

4.1 Generation of Inundation Layer

Computer software for modelling tsunami events called Community Model Interface (ComMIT) has the ability to export data in various formats, which can be used in QGIS. The format selection will depend on whether they are going to be used for other purposes besides the map to be developed. Formats to be integrated into GIS are:

1. KMZ, which can be displayed on the Google Earth platform and then be imported into QGIS.
2. Netted - binary file format for (typically) gridded output, with associated metadata included with the file. ComMIT (and MOST) uses this format internally, but QGIS can read it directly.
3. Asia Raster File - image file information attached to pixel. This file shows an ideal balance between attributes and the display layer.
4. GeoTIFF Raster File - a georeferenced image that can be viewed and converted to vector in QGIS for further analysis. This format is one of the easiest to handle and can support different resolutions in the latitude and longitude-directions.

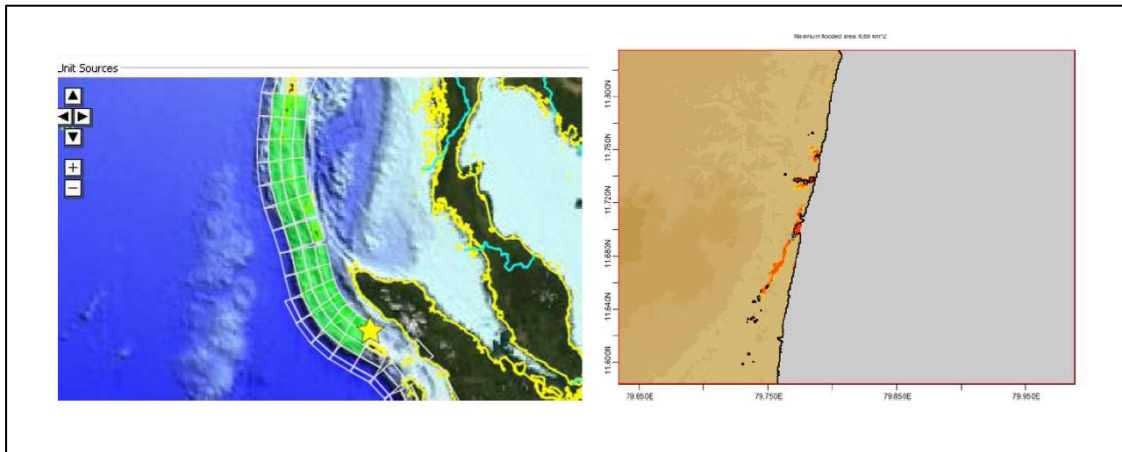
The recommended procedure for saving output for use in creating an inundation map depends on whether the hazard assessment run was using just the Worst-Case Scenario or if several earthquake scenarios were used. In the case of several (or many) scenarios running, a Composite Maximum inundation can be exported, and is perhaps the most used option, but a single scenario can be exported in the same way.

It is recommended that for an evacuation map, the inundation is saved as Flow Depth as opposed to Wave Amplitude using the Composite Maximum Wave feature.

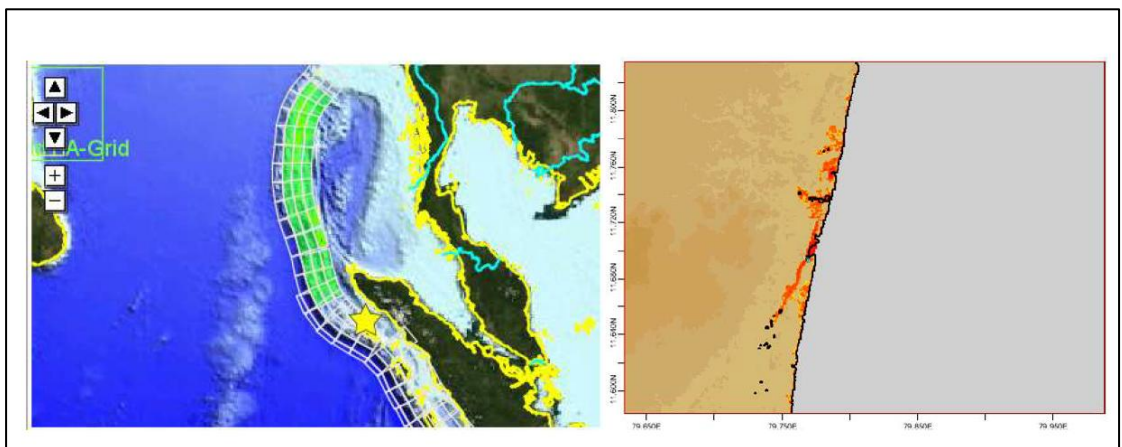
Flow Depth is the water depth flowing over land and is measured as wave amplitude minus altitude. Wave amplitude itself is measured from the reference water level (often Mean Sea Level or Mean High Water). These directions will assume the reader is saving Flow Depth.

1. To export Inundation (Maximum Flow Depth) after running the scenarios in a hazard assessment, the ComMIT user selects "Model-Create Composite Wave file" The following dialogue (right side) then allows the user to select which Model Runs to use in the composite (or to simply use one, for a Worst Case Scenario):
 - As Example consider a hazard assessment consisting of two sources around Cuddalore, southeast coast of India each with different maximum flow depth:

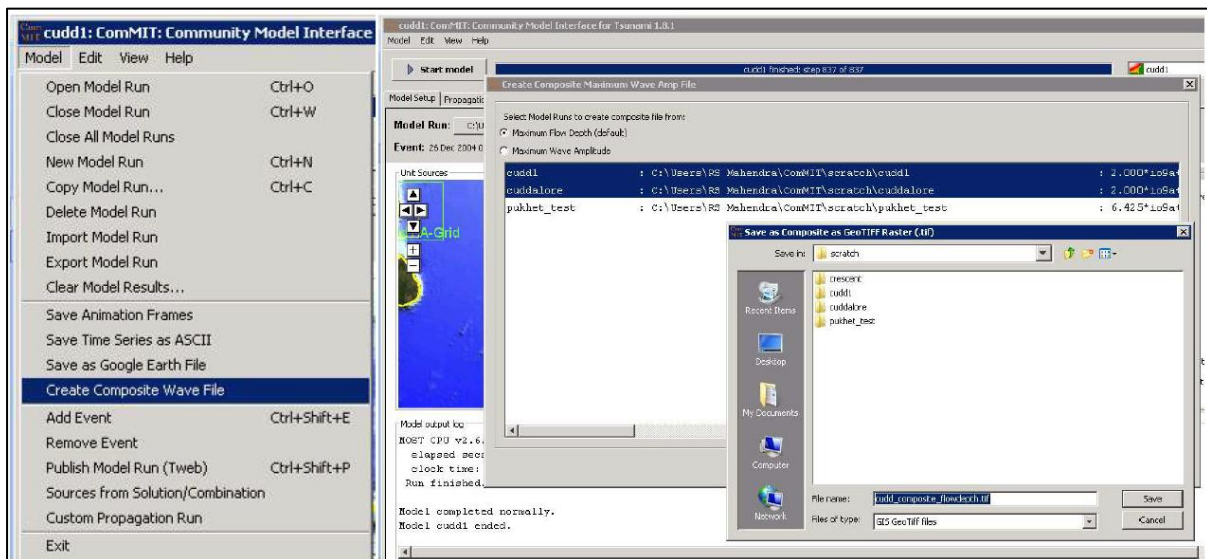
- Scenario 1:




- Scenario 2:

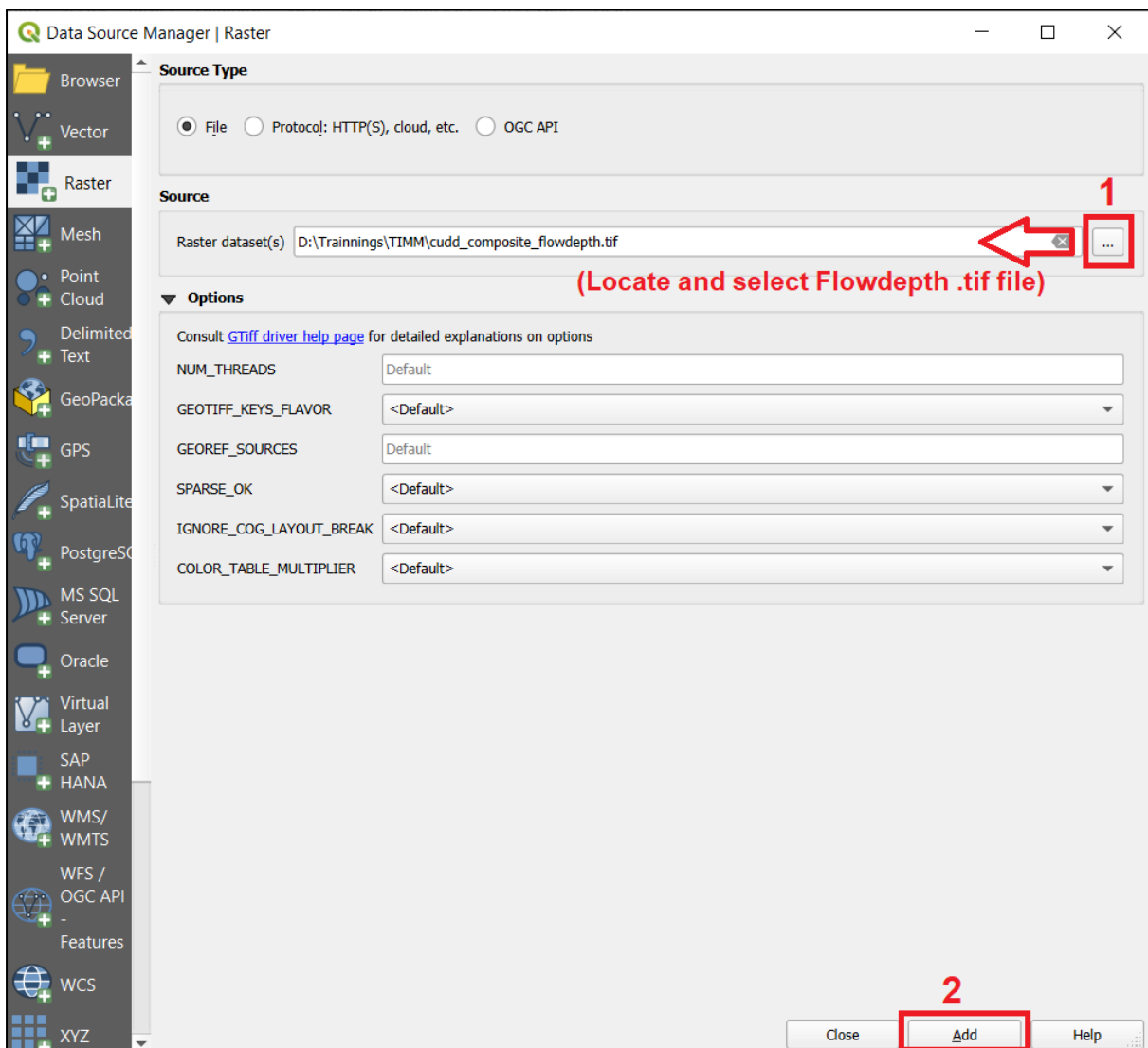
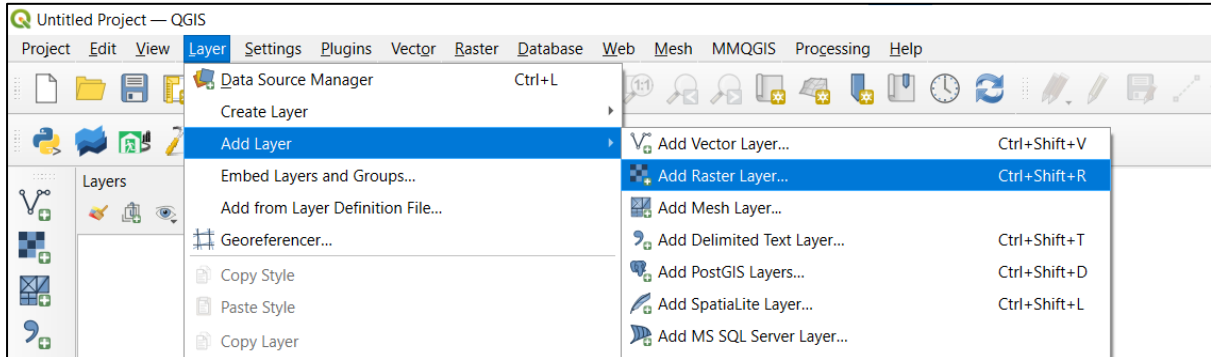


2. The resulting GeoTIFF file "cudd_composite_flowdepth.tif" is saved (by default) in the "ComMIT/scratch" folder, and can be directly imported into QGIS for processing by steps mentioned below:

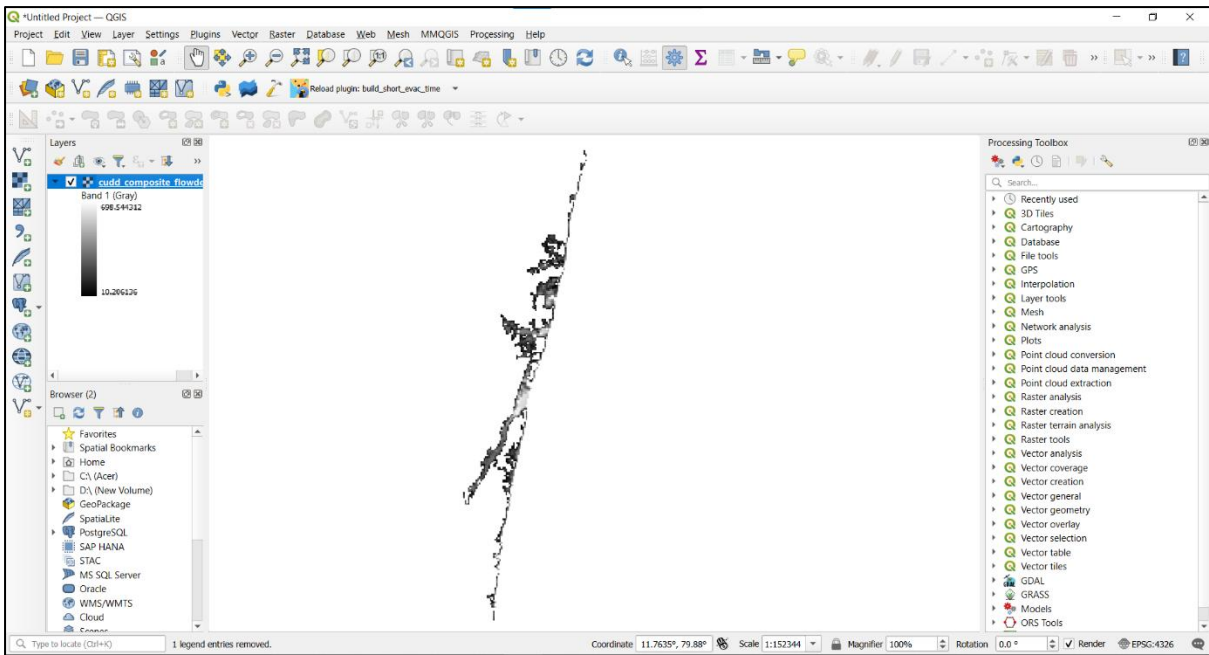


- Open QGIS → Layers → Add Layer → Add Raster Layer.. → Click on browse button

by clicking on this icon  → go to the flowdepth .tif file directory → select .tif file → Add

