भारत सरकार
अन्तरिक्ष विभाग
राष्ट्रीय वायुमंडलीय अनुसंधान प्रयोगशाला
पो बॉ नं. 123, एसवीयू कैंपस डाक घर
तिरुपति - 517 502
प्रयोगशाला : पो : गादंकी-517 112
पाकाला मंडल, चित्तूर जिला, आंध्र प्रदेश
दूरभाष : + 91 8585 272024, 222140
फैक्स : + 91 877 2248146 / + 91 8585 272018/21

GOVERNMENT OF INDIA
DEPARTMENT OF SPACE
NATIONAL ATMOSPHERIC RESEARCH LABORATORY
P.B. No.123, P.O SVU Campus
Tirupati-517 502

Laboratory: P.O. Gadanki - 517 112
Pakala Mandal, Chittoor Dist., Andhra Pradesh
Phone: + 91 8585 272024, 222140
Fax: + 91 877 2248146 / + 91 8585 272018/21

PERSONNEL AND GENERAL ADMINISTRATION

Establishment Section

सं./No.NARL/ESTT/SC/RF-0035/2013

नवंबर/November 26, 2013

CERTIFICATE

Certified that Shri K Krishna Kanth carried out Research in this Laboratory from 29.11.2012 to 26.11.2013 with a consolidated fellowship amount of ₹.16,000/- (Rupees Sixteen Thousand Only) per month.

This certificate is issued at his own request.

K.V.L 26/11/2013

(के. वी. लक्ष्मणा कुमार/K V Lakshmana Kumar)
वरिष्ठ प्रशासनिक अधिकारी /Sr. Administrative Officer

To

Shri K Krishna Kanth
RF-0035
Project Junior Research Fellow
NARL

SRI VENKATESWARA UNIVERSITY::TIRUPATI

Prof. S. Vijaya Bhaskara Rao
Co-ordinator
M.Tech Space Technology & Applications
Department of Physics
S.V.U. College of Sciences

S.V.U College of Sciences
Tirupati – 517 502.

Phone: (O):(+91) 0877- 2248485
Mobile : (+91) 9440953122
Fax : (+91) 0877-2248485
E-mail: HYPERLINK "mailto:drsvbr.acas@gmail.com" drsvbr.acas@gmail.com

PERSONNEL AND GENERAL ADMINISTRATION

Physics Lab

SVU/PHY METEOR/JA-0024/2019 16/04/2019

CERTIFICATE

Certified that Shri K KRISHNAKANTH carried out Research in SVU METEOR RADAR Laboratory as Junior Assistant from 14/04/2014 to 12/04/2019 with consolidated pay of Rupees 28,000 (Rs Twenty Eight Thousand Only) per month.

This Certificate is issued at his own request.

SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

(Approved by AICTE,New Delhi & Affiliated to JNTU, Hyderabad.)
74, Dr. Visweswaraiah Road, CHITTOOR - 517 127 . (A.P.)

CERTIFICATE

This is to certify that Mr/~~Ms~~. K. KRISHNAKANTH *of* II *year* ECE *Branch, from* SITAMS *has presented a paper on* NANO TECHNOLOGY *and ~~won~~* – */Participated at* **TARANG2K6**, *conducted by* **SITAMS** *on 13th & 14th October 2006. We appreciate his/~~her~~ vivacious participation and wish him/~~her~~ a bright future.*

Vice- Chairman	*Principal*	*Convener*	*Chief Co-ordinator*

A National Level Technical Fest

IWGGMS 16

THE 16TH INTERNATIONAL WORKSHOP ON GREENHOUSE GAS MEASUREMENTS FROM SPACE

EPF Graduate School of Engineering

EPF parisian campus
3 bis rue Lakanal
92330 Sceaux

EPF Campus in Troyes La Champagne
2, rue F. Sastre
10430 Rosières-prés-Troyes

EPF campus in Montpellier Méditéranée
21, Boulevard Berthelot
34000 Montpellier

www.epf.fr

CERTIFICATE OF ATTENDANCE

EPF VIRTUAL TECH CAMP 2020

CERTIFICATE OF PARTICIPATION

.

WEBINAR

On

"Application of Artificial Intelligence on Geo-Spatial Data"

ORGANIZED BY

Department of Information Technology

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY,West Bengal,INDIA

This is to certify that

KRISHNA KANTH

Participated in the webinar titled "Application of Artificial Intelligence on Geo-Spatial Data" *held on 13th June, 2020.*

Registration No : MAKAUT-WEB-130620-120
Event ID : 20200613-WEB-WAAIGSD
Date : 13th June, 2020

Dr. P.P. Lahiri
Registrar, MAKAUT, WB

Dr. Somdatta Chakravortty,
Coordinator, MAKAUT, WB

* This is system generated certificate.

SVURPGCET - 2010
DIRECTORATE OF ADMISSIONS
SRI VENKATESWARA UNIVERSITY, TIRUPATI - 517 502.

NAAC 'A' GRADE

RANK CARD

Hall Ticket No. 1390031   Caste : BCA   Gender : Male   App. No. 122924

Name KATTAMANCHI KRISHNA KANTH

Father's Name S/o K SUBRAMANYAM

Address :

Name: K KRISHNA KANTH

Address: PEDDAKALAYA [VILL & POST]

GANGADHARA NELLORE [MANDAL]

CHITTOOR [DT]

ANDHRA PRADESH   Pin: 517125

Phone / Mobile No. : 9985354697

Test Code & Name

39 - Space Technology

MARKS OBTAINED

SEC-A	SEC-B	SEC-C	TOTAL
9	10	17	36

RANK 32

RANK IN WORDS THREE TWO

STATUS QUALIFIED

CONVENER

DATE 25-06-2010

Note : Admission into any course is subject to fulfilment of eligibility criteria for that course.
Any correction in Biodata should be brought to the notice of the Convener at the time of counselling.

Government of India
India Meteorological Department

Ph & Fax: 044 –22561636
e-mail: suresh.imd@gmail.com
mwo.mds@imd.gov.in

Aerodrome Meteorological Office,
ATS complex,
Meenambakkam, Chennai 600027.

20th April 2012

Dr. R. Suresh, M.Sc, PGDMM, PGDPM, DSADP, Ph.D
Director

CERTIFICATE

This is to certify that the project dissertation titled "**Processing of Polar Orbiting Satellite remote sensing data for meteorological operational use**" submitted by **Shri. K. Krishna kanth**, II M.Tech (Space Technology & Applications), **Sri Venkateswara University, Tirupati** in partial fulfillment of the requirements for the award of **Degree of Master of Technology** is a record original work done under my supervision and guidance during the period **July 2011 – April 2012** and that this project work has not found the basis for any other Degree / Diploma / Fellowship of similar nature to any other candidate.

20/4/2012

Dr. R. Suresh
Director
Aerodrome Meteorological office
Chennai-600 027.

Dr.K.MURALI
प्रोफेसर और अध्यक्ष
Professor & Head

समुद्र इंजीनियरिंग विभाग
Department of Ocean Engineering
आईआईटी मद्रास, चेन्नै 600036 भारत
IIT Madras, Chennai 600 036, India

Date: 30.05.2021

Dear Mr./Ms. k krishnakanth

Sub: Interview call for Ph.D admission

***

With reference to your application for admission to Ph.D programme at this Institute, you are requested to be appear for online INTERVIEW on **8th and 9th June 2021**. You must attend the interview without which it is not possible to consider your candidature.

On the day of interview, kindly present (through online mode) your online application and all your original certificates, mark sheets/grade cards of your qualifying degree examination, GATE score card/UGC/CSIR and other fellowship award letter (as the case may be) for verification without fail. Candidates claiming reservation under OBC, SC/ST and EWS shall present the respective originals, failing which they will not be considered for test/interview. Project candidates who are employed in IIT MADRAS applying under Project-NHTRA category should present No Objection Certificate (NOC) from their project coordinator/employer. The interview process may get extend up to 8 pm. No request will be entertained for change of date and time. **Please submit your research proposal (not exceeding 2 pages) along with the Google form submission given in the below link**.

Confirm your response to attend the interview/test by submitting the below given Google form before **5:00pm on 02-06-2021**.

1. You have to fill this Google form in order to schedule the interview time on the specified date as given in the call letter.
   PhD: https://forms.gle/6dwsk2KF3BBicjnf7
   MS : https://forms.gle/WYnvyNtUk6xajgkEA
2. IF YOU DO NOT COMPLETE THE STEP ABOVE, YOUR APPLICATION WILL NOT BE CONSIDERED FOR FURTHER PROCESSING FOR SELECTION.
3. After completing step 1 above, you will be intimated the time of interview by email, with details of video call.
4. The interview will be in 2 parts as below. The interview may be last for maximum 45 minutes.

Part-I: Your photo-ID will be verified. You should show a valid government photo ID in the camera to the official. The photo in the ID should match with the data submitted in your application form. After verification, you will be given details of attending the interview.

Part-II: You will be interviewed by a committee of professors. It will cover the following:

- Basic subjects and subjects you have learnt during your degree(s).
- Thesis / project you have done.
- Your proposed research interest.

5. It is necessary to keep a paper and pen ready with you during the interview. You may be asked to write/solve/explain some concepts and show it in front of the video.

6. Please ensure your laptop / mobile battery is fully charged prior to the interview.

7. Any clarification you may send an email to oeoffice@iitm.ac.in

Yours sincerely

(**Dr.K.MURALI)**
Head of the Department

Project Work (MTech)

Abstract:

Sea surface temperature (SST) measurements and fog detection are required for many meteorological applications. MCSST equations for calculating SST uses NOAA L1B data but it contains erroneous pixels because of noise and cloud contamination. In this case, we have used Threshold technique for the removal of respective pixels. Our work only suggests the fog detection but not the forecasting. In order to observe the phenomenon of warm tongue between two cold tongues during the cyclone period, we have analyzed THANE cyclone data. Unfortunately, it is completely out due to erroneous pixels.

Radiosonde observations have very high vertical resolution but poor in spatial and temporal coverage. For this case, we have developed a two dimensional matrix using AQUA & TERRA satellites data, so that high resolution and spatial coverage of Temperature, Dew-point, Humidity and Atmospheric profiles is available for the Latitude 8°N to 16°N and for the Longitude 74°E to 82°E. The coding used for developing the respective 2-Dimensional matrix can be used for any Latitude and Longitude provided the respective data is made available.

1. INTRODUCTION:

The project work has been started from the basic level analysis to the higher level analysis i.e., from smoothing of satellite data to the generation of 2-D matrix from the satellite data.the source of data for the entire project work is taken from Chennai central metop page of IMD wedsite(www.imd.gov.in). The Chennai metop provides the satellite data in various formats like HDF4, HDF5, NET CDF,JPG, PNG,BMP,GIF,GEOTIFF,ESS HDR,ESS PIC,SVG etc.Delhi metop provides only the formats like JPEG, PNG .

Of the above data formats, we have downloaded HDF4 and JPEG formats. HDF4 files can be viewed by the freely available softwares like HDF VIEWER,HDF EXPLORER(www.hdfgroup.com). we have preferred HDF EXPLORER to view the files.

For the project work,the data from various satellites have been taken namely NOAA,MODIS,AQUA,TERRA,METOP(MTA).Smoothing has been carried for metop satellite data. the IMD images of Temperature, Moisture,HIRS, ATOVS, Water Vapor profiles are scaled from 150K to 330K in the steps of 30K.we have scaled the respective images of Temperature,Moisture,HIRS, Water Vapor profiles from 150K to 330K in the steps of 5K. Smoothing process results in a smoothed value that is better estimate of the original value.

For Sea Surface Temperature(SST) calculation,NOAA19 L1B data has been taken.the channel 4 and channel 5 of L1b data was considered for the analysis.By various journals,we have noticed that the previous SST measurements have been done by the comparison of satellite data with ship buoys data.As we are not having the the data of ship buoys,we have approached different MCSST equations for measuring SST.we have not taken the Zenith angle in the MCSST equations as its effect is negligible.the respective measured SST has been compared with IMD SST image pixels(jpeg).the purpose of calculating accurate SST was for the removal of noisy and cloud contaminated areas.

One of the main challenges for the meteorologists is fog detection.as ,it is very difficult to differentiate the low level cloud and fog.By various journals,we have noticed that SYNOP data from several stations are compared with the pixels of satellite data,but the time lag between a SYNOP observation in hourly resolution and a satellite overpass is a problem for a proper comparison of both datasets. For fog detection, the MODIS L1B data of fog AQUA and fog TERRA has been considered.The IMD has given a legend of 2 to 6 for fog detection.The channel 31 and channel 20 of L1B data was taken for the analysis.

For THANE cyclone AQUA,TERRA & METOP(MTA) data has been considered.The paper entitled “Foreshadowing the tracks of tropical depressions and cyclonic storms and understanding their thermodynamical structure over bay of bengal and arabian sea using TOVS and ATOVS data” by Dr.R.Suresh suggested that the phenomena of warm tongue between two cold tongues must be observed during cyclone period for the pressure level difference of 700hPa-400hPa.But we are not having 400hPa pressure level data.So,we computed the pressure level difference of 700hPa-500hPa.Unfortunately the above phenomena has not been observed in our analysis as the data contains eranious values,when compared with data of university of wisconscin.But METOP(MTA) data was somewhat satisfactory compared to the other two satellites(AQUA/TERRA).We have gone through various pressure leve differences like,

780hPa-500hPa

850hPa-620hPa

920hPa-620hPa but the same results there also.

