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HF Radio Communication during the XIII Expedition

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Abstract

DEAL has been given the task to study and collect data on HF propagation condition existing in Antarctica, conduct various experiments to improve the quality and quantity of voice and data communication and to find out suitable alternative means for different requirements. This paper presents the results of the studies conducted during XIII expedition.

Introduction

DEAL is providing HF voice/data communication between Maitri (Antarctica) and Dehradun(India) since XI expedition. Various communication experiments were tried for improving the communication facilities. During the XIII expedition, DEAL member of the team provided:

1. **HF voice/data communication with DEAL.**
2. **Monitoring of various broadcast stations to provide general information/news/entertainment to the team members.**
3. **Ham contacts around the globe to foster international friendship and cooperation through Amateur Radio.**

In addition, various communication experiments and HF propagation studies were conducted during the expedition. The quality of the signal received during the above activities helped us in assessing the propagation conditions and correlating this with the geomagnetic data collected by IIG members of the team.

Experimental Setup

The experimental setup consisted of two 11 element Log Periodic Antenna (LPA) on 20 feet mast. Yaesu 757 GXII transceiver and FL 7000 HF linear amplifier. For data communication IBM compatible PC AT alongside KANTRONICS KAM modem was utilized. Since LPA could cover only 14 to 28

MHz band, fixed frequency dipoles were installed as and when required to cover complete HF band.

The AGC of the receiver was fed to the recording system consisting of calibrated chart recorder and PC based data acquisition system (DAQ). The PC-PLUS 141 data acquisition card used has multi-channel handling capability which can be used for recording a number of parameters simultaneously. The geomagnetic data was obtained through IIG systems located in Antarctica.

Amateur Radio Station - HAM

A special call sign AT3D was allotted by WPC, New Delhi for the expedition. Since this call sign was not available in the international call books, OM VU2VP Sandlas gave his consent to act as QSL manager. Yaesu 757 GXII transceiver and 11 element LPA were used as basic setup though KAM and Morse key were also added time to time in the set up. A total of 125 countries were covered through 1800 contacts made during the expedition.

Details of Analysis

The HF propagation data was divided in two parts:

Point to Point communication: Maitri to DEAL communication records and Ham data were clubbed.

Broadcast: Quality of signals from different broadcast stations were summed up to assess overall broadcast propagation.

The quality of point to point communication and Broadcast signals for each day was classified in these categories:

0: No signal received.

1: Signal of moderate strength.

2: Signal of good quality.

Geomagnetic disturbance was also roughly categorized as:

0: No geomagnetic disturbance.

1: Moderately disturbed geomagnetic condition.

2: Severely disturbed geomagnetic condition (geomagnetic storm).

Each day was assigned one of these values on the basis of hourly geomagnetic data supplied by IIG members of the team. These may differ from that of IIG because of qualitative assessment made by us from the point of view of radio wave propagation.

The monthly and annual variations in HF point to point communication and broadcast modes and days of aurora observed and geomagnetic disturbance are plotted in (Figs.l to 7).

The dates for different conditions were found out and compared with the propagation assessment of DSTO Australia in their monthly bulletins.

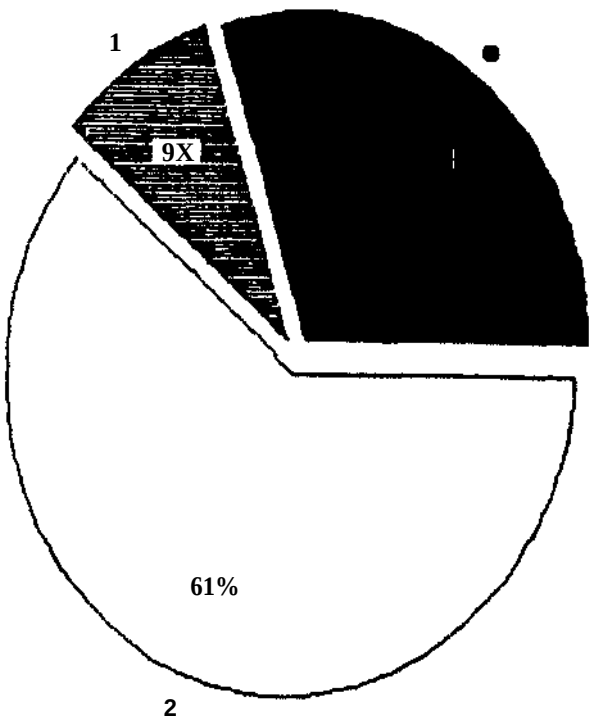

Fig. 1: Annual Variation in Point to Point HF

Results of Analysis

Noteworthy results are summarized below:

