

Hands-on Training on Flood Analysis Using SAR Images

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1. Introduction

In this hands-on training session, we will learn the complete end-to-end workflow for processing Synthetic Aperture Radar (SAR) images and performing flood analysis. The objective of this training is to help participants understand practical SAR data preprocessing, change detection, classification, and final flood extent extraction using open-source tools.

As a case study, we will analyze a recent flood event over **Mozambique** using **Sentinel-1 SAR data** downloaded from the **Copernicus Data Space Ecosystem**.

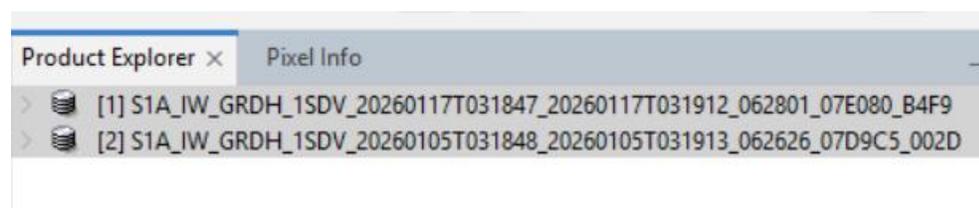
Dataset Used

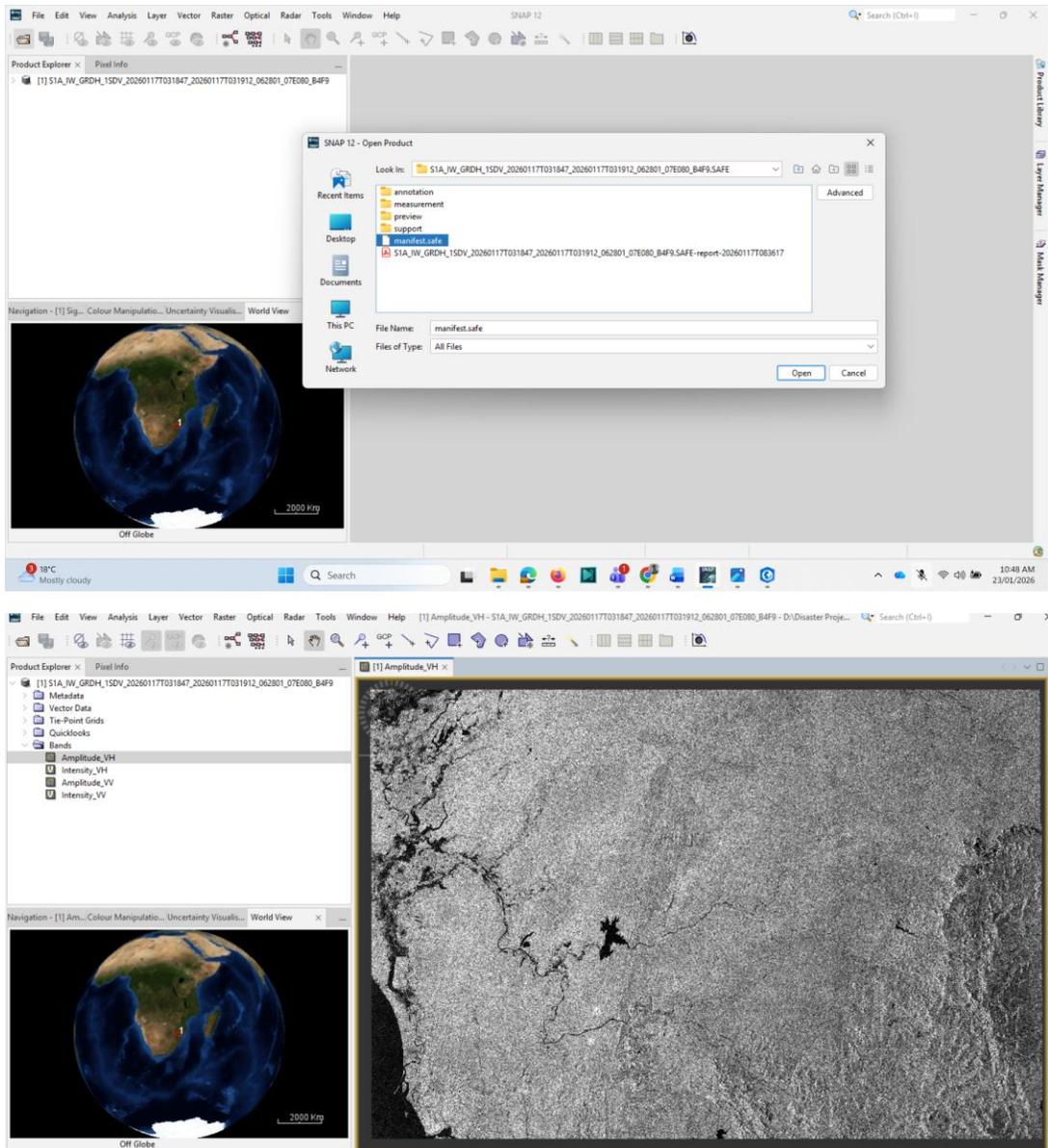
- **Pre-flood image:** 5 January 2026
 - **Post-flood image:** 17 January 2026
 - **Satellite:** Sentinel-1 (SAR)
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2. Opening SAR Data in SNAP

1. Open **SNAP** software.
2. Load the **pre-flood** and **post-flood** Sentinel-1 SAR images using the appropriate product files.
3. Once loaded, both images will appear in the **Product Explorer** window.

At this stage, ensure that both datasets are correctly displayed and ready for preprocessing.





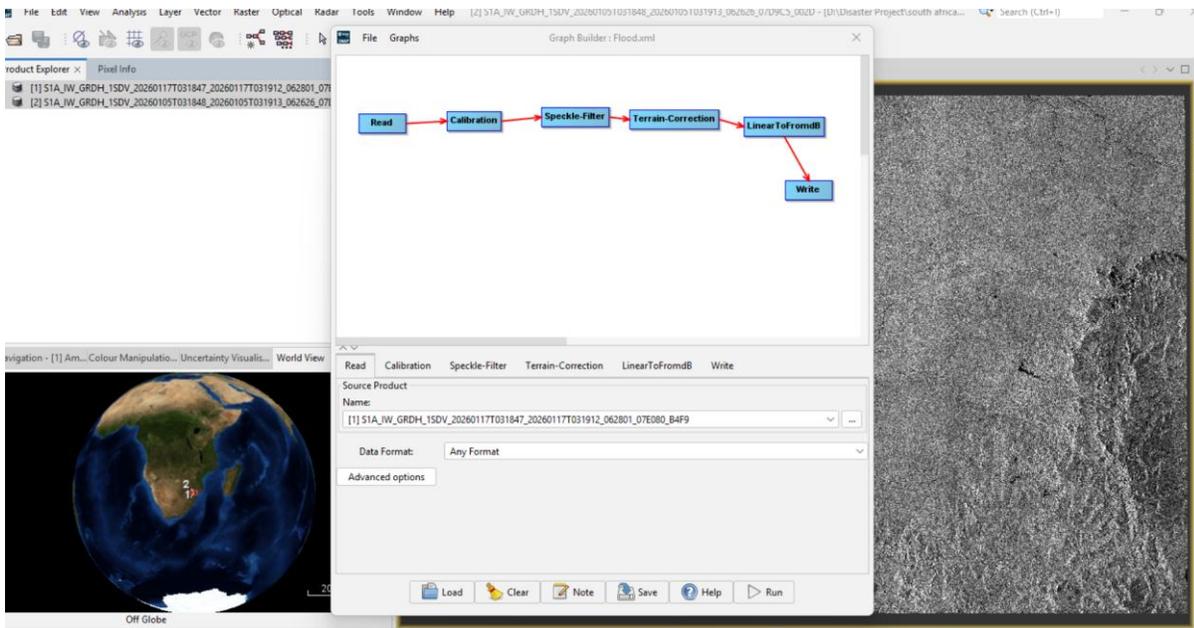
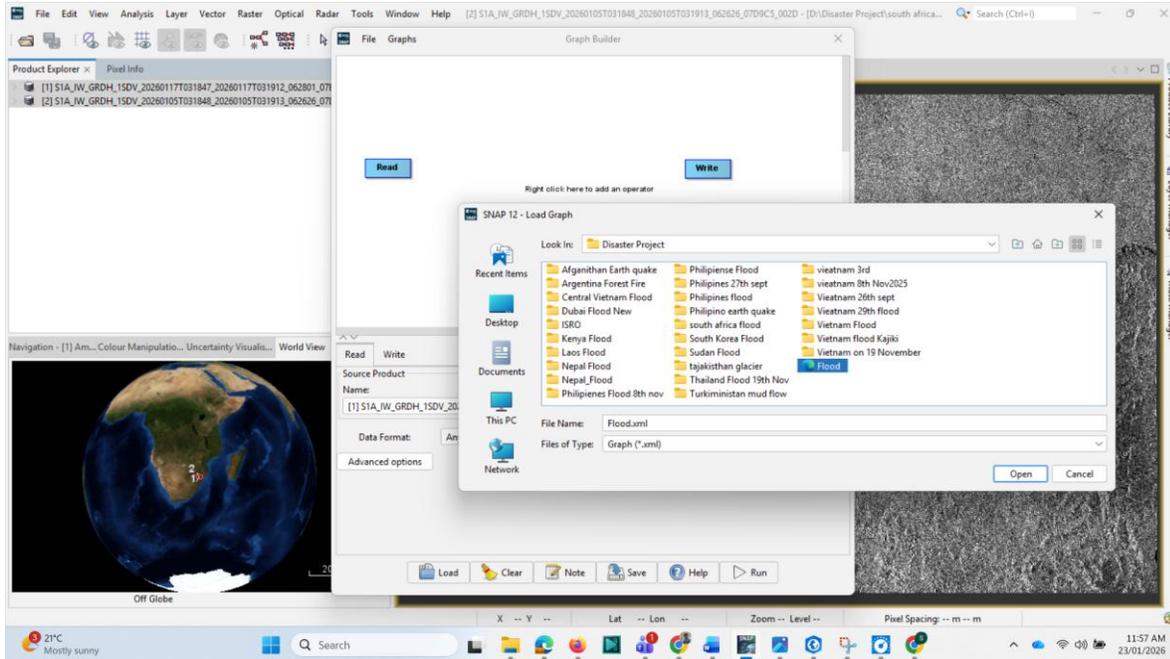
3. SAR Preprocessing Using Graph Builder

To preprocess the SAR images, a pre-built processing model named “**Flood**” has already been created.

