

Meteorological Report of 30th Indian Scientific Expedition to Antarctica

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Abstract

India Meteorological Department (IMD) has been participating in all the Indian Scientific Expeditions to the Antarctic since the first expedition in 1981. During the period 2010-2011, the meteorological weather parameters were analyzed and the results are presented in this paper. The average minimum temperature was recorded as -16.8°C . The highest Maximum & Lowest Minimum temperatures of the expedition were recorded as 7.0°C and -32.5°C respectively. The highest Maximum average temperatures and lowest minimum average temperatures were recorded as 4.2°C and -20.1°C respectively. The average Mean Sea Level Pressure (MSLP) fluctuated at its peak of 991.6 and low of 984.2 hPa. The highest Maximum MSLP of 1027.1 hPa was recorded during the month of July 2011 and the Lowest Minimum MSLP of 952.8 hPa was recorded during the month of May 2011. The month of July was the windiest month of the expedition recording Max average wind of 57 knots with Max Gust of 96 knots. However, the monthly average maximum wind was 24 knots and the lowest minimum average wind was recorded 13 knots. Out of 365 days of the year 176 days recorded wind more than or equal 23 knots.

1. Introduction

The meteorological observatory at Maitri is equipped with various weather sensors to monitor the weather parameters continuously. The data is communicated to HQ in New Delhi on daily basis. The Surface Ozone data logger was unserviceable from 23 Jan 2011 the same was repaired and made functional from 01 Feb 2011. The KI solution of the sensor was changed and routine cleaning of the pump and motor was also done.

2. Results

2.1 Temperature

The observation of the Surface Air Temperature (SAT) is analysed. Fig. 1 shows the monthly average maximum and minimum temperature recorded at Maitri during Dec 2010 to Nov 2011. The average minimum temperature was recorded as -16.8°C . The highest Maximum & Lowest Minimum temperatures of the expedition were recorded as 7.0°C and -32.5°C respectively. The highest

Maximum average temperatures and lowest minimum average temperatures were recorded as 4.2°C and -20.1°C respectively.

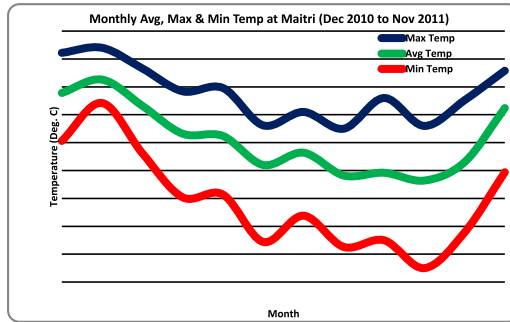


Fig. 1 The monthly average maximum and minimum temperature recorded at Maitri during Dec 2010 to Nov 2011.

2.2 Pressure

Monitoring the Mean Sea Level Pressure is one of the important meteorological parameters that give indications of the large-scale motion of the air circulation pattern. Fig. 2 shows the daily mean pressure level in three different categories. The first one is the average mean sea level pressure and the second one is the highest mean sea level pressure and the third one shows the lowest mean sea level pressure. Of these three parameters, the average mean sea level pressure shows two prominent peaks one in March and the other in July. This is observed in the average mean sea level pressure also, but they are not significant. The same is observed in the lowest mean pressure level. The average Mean Sea Level Pressure (MSLP) fluctuated at its peak of 991.6 and low of 984.2 hPa. The highest Maximum MSLP of 1027.1 hPa was recorded during July 2011 and the Lowest Minimum MSLP of 952.8 hPa was recorded during May 2011.

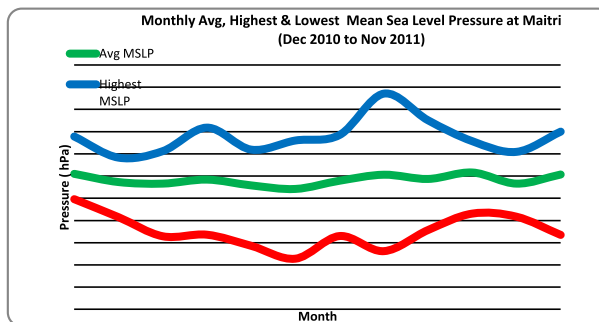


Fig 2 Mean Sea Level Pressure (MSLP) observed at Maitri. The three traces are 1) Average Mean Sea Level Pressure (green), Highest MSLP (blue) and lowest MSLP (red)

2.3 Wind

The month of July was the windiest month of the expedition recorded Max average wind of 57 knots with Max Gust of 96 knots. However, the monthly

average maximum wind was 24 knots and lowest minimum average wind was recorded 13 knots. Out of 365 days of the year 176 days recorded wind more than or equal 23 knots.

