Fifteenth Indian Expedition to Antarctica, Scientific Report, 1999
Department of Ocean Development, Technical Publication No. 13, pp 39-62

METEOROLOGICAL STUDIES CARRIED OUT DURING THE 15th INDIAN SCIENTIFIC EXPEDITION TO ANTARCTICA, 1996

A.S. Rasal and D.R. Mahor

India Meteorological Department

Abstract

Antarctica, the World's largest, coldest and driest continent ringed by ocean with unpredictable extreme weather conditions makes this region a challenging area of meteorologists to study and predict the weather of this region. With this aim the meteorological programme of the 15th Antarctic expedition was planned and carried out by the I.M.D.-team. Meteorological data of different meteorological parameters such as temperature, pressure, wind speed and direction, total global solar radiation and surface ozone was continuously recorded throughout the year with the help of autographic recorders. Three hourly synoptic observations were recorded and real-time transmission of main synoptic messages were made on GTS (4 times a day) for use of the forecasters all over the world. Data collected during 1996 of different meteorological parameters gives these extreme values : lowest minimum temperature -30.1 °C (in May), highest maximum temperature 12.2°C (in January), highest pressure 1014.0 hpa, lowest pressure 951.5 hpa, wind speed 68 kts, gasting to 112 kts, no. of blizzards 45. In addition to synoptic observations, 51 ozonesonde ascents were taken during the year to study the vertical distribution of atmospheric ozone and depletion of stratospheric ozone during winter period. Large scale depletion in the stratospheric ozone amount during September and October have been noticed. For earth radiation budget study, direct radiation observations were recorded, which were supplemented by 17 Radiometer sonde ascents, indicating December as the month of intense radiation than other summer months. Turbidity observations were taken during Sunshine period for aerosol study. Daily reception of cloud imageries was done through polar orbiting satellite and weather charts from Pretoria (South Africa) were received through Radio-Facsimile which were utilised for giving daily weather forecasts for the station. Aurora activity was prominent during the month of March. Work of balloon filling shed was nearly completed during this expedition period.

Introduction

Antarctica, the "Frozen Continent", has 98% of its total area covered **with** ice. The ice sheet contains about 90% of the world's ice and 68% of world's fresh water. The average thickness of the ice is 2.45 km and the maximum thickness is approximately 4.8 km at some places. Apart from these, it is world's windiest and extremely cold continent and is also known as "Home of Blizzards". The continent and surrounding seas provide vast natural laboratories with pollution free atmosphere for observing and measuring various natural weather phenomena. Considering these aspects, as well as its special physical characteristics and geographical position, this region is uniquely placed for a wide range of scientific research. It is one of the most important climate-regimes with a potential to influence long term global climatic patterns.

Meteorological Programme

With a view to study the effects of Antarctic climate especially over the Indian monsoon, India Meteorological Department is continuously participating in the Indian scientific expeditions to Antarctica. Daily synoptic observations recorded at Indian Antarctic Station, Maitri, enter into the global data network which contributes to the international effects for weather forecasting. Time series analysis of multi-year weather records from Antarctic stations gives us valuable clues for long range forecasts of monsoon. But to arrive at a general conclusion at least 10 years' data of the region is essential and to get a deeper knowledge of the climate pattern of the area at least 30 years' data of the region is needed. So a substantial database is required to arrive at definite conclusion. Antarctica's land surface characteristics.and insulation features critically influence the energy budget of the globe which in turn controls the climate. This fact necessitated radiation observations, both at the surface and in the upper atmosphere, to be included regularly in meteorological programme. These observations will form the basic inputs for the studies related to interaction of solar radiation with clouds, snow and ice surfaces. Stratospheric ozone measurements have been included since 1986 in IMD's programme to provide up to date information on "ozone-hole phenomena". Measurement of vertical ozone distribution by IMD has confirmed that the ozone-hole at south pole has been intensifying in time and space since 1987. The ozone density between 100 hpa to 30 hpa has shown pronounced decrease with ozone values between 80 to 50 hpa becoming nearly zero. This is the region of highest ozone concentration except during ozone-hole period. These findings are in conformity with observations of other countries. Considering these meteorological aspects of Antarctic region, the objectives for meteorological programme of 15th IAE were planned as follows:

A. To continue the following ongoing programme for preparing climatology of the area and providing weather services for the expedition—

(i) Continuous recording of various surface meteorological parameters including 3 hourly synoptic observations and real-time transmission of main synoptic messages (4 times a day) over GTS for use by the weather forecasters all over the world.

(ii) Recording of surface ozone and measurement of vertical distribution of ozone in the atmosphere through weekly ozonesonde ascents at Maitri.

(iii) Radiation Budget Studies : Total and diffused radiation observations supplemented by taking radiometer sonde ascents.

(iv) Turbidity measurements for aerosol study.

(v) Daily reception of satellite cloud imageries from polar orbiting satellite and weather broadcast over radio-facsimile as part of logistic support to the expedition.

(vi) Special hourly observations during blizzards.

B.(i) Recording of surface observations during onward and return cruise of the expedition and transmission of main hour's synoptic data over GTS.

(ii) Ozonesonde ascents during onward and return voyages of the expedition and at Maitri to study the vertical profile of atmospheric ozone in the subtropical zone and over Antarctica.

Behaviour of Main Meteorological Parameters

The meteorological programmes of 15th Indian Scientific Expedition to Antarctica were carried out successfully and some salient results based on 3 hourly synoptic observations are discussed below :

(i)Temperature (Table : 1-A, Fig. 1-B, Fig. 2-B)

It is known that the elevated central plateau is a cold desert with annual mean temperature between -50°C to -60°C. The lower altitude coastal regions are much warmer with annual mean of -10°C to -20°C. During 1996 the annual mean temperature at Indian Station, Maitri was -8.4°C. The lowest temperature recorded was -30.1°C on 24th August and the highest was +12.2°C on 3rd February. The mean maximum and mean minimum temperatures of the year were -5.4°C and -11.8°C respectively. May was the coldest month of the year with a monthly mean of -16.6°C and January was the hottest month with a mean value of +0.20°C

