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WARM SPELL OVER SCHIRMACHER REGION OF EAST ANTARCTICA DURING FEBRUARY, 1996

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Abstract

During the month of February, the surface air temperature on an average remains subzero, but at times, it shows unusually high values. One such event was recorded during the first week of February 1996. In the present paper, an attempt has been made to understand the dynamics of air and the physical processes through the observed data recorded by several PBL instruments operated at Maitri, Antarctica.

Introduction

In the summer months, the surface air temperature recorded over Schirmacher region shows a diurnal variation of the order of 3- 4°C. This diurnal variation ceases during winter, as there is no surface heating due to long winter night (Naithani, 1995; Hosalikar and Machnurkar, 1998). However, the surface air temperature shows at times an enhancement of air temperature in winter. These enhancements are basically due to the hot, moist air pumped in by the prevailing cyclones over the ocean (Naithani, 1995). But, in summer months, enhancements are caused by the cyclonic winds as the coastline is much closer and by unusual phenomena which need detailed investigations.

During February 1996, the surface air temperature went beyond +12°C, which is an unusual situation in the Schirmacher region; as **Table.l** shows that in the past 7 years, temperature had never crossed +8.2°C. Therefore, this paper presents direct evidences of this warm spell and in the light of these observations, an attempt has been made to explain the observed features. Moreover, on an average, the mean temperature is only around 0°C.

Table - 1 : Surface Air Temperature recorded at Maitri, Antarctica during January and February months (in °C)

Year	1990	1991	1992	1993	1994	1995	1996
January							
Highest	7.8	8.2	7.8	8.2	6.6	5.0	7.5
Lowest	7.6	-5.6	-6.4	-5.5	-6.2	-6.7	-7.5
Mean	0.9	0.9	1.3	0.7	-0.1	-0.4	0.4
February							
Highest	3.7	7.6	5.3	5.4	4.8	5.2	12.0
Lowest	-9.2	-8.5	-8.4	-13.8	-9.7	-11.6	-8.0
Mean	-.29	-0.9	-1.8	-3.5	-3.9	-2.6	-0.8

Data

National Physical Laboratory, New Delhi started Planetary Boundary Layer programme by inducting a monostatic acoustic sounder in the year 1990-91. Since then, many other systems were deployed including 4 levels of meteorological sensors mounted on a 28 m tower. Apart from these observations, UV-B data is being recorded continuously since 1988-89 in order to compute aerosol depth and assess atmospheric transparency. In the present paper, following data have been utilised.

1. Monostatic acoustic sounding data. This is available on continuous basis, except that utility of data becomes limited for winds beyond .10 m/s.
2. Automatic Weather Station : These data were recorded automatically after every 10 minutes.
3. Three-level meteorological sensors mounted on the 28 m tower.
4. UV-B radiation measurement on continuous basis. As part of this programme, total UV energy falling on the ground in the wavelength of 280-340 nm is converted into the units of Minimum Erylhemal Dose (MED/hour) 1 MED = 5.83 x 10-06 Watts.
5. Synoptic data obtained from India Meteorological Department.

Results

Fig.1 shows the observed variation of surface air temperature during the month February 1996. It clearly shows that a warm spell was observed over Schirmacher region during February.1 to 5, 1996. During this period, the wind velocity was higher than the normal velocity (Fig.2) and was inducted from the S-SE direction (Fig.3). Moreover, it has been observed that at the Maitri station,

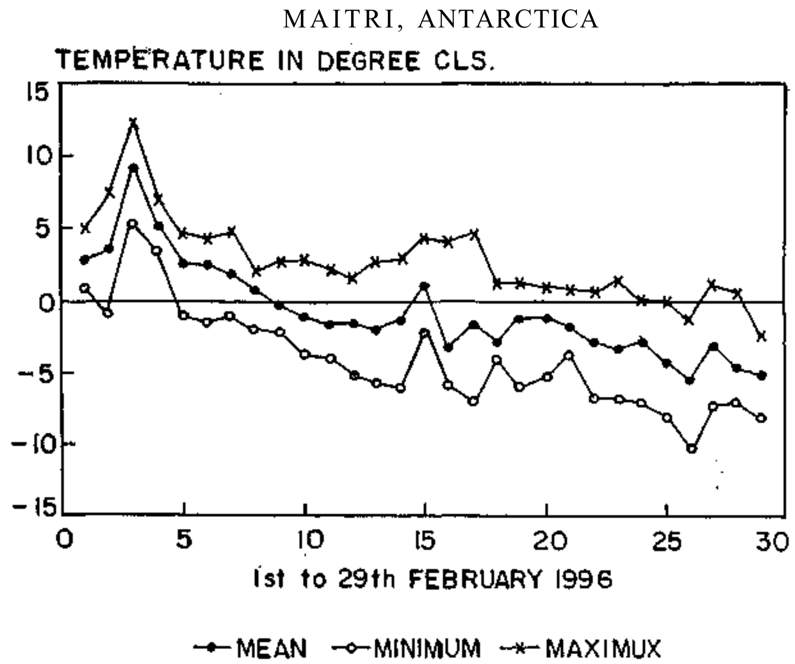

Fig. 1: Observed 3 hourly surface air temperature at Maitri during February, 1996

