



image: usgs

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and Make Recommendations.
Share and Discuss.

Modeling Lahars for Public Safety at Mt Rainier



LaharZ on VICTOR

Objectives:

1. **Analyze** and **discuss** the formation and hazards of lahars specific to Mt. Rainier
2. **Model** lahar flow scenarios using LaharZ on VICTOR
3. **Evaluate** current evacuation route based of hazard modeling practices and **make recommendations** for at-risk locations

Introduction and Background:

Using the LaharZ model on VICTOR, you will simulate lahar flow scenarios specific to Mt. Rainier to understand how these hazardous flows behave across different landscapes. By analyzing model outputs and evaluating real-world data, you will assess the effectiveness of current evacuation routes and identify at-risk locations. This lab will strengthen your problem-solving skills by applying hazard modeling practices to real-world risk assessment and mitigation.



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Preparation and Materials:

You will need...

- Access to the Internet.
- To be registered on VICTOR.
 - If you have not completed this step yet, navigate to victorproject.org and fill out the form under 'sign up' in the menu.
 - ✱ The VICTOR team needs to manually confirm all registrations, so this may take up to 24 hours.
- Optional tasks:
 - Background reading or review of the LaharZ model.
 - LaharZ paper: tinyurl.com/2hb9ksz2
 - Watch the Introduction to VICTOR Youtube video.
 - Watch the LaharZ on VICTOR tutorial.

VICTOR Youtube:



Tasks and Procedures

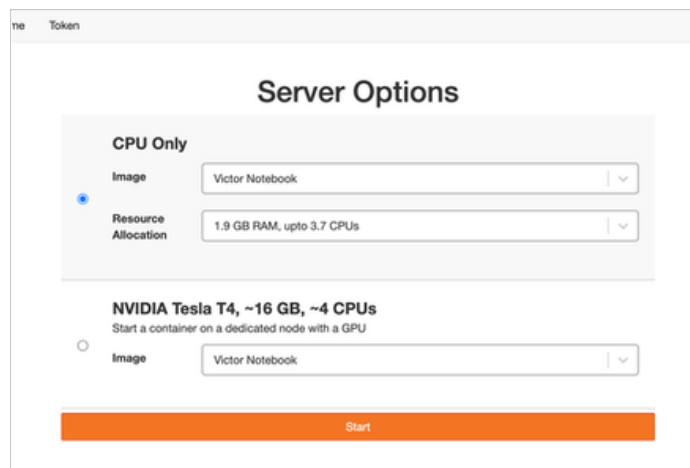
Part One:

Getting Started on VICTOR:

1. **Log in to VICTOR** at hub.victorproject.org
2. **"Server Options"**
 - Ensure Victor Notebook is selected
 - Under resource allocation, select

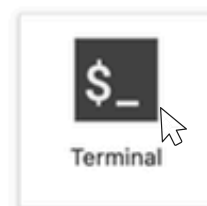
7.4 GB RAM, upto 3.7 CPUs

- Clicking **Start** will bring you to The Launcher.



3. The Launcher and VICTOR Setup command

- From the Launcher, open a new terminal by clicking the **terminal icon** at the bottom left of your launcher.
- In the new terminal, type `victor setup` and press enter.
- Identify **LaharZ** in the list that appears
- Type its corresponding number and press enter.



```

Terminal 2
(jupyter) jovyan@jupyter-ami-mullins:~$ victor setup
Hello, and welcome to the VICTOR platform.
We have a huge variety of models and tools for use.
This program is meant to make it simple to set up workflows and associated files.
To set up, please choose the number next to the model listed below.
1: alphaMELTS
2: CONFLOW
3: DISGAS
4: HAZMAP
5: HYSPLIT
6: IMEX (Lava)
7: IMEX_Sflow2D_V2
8: LaharZ
9: LAVA2D
10: MR LAVA LOBA
11: MOLASSES
12: PYFLOWGO/DOWNFLOWGO
13: Scoops3D
14: SULFUR_X
15: TEPHRA2
16: TITAN2D
17: TWODEE
Model: █
  
```

- On the left of your screen, a folder called **LaharZ** will appear.

4. Choosing a DEM:

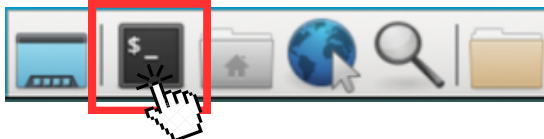
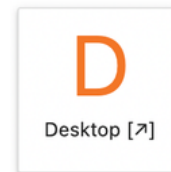
- Navigate to **/ shared / DEMs /** in your home directory and open the **NorthAmerica** folder.
- Copy the Mt. Rainier DEM that will appear as **Rainier.tif** by right clicking on the file name and selecting copy.
- Return to the LaharZ folder and open it by double clicking.
- Paste the Rainier DEM into the **/ LaharZ / example /** folder by right clicking within the folder the selecting paste. The procedures below will assist you in running the model with the Mt. Rainier DEM.