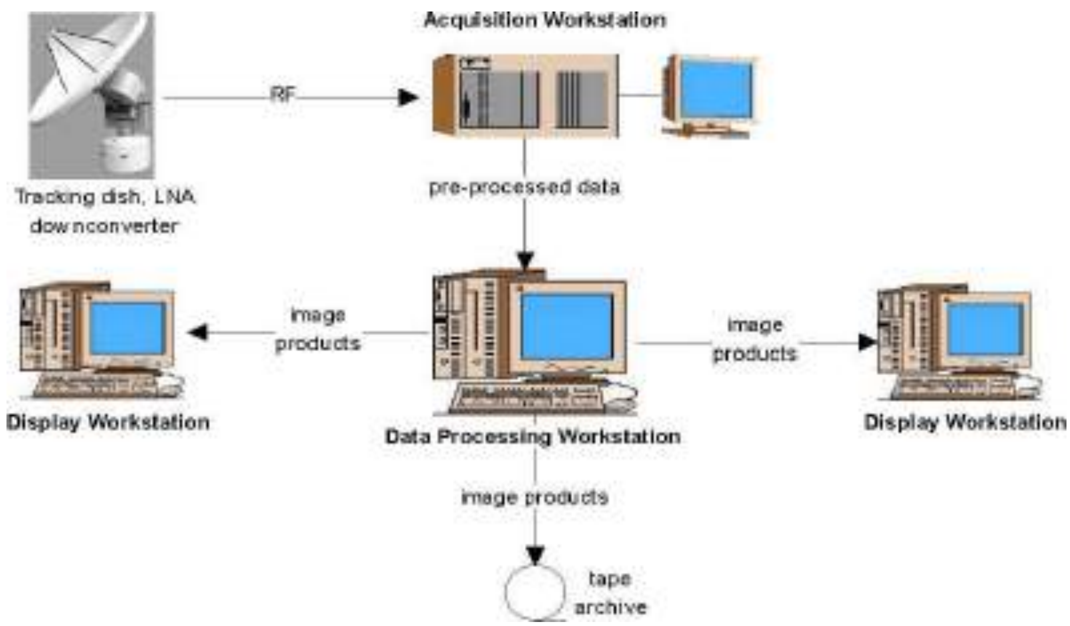
To overcome almost all the disadvantages of Radiosonde technique like cost, time and spatial coverage. we have prepared a tabular column from the TERRA & AQUA satellite data from which the parameters like Temperature,Humidity,Moisture,Atmospheric profiles (T_T,L_I,K_I,S_P,S_T, Ozone) can be measured for the respective lat and long of 8degreeX8degree grid i.e., from 8N to 16N & 74E to 82E.Previously,Dr.R.Suresh Director,IMD Chennai has prepared the tabular column for 6degreeX6degree grid using FORTRAN.

2. The Processing System of NOAA/METOP/MODIS

- Acquisition Workstation. Houses the receiver and pre-processes the raw data. This pre-processed data is automatically transferred to the Data Processing Workstation for image generation;
- Data Processing Workstation. Receives pre-processed data from the Acquisition Workstation and produces final image products according to user-defined setups. These final image products are automatically transferred to the Display Workstations; and
- One or more Display Workstations. Each Display Workstation runs the software METEOR product for the display and analysis of satellite imagery. All image products are transferred automatically to these machines from the Data Processing Workstation.

Up-to-date Two-Line Elements (TLEs) and other ancillary data is required for the correct operation of this system. The site administrator is responsible for providing and maintaining a reliable internet connection so this data can be updated automatically.

The METOP/NOAA/MODIS ground station is a high-performance, dual X- and L-band system that tracks, receives and processes data from the NASA Terra and Aqua satellites, and the US NOAA, EUMETSAT MetOp, and NSMC Fengyun-1 spacecraft series.Level-2 science products are derived from the Terra/Aqua MODIS, NOAA/MetOp AVHRR and ATOVS payloads and, if a GTS feed is available at site, MetOp IASI science products are generated and integrated with other system outputs. It additionally ecommutates all other direct-broadcast instruments from Aqua and makes this data available on disk for further processing.



2.1 NOAA and MetOp

All NOAA/MetOp satellites carry a suite of instruments providing data for various land, ocean, and atmospheric applications, including weather forecasting. The ES&S POESAT500 system receives all this data and processes the AVHRR and ATOVS (HIRS, AMSU-A, and AMSU-B) instrument data into level-1b and level-2 images for display in METEOR. As part of the Initial Joint Polar-Orbiting Operation Satellite System (IJRS), the EUMETSAT MetOp spacecraft flies in constellation with NOAA-19. Note that due to a failure on the side-A electronics, MetOp direct broadcast is not available globally. In addition, MetOp carries the Infrared

Atmospheric Sounding Interferometer (IASI). The POESAT500 generates level-1b products from this instrument and, if a GTS feed is available at site, MetOp IASI level-2 science products are generated and integrated with other system outputs. EUMETSAT, the designers and operators of MetOp/IASI, commit to delivering validated high-level IASI science products over the GTS within 180 minutes of observation. With its GTS interface, the SATRAX-XL leverages EUMETSAT's expertise and near real-time data delivery to fully integrate IASI level-2 products with all other system outputs.The US National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) jointly develop and operate a series of polar-orbiting meteorological satellites. The first satellite in this series began operations in 1978 and the series currently consists of five spacecraft: NOAA-15, NOAA-16, NOAA-17, NOAA-18, and NOAA-19.

AVHRR	A six-channel imaging radiometer, detects energy in the visible and IR portions of the electromagnetic spectrum.
HIRS	An atmospheric sounding instrument that provides multispectral data from one visible channel, seven shortwave channels, and twelve long wave channels. Used in conjunction with AMSU-A and AMSU-B to derive temperature and moisture profiles to an accuracy of 2ºper 2km of atmosphere.
AMSU-A	Measures scene radiance in 15 microwave channels.
AMSU-B	Measures scene radiance in 5 microwave channels.
IASI	IASI is designed for operational meteorological temperature and moisture soundings with a very high level of accuracy in addition to monitoring trace gases for atmospheric chemistry applications. Measures scene radiance in 8400 infrared channels to derive temperature and moisture profiles to an accuracy of 1ºper 1km of atmosphere.

2.1.1 L-band level-2 products (NOAA/Metop)

NOAA and MetOp AVHRR/ATOVS data can generate up to 19 level-2 products

1. Cloud-top pressure (from AVHRR);
2. Cloud-top height (from AVHRR);
3. Cloud-top temperature (from AVHRR);
4. Cloud type (from AVHRR);
5. Cloud amount (from AVHRR);
6. Sea-surface temperature (from AVHRR);
7. Land-surface temperature (from AVHRR);
8. Fire points (from AVHRR);
9. Temperature profile (from ATOVS);
10. Moisture profile (from ATOVS);
11. Water vapour profile (from ATOVS);
12. Total ozone (from ATOVS);
13. Surface emissivity (from ATOVS);
14. Total column precipitable water (from ATOVS);
15. Rainfall (from ATOVS);
16. Surface pressure (from ATOVS);
17. Surface water vapour (from ATOVS);
18. Cloud fraction (from ATOVS); and
19. Surface temperature (from ATOVS).

ATOVS products are derived using the International ATOVS Processing Package (IAPP) from the University of Wisconsin.

2.1.2 X-band level-2 products (MODIS)

The current processing system can generate up to 29 level-2 products from Terra/Aqua MODIS data. Most of these products are generated from the processing system package, which uses various NASA algorithms to derive the science data:

1. MODIS true colour;
2. Aerosol optical depth (MOD04);
3. Total totals index (MOD07);
4. Lifted index (MOD07);
5. K index (MOD07);
6. Surface temperature (MOD07);
7. Surface pressure (MOD07);
8. Total Ozone (MOD07);
9. Water vapour/precipitable water amount (MOD07);
10. Temperature profile (MOD07);
11. Moisture profile (MOD07);
12. Cloud top pressure (MOD06);
13. Cloud top temperature (MOD06);
14. Cloud top height (MOD06);
15. Cloud fraction (MOD06);
16. Cloud effective particle radius (MOD06);
17. Cloud optical thickness (MOD06);
18. Cloud effective emissivity (MOD06);
19. Cloud mask (MOD06);
20. Cloud phase (MOD06);
21. Cirrus reflectance (MOD06);

22. Tropopause height (MOD06);

23. Brightness temperature (MOD06);

24. Chlorophyll concentration (MOD18);

25. Sea-surface temperature (MOD28).

26. Vegetation index (MOD13);

27. Thermal anomalies (MOD14); .

28. Snow cover (NDSI); and

29. Fog

2.2 ATOVS Level 1b Products Overview:

The ATOVS (Advanced TIROS (Television and Infrared Observational Satellite) Operational Vertical Sounder) is a sounding instrument package first flown on the NOAA-KLM (-15, -16, -17) satellite series. It is composed of the Advanced Microwave Sounding Units A and B (AMSU-A, AMSU-B) and is complemented by the High Resolution InfraRed Sounder (HIRS/3). For Metop and the NOAA-18 and -19 satellite series, the AMSU-B sounder has been replaced by the Microwave Humidity Sounder (MHS), and the infrared sounder has been upgraded to HIRS/4.Although not considered formally part of the ATOVS package, the Advanced Very High Resolution Radiometer (AVHRR/3) is an imager also flying on Metop and on NOAA-18 and -19, which supports the ATOVS Level 1b processing.

2.2.1 AMSU-A:

The AMSU-A is a fifteen-channel microwave radiometer that is used for measuring global atmospheric temperature profiles and providing information on atmospheric water in all of its forms.AMSU-A measures in 15 spectral bands, summarised in the table below, where the temperature sounding mainly exploits the oxygen band at 50

GHz.

The following table summarises the spectral characteristics of AMSU-A.

Channel	Channel frequency (GHz)	No. of pass bands	Nominal bandwidth (MHz)	Temperature sensitivity (K)	Calibration accuracy (K)	Polarisation angles
AMSU-A2						
1	23.8	1	270	0.30	<2.0	90-θ
2	31.4	1	180	0.30	<2.0	90-θ
AMSU-A1						
3	50.3	1	180	0.40	<1.5	90-θ
4	52.8	1	400	0.25	<1.5	90-θ
5	53.59±0.115	2	170	0.25	<1.5	θ
6	54.40	1	400	0.25	<1.5	θ
7	54.94	1	400	0.25	<1.5	90-θ
8	55.50	1	330	0.25	<1.5	θ
9	F_{LO}= 57.290344	1	330	0.25	<1.5	θ
10	F_{LO} ± 0 .217	2	78	0.40	<1.5	θ
11	F_{LO} ± 0 .3222 ± 0 .048	4	36	0.40	<1.5	θ
12	F_{LO} ± 0 .3222 ± 0 .022	4	16	0.60	<1.5	θ
13	F_{LO} ± 0 .3222 ± 0 .010	4	8	0.80	<1.5	θ
14	F_{LO} ± 0 .3222 ± 0 .0045	4	3	1.20	<1.5	θ

15	89.0	1	<6000	0.50	<2.0	90-θ	

2.2.1 AMSU-B:

The purpose of this instrument is to receive and measure radiation from a number of different layers of the atmosphere in order to obtain global data on Humidity profiles. It works in conjuction with AMSU-A instruments to provide a 20 channel microwave radiometer.AMSU-B covers channels 16 through 20.Channels 18,19,20 strongly opaque water vapor absorption line at 183GHZ. Channels 16,17 have deeper penetration through the atmosphere to the earth's Surface at 89GHZ and 150GHZ.

2.3 Advanced Very High Resolution Radiometer/3 (AVHRR/3):

The AVHRR/3 is a six channel scanning radiometer providing three solar channels in the visible-near infrared region and three thermal infrared channels. The AVHRR/3 has two one-micrometer wide channels between 10.3 and 12.5 micrometers. Although AVHRR/3 is a six channel radiometer, only five channels are transmitted to the ground at any given time. Channels 3A and 3B cannot operate simultaneously.

Summary of AVHRR/3 Spectral Channel Characteristics:

Parameter	Ch. 1	Ch. 2	Ch. 3A	Ch. 3B	Ch. 4	Ch. 5
Spectral Range (μm)	0.58-0.68	.725-1.0	1.58-1.64	3.55-3.93	10.3-11.3	11.5-12.5
Resolution (km)	1.09	1.09	1.09	1.09	1.09	1.09

Temperature Range (K)	-	-	-	180 - 335	180 - 335	180 – 335

2.4 Moderate Resolution Imaging Spectro-Radiometer (MODIS)

The MODIS instrument is a passive imaging spectroradiometer. The instrument scans a cross-track swath of 2330 km using 36 discrete spectral bands between 0.41 and 14.2 micrometers. MODIS will provide imagery of the Earth's surface and cloud cover to develop an improved understanding of global dynamics and processes occurring on the surface and in the lower atmosphere.

Orbit:	705 km, 10:30 a.m. descending node (Terra) or 1:30 p.m. ascending node (Aqua), sun-synchronous, near-polar, circular
Scan Rate:	20.3 rpm, cross track
Swath Dimensions:	2330 km (cross track) by 10 km (along track at nadir)
Telescope:	17.78 cm diam. off-axis, afocal (collimated), with intermediate field stop
Size:	1.0 x 1.6 x 1.0 m
Weight:	228.7 kg
Data Rate:	10.6 Mbps (peak daytime); 6.1 Mbps (orbital average)
Quantization:	12 bits
Spatial	250 m (bands 1-2)

Resolution: 500 m (bands 3-7)

1000 m (bands 8-36)

Design Life: 6 years

Primary Use	Band	Bandwidth	Spectral Radiance	Required SNR
Land/Cloud/Aerosols Boundaries	1	620 – 670	21.8	128
	2	841 – 876	24.7	201
Land/Cloud/Aerosols Properties	3	459 – 479	35.3	243
	4	545 – 565	29.0	228
	5	1230 – 1250	5.4	74
	6	1628 – 1652	7.3	275
	7	2105 – 2155	1.0	110
Ocean Color/ Phytoplankton/ Biogeochemistry	8	405 – 420	44.9	880
	9	438 – 448	41.9	838
	10	483 – 493	32.1	802
	11	526 – 536	27.9	754
	12	546 – 556	21.0	750
	13	662 – 672	9.5	910
	14	673 – 683	8.7	1087
	15	743 – 753	10.2	586
	16	862 – 877	6.2	516
Atmospheric Water Vapor	17	890 – 920	10.0	167
	18	931 – 941	3.6	57
	19	915 – 965	15.0	250
Primary Use	**Band**	**Bandwidth**	**Spectral Radiance**	**Required NE[delta]T(K)**
Surface/Cloud Temperature	20	3.660 - 3.840	0.45(300K)	0.05
	21	3.929 - 3.989	2.38(335K)	2.00
	22	3.929 - 3.989	0.67(300K)	0.07
	23	4.020 - 4.080	0.79(300K)	0.07
Atmospheric	24	4.433 - 4.498	0.17(250K)	0.25

Temperature	25	4.482 - 4.549	0.59(275K)	0.25
Cirrus Clouds Water Vapor	26	1.360 - 1.390	6.00	150(SNR)
	27	6.535 - 6.895	1.16(240K)	0.25
	28	7.175 - 7.475	2.18(250K)	0.25
Cloud Properties	29	8.400 - 8.700	9.58(300K)	0.05
Ozone	30	9.580 - 9.880	3.69(250K)	0.25
Surface/Cloud Temperature	31	10.780 - 11.280	9.55(300K)	0.05
	32	11.770 - 12.270	8.94(300K)	0.05
Cloud Top Altitude	33	13.185 - 13.485	4.52(260K)	0.25
	34	13.485 - 13.785	3.76(250K)	0.25
	35	13.785 - 14.085	3.11(240K)	0.25
	36	14.085 - 14.385	2.08(220K)	0.35

Bands 1 to 19 are in nm;

Bands 20 to 36 are in µm ;

Spectral Radiance values are (W/m^2 -µm-sr).

