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Typical Meteorological and Oceanological Situations Encountered during the Fifth Indian Scientific Expedition to Antarctica (1985-86)

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Abstract

During the Fifth Indian Scientific Expedition to Antarctica, round the clock marine meteorological data was collected during the passage of the ship to and fro Antarctica, including the stay in polynya near Dakshin Gangotri. The paper highlights some of the prominent meteorological conditions encountered including the two typical storms on the return journey. Extreme values of meteorological parameters recorded in the polynya are also given in the paper.

Introduction

Fifth Indian Scientific Expedition on board MV Thuleland sailed for Antarctica on 30 Nov. 85 from Marmugoa harbour. During the passage to Antarctica from 30 Nov. to 24 Dec. 85 and return passage from 03 Mar. to 24 Mar. 86, the following typical meteorological and oceanological conditions were experienced:-

I. Intense low pressure area on 15 Dec. 85 in Southern Ocean.
II. Thick pack ice.
III. Thick fog causing reduction in visibility on 07 Mar. and 08 Mar. 86.
IV. Tropical storms 'Horoninia' and 'Irimma'.

The above mentioned meteorological and oceanological situations are discussed in this report.

Intense Low Pressure Area on 15 Dec 85

Most of the vortices in the Southern Ocean develop between 35° and 45°S, in winter and 50° and 55°S, during summer. The axis of most frequent cyclogenesis coincides with the Polar Front. In summer, the highest frequency is along 50°S with a branch from lower latitudes aligned NW-SE across the central and eastern parts of the ocean. Tropical cyclones develop in the zone of 10-20°S and most of them move westward at first and subsequently SW, S and SE in the zone

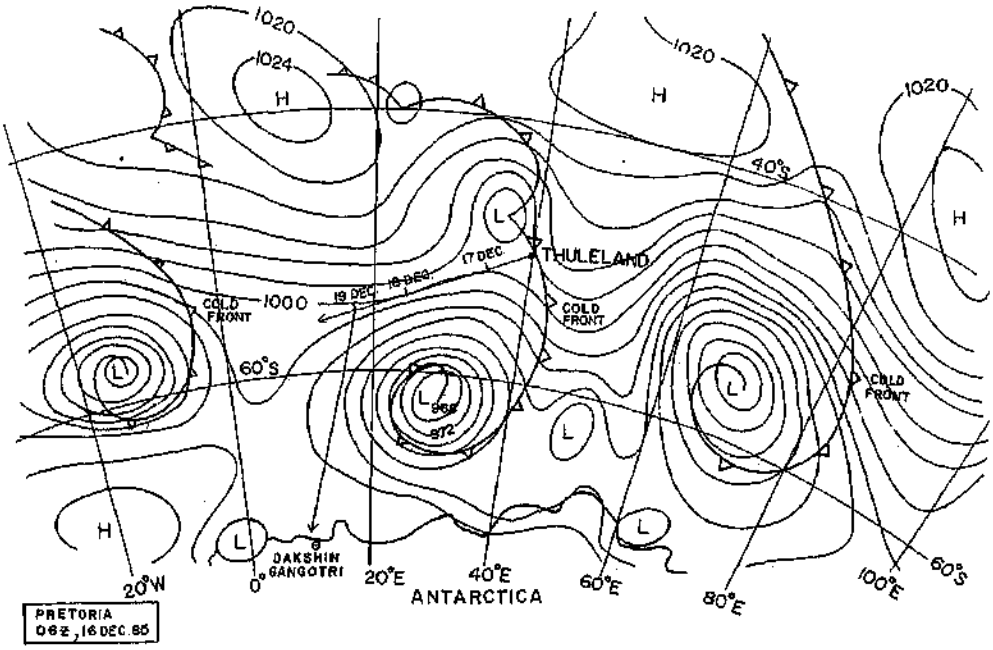
20-35°S. Three centres of maximum cyclone frequency identified in the Antarctic zone are 20-40°E, 60-75°E and 95° to beyond 115°E. The average speed of these cyclones is of the order of 24-29 kt in zone 40-60°S, 30 kt along 45-50°S and 35 kt in the zone 30-40°S.