Note: This model includes only SAR preprocessing steps and does not represent the complete flood analysis workflow.

Option 1: Running the Model Individually

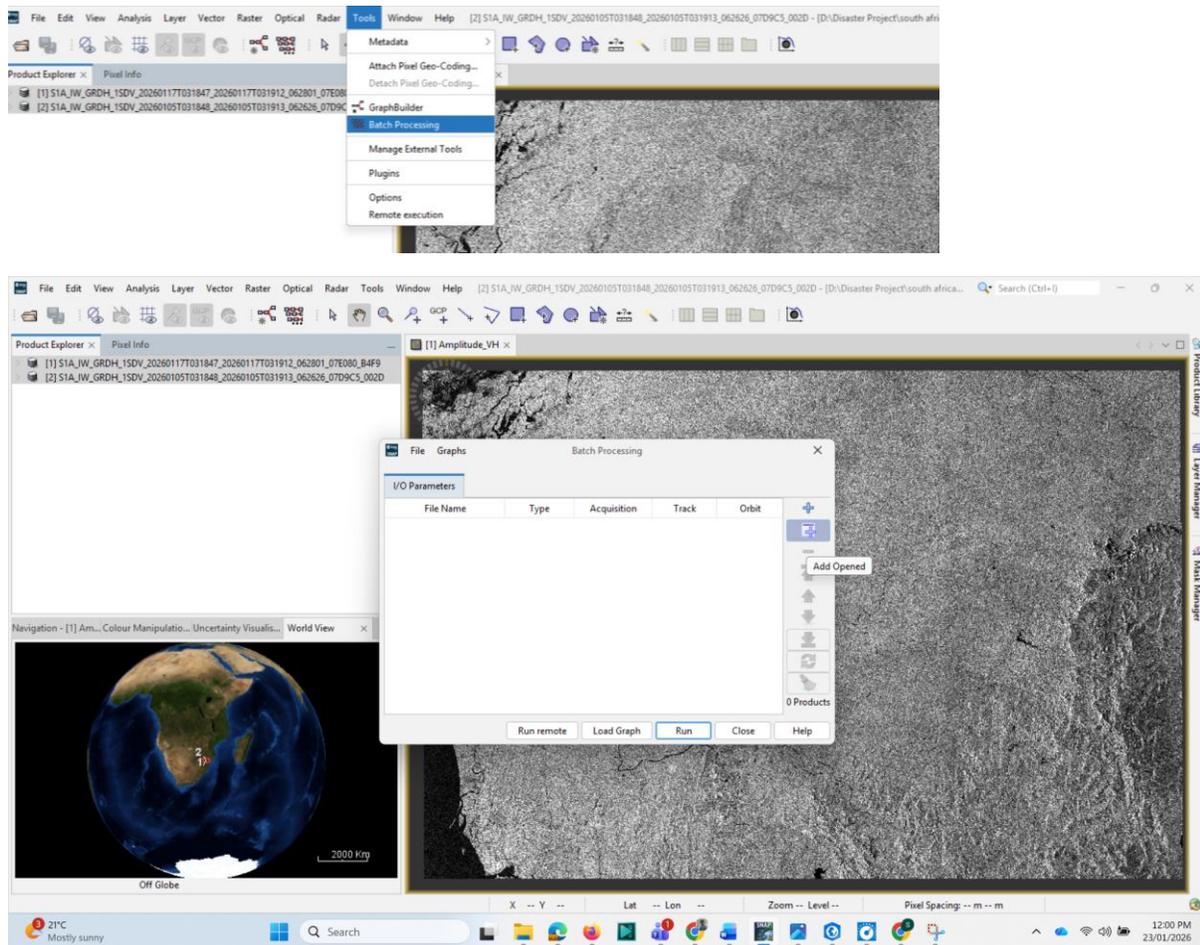
- Open **Tools** → **Graph Builder**.
- Load the **Flood** model.
- Run the model separately for the pre-flood and post-flood images.

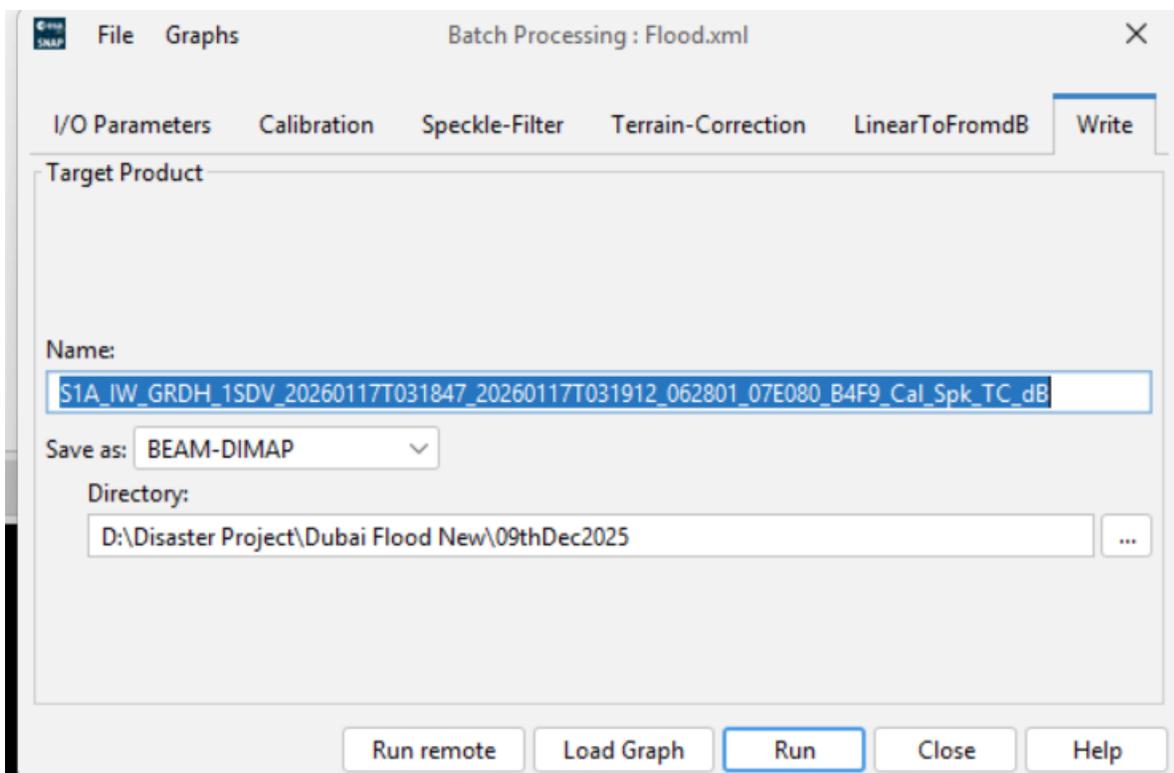
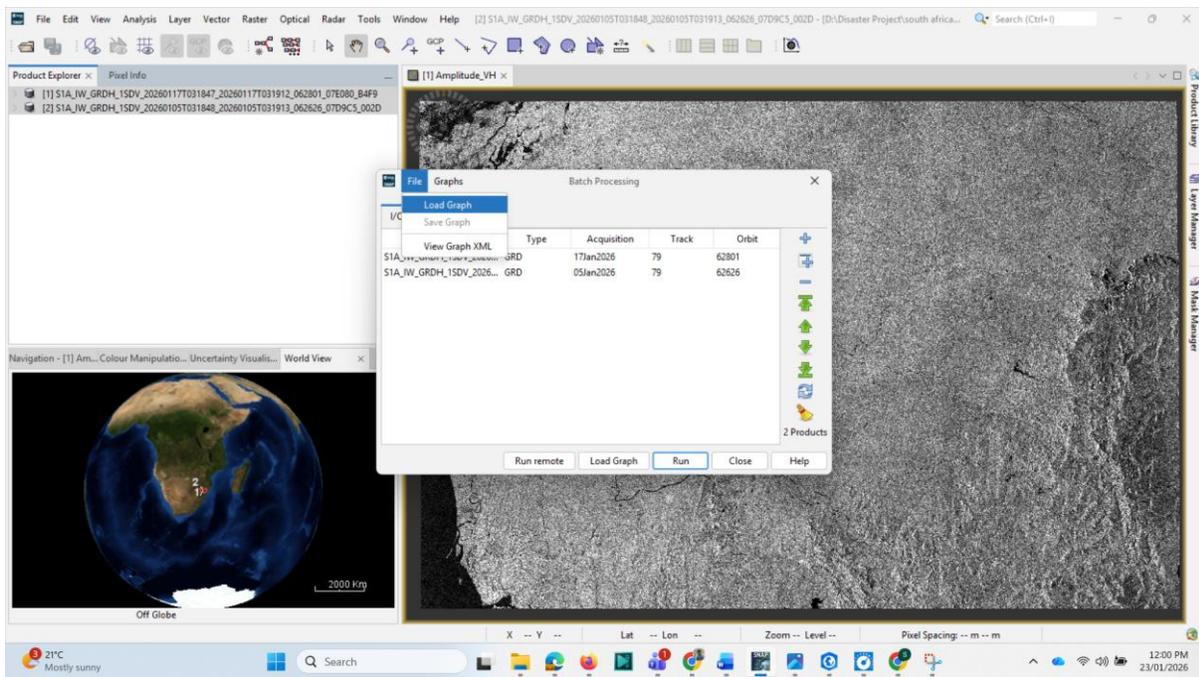


Option 2: Batch Processing (Recommended)

1. Open **Batch processing**.
2. Load the **Flood** model.
3. Select the or **Write** option in **Batch Processing**.
4. Specify the output folder where the processed images will be saved.
5. Click **Run** to start the preprocessing.