Tasks and Procedures

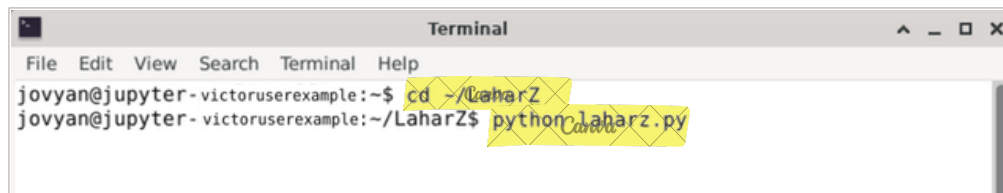
Part Two:

Running the Model: LaharZ

1. From the launcher window, **open the desktop** by clicking the desktop icon at the top of the window.
2. Once you are in the desktop, **open a terminal window** by clicking on the dark gray terminal icon at the bottom of your screen.



3. **Change directory** into the folder **LaharZ** by typing `cd ~/LaharZ` in the terminal window and pressing enter.
4. **Run the program** by typing `python laharz.py` and pressing enter. A new window will appear.



5. In the Graphical User Interface (GUI), type `example` for the folder name, then click

Create Initiation Points

6. Use the visual example on the right to **input the target values**.

- Enter the input parameters for the initiation points
- Click the “Initiation points” button
- If asked, click “overwrite” button

7. You will now visualize the lahars initiation points using a GIS program called QGIS. Return to the desktop by minimizing (not closing) the GUI. Open QGIS by clicking the icon:



Generate Initiation Points

DEM File

Stream and Flow Direction Files

- ☒ Generate files
- ☐ Use your own files
- ☒ Fill DEM file

Streams file ☒ MR-streams.tif

Stream Threshold

Flow direction file ☒ MR-flowdir.tif

Determine Energy Cone Apex

- ☐ Use Search File
- ☒ Use Longitude/Latitude

Apex

Incremental Height

H/L Ratio

Sea Level

☒ Plot Energy Cone Graphics

Energy Cone Graphics File ☐ MR_ec_cone.tif

Extent

Energy Cone Line File ☐ MR_ecline.tif

Proximal Hazard Zone File ☐ prox_hz_zn.gpkg

Initiation Points File ☐ MR_ipl.gpkg

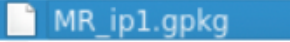
Tasks and Procedures

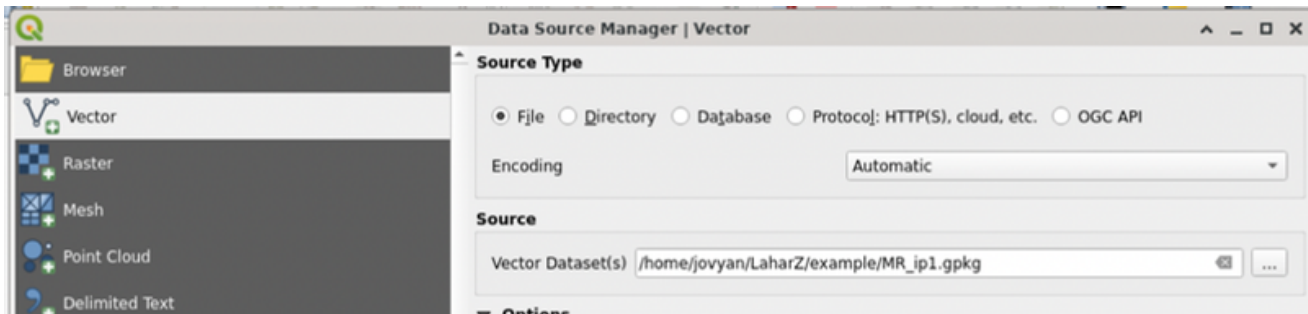
Part Two: (continued)

Running the Model: LaharZ

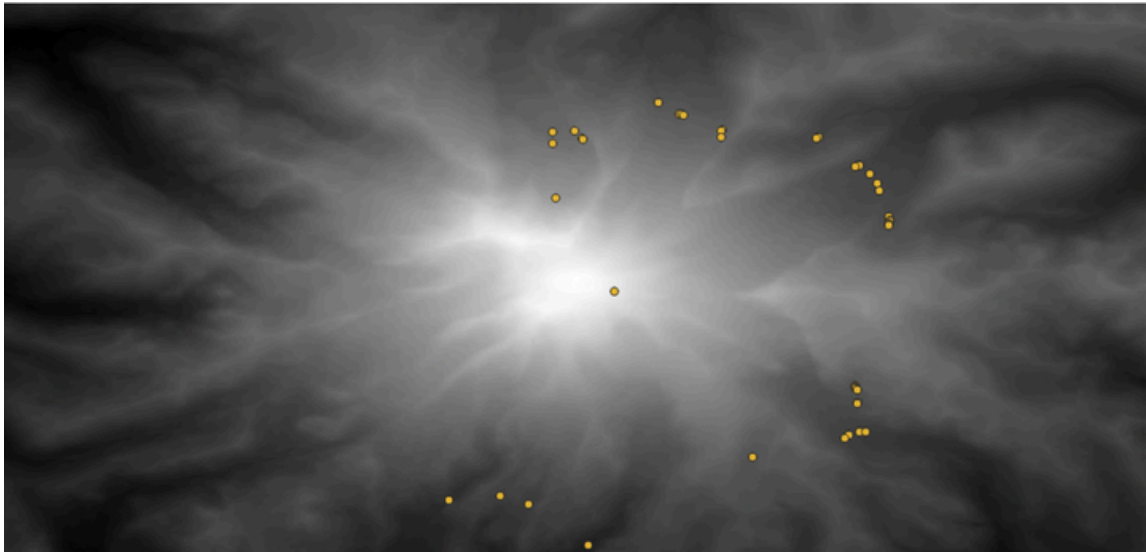
8. Load the Mt Rainier DEM using “**Layer->Add Layer->Add Raster Layer**” from the menu at the top of your window.