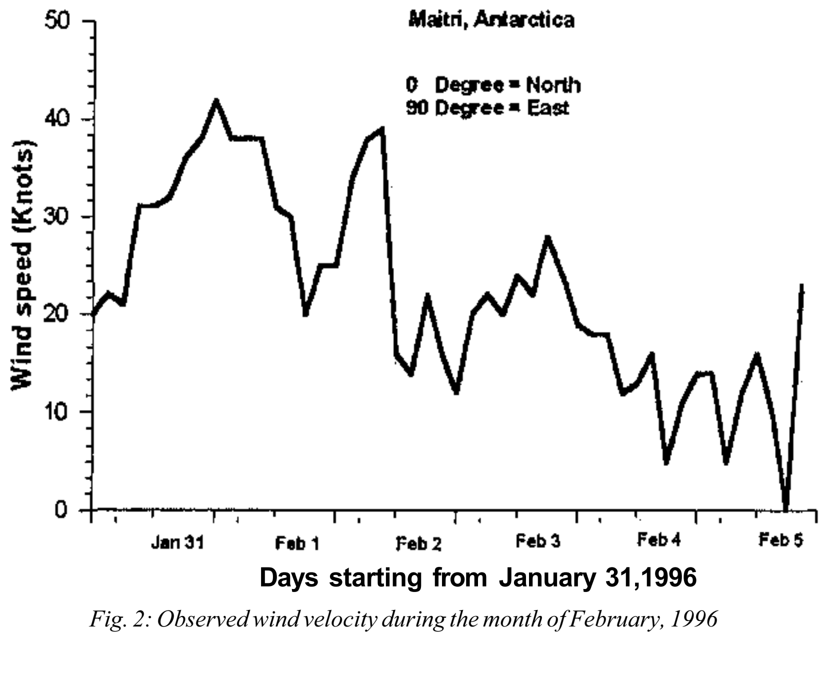

Fig. 2: Observed wind velocity during the month of February, 1996

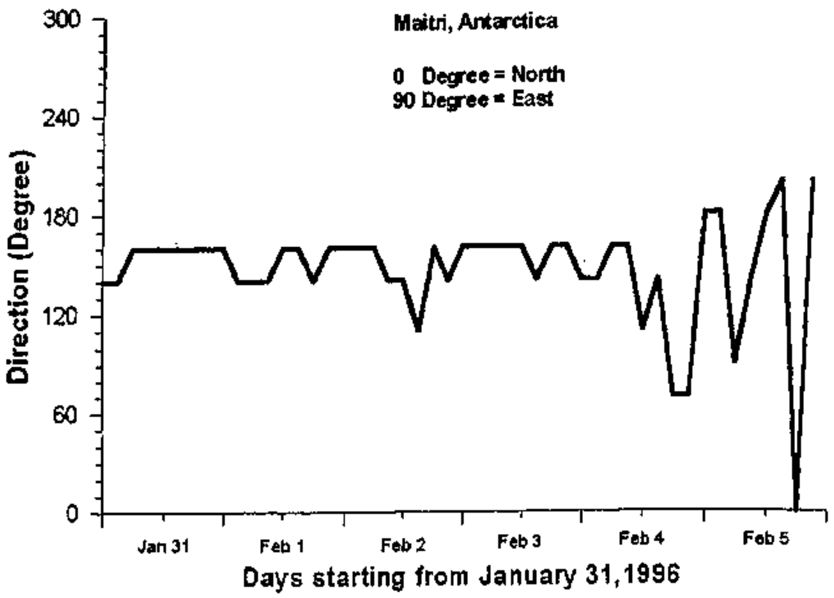

Fig 1: *The 3 hourly wind direction recorded during warm spell at Maitri, Antarctic*

katabatic flows have a degree of directional constancy, as the katabatic flows follow the flow lines or the slope over the polar ice cap (Naithani, 1995). In this case, during the warm spell period, flow has remained unidirectional from around 160 degrees. Also, the observed relative humidity was minimum during February 2, 1996, indicating that the winds have been inducted basically from the interior of the continent, as these alone can be the driest. However, the acoustic sounder data shows a dull convection during this period **(Fig.4)** and is confirmed from the simultaneous measurements of the heat flux which has been calculated from the tower measurements and is about 90 W/m . Naithani *et al.* (1994) and Pasricha et al (1991) have reported flux values to be as high as 800 W/m for well defined convection. Naithani *et al.,* 1994 have observed flux values to be as high as 800 W/m for a free, well-defined convection at Maitri. This is an interesting observation as over Schirmacher region, sky was absolutely clear on February 3, 1996 **(Fig.5).** The same **Fig.5** shows the amount of' total solar.energy received during this period on the ground and is confirmed from the high dose of UV-B radiations received on the ground **(Fig.6).** High UV-B values indicate clear transparent atmosphere (Singh *et al.*, 1992; Sharma and Srivastava, 1992).

