

First data from INSAT-3D

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Summary and Purpose of Document

India has launched INSAT-3D satellite exclusively for meteorological purposes having six-channel imager and nineteen-channel sounder system located at 82.0°E longitude on 26 July 2013. Imageries and products from the satellite are being operationally derived since 15 January 2014. Improved resolution of imageries and products of INSAT-3D will be useful in improving monitoring of different weather systems and forecasting.

The purpose of the document is to inform on the different imageries and products of INSAT-3D to user community.

ACTION PROPOSED

The eighth session is invited to:

- (a) Give comments on the data and products from INSAT 3D
- (b) Suggest for further improvement of the data and products.

DISCUSSION

Introduction

1. Satellite Meteorology Division has been set up in India Meteorological Department (IMD) in 1982 with mandate to provide satellite-based products to the forecasters. At present India has three geo-stationary satellites.
 - (i) METSAT (Kalpana-1) launched on 12 September 2002
 - (ii) INSAT-3A launched on 10 April 2003.
 - (iii) INSAT-3D launched on 26 July 2013.

Whereas Kalpana -1 and INSAT-3A are having three imager channels, INSAT-3D has six imager channels with improved resolution and nineteen sounder channels. The details of Imager and sounder channels are given in Appendix A.

2. Six-channel Visible (VIS), Shortwave Infrared (SWIR), Medium wave Infrared (MIR), water vapour (WV), Thermal Infrared (TIR1, TIR2) imagers are being derived on half hourly basis. Besides these, the following geophysical parameters are also being derived from INSAT-3D satellite:

- (1). Outgoing Long wave Radiation (OLR)
- (2). Quantative Precipitation estimation (QPE), INSAT Multispectral rainfall (IMSAR), Hydro Estimator (HE) etc.
- (3). Sea Surface Temperature (SST)
- (4). Snow cover
- (5). Fire
- (6). Smoke
- (7). Aerosol
- (8). Cloud Motion Vector (CMV), Visible winds
- (9). Water Vapour Wind (WVW)
- (10). Upper Tropospheric Humidity (UTH)
- (11). Temperature, Humidity profile and Total Ozone
- (12). Stability Indices from sounder data Lifting Index (LI) Wind Index (WI), Dry Microburst Index (DMBI), Total-Total (TT)
- (13). Flash Flood Analyzer, Hydro-estimator
- (14). Fog (day and night)

3. INSAT-3D data acquisition and processing system has been established at the India Meteorological Department, Lodi Road, New Delhi, by Satellite Application Centre (SAC) Ahmedabad, Indian Space Research Organization (ISRO) and Master Control Facility (MCF) Hassan, ISRO. The processing of INSAT-3D imager and sounder data takes place broadly in four steps on 24X365 basis:

- (1) Ground receiving system to receive data
- (2) Data Reception (DR) system to generate raw data (L0) files
- (3) Data Processing (DP) system to process L0 data and produce L1B data files (calibrated, geolocated).
- (4) Product generation and Dissemination system

The sounder and imager radiances along with other derived products such as winds and total precipitable water etc. will be assimilated into Numerical Weather Prediction (NWP) models of weather forecasting, which will improve NWP models outputs.

The imager having six channels generates high-resolution images in the visible (1 km) and infrared (4 km.) bands and derived parameters every half hour and therefore improve the interpretation of satellite data and products, resulting in improving weather forecasts. It will also improve tropical cyclone monitoring over Indian Ocean.

The improved resolution earth imagery and products every half hour will also be a boon for nowcasting thunderstorms and other short lived weather phenomena.

Various other derived parameters from this satellite data will be useful for monsoon studies, aviation, agriculture, Ocean services and forestry etc.

The vertical structure of the atmosphere along with several stability indices will also be a very useful product for conventional weather forecasting.

To calibrate optical sensors on INSAT-3D, the first joint campaign by scientists of IMD, ISRO, National Physical Laboratory (NPL) and Indian Institute of tropical Meteorology (IITM) was carried out at Jaisalmer, Rajasthan during 15-22 Dec 2013. This will facilitate making climatic studies using INSAT-3D and follow-on satellites data in future.

All INSAT-3D current Imager and sound products are available on the IMD website (http://www.imd.gov.in/section/satmet/dynamic/insat_3d.htm).

Appendix: INSAT-3D Instrument Characteristics

INSAT-3D Imager Channels		
Spectral Band	Wave length (μm)	Ground Resolution (km)
VIS	0.55-0.75	1 x 1
SWIR	1.55-1.70	1 x 1
MIR	3.80-4.00	4 x 4
WV	6.50-7.10	8 x 8
TIR1	10.2-11.3	4 x 4
TIR2	11.5-12.5	4 x 4

INSAT-3D Sounder Channels Characteristics						
Detector	Ch. No.	λ_c (μm)	ν_c (cm^{-1})	NEΔ T	Principal absorbing	Purpose
Long wave	1	14.67	682	0.17	CO ₂	Stratosphere
	2	14.32	699	0.16	CO ₂	Tropopause
	3	14.04	712	0.15	CO ₂	Upper-level
	4	13.64	733	0.12	CO ₂	Mid-level
	5	13.32	751	0.12	CO ₂	Low-level
	6	12.62	793	0.07	water vapor	Total precipitable
	7	11.99	834	0.05	water vapor	Surface temp
Mid wave	8	11.04	906	0.05	window	Surface
	9	9.72	1029	0.10	ozone	Total ozone
	10	7.44	1344	0.05	water vapor	Low-level
	11	7.03	1422	0.05	water vapor	Mid-level
	12	6.53	1531	0.10	water vapor	Upper-level
Short wave	13	4.58	2184	0.05	N ₂ O	Low-level
	14	4.53	2209	0.05	N ₂ O	Mid-level
	15	4.46	2241	0.05	CO ₂	Upper-level
	16	4.13	2420	0.05	CO ₂	Boundary-level
	17	3.98	2510	0.05	window	Surface
	18	3.76	2658	0.05	Window	Surface temp
Visible	19		14367	-	Visible	Cloud