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Meteorological Studies during Summer Part of 13th Indian Antarctic Expedition

G.SUDHAKAR RAO, S.B.GAONKAR, S.VENKATESWARLU and R.P.LAL

India Meteorological Department, New Delhi

Abstract

Meteorological Programme of IMD in Antarctica and its implementation during summer are explained. Based on the observations undertaken during onward voyage of 13th Indian Antarctic Expedition and at Maitri during Jan and Feb'94, latitudinal variation of meteorological parameters; summary of weather at Maitri; comparison of January ozonesonde ascents of Maitri with Syowa ozonesonde ascents and services being provided by IMD for the activities of the Expedition are discussed. Highest maximum air temperatures at Maitri are reaching positive values in January and temperatures falling in February. Occurrence of drifting/blowing snow is not frequent at Maitri during January and February months. Maitri and Syowa ozonesonde ascent values are tallying and comparable.

Introduction

India Meteorological Department is implementing its programmes continuously in all summer and winter components of Indian Antarctic expeditions starting from first expedition. The aim of meteorological programme is to study and understand antarctic weather and climate and their relations to global weather systems with special emphasis on weather systems which influence Indian sub continent like southwest monsoon. India Meteorological Dept is also showing keen interest on the recent thoughts of concern like ozone depletion over Antarctica. In addition to the main programme at Maitri; IMD is also having programme during both outward and return voyages. Three hourly monitoring of weather parameters during voyage not only gives latitudinal variation of meteorological parameters, but also it is an invaluable tool for weather forecasting all over the world on sea where the observational network is very poor. During this expedition IMD introduced ozonesonde programmes also during voyage for study of vertical profile of atmospheric ozone in the sub tropical zone, latitudinal variation and mixing of ozone between low and high latitudes. But due to practical problems like no balloon launching facility and

insufficient space in the laboratory container onboard the ship, ascents could not be taken during voyage enroute to Antarctica.

Meteorological Programme

Scientific objectives for meteorological programme during 13th expeditions are the study of Antarctica meteorology in general and the following in particular:

a. The daily, seasonal and annual variations of atmospheric pressure, surface wind, surface air temperature and cloud cover.

b. Pilot balloon observations for upper-air data of Antarctica atmosphere.

c. Slow rising low level radiosonde ascents for study of boundary layer conditions over Antarctica.

d. The Radiation Budget Studies, Diffuse radiation observations in addition to direct radiation observations as well as radiometersonde ascents.

e. Balloon borne measurements of ozone for its vertical profile over Maitri,Antarctica for the study of the occurrence of ozone-hole over Antarctica during spring months. In addition ozonesonde ascents on board the ship during onward and return voyages of Expedition for study of vertical profile of atmospheric ozone in th sub- tropical zone.

f. Monitoring and archival of information through weather satellites and HF radio sets regarding weather systems affecting the antarctic continent.

g. Atmospheric turbidity in Antarctica.

h. Monitoring of hourly surface meteorological parameters on real time basis through INSAT by DCP system.

Implementation of Programmes during Summer Part of the Expedition

(i) While on cruise (onward voyage)

Surface observations: Three hourly surface observations of following parameters were taken starting from 1200 hrs UTC of 9th DEC 1993, to the day when ship reached India Bay in Antarctica :-

Wind speed and direction

Visibility

Surface pressure

Air temperature

Humidity

Clouds

Sea surface temperature and weather

The observations were entered in log book and every six hourly observations were passed to IMD Head Quarter on HF link. In the beginning ship's telex machine had problem to be in touch with India hence observations could not be passed in real time on telex.

Ozonesonde ascents: Efforts were made to release the balloons but could not succeed because of insufficient space in laboratory for working, no balloon launching facility on the ship and non- stop movement of the ship. Also, the laboratory was filled with chemicals and batteries of other organisations which was unsuitable for delicate experiment like ozonesonde.

Above programmes were continued during return voyage also by the returning team.

(ii) In Antarctica at Maitri

(a) Surface observations: Continuous recording of windspeed, wind direction,pressure,temperature,total solar radiation(Direct and Diffuse) on self recording instruments. Three hourly synoptic observations were recorded and six hourly observations at main synoptic hours were transmitted to the IMD Delhi on real time.