SNR = Signal-to-noise ratio.

NE(delta)T = Noise-equivalent temperature difference.

Of the above L1B products, we have analyzed the following:

1. ATOVS (HIRS, AMSU-A, and AMSU-B).
2. Temperature profile.
3. Moisture profile.
4. Water vapor profile.
5. Humidity Profile.
6. Sea-surface temperature (from AVHRR)
7. Fog

3. PROJECT DESCRIPTION:

3.1 Methodology:

The products in the IMD website are available in various formats (HDF4, HDF5, PNG, JPEG ….), we downloaded the HDF4 and JPEG formats for the analysis. Plotting of real time image of Temperature Profile for the entire pass using MATLAB Software has been done. Followed by, Smoothed image of the profile by Moving Average Filtering method was plotted.

3.2 Moving Average Filtering: A moving average filter smooths data by replacing each data point with the average of the neighboring data points defined within the span.

RULES:

1. The number of pixels must be odd.
2. The data point to be smoothed must be at the center of the span.
3. The number of pixels is adjusted for data points that cannot accommodate the specified number of neighbors on either side.

3.2.1 Methodology:

The extreme edge pixels has retained as it is and its neighborhood is smoothed with three-ordinate moving average filtering.For the rest of the pixels pentad moving average filtering has been applied. MATLAB coding was developed for plotting the User-Defined Grid (say 0N to 10N, 75E to 90E). The above process has been carried out for various products like Temperature profile, Moisture profile, Water vapor profile and Humidity Profile.

3.3 SEA SURFACE TEMPERATURE (SST):

Definition:

Sea Surface Temperature (SST) is the water temperature close to the ocean's surface. The exact meaning of surface varies according to the measurement method used, but it is between 1 mm (0.04 in) & 20m (70ft) below the sea surface.

It is one of the key controllers of climate variability and acts as a vast thermal reservoir. SST regulates the transfer of long wave radiation to the atmosphere as well as the latent and sensible heat fluxes into the lower atmosphere

3.3.1 Product overview:

This product derives the sea-surface temperature (SST) for cloud-free areas and mosaics the latest dataset with previous results.

Generation	Day and night downlinks
Resolution	Can be set via setup. Optimum is 1km as algorithm is based on IR channels.
Channels used	VIS (CH1), CH4, CH5, CH3B
Physical values	Degrees Celsius

3.3.2 Applications:

- Provide the information related to cyclogenesis and intensification of cyclone.
- Generally the higher the SST, the stronger the storm and greater chance of genesis.

3.3.3 Description:

Sea surface temperature (SST) is one of the most fundamental parameters in ocean atmosphere thermodynamics and has been investigated in many studies in meteorology and Oceanography. In recent years, satellite measurements have become widely used to determine the SSTs in remote areas. A popular approach to estimate SSTs from space is the multi-channel sea surface temperature (MCSST) method. The basic idea of the MCSST came from Anding and Kauth (1970), which showed a quasi-linear relationship between the radiation deficit due to atmospheric water vapor and the brightness temperature difference in two adjacent wavelength bands in the infra-red.Since then, many studies were made to find the best combination of wavelength bands and to test various forms of equations. At Present, those combined with data from the Advanced Very High Resolution Radiometer (AVHRR) on board NOAA satellites are most Popular for practical use. The National Oceanographic and Atmospheric Administration/National Environmental Satellite, Data and Information Service (NOAA/NESDIS) has been supplying several forms of MCSST equations for each NOAA satellite for public use.

The AVHRR equipped on the NOAA-9 had five channels sensitive to the wavelength range of 0.58–0.68μm (CH1),0.725–1.1 μm (CH2), 3.55–3.93μm(CH3B),10.3–11.3μm(CH4) and 11.5–12.5 μm(CH5).

3.3.4 Methodology:

We have downloaded NOAA-19 L1B data, dated 27 September 2011 19:00 UTC from the Chennai METOP Page and using the following MCSST Equations, calculation of SST has been done.

$Ts= 0.9731*T4 + 2.6353 (T4 - T5) - 265.4789$------------(1) for day time

$Ts = 0.9994* T4 + 2.7057 (T4 - T5) - 273.0323$---------(2) for night time

Where

Ts is given in °C and $T4$ and $T5$ are Brightness Temperatures in Kelvin.

Procedure for calculating T4 and T5:

- CH4 and CH5 of NOAA L1B data contains radiance values

- Radiance values are converted to Brightness Temperatures T4 & T5 using Stefans-Boltzmann law

$$\boxed{E = \sigma T^4}$$

Where

$\sigma = 5.67 \text{ X } 10^{-4} \text{ W m}^{-2} \text{ K}^{-4}$ is the Stefan–Boltzmann constant

The calculated T4 & T5 are substituted in the Equations (1) & (2) and the result is stored in a separate HDF file. Calculated Ts pixels are compared to the Real-time pixels of SST image downloaded from IMD Website. The pixels that are having higher values than the Real-time pixels are treated as contaminated pixels. In cloud coverage, the brightness temperature differences are higher than that of non cloudy areas.

Hence, in order to differentiate the cloudy areas from Non- cloudy areas, we made a Threshold of Temperature for CH5 with Lower limit 279K (Olesen and Grassl,1985) and Upper limit 308K.

Reason

For considering Threshold only for CH5 is the brightness temperature of channel 5 in cloud has a greater optical depth at these wavelengths (Olesen and Grassl, 1985) .Now on comparing T4 with T5 (after Threshold), we have plotted Ts only when (T4-T5) is negative or very close to zero. Thus we have following cases:

[ABS (T4-T5) <=1K]

[ABS (T4-T5) <=2K] &

[ABS (T4-T5) <=3K]

NOTE: The above computation is valid only for Cloud free areas.

We have also computed SST(Ts) using different MCSST Equations.

MCSST Equations: (McClain et al., 1985)

$$Ts = 1.0346*T4+2.5779*[T4-T5]-283.21 \rightarrow \text{day time}$$

$$Ts= 3.6139*T4+2.5789*T5-283.18 \rightarrow \text{night time}$$

We have also computed SST(Ts) with Triple-Window Technique using KIDDER & VONDERHARR Equation.

$$\boxed{Ts= 1.0170*T4+0.9694*[T3-T5]-276.58}$$

Where,

Ts =Sea Surface Temperature (deg C)

T4 & T5 = Brightness Temperatures in Kelvin.

3.4 LAND-SURFACE TEMPERATURE:

This can be estimated using the Satellite data. Useful for variety of applications including frost detection and warning.

3.4.1 Methodology:

Plotting of CH4 Brightness Temperature (T4) only for land area has been done. Later comparison of IMD Cloud imageries of CH4 with plotted images has been done to delineate areas with Cloud or Cloud-free. The areas with Clouds were treated as Cloud-Top-Temperature (CTT) and those areas without Clouds are Land-Surface Temperature (LST).

3.5 FOG:

3.5.1 Product overview

Generation	Night passes only
Channels used	31, 20
Physical values	0 (no fog), 1 (fog)
Applications	Fog monitoring

During the night-time, fog and low-stratus cloud emissivity results in a positive difference between the window IR channel 31 and channel 20. A pixel is classified as fog/low-stratus if this value > 2.5K.

3.5.2 Description:

Fog, is a severe obstacle for land, air, and sea traffic. Unfortunately, an accurate and reliable spatiotemporal nowcasting offog still reveals technical problems, both by using interpolated synoptic observing station(SYNOP)data and NWP model results(Jacobs et al.2005;Bendix 2004). Data from second-generation Weather satellite systems [such as the Meteosat Second-Generation—Spinning Enhanced Visible and Infrared Imager (MSG-SEVIRI) and the National Aeronautics and Space Administration (NASA) *Terra* and *Aqua* satellite's Moderate Resolution Imaging Spectroradiometer (MODIS)] seem to offer new opportunities to improve the spatiotemporal nowcasting and monitoring of fog dynamics.

Several techniques for space borne fog detection have been developed over the last few decades. A common method makes use of the blackbody temperature difference between the IR 11& 3.9- μm bands of the Advanced Very High Resolution Radiometer (AVHRR) on board the polar-orbiting National Oceanic and Atmospheric Administration (NOAA) satellites, especially during nighttime. Fog detection during daytime is more complicated due to a similar spectral behavior of snow, fog, and other water clouds in thevisible bands and the contamination of the 3.9- μm band by solar radiation.

3.5.3 Methodology:

We downloaded MODIS L1B HDF data of FOG AQUA for the dates 22 & 23 of November 2011.The MODIS L1B data consists of various channels data as follows:

- CH1
- CH2
- CH3
- CH4
- CH6
- CH7
- **CH20**
- CH21
- **CH31**
- CH32

The Channels which are bolded are used for our analysis

The values which are available in the MODIS L1B data are converted according to the LOOK–UP TABLE (LUT) using MATLAB coding.

Using MATLAB coding, the difference of CH31 & CH20 (CH31-CH20) was computed and the respective result was saved in a separate HDF file. Having this file, the pixels that are in the limits 2.5 to 6.0 are treated as probable Fog pixels and hence they are plotted in the steps of 0.2.The images plotted using MATLAB are compared with the corresponding Fog real time images that are available in the IMD website. For more probable detection of Fog pixels, computed pixels are plotted in the limits ranging from 1.0 to 4.0 in the steps of 0.2.

For the following dates, the same analysis has been carried out using Fog AQUA.

i. **22 November 2011**

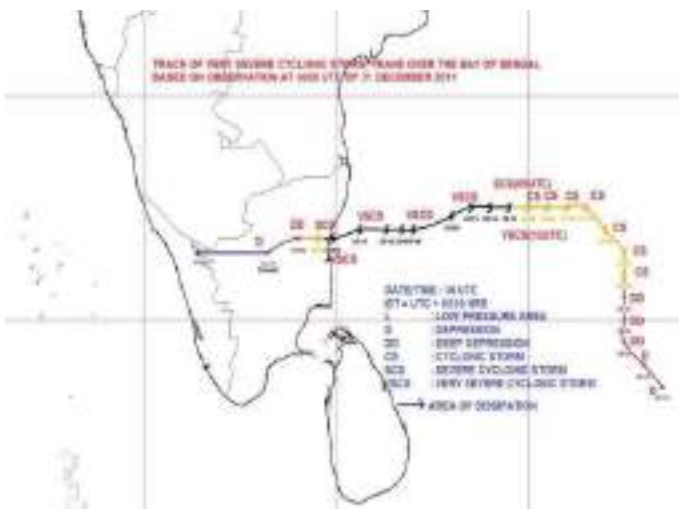
ii. **3 January 2012**

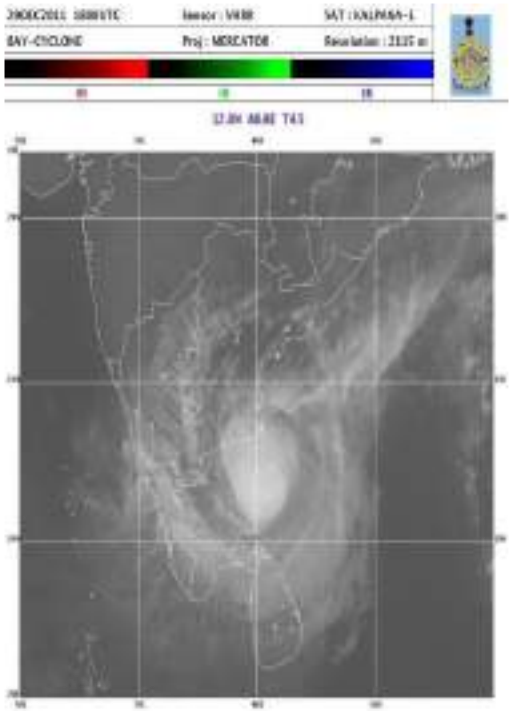
The same work has been done using Fog TERRA data for the dates 2,4 & 5 January 2012.