1. **Good quality HF point to point communication signal was received on 145 days during the expedition period with lesser number of days in the months of May to August.**
2. **Broadcast signal quality was very good for 194 days with a minimum in May. Amount of data collected during February- March period was limited due to interference from other powerful stations.**
3. **Aurora was observed on about 31 days in the year with a maximum in the month of September.**
4. **Geomagnetically disturbed days were roughly about 64 days for moderate activity and 88 days for severe activity. In the months of March to**

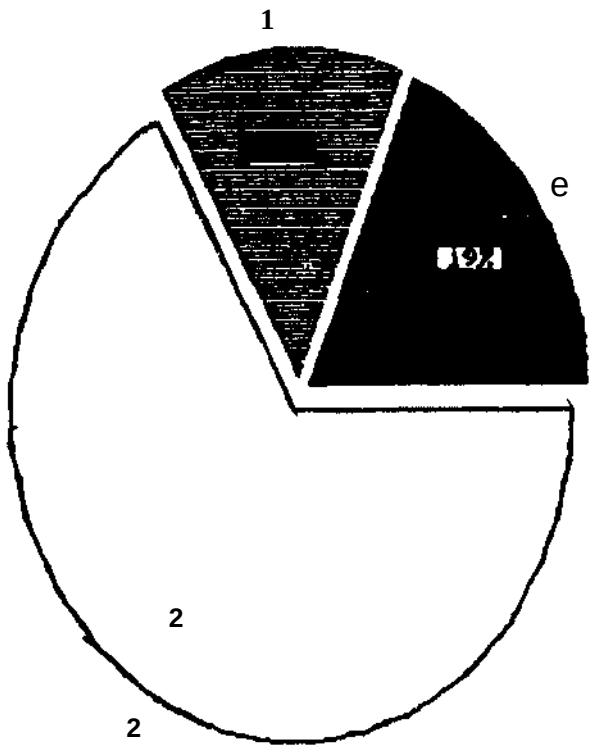

Fig. 2: Annual Variation in Broadcast HF

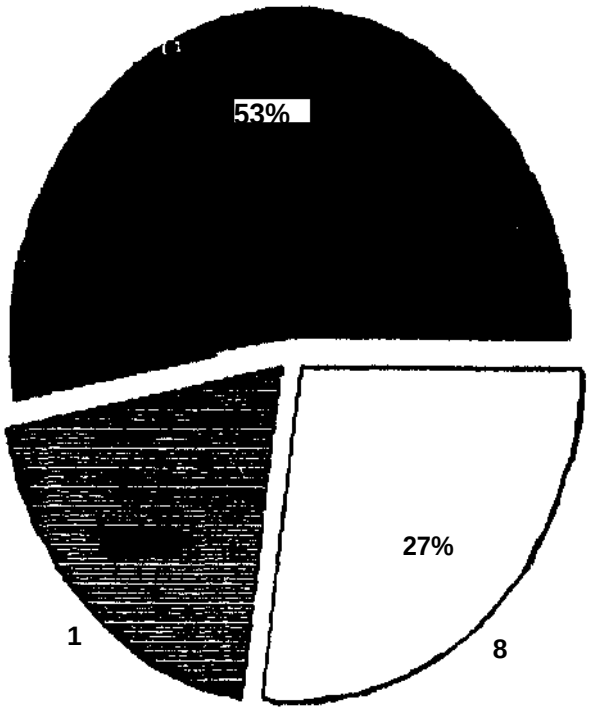

Fig. 3: Annual Geomagnetic Condition Occurrence

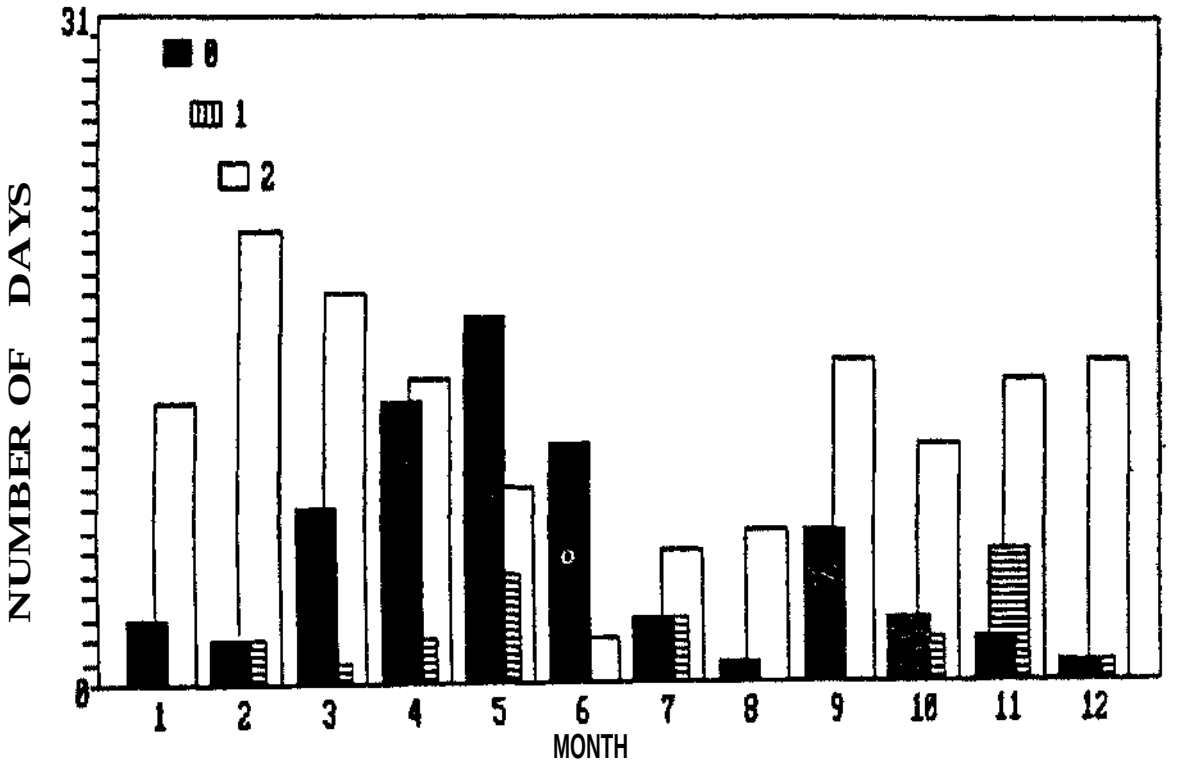

Fig.4: Monthly Variation in Point to Point HF

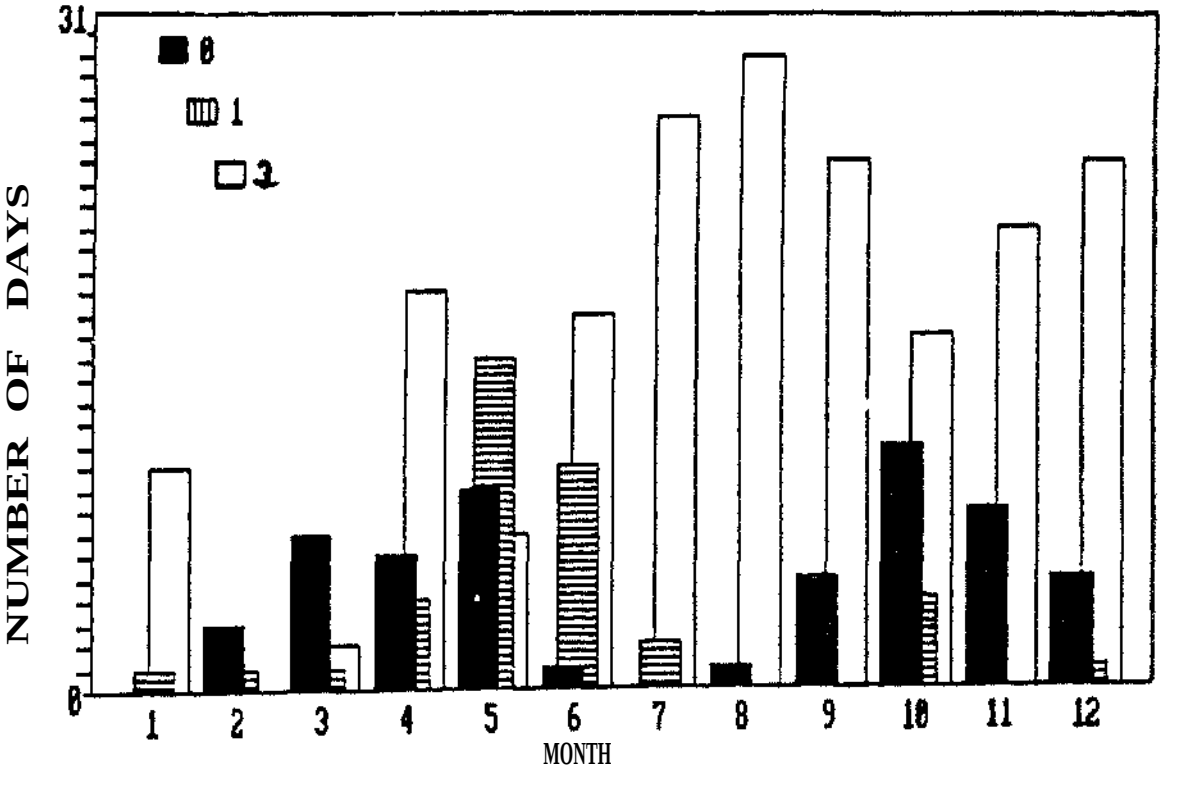

