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Interesting Features of Infrasonic Pressure Variations at Maitri, Antarctica

A.K.HANJURA AND R.VENKATACHARI

National Physical Laboratory, New Delhi

Abstract

A microbarograph, set up by NPL, was used to study the features of the infrasonic pressure variations at Maitri, Antarctica. A few interesting features are described and possible linkage of infrasonic pressure variations with temperature changes in the stratosphere is suggested.

Introduction

The tenth Indian Antarctic expedition (1990-92) carried out various experiments with ground based instruments at Maitri (70° 46'S, 11° 44'E). One of the ground based instruments was a microbarograph set up by National Physical Laboratory primarily to study the coupling between different layers of the atmosphere. The microbarograph is a condenser microphone type having a frequency response 0.001 to 2 Hz. This is the first time that microbarograph data for Antarctica was available for one full year. Based on limited data of the earlier expeditions, some features of the infrasonic pressure variations at Antarctica have already been reported (Venkatachari et al.,1984; 1987).

In this paper we are reporting the general features of infrasonics that are observed at Antarctica with special emphasis on wave motions observed there, especially in the month of October 1991, which may bear indirect evidence of temperature changes in the stratosphere.

General Features

1. Based on an annual temperature variation, there are only two main seasons in Antarctica viz., summer and winter (though one can interpose 4 seasons due to transition periods between these two main seasons). During summer (December to February), the highest temperature recorded at ground was 8.2°C and the lowest -20.7°C while during winter maximum recorded temperature was 1.4°C and the minimum was -30.6°C (Hanjura, 1992). During summer the infrasonic pressure

variations show larger amplitude due to convective heating as is found in tropics. In winter, due to lack of heating the amplitudes are small (Figs. 1 & 2).

2. Over Maitri, wind speeds were of a variable nature. Prolonged spells of light winds were interposed with the spells of high winds. Windy records were observed continuously on many days in Maitri.

3. Blizzards were not observed during the months of January, February, August and December 1991. The maximum wind speed observed during a blizzard was 74 kts. (Hanjura, op cit.).

4. In conformity with our earlier results (Venkatachari et al.,1987 & Srivastava et al.,1982) the infrasonic records are normally agitated on magnetically disturbed days, especially in summer. Since this aspect was discussed earlier, it is not found necessary to elaborate it.

5. Infrasonic wave motion was seen on many occasions throughout the year. A careful scrutiny of records shows that these waves were mostly observed in April (before the onset of Antarctic winter), sometimes during the winter seasons and after the winter as well. Some representative diagrams are shown in Figs. 3 & 4. It appears that a change in temperature was responsible for generating these waves in April 1991. The possibility of a sub-storm triggering the wave motion is also there but in the absence of a detailed data on daily temperature variation or sub-storm activity at Antarctica, it is difficult to say as to why these wave motions are observed only on some days and not on other. Perhaps a sub-storm would have triggered the wave motion in winter (Fig. 4) when the change of temperature is not considerable.

Interesting Features

A very interesting feature was seen in the infrasonic records during October 1991. This is a time when sunshine is increasing (0200 to 2200 hrs) after winter. After October 25, there was sunshine round the clock. Throughout this month wave motion is seen in infrasonic records unless they are modified by winds.

In Fig. 5, it can be seen that around 2000 hrs. UT (3rd October '91), a wave motion is triggered apparently by a shock wave and then goes on with reduced amplitude.

The stratospheric (100 mb, 15 km) temperature starts decreasing rapidly from the end of April and maintains at -80°C from June to September. When the Antarctic summer starts by the end of September, chemical reaction takes place and the ozone hole is formed (W.M.O, 1989) around first week of October. In 1991, it was around 5th October (Chandra, 1992). With the increase in temperature, when the stratospheric clouds disappear, ozone hole recovery starts and the whole process (formation to recovery) takes only 15 days.