9. Add the initiation points just created using “**Layer->Add Layer->Add Vector Layer**” and loading the file  (MR_ip1.gpkg)



This is what your visual output should look like at this step:



Tasks and Procedures

Part Two: (continued)

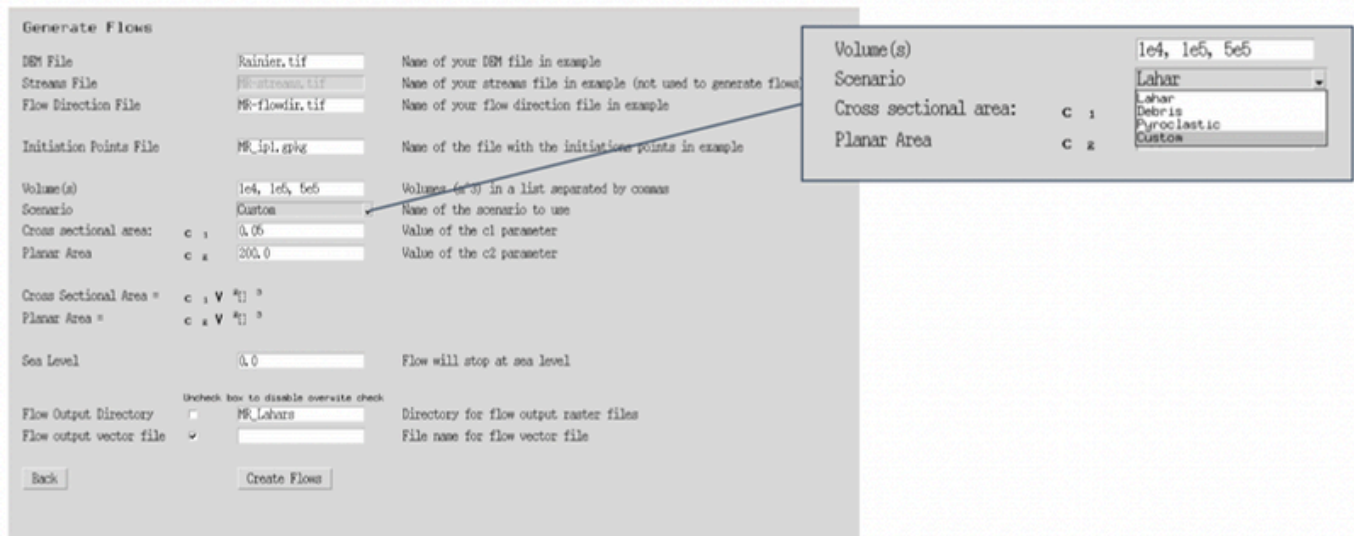
Running the Model: LaharZ



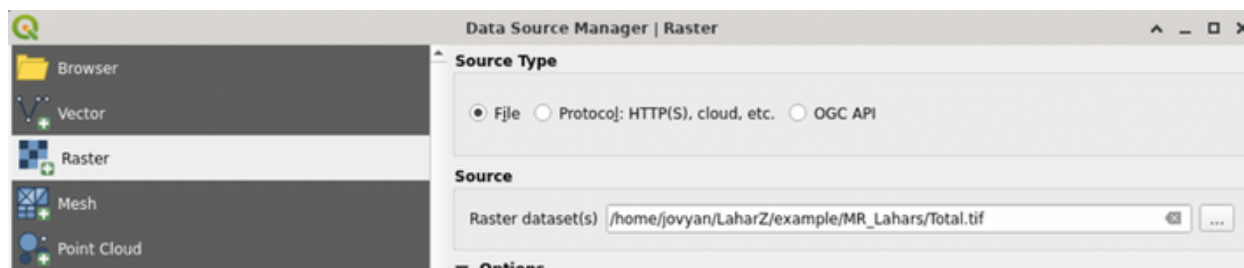
10. Return to the GUI and click **Create Flow Outputs** to run it.

11. Enter the file names to use the results of the first step and update flow parameters using the visual example below.

- Change the Scenario to “Custom” and the Planar Area to 200.0 (note the .0)



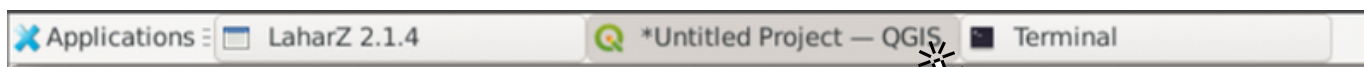

12. Return to your QGIS project. Add flow output tiff files from the results folder using **Layer→Add Layer→Add Raster Layer** and choosing the file **total.tif** from the **MR_Lahars** folder.