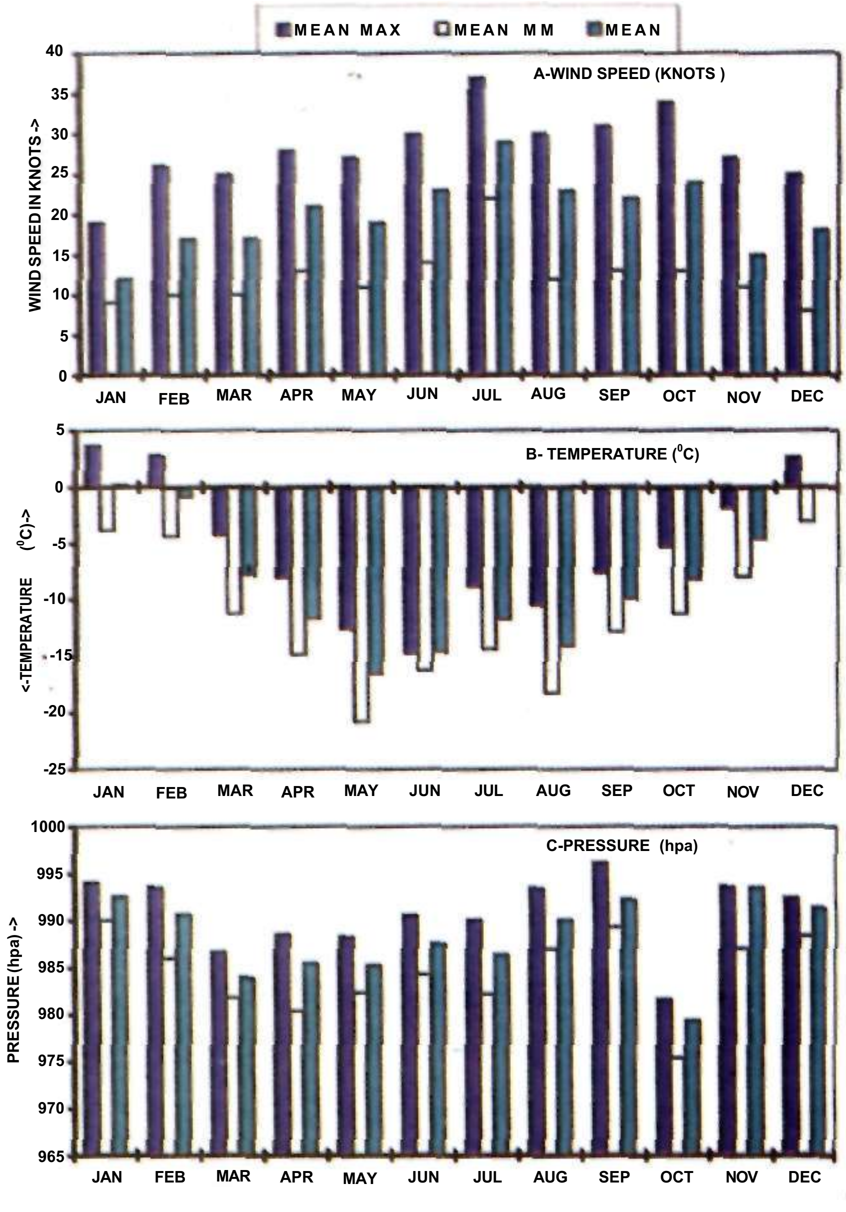


Fig. 1: Monthly means of wind,temperature and pressure during 1996

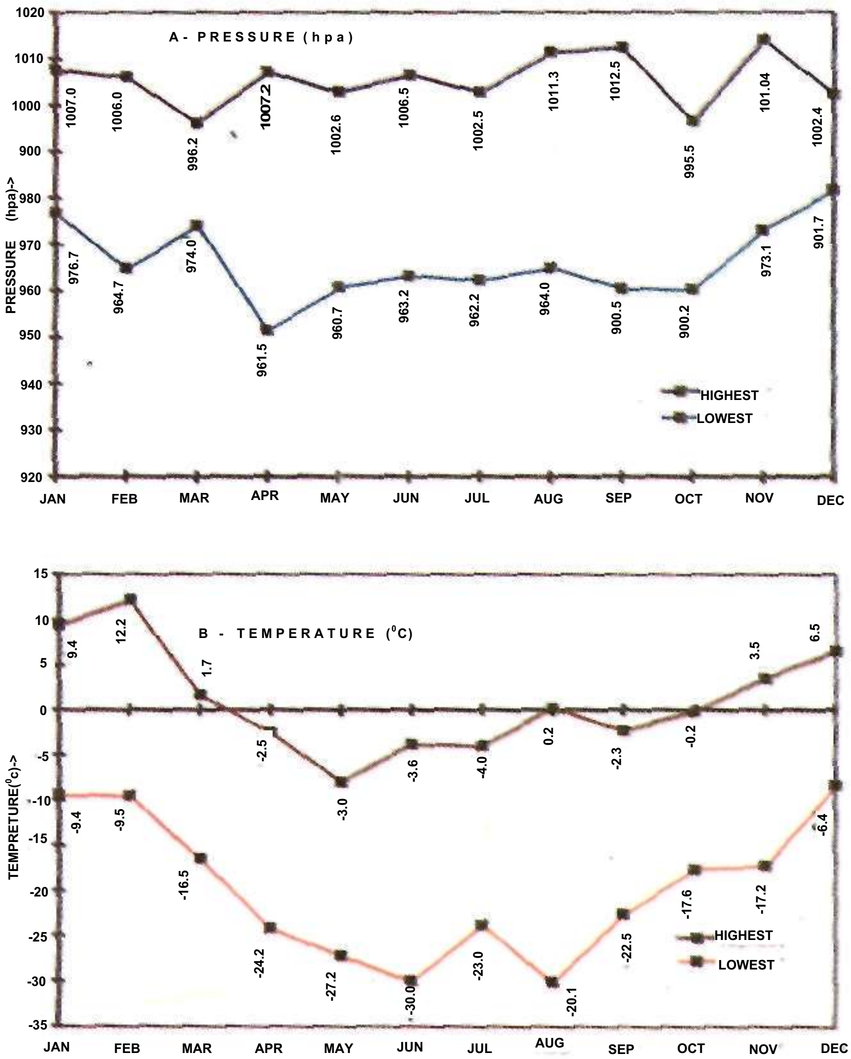


Fig. 2: Highest and lowest pressure/temperature of the month during 1996

(ii) Atmospheric Pressure (Table 1-B, Fig. 1-C, Fig. 2-A)

Atmospheric pressure is one of the most important meteorological parameter which indicates the change in atmospheric condition. The region of the

Table 1 — Table Showing Monthly/Annual Values of Max, Min, Mean etc., Temperature, Pressure and Wind for 1996

A-Temp.° C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Highest/Date	9.4/1	12.2/3	1.7/5	-2.5/8	-8.0/5	-3.8/30	-4.0/1	0.2/25	-2.3/20	-0.2/29	3.5/13	6.2/27	12.2
Lowest/Date	-9.4/15	-9.2/23	-16.5/16	-24.2/28	-27.2/23	-30.0/24	-23.9/15	-30.1/20	-2.6/24	-17.6/21	-17.2/5	-6.4/4	-30.1
Monthly Mean	0.18	-0.9	-7.9	-11.7	-16.6	-14.7	-11.8	-14.1	-10.0	-08.3	-04.7	0.0	-08.4
Av. Maximum	3.7	2.8	-4.3	-08.1	-12.7	-14.8	-08.9	-10.6	-07.7	-05.4	-02.0	2.7	-05.4
Av. Minimum	-3.9	-4.4	-11.3	-14.9	-20.8	-18.3	-14.4	-18.3	-12.9	-11.3	-08.0	-3.1	-11.8
B-PR. (hpa)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Highest	1007.6	1006.0	0996.2	1007.2	1002.8	1006.5	1002.8	1011.3	1012.5	0996.5	1014.0	1002.4	1014.0
Lowest	0997.2	0964.2	0974.0	0951.5	0960.7	0963.2	0962.2	0964.9	0960.5	0960.2	0973.1	0981.7	0951.5
Monthly Mean	0992.6	0990.7	0984.0	0985.5	0985.3	0987.6	0986.4	0990.1	0992.3	0979.4	0993.6	0999.4	0988.9
C-Wind (Knots)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Highest/Date	38/31	42/1	42/4	48/1	44/26	58/28	68/23	54/28	56/28	58/15	48/10	40/1	68
Monthly Mean	12	17	17	21	19	23	29	23	22	24	15	18	20
No. of Days with Speed >23	12	8	9	9	13	13	23	15	14	15	10	8	149

lowest pressure around the continent is known as the circumpolar trough which is mostly around the coastal region and the region of highest pressure is in high interior. This year's highest pressure at Maitri was 1014.0 hpa recorded on 15th November and lowest was 951.5 hpa recorded on 16th April. The maximum fall of pressure during 24 hours for the year was 21.0 hpa recorded on 16th April. The maximum rise of 28.2 hpa during 24 hours was recorded on 12th November. The annual mean pressure was 0988.9 hpa.

(iii) Wind (Table-1-C, Fig. LA)

Antarctica is the windiest continent on the earth. The land mass is scoured by a regime of persistent and powerful katabatic or gravity winds which are the result of cold dense air rolling down the continental slope from the high plateau. These katabatic winds interact with warmer air from the ocean to produce clouds, fog and extremely strong blizzards in association with moving low pressure systems. The local winds are strengthened with the passage of low pressure systems and wind speed of 88 knots gusting to more than 95 knots have been recorded. During this year the highest wind of 68 knots (124 kmph) with a maximum gusting of 112 knots (202 kmph) was recorded on 23rd July, 1996. July was the windiest month of the season with a mean monthly value of 29 knots. The annual mean wind speed reported was 20 knots. Monthly/Annual maximum, minimum and mean values of temperature, pressure and wind are given in the Table-1.

