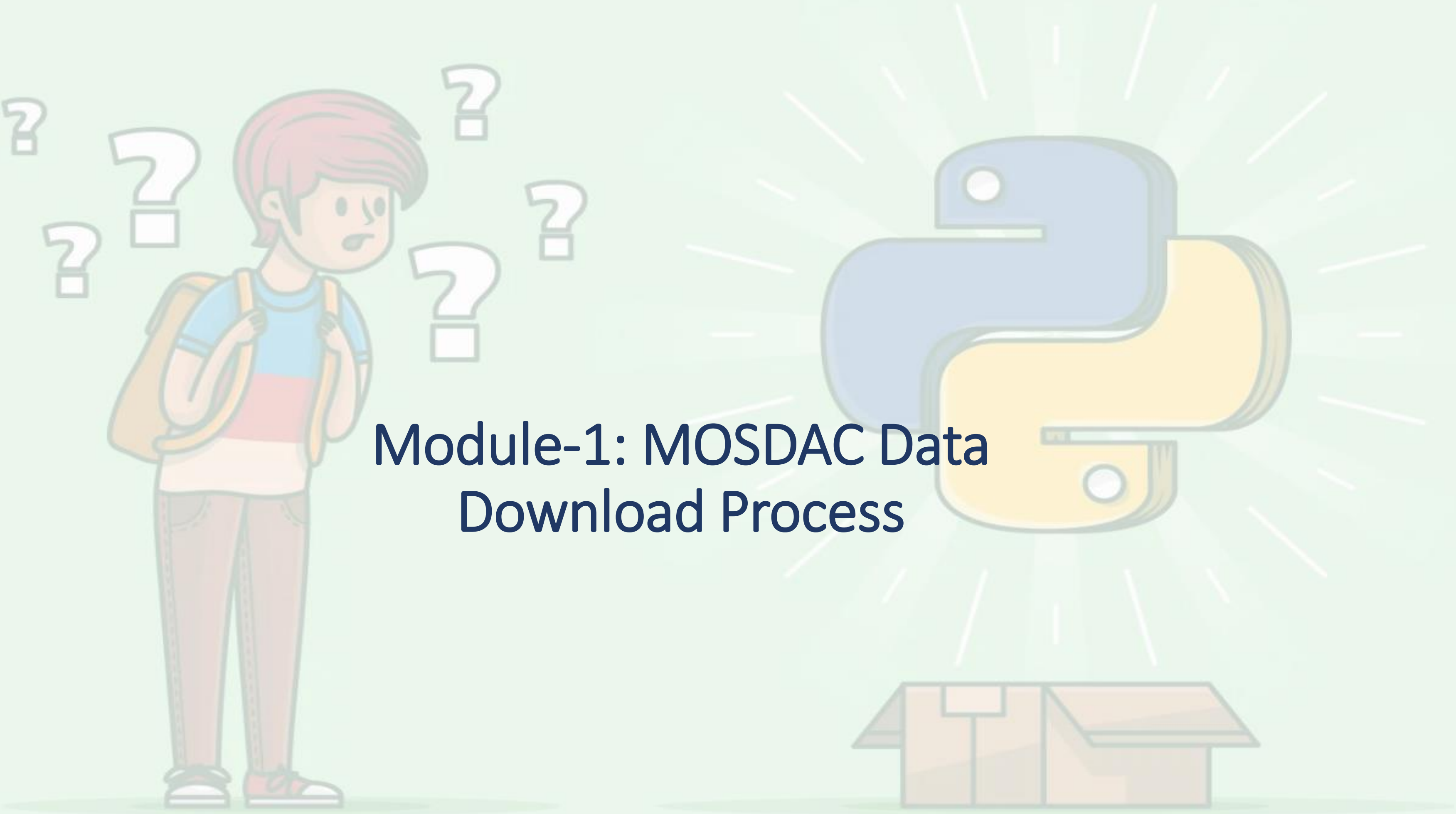
AFSIS Training on ISRO-Agromet Data Processing using QGIS & Python

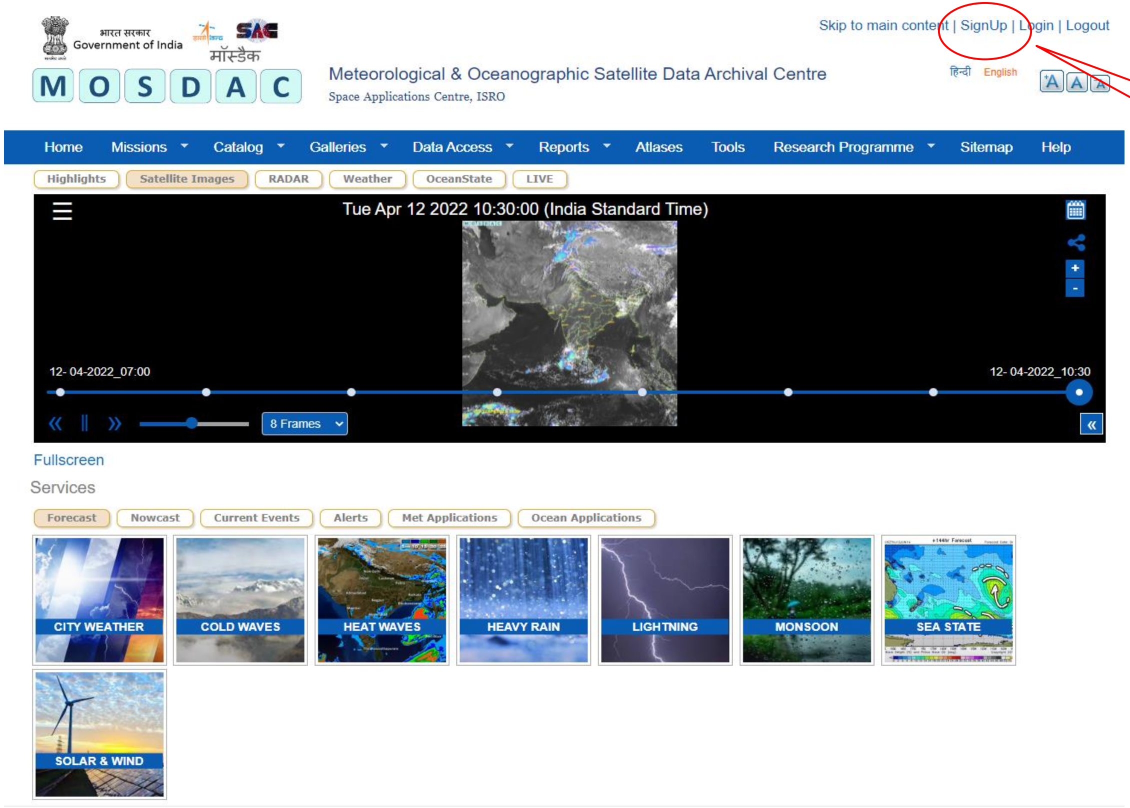
Ujjwal Kumar Gupta
Space Applications Centre, ISRO
Email: ujjwal_gupta@sac.isro.gov.in



Module-1: MOSDAC Data Download Process

MOSDAC Data Downloading

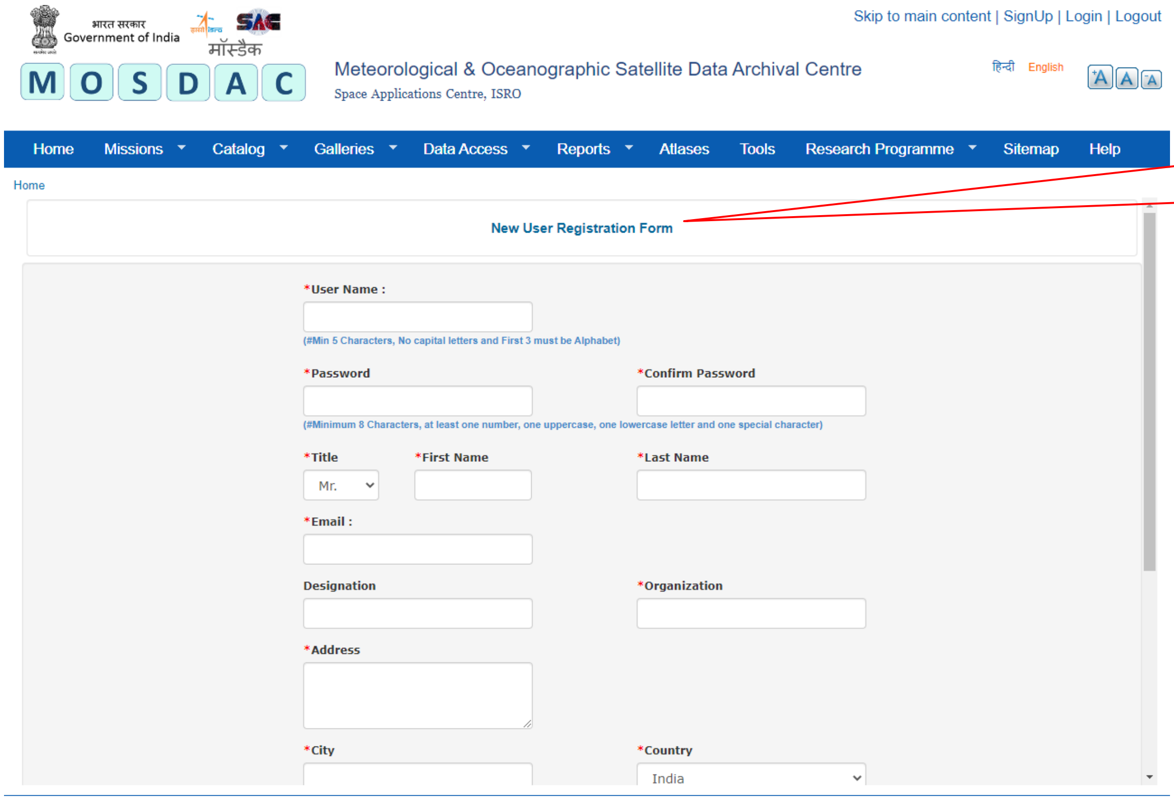
Step-1: Create an user ID and password by registering at MOSDAC website (ignore, if already registered)



1. Go to mosdac homepage https://mosdac.gov.in
2. Click on the SignUp button to register.

MOSDAC Data Downloading

Step-1: Create an user ID and password by registering at MOSDAC website (ignore, if already registered)



New User Registration Form

*User Name :

(#Min 5 Characters, No capital letters and First 3 must be Alphabet)

*Password

*Confirm Password

(#Minimum 8 Characters, at least one number, one uppercase, one lowercase letter and one special character)

*Title: Mr.

*First Name

*Last Name

*Email :

Designation

*Organization

*Address

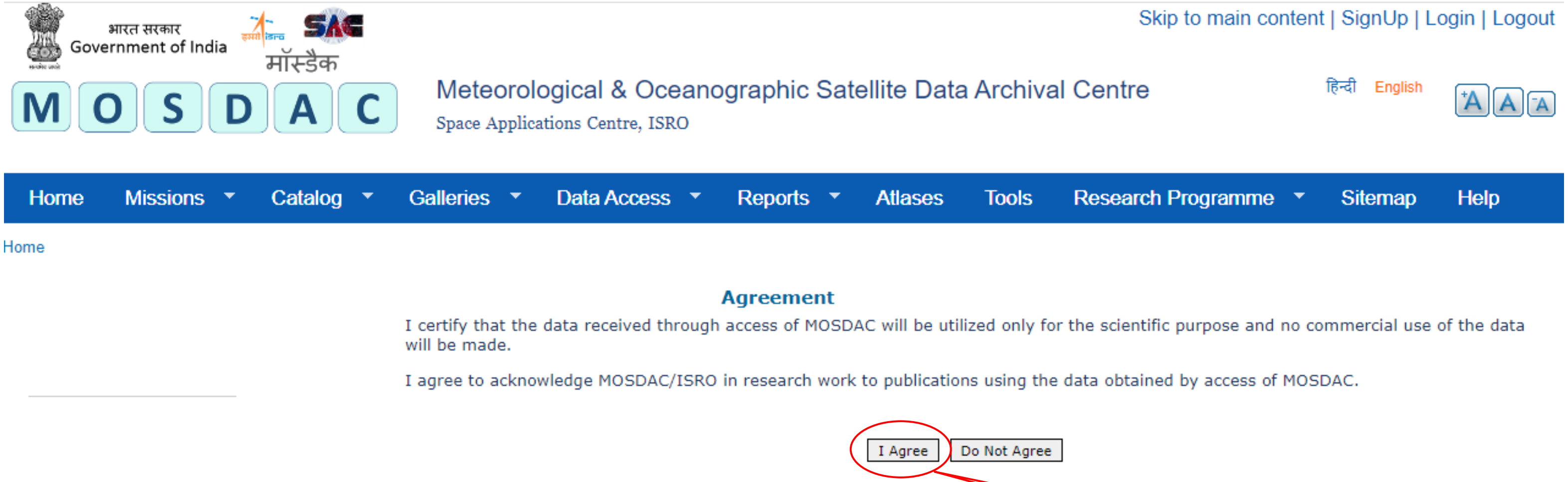
*City

*Country: India

3. Complete the registration form by filling required details

MOSDAC Data Downloading

Step-1: Create an user ID and password by registering at MOSDAC website (ignore, if already registered)



Agreement

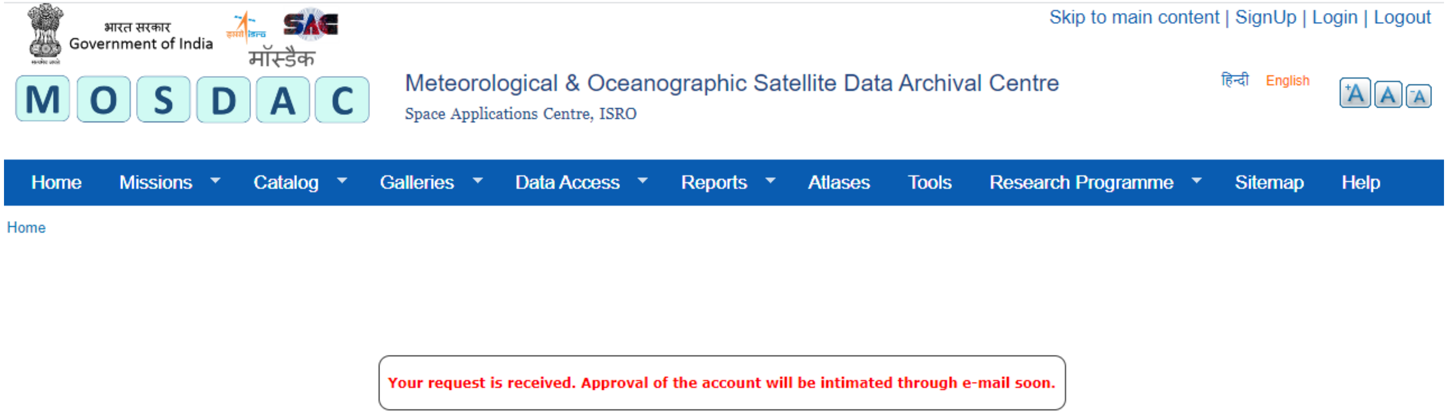
I certify that the data received through access of MOSDAC will be utilized only for the scientific purpose and no commercial use of the data will be made.

I agree to acknowledge MOSDAC/ISRO in research work to publications using the data obtained by access of MOSDAC.

4. Click on ‘I Agree’ button

MOSDAC Data Downloading

Step-1: Create an user ID and password by registering at MOSDAC website (ignore, if already registered)



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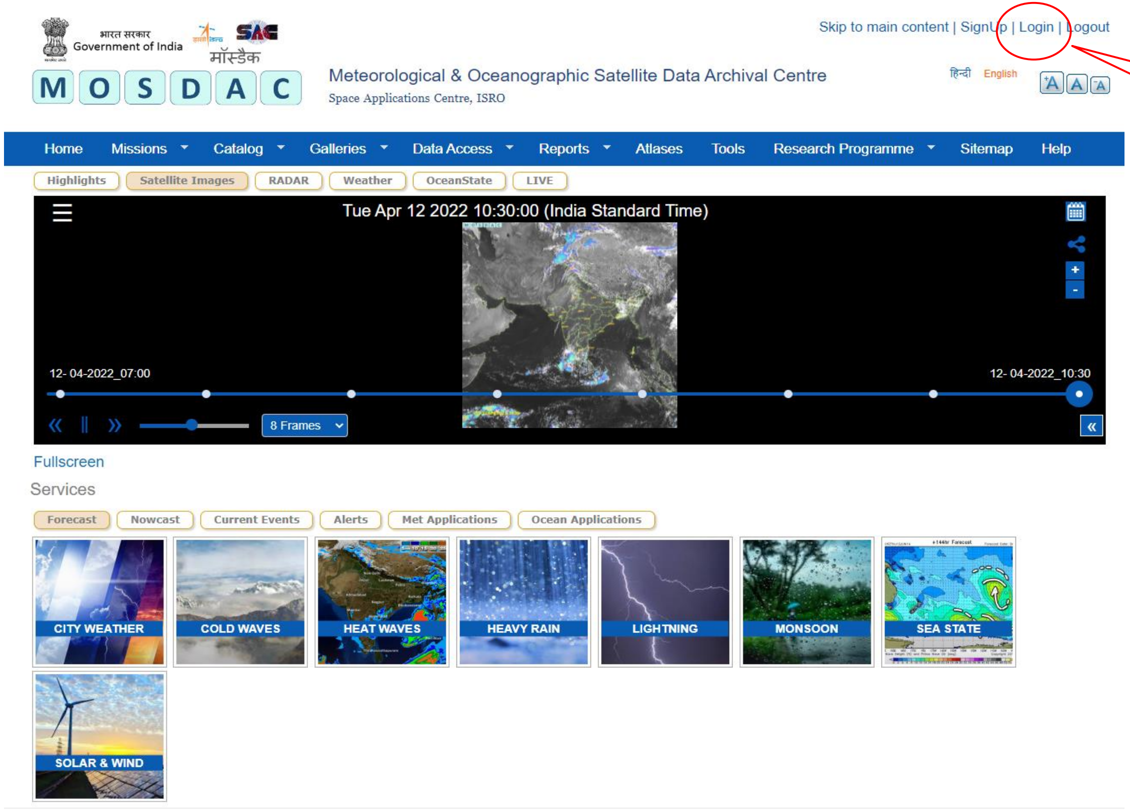
Your request is received. Approval of the account will be intimated through e-mail soon.

5. Wait for approval from MOSDAC. Once request is approved, a user can login with his/her credentials.

MOSDAC Data Downloading

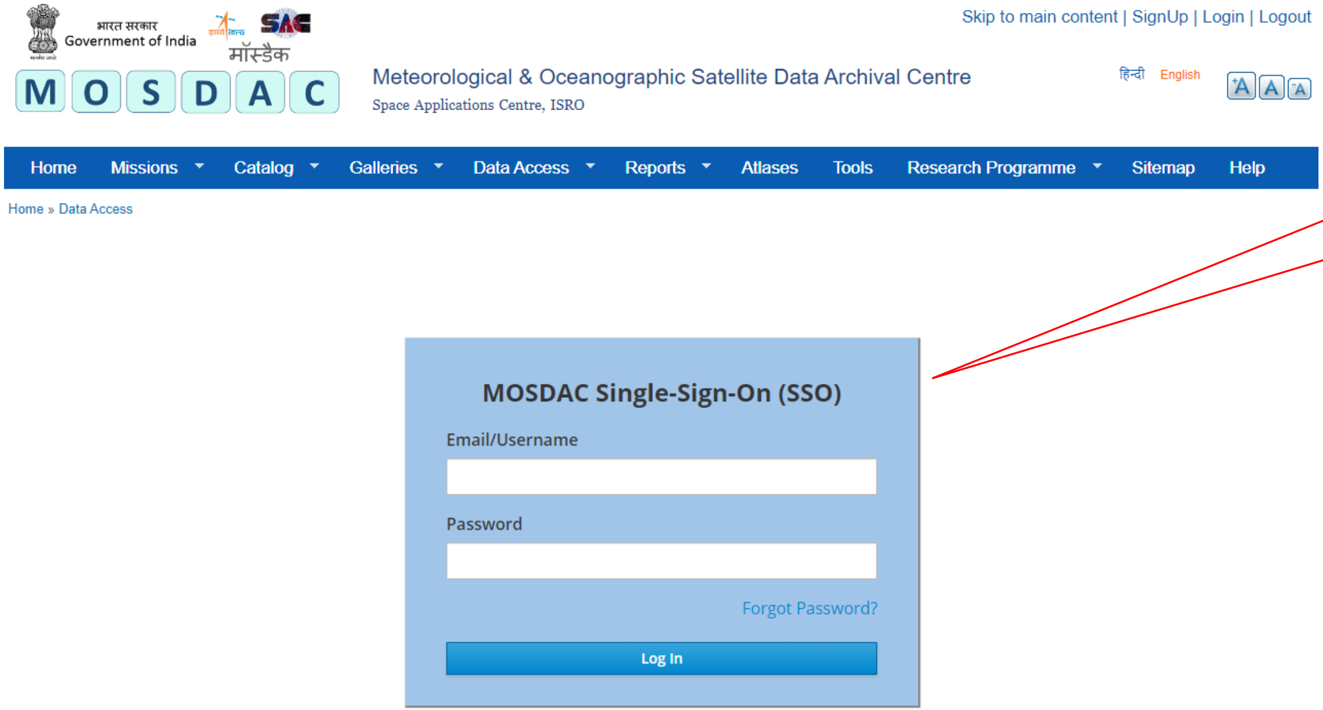
Step-2: Login to MOSDAC website



1. Login to MOSDAC website by clicking ‘Login’ button on MOSDAC home page

MOSDAC Data Downloading

Step-2: Login to MOSDAC website



MOSDAC Single-Sign-On (SSO)

Email/Username

Password

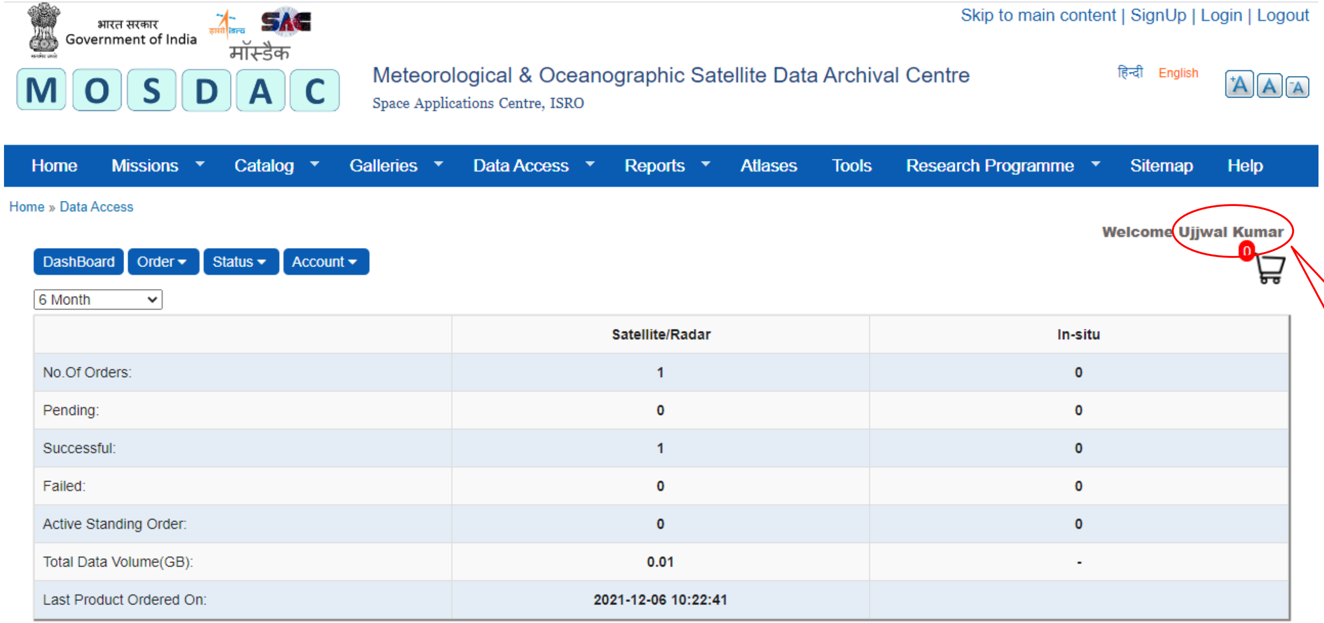
Forgot Password?

Log In

2. Fill the required details and click on "*Log in*" button.

MOSDAC Data Downloading

Step-2: Login to MOSDAC website



Meteorological & Oceanographic Satellite Data Archival Centre

Space Applications Centre, ISRO

Welcome Ujjwal Kumar

6 Month

	Satellite/Radar	In-situ
No.Of Orders:	1	0
Pending:	0	0
Successful:	1	0
Failed:	0	0
Active Standing Order:	0	0
Total Data Volume(GB):	0.01	-
Last Product Ordered On:	2021-12-06 10:22:41	

3. Once correct credentials are given, user is logged in to MOSDAC website. A username is displayed on *Dashboard* page.

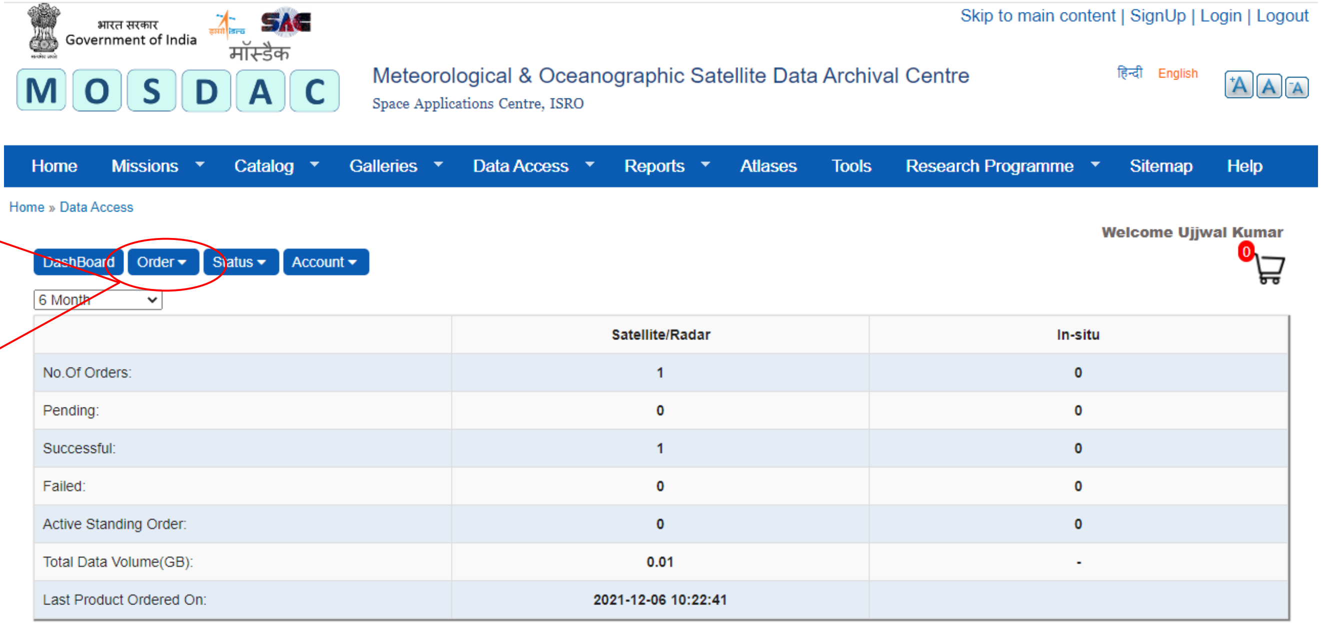
MOSDAC Data Downloading

Step-3: Order data from MOSDAC

1. Click on the “*Order*” button to order data in two modes (1) Archival and, (2) Standing request.

Data has three types:

(1) Satellite (Non-microwave)
(2) In-Situ
(3) Radar



Meteorological & Oceanographic Satellite Data Archival Centre
Space Applications Centre, ISRO

