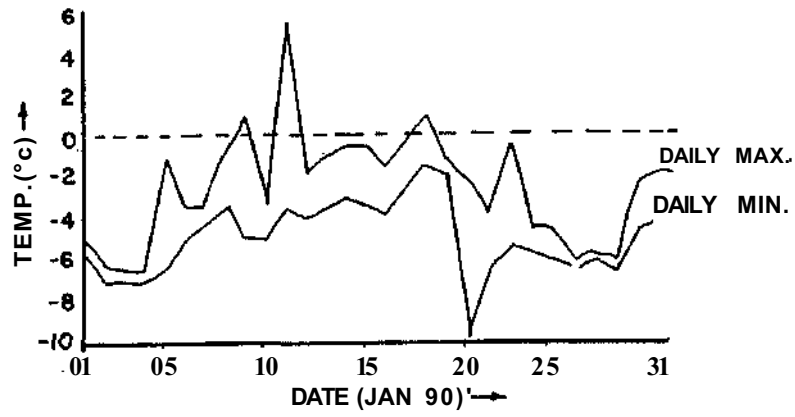


Fig. 6. Max/min temp, in Weddell Sea during Jan '90.

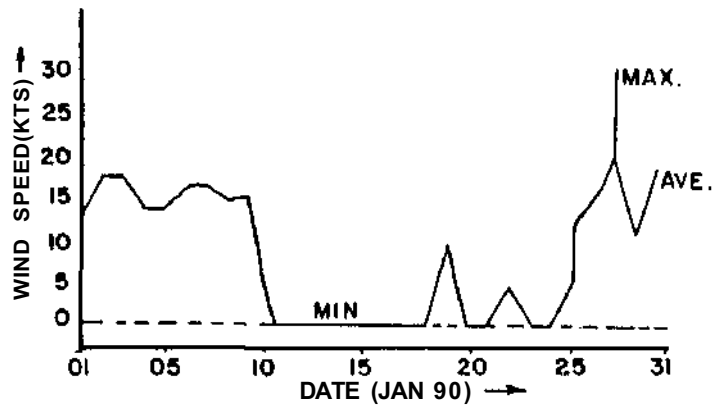


Fig. 7. Wind speed (daily average) during Jan '90.

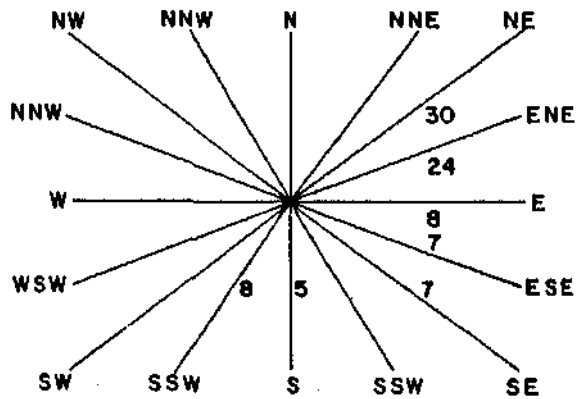


Fig. 8. Wind direction (FREQ) during Jan'90.

Plots of wind speed, wind direction (frequency) and Maximum and Minimum temperatures recorded during Jan.'90 in the Weddell Sea area are shown in Figs 6, 7 and 8 respectively.

Conclusion

It had been estimated that most of the southern part of the Weddell Sea would be covered by sea ice and the ice conditions in the area around the Filchner Ice Shelf and the Berkner Island would be unfavourable and unpredictable. In fact, the coastal Polynya has often been termed as 'mouse trap' by the people who have had to navigate in this area. In such difficult conditions, where the safety of members, helicopters, cargo and ship was of the utmost importance, lot depended upon the meteorological observations and forecasts. Accurate predictions had to be made so that every opportunity of clear weather was availed by the team to meet the objectives of the expedition.

Installation of the APT system on board helped the meteorologist to monitor weather systems and ice conditions and provide an update weather position to the team every three hours. It might be advisable to procure an Automatic Weather station for the future expeditions to' this area to provide more accurate meteorological data for airborne operations.