3.6 THANE:

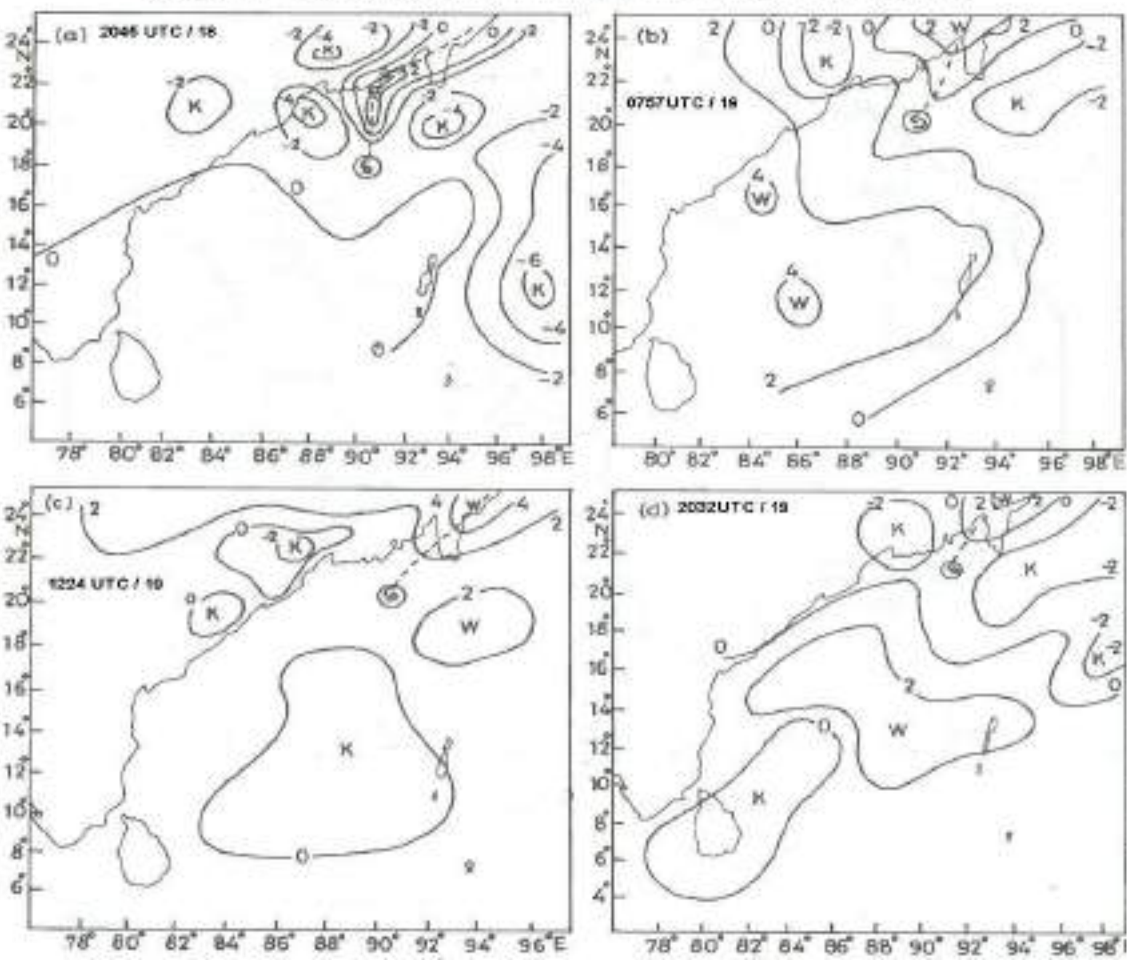
3.6.1 Description:

A depression formed over southeast Bay of Bengal in the evening of 25th December, 2011 and lay centred about 1000 km southeast of Chennai. It gradually moved north-northwestwards and intensified into a deep depression in the early morning of 26th December, 2011 and into a cyclonic storm ‘THANE’ in the same midnight. It then moved west-northwestwards and intensified into a severe cyclonic storm in the afternoon and into a very severe cyclonic storm in the evening of 28th December, 2011. It then moved west-southwestwards and crossed north Tamil Nadu & Puducherry coast between Cuddalore and Puducherry within 0630 and 0730 hrs IST of 30th December, 2011 with a wind speed of 120-140 kmph.




BAY-CYCLONE
Proj : MERCATOR
SAT : KALPANA-1

Analyses of 700-400 hPa layer mean temperature during 17 – 20 May, 1998



3.6.2 Methodology:

We downloaded MTA HDF data of TEMPERATURE PROFILE for the dates 28,29 & 30 of December 2011.The MTA HDF data consists of various Pressure levels like 0.1hPa,0.2hPa,0.5hPa............... 1000hPa,1025hPa & 1050hPa. From the above Pressure levels, we have done the mean for selected Pressure levels of data as follows:

- Mean(700-500)hPa
- Mean(780-500)hPa
- Mean(850-620)hPa
- Mean(920-620)hPa

Using MATLAB coding, the above analysis was computed for both MTA HDF data of 28 & 29 December 2011.The respective results were plotted simultaneously for Chennai grid (4 – 20)degree North / (74 – 80) degree East and the obtained images is saved in the form of JPEG file.

The respective image pixel was compared with the University of Wisconsin observatory results of 'THANE' data.

3.7 2-D Matrix:

3.7.1 Methodology:

For the data dated Dec 13 2011 of TERRA the following profiles have been taken for the analysis namely Temperature Profile, Moisture Profile, Humidity, Atmospheric Profile.The respective profiles are tabulated in Excel sheet according to their using Matlab coding.This Excel sheet has been taken as the input file for the Tabular Column Matfile. By using Tabular Column Matfile the respective latitudes and longitudes are plotted for User-Defined Grid say 8 deg N/74 deg E to 16 deg N/82 deg E to show values against Pressure levels 1000 hPa to 100 hPa (14 columns) showing Temperature, Dew-Point, Humidity &

Atmospheric profile Total Totals Index [TTI], Lifted Index [LI],K-Index[KI],
Surface Température [Surf_Temp],
Surface Pressure [Surf_Pres],
Water Vapor [Water_Vap],
Total Ozone[Ozone]
for all data with Original Resolution of 0.04545 deg.

Tabular column format

					Lat : 10.22705		Long:76.04525							
Press level / Param	**1000 hPa**	**950 hPa**	**920 hPa**	**850 hPa**	**780 hPa**	**700 hPa**	**620 hPa**	**500 hPa**	**400 hPa**	**300 hPa**	**250 hPa**	**200 hPa**	**150 hPa**	**100 hPa**
temp	15.4	14.41	13.25	10.05	6.45	1.75	-3.55	-13.7	-25.1	-39.4	-47.9	-56.6	-64.0	-72.2
Moist	7.0	6.74	5.55	-1.85	-1.85	-6.85	-13.0	-22.0	-30.8	-42.8	-56.1	-56.1	-64.4	-74.2
Hum	89.07	88.79	88.8	82.78	93.2	86.87	85.36	86.63	90.32	93.7	98.06	99.99	99.06	95.85
atmos	**TTI**	39.59	**LI**	7.84	**KI**	17.15	**S_P**	965.2	**S_T**	288.5	**W_V**	2.12	**T_O**	259

Where,

TTI	-	Total Totals Index
LI	-	Lifted Index
KI	-	George’s K - Index
S_P	-	Surface Pressure
S_T	-	Surface Temperature
W_V	-	Water Vapor
T_O	-	Total Ozone (in Dobson Unit)

In the tabular column,

Row 1 – indicates Lat,long

Row 2 – indicates Pressure levels

Row 3 - indicates Temperature

Row 4 – indicates Dew point

Row 5 - indicates Humidity

Row 6 – indicates Atmospheric Profile

The first pixel indicates the Temperature of 1000hPa in degree centigrades at latitude **1**0.22705 and longitude 76.04525

Similarly the other pixels indicates their respective values for various parameters like,

Dew-Point,

Humidity &

Atmospheric profile ---- Total Totals Index [TTI], Lifted Index [LI],K-Index[KI],

Surface Température [Surf_Temp],

Surface Pressure [Surf_Pres],

Water Vapor [Water_Vap],

Total Ozone[Ozone]

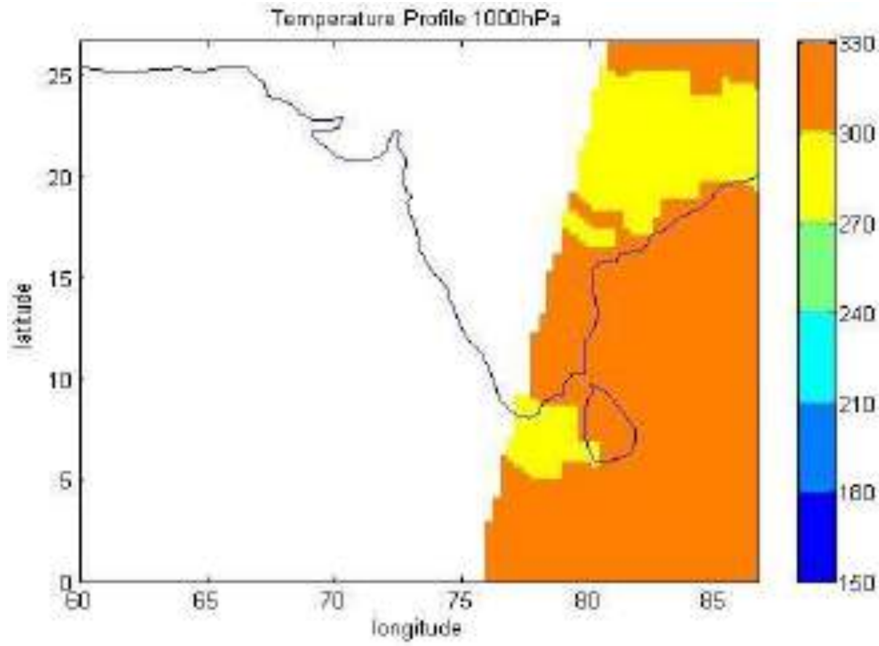
MAT FILES

&

FIGURES

MAT file for Real-Time Image

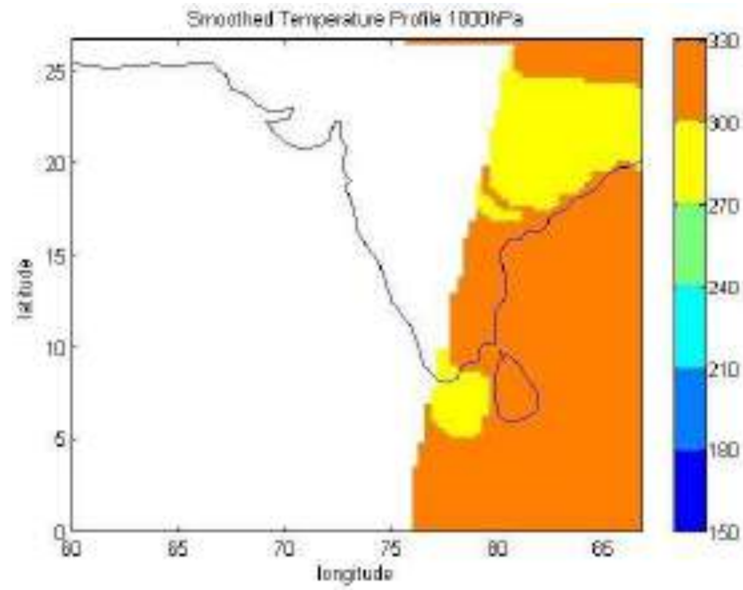
```
close all;
clc;
clear all;
a=hdfread('201108180330MTA.ChCentralMetOp--TEMPERATUREPROFILE.hd
f','Temperature_Profile_1000.0hPa_DATA');
a1=double(a);sz=size(a1);
for i=1:sz(1);
    for j=1:sz(2);
        if (a1(i,j)==0)
            a1(i,j)=NaN;
else
   a1(i,j)=[(a1(i,j)/100)-0.01];    // Conversion of Pixels as per Look-up table//
        end
    end
end
long=60:0.3:86.7;lat=0:0.3:26.7;
pcolor(long,lat,a1);shading flat;load coast;hold on;
plot(long,lat);
xlim([60,86.7]);ylim([0,26.7]);
title('Temperature Profile 1000hPa');
xlabel ('longitude');
ylabel ('latitude');
contourcmap([150:30:330],'jet','colorbar','on');
```

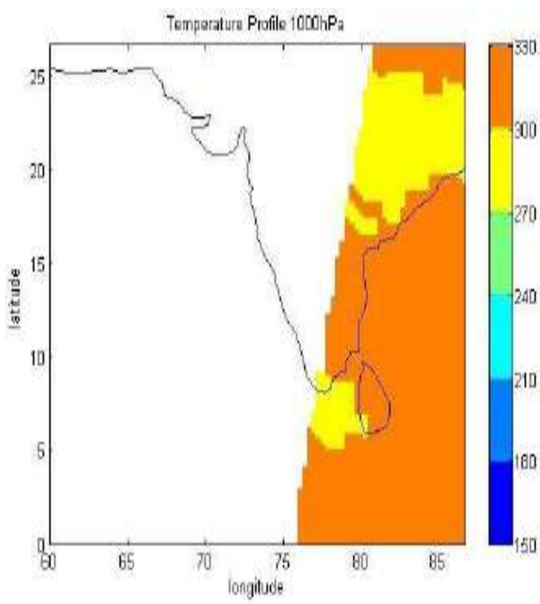


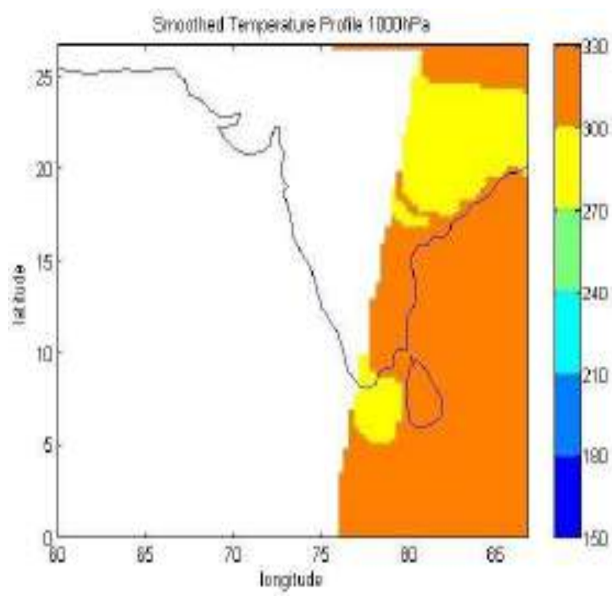
MAT file   for SMOOTHED Image

```
close all;
clc;
clear all;
a=hdfread('201108180330MTA.ChCentralMetOp--TEMPERATUREPROFILE.hdf','Temperature_Profile_1000.0hPa_DATA');
a1=double(a);sz=size(a1);
for i=1:sz(1);
    for j=1:sz(2);
        if (a1(i,j)==0)
            a1(i,j)=NaN;
        else
            a1(i,j)=[(a1(i,j)/100)-0.01];
        end
    end
```

```
end
yy=smooth(a1,5,'moving');zz=reshape(yy,90,90);
long=60:0.3:86.7;lat=0:0.3:26.7;
pcolor(long,lat,zz);shading flat;load coast;hold on;plot(long,lat);
xlim([60,86.7]);ylim([0,26.7]);title('Smoothed Temperature Profile 1000hPa');
xlabel ('longitude');ylabel ('latitude');contourcmap([150:30:330],'jet','colorbar','on');
```







