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A preliminary study of the Saurashtra cyclone from NOAA—5 VHRR imageries

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ABSTRACT. Data from NOAA-5 VHRR has been collected at the Sapce Applications Centre, Ahmedabad during the month of November 1978. In this period a sequence of satellite pictures depicting the various significant stages of the cyclone which hit the Saurashtra coast were obtained. A brief description of the data reception system and the preliminary results of analysis are presented.

1. Introduction

At the Space Applications Centre (SAC), ISRO, Ahmedabad the NOAA-5 Very High Resolution Radiometer (VHRR) transmissions at S-band were recorded with a 10′ dish antenna during a campaign organised in November 1978 as a part of a programme initiated for the study of tropical cyclones. During the month, two severe cyclonic storms were tracked, one between 6 and 13 November (Saurashtra cyclone) and the other between 18 and 28 November (Sri Lanka cyclone).

In this communication, we present the VHRR data reception system designed and built by ISRO engineers, and some of the high resolution pictures (resolution 1 km at sub-satellite point, compared to 7 km for APT pictures) of the first cyclone with this system.

2. Data reception system

A simplified block diagram of the reception system used at SAC is shown in Fig. 1. The complete terminal was built by ISRO using indigenously developed subsystems at SAC.

The reception system basically contains three subsystem-the antenna subsystem, reception subsystem and the recording and processing subsystem. In addition as the distance between the antenna site and recording site is about one km, an UHF link is used to transmit data received at the antenna site to the recording site.

2.1. *Antenna subsystem*

A 10 ft chicken mesh parabolic reflector with a prime focus feed has been used to accept the circularly polarised signals of NOAA satellites. The signals received at the focal point are amplified by ultra low noise amplifiers and passed through a band pass filter prior to down conversion. The down converter converts the 1967. 5 MHz HRPT NOAA signal to 70 MHz IF before transmitting to the recording site. Photographs of the 10 feet antenna is shown in Fig. 2.

As the terminal was not an auto-track type, tracking of the satellite was accomplished manually. The basic predicts from NOAA are used to generate the pointing angles for the antenna with respect to time, by a computer programme. These predicts were used while acquiring the satellite initially. Once acquired, the antenna is moved slowly so as to keep the maximum signal indicated by the AGC reading of the down-converter by a meter, which is kept before the operating personnel. This assurred a good signal reception. As the antenna beamwidth at this frequency is of the order of 4 manual tracking did not pose any problem.

2.2 *Link between antenna and reception sites and reception subsystem*

The 70 MHz IF signal thus received at antenna site is up converted to an UHF frequency and transmitted using a small helical antenna to another helical antenna at the receiving site. The quality of the UHF link is maintained best,

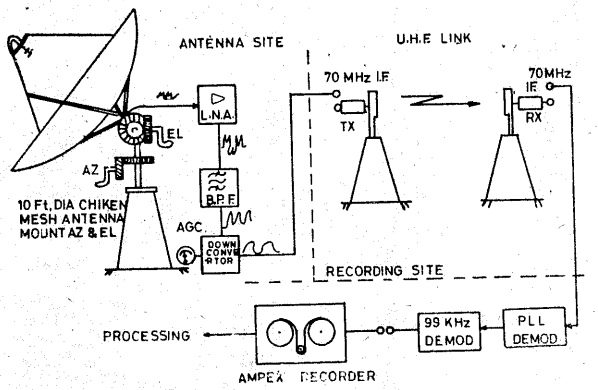

Fig. 1.

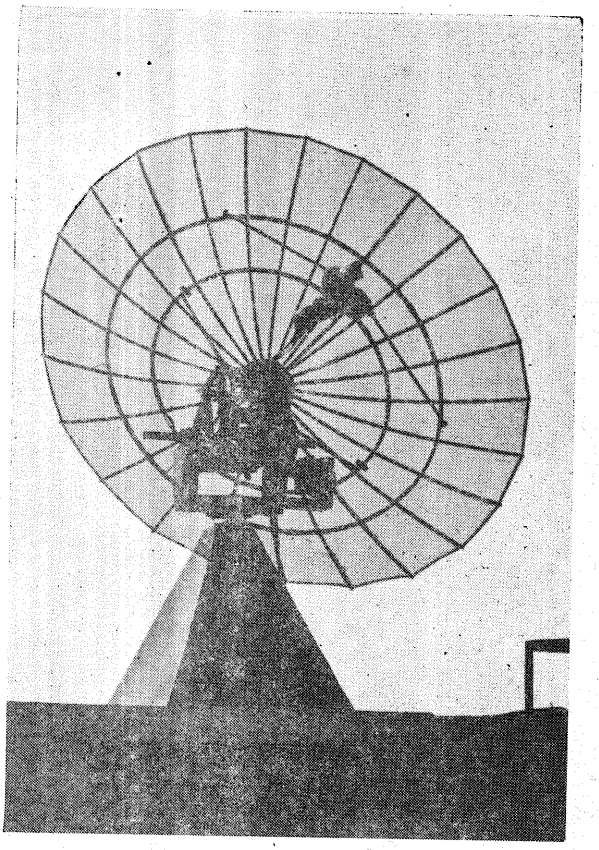

Fig. 2.