After completion, both pre-flood and post-flood processed images will be ready for further analysis.

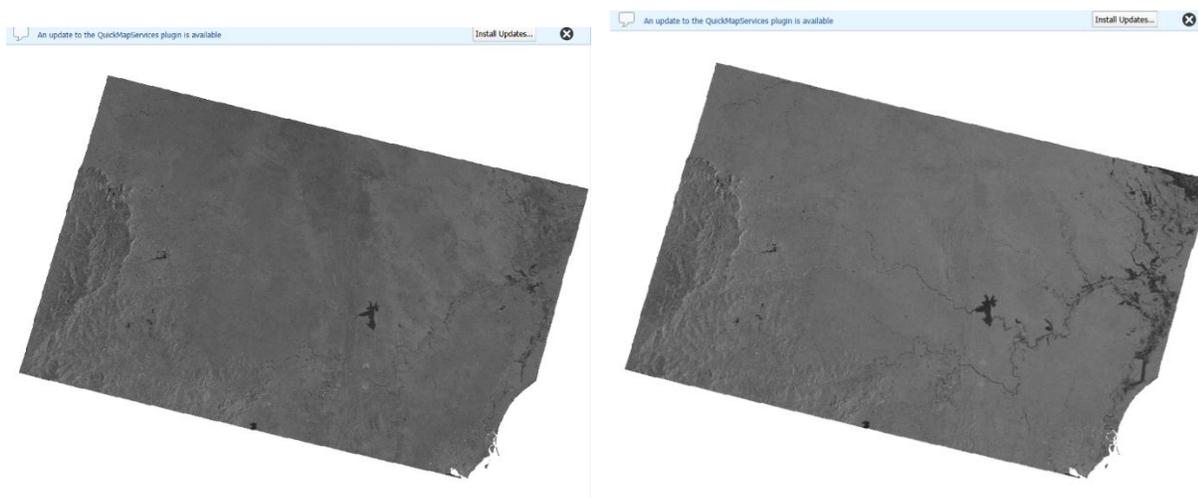
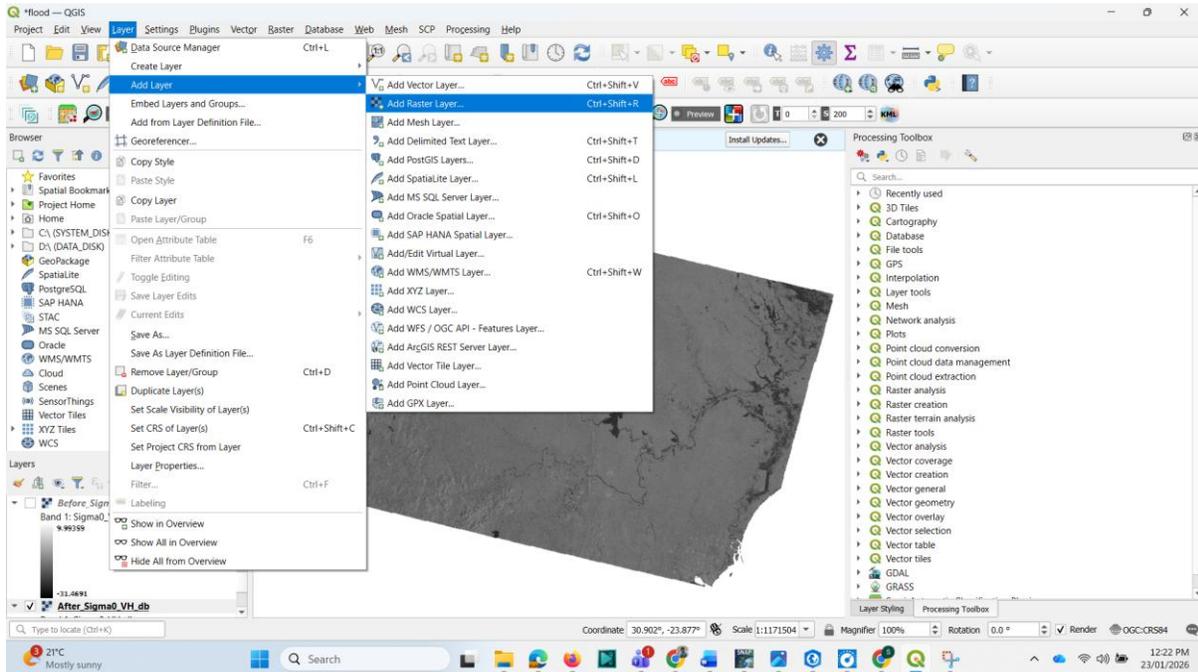




4. Loading Processed Images in QGIS

1. Open **QGIS** and create a new project.
2. Go to **Layer → Add Layer → Add Raster Layer**.
3. Add both the pre-flood and post-flood processed SAR images.

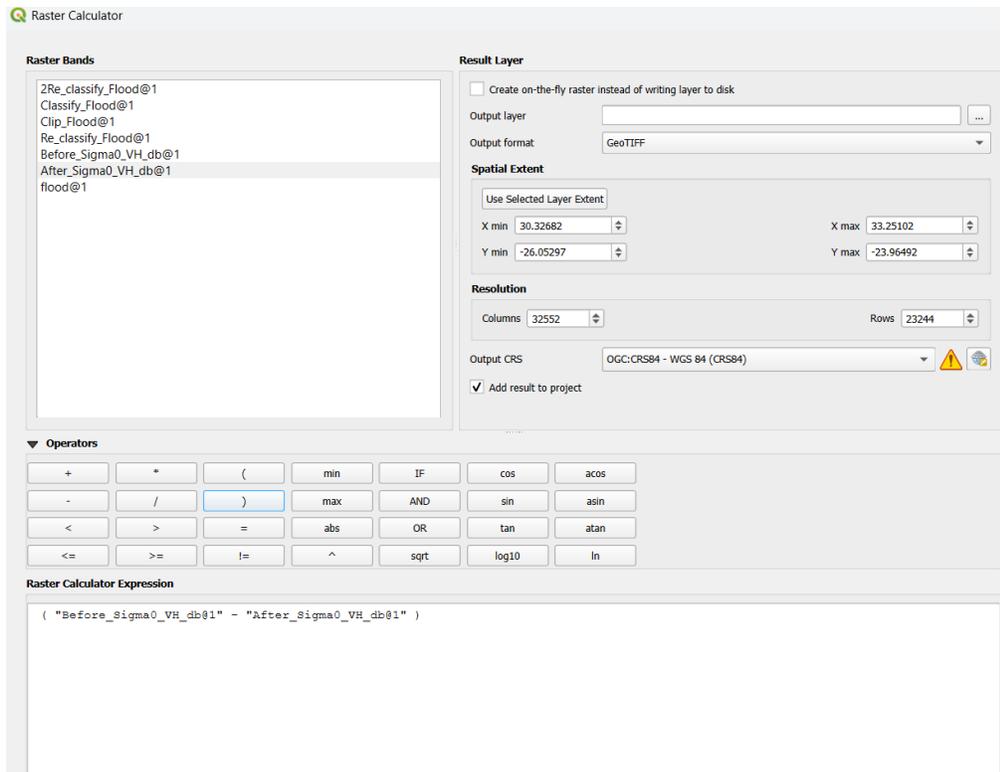
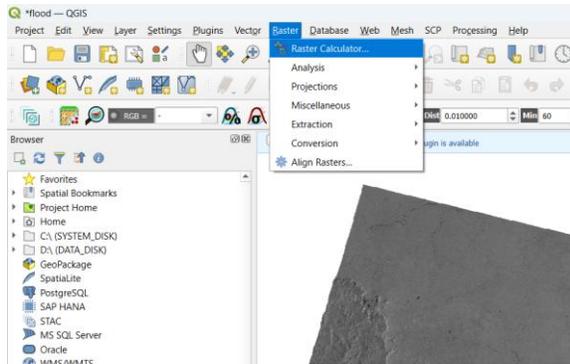
Ensure both raster layers are properly aligned and visible in the map canvas.