On 15 Dec 85, a cyclonic storm with central pressure of 968 mb was observed at 60°S-15°E on the facsimile chart received from Pretoria. The system was associated with a cold front extending N-S. The expected movement of the storm was eastward. Ship started experiencing very rough weather with extremely high speed winds of the order of 55 kt with overcast skies and gradual drop in pressure from 1007.5 mb to 989.6 mb in 12 hours. Sea state went upto 9. On 16 Dec 85, the storm had moved to position 62°S-35°E at 06Z. The meteorological situation was appreciated taking into account that maximum winds upto 80 to 100 kt would be experienced if the ship be allowed to pass through the storm. Such high speed winds with high swell and very rough seas could cause considerable damage to the ship's cargo which was of utmost importance for the Expedition. Any damage to helos or cargo could have been detrimental to the objectives of the expedition. Keeping these in view, the ship's Captain and the Expedition Leader were advised to change course of the ship westwards thereby allowing the storm to pass ahead of the ship's earlier intended course. On change to westerly course, the pressure gradually commenced rising after a little drop in the beginning; 1003.0 mb was recorded at 062 on 17 Dec 85. Westerly course was maintained till 19 Dec 85, when the storm passed clear, and the ship's course altered back towards destination thereby saving the cargo and the ship from any damage. Copy of the meteorological chart with ship's position duly, indicated is placed at Fig. 1.