Tasks and Procedures

Part Three

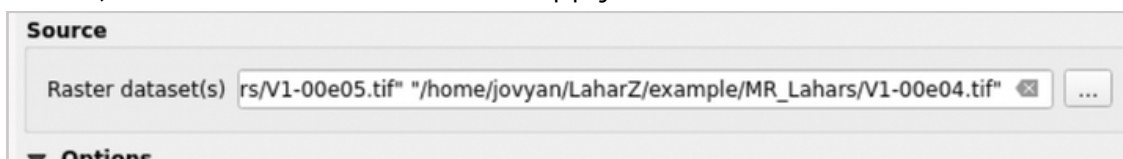
Visualizing Input Volumes



1. In QGIS, you can visualize the input volumes (1e4, 1e5, 5e5) by navigating to “**Layer->Add Raster Layer.**”
2. Similar to adding the ‘total.tif’ file in the previous section, you will add the files named as each inputted volume, shown below.

Name	Size	Type	Date Modified
V5-00e05.tif	11....KiB	tif File	4/9/25 5:13 PM
V1-00e05.tif	11....KiB	tif File	4/9/25 5:13 PM
V1-00e04.tif	10....KiB	tif File	4/9/25 5:13 PM
Total.tif	13....KiB	tif File	4/9/25 5:13 PM

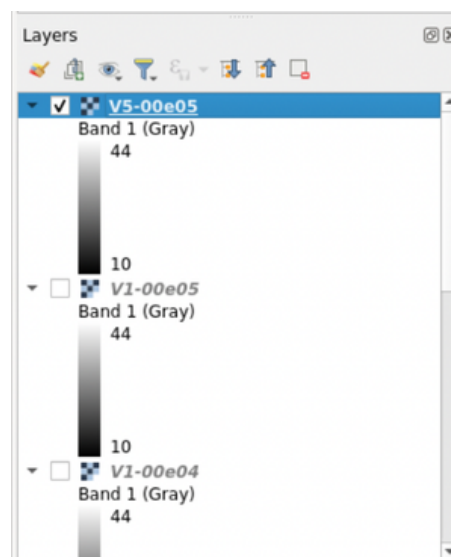
You are able add the files individually, by selecting one and clicking ‘apply’ until all three have been added. Or, select all three files and click ‘apply.’



3. Once all three volumes are added as layers, you can hide or show each layer by selecting or deselecting the check box next to the layer name in the “layers” panel at the bottom left of your window.

In the example on the right, the visual display is showing the input volume 5e5, while hiding 1e2 and 1e5.

Use the space below to write 3-5 sentences comparing and contrasting the visual outputs between all three volumes.

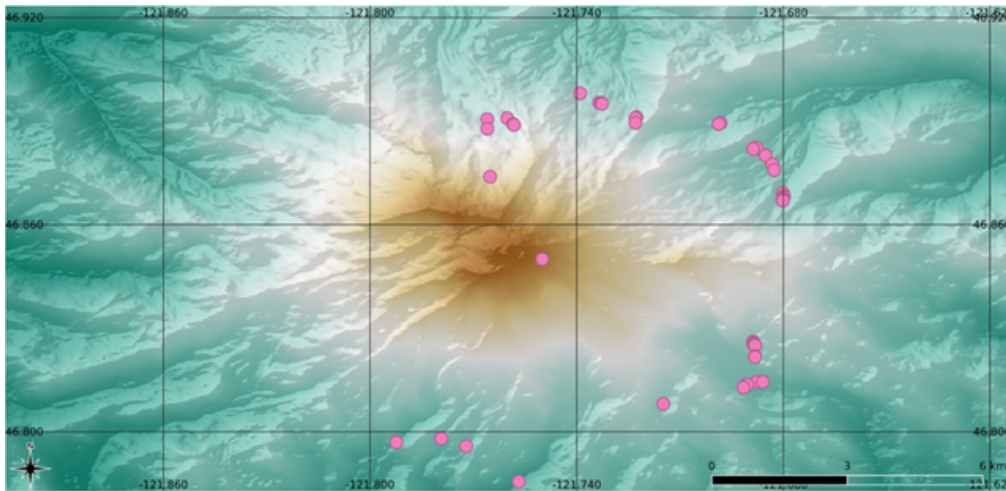


At this step, your visual output will still be in grayscale. Use the procedures on the following pages to adjust the visualization of the flow output (these steps are optional). The next required procedures of your lab are on page 11.

