

SARPOLTOOL

USER MANUAL & INSTALLATION GUIDE

MPSDD/MDPG/DPA/NRSC

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Introduction

SARPOLTOOL v3.0 is a comprehensive plugin for QGIS that enables advanced Synthetic Aperture Radar (SAR) and polarimetric SAR (PolSAR) data processing and analysis. Designed with researchers, analysts, and operational users in mind, SARPOLTOOL offers a streamlined interface for handling both full-polarimetric and hybrid-polarimetric SAR datasets, including emerging formats such as those from the NISAR mission. The plugin supports key functionalities such as radiometric calibration, coherency and covariance matrix generation, speckle filtering, polarimetric decomposition, and thematic product generation, making it a valuable tool for applications in agriculture, forestry, urban mapping, water resource monitoring, and disaster response.

This manual provides detailed installation instructions, followed by a step-by-step user guide covering all major features of SARPOLTOOL v3.0. It is intended for users with a basic understanding of SAR data and QGIS workflows. The installation section guides users through setting up the required dependencies and plugin files within the QGIS environment, ensuring that SARPOLTOOL functions smoothly across platforms. The user manual portion explains the functionality of each module with practical descriptions, interface screenshots, and input/output expectations to help users fully leverage the tool's capabilities.

With SARPOLTOOL v3.0, users can perform both scientific-grade polarimetric analysis and thematic product generation from within the familiar and extensible QGIS platform. The plugin is actively maintained and continues to evolve to support the latest SAR missions, including those using compact-pol formats. Whether you're a remote sensing expert or a new SAR user, this manual will help you quickly get started and make the most of what SARPOLTOOL has to offer.

Installation Guide

Introduction

In this section, the basic steps required for installing SARPOLTOOL are highlighted. The section is divided into pre-requisites for installation and the final Installation of SARPOLTOOL plugin (which is delivered as a zip) in QGIS.

Parameter	Required	Recommended
Operating System	Windows 7	Windows 10 & Above
QGIS	v3.0 & Above	v3.24 & Above
python3-h5py	v3.8.0	v3.10.0
dask	Compatible with QGIS	Compatible with QGIS
spectral	Compatible with QGIS	Compatible with QGIS
tqdm	Compatible with QGIS	Compatible with QGIS
xmltodict	Compatible with QGIS	Compatible with QGIS

Prerequisites

QGIS Installation

QGIS (Quantum Geographic Information System) is a free and open-source Geographic Information System that enables users to create, edit, visualize, analyze, and publish geospatial information across a wide range of formats. It supports both raster and vector data and offers a user-friendly interface, powerful plugins, and advanced tools for mapping and spatial analysis. QGIS is a versatile platform that integrates well with various geospatial data sources and processing libraries.

The current version is QGIS 3.42.1 'Münster' and was released on 2025-03-21. The long-term builds currently provide 3.40.5 'Bratislava'. Long Term Release (LTR) builds are intended for those who value stability over having the latest features. SARPOLTOOL is only supported on Windows Platform on QGIS. Please visit <https://qgis.org/download/> to continue with installation of QGIS on windows platform.

H5PY Installation

To enable support for HDF5 file formats used in NISAR Data Products within QGIS, it is necessary to install the `python-h5py` package using the OSGEO4W Network Installer. This package provides the required interface to work with HDF5 datasets, which are the standard format for storing and distributing NISAR mission outputs. The latest release now includes enhanced support for NISAR Data Products through direct

integration with HDF5 structures. Ensuring that `python-h5py` is properly installed guarantees full compatibility and functionality when working with these advanced remote sensing datasets in QGIS.

Steps for Installation

1. Open **OSGeo4W Setup** from Start Menu (it comes installed along with QGIS installation using OSGeo4W installer).
2. Select **Advanced Install** option from the options and click **Next**.
3. **Left click** on "**Next**" after selection of appropriate installation directory. It is recommended that the same be kept the default location.

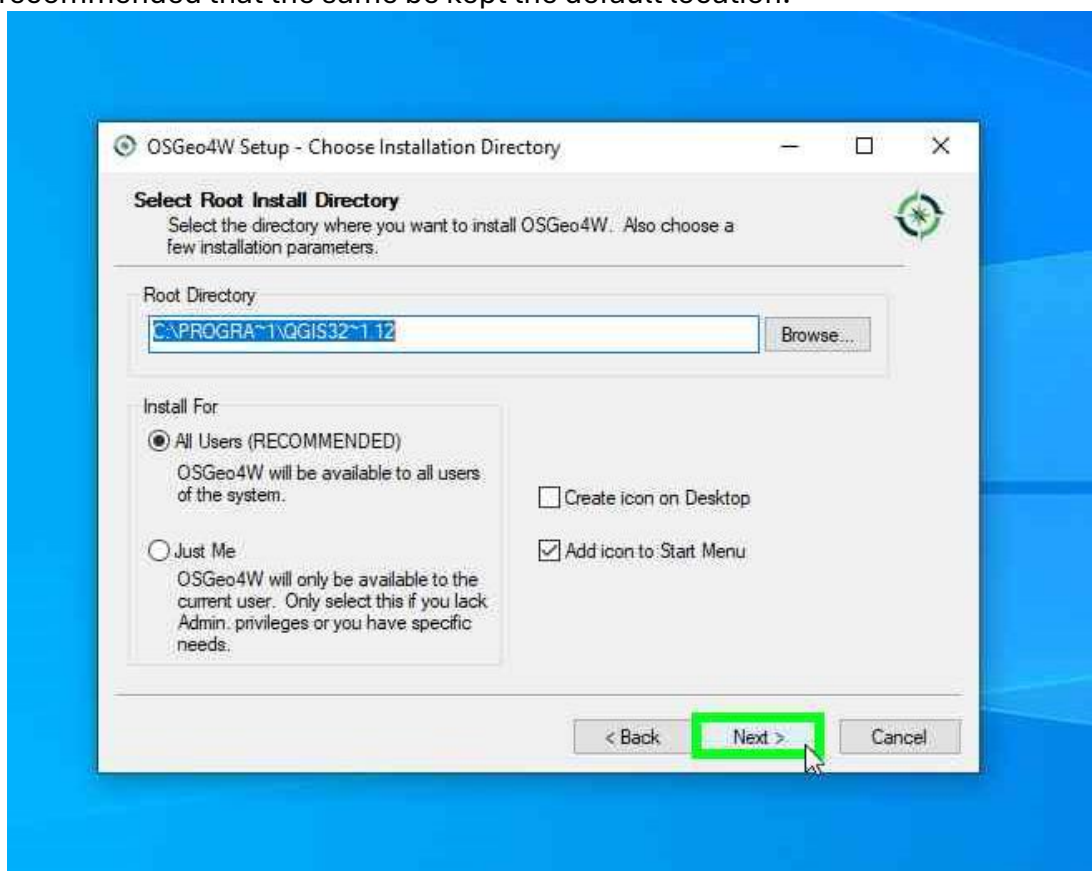


Figure 1: Denoting the directory selecting where the installation will take place

4. **Left click** on **"Next"** after selecting appropriate directory where the local h5py library will be installed. It is recommended that the same can be kept as the default location.

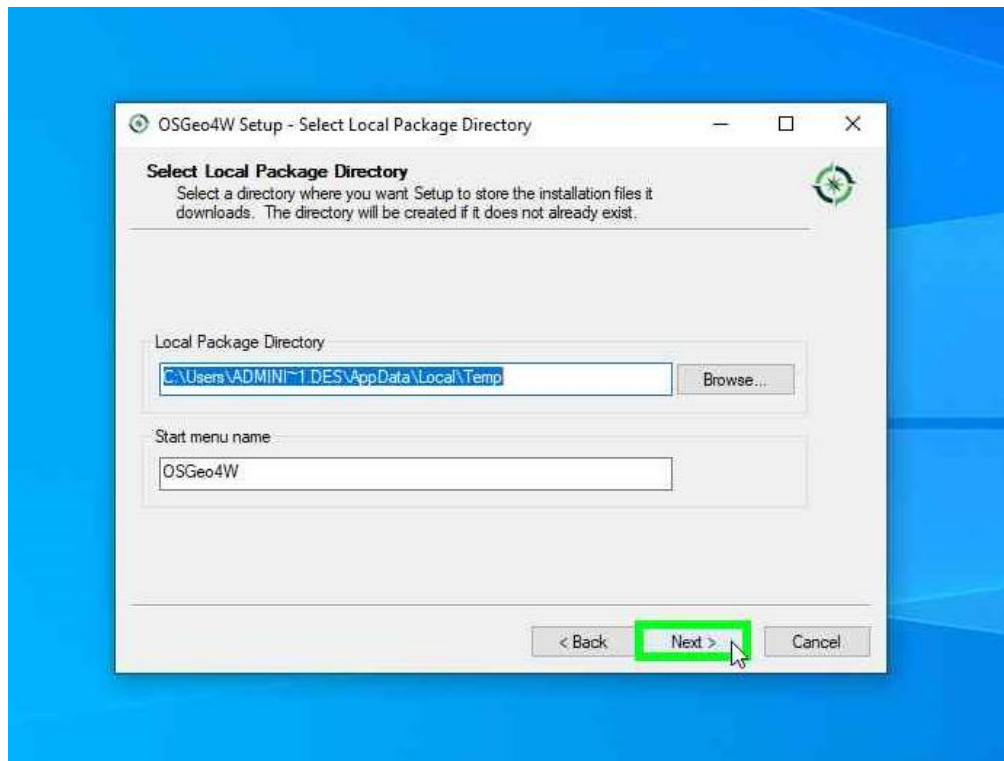


Figure 2: Selection of Local Package Directory

5. **Left click** on **"Next"** after selecting the required setting for connecting to Internet. It is important to make the right selection. If you are working behind proxy you can select the **"Use HTTP/FTP Proxy:"**, if not you can skip the next step as well and select **"Direct Connection"** or **"Use System Proxy Settings"**.

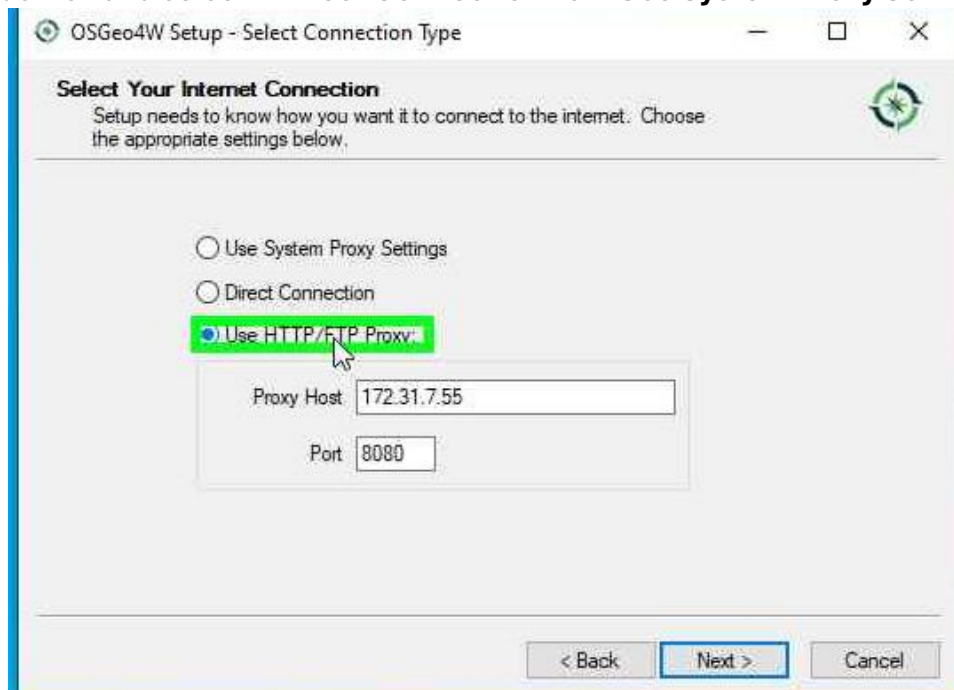


Figure 3: Selection of proper option to connect to the Internet for downloading the packages

6. If you have selected “Use HTTP/FTP Proxy” kindly fill the **appropriate Proxy Details**. You can contact your local system Administrator in case you are unaware of the details. Click **Next**.

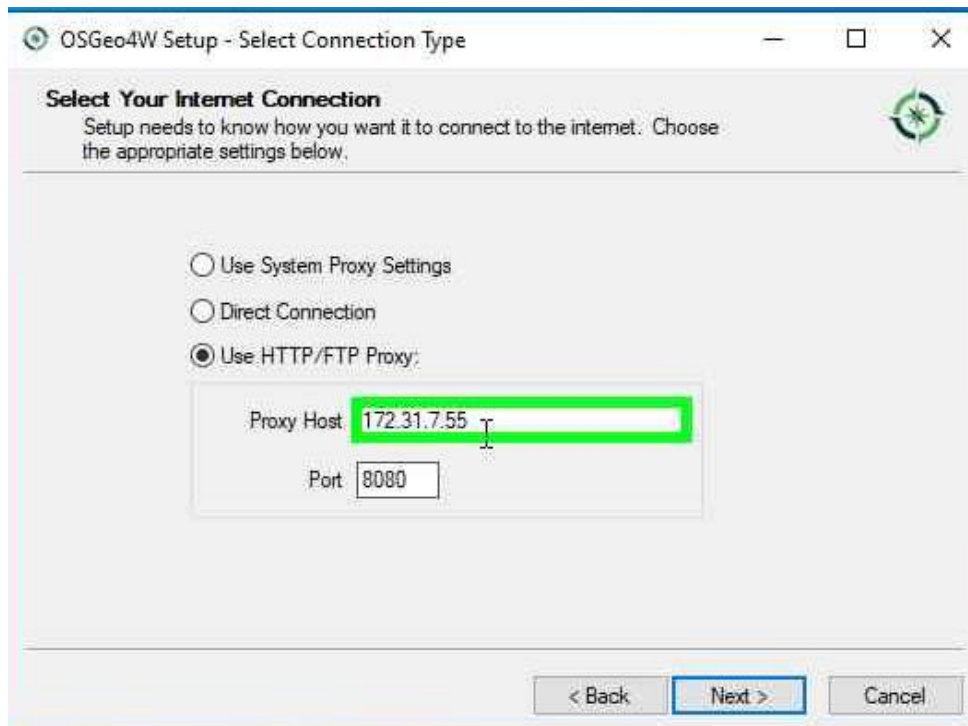


Figure 4: Filling up of appropriate proxy details for connecting to package repository.

7. Fill required **Proxy Authentication** Details for allowing the Installer to connect via the proxy. Click **OK**

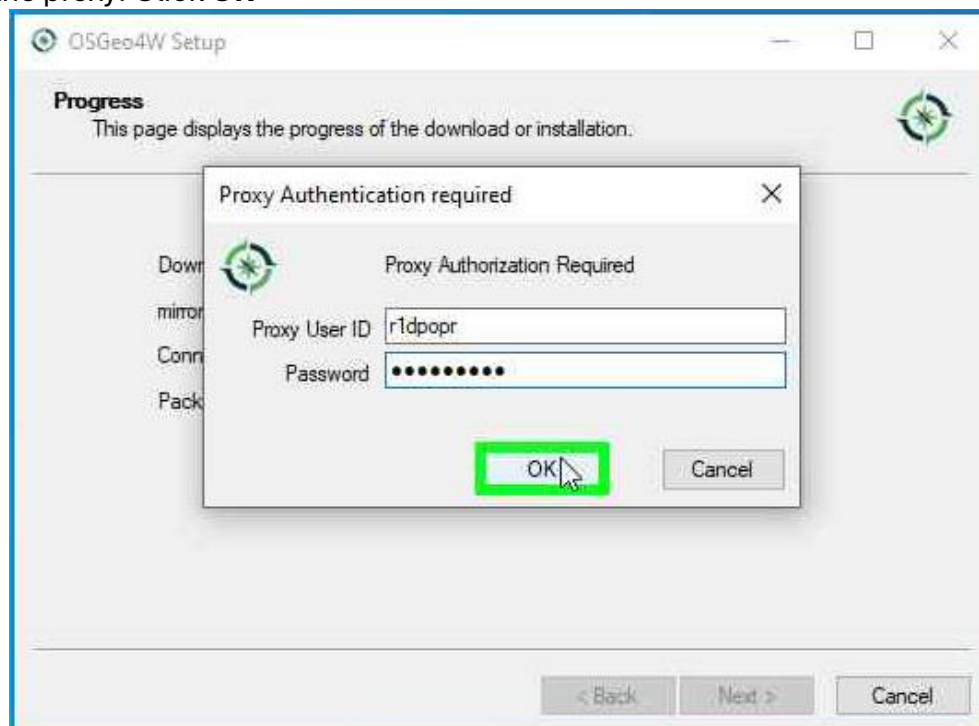


Figure 5: Filling up of Proxy Details for Authenticating via configured Proxy

8. **Select** appropriate **Download Site** for your location, the list of sites should load automatically if the Network Installer is able to connect to the repository. Click **Next** after you select the appropriate Download Site.

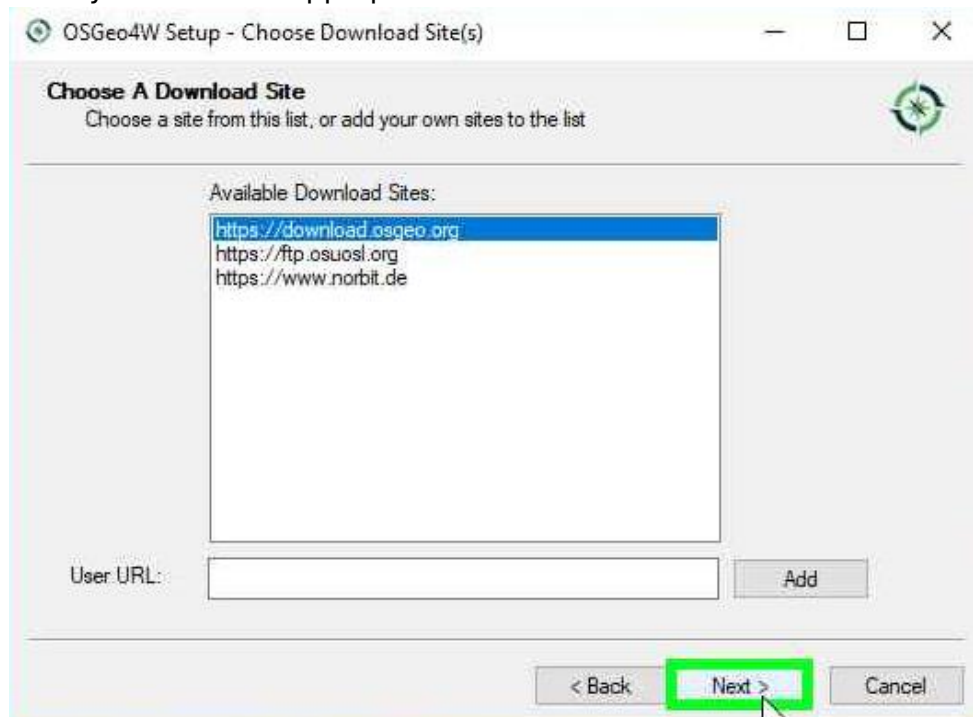


Figure 6: Selection of Appropriate Download Site for download of Required Libraries

9. Select **Keep** in the page to retain all the existing library versions, our goal is to only upgrade the “python-h5py” package to latest version. Alternatively if you select **Current** in this step all the packages will be upgraded and you can skip the next step.

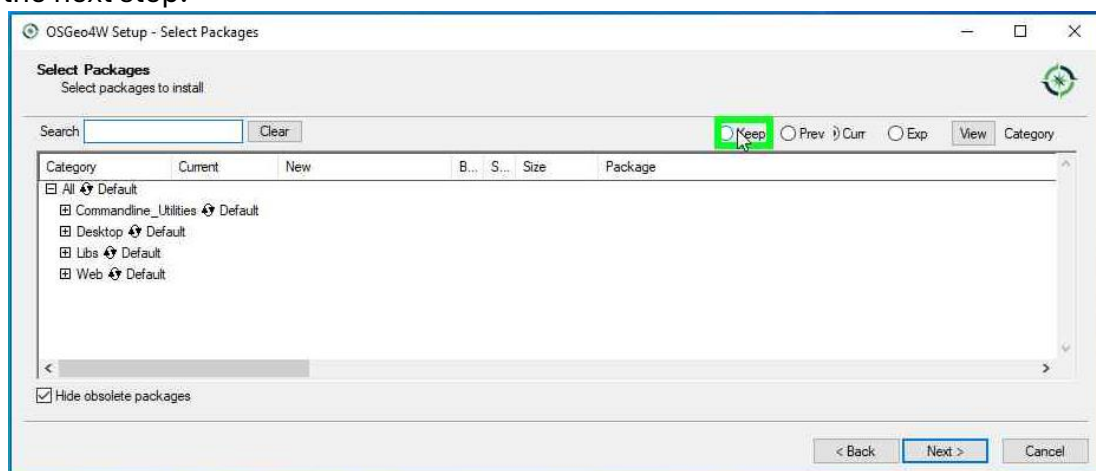


Figure 7: Selecting Appropriate Versions to be Installed for different packages

10. Search for **h5py** in Search bar, and select the latest version under **Libs** section. Click **Next**.

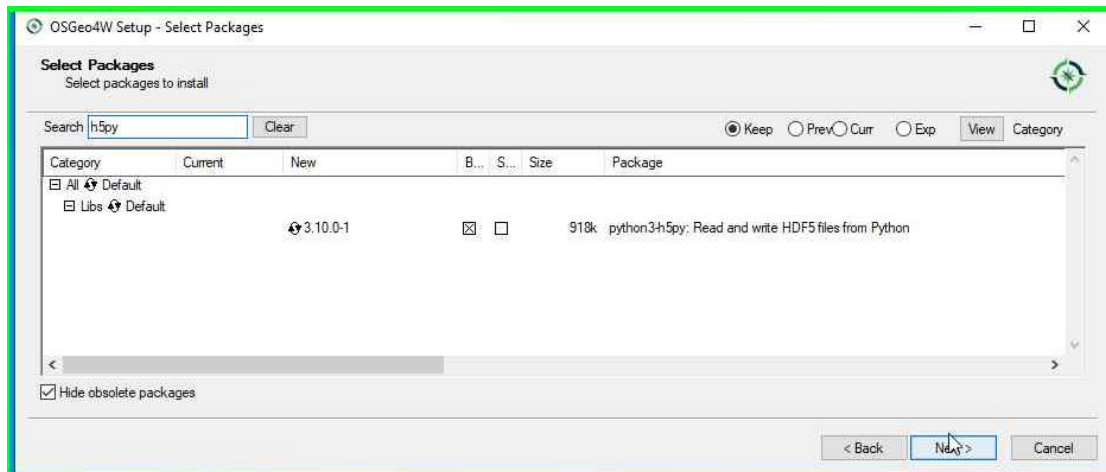


Figure 8: Selecting the Latest version of python3-h5py for Installation

11. Confirm the required packages to be upgraded, note that a list of packages may be marked for upgrade to support the installation of python3-h5py package. Please ensure the presence of python3-h5py package and click **Next**.

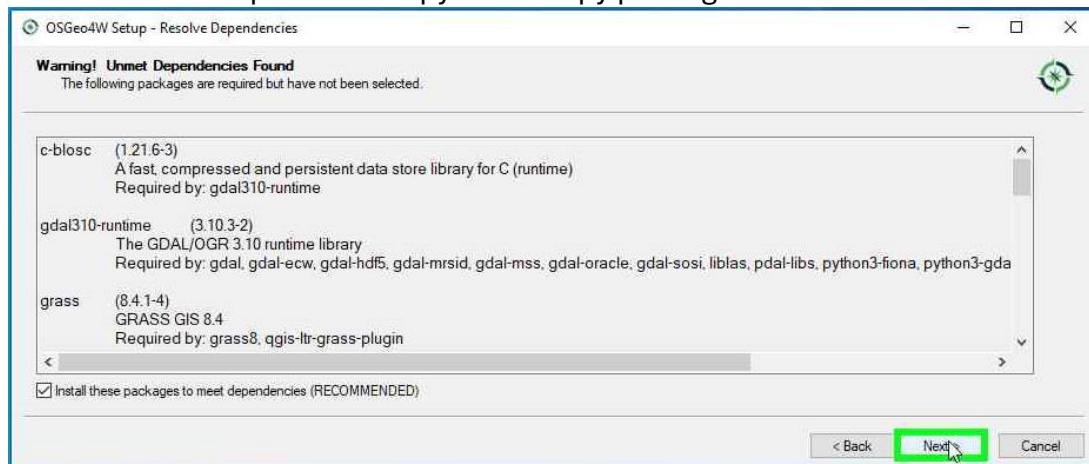


Figure 9: Confirmation Step for List of Packages to be upgraded

12. Provide necessary permissions and wait patiently till all the required packages are downloaded and installed on your OSGeo4W environment.

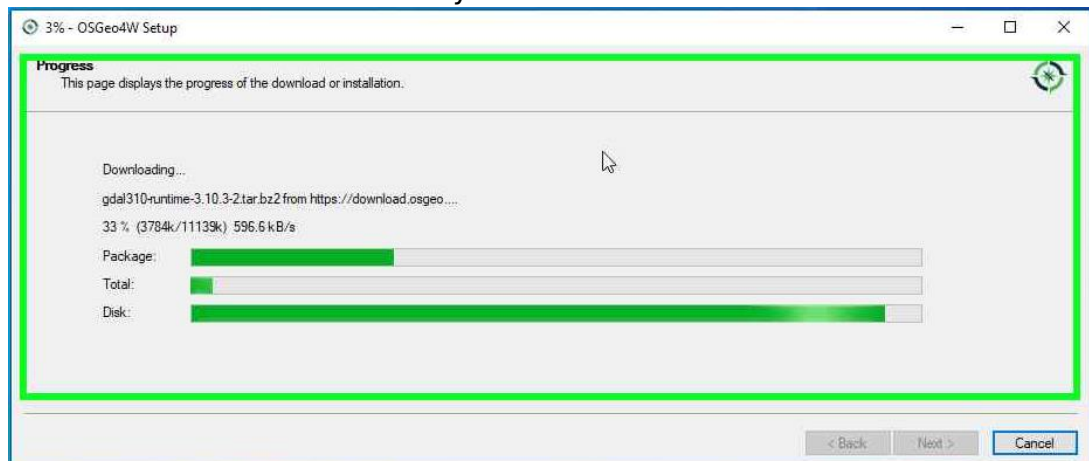


Figure 10: Progress Bar showing Status of Installation

13. Click **“Finish”** to finalize the changes, and if required Restart your system (if prompted) to ensure all the installations are effective.

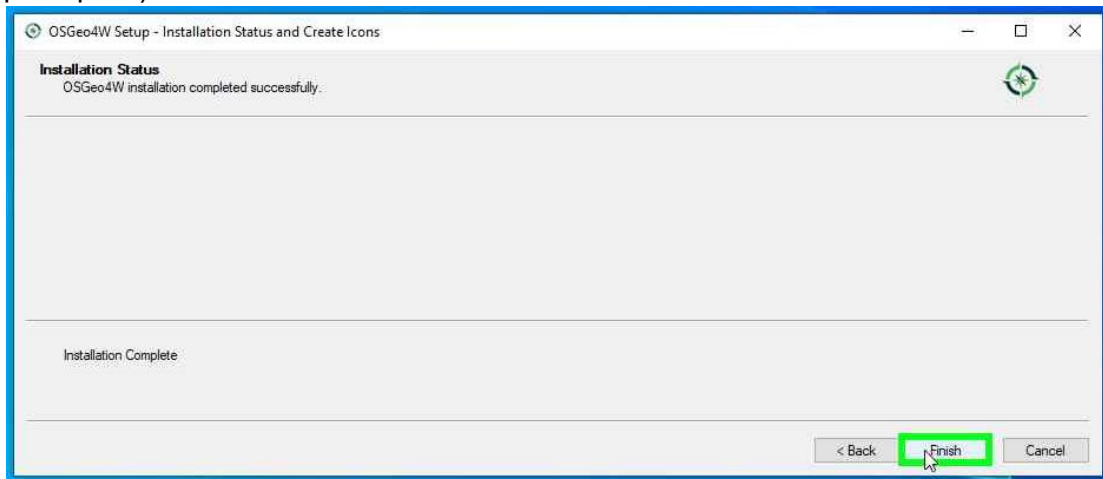


Figure 11: Finalizing the Installation by clicking Finish

Python Libraries Installation

For the SARPOLTOOL plugin to function properly, the dependent libraries also need to be installed. The same can be done from the OSGeo4W Shell. In order to use the shell to install libraries for the Python environment of QGIS, kindly ensure that the proxy settings are properly configured or the **pip** command can be used with proxy configuration in the shell itself. The following steps show the case with proxy configuration in pip.

Steps for Installation

1. Open the **OSGeo4W Shell** from the Windows Program Menu. It is a shell for the QGIS Python Environment.
2. Run the following command in OSGeo4W Shell:

```
pip install dask rasterio spectral tqdm xmldict
```

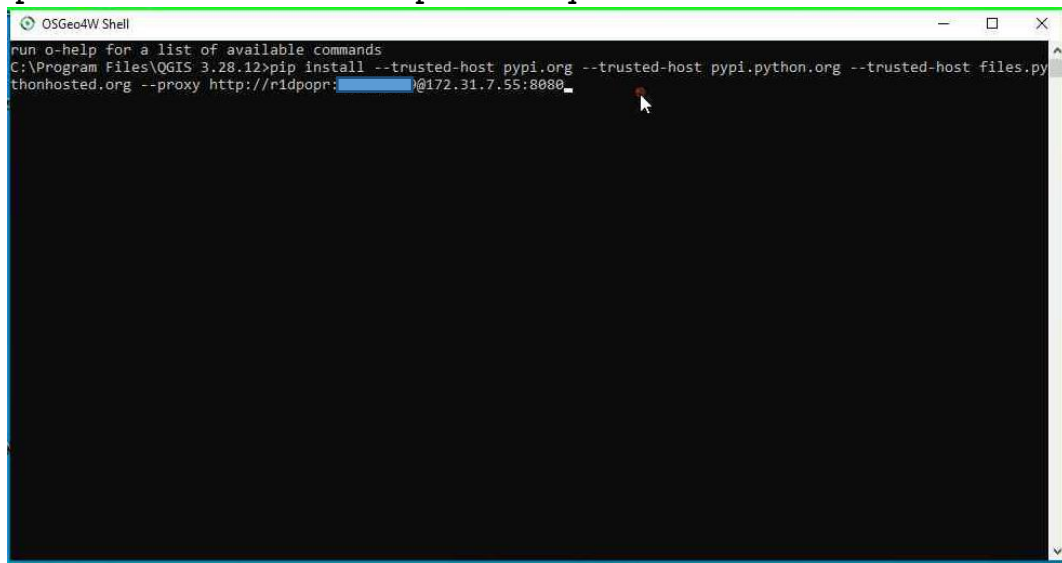


Figure 12: OSGeo4W Shell where command to install the remaining modules are run

- Alternatively if you are working in an environment which requires SSL Certificate check and Proxy Credentials you can use the following command to install from OSGeo4W Shell:

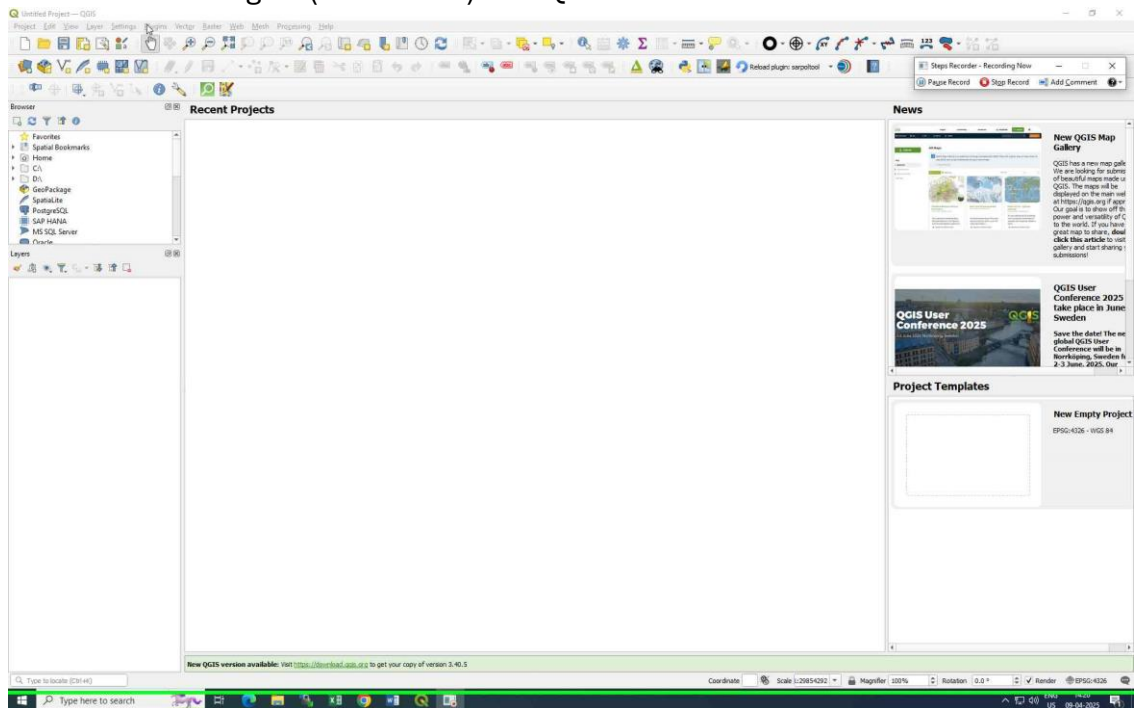
```
pip install --trusted-host pypi.org --trusted-host pypi.python.org --  
trusted-host files.pythonhosted.org --proxy http://<proxy-  
credentials> dask rasterio spectral tqdm xmltodict
```

SARPOLTOOL Installation

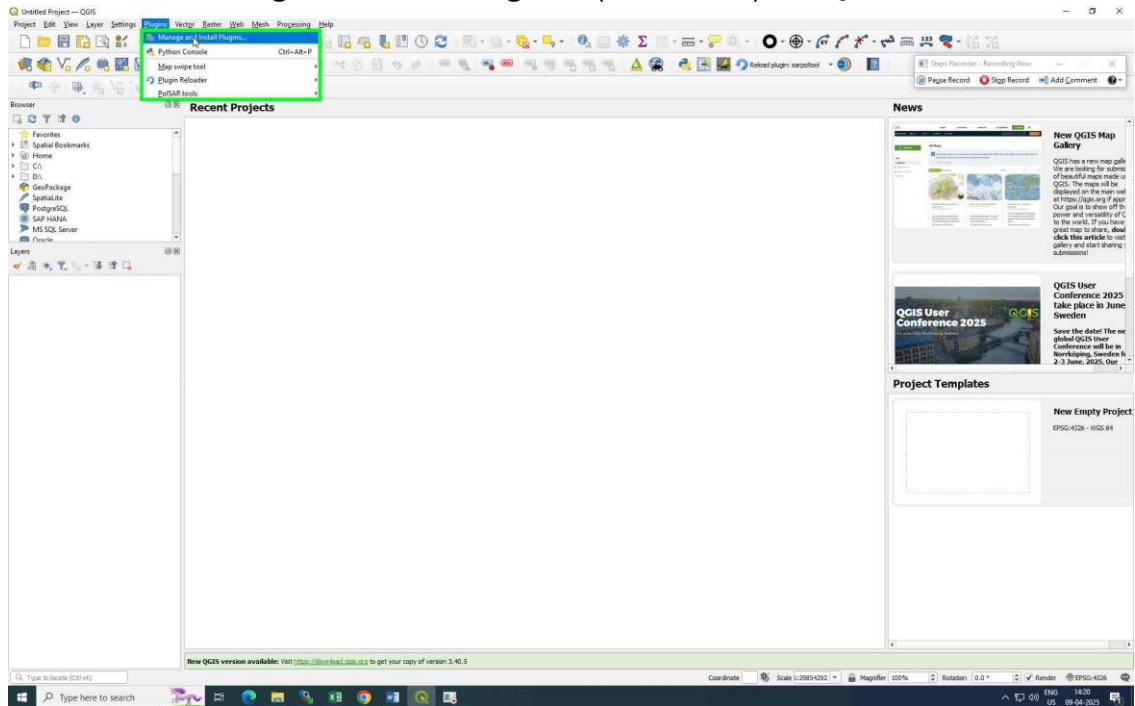
SARPOLTOOL is a QGIS plugin which can be installed from the zip provided. The same will be eventually be available for Install from the official QGIS plugin repository shortly. In order to install the same from QGIS please follow the steps in the following section.

Steps to Install

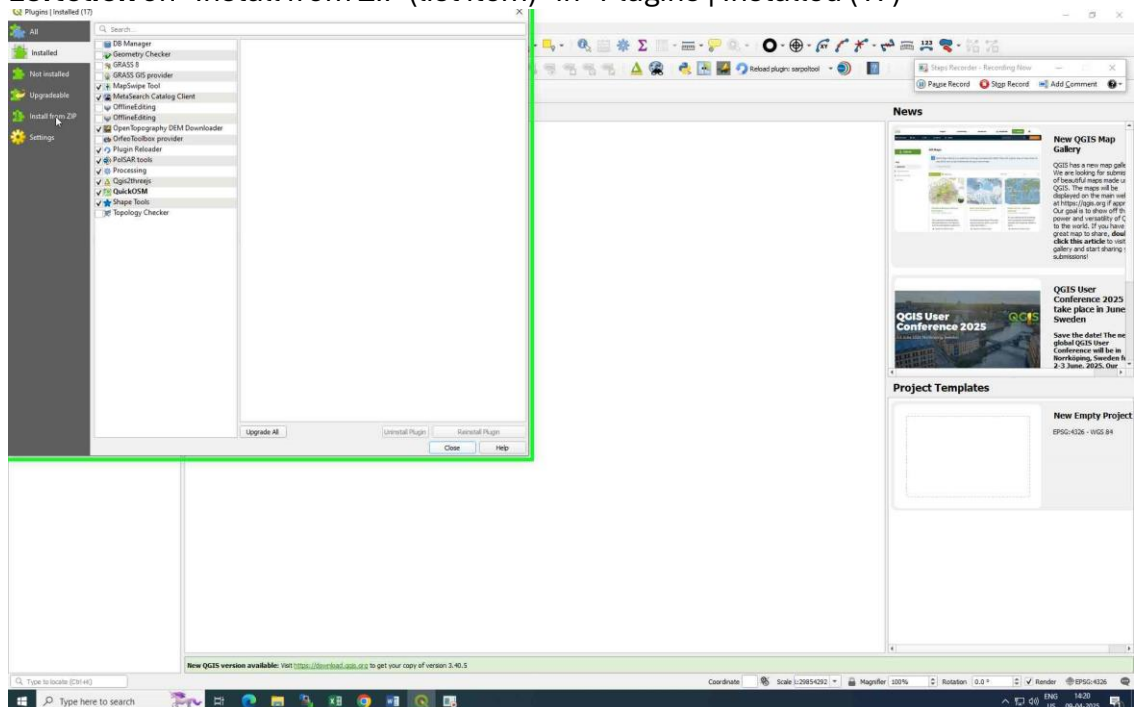
1. **Left click on "Plugins (menu item)" in " QGIS"**



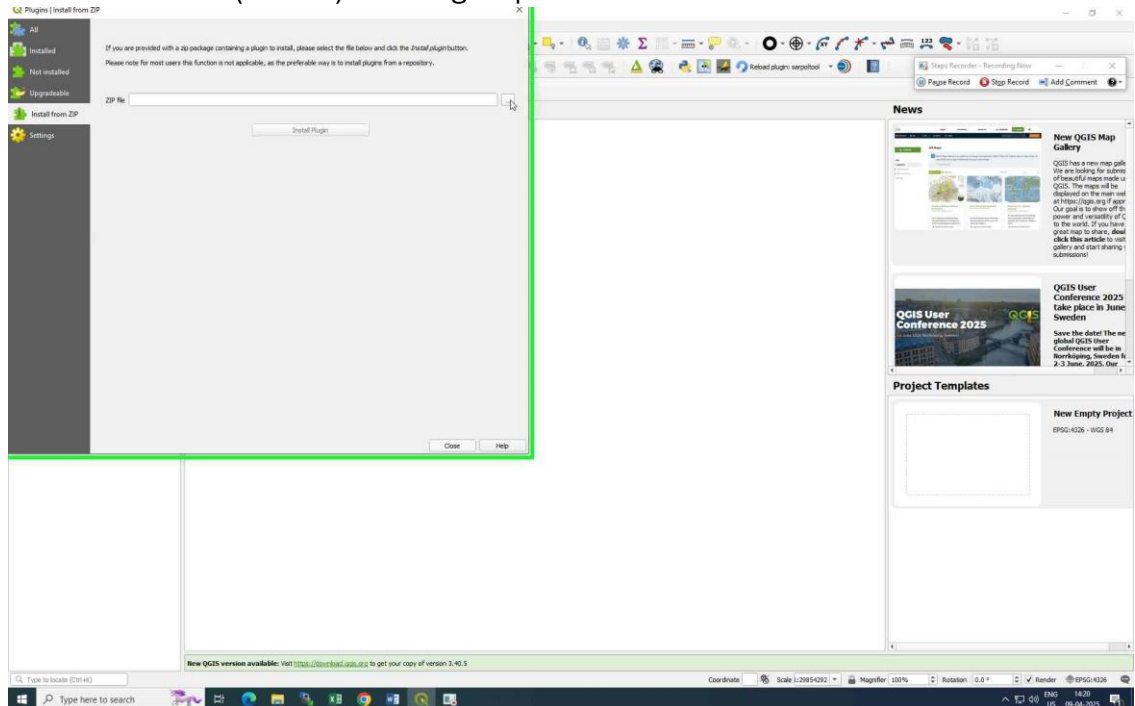
2. Leftclick on "Manage and Install Plugins... (menu item)" in "QGIS3"



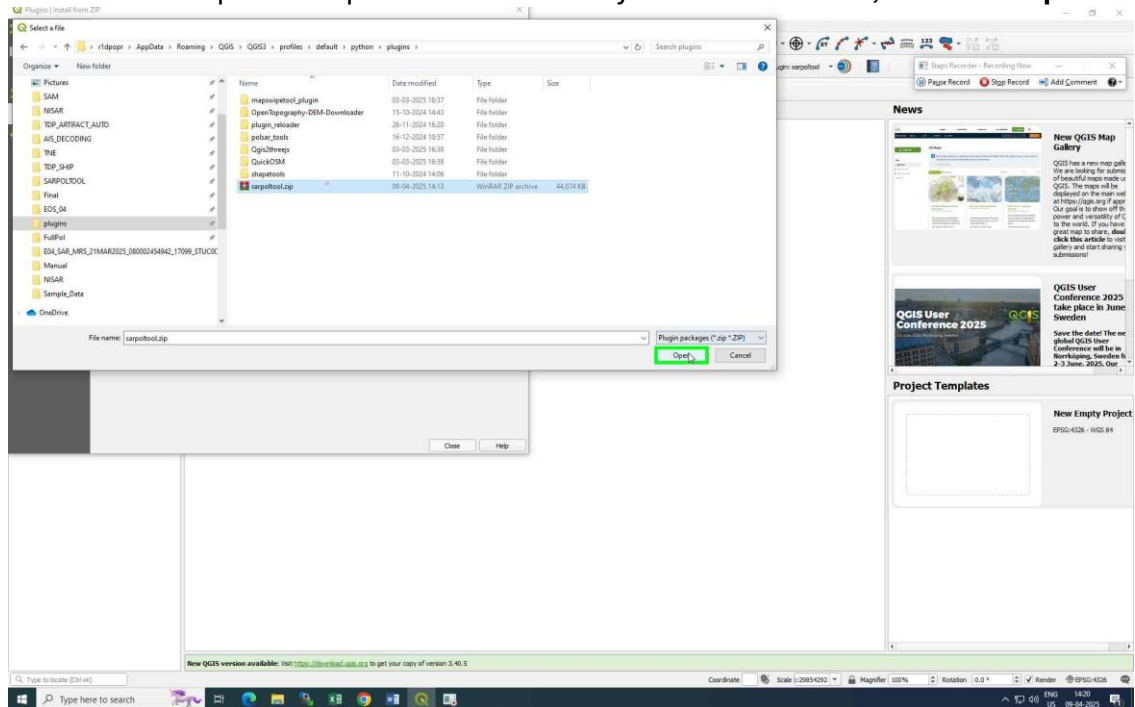
3. Leftclick on "Install from ZIP (list item)" in "Plugins | Installed (17)"



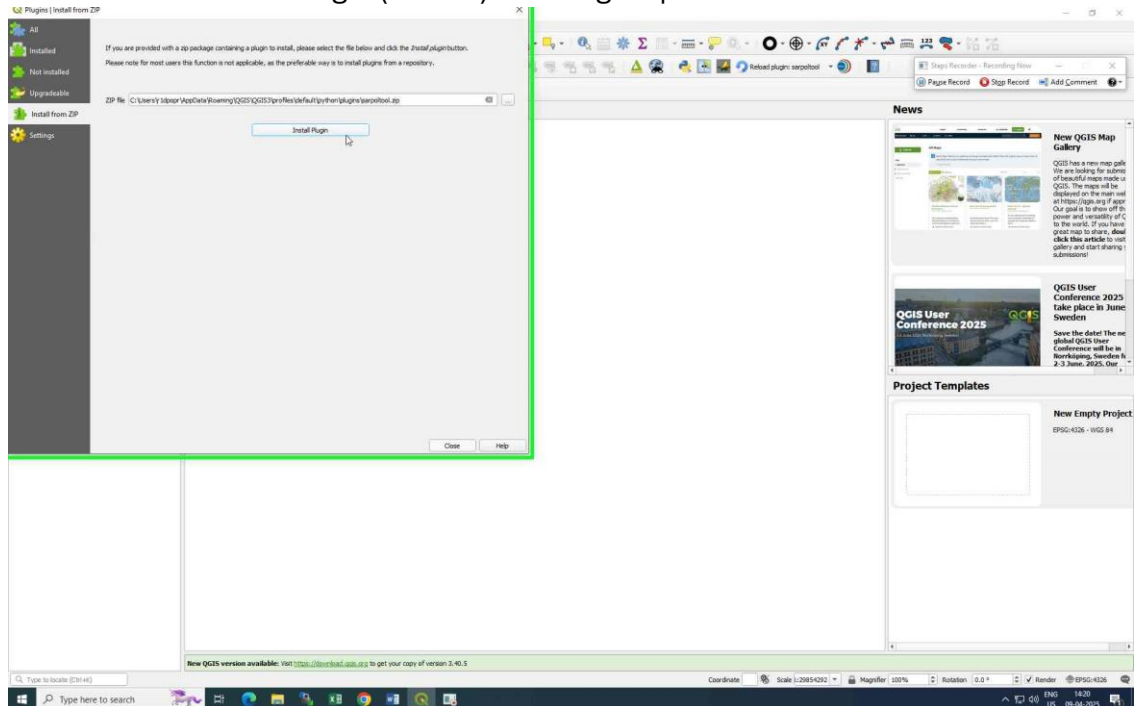
4. Left click on "... (button)" in "Plugins | Install from ZIP"



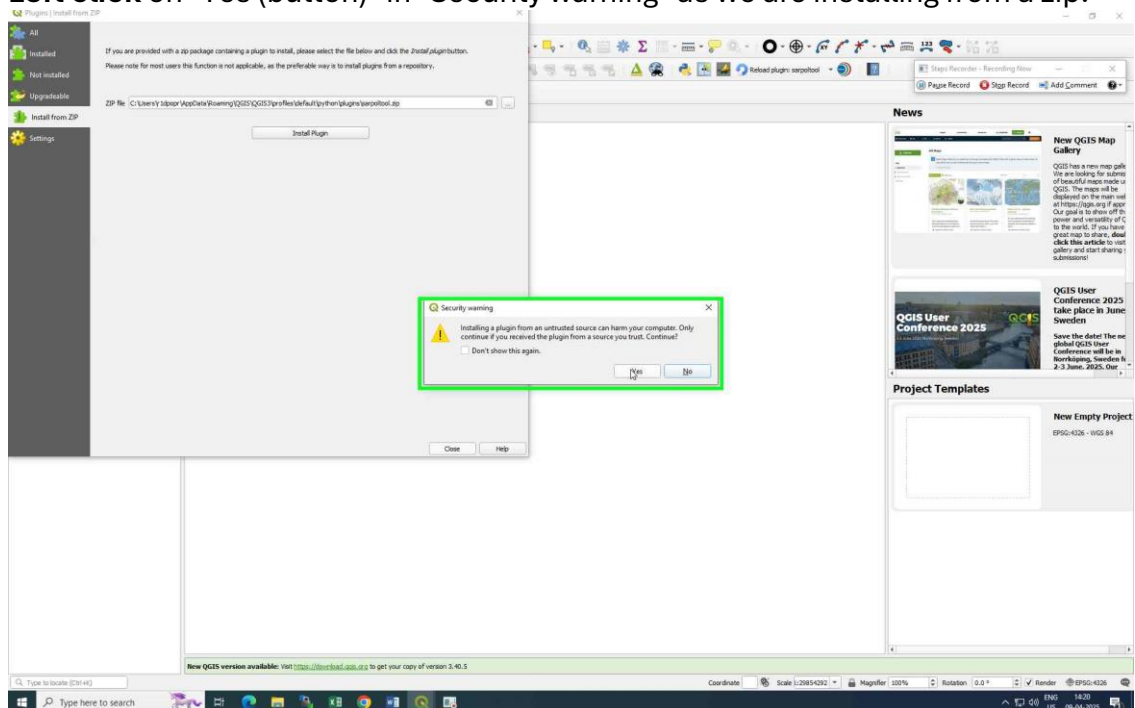
5. Select the "sarpoltool.zip" from the directory where it is stored, and click **Open**.



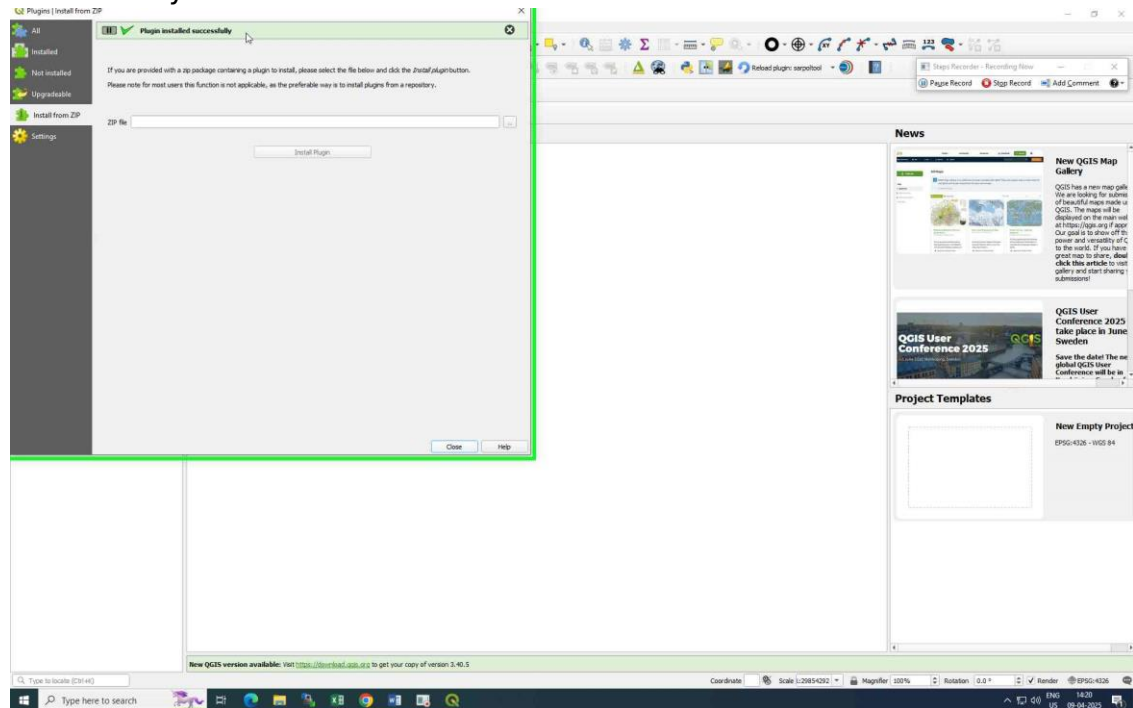
6. Leftclick on "Install Plugin (button)" in "Plugins | Install from ZIP"



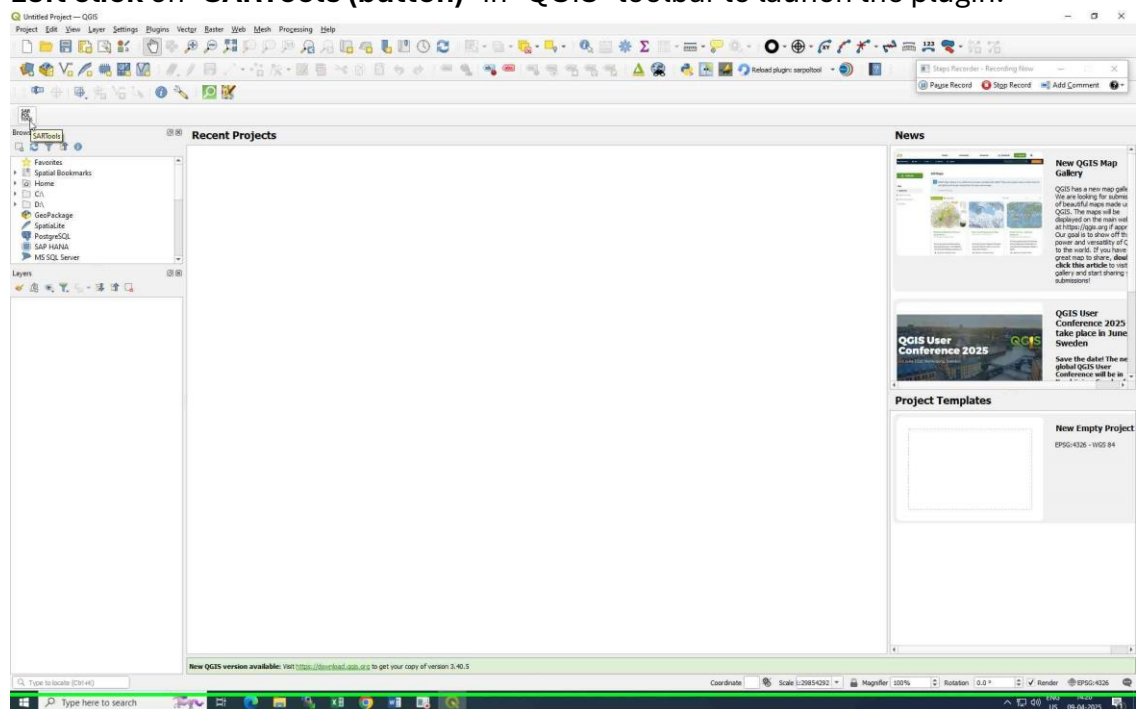
7. Left click on "Yes (button)" in "Security warning" as we are installing from a zip.



8. **Plugin installed successfully** message is displayed to show that the plugin was successfully installed.



9. **Left click on "SARTools (button)" in "QGIS" toolbar to launch the plugin.**



User Manual

Introduction

This chapter explains the various elements of the SARPOLTOOL User Interface and the functionalities available for the same are explained in depth in subsequent chapters dedicated to each interface. The general overview is explained using various elements below:

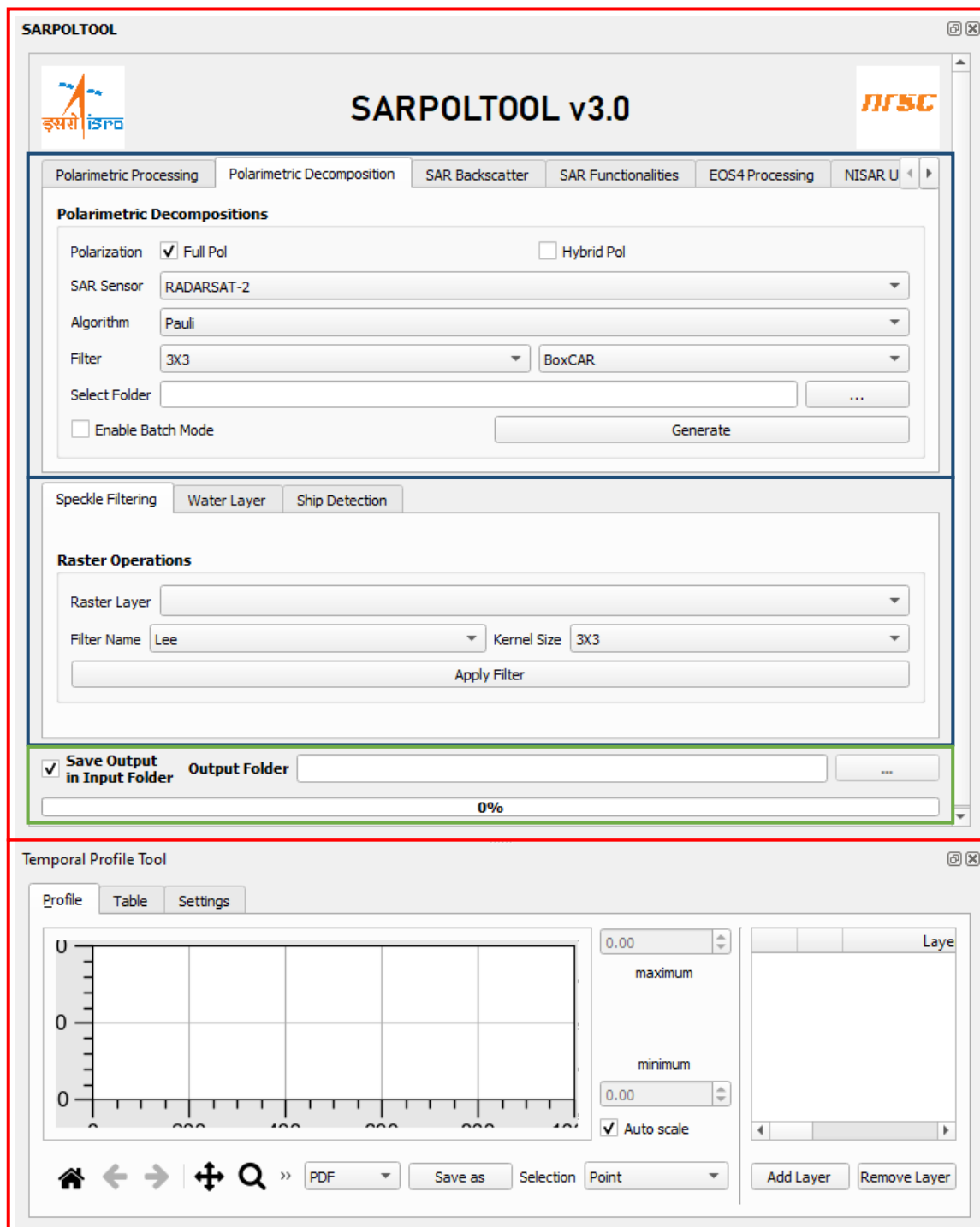


Figure 13: Different UI elements of SARPOLTOOL

SARPOLTOOL consists of two dockwidgets (depicted as Red Boxes in Figure 13) which can be independently undocked and docked to any pane in the QGIS GUI. All the processing elements are present in the dockwidget present above, and the second dockwidget contains the Temporal Profile Tool which often needs re-sizing to accommodate the full plot of the temporal profile. To enable the user to freely resize these plots, the dockwidget is separated from the other dockwidget.

Each Dockwidget contains multiple Groupboxes (denoted in Blue Boxes in Figure 13) which in turn contain multiple tabs which further group all the functionalities offered by SARPOLTOOL based on a common theme. The common UI elements are shown in Green Box in Figure 13). They consist of the Output Selection Option which are a checkbox if the output is to be saved in the Input Folder itself and an Output Folder, where the Output Folder path can be provided if required.

Processing dock-widget

The Processing dock-widget is shown as the top Blue Box in Figure 13. There are two Group-boxes (denoted in Blue) in this dock-widget. The first group-box consists of theme specific processing tools, and the second group-box consists of general theme tools. This section will describe each group-box and its tabs in details.

Theme specific group-box

In order to enable the users to search for functionalities based on what operation they want to do, multiple operations along the same theme are grouped into various tabs in this group-box. This section describes each tab present in the Theme specific group-box.

Polarimetric Processing

This tab contains all the common Polarimetric Operations available, such as generation of the Coherency Matrix elements, Covariance Matrix elements and conversion from Quad polarization data to Pseudo hybrid polarization data. The flow for operation is from top to bottom.

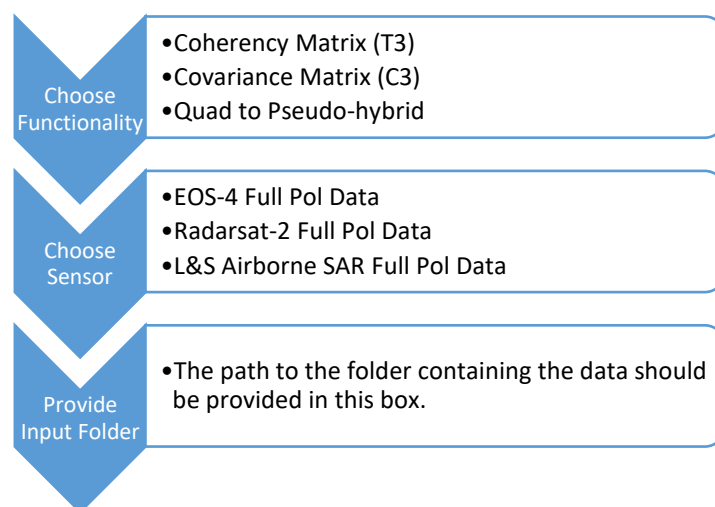


Figure 14: Flow of Operations for the Polarimetric Processing Tools

The general flow of operations for Polarimetric Processing Tools is presented in Figure 14. The UI elements of Processing Tools described in this section are shown in Figure 15. A detailed flow of operations is also provided in Annexure. The theory behind each operation is provided in the subsequent sections.

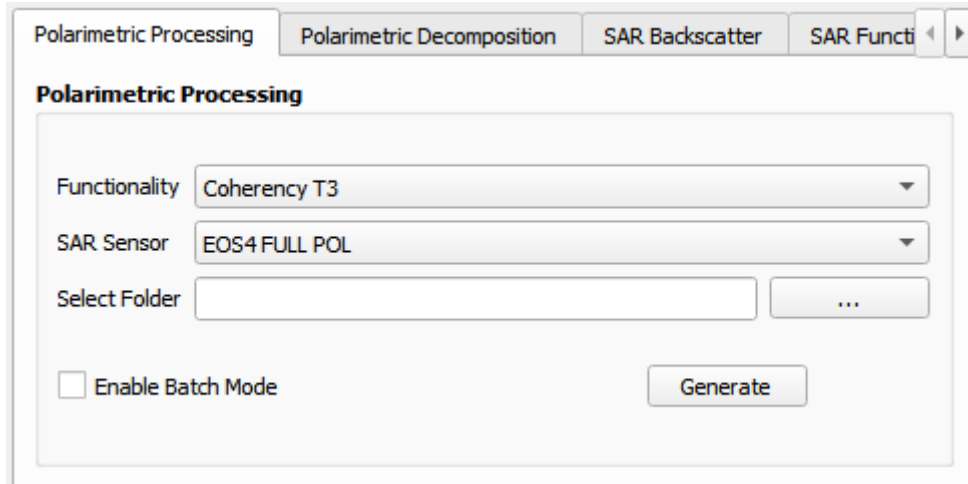


Figure 15: UI elements of the Polarimetric Processing tools in SARPOLTOOL

Coherency T3 Matrix Generation

The Coherency Matrix is a fundamental representation used in polarimetric Synthetic Aperture Radar (PolSAR) data analysis. It encapsulates the second-order statistics of the scattering process and provides a comprehensive description of the scattering mechanisms from a target area. In SARPOLTOOL, the Coherency Matrix is a crucial intermediate product used in many advanced polarimetric decompositions and classifications.

The Coherency Matrix, typically denoted as T , is a 3×3 Hermitian positive semi-definite matrix derived from full polarimetric SAR data. It represents the ensemble average of the outer product of the target vector with its Hermitian transpose. The Coherency Matrix captures the average scattering behavior over a resolution cell and is essential for identifying different scattering mechanisms such as surface, double-bounce, and volume scattering.

Full polarimetric SAR data captures the complete scattering matrix S , which contains the complex backscattered amplitudes:

$$S = \begin{bmatrix} S_{HH} & S_{HV} \\ S_{VH} & S_{VV} \end{bmatrix}$$

Assuming reciprocity, i.e. $S_{HV} = S_{VH}$ we can define the Pauli target vector \vec{k}_p in the Pauli basis as:

$$\vec{k}_p = \frac{1}{\sqrt{2}} \begin{bmatrix} S_{HH} + S_{VV} \\ S_{HH} - S_{VV} \\ 2S_{HV} \end{bmatrix}$$

Using this vector, the Coherency Matrix T is defined as:

$$[T] = \langle \vec{k}_p \vec{k}_p^\oplus \rangle$$

Where \vec{k}_p^\oplus denotes the Hermitian (conjugate transpose) of \vec{k}_p , and $\langle \rangle$ denote the ensemble average which is implemented as a spatial averaging over a given window.

In SARPOLTOOL, the Coherency Matrix is generated automatically from full-pol SAR data upon invoking polarimetric processing routines. It is a foundational input for subsequent analysis steps including polarimetric decomposition (e.g., Cloude-Pottier, Freeman-Durden) and classification. Users can select the window size for spatial averaging, which controls the degree of smoothing applied during the matrix formation.

Covariance C3 Matrix Generation

The Covariance Matrix is another essential representation in polarimetric SAR (PolSAR) data processing, closely related to the Coherency Matrix but formed in a different basis. It is used to describe the second-order statistical properties of the backscattered signals and is widely applied in feature extraction, target decomposition, and classification. In SARPOLTOOL, the Covariance Matrix is a critical input for many polarimetric algorithms.

The Covariance Matrix, usually denoted as C , is a 3×3 Hermitian positive semi-definite matrix constructed from the scattering vector expressed in the lexicographic basis. It captures the mutual coherence between different polarization channels and provides a complete statistical description of the polarimetric scattering behavior over a resolution cell.

Full polarimetric SAR data captures the complete scattering matrix S , which contains the complex backscattered amplitudes:

$$S = \begin{bmatrix} S_{HH} & S_{HV} \\ S_{VH} & S_{VV} \end{bmatrix}$$

Assuming reciprocity, i.e. $S_{HV} = S_{VH}$ we can defined the lexicographic scattering vector \vec{k}_l as:

$$\vec{k}_l = \begin{bmatrix} S_{HH} \\ \sqrt{2}S_{HV} \\ S_{VV} \end{bmatrix}$$

Using this vector, the Covariance Matrix C is defined as:

$$[C] = \langle \vec{k}_l \vec{k}_l^\oplus \rangle$$

Where \vec{k}_l^\oplus denotes the Hermitian (conjugate transpose) of \vec{k}_l , and $\langle \rangle$ denote the ensemble average which is implemented as a spatial averaging over a given window.

Quad to Pseudo Hybrid

In polarimetric SAR processing, Quad Polarization (Quad-Pol) data provides full information by capturing all four polarization combinations (HH, HV, VH, VV). However, some sensors or applications operate in Hybrid Polarization modes, which use a single transmit polarization and receive multiple combinations to reduce system complexity and data volume. To simulate such scenarios, SARPOLTOOL includes a module to convert Quad-Pol data into Pseudo Hybrid Polarization data. This involves synthesizing hybrid polarimetric measurements (e.g., circular transmit and linear receive combinations) from the full Quad-Pol dataset using mathematical transformations. These conversions enable the study and testing of hybrid-mode processing techniques and algorithms without requiring actual hybrid-mode data, making it valuable for algorithm development and performance evaluation.

Polarimetric Decompositions

This tab contains all the common Polarimetric Decompositions available. The selection of decomposition is further classified based on polarization available at input, in general there are two decompositions available, i.e. for Full Polarization data and Hybrid Polarization data. The user is supposed to select the type of polarization, then the decomposition to be applied, then the type of filtering to be used and the kernel size of the filter.

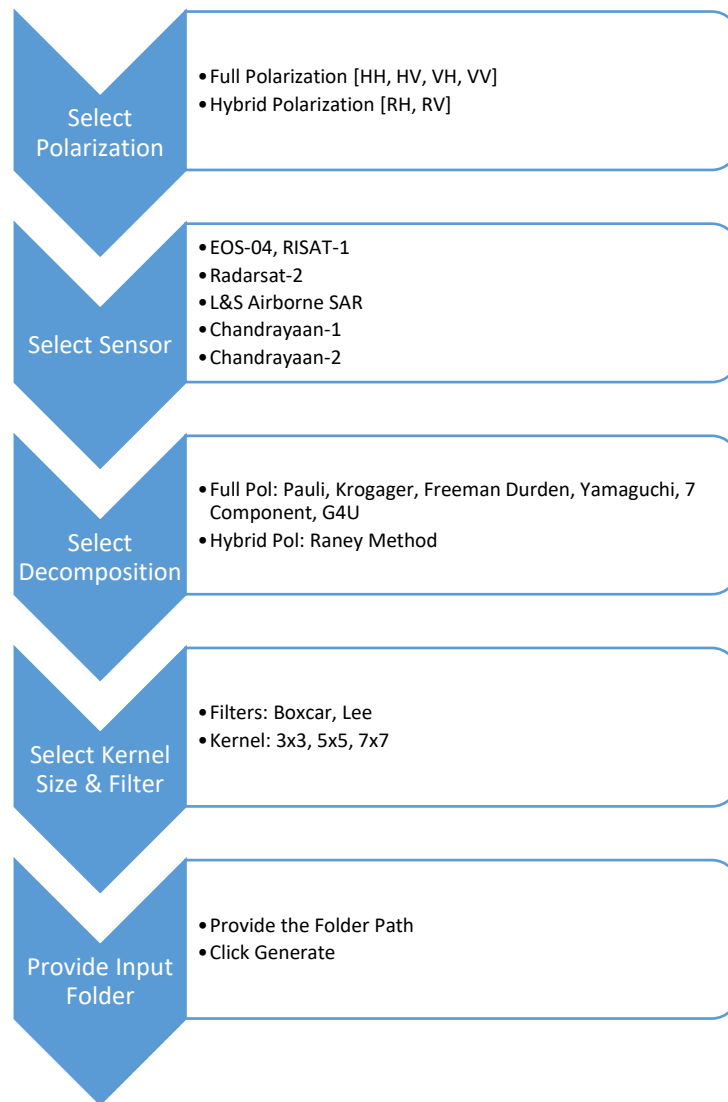


Figure 16: Flow of Operation for Polarimetric Decompositions

General flow of operation for applying Polarimetric Decompositions is shown in Figure 16. The UI elements for Polarimetric Decompositions Tab is also displayed in Figure 17, where all the elements referenced are shown. Subsequent sections explain all the available polarizations that are being used. Details of the algorithms can be found in the references section.

Polarimetric Decompositions

Polarization ☒ Full Pol ☐ Hybrid Pol

SAR Sensor EOS4

Algorithm General Four Component-Unitary-GFU

Filter 3X3 BoxCAR

Select Folder ...

☐ Enable Batch Mode

Figure 17: UI elements of Polarimetric Decompositions tab

Pauli Decomposition

Pauli Decomposition is a widely used technique in polarimetric SAR (PolSAR) data analysis that represents scattering mechanisms using a linear combination of the Pauli spin matrices. It expresses the scattering vector in the Pauli basis as a combination of physical scattering components: single-bounce (surface) scattering, double-bounce scattering, and volume scattering. The resulting RGB Pauli image is visually intuitive, with colors typically mapped as: red for double-bounce ($|HH - VV|$), green for volume ($|2HV|$), and blue for surface ($|HH + VV|$) scattering. This decomposition is especially useful for qualitative interpretation and visualization of scattering behavior in urban, forested, and agricultural environments.

Advantages of Pauli Decomposition include its simplicity, ease of implementation, and the ability to provide a quick visual understanding of dominant scattering mechanisms. It is also directly derived from the physically meaningful Pauli basis, making it a preferred first-step analysis tool in many applications. However, disadvantages include its limited quantitative capabilities, as it does not provide detailed information about the scattering power or entropy of the scene. Moreover, it may not distinguish complex mixed scattering processes accurately, making it less suitable for precise classification or modeling tasks.

Krogager Decomposition

Krogager Decomposition is a physically-based polarimetric SAR decomposition technique that expresses the scattering matrix as a coherent sum of three fundamental scattering components: sphere, dihedral, and helix. These components correspond to distinct physical scattering behaviors—sphere for volume scattering (e.g., from vegetation), dihedral for double-bounce scattering (e.g., from buildings or vertical structures), and helix for asymmetric or rotating targets (e.g., moving objects or spiral structures). Krogager Decomposition is derived using the symmetric properties of the Sinclair scattering matrix and enables clear interpretation of polarimetric signatures in terms of physical targets.

The advantages of Krogager Decomposition include its strong physical interpretability, which makes it particularly useful for identifying and characterizing man-made objects, natural features, and complex scattering environments. It provides direct insight into the geometrical structure of the scatterers and is useful in applications such as urban monitoring, vegetation analysis, and target detection. However, its disadvantages lie in its reliance on fully polarimetric data and its sensitivity to noise and calibration errors. Additionally, the presence of helix components can sometimes be ambiguous in interpretation, especially in natural environments where pure helix scattering is rare.

General 4 Component Unitary (G4U) Decomposition

The General 4-Component Unitary Decomposition is an advanced polarimetric SAR decomposition method that expands upon traditional three-component models by introducing an additional scattering component to better represent complex natural and man-made targets. It decomposes the coherency matrix into four distinct scattering mechanisms: surface scattering, double-bounce scattering, volume scattering, and a fourth component that captures helix or asymmetric scattering behaviors. This decomposition is performed using a unitary transformation of the coherency matrix, which allows for the rotation of the polarimetric basis to extract maximum physical information from the data. The inclusion of the fourth component helps improve discrimination of complex or mixed scattering phenomena, especially in urban or heterogeneous environments.

The advantages of this decomposition lie in its comprehensive representation of scattering behaviors and its flexibility in adapting to complex real-world scenes. It enhances the interpretation of PolSAR data by accounting for asymmetric or non-canonical scattering not captured by simpler models. This makes it valuable in applications such as land cover classification, urban analysis, and environmental monitoring. However, the disadvantages include its mathematical complexity, computational demand, and potential sensitivity to noise and calibration errors. Additionally, the physical interpretation of the fourth component may not always be straightforward, especially in areas with overlapping or diffuse scattering sources.

Seven Component Scattering Decomposition

The Seven Component Scattering Decomposition is a highly detailed polarimetric SAR decomposition technique that breaks down the scattering behavior into seven distinct physical components: surface, double-bounce, volume, helix, diffuse, dipole, and left/right-handed asymmetric scattering. This method builds on unitary and eigen-decomposition approaches and is designed to capture a wide range of scattering phenomena present in complex terrain, especially in mixed urban-natural environments. By incorporating additional components beyond the traditional three or four, this decomposition enables a finer classification of scattering mechanisms, improving target discrimination and interpretation accuracy.

The main advantage of the Seven Component Decomposition is its comprehensive representation of scattering diversity, making it extremely useful in detailed land cover mapping, urban infrastructure analysis, and target detection in cluttered scenes. It offers rich physical insight into complex scatterers by isolating subtle scattering behaviors that simpler models might overlook. However, this level of detail comes with disadvantages such as increased computational cost, higher sensitivity to noise, and greater dependency on full polarimetric data quality. Additionally, the interpretation of certain components—especially asymmetric or diffuse scattering—can be less intuitive, requiring expert knowledge to accurately analyze and apply the results.

Freeman Durdern Decomposition

The Freeman–Durdern Decomposition is a widely used model-based polarimetric SAR decomposition technique that separates the observed scattering into three canonical physical components: surface scattering, double-bounce scattering, and volume scattering. Developed to interpret radar backscatter from natural and man-made targets, this decomposition assumes that the observed coherency matrix can be modeled as a weighted sum of these three elementary scattering mechanisms. It is especially effective for terrain dominated by vegetation, buildings, and open surfaces, and is commonly used in land cover classification and environmental monitoring.

The advantages of the Freeman–Durdern Decomposition include its strong physical interpretability, low computational complexity, and robustness for forested and urban areas. It is effective in distinguishing between vegetation (volume), built-up structures (double-bounce), and bare ground (surface), making it suitable for a variety of remote sensing applications. However, it also has limitations, such as its assumption of a fixed volume scattering model (randomly oriented dipoles), which may not always accurately represent complex vegetation structures. Additionally, it may misclassify scattering contributions in areas with mixed or non-canonical scattering behavior, and it relies on full-polarimetric data, limiting its use with dual- or compact-pol systems.

Yamaguchi Decomposition

The Yamaguchi Decomposition is an extension of the Freeman–Durdern model-based polarimetric SAR decomposition, designed to handle more complex scattering environments. It introduces a fourth component—helix (or asymmetric scattering)—in addition to the standard surface, double-bounce, and volume scattering components. This modification improves decomposition performance in urban areas, where asymmetric scattering caused by oriented buildings or complex man-made structures is often significant. The Yamaguchi model uses the coherency matrix and applies unitary rotation techniques to better adapt the decomposition to the dominant scattering direction, thus enhancing the physical realism of the results.

The advantages of the Yamaguchi Decomposition include its enhanced accuracy in urban and complex scenes, improved handling of oriented targets, and better representation of asymmetric scattering. It is particularly useful in applications such as urban classification, infrastructure mapping, and disaster monitoring. However, disadvantages include increased computational complexity, dependence on accurate orientation angle estimation, and sensitivity to volume scattering model assumptions, similar to those in Freeman–Durden. Additionally, while the fourth component improves flexibility, its interpretation can be less intuitive, especially in natural or mixed environments.

Raney Decomposition

Raney Decomposition is a specialized polarimetric decomposition technique designed for use with Hybrid Polarization SAR data, where a single circular polarization is transmitted (typically right circular, RCP or left circular, LCP) and linear polarizations (HH, HV, VV) are received. This decomposition method, proposed by R. K. Raney, allows the extraction of physical scattering information from hybrid-polarimetric systems, which acquire fewer polarization channels compared to full-pol systems. Raney Decomposition separates the received signal into two primary scattering components: symmetric and asymmetric, based on the polarization behavior of the target and its interaction with the transmitted wave. These components help infer dominant scattering mechanisms such as dihedral, surface, or volume scattering, despite the reduced data dimensionality.

The advantages of Raney Decomposition include its applicability to lightweight or compact SAR systems, reduced data volume, and lower hardware complexity, making it well-suited for small satellites and UAV-based platforms. It enables meaningful polarimetric analysis even when full quad-pol data is unavailable. However, the main disadvantage is its limited discriminative power compared to full-pol decompositions, as it works with reduced polarimetric information. Additionally, interpretation may be less detailed, and the decomposition's effectiveness heavily depends on sensor calibration and polarization purity.