MAT file for Brightness Temperature(T4) Calculation

```
close all;clc;clear all;
data = hdfread('201109271901N19.ChCentralNOAA--L1B.hdf',
'NOAA_CH4_DATA');
a12=double(data);sz=size(a12);
for i=1:sz(1)
    for j=1:sz(2)
        if(a12(i,j)==0)
            a12(i,j)=a12(i,j);
        else
       a12(i,j)=[a12(i,j)/(5.67*10^-8)]^0.25;
        end
    end
end
A=uint16(a12);B=A';
sd_id = hdfsd('start',' T4data.hdf','DFACC_CREATE');
sd_id = hdfsd('start',' T4data.hdf'','DFACC_RDWR');
ds_name = 'A';
ds_type = 'uint16';
ds_rank = ndims(B);
ds_dims = fliplr(size(B));
sds_id = hdfsd('create',sd_id,ds_name,ds_type,ds_rank,ds_dims);
ds_start = zeros(1:ndims(B));    // % Start at the beginning //
ds_stride = [ ];                 // % Write every element //
```

```
ds_edges = fliplr(size(B));
stat = hdfsd('writedata',sds_id,ds_start, ds_stride, ds_edges, B);
stat = hdfsd('endaccess',sds_id);
stat = hdfsd('endaccess',sd_id);
stat = hdfsd('end',sd_id);
stat = hdfsd('end',sds_id);
```

MAT file for Brightness Temperature(T5) Calculation

```
close all;clc;clear all;
data = hdfread('201109271901N19.ChCentralNOAA--L1B.hdf',
'NOAA_CH5_DATA');
a12=double(data);sz=size(a12);
for i=1:sz(1)
    for j=1:sz(2)
        if(a12(i,j)==0)
            a12(i,j)=a12(i,j);
        else
       a12(i,j)=[a12(i,j)/(5.67*10^-8)]^0.25;
        end
    end
end
A=uint16(a12);B=A';
sd_id = hdfsd('start',' T5data.hdf','DFACC_CREATE');
sd_id = hdfsd('start',' T5data.hdf','DFACC_RDWR');
ds_name = 'A';ds_type = 'uint16';ds_rank = ndims(B);ds_dims = fliplr(size(B));
sds_id = hdfsd('create',sd_id,ds_name,ds_type,ds_rank,ds_dims);
ds_start = zeros(1:ndims(B));ds_stride = [ ];
```

```
ds_edges = fliplr(size(B));
stat = hdfsd('writedata',sds_id,ds_start, ds_stride, ds_edges, B);
stat = hdfsd('endaccess',sds_id);stat = hdfsd('endaccess',sd_id);
stat = hdfsd('end',sd_id);stat = hdfsd('end',sds_id);
```

<u>MAT file for Sea Surface Temperature(Ts day) Calculation</u>

```
close all;clc;clear all;
data1 = hdfread('T4data.hdf', 'A');
data2 = hdfread('T5data.hdf', 'A');
T4=double(data1); T5=double(data2);
Tsd=[ ];
k=size(T4);
for i=1:k(1)
    for j=1:k(2)
        Tsd(i,j)=0.9731*T4(i,j)+2.6353*[T4(i,j)-T5(i,j)]-265.4789;
    end
end
k1=size(Tsd);
for i=1:k1(1)
    for j=1:k1(2)
        if(Tsd(i,j)<=0)
            Tsd(i,j)=NaN;
           else
           Tsd(i,j)=Tsd(i,j);
        end
    end
end
```

```
clear i j k1;
A=uint16(Tsd);B=A';
sd_id = hdfsd('start','Tsdaydata.hdf','DFACC_CREATE');
sd_id = hdfsd('start','Tsdaydata.hdf','DFACC_RDWR');
ds_name = 'A';ds_type = 'uint16';ds_rank = ndims(B);ds_dims = fliplr(size(B))';
sds_id = hdfsd('create',sd_id,ds_name,ds_type,ds_rank,ds_dims);
ds_start = zeros(1:ndims(B));ds_stride = [ ];ds_edges = fliplr(size(B));
stat = hdfsd('writedata',sds_id,ds_start, ds_stride, ds_edges, B);
stat = hdfsd('endaccess',sds_id);stat = hdfsd('endaccess',sd_id);
stat = hdfsd('end',sd_id);
stat = hdfsd('end',sds_id);
```

<u>MAT file for User-defined Ts day Calculation</u>

```
close all;clc;clear all;
data = hdfread('Tsdaydata.hdf', 'A');
a12=double(data);
userlat=input('enter latitude:');userlong=input('enter longitude:');
c=input('enter desired latitude pixels:');d=input('enter desired longitude pixels:');
res=0.009;k=round(1/res);
k1=round((userlat+20)*k);k2=round((userlong-60)*k);
b1=a12(k1:k1+c,k2:k2+d);
long=userlong:res:userlong+c*res;lat=userlat:res:userlat+d*res;
pcolor(long,lat,b1);shading flat; hold on;load coast;
plot(long,lat);
xlim([60 110]);
ylim([-20 30]);
title('User defined');
```

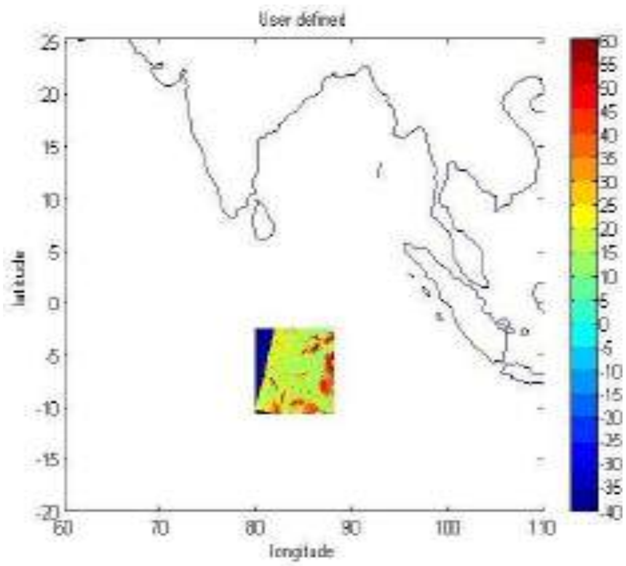
```
xlabel ('longitude');
ylabel ('latitude');
contourcmap([0:10:70],'jet','colorbar','on');
```

Input:

enter latitude : -10.603 enter longitude : 80 enter desired latitude pixels : 900

enter desired longitude pixels: 900

OUTPUT :



MAT file for THRESHOLD

```
close all;clc;clear all;
data2 = hdfread('T5data.hdf', 'A');
T5=double(data2);
sz=size(T5);
for i=1:sz(1)
    for j=1:sz(2)
        if(T5(i,j)>=279 & T5(i,j)<=308)
            T5(i,j)=T5(i,j);
        else
```

```
            T5(i,j)=NaN;
        end
    end
end
A=uint16(T5);B=A';
sd_id = hdfsd('start','threshT5.hdf','DFACC_CREATE');
sd_id = hdfsd('start','threshT5.hdf','DFACC_RDWR');
ds_name = 'A';
ds_type = 'uint16';
ds_rank = ndims(B);
ds_dims = fliplr(size(B))';
sds_id = hdfsd('create',sd_id,ds_name,ds_type,ds_rank,ds_dims);
ds_start = zeros(1:ndims(A)); % Start at the beginning
ds_stride = [ ];                    % Write every element.
ds_edges = fliplr(size(B));
stat = hdfsd('writedata',sds_id,ds_start, ds_stride, ds_edges, B);
stat = hdfsd('endaccess',sds_id);
stat = hdfsd('endaccess',sd_id);
stat = hdfsd('end',sd_id);
stat = hdfsd('end',sds_id);
```

MAT file for ABSOLUTE

```
close all;clc;clear all;
data1 = hdfread('T4data.hdf', 'A');data2 = hdfread('threshT5.hdf', 'A');
T4=double(data1);T5=double(data2);
sz=size(T4);
for i=1:sz(1)
```

```
    for j=1:sz(2)
        if(abs(T4(i,j)-T5(i,j))<=1)
            T4(i,j)=T4(i,j);
            T5(i,j)=T5(i,j);
        else
            T4(i,j)=NaN;
            T5(i,j)=NaN;
        end
    end
end
userlat=input('enter latitude:');userlong=input('enter longitude:');
c=input('enter desired latitude pixels:');d=input('enter desired longitude pixels:');
res=0.009;k=round(1/res);
k1=round((userlat+20)*k);
k2=round((userlong-60)*k);
b1=a12(k1:k1+c,k2:k2+d);
long=userlong:res:userlong+c*res;lat=userlat:res:userlat+d*res;
pcolor(long,lat,b1);shading flat; hold on;load coast;
plot(long,lat);
xlim([60 110]);ylim([-20 30]);title('User defined');
xlabel ('longitude');ylabel ('latitude');
contourcmap([0:10:70],'jet','colorbar','on');
A=uint16(T5); B=A';
 sd_id = hdfsd('start','absT5for1k.hdf','DFACC_CREATE');
 sd_id = hdfsd('start','absT5for1k.hdf','DFACC_RDWR');
 ds_name = 'A';
```

```
ds_type = 'uint16';
ds_rank = ndims(B);
ds_dims = fliplr(size(B))';
sds_id = hdfsd('create',sd_id,ds_name,ds_type,ds_rank,ds_dims);
ds_start = zeros(1:ndims(A));
ds_stride = [];
ds_edges = fliplr(size(B));
stat = hdfsd('writedata',sds_id,ds_start, ds_stride, ds_edges, B);
stat = hdfsd('endaccess',sds_id);
stat = hdfsd('endaccess',sd_id);
stat = hdfsd('end',sd_id);
stat = hdfsd('end',sds_id);
```

MAT file for ABSOLUTE SST for Day time

```
close all;clc;clear all;
data1 = hdfread('absT4for1k.hdf', 'A');data2 = hdfread('absT5for1k.hdf', 'A');
T4=double(data1);T5=double(data2);
Tsd=[ ];k=size(T4);
for i=1:k(1)
    for j=1:k(2)
        Tsd(i,j)=0.9731*T4(i,j)+2.6353*[T4(i,j)-T5(i,j)]-265.4789;
    end
end
clear i j sz;
k1=size(Tsd)
for i=1:k1(1)
    for j=1:k1(2)
```

```
            if(Tsd(i,j)<=0)
                  Tsd(i,j)=NaN;
                else
                Tsd(i,j)=Tsd(i,j);
            end
      end
end
A=uint16(Tsd);
B=A';
sd_id = hdfsd('start','absSSTdfor1k.hdf','DFACC_CREATE');
sd_id = hdfsd('start','absSSTdfor1k.hdf','DFACC_RDWR');
ds_name = 'A';
ds_type = 'uint16';
ds_rank = ndims(B);
ds_dims = fliplr(size(B))';
sds_id = hdfsd('create',sd_id,ds_name,ds_type,ds_rank,ds_dims);
ds_start = zeros(1:ndims(A)); % Start at the beginning
ds_stride = [ ];                      % Write every element.
ds_edges = fliplr(size(B));
stat = hdfsd('writedata',sds_id,ds_start, ds_stride, ds_edges, B);
stat = hdfsd('endaccess',sds_id);
stat = hdfsd('endaccess',sd_id);
stat = hdfsd('end',sd_id);
stat = hdfsd('end',sds_id);
```

<u>MAT file for User-defined ABSOLUTE SST for 1K</u>

```
close all;clc;clear all;
```

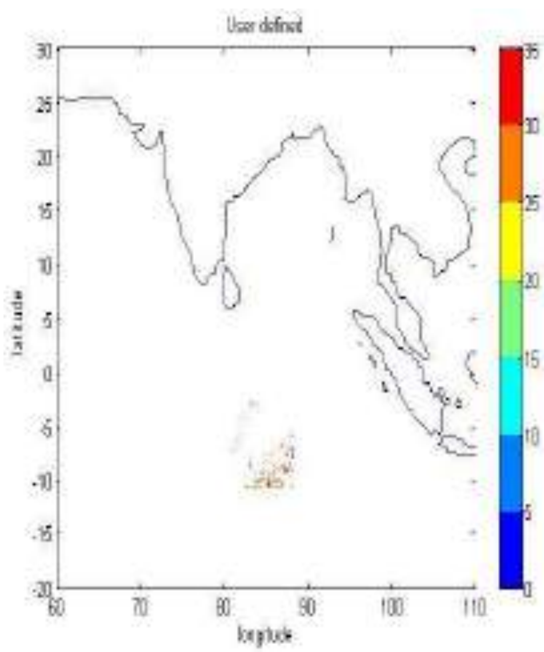
```
data = hdfread('absSSTdfor1k.hdf', 'A');
a12=double (data);
userlat=input('enter latitude:');userlong=input('enter longitude:');
c=input('enter desired latitude pixels:');d=input('enter desired longitude pixels:');
res=0.009;k=round(1/res);
k1=round((userlat+20)*k);k2=round((userlong-60)*k);
b1=a12(k1:k1+c,k2:k2+d);
long=userlong:res:userlong+c*res;lat=userlat:res:userlat+d*res;
pcolor(long,lat,b1);shading flat; hold on;load coast; plot(long,lat);
xlim([60 110]);ylim([-20 30]);title('User defined');
xlabel ('longitude');ylabel ('latitude');contourcmap([0:6:36],'jet','colorbar','on');
```