Fig. 3. 9 November 1978 IR (gridded)

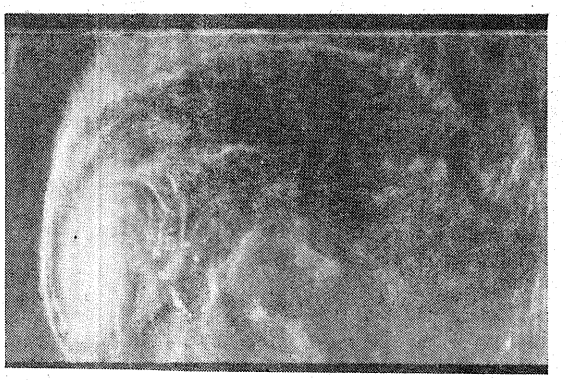

Fig. 4. 9 November 1978 IR

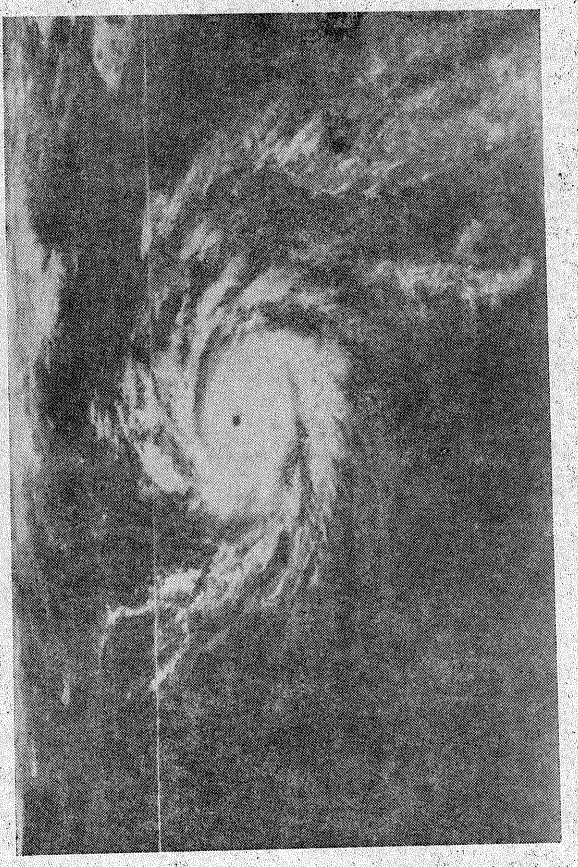

Fig. 5. 23 November 1978 VIS (Sri Lanka cyclone)

not to degrade the 70 MHz IF. At the receiving end it is fed to PLL demodulator to extract the modulated subcarrier at 99 KHz. This FM signal is further demodulated to get the base band signal consisting of visible and IR channels.

2.3. *Recording subsystem*

The analog VHRR transmissions have been digitised and photowritten on an optical device (optronics) to prepare the imageries. A laser beam recorder for producing real time imageries (from analog data) also exists. The former mode, though more time consuming, also yields computer compatible tapes (CCTs) for quantitative processing of the cyclonic cloud structure and features from the infrared and visible data.

3. The Saurashtra cyclone system

A depression formed in the Bay of Bengal on 3 November 1978, crossed the Peninsula and intensified into a cyclonic storm on 6 November in the Arabian Sea attaining its maturity stage on 8th. After recurving, it hit the Saurashtra coast on the early morning of 12th.

A few of the series of VHRR imageries produced on Optronics from the transmissions received at SAC are presented in Figs. 3 and 4 corresponding to 9 November, depicting the stages of the system.

Fig. 5 shows the Sri Lanka cyclone (in the visible band) produced on the laser beam recorder, as of 23 November at 9.00 A.M. This cyclone hit the north Sri Lanka coast on the night of 23 November. The eye can be clearly seen.

The following significant features were observed from the high resolution pictures of the Saurashtra cyclone :

(*i*) The morning picture of 6 November (the first available from our recordings) showed a well organised cloud structure. The Central Dense Overcast area was bright, with prominent cirrus outflow at higher levels in the northwest and northern sectors. The intense convective activity in the southwest sector and the cirrus outflow were indications of further intensification.

(*ii*) The night picture of the 8th showed a pattern with feeder bands spiralling into the central area. The cirrus spread to longer distances from the centre to the north and southeast directions.

(*iii*) The computer gridded picture of 9th morning showed the eye of the storm, which was centred near 18.5°N, 63° E. It was approximately 25 km in diameter. The cirrus outflow on the northern side was more pronounced in any other sector. The feeder bands from the south are, however, less marked.

(*iv*) The picture of 10th showed a decrease in the cirrus outflow.

(v) Though indications of the storm's weakening was apparent after 9th, it was seen that the system weakened considerably after the 10th, as observed from its disorganised structure on the 11th.

4. Discussion

The sea surface temperature distribution over Indian seas as supplied by NOAA, did not indicate that the weakening of the system over the sea was likely after 9 November. A preliminary examination of the upper air circulation pertaining to 6-13 November suggests that the weakening could be associated with the southward extension (up to 18°N) of the middle latitude westerlies above 500 mb and the cyclone getting embedded in the westerly system on 10th. A detailed study on this has been undertaken and these results will be published separately.

Acknowledgement

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