(iv) Sky condition

The most common clouds of coastal regions are Altostratus and Altocumulus. High clouds like Cirrus, Cirrostratus were also seen frequently. Low clouds like Cumulus, Stratus, Stratocumulus were also noticed during summer period. September, October were the cloudiest months of the season and December was the month of mostly clear sky. Sky condition was obscured on most of the days during July due to blizzards. For a total of 52 days in a year, the sky condition was obscured.

Monthly mean cloud amount (okt)/no, of days with obscured sky in 1996

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	A.M./Total
4/0	4/0	3/1	3/4	1/6	1/11	1/21	2/5	5/4	5/0	4/0	0/0	3/52

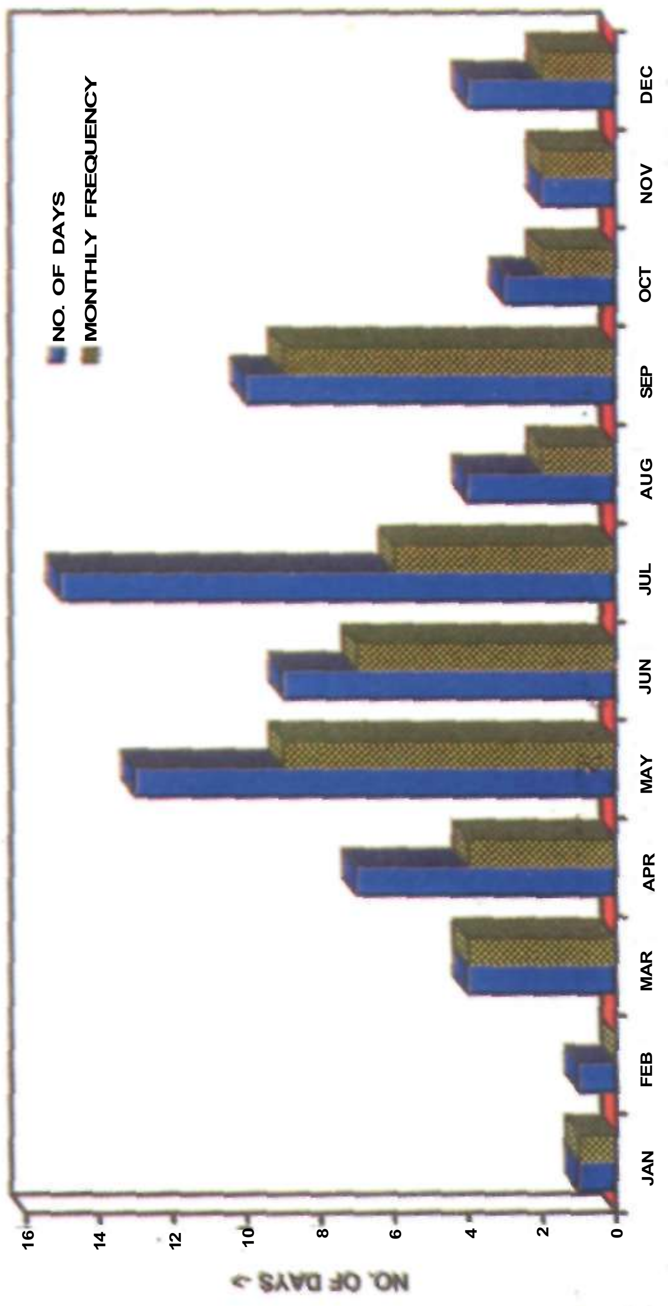


Fig. 3: No. of days/monthly frequency of blizzards during 1996

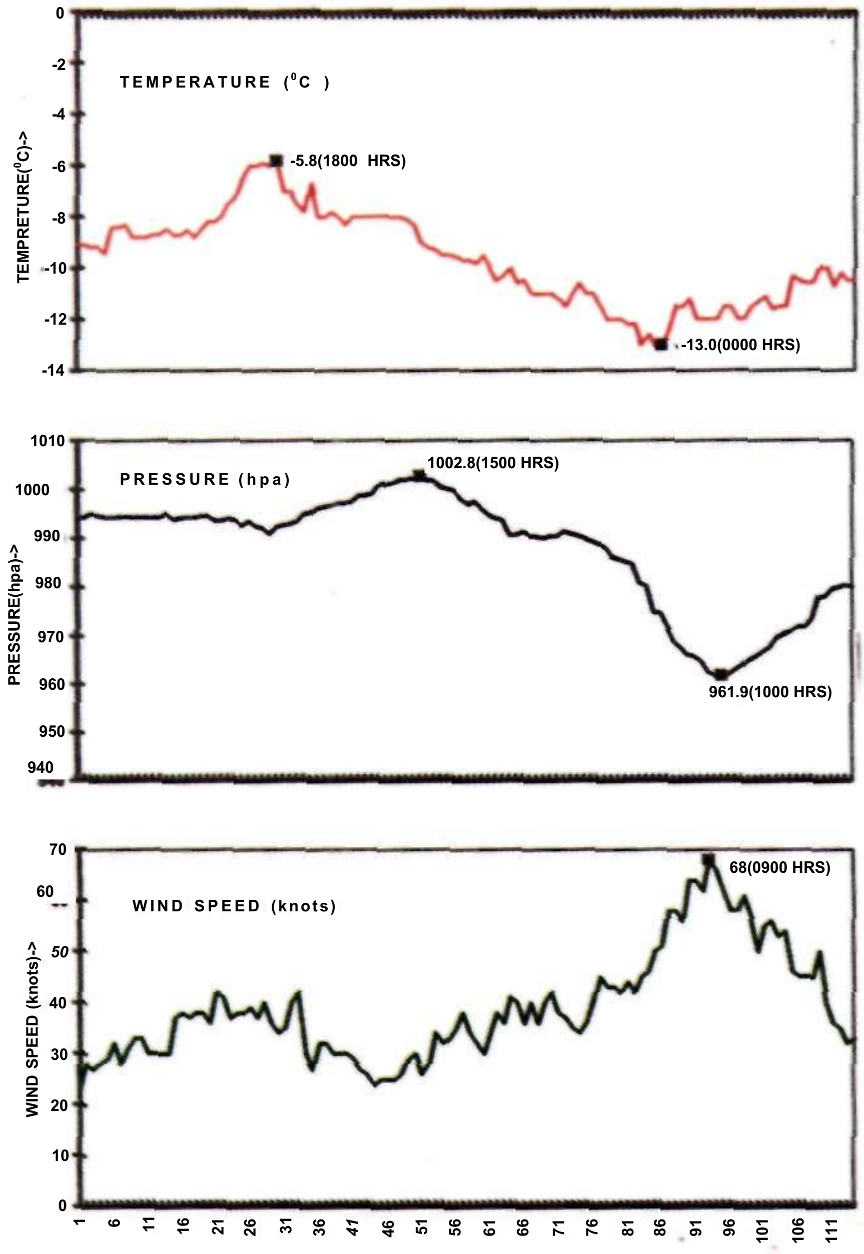


Fig. *4 : Hourly changes in temperature /pressure / wind speed during longest blizzard of 1996 (from 19th to 24th July)* *(v) Blizzards (Figs 3 to 7)*

Antarctica is called "The Home of Blizzards". A blizzard is a blinding snow-storm, which is a combination of strong winds and moderate to heavy snow fall, blowing with the strong wind, reducing the visibility condition to nearly zero. Blizzard brings all the outside activities to a halt and can cause considerable damage to unprotected machines, buildings and sometimes to human lives also. Blizzard is the result of interaction between strong katabatic winds and the warm moist current from the ocean in association with a passing low pressure system over the area. A blizzard is reported when the wind speed is more than 23 knots along with moderate to heavy blowing snow and low visibility (less than 1000 m). During 1996, a total of 45 blizzards were experienced out of which the blizzard experienced during 19th to 24th July was the longest and strongest covering a total period of 113 hours. The visibility was reduced to nearly zero due to heavy drifting and blowing of snow during this blizzard. Highest wind speed of 68 knot gusting to 112 knots was recorded