Input:

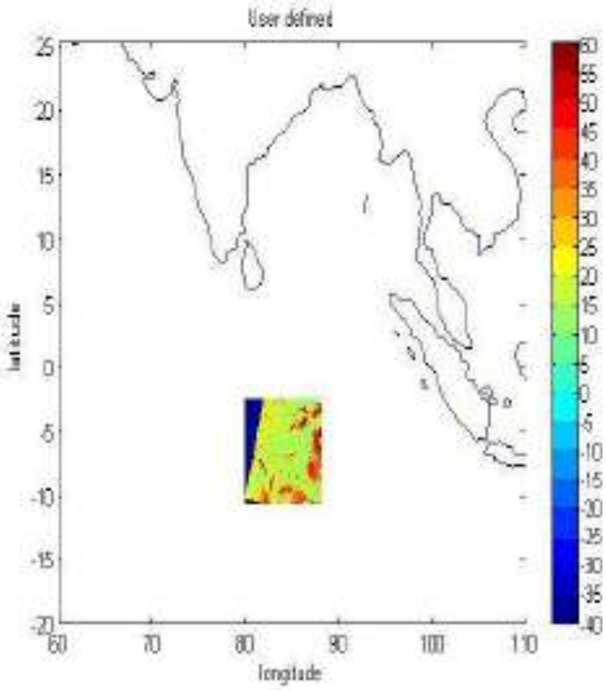
enter latitude : -10.603 enter longitude : 80 enter desired latitude pixels : 900

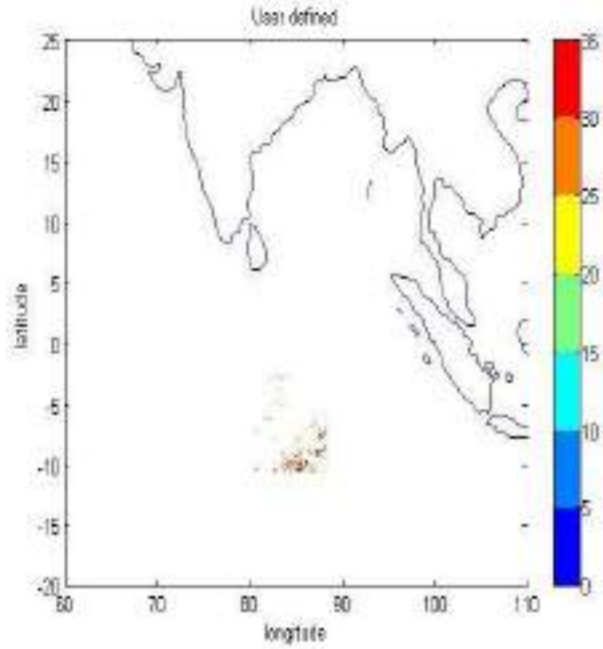
enter desired longitude pixels: 900

Output:



Comparison:





<u>TRIPLE-WINDOW Technique</u>

```
clc;clear all;
data1 = hdfread('absT4for1k.hdf', 'A');
data2 = hdfread('absT5for1k.hdf', 'A');
data3 = hdfread('T3Bdata.hdf', 'A');
T3=double(data3);T4=double(data1);T5=double(data2);
Tsn=[ ];k=size(T4);
for i=1:k(1)
    for j=1:k(2)
        Tsn(i,j)=1.0170*T4(i,j)+0.9694*[T3(i,j)-T5(i,j)]-276.58;
    end
end
k1=size(Tsn);
```

```
for i=1:k1(1)
    for j=1:k1(2)
        if(Tsn(i,j)<=0)
            Tsn(i,j)=NaN;
           else
           Tsn(i,j)=Tsn(i,j);
        end
    end
end
A=uint16(Tsn);B=A';
sd_id = hdfsd('start','Triple window.hdf','DFACC_CREATE');
sd_id = hdfsd('start','Triple window.hdf','DFACC_RDWR');
ds_name = 'A';
ds_type = 'uint16';
ds_rank = ndims(B);
ds_dims = fliplr(size(B))';
sds_id = hdfsd('create',sd_id,ds_name,ds_type,ds_rank,ds_dims);
ds_start = zeros(1:ndims(B)); % Start at the beginning
ds_stride = [ ];                   % Write every element.
ds_edges = fliplr(size(B));
stat = hdfsd('writedata',sds_id,ds_start, ds_stride, ds_edges, B);
stat = hdfsd('endaccess',sds_id);
stat = hdfsd('endaccess',sd_id);
stat = hdfsd('end',sd_id);
stat = hdfsd('end',sds_id);
```

MAT file for Fog Detection at Trichy on 03/01/2012

```
close all;clc;clear all;
data = hdfread('201201032000AQU.ChCentralModis-atmos--L1B.hdf',
'MODIS_ch31_DATA');
data1 = hdfread('201201032000AQU.ChCentralModis-atmos--L1B.hdf',
'MODIS_ch31_LUT');
data2 = hdfread(' 201201032000AQU.ChCentralModis-atmos--L1B.hdf',
'MODIS_ch20_DATA');
data3 = hdfread('201201032000AQU.ChCentralModis-atmos--L1B.hdf',
'MODIS_ch20_LUT');
a12=double(data);b12=data1;c12=double(data2);d12=data3;
fd=a12;fe=c12;k1=1;
sz=size(a12);
for i=1:sz(1)
    for j=1:sz(2)
        if(a12(i,j)==0)
            a12(i,j)=NaN;
        else
            k=a12(i,j);
            fd(i,j)=b12(k1,k);
        end
    end
end
Rd31=fd;k2=size(c12);
for i=1:sz(1)
    for j=1:sz(2)
```

```
            if(c12(i,j)==0)
                  c12(i,j)=NaN;
            else
                  k3=c12(i,j);
                  fe(i,j)=d12(k1,k3);
            end
      end
end
Rd21=fe;clear i j k k1 k2 k3 sz;res=0.009;B= [ ];sz=size(Rd31);
for i=1:sz(1)
      for j=1:sz(2)
            B(i,j)=Rd31(i,j)-Rd21(i,j);
      end
end
for i=1:sz(1)
      for j=1:sz(2)
            if(B(i,j)>2 && B(i,j)<6)
                  B(i,j)=B(i,j);
            else
                  B(i,j)=NaN;
            end
      end
end
A=B;
userlat=input('Enter latitude:');userlong=input('Enter longitude:');
c=input('enter desired latitude pixels:');d=input('enter desired longitude pixels:');
```

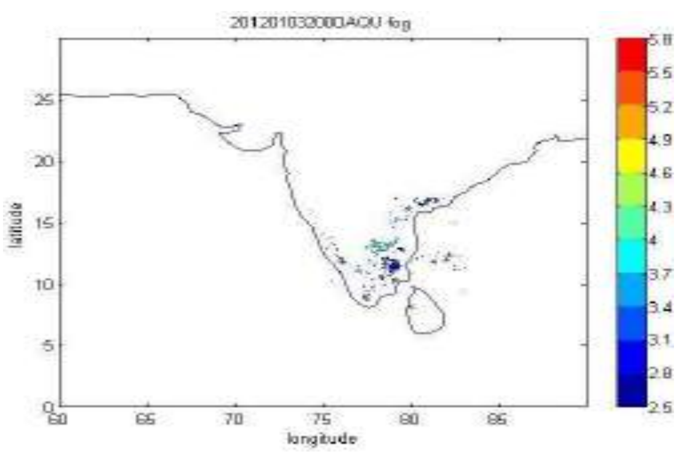
```
res=0.009;k=round(1/res);
k1=round(userlat*k);
k2=round((userlong-67.5)*k);
b1=A(k1:k1+c,k2:k2+d);
long=userlong:res:userlong+c*res;
lat=userlat:res:userlat+d*res;
pcolor(long,lat,b1);shading flat; hold on;
load coast;
plot(long,lat);
xlim([60 89.955]); ylim([0 29.95]);
title('User defined');
xlabel  ('longitude');
ylabel ('latitude');
contourcmap([2.5:0.3:6],'gray','colorbar','on');
```

Input:

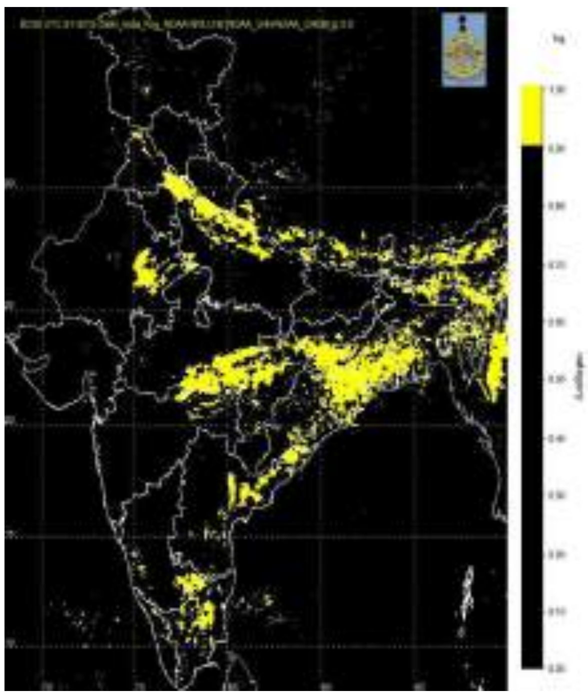
enter latitude: 8 enter longitude: 74 enter desired latitude pixels : 1000

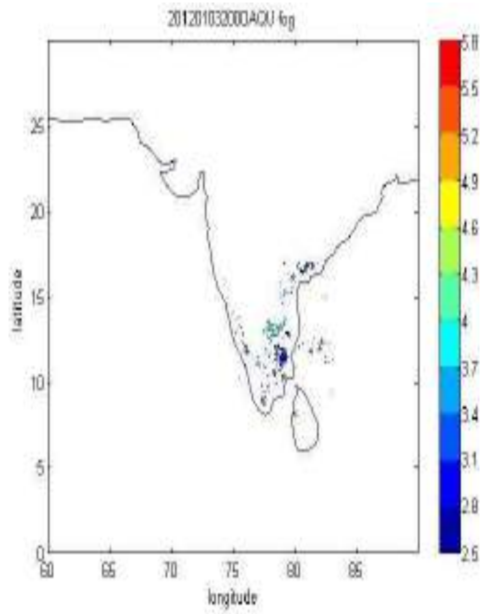
enter desired longitude pixels : 1000

Output :



Comparison :





<u>**MAT file for 'THANE' detection on 28/12/2011**</u>

```
close all;clc;clear all;
data =
hdfread('201112281547MTA.ChCentralMetOp--TEMPERATUREPROFILE.hdf',
'Temperature_Profile_700.0hPa_DATA');
data1 =
hdfread('201112281547MTA.ChCentralMetOp--TEMPERATUREPROFILE.hdf',
'Temperature_Profile_700.0hPa_LUT');
data2 =
hdfread('201112281547MTA.ChCentralMetOp--TEMPERATUREPROFILE.hdf',
'Temperature_Profile_500.0hPa_DATA');
data3 =
```

```
hdfread('201112281547MTA.ChCentralMetOp--TEMPERATUREPROFILE.hdf',
'Temperature_Profile_500.0hPa_LUT');
a12=double(data);b12=data1;c12=double(data2);d12=data3;
fd=a12;fe=c12;
k1=1;
sz=size(a12);
for i=1:sz(1)
    for j=1:sz(2)
        if(a12(i,j)==0)
            a12(i,j)=NaN;
        else
            k=a12(i,j);
            fd(i,j)=b12(k1,k);
        end
    end
end
Rd31=fd; k2=size(c12);
for i=1:sz(1)
    for j=1:sz(2)
        if(c12(i,j)==0)
            c12(i,j)=NaN;
        else
            k3=c12(i,j);
            fe(i,j)=d12(k1,k3);
        end
    end
```

```
end
Rd21=fe;clear i j k k1 k2 k3 sz;
B=[];
sz=size(Rd31);
for i=1:sz(1)
    for j=1:sz(2)
        B(i,j)=round(Rd31(i,j)-273.15);
    end
end
F=[ ];
for i=1:sz(1)
    for j=1:sz(2)
        F(i,j)=round(Rd21(i,j)-273.15);
    end
end
D=[ ];
for i=1:sz(1)
    for j=1:sz(2)
        D(i,j)=[B(i,j)+F(i,j)]/2;
    end
end
userlat=input('enter latitude:');
userlong=input('enter longitude:');
c=input('enter desired latitude pixels:');
d=input('enter desired longitude pixels:');
res=0.3;
```