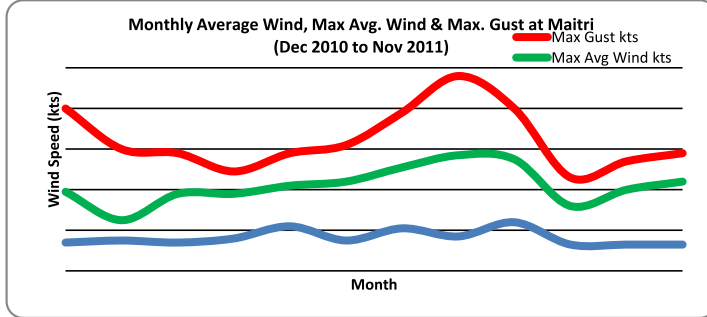


Fig 3. Monthly mean wind speed variation for three different parameters 1] Maximum gust (red) 2] Maximum average wind speed (green) and 3] Average wind speed (blue)

2.4 Blizzards

In comparison with the last expedition of 10 Blizzards, the present 30th ISEA experienced 22 Blizzards throughout the year with Maximum of 4 each in June & August, 3 in July; 2 each in February, March, April, May & October, and 1 in September 2011. There were no Blizzards during Dec'10, Jan'11, and Nov'11.

In association with the above-mentioned Blizzards, the total snowfall precipitation throughout the expedition was recorded as 399.1 mm. The heaviest snowfall precipitation occurred during June, July, and August with Maximum snowfall precipitation of 108.0 mm during July 2011. Subsequently, June & August recorded snowfall precipitation of 88.0 mm and 103.7 mm respectively. The month of December 2010 and January 2011 of the expedition recorded the least snowfall precipitation of amount Trace. As such throughout the entire expedition, 107 days were precipitation days.

2.5. History of blizzards

S. No	Date/Time		Extreme Values (with Date/Time)				
			MSL Pressure (hPa)		Temperature °C		Wind (Knots)
	Commencement	Cessation	Max.	Min.	Max.	Min.	Max.
December 2010							
-	-	-	-	-	-	-	-
January 2011							
-	-	-	-	-	-	-	-
February 2011							
1	13/0200z	13/1315z	990.2 13/2100z	981.3 13/0600z	-01.4 13/0800z	-04.7 13/0300z	36/0300z G52/0300z
2	15/0808z	15/1900z	980.2 15/0900z	977.4 15/1200z	-2.5 15/1200z	-3.0 15/1500z	36/1200z G58/0900z
March – 2011							
3	05/1110z	05/2100z	981.8 05/1100z	979.2 05/1800z	-07.4 05/1200z	-07.9 05/2100z	38 05/1100z G46 05/1200z

S. No	Date/Time		Extreme Values (with Date/Time)				
			MSL Pressure (hPa)		Temperature °C		Wind (Knots)
	Commencement	Cessation	Max.	Min.	Max.	Min.	Max.
4	27/1445z	28/2130z	995.8 28/2100z	990.1 28/0400z	-3.5 28/1500z	-6.1 27/1500z	32 27/2300z, 28/1700z G49 28/0600z
April – 2011							
5	13/1500z	13/1950z	972.4 13/1800z	966.9 13/1500z	-02.1 13/1900z	-04.8 13/1500z	28 13/1600z G52 13/1800z
6	28/0800z	30/1445z	990.2 28/0800z	978.1 30/1400z	-6.9 30/0900z	-9.2 28/0800z	38 28/2300z, 29/0000z G58 28/2100z
May – 2011							
7	21/0700z	21/1915z	990.0 21/0700z	983.3 21/1900z	-12.7 21/1900z	-13.7 21/1100z	28 21/0900z G39 21/0800z
8	23/1100z	24/2030z	979.0 23/1200z	973.0 24/2000z	-12.1 24/2000z	-16.6 23/1200z	44 24/0400z, G62 24/0700z
June – 2011							
9	19/1710z	20/2130z	991.0 19/2100z 19/2200z	963.0 20/1700z	-7.2 20/1000z	-11.1 20/2100z	51 20/1300z G76 19/2100z
10	23/1900z	24/1710z	993.0 23/2100z	967.6 24/1200z	-8.4 24/0100z	-11.3 23/2000z	49 24/07,11, 13z, G78 24/0900z
11	25/0656z	25/2114z	996.8 25/0700z	974.2 25/2100	-5.4 25/1700	-8.6 25/07z,08z	35 25/15Z, 16z G48 25/1700z
12	26/2235z	27/0530z	980.6 26/2300z	979.2 27/0500z	-10.5 27/0500z	-11.0 26/23z, 24z	37 27/01z, 02z G50 27/0200z
July – 2011							
13	02/2117z	03/1214z	980.0 02/2200z	970.0 03/1200z	-18.8 03/1200z	-19.7 03/00, 02 & 03z	36 03/0700z G48 03/06 & 07z
14	11/0810z	13/1640z	987.5 12/01 & 02z	966.4 11/1600z	-8.4 12/1700z 13/0900z	-15.2 11/19, 20 & 21z	57 11/1400z, G96 11/1500z
15	30/0500z	31/0345z	1004.3 31/0300z	996.6 30/0600	-9.2 31/0300	-14.6 30/0500z	47 30/1200z G64 30/06, 08 & 09z
August – 2011							
16	06/1240z	07/0815z	982.2 06/1300z	977.9 06/1500z	-14.1 07/0800z	-20.3 06/1300z	50 06/1600z G70 06/1500z