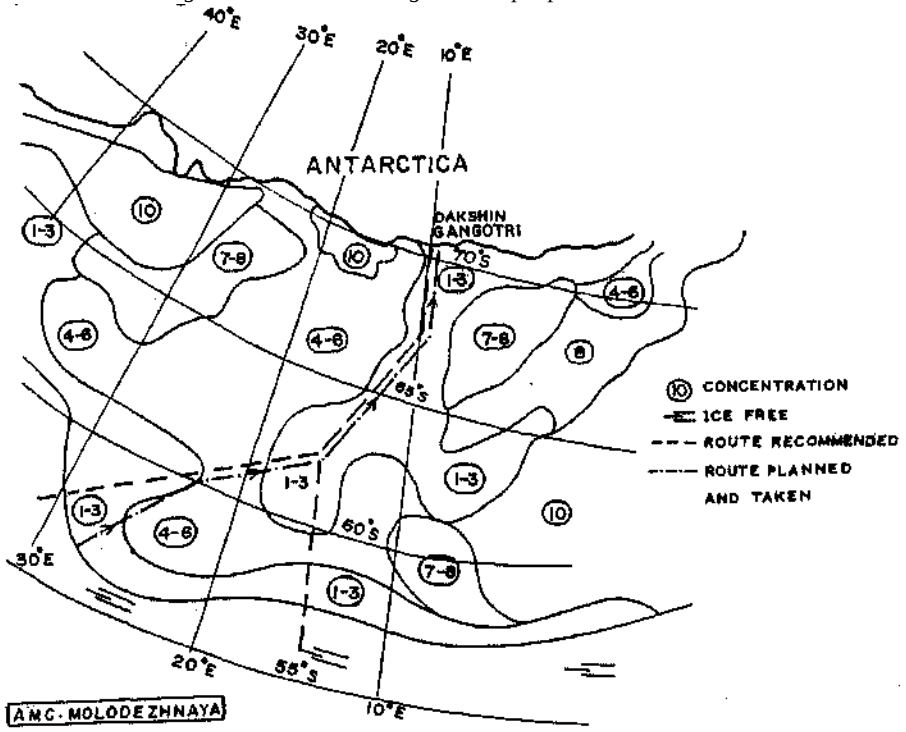
Passage through Thick Pack Ice

The minimum extent of pack ice around Antarctica is observed in March. Freezing of sea commences in the end of March and the area covered by the pack ice increase until maximum in September or October—more than double the area of Antarctica. The width of the ice belt around Antarctica ranges from 600 km to 30,00 km. The ice limits normally coincide with —1.8°C sea isotherm. Melting of ice starts in November. However, rapid melting and retreat occur mainly during December and continue till March. During February and March, large parts of the Antarctic coast are ice free. During this period, the outer limit of pack ice varies from 1 to 4 degrees from the coast. It is during the period November to March each year that ships can attempt to reach the Antarctic coast. The mobility of the pack ice under the influence of ships force, allows ships to penetrate it. Winds and ocean currents causing the pack ice to close sometimes results in trapping and crushing of ships.

MV Thuleland entered the pack ice on 17 Dec 85. On 18 Dec 85 a special request was made to Molodezhnaya station through Dakshin Gangotri for the



Fie. I. Meteorological Chart Showing the ships position and the altered Cruise line



Fig, 2, Satellite chart showing ice concentration on 14.12.85 (Received on 19.12.85)

special facsimile transmission of the latest ice chart. The chart was transmitted by Molodezhnaya on 19 Dec 85 with two route-recommendations marked on it. A copy of this chart is placed at Fig. 2. The ship immediately altered course to converge to the nearest point of the recommended route and was able to reach the polynya without much difficulty.

Generally, in the month of March, whenever the ocean cools and the surface begins to freeze, it takes an oily appearance as frazil ice crystals start to form in the water. These crystals float to surface of the ocean to create grease ice. Further cooling causes pan cake ice to form. Formation of pan cake ice is a good indication for a ship to start preparing to leave Antarctica.

Stoppage of ship on Return Journey in Thick Fog due to Cold Front

Climatology of Fronts

Fronts are equally frequent in summer and winter with the maxima reaching 60 systems per 100 days along 40-45°S. Frequencies along 25°S and along the Antarctic coast are about twice as high in winter as in summer. Generally cold fronts move in NE or ENE direction. These fronts in the Indian Ocean are associated with thick fog conditions.

Stoppage of Ship due to Fog

On 06 Mar 86, a cold front in N-S orientation at 25°E longitude between 50 and 60°S latitudes was observed on 06Z chart. The front was moving eastward. On 07 Mar 86, the ship was affected by the cold front and visibility reduced at night to less than 50 m. It was extremely difficult to detect growlers even with two strong search lights and enhanced night vision binoculars. Search lights are generally used to spot growlers at night, as the growlers cannot be picked up on the radar screen especially when the sea is rough. Search lights become ineffective in extremely poor visibility and hence it was impossible to detect growlers. The advance of the ship had to be arrested from 1938Z on 07 Mar 86 to 0235Z on 08 Mar 86 and from 1306Z on 08 Mar 86 to 0016Z on 09 Mar 86.

Tropical Storm 'Horoninia' and 'Irimma'

A tropical storm named 'Horoninia' was observed on 09 Mar 86 during return passage at position 18°S 75°E. The cyclone was reported to be moving westward. As per the climatology of tracks of cyclones in this area, the cyclone was expected to move upto Madagascar and then take a recurvature. Thus there was a considerable chance of 'Horoninia' crossing the future path of the ship. A close watch on the movement of 'Horoninia' was kept on facsimile charts received twice daily from Pretoria. Special cyclone warning were also received regularly on HF from Pretoria, indicating the exact position, intensity and probable direction and speed of movement of the cyclone. The cyclone moved in W/WSW direction and became stagnant over northern parts of Madagascar.

On 15 Mar 86, it became unimportant for the ship as the future path of the ship was not under its influence. A meteorological chart showing the relative positions of the ship and 'Horoninia' is placed at Fig. 3.