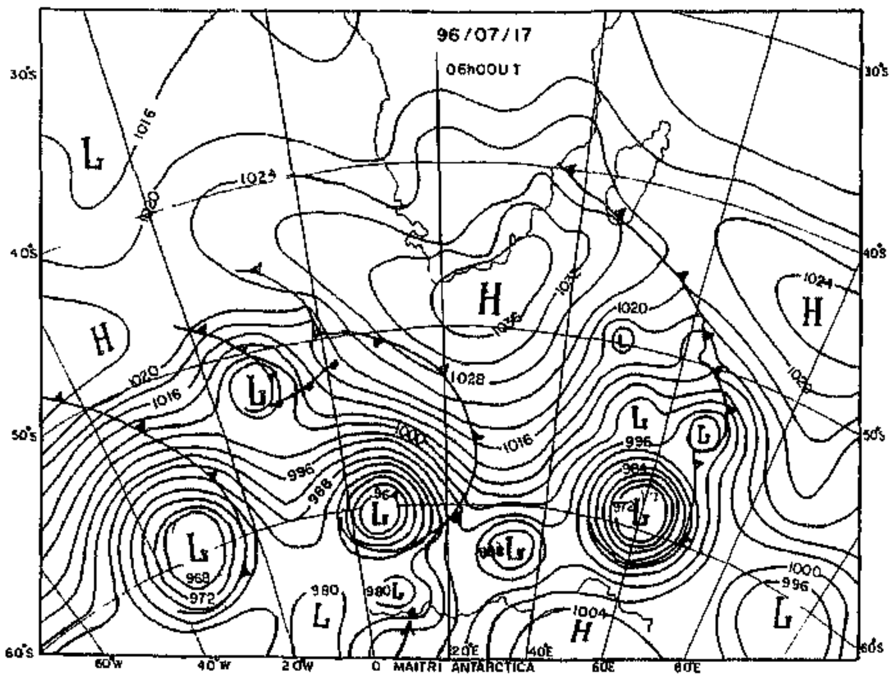


Fig.5: Pretoria weather charts of Maitri, Antarctica during blizzard period

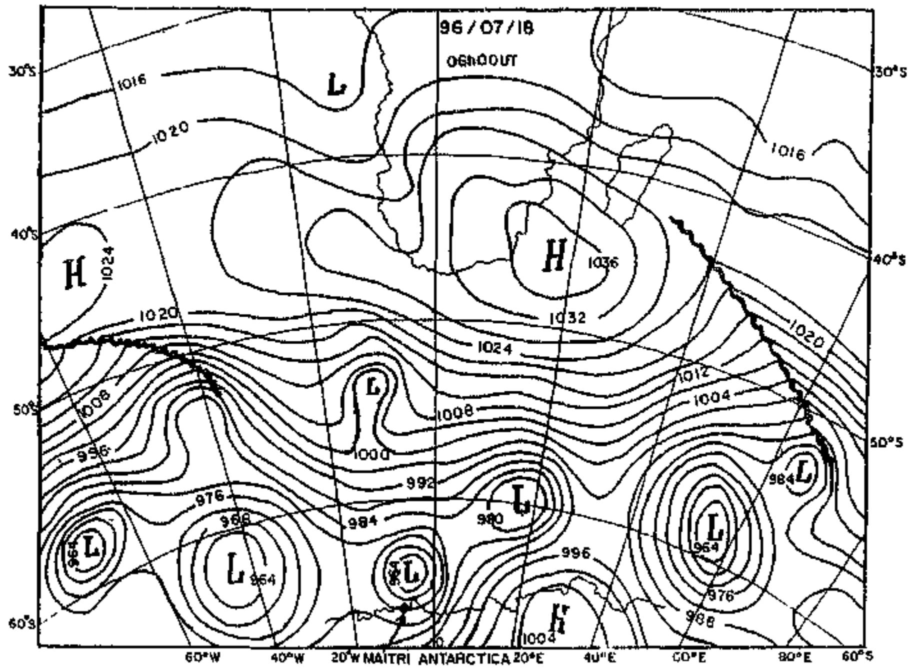


Fig. 6: Pretoria weather charts of Maitri, Antarctica during blizzard period

during this blizzard. Maximum blizzards were experienced during May and September. Out of 45 blizzards, 31 were experienced during the four months, i.e. May, June, July and September.

Monthly frequency/no. of days of blizzards during 1996

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Frequency	1/1	0/1	4/4	4/7	9/13	7/9	6/15	2/4	9/10	2/3	2/2	2/4	45/73

Ozone-Hole Study (Figs 8 to 14)

During 1996, a total of 51 ozonesonde ascents were taken to study the vertical distribution of ozone over Antarctica. The analysis shows that January was the month having maximum amount of ozone in the stratosphere. During the month of September and October ozone amount in the stratosphere rapidly

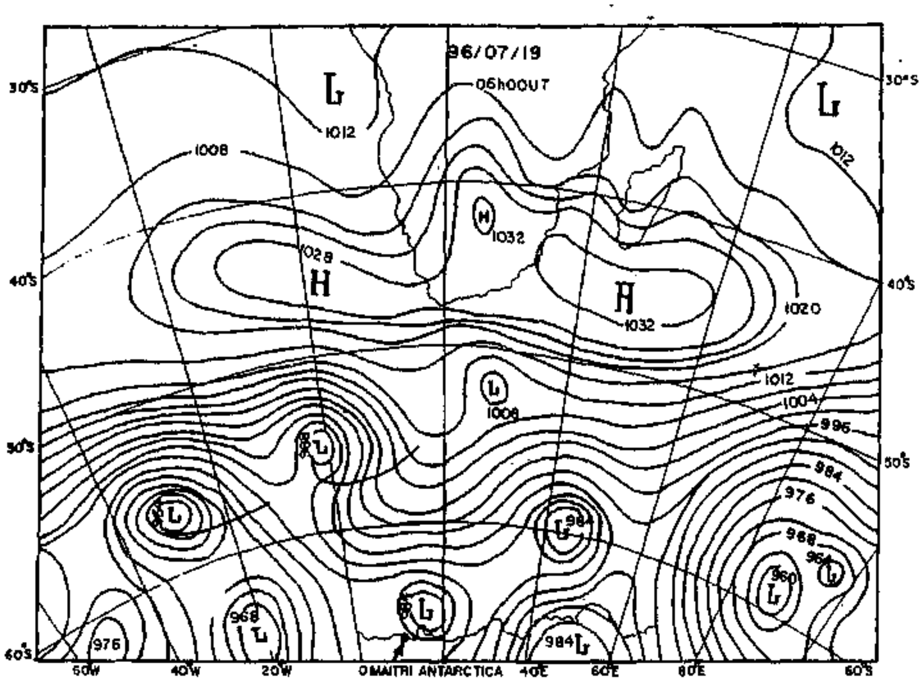
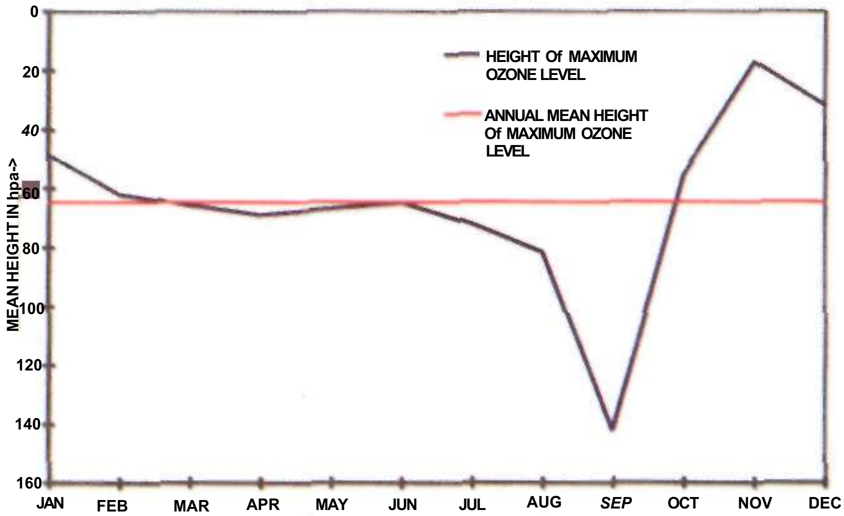


