OPERATIONAL DERIVATION OF INSAT WINDS

PRESENT STATUS AND FUTURE PLANS

U. V. GOPALA RAO

INDIA METEOROLOGICAL DEPARTMENT
LODI ROAD, NEW DELHI--110003

ABSTRACT

Cloud motion vectors using INSAT-1 data are being derived from 1984. Initially the procedures were mainly interactive and the system could not meet the operational requirement of satellite winds. Automatic procedures have been introduced in 1985. Due to various limitations winds are being derived only at 06Z over the Bay of Bengal, Arabian Sea and parts of the Indian Ocean. Based on the experience in the first few years, quality control has been improved . A new processing facility is being established by the end of this year to facilitate derivation of winds over the complete field of view faster, to meet the requirements. Important features of the new system are described.

1 INTRODUCTION.

Extraction of Cloud Motion Wind Vectors (CMVs) was started on an experimental basis after the launch of INSAT-IB. During 1983-84, the winds were derived experimentally using manual target selection and semi-automatic Wind Vector Computations. During the initial period, a number of problems were encountered in streamlining the procedures for registration of Images and assuring consistency and accuracy of the derived winds. INSAT is the first 3-Axes stabilized geostationary satellite to be used operationally as a meteorological satellite. The experience of ATS-F has been used in devising operational procedures in data reduction and product generation. The INSAT-I Ground Processing System was built around PDP-11/70 Mini Computers with a very low throughput. Based

on the experience during the first one year, the procedures were modified and automated extraction of winds was started towards the end of 1984. Details of the method are described in Kelkar and Khanna (1986). The same method, with certain modifications, is being used currently for the derivation of winds.

2 CMVs are extracted using navigated visible images of 0530 and 0600 GMT. Visible Images (2.75 Km Resolution) are used in the extraction. Sectors of 512 x 512 pixels are registered using Semi-automatic Manual Method before the images are subjected to automatic wind extraction. The procedure uses a 15 x 15 pixel array as a reference window and the search window is 37 x 37 pixels for the low clouds and 61 x 61 pixels for high clouds. The pattern matching technique adopted is to take an absolute difference of gray shades between the corresponding pixels in the reference window and a sub-set of the search window of the same size. This is done for different lag positions and the position of the reference window in the search window, giving the minimum absolute difference is taken to be the new position, for the cloud target and the direction and magnitude of the wind vector is computed. Criteria have been fixed for the minimum gray shade level for clouds as well as to avoid use of reference windows having large cloud patches. Use of minimum absolute difference instead of conventional cross correlation has resulted in quicker computation of wind vectors and eliminated some instances of spurious winds. The heights are estimated by using the corresponding Infrared image and assumed vertical temperature profiles.

With the existing procedures, there is an inherent error of ± 1 pixel in addition to the error due to accurate navigation and registration. Due to various limitations, the wind vectors are being derived in SIX, 512 x 512 sectors Over the Bay of Bengal, Arabian Sea and the Northern Indian Ocean (Fig.1). The winds are put on the GTS at 09 & 11 Z. The winds could not be derived over the rest of the useful area on an operational basis due to processing limitations. An example of CMVs derived operationally is given in Fig .2.

2.1 QUALITY CONTROL : Quality Control Methods used changed from time to time based on experience. The procedures are mainly manual and done by meteorologists using the latest analysis and the forecast charts available. Winds showing large deviations from the expected flow pattern are removed. The CMVs derived are of acceptable quality

2.2 LIMITATIONS; The main limitations of the INSAT winds are present are their availability over a limited area and only once a day. As already mentioned, this is primarily due to processing limitations and the position will improve substantially when the new processing system described later is installed by the end of this year.

2.3 USE OF CMV DATA: The CMVs generated are regularly put on the GTS. The winds are used operationally to provide much needed data over the oceanic regions south of India for monitoring the progress of Monsoon. The data are also being ingested into the numerical models being used/developed in India.

3 FUTURE PLANS:

3.1 SPACE SEGMENT: INSAT-ID is the last of the present series of Satellites and the program will be continued by the INSAT-II Series of Satellites. INSAT-IIA being built in India is proposed to be launched by ARIANE launch vehicle in February 1992. The meteorological payloads are similar excepting that the resolution of the Visible and infrared channels will be improved to 2 Km and 8 Km respectively. The Satellite is likely to be located at 74 degrees East Longitude.

3.2 METEOROLOGICAL GROUND SEGMENT: A new facility is being built for processing the INSAT-II meteorological data in IMD and this is expected to be installed by the end of this year. The new processing system will have capability to process the data both from INSAT-ID(which can be used till 1998) and INSAT-II.