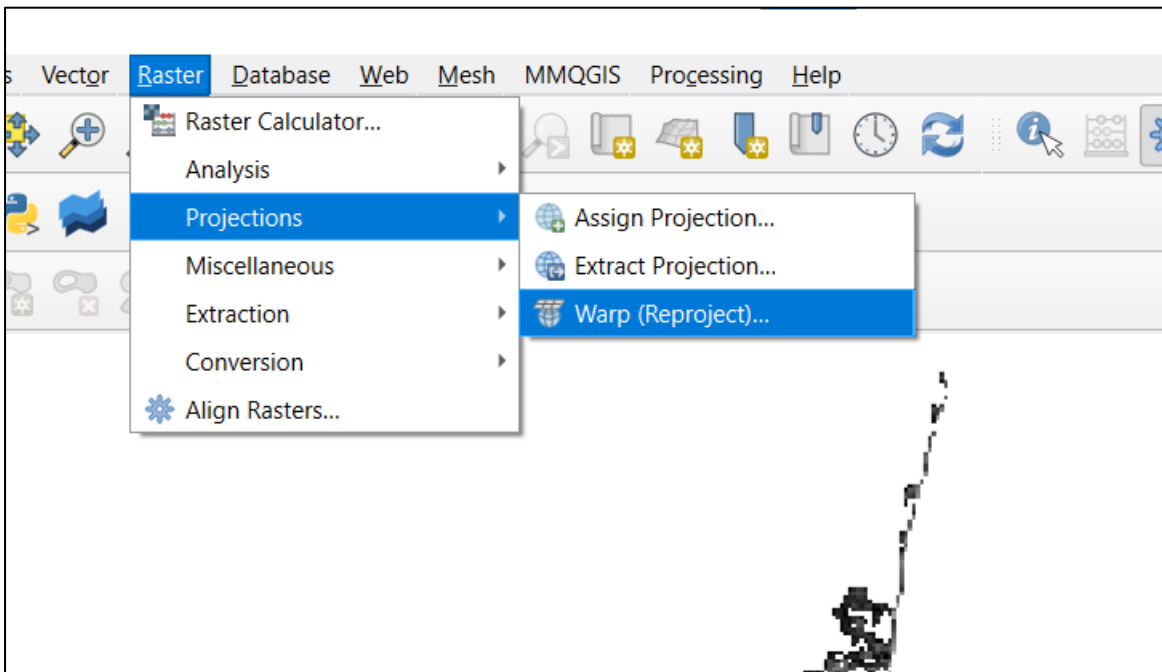


3. Raster depicting the Tsunami Inundation areas is displayed in the QGIS viewer

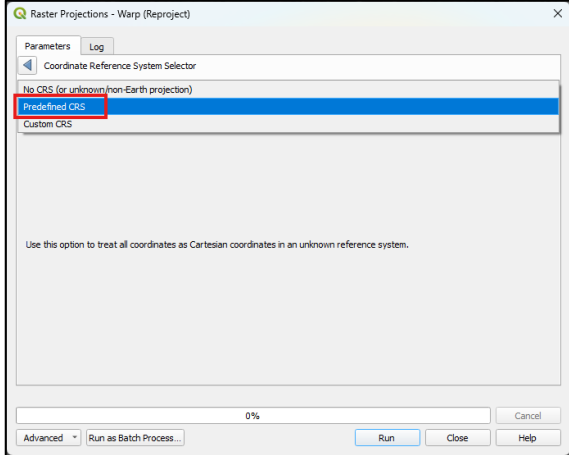
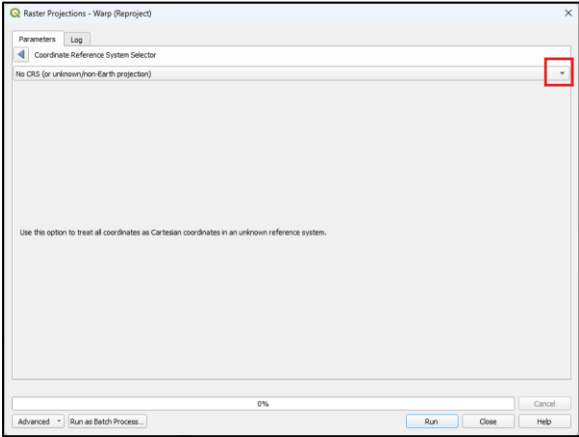
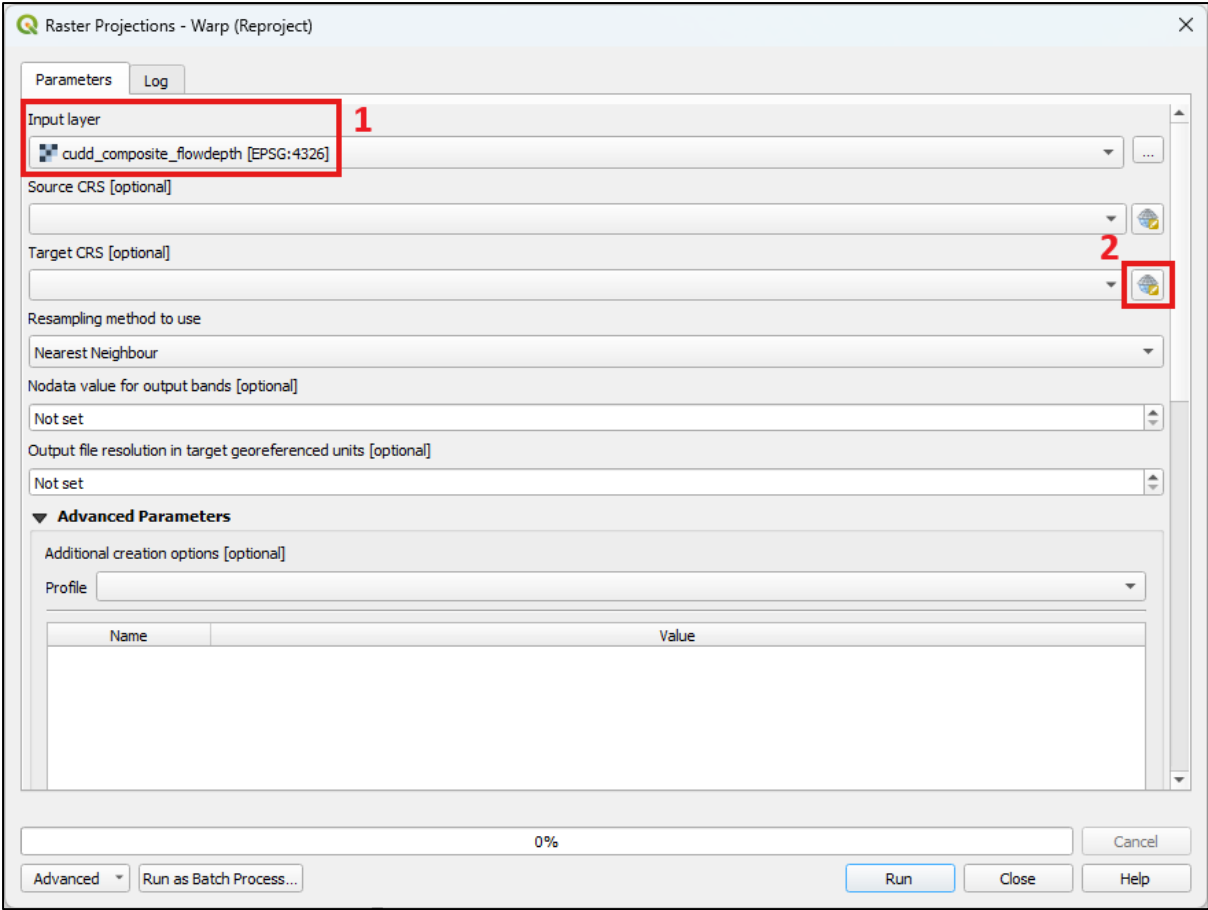


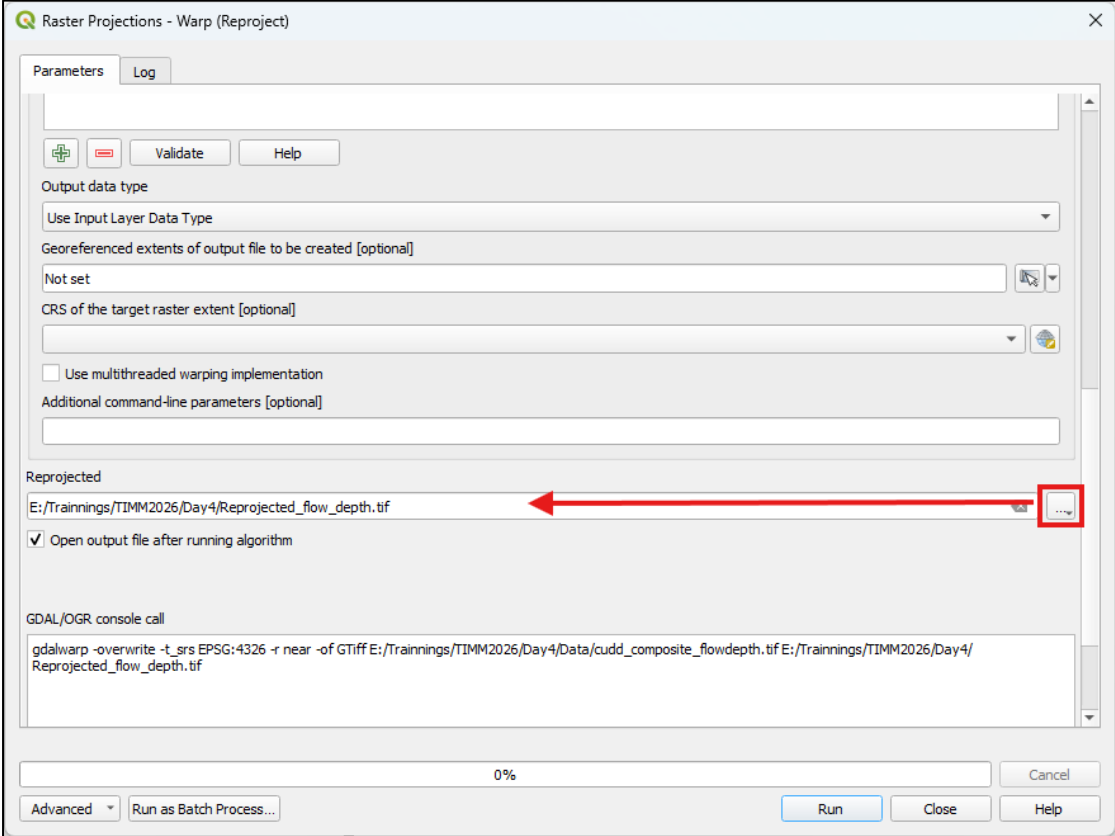
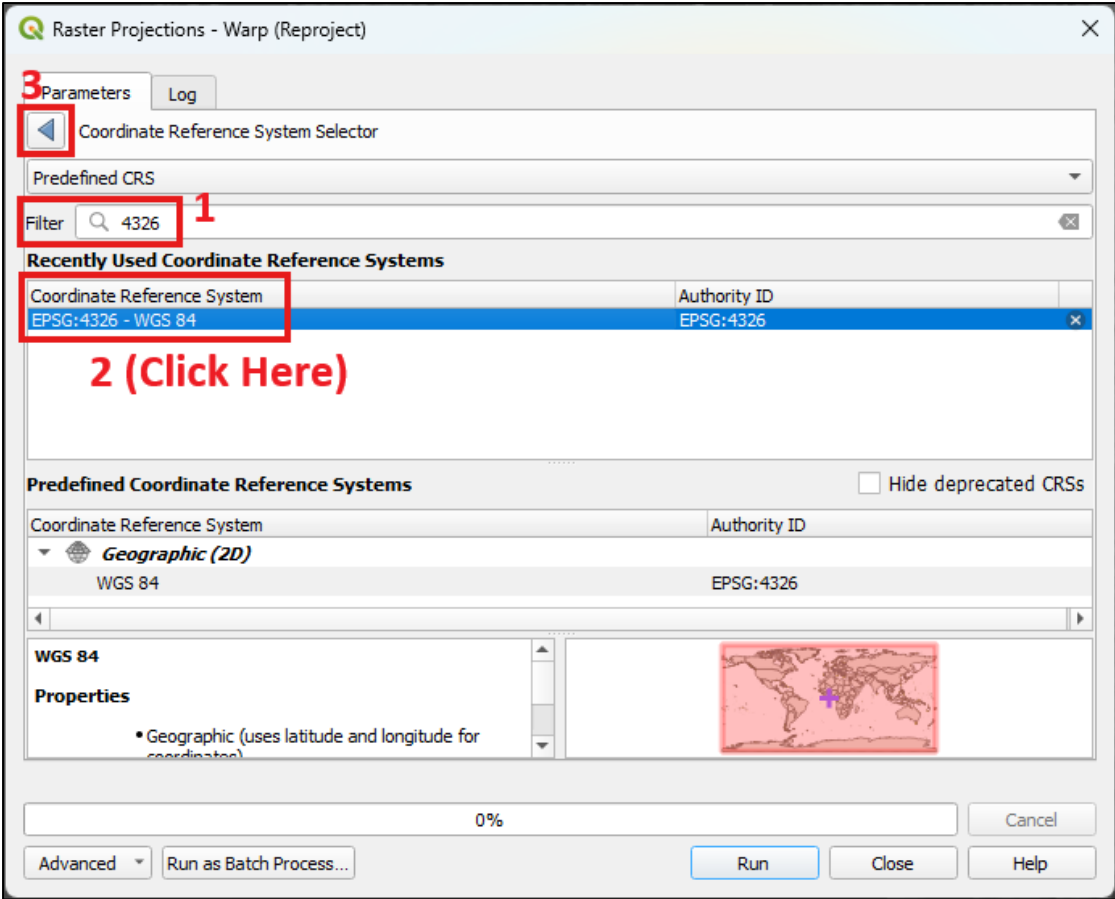
4. Image Wrap:

- Reproject the image to the coordinate system in which the map is being developed and worked. This step is very important because ComMIT contains the WGS -84 projection in this direction and many applications may experience problems when making projections with automatic coordinates.
- Go to Raster → Projections → Warp (Reproject)...



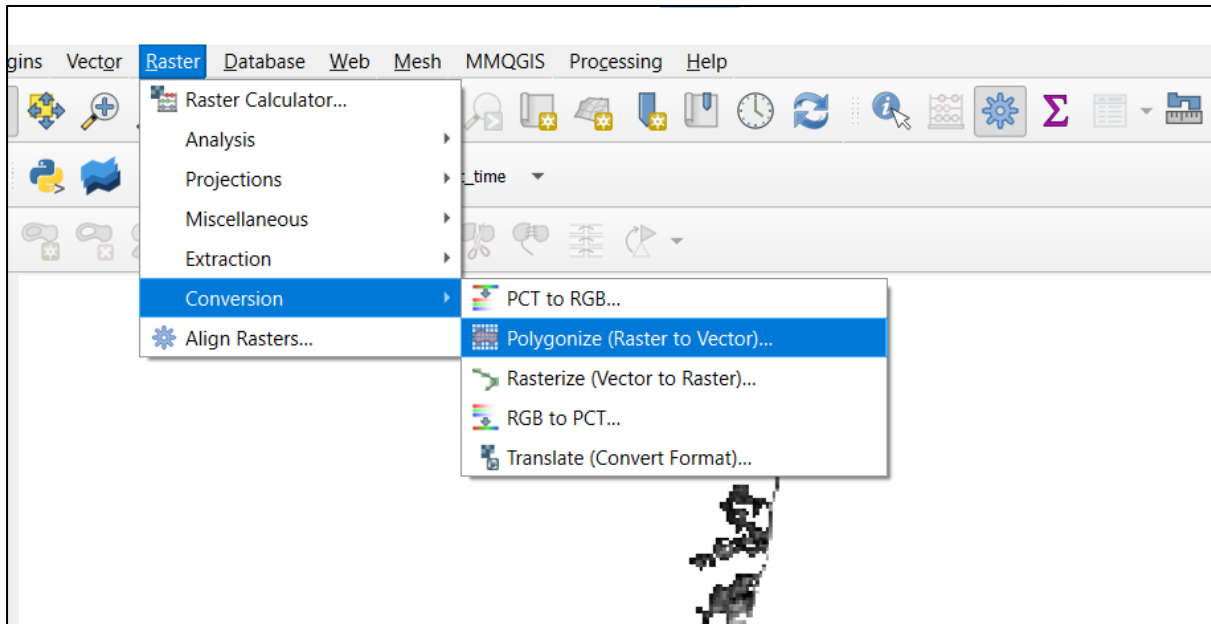
- The following dialog appears keep blank as source CRS, target CRS as EPSG: 4326-WGS 84 as given in the following. Enter the output file name as reproject.tif



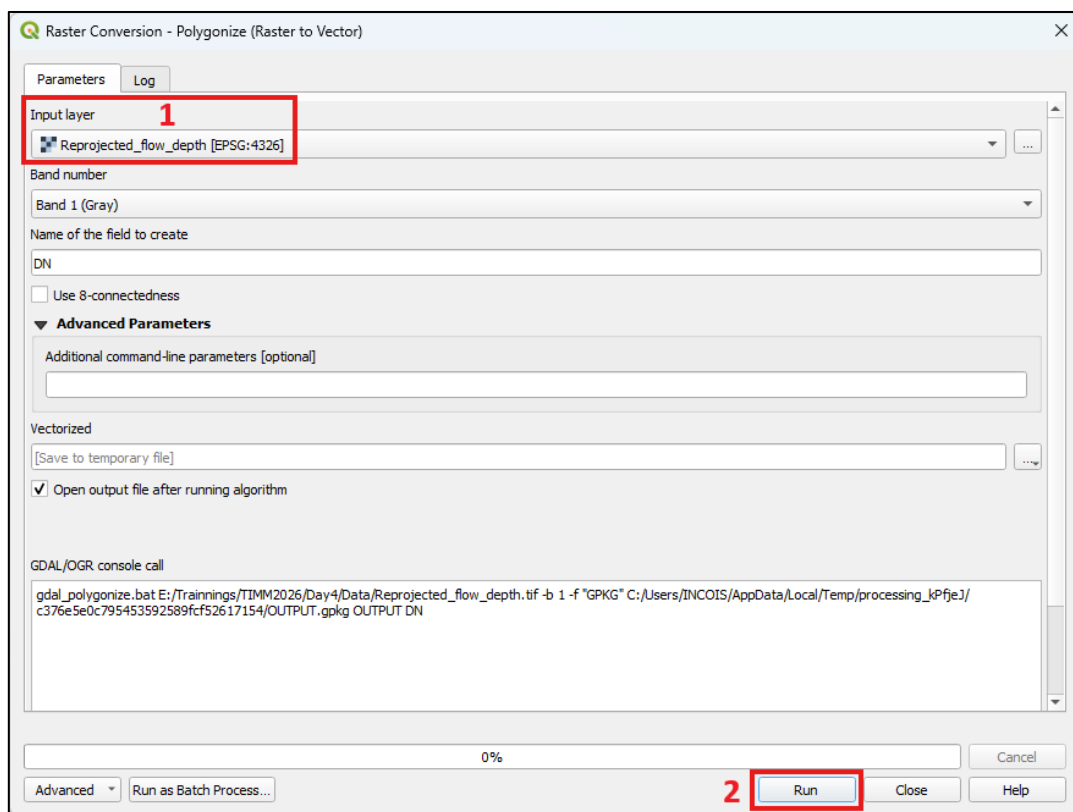


5. Raster to Vector Conversion:

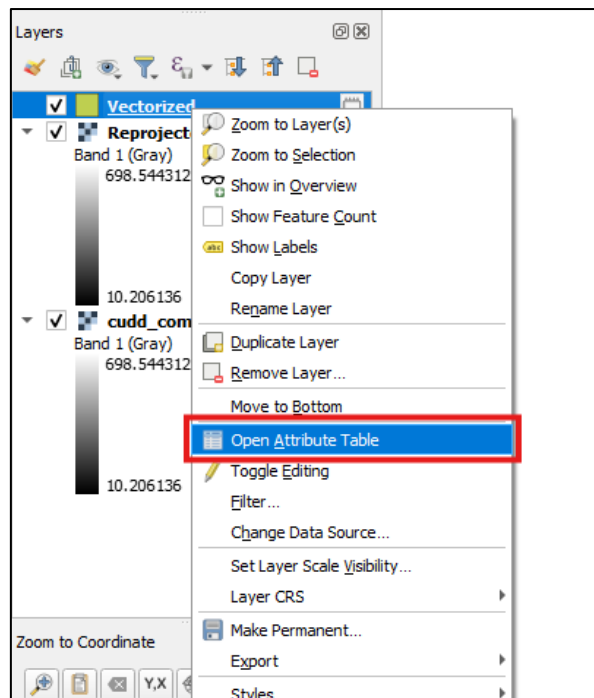
- Select the new file reproject.tif to start with the information development.
- Raster → Conversion → Select the option "Raster, Conversion, Polygonize (Raster to Vector)".




- Make sure the input file "reproject.tif" is selected, then select "DN" in the field. Then run the vector file that corresponds to the flow depth is created.