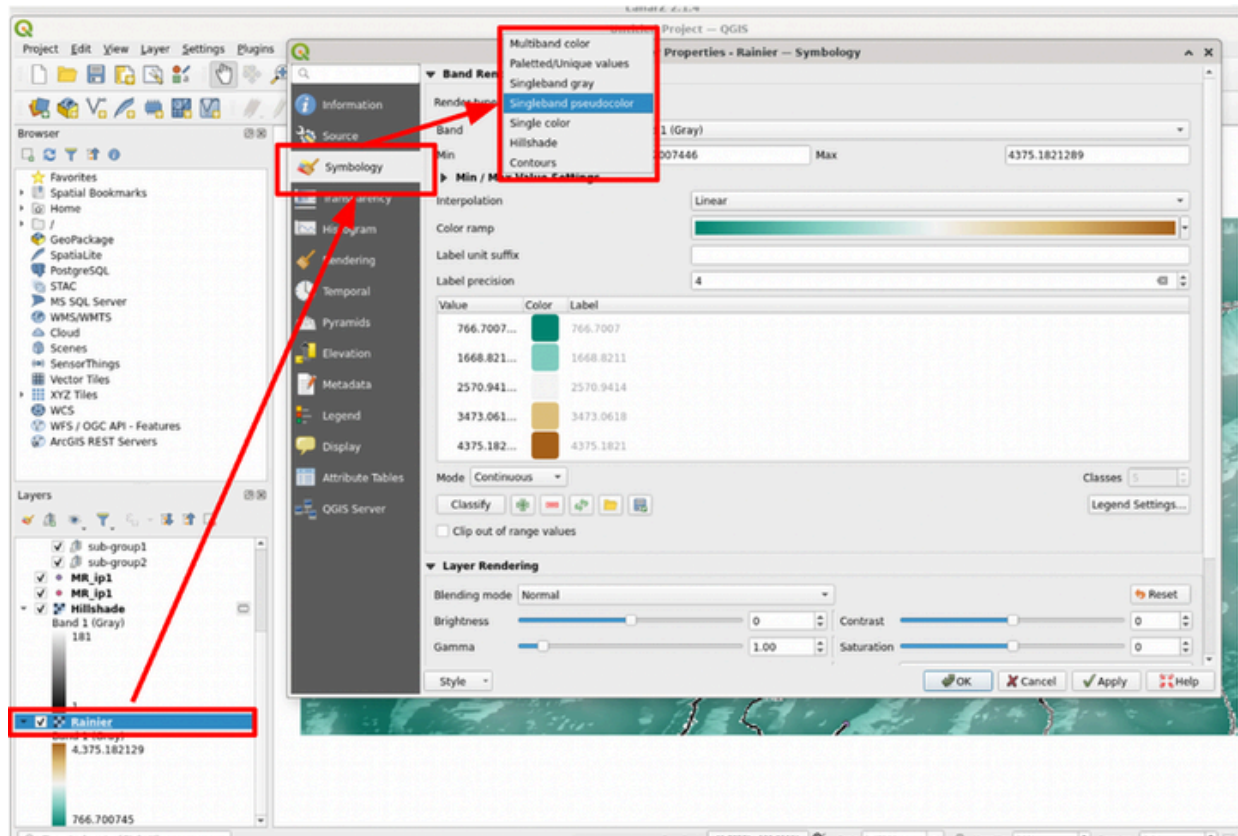
Tasks and Procedures

Part Four: (optional)

Adjust the Visualization of the Flow Outputs: Color



1. In the 'layers' panel at the bottom left of your QGIS screen, double click the Rainier layer.
2. A window will appear. From here, ensure you are in the 'symbology' tab from the list on the left of the window.
3. Change the drop down menu labeled "Render Type" at the top of the window to "Singleband Pseudocolor"