SAR Backscatter

SAR backscatter, commonly represented as Sigma-zero (σ^0), is a fundamental measure in Synthetic Aperture Radar (SAR) data that quantifies the normalized radar reflectivity of a surface. It indicates the fraction of the transmitted radar power that is scattered back toward the sensor per unit area on the ground. This tab contains the functionality for converting the SAR Data Products to corresponding Sigma Zero values.

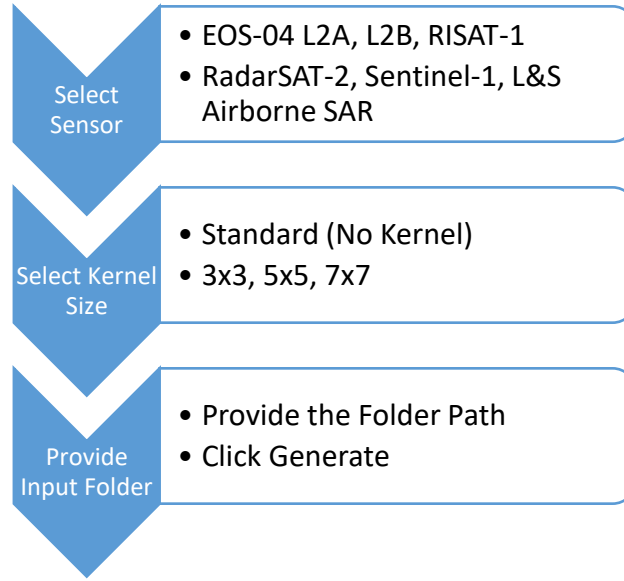


Figure 18: General Flow of Operations for SAR Backscatter Generation

The general flow of Operations to generate Sigma-Zero values from SAR Data Products is outlined in Figure 18. The UI elements described in the same are shown in Figure 19. The subsequent sections of this chapter describe the general methodology of generation of SAR Backscatter from the Data Products.

SAR Backscatter

SAR Sensor: EOS4 L2A

Kernel Size: Standard

Select Folder: [Text Field] [Browse Button]

☐ Enable Batch Mode

[Generate Button]

Figure 19: UI Elements of SAR Backscatter Generation Tab

Generation of SAR Backscatter

Sigma⁰ is expressed in decibels (dB) and varies based on surface roughness, moisture content, incidence angle, and target geometry. It is derived from the intensity of the received SAR signal, corrected for system gains, geometric distortions, and the radar's incidence angle. Mathematically, σ^0 is computed as:

$$\sigma^0 = \frac{P_{backscatter}}{P_{incident} \cdot A}$$

where $P_{backscatter}$ is the power returned to the radar, $P_{incident}$ is the transmitted power, and A_{is} is the illuminated ground area. In practice, SAR processors extract σ^0 from the amplitude or intensity image using calibration constants and geometry-based normalization. σ^0 plays a key role in land cover classification, soil moisture estimation, and change detection, serving as a core product in most SAR analysis workflows.

SAR Functionalities

There are various SAR functionalities that are supported by SARPOLTOOL. These include generation of Radar Vegetation Index & Pedestal Height. These functionalities are provided in this tab.

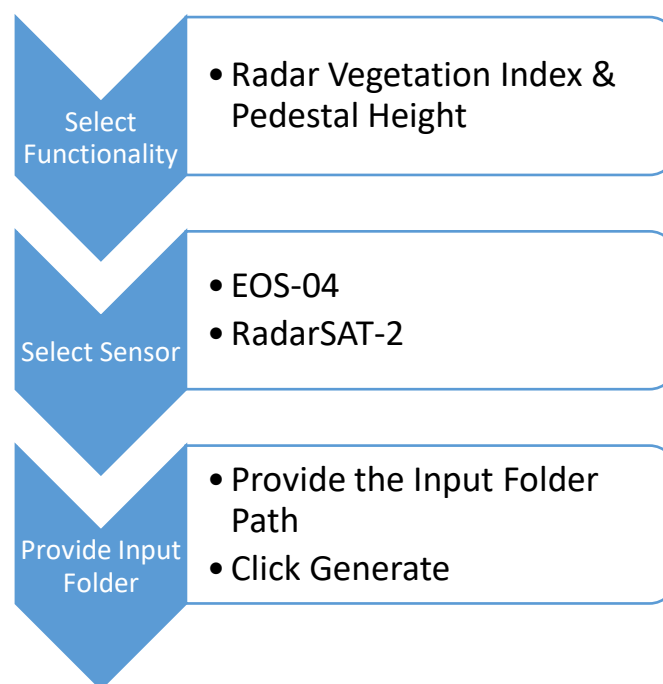


Figure 20: General Flow of Operations for SAR Functionalities

The general flow of operations for using a methodology in SAR Functionalities tab is depicted in Figure 20. The UI elements referenced in this tab are also shown in Figure 21.

SAR Functionalities

Functionality: Radar Vegetation Index & Pedestal Height(Input Full Pol SLC) ▼

SAR Sensor: EOS4 FULL POL ▼

Select Folder: ...

☐ Enable Batch Mode

Generate

Figure 21: UI Elements of the SAR Functionalities Tab

Radar Vegetation Index & Pedestal Height

The Radar Vegetation Index (RVI) and Pedestal Height (PH) are polarimetric indicators derived from SAR data to characterize vegetation structure and scattering behavior. RVI is a widely used metric that quantifies the proportion of volume scattering in a scene, which is typically associated with vegetation. It is derived from the elements of the coherency or covariance matrix, and is computed as:

$$RVI = \frac{4|S_{HV}|^2}{|S_{HH}|^2 + |S_{VV}|^2 + 2|S_{HV}|^2}$$

RVI values range from 0 to 1, where higher values indicate dense or randomly oriented vegetation (high volume scattering), and lower values suggest surface or double-bounce dominated scattering. Pedestal Height (PH), on the other hand, is a measure of the scattering power at the lowest eigenvalue of the coherency matrix, relative to the total power. It helps identify depolarization effects and volume scattering due to vegetation or rough surfaces. It is defined as:

$$PH = \frac{\lambda_3}{\lambda_1 + \lambda_2 + \lambda_3}$$

Where $\lambda_1, \lambda_2, \lambda_3$ are the eigenvalues of the coherency matrix, sorted in descending order. In SARPOLTOOL, both RVI and PH are generated from full-polarimetric data after coherency matrix computation, and the outputs can be visualized as grayscale or false-color maps in QGIS. These indices are valuable in applications such as forest monitoring, crop classification, and vegetation change detection.

EOS4 Processing Toolbox

EOS-04 is a C-Band SAR Satellite launched by ISRO in February, 2022. This Satellite covers India in a 17-day cycle Systematic Coverage fashion in Dual Polarization mode. All the additional steps for processing are grouped together and made available in this tab. The functionalities in this section are Generation of Sigma0, Gamma0, False Color Composite Images, Generation of S2/C2/C3 parameters in PolSARPro formats which allow the further processing of EOS-04 data products in PolSARPro Software. A functionality to generate a mosaic from SLC products of MRS & CRS mode is also provided for generation of EOS-04 Data Products.

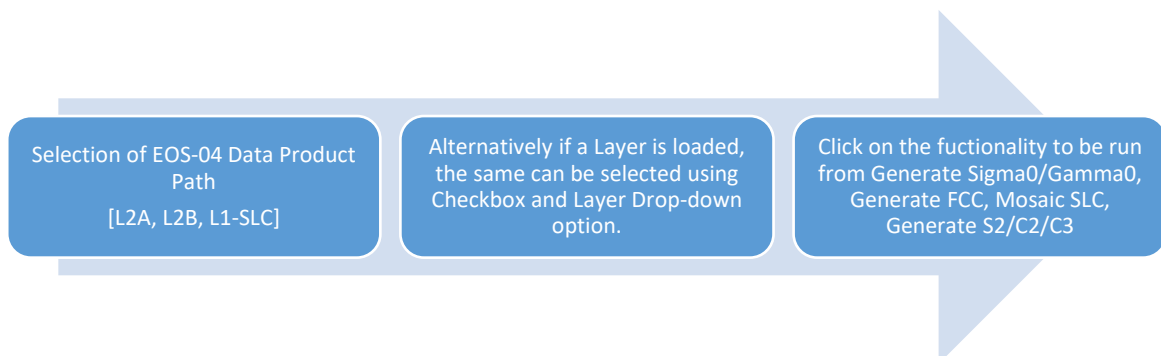


Figure 22: General Flow of Operations for EOS-04 Processing Toolbox

The general flow of operation for processing EOS-04 data can be seen in Figure 22. The UI elements described in this section are shown in Figure 23. The following subsections describe the various functionalities available in this toolbox.

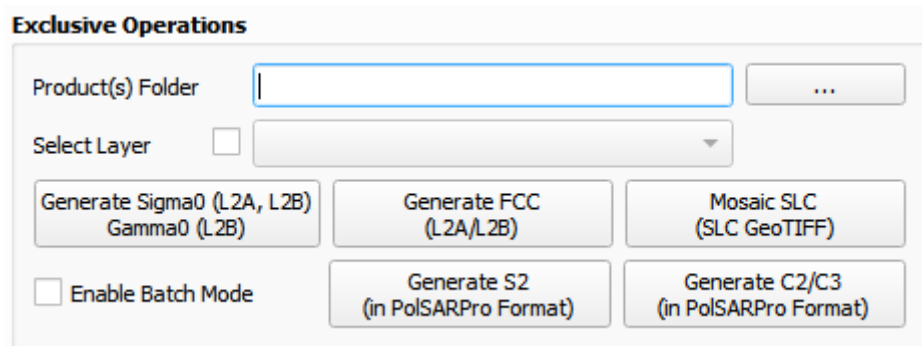


Figure 23: UI Elements showing the EOS-04 processing toolbox and its functionalities

Sigma0 and Gamma0 Generation

EOS-04 data products are organized in different levels, and this functionality takes input of both Level-2A and Level-2B data products. The Level-2A data products contain a band meta containing a calibration constant, a local incidence angle file, level-2B products also contain the same but an additional area file which provides the accurate area each pixel in the image. The Level-2A products can be converted to appropriate Radar Backscatter in Sigma0 plane, using these auxiliary data. The Level-2B products also have the required information to generate the backscatter values in the Gamma0 plane. Using the equations referenced in EOS-04 Data Product Format Document, the Sigma0 layers are generated for all the polarizations available in the product. Similarly for Level-2B products both Sigma0 and Gamma0 products are generated.

False Color Composite (FCC) Generation

This is an exclusive operation for EOS-04 Dual Polarization Level-2A and Level-2B data products. It is easy to generate colorful and meaningful images using Polarimetric Decompositions. However, for Dual Polarization data the presence of only two polarization, require the generation of a third band which is computed as difference of co-polarization and cross-polarization parameter when the value of cross-polarization channel is close to noise equivalent sigma level. The red-band in the FCC image is the co-polarization channel backscatter, the green channel is cross-polarization channel backscatter and is indicative of vegetation. The third channel indicates smooth regions.

Mosaicking of MRS & CRS SLC GeoTIFF Products

MRS & CRS modes of EOS-04 are acquired in ScanSAR mode, where each band is acquired in multiple bursts. The Level-1 & 2 products are generated after focusing

and mosaicking across each burst and band/beam. In case of the SLC products for each polarization there are eight bands for MRS and twelve bands for CRS each in a tif containing all the bursts laid sequentially. In order to mosaick them properly proper information based on the burst and beam boundaries are selected and a mosaicked image is more representative of the real scene. The mosaicked SLC products can be further used for all kinds of Polarimetric Processing.

Generation of S2/C2/C3 parameters in PolSARPro Format

SARPOLTOOL offers a lot of features for SAR Polarimetry. Similarly, PolSARPro is a powerful tool developed by ESA for Polarimetric Analysis. In order to enable users of EOS-04 data products to harness the wide range of polarimetric tools available in PolSARPro, this feature is introduced in SARPOLTOOL. This exports the data in standard PolSARPro format in form of ENVI readable rasters and a config file to ingest the same data in PolSARPro. For all possible combinations of Polarizations the S2 product can be generated from SARPOLTOOL and the same can be imported in PolSARPro. Coherency Matrices C2 & C3 for Hybrid and Full Polarization products are also generated from SARPOLTOOL. These are standard products for Polarimetric Analysis in PolSARPro.

NISAR Utilities

NISAR (NASA-ISRO Synthetic Aperture Radar) is a cutting-edge Earth observation mission jointly developed by NASA and ISRO, designed to systematically monitor Earth's land and ice surfaces using L-band and S-band SAR sensors. Scheduled for launch in the near future, NISAR will be the first radar satellite mission to employ dual-frequency SAR with a hybrid-polarimetric (compact-pol) configuration, enabling wide-area, high-resolution imaging with enhanced revisit times. It represents a state-of-the-art advancement in global monitoring, supporting critical applications like agriculture, forestry, hydrology, natural hazards, and climate change studies. Recognizing the importance of NISAR's unique data structure, SARPOLTOOL integrates support for NISAR hybrid polarimetric products, providing users with the ability to visualize, analyze, and perform polarimetric decompositions such as m-delta, m-chi and other hybrid-pol tailored algorithms. This enables researchers and analysts to fully exploit the potential of NISAR data for environmental monitoring and geospatial intelligence directly within the QGIS environment. The tool also allows the users to visualize images from the hdf5 file.

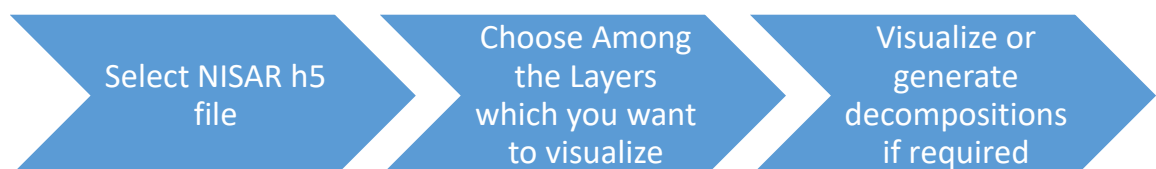


Figure 24: Basic Flow of Operations for NISAR Utilities

The basic flow of operations for visualization and polarimetric decomposition of NISAR Data Products is provided in Figure 24. The UI for the same is presented in Figure

25. The sites from which the data products can be downloaded are provided in the GUI. During the release of this tool only Sample Products of NISAR were available and hence the website of the same have been referenced.

Figure 25: UI elements of NISAR Utilities Toolbox in SARPOLTOOL

SLC Magnitude Viewer

QGIS is one of the most powerful open source GIS tools available. It has native support for most of the datatypes encountered in GIS processing. However when it comes to visualization of complex SLC images, it fails to visualize them inherently. Hence a tool is added in SARPOLTOOL to visualize the magnitude of the SLC images of both complex, and integer types where real and imaginary data is stored in multiple bands. This allows for seamless visualization from Complex SLC tif images of EOS-04, Sentinel, Radarsat-2 etc.

Figure 26: UI elements of the Complex SLC Image Viewer in SARPOLTOOL

The flow of operations for the complex SLC viewer is simplest among all the utilities where the SLC GeoTIFF file path needs to be provided and upon clicking visualize the magnitude is computed stored in another tif and the same is added to the canvas of QGIS.

General Purpose Toolbox

This is the second groupbox of the Processing Toolbox Dockwidget of SARPOLTOOL. This group consists of standard operations that are applicable on any raster layer. This toolbox mainly consists of three tabs that enable Speckle Filtering, Water Layer Generation & CFAR based Ship Detection. This section describes all the tabs present in the General-Purpose Toolbox.

Speckle Filtering

Speckle noise is an inherent characteristic of SAR imagery, caused by the coherent nature of radar signal acquisition. It appears as granular, salt-and-pepper-like noise, which degrades image quality and can obscure important features, making interpretation and analysis more challenging. To address this, SARPOLTOOL provides a suite of speckle filtering algorithms that help suppress noise while preserving structural and textural details. The plugin includes commonly used filters such as the Lee, Enhanced Lee, Kuan, Frost, and Median filters—each suitable for different scenarios and levels of noise. Users can apply these filters to any raster layer by specifying the kernel size, allowing fine control over the balance between smoothing and detail preservation. This flexibility enables effective pre-processing of SAR data for improved visualization, classification, and polarimetric analysis within the QGIS environment.

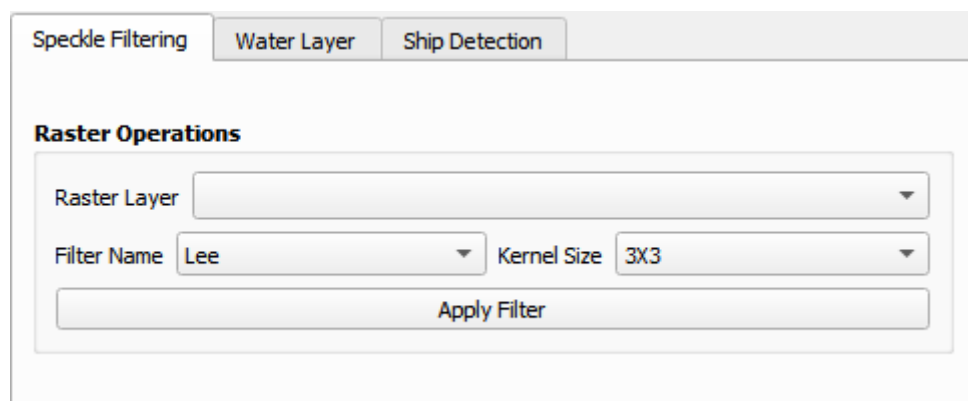


Figure 27: UI Elements of Speckle Filtering Tab of General Purpose Tools

The flow of operations for speckle filtering starts when the raster to be filtered is loaded as a layer and present in QGIS canvas. In such a scenario, select the layer to be filtered in the drop-down, then select the nature of filter and kernel size. When Apply Filter is clicked another tif containing the filtered image is created and loaded in the canvas.

Water Layer Generation

SAR images often require delimitation of Water Layer as they cause specular reflection and cause remaining analysis of the scene to be biased. In order to generate a segmentation map of which pixels are representative of water on ground a comprehensive algorithm to segment water from image is implemented. It is referenced

from the OpenSARLab ASF notebooks for Sentinel-1 automated water body segmentation. In this approach the DN layer, corresponding Sigma0 layer and a Height Above Nearest Drainage (HAND) layer is utilized to generate a Water Layer corresponding to the scene, it must be noted that all the three layers should be of similar dimensions and correspond to the same area.

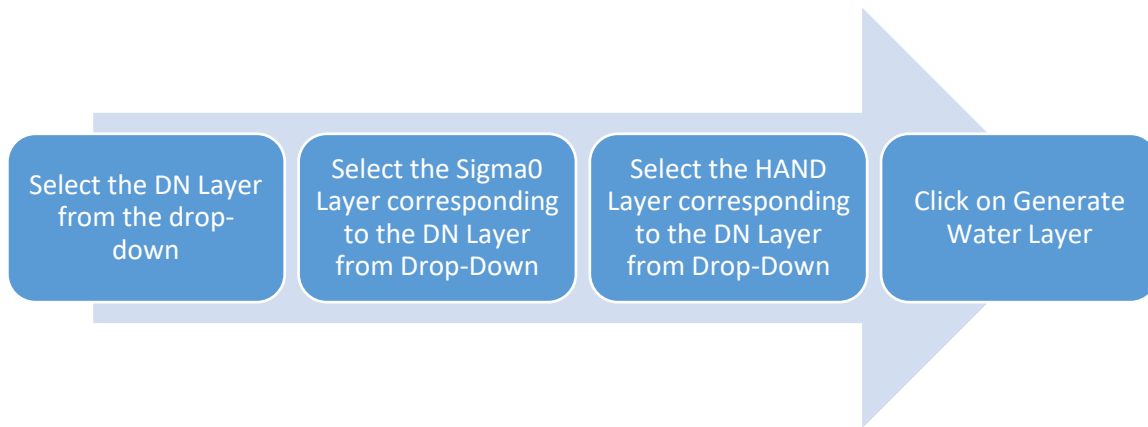


Figure 28: General Flow of Operation for Generation of Water Layer in SARPOLTOOL

The general flow of operations for generation of Water Layer in SARPOLTOOL is shown in Figure 28. The UI elements which are referenced in this section are shown in Figure 29.

The screenshot displays the SARPOLTOOL user interface with three tabs: 'Speckle Filtering', 'Water Layer', and 'Ship Detection'. The 'Water Layer' tab is active. Under the 'Water Layer' heading, there are three dropdown menus labeled 'DN Tif', 'Sigma0 Tiff', and 'HAND Tif'. Below these menus is a button labeled 'Generate Water Layer'.

Figure 29: UI elements showing the components for generation of Water Layer in SARPOLTOOL

Ship Detection

Ship detection in SAR imagery is a critical application in maritime surveillance, and SARPOLTOOL implements an efficient detection algorithm based on CFAR (Constant False Alarm Rate) processing. CFAR is a statistical technique that dynamically adapts a detection threshold based on the local background clutter, allowing robust identification of bright targets—such as ships—against the ocean surface. In SARPOLTOOL, the CFAR module scans the SAR backscatter image using a sliding window approach, analyzing the pixel intensity in relation to its surrounding background pixels. Users can configure parameters such as window size, guard cells,

and the desired false alarm rate to optimize performance based on sea conditions and image resolution. The output is a binary detection map highlighting potential ship targets, which can be visualized, vectorized, and exported for further analysis. This tool enables reliable ship detection even in challenging environments, supporting maritime security, traffic monitoring, and illegal fishing detection. SARPOLTOOL offers users to implement ship detection in Cell-Averaging, Line Ordered Statistics and Ordered Statistics CFAR algorithm.

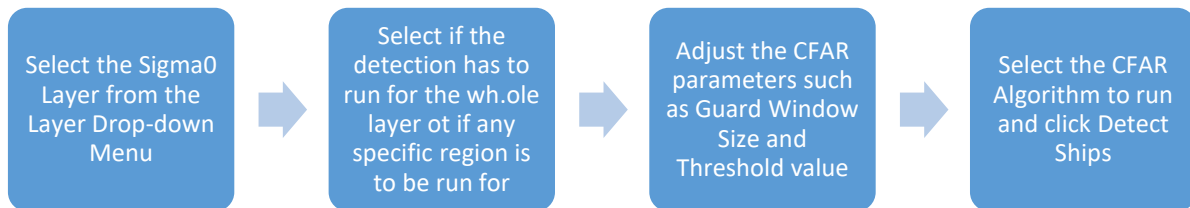


Figure 30: General Flow of Operations for Ship Detection in SARPOLTOOL

The general flow of Operations for ship detection in SARPOLTOOL is provided in Figure 30. The UI elements discussed in this section are displayed in Figure 31.

The screenshot shows the 'Ship Detection' tab selected in the 'General Purpose Toolbox'. The interface includes a 'Sigma 0 Layer' dropdown menu, an 'AOI Layer' dropdown menu with a 'Full' checkbox, and 'CFAR Parameters' with three input fields (0.1, 25, 25), a 'Cell Averaging' dropdown menu, and a 'Detect Ships' button.

Figure 31: UI elements for Ship Detection Tab of the General Purpose Toolbox

Batch Processing

This version of SARPOLTOOL allows users to process batchwise for multiple similar operations in a single click. The approach is enabled in every tab of the Theme Specific Toolbox where a checkbox ☐ **Enable Batch Mode** is provided for the user. The mode of operation is that if user checks this box and provides a directory path containing all the folders on which the same process has to be run, SARPOLTOOL will sequentially run all the products for the same operation. The progress during this run is displayed in the Batch Processing Progressbar located below the General Purpose Toolbox in Figure 32. The options for choosing where the output will be saved is common for all the processing toolboxes as well as batch processing. It is highly recommended that the same must be initialized before running SARPOLTOOL. By default most of the

processing happens in the directory specified in Output Folder or in the Input Folder if the check box is enabled.

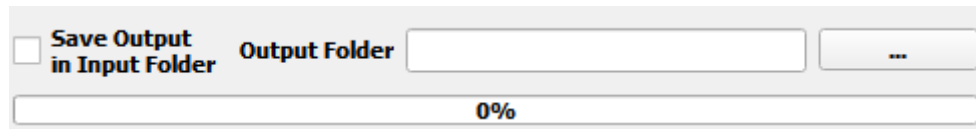


Figure 32: Batch Processing Progress-bar and Output Location Selection

Output Folder

As shown in Figure 32, the selection of Output Folder can be any writable folder path, or by click of a check box the Output Directory can be initialized to the input directory, this is made to save time such that all the outputs corresponding to a product are stored in a folder corresponding to that product. The Tabs of Polarimetric Processing, Polarimetric Decomposition, SAR Backscatter and SAR Functionalities provide output only in the Input Folder.

Time Series Analysis Dockwidget

This version of SARPOLTOOL brings along with the TimeSeries Analysis Toolbox, the salient functionalities of this toolbox include automatic plotting of the layer values across different bands. In order to use this functionality, all the layers which have to be tracked in time have to be stacked into a single layer such that each date corresponds to a band. Then the Layer is to be added in the Time Series Analysis Tool, and upon clicking on a point in canvas the location's time profile can be displayed. This can also be extended to a Region of Interest if its corresponding Vector Layer is also loaded. Detailed steps are provided in Annexure.

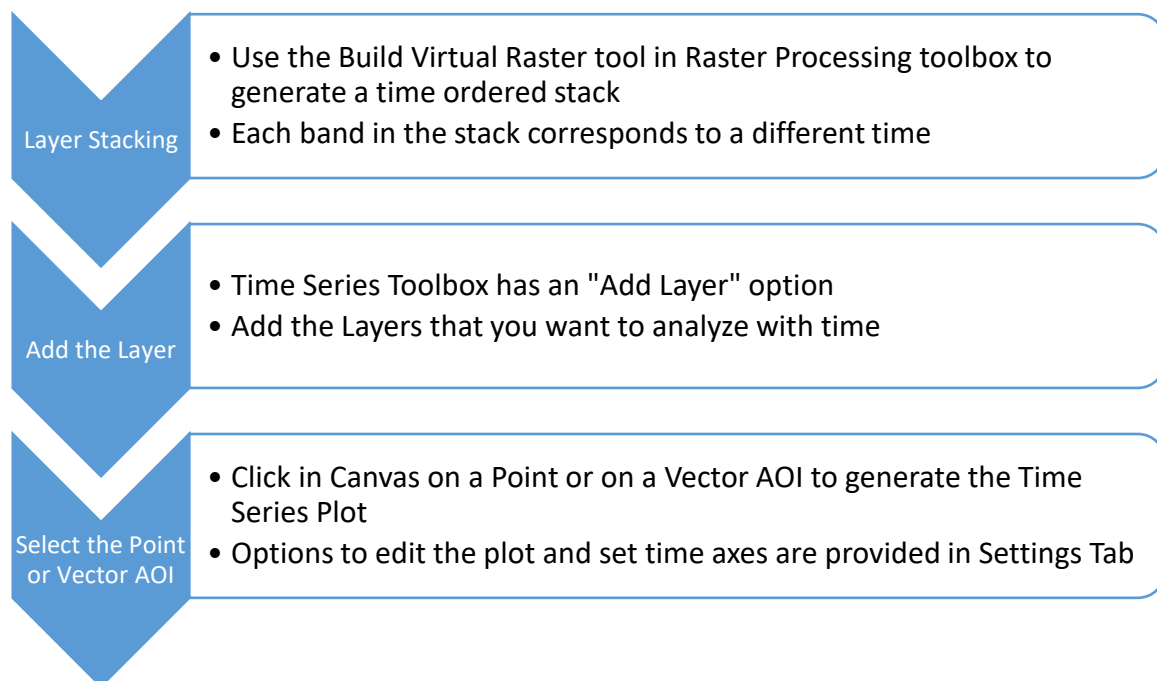


Figure 33: General Flow of Operations for the Time Series Analysis Toolbox

The general flow of operations for the Time Series Toolbox is shown in Figure 33, and the UI elements for the same can be seen in Figure 34. The remaining section denotes the other features of this tool.

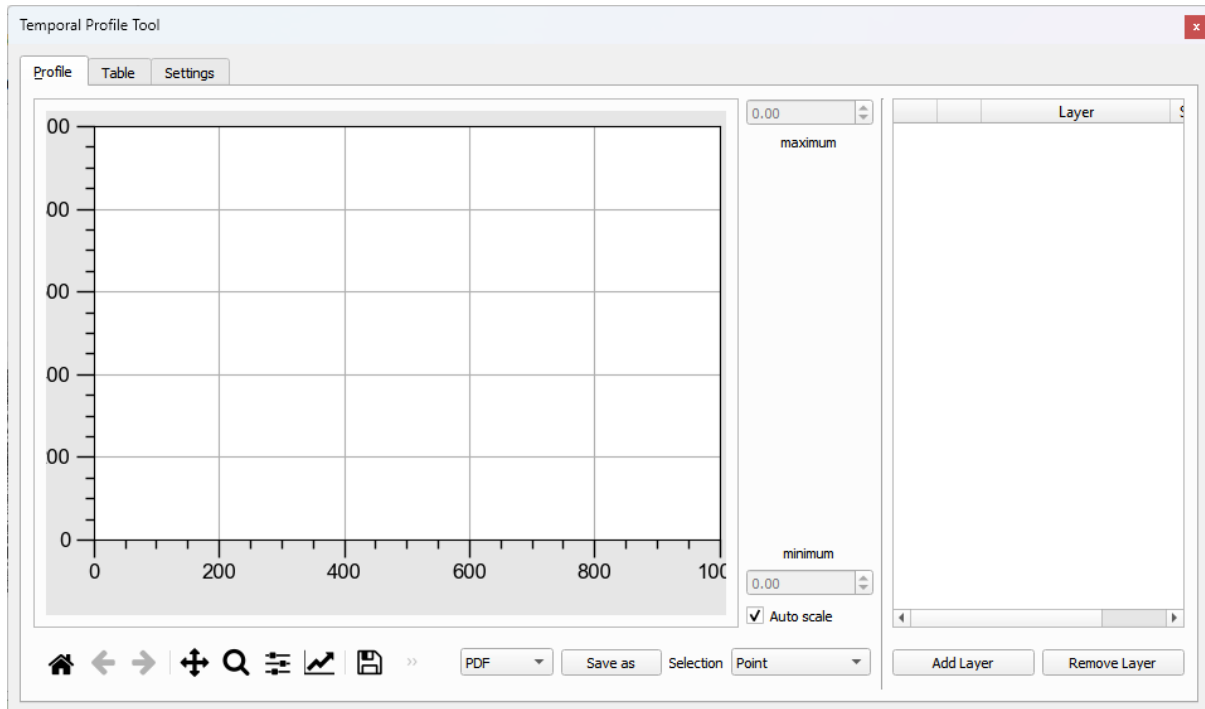


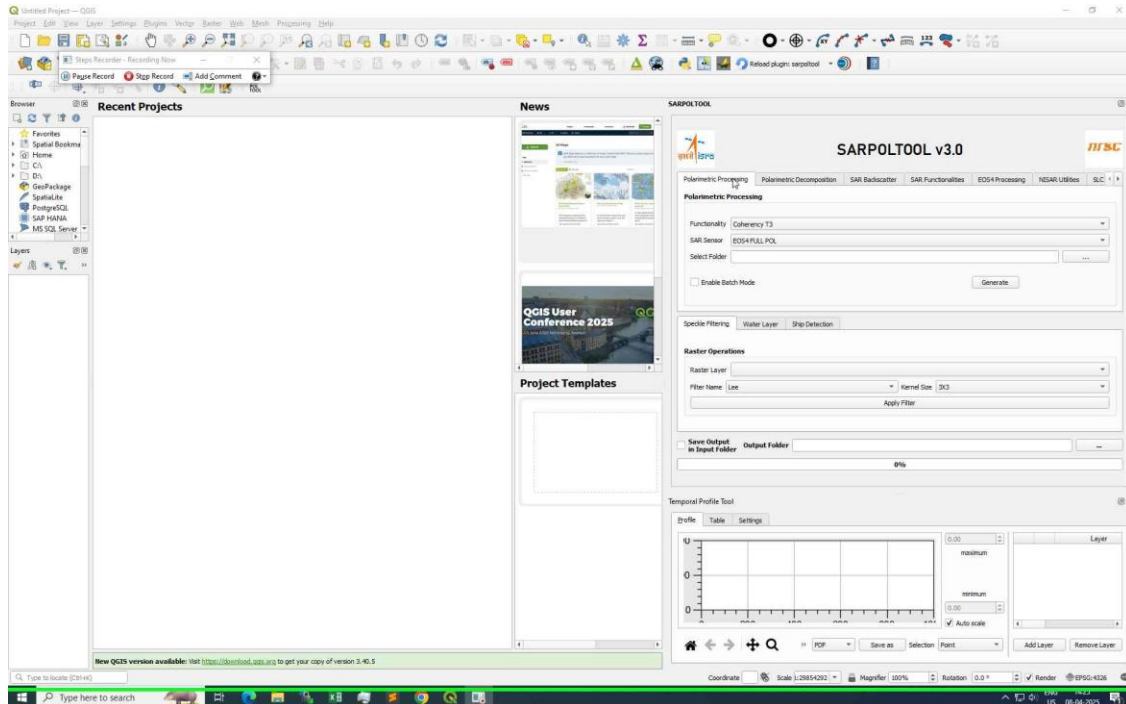
Figure 34: UI Elements of the Temporal Profile Tool of SARPOLTOOL

The other tabs in this toolbox allow users to configure the display, show tabular display of the information displayed in the graph. The table tab is useful if data for an area or point is to be extracted and used in another processing framework. The settings tab allows user to set the plotting backend if more than one plotting framework is found installed. Users can also set the Timestamps in the x-axis in the Settings tab, otherwise general graph editing can be done in the buttons provided below the graph in Profile tab itself.

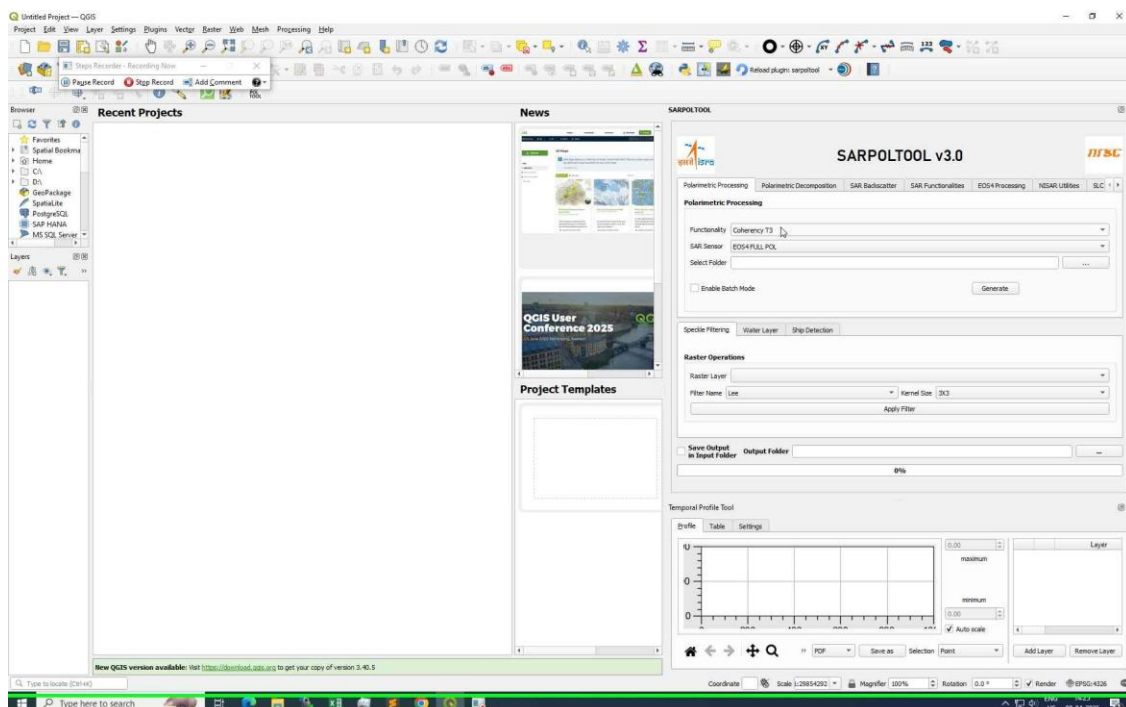
Annexure

Polarimetric Processing – Sample Operation

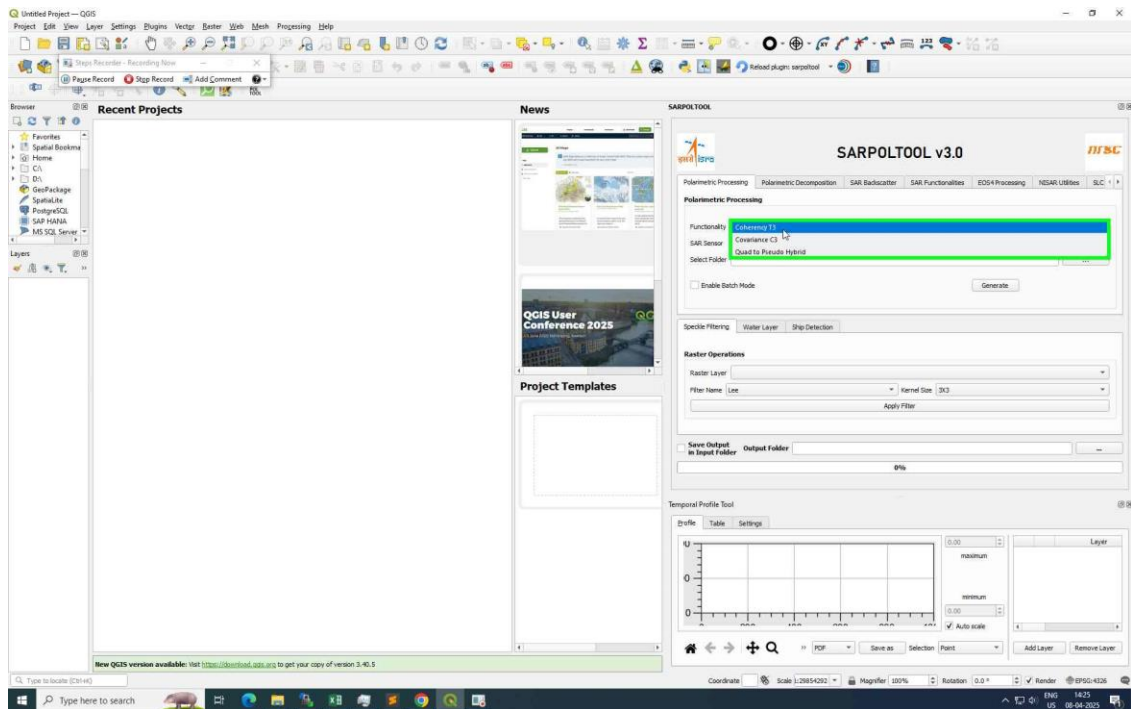
Step 1: (08-04-2025 14:25:12) User left click in "Untitled Project — QGIS"



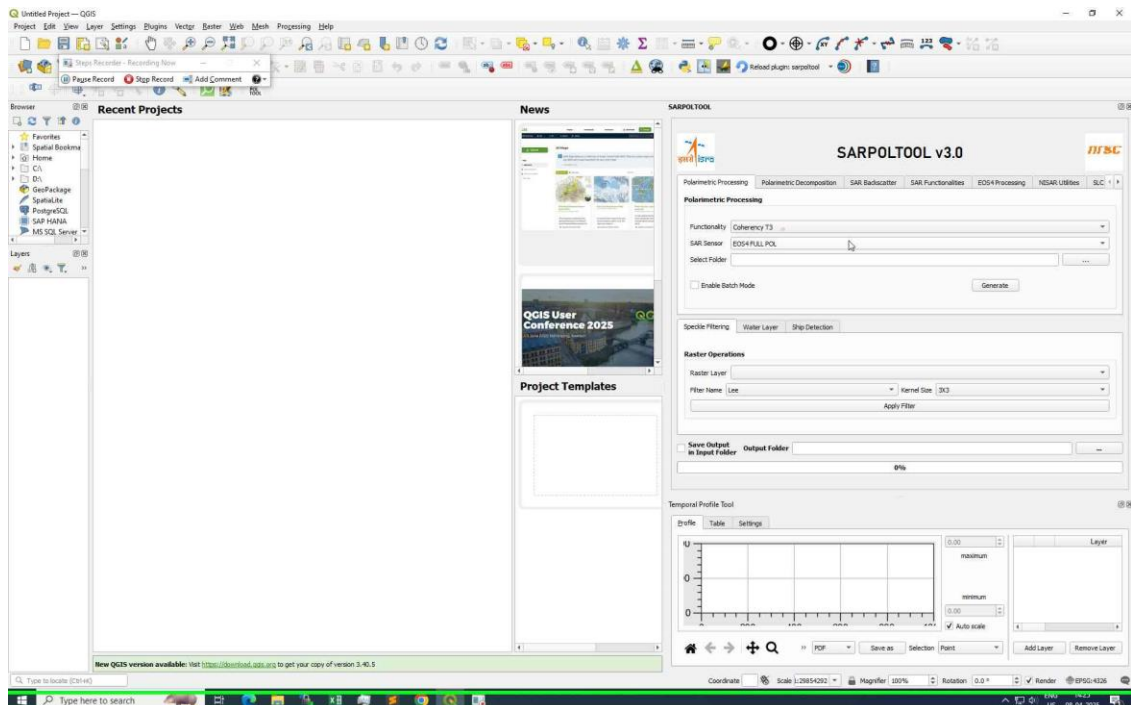
Step 2: (08-04-2025 14:25:14) User left click in "Untitled Project — QGIS"



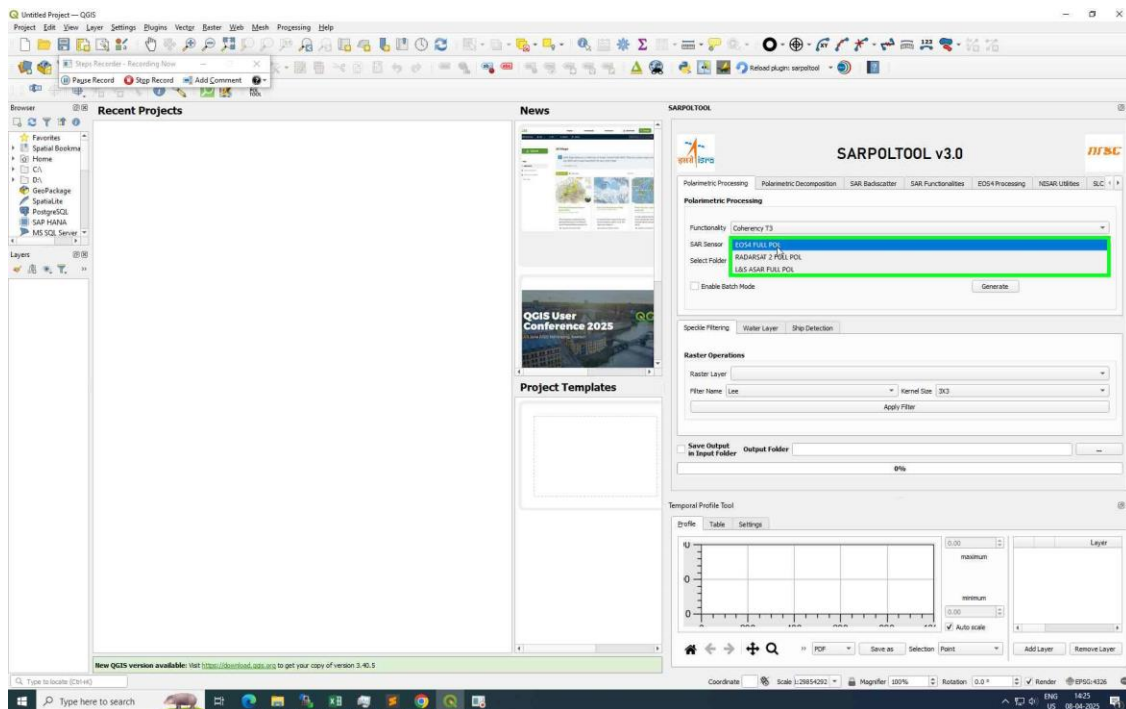
Step 3: (08-04-2025 14:25:20) User left click in "QGIS3"



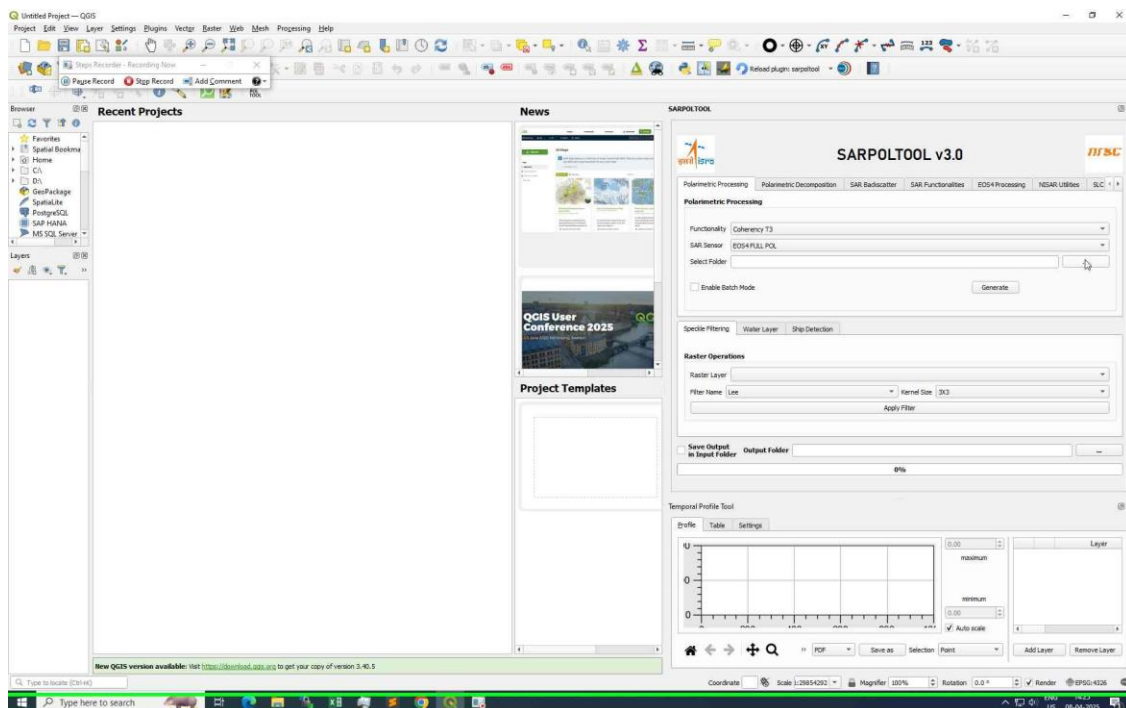
Step 4: (08-04-2025 14:25:21) User left click in "Untitled Project — QGIS"



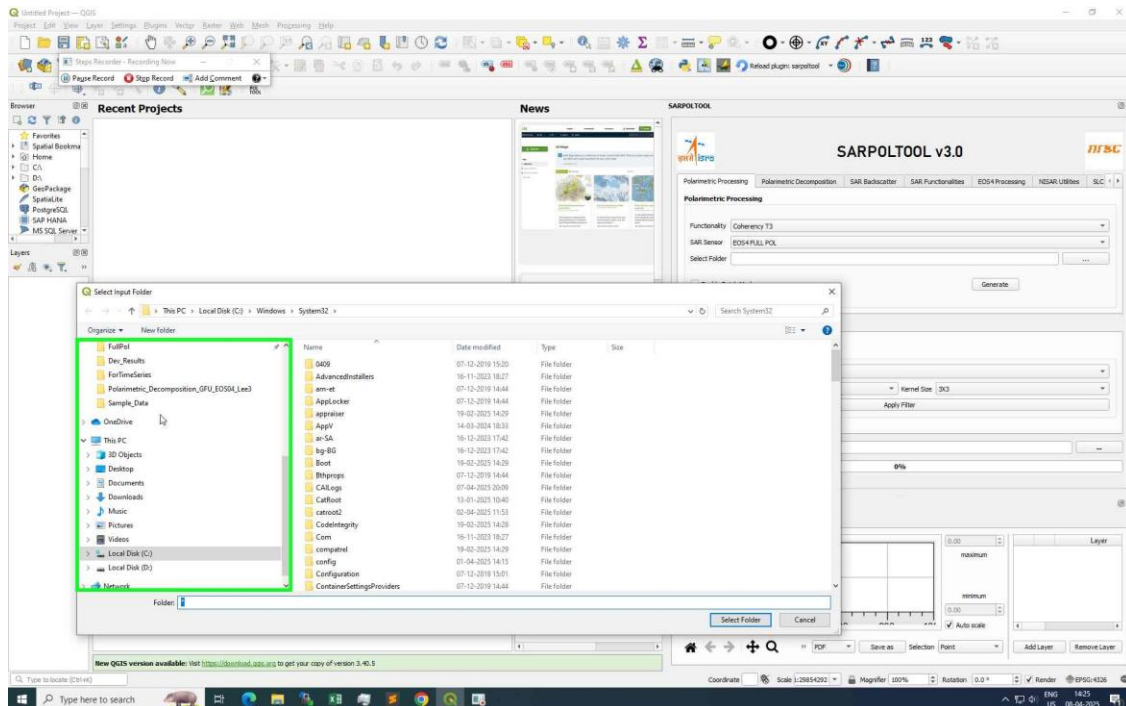
Step 5: (08-04-2025 14:25:25) User left click in "QGIS3"



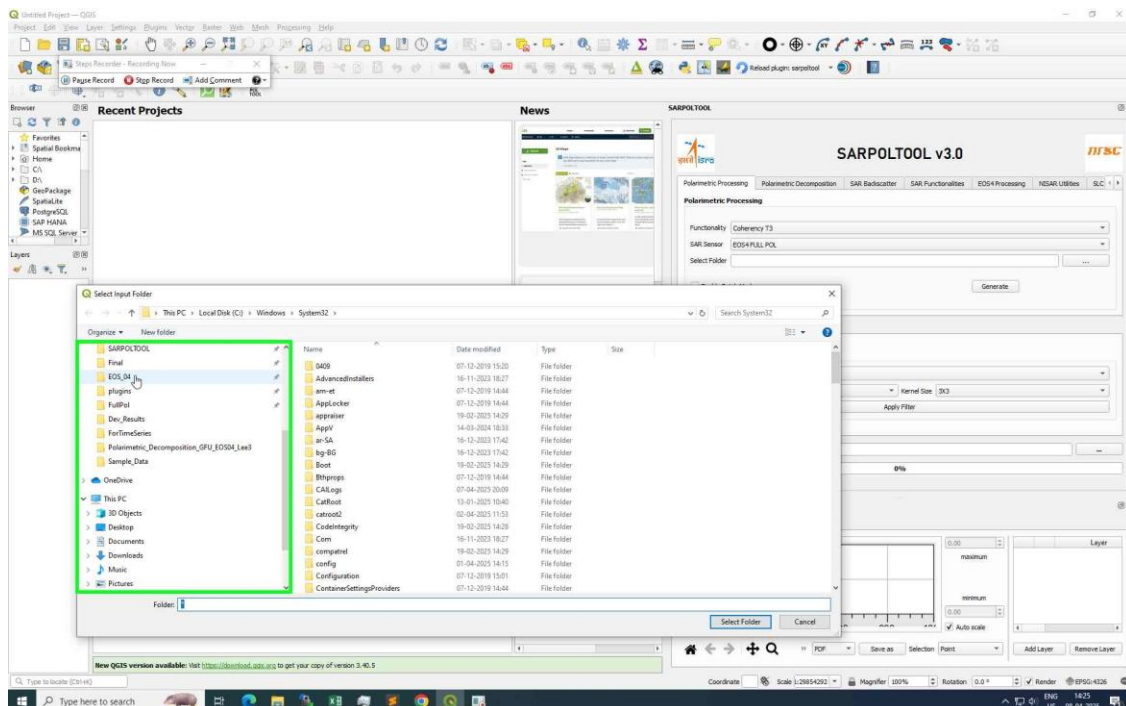
Step 6: (08-04-2025 14:25:27) User left click in "Untitled Project — QGIS"



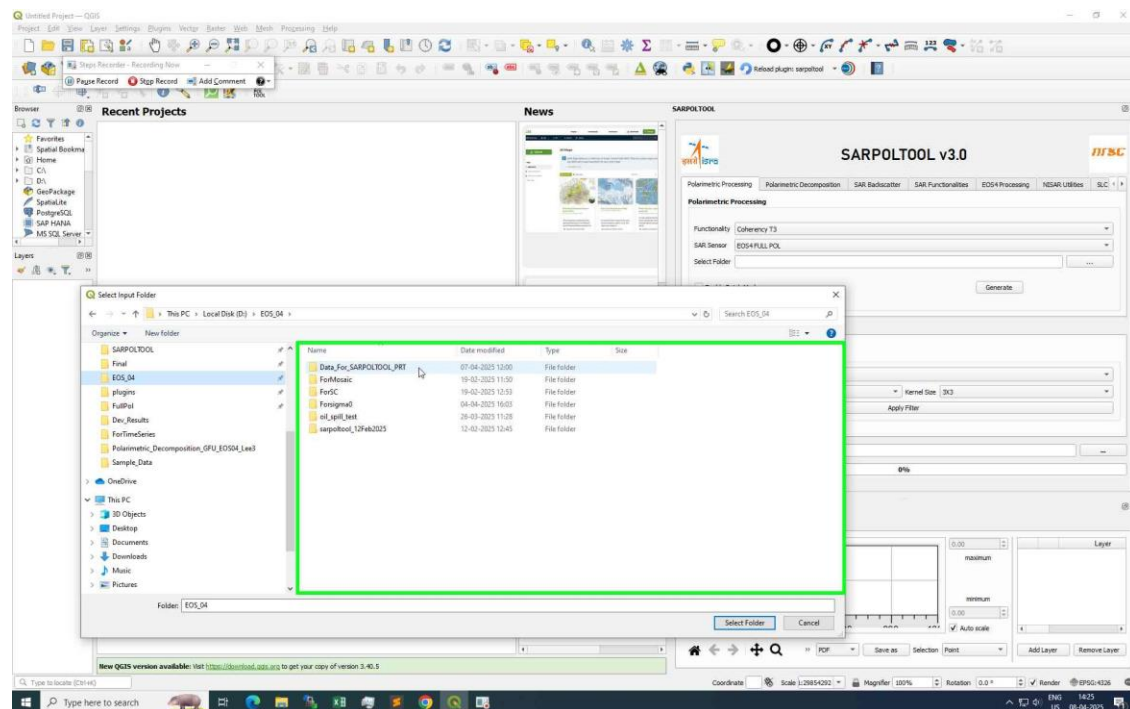
Step 7: (08-04-2025 14:25:31) User mouse wheel up on "OneDrive (tree item)" in "Select Input Folder"



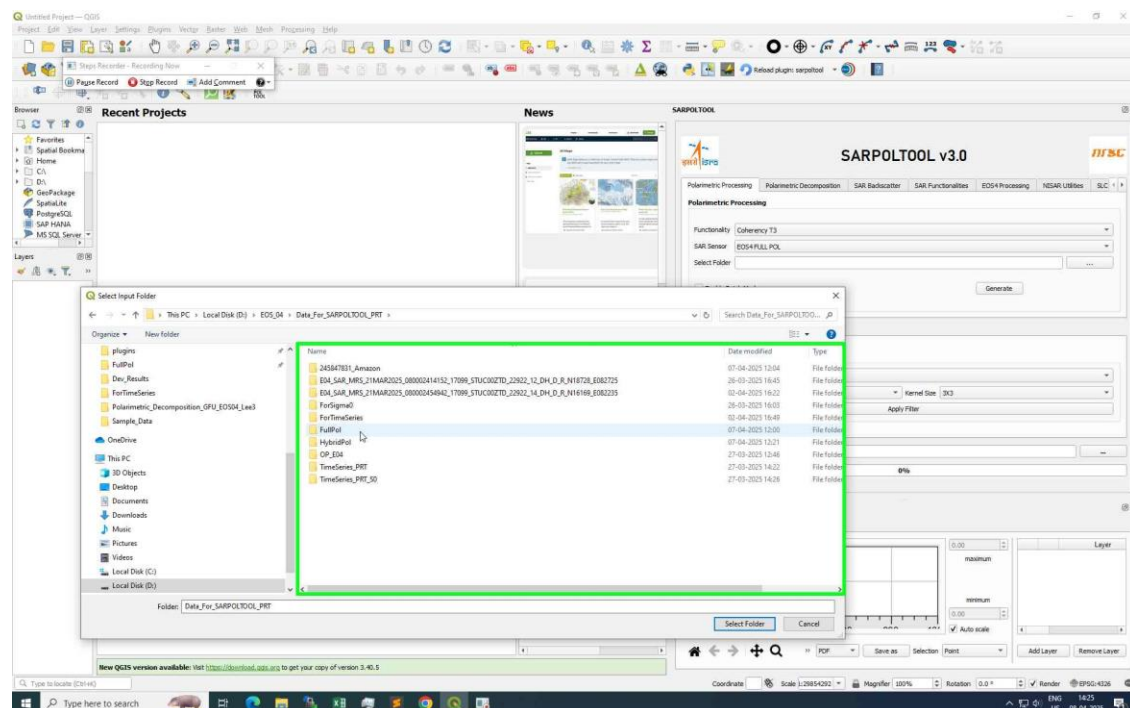
Step 8: (08-04-2025 14:25:32) User left click on "EOS_04 (pinned) (tree item)" in "Select Input Folder"



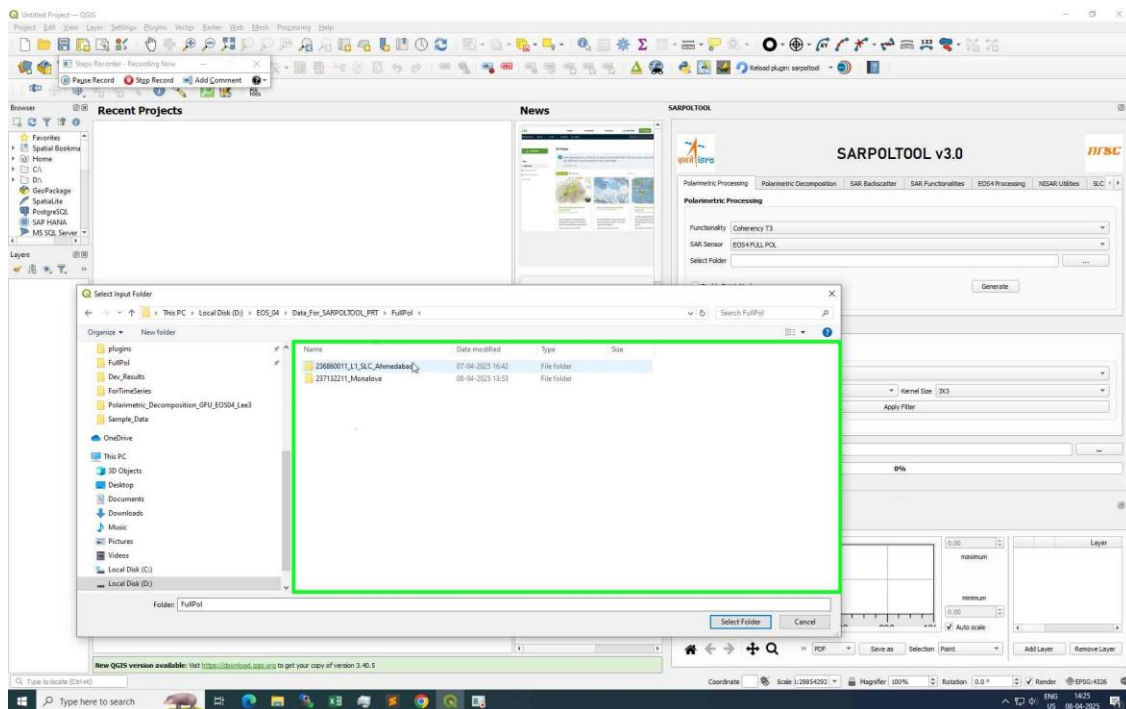
Step 9: (08-04-2025 14:25:35) User left double click on "Name (edit)" in "Select Input Folder"



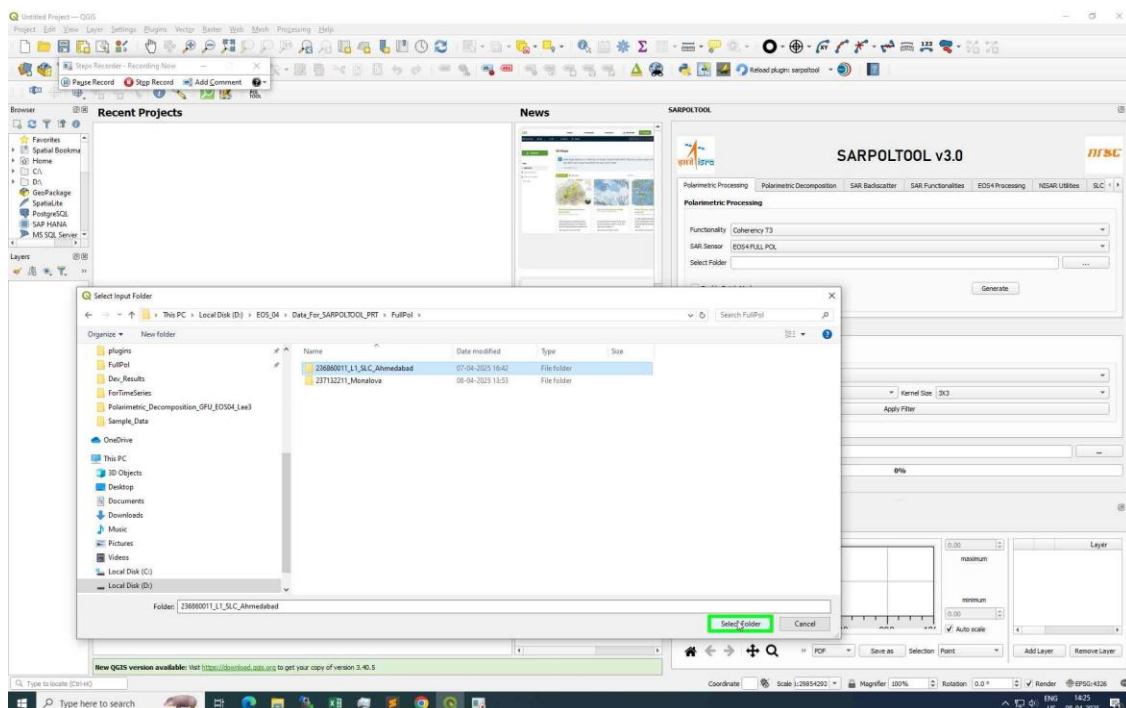
Step 10: (08-04-2025 14:25:38) User left double click on "Name (edit)" in "Select Input Folder"



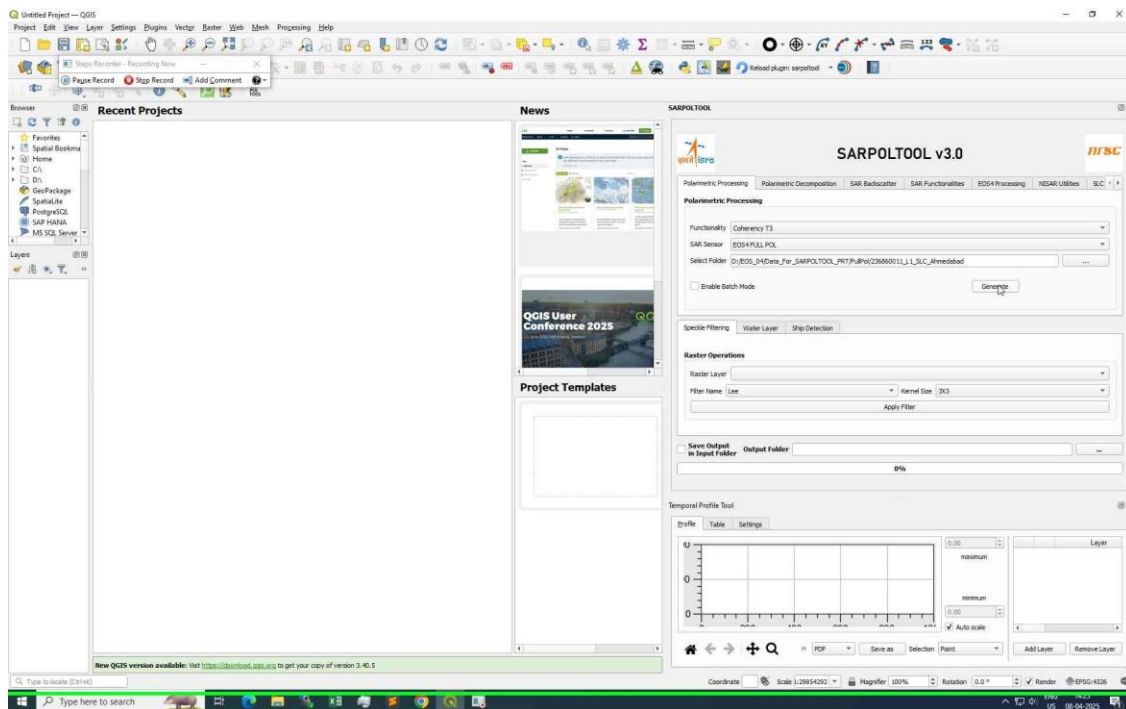
Step 11: (08-04-2025 14:25:40) User left click on "Name (edit)" in "Select Input Folder"



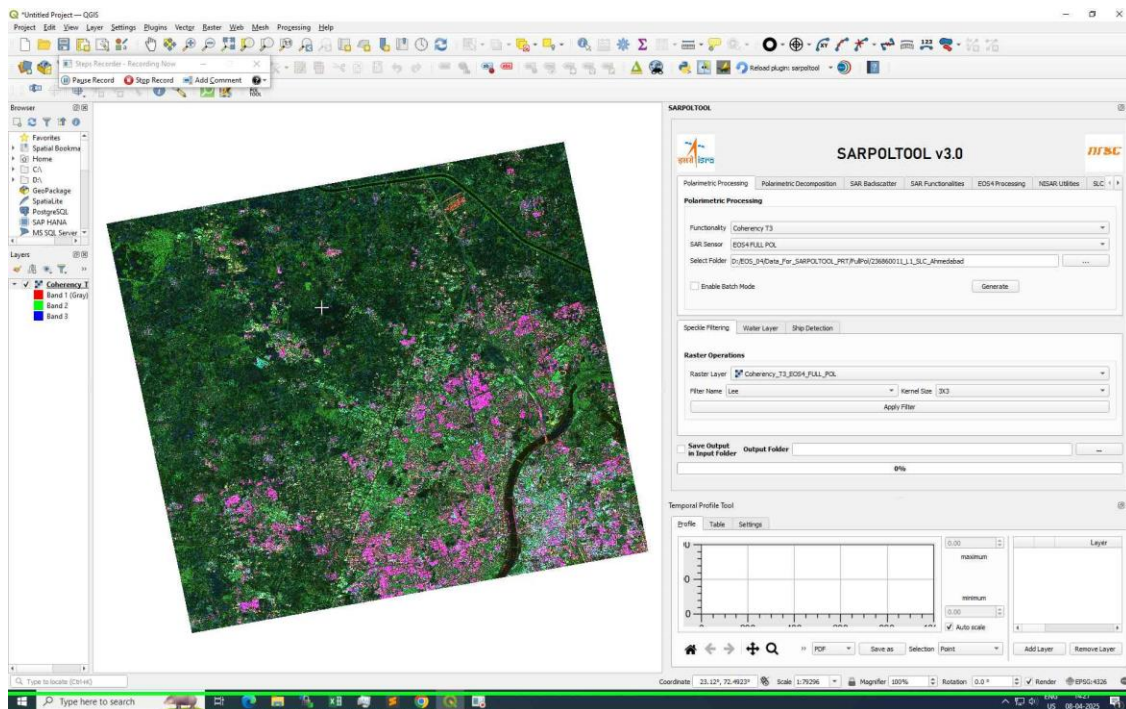
Step 12: (08-04-2025 14:25:44) User left click on "Select Folder (button)" in "Select Input Folder"



Step 13: (08-04-2025 14:25:50) User left click in "Untitled Project — QGIS"

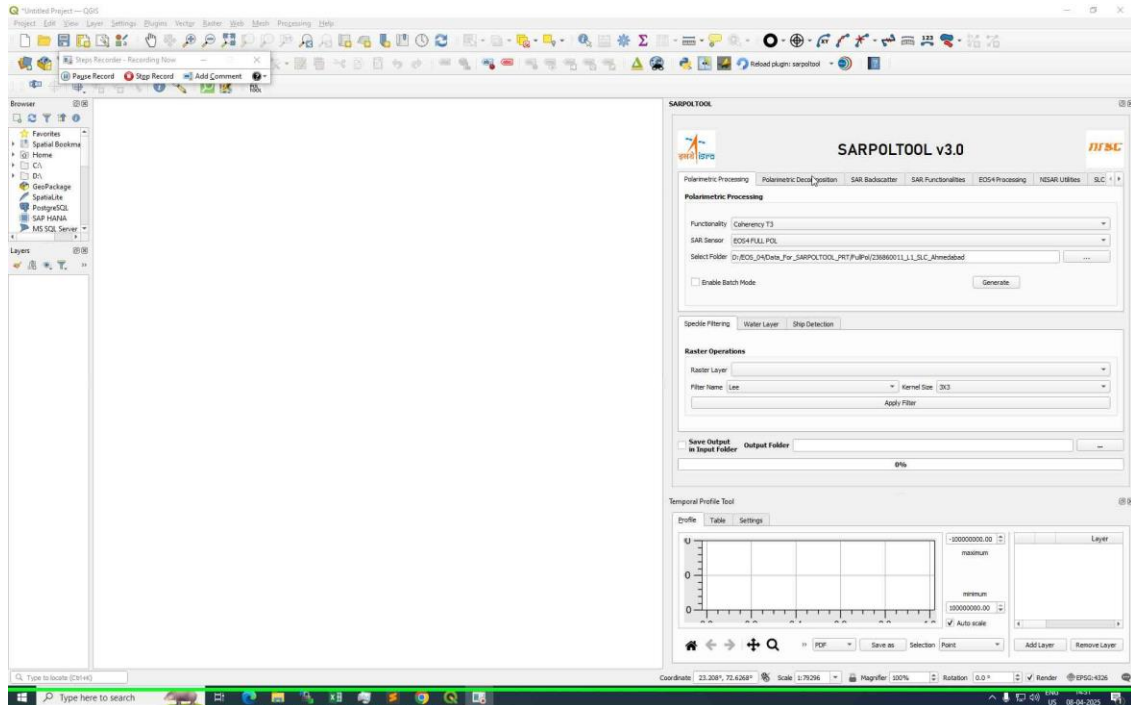


Step 14: (08-04-2025 14:27:21) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

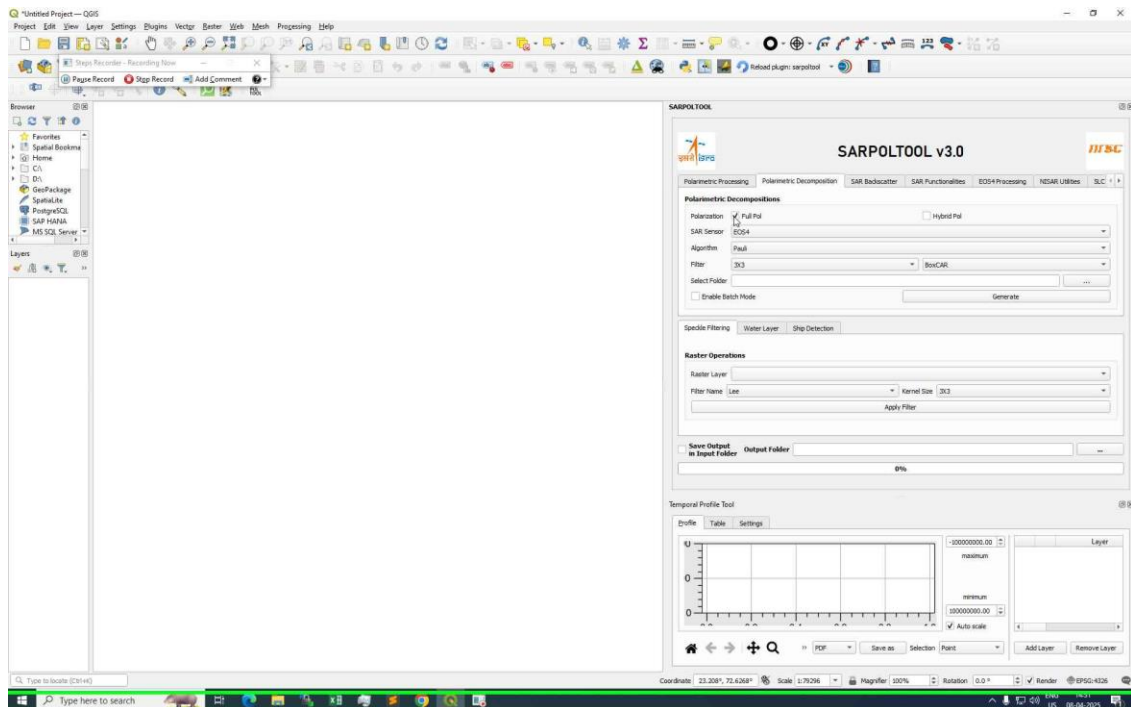


Polarimetric Decomposition – Sample Operation

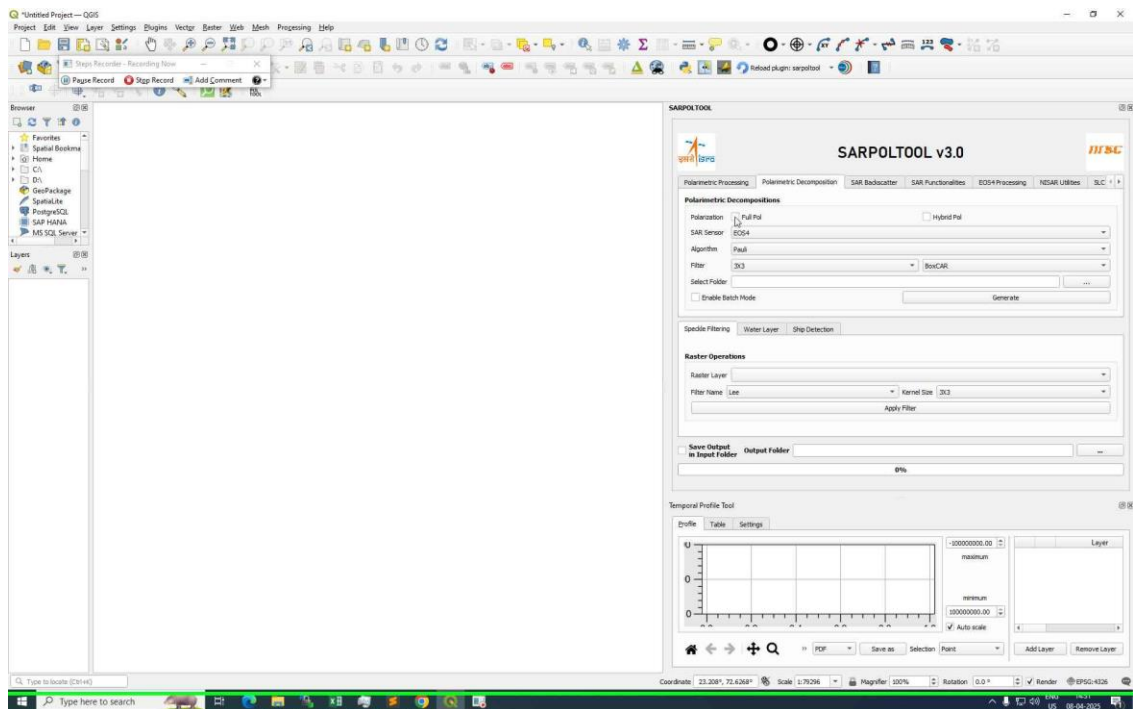
Step 1: (08-04-2025 14:31:03) User left click in "*Untitled Project — QGIS"



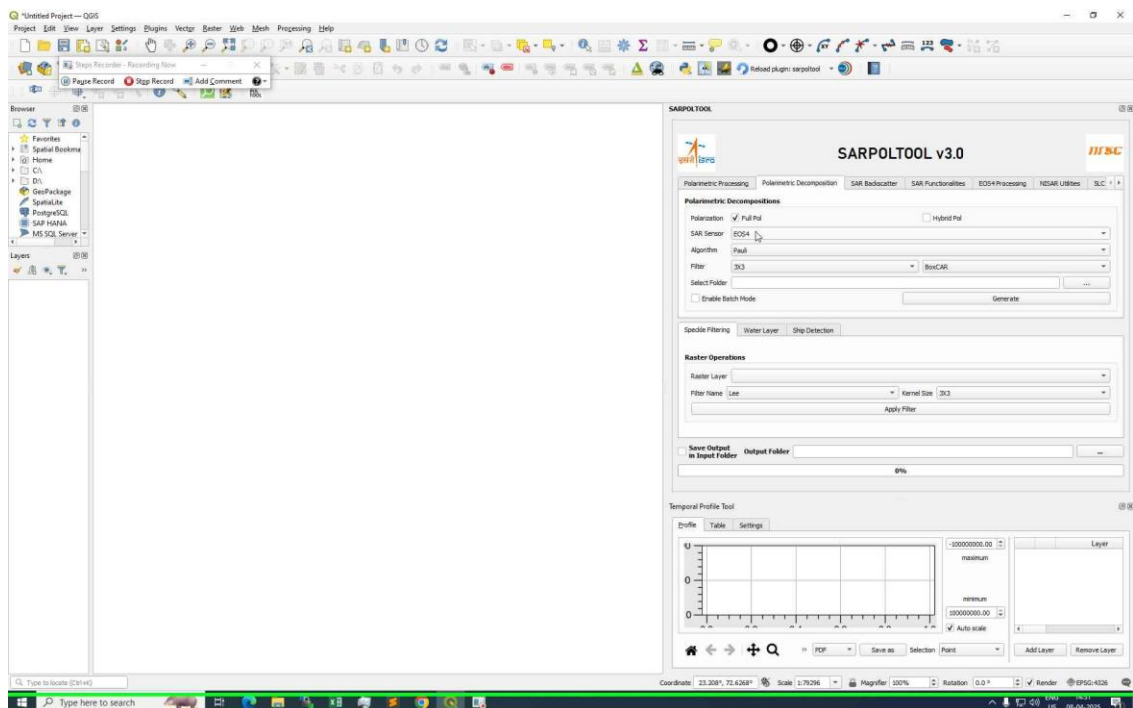
Step 2: (08-04-2025 14:31:07) User left click in "*Untitled Project — QGIS"