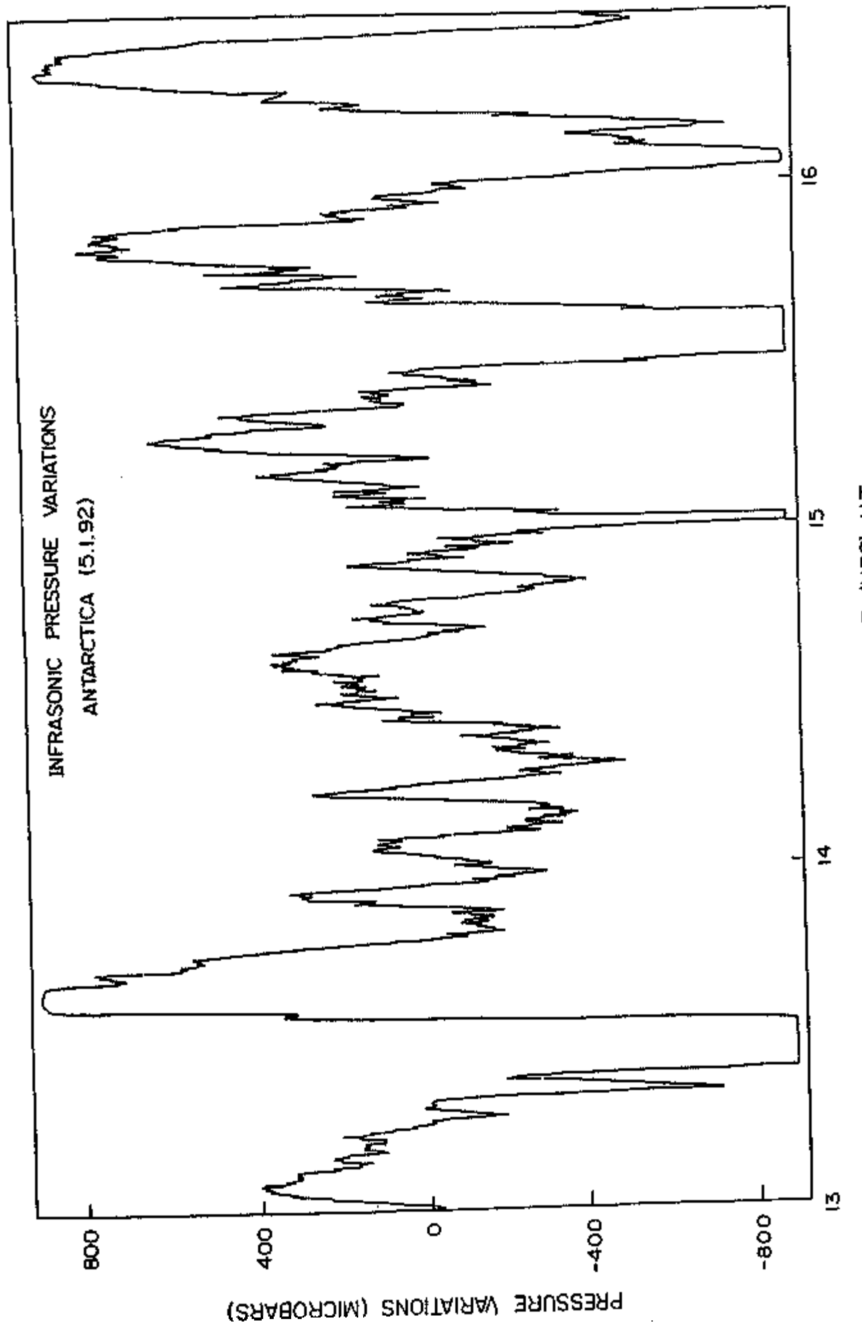


*Fig.1, Infrasonic pressure variations at Maitri during summer (*5.1.1992