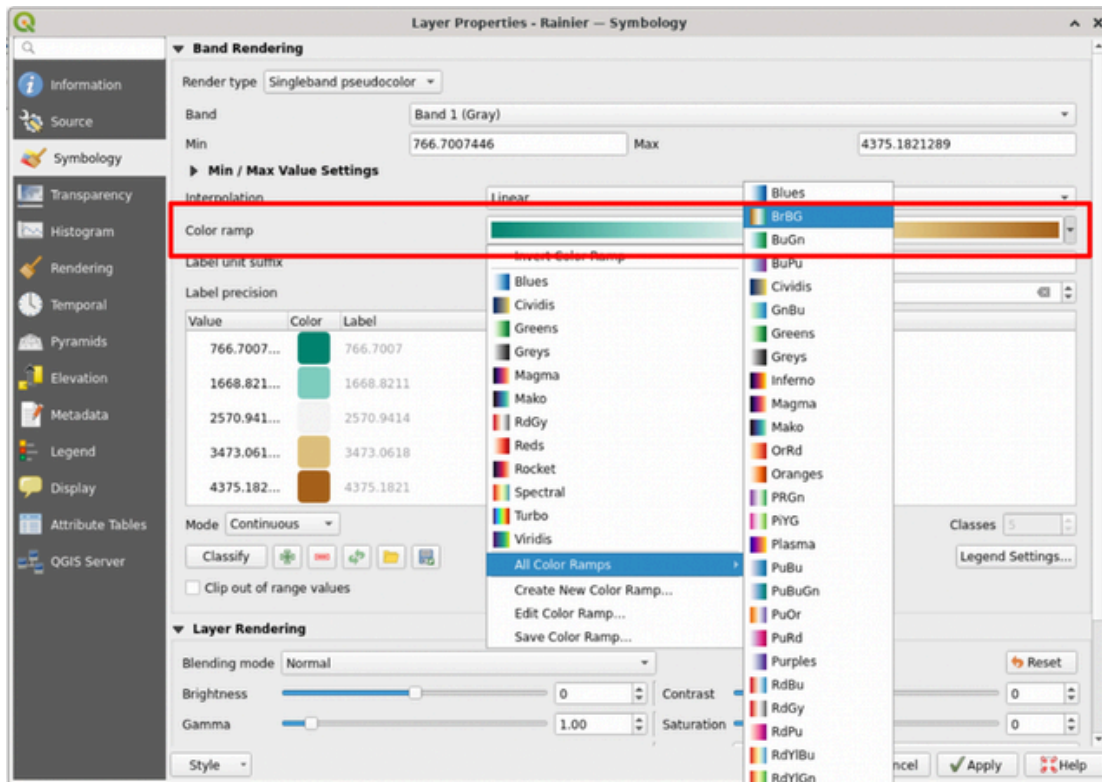


Tasks and Procedures

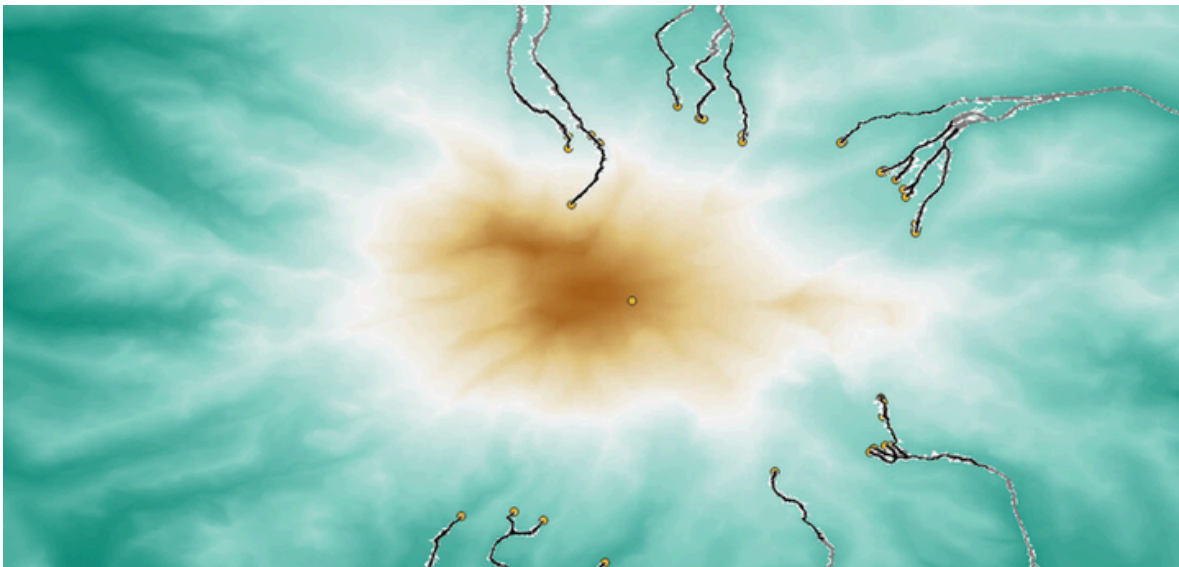
Part Four: (optional)

Adjust the Visualization of the Flow Outputs: Color

4. In order to match the example, click the arrow to the right of the 'color ramp' option.
5. Hover over 'All color ramps' from the list that appears and choose **"BrBG."**
6. Click the arrow to the right of color ramp again and click 'Invert Color Ramp' at the top of the list that appears.
7. Click apply before closing the window.



This is what your visual output will look like at this step:

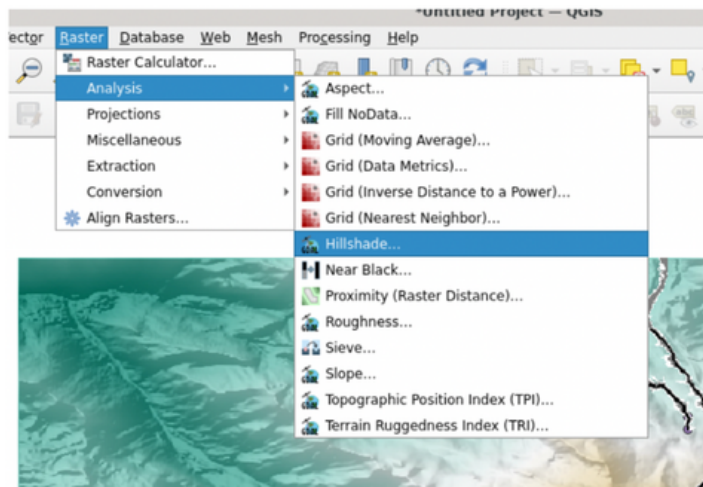


Tasks and Procedures

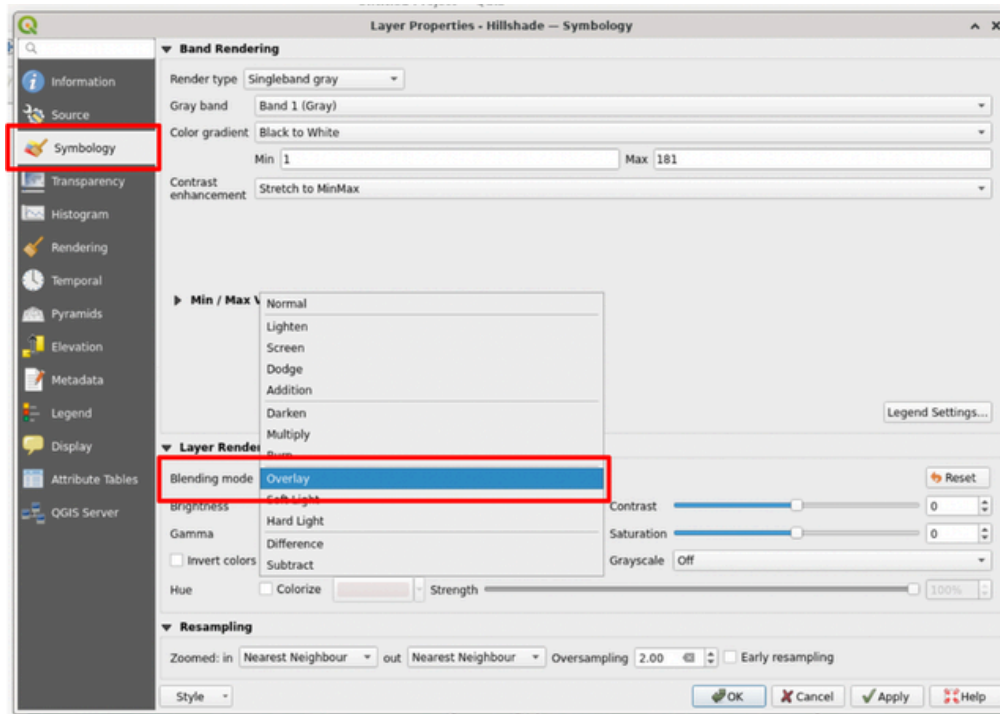
Part Four: (optional)

Adjust the Visualization of the Flow Outputs: Topography

1. Navigate to the Raster menu item at the top of the window.
2. Hover over 'Analysis' and select 'Hillshade' from the list that appears.
3. After ensuring the DEM being used is Rainier.tif, select 'run' at the bottom of the window that appears.



4. Close the window and double click the new 'Hillshade' layer in the layers panel.
5. Ensure you are in the symbology tab. Open the dropdown menu under the "Blending Mode" option and select overlay.
6. Click apply at the bottom of the window.

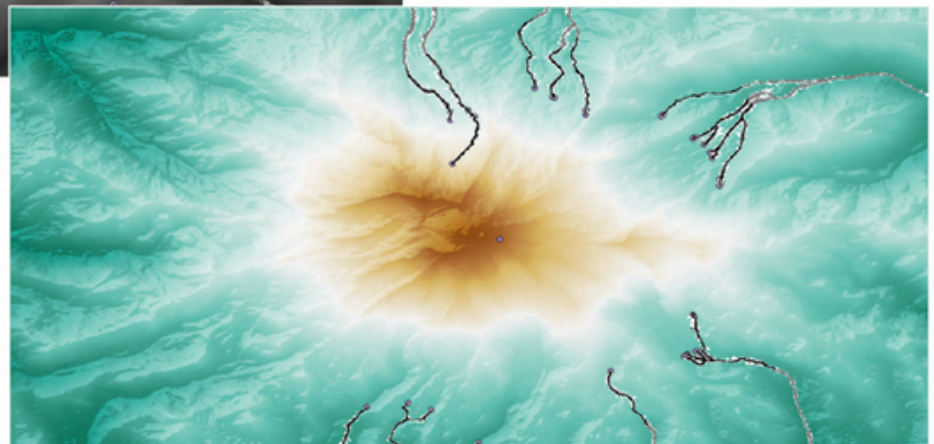
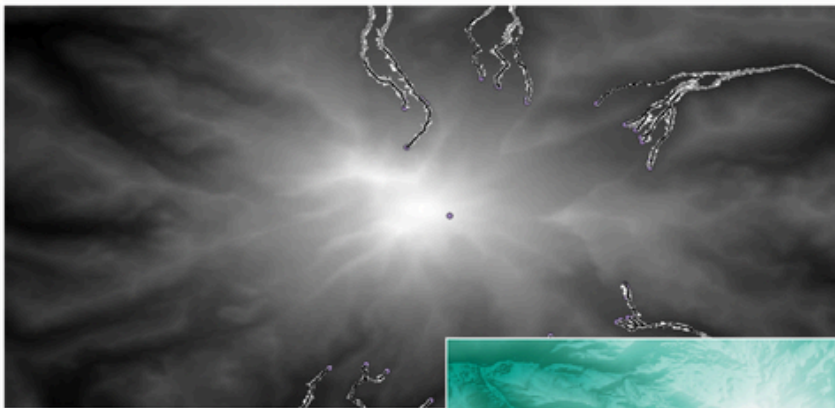
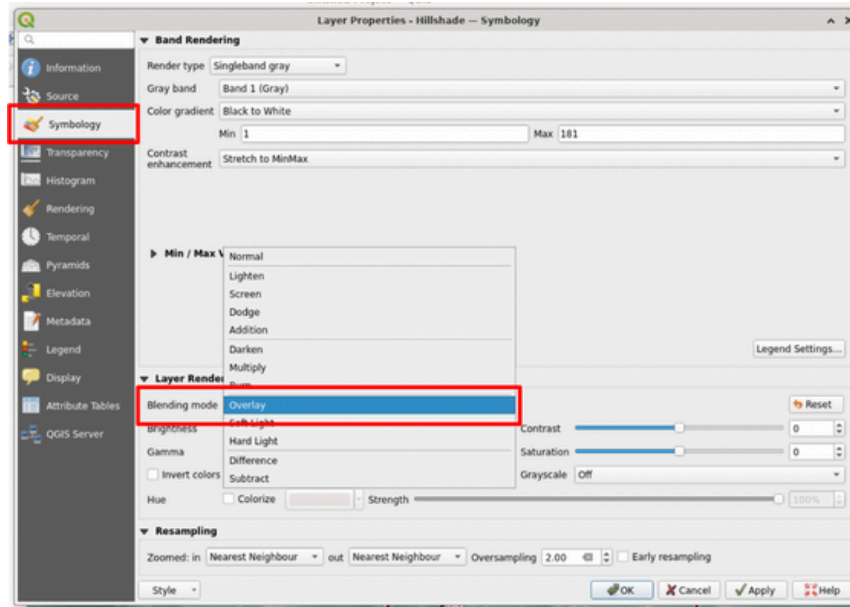