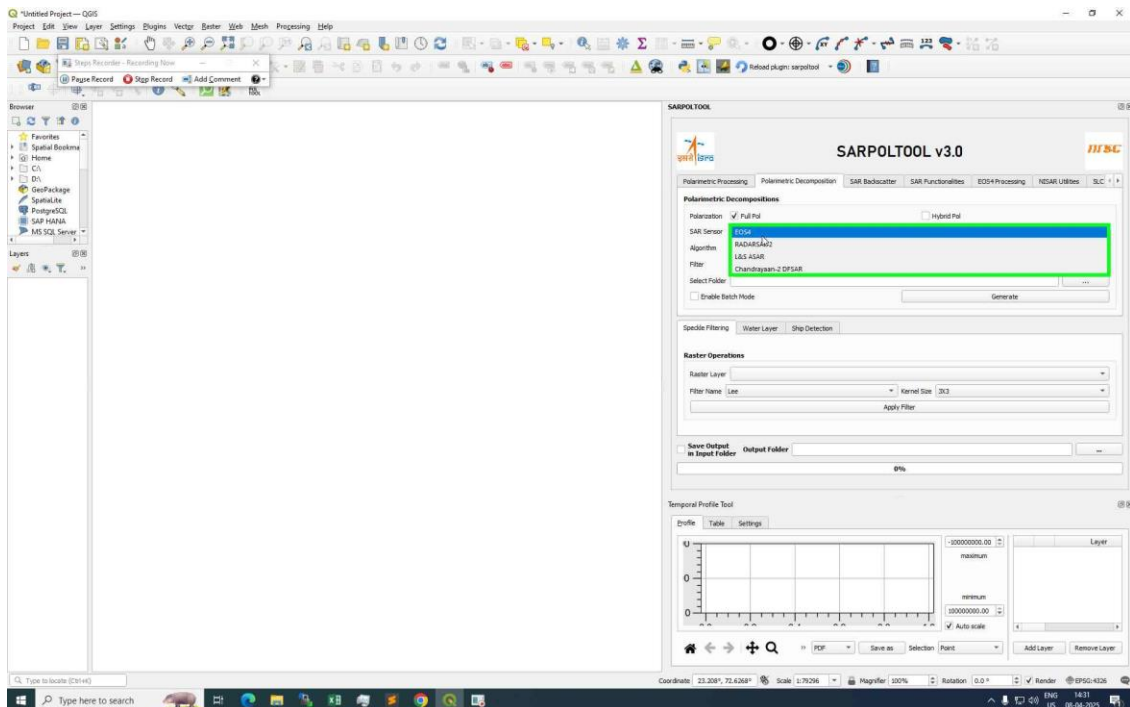
Step 3: (08-04-2025 14:31:09) User left click in "*Untitled Project — QGIS"



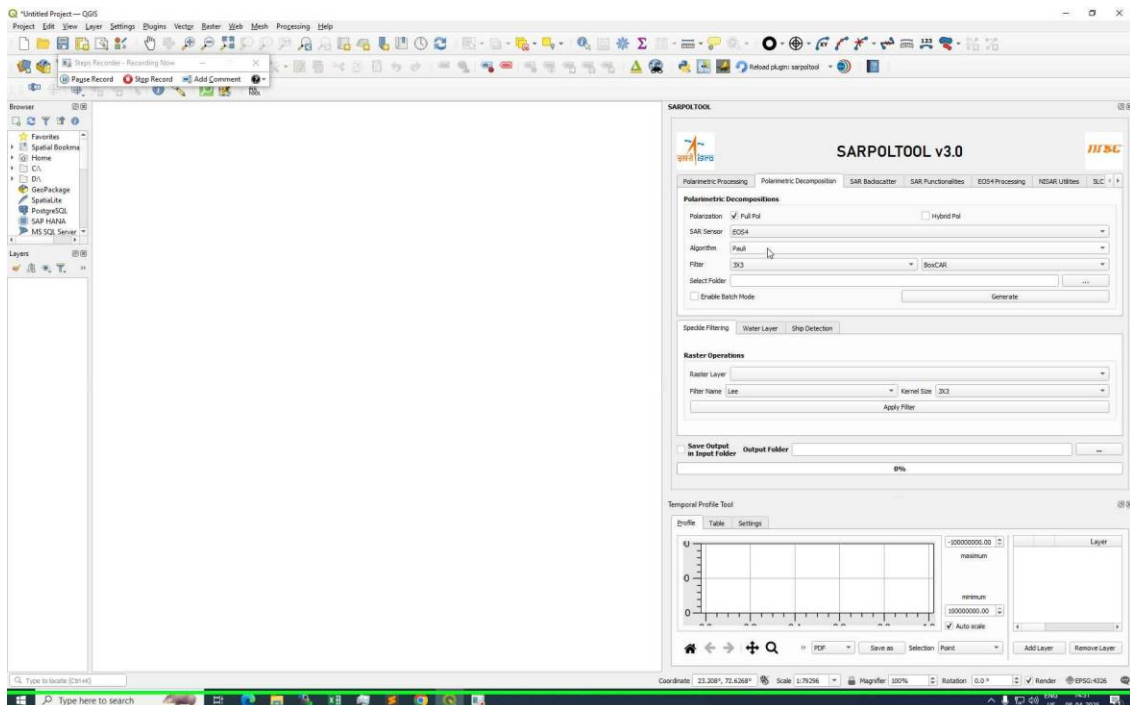
Step 4: (08-04-2025 14:31:10) User left click in "*Untitled Project — QGIS"



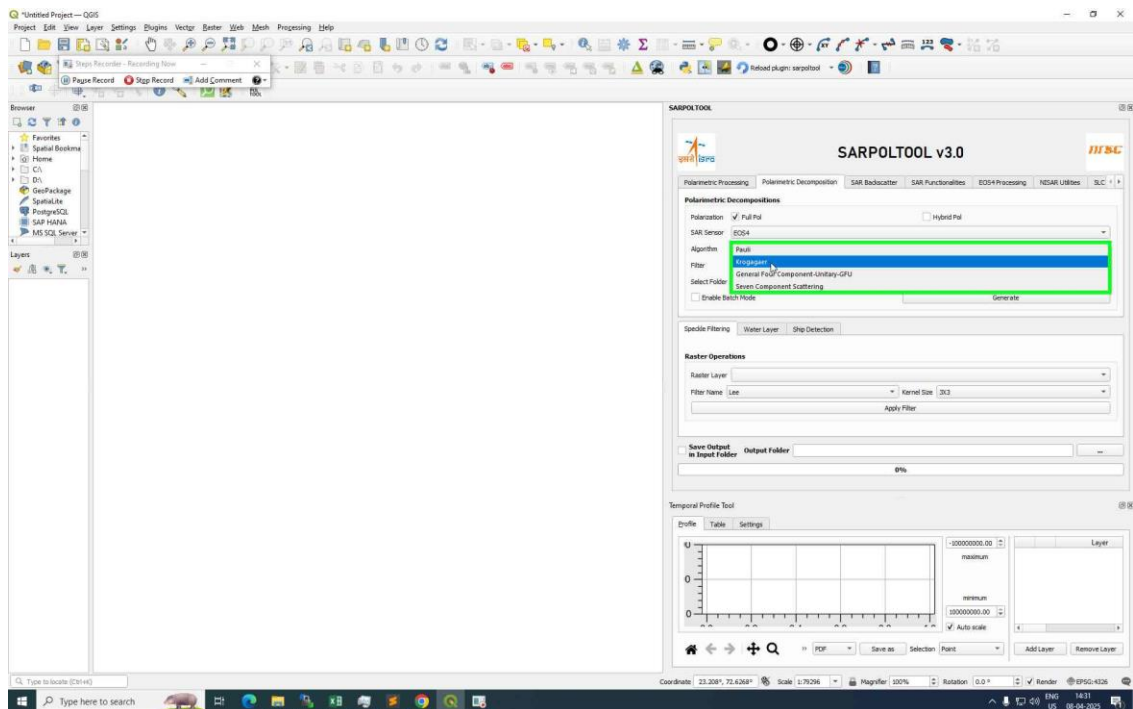
Step 5: (08-04-2025 14:31:13) User left click in "QGIS3"



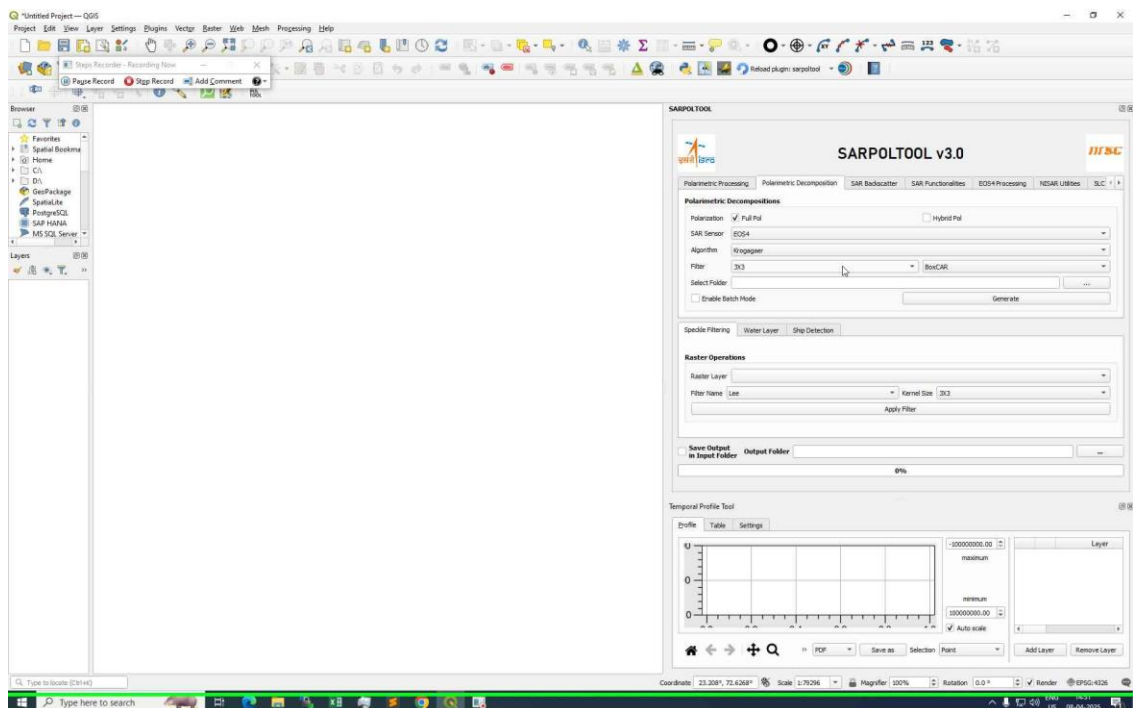
Step 6: (08-04-2025 14:31:15) User left click in "*Untitled Project — QGIS"



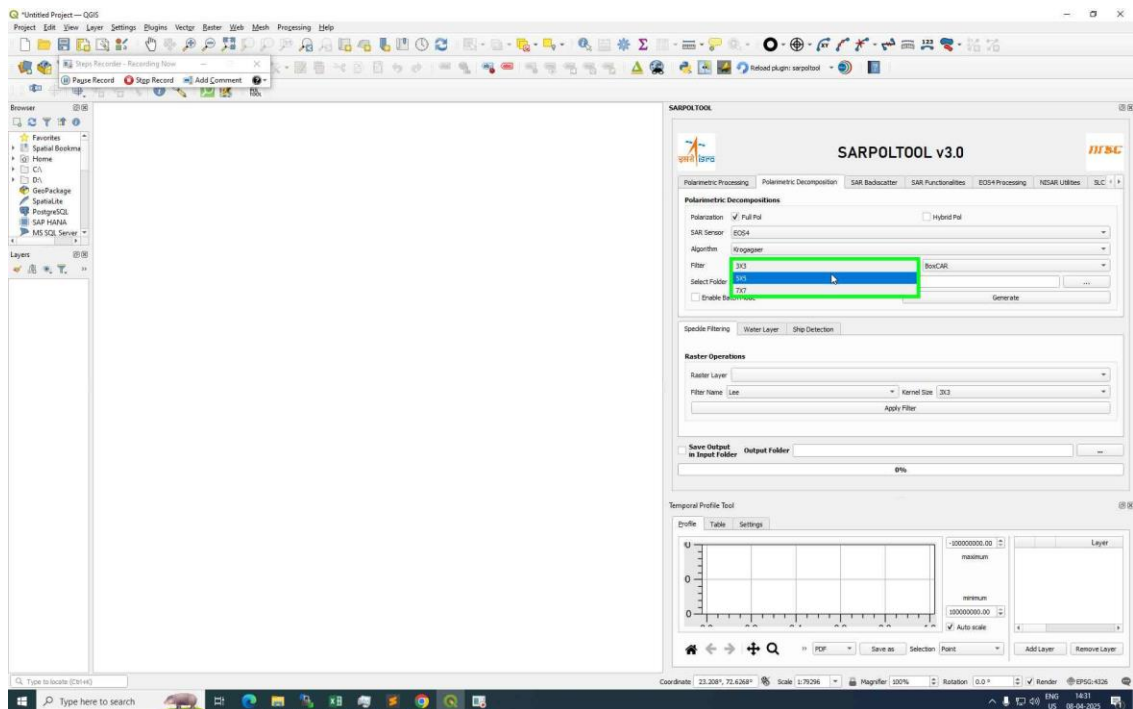
Step 7: (08-04-2025 14:31:19) User left click in "QGIS3"



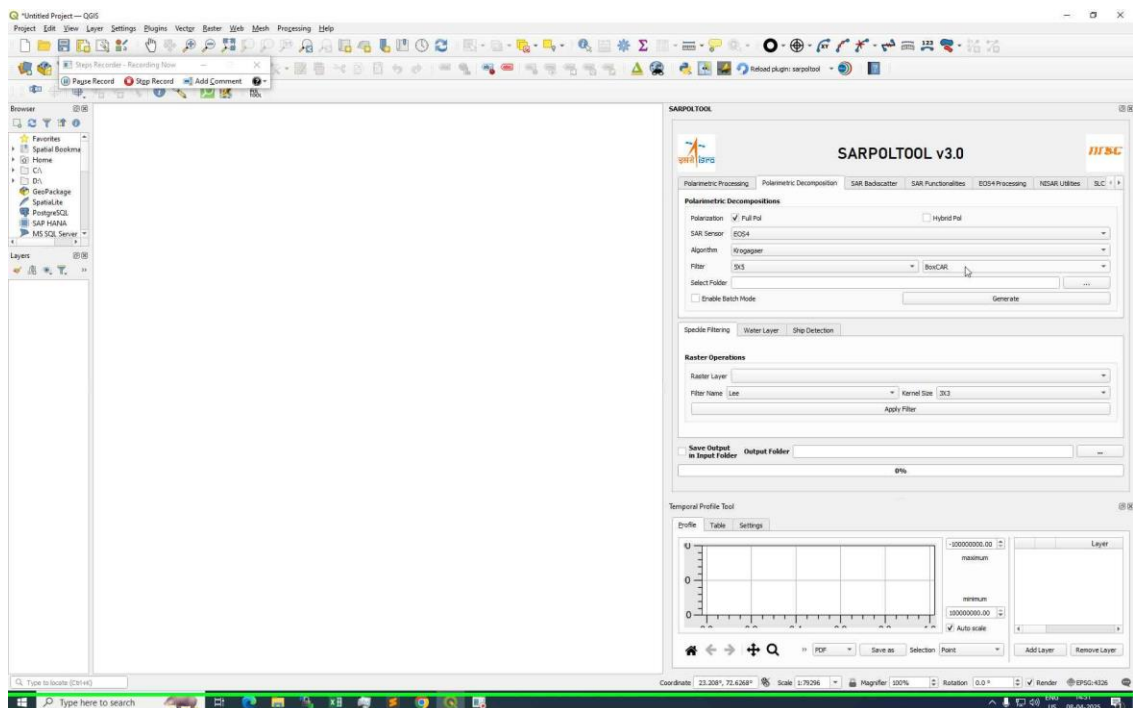
Step 8: (08-04-2025 14:31:20) User left click in "*Untitled Project — QGIS"



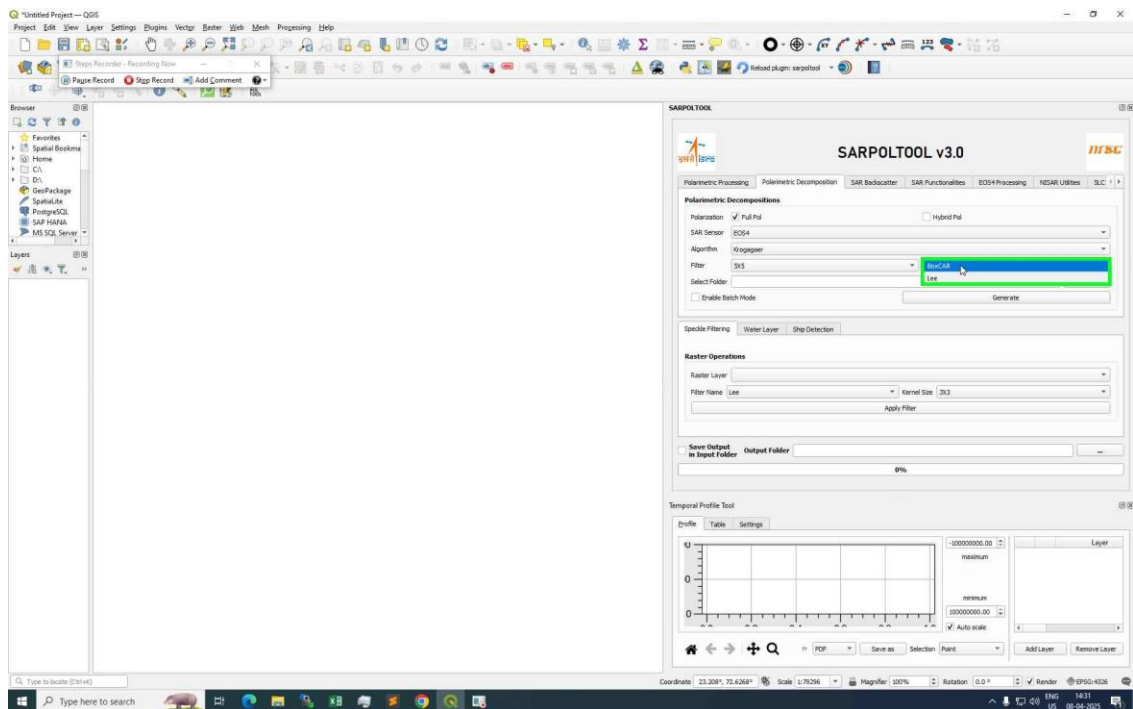
Step 9: (08-04-2025 14:31:21) User left click in "QGIS3"



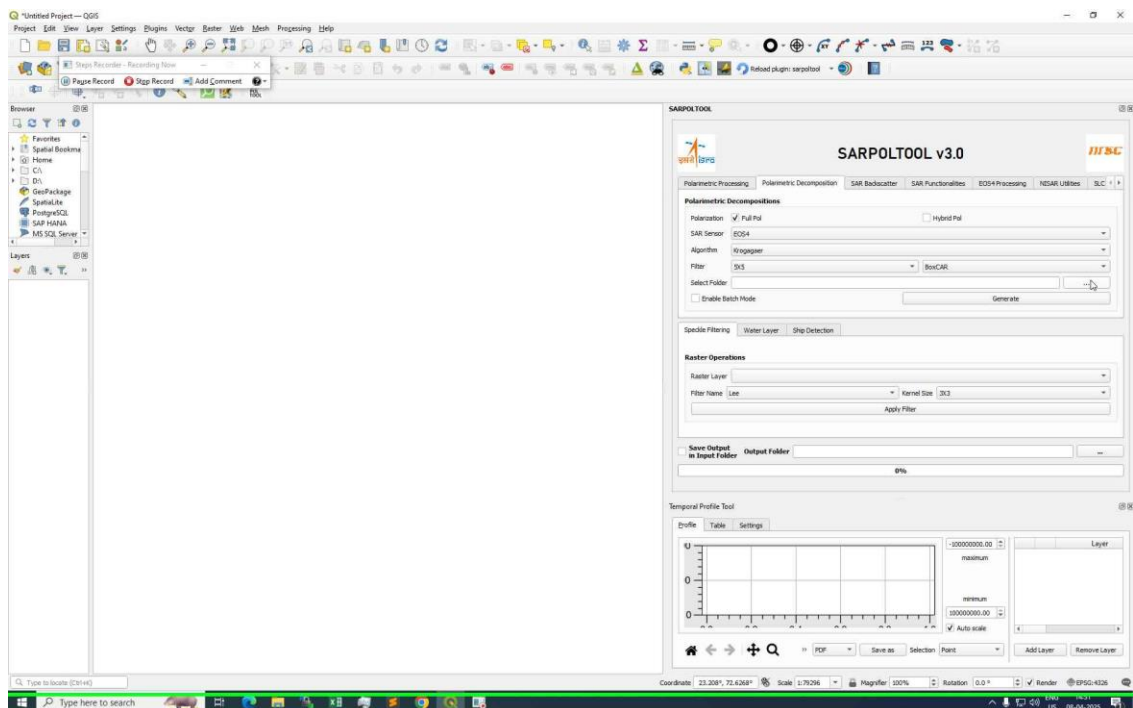
Step 10: (08-04-2025 14:31:23) User left click in "*Untitled Project — QGIS"



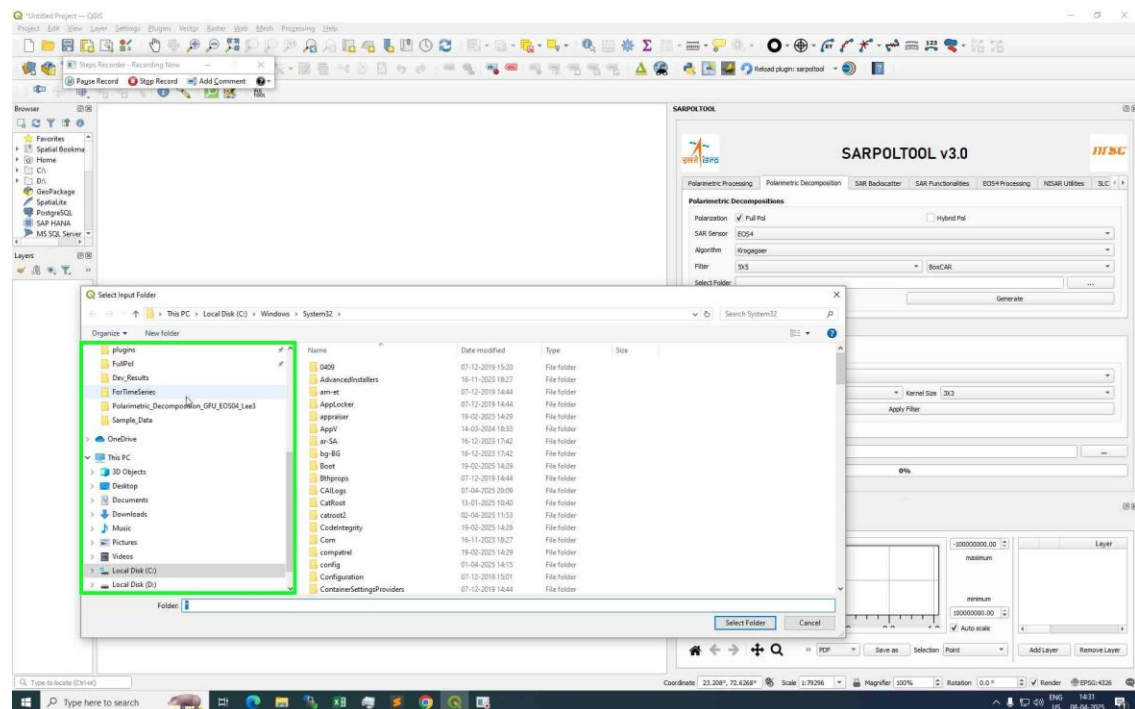
Step 11: (08-04-2025 14:31:24) User left click in "QGIS3"



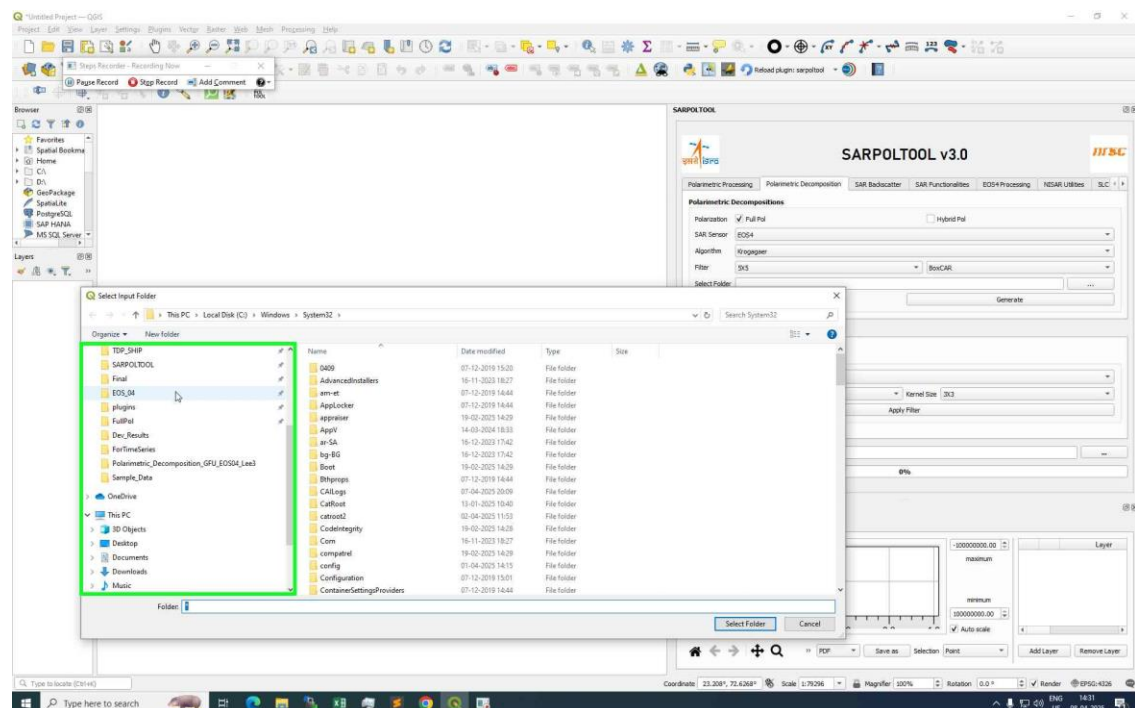
Step 12: (08-04-2025 14:31:26) User left click in "*Untitled Project — QGIS"



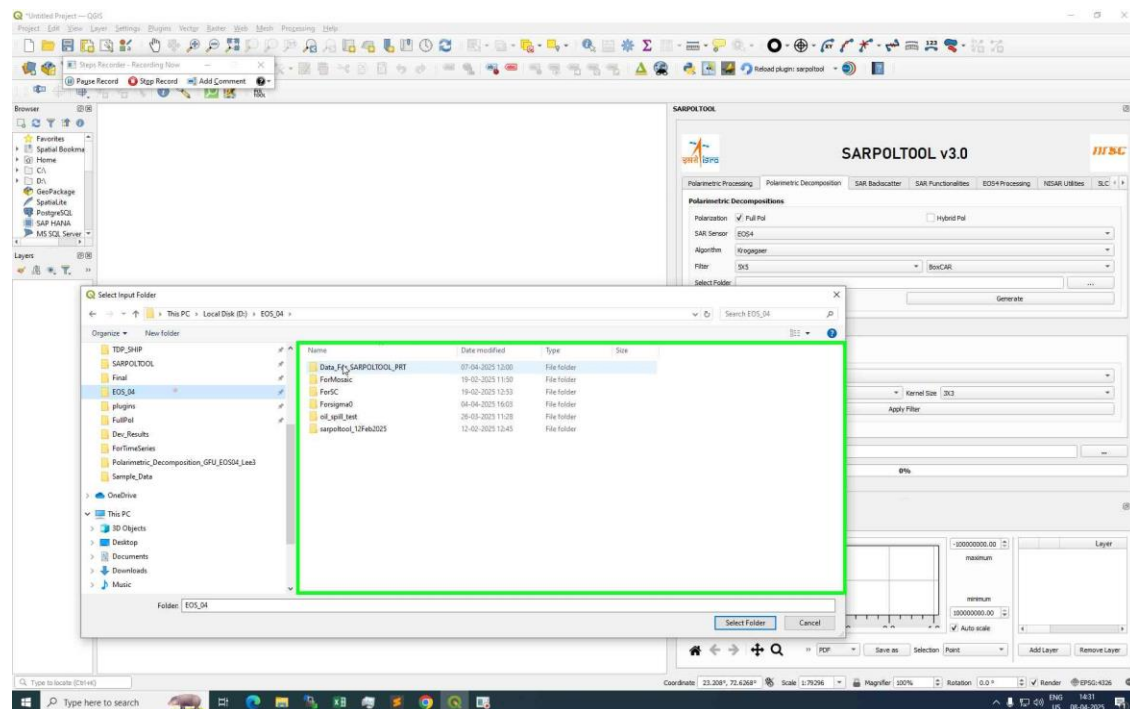
Step 13: (08-04-2025 14:31:30) User mouse wheel up on "ForTimeSeries (tree item)" in "Select Input Folder"



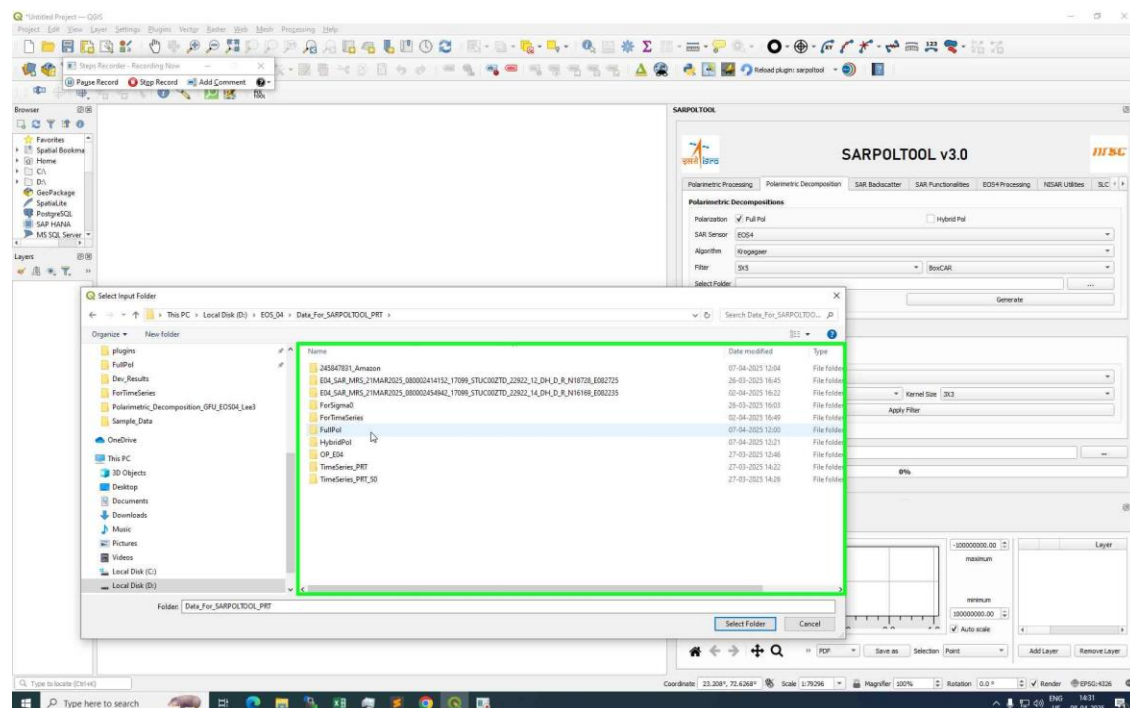
Step 14: (08-04-2025 14:31:34) User left click on "EOS_04 (pinned) (tree item)" in "Select Input Folder"



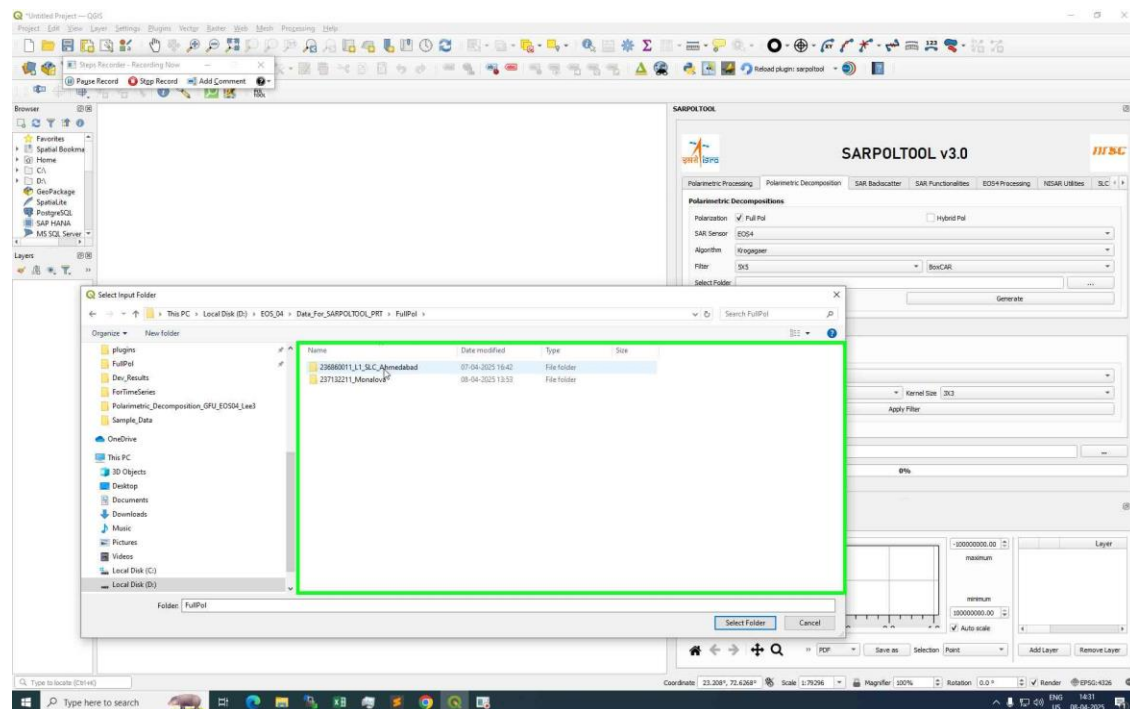
Step 15: (08-04-2025 14:31:35) User left double click on "Name (edit)" in "Select Input Folder"



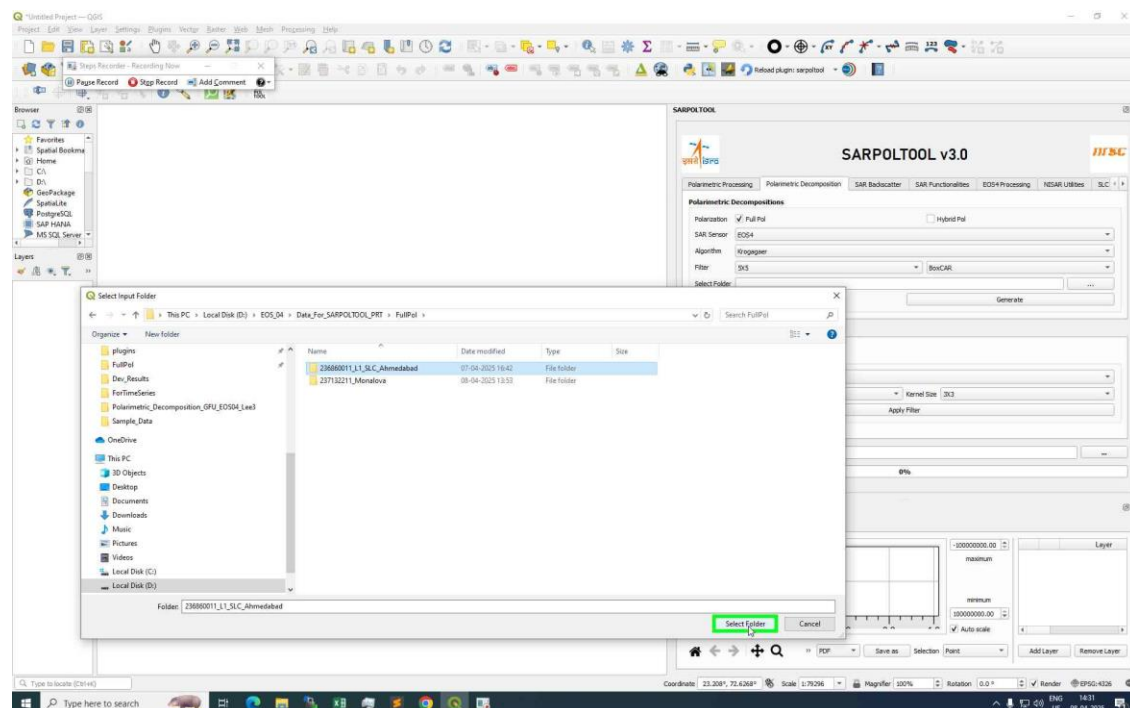
Step 16: (08-04-2025 14:31:41) User left double click on "Name (edit)" in "Select Input Folder"



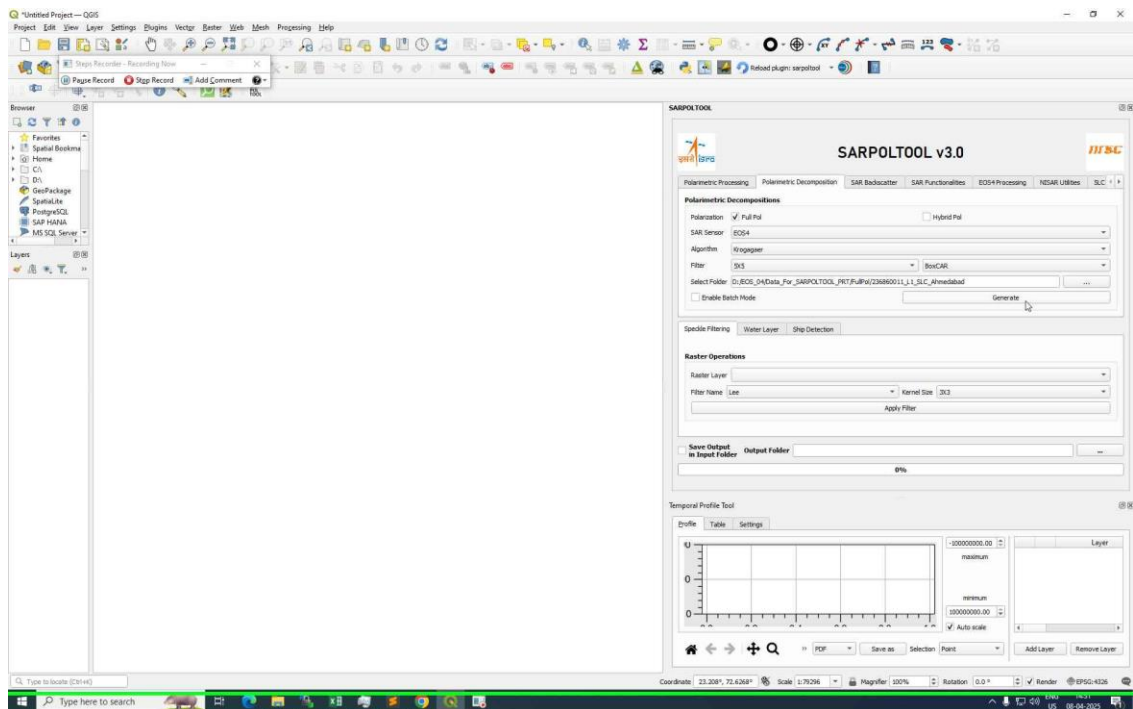
Step 17: (08-04-2025 14:31:43) User left click on "Name (edit)" in "Select Input Folder"



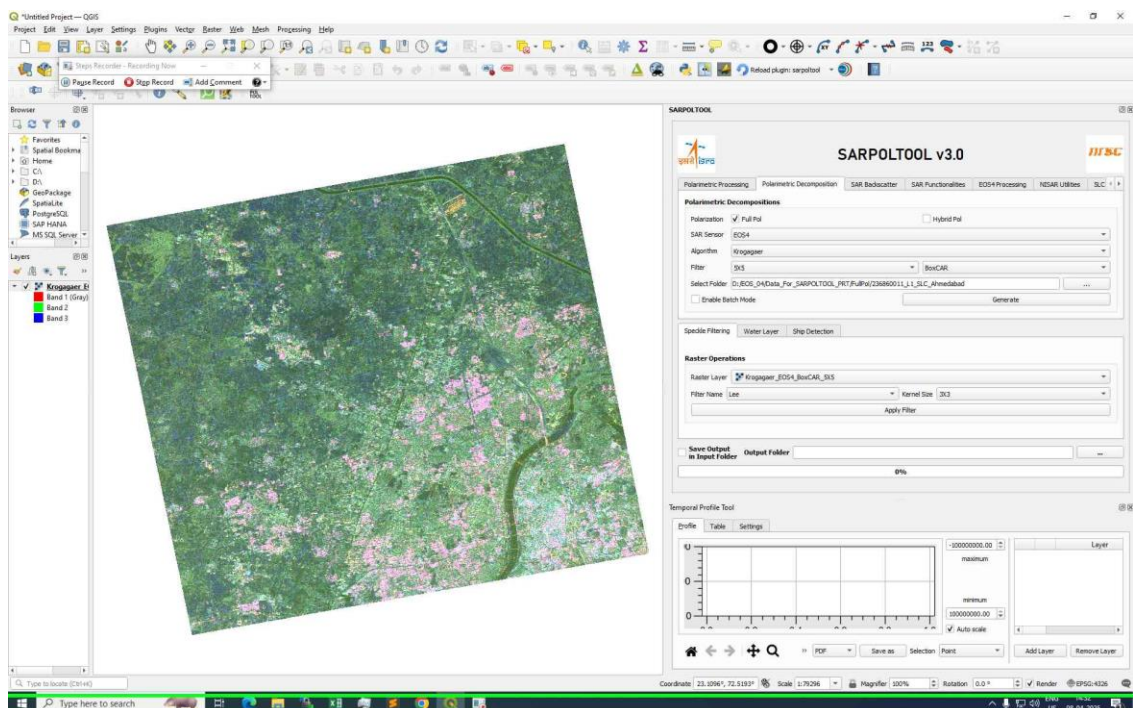
Step 18: (08-04-2025 14:31:50) User left click on "Select Folder (button)" in "Select Input Folder"



Step 19: (08-04-2025 14:31:54) User left click in "*Untitled Project — QGIS"

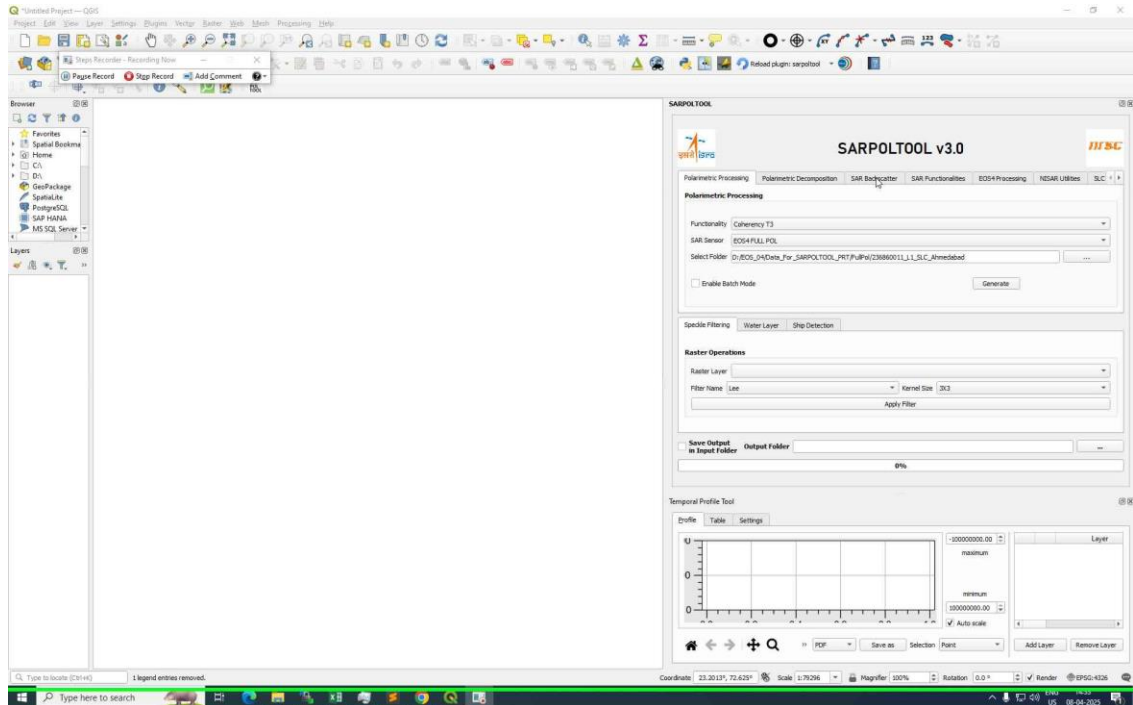


Step 20: (08-04-2025 14:32:40) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

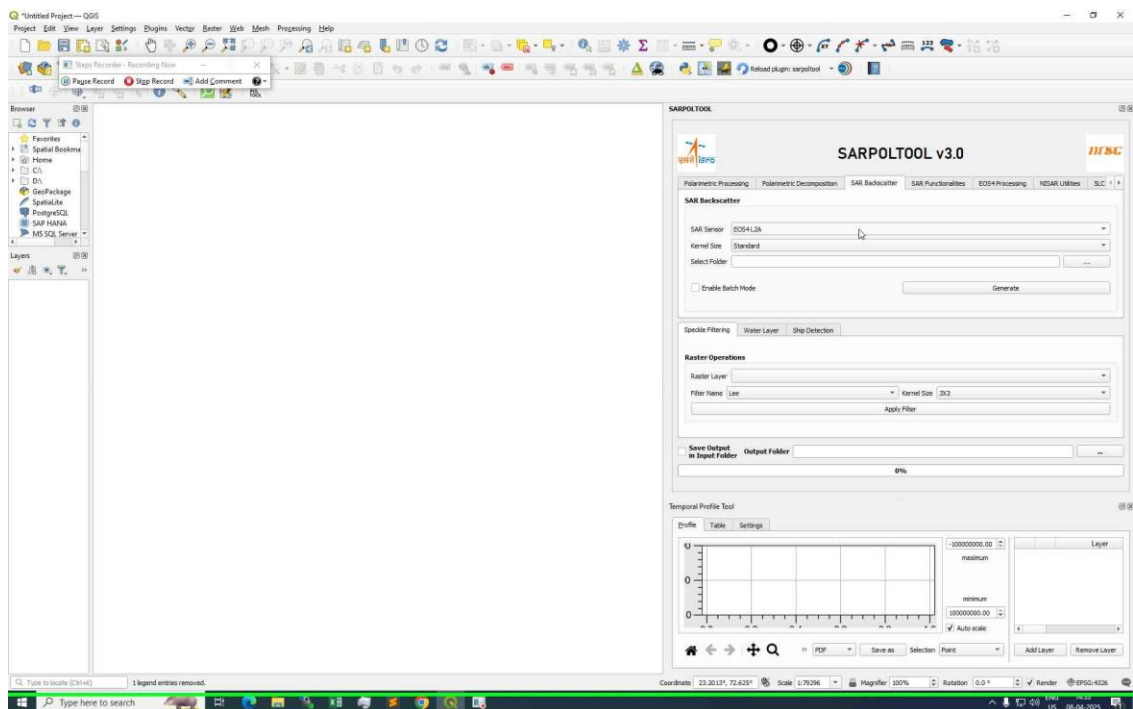


SAR Backscatter – Sample Operation

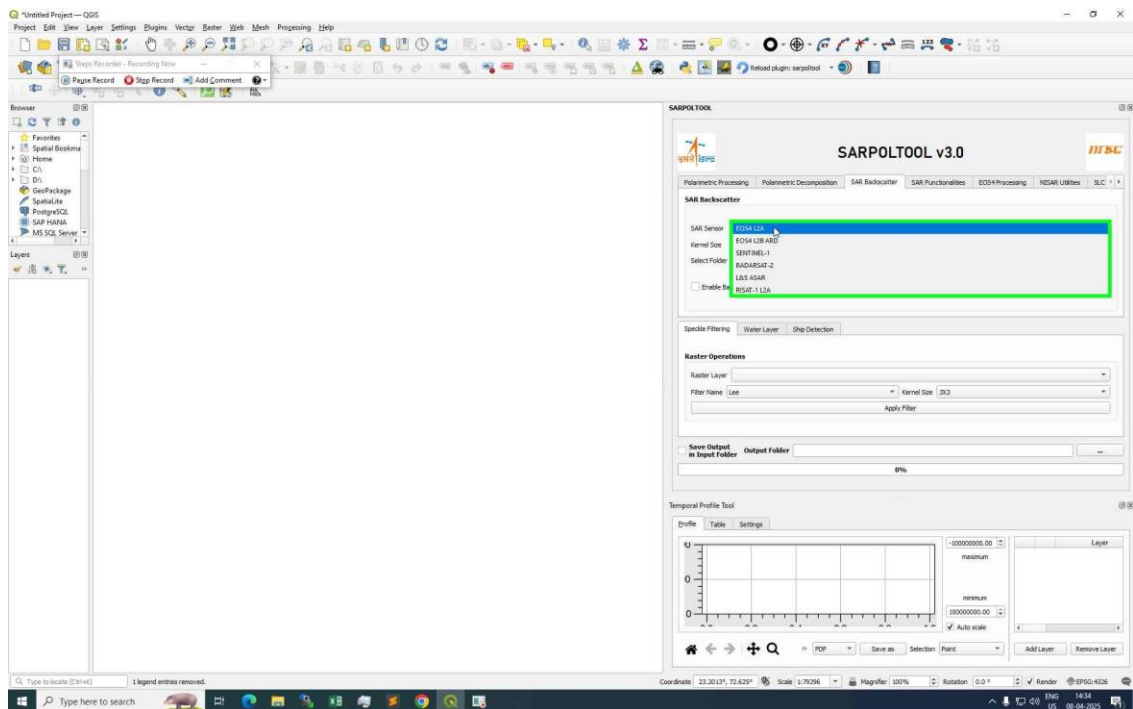
Step 1: (08-04-2025 14:33:56) User left click in "*Untitled Project — QGIS"



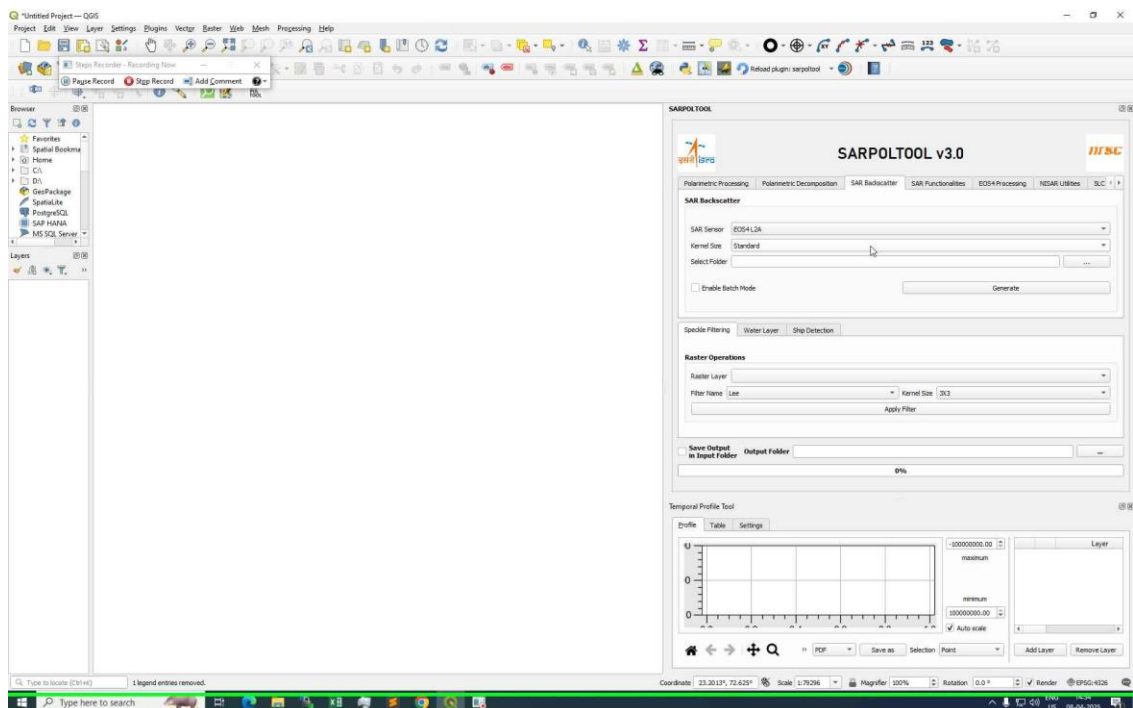
Step 2: (08-04-2025 14:33:59) User left click in "*Untitled Project — QGIS"



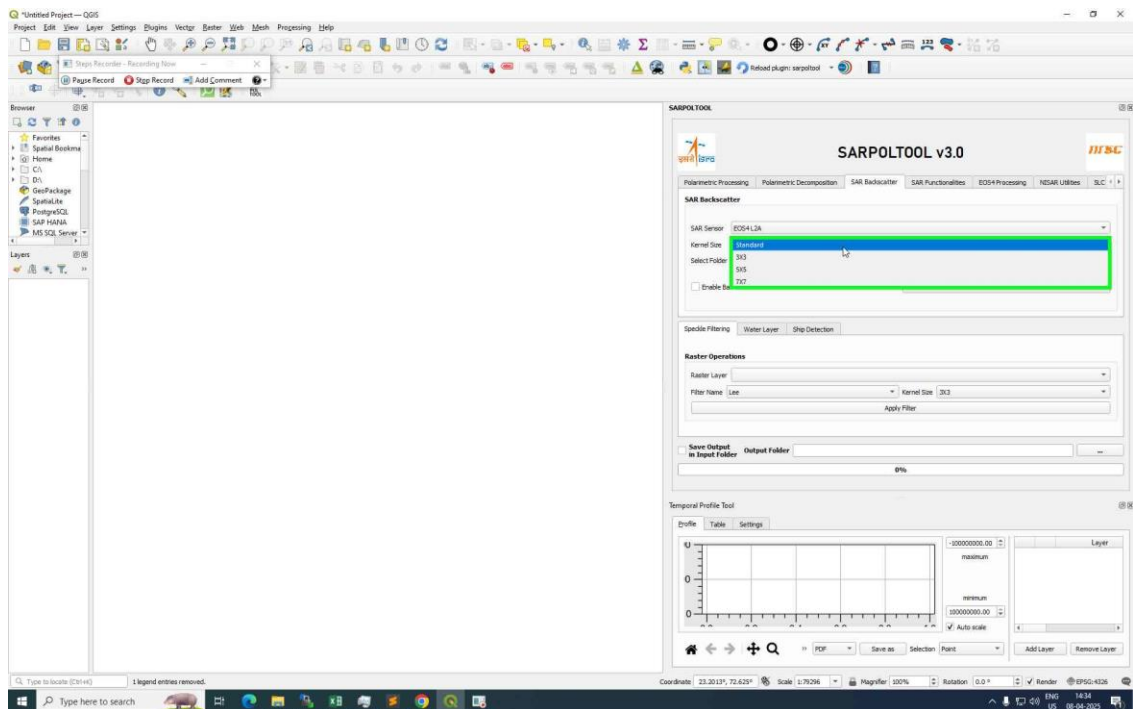
Step 3: (08-04-2025 14:34:03) User left click in "QGIS"



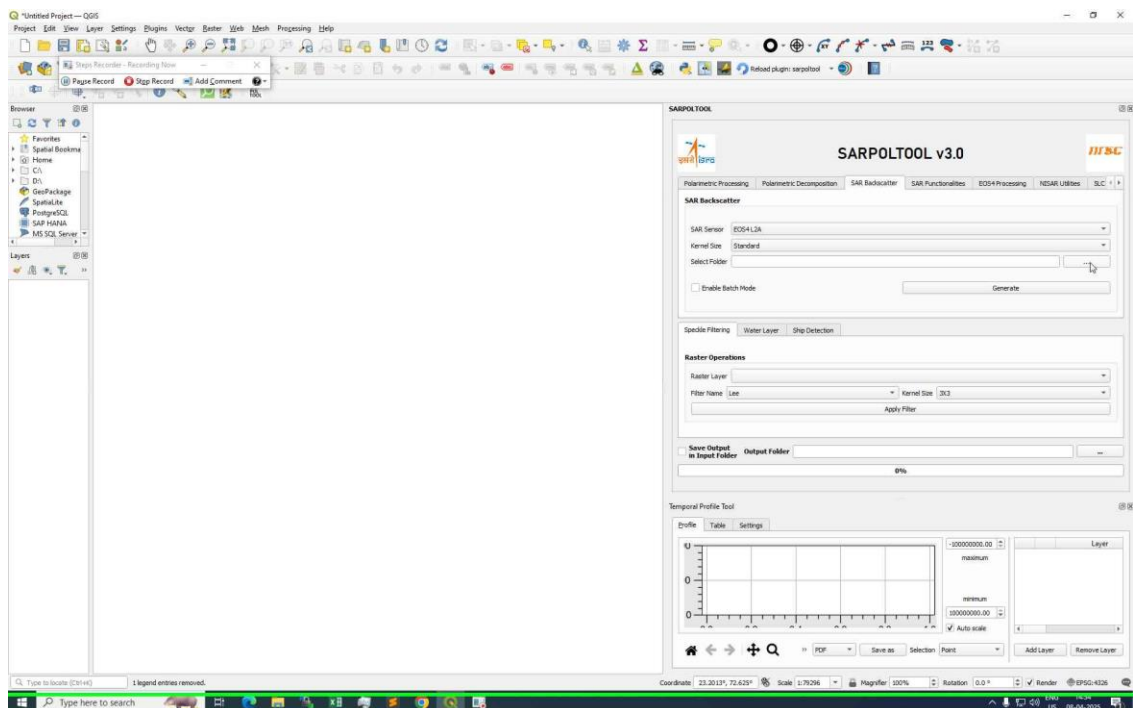
Step 4: (08-04-2025 14:34:04) User left click in "*Untitled Project — QGIS"



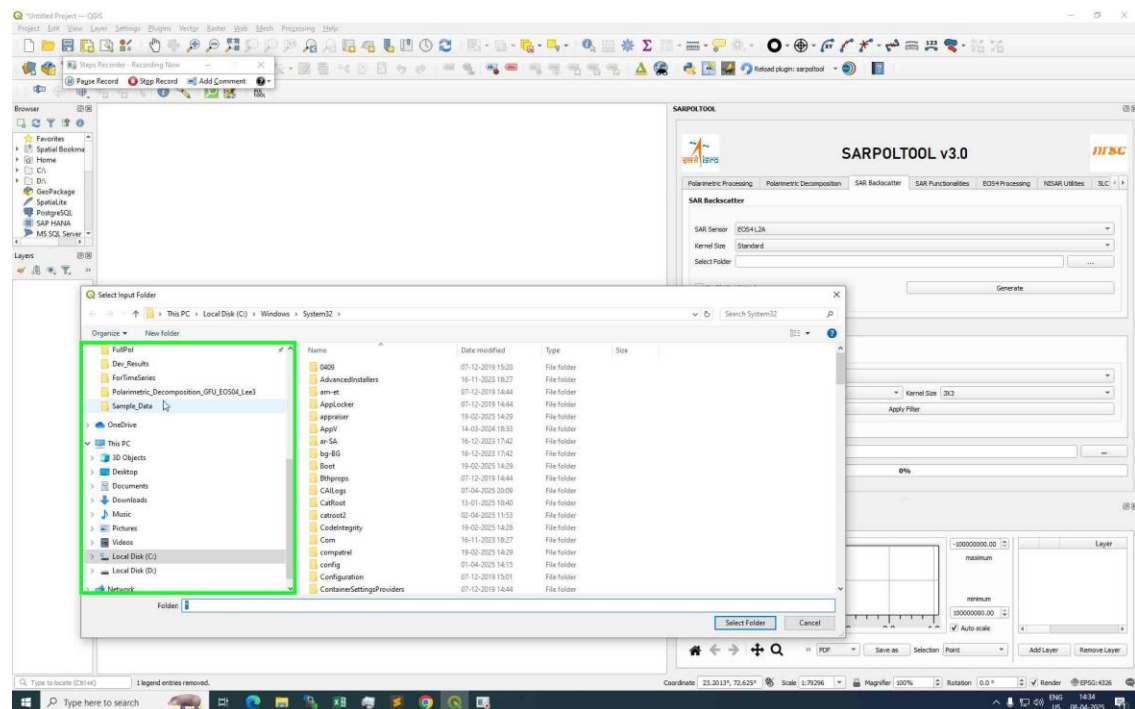
Step 5: (08-04-2025 14:34:06) User left click in "QGIS3"



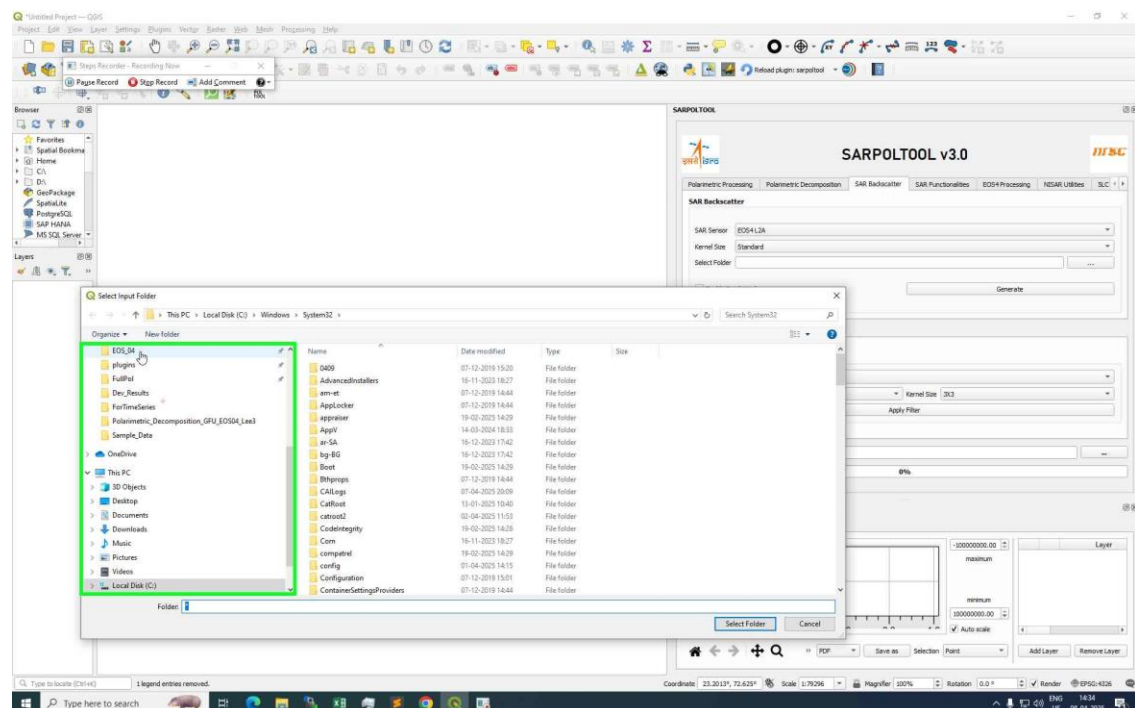
Step 6: (08-04-2025 14:34:08) User left click in "*Untitled Project — QGIS"



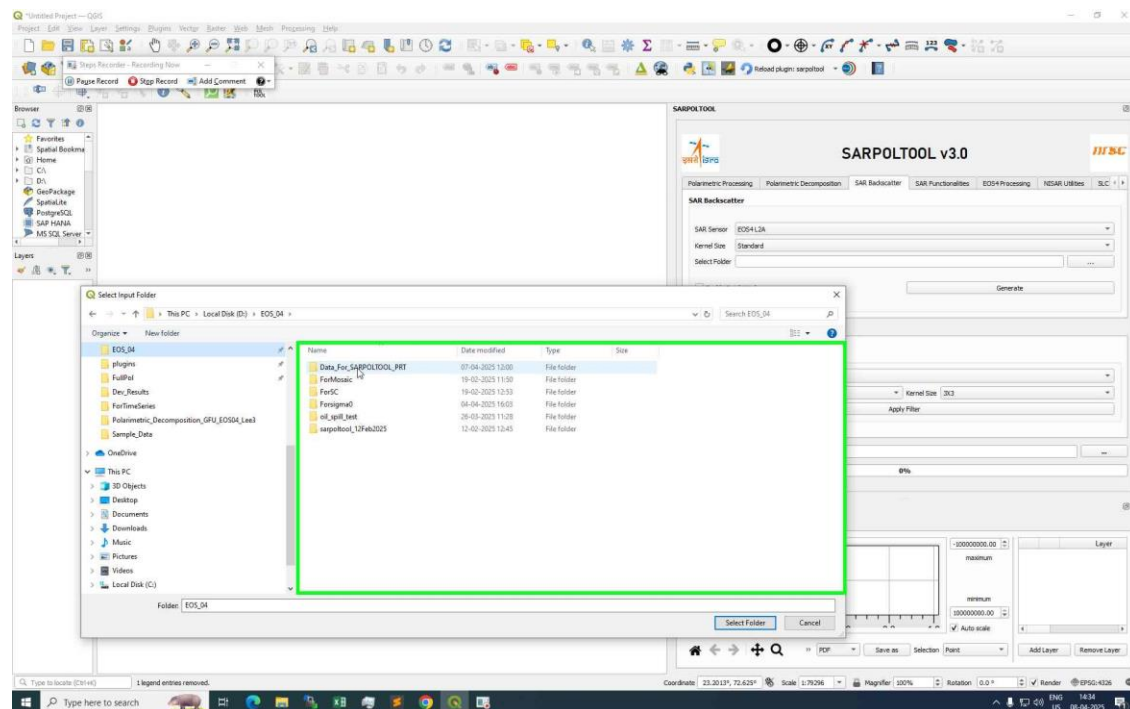
Step 7: (08-04-2025 14:34:10) User mouse wheel up on "Sample_Data (tree item)" in "Select Input Folder"



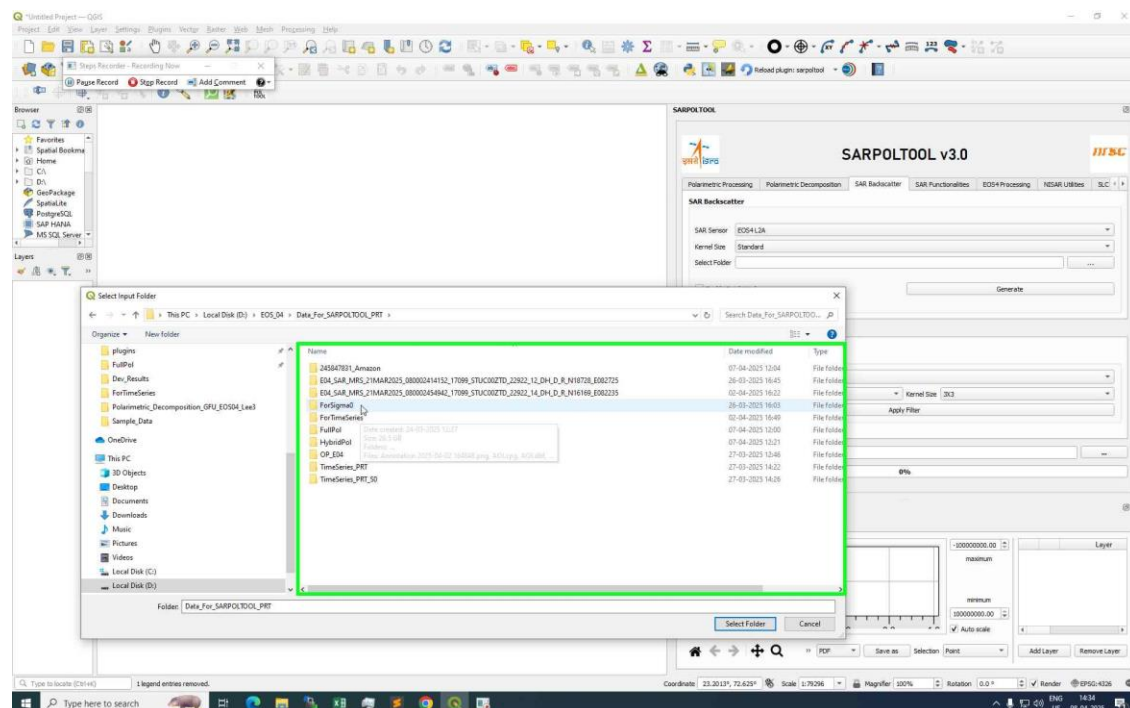
Step 8: (08-04-2025 14:34:11) User left click on "EOS_04 (pinned) (tree item)" in "Select Input Folder"



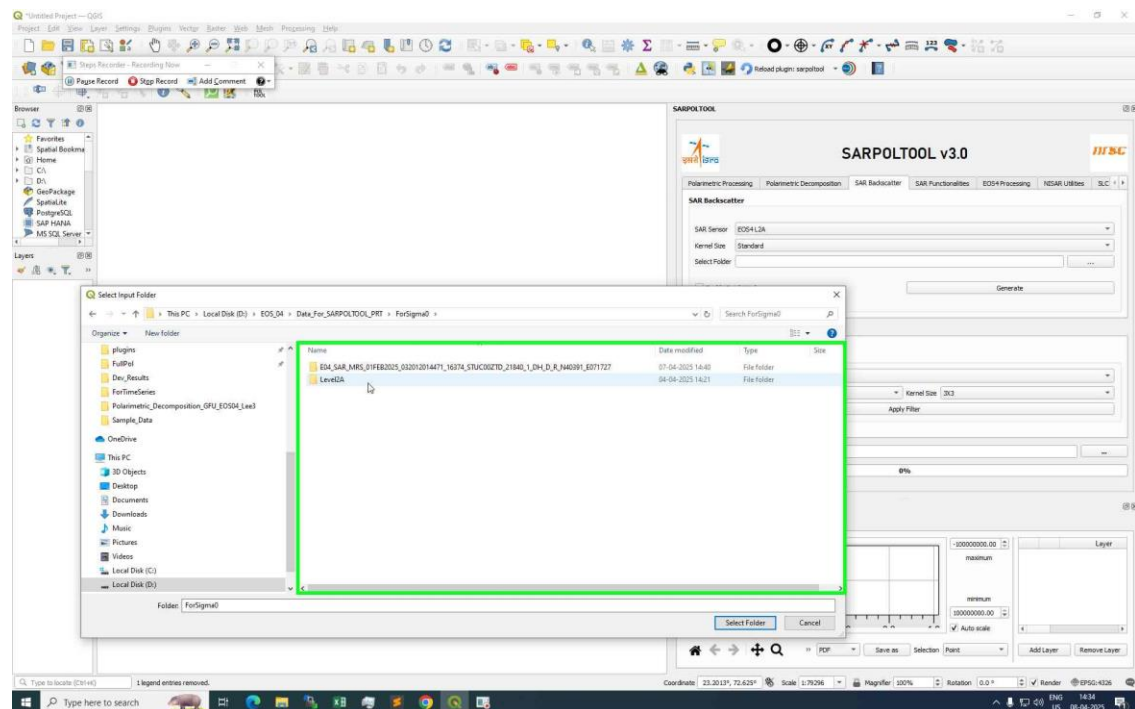
Step 9: (08-04-2025 14:34:16) User left double click on "Name (edit)" in "Select Input Folder"



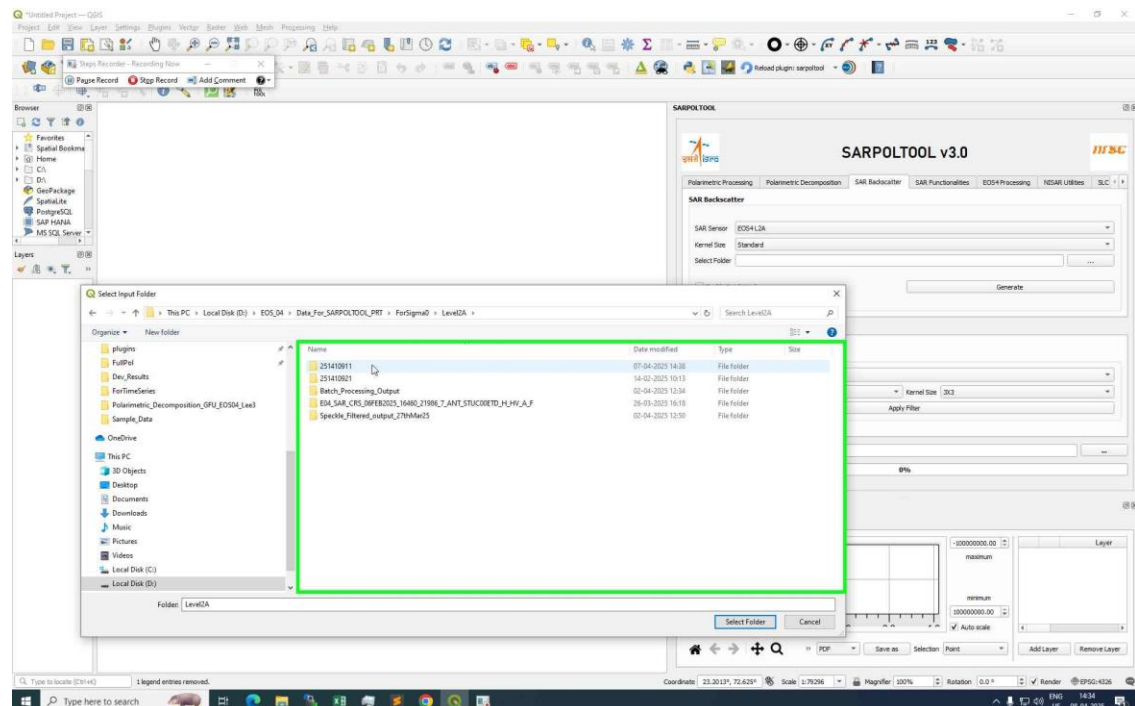
Step 10: (08-04-2025 14:34:35) User left double click on "Name (edit)" in "Select Input Folder"



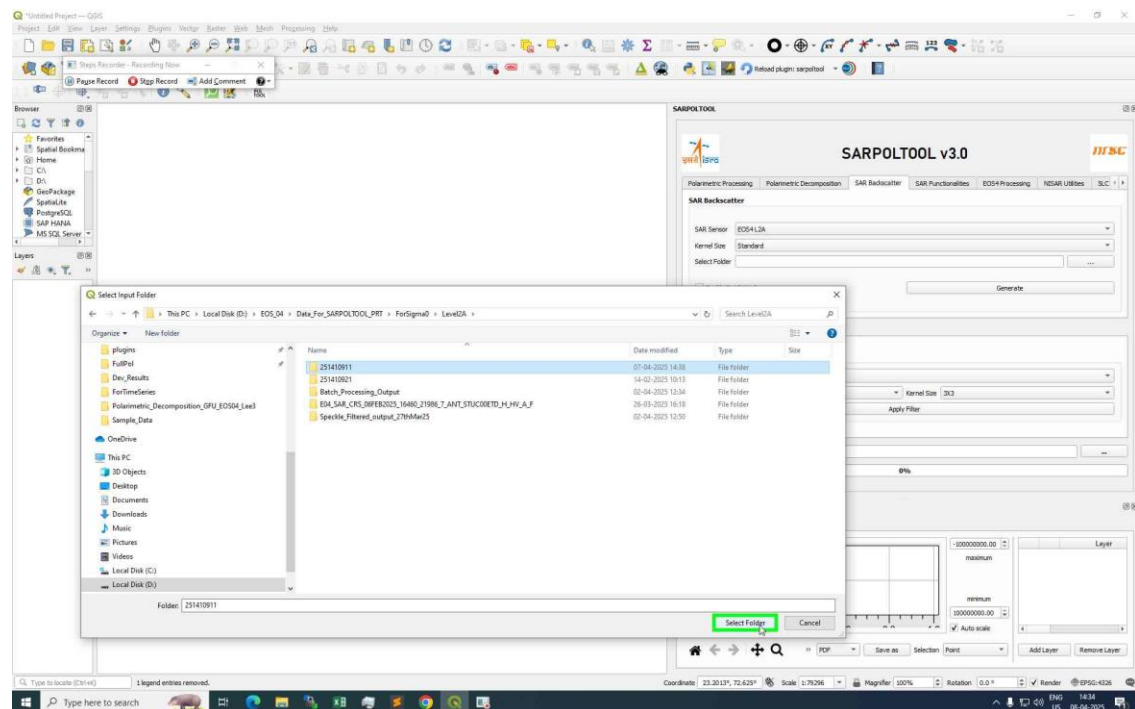
Step 11: (08-04-2025 14:34:37) User left double click on "Name (edit)" in "Select Input Folder"



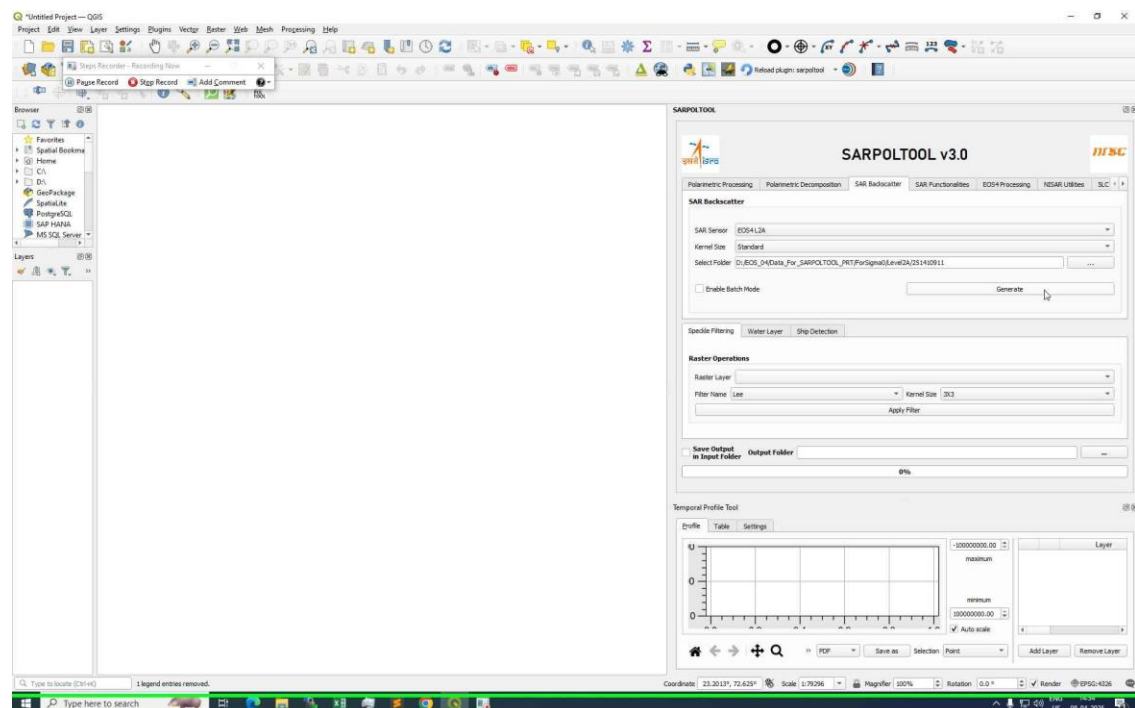
Step 12: (08-04-2025 14:34:40) User left click on "Name (edit)" in "Select Input Folder"