(b) Atmospheric turbidity observations: Turbidity observations were taken on clear sunny days.

(c) Data collection platform: Transmission of hourly surface met- parameters(pressure,air temperature,wind speed and direction) on real time basis through INSAT was continued.

(d) Fax reception: Analysed charts of surface weather were received from Pretoria(South Africa) on H/F.

(e) APT pictures:CIoud pictures through NOAA Satellites were received daily.

(f) Slow rising low level radiosonde ascents: During the period under consideration three ascents were taken.

(g) Pilot balloon ascents: one ascent was taken in the month of January.

(h) Ozone observations: Surface ozone was being recorded continuously. Ozone sonde ascents were taken at the rate of about once in a week.

Results and Discussion

(i) Latitudinal variation of meteorological parameters from Arabian sea off Goa to Indian Bay in Antarctica during Dec'93:

Following table gives the meteorological observations undertaken during onward voyages of the expedition at 0000 and 1200 UTC observations.

Table

Date	Time UTC	Lat. N/S	Long. E	Cloud Octa	Wind DIR/SPD	Air T Deg.C	Pres. HPA	SST Deg.C
09	12	10.3	71.1	1	050/09	28.6	0992.6	29.0
10	00	07.5	69.4	4	010/09	27.0	0983.5	28.6
	12	05.1	68.0	3	310/05	28.8	0990.9	28.6
11	00	02.3	66.3	4	330/07	27.4	0993.9	29.0
	12	00.1	65.0	3	320/09	28.4	1006.6	28.6
12	00	02.8	63.4	1	300/05	26.8	1009.0	28.0
	12	04.8	62.1	7	270/14	26.0	1007.4	28.0
13	00	07.0	60.8	2	250/05	27.9	1009.0	28.0
	12	10.4	59.3	5	140/07	27.8	1008.1	28.0
14	00	12.9	58.9	6	140/10	27.4	1011.5	28.0
	12	16.0	58.2	4	120/25	28.4	1011.5	26.0
15	00	18.1	57.7	5	120/08	25.2	1015.9	26.0
	12	20.1	57.4	3	140/12	26.8	1015.0	26.0
16	00	20.1	57.4	2	140/08	24.6	1014.6	25.0
	12	20.1	57.4	4	140/08	25.6	1012.5	25.0
17	00	20.6	57.0	5	140/08	25.2	1013.9	25.6
	12	22.5	55.1	4	140/15	26.0	1012.9	26.0
18	00	24.0	53.2	6	090/08	25.2	1014.0	25.0
	12	26.1	50.9	5	070/11	27.2	1012.2	25.2
19	00	27.9	48.6	6	050/12	24.6	1010.2	24.6
	12	29.8	46.6	7	340/16	25.6	1005.6	23.2
20	00	31.2	44.8	5	250/15	25.0	1007.8	23.0
	12	33.1	43.1	1	230/15	20.0	1011.6	20.0
21	00	34.8	41.0	3	230/25	18.0	1015.5	19.0
	12	36.6	40.6	3	270/11	20.2	1016.1	19.0

Contd....

Table: Contd.

Date	Time UTC	Lat. N/S	Long. E	Cloud Octa	Wind DIR/SPD	Air T Deg.C	Pres. HPA	SST Deg.C
22	00	38.2	39.1	8	290/10	19.0	1009.4	19.0
	12	40.1	38.0	7	239/30	17.0	1013.0	16.0
23	00	41.1	37.1	5	210/15	14.0	1018.7	16.0
	12	42.5	35.6	4	230/12	15.0	1018.1	19.0
24	00	43.1	35.5	3	270/10	15.0	1015.6	16.0
	12	44.9	31.5	7	290/08	15.8	1006.8	16.0
25	00	46.5	30.5	1	290/08	13.0	1001.9	14.0
	12	49.1	28.9	3	270/14	08.0	0998.0	14.0
26	00	50.5	27.1	3	290/12	06.8	0996.1	11.0
	12	52.2	25.3	8	320/12	06.0	0991.5	10.0
27	00	54.2	24.0	4	360/10	03.8	0985.6	09.0
	12	57.0	22.5	6	270/06	04.0	0984.4	03.0
28	00	58.4	18.9	7	320/09	03.0	0980.3	03.0
	12	60.7	16.5	7	090/06	04.0	0976.3	02.0
29	00	63.1	15.9	7	090/06	03.0	0982.7	02.0
	12	66.0	15.1	7	270/06	05.2	0987.4	01.0
30	00	68.1	14.5	7	000/00	03.6	0990.2	01.0
	12	69.7	13.2	3	020/02	03.2	0992.1	01.0
31	00	69.9	12.0	3	090/02	01.8	0984.3	01.0
	12	69.9	11.9	3	230/10	02.0	0976.2	00.0