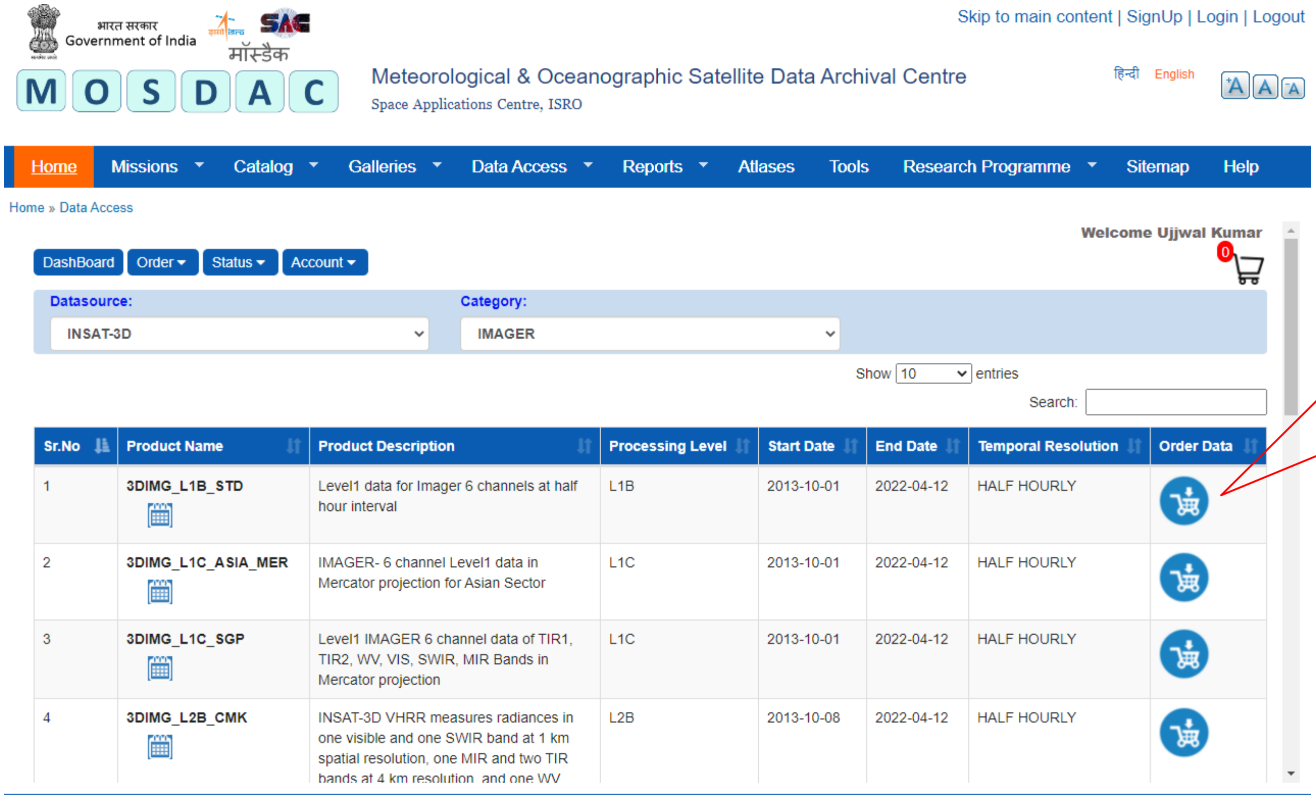
Home » Data Access

Welcome Ujjwal Kumar

	Satellite/Radar	In-situ
No.Of Orders:	1	0
Pending:	0	0
Successful:	1	0
Failed:	0	0
Active Standing Order:	0	0
Total Data Volume(GB):	0.01	-
Last Product Ordered On:	2021-12-06 10:22:41	

MOSDAC Data Downloading

Step-3: Order data from MOSDAC



Meteorological & Oceanographic Satellite Data Archival Centre
Space Applications Centre, ISRO

Datasource: INSAT-3D

Category: IMAGER

Show 10 entries

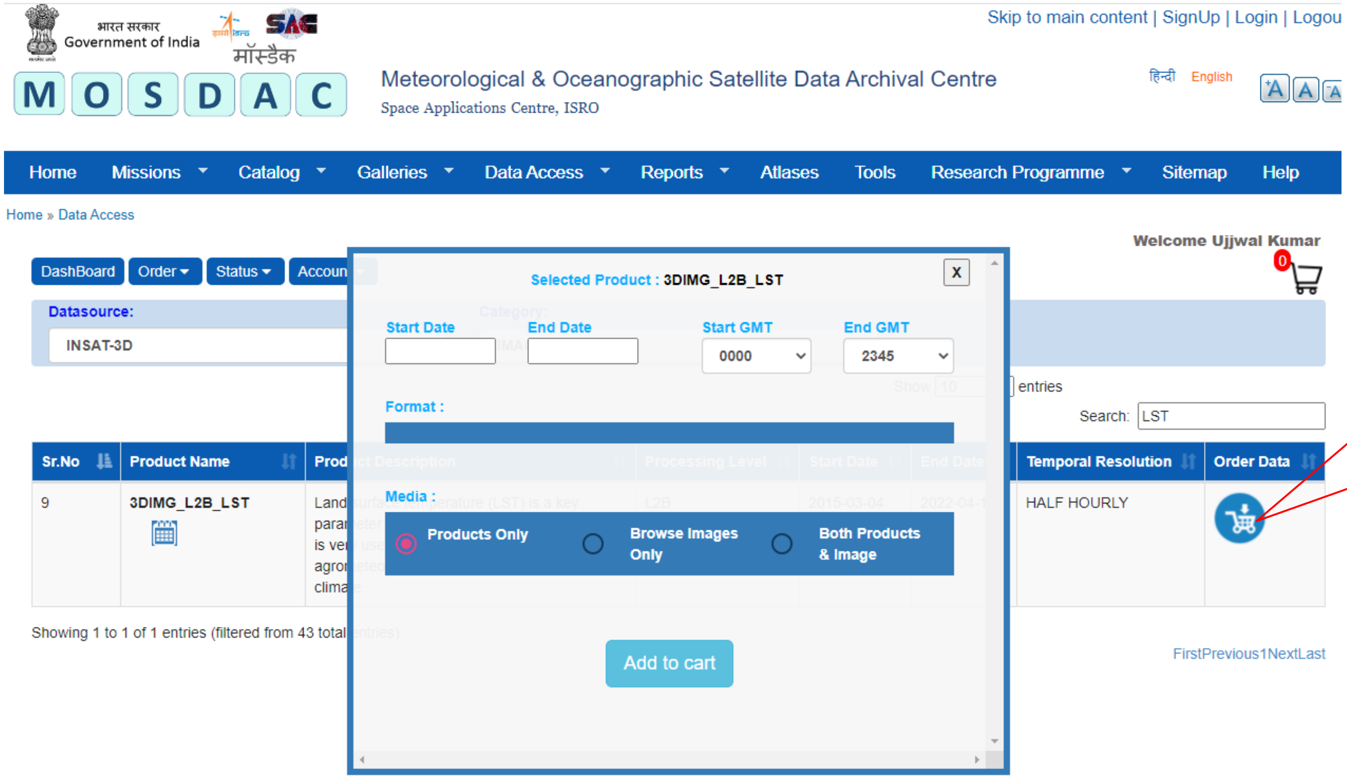
Search:

Sr.No	Product Name	Product Description	Processing Level	Start Date	End Date	Temporal Resolution	Order Data
1	3DIMG_L1B_STD	Level1 data for Imager 6 channels at half hour interval	L1B	2013-10-01	2022-04-12	HALF HOURLY	
2	3DIMG_L1C_ASIA_MER	IMAGER- 6 channel Level1 data in Mercator projection for Asian Sector	L1C	2013-10-01	2022-04-12	HALF HOURLY	
3	3DIMG_L1C_SGP	Level1 IMAGER 6 channel data of TIR1, TIR2, WV, VIS, SWIR, MIR Bands in Mercator projection	L1C	2013-10-01	2022-04-12	HALF HOURLY	
4	3DIMG_L2B_CMK	INSAT-3D VHRR measures radiances in one visible and one SWIR band at 1 km spatial resolution, one MIR and two TIR bands at 4 km resolution, and one WV	L2B	2013-10-08	2022-04-12	HALF HOURLY	

2. A data product is selected from the given catalog and added to cart for ordering. Data products are displayed based on data source and category.

MOSDAC Data Downloading

Step-3: Order data from MOSDAC



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MOSDAC
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Home » Data Access
DashBoard Order Status Accoun
Welcome Ujjwal Kumar
0

Meteorological & Oceanographic Satellite Data Archival Centre
Space Applications Centre, ISRO

Datasource: INSAT-3D

Show 10 entries

Search: LST

Sr.No	Product Name	Prod...	Temporal Resolution	Order Data
9	3DIMG_L2B_LST	Land ... para... is ve... agro... clima...	HALF HOURLY	

Showing 1 to 1 of 1 entries (filtered from 43 total entries)

FirstPrevious1NextLast

Selected Product : 3DIMG_L2B_LST

Start Date:
End Date:
Start GMT: 0000
End GMT: 2345

Format :

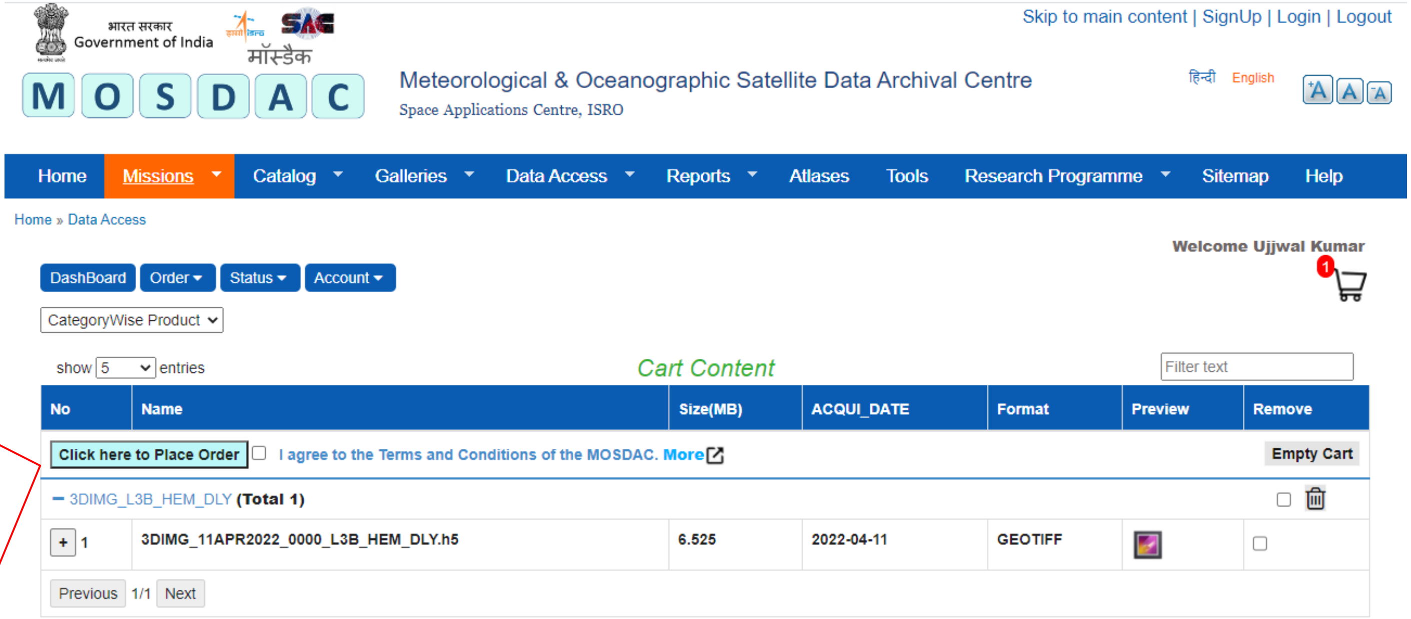
Media : ● Products Only ○ Browse Images Only ○ Both Products & Image

3. Once data product is selected, number of data products can filtered based on date, time, format (HDF or GeoTiff), media and coverage (FULL or AOI).

MOSDAC Data Downloading

Step-3: Order data from MOSDAC

4. Filtered products are displayed in cart. User has to agree with "*Terms and Conditions*" to proceed further by clicking on check box. After that user has to click on "*Click here to Place Order*" button. Next, he/she should confirm order by clicking on confirm button in next popup message.



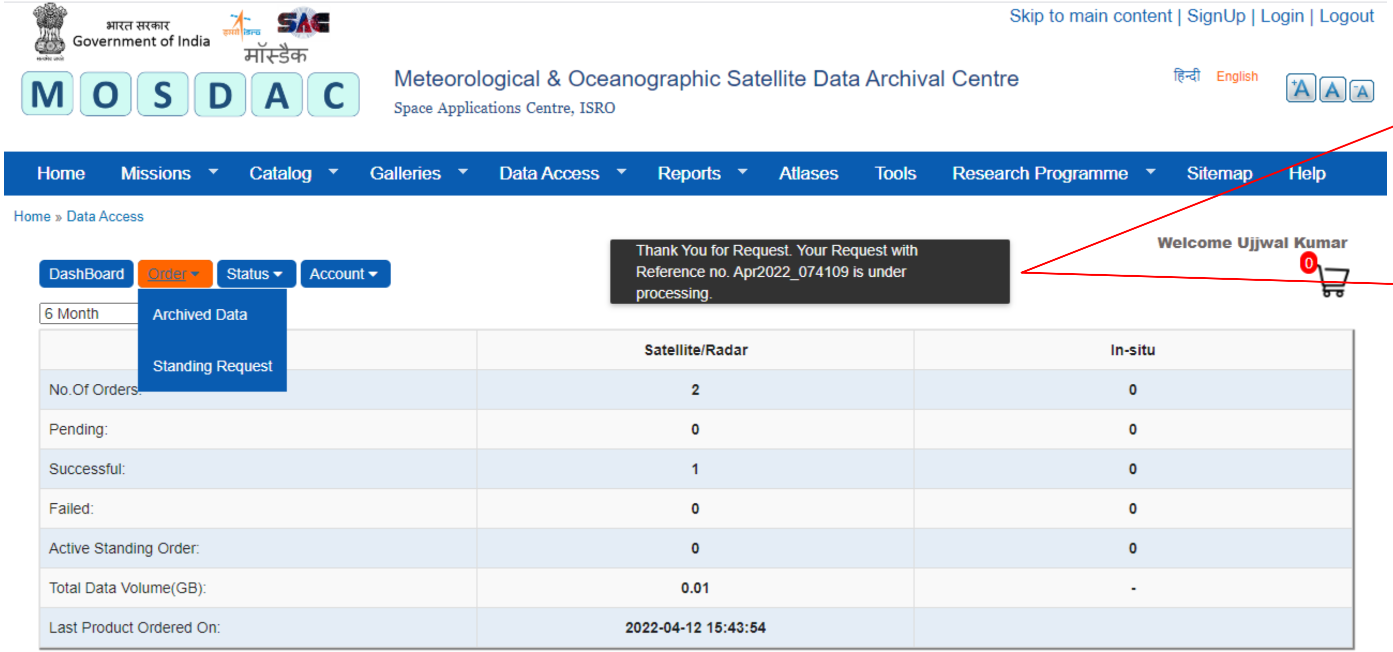
Cart Content

No	Name	Size(MB)	ACQUI_DATE	Format	Preview	Remove
Click here to Place Order □ I agree to the Terms and Conditions of the MOSDAC. More						Empty Cart
— 3DIMG_L3B_HEM_DLY **(Total 1)**						□
+ 1	3DIMG_11APR2022_0000_L3B_HEM_DLY.h5	6.525	2022-04-11	GEOTIFF		□

Previous 1/1 Next

MOSDAC Data Downloading

Step-3: Order data from MOSDAC



Meteorological & Oceanographic Satellite Data Archival Centre
Space Applications Centre, ISRO

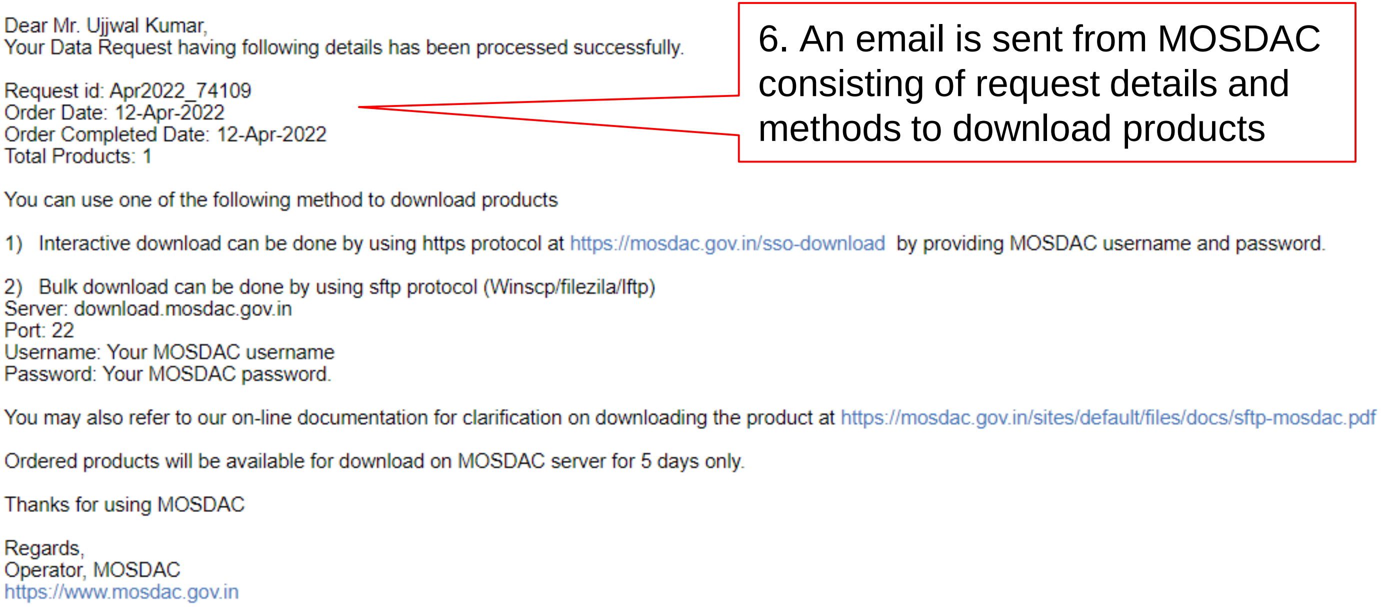
Thank You for Request. Your Request with Reference no. Apr2022_074109 is under processing.

	Satellite/Radar	In-situ
No.Of Orders:	2	0
Pending:	0	0
Successful:	1	0
Failed:	0	0
Active Standing Order:	0	0
Total Data Volume(GB):	0.01	-
Last Product Ordered On:	2022-04-12 15:43:54	

5. Once order is placed, a reference number is generated which is communicated with user through email and popup message. The cart items are processed by MOSDAC server in backend.

MOSDAC Data Downloading

Step-3: Order data from MOSDAC



Dear Mr. Ujjwal Kumar,
Your Data Request having following details has been processed successfully.

Request id: Apr2022_74109
Order Date: 12-Apr-2022
Order Completed Date: 12-Apr-2022
Total Products: 1

You can use one of the following method to download products

1) Interactive download can be done by using https protocol at https://mosdac.gov.in/sso-download by providing MOSDAC username and password.

2) Bulk download can be done by using sftp protocol (Winscp/filezila/lftp)
Server: download.mosdac.gov.in
Port: 22
Username: Your MOSDAC username
Password: Your MOSDAC password.

You may also refer to our on-line documentation for clarification on downloading the product at https://mosdac.gov.in/sites/default/files/docs/sftp-mosdac.pdf

Ordered products will be available for download on MOSDAC server for 5 days only.

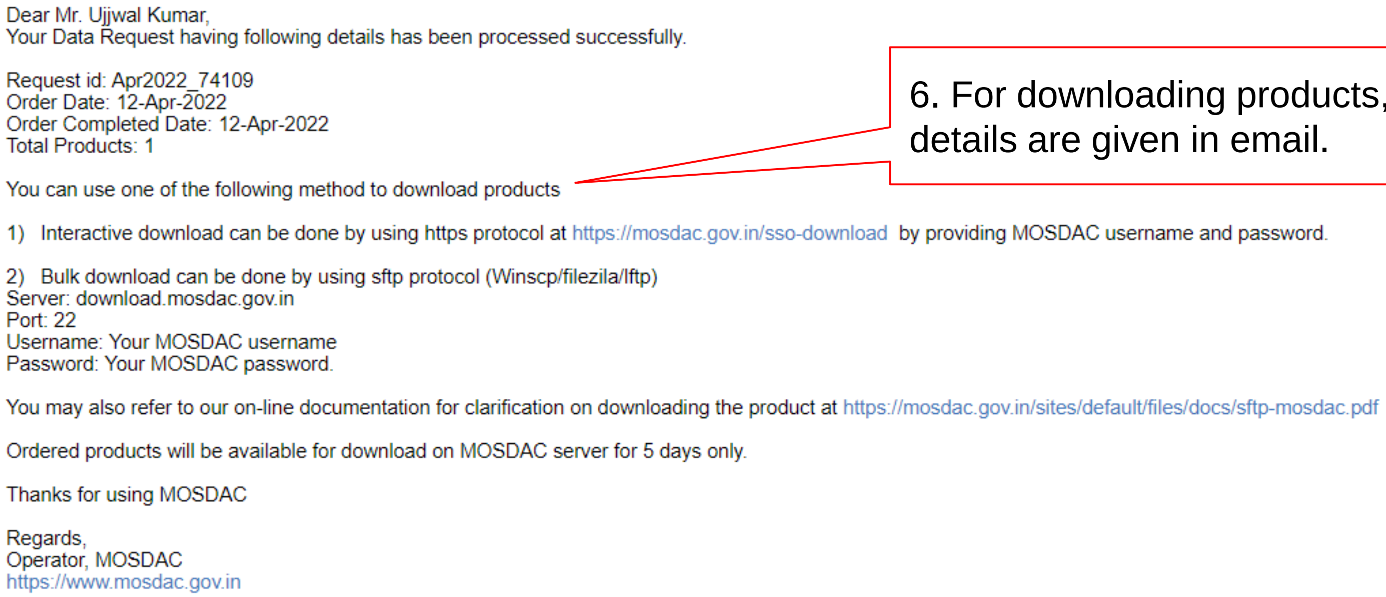
Thanks for using MOSDAC

Regards,
Operator, MOSDAC
https://www.mosdac.gov.in

6. An email is sent from MOSDAC consisting of request details and methods to download products

MOSDAC Data Downloading

Step-3: Order data from MOSDAC



Dear Mr. Ujjwal Kumar,
Your Data Request having following details has been processed successfully.

Request id: Apr2022_74109
Order Date: 12-Apr-2022
Order Completed Date: 12-Apr-2022
Total Products: 1

You can use one of the following method to download products

1) Interactive download can be done by using https protocol at https://mosdac.gov.in/sso-download by providing MOSDAC username and password.

2) Bulk download can be done by using sftp protocol (Winscp/filezila/lftp)
Server: download.mosdac.gov.in
Port: 22
Username: Your MOSDAC username
Password: Your MOSDAC password.

You may also refer to our on-line documentation for clarification on downloading the product at https://mosdac.gov.in/sites/default/files/docs/sftp-mosdac.pdf

Ordered products will be available for download on MOSDAC server for 5 days only.

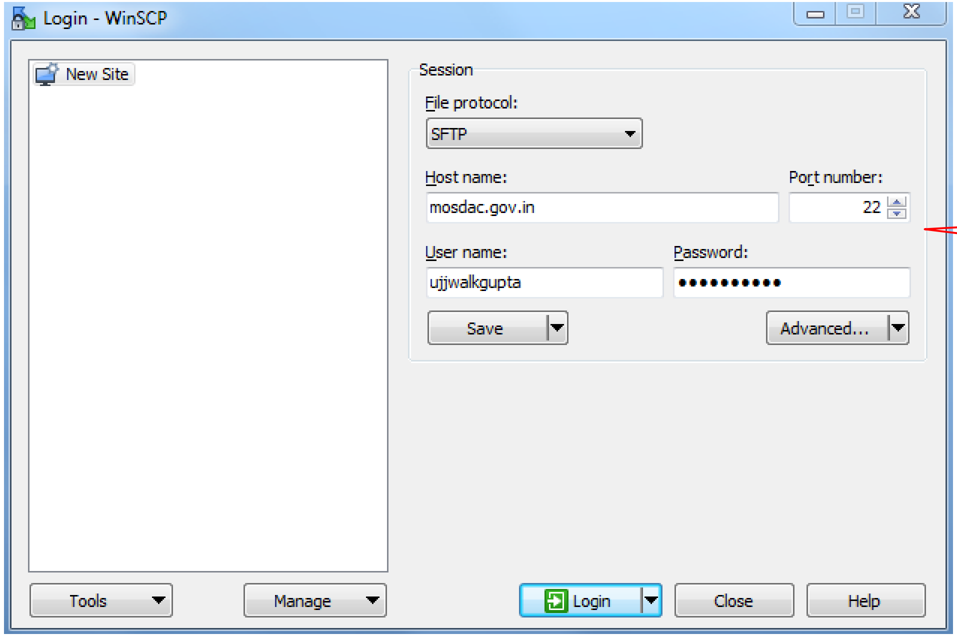
Thanks for using MOSDAC

Regards,
Operator, MOSDAC
https://www.mosdac.gov.in

6. For downloading products, details are given in email.

MOSDAC Data Downloading

Step-4: Download data from MOSDAC Server using WinSCP Software



File protocol: SFTP

Host name: mosdac.gov.in

Port number: 22

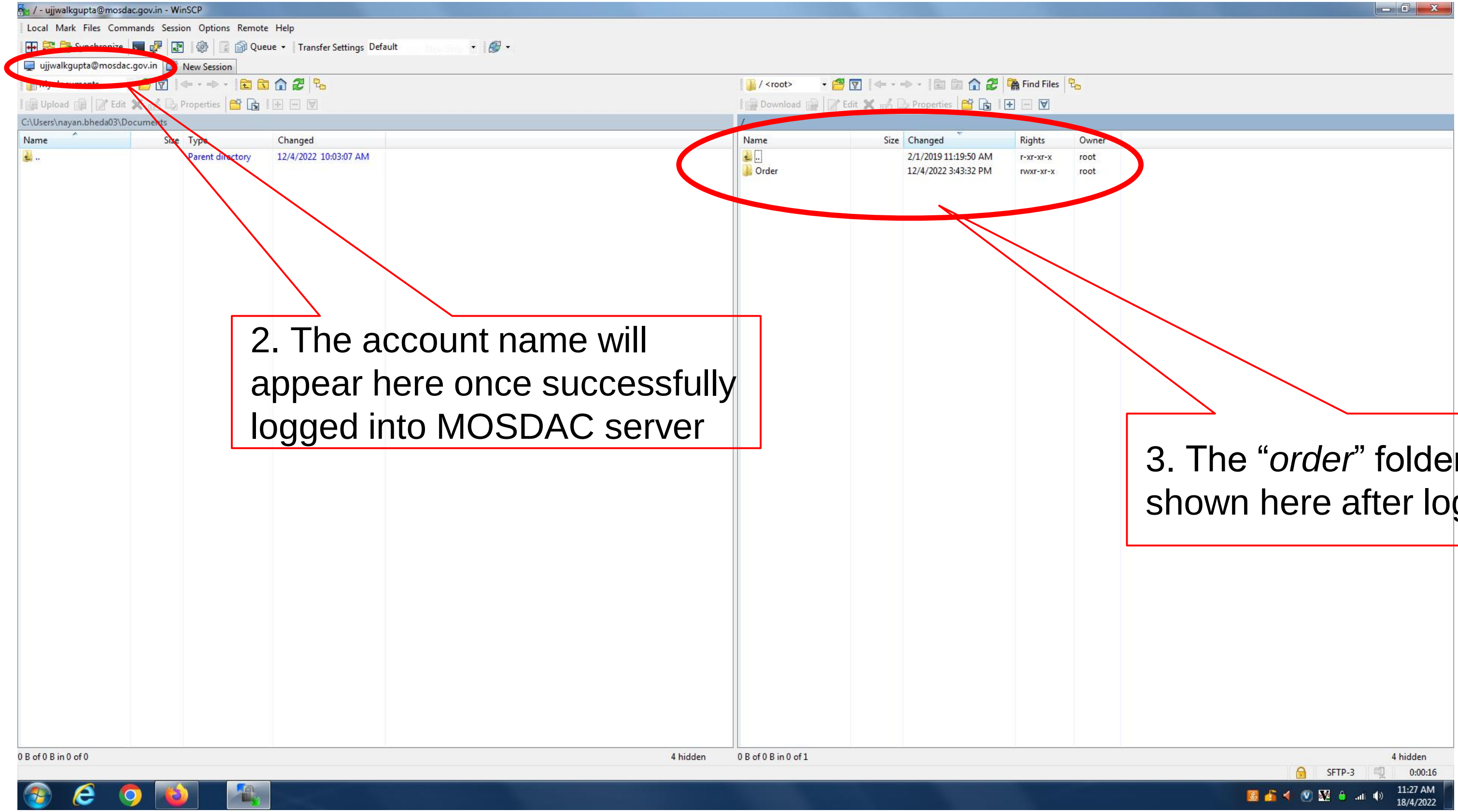
User name: ujjwalkgupta

Password: ●●●●●●●●●●

1. Open WinSCP software, and fill details for downloading products as per given in email.

MOSDAC Data Downloading

Step-4: Download data from MOSDAC Server using WinSCP Software



/ - ujjwalkgupta@mosdac.gov.in - WinSCP
Local Mark Files Commands Session Options Remote Help
Synchronize
Queue
Transfer Settings Default
ujjwalkgupta@mosdac.gov.in
New Session
My documents
Upload
Edit
Properties
/ <root>
Find Files
Download
Edit
Properties