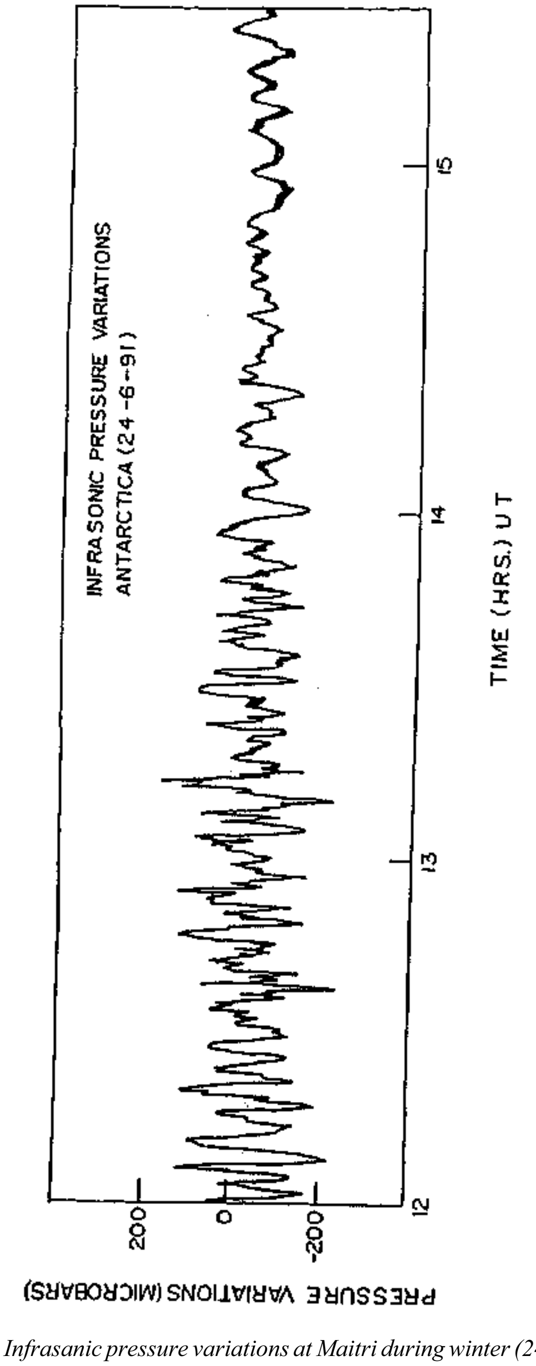


Fig. 2. Infrasanic pressure variations at Maitri during winter (24.6.1992).