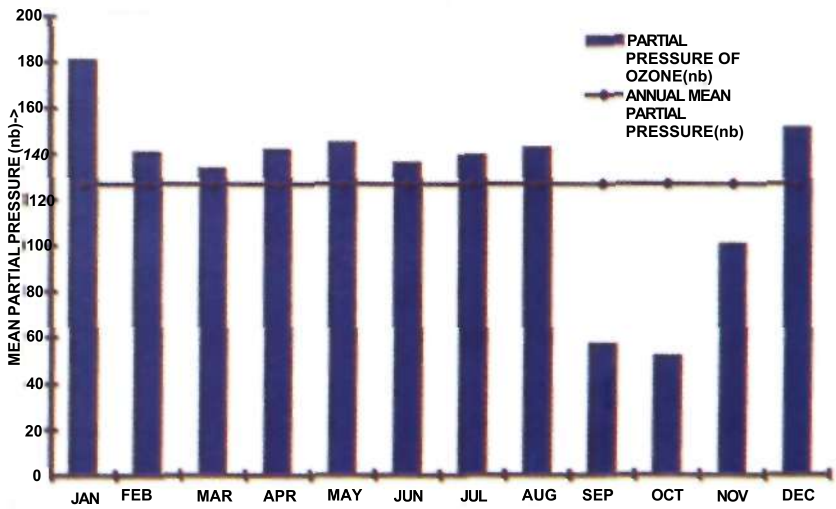
Fig. 7: Pretoria weather charts of Maitri, Antarctica during blizzard period

decreased between 12 to 21 km, where ozone was reduced by at least 70% of normal. While between 15 and 19 km, practically all the ozone was annihilated for most of the days in October. Two ozone maximas were noticed during September and October. This is due to the fact that main ozone maxima around 70 hpa has been depleted and two levels above and below this level appear as maxima. On 5 January the partial pressure of ozone was 200.7 nb which reduced to 43 nb during fourth week of September. Based on the monthly mean partial pressure of maximum ozone level October was the month of maximum depletion of ozone during 1996. During 4th week of October the ozone amount was nearly zero between 108 hpa to 48 hpa levels. Since early November onwards gradual increase in ozone amount was observed and upto December end the average partial pressure of ozone was 15.2 nb indicating recovery in ozone amount.

Ozone loss is especially strong over the Antarctic continent because the winter circumpolar stratospheric vortex prevents extensive air exchange with



A



B

Fig. 8: (A) Monthly mean height of maximum ozone level during 1996, (B) Monthly mean maximum partial pressure (pp) of ozone during 1996

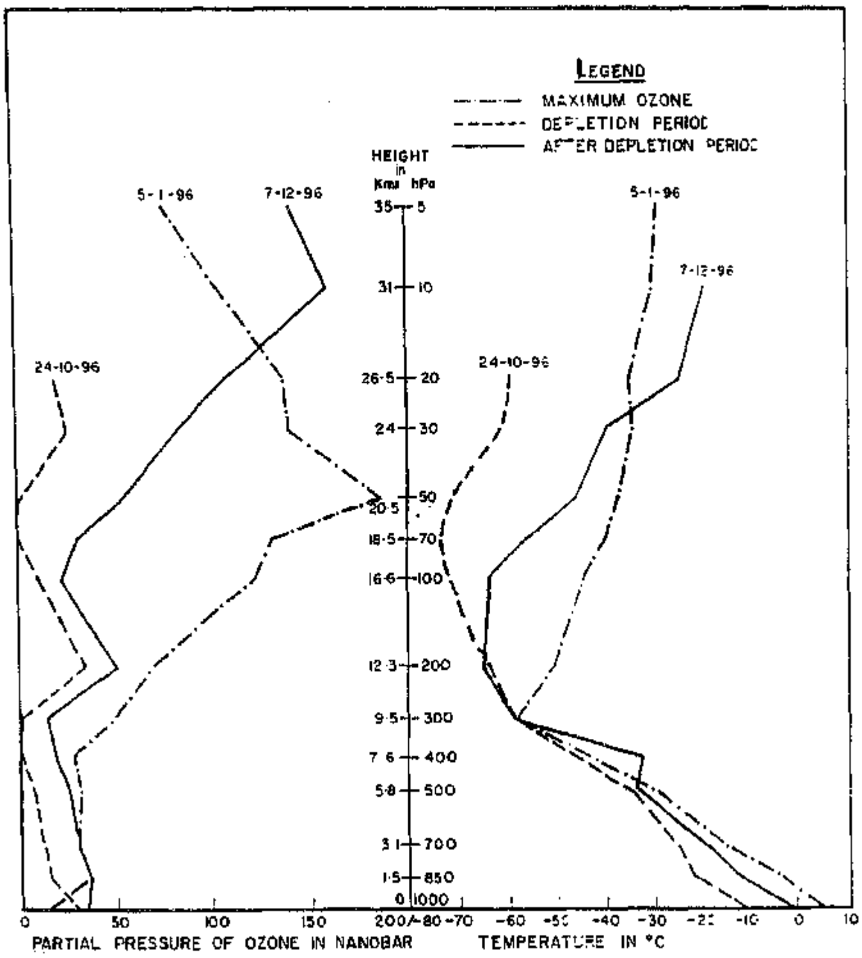


Fig. 9: Results of ozonesonde ascents taken in 1996 at Maitri, Antarctica during maximum ozone period, depletion period and after depletion period along with the upper air temperature profile

mid-latitudes. This produces very low temperature (below -80°C) in the stratosphere which favours the generation of polar stratospheric clouds (PSU) containing ice particles. The CFC compound (such as $CIONO_2$, $BrONO_2$) are available in abundance in Antarctic stratosphere: In cold stratospheric temperatures (below -80°C) these CFC compounds react with UV radiation from sunlight and release active chlorine & bromine atoms. With the return of sunlight in the early spring these active chlorine and bromine atoms react with atmospheric ozone reducing it to zero. These atomic chlorine and bromine can break apart ozone molecules with amazing efficiency, causing the depletion of stratospheric ozone.

Table showing monthly mean partial pressure (PP) of ozone and mean height of maximum ozone level is given here :

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	A.M.
PP(nb)	181.0	140.6	133.5	141.7	144.6	135.9	139.1	142.4	57.1	51.7	100.5	151.2	126.6
Ht(hpa)	48.5	62.0	65.8	69.0	67.0	64.8	72.0	81.5	142.0	55.2	17.2	31.9	64.7

Figs 10-12 show the monthly mean partial pressure of ozone during 1996 Ozonesonde data presented here are not normalised to total ozone values.

