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Study of the Ionised and Non-Ionised Atmosphere

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ABSTRACT

During the Third Indian Scientific Expedition to Antarctica, a permanent station with all facilities for conducting laboratory experiments was established, and D-region ionisation and the ground level pressure variations were studied. These studies were made in continuation of experiments conducted during the earlier expeditions. The results are discussed in this paper.

INTRODUCTION

The experiments conducted by NPL during the Third Antarctic Expedition were in the nature of continuation of those conducted during earlier two expeditions. Mainly two experiments were performed during this expedition successfully. (I) Study of the D region ionisation behaviour using riometer observations (II) Study of ground level pressure variations using microbarographs. These two experiments have been described in the following sections. One of the main achievements of the present expedition was the building of a permanent manned station with all facilities for conducting laboratory experiments. The air conditioned laboratory in the permanent station has uninterrupted electric supply. Towards the latter part of our stay the two above mentioned experiments were shifted to the laboratory from the tents and have been left behind in running condition for continuing the observations during the Antarctic winter.

RIOMETER EXPERIMENTS

The study of ionised atmosphere ie ionosphere has been undertaken right from the first Indian expedition to Antarctica. This study is of a continuing nature, and data over a long period of time is required to make these studies useful. The state of ionosphere keeps on changing at different times of the day and from season to season. From HF communication point of view, it is necessary to predict the state of ionosphere with time. Since the HF communication is being tried between Antarctica and India the present studies will be quite useful. A riometer tuned to 20 MHz was used for this study. The data were collected for the summer months at the station site. The locally fabricated antenna for the reception of 20 MHz noise comprised of two open dipoles 21 ft apart, element length being 11 ft. The antenna output were matched through baluns made out of triaxial cable and were combined in the same phase. Reflectors were also used and their height above ground was adjusted to give maximum signal strength. The height of antenna above ground was 90. The dipoles were aligned along geographical N-S. The riometer was fed from the baluns through a 50 ohm co-axial cable and gave a d c output proportional to the signal strength input. The output was recorded on a strip chart recorder. In a place like Antarctica where there was no man made-noise the noise signal recorded was the one received from sources outside the ionosphere like the radiostars. The signal traversed the ionosphere and in doing so got partially absorbed depending upon the state of ionosphere.

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Since the noise source was steady the variations in recorded signal strength gave an idea of the state of ionisation. In order to record data over a long period of time the set up was shifted to the permanent station. Antenna was erected about 100 m away from the building so as to be away from any man made noise. Since a long coaxial cable from antenna to the laboratory would seriously deteriorate the signal strength the riometer was placed in a weather proof box sealed completely and guyed properly to resist strong winds. The box was placed a little distance away from the antenna and the riometer output taken to the recorder in the laboratory. A weather proof 3 core cable was used for this purpose as well as for giving power to the riometer. Hourly time markers were provided by the riometer itself.

A typical record of 20 MHz riometer observations is shown in Fig 1. This record shows a geomagnetic quiet time behaviour with the received noise remaining relatively steady. The riometer data are being compared with the previous year's observations. These will be analysed in a similar way and the results reported in a subsequent publication.

MICROBAROGRAPH EXPERIMENT

Apart from ionospheric studies an experiment to study the surface wind pressure fluctuations was conducted using a microbarograph. The sensor of the instrument was having three symmetrical inlets and one of them was kept facing the prevailing wind direction which for the station site was east of south east (~100°). The microbarograph was kept in the open far away from any structures or obstacles. The experiment was carried out at the station site and simultaneously at *Dakshin Gangotri* hills. The prevailing wind directions at both the places was roughly the same. The output of the microbarograph was a d c voltage proportional to the pressure fluctuations at the sensor. The power to the instrument was fed through an audio cable and its output taken to the recorder through another cable. This system was later shifted to the permanent station to get the data for the whole year. The only problem was the blocking of the sensor inlets due to snow drift during blizzard. Since snow drift associated with strong winds at sub-zero temperature was a regular feature in Antarctica the problem was acute and was solved by installing microbarograph on a raised platform and also exposing it to room temperature (~12C°) overnight after each blizzard. The microbarograph was fixed at a place far away from any obstacle so as to have minimum drifted snow deposition. The recordings were done at 4 /hr chart speed.