S. No	Date/Time		Extreme Values (with Date/Time)				
			MSL Pressure (hPa)		Temperature °C		Wind (Knots)
	Commencement	Cessation	Max.	Min.	Max.	Min.	Max.
17	07/2130z	08/1730z	992.6 08/1700z	970.6 07/2200z	-11.5 07/2300z	-12.2 08/0100z	48 08/03 & 04z, G80 08/0600z
18	17/0845z	17/1830z	977.8 17/1800z	972.3 17/0900	-11.6 17/1800	-12.6 17/1300z	48 17/1400z G61 17/1200z
19	24/0245z	25/1645z	985.7 24/1800z	970.6 25/1600z	-8.9 25/1600z	-19.8 24/0300z	45 25/1600z' G62 25/02 & 06z
September – 2011							
20	20/2145z	21/0110z	980.5 20/2200z	978.8 21/0100z	-14.3 21/0100z	-15.4 20/2200z	29 21/0100z G46 21/0100z
October – 2011							
21	03/0045z	04/0245z	996.9 03/0100z	992.4 03/1100z 03/1300z	-9.7 03/0200z 03/0400z	-11.7 03/2300z	37 03/12z & 14z G45 03/11z & 15z 04/0100z
22	26/1030z	27/0230z	987.9 27/0200z	984.3 26/1800z, 26/1900z	-8.0 26/1400z, 26/1500z	-9.5 27/0200z	40 26/1600z G54 26/17z & 18z
November – 2011							
-	-	-	-	-	-	-	-