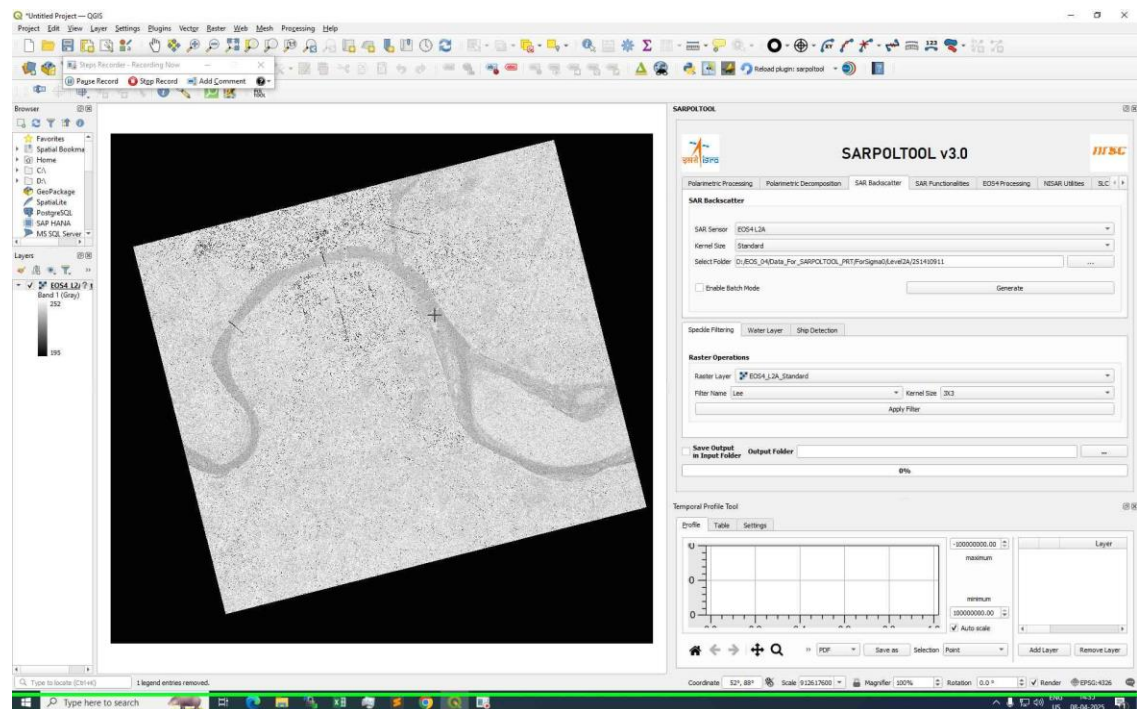
Step 13: (08-04-2025 14:34:42) User left click on "Select Folder (button)" in "Select Input Folder"



Step 14: (08-04-2025 14:34:46) User left click in "*Untitled Project — QGIS"

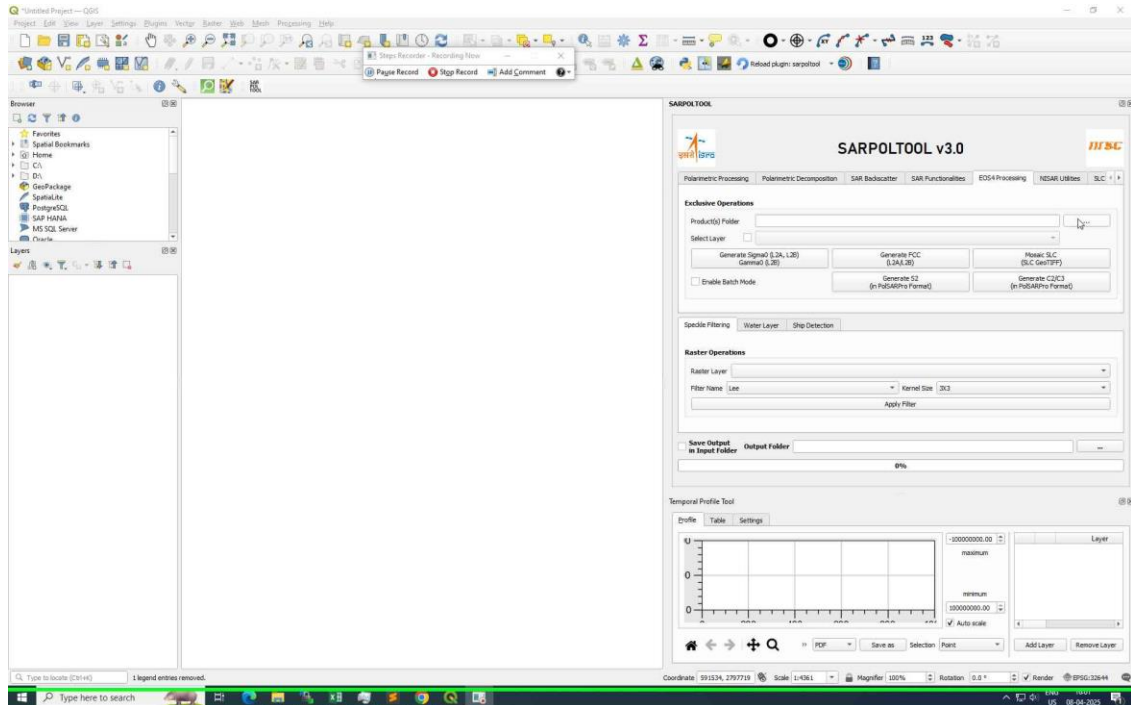


Step 15: (08-04-2025 14:35:58) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

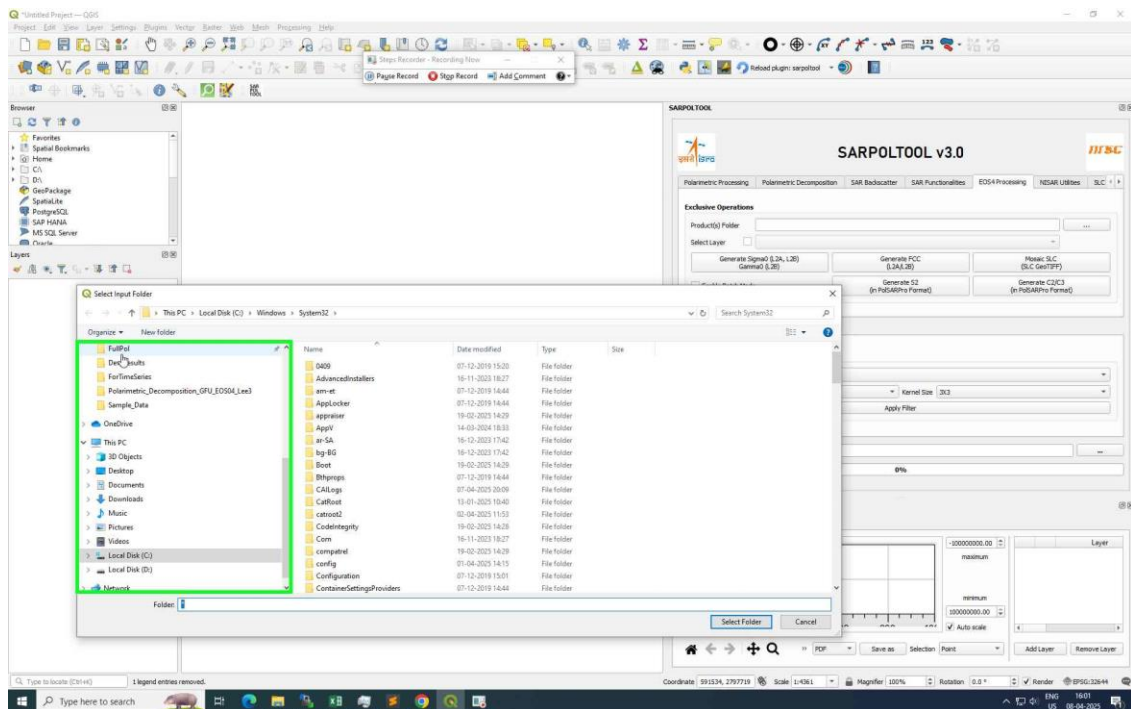


EOS-04 Processing – L2 – Sample Operation

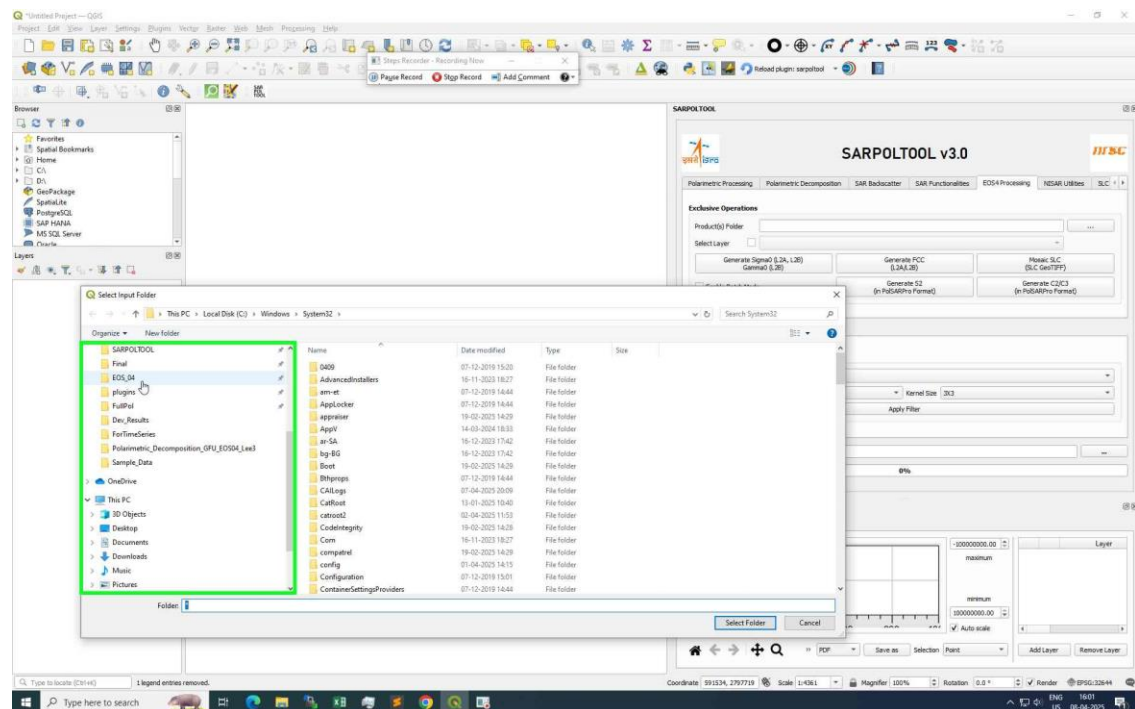
Step 1: (08-04-2025 16:01:16) User left click in "*Untitled Project — QGIS"



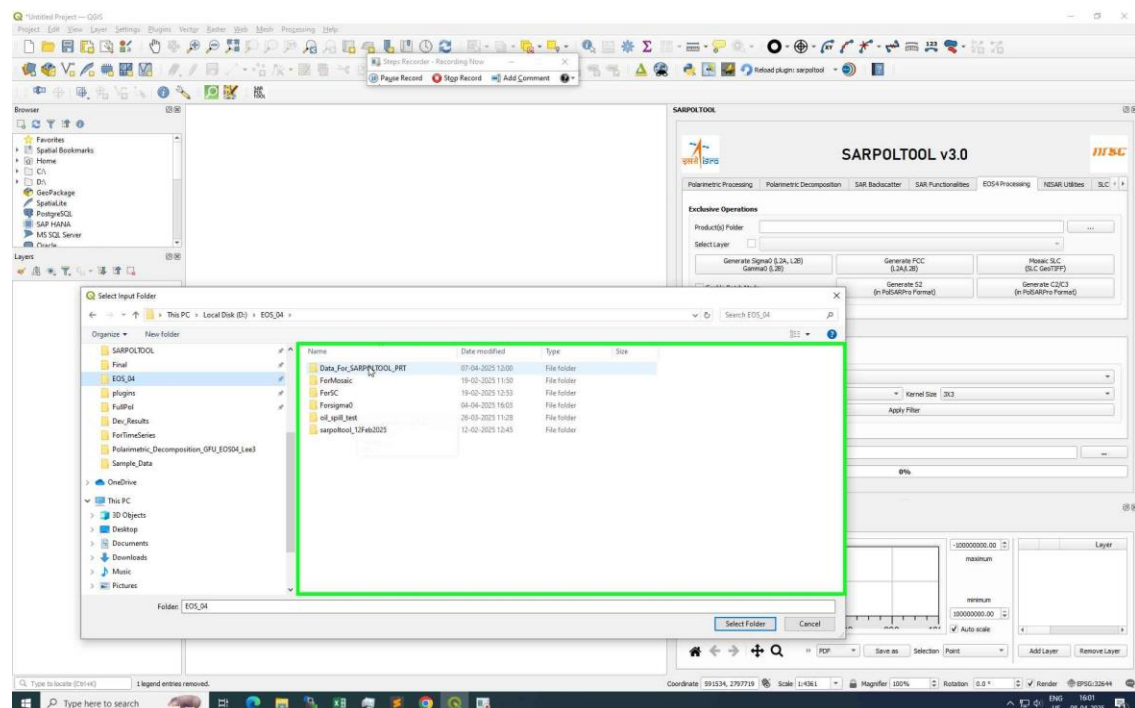
Step 2: (08-04-2025 16:01:21) User mouse wheel up on "FullPol (pinned) (tree item)" in "Select Input Folder"



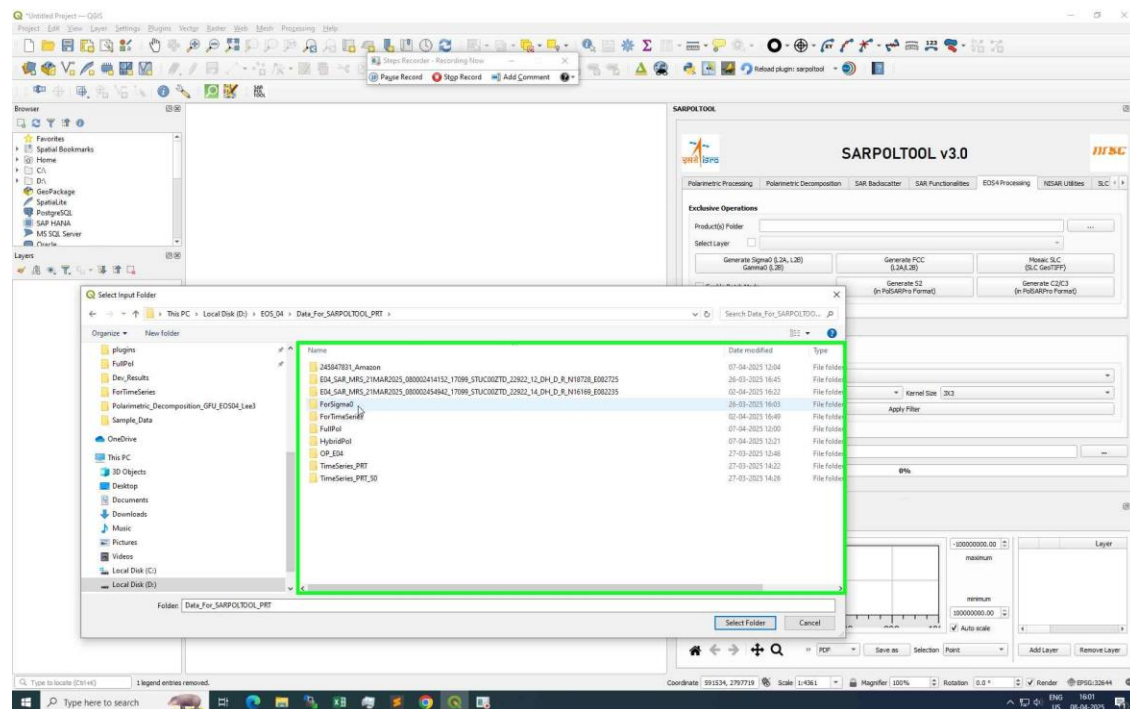
Step 3: (08-04-2025 16:01:23) User left click on "EOS_04 (pinned)" (tree item)" in "Select Input Folder"



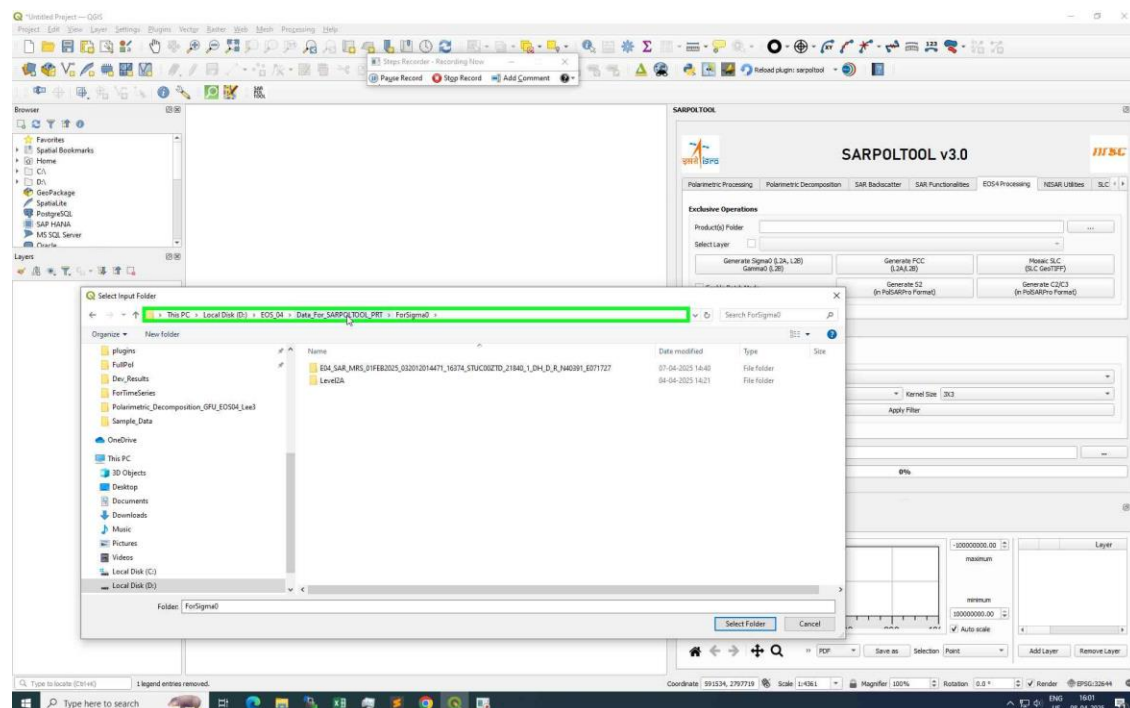
Step 4: (08-04-2025 16:01:26) User left double click on "Name (edit)" in "Select Input Folder"



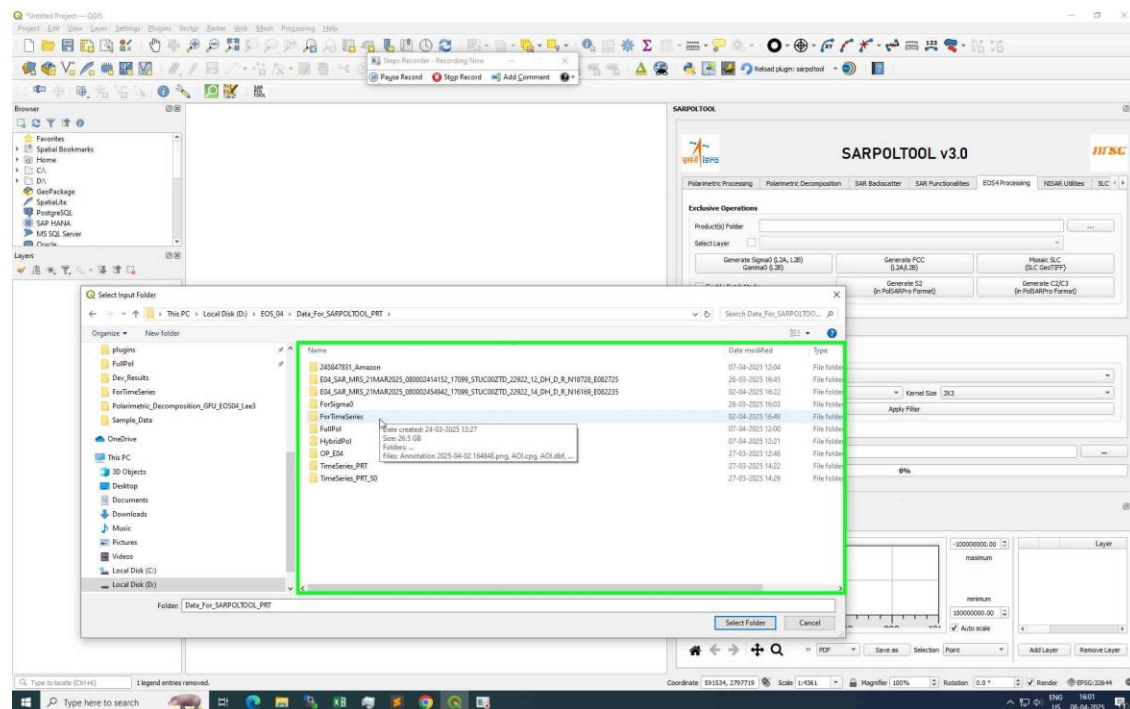
Step 5: (08-04-2025 16:01:28) User left double click on "Name (edit)" in "Select Input Folder"



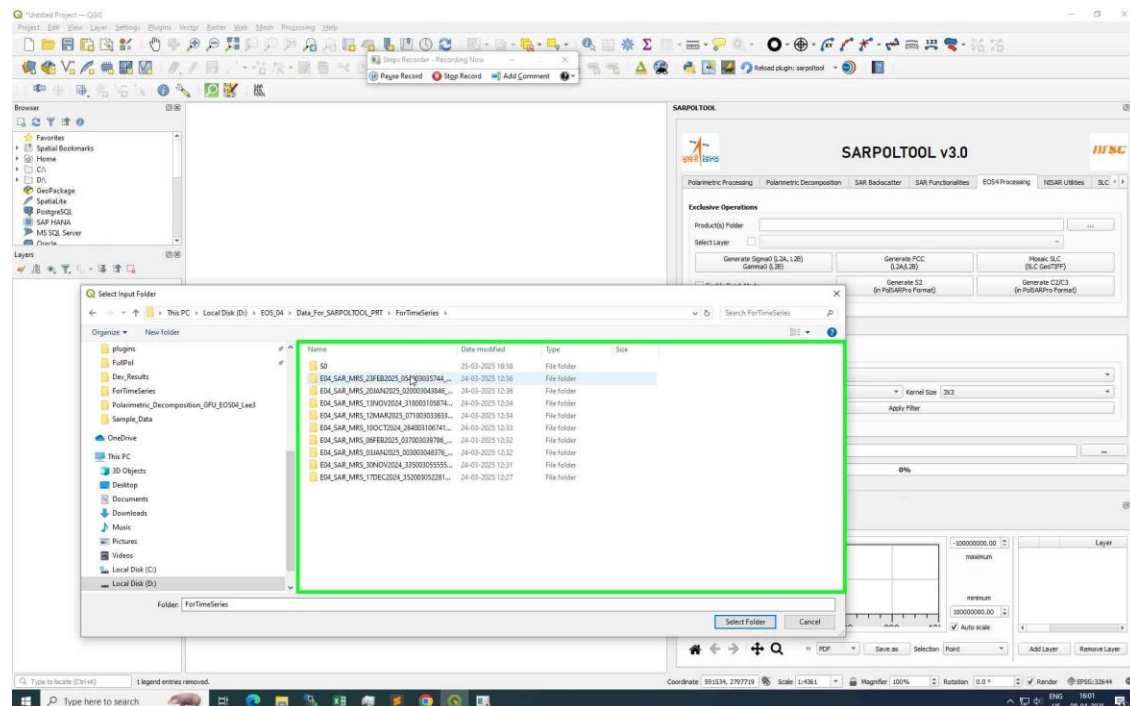
Step 6: (08-04-2025 16:01:30) User left click on "Data_For_SARPOLTOOL_PRT (split button)" in "Select Input Folder"



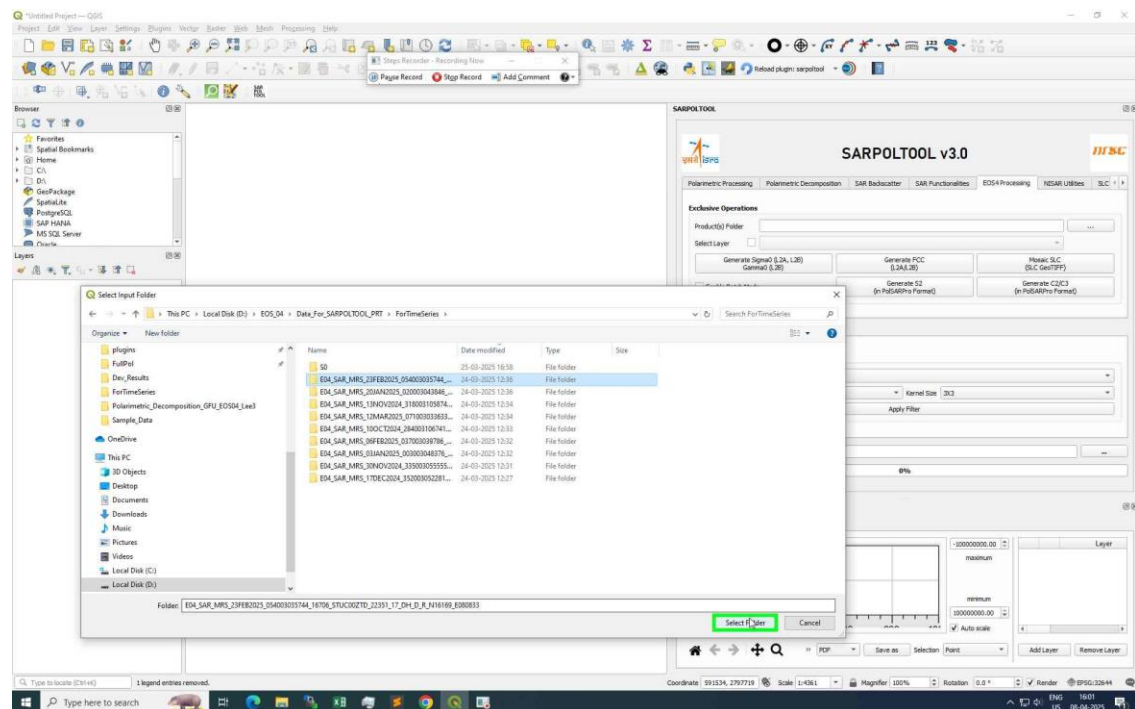
Step 7: (08-04-2025 16:01:36) User left double click on "Name (edit)" in "Select Input Folder"



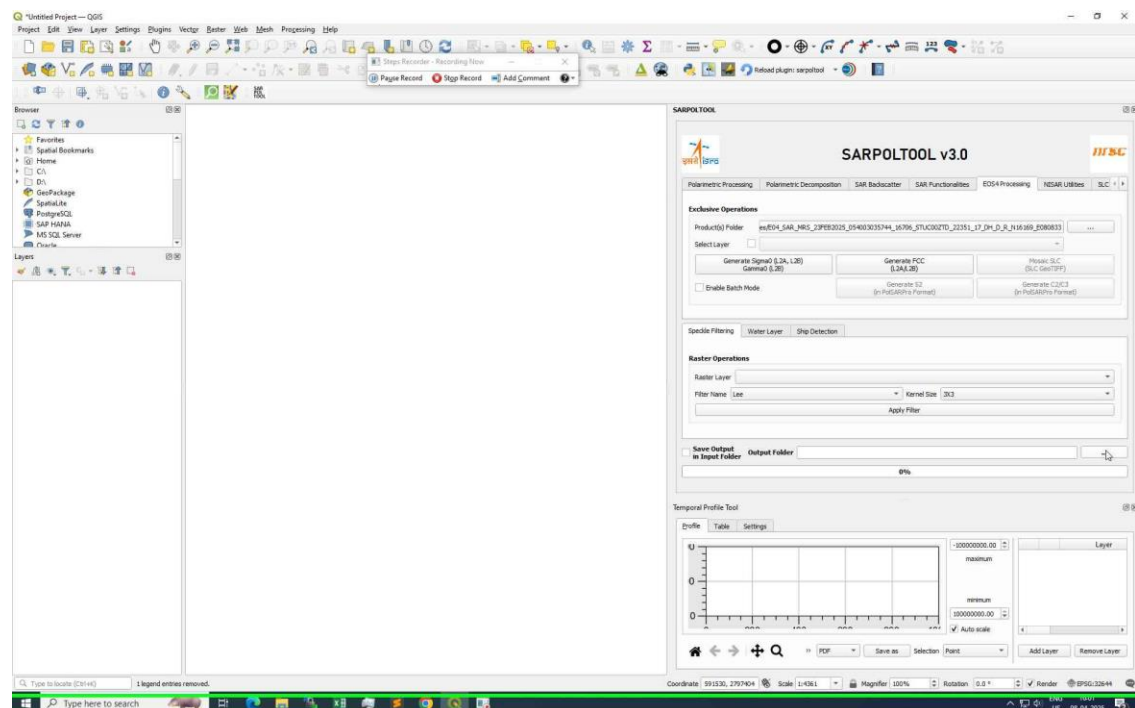
Step 8: (08-04-2025 16:01:37) User left click on "Name (edit)" in "Select Input Folder"



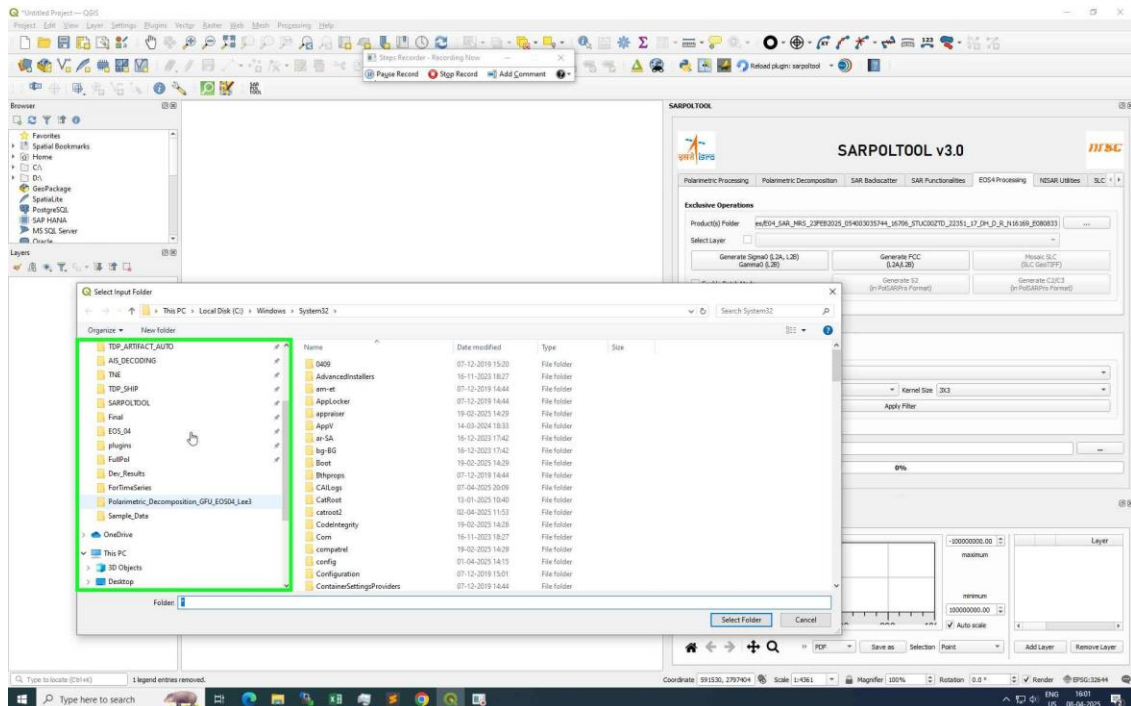
Step 9: (08-04-2025 16:01:38) User left click on "Select Folder (button)" in "Select Input Folder"



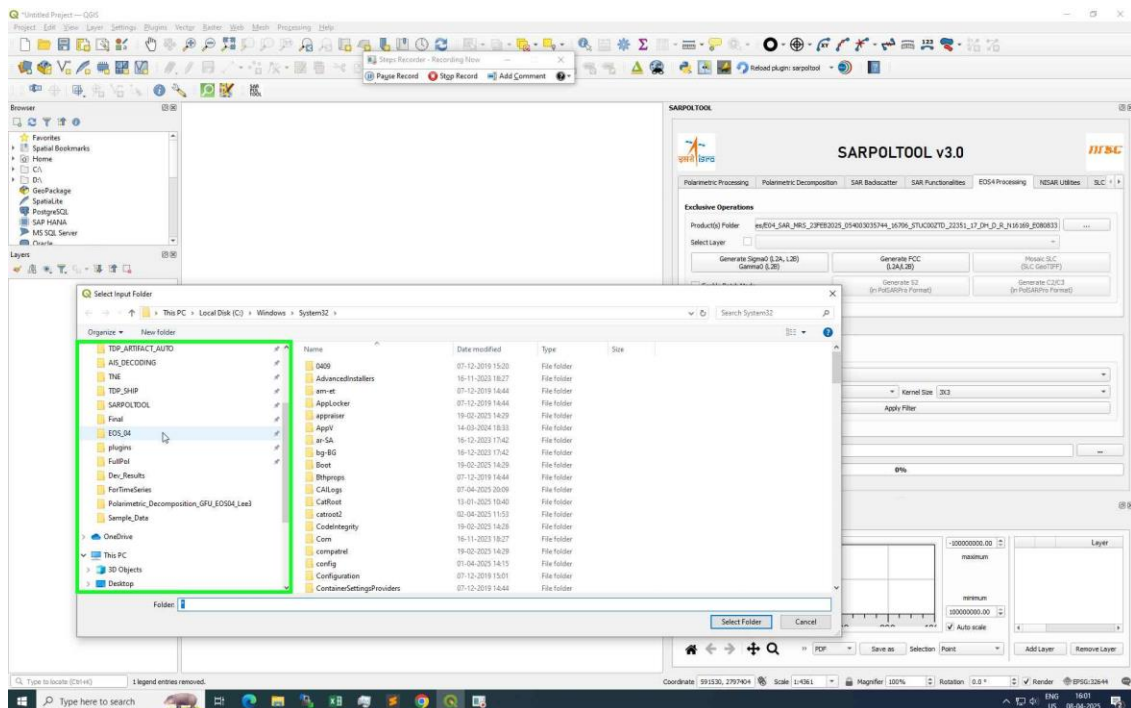
Step 10: (08-04-2025 16:01:51) User left click on "... (button)" in "*Untitled Project — QGIS"



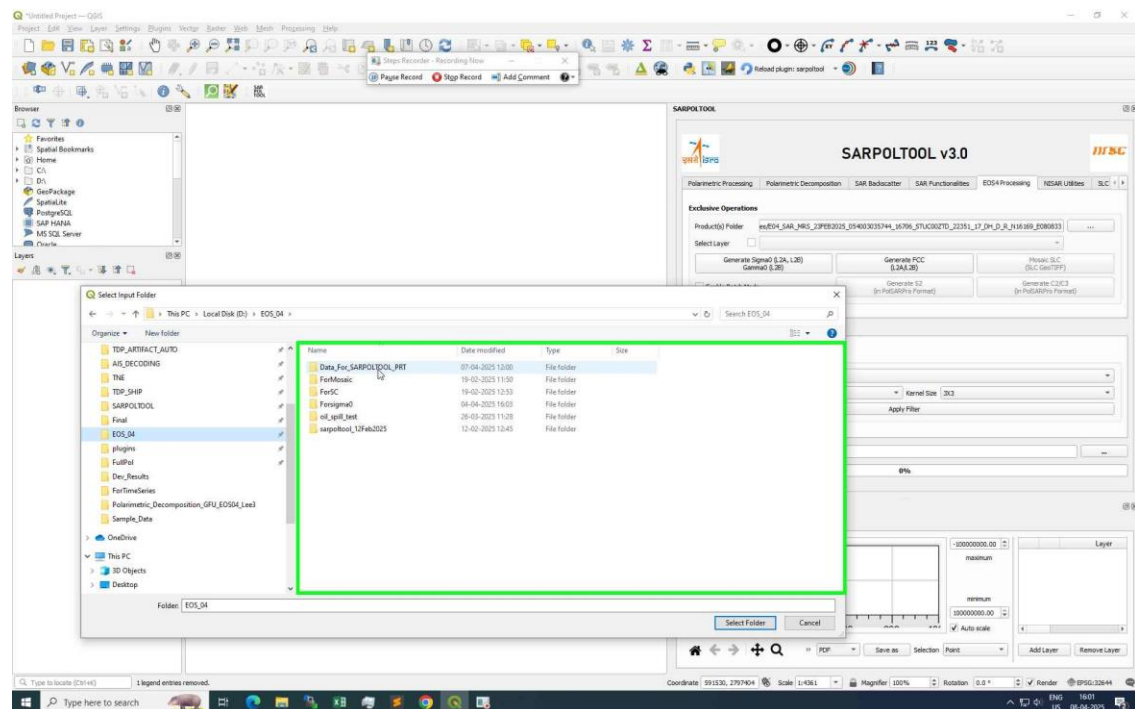
Step 11: (08-04-2025 16:01:53) User mouse wheel up on "Polarimetric_Decomposition_GFU_EOS04_Lee3 (tree item)" in "Select Input Folder"



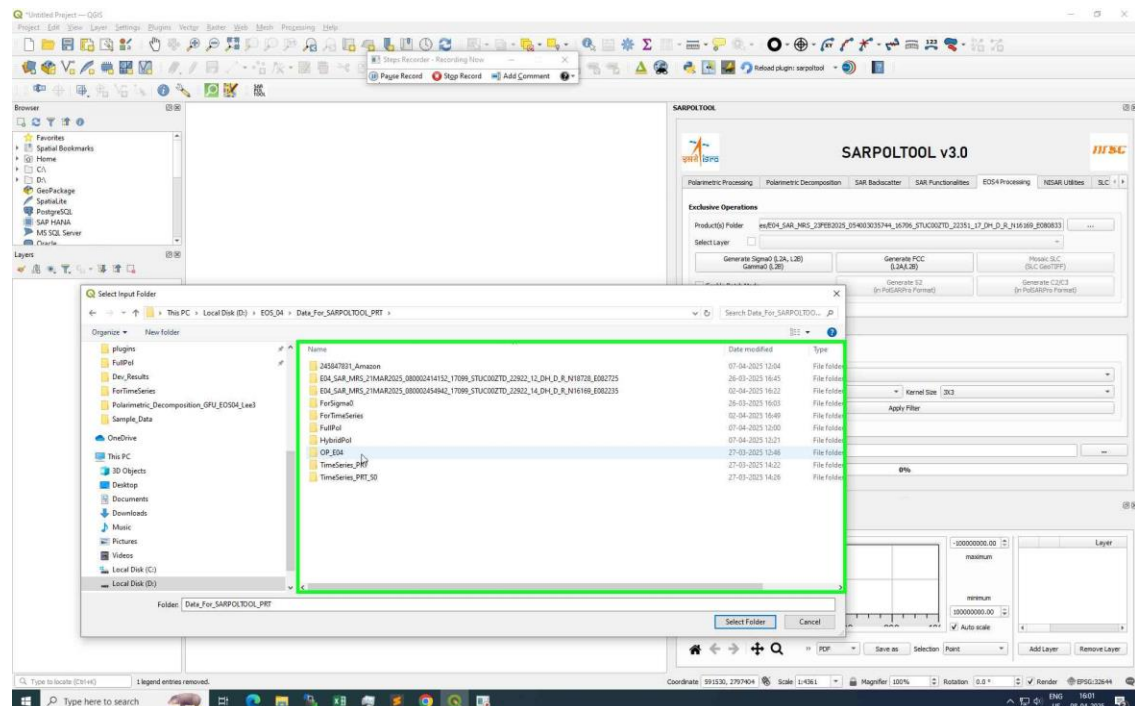
Step 12: (08-04-2025 16:01:54) User left click on "EOS_04 (pinned)" (tree item)" in "Select Input Folder"



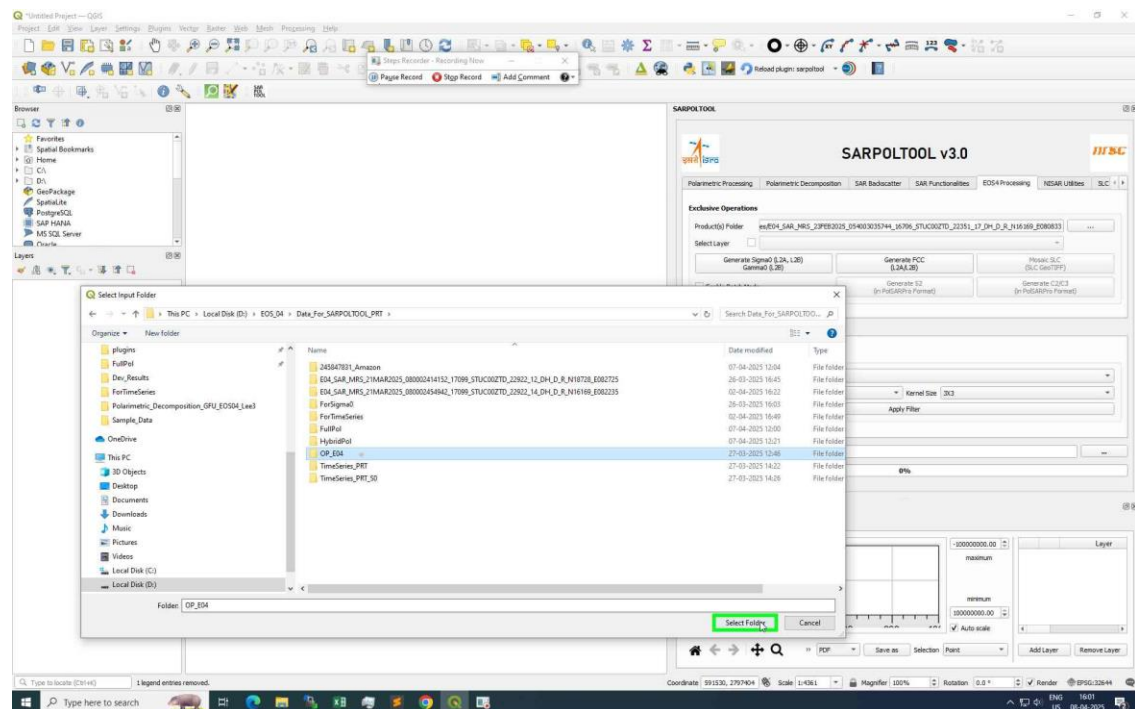
Step 13: (08-04-2025 16:01:56) User left double click on "Name (edit)" in "Select Input Folder"



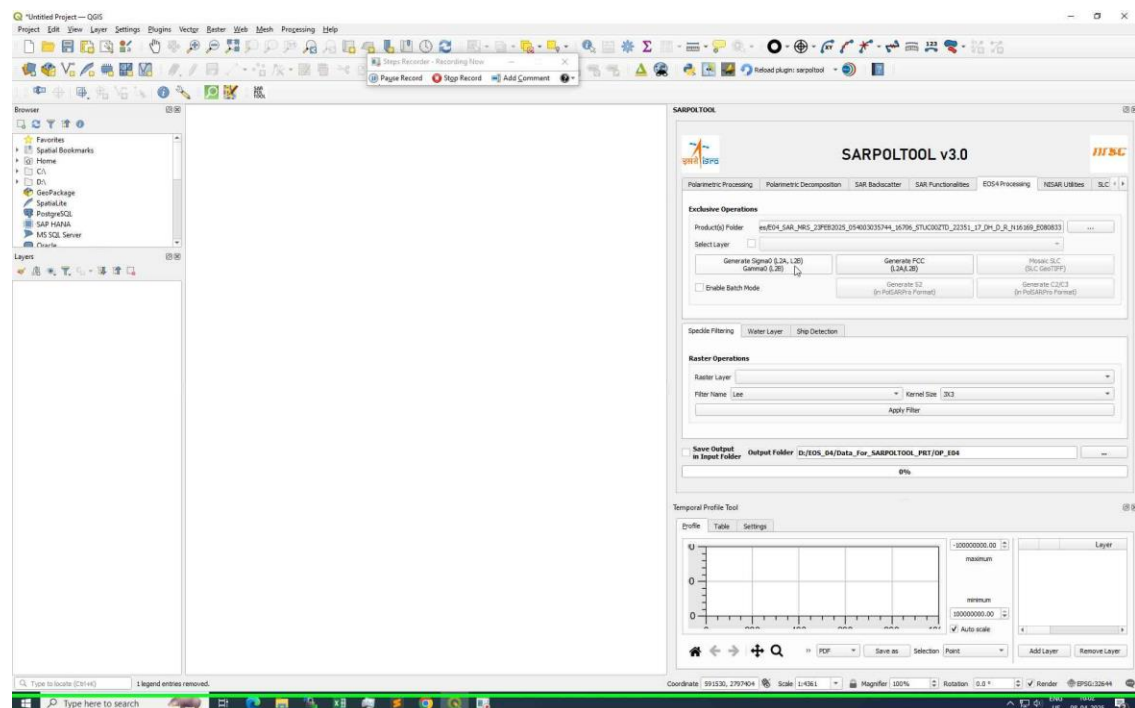
Step 14: (08-04-2025 16:01:59) User left click on "Name (edit)" in "Select Input Folder"



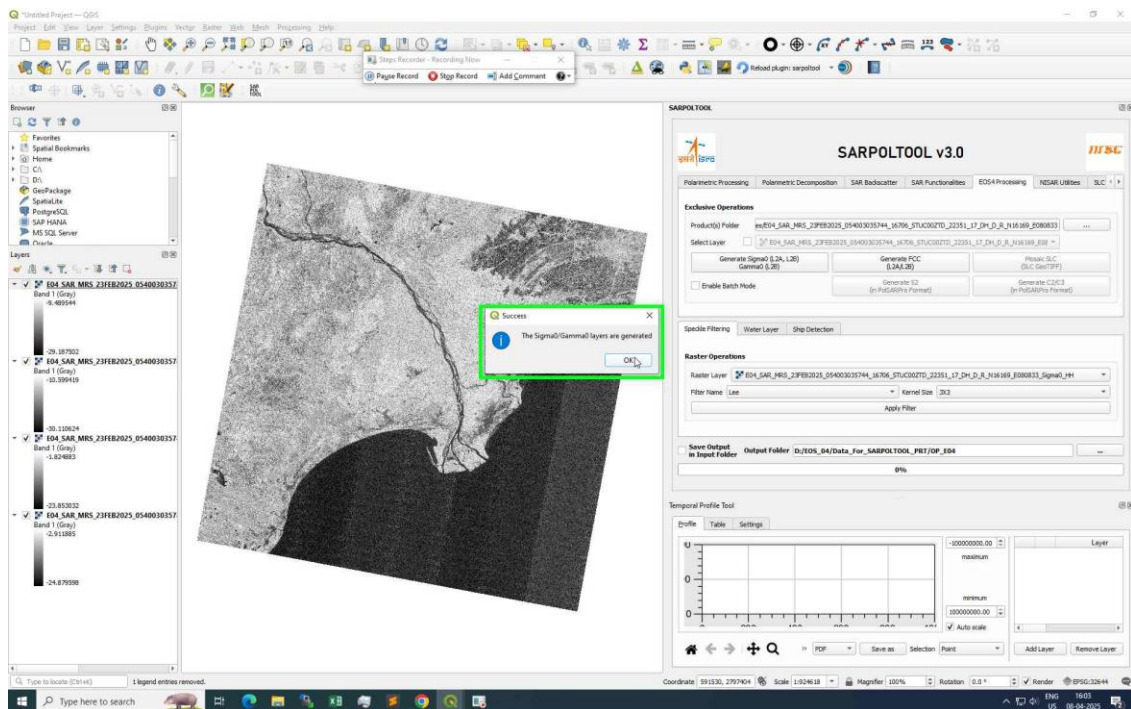
Step 15: (08-04-2025 16:01:59) User left click on "Select Folder (button)" in "Select Input Folder"



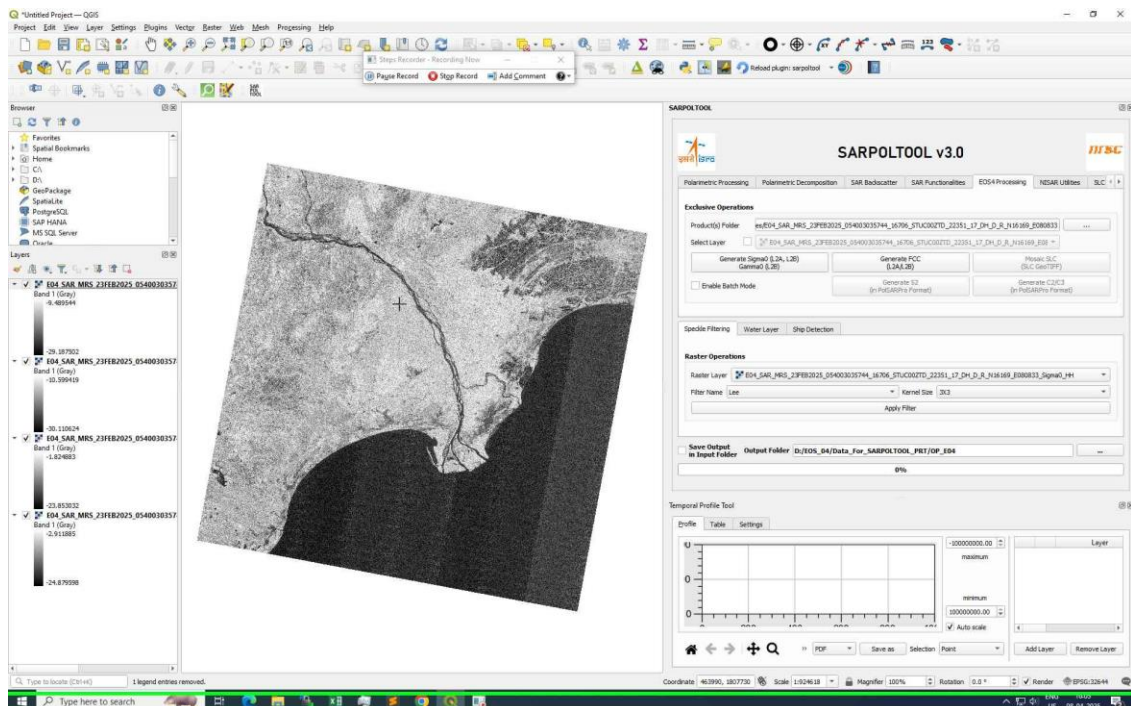
Step 16: (08-04-2025 16:02:07) User left click in "*Untitled Project — QGIS"



Step 17: (08-04-2025 16:03:32) User left click on "OK (button)" in "Success"

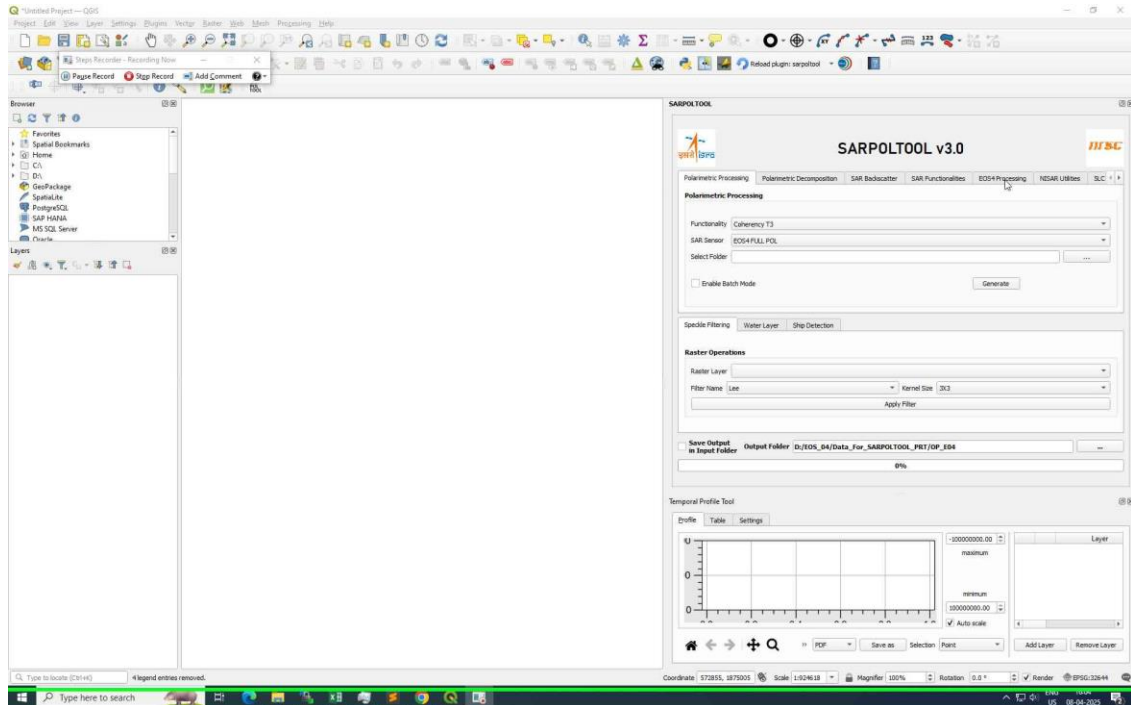


Step 18: (08-04-2025 16:03:36) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

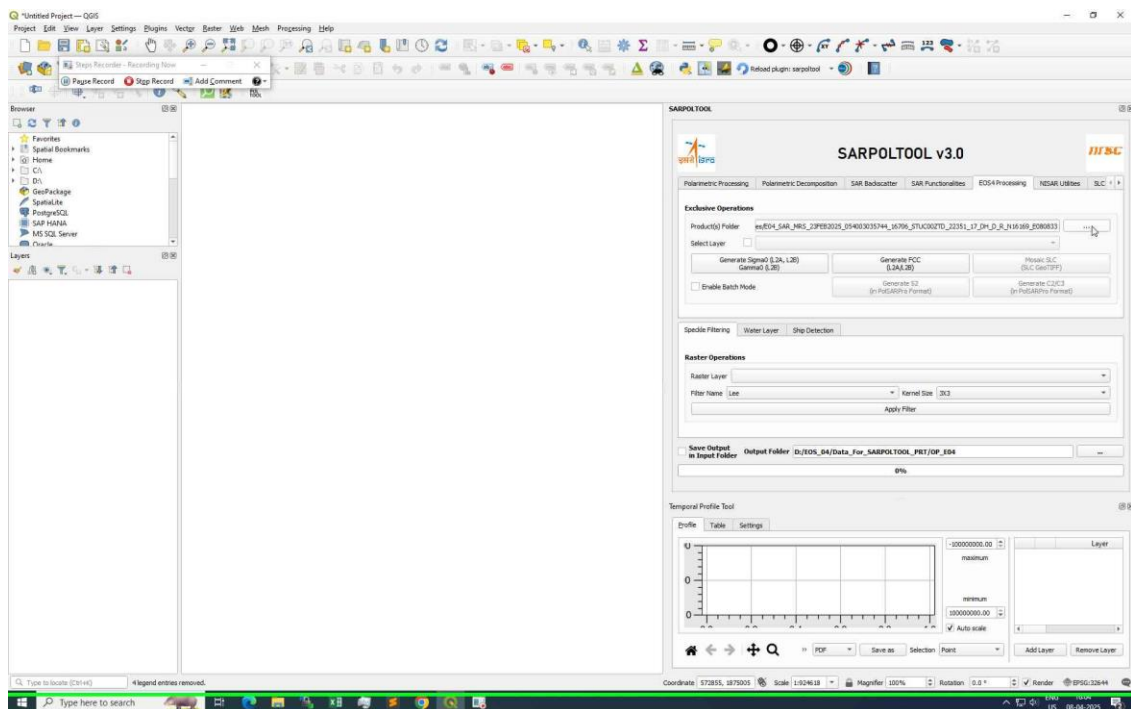


EOS4 Processing – SLC – Sample Operation

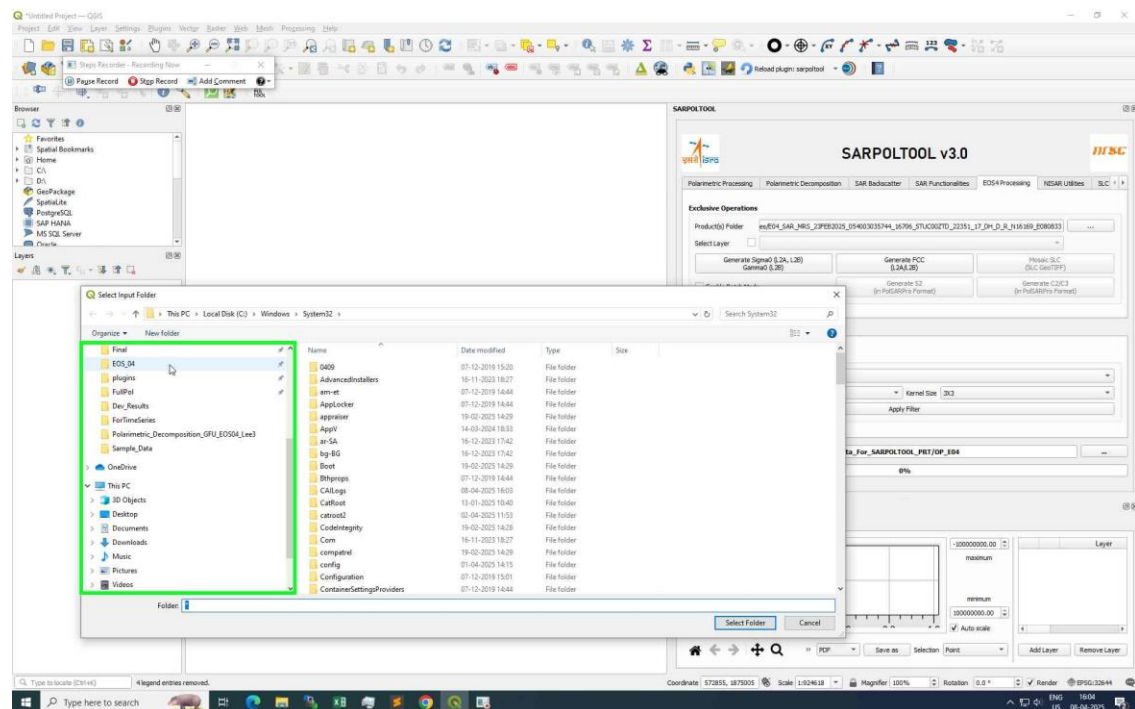
Step 1: (08-04-2025 16:04:34) User left click in "*Untitled Project — QGIS"



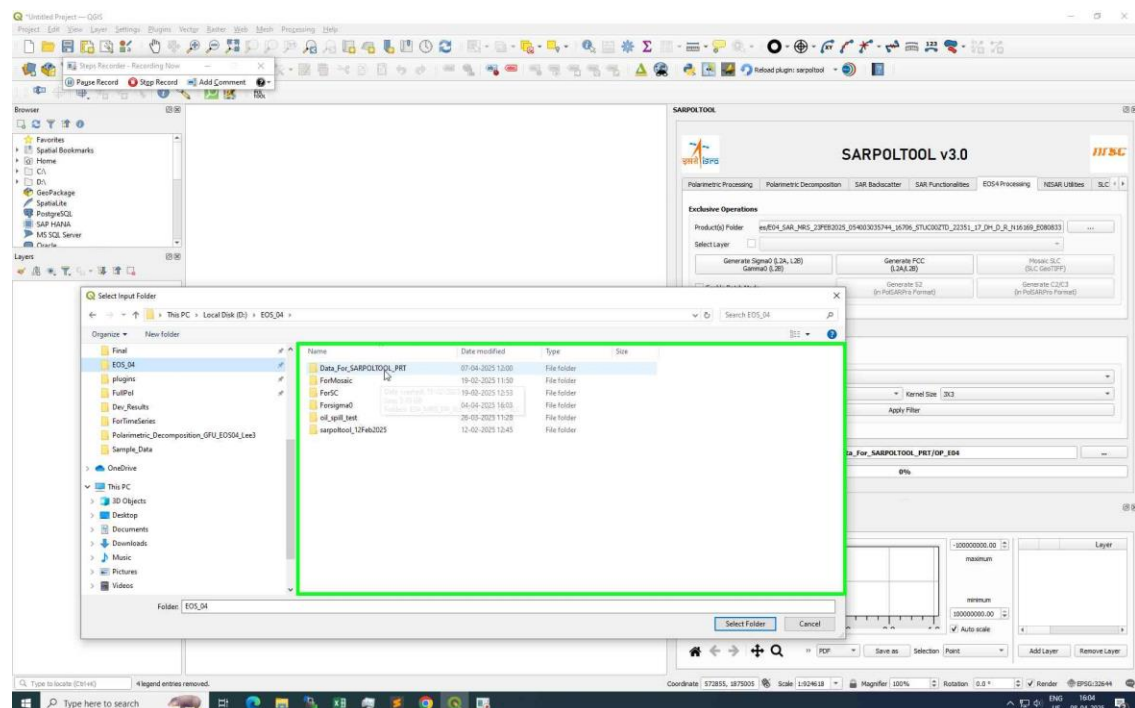
Step 2: (08-04-2025 16:04:36) User left click in "*Untitled Project — QGIS"



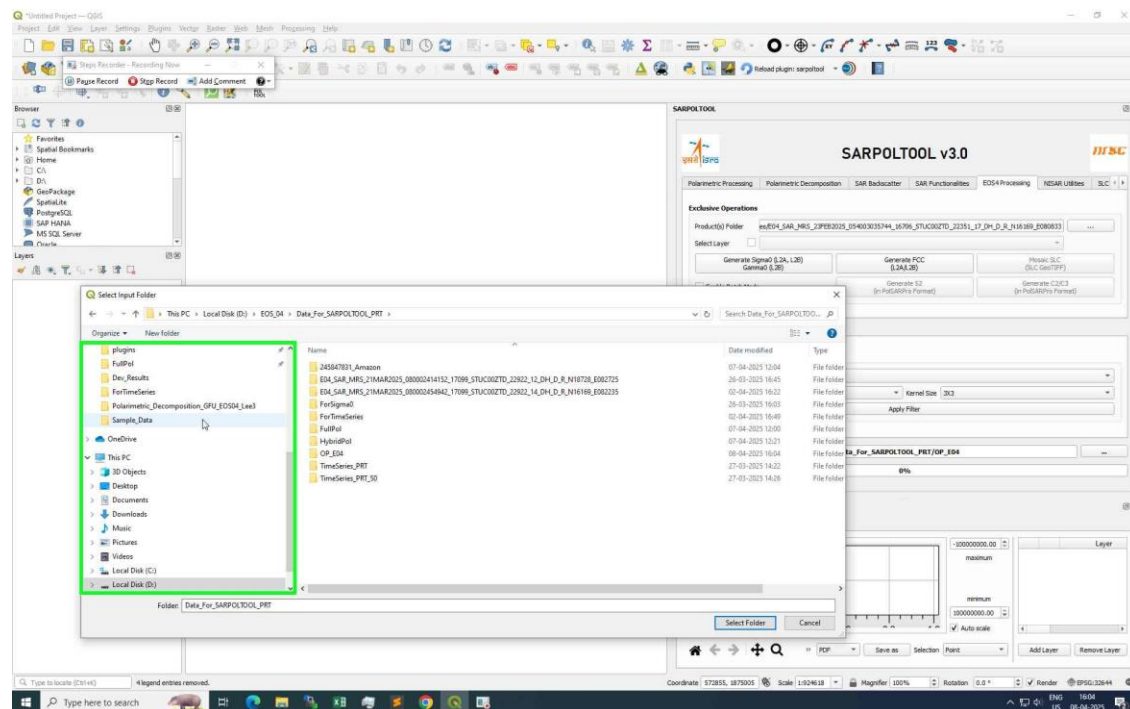
Step 3: (08-04-2025 16:04:39) User left click on "EOS_04 (pinned)" (tree item)" in "Select Input Folder"



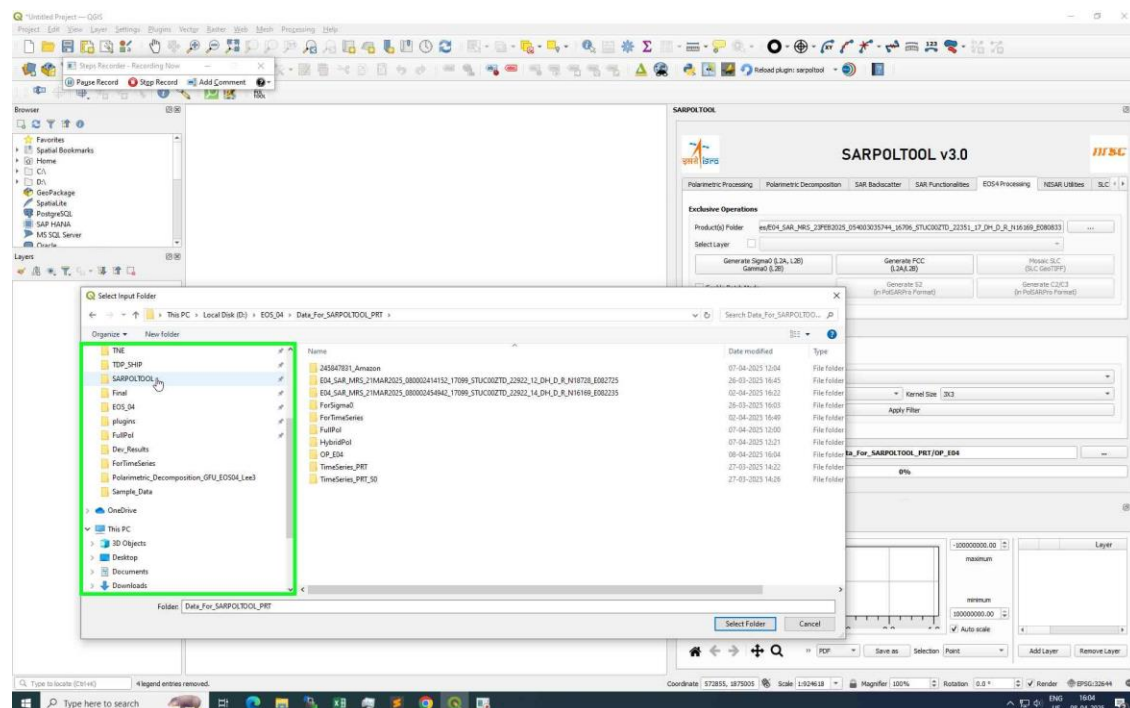
Step 4: (08-04-2025 16:04:42) User left double click on "Name (edit)" in "Select Input Folder"



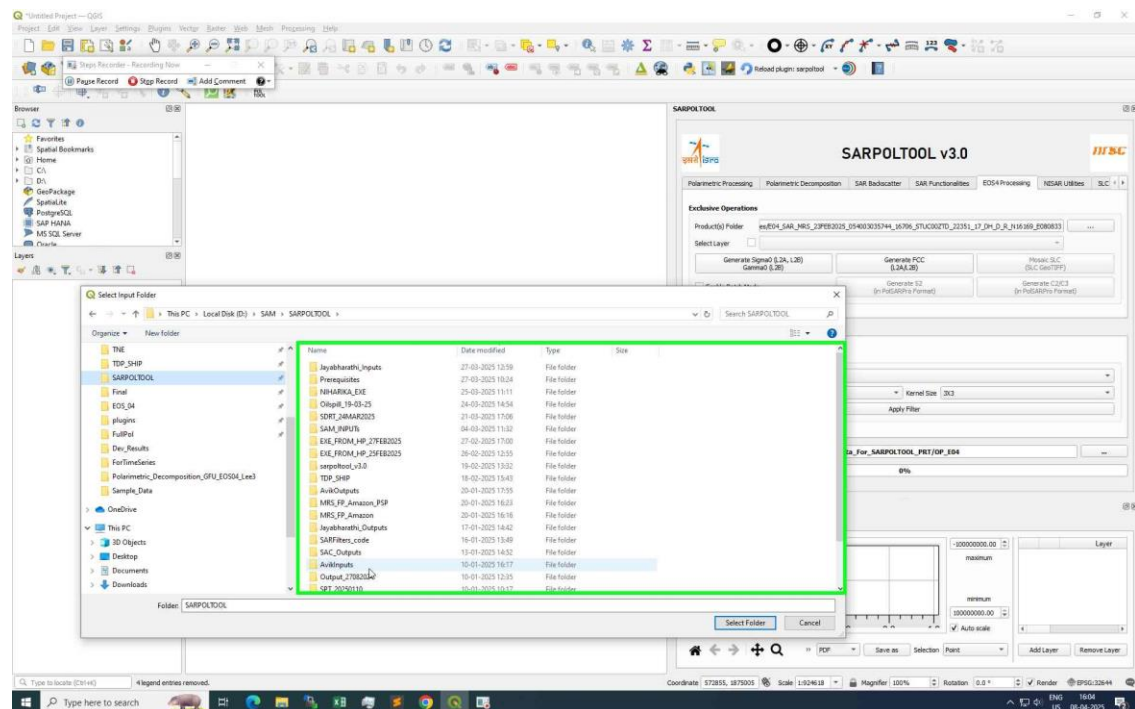
Step 5: (08-04-2025 16:04:54) User mouse wheel up on "Sample_Data (tree item)" in "Select Input Folder"



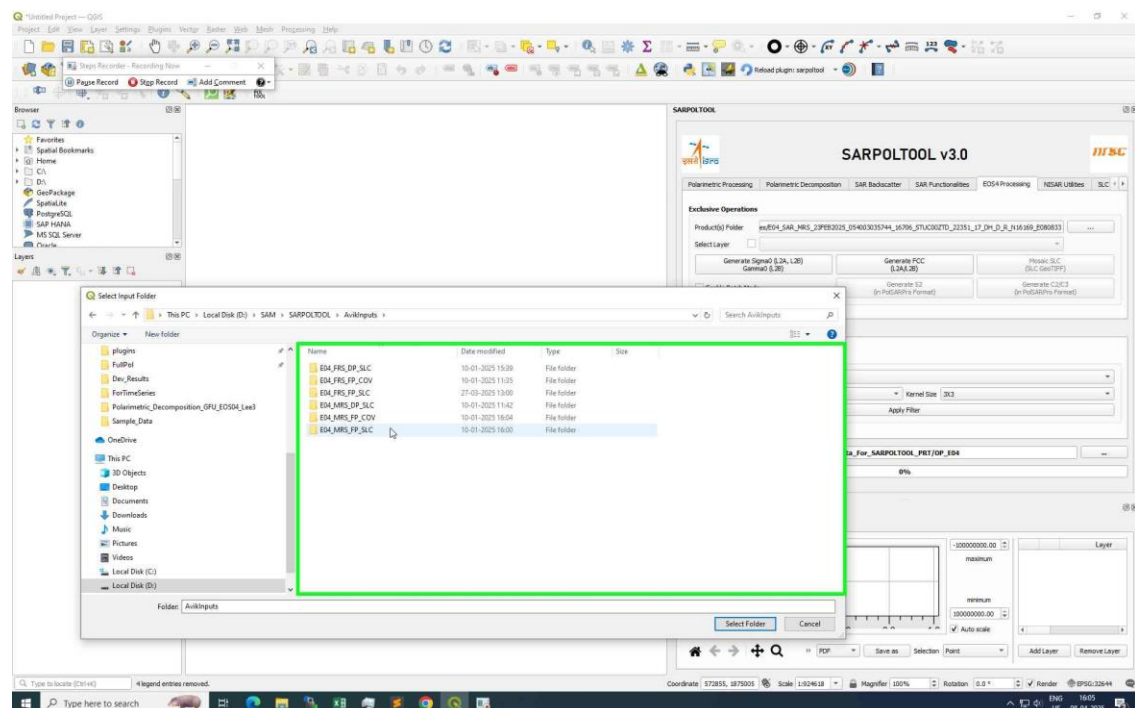
Step 6: (08-04-2025 16:04:55) User left click on "SARPOLTOOL (pinned) (tree item)" in "Select Input Folder"



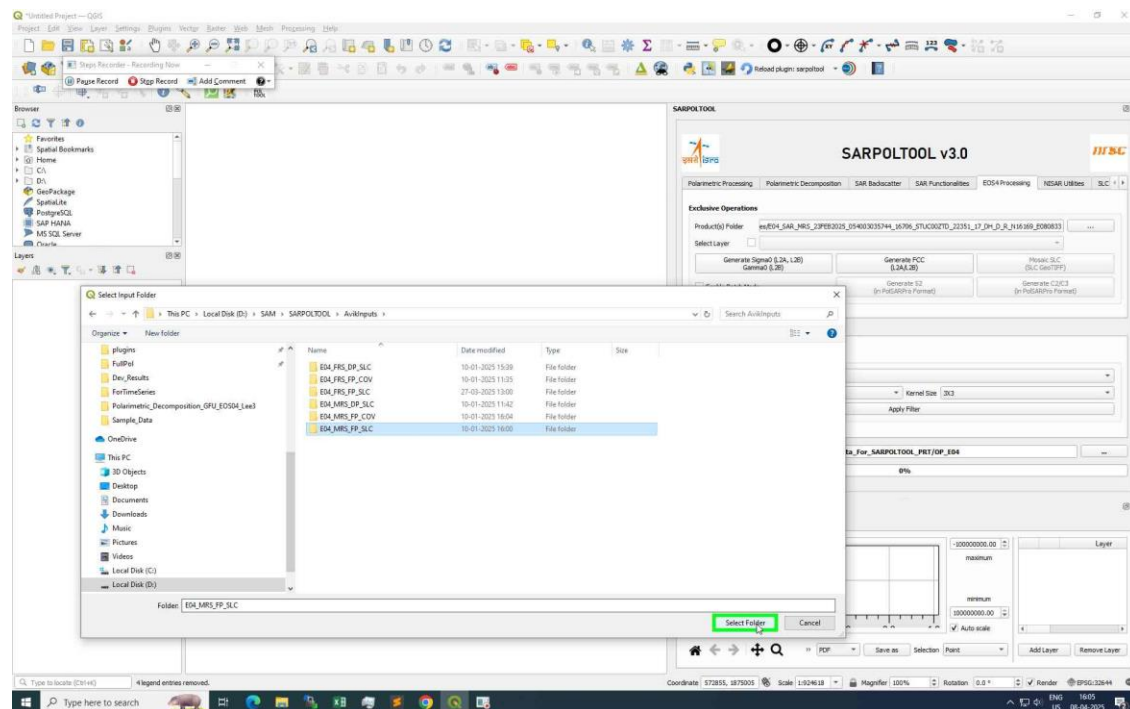
Step 7: (08-04-2025 16:05:00) User left double click on "Name (edit)" in "Select Input Folder"



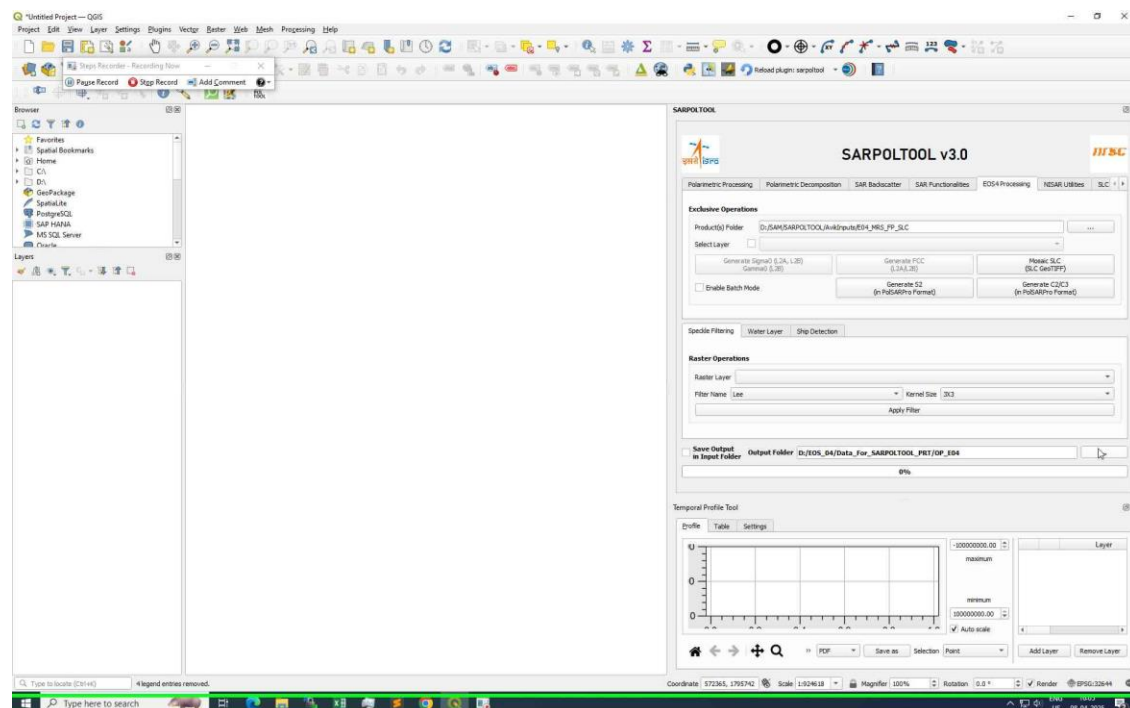
Step 8: (08-04-2025 16:05:05) User left click on "Name (edit)" in "Select Input Folder"