During the second expedition several factors were noted in the microbarograph recordings. There were normally pressure oscillations with amplitudes around + 200 microbars. These oscillatory disturbances were connected with infrasonic disturbances in troposphere which during quiet time were mostly of local meteorological origin. A study of the interconnection between the Antarctic microbarograph records with observations taken in India at Hyderabad and at Delhi was made. Certain characteristic patterns in the infrasonic pressure variation believed to be connected with the auroral events and solar particle precipitation during geomagnetic storms were connected with similar observations at lower latitudes in India. It was noted in general that during geomagnetic disturbances enhanced infrasonic activity was recorded in Antarctic records. A special event was the occurrence of a large pressure oscillation arising out of an under sea earthquake near the Andaman Islands. Yet another event was the occurrence of an infrasonic disturbance train of quite large amplitude which was speculated to be connected with some unannounced explosion in some part of the world.

The observations made during the present expedition show the normal features as described above for the previous expedition. A typical recording is shown in Fig 2. One particular difference that was noted was in the amplitude of the pressure oscillations which were found to be larger in general in the present observations than those recorded during the second expedition. This may have some bearing on the changing solar activity which is on the decline. More detailed investigations on the

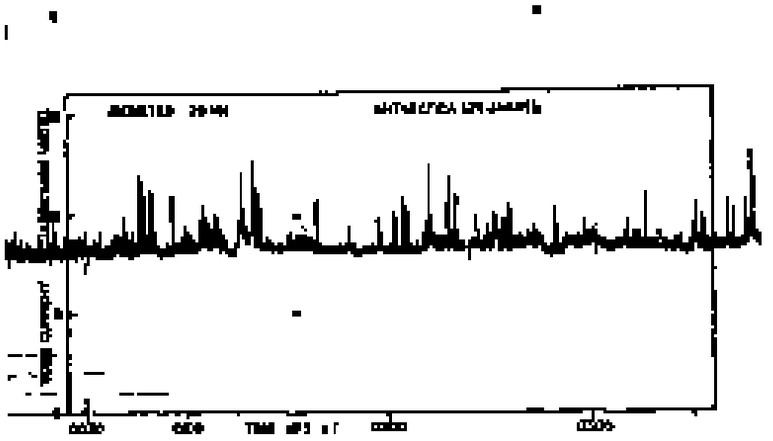

Fig. 1 Record of 20 MHz riometer observations on January 22, 1984

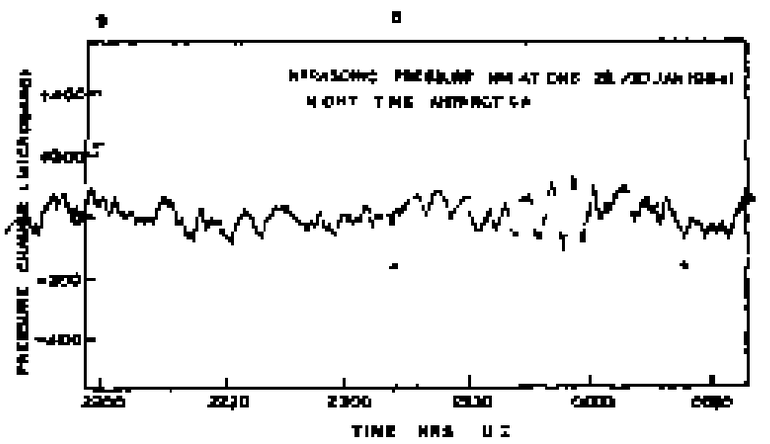

Fig. 2 Infrasonic pressure varations on January 29/30, 1984

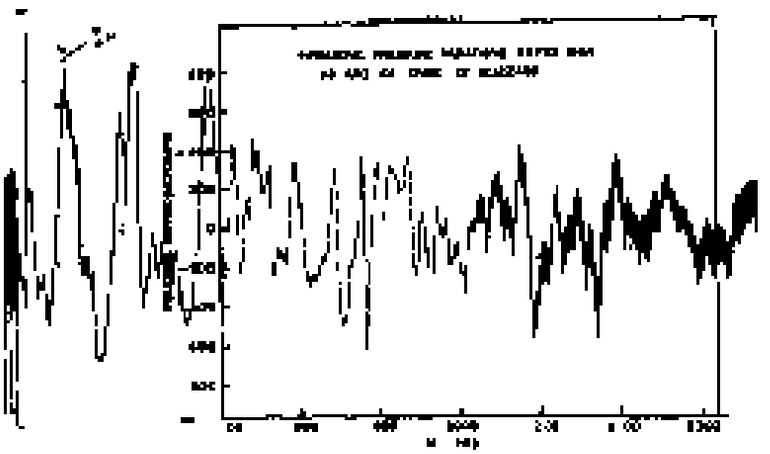

Fig. 3 Infrasonic pressure variation on February 25, 1984 during the onset of a blizzard.