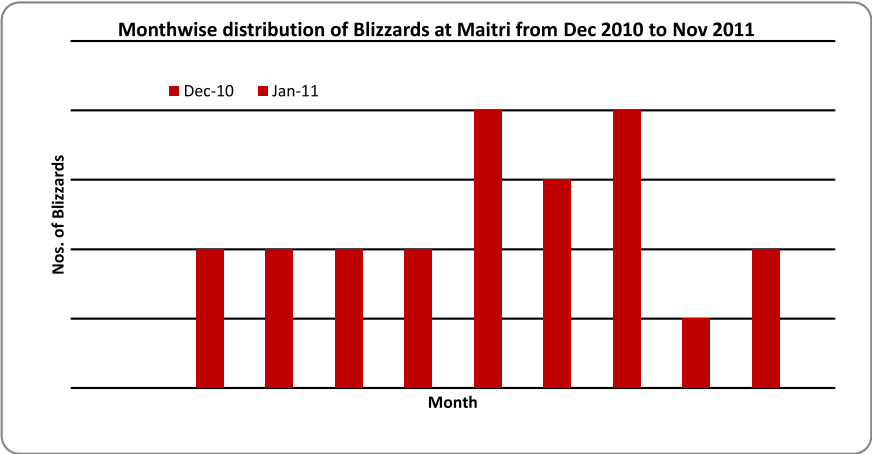


Fig 4 Distribution of the days of blizzards over the year

2.6. Snowfall

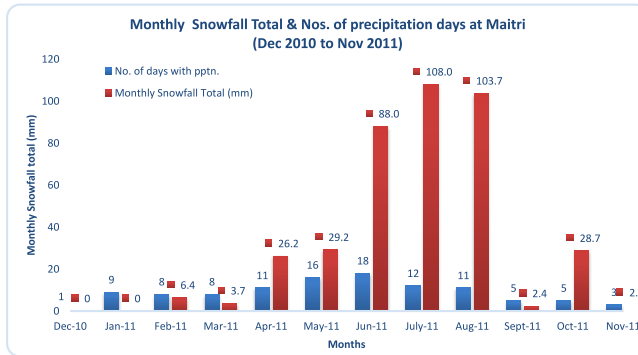


Fig 5 Monthly snowfall details. 1) The blue bar shows the number of days with precipitation and the red line shows the quantity of the precipitation in mm.

2.7 Ozone

Since Brewer Photo Spectrophotometer was backloaded for servicing, efforts were made to obtain the total column ozone data from NASA- TOMS website and total ozone data exchanged with Russian station Novolazrevskaya for the whole year. These two values, one measured from ground-based equipment at Novolazrevskaya station and another over Maitri station from TOMS (Total Ozone Mapping System) from the satellite are very much matching, and the variations in the total ozone concentration are very well matching. It is observed that during January 2010, the Total Ozone values recorded at Novolazrevskaya was at higher than the rest of the data. It is also observed that the maximum depletion of ozone was observed on 22nd September 2011 when the total ozone values were lowest. Similarly, during the last expedition, the maximum depletion occurred on the 1st of October 2010.

In all total 46 Balloon, borne accents (30 Ozone Sonde and 16 Radio Meter Sonde) were taken for the study of the vertical distribution of Ozone & Terrestrial Radiation respectively. The intense Ozone Sonde observations during the Depletion period also indicate the thinning of Ozone at the Stratosphere. (Fig. 6)

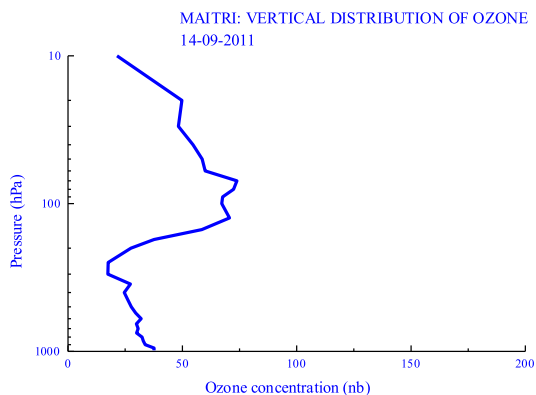


Fig 6 Profile of ozone concentration obtained from 30 ozone ascents

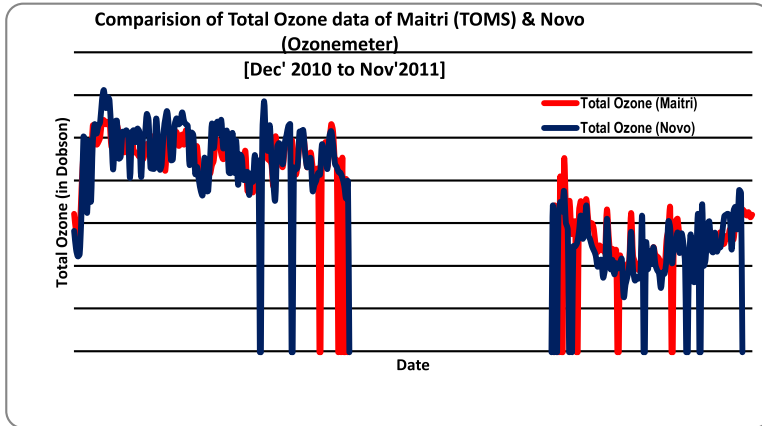


Fig 7. Comparison of total ozone data Maitri (TOMS) and Novo (ozonometer) during the period Dec 2010 to Nov 2011.