On 15 Mar 86, another tropical depression, this time 'Irimma', was sighted on the facsimile chart. A quick meteorological appreciation was carried out and it was found that even if 'Irimma' takes a worst possible westerly course and moves at maximum speed of 10 kt the ship would be just able to sail clear without coming under the influence of 'Irimma'. However, rough sea was experienced on 17 Mar 86. Meteorological appreciation for 'Irimma' is shown on Fig. 4.

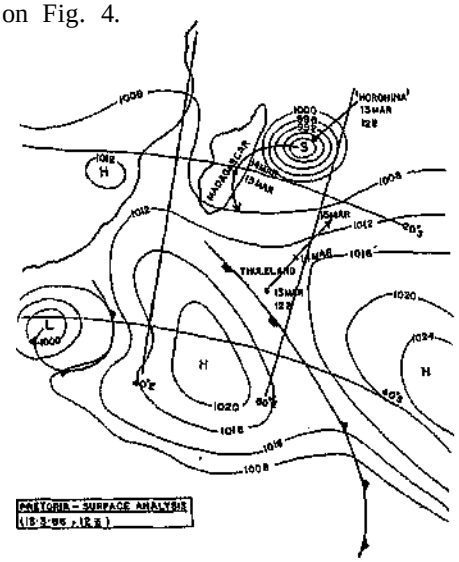


Fig. 3. Meteorological chart showing the relative position of ship and 'Horonina'

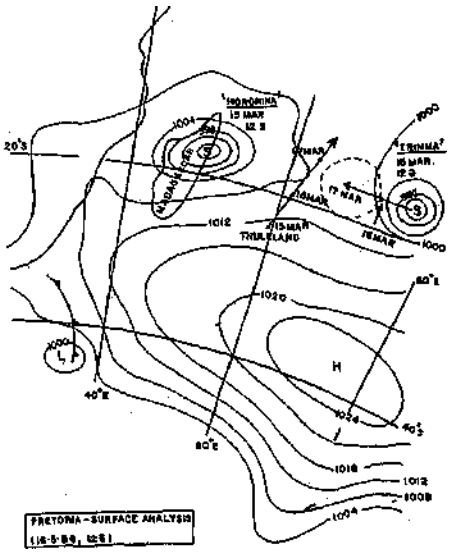


Fig. 4. Meteorological chart showing the relative position of ship and 'Irimma'

As per the facsimile chart received on 16 Mar 86 (06Z), 'Irimma' was observed moving slowly towards SE and hence caused no worry.

Meteorological Data (Extreme Values) Recorded during Ship's Stay in Polynya

During stay of the ship in Polynya near Dakshin Gangotri from 25 Dec 85 to 03 Mar 86, the following extreme values of the meteorological data have been recorded:-

(a) Max. Surface Wind — 70 kt on 26 Feb 86 at 182
(b) Temperature (PB) — Max. + 10.6°C on 21 Jan 86 at 12Z Least-10.0°C on 23, 24 and 25 Feb 86 at 212, 002 and 002 respectively.
(c) Min. Visibility — 50 m on 12 Feb 86 at 092

(d) Min. Atmospheric Pressure — 980.0 mb on 28 Jan and 30 Jan 86 at 09 and 15Z respectively.

(e) Magnetic Storm — 1200Z (07 Feb 86) to 0300Z (09 Feb 86) during which communication failure occurred.

Conclusions

During the passage of MV Thuleland, four typical meteorological situations experienced have been described. These were encountered with a low pressure area, passage through thick pack-ice, extremely poor visibility due to thick fog caused by a cold front and movement of two tropical storms 'Horoninia' and 'Irimma'. These situations were dealt with by the Leader, Captain of the Ship and meteorological staff with total professionalism and aptness. The safety of the ship, cargo and personnel was not compromised at any stage. The avoiding actions taken to handle the emergencies, brought out in this article, should act as guidelines for the future expeditions. Keeping a helicopter on deck prior to entering ice field during onward journey and till ship comes out of ice field during return voyage has been found to be extremely useful for ice recce of the pack-ice for ship routing.,

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