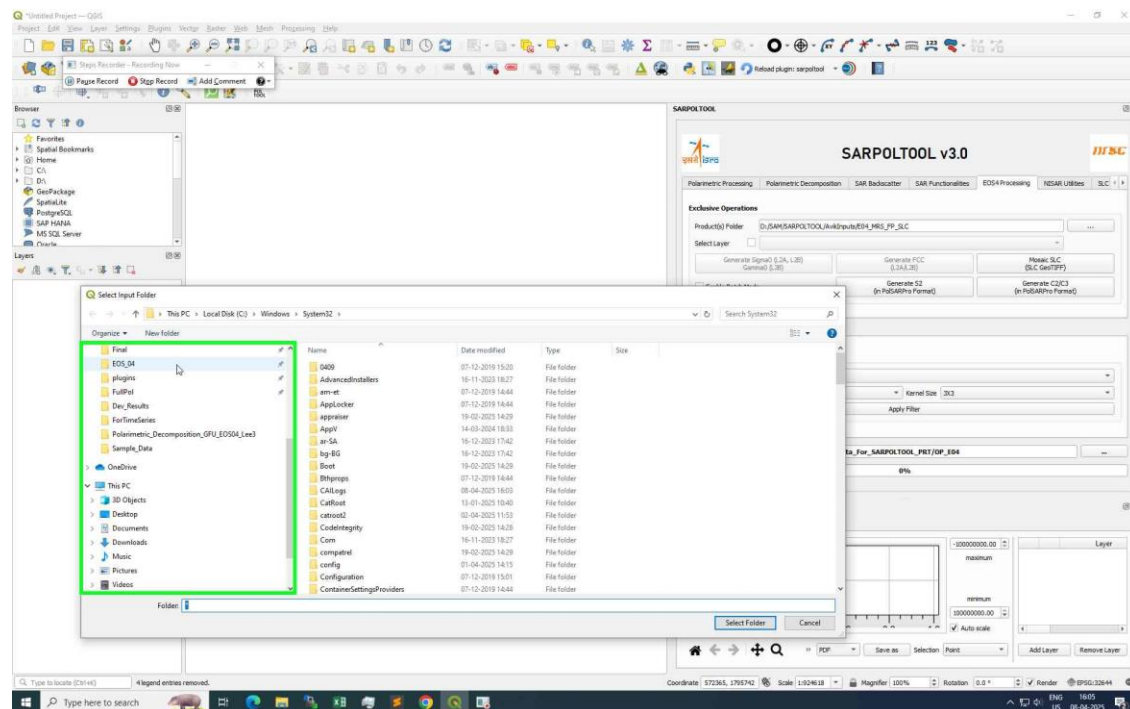
Step 9: (08-04-2025 16:05:09) User left click on "Select Folder (button)" in "Select Input Folder"



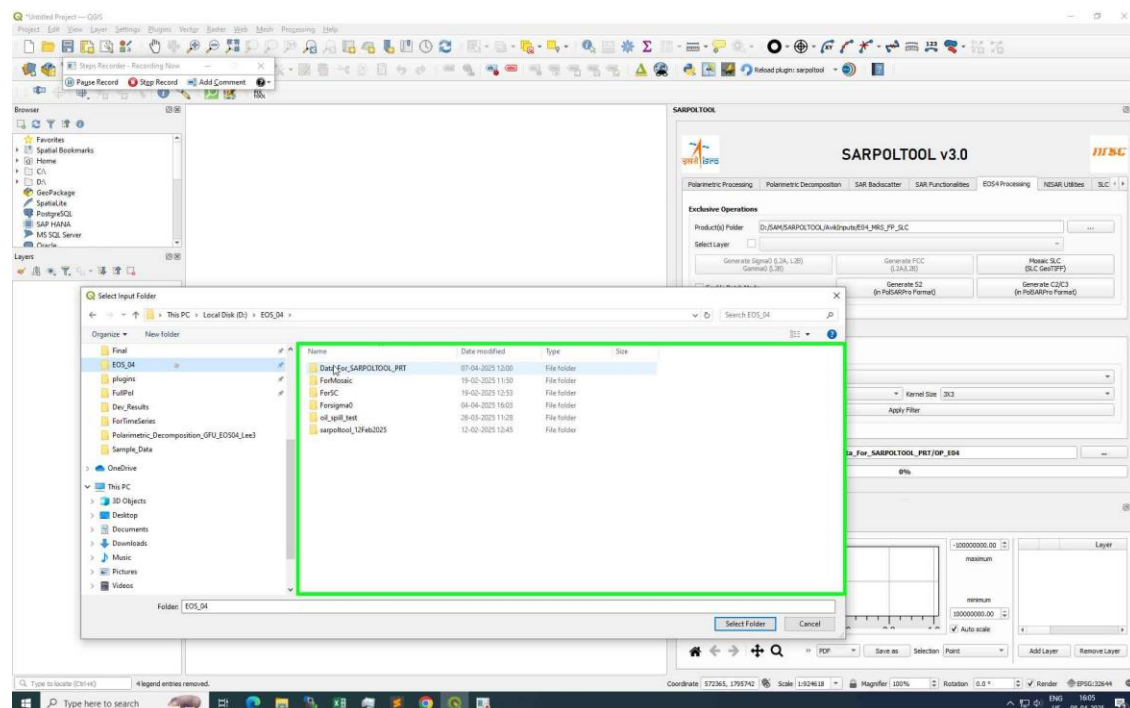
Step 10: (08-04-2025 16:05:16) User left click on "... (button)" in "*Untitled Project — QGIS"



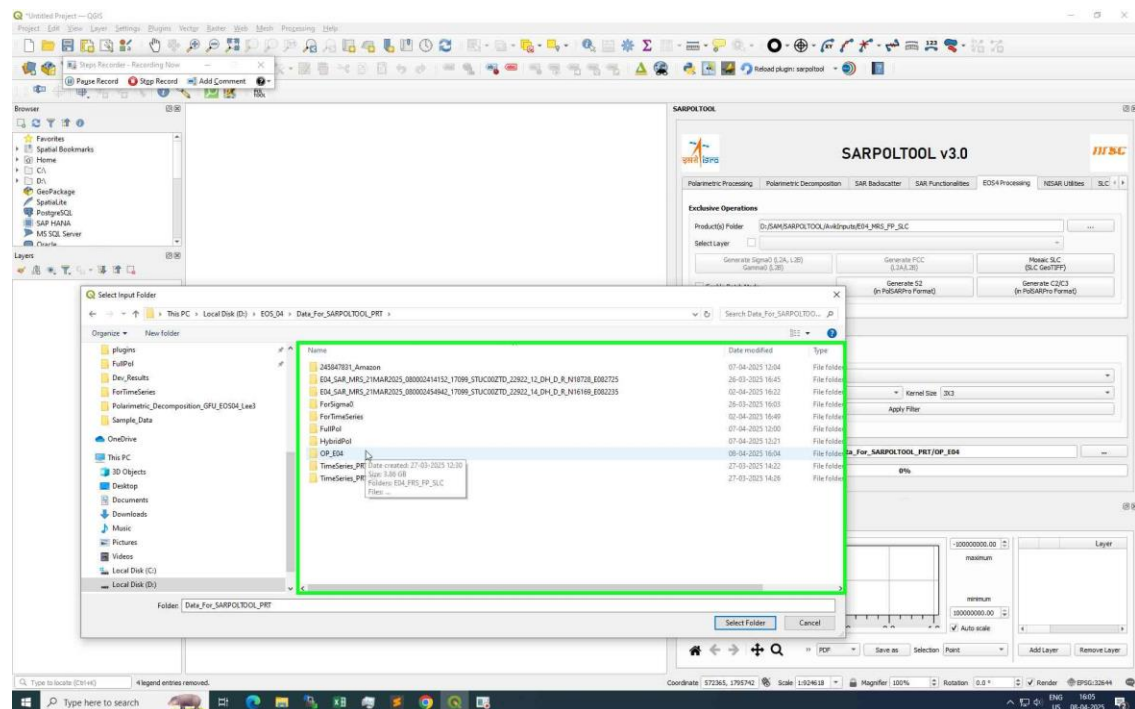
Step 11: (08-04-2025 16:05:19) User left click on "EOS_04 (pinned) (tree item)" in "Select Input Folder"



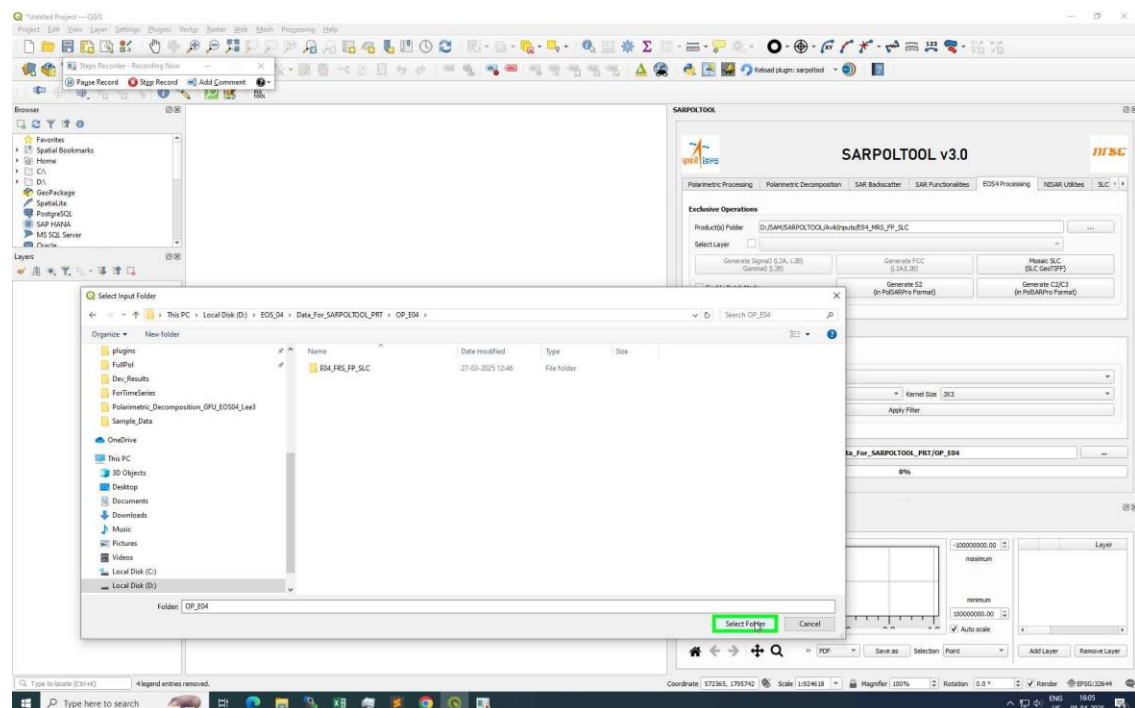
Step 12: (08-04-2025 16:05:20) User left double click on "Name (edit)" in "Select Input Folder"



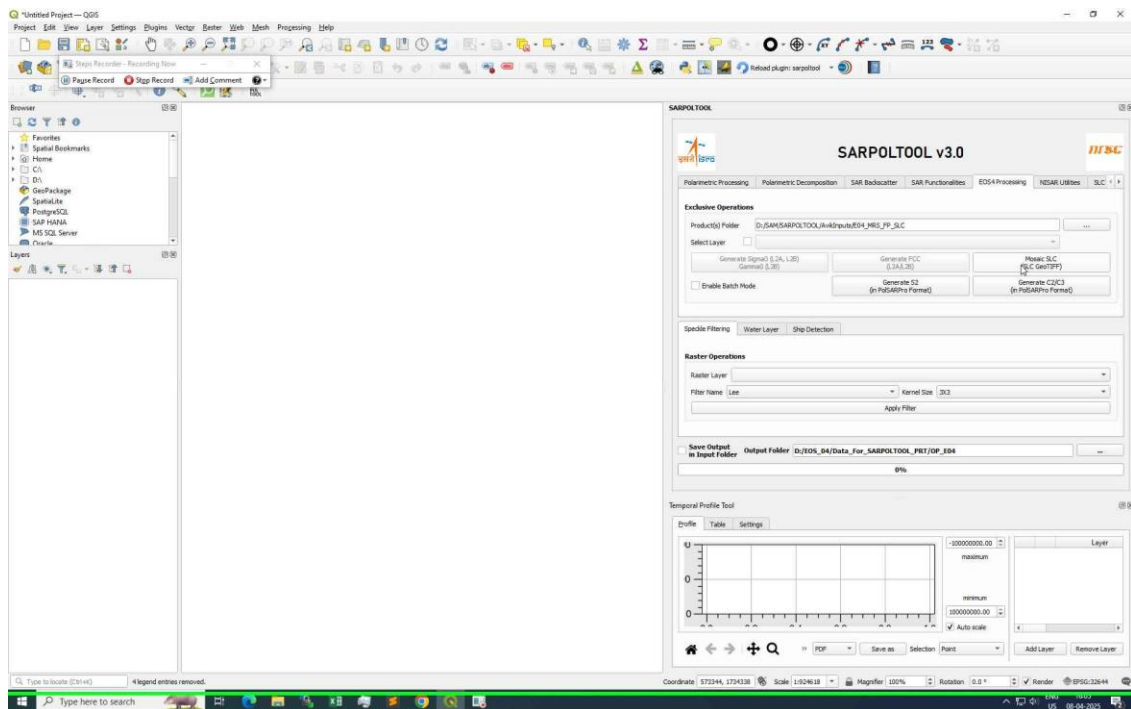
Step 13: (08-04-2025 16:05:22) User left double click on "Name (edit)" in "Select Input Folder"



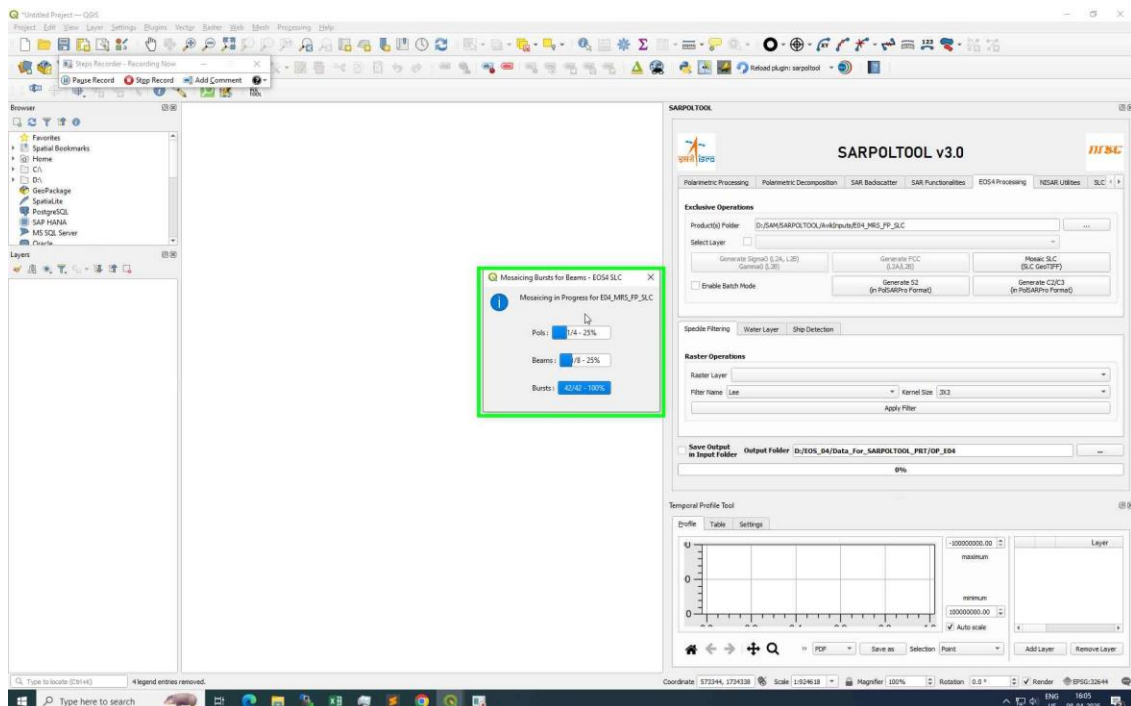
Step 14: (08-04-2025 16:05:23) User left click on "Select Folder (button)" in "Select Input Folder"



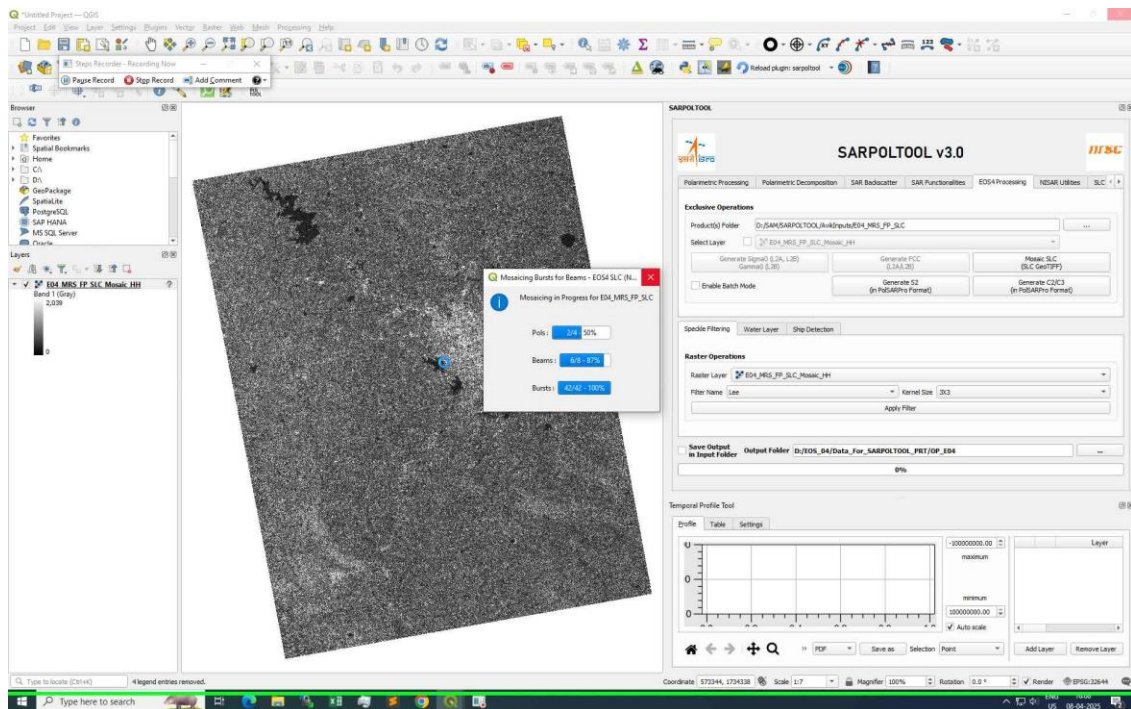
Step 15: (08-04-2025 16:05:30) User left click in "*Untitled Project — QGIS"



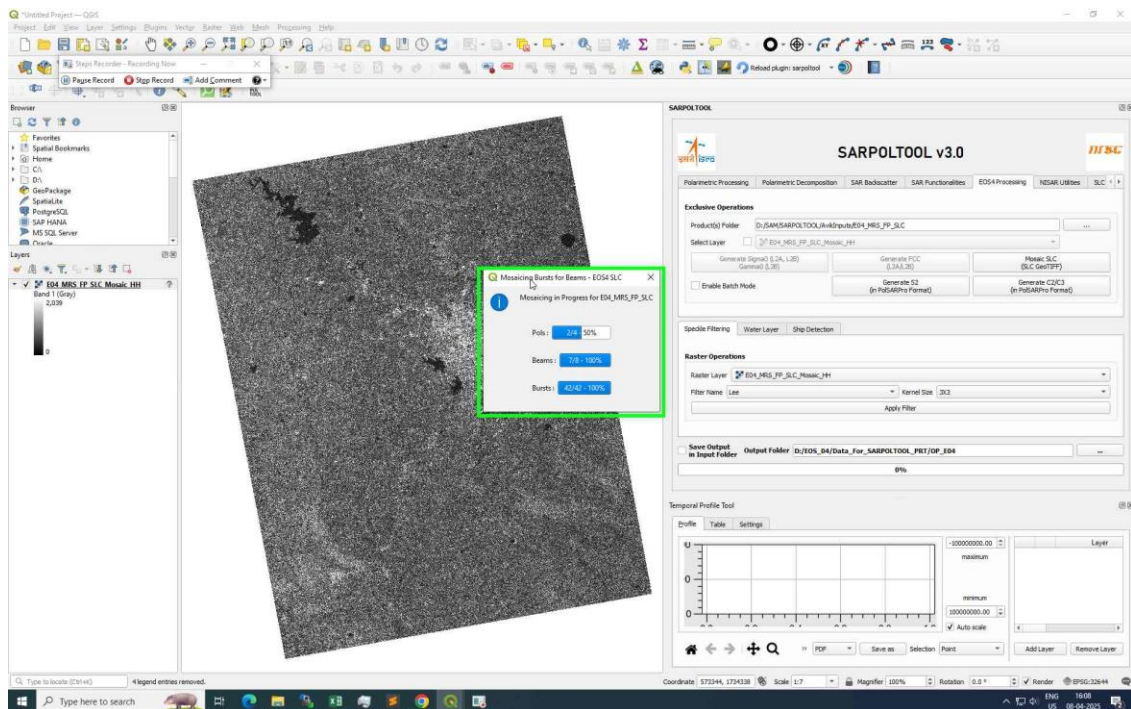
Step 16: (08-04-2025 16:05:37) User left click on "Mosaicing Bursts for Beams - EOS4 SLC (window)" in "Mosaicing Bursts for Beams - EOS4 SLC"



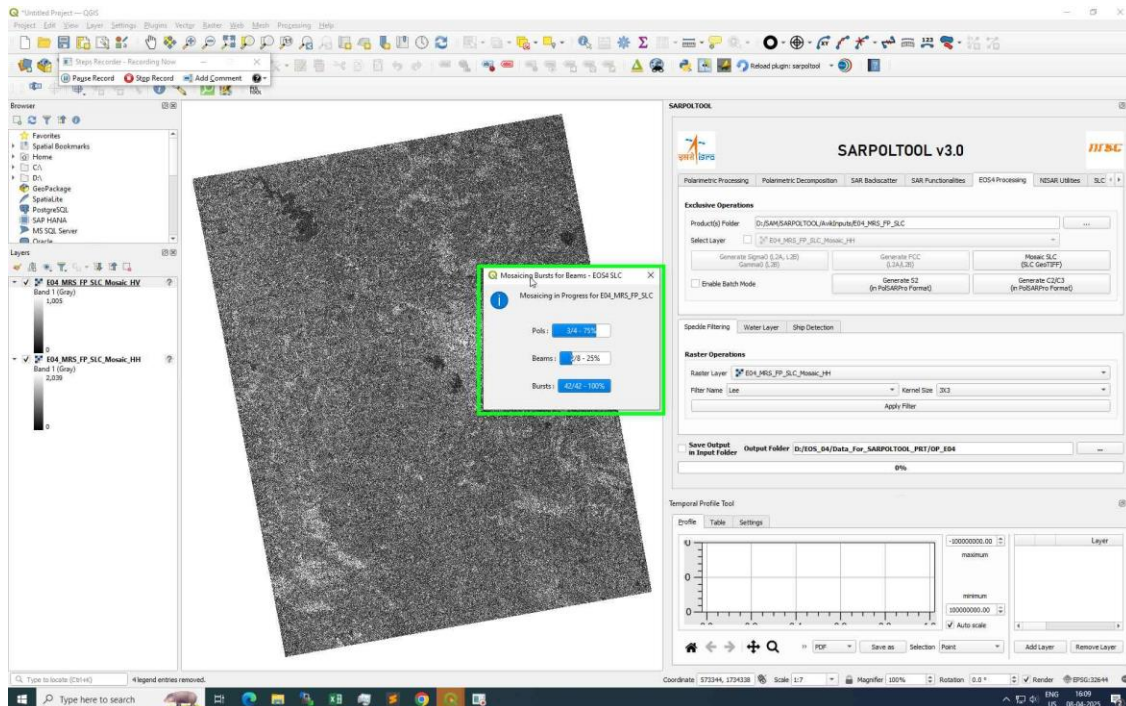
Step 17: (08-04-2025 16:08:21) User left click in "*Untitled Project — QGIS"



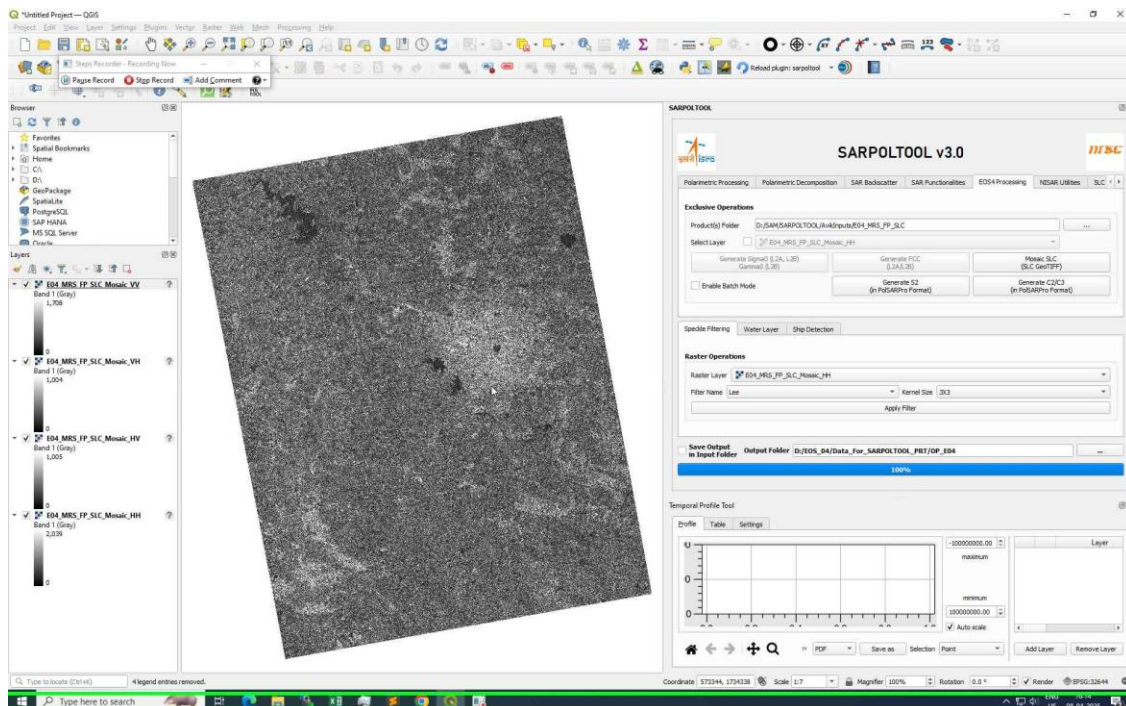
Step 18: (08-04-2025 16:08:29) User left click on "Mosaicing Bursts for Beams - EOS4 SLC (window)" in "Mosaicing Bursts for Beams - EOS4 SLC"



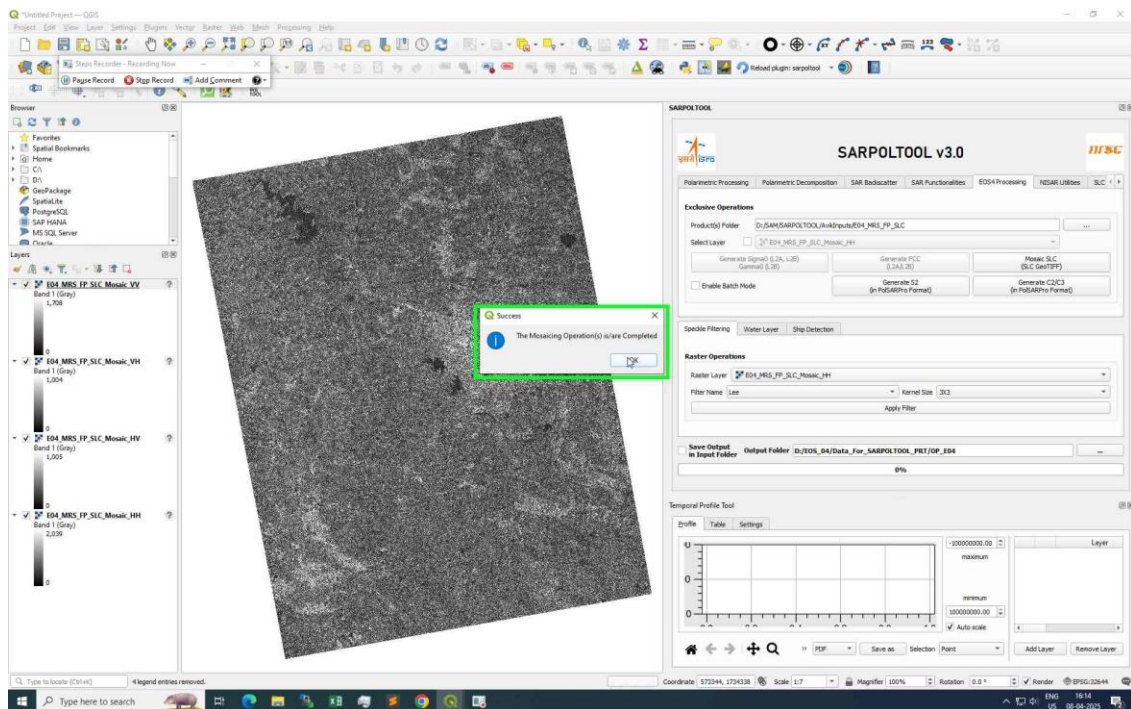
Step 19: (08-04-2025 16:09:16) User left click on "Mosaicing Bursts for Beams - EOS4 SLC (window)" in "Mosaicing Bursts for Beams - EOS4 SLC"



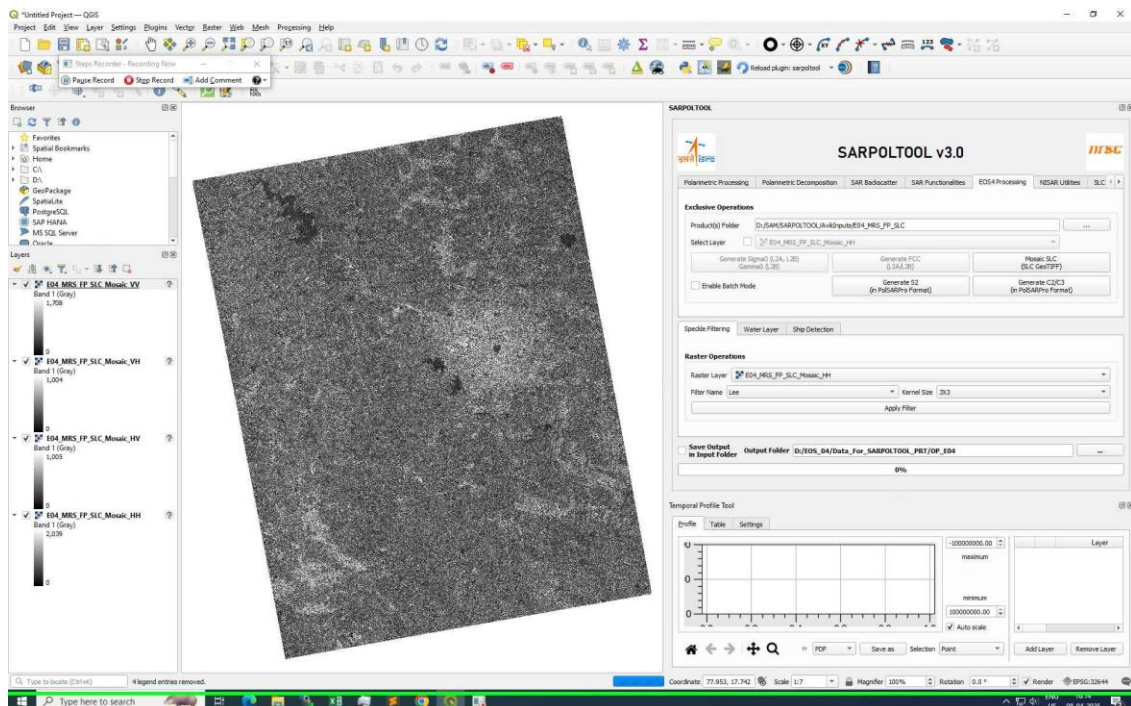
Step 20: (08-04-2025 16:14:00) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"



Step 21: (08-04-2025 16:14:05) User left click on "OK (button)" in "Success"

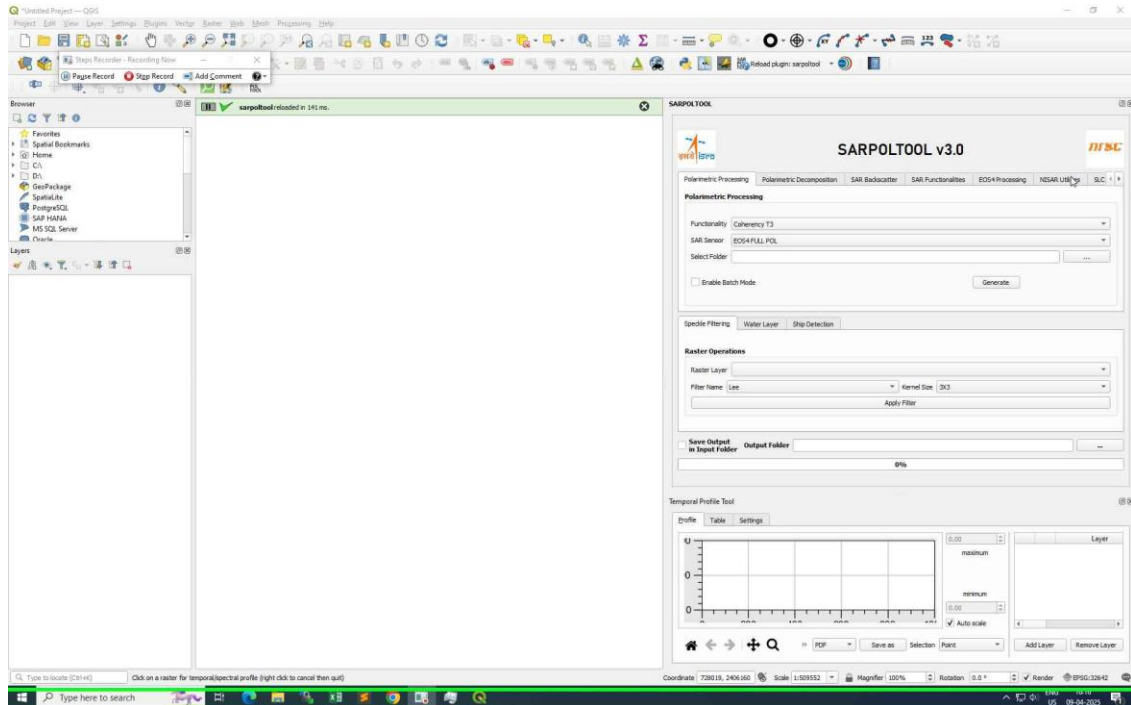


Step 22: (08-04-2025 16:14:07) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

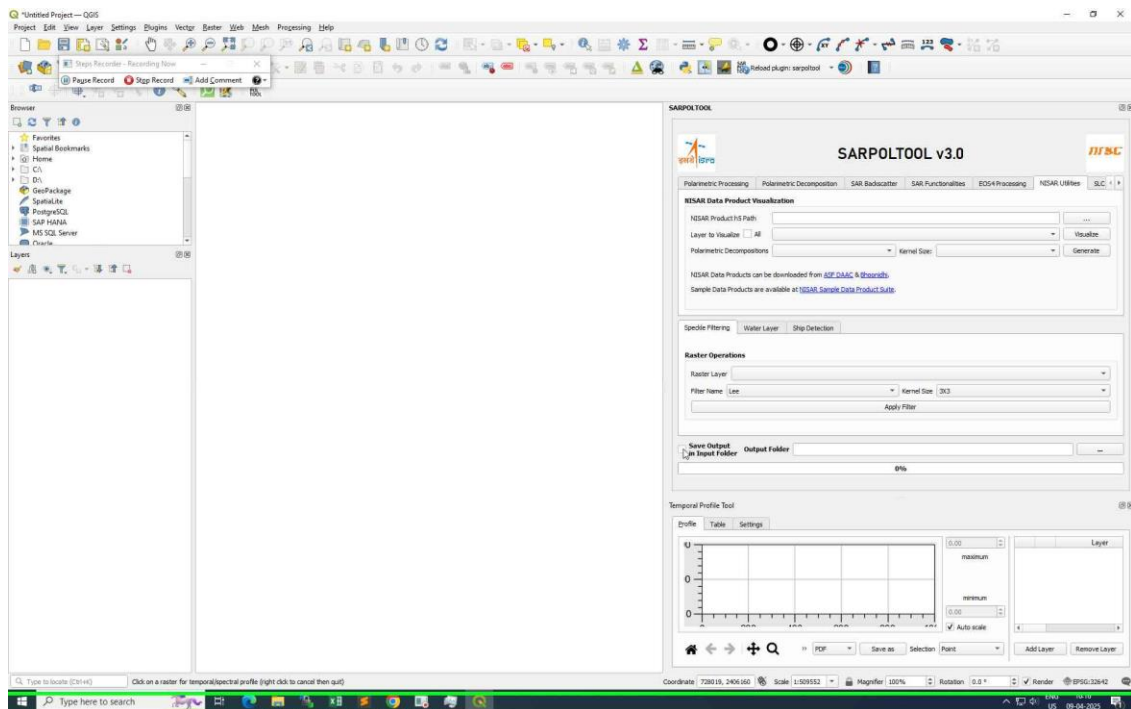


NISAR Utilities – Visualization – Sample Operation

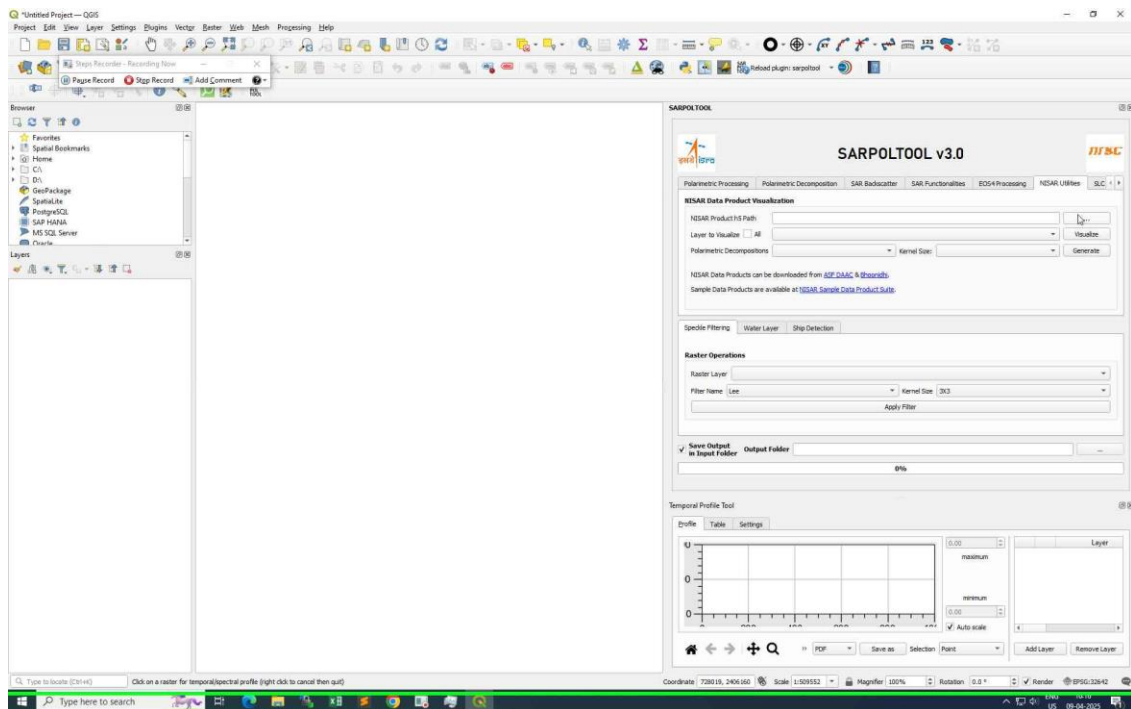
Step 1: (09-04-2025 10:16:04) User left click in "*Untitled Project — QGIS"



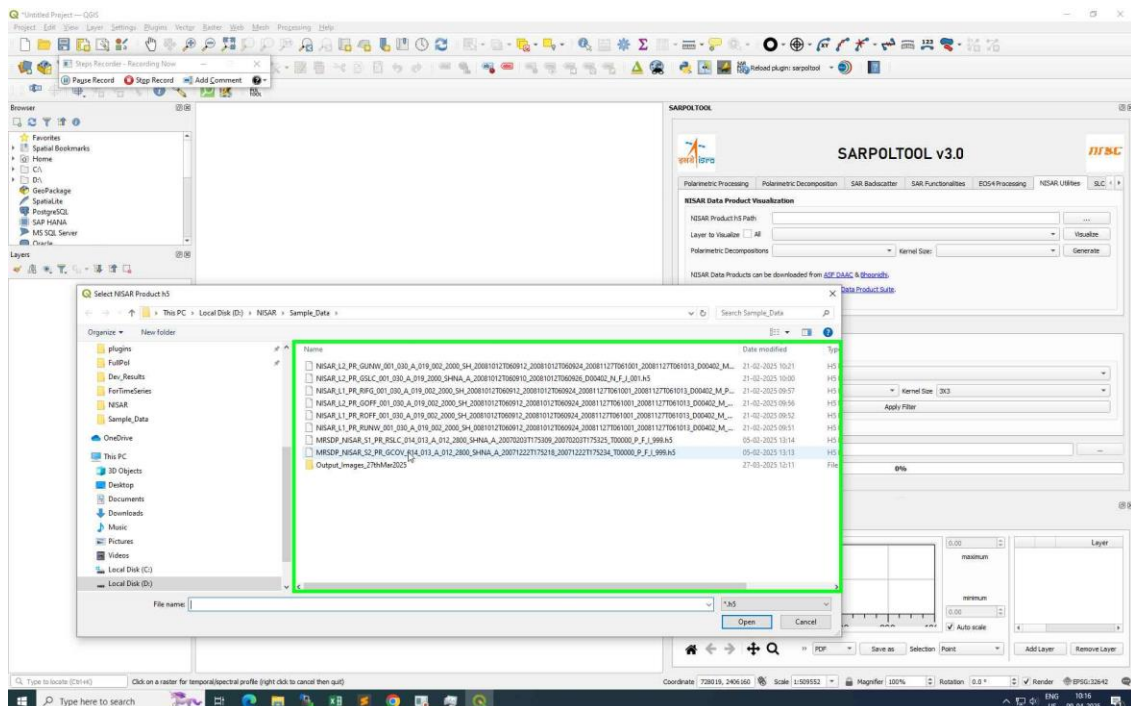
Step 2: (09-04-2025 10:16:13) User left click on "Save Output in Input Folder (check box)" in "*Untitled Project — QGIS"



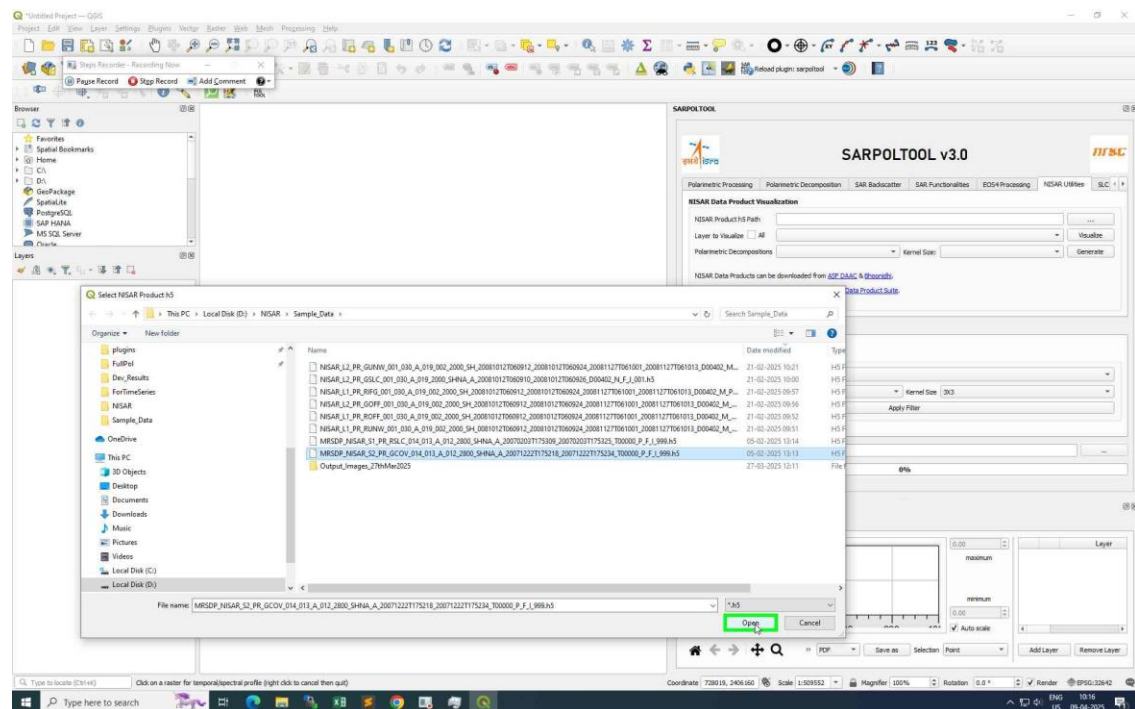
Step 3: (09-04-2025 10:16:14) User left click in "*Untitled Project — QGIS"



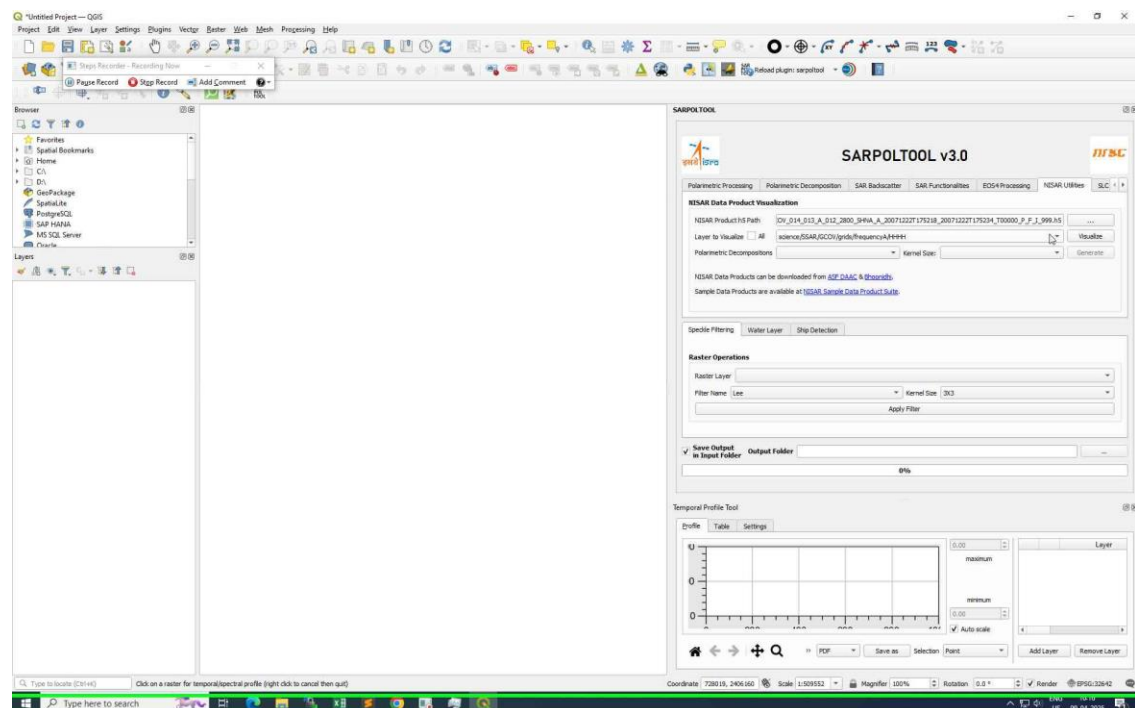
Step 4: (09-04-2025 10:16:17) User left click on "Name (edit)" in "Select NISAR Product h5"



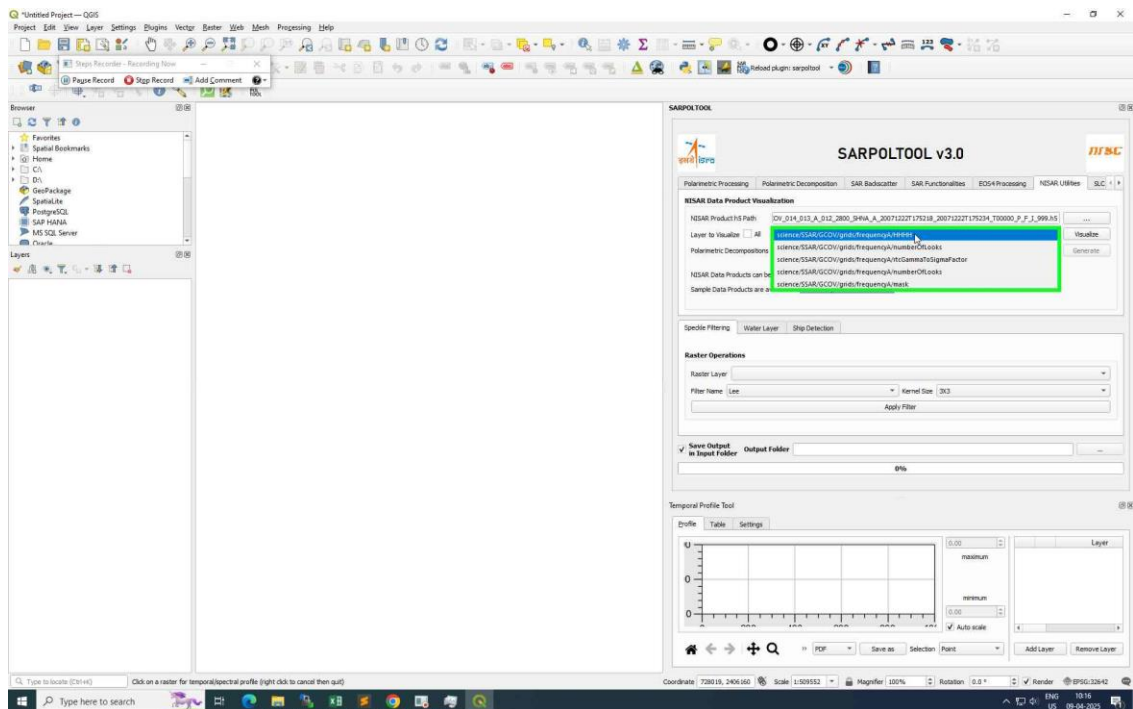
Step 5: (09-04-2025 10:16:18) User left click on "Open (button)" in "Select NISAR Product h5"



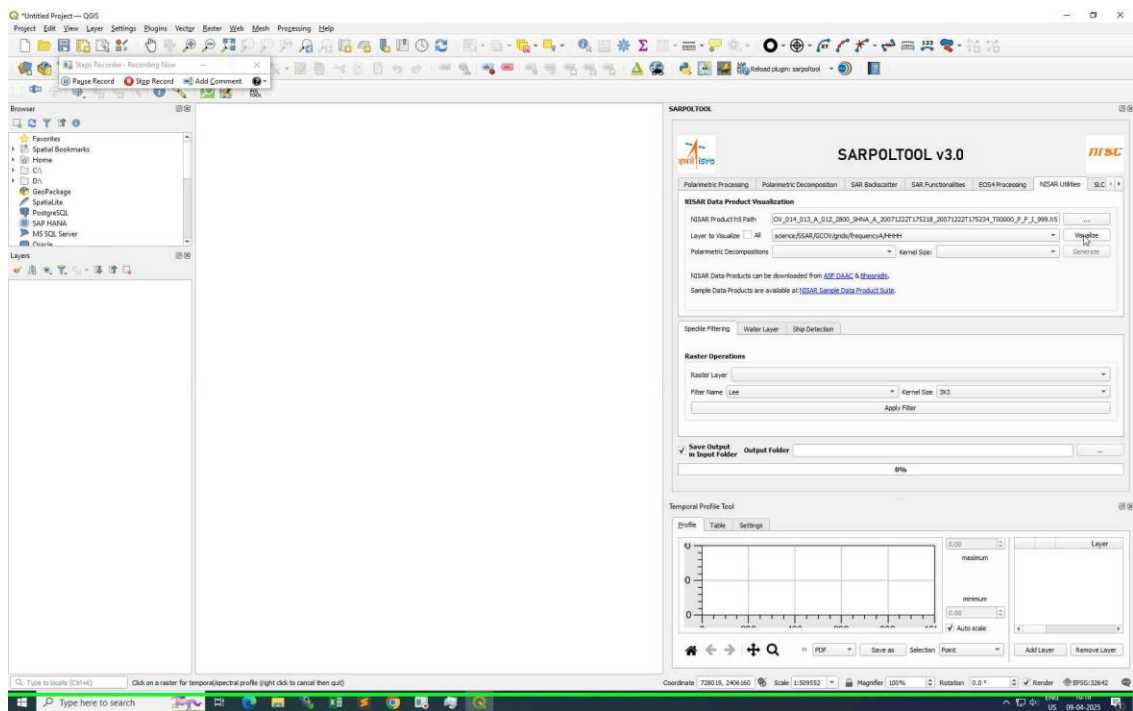
Step 6: (09-04-2025 10:16:20) User left click in "*Untitled Project — QGIS"



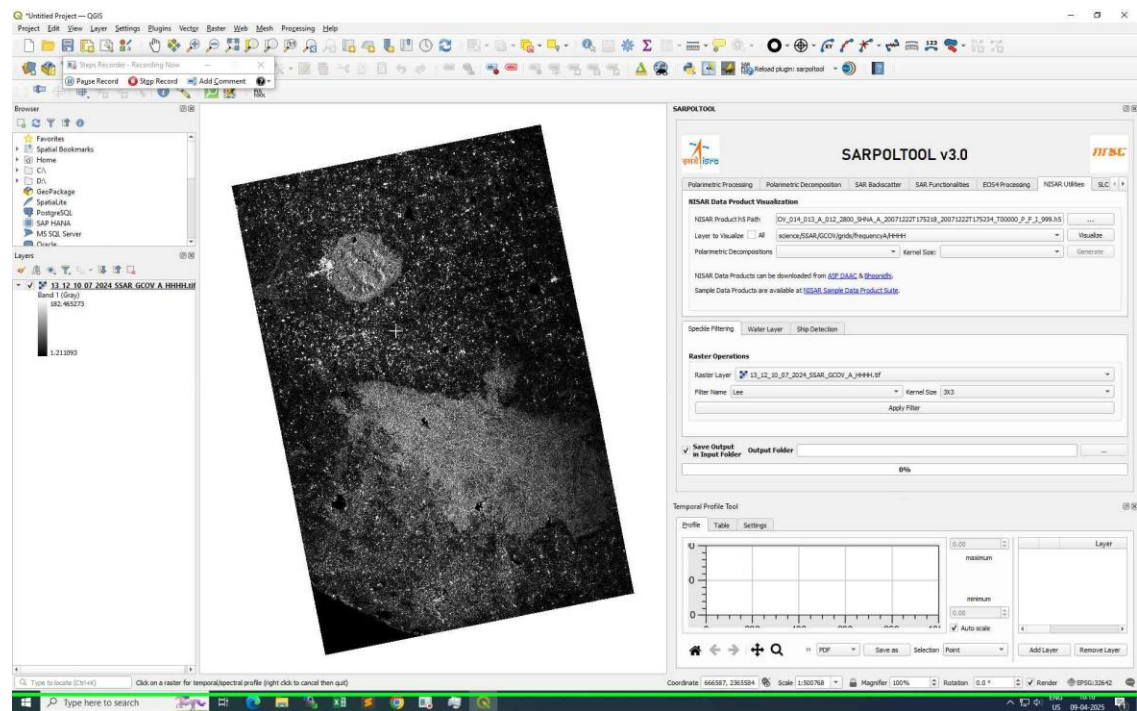
Step 7: (09-04-2025 10:16:22) User left click in "QGIS"



Step 8: (09-04-2025 10:16:26) User left click in "*Untitled Project — QGIS"

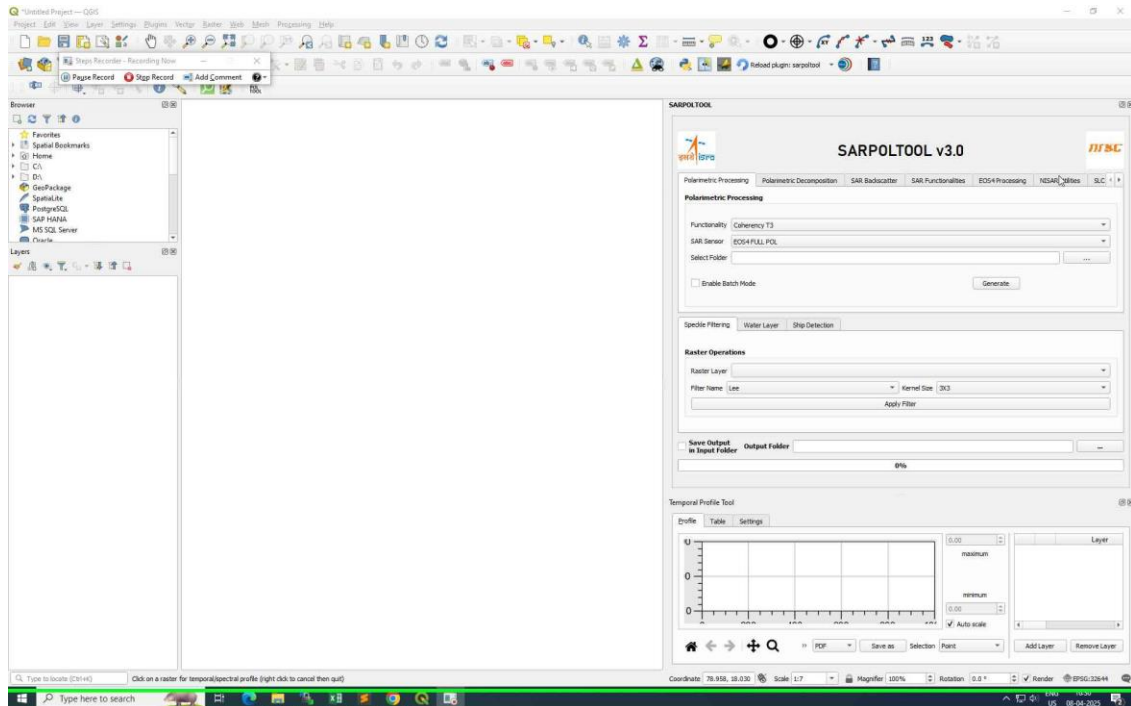


Step 9: (09-04-2025 10:16:29) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

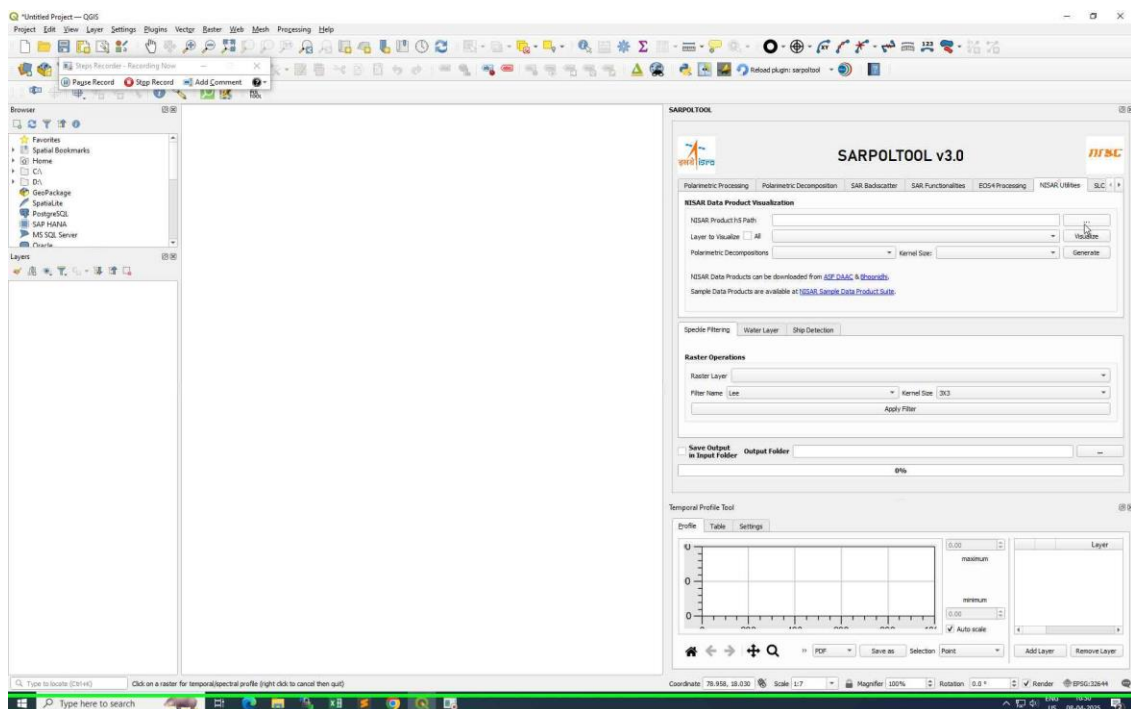


NISAR Utilities – Decomposition – Sample Operation

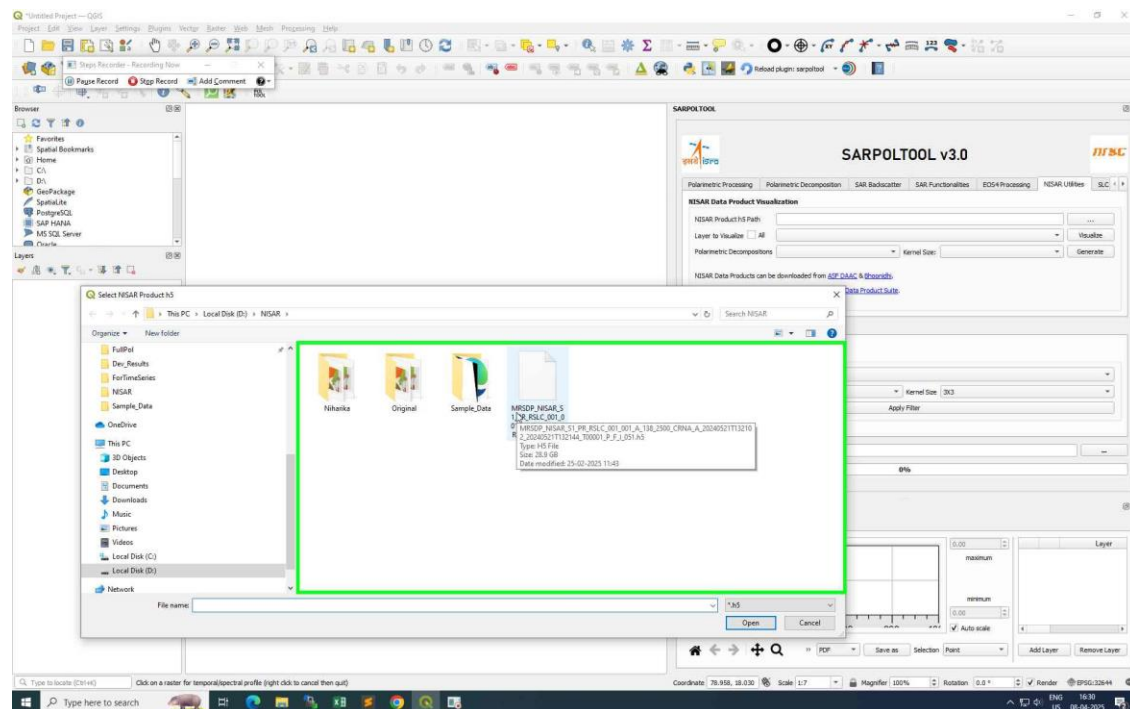
Step 1: (08-04-2025 16:30:16) User left click in "*Untitled Project — QGIS"



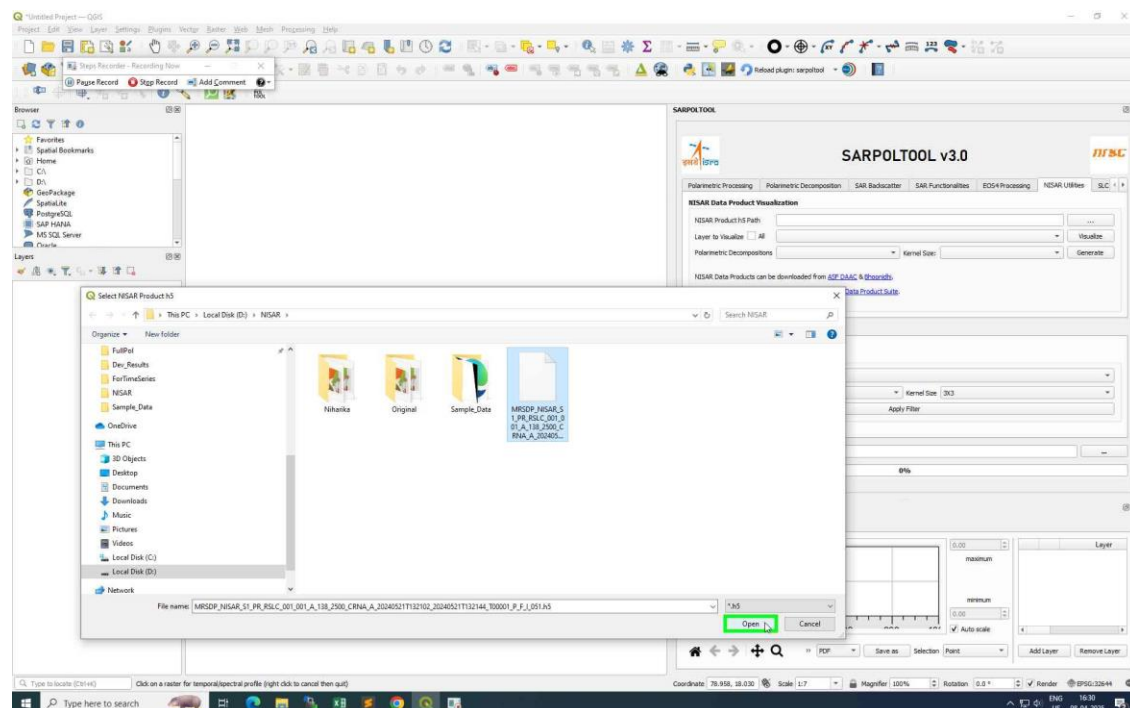
Step 2: (08-04-2025 16:30:17) User left click in "*Untitled Project — QGIS"



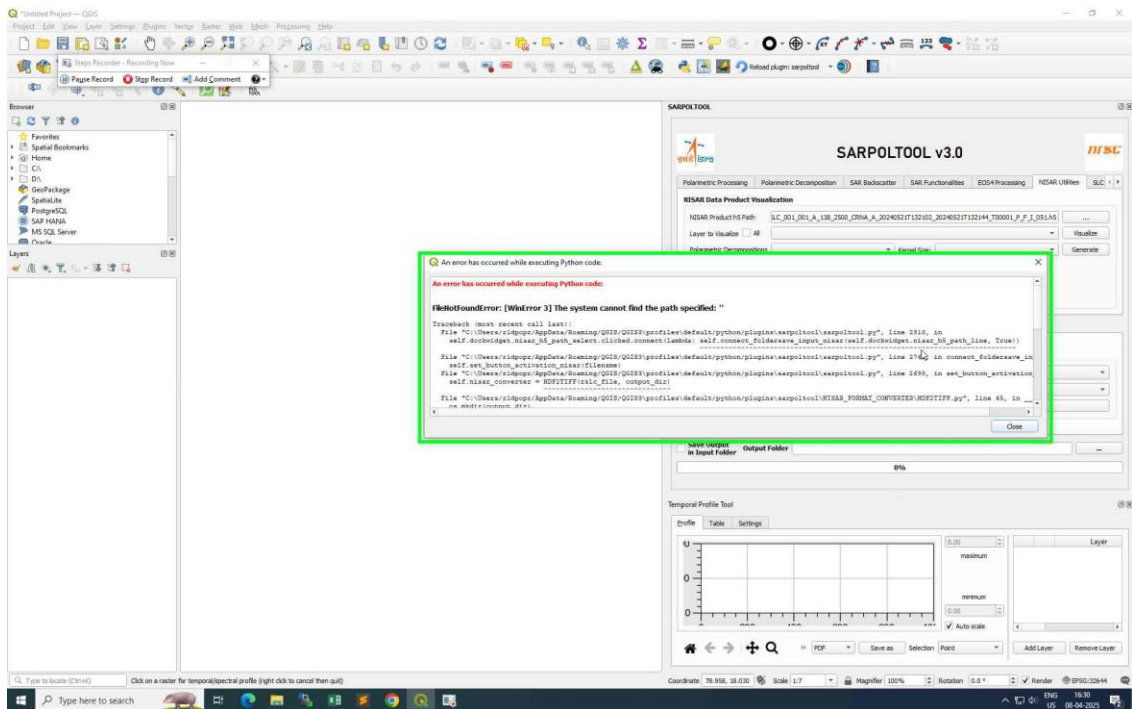
Step 3: (08-04-2025 16:30:21) User left click on "Name (edit)" in "Select NISAR Product h5"



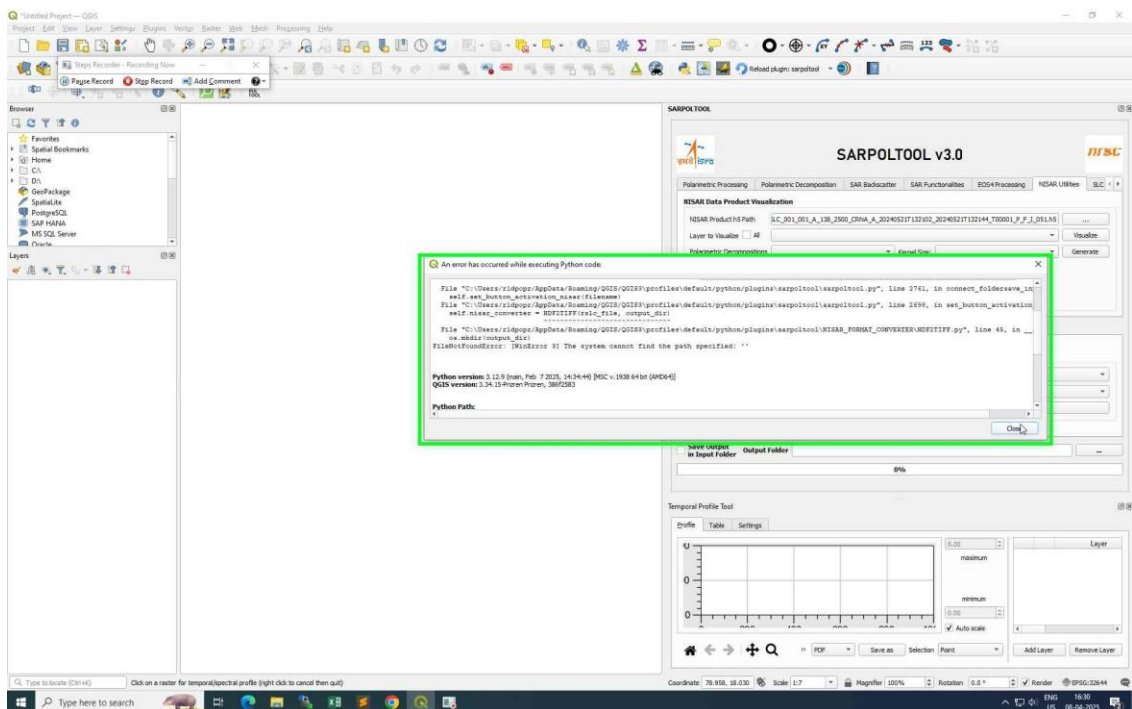
Step 4: (08-04-2025 16:30:23) User left click on "Open (button)" in "Select NISAR Product h5"



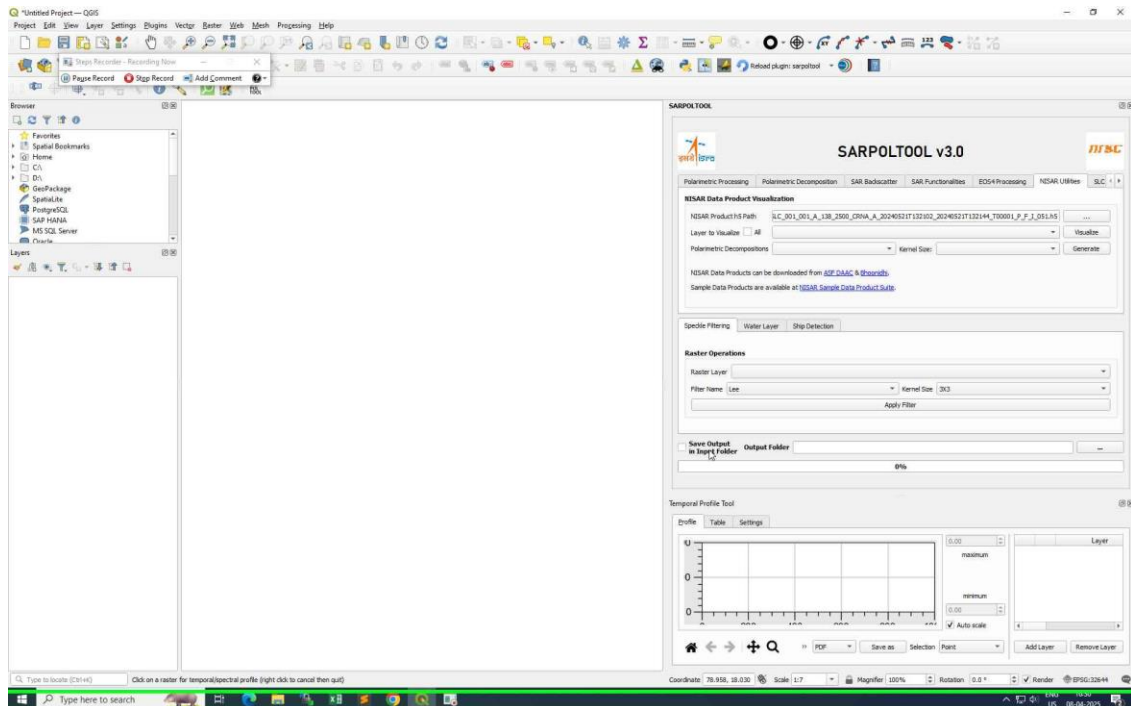
Step 5: (08-04-2025 16:30:26) User mouse wheel down on "An error has occurred while executing Python code: (window)" in "An error has occurred while executing Python code:"



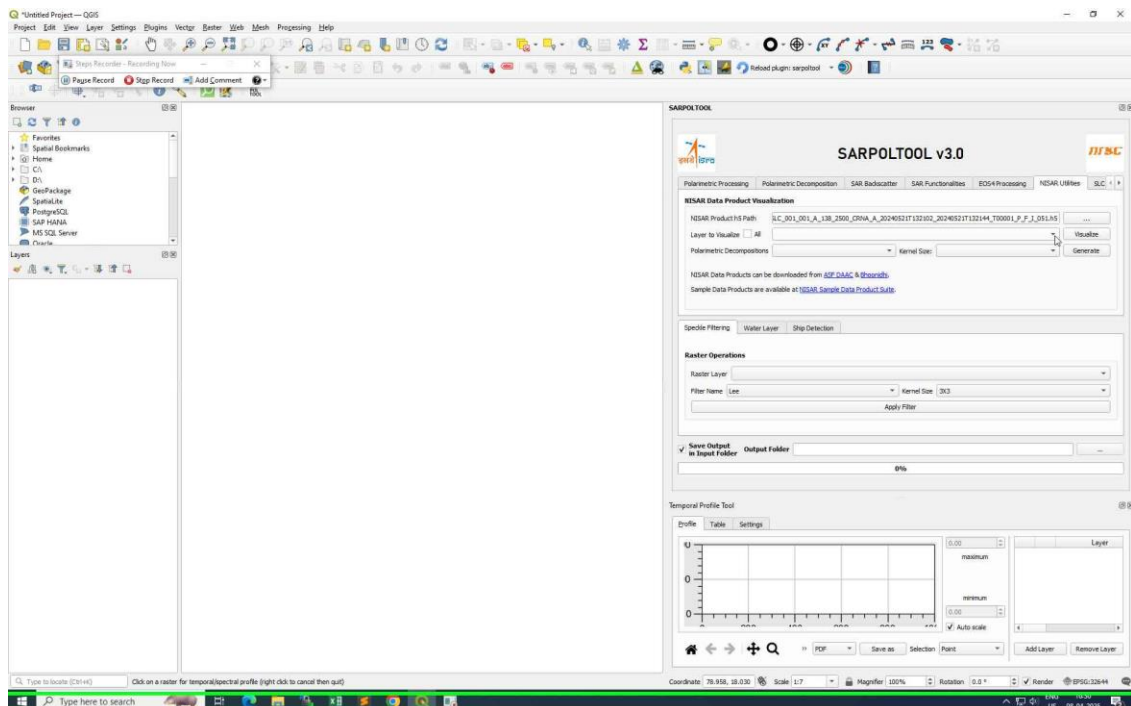
Step 6: (08-04-2025 16:30:34) User left click on "Close (button)" in "An error has occurred while executing Python code:"



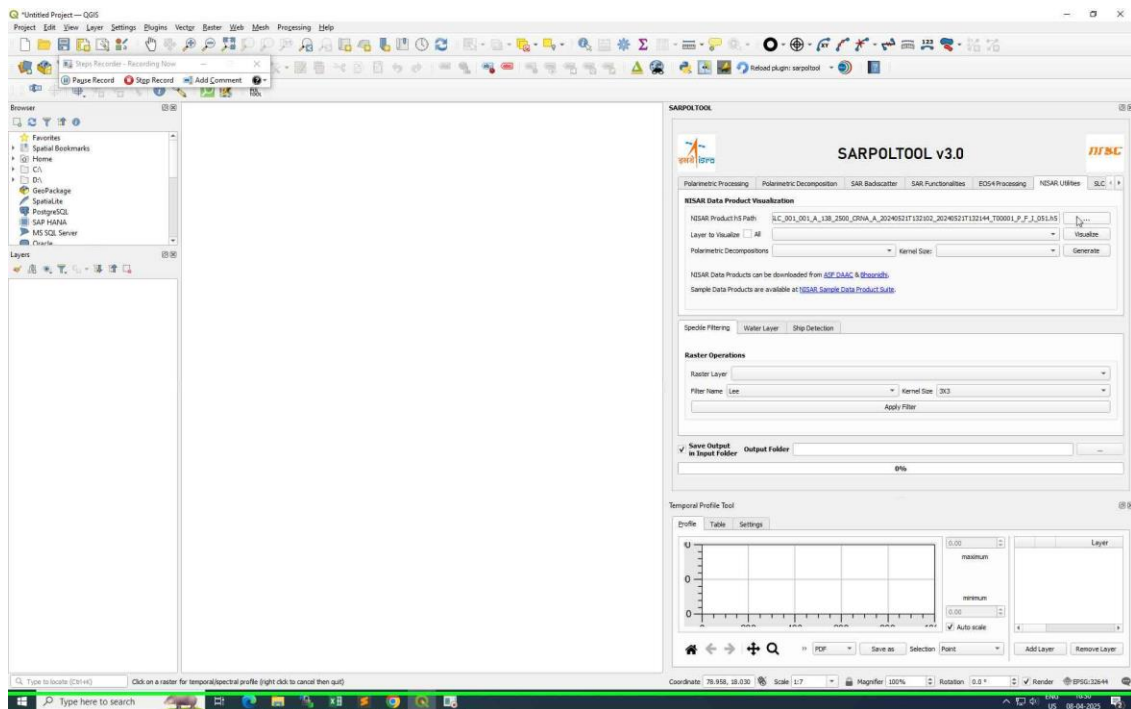
Step 7: (08-04-2025 16:30:36) User left click on "Save Output in Input Folder (check box)" in "*Untitled Project — QGIS"