Fig. 5: Monthly Variation in Broadcast HF

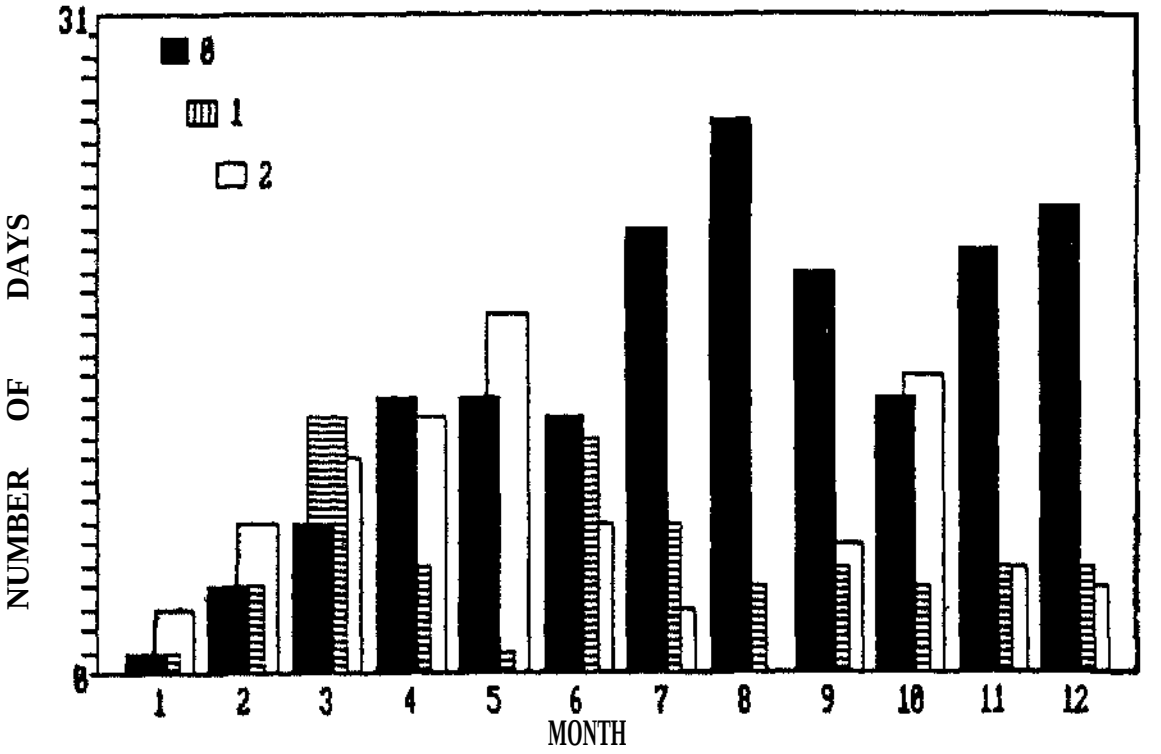

Fig 6 Monthly Geomagnetic Condition Occurrence

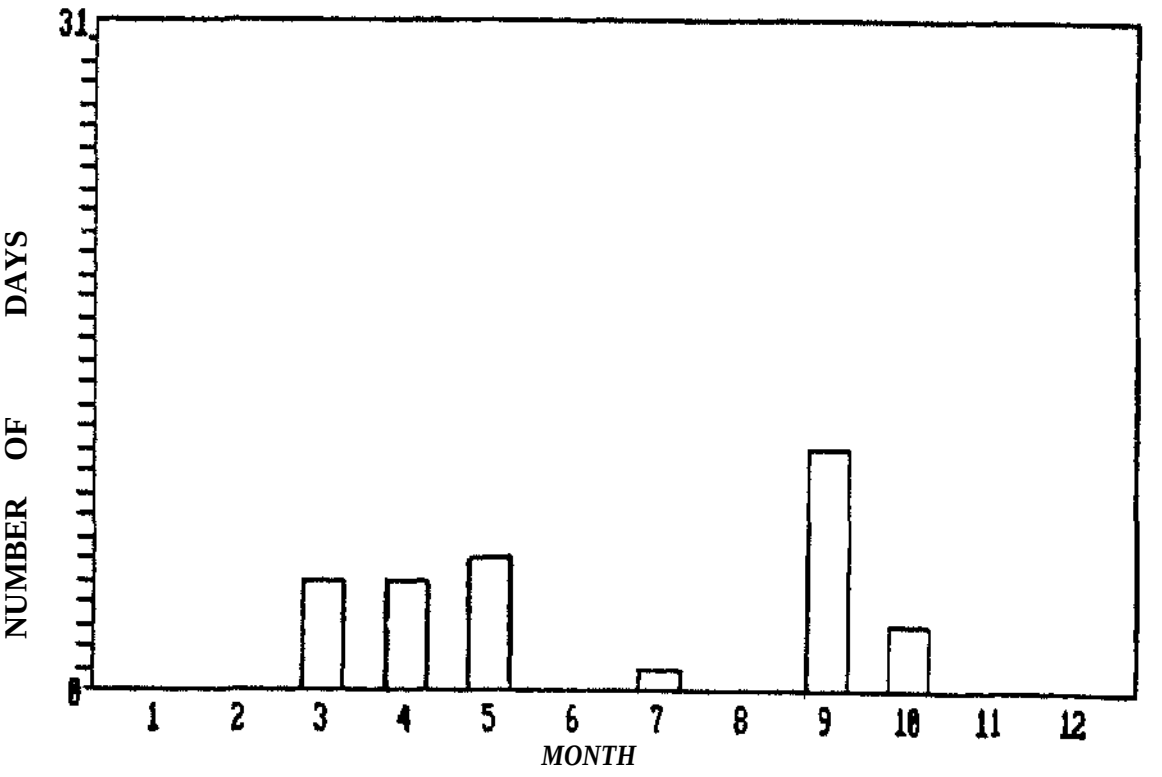

Fig 7: Monthly Occurrence of Aurora

May and October the severe activity was on 10 or more days. Sun spot activity was much lower in the solar cycle in the year 1994 and presence of a coronal hole on the sun was responsible for large number of magnetically disturbed days with a near 27 day cycle repetitions.

5. No HF point to point communication signal was received for 49 days and no broadcast signal was received for 44 days when the.geomagnetic activity was severe. Such periods were more in the months of March to May and October. The October was the worst month to the extent that HF communication between Maitri and DEAL was not even tried for a large number of days seeing the dead broadcast condition. DSTO bulletin has also reported similar propagation conditions.