C:\Users\nayan.bheda03\Documents

Name	Size	Type	Changed
..		Parent directory	12/4/2022 10:03:07 AM

/

Name	Size	Changed	Rights	Owner
..		2/1/2019 11:19:50 AM	r-xr-xr-x	root
Order		12/4/2022 3:43:32 PM	rwxr-xr-x	root

0 B of 0 B in 0 of 0 4 hidden

0 B of 0 B in 0 of 1 4 hidden

SFTP-3 0:00:16

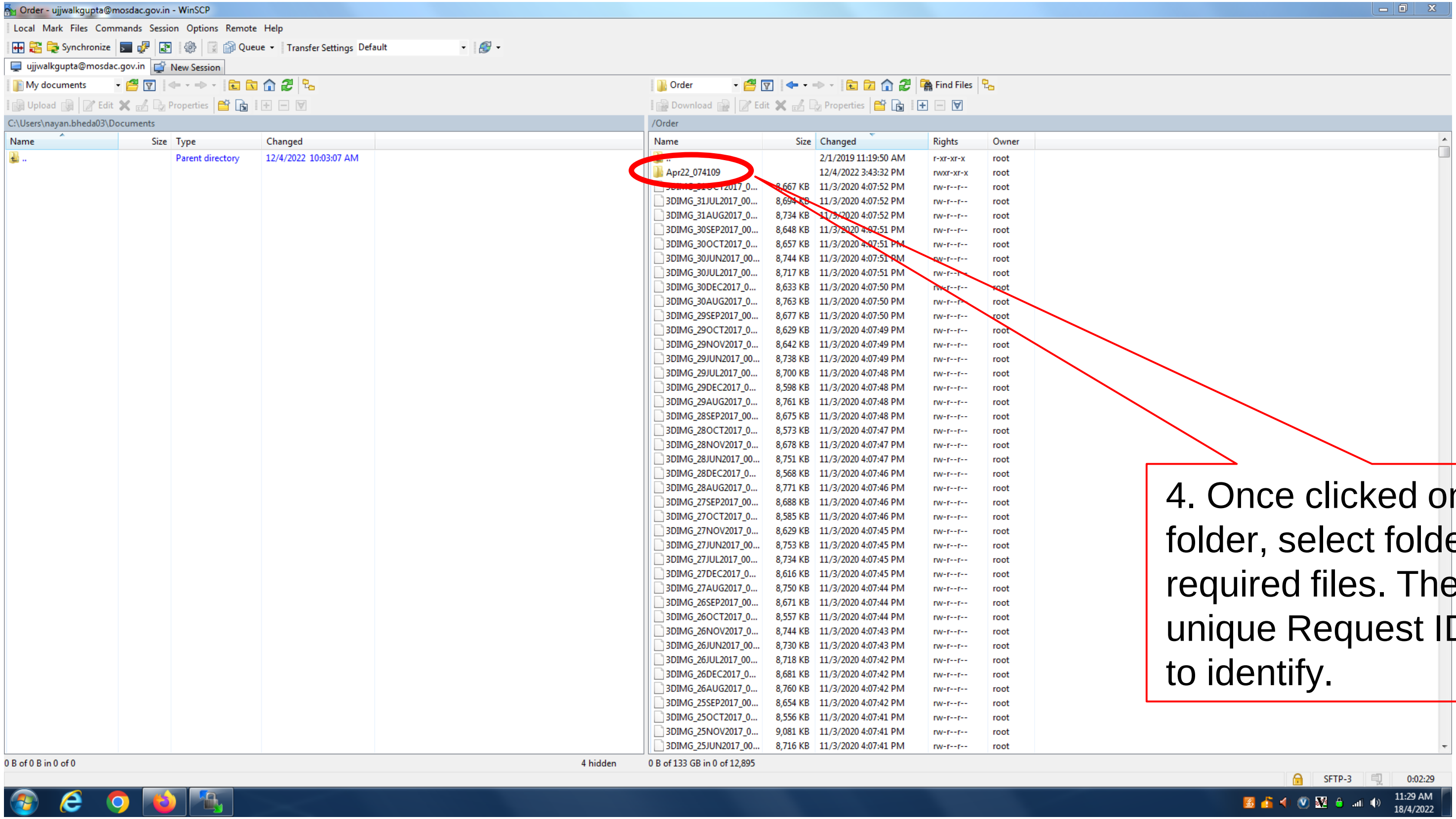
11:27 AM
18/4/2022

2. The account name will appear here once successfully logged into MOSDAC server

3. The “*order*” folder will be shown here after login

MOSDAC Data Downloading

Step-4: Download data from MOSDAC Server using WinSCP Software


Order - ujjwalkgupta@mosdac.gov.in - WinSCP
Local Mark Files Commands Session Options Remote Help
Synchronize
Queue
Transfer Settings Default
ujjwalkgupta@mosdac.gov.in
New Session
My documents
Upload
Edit
Properties
Order
Find Files
Download
Edit
Properties
SFTP-3
0:02:29
11:29 AM
18/4/2022

C:\Users\nayan.bheda03\Documents

Name	Size	Type	Changed
..		Parent directory	12/4/2022 10:03:07 AM

/Order

Name	Size	Changed	Rights	Owner
..		2/1/2019 11:19:50 AM	r-xr-xr-x	root
Apr22_074109		12/4/2022 3:43:32 PM	rwxr-xr-x	root
3DIMG_31OCT2017_0...	8,667 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31JUL2017_00...	8,694 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31AUG2017_0...	8,734 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_30SEP2017_00...	8,648 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30OCT2017_0...	8,657 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUN2017_00...	8,744 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUL2017_00...	8,717 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30DEC2017_0...	8,633 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_30AUG2017_0...	8,763 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_29SEP2017_00...	8,677 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_29OCT2017_0...	8,629 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29NOV2017_0...	8,642 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29JUN2017_00...	8,738 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29JUL2017_00...	8,700 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_29DEC2017_0...	8,598 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_29AUG2017_0...	8,761 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_28SEP2017_00...	8,675 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_28OCT2017_0...	8,573 KB	11/3/2020 4:07:47 PM	rw-r--r--	root
3DIMG_28NOV2017_0...	8,678 KB	11/3/2020 4:07:47 PM	rw-r--r--	root
3DIMG_28JUN2017_00...	8,751 KB	11/3/2020 4:07:47 PM	rw-r--r--	root
3DIMG_28DEC2017_0...	8,568 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_28AUG2017_0...	8,771 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27SEP2017_00...	8,688 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27OCT2017_0...	8,585 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27NOV2017_0...	8,629 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUN2017_00...	8,753 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUL2017_00...	8,734 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27DEC2017_0...	8,616 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27AUG2017_0...	8,750 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26SEP2017_00...	8,671 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26OCT2017_0...	8,557 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26NOV2017_0...	8,744 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUN2017_00...	8,730 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUL2017_00...	8,718 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26DEC2017_0...	8,681 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26AUG2017_0...	8,760 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25SEP2017_00...	8,654 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25OCT2017_0...	8,556 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25NOV2017_0...	9,081 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25JUN2017_00...	8,716 KB	11/3/2020 4:07:41 PM	rw-r--r--	root

0 B of 0 B in 0 of 0

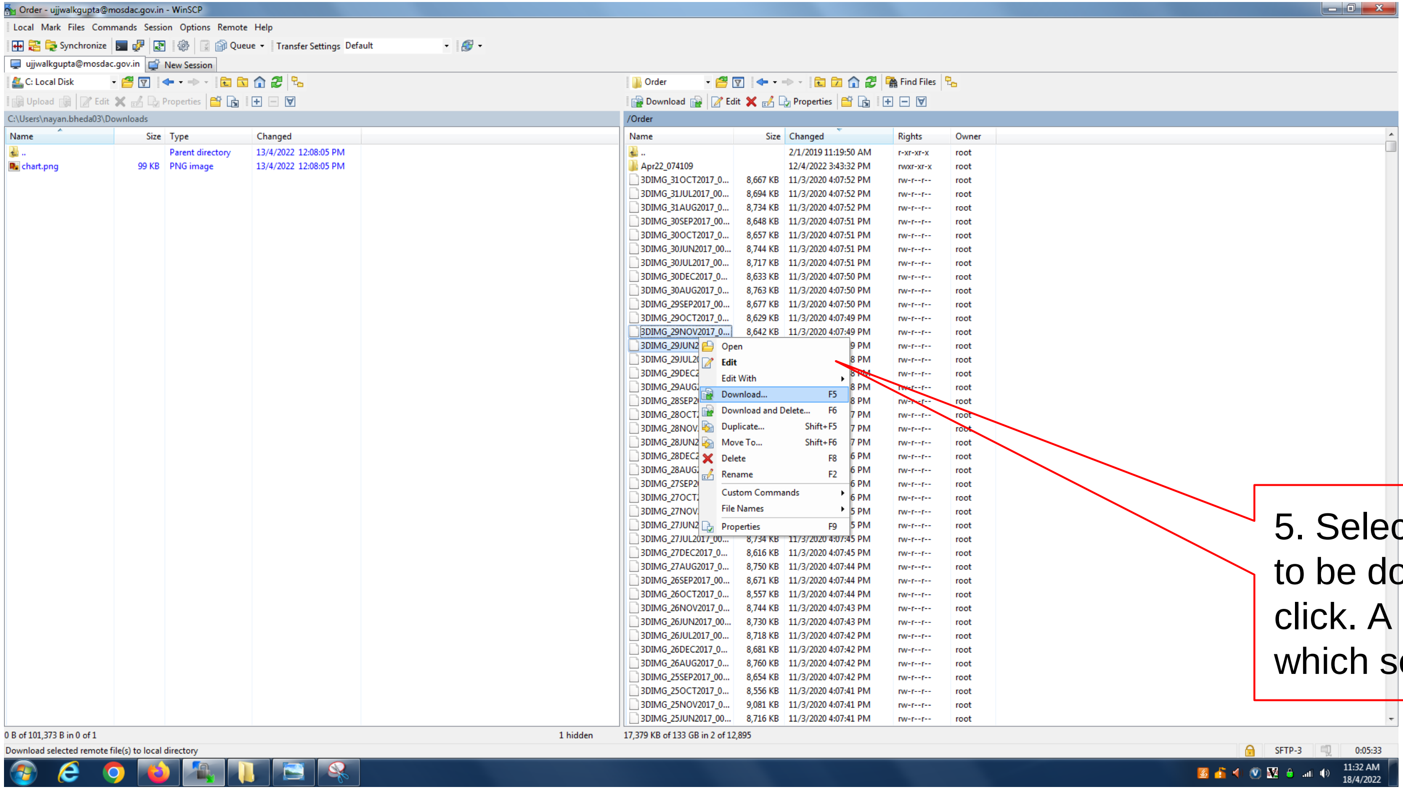
4 hidden

0 B of 133 GB in 0 of 12,895

4. Once clicked on order folder, select folder which has required files. The folder has unique Request ID in its name to identify.

MOSDAC Data Downloading

Step-4: Download data from MOSDAC Server using WinSCP Software



C:\Users\nayan.bheda03\Downloads

Name	Size	Type	Changed
..		Parent directory	13/4/2022 12:08:05 PM
chart.png	99 KB	PNG image	13/4/2022 12:08:05 PM

/Order

Name	Size	Changed	Rights	Owner
..		2/1/2019 11:19:50 AM	r-xr-xr-x	root
Apr22_074109		12/4/2022 3:43:32 PM	rwxr-xr-x	root
3DIMG_31OCT2017_0...	8,667 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31JUL2017_00...	8,694 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31AUG2017_0...	8,734 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_30SEP2017_00...	8,648 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30OCT2017_0...	8,657 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUN2017_00...	8,744 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUL2017_00...	8,717 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30DEC2017_0...	8,633 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_30AUG2017_0...	8,763 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_29SEP2017_00...	8,677 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_29OCT2017_0...	8,629 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29NOV2017_0...	8,642 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29JUN2		9 PM	rw-r--r--	root
3DIMG_29JUL2		8 PM	rw-r--r--	root
3DIMG_29DEC2		8 PM	rw-r--r--	root
3DIMG_29AUG2		8 PM	rw-r--r--	root
3DIMG_28SEP2		8 PM	rw-r--r--	root
3DIMG_28OCT2		7 PM	rw-r--r--	root
3DIMG_28NOV		7 PM	rw-r--r--	root
3DIMG_28JUN2		7 PM	rw-r--r--	root
3DIMG_28DEC2		6 PM	rw-r--r--	root
3DIMG_28AUG2		6 PM	rw-r--r--	root
3DIMG_27SEP2		6 PM	rw-r--r--	root
3DIMG_27OCT2		6 PM	rw-r--r--	root
3DIMG_27NOV		5 PM	rw-r--r--	root
3DIMG_27JUN2		5 PM	rw-r--r--	root
3DIMG_27JUL2017_00...	8,734 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27DEC2017_0...	8,616 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27AUG2017_0...	8,750 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26SEP2017_00...	8,671 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26OCT2017_0...	8,557 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26NOV2017_0...	8,744 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUN2017_00...	8,730 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUL2017_00...	8,718 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26DEC2017_0...	8,681 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26AUG2017_0...	8,760 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25SEP2017_00...	8,654 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25OCT2017_0...	8,556 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25NOV2017_0...	9,081 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25JUN2017_00...	8,716 KB	11/3/2020 4:07:41 PM	rw-r--r--	root

0 B of 101,373 B in 0 of 1 1 hidden

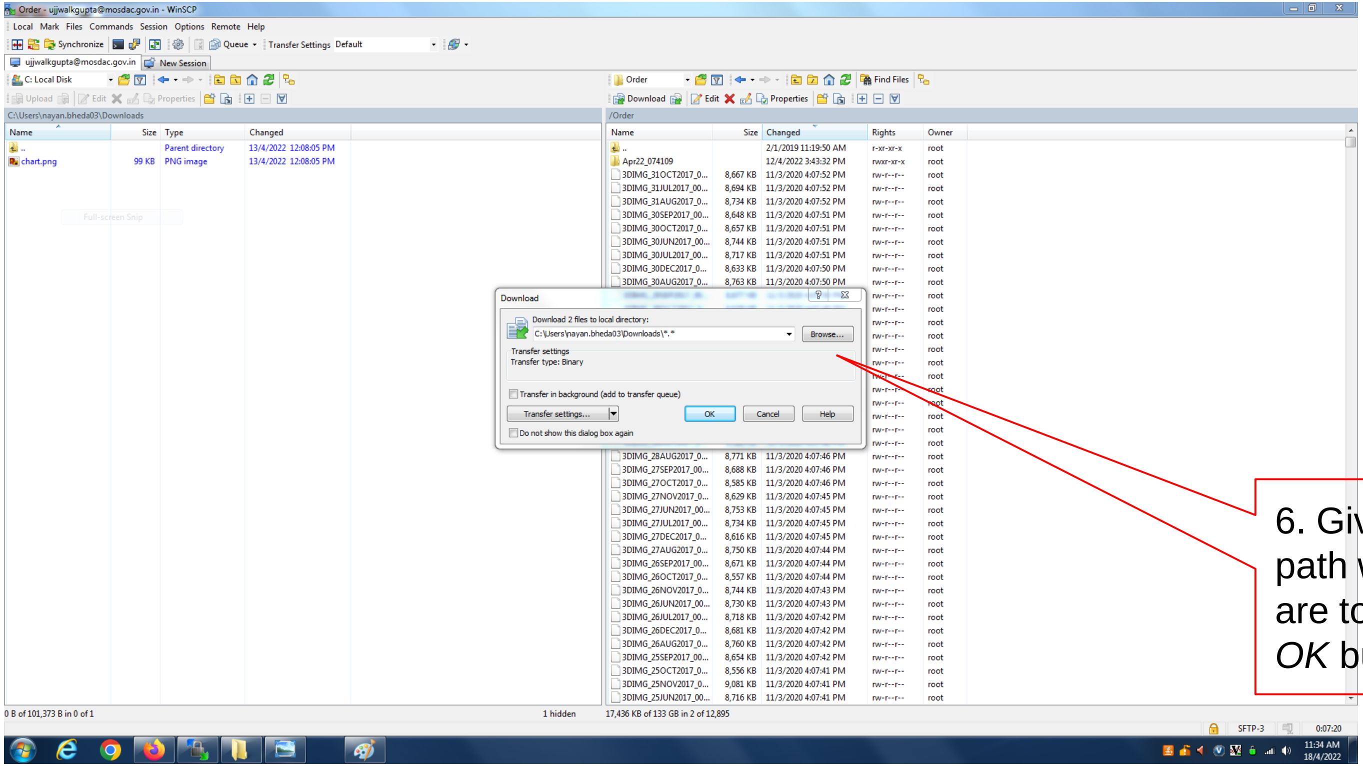
17,379 KB of 133 GB in 2 of 12,895

Download selected remote file(s) to local directory

5. Select all the files which are to be downloaded and right click. A box will appear from which select *Download* option.

MOSDAC Data Downloading

Step-4: Download data from MOSDAC Server using WinSCP Software


Order - ujjwalkgupta@mosdac.gov.in - WinSCP
Local Mark Files Commands Session Options Remote Help
Synchronize
Queue
Transfer Settings Default
ujjwalkgupta@mosdac.gov.in
New Session
C: Local Disk
Upload
Edit
Properties
Order
Find Files
Download
Edit
Properties

C:\Users\nayan.bheda03\Downloads

Name	Size	Type	Changed
..		Parent directory	13/4/2022 12:08:05 PM
chart.png	99 KB	PNG image	13/4/2022 12:08:05 PM

/Order

Name	Size	Changed	Rights	Owner
..		2/1/2019 11:19:50 AM	r-xr-xr-x	root
Apr22_074109		12/4/2022 3:43:32 PM	rwxr-xr-x	root
3DIMG_31OCT2017_0...	8,667 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31JUL2017_00...	8,694 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31AUG2017_0...	8,734 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_30SEP2017_00...	8,648 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30OCT2017_0...	8,657 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUN2017_00...	8,744 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUL2017_00...	8,717 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30DEC2017_0...	8,633 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_30AUG2017_0...	8,763 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
			rw-r--r--	root
3DIMG_28AUG2017_0...	8,771 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27SEP2017_00...	8,688 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27OCT2017_0...	8,585 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27NOV2017_0...	8,629 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUN2017_00...	8,753 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUL2017_00...	8,734 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27DEC2017_0...	8,616 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27AUG2017_0...	8,750 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26SEP2017_00...	8,671 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26OCT2017_0...	8,557 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26NOV2017_0...	8,744 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUN2017_00...	8,730 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUL2017_00...	8,718 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26DEC2017_0...	8,681 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26AUG2017_0...	8,760 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25SEP2017_00...	8,654 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25OCT2017_0...	8,556 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25NOV2017_0...	9,081 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25JUN2017_00...	8,716 KB	11/3/2020 4:07:41 PM	rw-r--r--	root

Download

Download 2 files to local directory:
C:\Users\nayan.bheda03\Downloads\*.*
Browse...

Transfer settings
Transfer type: Binary

□ Transfer in background (add to transfer queue)

Transfer settings... | OK | Cancel | Help

□ Do not show this dialog box again

0 B of 101,373 B in 0 of 1 1 hidden 17,436 KB of 133 GB in 2 of 12,895

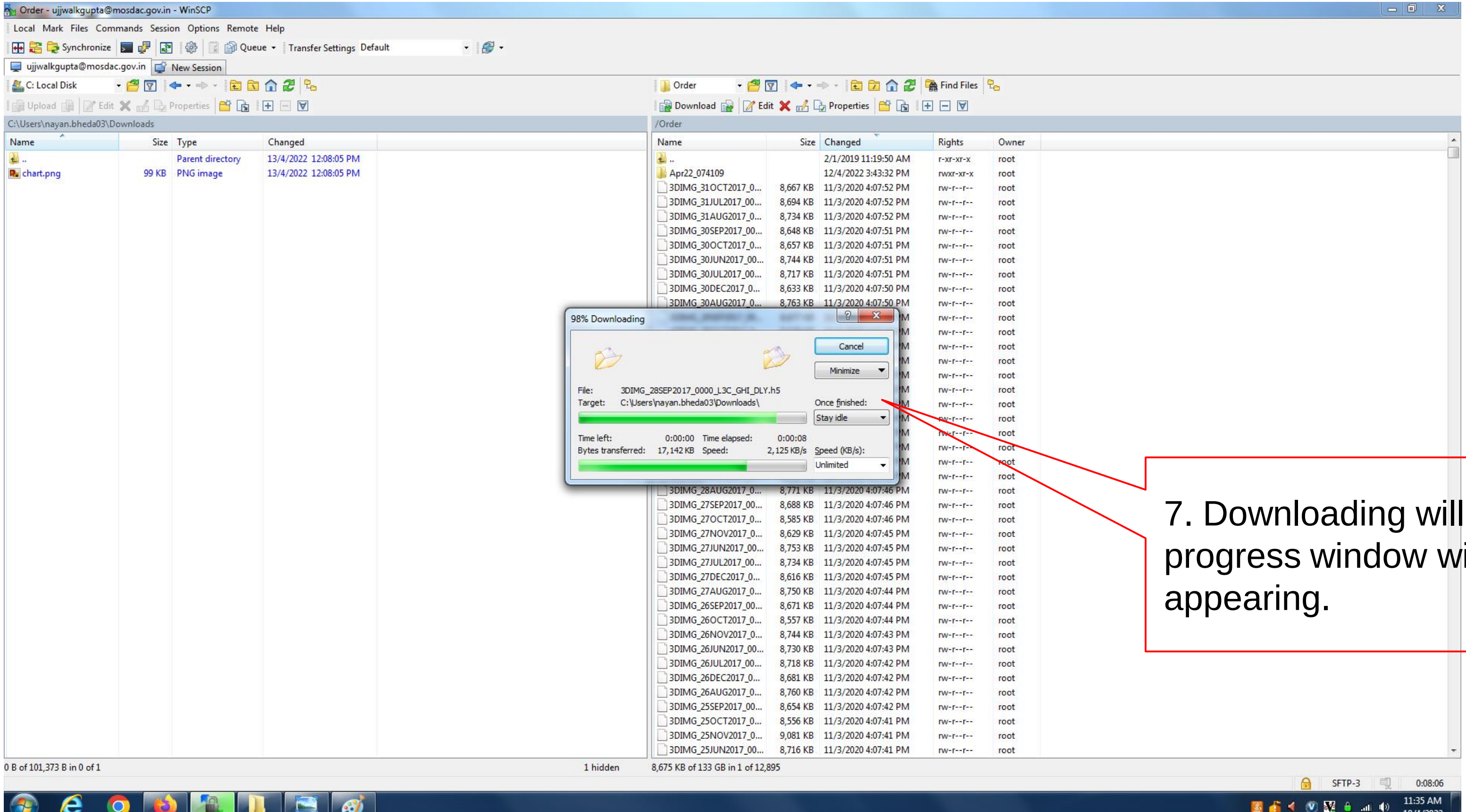
SFTP-3 0:07:20

11:34 AM
18/4/2022

6. Give the destination folder path where downloaded files are to be stored and click on *OK* button.

MOSDAC Data Downloading

Step-4: Download data from MOSDAC Server using WinSCP Software



Order - ujjwalkgupta@mosdac.gov.in - WinSCP
Local Mark Files Commands Session Options Remote Help
Synchronize
Queue
Transfer Settings Default
ujjwalkgupta@mosdac.gov.in
New Session
C: Local Disk
Upload
Edit
Properties
Order
Find Files
Download
Edit
Properties

C:\Users\nayan.bheda03\Downloads

Name	Size	Type	Changed
..		Parent directory	13/4/2022 12:08:05 PM
chart.png	99 KB	PNG image	13/4/2022 12:08:05 PM

/Order

Name	Size	Changed	Rights	Owner
..		2/1/2019 11:19:50 AM	r-xr-xr-x	root
Apr22_074109		12/4/2022 3:43:32 PM	rwxr-xr-x	root
3DIMG_31OCT2017_0...	8,667 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31JUL2017_00...	8,694 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31AUG2017_0...	8,734 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_30SEP2017_00...	8,648 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30OCT2017_0...	8,657 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUN2017_00...	8,744 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUL2017_00...	8,717 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30DEC2017_0...	8,633 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_30AUG2017_0...	8,763 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
		M	rw-r--r--	root
3DIMG_28AUG2017_0...	8,771 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27SEP2017_00...	8,688 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27OCT2017_0...	8,585 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27NOV2017_0...	8,629 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUN2017_00...	8,753 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUL2017_00...	8,734 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27DEC2017_0...	8,616 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27AUG2017_0...	8,750 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26SEP2017_00...	8,671 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26OCT2017_0...	8,557 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26NOV2017_0...	8,744 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUN2017_00...	8,730 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUL2017_00...	8,718 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26DEC2017_0...	8,681 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26AUG2017_0...	8,760 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25SEP2017_00...	8,654 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25OCT2017_0...	8,556 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25NOV2017_0...	9,081 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25JUN2017_00...	8,716 KB	11/3/2020 4:07:41 PM	rw-r--r--	root

98% Downloading

File: 3DIMG_28SEP2017_0000_L3C_GHI_DLY.h5
Target: C:\Users\nayan.bheda03\Downloads\
Once finished: Stay idle
Time left: 0:00:00 Time elapsed: 0:00:08
Bytes transferred: 17,142 KB Speed: 2,125 KB/s
Speed (KB/s): Unlimited

0 B of 101,373 B in 0 of 1 1 hidden 8,675 KB of 133 GB in 1 of 12,895

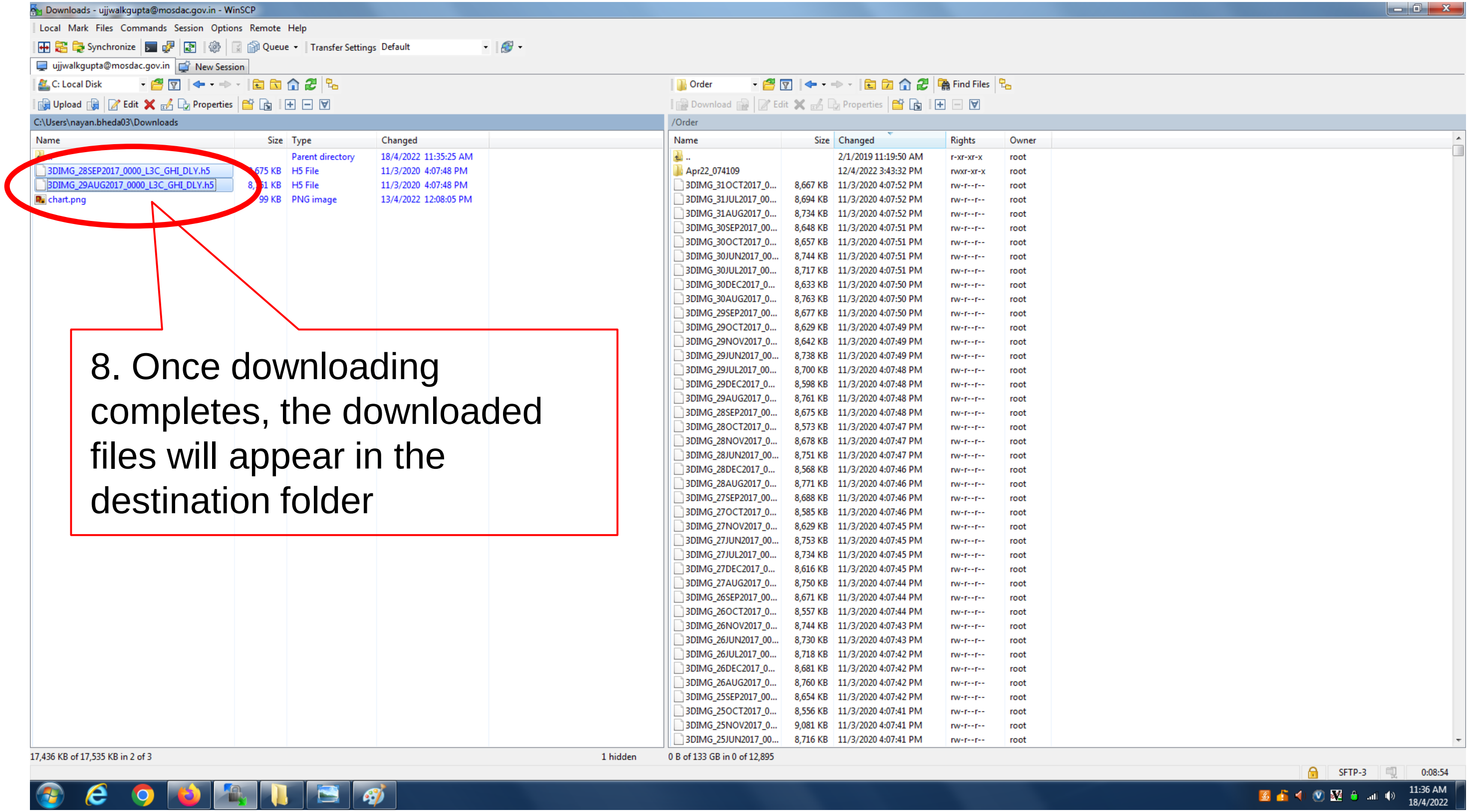
SFTP-3 0:08:06

11:35 AM

7. Downloading will start and a progress window will be appearing.

MOSDAC Data Downloading

Step-4: Download data from MOSDAC Server using WinSCP Software



Downloads - ujjwalkgupta@mosdac.gov.in - WinSCP
Local Mark Files Commands Session Options Remote Help
Synchronize
Queue
Transfer Settings Default
ujjwalkgupta@mosdac.gov.in
New Session
C: Local Disk
Upload
Edit
Properties
Order
Find Files
Download
Edit
Properties