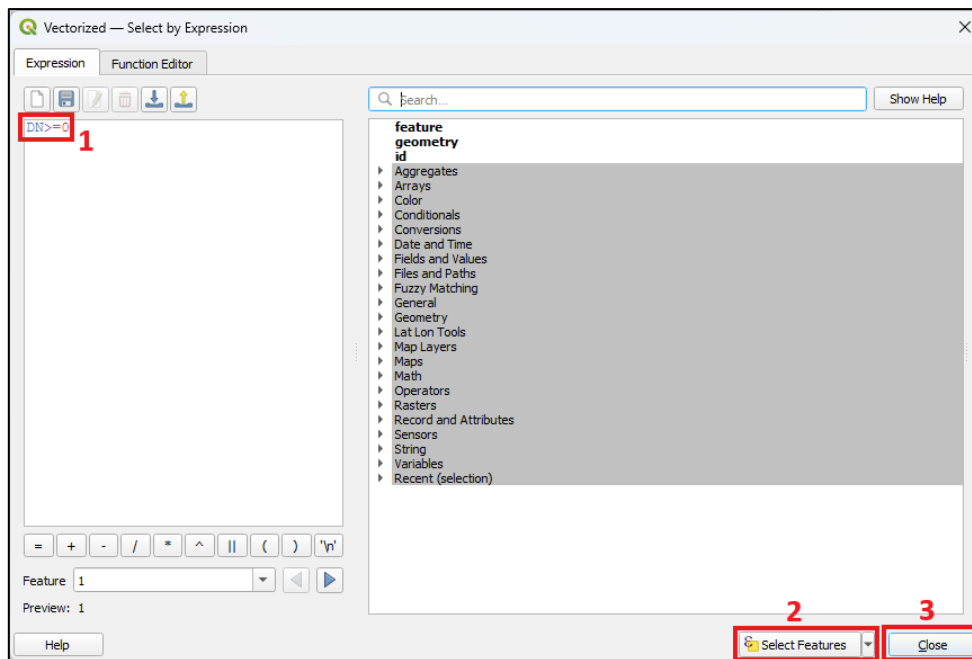
6. We must retain the inundation areas as the flow depth values (DN values here) are greater than zero. The DN values zero are the areas outside the inundation, hence we have to remove the zero values in the vector. To do this we have to open the attribute table of the Vectorized.shp by right clicking on the layer select open attribute table as shown below.



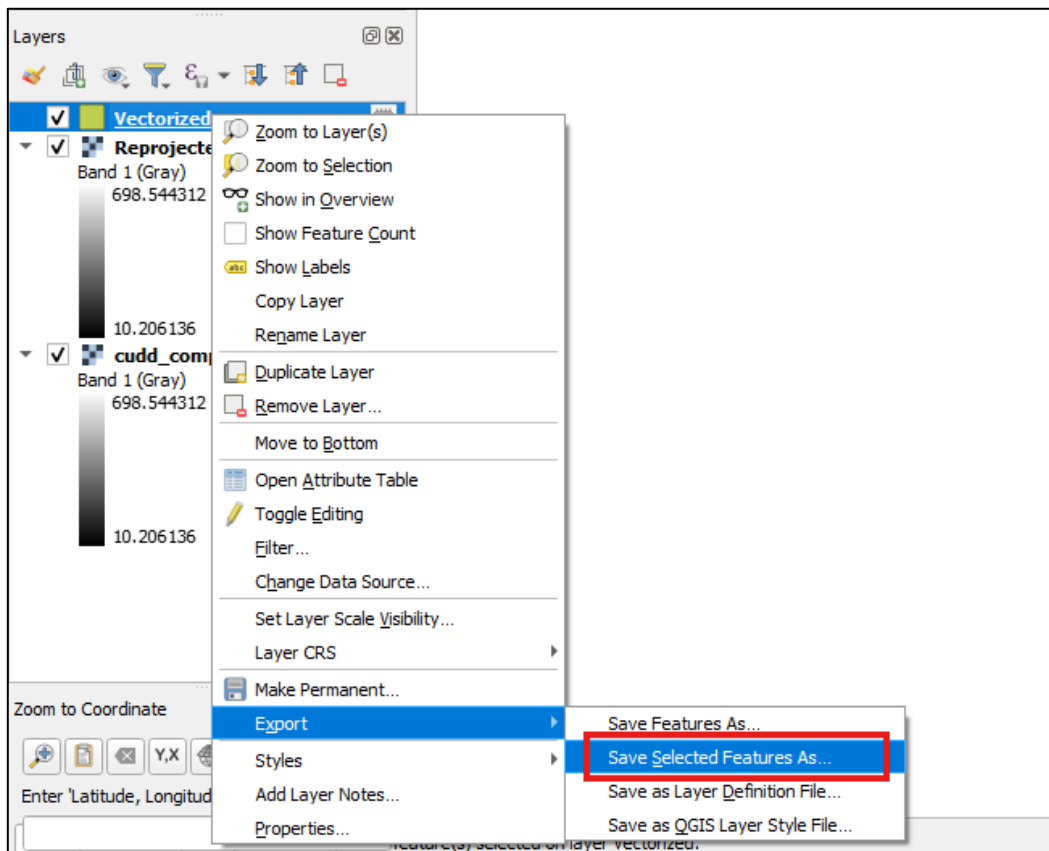
- Select the tool "Select feature by expression" () and type $DN \geq 0$ and select

The screenshot shows the QGIS attribute table for the 'Vectorized' layer. The table has two columns: 'fid' and 'DN'. The 'fid' column is highlighted with a green box. The 'Select feature by expression' tool icon in the toolbar is highlighted with a red box. The table contains 14 rows of data.

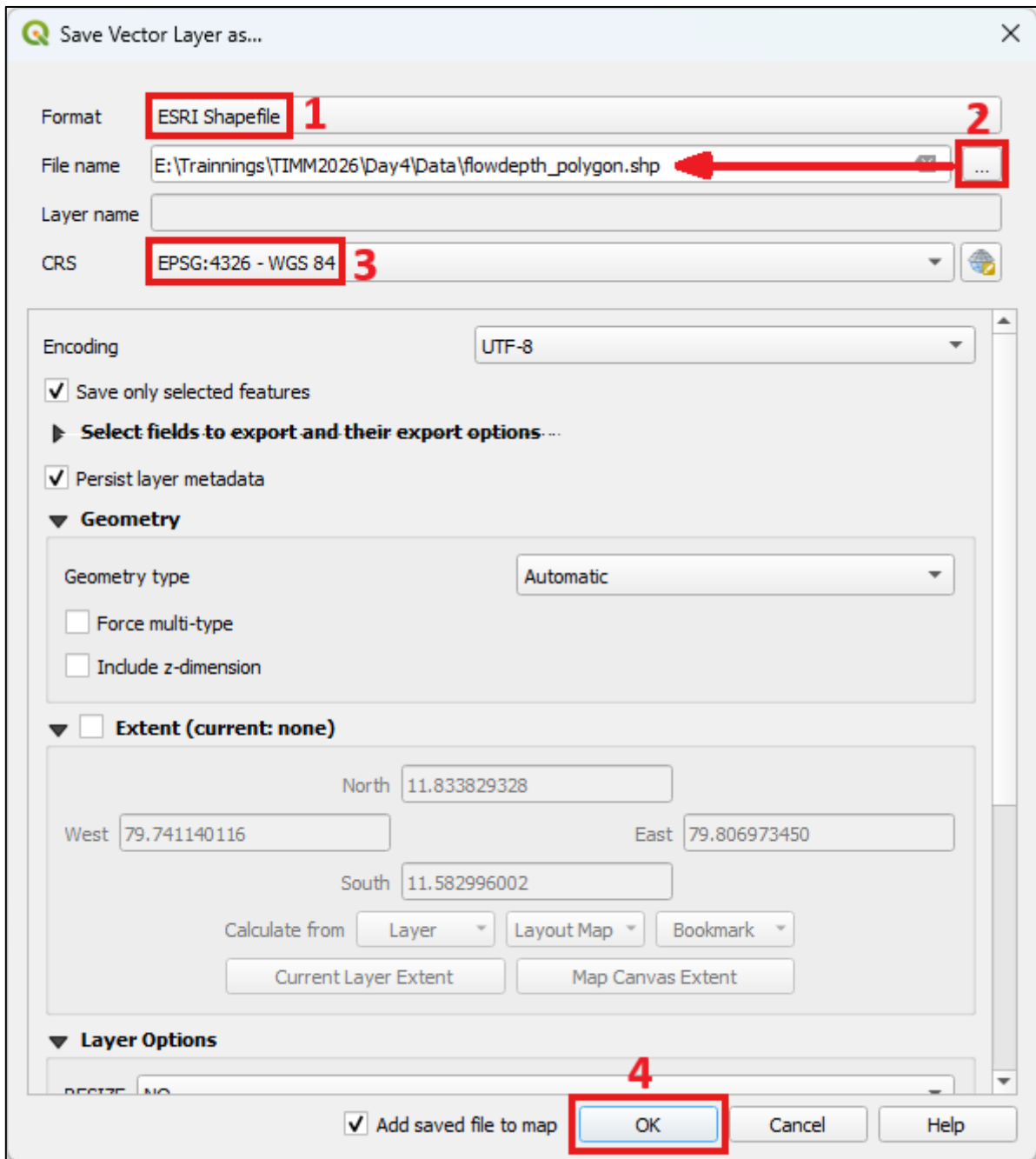
	fid	DN
1	1	76
2	2	168
3	3	13
4	4	270
5	5	180
6	6	182
7	7	21
8	8	156
9	9	202
10	10	145
11	11	326
12	12	129
13	13	171
14	14	51



- All the features having DN value greater than or equal to zero will be selected
7. Save the selected features into new shape file by right click on Vectorized.shp select export-save selected feature as vector.shp in the working folder.