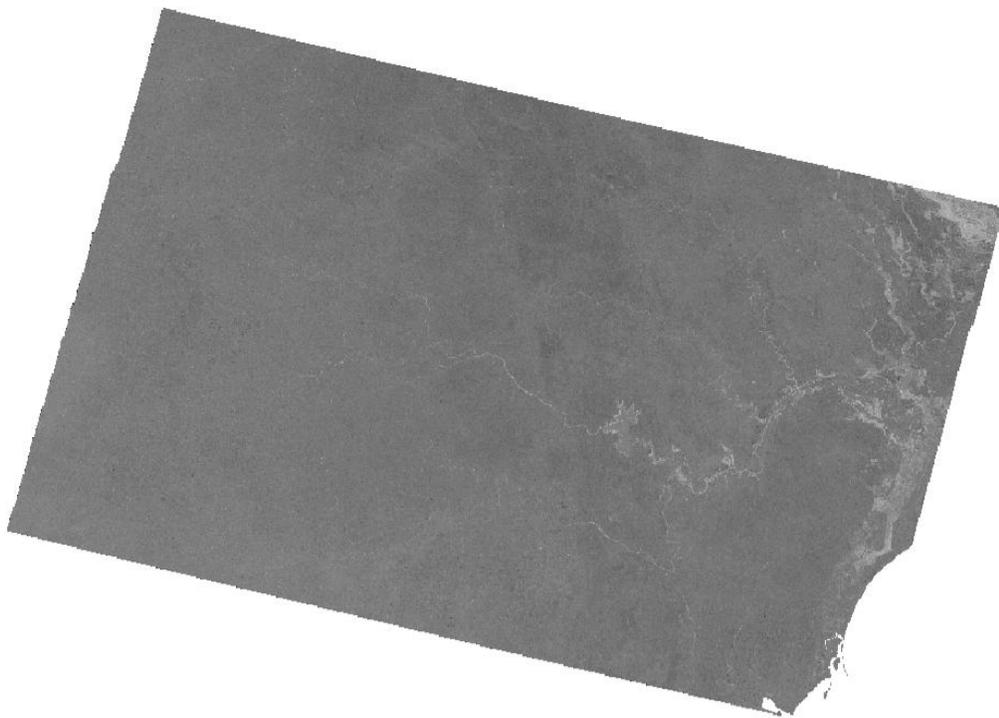


5. Flood Change Detection Using Raster Calculator

1. Open **Raster Calculator** in QGIS.
2. Subtract the **pre-flood image** from the **post-flood image**.

This operation generates a **change detection image**, where: - High pixel values (displayed in white) represent flooded areas.



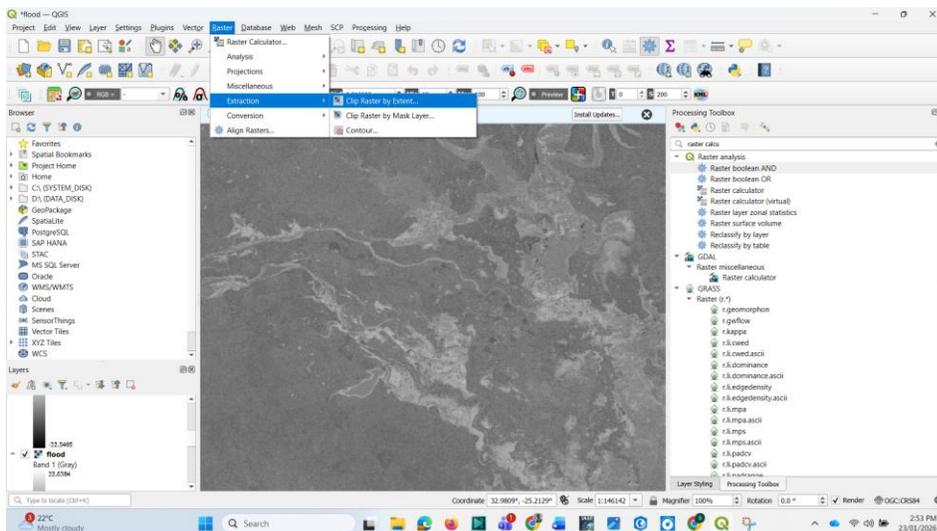


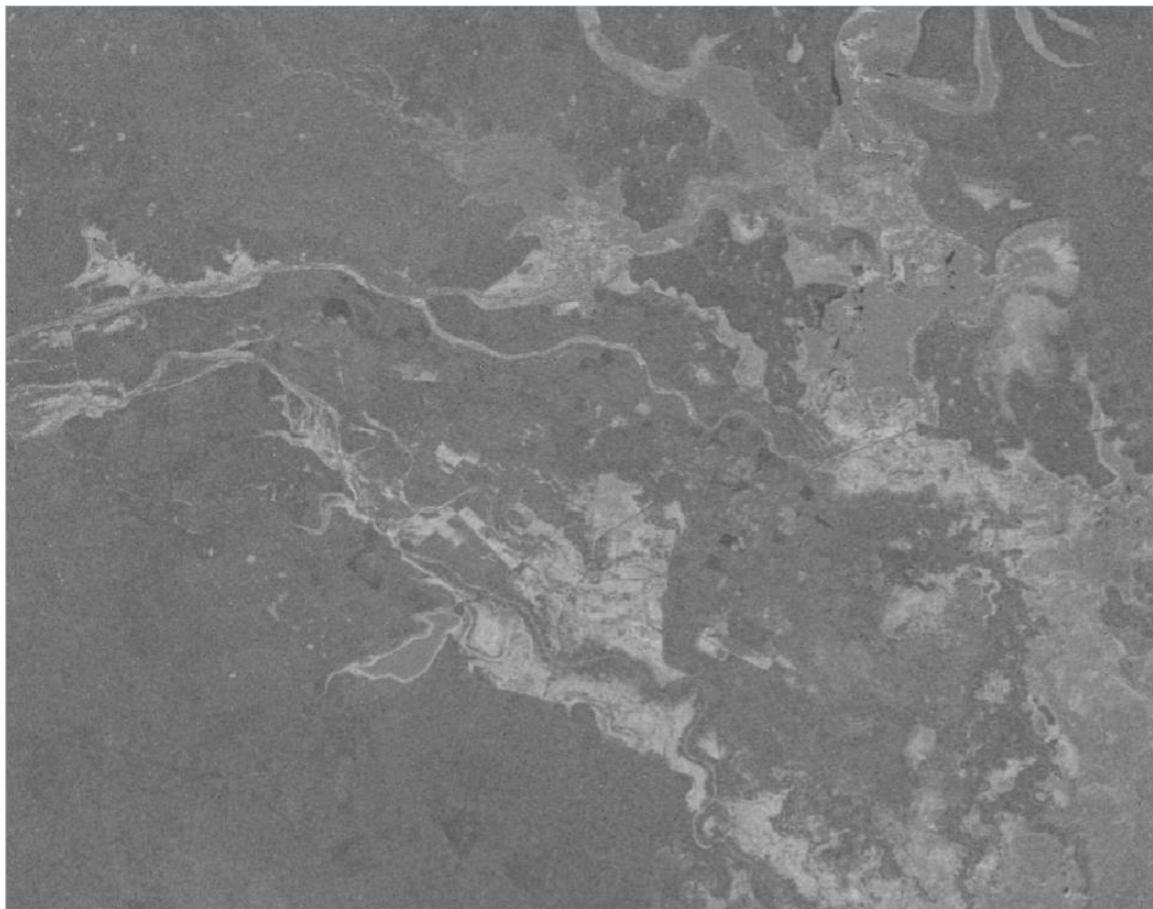
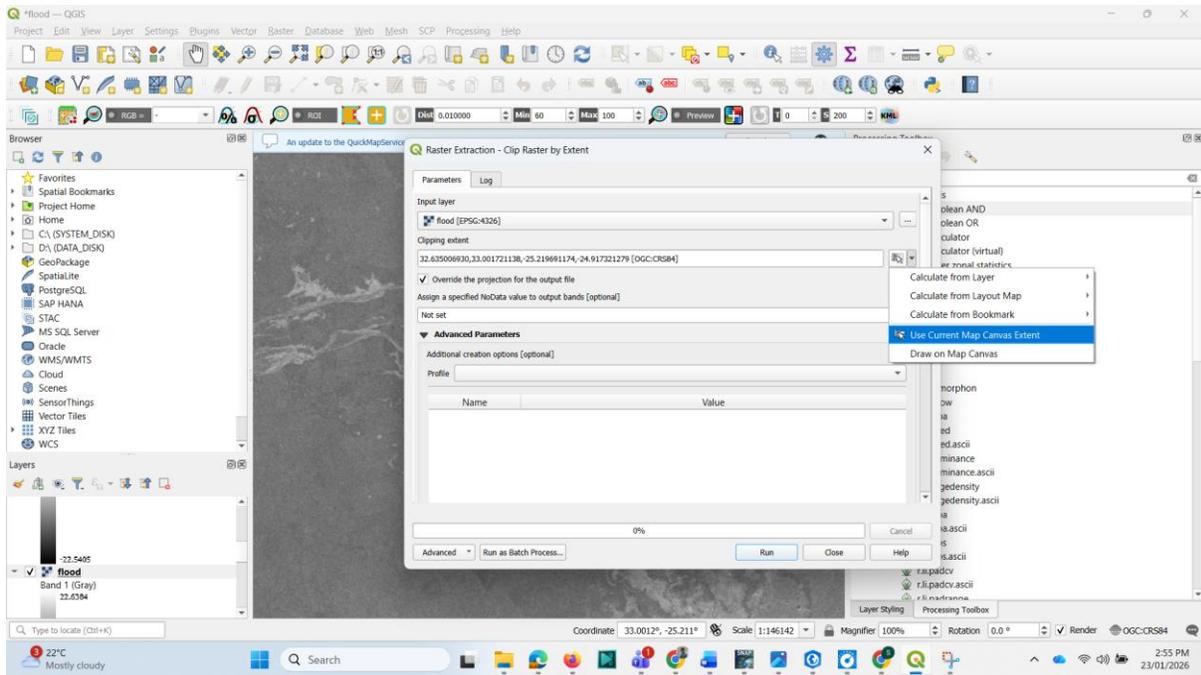
6. Clipping the Area of Interest

To simplify analysis and improve classification accuracy:

1. Identify an area where flood intensity is high.
2. Use the **Clip by Extent** tool to extract this region from the change detection image.