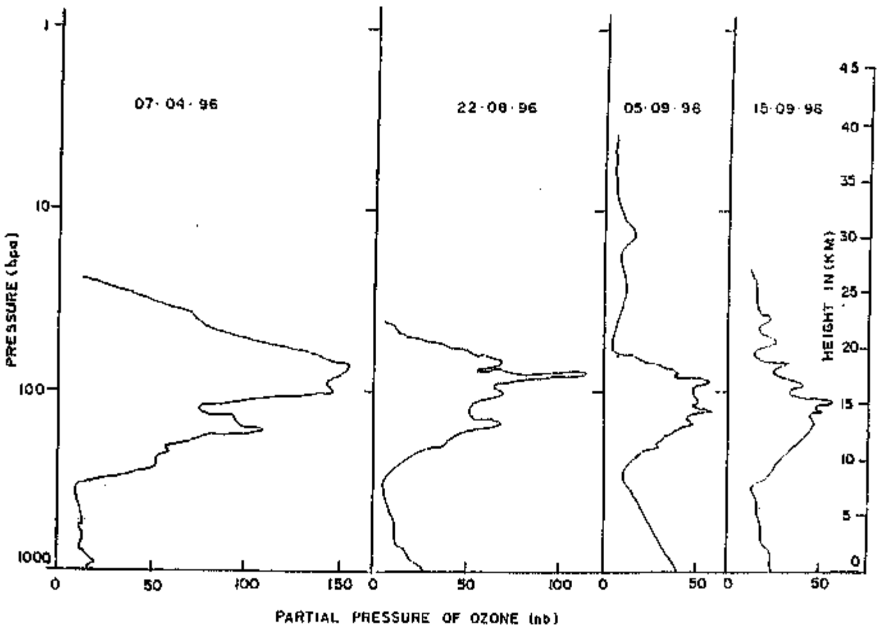


Fig. 10: Vertical ozone profile over Maitri 1996

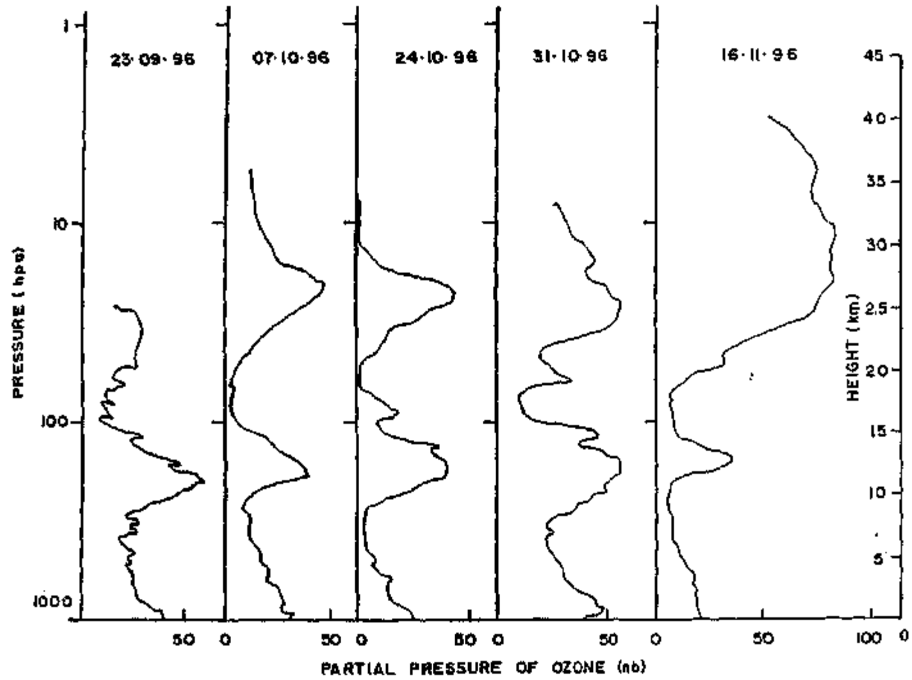


Fig. 11 : Vertical ozone profile over Maitri 1996

Surface Ozone

Continuous recording of surface ozone was done throughout the year which gave the following results :

(a) The values of surface ozone concentration do not show any significant diurnal variation throughout the year.

(b) The annual cycle in surface ozone shows a summer minimum with average value of the order of 11 ppbv and a winter maximum of 32 ppbv.

Solar Radiation

Because of curvature of the earth and because the axis around which the earth rotates round the sun is inclined by 23.30 to the Earth's annual path, the net annual radiation budget in the Polar regions is less than elsewhere in the world. Most of the solar radiation received by the Antarctic continent is reflected back into the space by the ice sheet and, therefore, Antarctica is a net

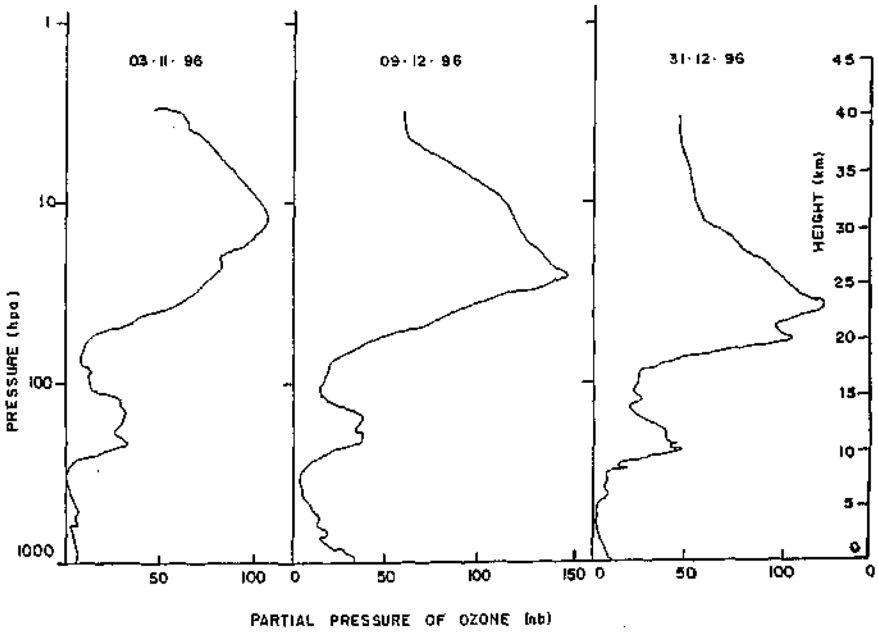


Fig. 12: Vertical ozone profile over Maitri 1996

loser of heat by radiation. The difference between solar radiation received in the tropics and radiation lost to space from polar regions establishes energy transfers that drives the Global Atmospheric circulation.

Global solar radiation was continuously recorded using Pyranometer and Protek recorder. The volume of data is very huge and yet to be analysed so only general distribution is discussed here. During polar night period, the radiation was nil due to absence of sunshine and very low zenith angle of the sun. It is also observed that the radiation received during second half of the year was more than that received during first half of the year. Solar radiation was more intense in the month of December than other summer months.

Continuous recording of Global Solar Radiation was supplemented by 15 Radiometersonde ascents during the sunshine period to supplement the study of radiation budget of Antarctic region. Apart from this regular Turbidity observations were taken during sunshine period for the purpose of Aerosol studies.

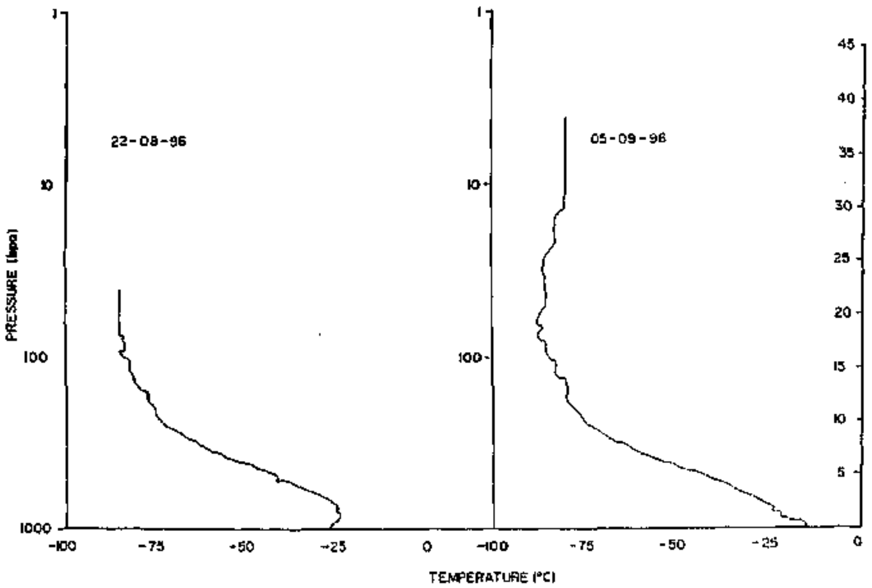


Fig. 13: Vertical temperature profile over Maitri 1996

Snowfall/Rainfall (Fig. 15)