Tasks and Procedures

Part Four: (optional)

Adjust the Visualization of the Flow Outputs: Topography

7. Open the 'Transparency' tab in the same window.
8. Adjust the 'global opacity' slider to around 25%.
9. Click apply at the bottom of the window.



Analysis and Discussion

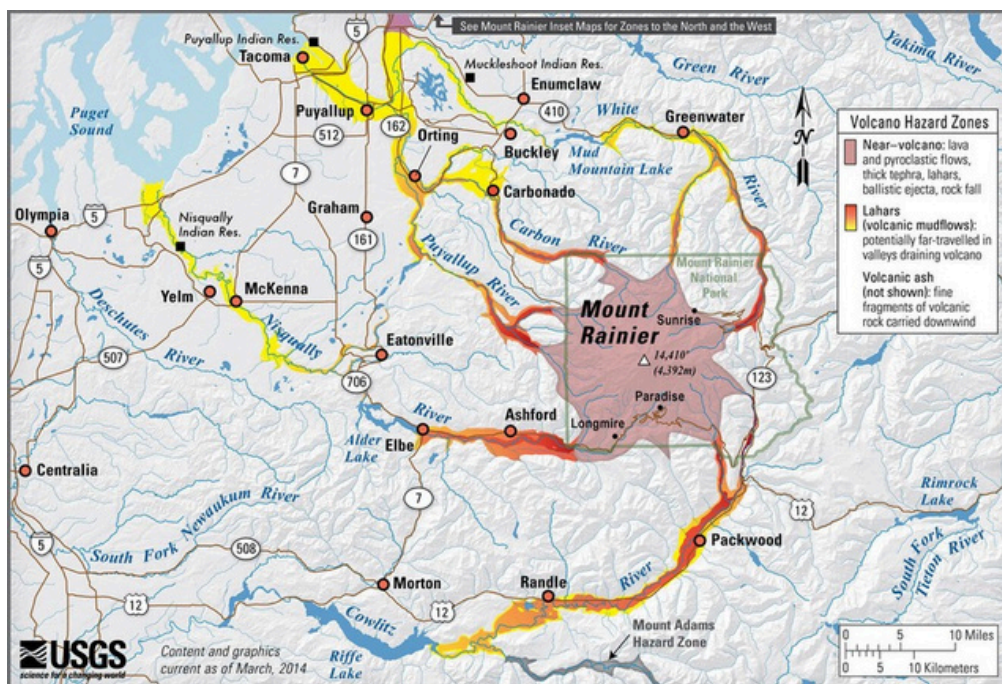
Part Five

Analyze Model Outputs and Make Recommendations

Using your visual outputs, you will analyze potential impacts on Mt. Rainier's surrounding communities. You will focus on applying your model results to evaluate real-world hazard preparedness and response.

To complete this step you will...

1. Choose a nearby town from the following: **Longmire, Paradise, Sunrise**. The map below shows these locations.



2. Research evacuation routes for your town. use reliable sources such as local government .gov websites, USGS resources, etc.
3. Evaluate current evacuation routes and preparedness strategies by answering the following questions. To answer these questions, you will use your visual outputs, the provided USGS map, and the evacuation route materials you sourced.
 - Are the current evacuation routes safe given the direction of lahars indicated in your visual outputs?
 - Which important infrastructure landmarks in this area need to be considered?

Next, make recommendations.

Based on your research of preparedness and mitigation strategies, make recommendations specific to your target location. This can pertain to signage, community awareness (especially considering local infrastructure), or additional route options.