C:\Users\nayan.bheda03\Downloads

Name	Size	Type	Changed
..		Parent directory	18/4/2022 11:35:25 AM
3DIMG_28SEP2017_0000_L3C_GHI_DLY.h5	[illegible]675 KB	H5 File	11/3/2020 4:07:48 PM
3DIMG_29AUG2017_0000_L3C_GHI_DLY.h5	8,[illegible]1 KB	H5 File	11/3/2020 4:07:48 PM
chart.png	99 KB	PNG image	13/4/2022 12:08:05 PM

17,436 KB of 17,535 KB in 2 of 3

1 hidden

/Order

Name	Size	Changed	Rights	Owner
..		2/1/2019 11:19:50 AM	r-xr-xr-x	root
Apr22_074109		12/4/2022 3:43:32 PM	rwxr-xr-x	root
3DIMG_31OCT2017_0...	8,667 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31JUL2017_00...	8,694 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31AUG2017_0...	8,734 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_30SEP2017_00...	8,648 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30OCT2017_0...	8,657 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUN2017_00...	8,744 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUL2017_00...	8,717 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30DEC2017_0...	8,633 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_30AUG2017_0...	8,763 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_29SEP2017_00...	8,677 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_29OCT2017_0...	8,629 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29NOV2017_0...	8,642 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29JUN2017_00...	8,738 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29JUL2017_00...	8,700 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_29DEC2017_0...	8,598 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_29AUG2017_0...	8,761 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_28SEP2017_00...	8,675 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_28OCT2017_0...	8,573 KB	11/3/2020 4:07:47 PM	rw-r--r--	root
3DIMG_28NOV2017_0...	8,678 KB	11/3/2020 4:07:47 PM	rw-r--r--	root
3DIMG_28JUN2017_00...	8,751 KB	11/3/2020 4:07:47 PM	rw-r--r--	root
3DIMG_28DEC2017_0...	8,568 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_28AUG2017_0...	8,771 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27SEP2017_00...	8,688 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27OCT2017_0...	8,585 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27NOV2017_0...	8,629 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUN2017_00...	8,753 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUL2017_00...	8,734 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27DEC2017_0...	8,616 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27AUG2017_0...	8,750 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26SEP2017_00...	8,671 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26OCT2017_0...	8,557 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26NOV2017_0...	8,744 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUN2017_00...	8,730 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUL2017_00...	8,718 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26DEC2017_0...	8,681 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26AUG2017_0...	8,760 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25SEP2017_00...	8,654 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25OCT2017_0...	8,556 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25NOV2017_0...	9,081 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25JUN2017_00...	8,716 KB	11/3/2020 4:07:41 PM	rw-r--r--	root

0 B of 133 GB in 0 of 12,895

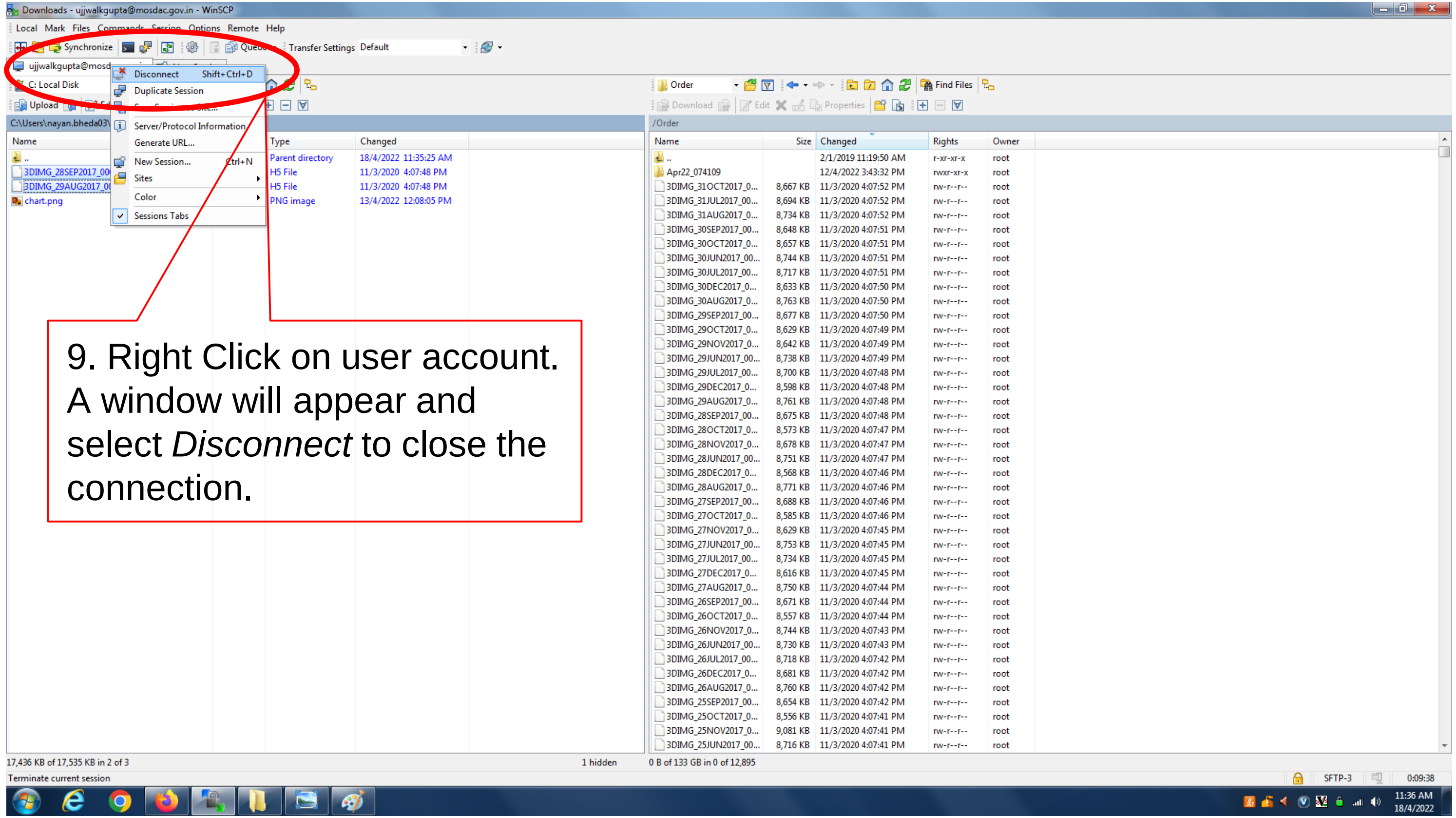
SFTP-3 0:08:54

11:36 AM 18/4/2022

8. Once downloading completes, the downloaded files will appear in the destination folder

MOSDAC Data Downloading

Step-4: Download data from MOSDAC Server using WinSCP Software



C:\Users\nayan.bheda03\

Name	Type	Changed
..	Parent directory	18/4/2022 11:35:25 AM
3DIMG_28SEP2017_00	H5 File	11/3/2020 4:07:48 PM
3DIMG_29AUG2017_00	H5 File	11/3/2020 4:07:48 PM
chart.png	PNG image	13/4/2022 12:08:05 PM

/Order

Name	Size	Changed	Rights	Owner
..		2/1/2019 11:19:50 AM	r-xr-xr-x	root
Apr22_074109		12/4/2022 3:43:32 PM	rwxr-xr-x	root
3DIMG_31OCT2017_0...	8,667 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31JUL2017_00...	8,694 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_31AUG2017_0...	8,734 KB	11/3/2020 4:07:52 PM	rw-r--r--	root
3DIMG_30SEP2017_00...	8,648 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30OCT2017_0...	8,657 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUN2017_00...	8,744 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30JUL2017_00...	8,717 KB	11/3/2020 4:07:51 PM	rw-r--r--	root
3DIMG_30DEC2017_0...	8,633 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_30AUG2017_0...	8,763 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_29SEP2017_00...	8,677 KB	11/3/2020 4:07:50 PM	rw-r--r--	root
3DIMG_29OCT2017_0...	8,629 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29NOV2017_0...	8,642 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29JUN2017_00...	8,738 KB	11/3/2020 4:07:49 PM	rw-r--r--	root
3DIMG_29JUL2017_00...	8,700 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_29DEC2017_0...	8,598 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_29AUG2017_0...	8,761 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_28SEP2017_00...	8,675 KB	11/3/2020 4:07:48 PM	rw-r--r--	root
3DIMG_28OCT2017_0...	8,573 KB	11/3/2020 4:07:47 PM	rw-r--r--	root
3DIMG_28NOV2017_0...	8,678 KB	11/3/2020 4:07:47 PM	rw-r--r--	root
3DIMG_28JUN2017_00...	8,751 KB	11/3/2020 4:07:47 PM	rw-r--r--	root
3DIMG_28DEC2017_0...	8,568 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_28AUG2017_0...	8,771 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27SEP2017_00...	8,688 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27OCT2017_0...	8,585 KB	11/3/2020 4:07:46 PM	rw-r--r--	root
3DIMG_27NOV2017_0...	8,629 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUN2017_00...	8,753 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27JUL2017_00...	8,734 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27DEC2017_0...	8,616 KB	11/3/2020 4:07:45 PM	rw-r--r--	root
3DIMG_27AUG2017_0...	8,750 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26SEP2017_00...	8,671 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26OCT2017_0...	8,557 KB	11/3/2020 4:07:44 PM	rw-r--r--	root
3DIMG_26NOV2017_0...	8,744 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUN2017_00...	8,730 KB	11/3/2020 4:07:43 PM	rw-r--r--	root
3DIMG_26JUL2017_00...	8,718 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26DEC2017_0...	8,681 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_26AUG2017_0...	8,760 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25SEP2017_00...	8,654 KB	11/3/2020 4:07:42 PM	rw-r--r--	root
3DIMG_25OCT2017_0...	8,556 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25NOV2017_0...	9,081 KB	11/3/2020 4:07:41 PM	rw-r--r--	root
3DIMG_25JUN2017_00...	8,716 KB	11/3/2020 4:07:41 PM	rw-r--r--	root

17,436 KB of 17,535 KB in 2 of 3

1 hidden

0 B of 133 GB in 0 of 12,895

Terminate current session

SFTP-3

0:09:38

11:36 AM
18/4/2022

9. Right Click on user account. A window will appear and select *Disconnect* to close the connection.

Module-2: Processing of INSAT-3D HEM Product for AFSIS Report Generation (in QGIS)

Brief Introduction of QGIS

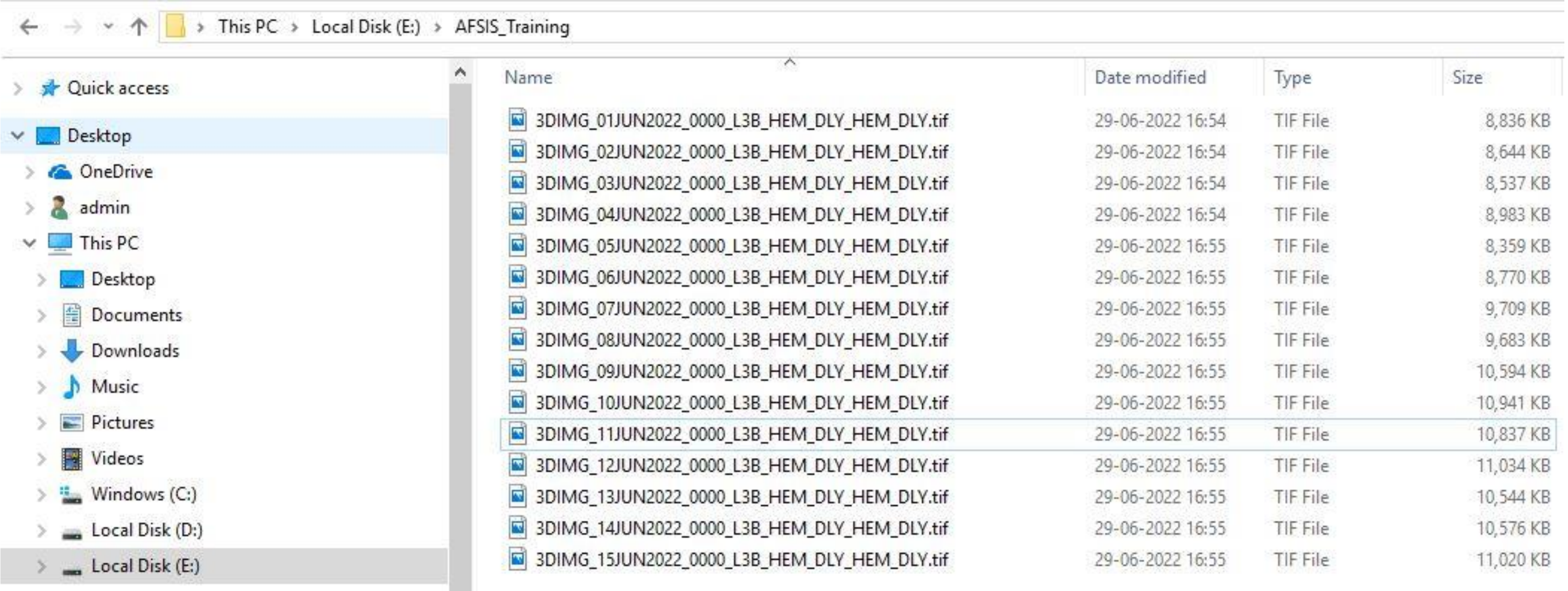
- QGIS is a cross-platform, Free and Open Source Software (FOSS) for GIS operations.
- It supports hundreds of plugins for specific applications.
- It has capability of generating maps from raster for publishing online and offline.
- QGIS Download and Installation Steps:
  - Users can visit below site for QGIS download and installation guide – https://www.geeksforgeeks.org/how-to-install-qgis-on-windows/

Problem statement:

To generate twice a month 15-Days Cumulative Precipitation Map of South and South East Asian region in such a way that each precipitation map is generated by integrating each half of the month INSAT-HEM daily products.

INSAT-3D HEM Product Processing Steps

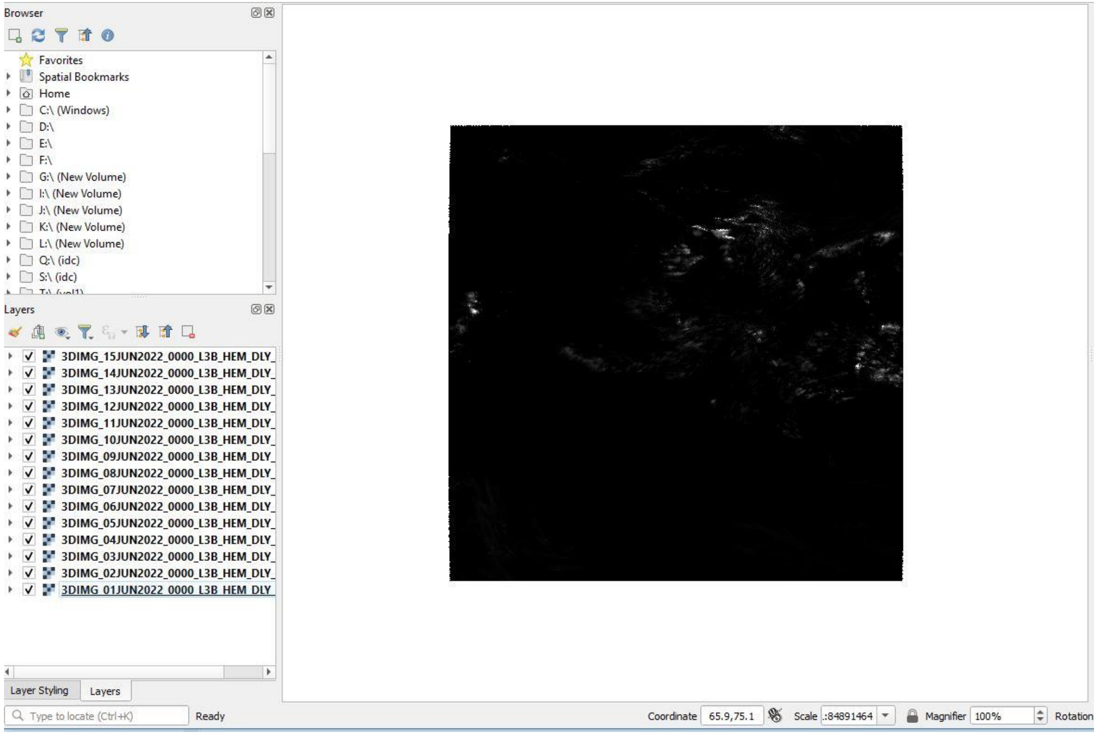
- Step-1: Download INSAT-3D HEM Products in GeoTIFF format from MOSDAC for required dates/fortnight. These files are geo-referenced and are in Geographic Coordinate System.



Name	Date modified	Type	Size
3DIMG_01JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:54	TIF File	8,836 KB
3DIMG_02JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:54	TIF File	8,644 KB
3DIMG_03JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:54	TIF File	8,537 KB
3DIMG_04JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:54	TIF File	8,983 KB
3DIMG_05JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	8,359 KB
3DIMG_06JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	8,770 KB
3DIMG_07JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	9,709 KB
3DIMG_08JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	9,683 KB
3DIMG_09JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	10,594 KB
3DIMG_10JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	10,941 KB
3DIMG_11JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	10,837 KB
3DIMG_12JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	11,034 KB
3DIMG_13JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	10,544 KB
3DIMG_14JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	10,576 KB
3DIMG_15JUN2022_0000_L3B_HEM_DLY_HEM_DLY.tif	29-06-2022 16:55	TIF File	11,020 KB

INSAT-3D HEM Product Processing Steps

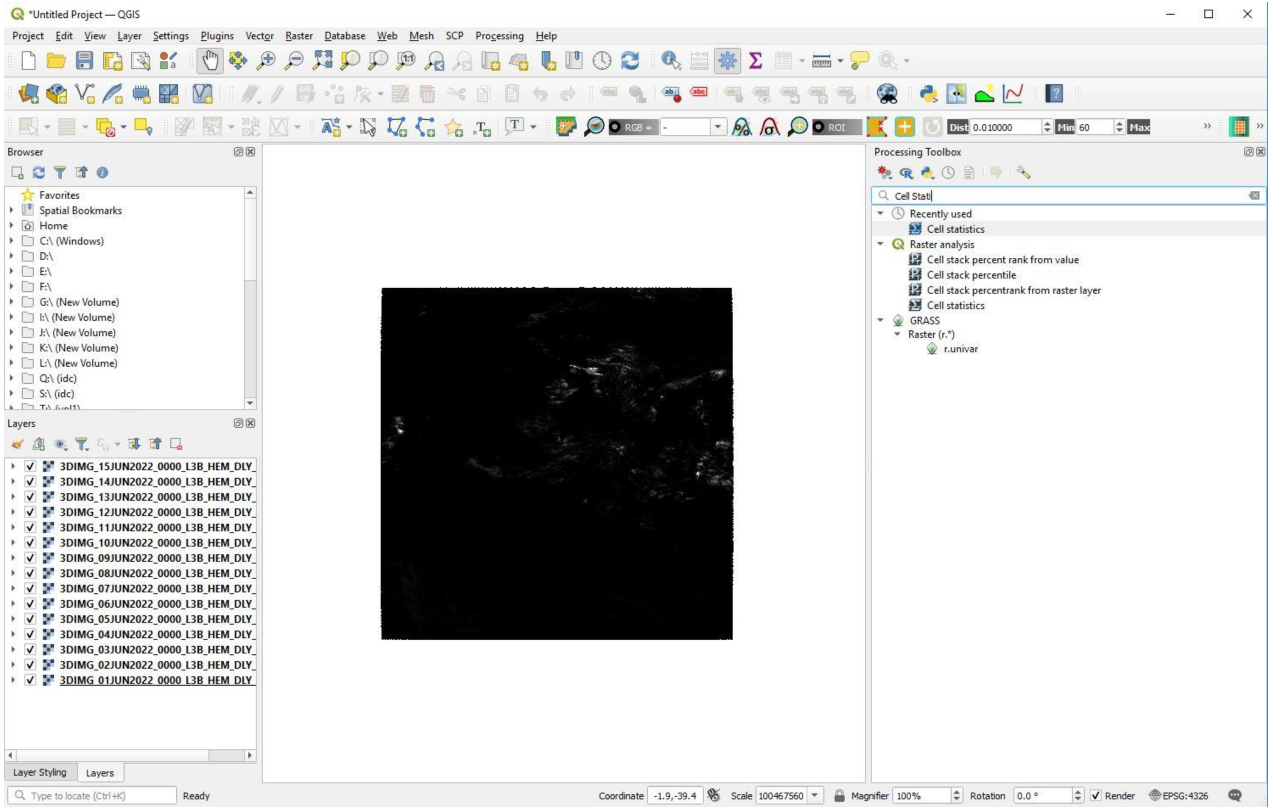
- Step-2: Load the images in QGIS by dragging and dropping selected images in QGIS panel.



- ☑ 3DIMG_15JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_14JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_13JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_12JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_11JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_10JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_09JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_08JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_07JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_06JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_05JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_04JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_03JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_02JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_01JUN2022_0000_L3B_HEM_DLY

INSAT-3D HEM Product Processing Steps

- Step-3: Open Cell Statistics in QGIS from list given in processing toolbox



Dist 0.010000 Min 60

Processing Toolbox search: Cell Stati

- Recently used
  - Cell statistics
- Raster analysis
  - Cell stack percent rank from value
  - Cell stack percentile
  - Cell stack percentrank from raster layer
  - Cell statistics
- GRASS
  - Raster (r.*)
    - r.univar

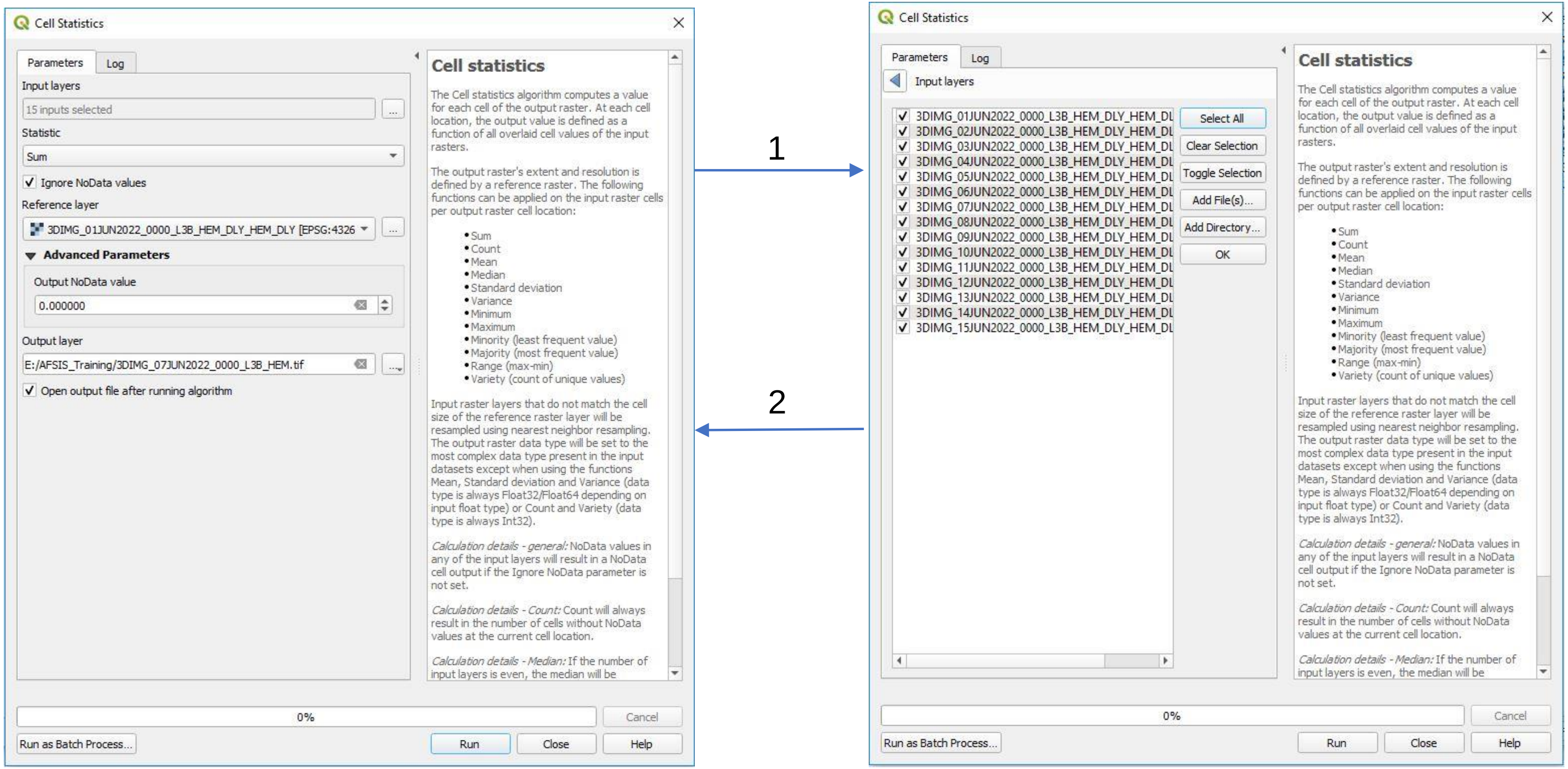
Layers:

- ☑ 3DIMG_15JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_14JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_13JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_12JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_11JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_10JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_09JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_08JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_07JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_06JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_05JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_04JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_03JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_02JUN2022_0000_L3B_HEM_DLY_
- ☑ 3DIMG_01JUN2022_0000_L3B_HEM_DLY

Coordinate -1.9,-39.4 Scale 100467560 Magnifier 100% Rotation 0.0 ° ☑ Render EPSG:4326

INSAT-3D HEM Product Processing Steps

- Step-4: Integrate Precipitation data using Cell Statistics in QGIS



Cell Statistics

Parameters | Log

Input layers

15 inputs selected

Statistic

Sum

☑ Ignore NoData values

Reference layer

3DIMG_01JUN2022_0000_L3B_HEM_DLY_HEM_DLY [EPSG:4326

▼ Advanced Parameters

Output NoData value

0.000000

Output layer

E:/AFSIS_Training/3DIMG_07JUN2022_0000_L3B_HEM.tif

☑ Open output file after running algorithm

Cell statistics

The Cell statistics algorithm computes a value for each cell of the output raster. At each cell location, the output value is defined as a function of all overlaid cell values of the input rasters.

The output raster's extent and resolution is defined by a reference raster. The following functions can be applied on the input raster cells per output raster cell location:

- Sum
- Count
- Mean
- Median
- Standard deviation
- Variance
- Minimum
- Maximum
- Minority (least frequent value)
- Majority (most frequent value)
- Range (max-min)
- Variety (count of unique values)

Input raster layers that do not match the cell size of the reference raster layer will be resampled using nearest neighbor resampling. The output raster data type will be set to the most complex data type present in the input datasets except when using the functions Mean, Standard deviation and Variance (data type is always Float32/Float64 depending on input float type) or Count and Variety (data type is always Int32).

Calculation details - general: NoData values in any of the input layers will result in a NoData cell output if the Ignore NoData parameter is not set.

Calculation details - Count: Count will always result in the number of cells without NoData values at the current cell location.

Calculation details - Median: If the number of input layers is even, the median will be

0% | Cancel

Run as Batch Process... | Run | Close | Help

Cell Statistics

Parameters | Log

Input layers

☑ 3DIMG_01JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_02JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_03JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_04JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_05JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_06JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_07JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_08JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_09JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_10JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_11JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_12JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_13JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_14JUN2022_0000_L3B_HEM_DLY_HEM_DL
☑ 3DIMG_15JUN2022_0000_L3B_HEM_DLY_HEM_DL

Cell statistics

The Cell statistics algorithm computes a value for each cell of the output raster. At each cell location, the output value is defined as a function of all overlaid cell values of the input rasters.

The output raster's extent and resolution is defined by a reference raster. The following functions can be applied on the input raster cells per output raster cell location:

- Sum
- Count
- Mean
- Median
- Standard deviation
- Variance
- Minimum
- Maximum
- Minority (least frequent value)
- Majority (most frequent value)
- Range (max-min)
- Variety (count of unique values)

Input raster layers that do not match the cell size of the reference raster layer will be resampled using nearest neighbor resampling. The output raster data type will be set to the most complex data type present in the input datasets except when using the functions Mean, Standard deviation and Variance (data type is always Float32/Float64 depending on input float type) or Count and Variety (data type is always Int32).