In Antarctic region most of the snowfall is associated with blizzards. It is a regular phenomenon over Antarctica, which occurs throughout the year. Maximum accumulation of snow takes place over coastal regions during April to July, During 1996, a total of 71 snowfall days were reported and maximum snowfall was experienced in the month May and June. August and November were the months of minimum snowfall during 1996. Monthly frequency of snowfall days during 1996 is given in the following table :

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	5	3	5	8	11	11	7	2	7	5	2	5	71

Over the Antarctic region precipitation occurs mostly in the form of snow. The interior plateau is a cold desert. Air over the coastal regions contains more moisture so the precipitation in the form of snow is equivalent to over a metre of water. During summer period sometimes the precipitation also occurs in the form of water. This year we experienced the same on 2nd February. Light to moderate rainfall was experienced by the station which may be equivalent to

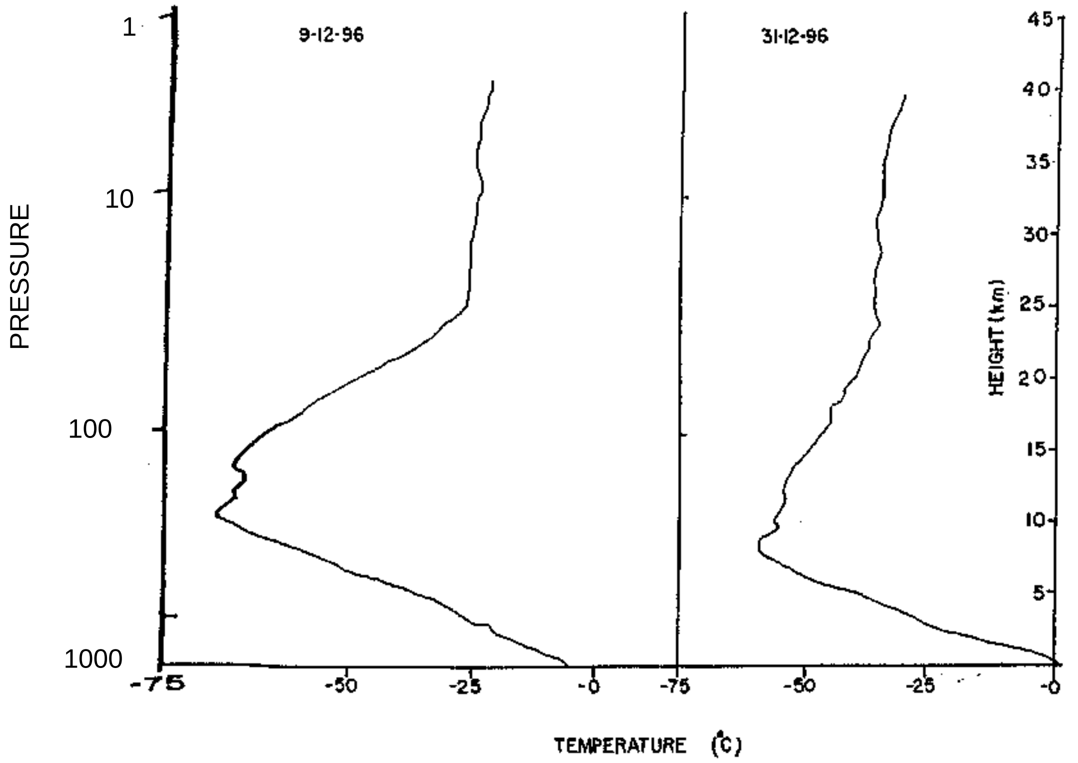


Fig. 14: Vertical temperature profile over Maitri 1996

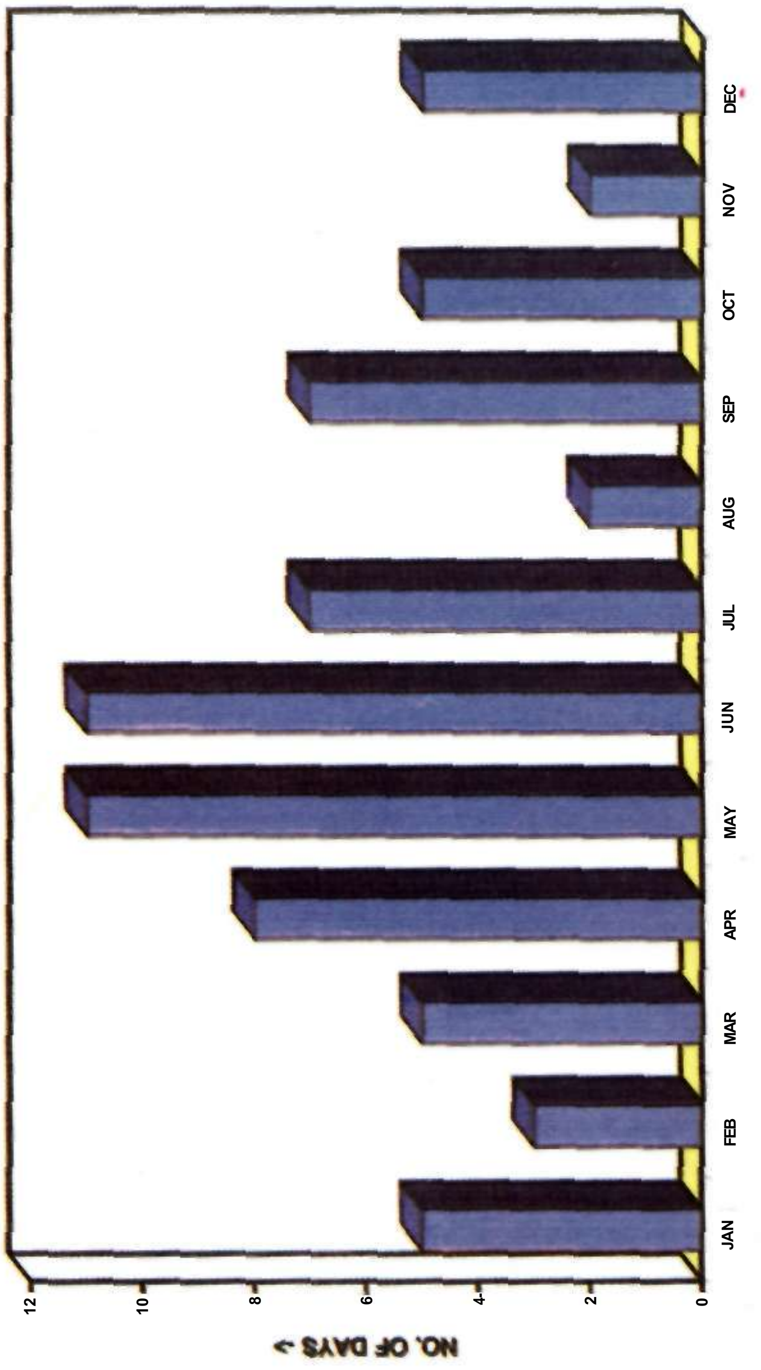


Fig. 15: No, of days of snowfall during 1996

During this year many Auroras were observed in the sky during March, vlay and June. This activity was more intense in the month of March. On 21^{st} vlarch 4 Aurora loops at a time were seen in the eastern sky, one below the)ther. There was a combination of green and yellow colours with a very fast ;hanging structure.

Other Routine Works

Apart from continuous recording of surface ozone, global solar radiation, emperature, atmospheric pressure and wind, APT cloud imageries were taken hrough polar orbiting Satellite NOOA-12. Analysed Weather Charts from ^{3}reloria were collected during the year through DEAL. These were very useful ;o know the movement of low pressure system towards the station and for giving ;orrect forecasts of day-to-day weather over the station.