This clipped image will be used for further classification.



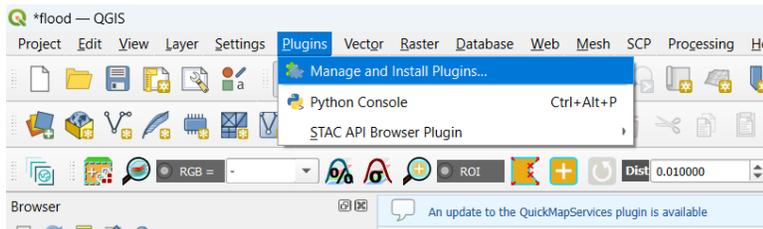


7. Classification Using SCP Plugin

In the next step, we perform clustering-based classification.

Prerequisite

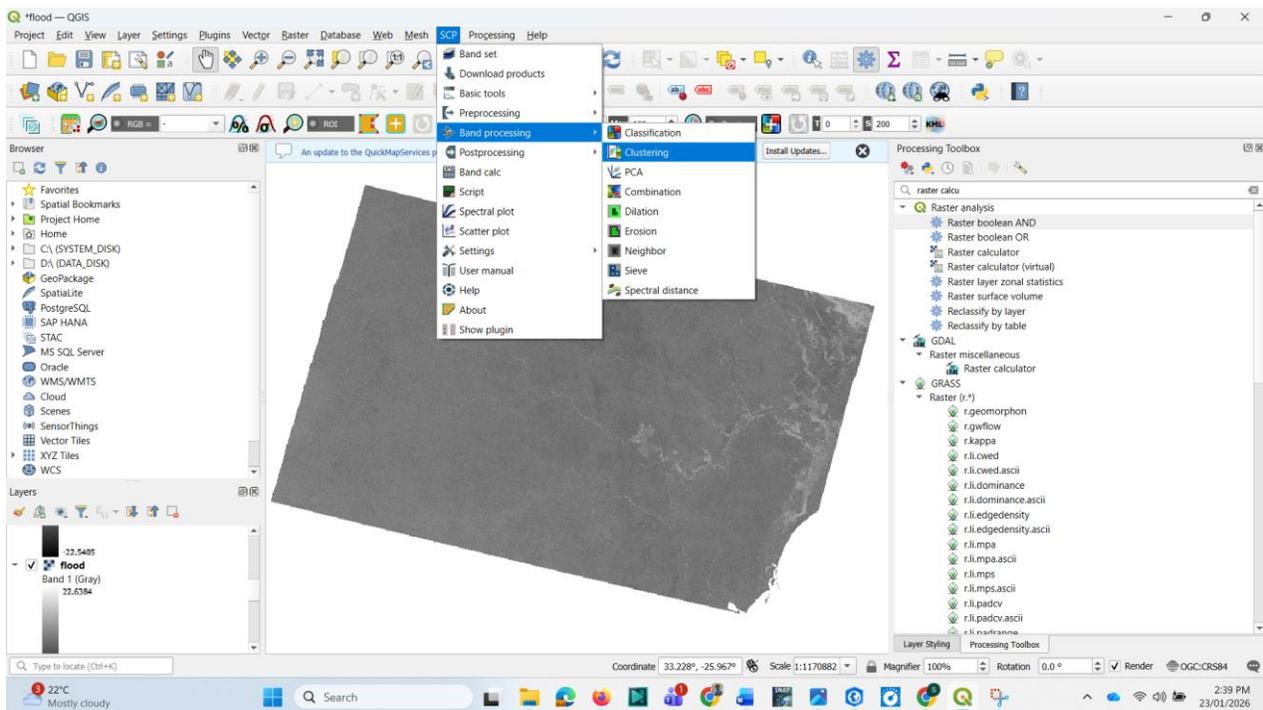
- Download and install the **Semi-Automatic Classification Plugin (SCP)** in QGIS.

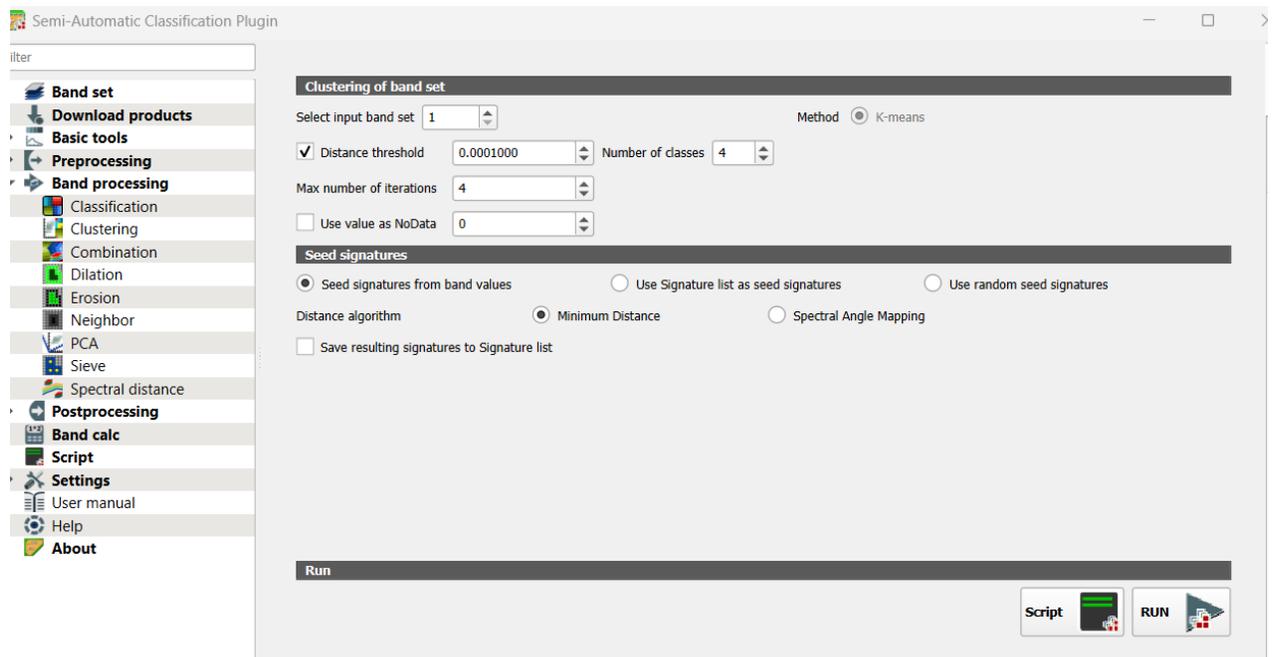
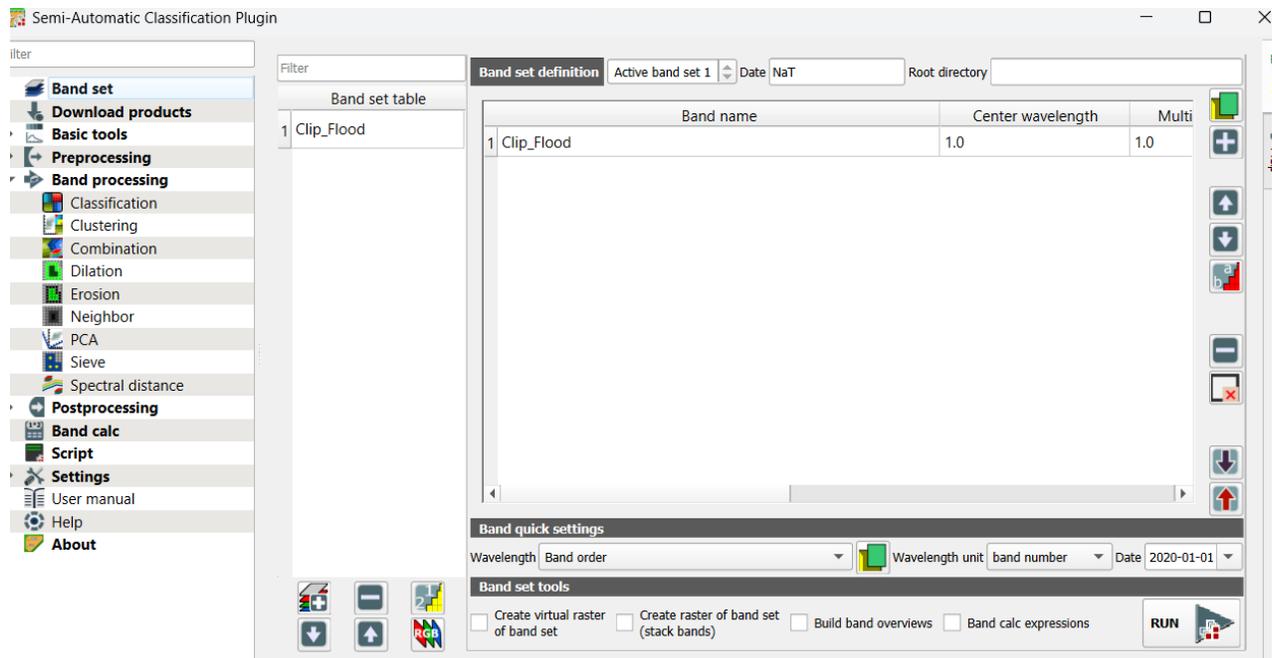