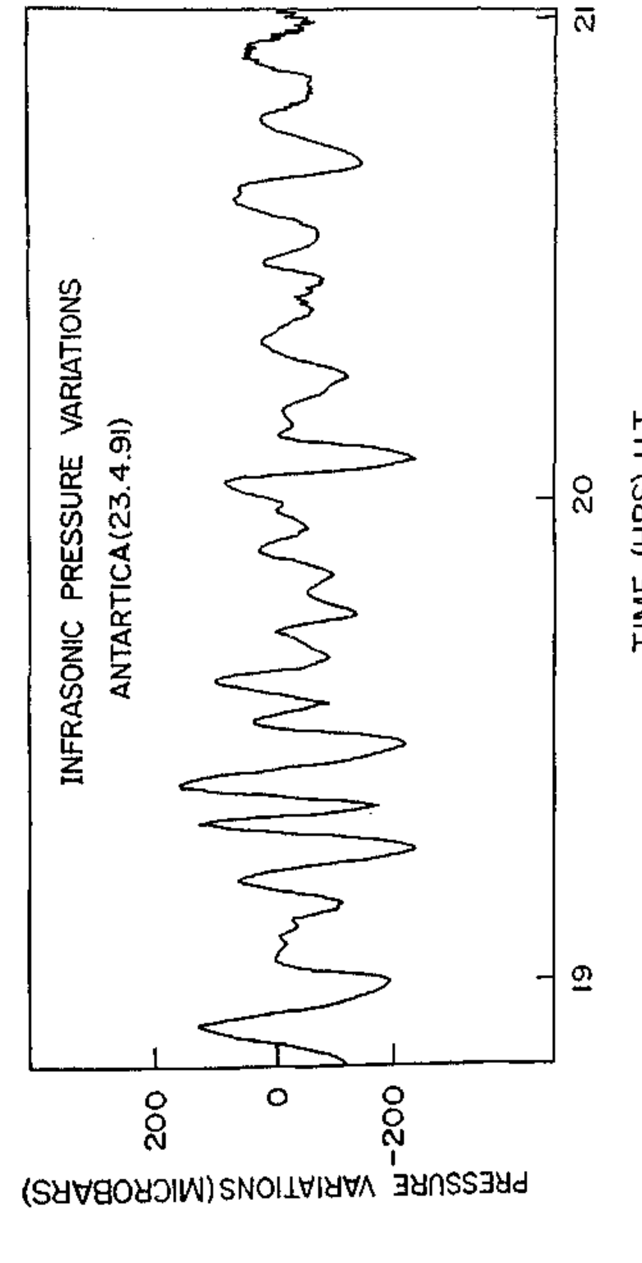
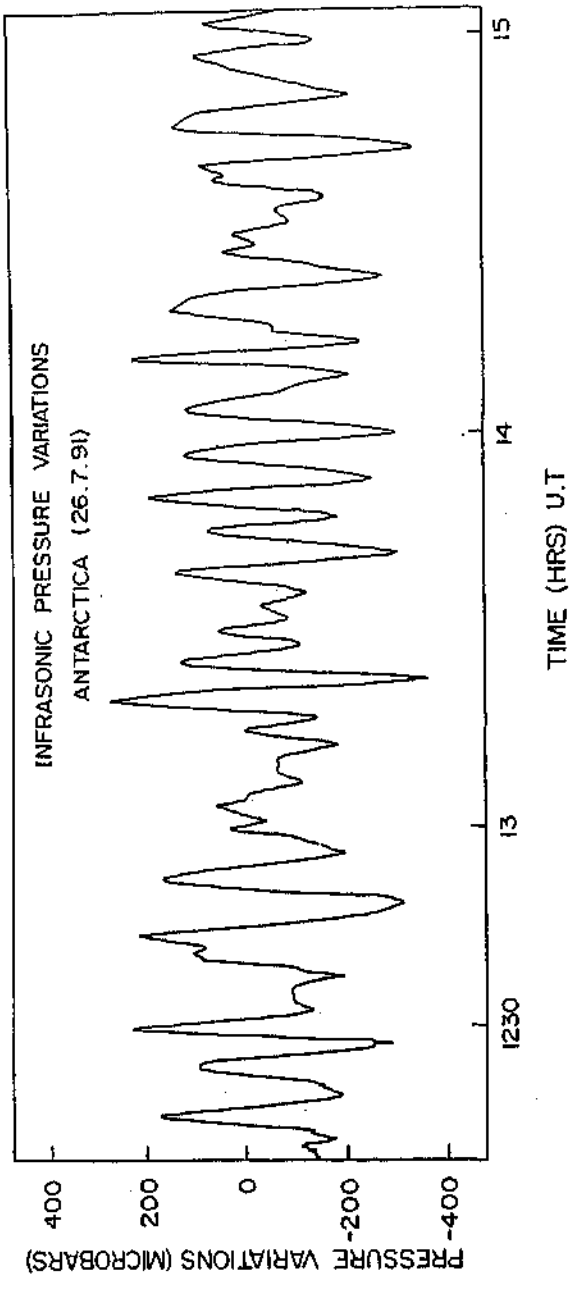