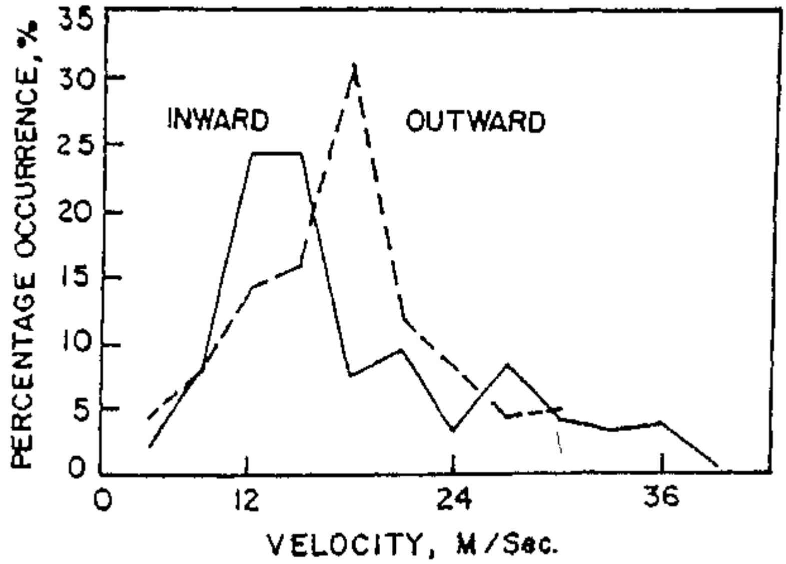

Fig.4: Acoustic sounding data showing dull convection

Discussion

To explain the observed warm spell and that too in the month of February, we need to have a closer look on the observed acoustic sounder data recorded on a clear sunny day over Maitri. A facsimile picture **(Fig.** 7) shows clear thermal convection, which means, high surface heating and a high lapse rale of temperature (Naithani and Dutta, 1995), The absence of thermal convection during the warm spell period indicates that warming was not only localised, but the air was basically warm, when being induced into the Schirmacher region. Moreover, absence of thermal convection and low heat flux indicate that the falling solar energy over the Schirmacher region was unable to heat up the local surface, as this energy was basically utilised in eroding the polar glacier and the quantity of water that was flown in to various lakes was so much, that the overflowing water over the lakes transported the energy falling on the surface, in spite of clear sky conditions. This way the surface could never become warmer to generate a noticeable thermal convection over this region.

Moreover, since the direction of movement of air was basically from SE and the relative humidity was at its minimum during the spell period, this shows that the warming first started in the interior of the east Antarctic region and then got transported down towards the periphery. It was basically not due to any localised phenomena over Schirmacher region. In fact, during this period, it rained and this rainfall eroded so much of polar glacier ice that the sensible heat

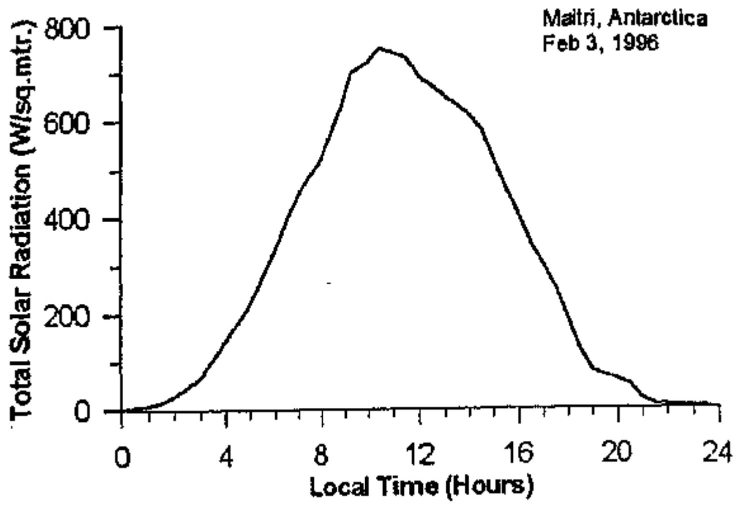

Fig.5: Amount of Solar energy recorded on 3rd February, 1996 at Maitri, Antarctica