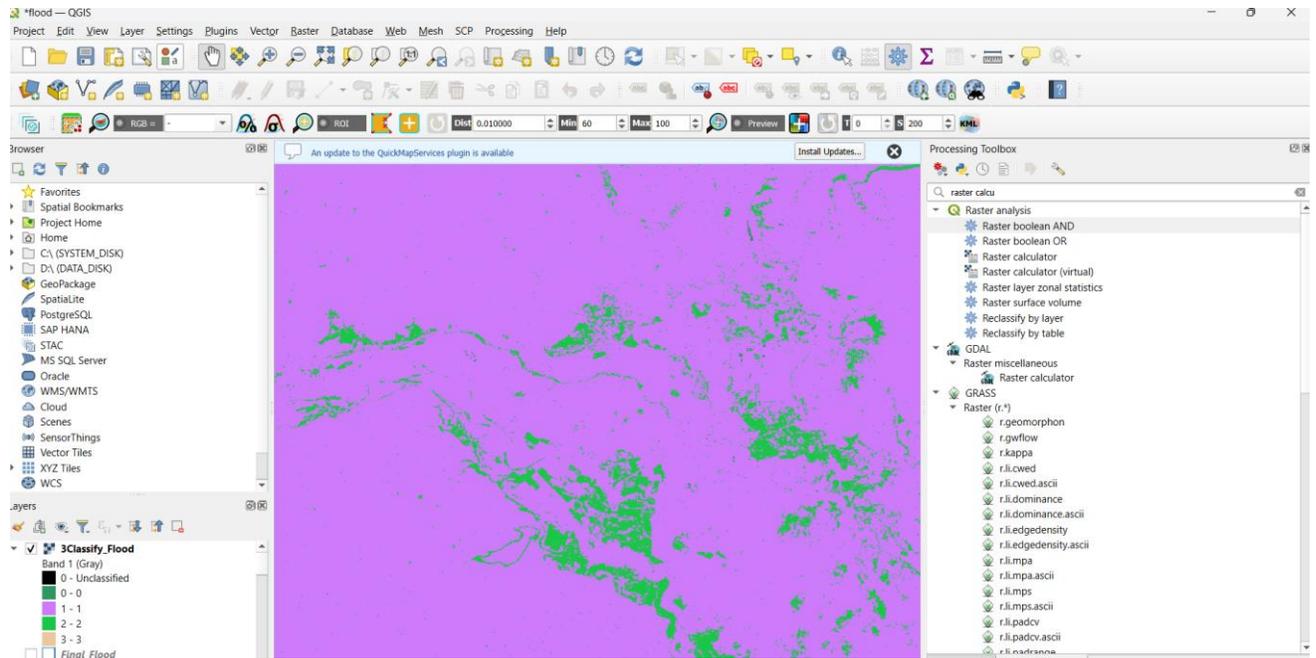
Classification Steps

1. Open the **SCP interface**.
2. In the **Band Set** tab, ensure the clipped flood image is selected.
3. Run the clustering classification process.

After execution, a classified raster image will be generated.







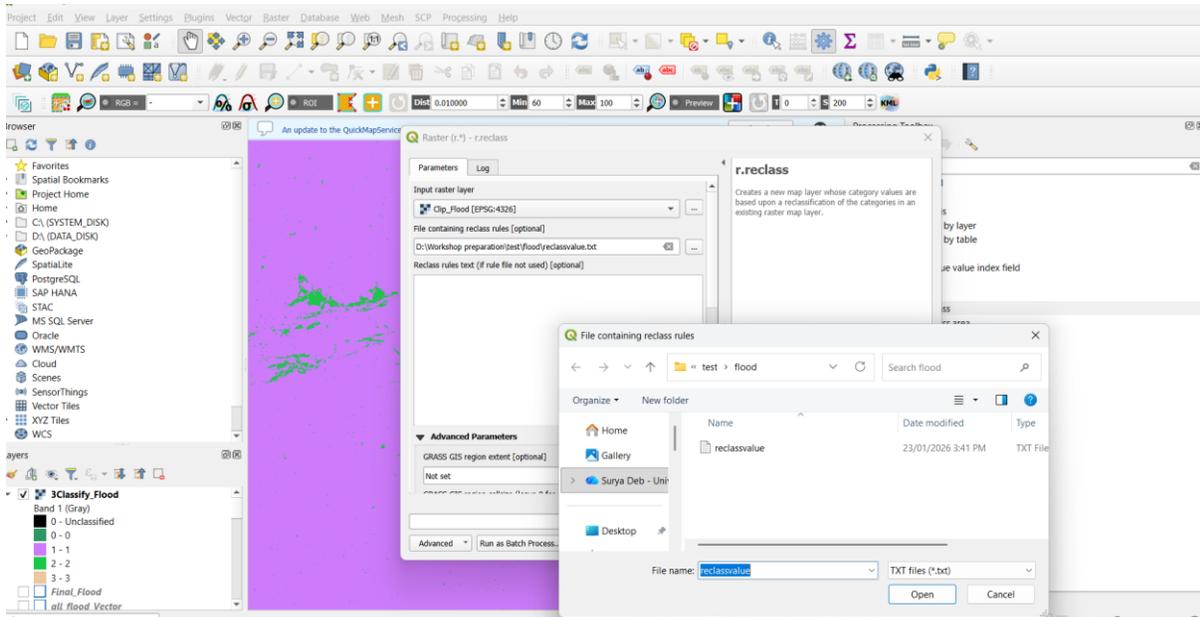
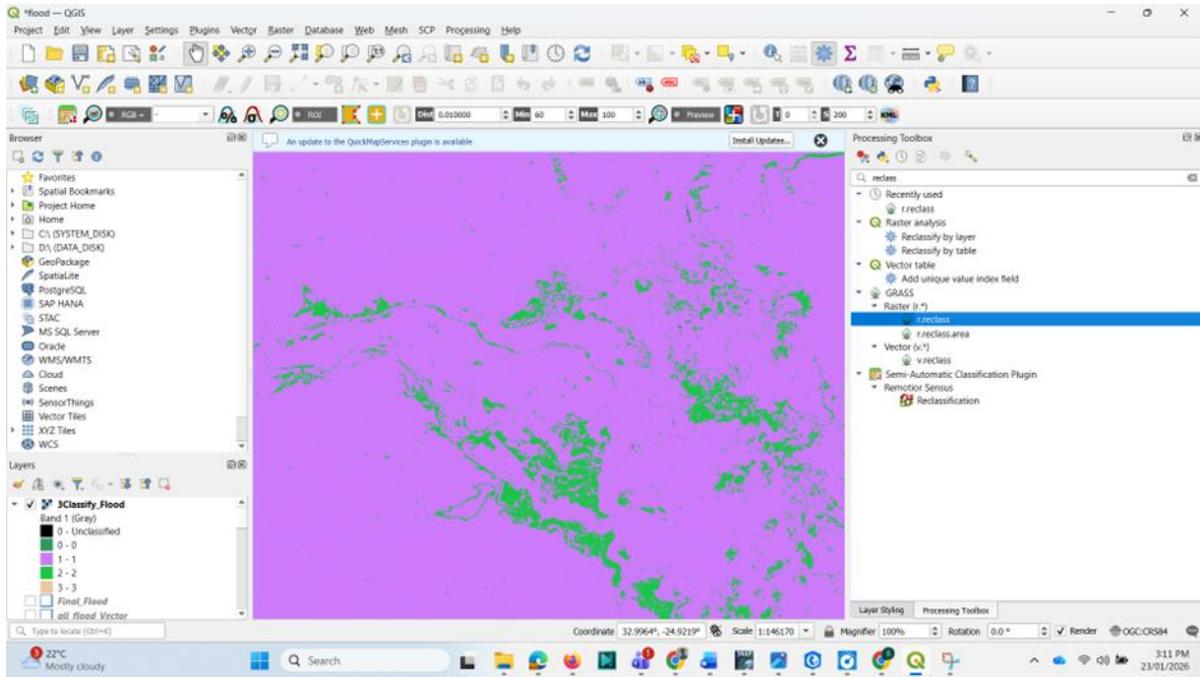
8. Reclassification into Water and Non-Water Classes