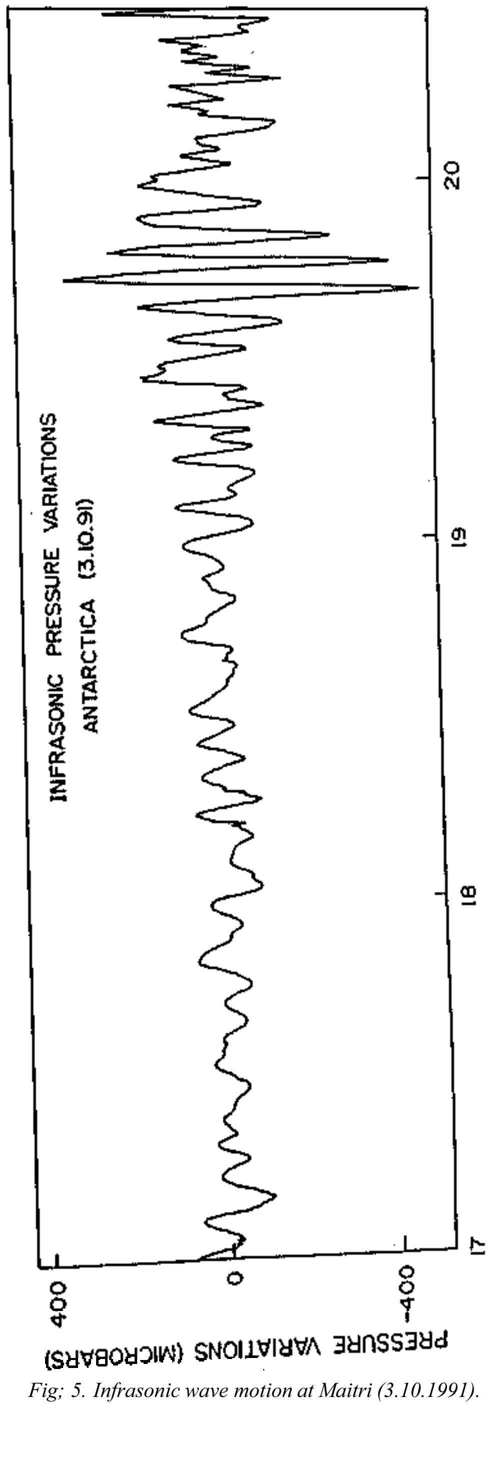