6. HF point to point communication was good for 25 days and broadcast was good for 17 days even in the presence of severe geomagnetic disturbance. This type of observation needs further study and data collection by a team of experts in the areas of radio propagation and geomagnetism.

7. On 21 days the broadcast signal was good even in the presence of geomagnetic disturbance and HF point to point signal being not re ceived. Such periods were more in the months of April to June. This may be due to high power and Wide beam width antennas used for broadcast. Some signals from various alternate modes of ionospheric communication from a large area of ionosphere may reach the receiver.

8. On 8 days the HF point to point signal was good even in the presence of geomagnetic disturbance and broadcast being not received.

9. On 11 days the HF point to point and broadcast signal quality was good on the days when Aurora was observed. More fine data recording of HF and geomagnetic parameters on the same DAQ system and joint analysis by a team of experts from Geomagnetism and Ionospheric Physics is required to throw light on such observations. On 13-14 days the HF point to point communication was blocked in the presence of Aurora.

Conclusion

Low power HF link between Antarctica and India can be utilized for voice/data communication for nearly half of the days in a year. For rest of the period it can not be used reliably and even increasing the transmitted power does not give any appreciable gain. More propagation and Geomagnetic data should be collected in future expeditions and International collaboration is required to compare it with the data collected by stations of other countries in Antarctica.

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