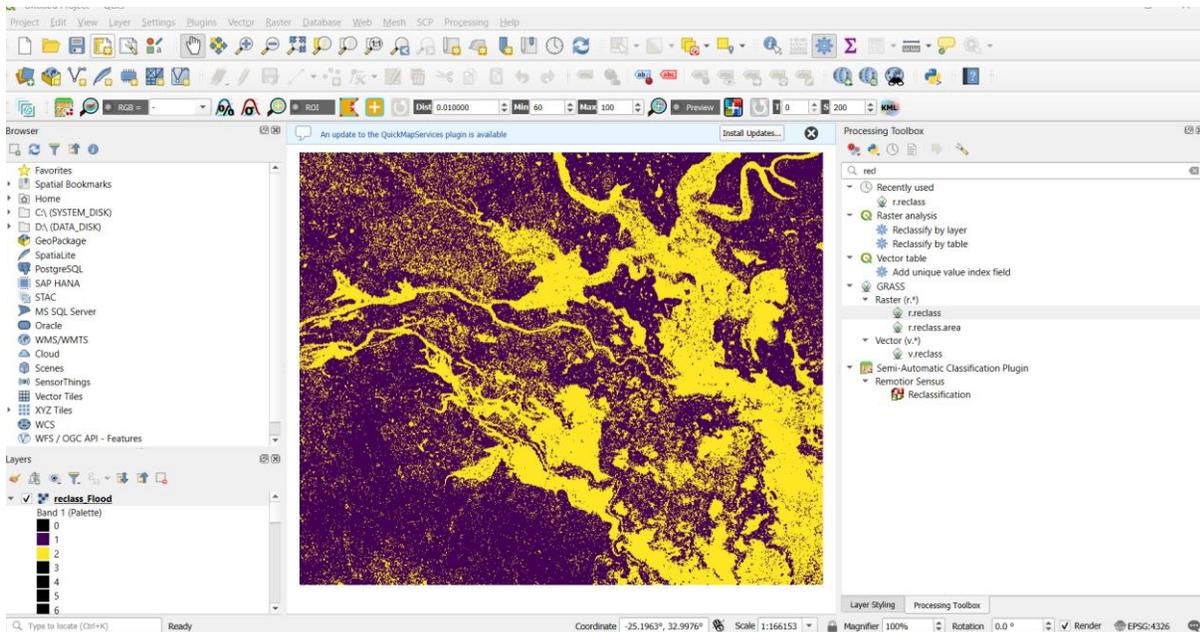
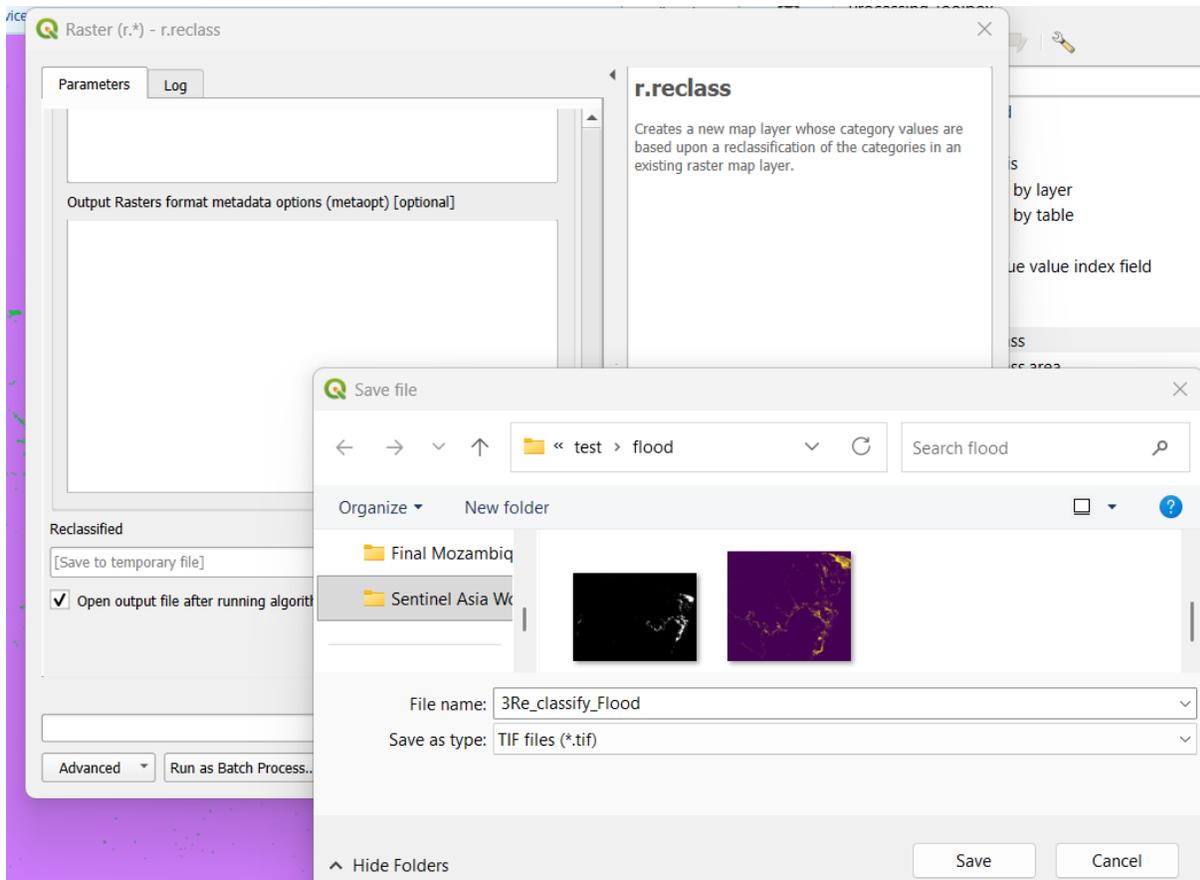
Now, the classified image will be simplified into two final classes.

1. Open the **Processing Toolbox**.
2. Search for the **Reclassify** tool.
3. Use a predefined reclassification table:
 - Original values **0 and 1** → **Class 1 (Non-water)**
 - Original values **2 and 3** → **Class 2 (Water)**

```
0 thru 1 = 1
2 thru 3 = 2
```

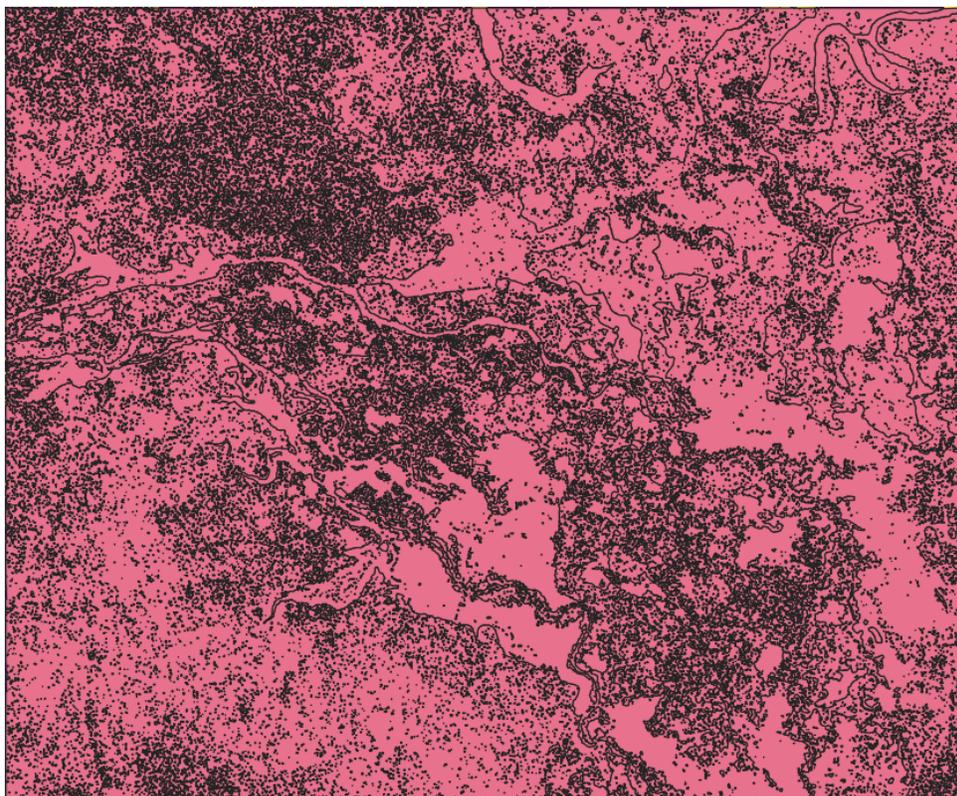
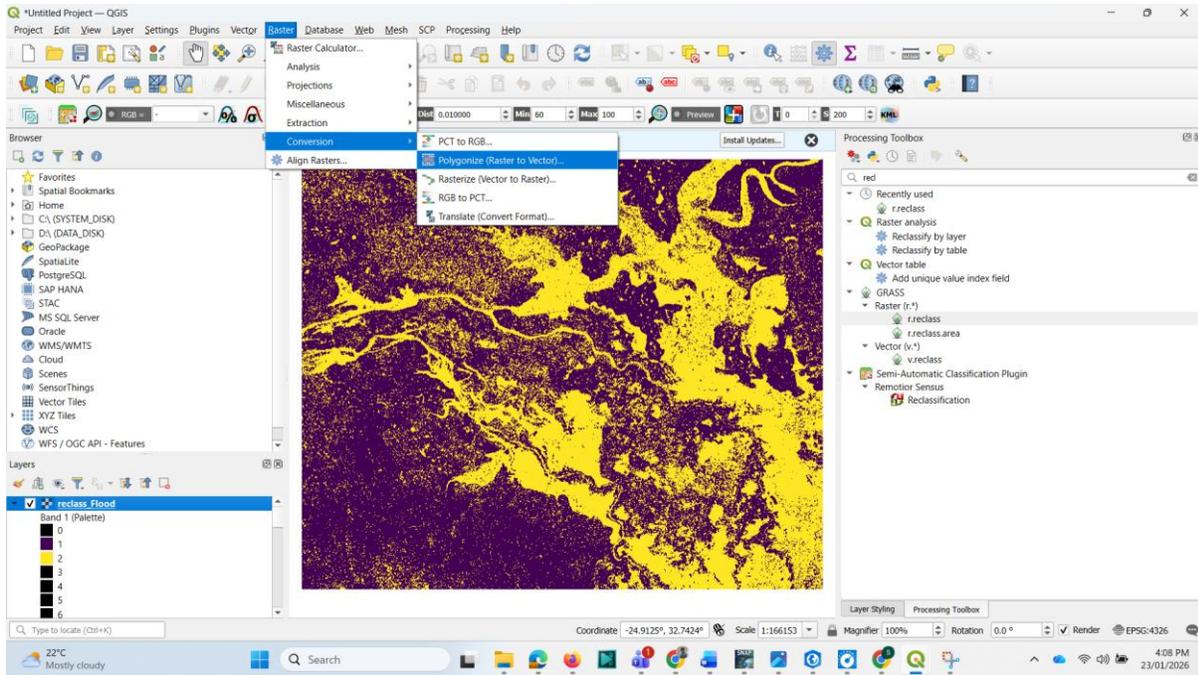
This step produces a clean raster with only **water** and **non-water** classes.