Fig. 3. Infrasonic pressure variations at Maitri - wave motion (23.4.1991).



Fig, 4. Infrasonic pressure variations at Maitri - wave motion (26.7.1991).



Fig; 5. Infrasonic wave motion at Maitri (3.10.1991).

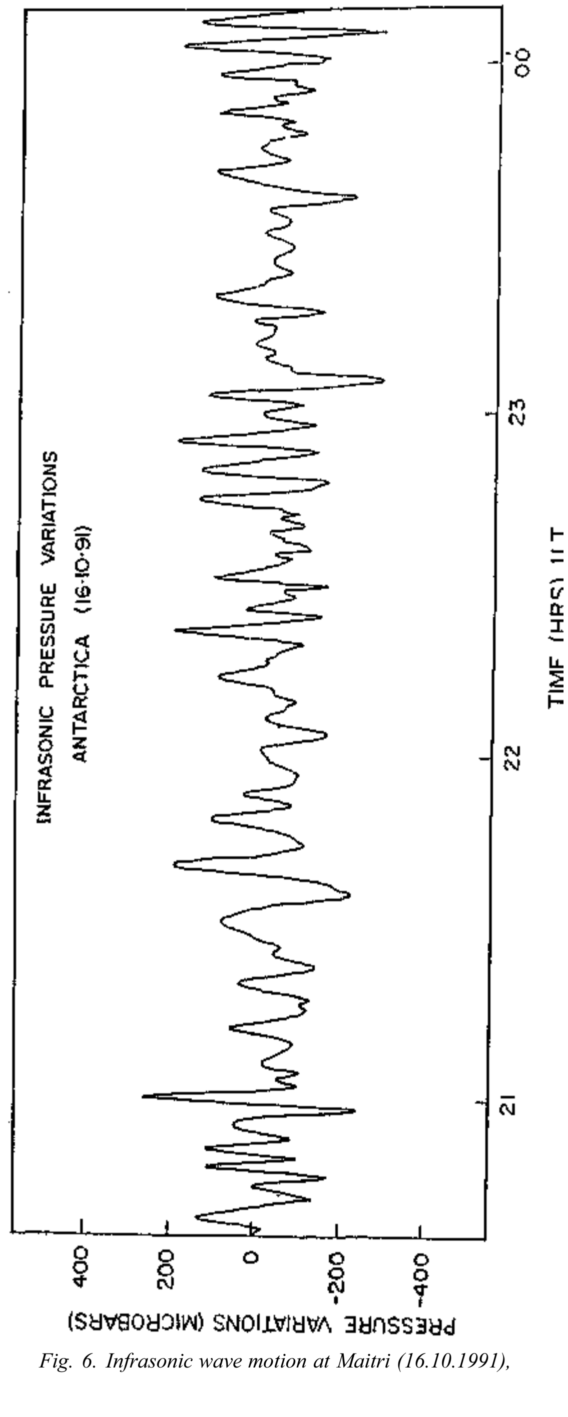


Fig. 6. Infrasonic wave motion at Maitri (16.10.1991),

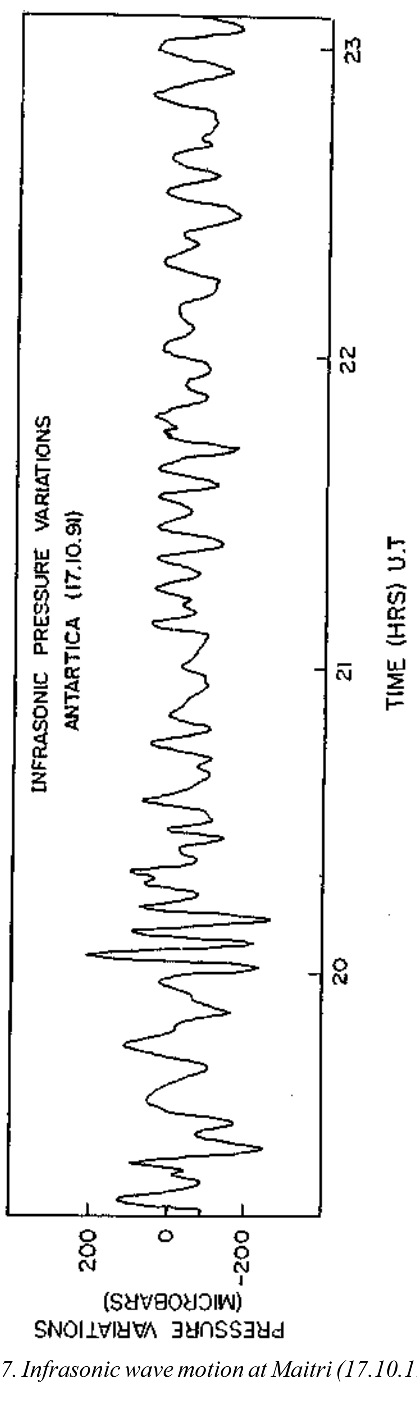


Fig. 7. Infrasonic wave motion at Maitri (17.10.1991).