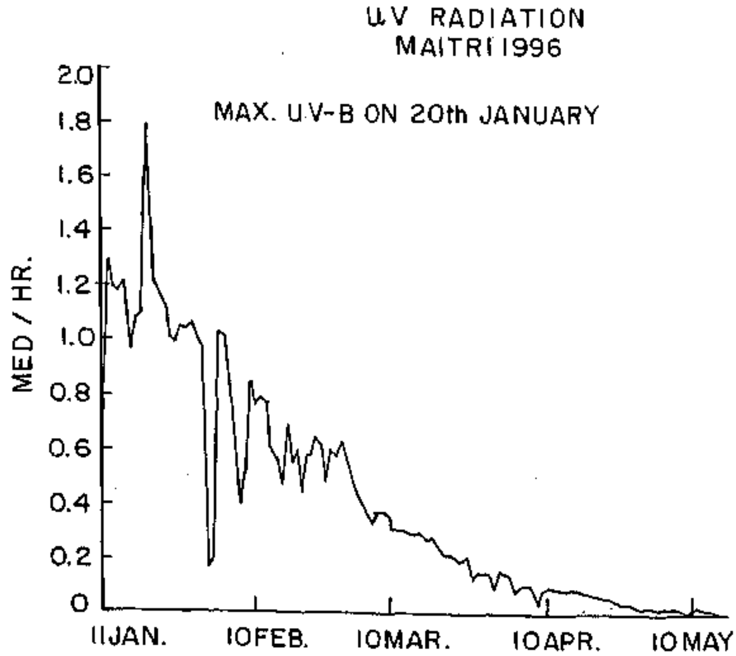

Fig.6: Amount of total UV-B recorded at ground. It indicates highest values observed during the warm spell, indicating clear sky conditions

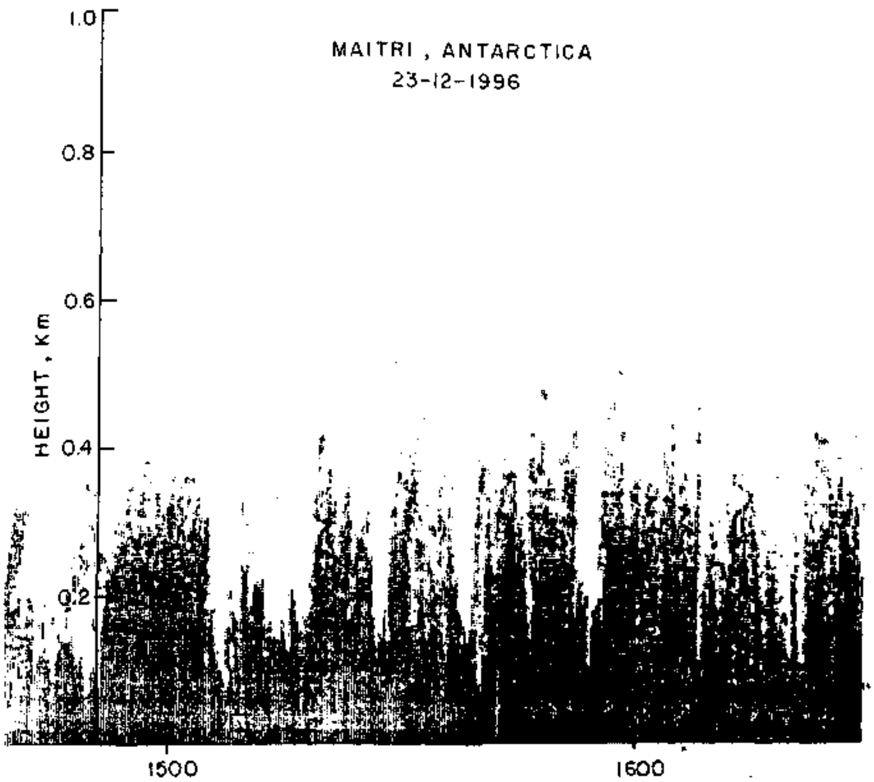

Fig. 7: Well defined, clear cut thermal convection observed on a clear sunny day at Maitri, Antarctica

released from the melted ice, remained trapped below a subsidence inversion caused by the prevailing high over this area. It is important to note that the highest pressure recorded during January-February, 1996 was during this period. It only confirms our explanation partially, however, we need to examine the upper atmospheric conditions from other groups working over east Antarctica.

Enomoto *et al.* (1998) have reported an abrupt surface air warming even during June, 1994 at Dome Fuji in the East Antarctic region and it was explained on the basis of a blocking high in middle troposphere. At our station, the atmospheric pressure also indicates the highest values during the warm spell period. Enomoto *et al.* (1998) have observed a blocking high even in the upper troposphere; this high-pressure area corresponded to a ridge of stratospheric circulation.

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