Calculation details - general: NoData values in any of the input layers will result in a NoData cell output if the Ignore NoData parameter is not set.

Calculation details - Count: Count will always result in the number of cells without NoData values at the current cell location.

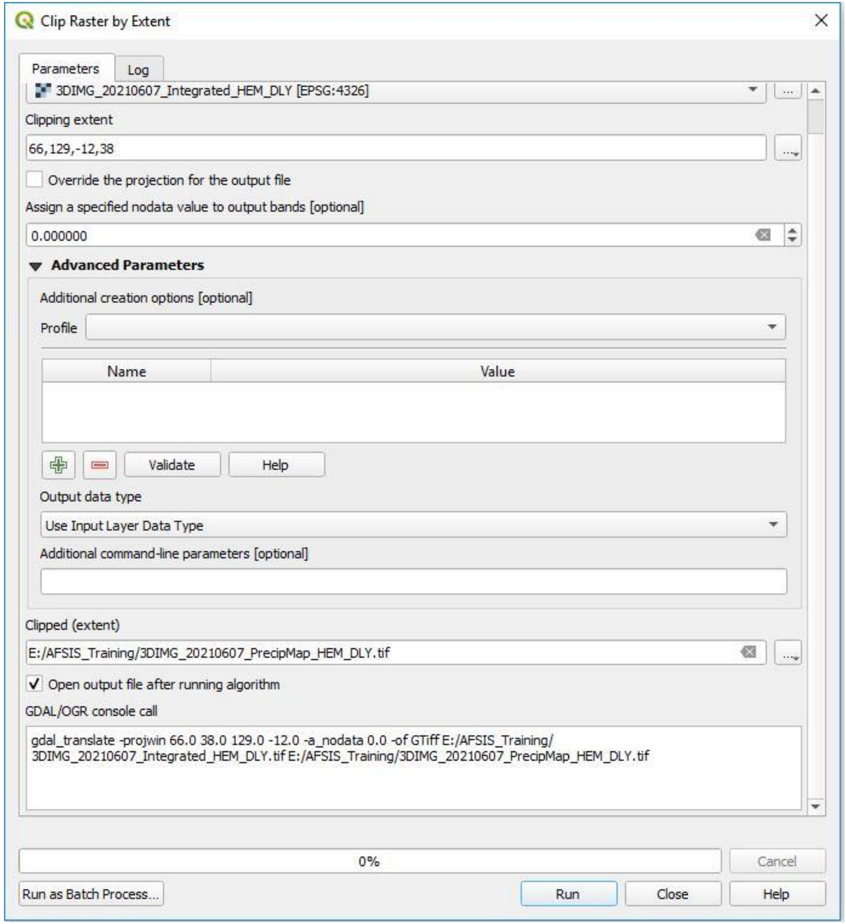
Calculation details - Median: If the number of input layers is even, the median will be

0% | Cancel

Run as Batch Process... | Run | Close | Help

INSAT-3D HEM Product Processing Steps

- Step-5: Clip Integrated Map by Extent in QGIS
  - Raster→ Extraction →Clip Raster by Extent
  - Extents are:
    - Minimum X: 66
    - Maximum X: 129
    - Minimum Y: -12
    - Maximum Y: 38



3DIMG_20210607_Integrated_HEM_DLY [EPSG:4326]

Clipping extent

66,129,-12,38

☐ Override the projection for the output file

Assign a specified nodata value to output bands [optional]

0.000000

Advanced Parameters

Additional creation options [optional]

Profile

Name	Value

Output data type

Use Input Layer Data Type

Additional command-line parameters [optional]

Clipped (extent)

E:/AFSIS_Training/3DIMG_20210607_PrecipMap_HEM_DLY.tif

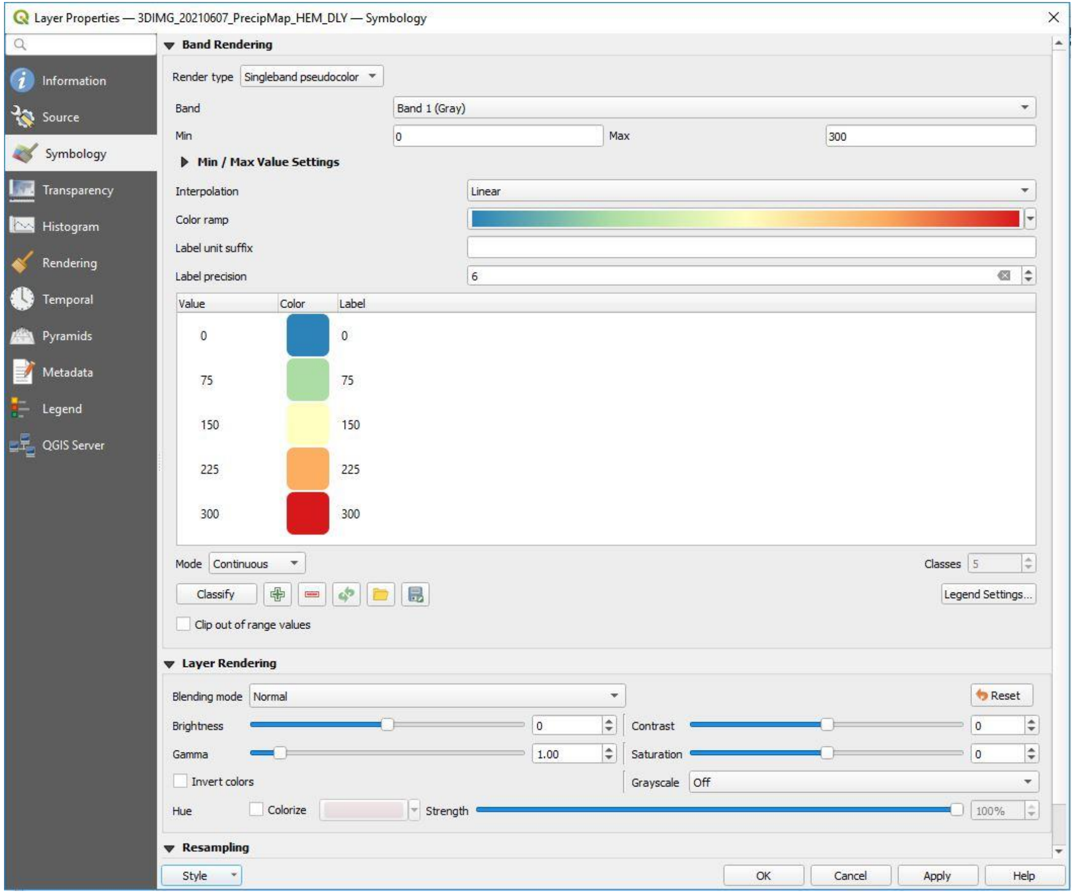
☑ Open output file after running algorithm

GDAL/OGR console call

```
gdal_translate -projwin 66.0 38.0 129.0 -12.0 -a_nodata 0.0 -of GTiff E:/AFSIS_Training/
3DIMG_20210607_Integrated_HEM_DLY.tif E:/AFSIS_Training/3DIMG_20210607_PrecipMap_HEM_DLY.tif
```

INSAT-3D HEM Product Processing Steps

- Step-6: Apply Symbology in Precipitation Map
  - Right Click on Raster Layer (Precipitation Map from Step-5) and click on **Properties**
  - Choose parameters as per given image
  - Click on **Apply**



Layer Properties — 3DIMG_20210607_PrecipMap_HEM_DLY — Symbology

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 0 Max: 300

Min / Max Value Settings

Interpolation: Linear

Color ramp

Label unit suffix

Label precision: 6

Value	Color	Label
0	🟦	0
75	🟩	75
150	🟨	150
225	🟧	225
300	🟥	300

Mode: Continuous Classes: 5

Classify Legend Settings...

□ Clip out of range values

Layer Rendering

Blending mode: Normal Reset

Brightness: 0 Contrast: 0

Gamma: 1.00 Saturation: 0

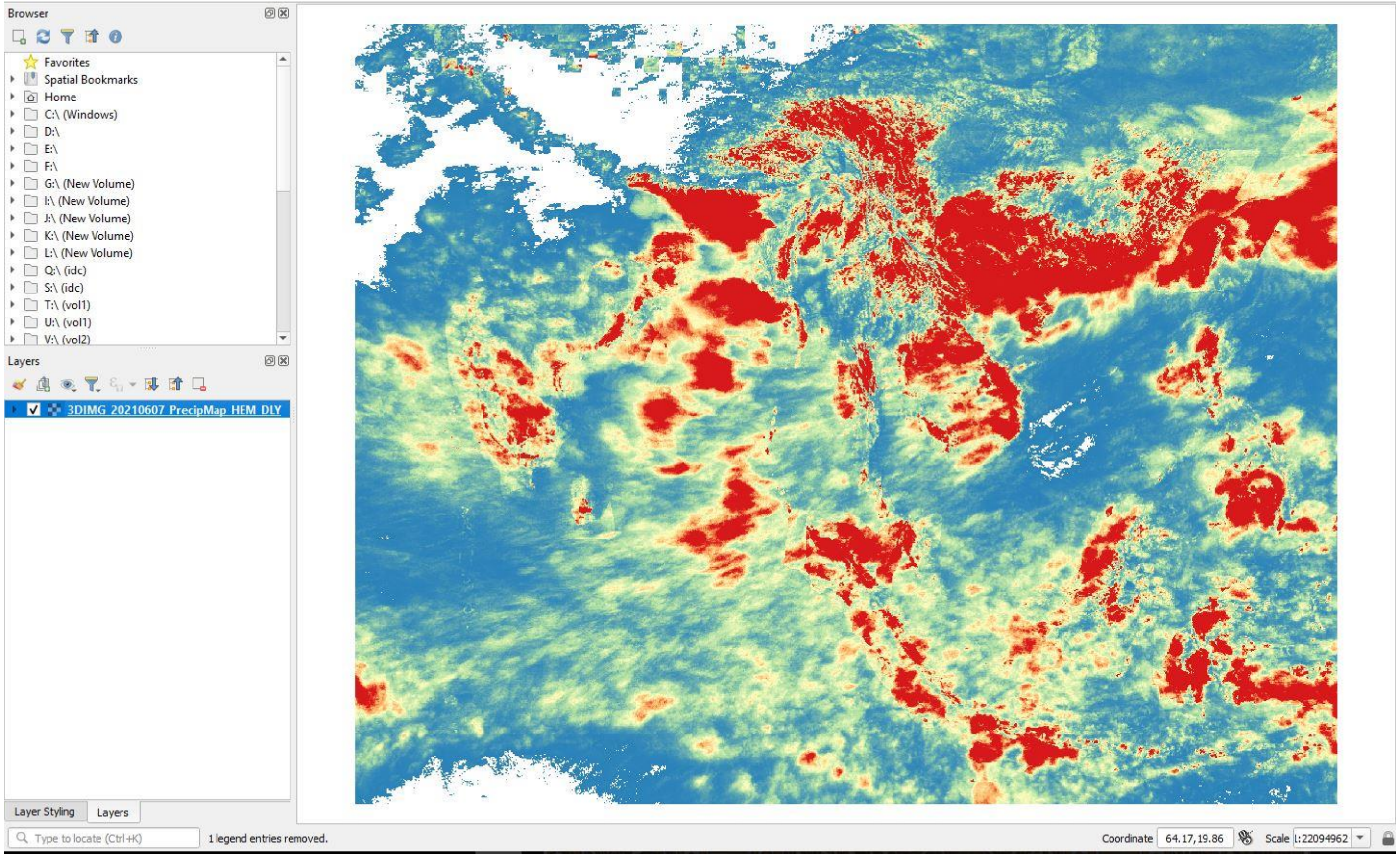
□ Invert colors Grayscale: Off

Hue □ Colorize Strength: 100%

Resampling

INSAT-3D HEM Product Processing Steps

- Step-7: Get the classified output



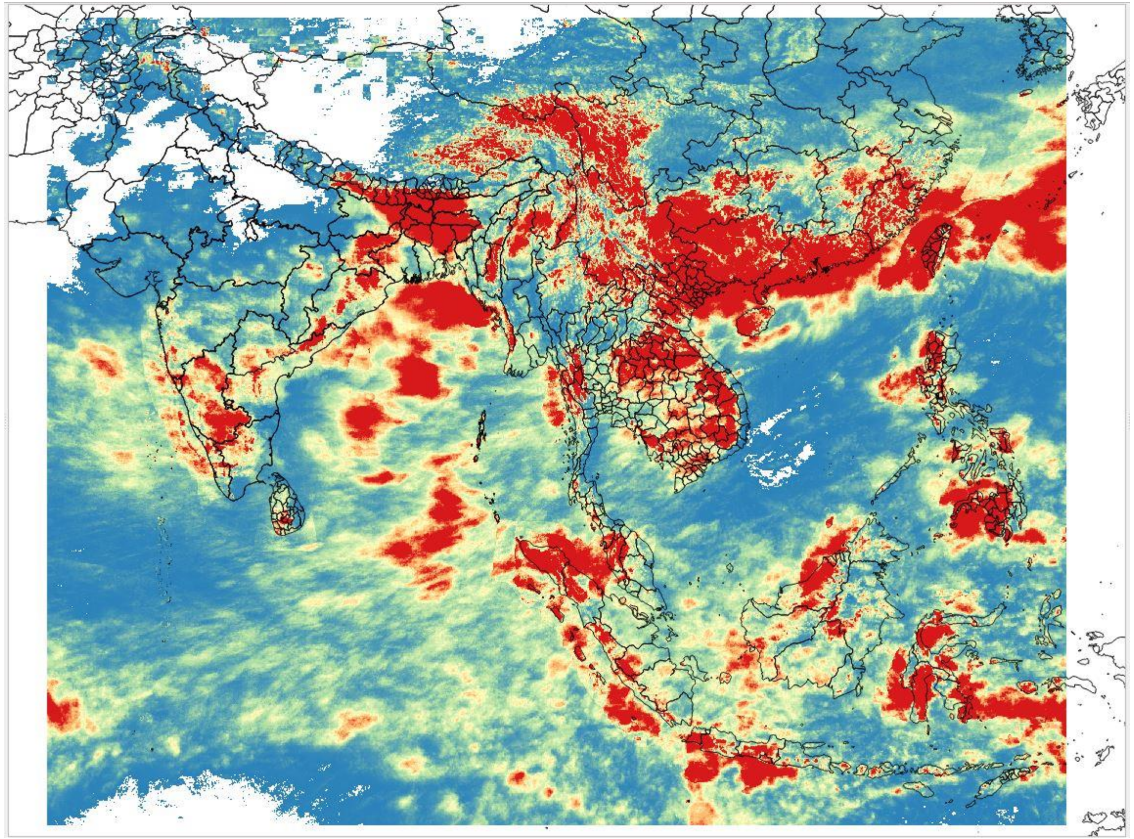
☑ 3DIMG_20210607_PrecipMap_HEM_DLY

1 legend entries removed.

Coordinate 64.17,19.86 Scale 1:22094962

INSAT-3D HEM Product Processing Steps

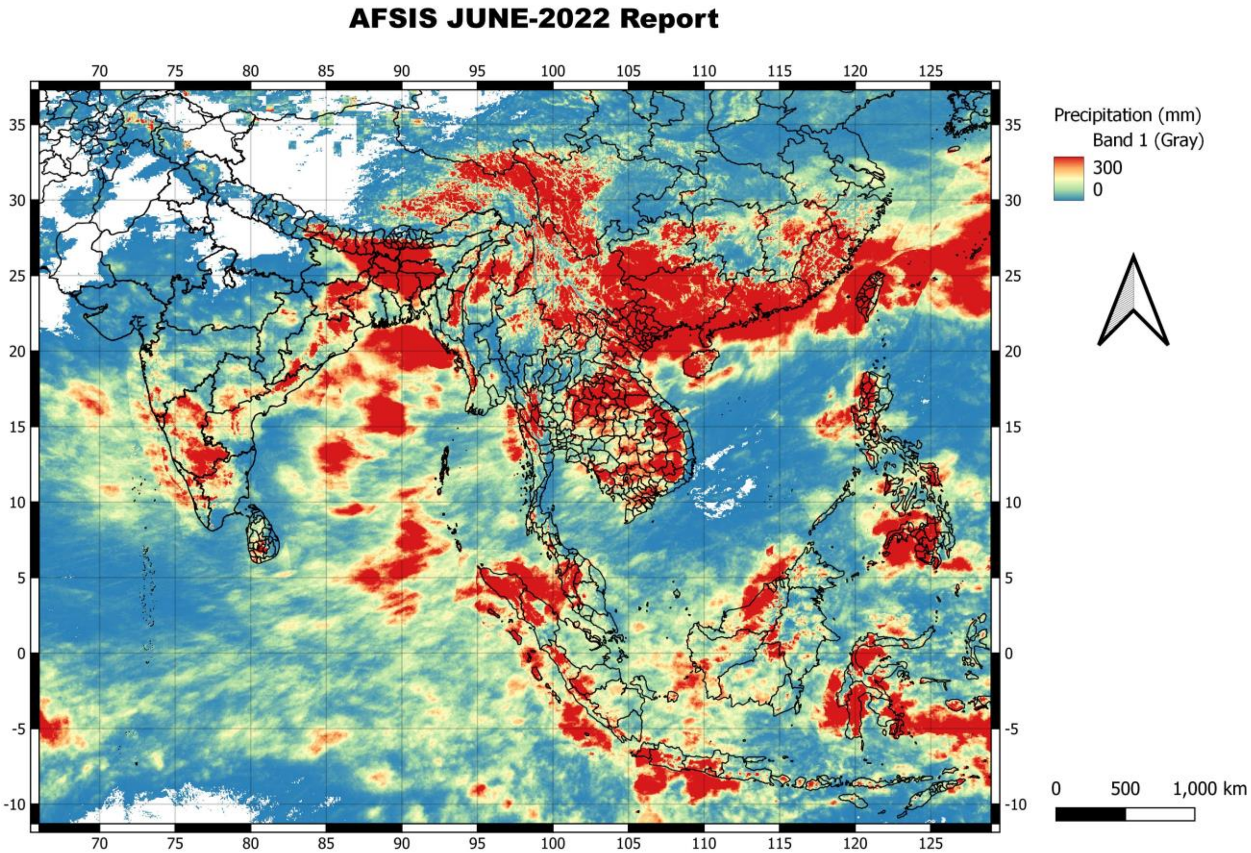
- Step-8: Add the boundaries to analyse map

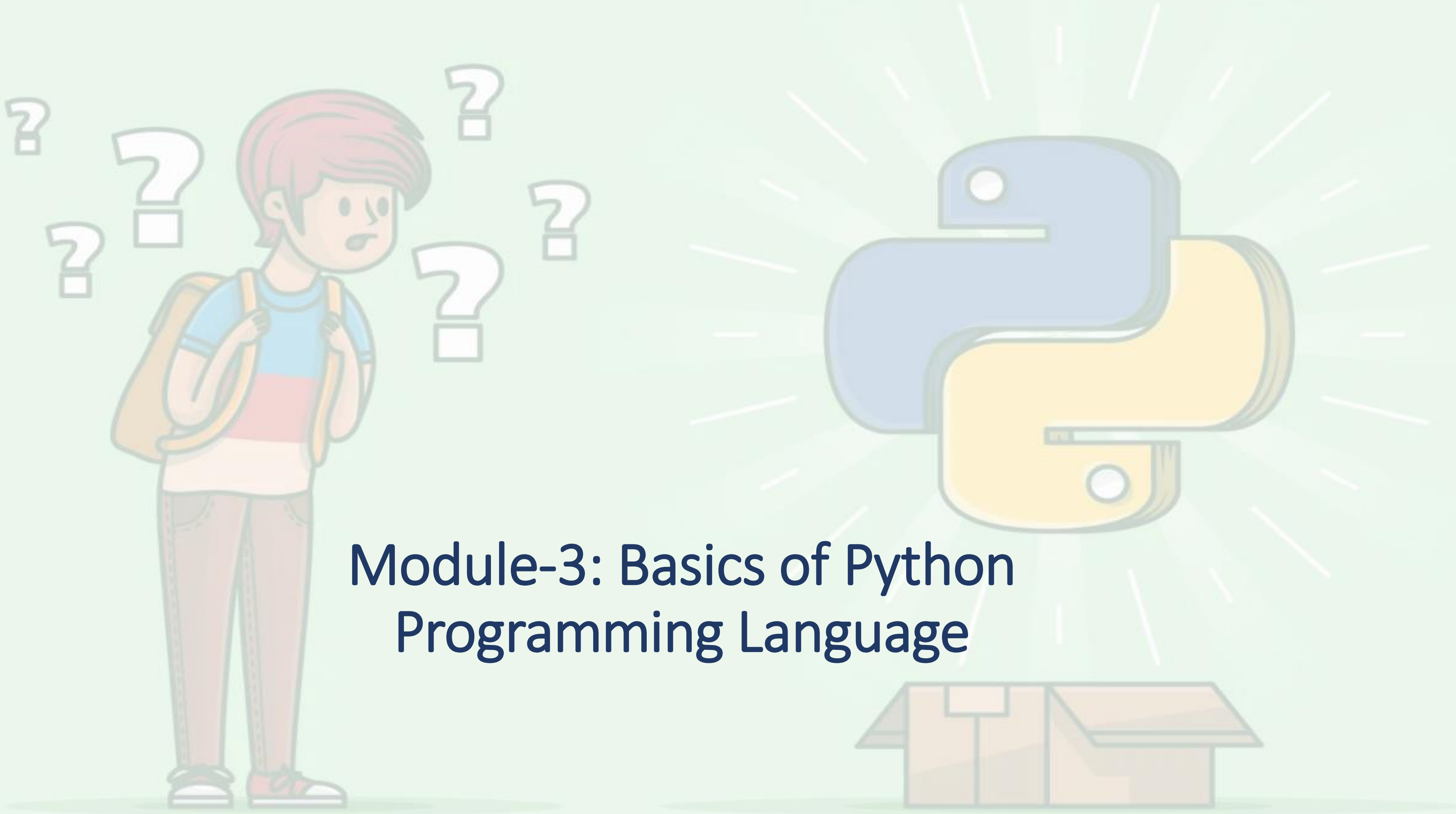


INSAT-3D HEM Product Processing Steps

- Step-9: Load Raster into QGIS Print Layout and Add Grids, Frame, Boundary Coordinates, Legends, Scale bar and Title of the map.
- Step-10: Export Prepared Map as Image

(Step-9 & 10 are given as video in next slide)





Module-3: Basics of Python Programming Language

Python - Basic

- Interpreted language
- Dynamically typed: variables do not have a predefined type
- Concise
- Indentation instead of braces
- Rich, built-in collection types:
  - Lists: made of anything, mutable
  - Strings: made of characters, immutable
  - Tuples: made of anything, immutable
  - Dictionaries (maps)
  - Sets

Dynamic vs Static typing

- Static Typing:
  - Variables are declared to refer to objects of a given type
  - Methods use type signatures to enforce contracts
  - Example: Java, C, C++
  - Syntax: float a = 5.0
- Dynamic Typing:
  - Variables come into existence when first assigned to
  - A variable can refer to an object of any type
  - All types are (almost) treated the same way
  - Main drawback: type errors are only caught at runtime
  - Example: Python, JavaScript
  - Syntax: a = 5.0

Installation

- Easiest way is to install Anaconda Software (Comes in installed python and some of the commonly used packages)
- Anaconda provides Jupiter and Spyder as script editor.
- Installation of packages is easy.
    - conda install <package-name>
    - pip install <package-name>

The Basics

An example program:

```
x = 34 - 23 # A comment.

y = “Hello” # Another one.

z = 3.45

if z == 3.45 or y == “Hello”:

    x = x + 1

    y = y + “ World” # String concat.

print x

print y
```

Takeaways from code:

- Indentation matters to the meaning of the code:
    - Block structure indicated by indentation
- Variable types don’t need to be declared. Python figures out the variable types on its own.
- Assignment uses = and comparison uses ==.
- For numbers + - * / % are as expected. Special use of + for string concatenation.
- Logical operators are words (and, or, not) not symbols
- Simple printing can be done with print.

Basic Data Types

- Integers (default for numbers)
  - z = 5 / 2 # Answer is 2, integer division.
- Floats (Real Numbers)
  - x = 3.456
- Strings
  - Can use “” or ‘’ to specify. “abc” ‘abc’ (Same thing)
  - Unmatched can occur within the string. “matt’s”
  - Use triple double-quotes for multi-line strings or strings than contain both ‘ and “ inside of them: “““a‘b“c”””

Whitespaces

- Whitespace is meaningful in Python: especially indentation and placement of newlines.
- Use a newline to end a line of code.
  - Use \ when must go to next line prematurely.
- No braces { } to mark blocks of code in Python… Use consistent indentation instead.
  - The first line with less indentation is outside of the block.
  - The first line with more indentation starts a nested block
- Often a colon appears at the start of a new block. (E.g. for function and class definitions.)

Comments

- Start comments with # – the rest of line is ignored.
- Can include a “documentation string” as the first line of any new function or class that you define. The development environment, debugger, and other tools use it:
    - it’s good style to include one.

```
def my_function(x, y):
    “““This is the docstring. This function does blah blah blah.”””
    # The code would go here...
```

Decision Making (if-elif-else block)

Syntax:

```
if (condition):

    statement

elif (condition):

    statement

.

.

else:

    statement
```

Sample Code:

```
#!/usr/bin/python

i = 20

if (i == 10):

    print("i is 10")

elif (i == 15):

    print("i is 15")

elif (i == 20):

    print("i is 20")

else:

    print("i is not present")
```

Loops (while loops - Indefinite iteration & Conditional exit)

Syntax:

```
while expression:

      statement(s)
```

When a while loop is executed, expr is first evaluated in a Boolean context and if it is true, the loop body is executed. Then the expr is checked again, if it is still true then the body is executed again and this continues until the expression becomes false.

Sample Code (While Loop)

```
# Python program to illustrate while loop
count = 0
while (count < 3):
    count = count + 1
    print("Hello All")
```

Output:

```
Hello All
Hello All
Hello All
```

Loops (for loops - definite iteration)

Syntax:

```
for var in iterable:

     # statements
```

Python For loop is used for sequential traversal i.e. it is used for iterating over an iterable like string, tuple, list, etc. There is “for in” loop which is similar to for each loop in other languages.

Sample Code (For Loop)

```
# printing a number
for i in range(10):
    print(i, end=" ")
print()

# using range for iteration
l = [10, 20, 30, 40]
for i in range(len(l)):
    print(l[i], end=" ")
print()

# performing sum of first 10 numbers
sum = 0
for i in range(1, 10):
    sum = sum + i
print("Sum of first 10 numbers :", sum)
```

Output:

```
0 1 2 3 4 5 6 7 8 9

10 20 30 40

Sum of first 10 numbers : 45
```

Continue, Break and Pass statement

Continue: It is a loop control statement that forces to execute the next iteration of the loop while skipping the rest of the code inside the loop for the current iteration only.

Break: Used to bring the control out of the loop when some external condition is triggered. Break statement is put inside the loop body (generally after if condition).

Pass: It is a null statement. The **pass** statement is generally used as a placeholder i.e. when the user does not know what code to write.