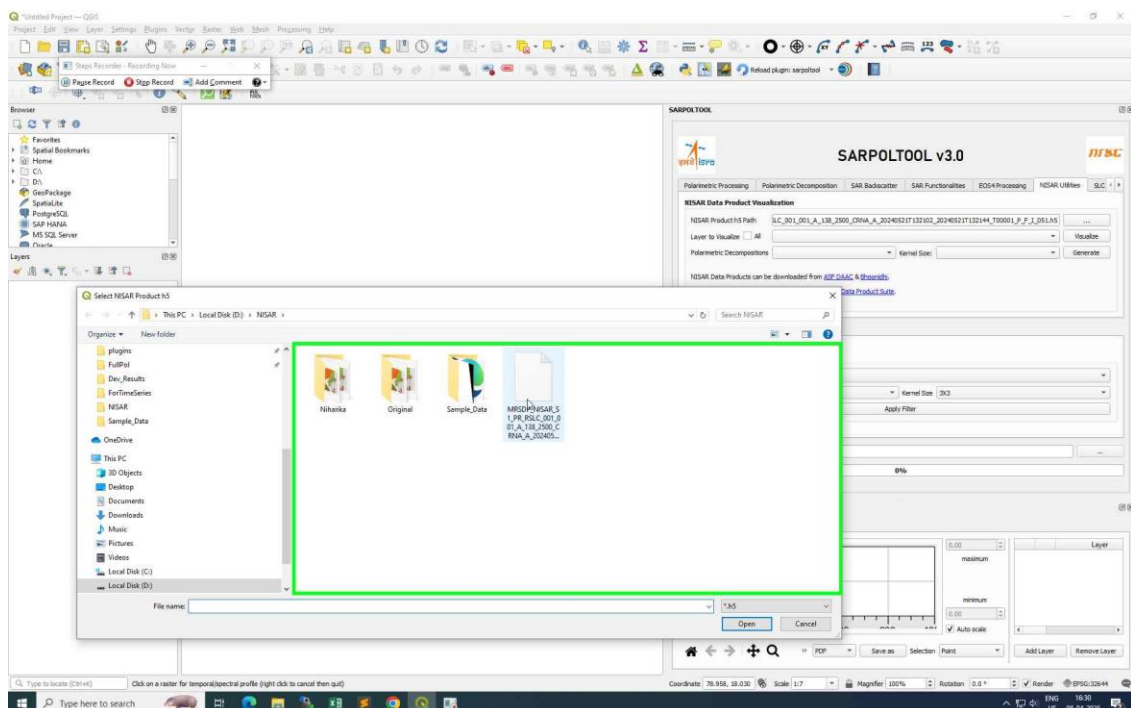
Step 8: (08-04-2025 16:30:42) User left click in "*Untitled Project — QGIS"



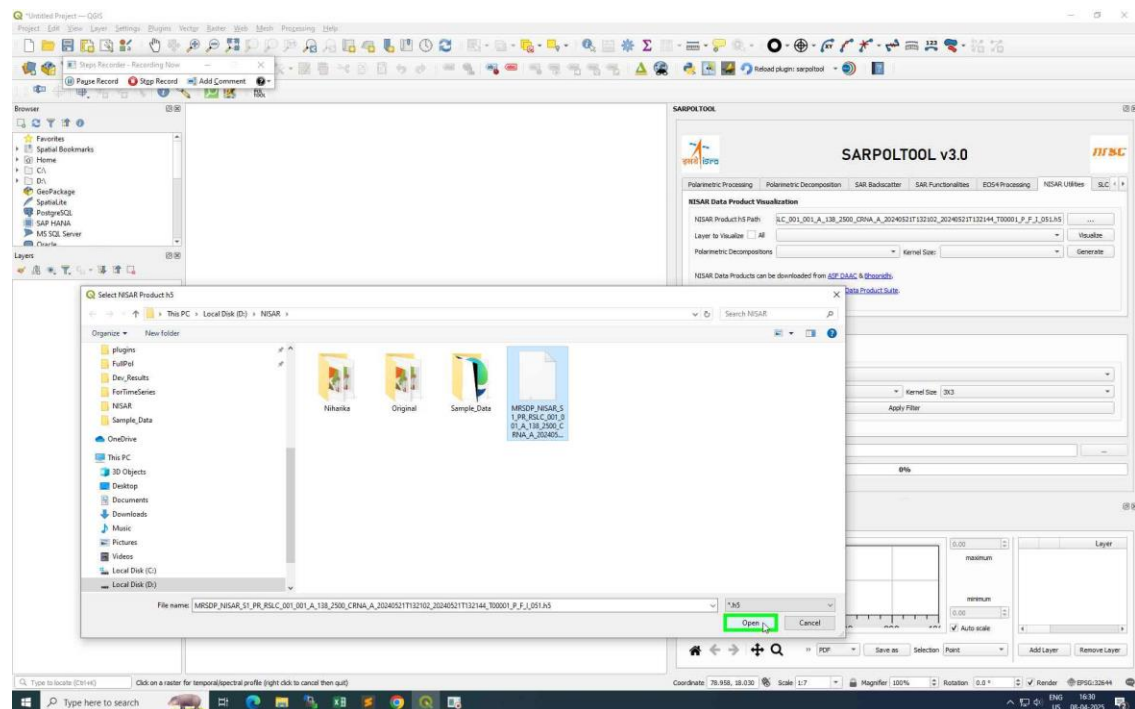
Step 9: (08-04-2025 16:30:44) User left click in "*Untitled Project — QGIS"



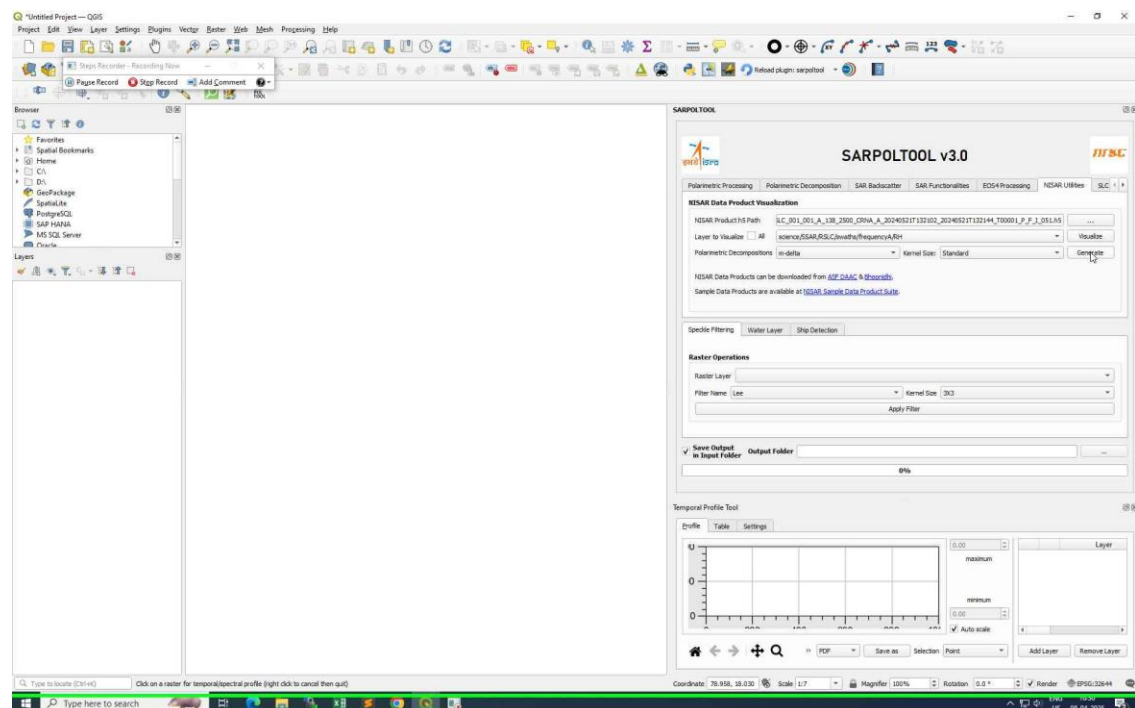
Step 10: (08-04-2025 16:30:46) User left click on "MRSDP_NISAR_S1_PR_RSLC_001_001_A_138_2500_CRNA_A_20240521T132102_20240521T132144_T00001_P_F_I_051.h5 (list item)" in "Select NISAR Product h5"



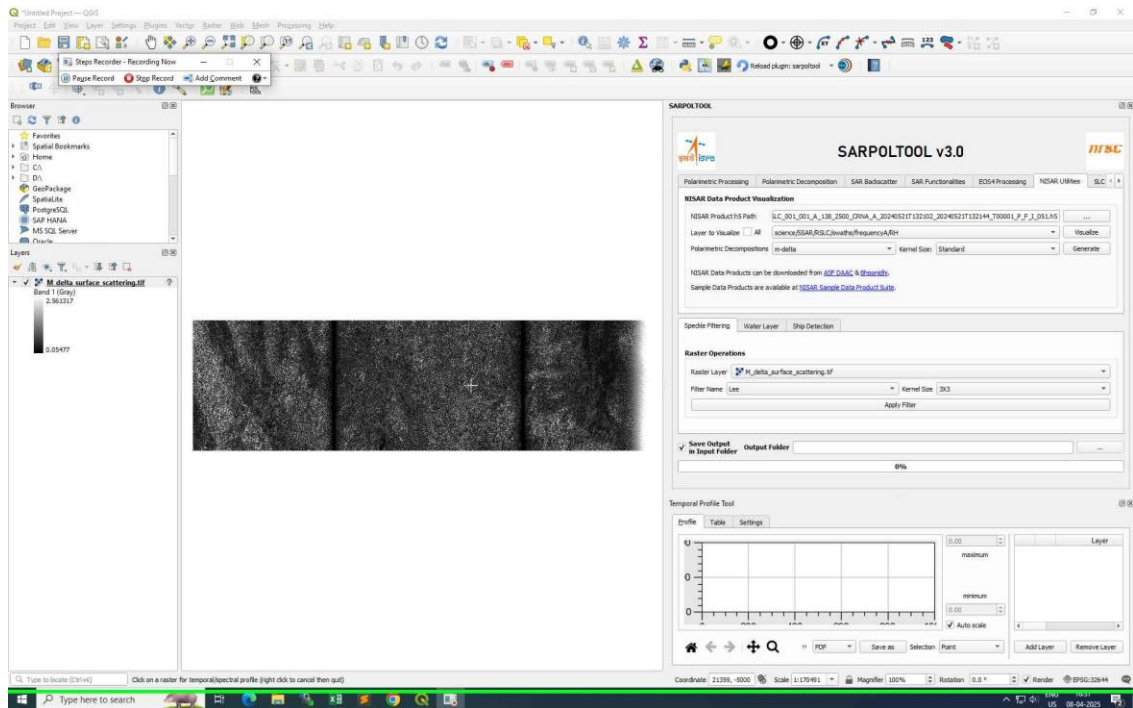
Step 11: (08-04-2025 16:30:47) User left click on "Open (button)" in "Select NISAR Product h5"



Step 12: (08-04-2025 16:30:53) User left click in "*Untitled Project — QGIS"

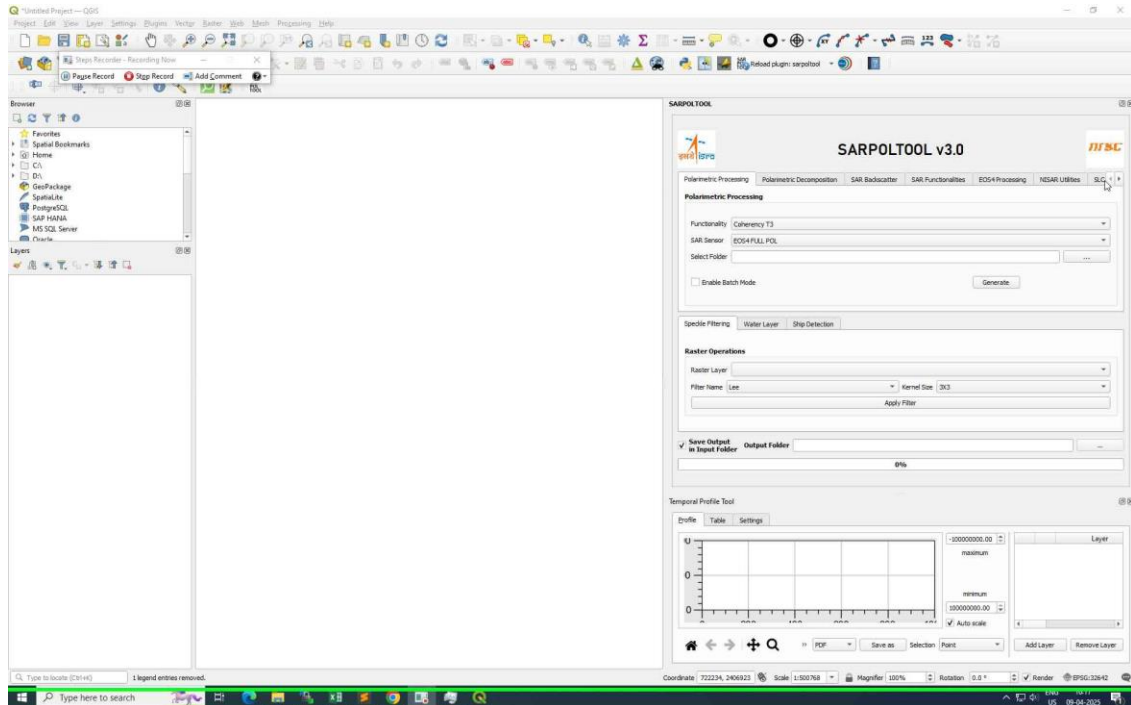


Step 13: (08-04-2025 16:37:10) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

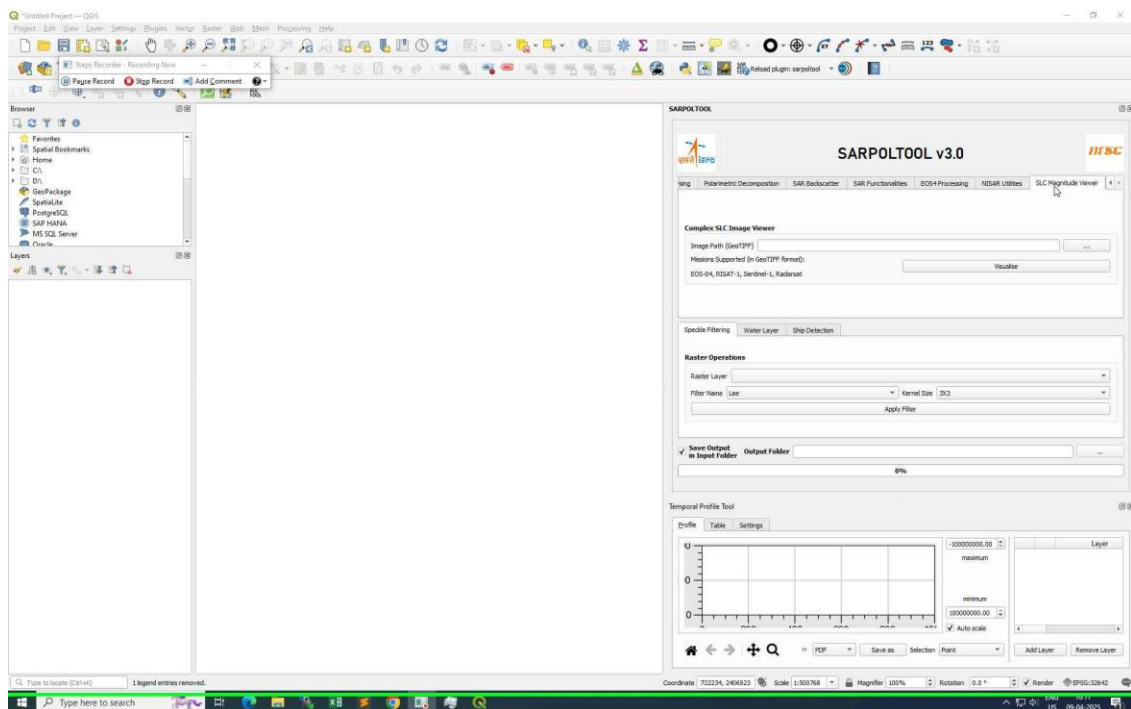


SLC Magnitude Viewer – Sample Operation

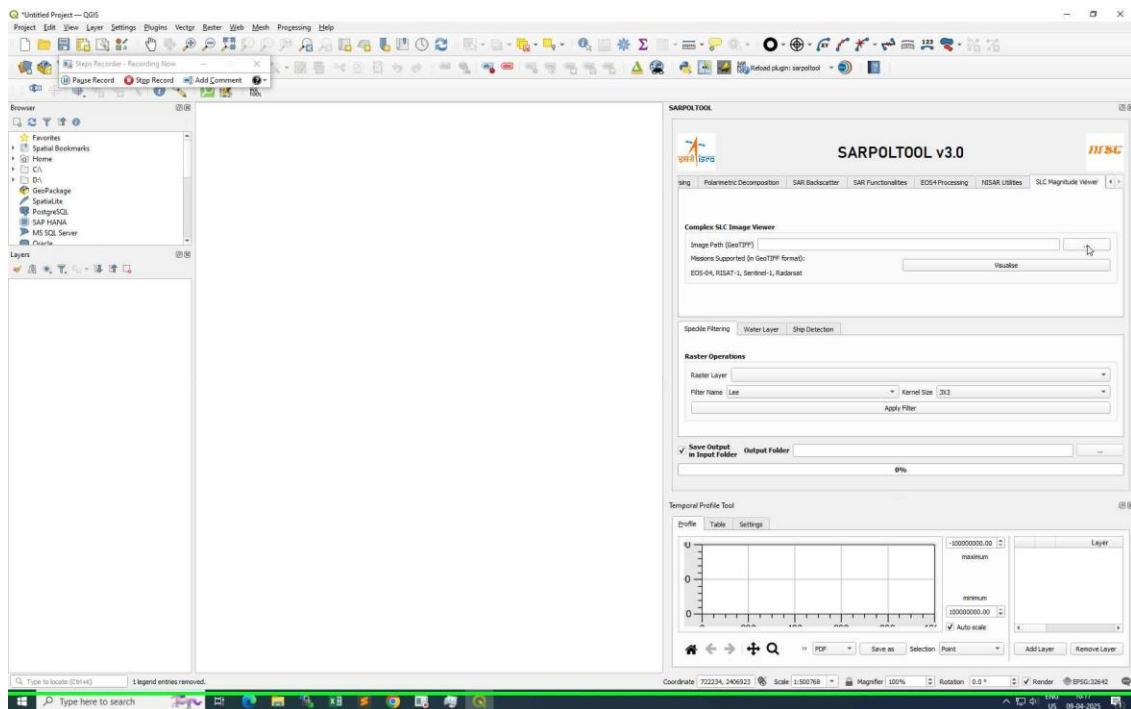
Step 1: (09-04-2025 10:17:28) User mouse wheel down in "*Untitled Project — QGIS"



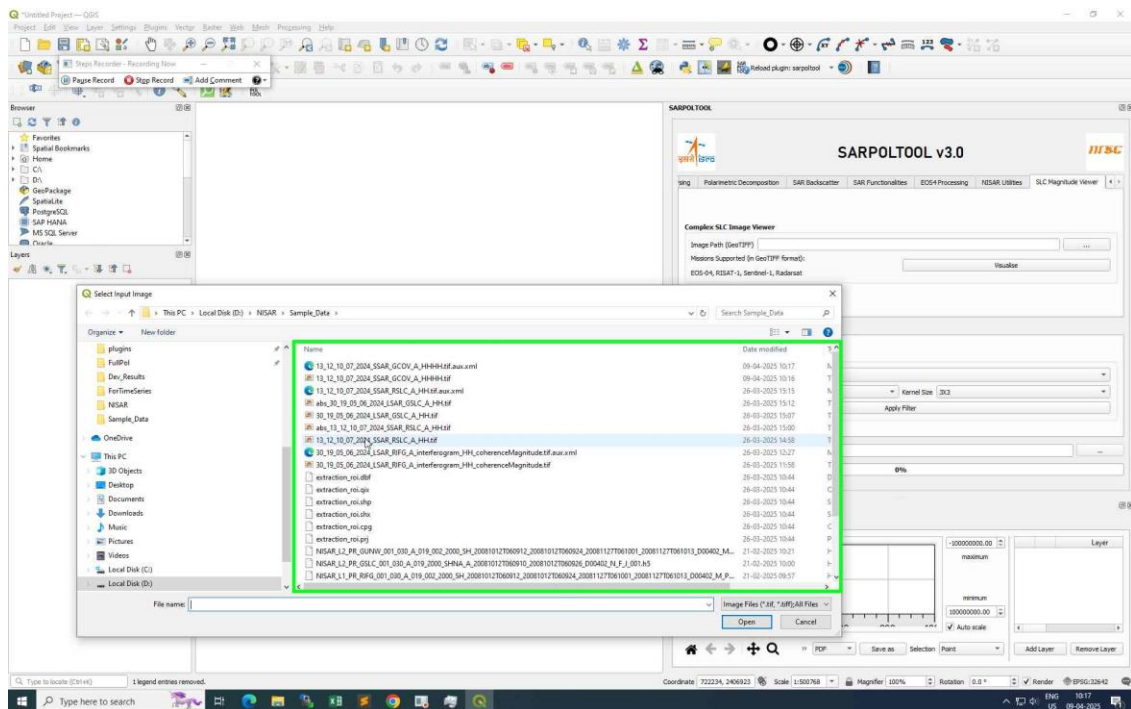
Step 2: (09-04-2025 10:17:31) User left click in "*Untitled Project — QGIS"



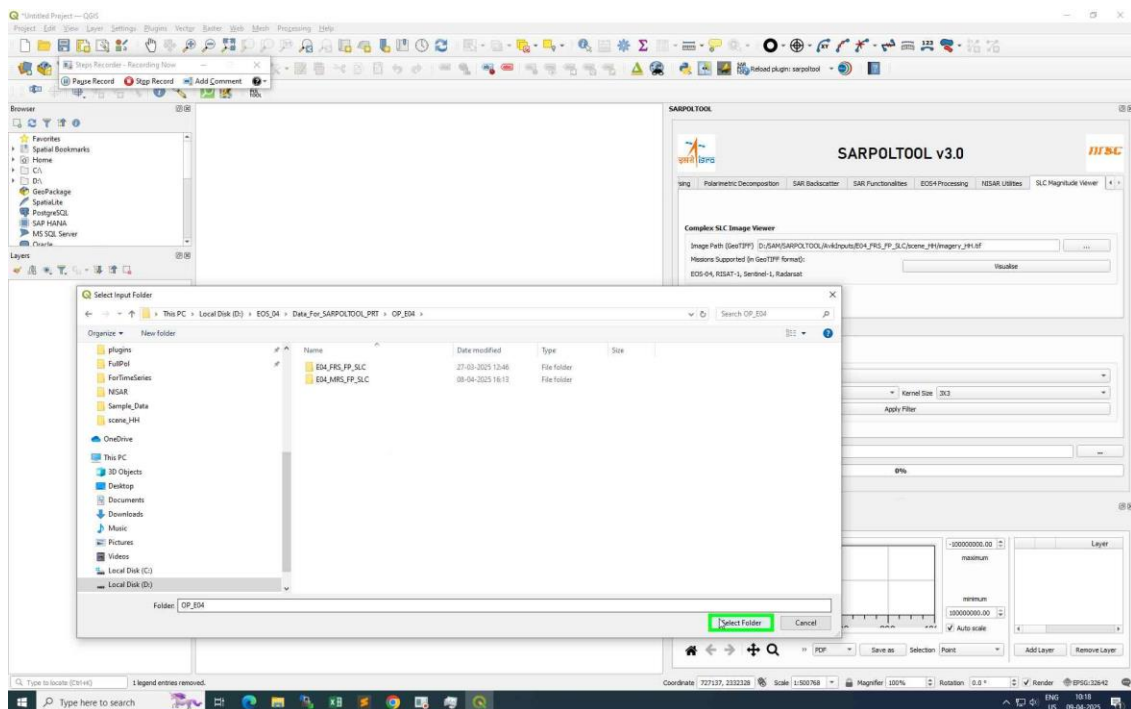
Step 3: (09-04-2025 10:17:37) User left click in "*Untitled Project — QGIS"



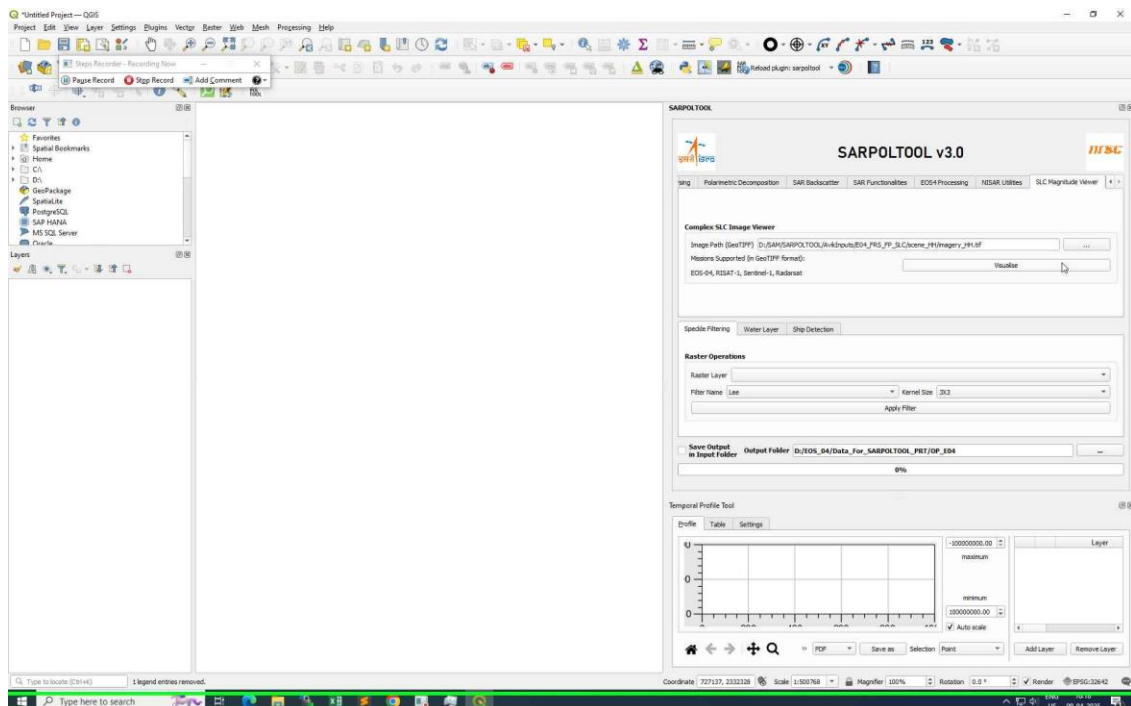
Step 4: (09-04-2025 10:17:43) User mouse wheel down on "Name (edit)" in "Select Input Image"



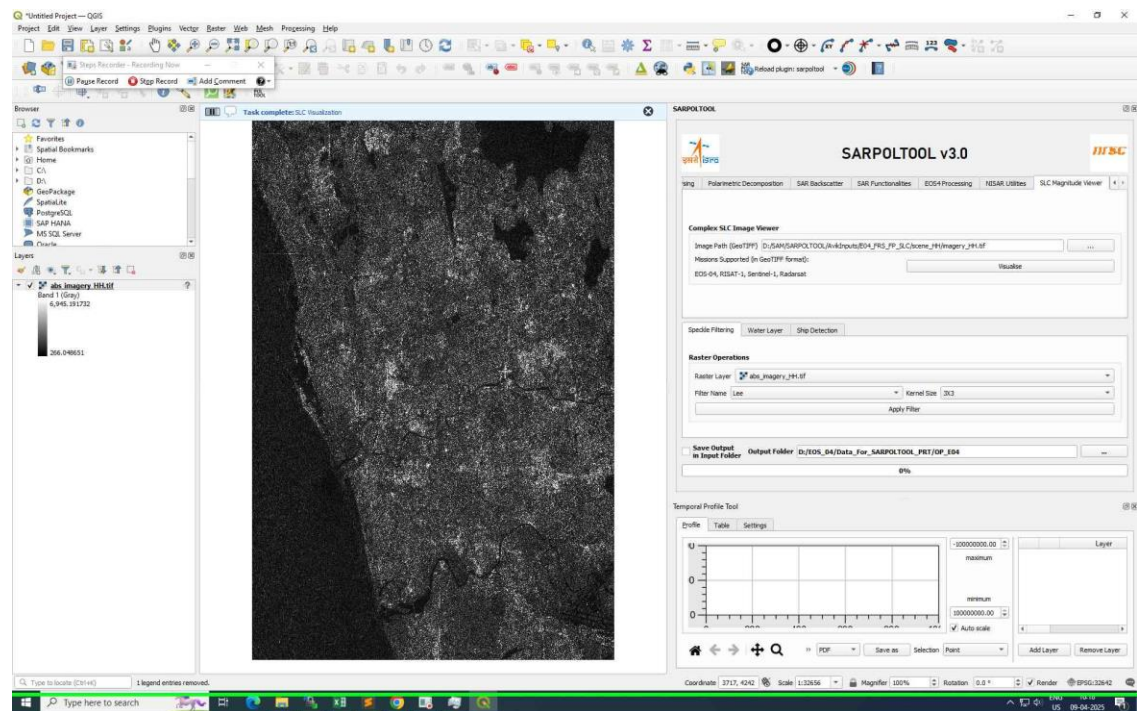
Step 5: (09-04-2025 10:18:23) User left click on "Select Folder (button)" in "Select Input Folder"



Step 6: (09-04-2025 10:18:28) User left click in "*Untitled Project — QGIS"

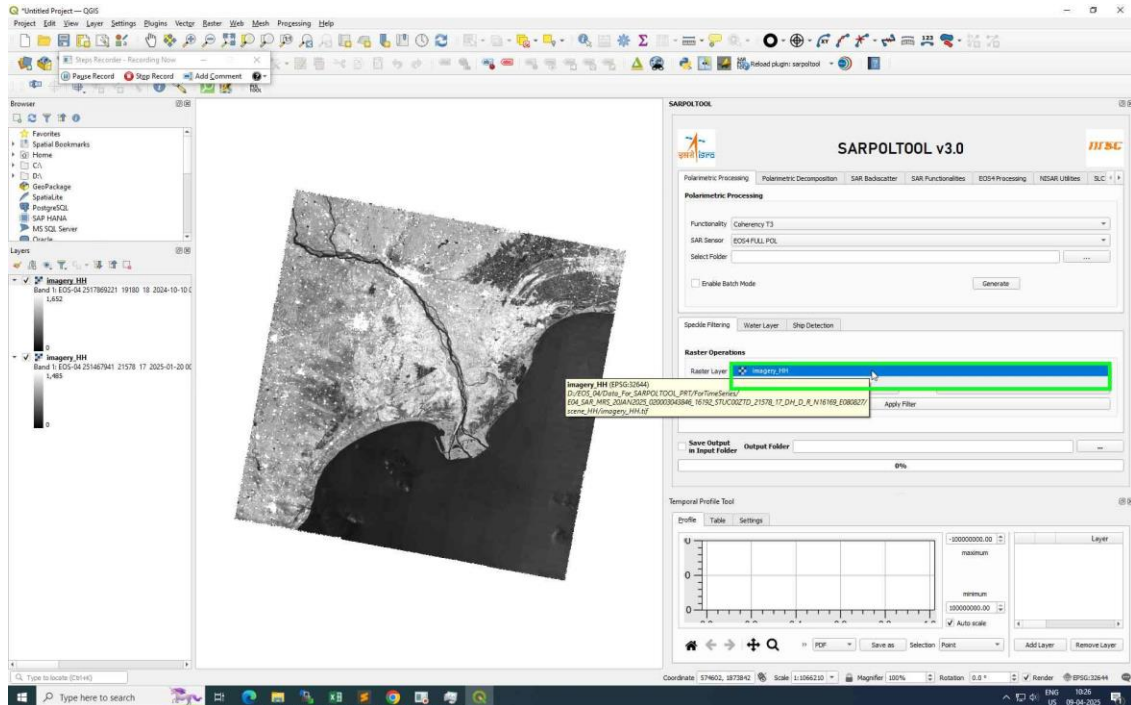


Step 7: (09-04-2025 10:18:38) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

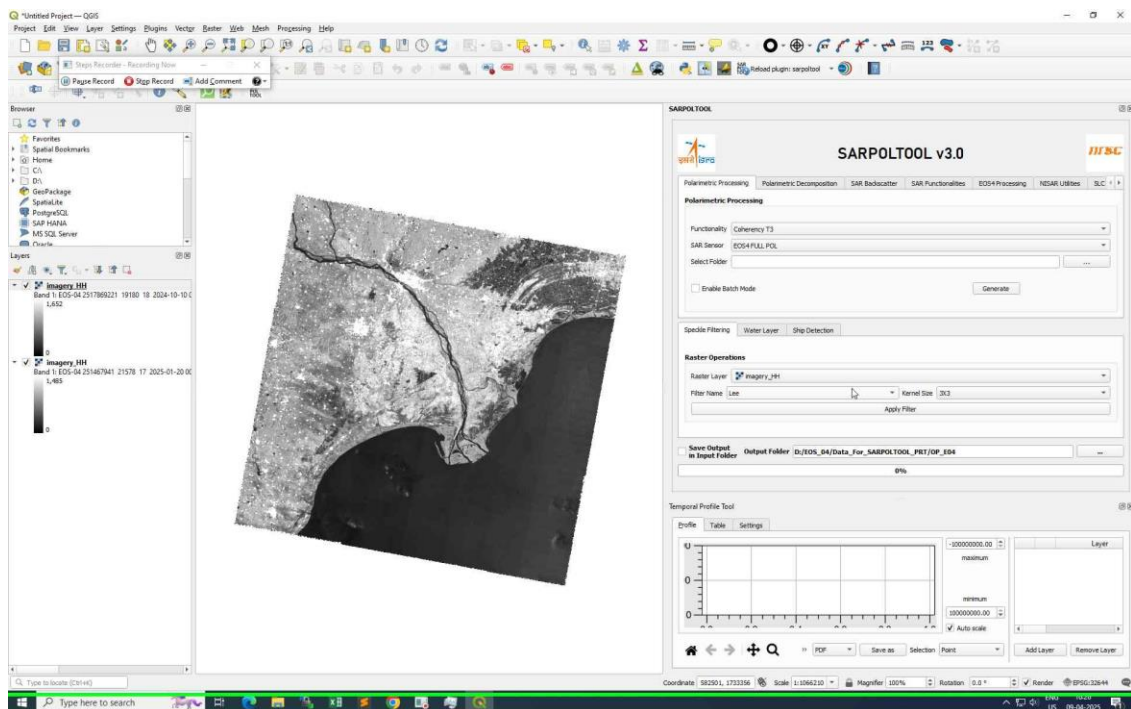


Speckle Filtering – Sample Operation

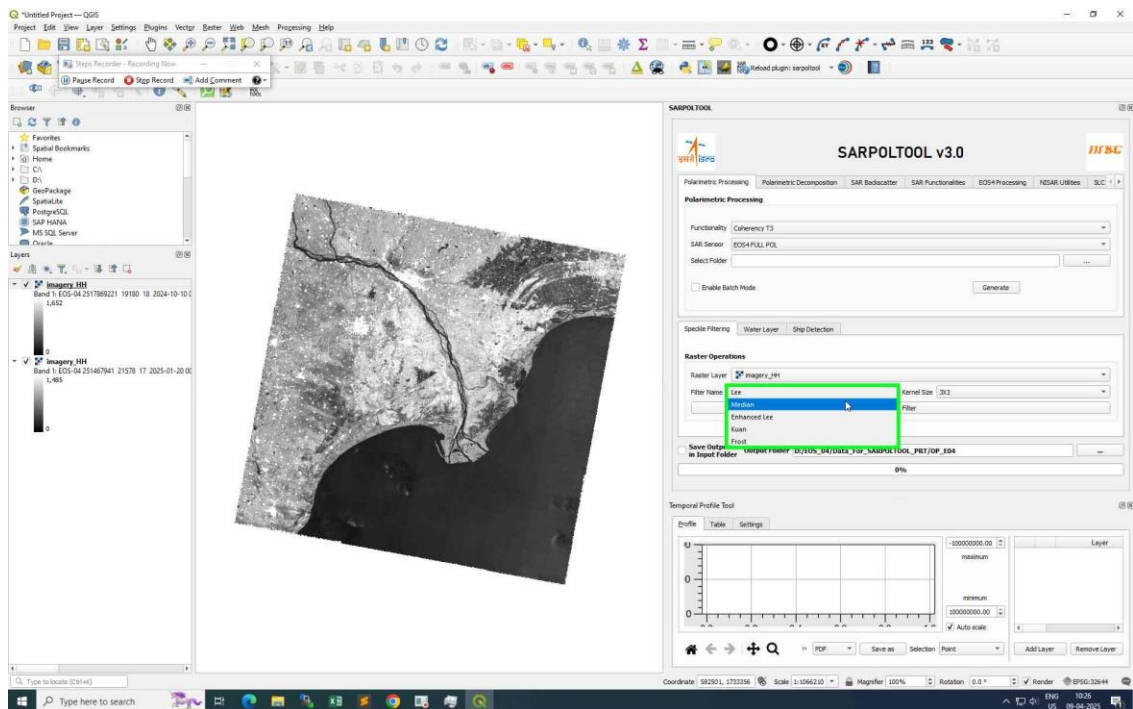
Step 1: (09-04-2025 10:26:30) User left click in "QGIS"



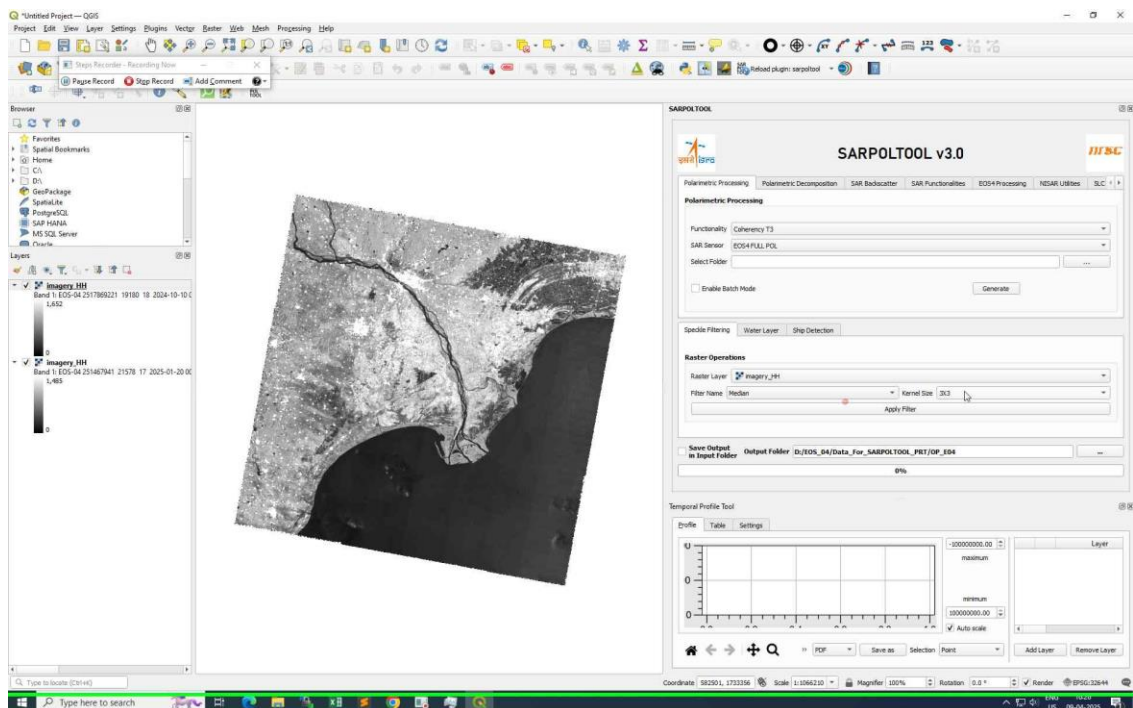
Step 2: (09-04-2025 10:26:50) User left click in "*Untitled Project — QGIS"



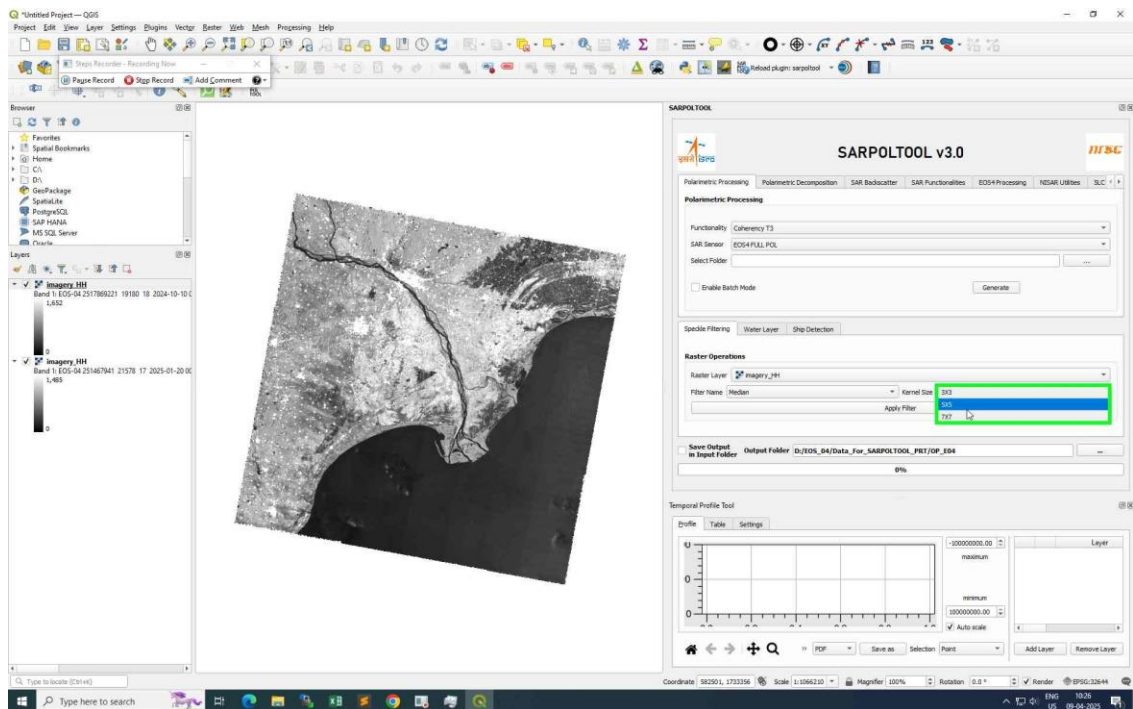
Step 2: (09-04-2025 10:26:54) User left click in "QGIS3"



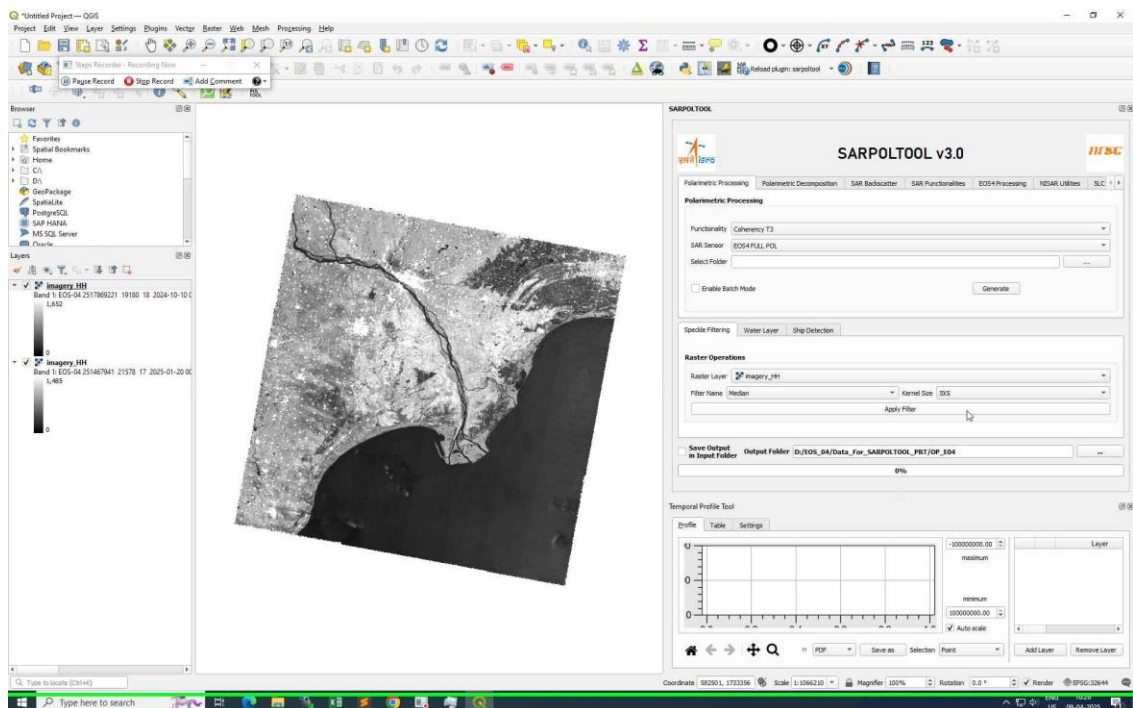
Step 3: (09-04-2025 10:26:54) User left click in "*Untitled Project — QGIS"



Step 4: (09-04-2025 10:26:56) User left click in "QGIS3"

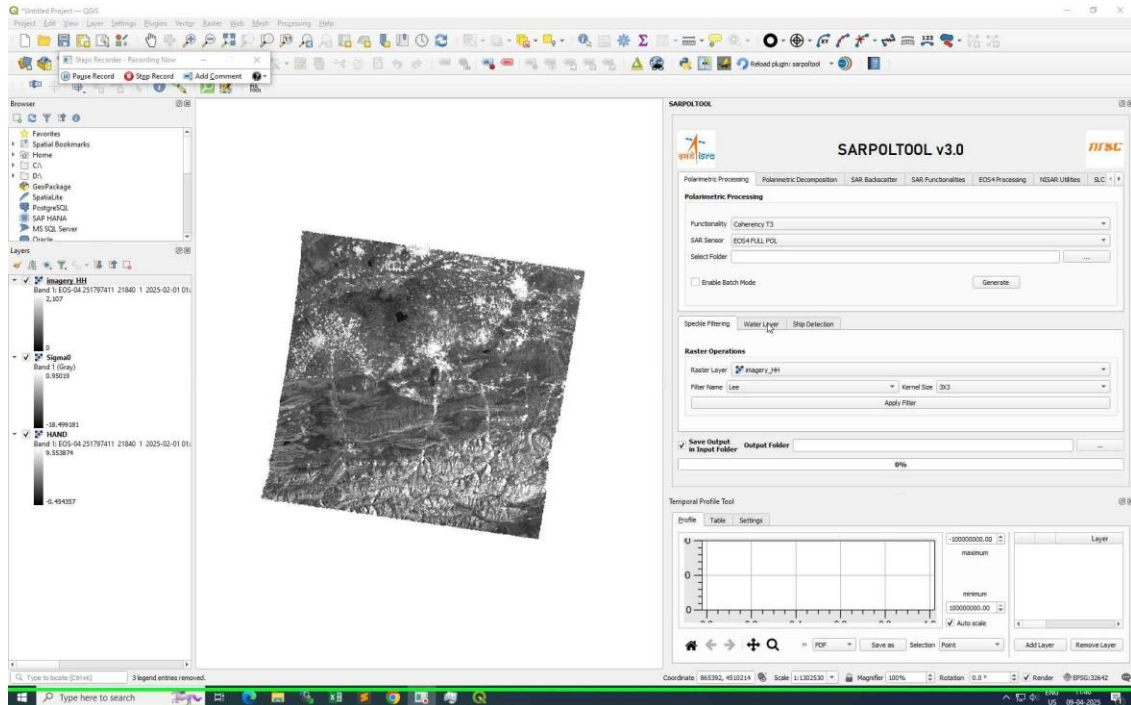


Step 5: (09-04-2025 10:26:57) User left click in "*Untitled Project — QGIS"

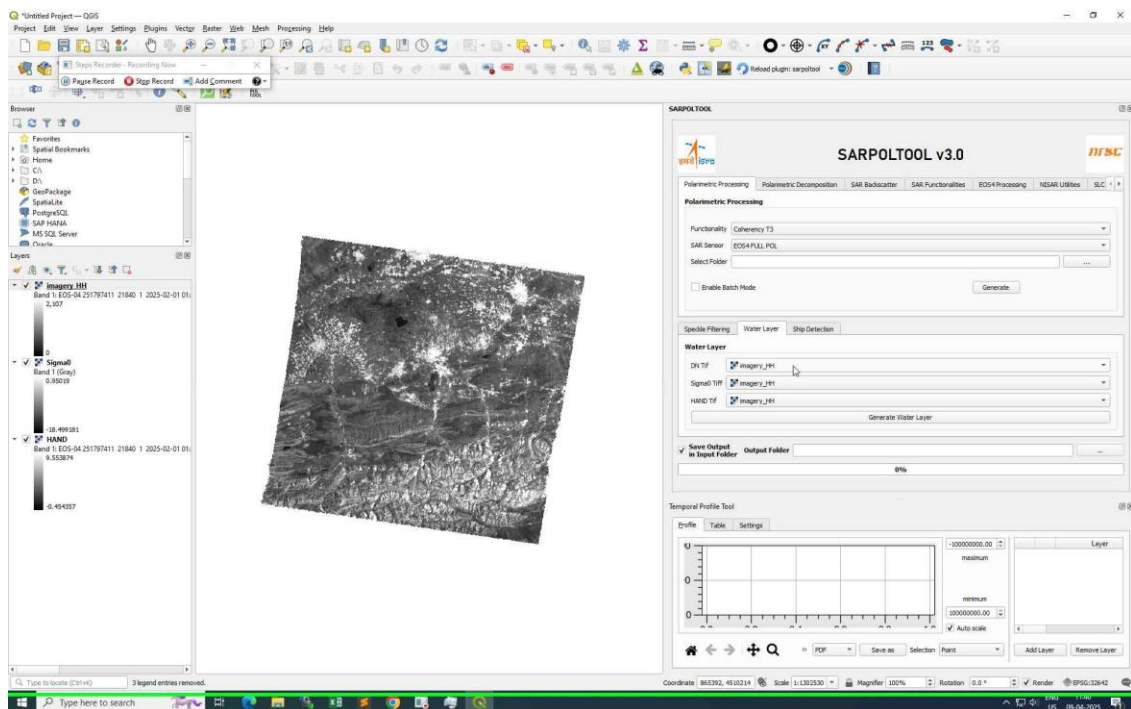


Water Layer Generation – Sample Operation

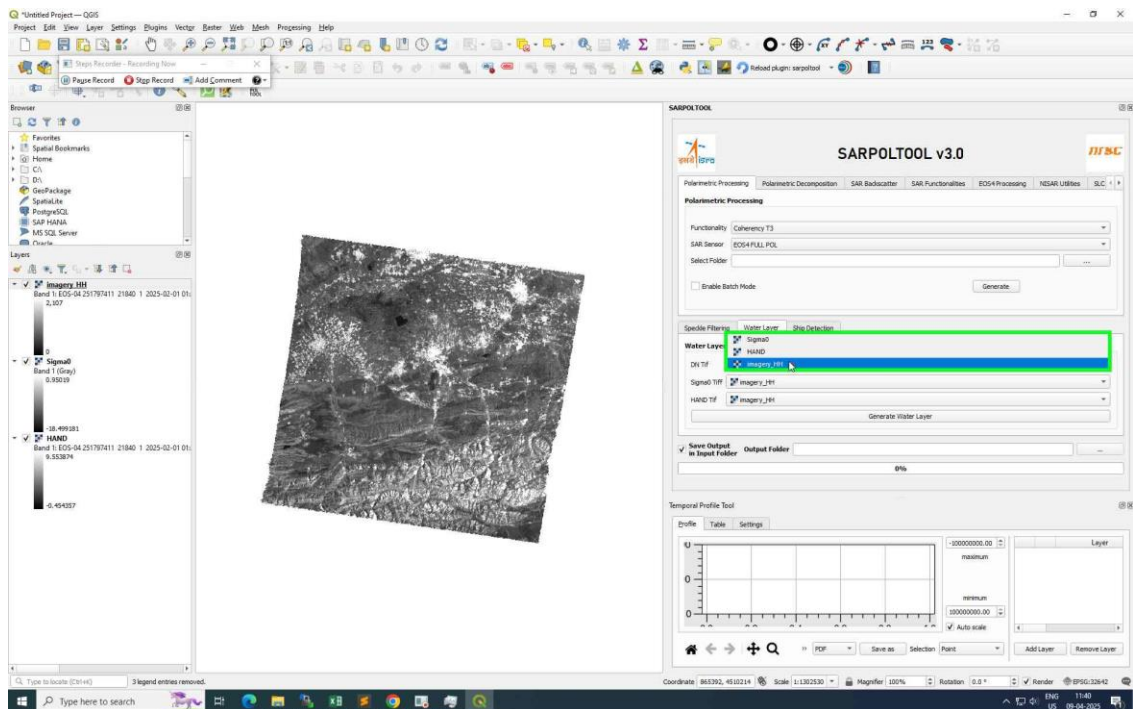
Step 1: (09-04-2025 11:40:12) User left click in "*Untitled Project — QGIS"



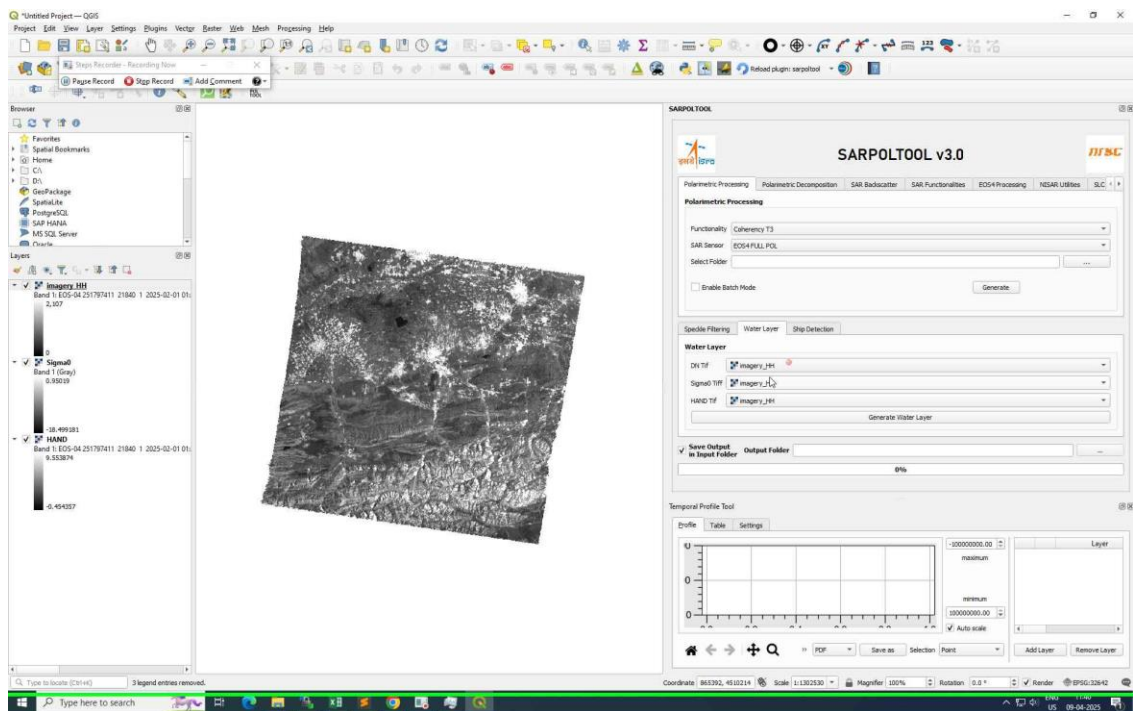
Step 2: (09-04-2025 11:40:13) User left click in "*Untitled Project — QGIS"



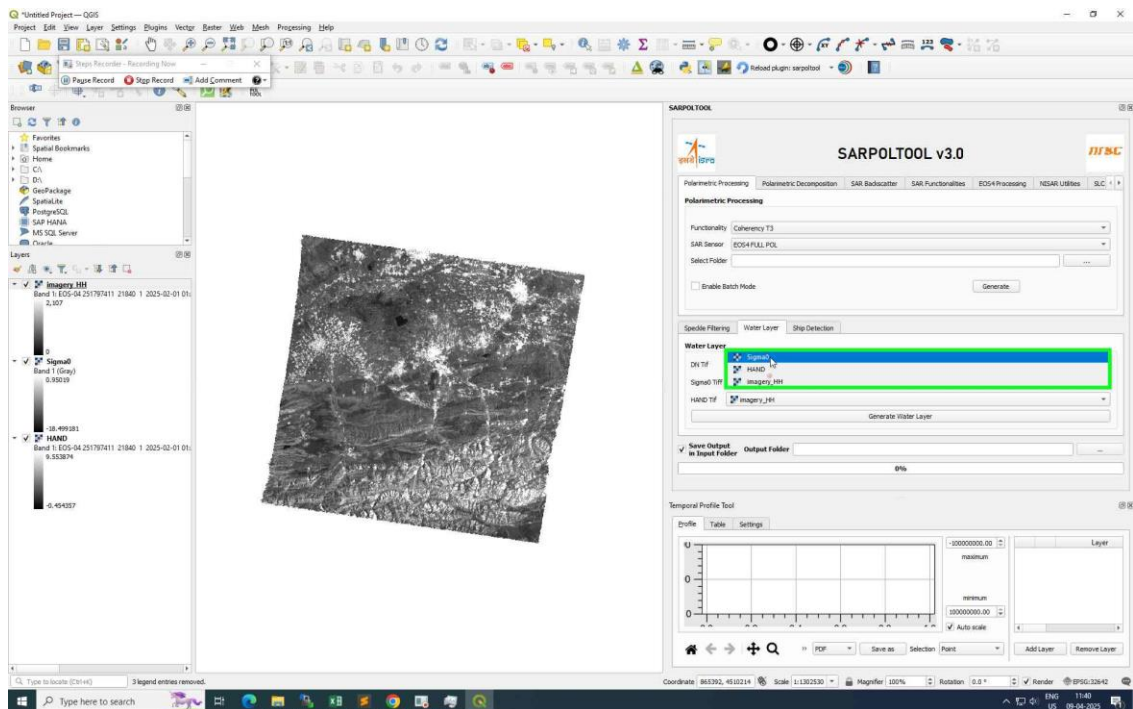
Step 3: (09-04-2025 11:40:14) User left click in "QGIS3"



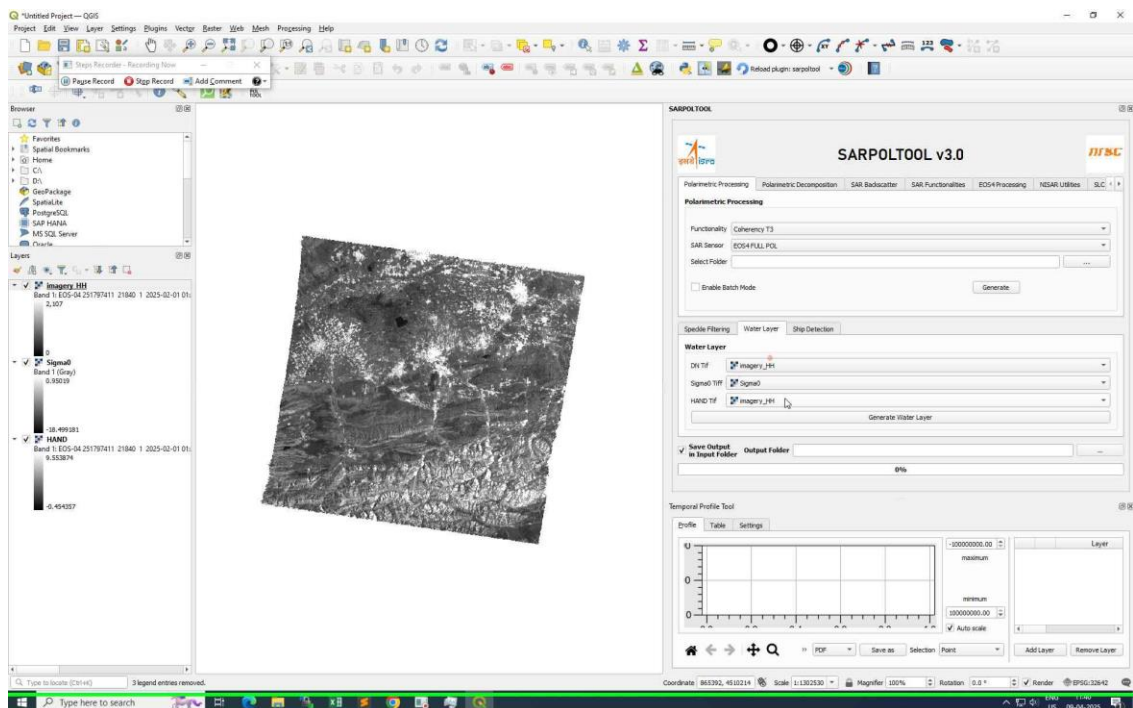
Step 4: (09-04-2025 11:40:15) User left click in "*Untitled Project — QGIS"



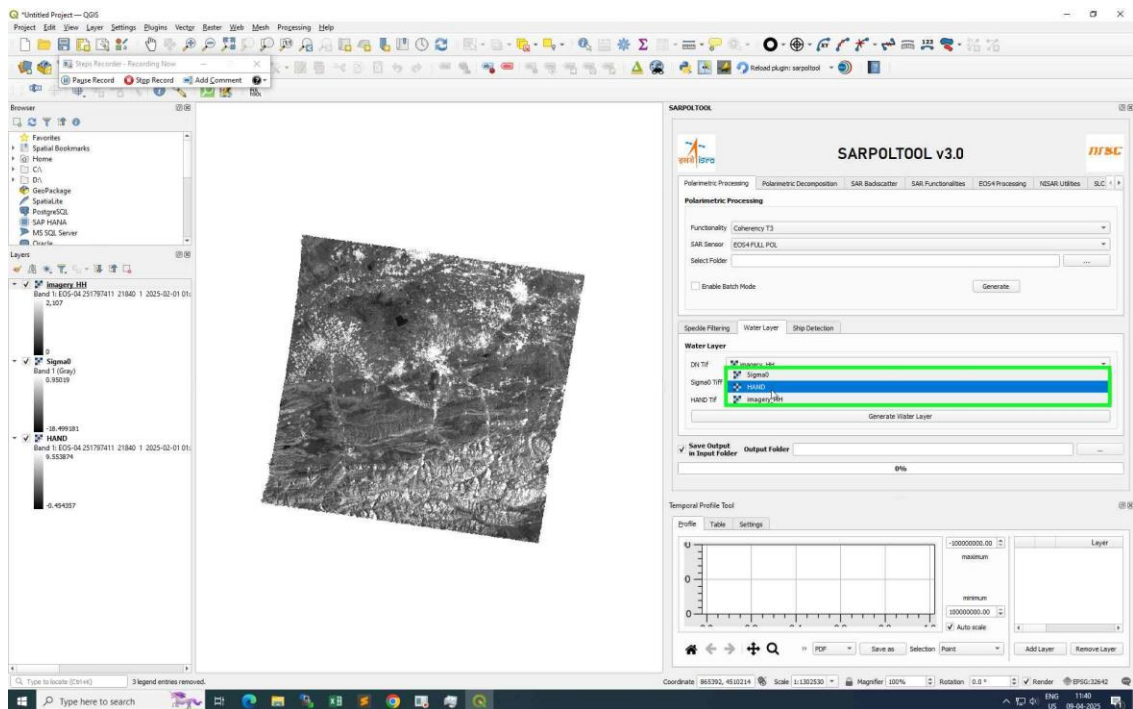
Step 5: (09-04-2025 11:40:16) User left click in "QGIS3"



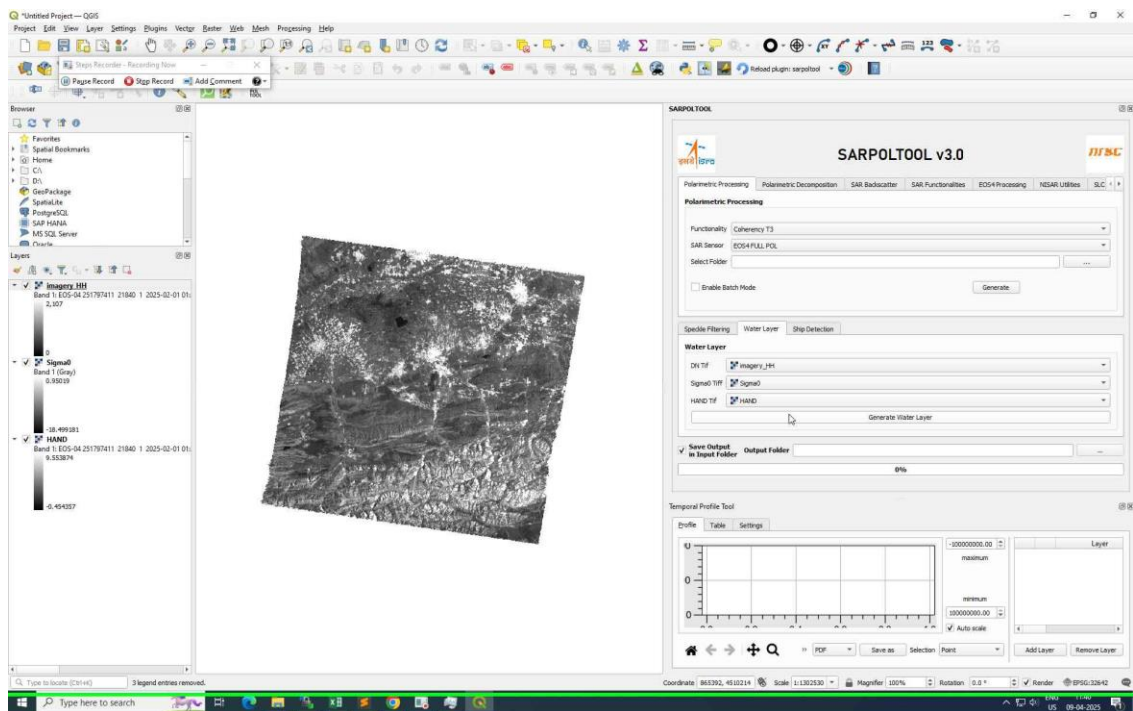
Step 6: (09-04-2025 11:40:16) User left click in "*Untitled Project — QGIS"



Step 7: (09-04-2025 11:40:18) User left click in "QGIS3"

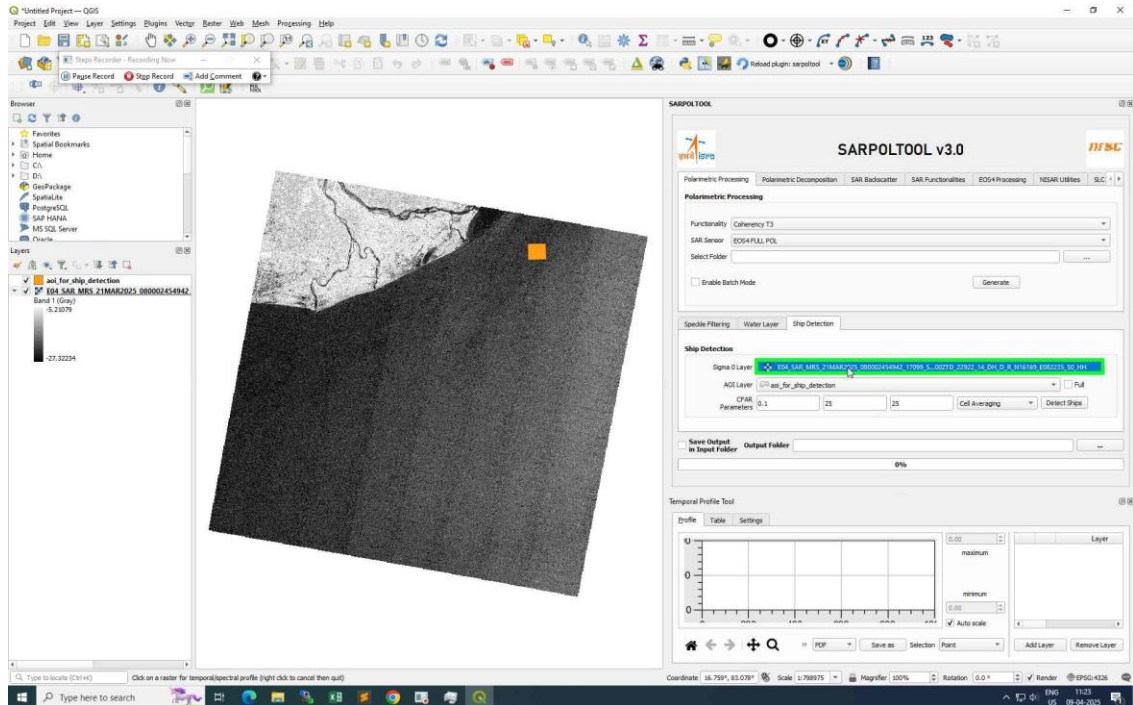


Step 8: (09-04-2025 11:40:22) User left click in "*Untitled Project — QGIS"

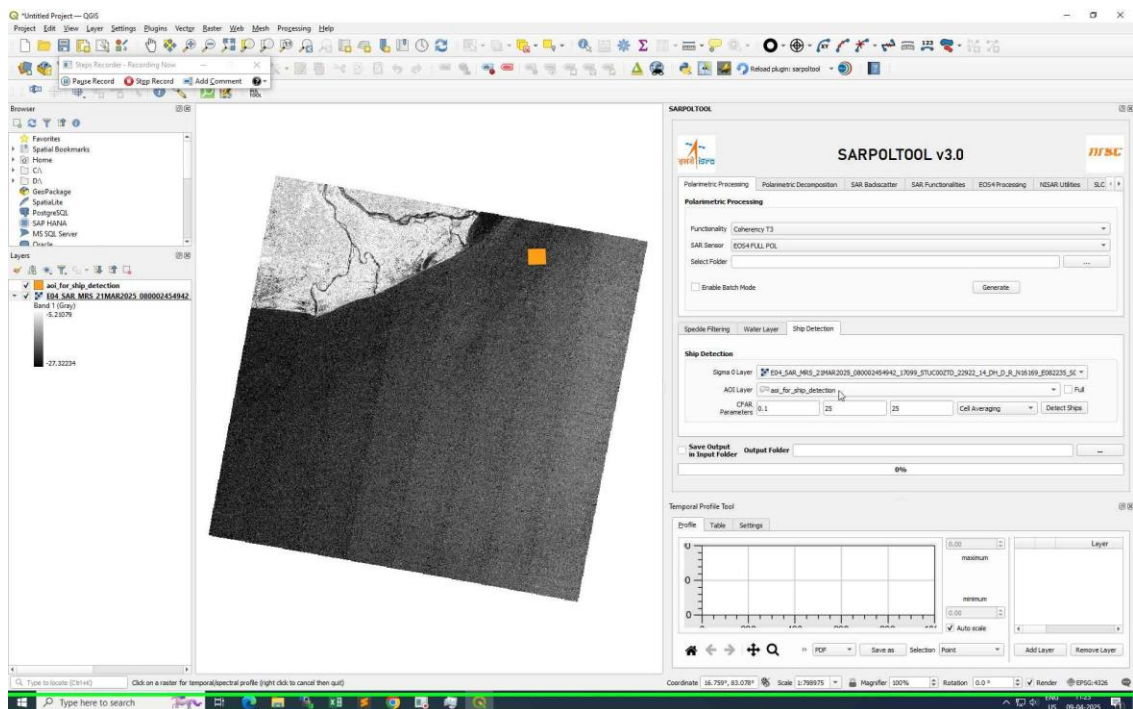


Ship Detection – Sample Operation

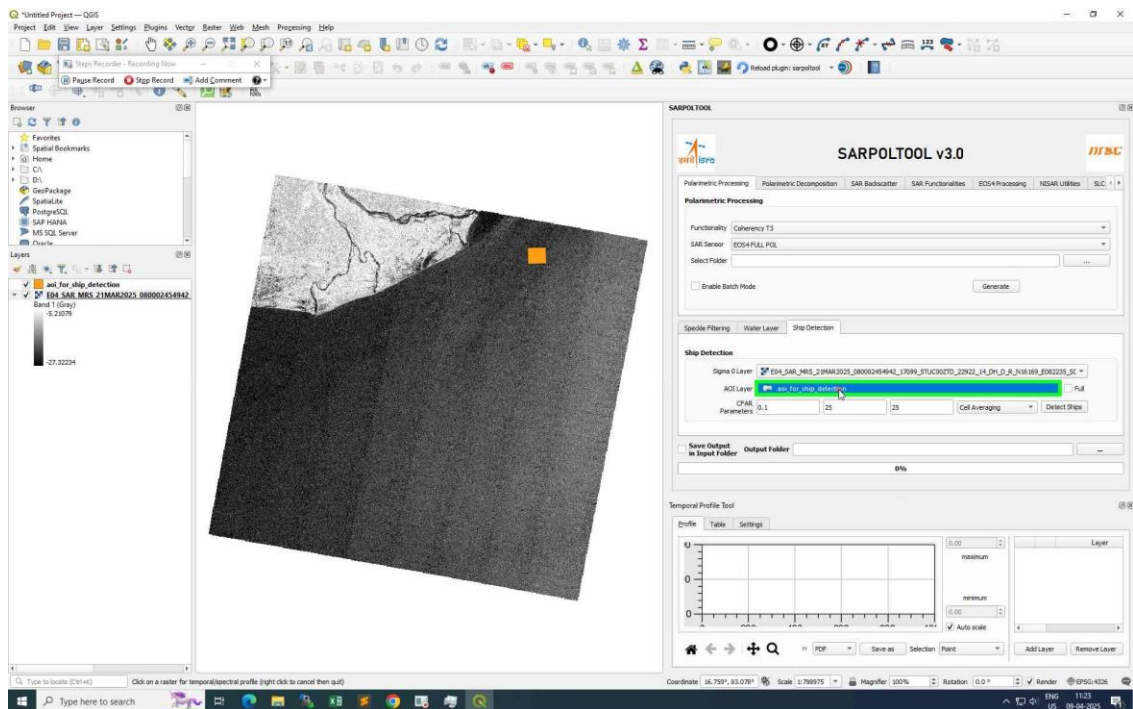
Step 3: (09-04-2025 11:23:42) User left click in "QGIS"



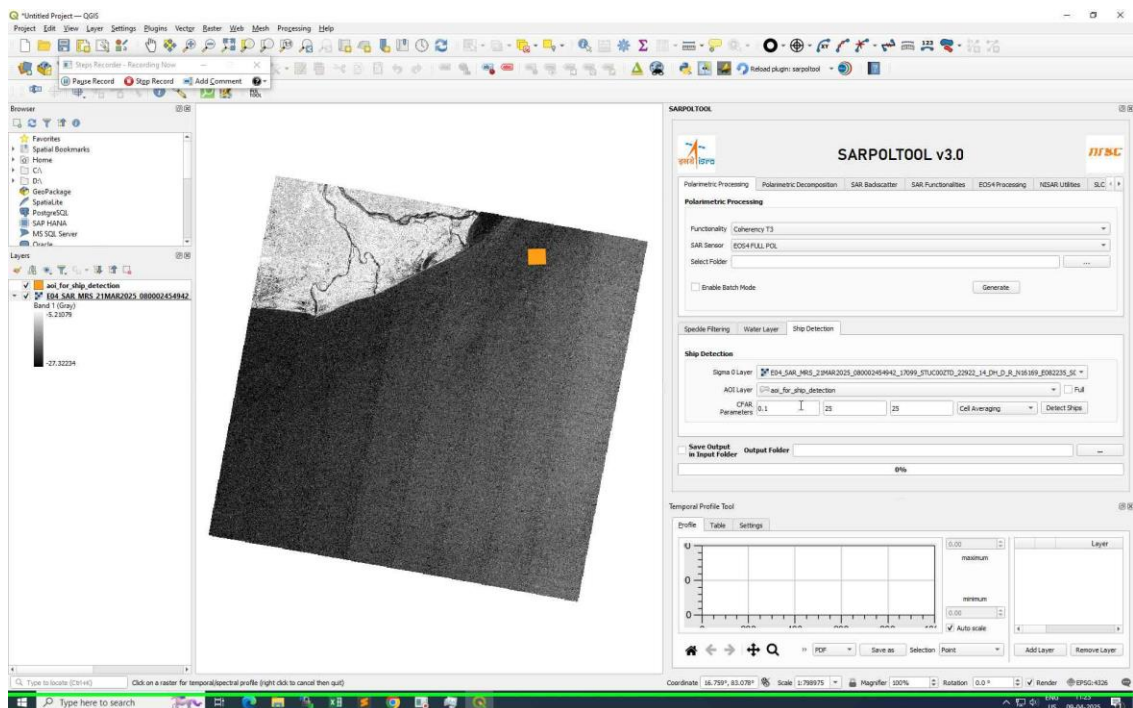
Step 4: (09-04-2025 11:23:43) User left click in "*Untitled Project — QGIS"



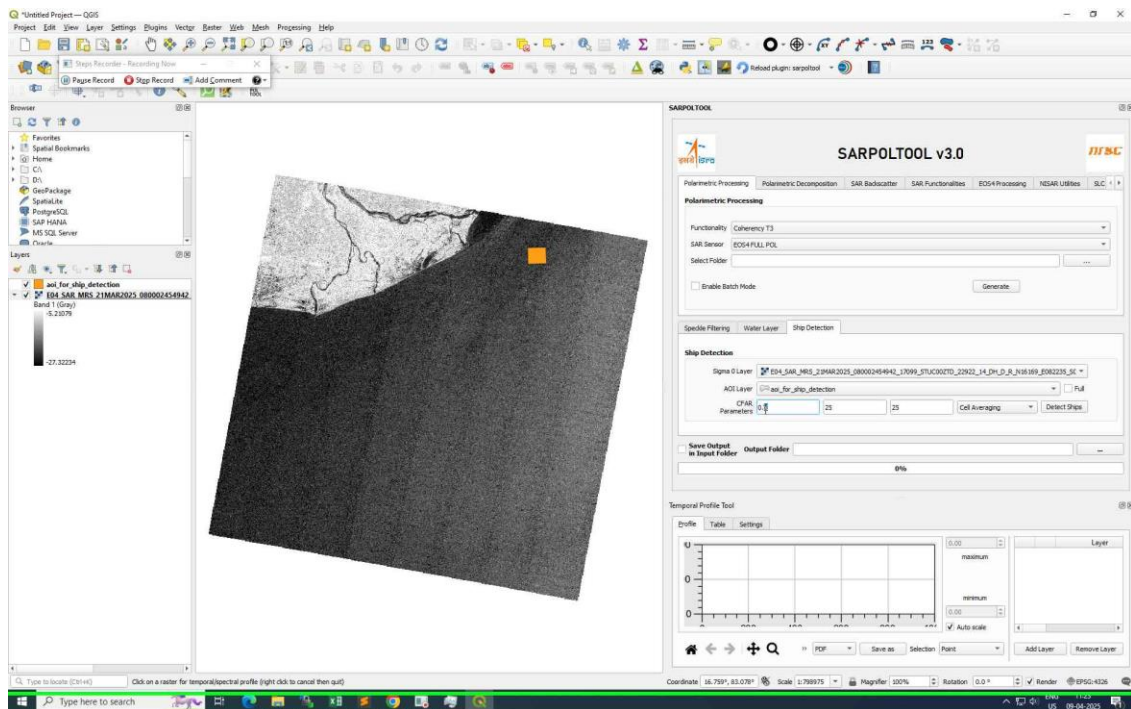
Step 5: (09-04-2025 11:23:44) User left click in "QGIS3"



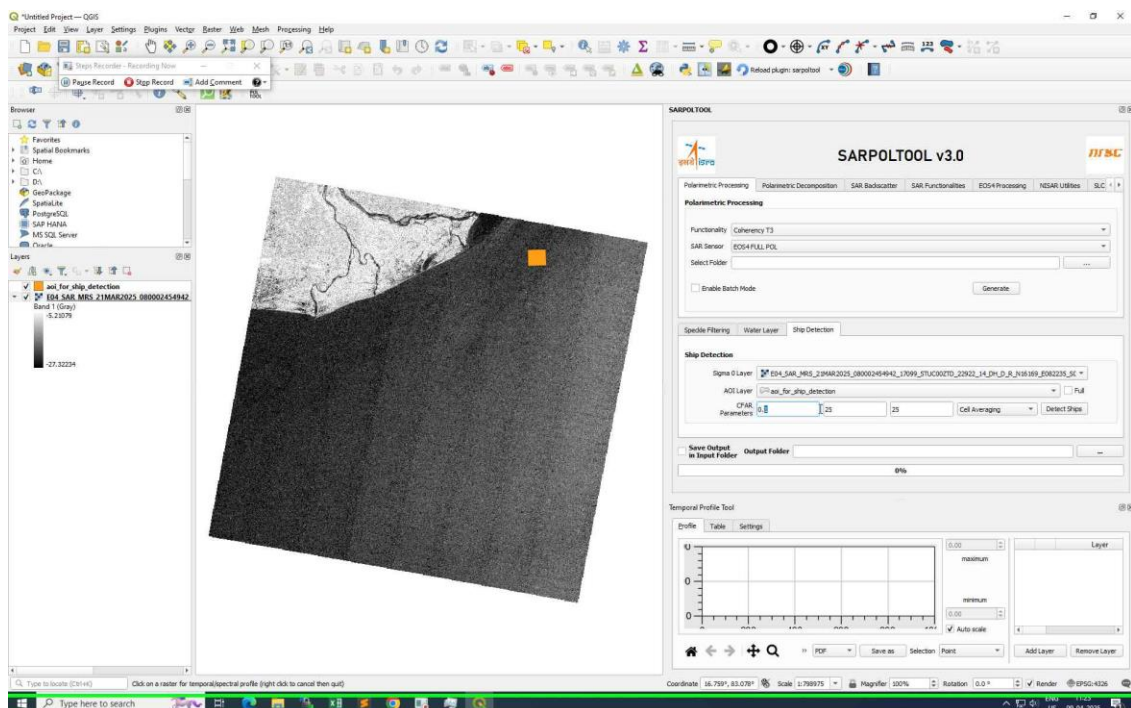
Step 6: (09-04-2025 11:23:47) User mouse drag start in "*Untitled Project — QGIS"



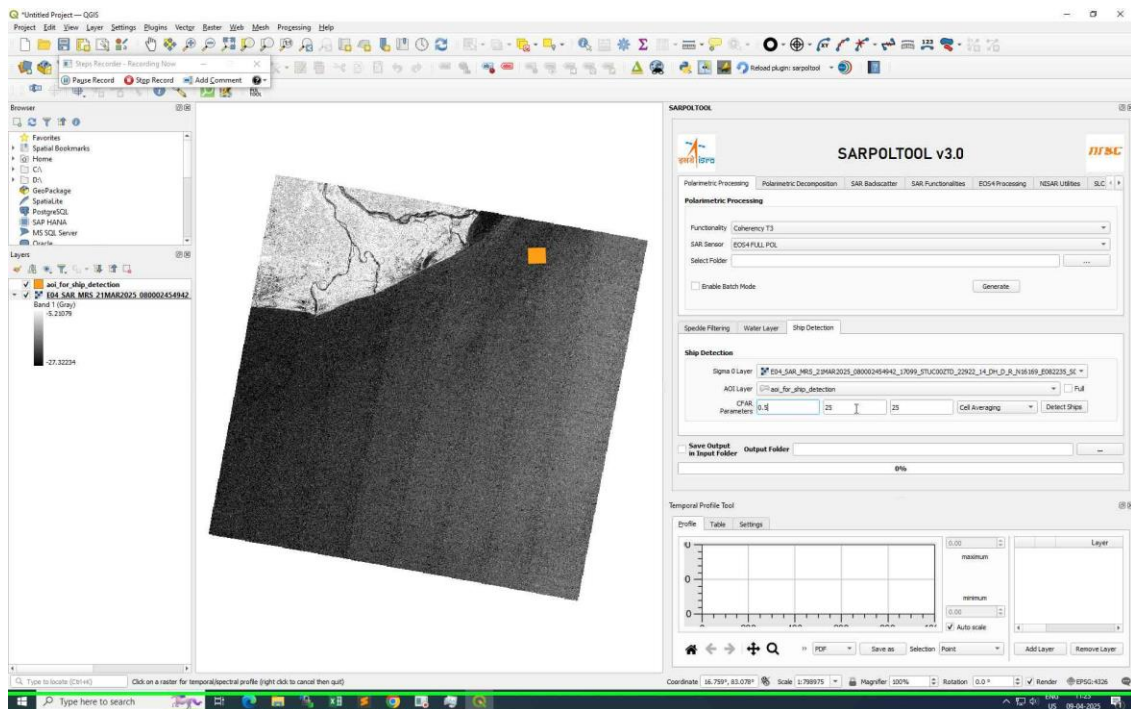
Step 7: (09-04-2025 11:23:49) User mouse drag end in "*Untitled Project — QGIS"



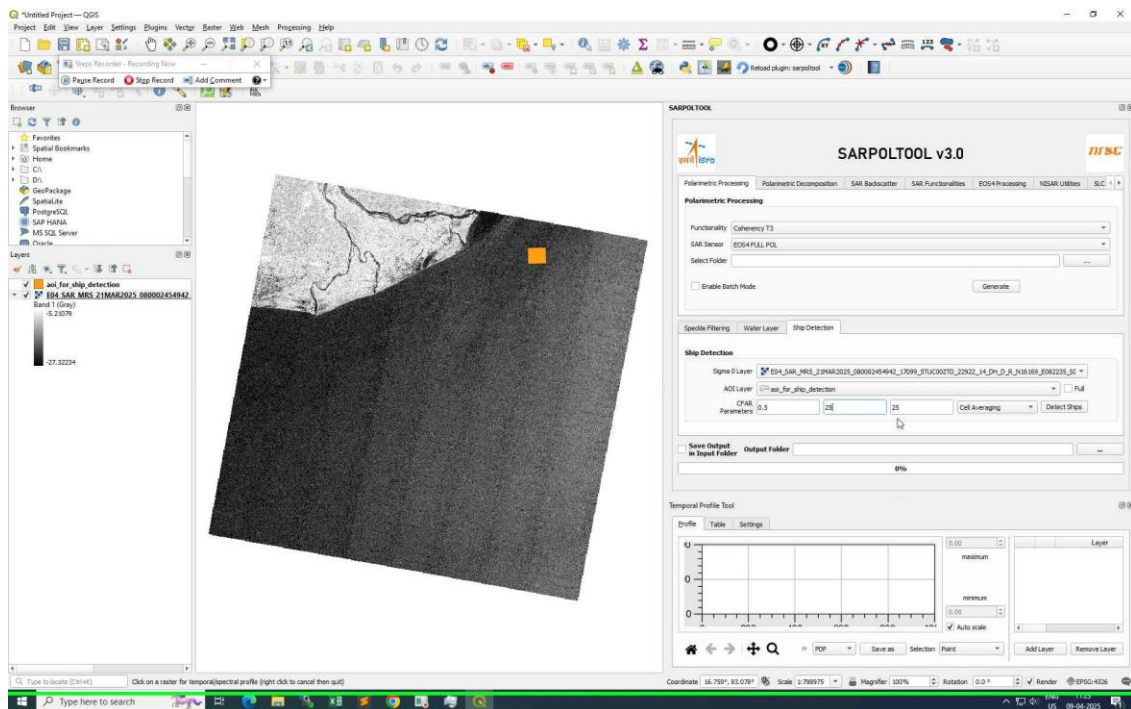
Step 8: (09-04-2025 11:23:50) User keyboard input on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS" [...]