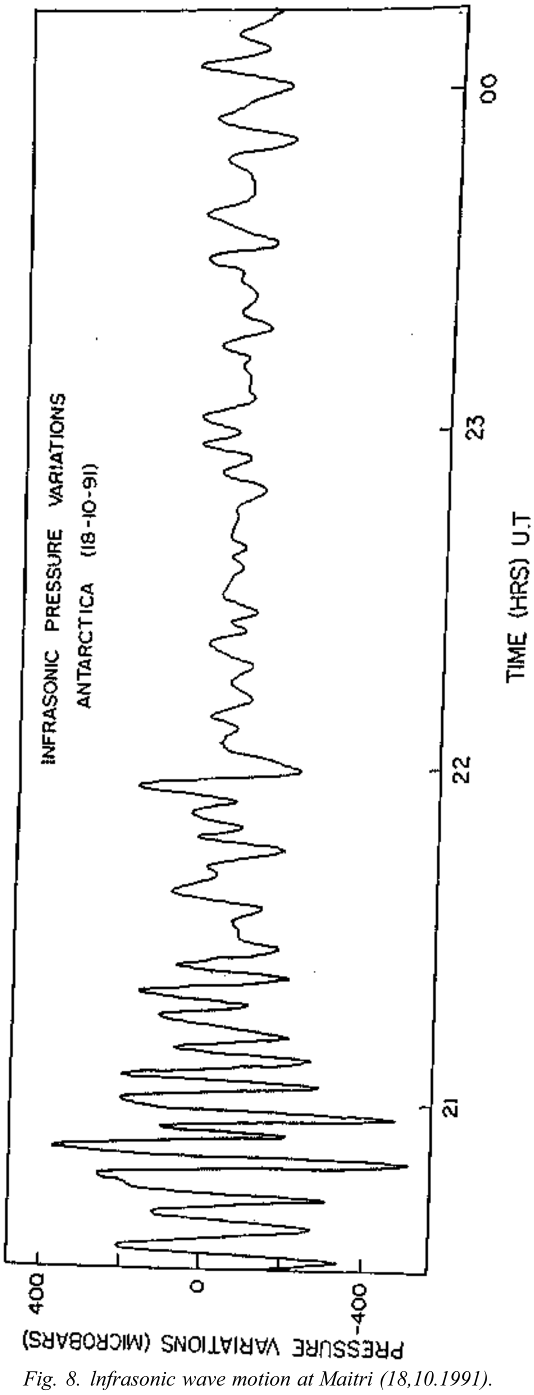


Fig. 8. lnfrasonic wave motion at Maitri (18,10.1991).

The surface temperature also decreases by 8 to 10°C from April to May and increases by 8 to 10°C from September to October. However, these wave motions are not found in sodar records and hence the possibility of tropospheric origin of these waves is ruled out.

Similarly, on 16, 17 and 18 October '91, wave motions are seen (Figs. 6, 7, 8) with a shock.wave in the begining between 2000 and 2100 hrs. UT. Though we can conjucture that this may also be related to the temperature changes in the stratosphere, it cannot be explained why it starts between 2000 and 2100 hrs only.

Another possibility is that some other country is conducting some explosion experiments in the area around that time. But if it is a shock wave due to explosion, the wave motion will die out after some time. In the present case the wave motion continues for days together (diagram shows only a portion of the wave motion). Perhaps some triggering action is taking place between 2000 and 2100 hrs. on those days. These days are not magnetically disturbed days at Antarctica. There is no information regarding sub-storm activity there. Even if a sub-storm triggers the wave motion, it cannot last long and will die out after few hours. Since the variation of temperature at ground is not much during October '91, tropospheric origin of these waves is ruled out. The height of the troposphere is only 9 km at Antarctica (Hanjura, op cit). Incidentally sodar records taken at Antarctica donot show these wave motions.

If this phenomenon is a regular feature during October, even then, it can be conjectured that it has some connection with the temperature changes in the stratosphere.

We would like to leave it here, just mentioning the possibility that, perhaps, complete recovery of ozone hole may be around these dates in October 1991. In the present study we were essentially concerned with the stratospheric temperature changes and not the ozone hole phenomenon. It may be pointed out that microbarograph can respond to any change in pressure (or wave motion) upto a height of 100 km. If temperature measurements are available, the source can be fixed.

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