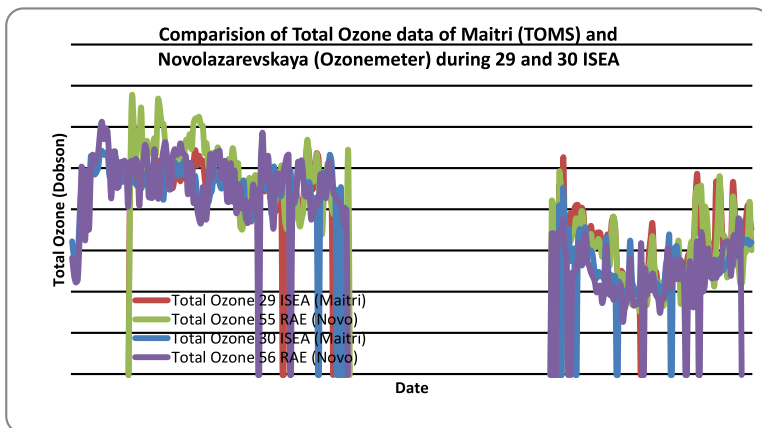


Fig 8. Comparison of Total ozone data for two consecutive years i.e. 2010 and 2011. At Maitri ozone data is obtained from TOMS and at Novolazarevskaya the same is obtained from the ozonometer

3. Discussions

Synoptic data is collected every three hours including visibility, sky condition, wind speed and direction, pressure, temperature, weather conditions, and snowfall if any. Aerosol optical thickness observations are also regularly taken. Radiation parameters viz. global radiation and diffuse radiation were continuously recorded. Synoptic charts and satellite pictures were also collected regularly which are essential for the outlook for the next few days. Forecast provided for the station and outdoor logistics/ scientific activity.

Apart from the above routine scientific observations, the High Wind Speed Recording System (HWSR) was installed and commissioned on 10th Dec 2010.

It has the capacity to measure very high wind speed (>100 Knots) along with wind direction. In addition to this, it also measures the ambient temperature, Relative Humidity, and station level pressure. It facilitates with real-time display of the above meteorological parameters in the graphical form for each minute interval and the data acquisition system also.

The Surface Ozone data logger was lying defective since long back, and same was serviced, and the restoration of Surface Ozone recording system was done by installing new data logger, Ozone sensor, Pump and motor etc. The system was restored and commissioned on 18th Dec 2010.

Month	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11
Pressure												
Avg. MSLP	991.0	987.3	986.6	988.4	985.8	984.2	987.9	990.6	988.7	991.6	986.6	990.7
Highest MSLP	1007.8	998.3	1001.2	1011.8	1001.9	1006.0	1008.5	1027.1	1015.1	1005.7	1000.9	1010.0
Lowest MSLP	979.6	971.5	962.9	963.6	958.6	952.8	963.0	956.2	965.7	973.1	971.7	963.5
Temperature												
Avg. Temp	-1.1	1.3	-3.4	-8.4	-8.8	-14.0	-11.8	-15.9	-15.4	-16.8	-13.5	-3.8
Max Temp	6.1	7.0	3.3	-0.8	-0.2	-6.9	-4.5	-7.5	-2.0	-7.0	-2.4	2.9
Min Temp	-9.7	-2.9	-11.9	-19.8	-19.3	-27.8	-23.1	-28.7	-27.5	-32.5	-26.1	-15.3
Avg. Max	2.0	4.2	-0.5	-5.6	-6.9	-11.9	-9.2	-13.4	-11.9	-13.3	-9.9	-1.1
Avg. Min	-3.5	-0.6	-6.1	-11.1	-11.5	-17.8	-14.7	-19.2	-17.7	-20.1	-17.4	-7.2
Wind												
Avg. kts	14	15	14	16	22	15	21	17	24	13	13	13
Max Avg. kts	39	25	38	38	42	44	51	57	55	32	40	44
Max Gust	80	60	58	49	58	62	78	96	80	46	54	58
No of >23 kts	6	3	3	19	22	12	22	20	26	14	10	19
Blizzards												
No. of Blizzards	0	0	2	2	2	2	4	3	4	1	2	0
No. of Days with pptn	1	9	8	8	11	16	18	12	11	5	5	3
Snowfall	Trace	Trace	6.4	3.7	26.2	29.2	88.0	108.0	103.7	2.4	28.7	2.8

4. Conclusions

The monitoring of the meteorological weather parameters is carried out throughout the year successfully.

Acknowledgements

We are thankful to the Secretary, MoES; the Director-NCPOR (erstwhile NCAOR); Programme Director- Science, Programme Director Logistics, and Director General of Meteorology for providing all the necessary support to make the Meteorological studies success during the 30 Indian Scientific Expedition.

We are thankful to Shri K. Jeeva, Leader of the expedition and Station commander of Maitri for providing all the support in the field to accomplish the tasks successfully. Our sincere thanks to all the expedition members who cordially supported the balloon launching missions and helped as and when required.