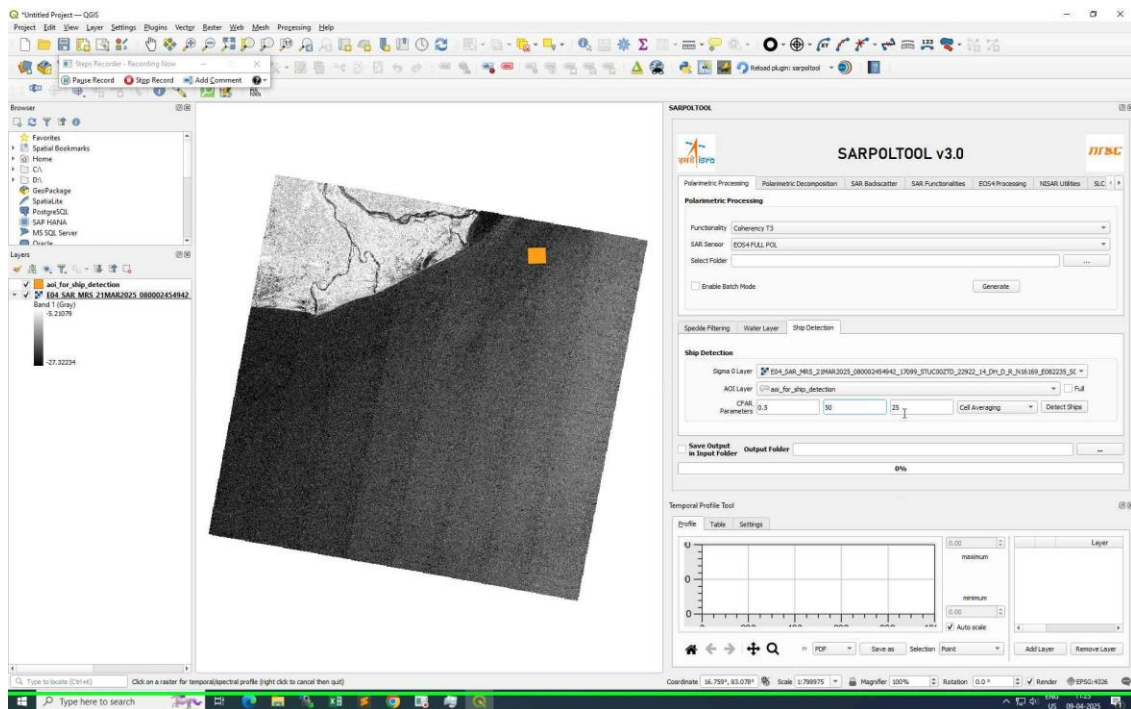
Step 9: (09-04-2025 11:23:51) User left click in "*Untitled Project — QGIS"



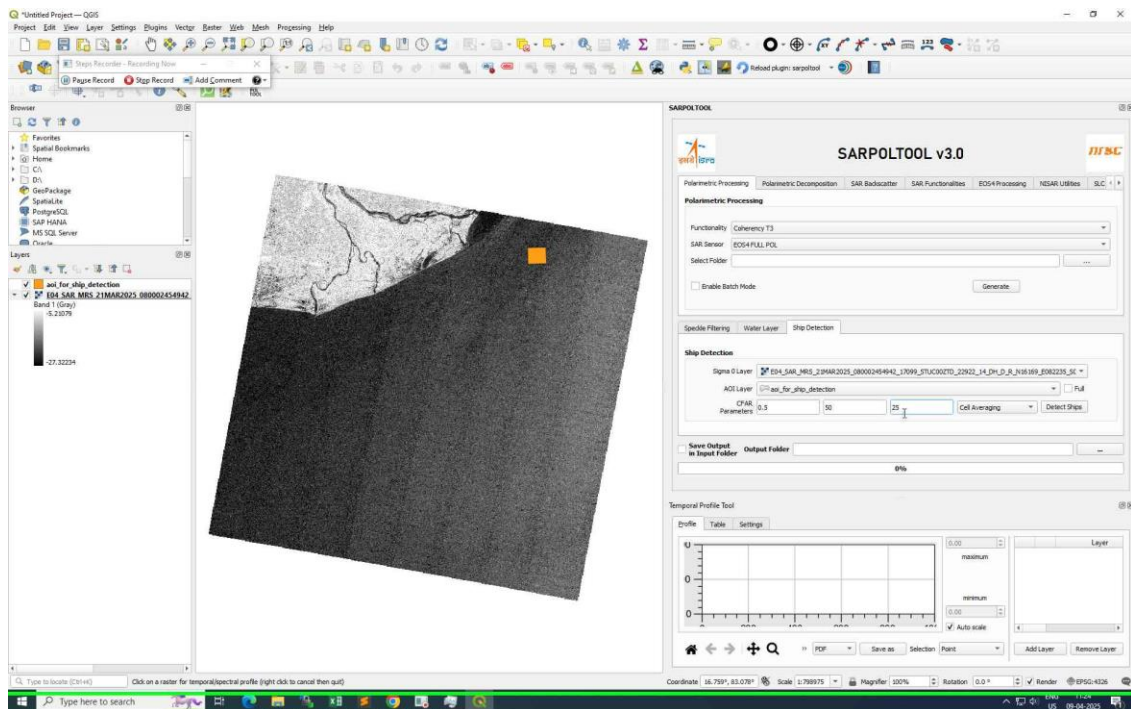
Step 10: (09-04-2025 11:23:54) User keyboard input on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS" [Backspace Backspace ...]



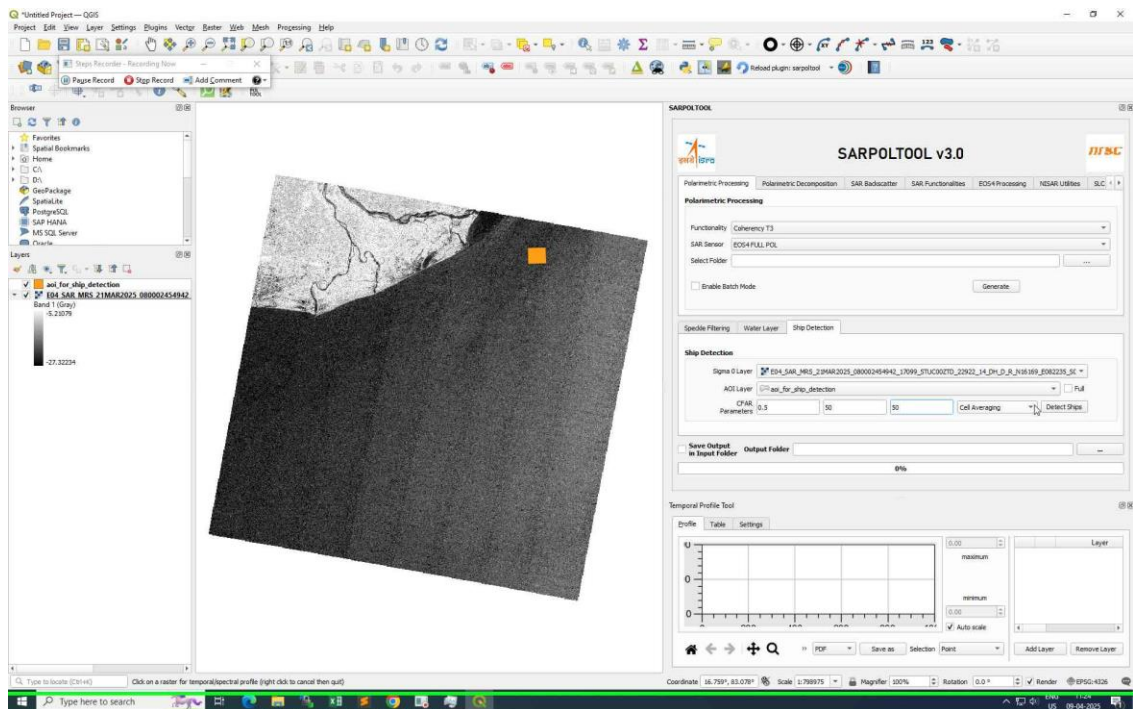
Step 11: (09-04-2025 11:23:59) User left click in "*Untitled Project — QGIS"



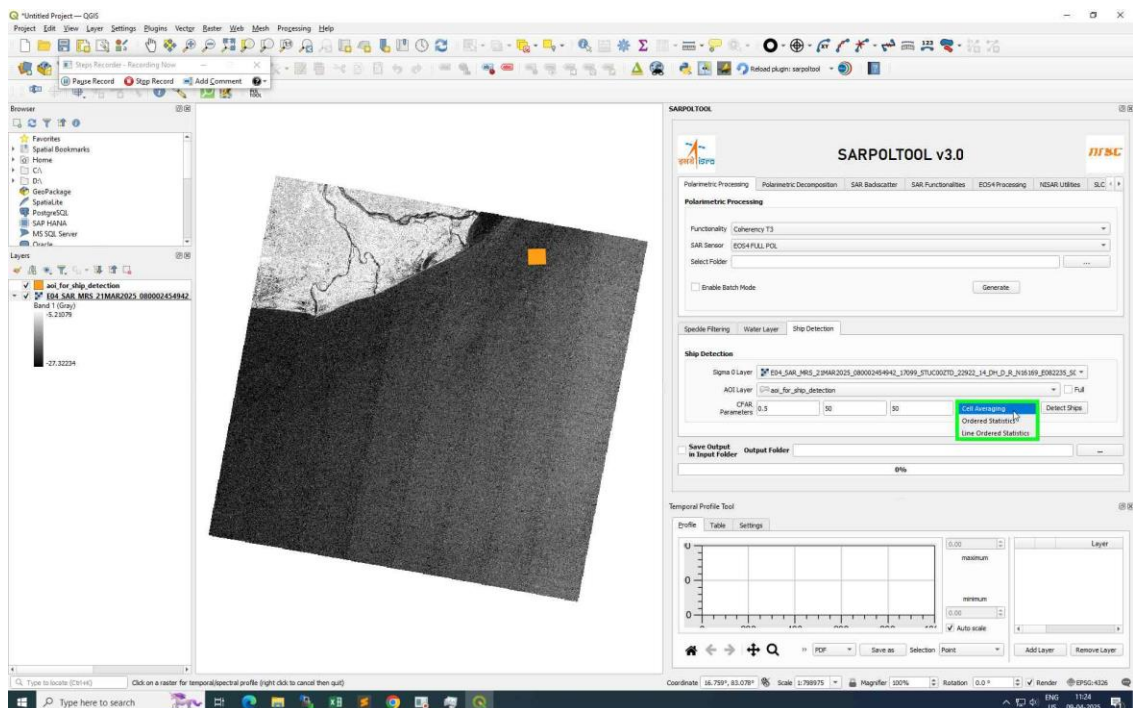
Step 12: (09-04-2025 11:24:00) User keyboard input on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS" [... Shift-Left Shift-Left ...]



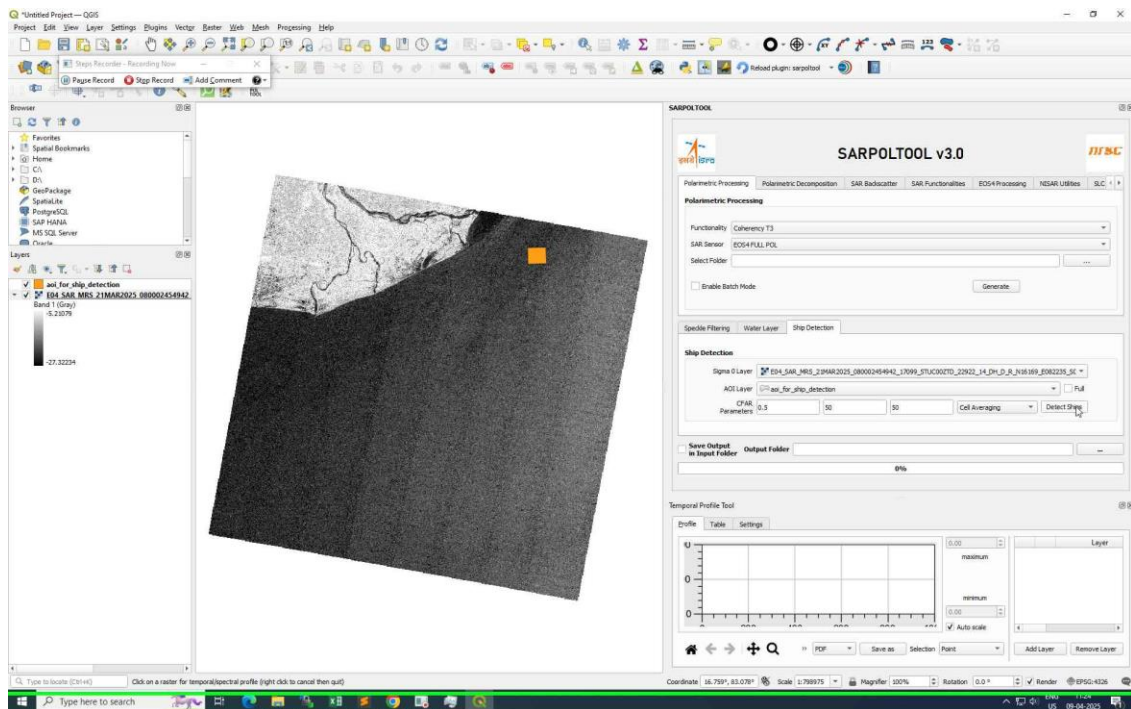
Step 13: (09-04-2025 11:24:04) User left click in "*Untitled Project — QGIS"



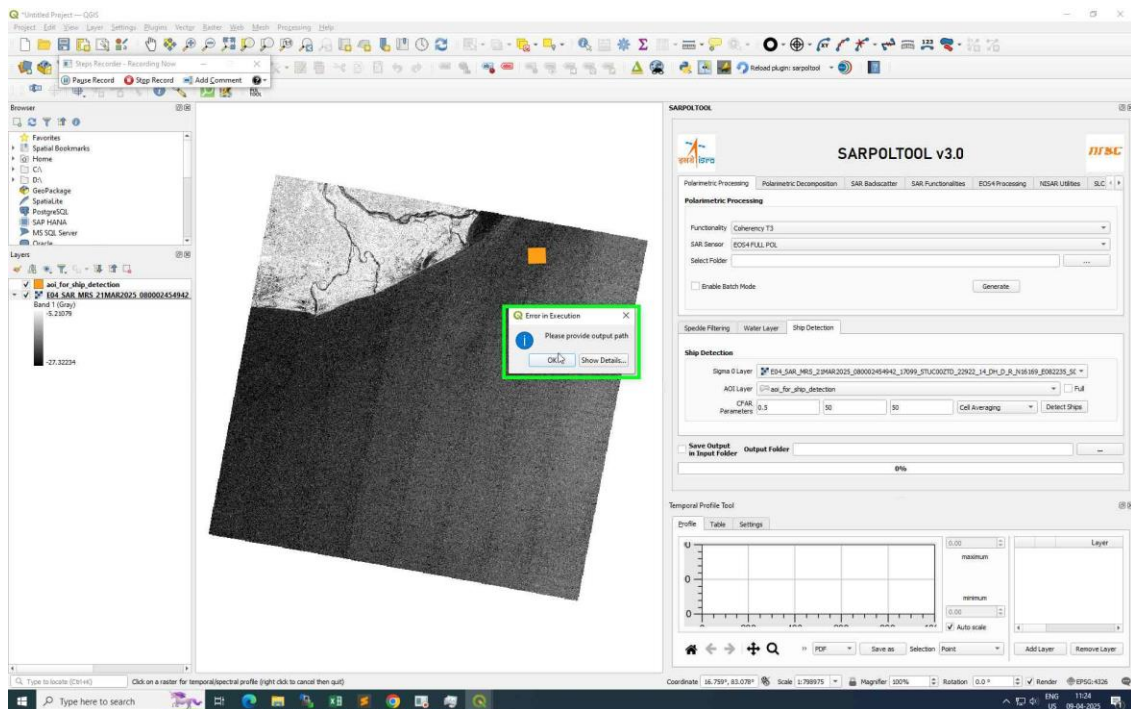
Step 14: (09-04-2025 11:24:05) User left click in "QGIS3"



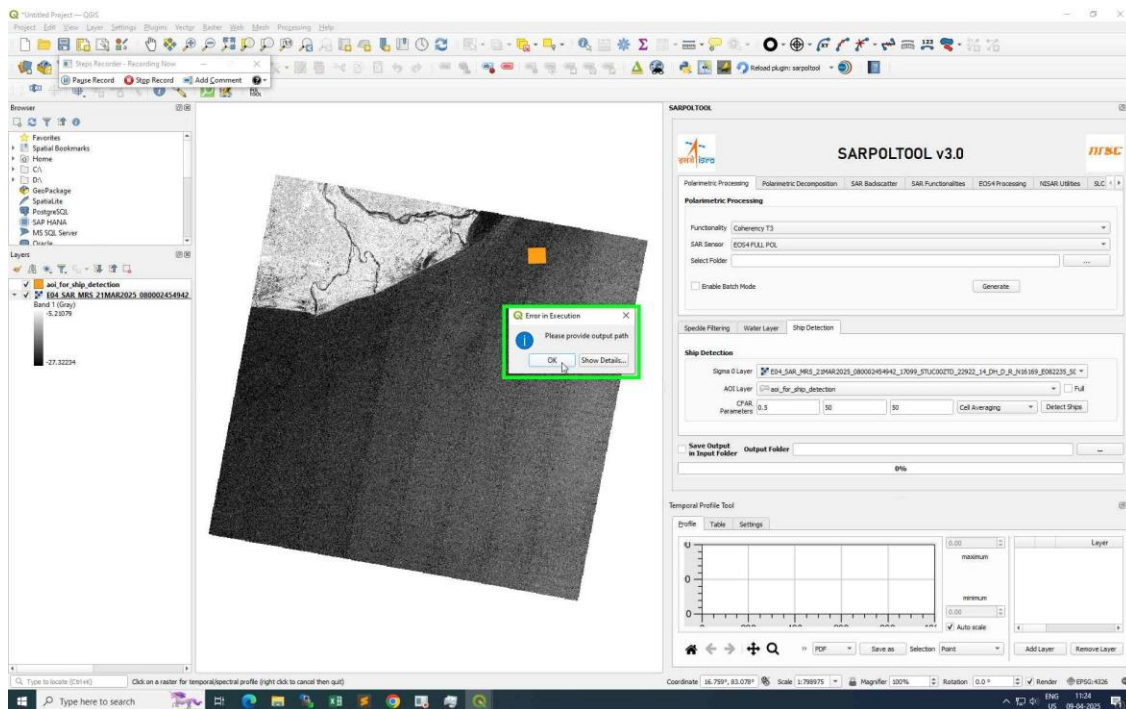
Step 15: (09-04-2025 11:24:08) User left click in "*Untitled Project — QGIS"



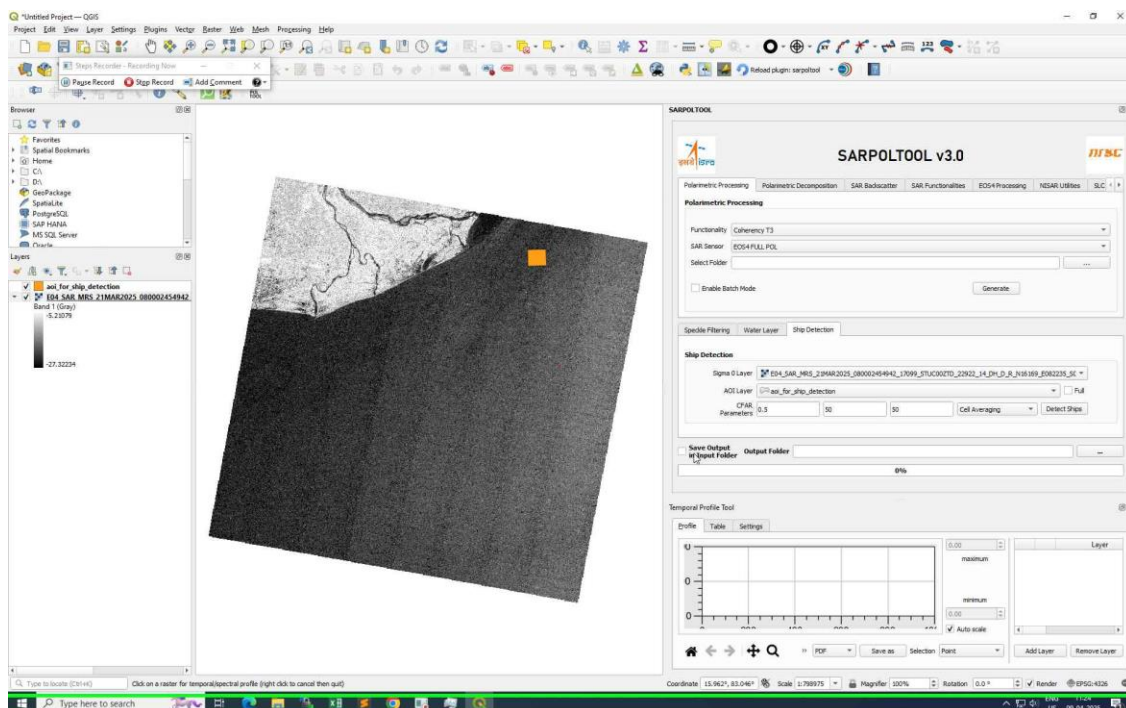
Step 16: (09-04-2025 11:24:10) User left click on "Error in Execution (window)" in "Error in Execution"



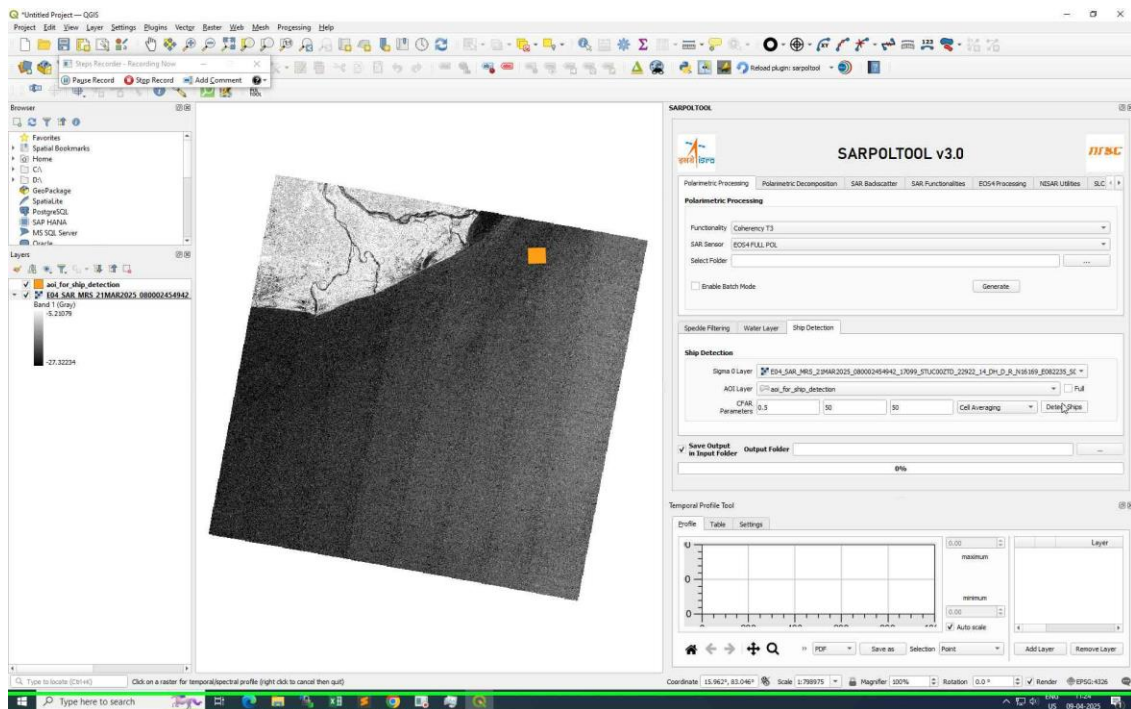
Step 17: (09-04-2025 11:24:12) User left click on "OK (button)" in "Error in Execution"



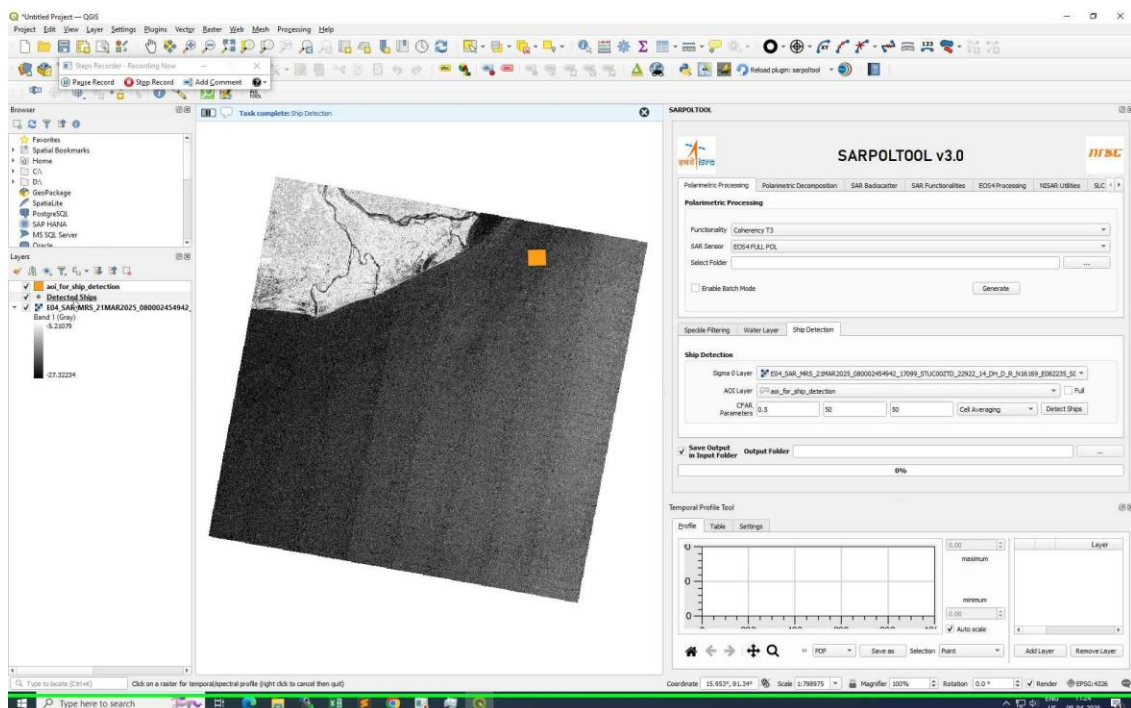
Step 18: (09-04-2025 11:24:12) User left click on "Save Output in Input Folder (check box)" in "*Untitled Project — QGIS"



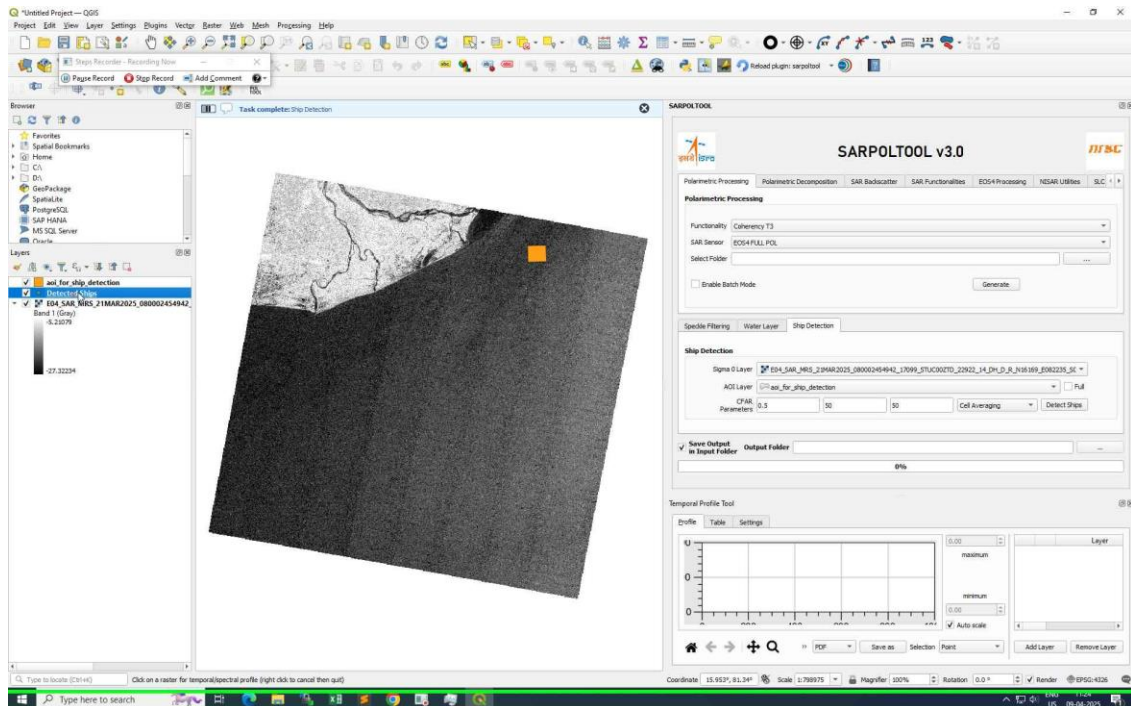
Step 19: (09-04-2025 11:24:15) User left click in "*Untitled Project — QGIS"



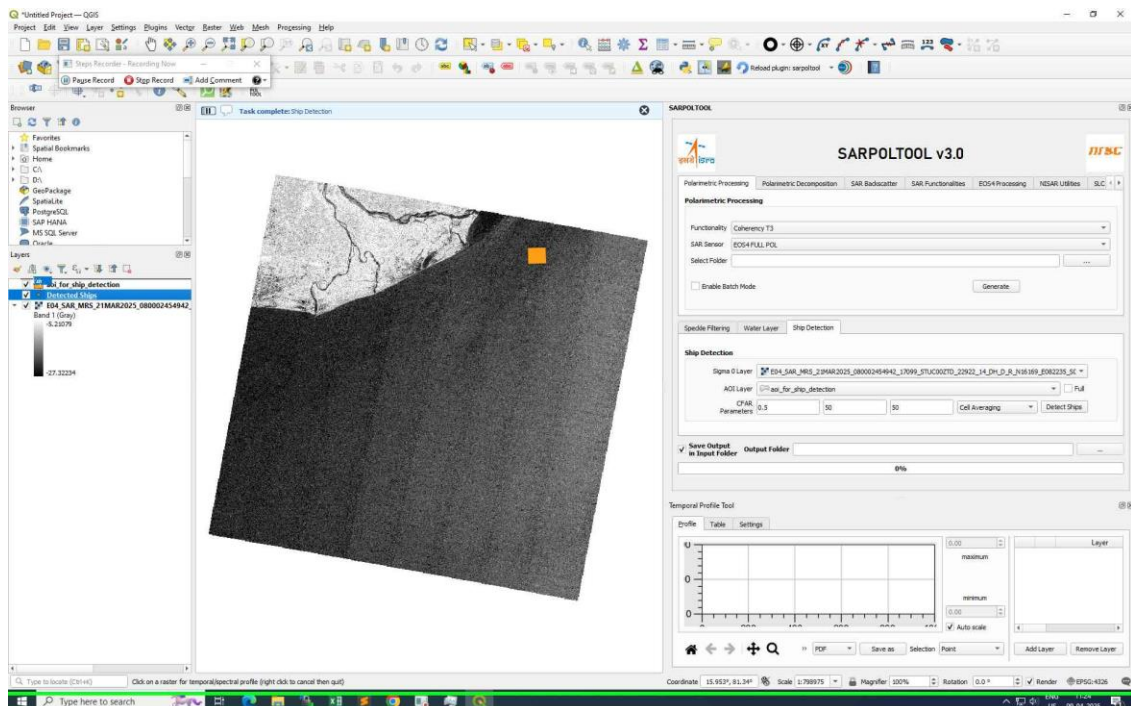
Step 20: (09-04-2025 11:24:31) User left click on "Layers (window)" in "*Untitled Project — QGIS"



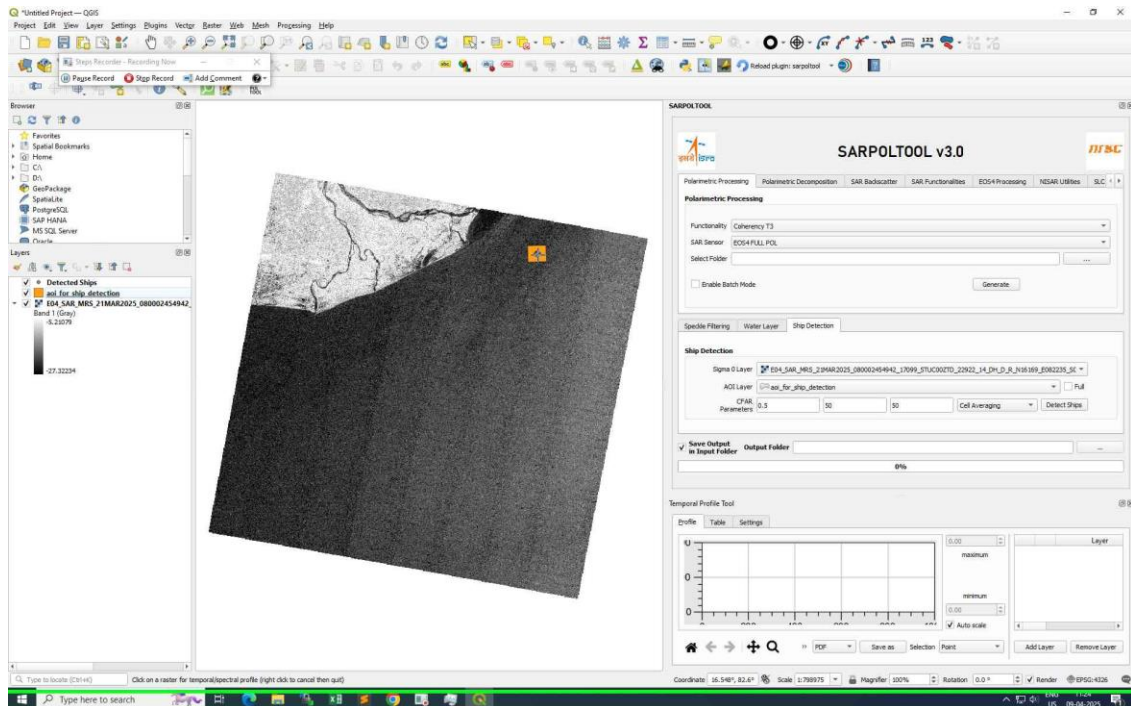
Step 21: (09-04-2025 11:24:31) User mouse drag start on "Layers (window)" in "*Untitled Project — QGIS"



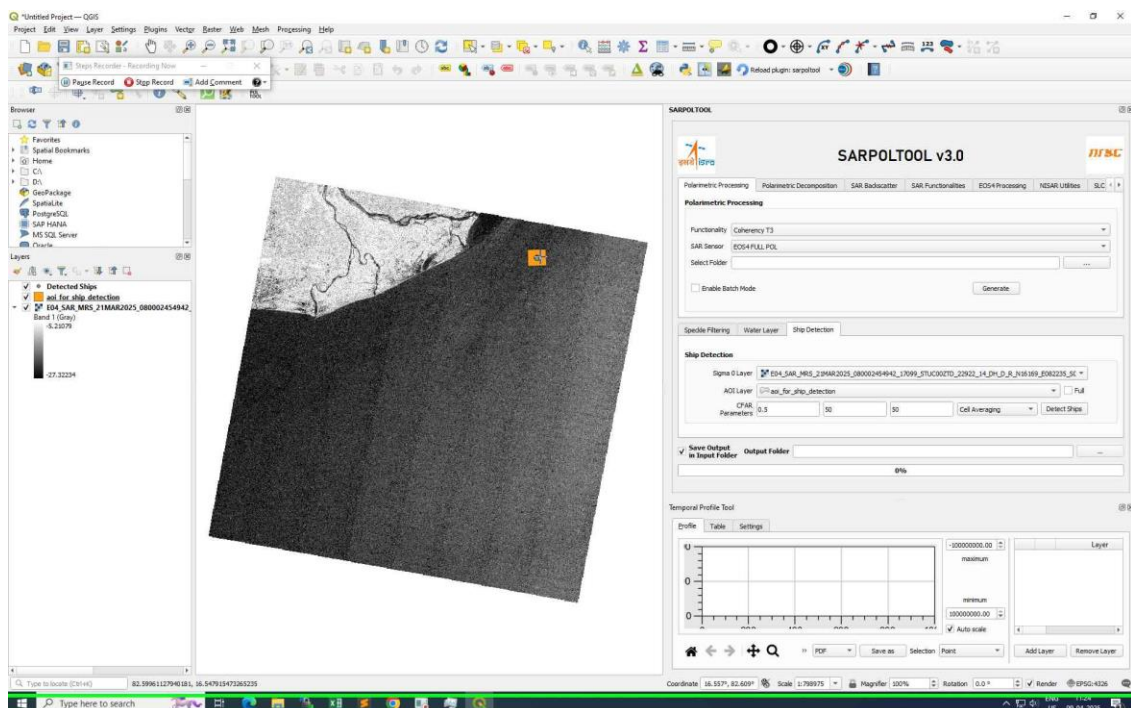
Step 22: (09-04-2025 11:24:32) User mouse drag end on "Layers (window)" in "*Untitled Project — QGIS"



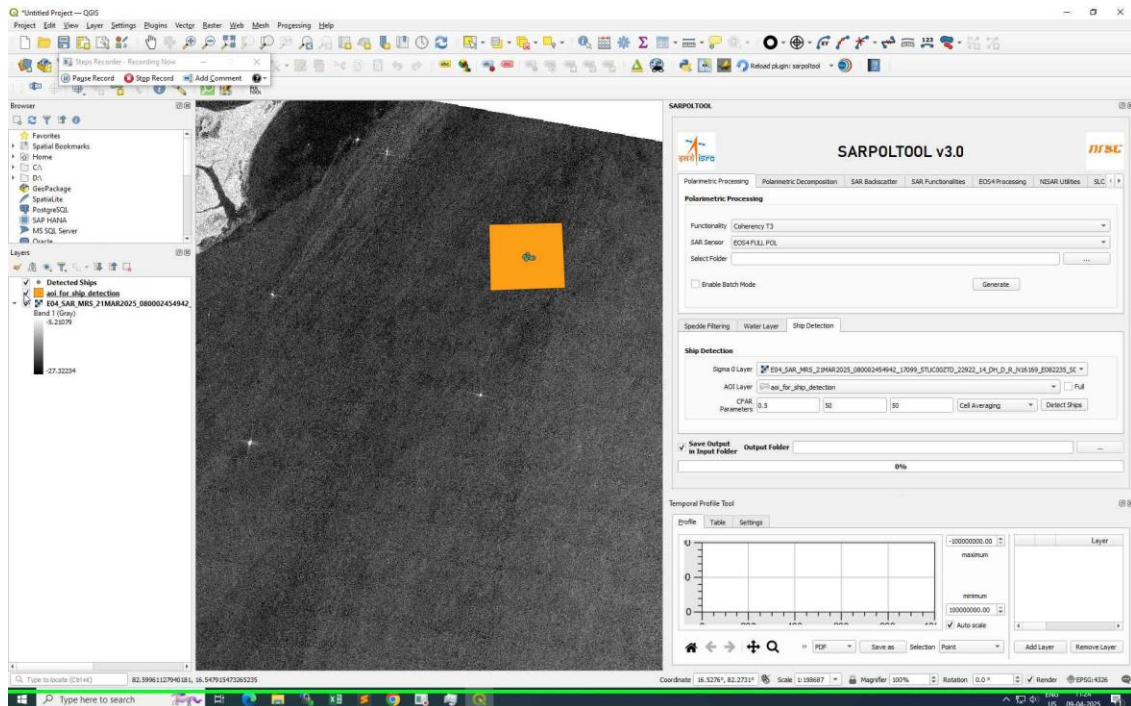
Step 23: (09-04-2025 11:24:36) User left click on "*Untitled Project — QGIS" in "*Untitled Project — QGIS"



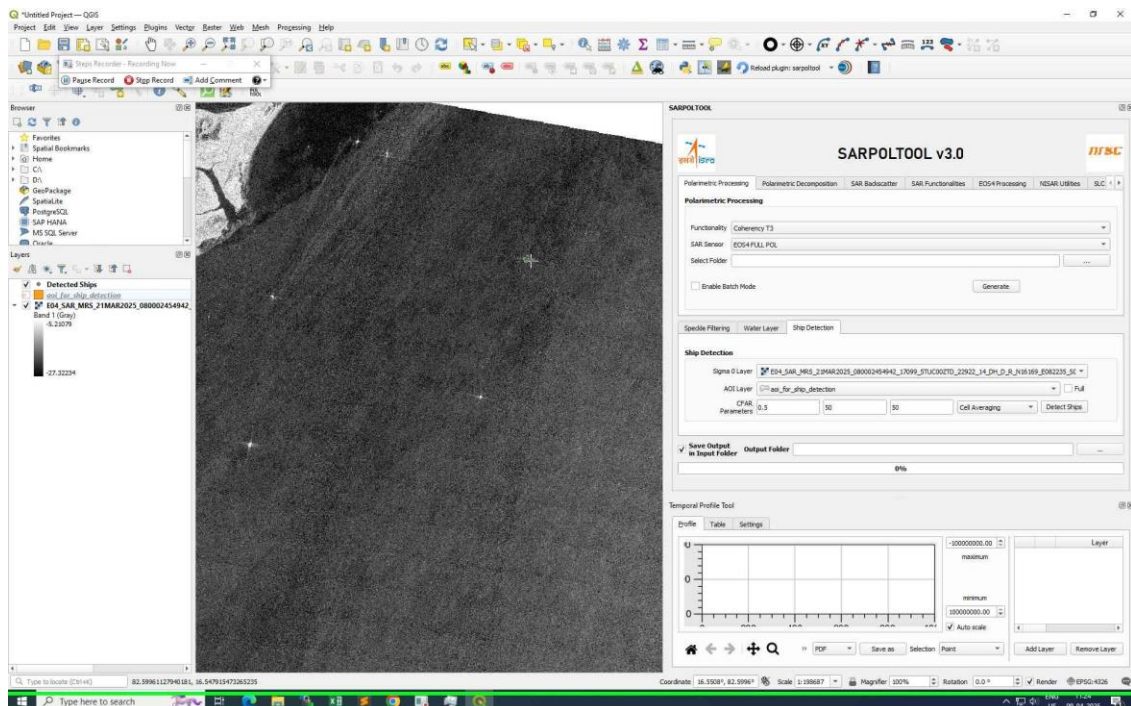
Step 24: (09-04-2025 11:24:38) User mouse wheel up on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"



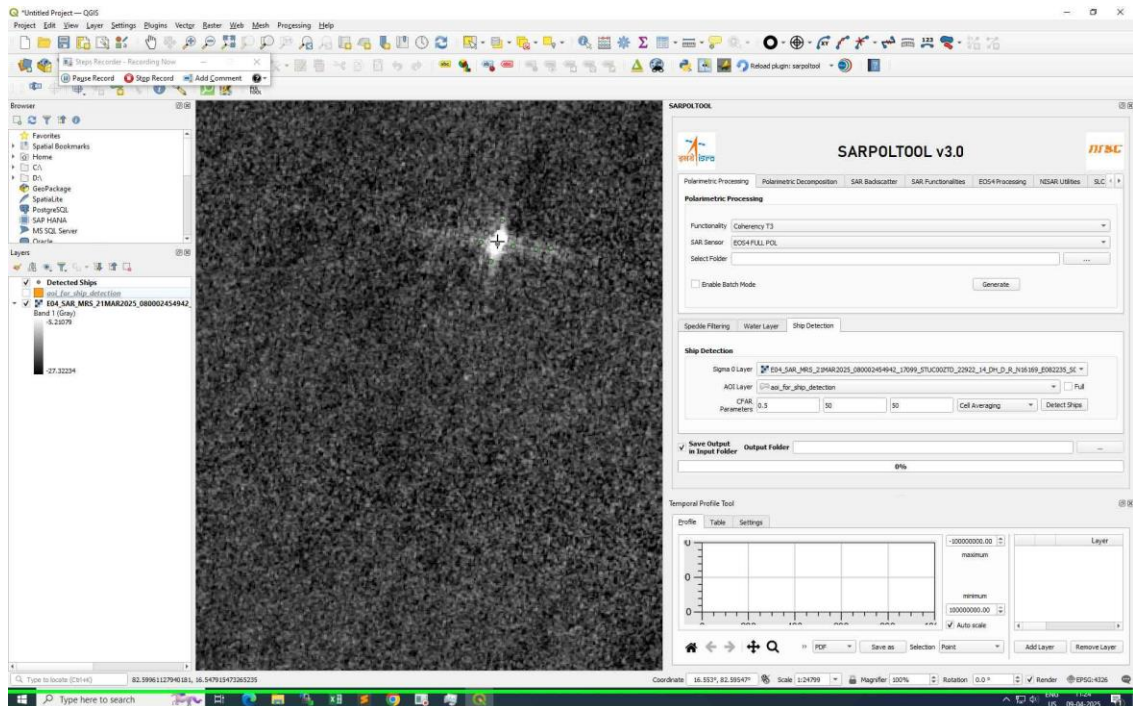
Step 25: (09-04-2025 11:24:41) User left click on "Layers (window)" in "*Untitled Project — QGIS"



Step 26: (09-04-2025 11:24:42) User mouse wheel up on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

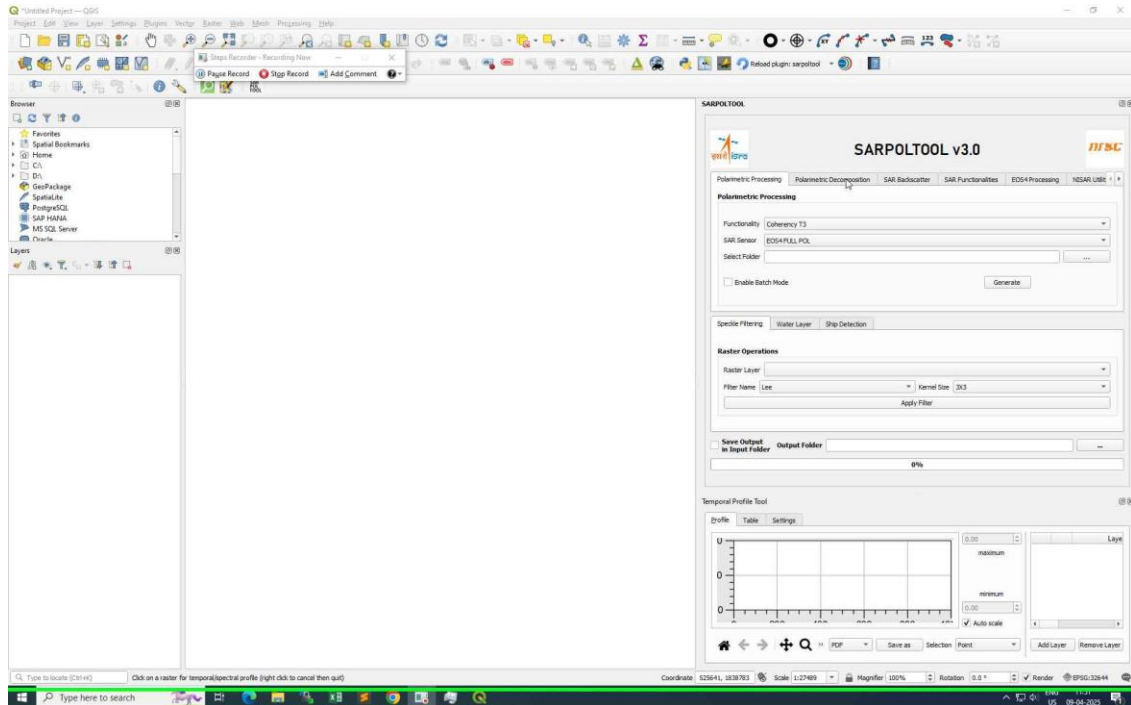


Step 27: (09-04-2025 11:24:43) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

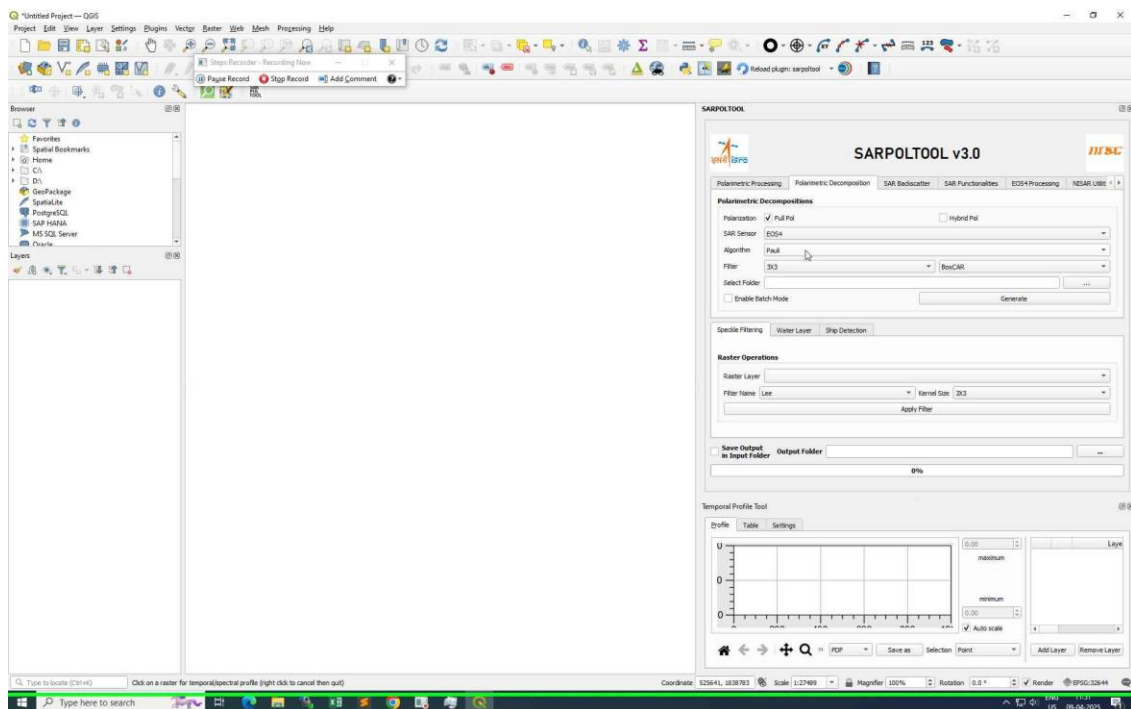


Batch Processing – Sample Operation

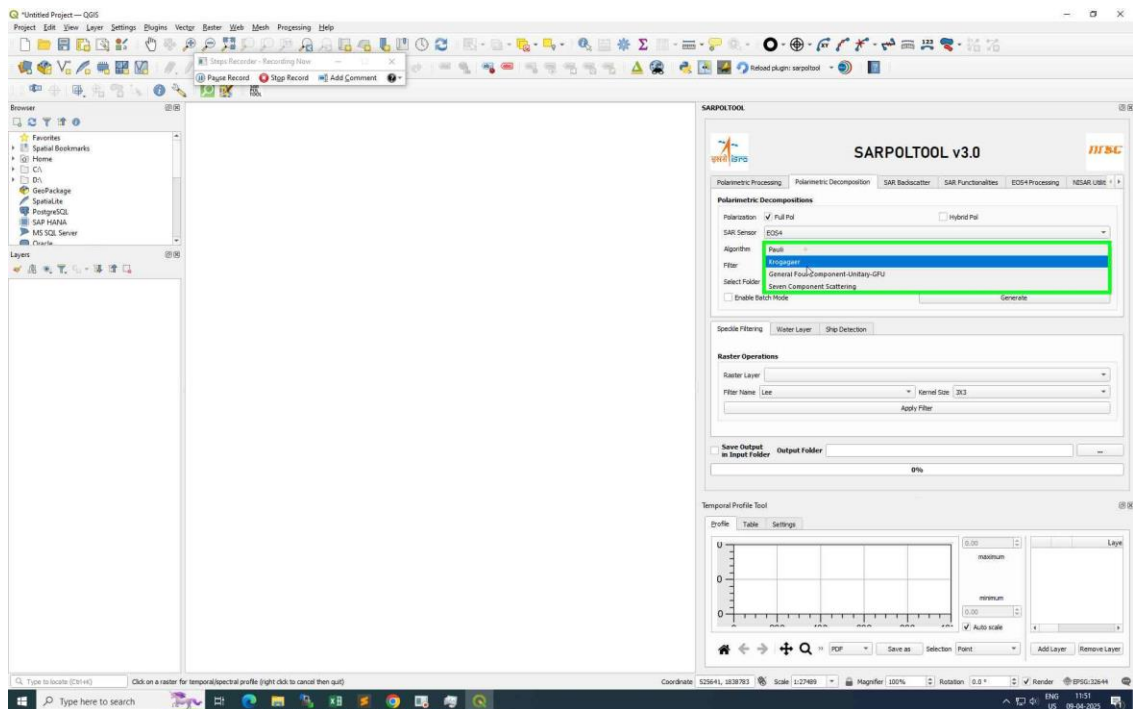
Step 1: (09-04-2025 11:51:29) User left click in "*Untitled Project — QGIS"



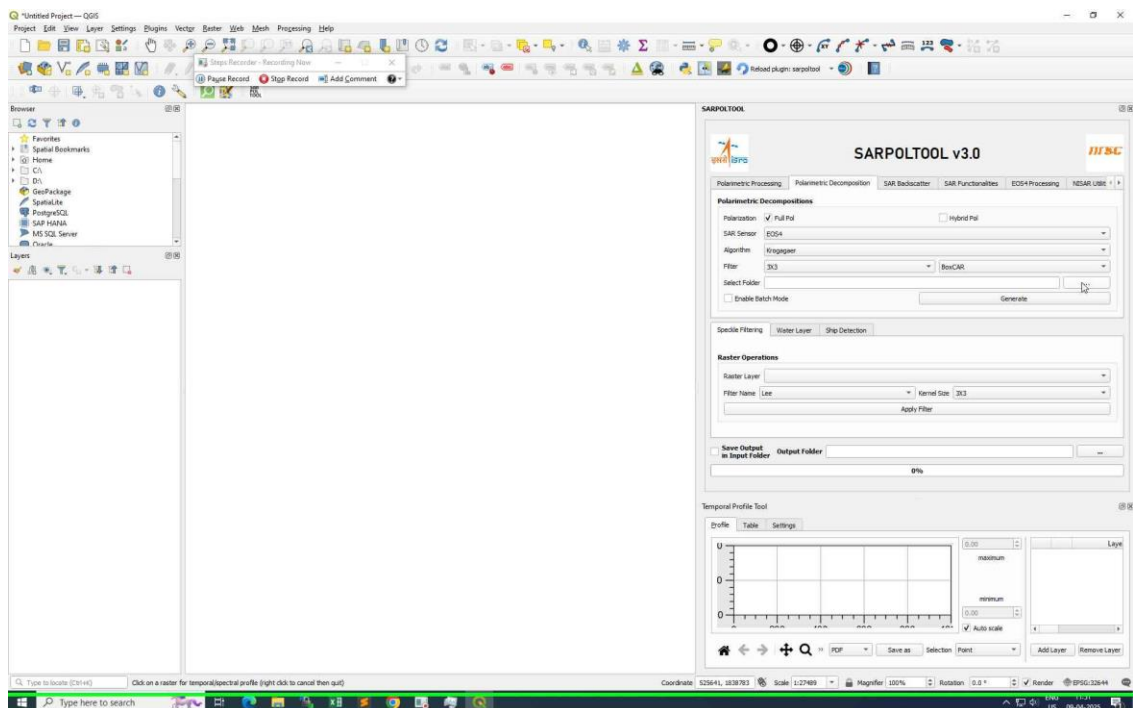
Step 2: (09-04-2025 11:51:32) User left click in "*Untitled Project — QGIS"



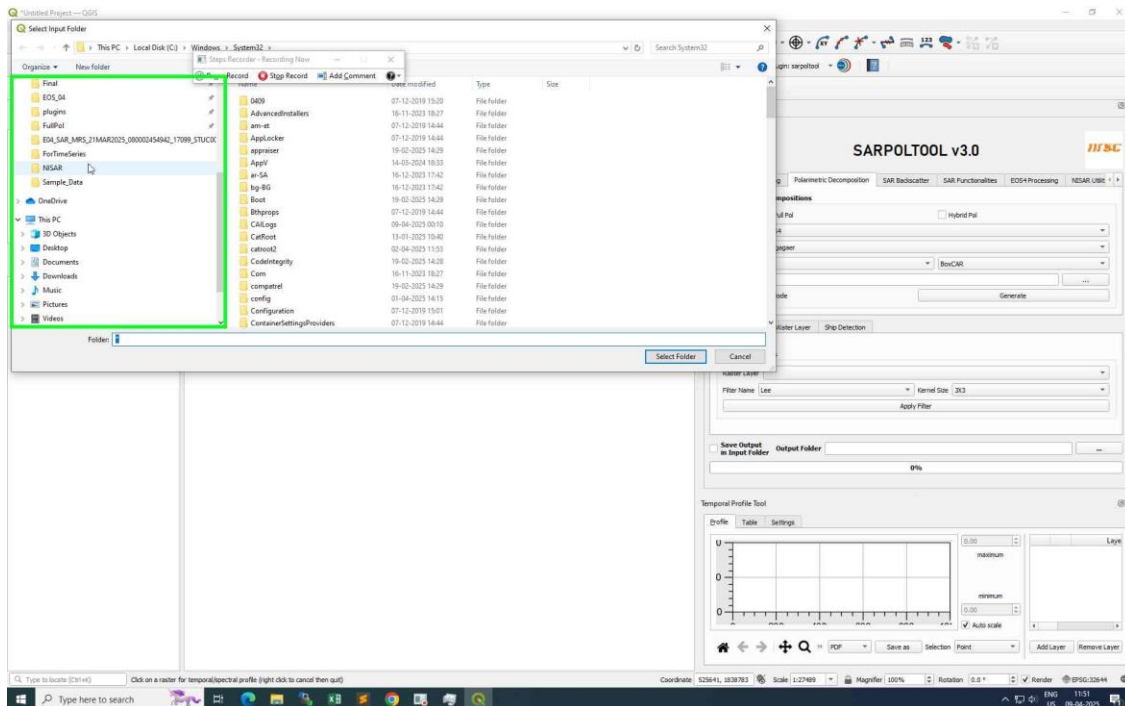
Step 3: (09-04-2025 11:51:33) User left click in "QGIS"



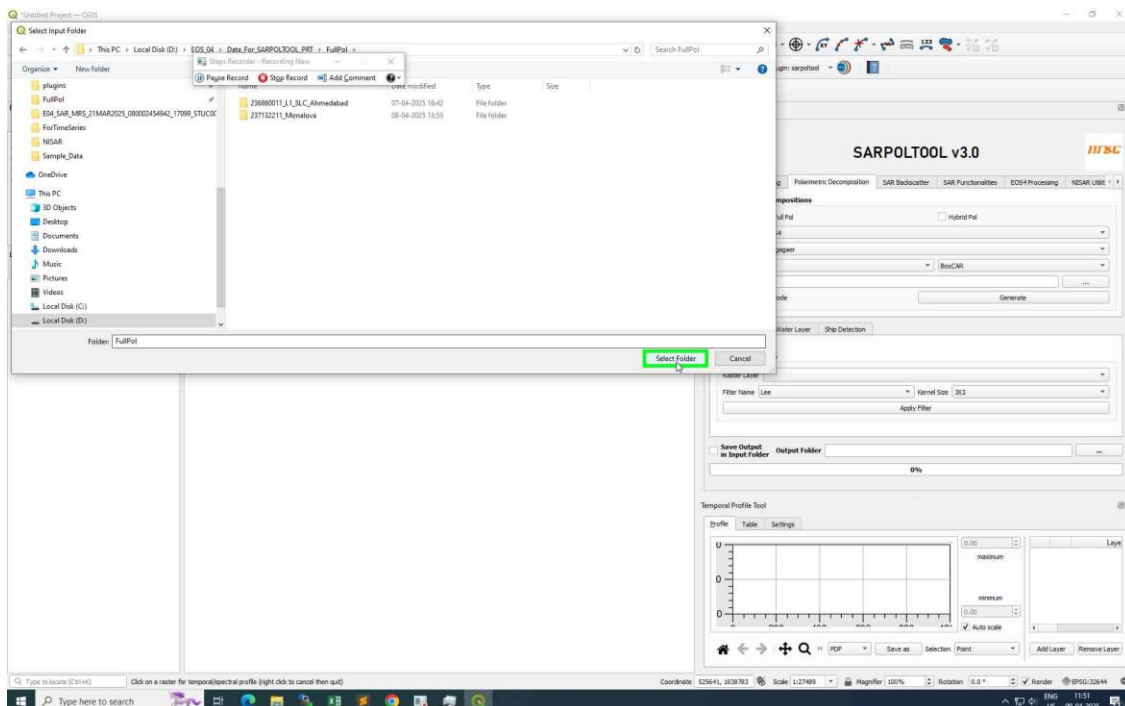
Step 4: (09-04-2025 11:51:35) User left click in "*Untitled Project — QGIS"



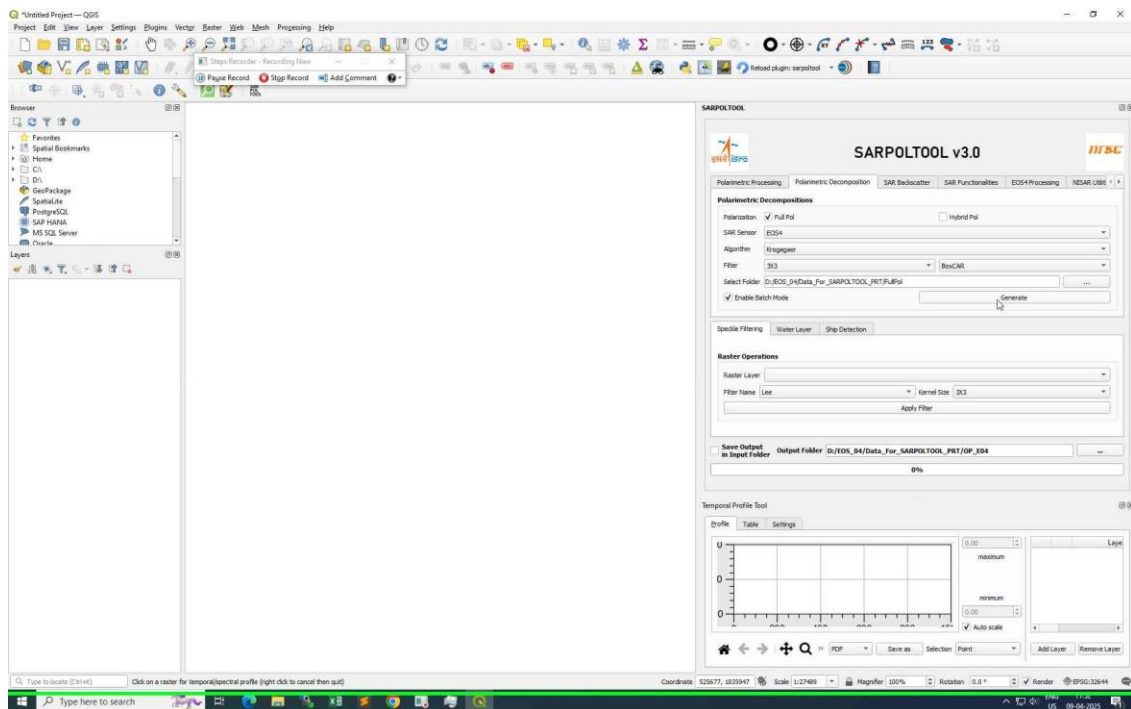
Step 5: (09-04-2025 11:51:38) User mouse wheel up on "NISAR (tree item)" in "Select Input Folder"



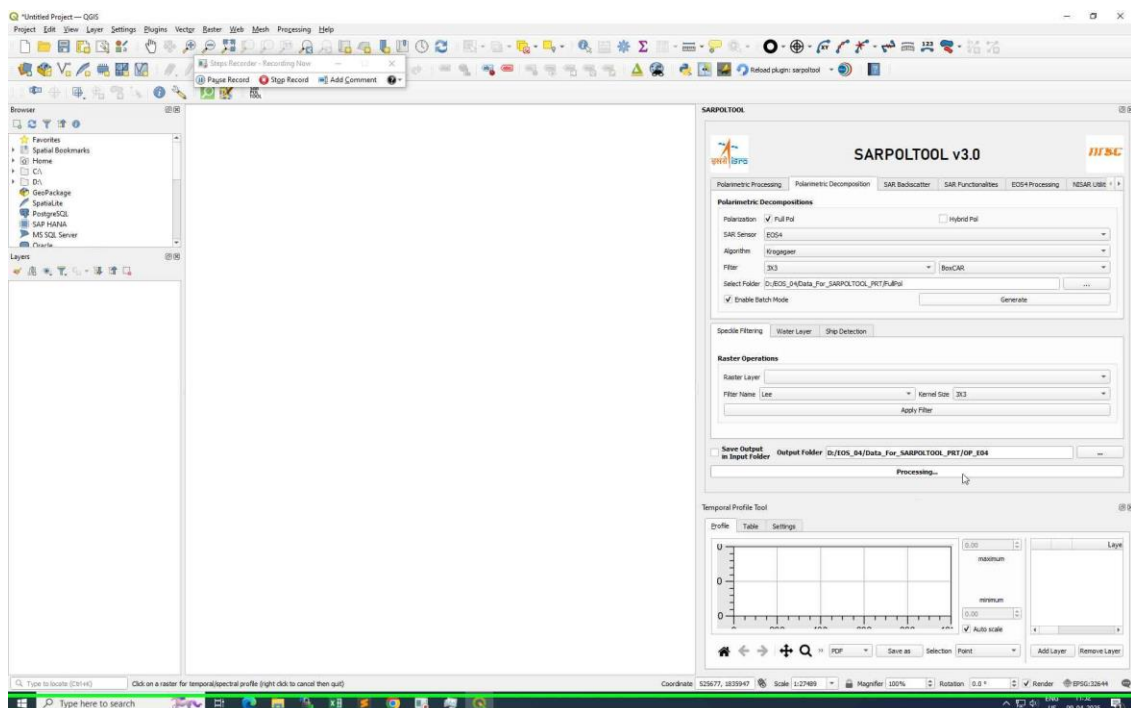
Step 10: (09-04-2025 11:51:46) User left click on "Select Folder (button)" in "Select Input Folder"



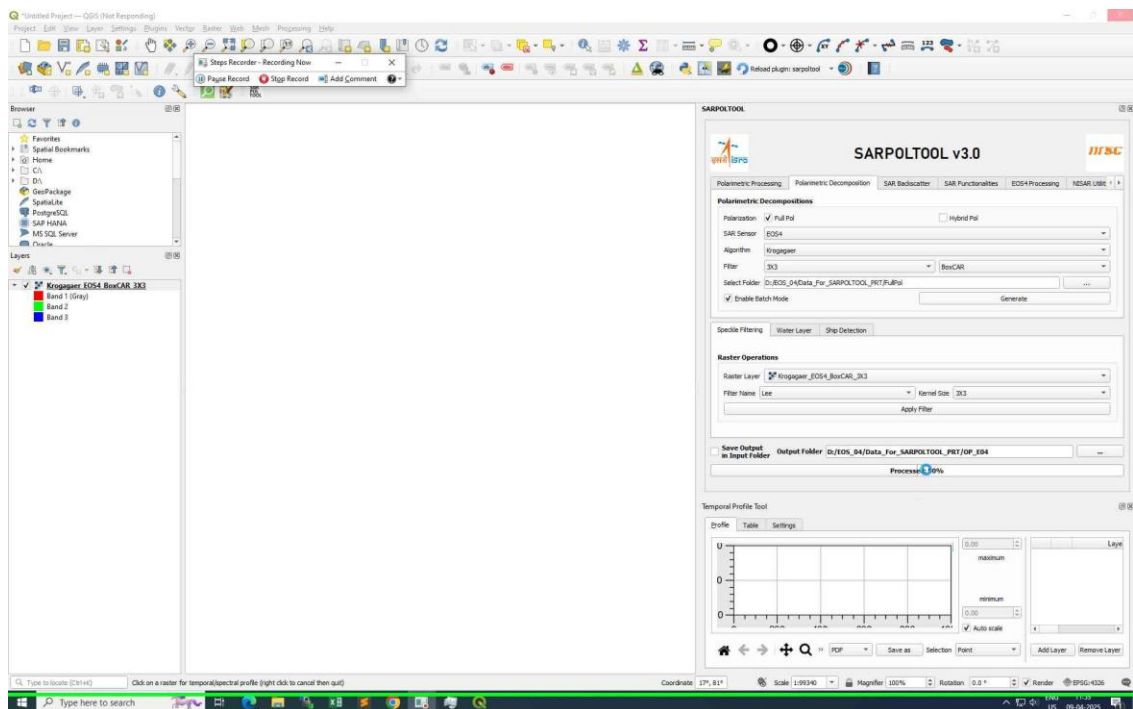
Step 18: (09-04-2025 11:52:07) User left click in "*Untitled Project — QGIS"



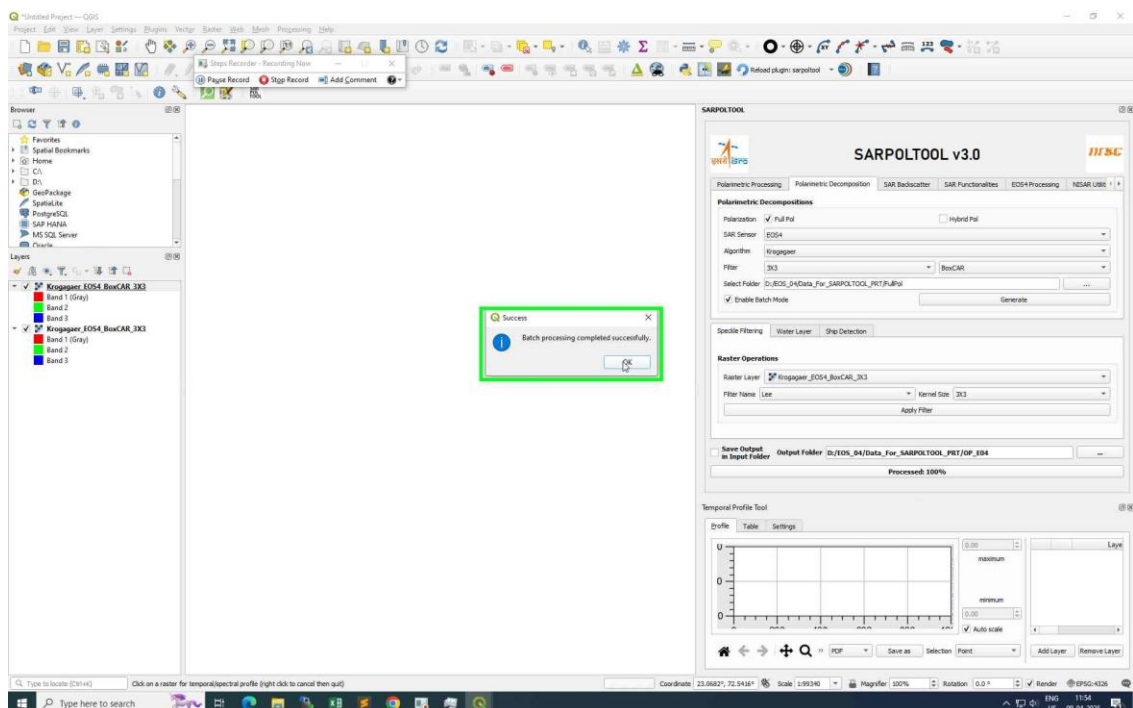
Step 19: (09-04-2025 11:52:10) User left click on "Items View (list)" in "*Untitled Project — QGIS"



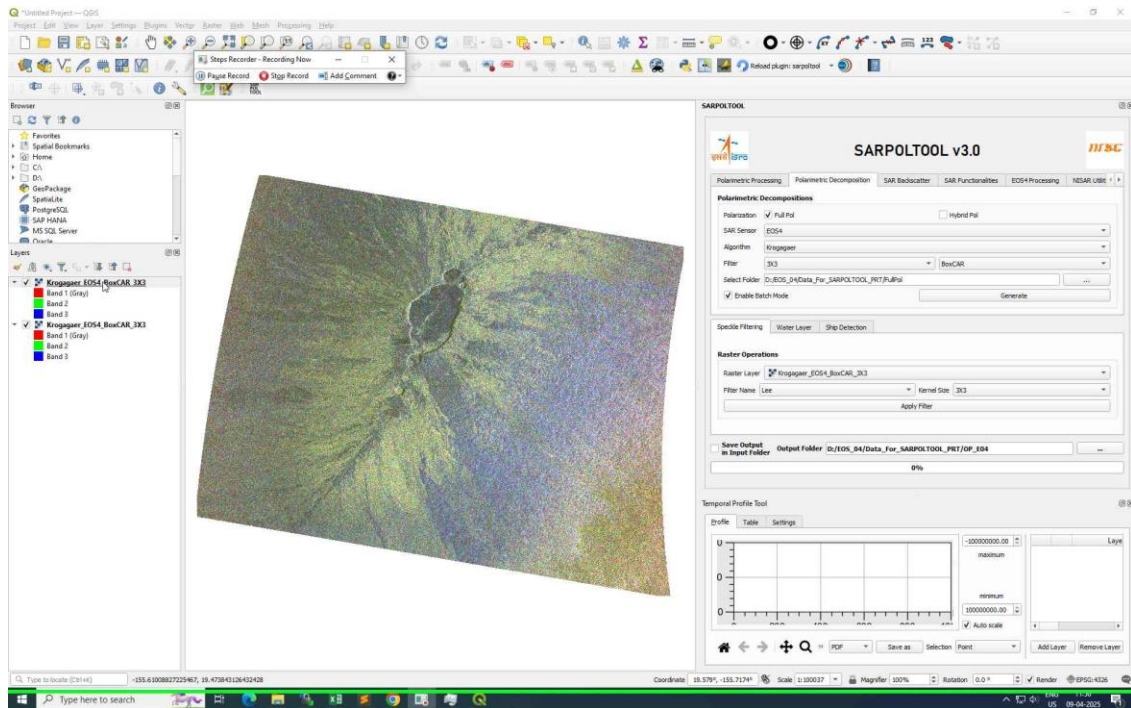
Step 20: (09-04-2025 11:53:56) User left click in "*Untitled Project — QGIS (Not Responding)"



Step 21: (09-04-2025 11:54:35) User left click on "OK (button)" in "Success"



Step 22: (09-04-2025 11:56:44) User left click on "Layers (window)" in "*Untitled Project — QGIS"



Temporal Profile – Sample Operation

Step 1: (09-04-2025 11:44:10) User left click on "Raster (menu item)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 2: (09-04-2025 11:45:36) User left click on "Build Virtual Raster... (menu item)" in "QGIS3"

No screenshots were saved for this step.