Sample Code (While with continue)

```
# Prints all letters except 'e' and
's'

i = 0
a = 'LetterBox'

while i < len(a):
    if a[i] == 'e' or a[i] == 'o':
        i += 1
        continue

    print('Current Letter :', a[i])
    i += 1
```

Output:

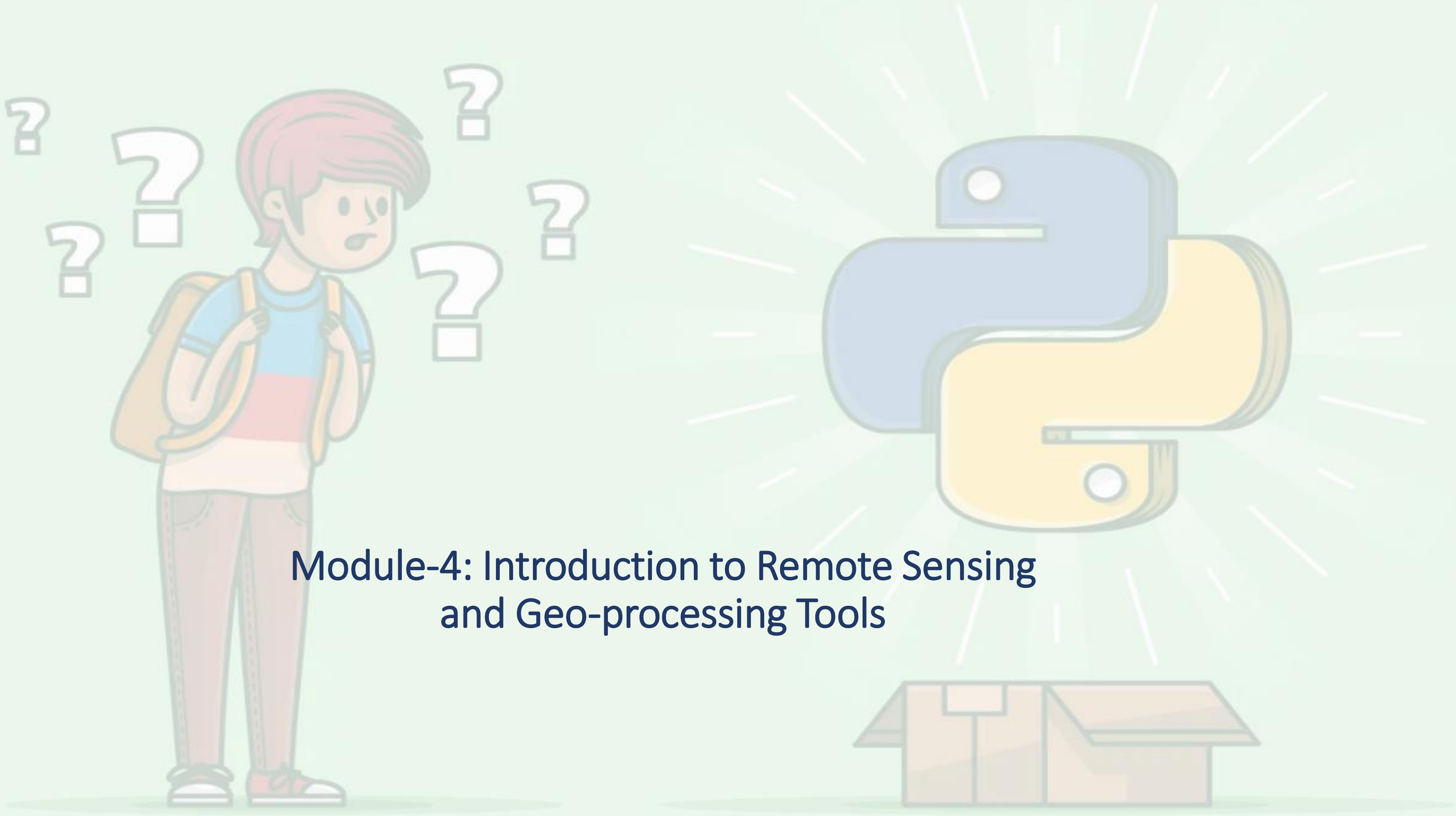
```
Current Letter : L
Current Letter : t
Current Letter : t
Current Letter : r
Current Letter : B
Current Letter : x
```

Sample Code (While with break)

```
# break the loop as soon it sees 'e'
or 's'

i = 0
a = 'LetterBox'

while i < len(a):
    if a[i] == 'e' or a[i] == 's':
        i += 1
        break

    print('Current Letter :', a[i])
    i += 1
```

Output:

```
Current Letter : L
```



Module-4: Introduction to Remote Sensing and Geo-processing Tools

Image Projection

- Projection (Map Projection): It is a mathematical model which projects 3D-surface of earth into 2D-plane.

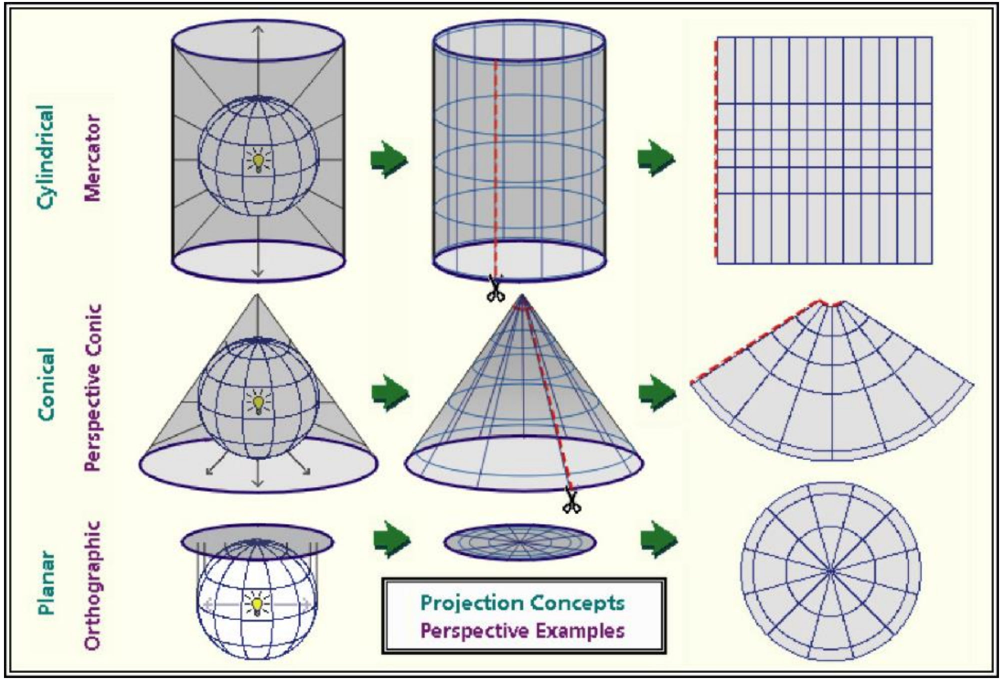


Image Adapted From: https://www.nwcg.gov/publications/pms437/mapping/using-gis

Geoprocessing & Types of Geospatial Data

- Geoprocessing – Manipulation of geospatial data.
- Geospatial Data

Raster Data	Vector Data
Spatial data represented in the form of image/matrix/array where each pixel contains specific information about that coordinate.	Spatial data where data is represented using geometries (Point, Line and Polygon).
Continuous Data	Discrete Data
Ex. – Temperature, elevation (DEM), air pressure	Ex. – Administrative Boundary (Polygon), Road Network (Line), Educational Institutions (Point)

Geospatial Data

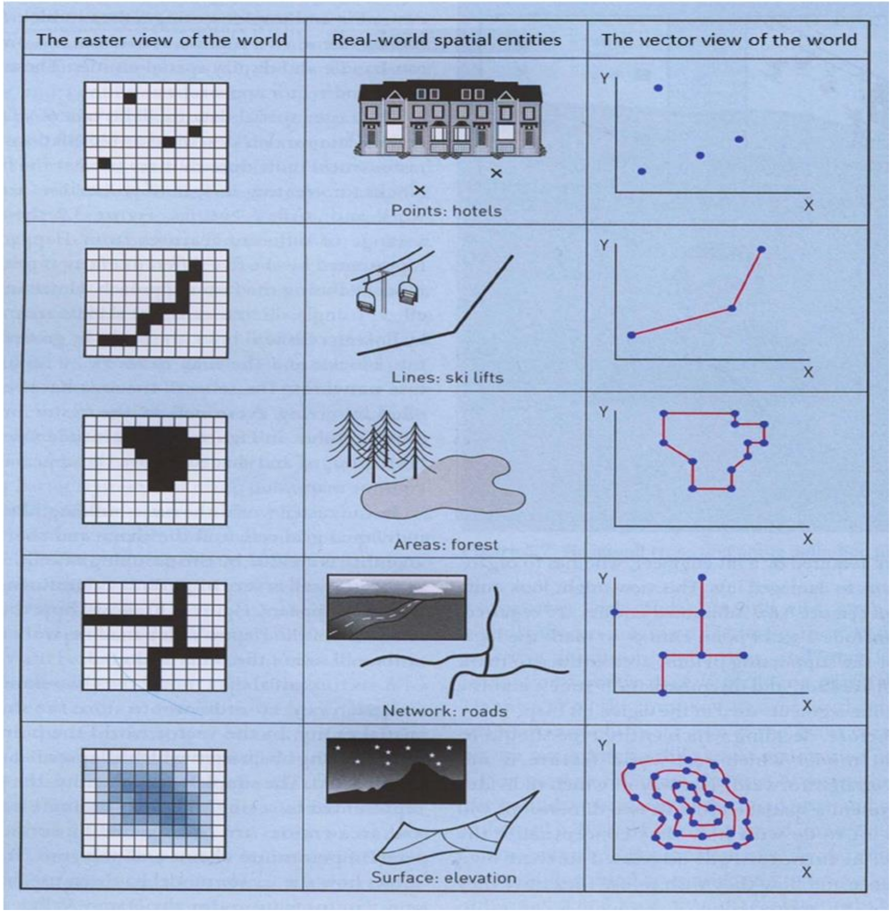
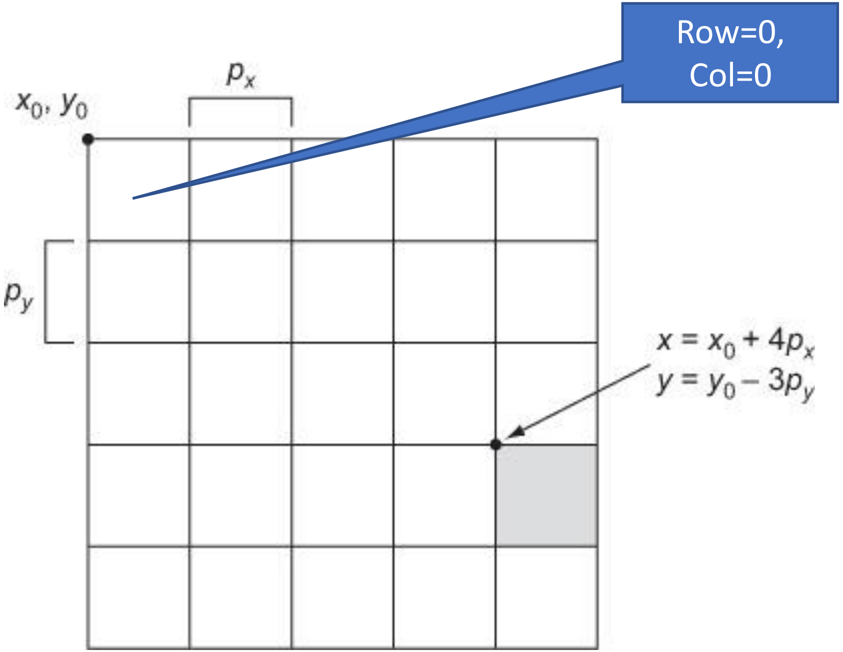

The raster view of the world
Real-world spatial entities
The vector view of the world
Points: hotels
Lines: ski lifts
Areas: forest
Network: roads
Surface: elevation
Y
X

Image Adapted From: Heywood et al. (2006)

Geotransform

- Geotransform: It is a affine transformation from image coordinate system (row,column) or (pixel, line) to georeferenced coordinate space (projected space).



Row=0,
Col=0

Parameters

GT(1) : x-coordinate of the upper-left corner of the upper-left pixel.

GT(1): pixel width.

GT(2): row rotation (typically zero).

GT(3): y-coordinate of the upper-left corner of the upper-left pixel.

GT(4): column rotation (typically zero).

GT(5): n-s pixel resolution / pixel height (negative value for a north-up image).

Image Adapted From: Chris Garrard (2016)

Why use GDAL+NumPy instead of Standard GIS software?

- Not advisable if what you want to do is easily handled within ArcGIS/Imagine/QGIS etc. – there is a lot of programming overhead
- Well suited for process model applications where the logic at a cell based is too complex.

  Example:
  - Grid algebra : grid1 + grid2 (probably use GIS)
  - Finding NN in multidimensional space (maybe use GDAL/Numpy)
- Also useful if given spatial data is NOT in standard GIS formats (JPEG, GTiff etc.)
- When large amount of data is to be processed repeatedly.
- Want to write custom algorithms or processes.

Python Libraries for Geospatial Development

- **GDAL** (Geospatial Data Abstraction Library)
  - Is for raster and vector based geospatial data; available for download at: http://gdal.org/download.html
  - Supports about 100 different formats
  - ArcInfo grids, ArcSDE raster, Imagine, Idrisi, ENVI, GRASS, GeoTIFF
  - HDF4, HDF5
  - USGS DOQ, USGS DEM
  - ECW, MrSID
  - TIFF, JPEG, JPEG2000, PNG, GIF, BMP

NOTE: GDAL also comes with command line utility. It can be downloaded and installed from https:\\trac.osgeo.org\osgeo4w

Python Libraries for Geospatial Development

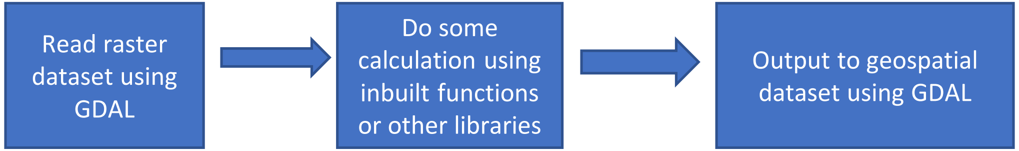
- **GeoPandas:** makes working with vector data easier.
    - Pandas: For spatial operations
    - Shapely: For high level interface to multiple geometries
    - Fiona: For file access
    - Matplotlib: For data plotting

Python Libraries for Geospatial Development

- **Numpy** (Numerical Python)
    - An array/matrix package for Python.
    - Well suited for image processing – i.e. one function can operate on the entire array.
    - Slicing by dimensions and applying functions to these slices is concise and straightforward.
    - Nearly 400 methods defined for use with NumPy arrays (e.g. type conversions, mathematical, logical etc.
- NOTE: Unofficial windows binaries can be downloaded from https://lfd.uci.edu/~gohlke/pythonlibs/

Geoprocessing with GDAL and Geopandas in Python

- GDAL - Geospatial Data Abstraction Library
- Numpy - the N-dimensional array package for scientific computing with Python.
- Geopandas – Powerful library for vector operations

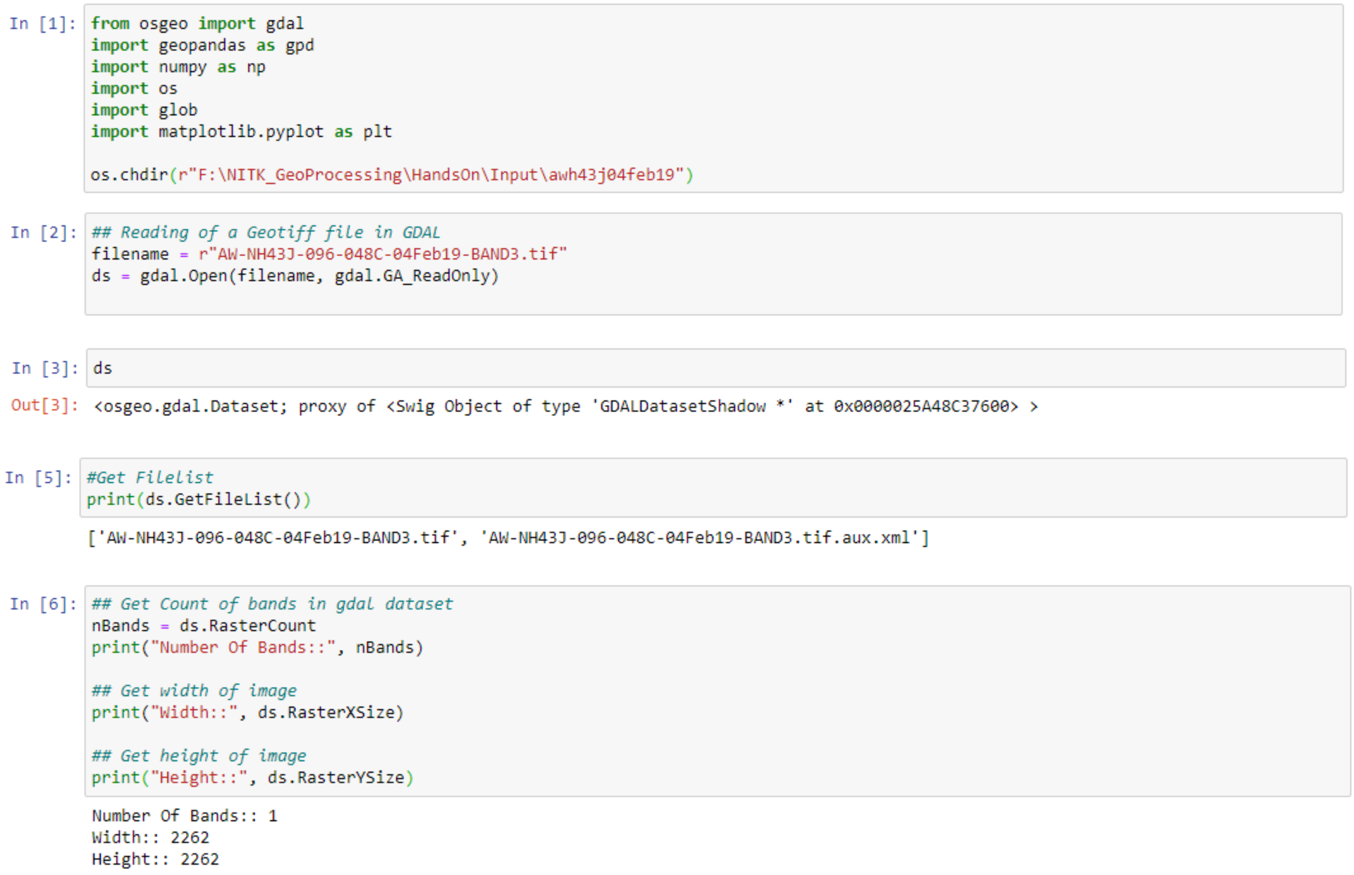


Read raster dataset using GDAL

Do some calculation using inbuilt functions or other libraries

Output to geospatial dataset using GDAL

Reading Sample File



In [1]:
```
from osgeo import gdal
import geopandas as gpd
import numpy as np
import os
import glob
import matplotlib.pyplot as plt

os.chdir(r"F:\NITK_GeoProcessing\HandsOn\Input\awh43j04feb19")
```

In [2]:
```
## Reading of a Geotiff file in GDAL
filename = r"AW-NH43J-096-048C-04Feb19-BAND3.tif"
ds = gdal.Open(filename, gdal.GA_ReadOnly)
```

In [3]:
```
ds
```

Out[3]:
```
<osgeo.gdal.Dataset; proxy of <Swig Object of type 'GDALDatasetShadow *' at 0x0000025A48C37600> >
```

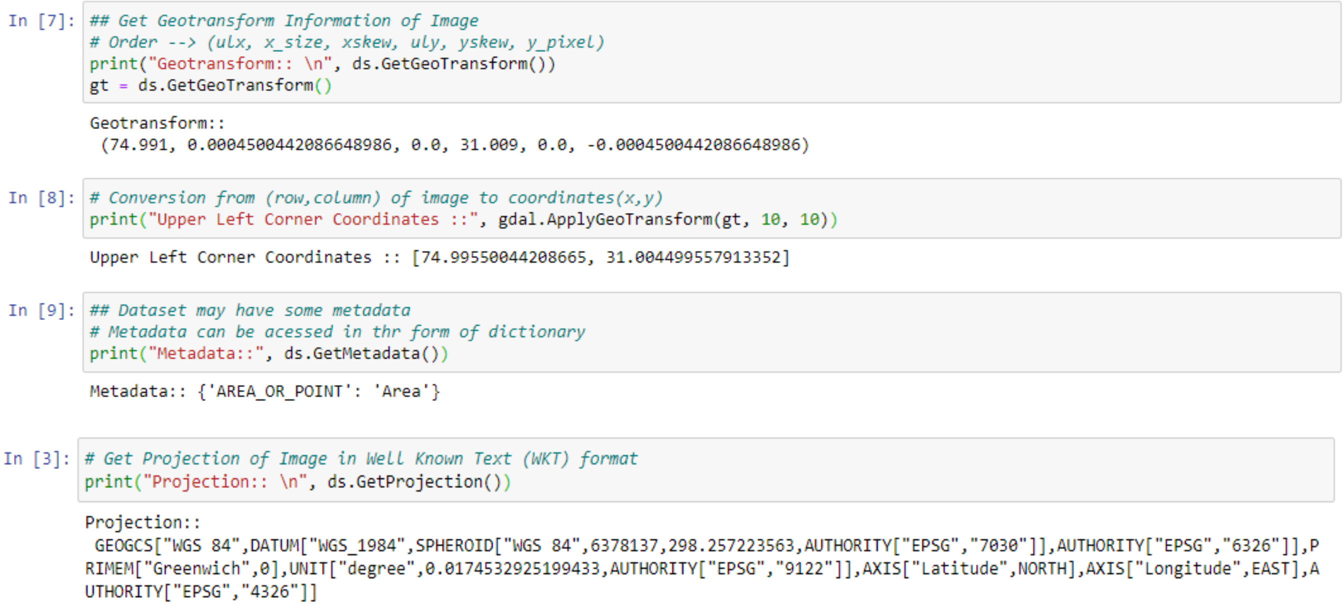
In [5]:
```
#Get Filelist
print(ds.GetFileList())
```

```
['AW-NH43J-096-048C-04Feb19-BAND3.tif', 'AW-NH43J-096-048C-04Feb19-BAND3.tif.aux.xml']
```

In [6]:
```
## Get Count of bands in gdal dataset
nBands = ds.RasterCount
print("Number Of Bands::", nBands)

## Get width of image
print("Width::", ds.RasterXSize)

## Get height of image
print("Height::", ds.RasterYSize)
```

```
Number Of Bands:: 1
Width:: 2262
Height:: 2262
```

Reading Sample File Contd…



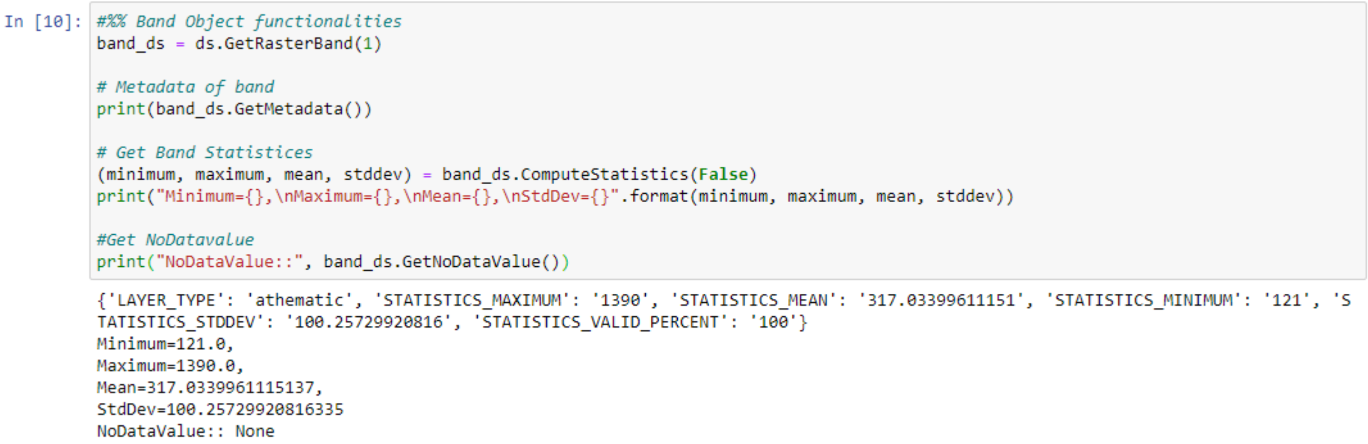
```
In [7]: ## Get Geotransform Information of Image
        # Order --> (ulx, x_size, xskew, uly, yskew, y_pixel)
        print("Geotransform:: \n", ds.GetGeoTransform())
        gt = ds.GetGeoTransform()

        Geotransform::
         (74.991, 0.0004500442086648986, 0.0, 31.009, 0.0, -0.0004500442086648986)
```

```
In [8]: # Conversion from (row,column) of image to coordinates(x,y)
        print("Upper Left Corner Coordinates ::", gdal.ApplyGeoTransform(gt, 10, 10))

        Upper Left Corner Coordinates :: [74.99550044208665, 31.004499557913352]
```

```
In [9]: ## Dataset may have some metadata
        # Metadata can be acessed in thr form of dictionary
        print("Metadata::", ds.GetMetadata())

        Metadata:: {'AREA_OR_POINT': 'Area'}
```

```
In [3]: # Get Projection of Image in Well Known Text (WKT) format
        print("Projection:: \n", ds.GetProjection())

        Projection::
         GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS 84",6378137,298.257223563,AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","6326"]],P
        RIMEM["Greenwich",0],UNIT["degree",0.0174532925199433,AUTHORITY["EPSG","9122"]],AXIS["Latitude",NORTH],AXIS["Longitude",EAST],A
        UTHORITY["EPSG","4326"]]
```

Band Functionalities

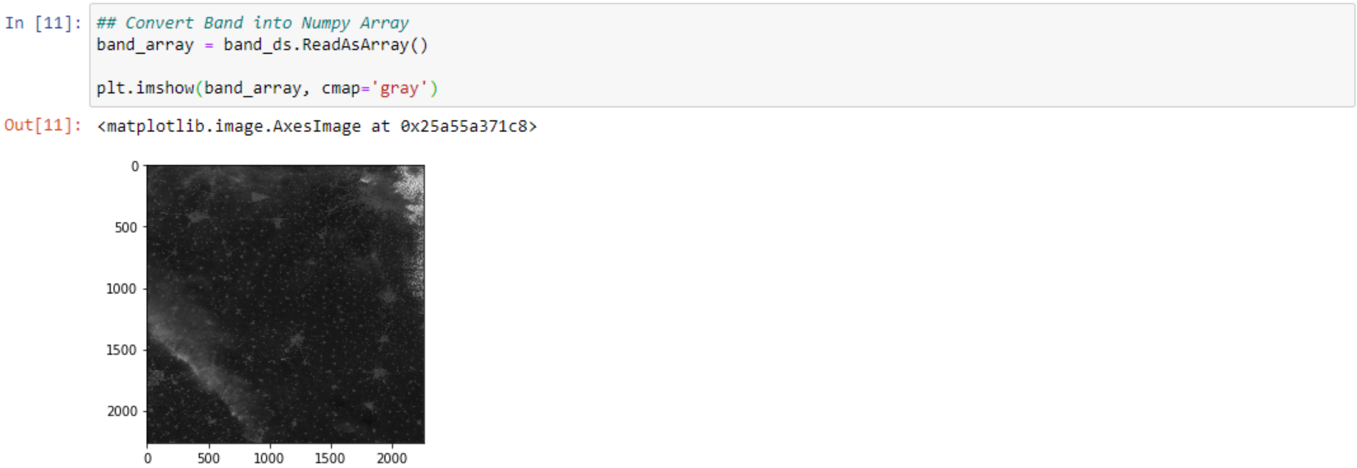


In [10]:

```python
#%% Band Object functionalities
band_ds = ds.GetRasterBand(1)

# Metadata of band
print(band_ds.GetMetadata())

# Get Band Statistices
(minimum, maximum, mean, stddev) = band_ds.ComputeStatistics(False)
print("Minimum={},\nMaximum={},\nMean={},\nStdDev={}".format(minimum, maximum, mean, stddev))

#Get NoDatavalue
print("NoDataValue::", band_ds.GetNoDataValue())
```