Regular meteorological forecasts were given for helicopter operations luring summer period. Forecasts were also given for convoy activities of the station. Daily weather summary was regularly exhibited on station board for nformation of other members.

Special Activities

The 36^{11}WMO Day was celebrated on a big scale on 23^{r} March. A balloon ■vith print "36^{l} WMO DAY 1996 IMD" was also released on this occasion. \s this year's WMO theme was "Meteorology in the Service of Sports", a sport ;ompetition was organised on this day and first and second prizes were distributed to the winners. On this occasion DG-IMD's message was read and in informative lecture on WMO and IMD's activities was delivered.

Some Salient Features of Meteorological Observations during 1996

Highest temperature recorded during the year was 12.2°C on 3^{r} February ind lowest was -30.1 °C on 24^{11} August. Annual mean temperature was -8.4°C tvhile the annual me'ah pressure was 998.9 hpa.

Highest and lowest pressures of the year were recorded asl014.0and951.5 ipaon 15^{n} November and 16^{l} April, respectively.

Total no. of 45 blizzards were experienced during 1996; out of which the Dlizzard experienced during 19 to 24^{1} July was the longest and strongest Dlizzard, covering total period of 113 hours.

The ozone destruction was strongest in the lower stratosphere during late September and in the month of October, Ozone at Maitri was practically annihilated between 15 and 20 km as shown in Fig. **11.**

The height of maximum ozone level was highest in the month of November which was 17.2 hpa and was lowest in the month of September as 142 hpa and the annual mean height of maximum ozone level comes to 68.7 hpa.

Light to moderate rainfall in the form of water was experienced on 2nd February 1996 which is a very rare occasion over Antarctic region.

Global solar radiation was more intense during December than other summer months. The continent receives more radiation during 2nd half of the year than that of first half.

No significant diurnal variation is observed in the values of surface ozone concentration throughout the year over the Indian Antarctic Station, Maitri. The annual cycle in surface ozone shows a summer minima with average value of 11 ppby and a winter maxima of 32 ppbv.

Acknowledgements

We express our sincere thanks to Dr. N. Sen Roy, Director General of Meteorology for giving us this opportunity of working in Antarctic Region and serving the department and the nation. We are also thankful to Dr. R.R. Kelkar, Additional Director General of Meteorology (Services), Shri B. Laxmanaswamy, Additional Director General of Meteorology (Hydrometeorology) and Dr. V.S. Tiwari, Director, APEC unit of IMD HQ and Dr. S.K. Peshin, Met-1, Incharge, National Ozone Center, IMD, New Delhi for their guidance, encouragement and support. We also express our gratitude to Shri Aran Chaturvedi, Leader of the 15 IAE for his help and guidance during the expedition. We are also thankful to all Maitrians for their timely help and support to us. We express our thanks to Capt. Rajesh Bhat and his Army team members and R&DE(E), Pune team members for initiating the work of IMD Shelter and nearing it to completion stage. Our special thanks goes to Shri Pramod Dabeer of R&DE(E), Pune andShri Amar Singh of GSI. Shri Pramod Dabeer helped us in balloon filling for ozone ascent programme since our first ascent to last ascent. Shri Amar Singh also helped us many times in balloon filling and other works. We express our sincere thanks to Major Varghese Abraham, OiC-Army Team and his army team members for the logistic support given by them to IMD.

Table 2 : Monthly Mean Upper-Air Temperatures at Maitri, Antarctica during 1996

Ht .in hpa/kms	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	A.M.
0005./35	-29.4	-	-	-	-	-	-	-54.2	-76.7	-	-20.5	-24.4	-46.2
0010/31	-28.8	-	-52.1	-	-	-	-	-61.8	-74.4	-47.5	-30.5	-25.2	-47.3
0020/26.5	-34.2	-	-48.9	-	-	-	-	-76.1	-75.1	-58.9	40.0	-28.5	-51.7
0030/24.0	-35.8	-	-52.4	-71.4	-	-	-	-81.6	-75.9	-68.4	-50.9	-34.4	-58.9
0050/20.5	-38.7	-48.0	-49.7	-67.8	-	-	-	-82.7	-76.7	-75.9	-66.8	-40.0	-68.3
0070/18.5	-41.4	-49.4	-48.1	-66.3	-	-	-	-83.1	-81.3	-76.8	-73.0	-45.2	-62.7
0100/16.6	-44.5	-45.4	-49.7	-63.5	-	-	-84.5	-79.2	-79.5	-76.0	-74.2	-52.2	-64.9
0200/12.3	-48.7	-44.0	-50.0	-57.8	-75.0	-	-79.7	-72.1	-72.4	-68.6	-68.4	-58.9	-56.7
0300/09.5	-57.2	-46.3	-56.3	-63.8	-66.0	-90.0	-67.7	-61.2	-64.1	-61.8	-60.9	-55.9	-62.6
0400/07.6	-44.5	-38.5	-47.8	-55.3	-40.6	-59.2	-57.7	-49.8	-52.5	-49.6	-46.7	-42.9	-48.8
0500/05.8	-34.0	-25.0	-37.4	-43.4	-32.4	-48.0	-47.5	-42.4	-42.1	-38.9	-36.9	-35.7	-38.6
0700/03.1	-18.3	-15.6	-229	-29.6	-22.8	-31.8	-28.4	-27.2	-27.3	-23.6	-20.7	-18.9	-23.9
0850/01.5	-07.6	-07.0	-17.1	-12.6	-17.2	-22.0	-19.2	-22.1	-18.8	-17.7	-11.8	-09.2	-15.2
1000/0	00.7	-06.0	-06.2	-07.6	-12.9	-15.4	-14.0	-19.4	-11.3	-07.8	-05.8	01.7	-08.7

Table 3: Weather Summary for - 1996. Station - Maitri Antarctica (Monthly Mean Values)

Month	Temperature °C			Pressure (hpa.)			Wind (Kts.)			Cl Amt	Biz	Cy.St	S.F.	R/F	Aurora	Ht. Max	PP of O_3
	Max	Min	Mn	Max	Min	Mn	Max	Min	Mn	(Okt)	(Nos)	(Nos)	(Days)	(Days)	(Nos)	O_3 LEV (hpa)	(nb)
Jan	03.7	-03.9	00.2	994.1	990.0	992.6	19	09	12	4	1	0	05	0	0	048.5	181
Feb	02.8	-04.4	-00.9	993.6	986.0	990.7	26	10	17	4	0	1	03	1	0	062.0	141
Mar	-04.3	-11.3	-07.9	986.7	981.8	984.0	25	10	17	3	4	1	05	0	6	065.8	134
Apr	-08.1	-14.9	-11.7	988.6	980.4	985.5	28	13	21	3	4	3	08	0	0	069.0	142
May	-12.7	-20.8	-16.6	988.3	982.4	985.3	27	11	19	1	9	4	11	0	1	067.0	145
Jun	-14.8	-18.3	-14.7	990.6	984.3	987.6	30	14	23	1	7	4	11	0	1	064.8	136
Jul	-08.9	-14.4	-11.8	990.1	982.2	986.4	37	22	29	2	6	8	07	0	0	072.0	139
Aug	-10.6	-18.3	-14.1	993.5	987.0	990.1	30	12	23	5	2	3	02	0	1	081.5	143
Sep	-07.7	-12.9	-10.0	996.2	989.3	992.3	31	13	22	5	9	3	07	0	0	142.0	057
Oct	-05.4	-11.3	-08.3	981.7	975.4	979.4	34	13	24	4	2	7	05	0	0	055.2	052
Nov	-02.0	-08.0	-04.7	993.7	987.1	993.6	27	11	15	4	2	4	02	0	0	017.2	101
Dec	02.7	-03.1	00.0	992.5	988.4	991.4	25	08	18	4	2	0	05	0	0	032.8	151
A.M.	05.4	-11.8	-8.4	990.8	984.5	988.2	28.3	12.2	20	3.3						64.8	126.6