The month of December during which the onward voyage was undertaken is Winter in Northern Hemisphere and Summer in Southern Hemisphere. It is clear from the table that in December the tropical airmass is cooler than during March and Polar airmass beyond about 57 Deg South latitude is reverse. There is little variation in the air temperatures in-between. However the cyclonic storms traveling around Antarctica influence very much the day to day temperatures on the periphery of Antarctic continent. It is clear that the temperatures gradually fall beyond 25 Deg S latitude and reach near zero and sub-zero values over oceans after crossing Antarctic circle.

In the tropics pressures were higher during onward voyage, may be because of the Northern winter. As expected the pressures during both voyages are higher around 30 Deg S latitude, the Sub-tropical High region. Beyond the Sub-tropical High belt upto the periphery of Antarctica, the day to day variation

of pressures are highly variable depending on the presence of the pressure systems and fronts.

Wind was stronger during return voyage from Antarctica till about 20 Deg S latitude. In these latitudes, wind is generally stronger and highly variable from day to day depending on the position of the passing weather systems. Within the tropics, wind was almost same with little fluctuations during both voyages.

It is highly variable from day during both voyages but during return voyage it persistently higher from Antarctica till about 20 Deg S latitude because of the encounter with pressure systems. This is nicely matching with the wind speed which is discussed above. Near Sub-tropical High region, the cloud amount is lowest. As expected near equator around the equatorial trough region the cloud amount is high during both voyages due to the convective clouds.

(ii) Weather Summary at Maitri during Jan'94 and Feb'94

Meteorological Parameter		January 94	February 94
1	PRESSURE (hPa)		
	Average	987.7	985.0
	highest/date	995.6/ 14th	995.9/11th
	lowest/date	979.0/28th	973.1/20th
2	TEMPER ATURE(Deg.C)		
	Average	-00.1	-03.9
	highest/date	+06.6/25th	+04.8/05th
	lowest/date	-06.2/31st	-09.7/16th
3	WIND SPEED (Knots)		
	Average	13.5	14.3
	highest/date	30/18th	35/26&27th
4	BLIZZARD		
	No of days with drifting/ blowing snow	00	00
5	SKY CONDITION		
	No of days with		
	- clear sky	08	06
	- partly cloudy sky	05	02
	- mainly cloudy sky	13	17
	- overcast sky	05	03
	MEAN	4.4	4.5
6	WEATHER		
	No of days with snow	7	1
	fog	0	0

(iii) Information about ozone sonde ascents taken at Maitri during January, 1995 and comparison with the ozone data received from Syowa station

Date	Time (UTC) (hPa)	Terminate Pressure (hPa)	Ozone Max Level (nb)
(a) Maitri			
Jan 08	2225	05	48.5
11	1734	05	33.0
21	1543	05	48.5
27	1940	05	50.0
31	1837	05	69.0
(b) Syowa:			
Jan 05	1427	06	42.5
12	1439	05	40.5
21	1414	05	40.9
26	1427	04	44.9

The above ozone data indicate that Maitri and Syowa recordings are tallying and comparable.

Weather Service

Weather service in the form of present condition of weather and likely variations of weather in a day or two is being provided for planning and execution of flying operations,Convoy movements, station maintenance, scientific and other logistic activities. Some of the data collected by IMD scientists was being utilized by many organisations who were part of the expedition like NEERI, AIMS, NPL, Indian Navy etc.

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