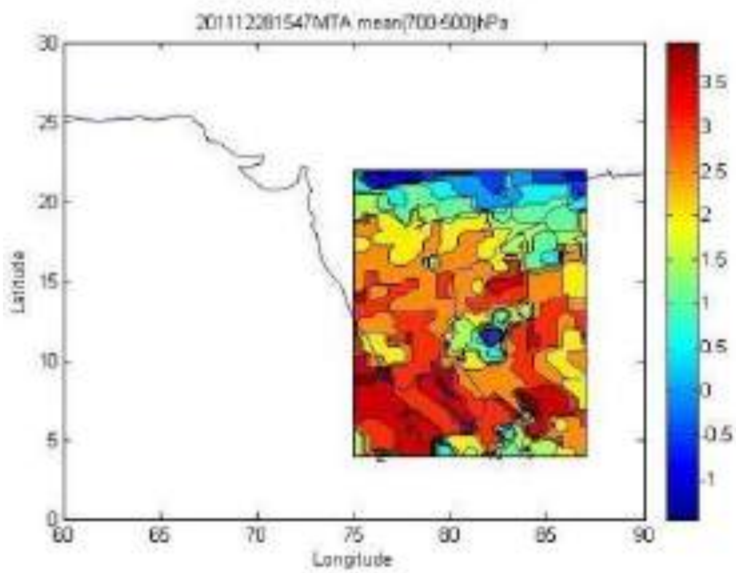
```
k=round(1/res);
k1=round(userlat*k);
k2=round((userlong-60)*k);
b1=D(k1:k1+c,k2:k2+d);
k1=size(b1);
for i=1:k1(1)
    for j=1:k1(2)
        if(b1(i,j)==-273)
            b1(i,j)=NaN;
        else
            b1(i,j)=b1(i,j);
        end
    end
end
long=userlong:res:userlong+d*res;
lat=userlat:res:userlat+c*res;
[C,h]=contourf(long,lat,b1);shading flat;
set(h,'ShowText','on','TextStep',get(h,'LevelStep')*4);
hold on;
load coast; plot(long,lat);
  title('201112281547MTA mean(700-500)hPa')
 xlabel('Longitude');
ylabel('Latitude');
xlim([60 90])
ylim([0 30])
```

Input:

enter latitude: 4 enter longitude: 74 enter desired latitude pixels : 40

enter desired longitude pixels : 40

Output:



<u>MAT file for 'THANE' detection on 29/12/2011</u>

```
close all;
clc;
clear all;
data =
hdfread('201112291526MTA.ChCentralMetOp--TEMPERATUREPROFILE.hdf',
'Temperature_Profile_700.0hPa_DATA');
data1 =
hdfread('201112291526MTA.ChCentralMetOp--TEMPERATUREPROFILE.hdf',
'Temperature_Profile_700.0hPa_LUT');
data2 =
hdfread('201112291526MTA.ChCentralMetOp--TEMPERATUREPROFILE.hdf',
```

```
'Temperature_Profile_500.0hPa_DATA');
data3 =
hdfread('201112291526MTA.ChCentralMetOp--TEMPERATUREPROFILE.hdf',
'Temperature_Profile_500.0hPa_LUT');
a12=double(data);
b12=data1;
c12=double(data2);
d12=data3;
fd=a12;
fe=c12;
k1=1;
sz=size(a12);
for i=1:sz(1)
    for j=1:sz(2)
        if(a12(i,j)==0)
            a12(i,j)=NaN;
        else
            k=a12(i,j);
            fd(i,j)=b12(k1,k);
        end
    end
end
Rd31=fd;
k2=size(c12);
for i=1:sz(1)
    for j=1:sz(2)
```

```
        if(c12(i,j)==0)
            c12(i,j)=NaN;
        else
            k3=c12(i,j);
            fe(i,j)=d12(k1,k3);
        end
    end
end
Rd21=fe;
clear i j k k1 k2 k3 sz;
B=[];
sz=size(Rd31);
for i=1:sz(1)
    for j=1:sz(2)
        B(i,j)=round(Rd31(i,j)-273.15);
    end
end
F=[];
for i=1:sz(1)
    for j=1:sz(2)
        F(i,j)=round(Rd21(i,j)-273.15);
    end
end
D=[];
for i=1:sz(1)
    for j=1:sz(2)
```

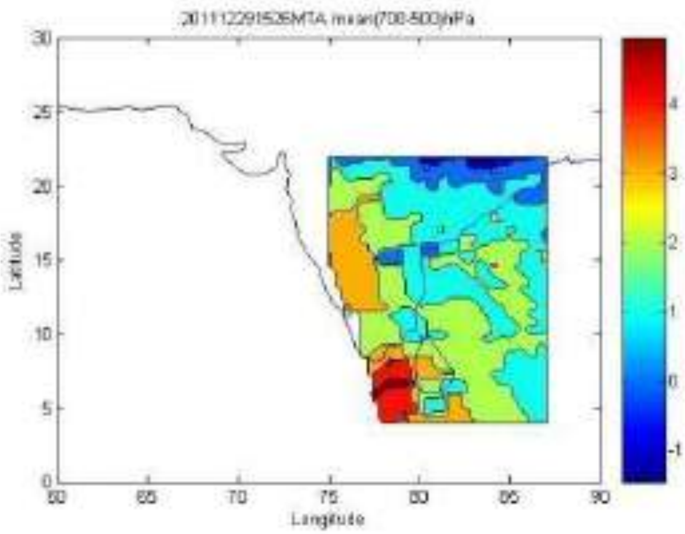
```
        D(i,j)=[B(i,j)+F(i,j)]/2;
    end
end
userlat=input('enter latitude:');userlong=input('enter longitude:');c=input('enter
desired latitude pixels:');d=input('enter desired longitude pixels:');
res=0.3;k=round(1/res);k1=round(userlat*k);k2=round((userlong-60)*k);
b1=D(k1:k1+c,k2:k2+d);k1=size(b1);
for i=1:k1(1)
    for j=1:k1(2)
        if(b1(i,j)==-273)
            b1(i,j)=NaN;
        else
            b1(i,j)=b1(i,j);
        end
    end
end
long=userlong:res:userlong+d*res;lat=userlat:res:userlat+c*res;
[C,h]=contourf(long,lat,b1);shading flat;
set(h,'ShowText','on','TextStep',get(h,'LevelStep')*4);
hold on;
load coast;
 plot(long,lat);   title('201112291526MTA mean(700-500)hPa')
xlabel('Longitude'); ylabel('Latitude');xlim([60 90])   ylim([0 30])
```

Input:

enter latitude: 4   enter longitude: 74   enter desired latitude pixels : 40

enter desired longitude pixels : 40

Output:



<u>MAT file for all profiles</u>

```
close all;
clc;
clear all;
a =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_1000hPa_DATA'));
a1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_1000hPa_LUT'));
b =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_950hPa_DATA'));
b1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_950hPa_LUT'));
c =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_920hPa_DATA'));
c1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_920hPa_LUT'));
```

```
d =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_850hPa_DATA'));
d1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_850hPa_LUT'));
e =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_780hPa_DATA'));
e1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_780hPa_LUT'));
f =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_700hPa_DATA'));
f1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_700hPa_LUT'));
g =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_620hPa_DATA'));
g1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_620hPa_LUT'));
h =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_500hPa_DATA'));
h1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_500hPa_LUT'));
I =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_400hPa_DATA'));
I1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_400hPa_LUT'));
J =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_300hPa_DATA'));
```

```
J1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_300hPa_LUT'));
k2 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_250hPa_DATA'));
k1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_250hPa_LUT'));
l =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_200hPa_DATA'));
l1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_200hPa_LUT'));
m =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_150hPa_DATA'));
m1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_150hPa_LUT'));
n =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_100hPa_DATA'));
n1 =
double(hdfread('201112131653TER.ChCentralModis-atmos--TEMPERATUREPR
OFILE.hdf','Temperature_Profile_100hPa_LUT'));
sz=size(a);
L=1;
U=a;
for i=1:sz(1)
    for j=1:sz(2)
        if(a(i,j)==0)
            a(i,j)=0;
        else
            k=a(i,j);
            U(i,j)=a1(L,k);
        end
    end
```

```
end
for i=1:sz(1)
     for j=1:sz(2)
         if(U(i,j)<=0)
             U(i,j)=0;
            else
             U(i,j)=U(i,j);
         end
     end
end
V=b;
for i=1:sz(1)
    for j=1:sz(2)
        if(b(i,j)==0)
            b(i,j)=0;
        else
            k=b(i,j);
            V(i,j)=b1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(V(i,j)<=0)
             V(i,j)=0;
            else
             V(i,j)=V(i,j);
         end
     end
end
W=c;
for i=1:sz(1)
    for j=1:sz(2)
        if(c(i,j)==0)
            c(i,j)=0;
        else
            k=c(i,j);
            W(i,j)=c1(L,k);
        end
```

```
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(W(i,j)<=0)
             W(i,j)=0;
            else
             W(i,j)=W(i,j);
         end
     end
end
X=d;
for i=1:sz(1)
    for j=1:sz(2)
        if(d(i,j)==0)
            d(i,j)=0;
        else
            k=d(i,j);
            X(i,j)=d1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(X(i,j)<=0)
             X(i,j)=0;
            else
             X(i,j)=X(i,j);
         end
     end
end
Y=e;
for i=1:sz(1)
    for j=1:sz(2)
        if(e(i,j)==0)
            e(i,j)=0;
        else
            k=e(i,j);
            Y(i,j)=e1(L,k);
```

```
            end
        end
end
for i=1:sz(1)
          for j=1:sz(2)
                 if(Y(i,j)<=0)
                        Y(i,j)=0;
                      else
                        Y(i,j)=Y(i,j);
                 end
          end
end

Z=f;
for i=1:sz(1)
        for j=1:sz(2)
                if(f(i,j)==0)
                        f(i,j)=0;
                else
                        k=f(i,j);
                        Z(i,j)=f1(L,k);
                end
        end
end
for i=1:sz(1)
          for j=1:sz(2)
                 if(Z(i,j)<=0)
                        Z(i,j)=0;
                      else
                        Z(i,j)=Z(i,j);
                 end
          end
end

U1=g;
for i=1:sz(1)
        for j=1:sz(2)
                if(g(i,j)==0)
                        g(i,j)=0;
```

```
        else
            k=g(i,j);
            U1(i,j)=g1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(U1(i,j)<=0)
             U1(i,j)=0;
            else
             U1(i,j)=U1(i,j);
         end
     end
end
V1=h;
for i=1:sz(1)
    for j=1:sz(2)
        if(h(i,j)==0)
            h(i,j)=0;
        else
            k=h(i,j);
            V1(i,j)=h1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(V1(i,j)<=0)
             V1(i,j)=0;
            else
             V1(i,j)=V1(i,j);
         end
     end
end
W1=I;
for i=1:sz(1)
    for j=1:sz(2)
        if(I(i,j)==0)
```

```
            I(i,j)=0;
        else
            k=I(i,j);
            W1(i,j)=I1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(W1(i,j)<=0)
             W1(i,j)=0;
            else
             W1(i,j)=W1(i,j);
         end
     end
end
X1=J;
for i=1:sz(1)
    for j=1:sz(2)
        if(J(i,j)==0)
            J(i,j)=0;
        else
            k=J(i,j);
            X1(i,j)=J1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(X1(i,j)<=0)
             X1(i,j)=0;
            else
             X1(i,j)=X1(i,j);
         end
     end
end
Y1=k2;
for i=1:sz(1)
    for j=1:sz(2)
```

```
        if(k2(i,j)==0)
            k2(i,j)=0;
        else
            k=k2(i,j);
            Y1(i,j)=k1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(Y1(i,j)<=0)
              Y1(i,j)=0;
             else
              Y1(i,j)=Y1(i,j);
         end
     end
end
Z1=l;
for i=1:sz(1)
    for j=1:sz(2)
        if(l(i,j)==0)
            l(i,j)=0;
        else
            k=l(i,j);
            Z1(i,j)=l1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(Z1(i,j)<=0)
              Z1(i,j)=0;
             else
              Z1(i,j)=Z1(i,j);
         end
     end
end
U11=m;
for i=1:sz(1)
```

```
    for j=1:sz(2)
        if(m(i,j)==0)
            m(i,j)=0;
        else
            k=m(i,j);
            U11(i,j)=m1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(U11(i,j)<=0)
             U11(i,j)=0;
            else
             U11(i,j)=U11(i,j);
         end
     end
end
V11=n;
for i=1:sz(1)
    for j=1:sz(2)
        if(n(i,j)==0)
            n(i,j)=0;
        else
            k=n(i,j);
            V11(i,j)=n1(L,k);
        end
    end
end
for i=1:sz(1)
     for j=1:sz(2)
         if(V11(i,j)<=0)
            V11(i,j)=0;
            else
             V11(i,j)=V11(i,j);
         end
     end
end
clear sz i j k L;
```

```
res=0.04545;K=round(1/res);
userlat=8;
sz=8:res:16;
for i=1:177;
     stlong=74;
   for j=1:177
     userlong=round(stlong-67.5);
     k3=round(userlat*K);k4=round(userlong*K);
     b00(i,j)=U(k3,k4); b2(i,j)=V(k3,k4);b3(i,j)=W(k3,k4); b4(i,j)=X(k3,k4);
     b5(i,j)=Y(k3,k4);  b6(i,j)=Z(k3,k4);b7(i,j)=U1(k3,k4);b8(i,j)=V1(k3,k4);
     b9(i,j)=W1(k3,k4);b10(i,j)=X1(k3,k4);b11(i,j)=Y1(k3,k4); b12(i,j)=Z1(k3,k4);
     b13(i,j)=U11(k3,k4); b14(i,j)=V11(k3,k4);
   stlong=stlong+res;
     end
     userlat=userlat+res;
end
y1=b00;y2=b2;y3=b3;y4=b4;y5=b5;y6=b6;y7=b7;y8=b8;y9=b9;y10=b10;
y11=b11;y12=b12;y13=b13;y14=b14;z1=y1.';z2=y2.';z3=y3.';z4=y4.';
z5=y5.';z6=y6.';z7=y7.';z8=y8.';z9=y9.';z10=y10.';z11=y11.';z12=y12.';
z13=y13.';z14=y14.';clear i j k3 k4;
k2=reshape(z1,31329,1);k3=reshape(z2,31329,1);k4=reshape(z3,31329,1);
k5=reshape(z4,31329,1);k6=reshape(z5,31329,1);k7=reshape(z6,31329,1);
k8=reshape(z7,31329,1);k9=reshape(z8,31329,1);k10=reshape(z9,31329,1);
k11=reshape(z10,31329,1);k12=reshape(z11,31329,1);k13=reshape(z12,31329,1);
k14=reshape(z13,31329,1);k15=reshape(z14,31329,1);M=[k2,k3,k4,k5,k6,k7,k8,k
9,k10,k11,k12,k13,k14,k15];
userlat=8;
for i=1:177
    for j=1:177
         N(i,j)=userlat;
     end
     userlat=userlat+res;
end
W=N.';
P=reshape(W,31329,1);
for i=1:177
     stlong=74
    for j=1:177
         S(i,j)=stlong;
```

```
            stlong=stlong+res;
        end
end
 O=S.'; T=reshape(O,31329,1); A=[P,T,M]; clear i j;
 C=A; D={'parameter','--->', 'temperature profile'};
B={'lat','long','1000hpa','950hpa','920hpa','850hpa','780hpa','700hpa','620hpa','500h
pa','400hpa','300hpa','250hpa','200hpa','150hpa','100hpa'  };
xlswrite('allprofiles.xls', D, 1, 'F1')
 xlswrite('allprofiles.xls', B, 1, 'A2'); xlswrite('allprofiles.xls', C, 1, 'A3')
```