9. Raster to Vector Conversion

1. Convert the reclassified raster into a vector layer using the **Raster to Vector (Polygonize)** tool.
2. The resulting vector layer will contain polygons representing classified regions.



10. Selecting Flooded Areas

1. Open the **attribute table** of the vector layer.
2. Run a query to select features with **value = 2**, which represents **water (flooded) areas**.
3. Export the selected features as a new vector layer.

The screenshot displays the QGIS desktop environment. The main window shows a map with a vector layer named 'All_water' selected. The attribute table for this layer is open, showing a column 'DN' with values ranging from 1 to 13. The 'DN' column is highlighted in blue, indicating that features with a value of 2 are selected. The 'Processing Toolbox' is visible on the right side of the interface. The 'Layers' panel on the left shows the 'All_water' layer selected, and the 'Export' menu is open, with 'Save Selected Features As...' highlighted. The map view shows a satellite-style image with a yellow and red overlay representing the selected flooded areas.

Browser

- Home
- C:\ (SYSTEM_DISK)
- D:\ (DATA_DISK)
- GeoPackage
- Spatialite
- PostgreSQL
- SAP HANA
- STAC
- MS SQL Server
- Oracle
- WMS/WMTS
- Cloud
- Scenes
- SensorThings
- XYZ Tiles
- WCS
- WFS / OGC API - Features

Layers

- All_water
- reclass_Flood

Attribute Table

DN	Value
1	1
2	2
3	2
4	2
5	2
6	2
7	2
8	1
9	2
10	2
11	2
12	2
13	2

Processing Toolbox

- Recently used
- r_reclass
- Raster analysis
- Reclassify by layer
- Vector table
- Add unique value index field
- GRASS
- Raster (r*)
- r_reclass
- r_reclass_area
- Vector (v*)
- v_reclass
- Semi-Automatic Classification Plugin
- Remotion Sensus
- Reclassification

Export

- Save Features As...
- Save Selected Features As...
- Save as Layer Definition File...
- Save as QGIS Layer Style File...

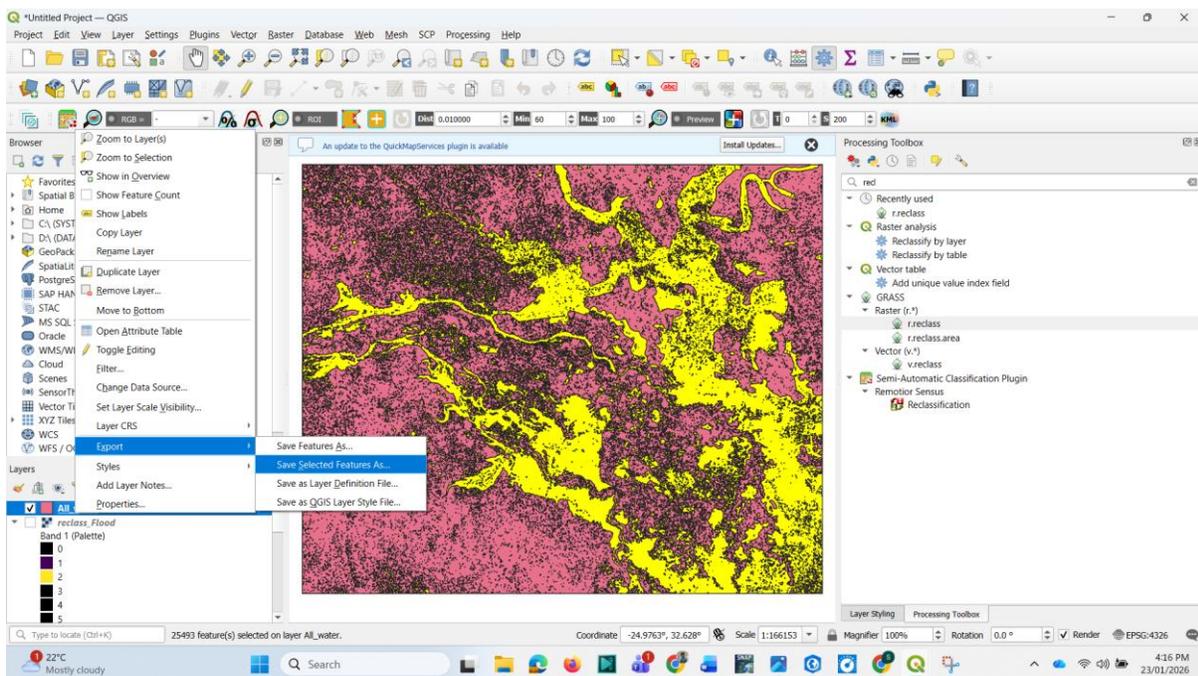
Coordinate: -24.9763°, 32.628° Scale: 1:166153 Magnifier: 100% Rotation: 0.0° Render: EPSG:4326

11. Cleaning and Finalizing Flood Polygons

The extracted flooded layer may still contain small, irrelevant polygons.

1. Use reference data and visual inspection.
2. Apply the **Manual Selection** tool to select only large, meaningful flood polygons.
3. Save the selected features as a new layer.

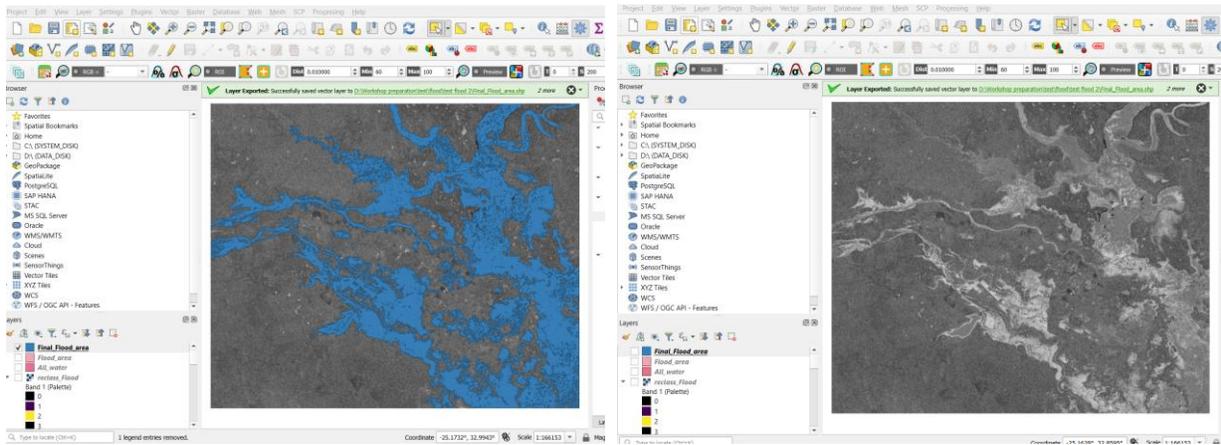
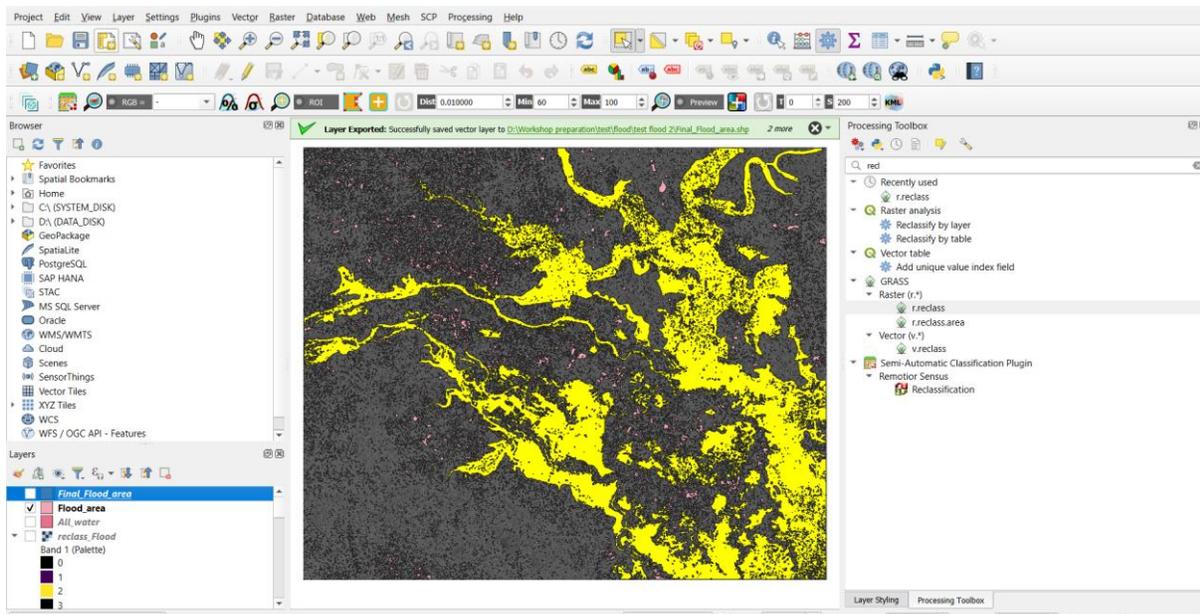
This final layer represents the **accurate flooded area**.



12. Final Output

The **final flooded area map** is now ready for visualization, analysis, and reporting.

This workflow demonstrates a complete, practical approach to flood mapping using SAR data and open-source geospatial tools.



End of Training Document