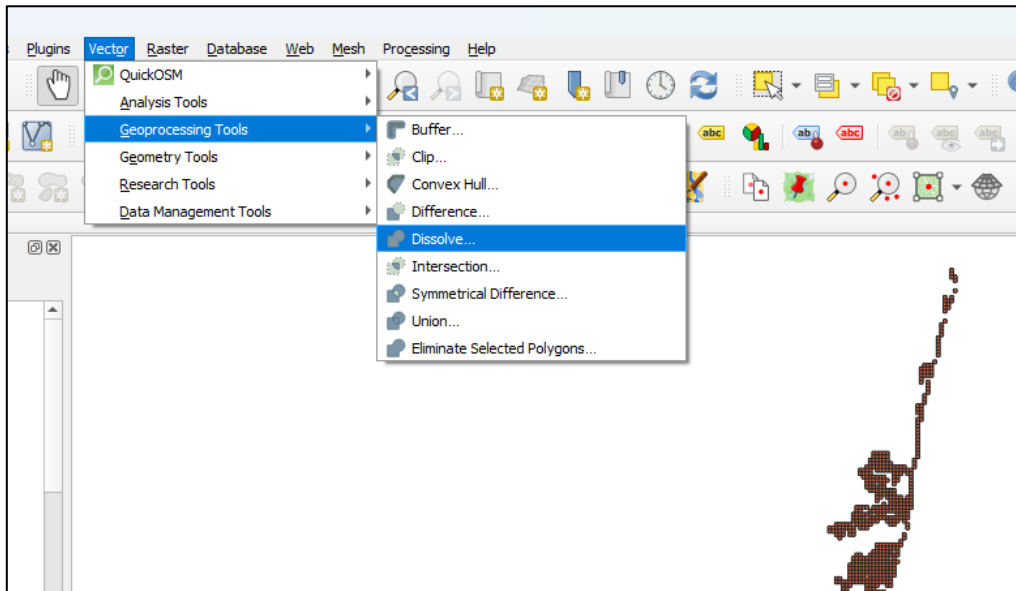


- Following dialog will open and enter new file name and don't forget to select "Save only selected"
- features" and select format as "ESRI Shapefile, give output file name as flowdepth_polygons.shp and click ok.

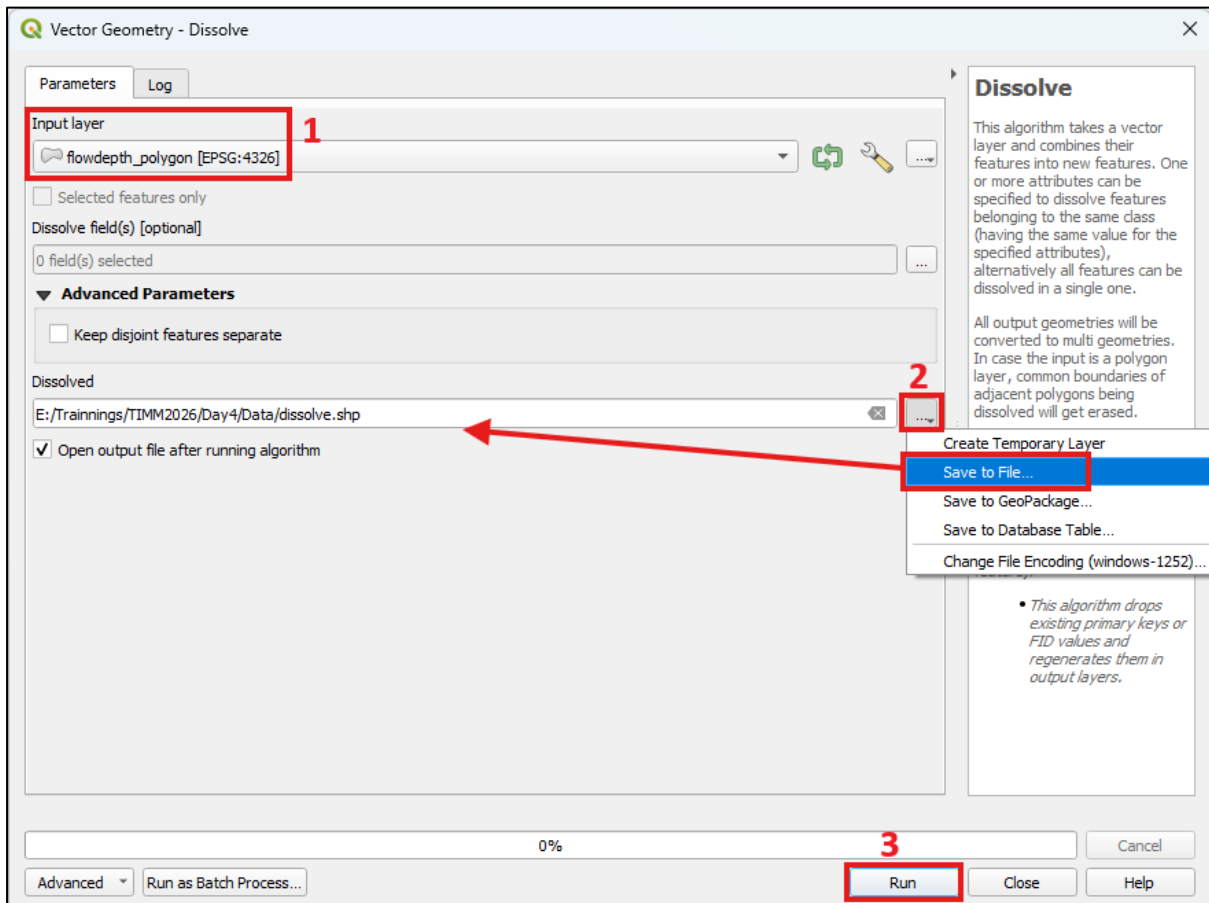


8. Dissolve: The vector.shp is representing the grids similar to image. In order to have extent of inundation we have to dissolve this vector.shp file in order to make single polygon i.e. single feature value.

- The vectorized polygons floodplain proceed to perform the bonding process polygons known as "Dissolve" Then choose. In this process there will only be clean polygons which indicates to the limits of tsunami inundation extent. This is a rather complicated process and depending on the type computers or computer can take up to hours depending on the extent of the area to develop the map.
- Go to vector-Geoprocessing Tools- Dissolve

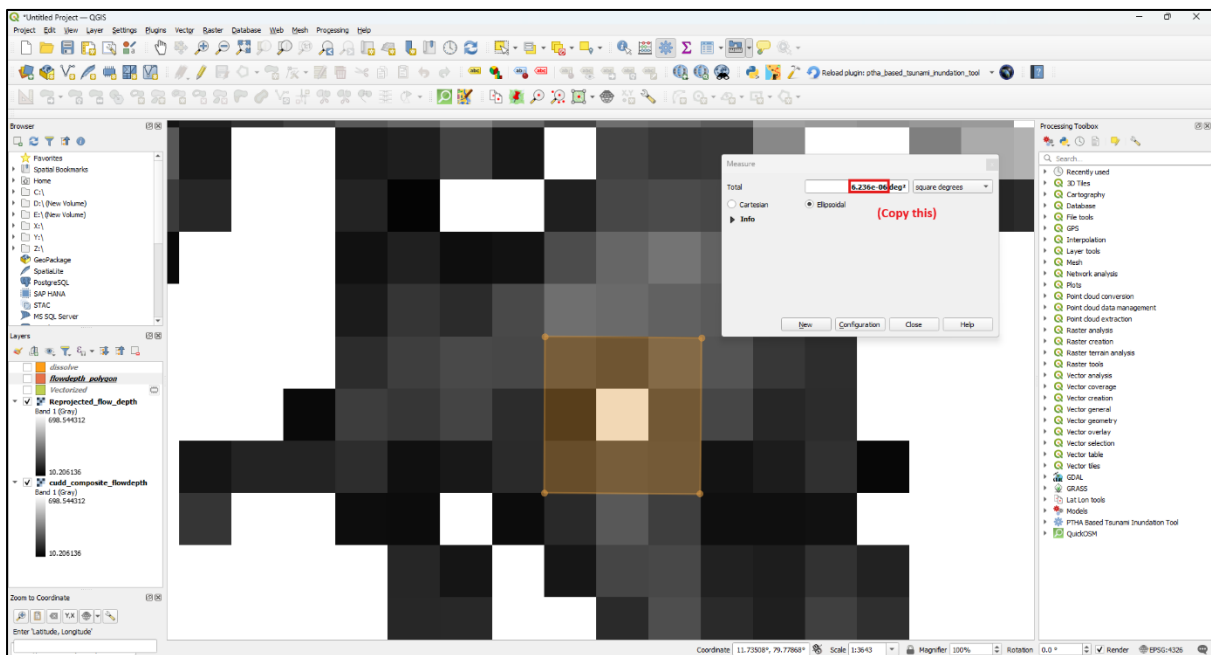
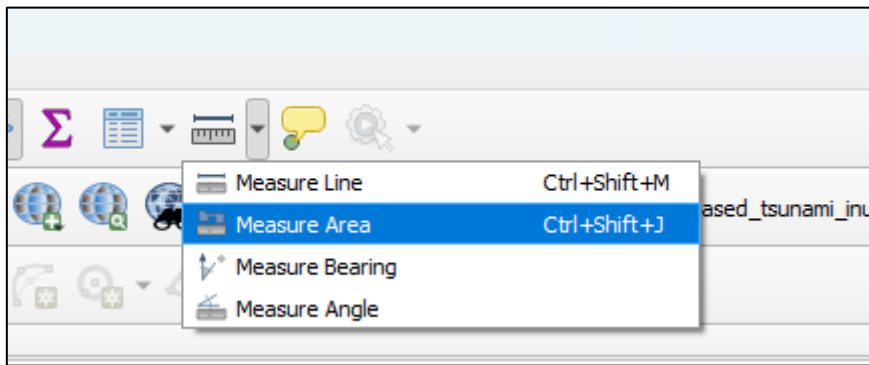


- Then the following dialog appears give out put file name as dissolve.sho then click on Run.