MAT file for Tabular Column

```
clc;
clear all;
m1=xlsread('allprofiles.xls',1);m2=xlsread('allprofiles.xls',2);m3=xlsread('allprofile
s.xls',3);m4=xlsread('allprofiles.xls',4);
n1=m1(:,3);n2=m1(:,4);n3=m1(:,5);n4=m1(:,6);n5=m1(:,7);n6=m1(:,8);n7=m1(:,9)
;n8=m1(:,10);n9=m1(:,11);n10=m1(:,12);n11=m1(:,13);n12=m1(:,14);
n13=m1(:,15);n14=m1(:,16);
l1=reshape(n1,176,176);l2=reshape(n2,176,176);l3=reshape(n3,176,176);l4=resha
pe(n4,176,176);l5=reshape(n5,176,176);l6=reshape(n6,176,176);
l7=reshape(n7,176,176);l8=reshape(n8,176,176);l9=reshape(n9,176,176);l10=resh
ape(n10,176,176);l11=reshape(n11,176,176);l12=reshape(n12,176,176);l13=resha
pe(n13,176,176);l14=reshape(n14,176,176);
a1=l1(:,50);a2=l2(:,50);a3=l3(:,50);a4=l4(:,50);a5=l5(:,50);a6=l6(:,50);a7=l7(:,50);
a8=l8(:,50);a9=l9(:,50);a10=l10(:,50);a11=l11(:,50);a12=l12(:,50);a13=l13(:,50);
a14=l14(:,50);
p1=m2(:,3);p2=m2(:,4);p3=m2(:,5);p4=m2(:,6);p5=m2(:,7);p6=m2(:,8);p7=m2(:,9)
;p8=m2(:,10);p9=m2(:,11);p10=m2(:,12);p11=m2(:,13);p12=m2(:,14);p13=m2(:,1
5);p14=m2(:,16);
j1=reshape(p1,176,176);j2=reshape(p2,176,176);j3=reshape(p3,176,176);j4=resha
```

```
pe(p5,176,176);j5=reshape(p5,176,176);j6=reshape(p6,176,176);
j7=reshape(p7,176,176);j8=reshape(p8,176,176);j9=reshape(p9,176,176);j10=resh
ape(p10,176,176);j11=reshape(p11,176,176);j12=reshape(p12,176,176);j13=resha
pe(p13,176,176);j14=reshape(p14,176,176);
a01=j1(:,50);a02=j2(:,50);a03=j3(:,50);a04=j4(:,50);a05=j5(:,50);a06=j6(:,50);a07
=j7(:,50);a08=j8(:,50);a09=j9(:,50);a010=j10(:,50);a011=j12(:,50);
a012=j12(:,50);a013=j13(:,50);a014=j14(:,50);
o1=m3(:,3);o2=m3(:,4);o3=m3(:,5);o4=m3(:,6);o5=m3(:,7);o6=m3(:,8);o7=m3(:,9)
;o8=m3(:,10);o9=m3(:,11);o10=m3(:,12);o11=m3(:,13);o12=m3(:,14);o13=m3(:,1
5);o14=m3(:,16);
v1=reshape(o1,176,176);v2=reshape(o2,176,176);v3=reshape(o3,176,176);v4=resh
ape(o4,176,176);v5=reshape(o5,176,176);v6=reshape(o6,176,176);
v7=reshape(o7,176,176);v8=reshape(o8,176,176);v9=reshape(o9,176,176);v10=res
hape(o10,176,176);v11=reshape(o11,176,176);v12=reshape(o12,176,176);v13=res
hape(o13,176,176);v14=reshape(o14,176,176);
a001=v1(:,50);a002=v2(:,50);a003=v3(:,50);a004=v4(:,50);a005=v5(:,50);a006=v6
(:,50);a007=v7(:,50);a008=v8(:,50);a009=v9(:,50);a0010=v10(:,50);a0011=v11(:,5
0);a0012=v12(:,50);a0013=v13(:,50);a0014=v14(:,50);
s1=m4(:,3);s2=m4(:,4);s3=m4(:,5);s4=m4(:,6);s5=m4(:,7);s6=m4(:,8);s7=m4(:,9);
x1=reshape(s1,176,176);x2=reshape(s2,176,176);x3=reshape(s3,176,176);
x4=reshape(s4,176,176);x5=reshape(s5,176,176);x6=reshape(s6,176,176);x7=resh
ape(s7,176,176);
a0001=x1(:,50);a0002=x2(:,50);a0003=x3(:,50);a0004=x4(:,50);a0005=x5(:,50);a0
006=x6(:,50);a0007=x7(:,50);
i=1;
h1=a0001(i,1);h2=a0002(i,1);h3=a0003(i,1);h4=a0004(i,1);h5=a0005(i,1);h6=a000
```

```
6(i,1);h7=a0007(i,1);
userlat1=10.22705;userlong1=74:0.04545:82;
b={'userlat',userlat1,'userlong',userlong1(1,i)};
c={'parameter','1000hpa','950hpa','920hpa','850hpa','780hpa','700hpa','620hpa','500
hpa','400hpa','300hpa','250hpa','200hpa','150hpa','100hpa' };
d={'Temp(K)';'Dewpt(K)';'Humidity(%)';'Atmosph'};
e=[a1(i,1),a2(i,1),a3(i,1),a4(i,1),a5(i,1),a6(i,1),a7(i,1),a8(i,1),a9(i,1),a10(i,1),ai1(i,1
),a12(i,1),a13(i,1),a14(i,1)];
f=[a01(i,1),a02(1,1),a03(1,1),a04(1,1),a05(1,1),a06(1,1),a07(1,1),a08(1,1),a09(1,1)
,a010(1,1),a011(1,1),a012(1,1),a013(1,1),a014(1,1)];
g=[a001(1,1),a002(1,1),a003(1,1),a004(1,1),a005(1,1),a006(1,1),a007(1,1),a008(1,
1),a009(1,1),a0010(1,1),a0011(1,1),a0012(1,1),a0013(1,1),a0014(1,1)];
h={'TTI','','LI','','KI','','Surf_Pres','','Surf_Temp','','Water_Vap','','Ozone',''};
z1=xlswrite('table.xls',b,1,'F1');z2=xlswrite('table.xls',c,1,'A2');
z3=xlswrite('table.xls',d,1,'A3');z4=xlswrite('table.xls',e,1,'B3');
z5=xlswrite('table.xls',f,1,'B4');z6=xlswrite('table.xls',g,1,'B5');
z7=xlswrite('table.xls',h,1,'B6');
z8=xlswrite('table.xls',h1,1,'C6');z9=xlswrite('table.xls',h2,1,'E6');z10=xlswrite('tab
le.xls',h3,1,'G6');z11=xlswrite('table.xls',h4,1,'I6');
z12=xlswrite('table.xls',h5,1,'K6');z13=xlswrite('table.xls',h6,1,'M6');z14=xlswrite('
table.xls',h7,1,'O6');
clear e f g h1 h2 h3 h4 h5 h6 h7 z1 z2 z3 z4 z5 z6 z7 z8 z9 z10 z11 z12 z13 z14 b i;
```

The above Program is Compiled by Iteration i.e.,i=2,3.4……176.

5.Conclusion:

1. NOAA-9 MCSST Equations are well matched with the Real-time image of SST (IMD Website).
2. Fog detection helps to avoid the problems of Aviation and the Methodology which we adopted in our project work is better than the previous Methodology of considering the SYNOP data.
3. Unfortunately the phenomena of warm tongue between two cold tongues has not been observed in our analysis as the data contains erraneous values.
4. METOP data(MTA) is somewhat satisfactory for the phenomenon but AQUA and TERRA data is completely out of the phenomenon.
5. By using the Tabular Column, one can have the data of 14 Pressure levels(1000hPa…........ up to 100hPa) of the parameters Temperature, Moisture,Humidity &Atmospheric Profile at the respective Latitudes & Longitudes i.e., from 8N to 16N & 74E to 82E
6. Tabular column data almost overcomes the demerits of RADIOSONDE technique.

6. References:

Shoichi Kizu and Futoki Sakaida (1996), A New Set of MCSST Equations for NOAA-9/AVHRR.Rev., Vol. 52, pp. 235 to 249. 1996.

X. LI, W. PICHEL, E. MATURI, P. CLEMENTE-COLO´ N and J. SAPPER (2001), Deriving the operational nonlinear multichannel sea surface temperature algorithm coefficients for NOAA-15 AVHRR/3. Rev., vol. 22, no. 4, 699–704.

Jorge Vazquez-Cuervo and Rosanna Sumagaysay(2001), A Comparison between Sea Surface Temperatures as Derived from the European Remote Sensing Along-Track Scanning Radiometer and the NOAA/NASA AVHRR Oceans Pathfinder Dataset. Rev., vol. 82, no.5, May 2001.

Quazi Khalid Hassan, M. Mostafa Kamal & A. K. M. Azad Hossain(1998), IMPLEMENTATION OF ALGORITHMS OF GEOCODING AND SST ESTIMATION USING AVHRR DATA IN THE EASI/PACE PCI IMAGE PROCESSING SOFTWARE OVER THE BAY OF BENGAL. Rev., THE JOURNAL OF NOAMI VOLUME 15 NUMBER 2 DECEMBER 1998.

Kidder & Vonderharr,SATELLITE METEOROLOGY AN INTRODUCTION. Rev., Pg,No: 221-222.

Suresh, R., and Rengarajan, S., “On forecasting cyclone movement using TOVS data”, 2002, Mausam, 53, 2, 215-224.

Kidder S.Q., and Vonder Haar T.H., 1995. Satellite Meteorology - An Introduction. Academic Press Inc., San Diego, CA, p466.

J Bendix, B Thies, J Cermak & T Nauß, Detection of fog with MODIS, COST 722 Expert meeting, Helsinki, 9 June2004.

JÖRG BENDIX, BORIS THIES, JAN CERMAK, AND THOMAS NAUß, Ground Fog Detection from Space Based on MODIS Daytime Data—A Feasibility Study, VOLUME 20, 4 May 2005

DANIELA NOWAK, DOMINIQUE RUFFIEUX, JUDITH L. AGNEW, LAURENT VUILLEUMIER,Detection of Fog and Low Cloud Boundaries with Ground-Based Remote Sensing Systems, VOLUME 25, AUGUST 2008.

Dear Sir/Madam,

I hold MTech degree in Space Technology & Its Applications from the Sri Venkateswara University and I would like to apply for the PhD position with reference code **GS-EAS-EMME-21-7** at CYPRUS Institute. My goal is to become a Scientist to investigate the improvements that can be done in actual climate models and in NWF. This program would help me to start my career as a specialist in climate researcher.

I am very excited by Space Sciences and Climate observations, as both of them have major applications in Space Engineering. Because the Atmosphere climate has been gradually changing time to time and most of the models have been established to predict the climate conditions and I hope that soon I will bring my contribution in this area. I also believe that my work experience in Climate modeling and oceanic SST represents an advantage because i have learned to evaluate the climatic models and strong background in programming, and for the reason that i have managed to integrate myself in a team where each member could learn from the other without hesitation.

From practical experience, and study, I have knowledge in climate research area that I have been worked for two years in NATIONAL ATMOSPHERIC RESEARCH LABORATORY as Project Junior Researcher. My work is on MST RADAR Troposphere data analyzing vertical limit of up to 20kms by Atmospheric Data Processing Software. Running of MST DRADAR and Testing the RADAR for detecting the noise efficiency. When mission launching is there as team member we collectively analyzing the Troposphere data and estimating the vertical wind profiles and sending the data to Sriharikota Rocket Launching Station (SHAR).

On the faculty I was a good student, I completed my graduation in Electronics and Communication engineering with first class and in my masters stand on the 2nd place (from aproximatively 14 students)in University Department of Physics. My master these name was “Processing of Polar Orbiting Satellite Remote Sensing Data for Meteorological Applications” worked under the direction of Professor Dr. R.SURESH Director of Indian Meteorological Department.

In regard to my extracurricular activities, I like playing Cricket, Chess, Badminton and traveling. I appreciate the value of the insistence, ambition and team spirit. I have learnt the commitment is necessary for success as an individual and how to work as a team member.

Research Interests:

My research has focused primarily on understanding and modeling of land surface processes, their parameterizations in numerical weather prediction and global climate models, and the role of land in shaping weather, climate, air quality, and water resources. I view land as an integral part of the earth system, which should be considered in a holistic way, linking the atmosphere, biosphere, cryosphere, ocean, and solid earth.

I use powerful methodologies such as satellite remote sensing and supercomputing simulations which are now profoundly changing research in the earth sciences. I place a strong emphasis on the societal impact of the research in the earth sciences.

Specifically, I have been working to answer a wide variety of research and science questions below.

- How does land shape climate, or vice versa, on all time and space scales?
- What has been the impact of human activity on the Earth?
- What is the future of our environment under climate change, land use change and water use change?
- How good are climate models in simulating biosphere–hydrosphere–atmosphere interactions?
- What are their uncertainties?
- How can we use satellite datasets, aircraft measurements, and surface observations to improve the coupled land surface and climate models?

Should you require further information, please do not hesitate to contact me. Thank you for considering my application, and I look forward to your favorable reply.

Yours Sincerely,

K KRISHNAKANTH