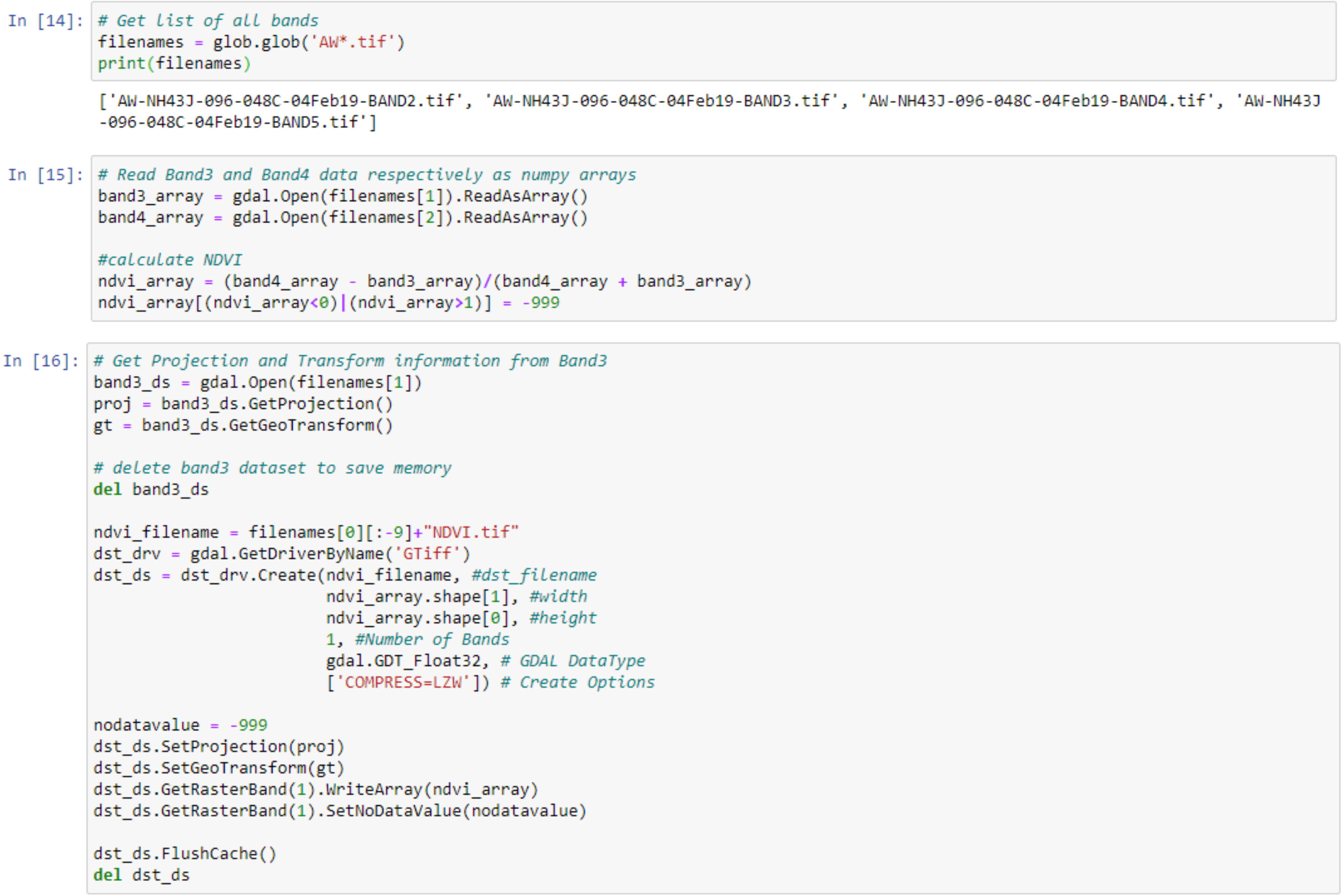
```
{'LAYER_TYPE': 'athematic', 'STATISTICS_MAXIMUM': '1390', 'STATISTICS_MEAN': '317.03399611151', 'STATISTICS_MINIMUM': '121', 'S
TATISTICS_STDDEV': '100.25729920816', 'STATISTICS_VALID_PERCENT': '100'}
Minimum=121.0,
Maximum=1390.0,
Mean=317.0339961115137,
StdDev=100.25729920816335
NoDataValue:: None
```

Reading and Plotting of Bands



```
In [11]: ## Convert Band into Numpy Array
         band_array = band_ds.ReadAsArray()

         plt.imshow(band_array, cmap='gray')

Out[11]: <matplotlib.image.AxesImage at 0x25a55a371c8>
```

Creating NDVI Images



In [14]:

```
# Get list of all bands
filenames = glob.glob('AW*.tif')
print(filenames)
```

```
['AW-NH43J-096-048C-04Feb19-BAND2.tif', 'AW-NH43J-096-048C-04Feb19-BAND3.tif', 'AW-NH43J-096-048C-04Feb19-BAND4.tif', 'AW-NH43J
-096-048C-04Feb19-BAND5.tif']
```

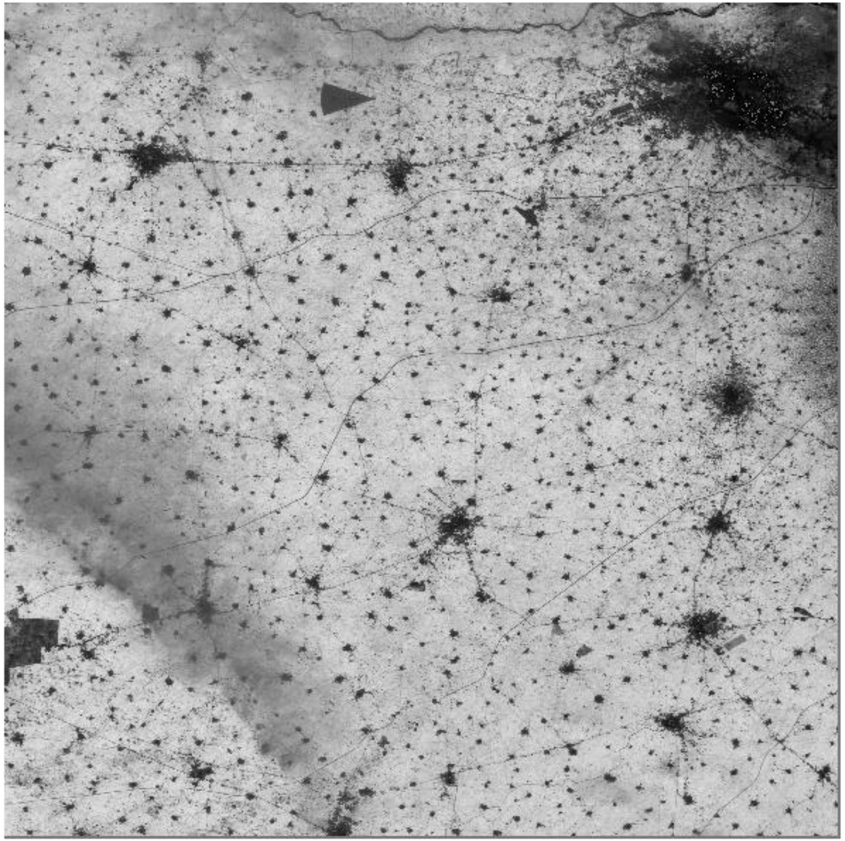
In [15]:

```
# Read Band3 and Band4 data respectively as numpy arrays
band3_array = gdal.Open(filenames[1]).ReadAsArray()
band4_array = gdal.Open(filenames[2]).ReadAsArray()

#calculate NDVI
ndvi_array = (band4_array - band3_array)/(band4_array + band3_array)
ndvi_array[(ndvi_array<0)|(ndvi_array>1)] = -999
```

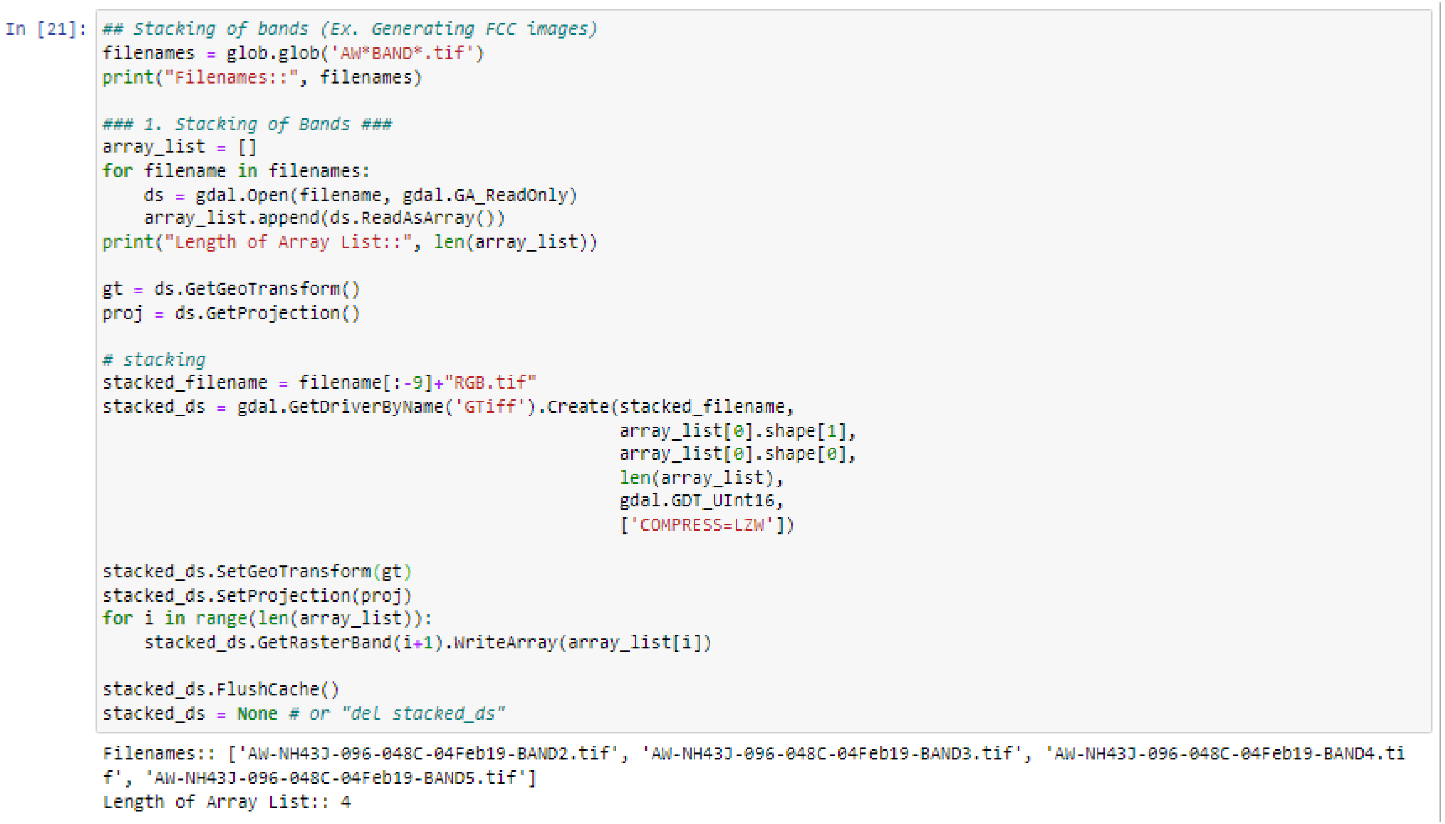
In [16]:

```
# Get Projection and Transform information from Band3
band3_ds = gdal.Open(filenames[1])
proj = band3_ds.GetProjection()
gt = band3_ds.GetGeoTransform()

# delete band3 dataset to save memory
del band3_ds

ndvi_filename = filenames[0][:-9]+"NDVI.tif"
dst_drv = gdal.GetDriverByName('GTiff')
dst_ds = dst_drv.Create(ndvi_filename, #dst_filename
                        ndvi_array.shape[1], #width
                        ndvi_array.shape[0], #height
                        1, #Number of Bands
                        gdal.GDT_Float32, # GDAL DataType
                        ['COMPRESS=LZW']) # Create Options

nodatavalue = -999
dst_ds.SetProjection(proj)
dst_ds.SetGeoTransform(gt)
dst_ds.GetRasterBand(1).WriteArray(ndvi_array)
dst_ds.GetRasterBand(1).SetNoDataValue(nodatavalue)

dst_ds.FlushCache()
del dst_ds
```

Creating NDVI Images



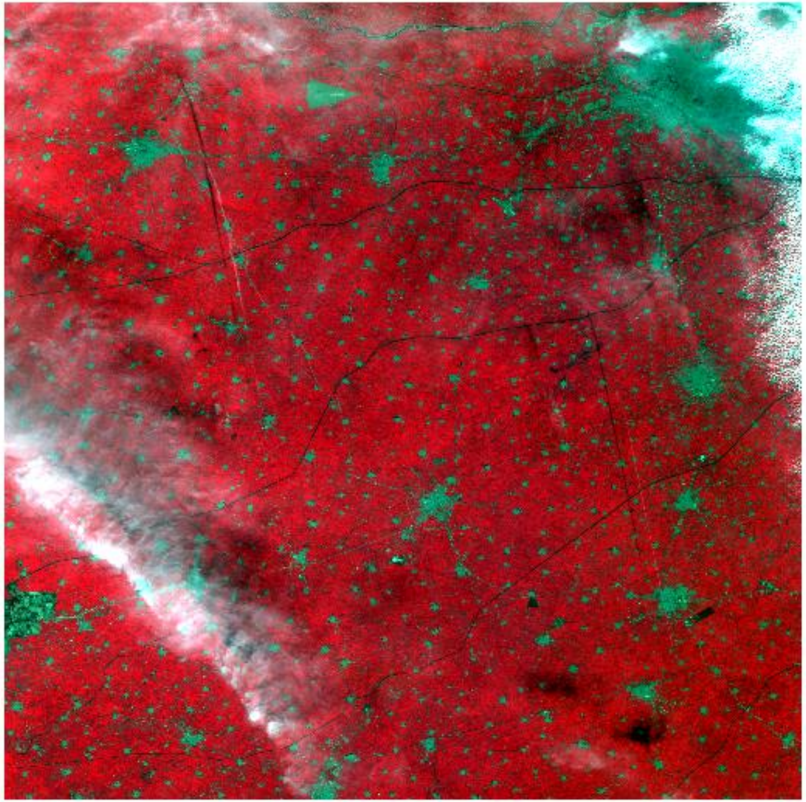
Stacking of Bands (FCC generation)



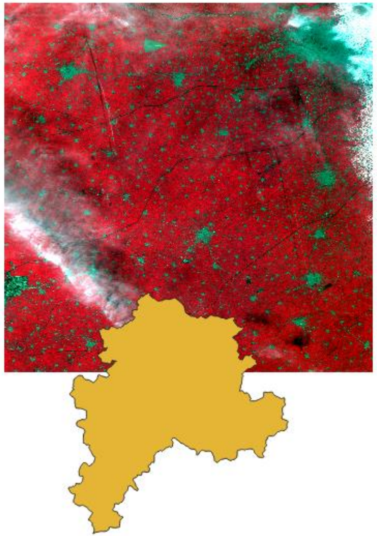
```
In [21]: ## Stacking of bands (Ex. Generating FCC images)
         filenames = glob.glob('AW*BAND*.tif')
         print("Filenames::", filenames)

         ### 1. Stacking of Bands ###
         array_list = []
         for filename in filenames:
             ds = gdal.Open(filename, gdal.GA_ReadOnly)
             array_list.append(ds.ReadAsArray())
         print("Length of Array List::", len(array_list))

         gt = ds.GetGeoTransform()
         proj = ds.GetProjection()

         # stacking
         stacked_filename = filename[:-9]+"RGB.tif"
         stacked_ds = gdal.GetDriverByName('GTiff').Create(stacked_filename,
                                                           array_list[0].shape[1],
                                                           array_list[0].shape[0],
                                                           len(array_list),
                                                           gdal.GDT_UInt16,
                                                           ['COMPRESS=LZW'])

         stacked_ds.SetGeoTransform(gt)
         stacked_ds.SetProjection(proj)
         for i in range(len(array_list)):
             stacked_ds.GetRasterBand(i+1).WriteArray(array_list[i])

         stacked_ds.FlushCache()
         stacked_ds = None # or "del stacked_ds"
```

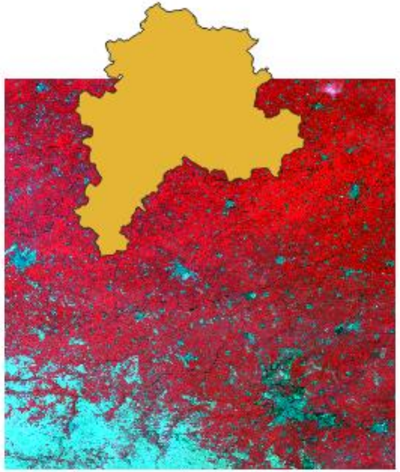
```
Filenames:: ['AW-NH43J-096-048C-04Feb19-BAND2.tif', 'AW-NH43J-096-048C-04Feb19-BAND3.tif', 'AW-NH43J-096-048C-04Feb19-BAND4.ti
f', 'AW-NH43J-096-048C-04Feb19-BAND5.tif']
Length of Array List:: 4
```

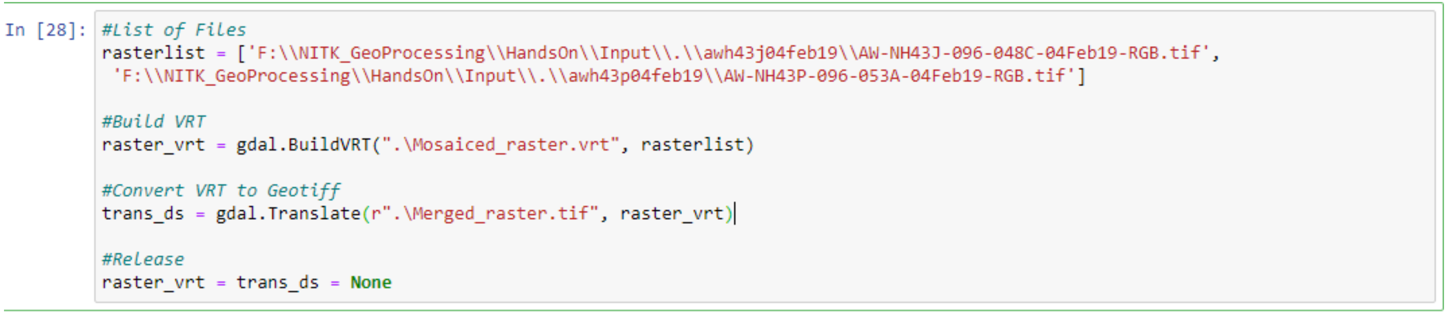
Stacking of Bands (FCC generation)



Mosaicking of Images



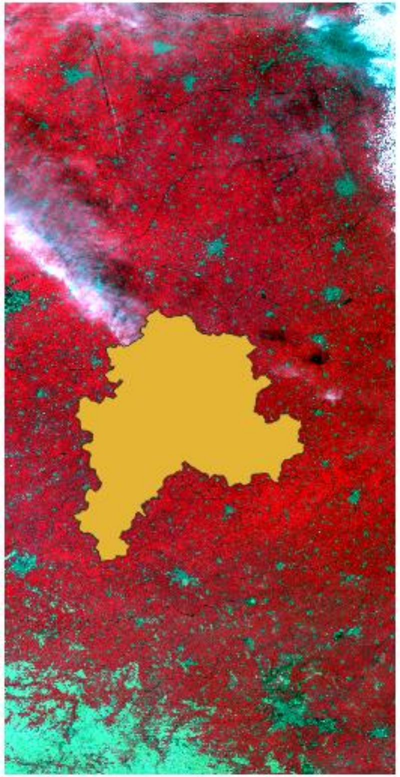




In [28]:

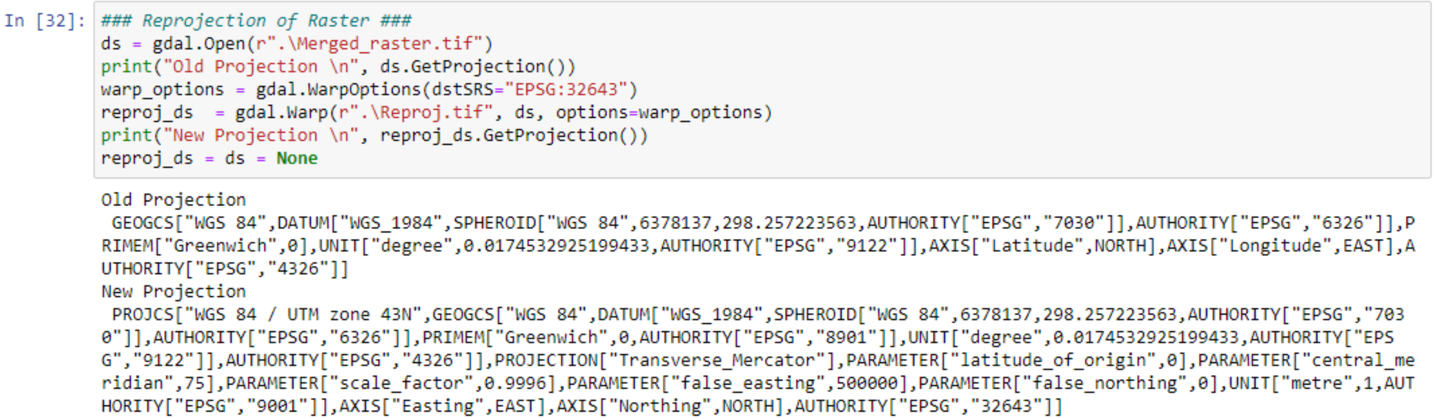
```
#List of Files
rasterlist = ['F:\\NITK_GeoProcessing\\HandsOn\\Input\\.\\awh43j04feb19\\AW-NH43J-096-048C-04Feb19-RGB.tif',
 'F:\\NITK_GeoProcessing\\HandsOn\\Input\\.\\awh43p04feb19\\AW-NH43P-096-053A-04Feb19-RGB.tif']

#Build VRT
raster_vrt = gdal.BuildVRT(".\Mosaiced_raster.vrt", rasterlist)

#Convert VRT to Geotiff
trans_ds = gdal.Translate(r".\Merged_raster.tif", raster_vrt)

#Release
raster_vrt = trans_ds = None
```

Mosaicking of Images



Mosaicked Image as Output

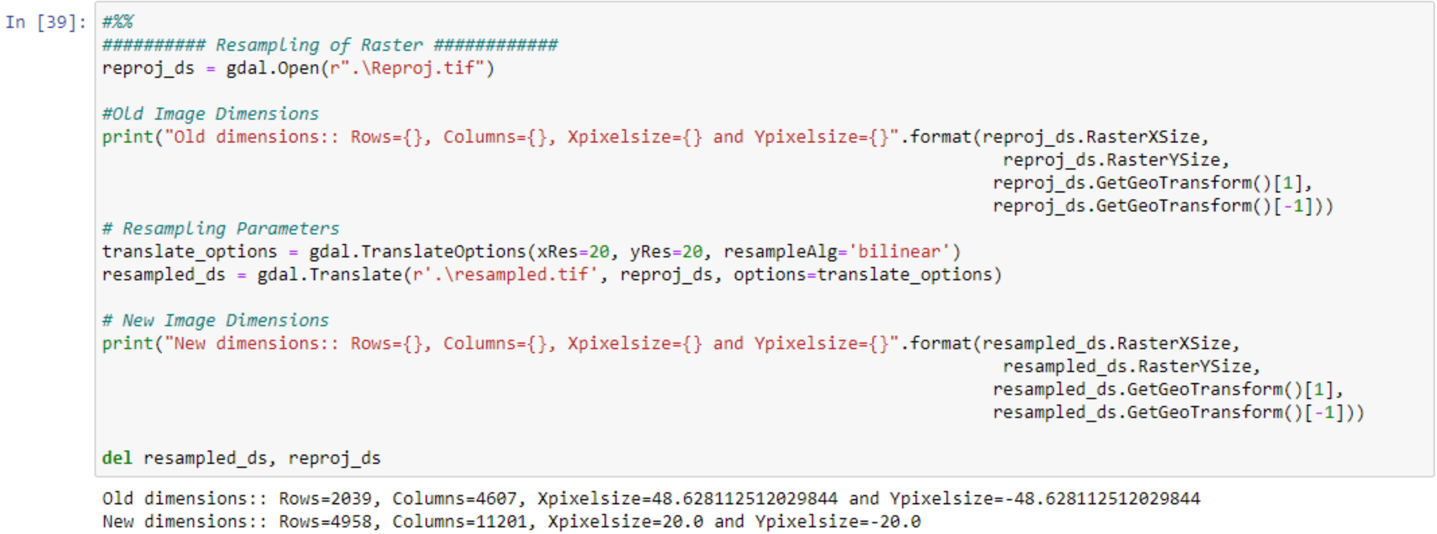
Reprojection of Images



```
In [32]: ### Reprojection of Raster ###
         ds = gdal.Open(r".\Merged_raster.tif")
         print("Old Projection \n", ds.GetProjection())
         warp_options = gdal.WarpOptions(dstSRS="EPSG:32643")
         reproj_ds  = gdal.Warp(r".\Reproj.tif", ds, options=warp_options)
         print("New Projection \n", reproj_ds.GetProjection())
         reproj_ds = ds = None
```

```
Old Projection
 GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS 84",6378137,298.257223563,AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","6326"]],P
RIMEM["Greenwich",0],UNIT["degree",0.0174532925199433,AUTHORITY["EPSG","9122"]],AXIS["Latitude",NORTH],AXIS["Longitude",EAST],A
UTHORITY["EPSG","4326"]]
New Projection
 PROJCS["WGS 84 / UTM zone 43N",GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS 84",6378137,298.257223563,AUTHORITY["EPSG","703
0"]],AUTHORITY["EPSG","6326"]],PRIMEM["Greenwich",0,AUTHORITY["EPSG","8901"]],UNIT["degree",0.0174532925199433,AUTHORITY["EPS
G","9122"]],AUTHORITY["EPSG","4326"]],PROJECTION["Transverse_Mercator"],PARAMETER["latitude_of_origin",0],PARAMETER["central_me
ridian",75],PARAMETER["scale_factor",0.9996],PARAMETER["false_easting",500000],PARAMETER["false_northing",0],UNIT["metre",1,AUT
HORITY["EPSG","9001"]],AXIS["Easting",EAST],AXIS["Northing",NORTH],AUTHORITY["EPSG","32643"]]
```

Resampling of Images

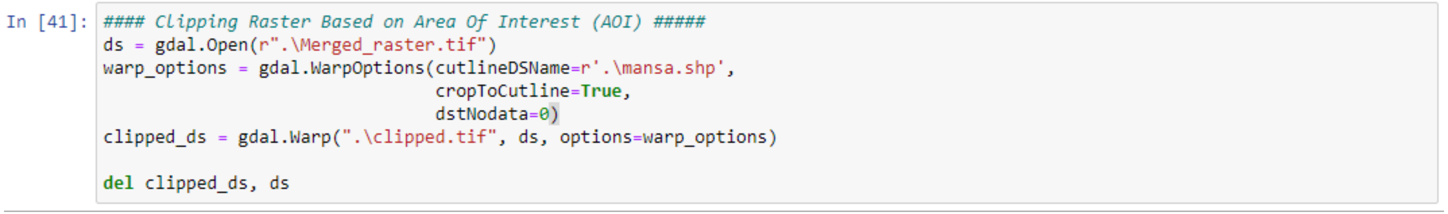


In [39]:

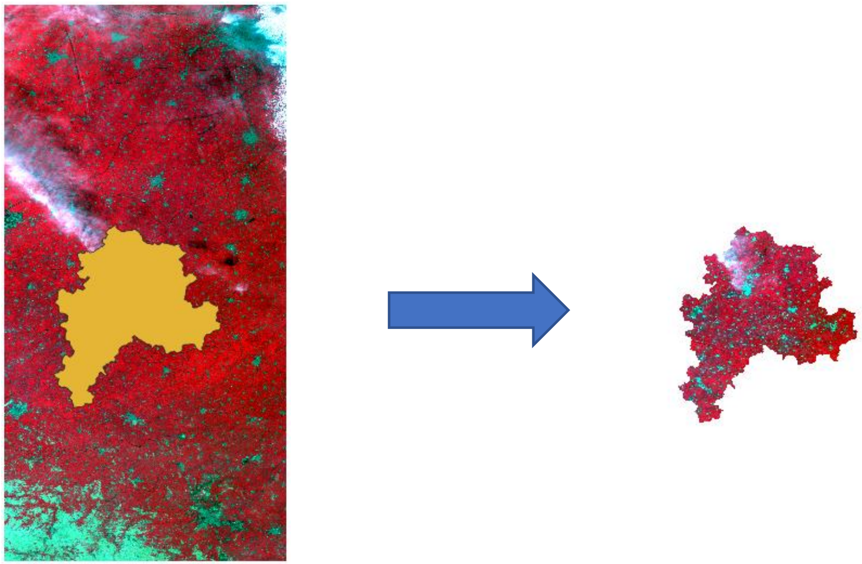
```
#%%
########## Resampling of Raster ############
reproj_ds = gdal.Open(r".\Reproj.tif")

#Old Image Dimensions
print("Old dimensions:: Rows={}, Columns={}, Xpixelsize={} and Ypixelsize={}".format(reproj_ds.RasterXSize,
                                                                                         reproj_ds.RasterYSize,
                                                                                        reproj_ds.GetGeoTransform()[1],
                                                                                        reproj_ds.GetGeoTransform()[-1]))

# Resampling Parameters
translate_options = gdal.TranslateOptions(xRes=20, yRes=20, resampleAlg='bilinear')
resampled_ds = gdal.Translate(r'.\resampled.tif', reproj_ds, options=translate_options)

# New Image Dimensions
print("New dimensions:: Rows={}, Columns={}, Xpixelsize={} and Ypixelsize={}".format(resampled_ds.RasterXSize,
                                                                                         resampled_ds.RasterYSize,
                                                                                        resampled_ds.GetGeoTransform()[1],
                                                                                        resampled_ds.GetGeoTransform()[-1]))


del resampled_ds, reproj_ds
```

```
Old dimensions:: Rows=2039, Columns=4607, Xpixelsize=48.628112512029844 and Ypixelsize=-48.628112512029844
New dimensions:: Rows=4958, Columns=11201, Xpixelsize=20.0 and Ypixelsize=-20.0
```

Clipping of Raster based on AOI



```
In [41]: #### Clipping Raster Based on Area Of Interest (AOI) #####
         ds = gdal.Open(r".\Merged_raster.tif")
         warp_options = gdal.WarpOptions(cutlineDSName=r'.\mansa.shp',
                                         cropToCutline=True,
                                         dstNodata=0)
         clipped_ds = gdal.Warp(".\clipped.tif", ds, options=warp_options)

         del clipped_ds, ds
```



References:

- Heywood, Ian, Sarah Cornelius & Steve Carver. 2006. An Introduction to Geographical Information Systems, 3rd edn. Harlow, UK: Pearson Prentice Hall.
- Chris Garrard. 2016. Geoprocessing with Python, Manning Publications Co. ISBN:9781617292149

Module-5: Processing of INSAT-3D HEM Product for AFSIS Report Generation (in Python)

Problem statement:

To generate twice a month 15-Days Cumulative Precipitation Map of South and South East Asian region in such a way that each precipitation map is generated by integrating each half of the month INSAT-HEM daily products.