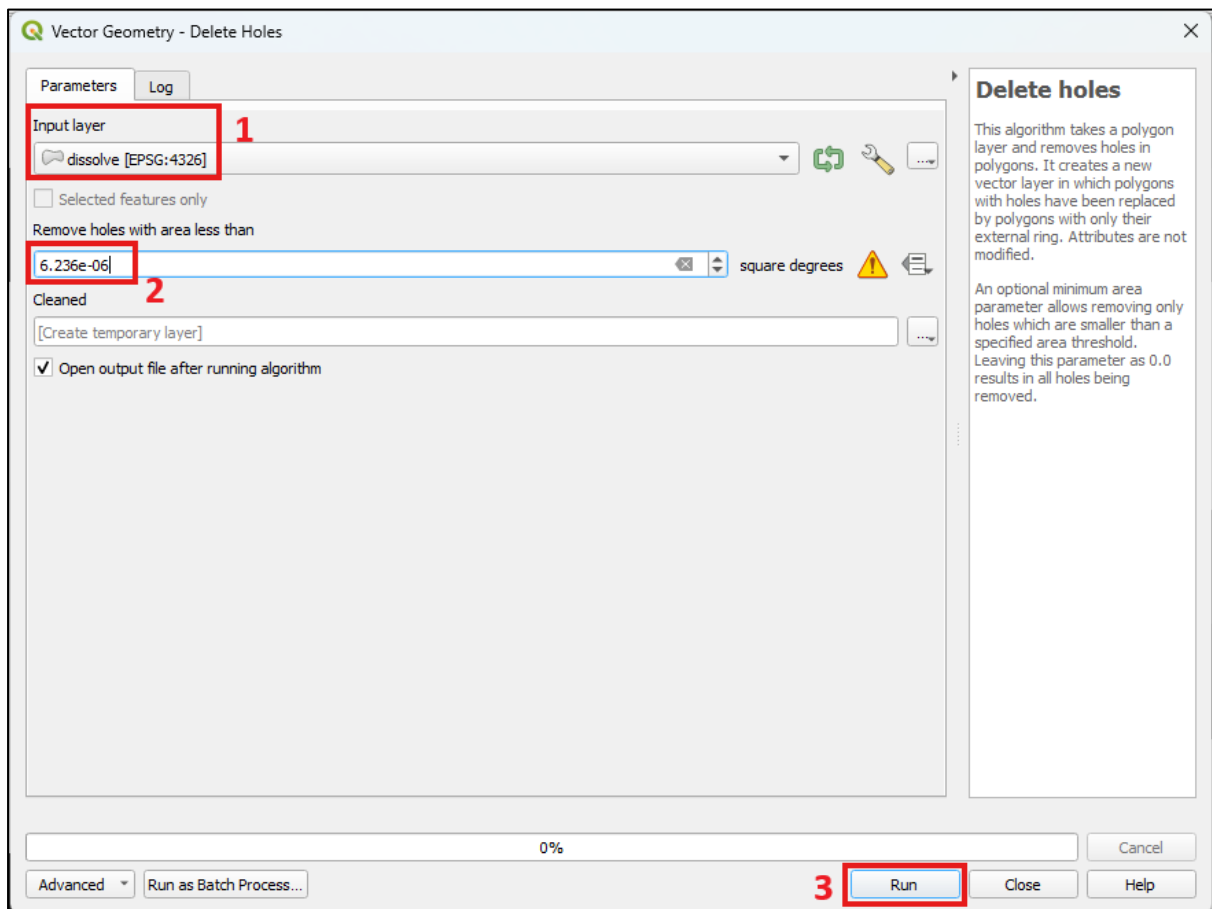
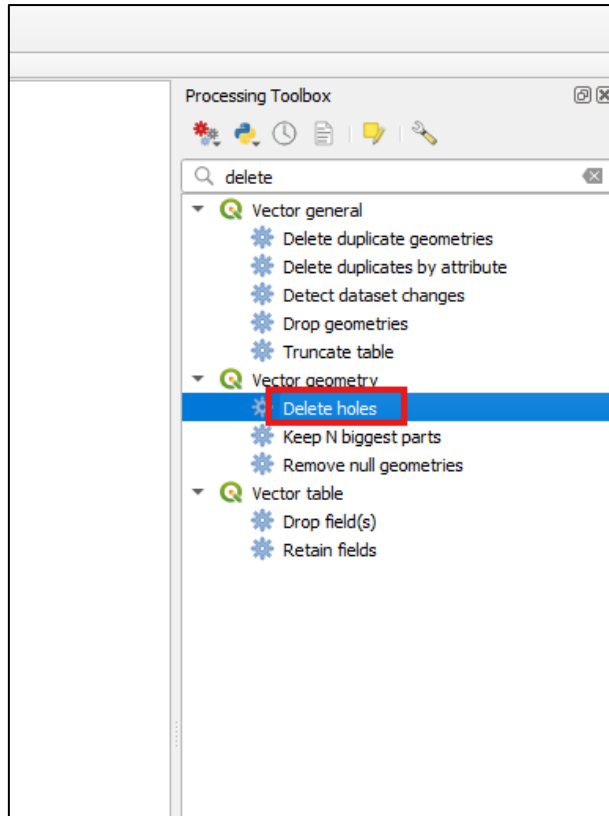


9. Delete holes:

- The shape file after dissolving may have few open places within inundation area this is because that grid might not become wet. As per the thematic mapping standards, we need to do some cartographic cleaning. Hence minimum mappable unit is 3X3 pixels, hence we fill the areas lesser than this value. To know the area of 3X3 pixels switch on the flow depth image and zoom to pixel level. Select measure area tool and measure the size of 3X3 pixels as below the value of the minimum hole to be merged is 6.144e-06 sq degrees, as degrees is the map unit we need to provide values in sq. degrees.

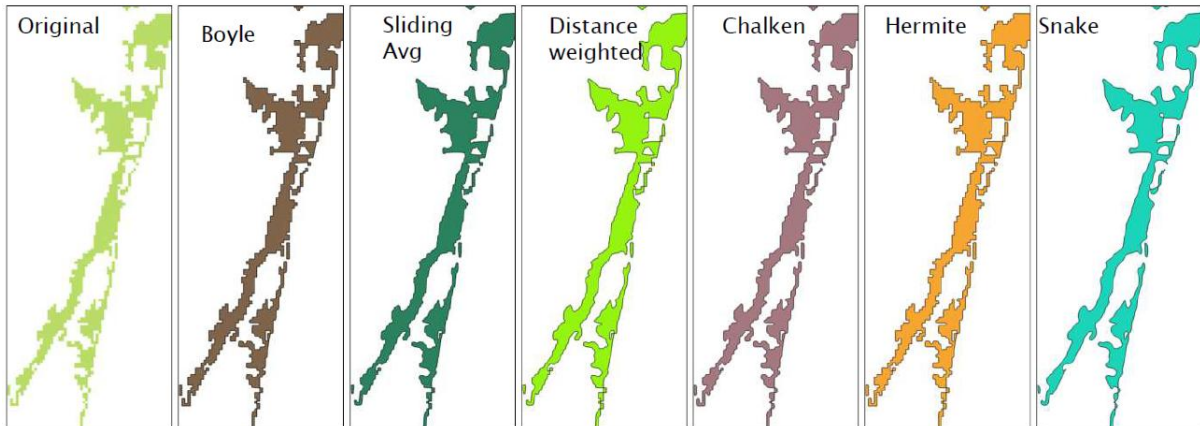


- Select the the appropriate to fill a gaps (holes) in the vector layer, type fill in the provessong tool box as shown below (left) select tool Delete Hole dialog appear as show in th eright below. Give output file name as filled.shp and enter the values corresponding to 3X3 pixcels calculated above in the “remove holes with area less than” and the run, the areas less than the area mentioned will be get fillles. If you keep 0 in this field all the open areas will get filled.