3.3 BRIEF DESCRIPTION OF THE NEW PROCESSING CENTER :

The INSAT-II Meteorological Data Processing System (IMDPS) is being built around Eight VAX 3400

with direct access to 4 Gb disk storage. The distributed processing architecture provides dedicated computers for realtime ingest, product generation, work stations and also provides redundancy in case of a computer failure. The system is provided with four advanced work-stations and has capability to ingest INSAT-I, INSAT-II, and TIROS-N data in addition to a limited amount of conventional data available on the GTS.

3.4 WIND EXTRACTION : The hardware design takes into consideration the requirement to generate winds over the field of view within one hour. This is accomplished using array processors with two of the VAX 3400 Computers. The procedures envisage fully automatic methods for deriving CMVs for low-medium and high clouds separately. The heights are assigned using available Radio-sonde observations, TOVS data or climatology. Cloud tracking is done using reference and search windows and cross correlation methods. In addition to the fully automatic method, provision is made for manual derivation of winds using Image Display Workstations by choosing the tracers in the two consecutive images. Alternatively, the operator can chose a tracer location in a reference window and derive the winds by method of cross correlation in the search window of the second image.

3.5 QUALITY CONTROL : Automatic Quality Control of the derived winds is achieved by checking speed and directional consistency of winds derived using image 1 & 2 and 2 & 3, gradients and climatology. Provision is also made to display the winds for a final manual quality control check, if necessary.

Reference

Kelkar R.R and P.N.Khanna, (1986), Automated extraction of cloud motion vectors from INSAT-1B imagery MAUSAM,495-500