Processing Steps:

1. List all the HDF files into directory.

2. For each HDF file:

    2.1. Convert HDF File into projected GeoTiff file.

    - Read HDF File using GDAL, give documented projection using gdal_translate and create VRT file.
    - Reproject the VRT file into GCS Projection and store output in GeoTiff image.

    2.2. 15-Days Binning based on date of product.

3. For each bin:

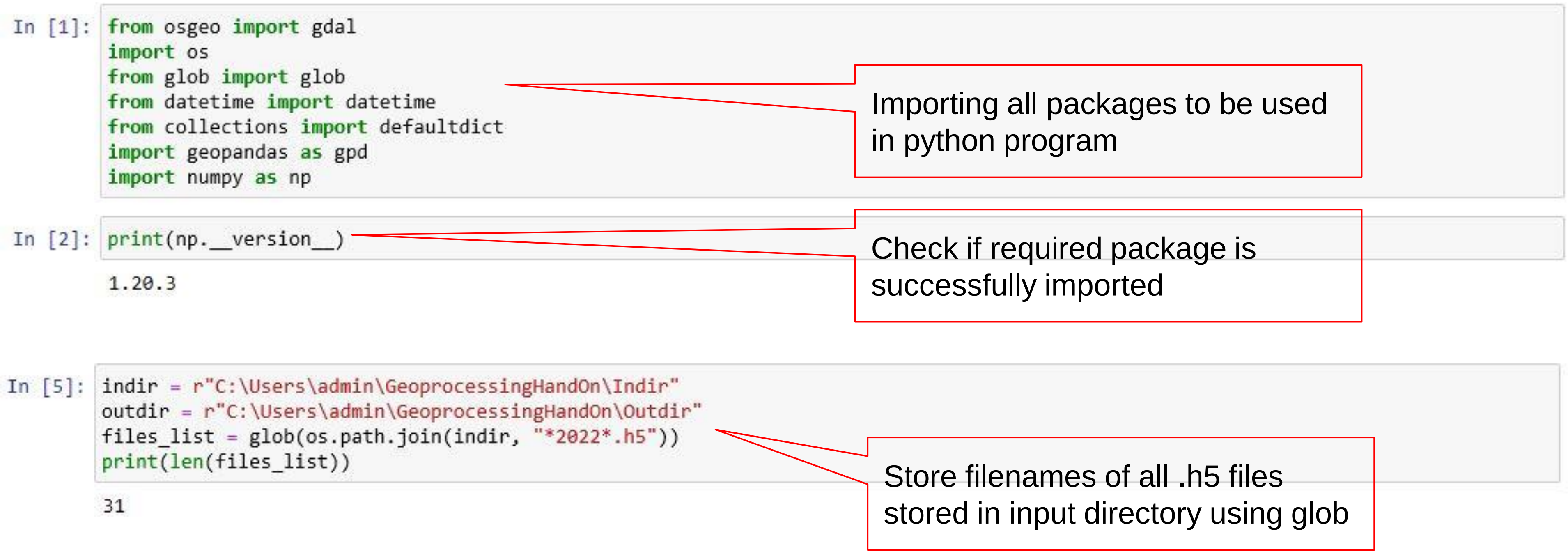
    3.1. Integrate product values using numpy array.

    3.2. Store integrated sum array into GeoTiff image.

    3.3. Clip raster based on extent.

Processing Steps in Python

STEP-1: List all the HDF files into directory



```
In [1]: from osgeo import gdal
        import os
        from glob import glob
        from datetime import datetime
        from collections import defaultdict
        import geopandas as gpd
        import numpy as np
```

Importing all packages to be used in python program

```
In [2]: print(np.__version__)

        1.20.3
```

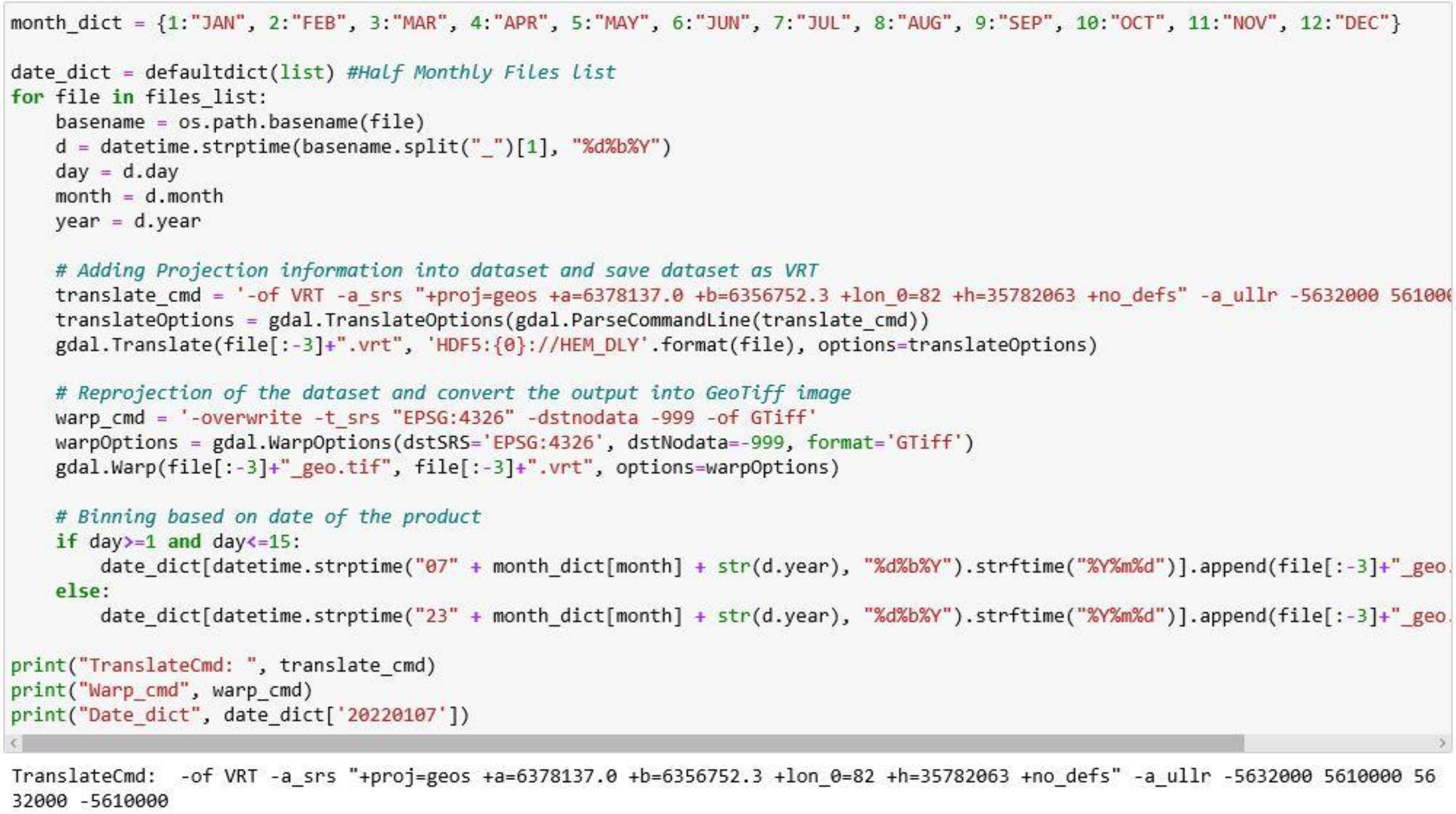
Check if required package is successfully imported

```
In [5]: indir = r"C:\Users\admin\GeoprocessingHandOn\Indir"
        outdir = r"C:\Users\admin\GeoprocessingHandOn\Outdir"
        files_list = glob(os.path.join(indir, "*2022*.h5"))
        print(len(files_list))

        31
```

Store filenames of all .h5 files stored in input directory using glob

Processing Steps in Python

STEP-2: Code

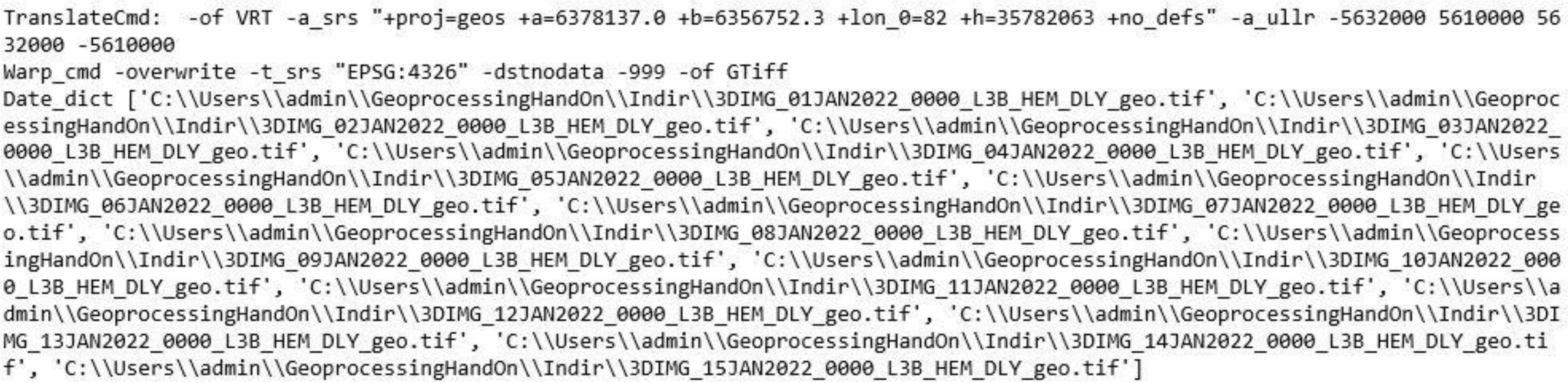


```
month_dict = {1:"JAN", 2:"FEB", 3:"MAR", 4:"APR", 5:"MAY", 6:"JUN", 7:"JUL", 8:"AUG", 9:"SEP", 10:"OCT", 11:"NOV", 12:"DEC"}

date_dict = defaultdict(list) #Half Monthly Files list
for file in files_list:
    basename = os.path.basename(file)
    d = datetime.strptime(basename.split("_")[1], "%d%b%Y")
    day = d.day
    month = d.month
    year = d.year

    # Adding Projection information into dataset and save dataset as VRT
    translate_cmd = '-of VRT -a_srs "+proj=geos +a=6378137.0 +b=6356752.3 +lon_0=82 +h=35782063 +no_defs" -a_ullr -5632000 561000
    translateOptions = gdal.TranslateOptions(gdal.ParseCommandLine(translate_cmd))
    gdal.Translate(file[:-3]+".vrt", 'HDF5:{0}://HEM_DLY'.format(file), options=translateOptions)

    # Reprojection of the dataset and convert the output into GeoTiff image
    warp_cmd = '-overwrite -t_srs "EPSG:4326" -dstnodata -999 -of GTiff'
    warpOptions = gdal.WarpOptions(dstSRS='EPSG:4326', dstNodata=-999, format='GTiff')
    gdal.Warp(file[:-3]+"_geo.tif", file[:-3]+".vrt", options=warpOptions)

    # Binning based on date of the product
    if day>=1 and day<=15:
        date_dict[datetime.strptime("07" + month_dict[month] + str(d.year), "%d%b%Y").strftime("%Y%m%d")].append(file[:-3]+"_geo
    else:
        date_dict[datetime.strptime("23" + month_dict[month] + str(d.year), "%d%b%Y").strftime("%Y%m%d")].append(file[:-3]+"_geo

print("TranslateCmd: ", translate_cmd)
print("Warp_cmd", warp_cmd)
print("Date_dict", date_dict['20220107'])
```

```
TranslateCmd:  -of VRT -a_srs "+proj=geos +a=6378137.0 +b=6356752.3 +lon_0=82 +h=35782063 +no_defs" -a_ullr -5632000 5610000 56
32000 -5610000
```

Processing Steps in Python

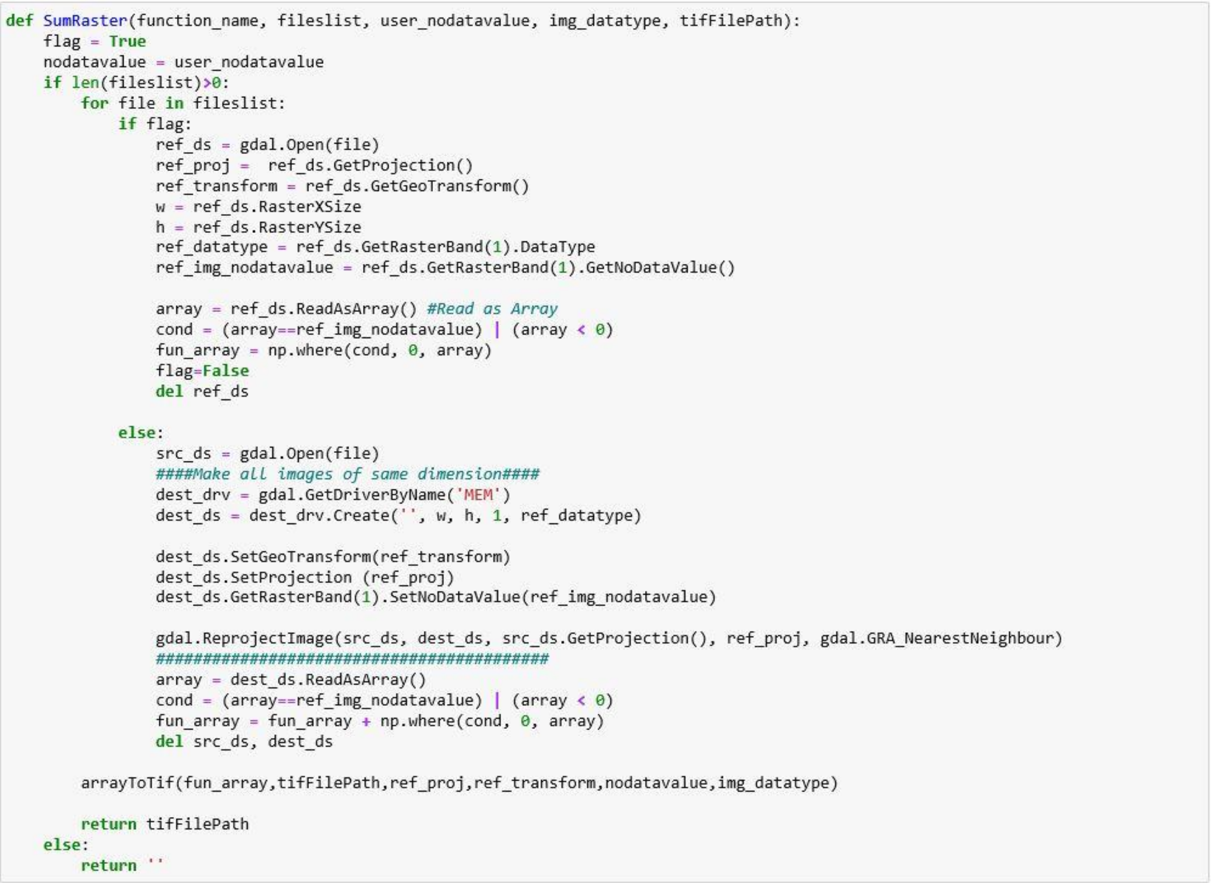
STEP-2 Output



```
TranslateCmd:  -of VRT -a_srs "+proj=geos +a=6378137.0 +b=6356752.3 +lon_0=82 +h=35782063 +no_defs" -a_ullr -5632000 5610000 56
32000 -5610000
Warp_cmd -overwrite -t_srs "EPSG:4326" -dstnodata -999 -of GTiff
Date_dict ['C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_01JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\Geoproc
essingHandOn\\Indir\\3DIMG_02JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_03JAN2022_
0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_04JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users
\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_05JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir
\\3DIMG_06JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_07JAN2022_0000_L3B_HEM_DLY_ge
o.tif', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_08JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\Geoprocess
ingHandOn\\Indir\\3DIMG_09JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_10JAN2022_000
0_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_11JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\a
dmin\\GeoprocessingHandOn\\Indir\\3DIMG_12JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DI
MG_13JAN2022_0000_L3B_HEM_DLY_geo.tif', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_14JAN2022_0000_L3B_HEM_DLY_geo.ti
f', 'C:\\Users\\admin\\GeoprocessingHandOn\\Indir\\3DIMG_15JAN2022_0000_L3B_HEM_DLY_geo.tif']
```

Processing Steps in Python

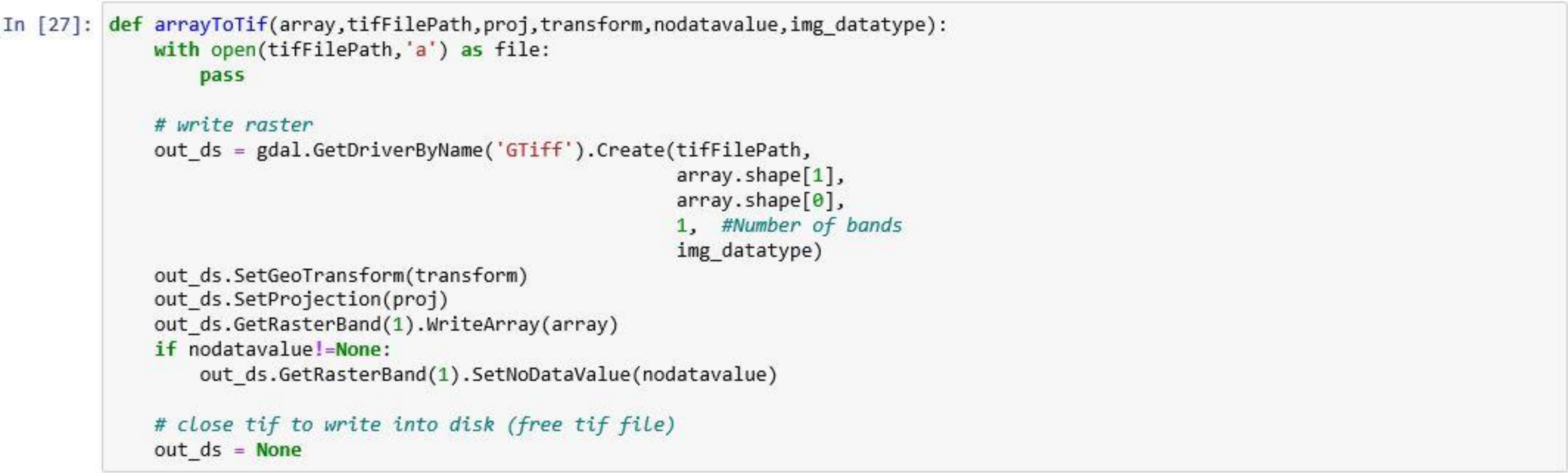
STEP-3.1: Function for Integration of HEM product values using numpy array



```
def SumRaster(function_name, fileslist, user_nodatavalue, img_datatype, tifFilePath):
    flag = True
    nodatavalue = user_nodatavalue
    if len(fileslist)>0:
        for file in fileslist:
            if flag:
                ref_ds = gdal.Open(file)
                ref_proj =  ref_ds.GetProjection()
                ref_transform = ref_ds.GetGeoTransform()
                w = ref_ds.RasterXSize
                h = ref_ds.RasterYSize
                ref_datatype = ref_ds.GetRasterBand(1).DataType
                ref_img_nodatavalue = ref_ds.GetRasterBand(1).GetNoDataValue()

                array = ref_ds.ReadAsArray() #Read as Array
                cond = (array==ref_img_nodatavalue) | (array < 0)
                fun_array = np.where(cond, 0, array)
                flag=False
                del ref_ds

            else:
                src_ds = gdal.Open(file)
                ####Make all images of same dimension####
                dest_drv = gdal.GetDriverByName('MEM')
                dest_ds = dest_drv.Create('', w, h, 1, ref_datatype)

                dest_ds.SetGeoTransform(ref_transform)
                dest_ds.SetProjection (ref_proj)
                dest_ds.GetRasterBand(1).SetNoDataValue(ref_img_nodatavalue)

                gdal.ReprojectImage(src_ds, dest_ds, src_ds.GetProjection(), ref_proj, gdal.GRA_NearestNeighbour)
                ##########################################
                array = dest_ds.ReadAsArray()
                cond = (array==ref_img_nodatavalue) | (array < 0)
                fun_array = fun_array + np.where(cond, 0, array)
                del src_ds, dest_ds

        arrayToTif(fun_array,tifFilePath,ref_proj,ref_transform,nodatavalue,img_datatype)

        return tifFilePath
    else:
        return ''
```

Processing Steps in Python

STEP-3.2: Function for converting integrated sum array into GeoTiff image.

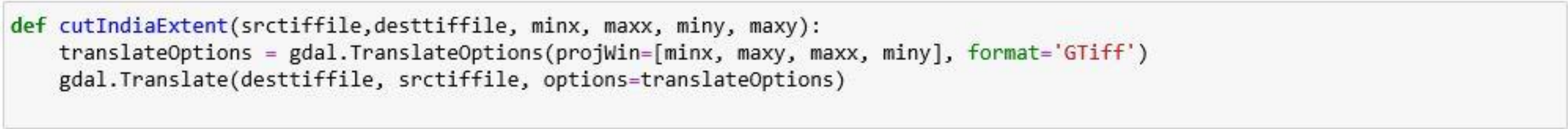


In [27]:

```
def arrayToTif(array,tifFilePath,proj,transform,nodatavalue,img_datatype):
    with open(tifFilePath,'a') as file:
        pass

    # write raster
    out_ds = gdal.GetDriverByName('GTiff').Create(tifFilePath,
                                                  array.shape[1],
                                                  array.shape[0],
                                                  1,  #Number of bands
                                                  img_datatype)
    out_ds.SetGeoTransform(transform)
    out_ds.SetProjection(proj)
    out_ds.GetRasterBand(1).WriteArray(array)
    if nodatavalue!=None:
        out_ds.GetRasterBand(1).SetNoDataValue(nodatavalue)

    # close tif to write into disk (free tif file)
    out_ds = None
```

Processing Steps in Python

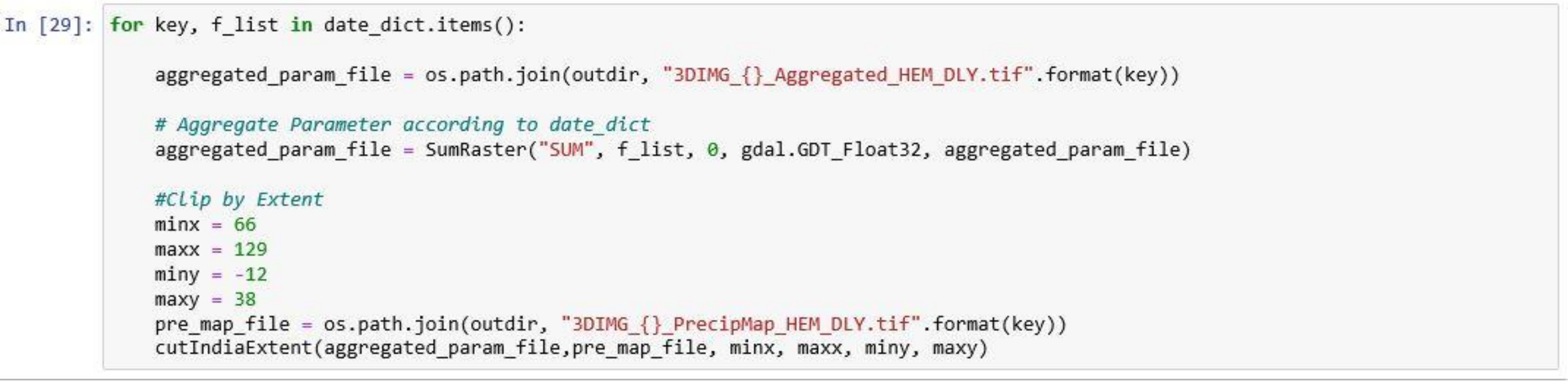
STEP-3.2: Function for clipping Integrated Precipitation Image by given extent



```
def cutIndiaExtent(srctiffile,desttiffile, minx, maxx, miny, maxy):
    translateOptions = gdal.TranslateOptions(projWin=[minx, maxy, maxx, miny], format='GTiff')
    gdal.Translate(desttiffile, srctiffile, options=translateOptions)
```

Processing Steps in Python

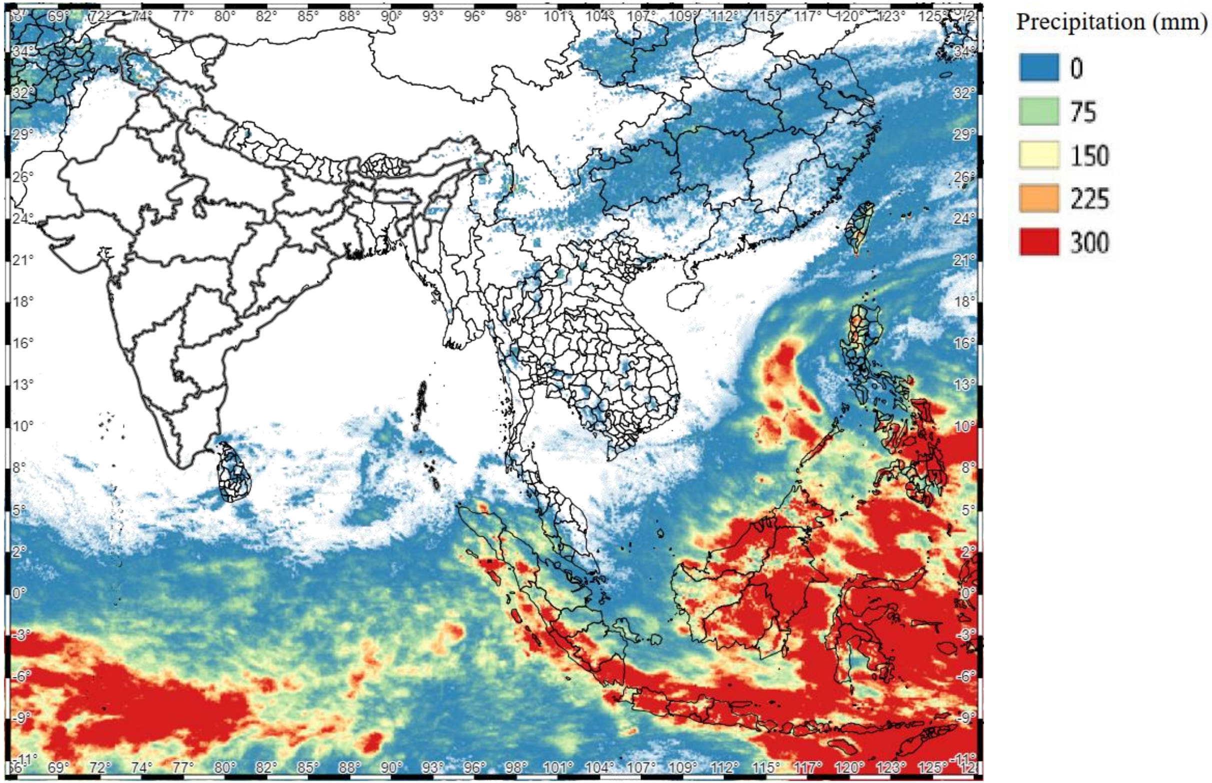
STEP-3: Code



```
In [29]: for key, f_list in date_dict.items():

             aggregated_param_file = os.path.join(outdir, "3DIMG_{}_Aggregated_HEM_DLY.tif".format(key))

             # Aggregate Parameter according to date_dict
             aggregated_param_file = SumRaster("SUM", f_list, 0, gdal.GDT_Float32, aggregated_param_file)

             #Clip by Extent
             minx = 66
             maxx = 129
             miny = -12
             maxy = 38
             pre_map_file = os.path.join(outdir, "3DIMG_{}_PrecipMap_HEM_DLY.tif".format(key))
             cutIndiaExtent(aggregated_param_file,pre_map_file, minx, maxx, miny, maxy)
```

Processing Steps in Python

STEP-3: Output (Visualization in AFSIS section of VEDAS Geoportal)


Precipitation (mm)
0
75
150
225
300
69° 72° 74° 77° 80° 82° 85° 88° 90° 93° 96° 98° 101° 104° 107° 109° 112° 115° 117° 120° 123° 125°
34° 32° 29° 26° 24° 21° 18° 16° 13° 10° 8° 5° 2° 0° -3° -6° -9° -11°