Step 3: (09-04-2025 11:45:40) User left click in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 4: (09-04-2025 11:45:50) User left click in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 5: (09-04-2025 11:45:51) User mouse drag start in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 6: (09-04-2025 11:45:52) User mouse drag end in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 7: (09-04-2025 11:45:54) User left click in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 8: (09-04-2025 11:45:54) User mouse drag start in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 9: (09-04-2025 11:45:55) User mouse drag end in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 10: (09-04-2025 11:46:24) User left click in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 11: (09-04-2025 11:46:26) User left click in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 12: (09-04-2025 11:46:28) User left click in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 13: (09-04-2025 11:46:28) User left click in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 14: (09-04-2025 11:46:32) User mouse drag start in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 15: (09-04-2025 11:46:34) User mouse drag end on "Raster Miscellaneous - Build Virtual Raster (window)" in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 16: (09-04-2025 11:46:35) User left click in "Raster Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 17: (09-04-2025 11:46:36) User left click on "Save to File... (menu item)" in "QGIS3"

No screenshots were saved for this step.

Step 18: (09-04-2025 11:46:41) User left click on "Data_For_SARPOLTOOL_PRT (split button)" in "Save file"

No screenshots were saved for this step.

Step 19: (09-04-2025 11:46:42) User left double click on "Name (edit)" in "Save file"

No screenshots were saved for this step.

Step 20: (09-04-2025 11:46:44) User left click on "File name: (edit)" in "Save file"

No screenshots were saved for this step.

Step 21: (09-04-2025 11:46:45) User keyboard input on "File name: (edit)" in "Save file"
[... Backspace Backspace ... Shift-Backspace ... Backspace ... Enter]

No screenshots were saved for this step.

Step 22: (09-04-2025 11:46:53) User left click on "Run (button)" in "Raster
Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 23: (09-04-2025 11:46:58) User left click on "Close (button)" in "Raster
Miscellaneous - Build Virtual Raster"

No screenshots were saved for this step.

Step 24: (09-04-2025 11:47:00) User left click on "Layers (window)" in "*Untitled Project
— QGIS"

No screenshots were saved for this step.

Step 25: (09-04-2025 11:47:00) User keyboard input on "*Untitled Project — QGIS
(window)" in "*Untitled Project — QGIS" [... Shift-Down Shift-Down Shift-Down Shift-
Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-
Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-
Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-
Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-
Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-Down Shift-
Down ... Ctrl-D]

No screenshots were saved for this step.

Step 26: (09-04-2025 11:47:05) User left click on "Remove layers and groups (window)"
in "Remove layers and groups"

No screenshots were saved for this step.

Step 27: (09-04-2025 11:47:06) User left click on "OK (button)" in "Remove layers and groups"

No screenshots were saved for this step.

Step 28: (09-04-2025 11:47:13) User left click on "Layers (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 29: (09-04-2025 11:47:15) User left click on "Add Layer (button)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 30: (09-04-2025 11:47:17) User mouse wheel up on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 31: (09-04-2025 11:47:35) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 32: (09-04-2025 11:47:38) User mouse drag start on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 33: (09-04-2025 11:47:40) User mouse drag end on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 34: (09-04-2025 11:47:41) User mouse drag start on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 35: (09-04-2025 11:47:44) User mouse drag end on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 36: (09-04-2025 11:47:46) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 37: (09-04-2025 11:47:48) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 38: (09-04-2025 11:47:52) User left click on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 39: (09-04-2025 11:47:56) User left click in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 40: (09-04-2025 11:47:58) User left click on "Figure options (window)" in "Figure options"

No screenshots were saved for this step.

Step 41: (09-04-2025 11:47:59) User mouse drag start on "Figure options (window)" in "Figure options"

No screenshots were saved for this step.

Step 42: (09-04-2025 11:48:01) User mouse drag end on "Figure options (window)" in "Figure options"

No screenshots were saved for this step.

Step 43: (09-04-2025 11:48:02) User left click on "Title (edit)" in "Figure options"

No screenshots were saved for this step.

Step 44: (09-04-2025 11:48:02) User keyboard input on "Figure options (window)" in "Figure options" [... Backspace ...]

No screenshots were saved for this step.

Step 45: (09-04-2025 11:48:09) User left click on "Label (edit)" in "Figure options"

No screenshots were saved for this step.

Step 46: (09-04-2025 11:48:09) User keyboard input on "Figure options (window)" in "Figure options" [...]

No screenshots were saved for this step.

Step 47: (09-04-2025 11:48:14) User left click on "Label (edit)" in "Figure options"

No screenshots were saved for this step.

Step 48: (09-04-2025 11:48:15) User keyboard input on "Figure options (window)" in "Figure options" [... Shift-Backspace ...]

No screenshots were saved for this step.

Step 49: (09-04-2025 11:48:22) User left click on "Apply (button)" in "Figure options"

No screenshots were saved for this step.

Step 50: (09-04-2025 11:48:24) User left click on "OK (button)" in "Figure options"

No screenshots were saved for this step.

Step 51: (09-04-2025 11:48:26) User mouse drag start on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 52: (09-04-2025 11:48:28) User mouse drag end on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 53: (09-04-2025 11:48:30) User mouse drag start on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 54: (09-04-2025 11:48:33) User mouse drag end on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 55: (09-04-2025 11:48:35) User mouse drag start on "*Untitled Project — QGIS (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

Step 56: (09-04-2025 11:48:39) User mouse drag end on "SARPOLTOOL (window)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

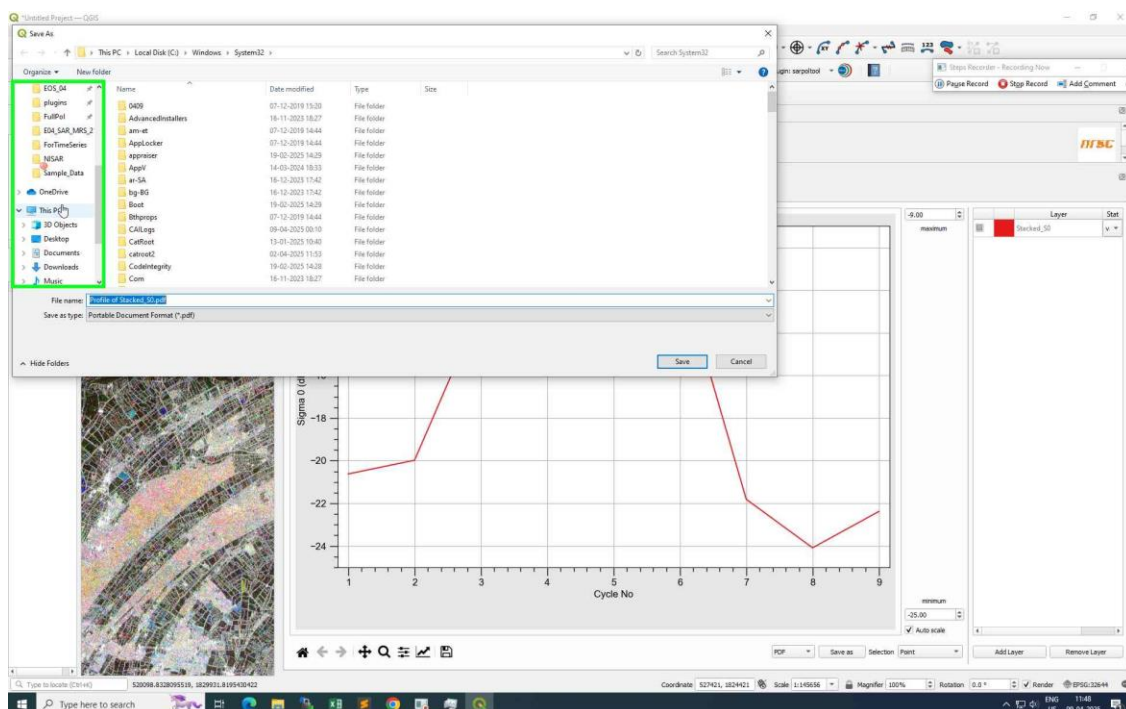
Step 57: (09-04-2025 11:48:48) User left click on "Save as (button)" in "*Untitled Project — QGIS"

No screenshots were saved for this step.

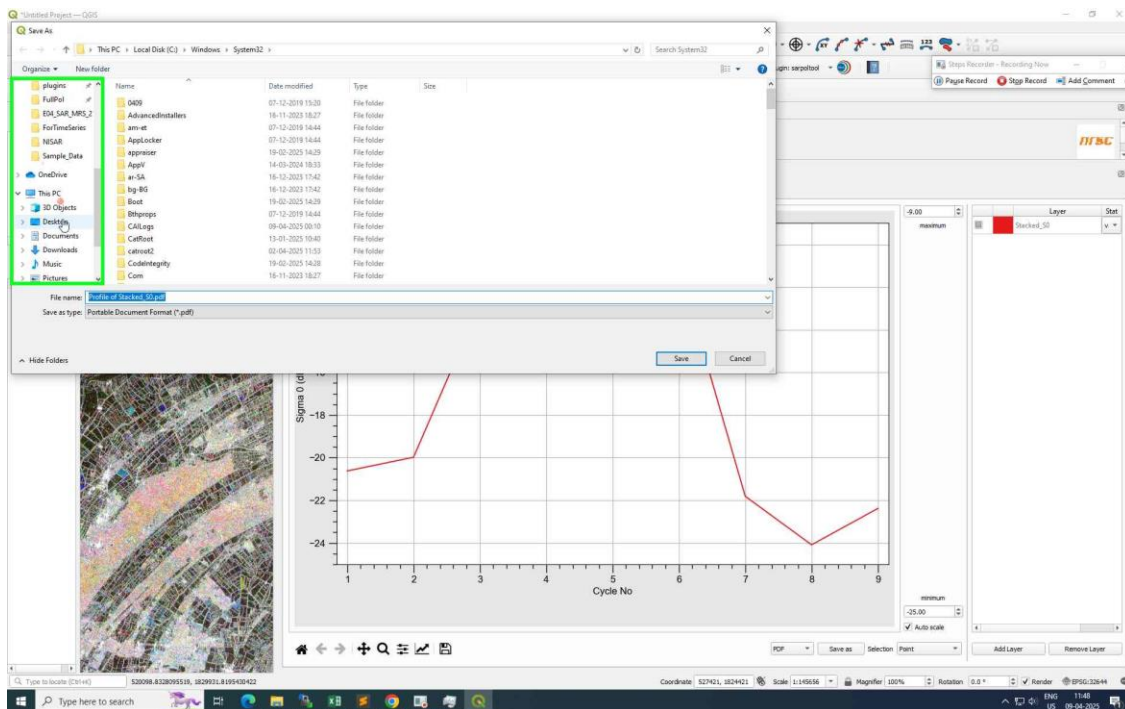
Step 58: (09-04-2025 11:48:53) User mouse wheel up on "This PC (tree item)" in "Save As"

No screenshots were saved for this step.

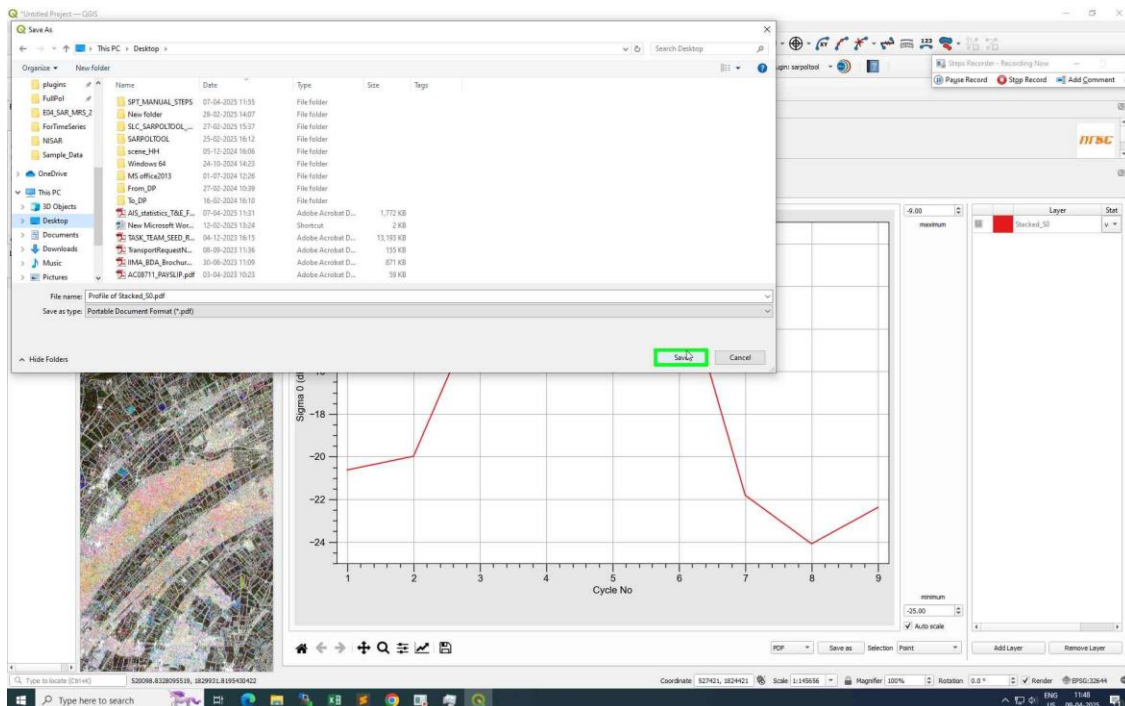
Step 59: (09-04-2025 11:48:53) User mouse wheel down on "This PC (tree item)" in "Save As"



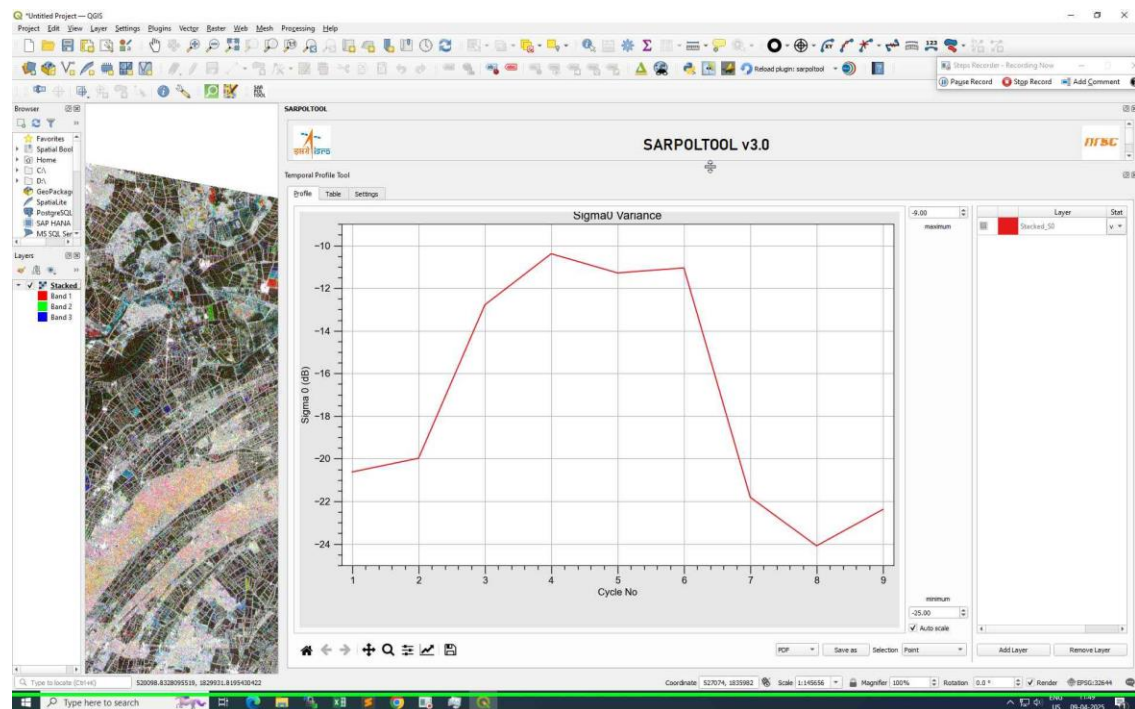
Step 60: (09-04-2025 11:48:54) User left click on "Desktop (tree item)" in "Save As"



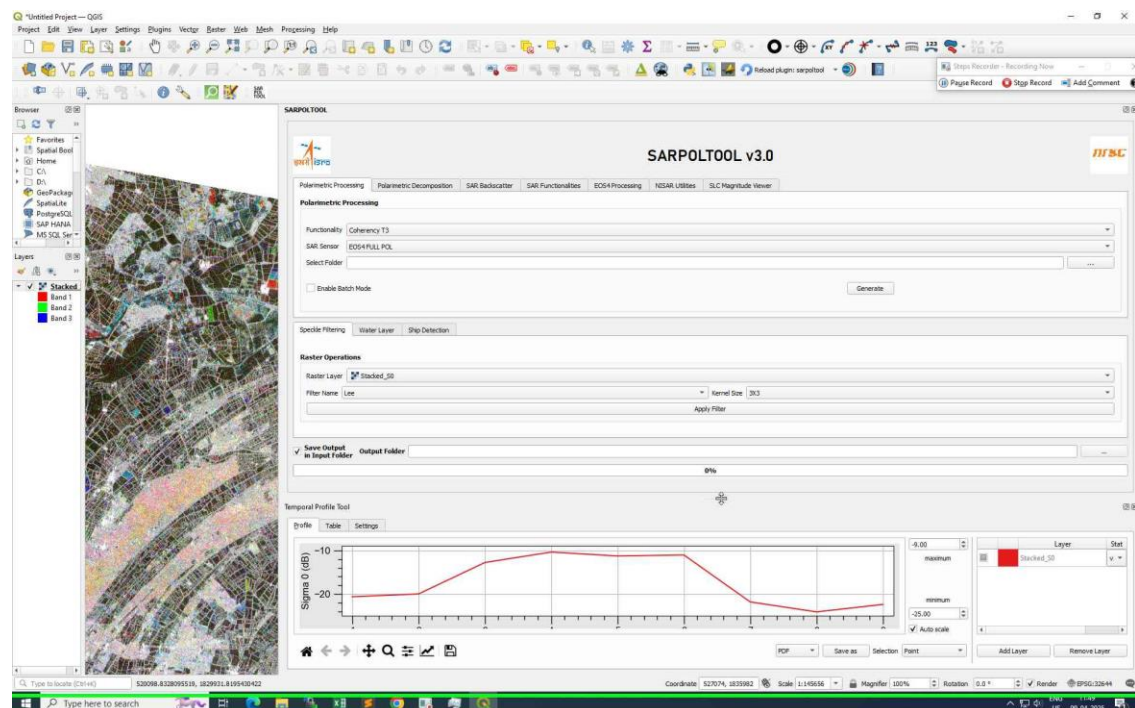
Step 61: (09-04-2025 11:48:55) User left click on "Save (button)" in "Save As"



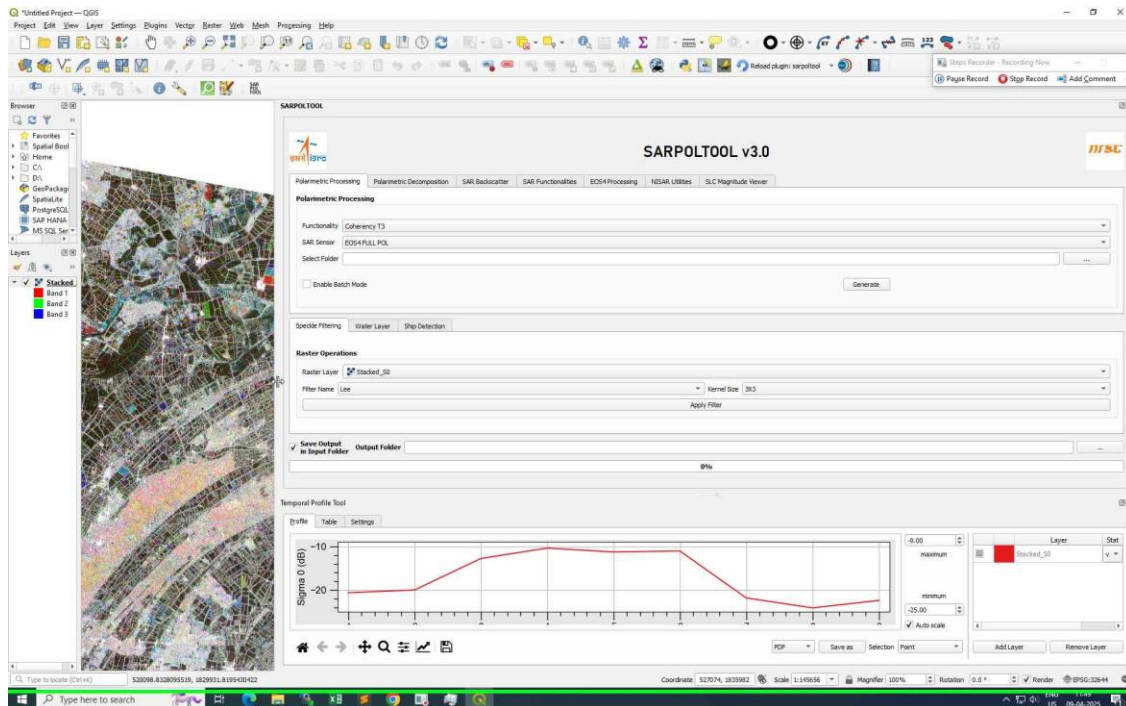
Step 62: (09-04-2025 11:49:06) User mouse drag start on "*Untitled Project — QGIS" (window)" in "*Untitled Project — QGIS"



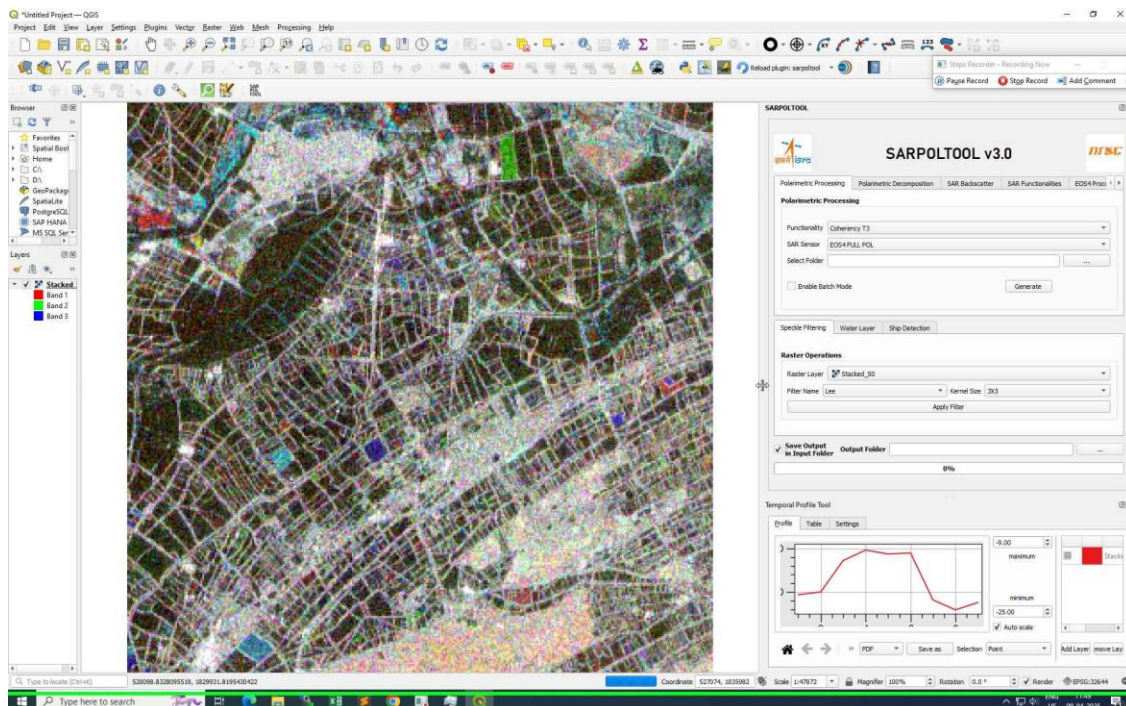
Step 63: (09-04-2025 11:49:09) User mouse drag end on "*Untitled Project — QGIS" (window)" in "*Untitled Project — QGIS"



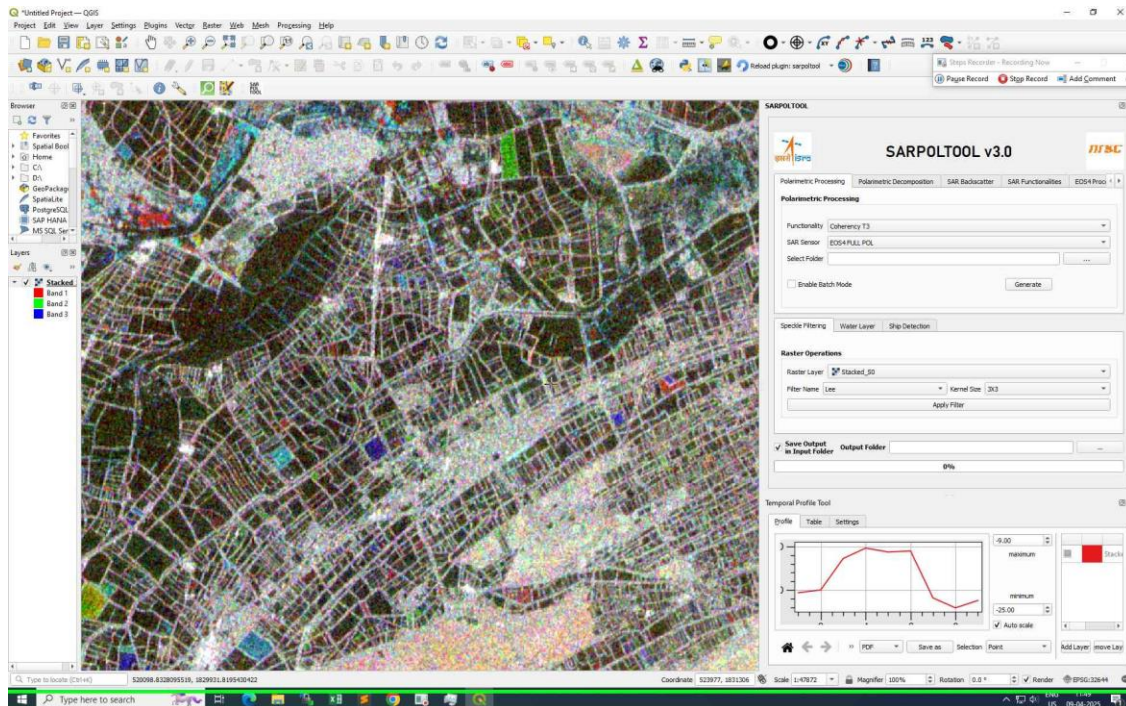
Step 64: (09-04-2025 11:49:10) User mouse drag start on "*Untitled Project — QGIS" (window)" in "*Untitled Project — QGIS"



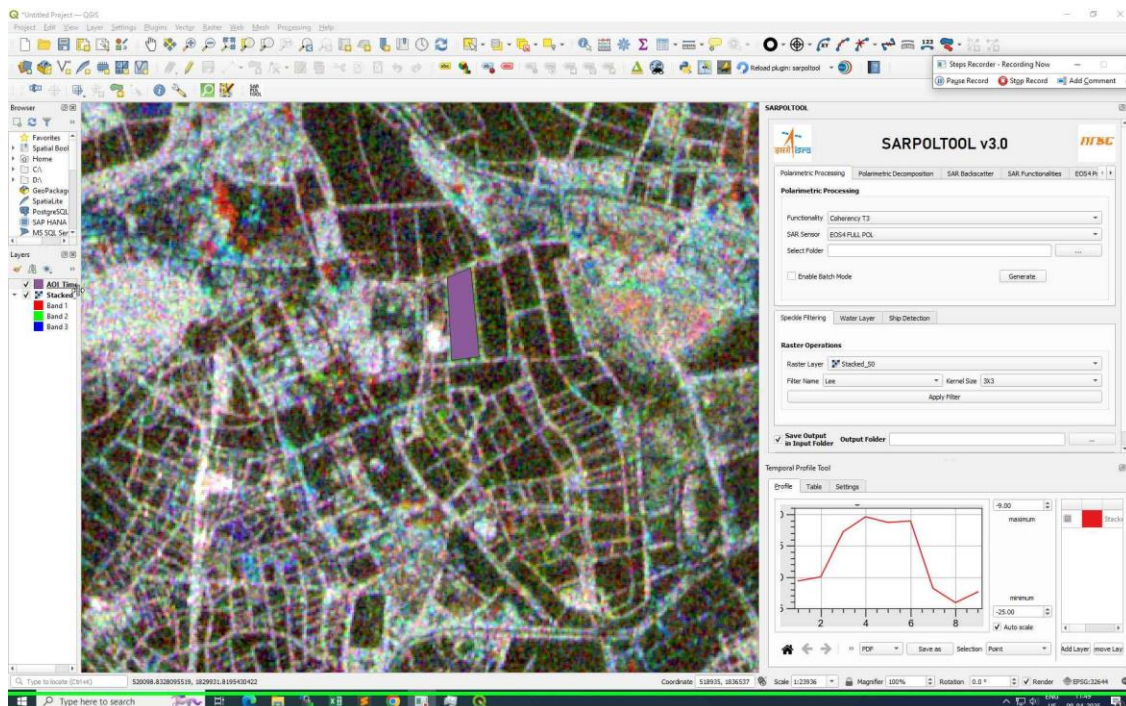
Step 65: (09-04-2025 11:49:11) User mouse drag end on "*Untitled Project — QGIS" (window)" in "*Untitled Project — QGIS"



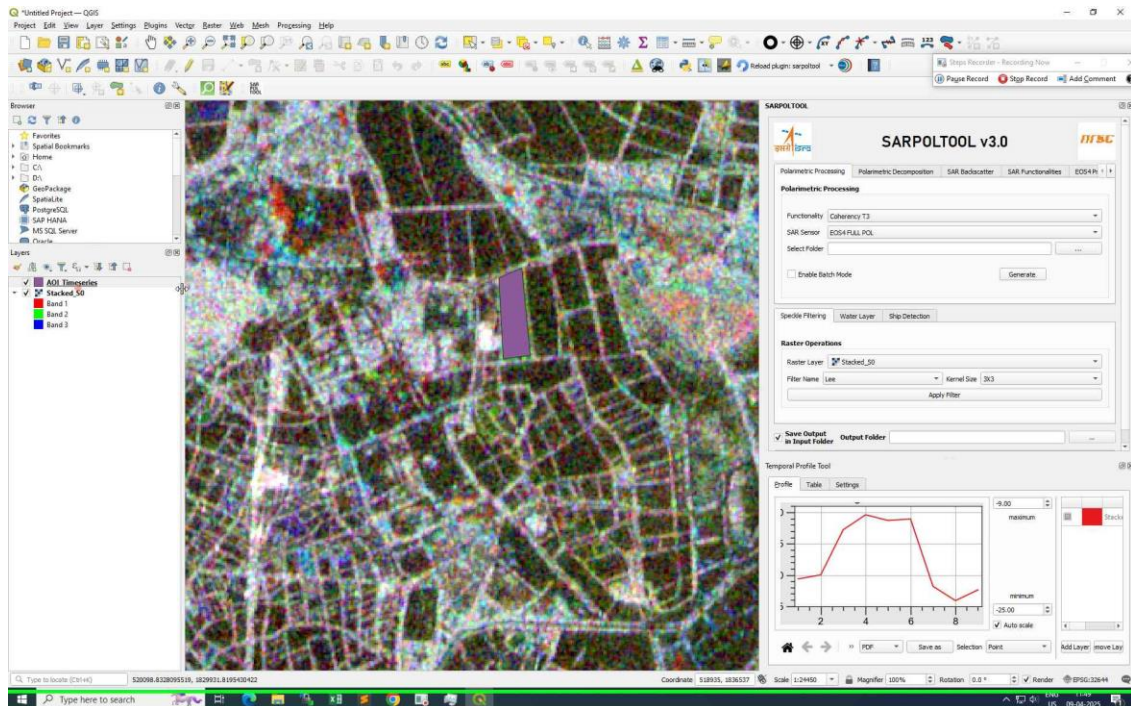
Step 66: (09-04-2025 11:49:13) User mouse wheel down on "*Untitled Project — QGIS" (window)" in "*Untitled Project — QGIS"



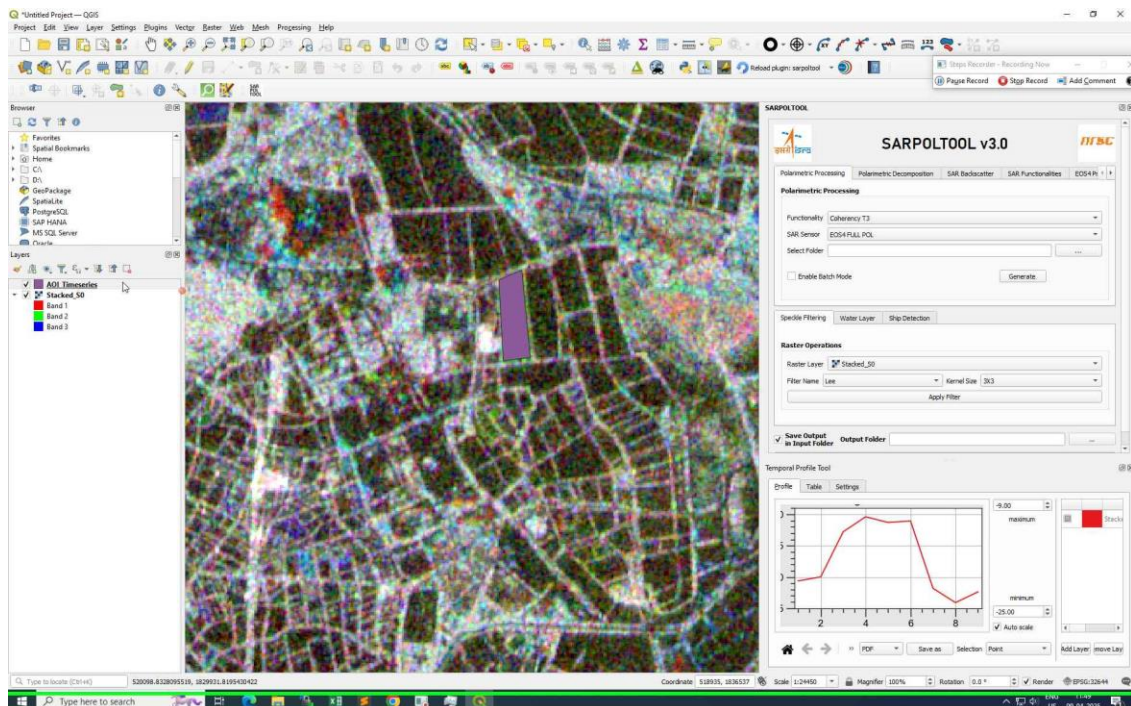
Step 67: (09-04-2025 11:49:51) User mouse drag start on "*Untitled Project — QGIS" (window)" in "*Untitled Project — QGIS"



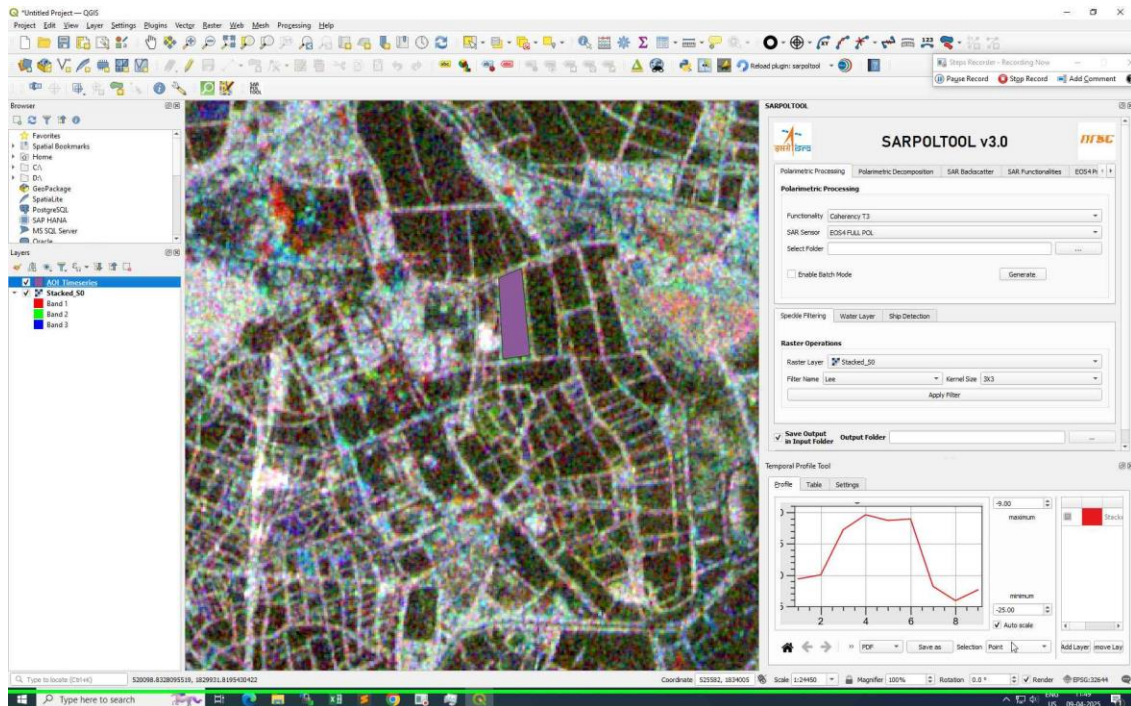
Step 68: (09-04-2025 11:49:52) User mouse drag end on "*Untitled Project — QGIS" (window)" in "*Untitled Project — QGIS"



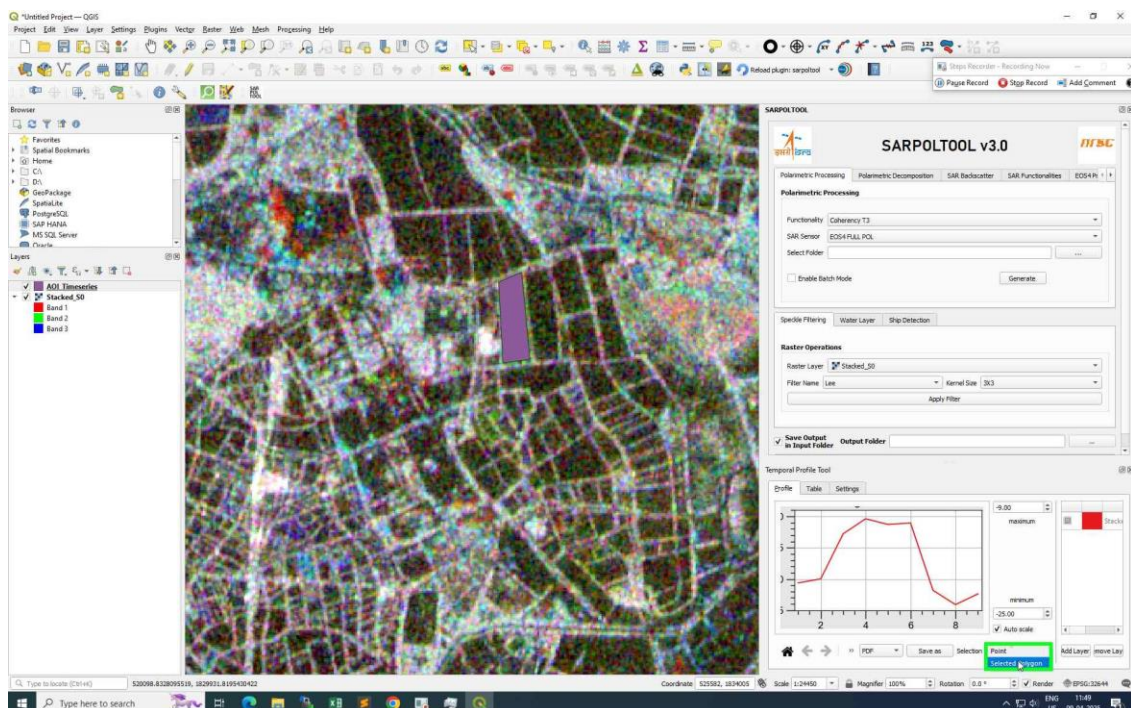
Step 69: (09-04-2025 11:49:52) User left click on "Layers (window)" in "*Untitled Project — QGIS"



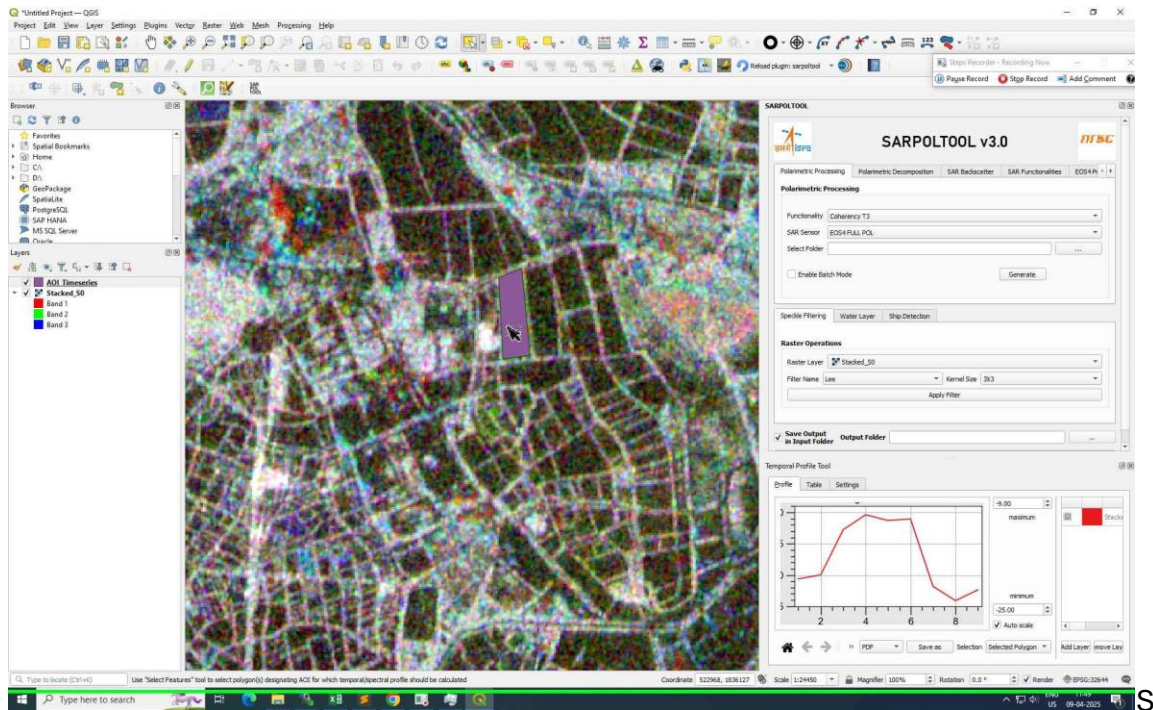
Step 70: (09-04-2025 11:49:55) User left click on "Temporal Profile Tool (window)" in "*Untitled Project — QGIS"



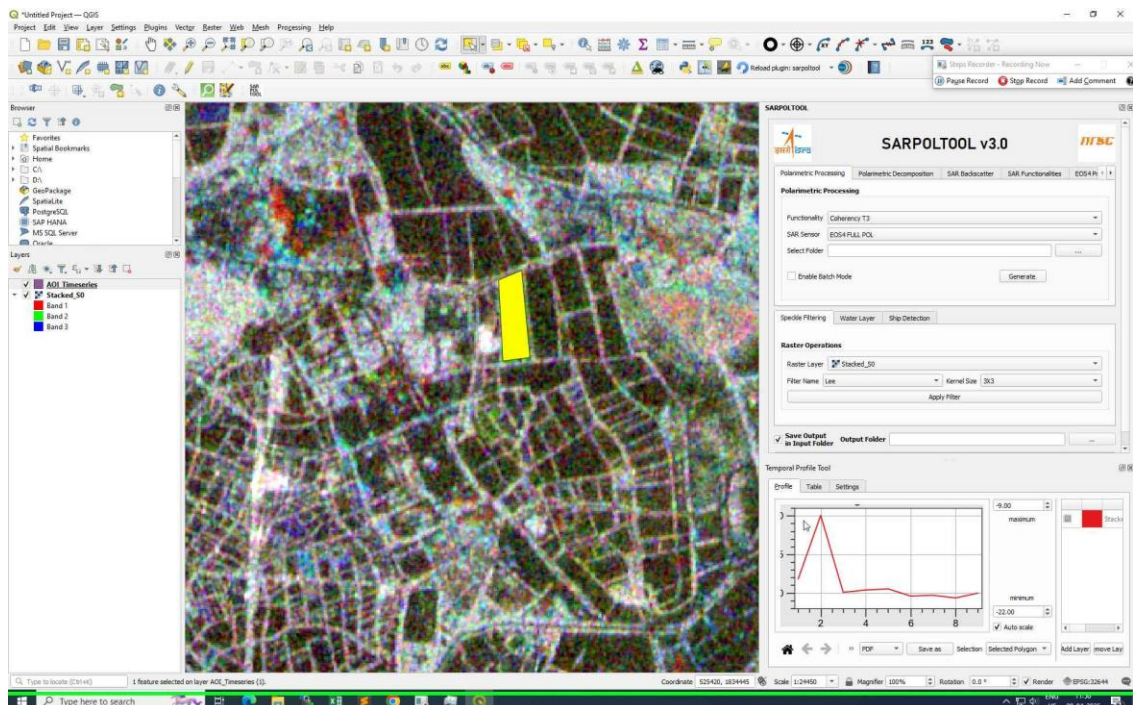
Step 71: (09-04-2025 11:49:56) User left click in "QGIS3"



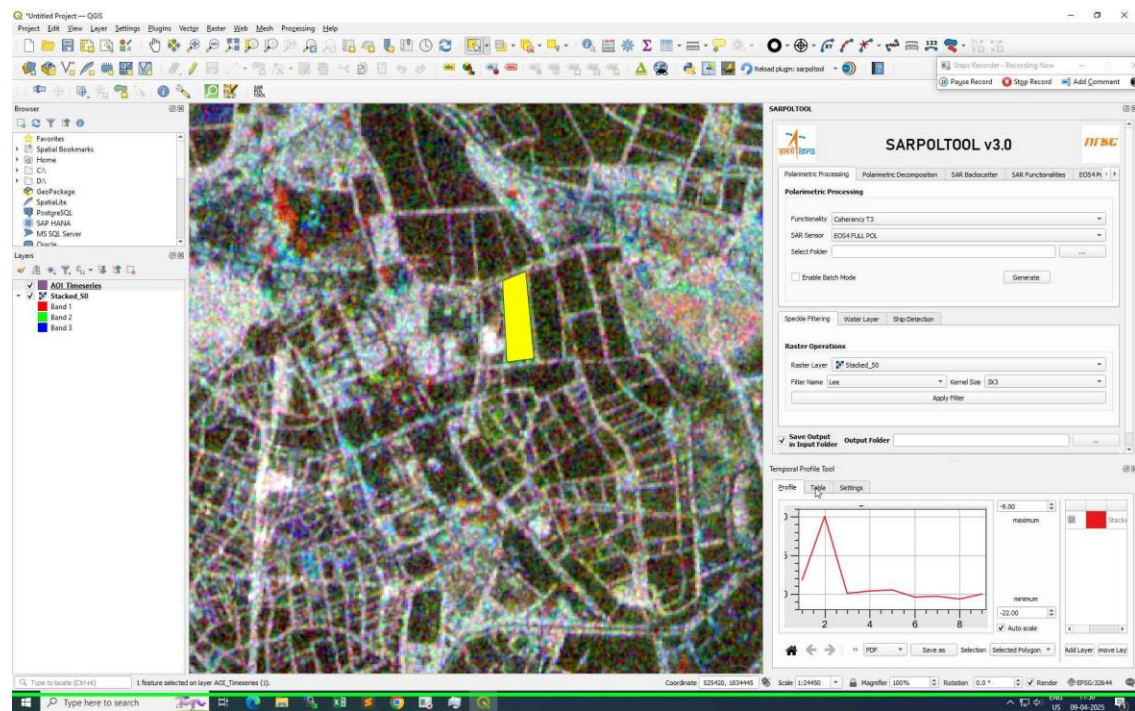
Step 72: (09-04-2025 11:49:57) User left click on "*Untitled Project — QGIS" in "*Untitled Project — QGIS"



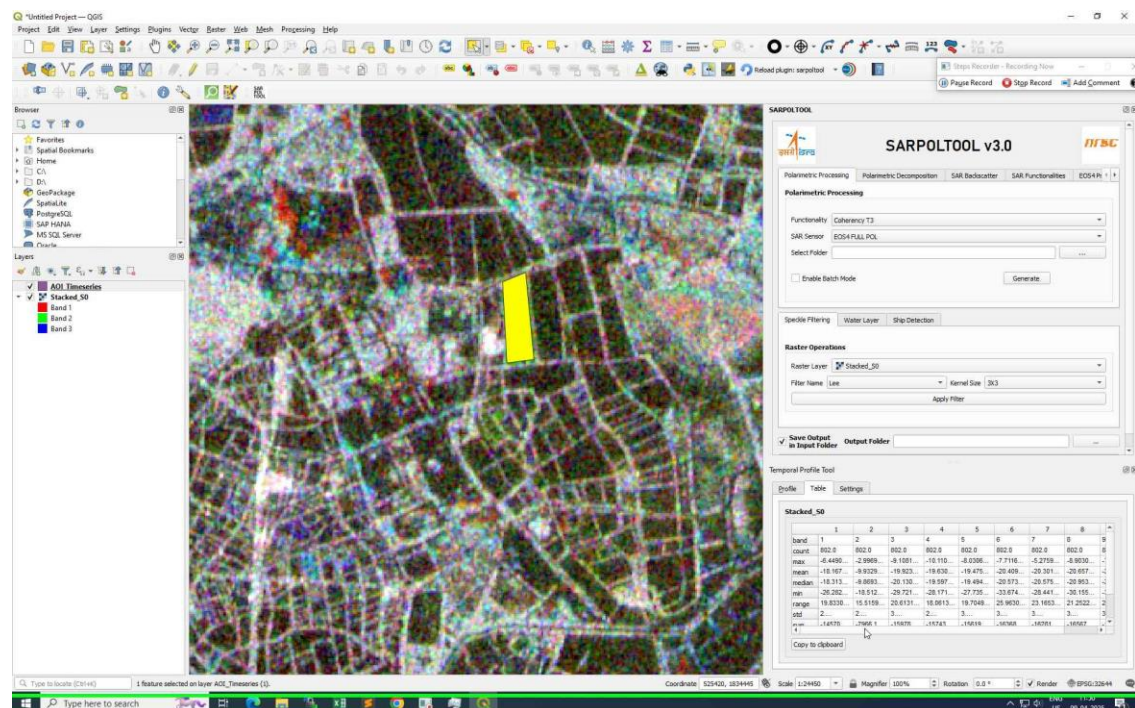
Step 73: (09-04-2025 11:50:03) User left click on "Temporal Profile Tool (window)" in "*Untitled Project — QGIS"



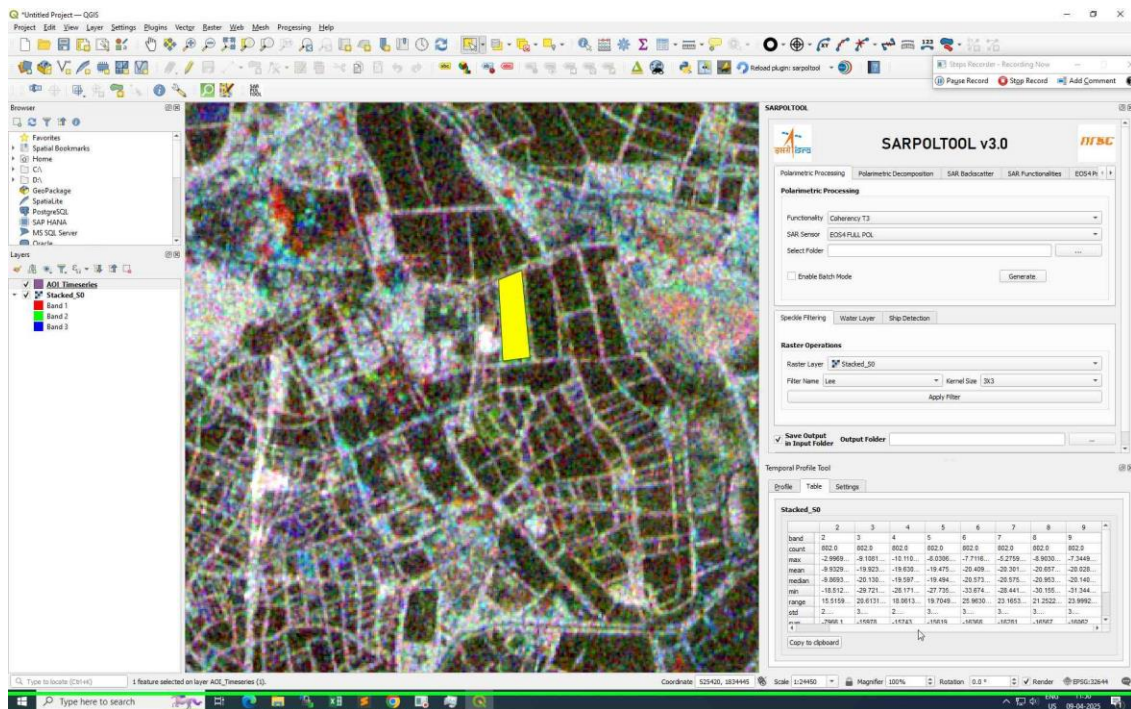
Step 74: (09-04-2025 11:50:05) User left click on "Table (tab item)" in "*Untitled Project — QGIS"



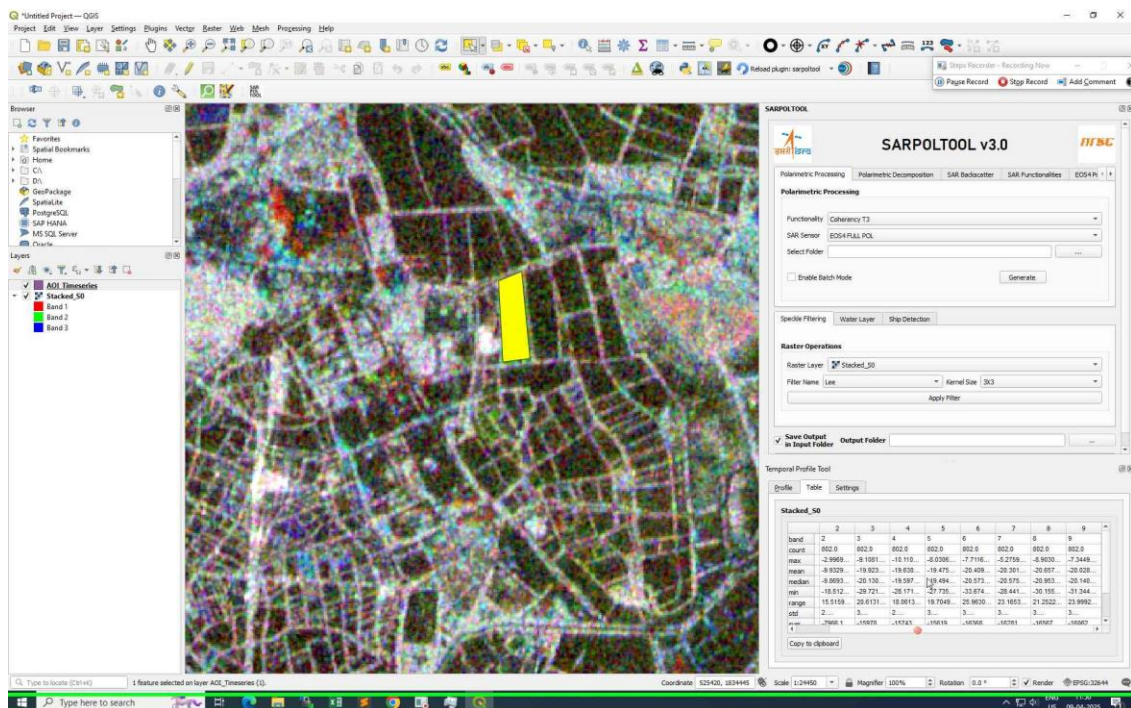
Step 75: (09-04-2025 11:50:07) User mouse drag start in "*Untitled Project — QGIS"



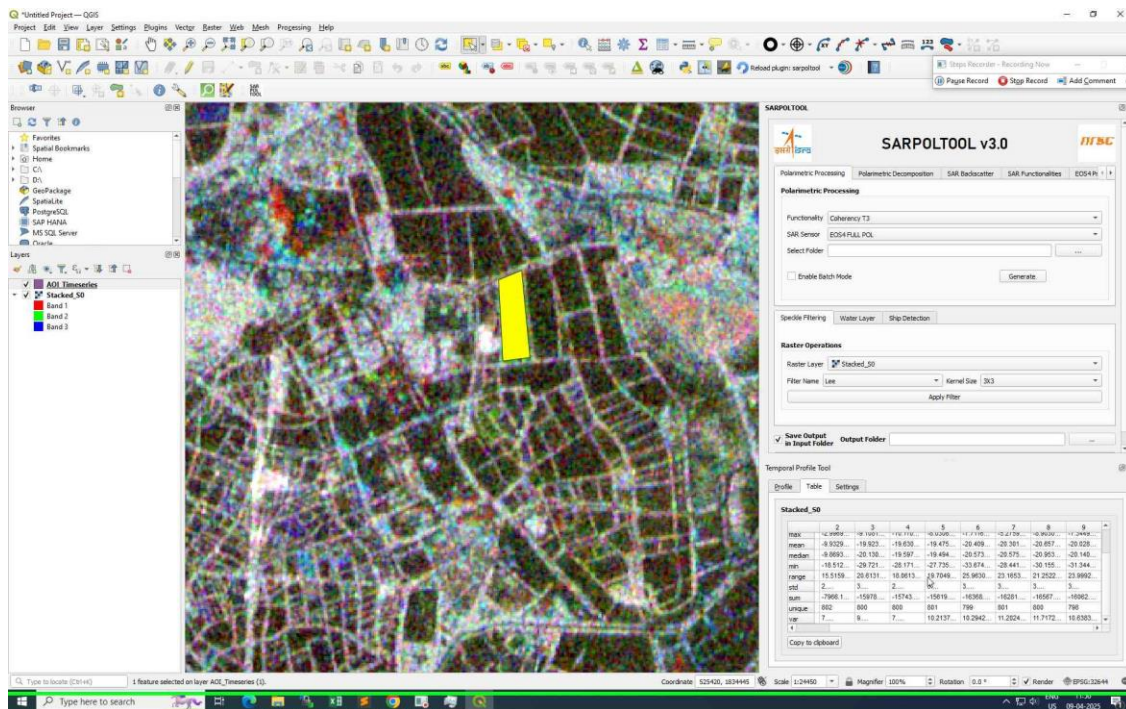
Step 76: (09-04-2025 11:50:09) User mouse drag end in "*Untitled Project — QGIS"



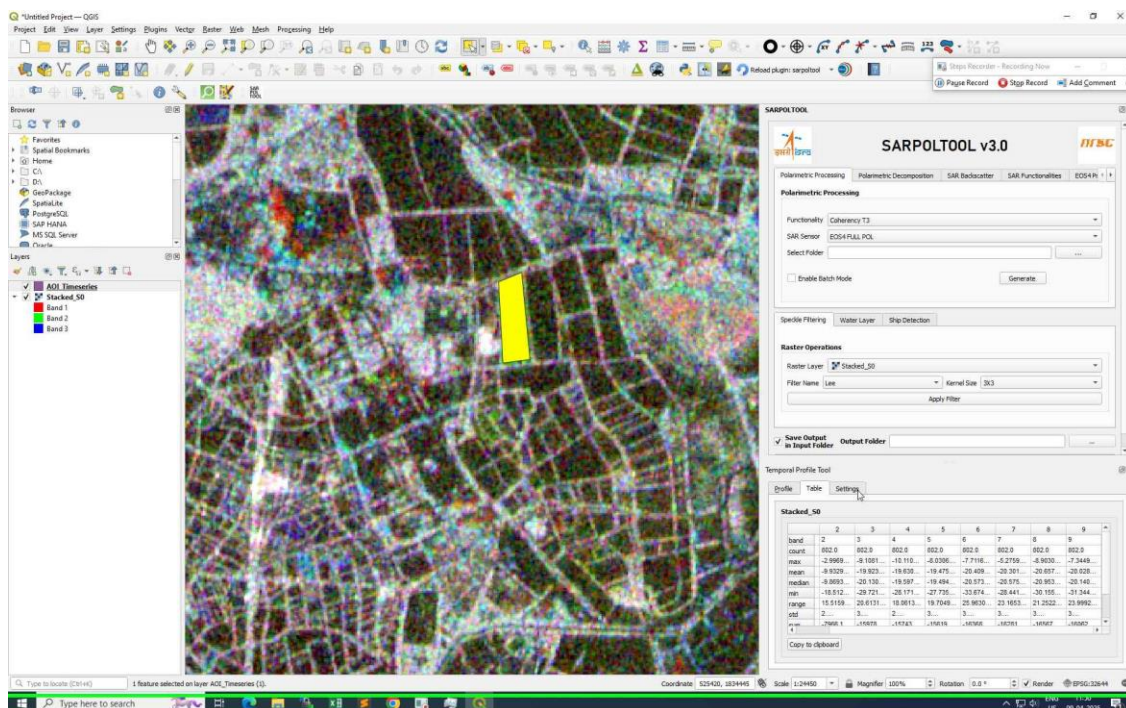
Step 77: (09-04-2025 11:50:10) User mouse wheel down in "*Untitled Project — QGIS"



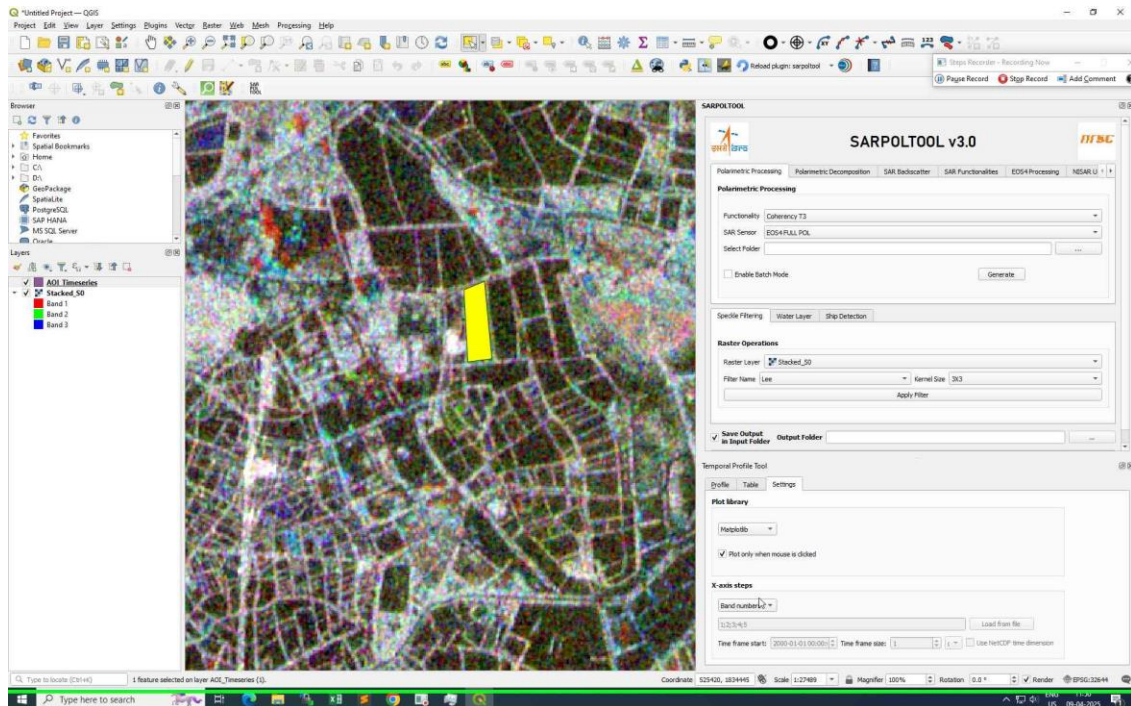
Step 78: (09-04-2025 11:50:11) User mouse wheel up in "*Untitled Project — QGIS"



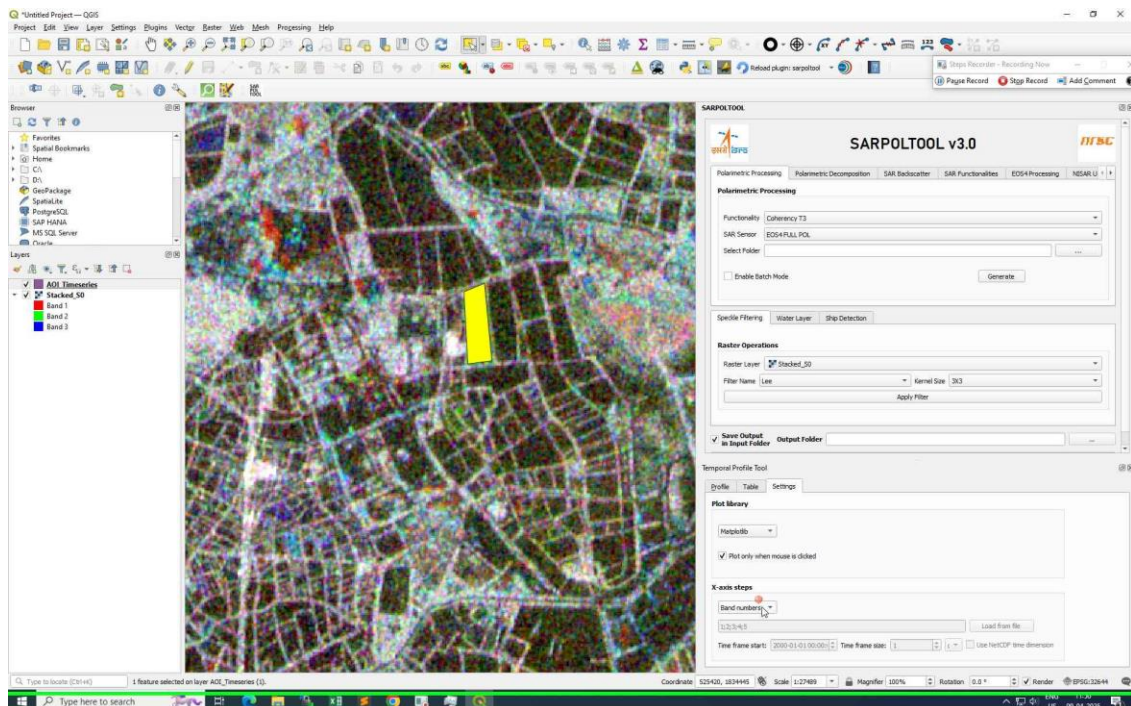
Step 79: (09-04-2025 11:50:15) User left click on "Settings (tab item)" in "*Untitled Project — QGIS"



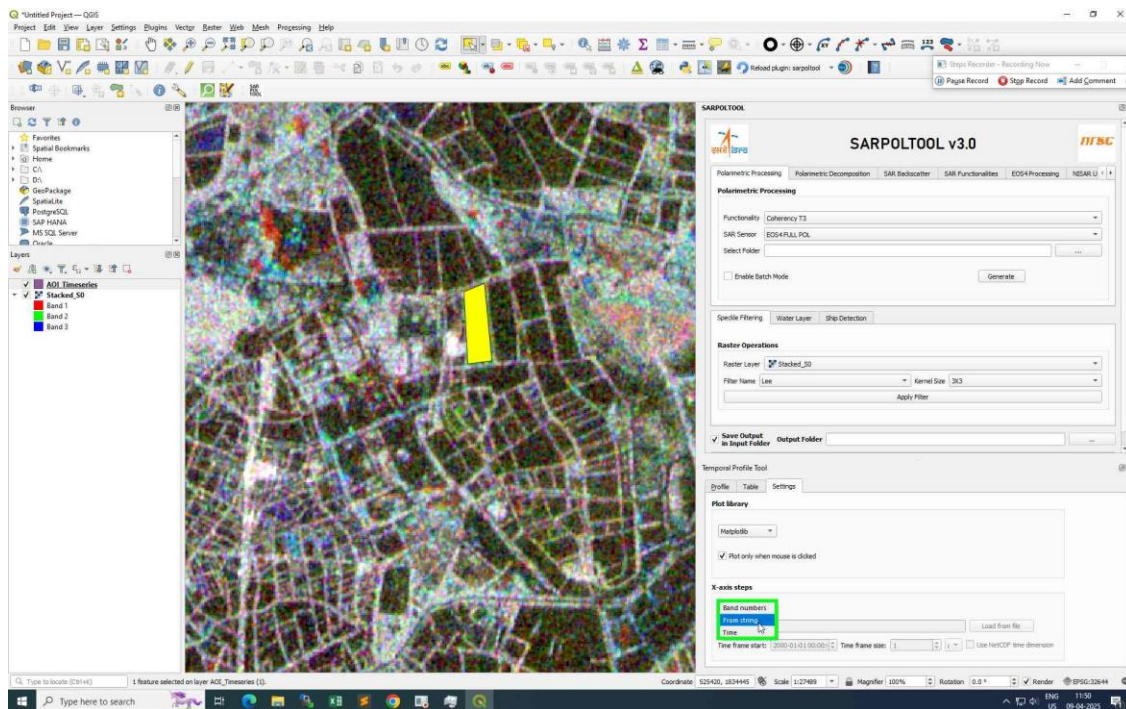
Step 80: (09-04-2025 11:50:18) User left click on "X-axis steps (group)" in "*Untitled Project — QGIS"



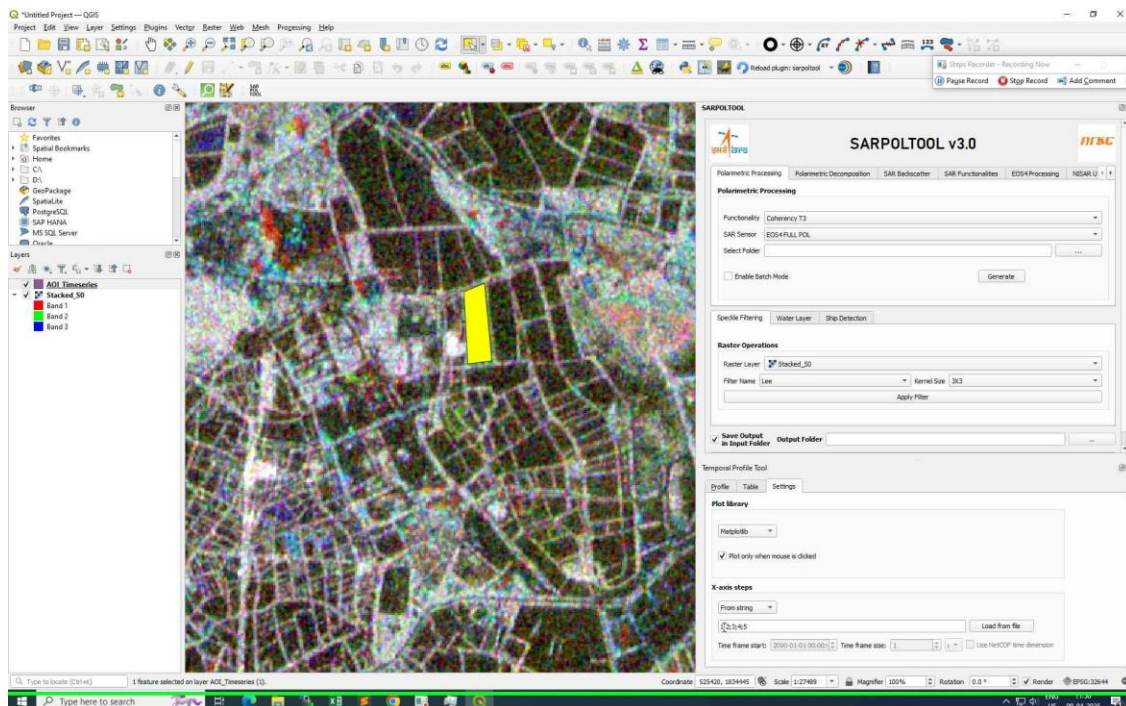
Step 81: (09-04-2025 11:50:19) User left click on "X-axis steps (combo box)" in "*Untitled Project — QGIS"



Step 82: (09-04-2025 11:50:20) User left click in "QGIS3"



Step 83: (09-04-2025 11:50:22) User left click on "X-axis steps (edit)" in "*Untitled Project — QGIS"



References

1. https://bhoonidhi.nrsc.gov.in/bhoonidhi_resources/help/docs/EOS_04_Data_Products_Format_Document.pdf
2. https://bhoonidhi.nrsc.gov.in/bhoonidhi_resources/help/docs/Sentinel-1-Product-Specification.pdf
3. <https://bhoonidhi.nrsc.gov.in/bhoonidhi/index.html>

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✉ Email Address: **feedback_mpsdd@nrsc.gov.in**