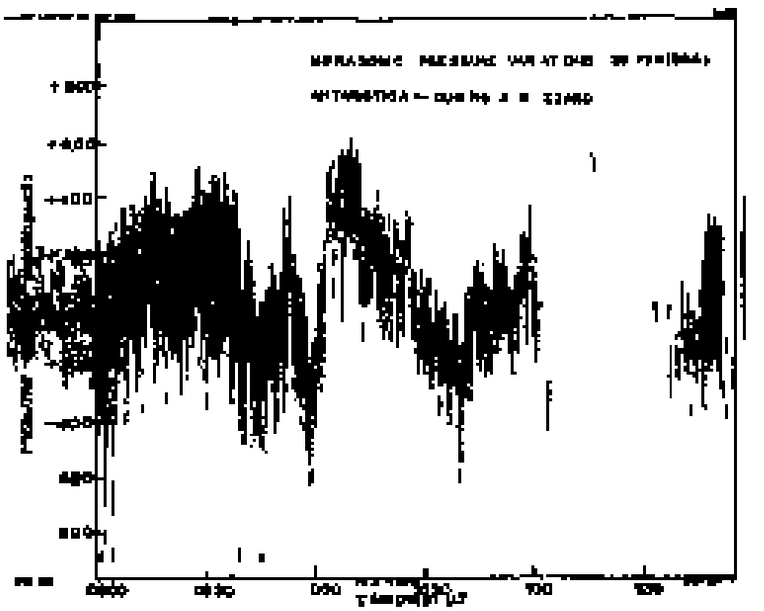

Fig. 4 Infrasonic pressure variations on February 28, 1984 during a blizzard

velocity of travel of the infrasonic disturbances in the present data are being made using the observations made at two locations - the base camp on the ice-shelf and the hills of *Dakshin Gangotri.* These should provide more quantitative connection between the occurrence of auroral disturbances and the infrasonic oscillations.

An interesting recording was made during a blizzard which lasted more than three days (26th to 28th Feb 84). The recording shown in Fig 3 was made during the onset of the blizzard. It was noted that prior to the onset large pressure oscillations appeared which were precursors to the main event while it was still away. During the onset while the winds built up very short period fluctuations started appearing on the recording making it look blurred because of the slow chart speed. During the main blizzard the record was totally blurred as seen in Fig 4 with very large amplitude short period oscillations superimposed on longer period variations. The present data on the behaviour during a blizzard is rather inadequate as it is only for one event. But it does indicate possibilities for future work in this area especially in regard to the studies of the characteristics of the precursor patterns which may help to forecast blizzards in advance.

CONCLUSION

The study of ionospheric variations is important for the purpose of HF communications which are being tried between Antarctica and India. Since ionospheric conditions change continously, data for long duration are needed for definite conclusions. Encouraging results are seen on comparison of inospheric data received during this expedition with those obtained earlier.

Amplitude of pressure oscillation is seen large during the present expedition compared to that of the second expedition. Detailed investigations are being made using observations taken at the base camp on the ice shelf and the hills of *Dakshin Gangotri.*