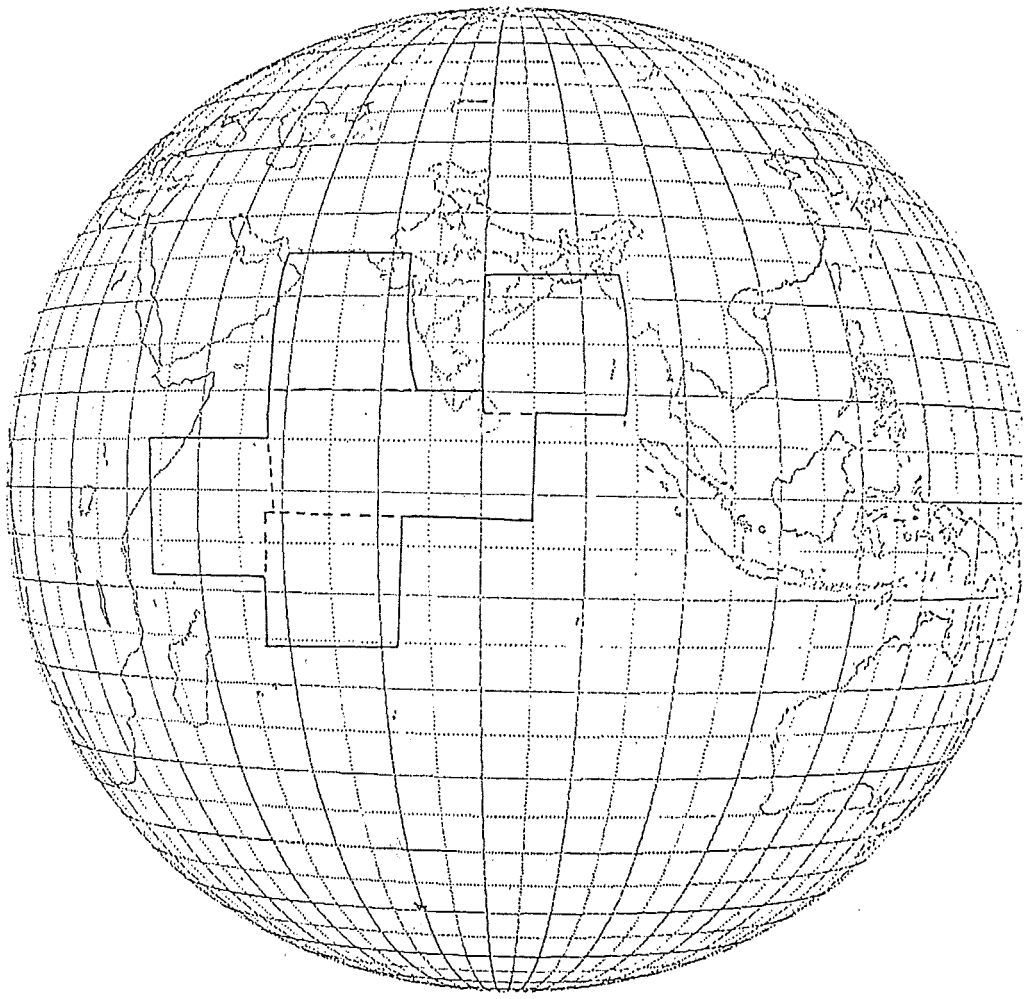

Fig 1. INSAT I field of view showing area of wind derivation

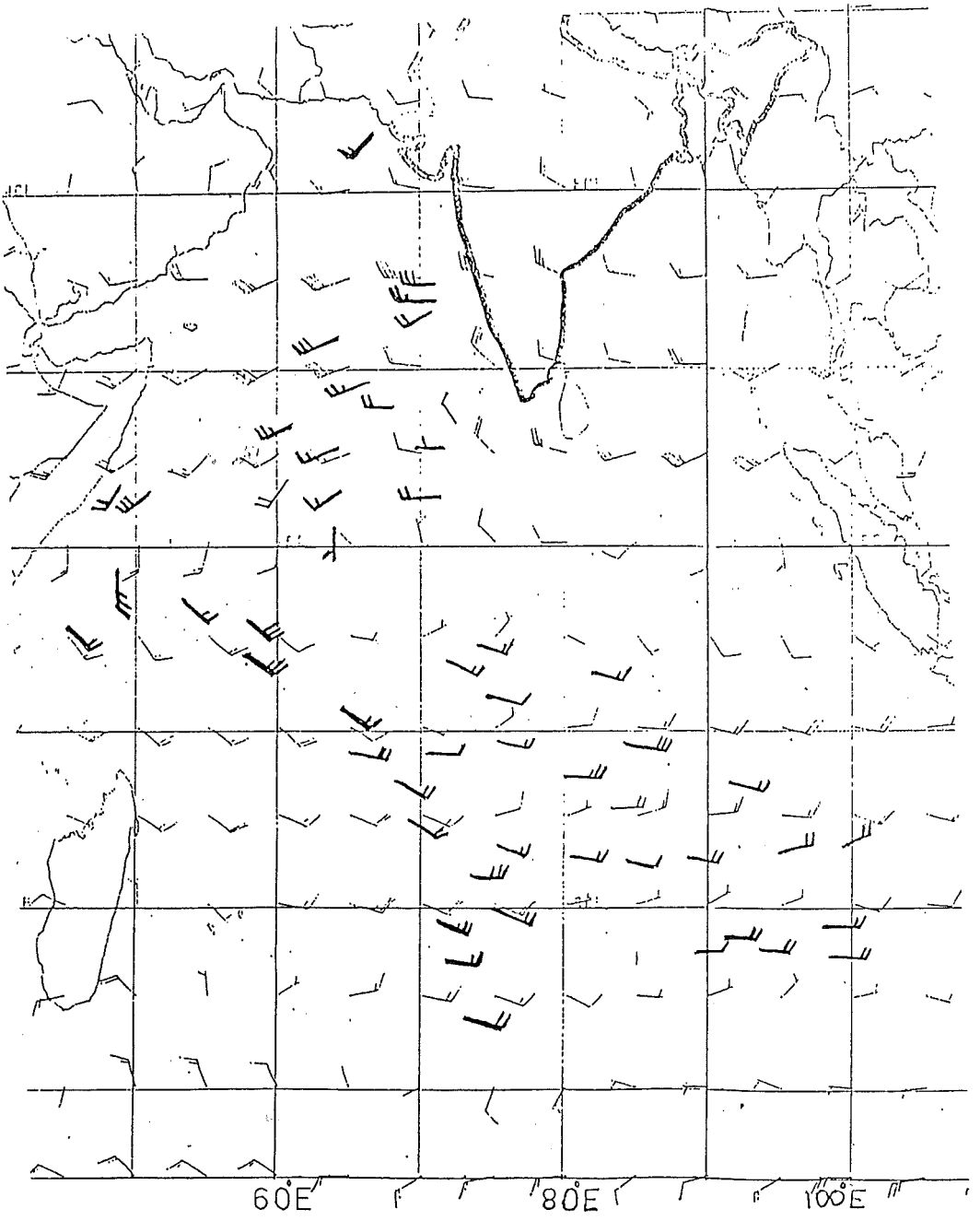

Fig 2 LOW LEVEL INSAT WINDS (OSz)
PLOTTED ON ECMWF (850 Mb) ANALYSIS (12z)
20 Aug 1991