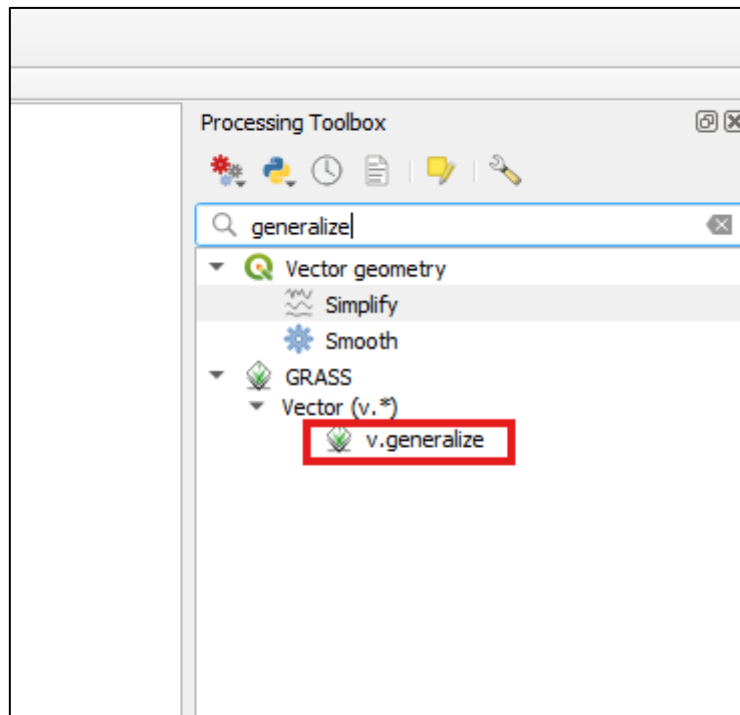


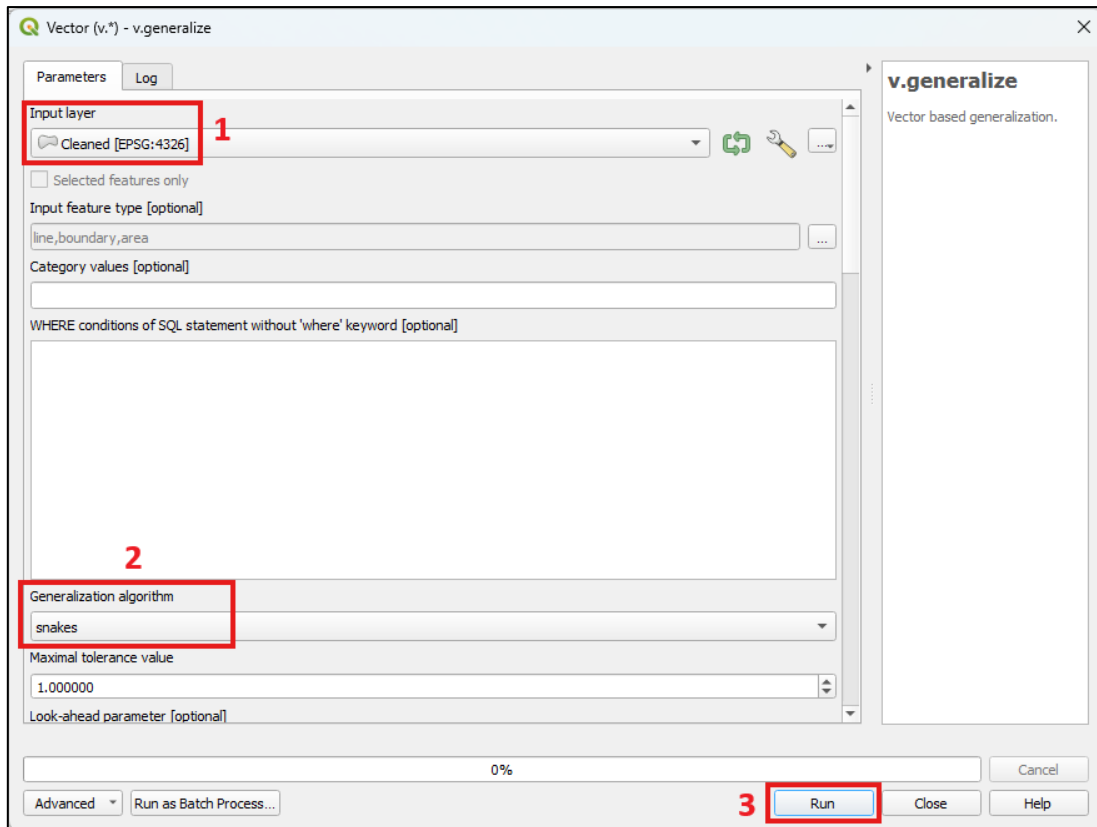
10. (optional). Depending on the resolution of the data for each region, often we can experience pixelated results in automatic vectorization of data. That is why we need to make a vector smoothing to the results obtained from the previous process. The main benefit of of the vector layer is that it will be presented in a more consistent and friendly to be presented on the development of the Evacuation map or Tsunami Evacuation. For smoothing vector work to perform we must use components Grass 7.04.

comparison of different Smoothing Methods:



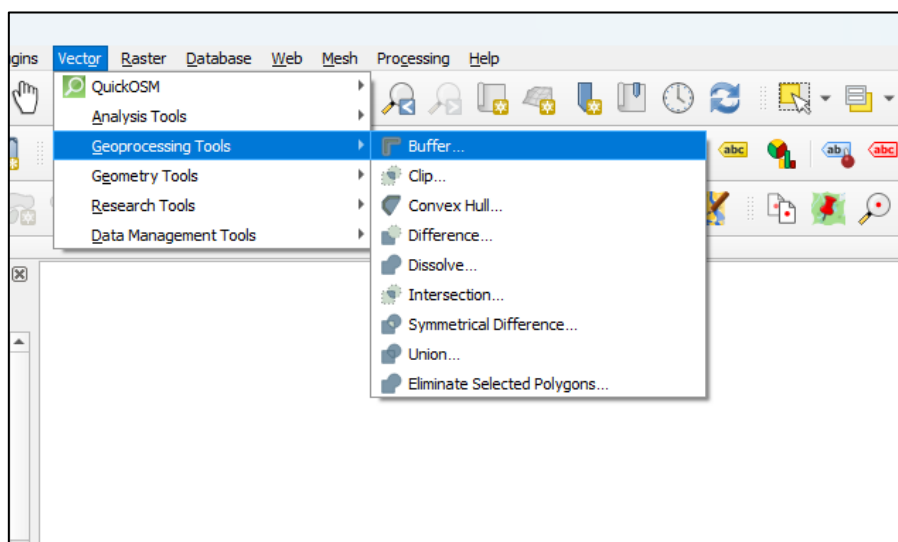
- Type generalize in the processing tool box select v.generalize under GRASS tools (left) dialog appears as shown right and select filled.shp as input file, select generalization algorithm snake and scroll down give output file name as smooth.shp and run.



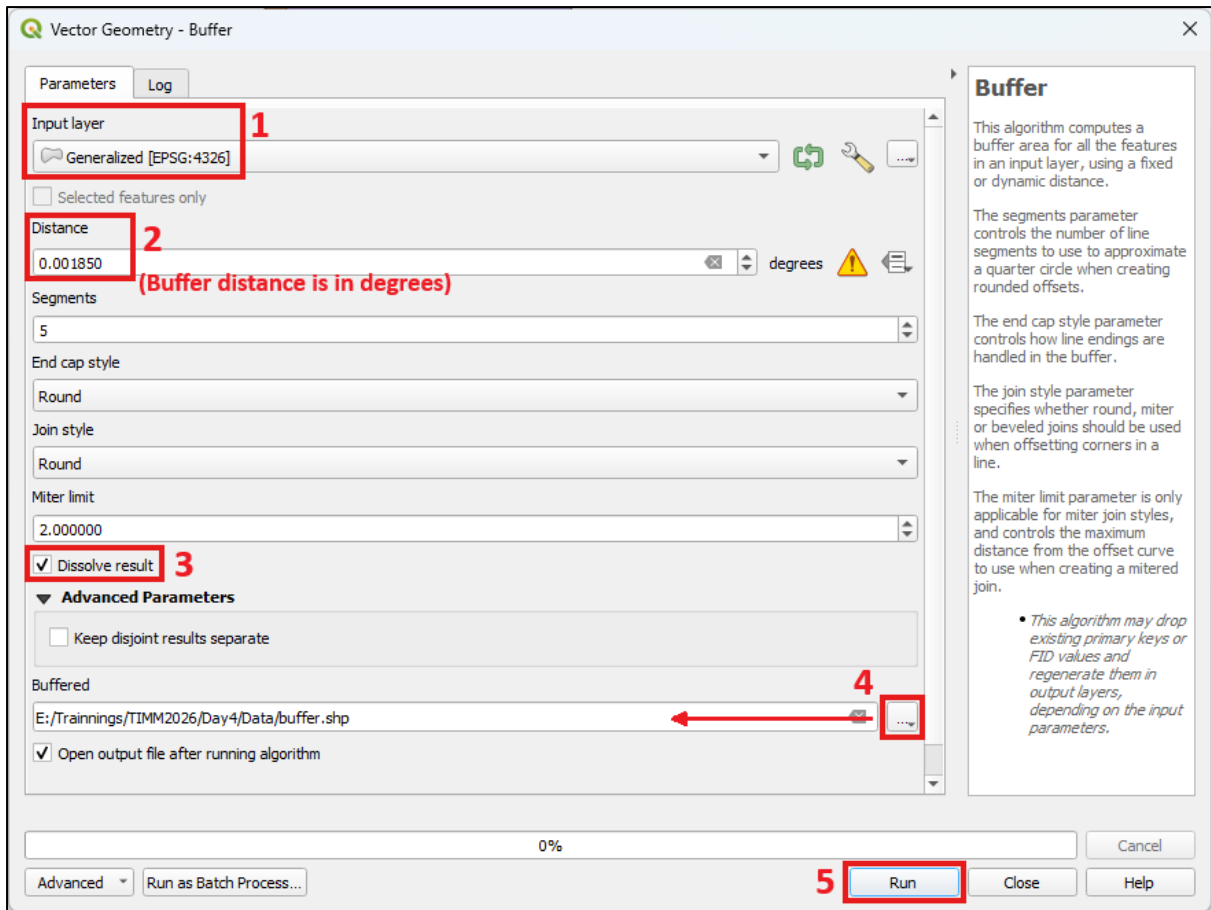


11. Creating Buffer to tsunami hazard zone

- It is necessary to add buffer to the tsunami hazard zone as transition zone to consider the uncertainties of the tsunami modelling. Hence add 200 m buffer to tsunami hazard zone. Go to Vector menu select Geoprocessing Tools and select Buffer.



- The following dialog will appear, Select the input layer to create buffer smooth.shp , enter buffer distance 200m [$200/(108 \times 1000) = 0.00185$ deg], check "dissolve all results" and enter output file name and then run



- The created buffer will appear in viewer as shown. Give appropriate symbology for buffer layer and add this in the map legend during the map generation

