

ERUPTION ON CAMPUS MODELING

In-class Activity by Arianna Soldati (NC State)

Activity

Model the emplacement of a series of lava flows on NC State University's campus and assess the risk they would pose to Jordan Hall.

Learning objectives

- Practice lava flow modeling using state-of-the-art software.
- Apply the hazard assessment concepts you learnt in class.

Format

A single PDF document showing all of your runs, clearly labeled; include your answers to the Analysis questions in the same document.

Time Commitment

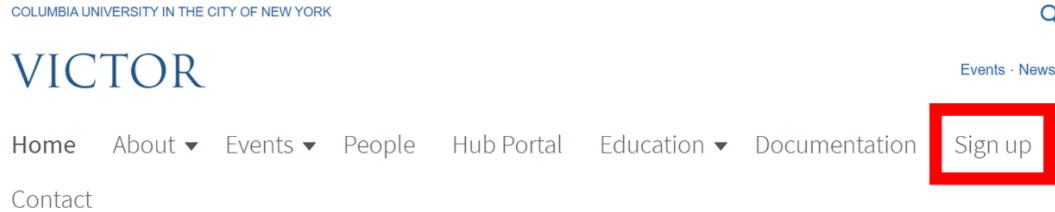
This activity is meant to be self-contained within a 75 min class period. Please note that you must register for a VICTOR account to complete this activity, and that the registration typically takes several days to go through. Therefore, you should register well in advance of the scheduled class period.

Beyond the assignment

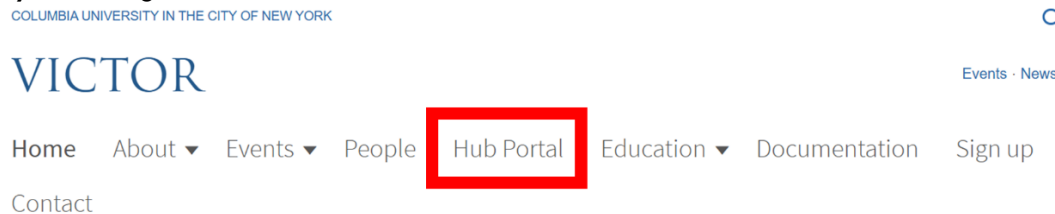
Hazard mitigation and prediction are a major part in how volcanologists can keep the communities living near active volcanoes safe. The ability to use models to predict how a lava flow might be emplaced is crucial in helping protect communities at risk.

Procedure

1. Prior to starting the assignment: register for VICTOR.
 - a. Go to <https://victor.ldeo.columbia.edu/>
 - b. Click "Sign Up" in the top right corner of the website
 - c. Fill out the short Google Form that opens up



- d. In a few days, you will receive an email with subject line "VICTOR access" confirming that you have been granted access to the hub.
2. Once your account has been set up, access the hub at <https://victor.ldeo.columbia.edu/> by selecting "Hub Portal"



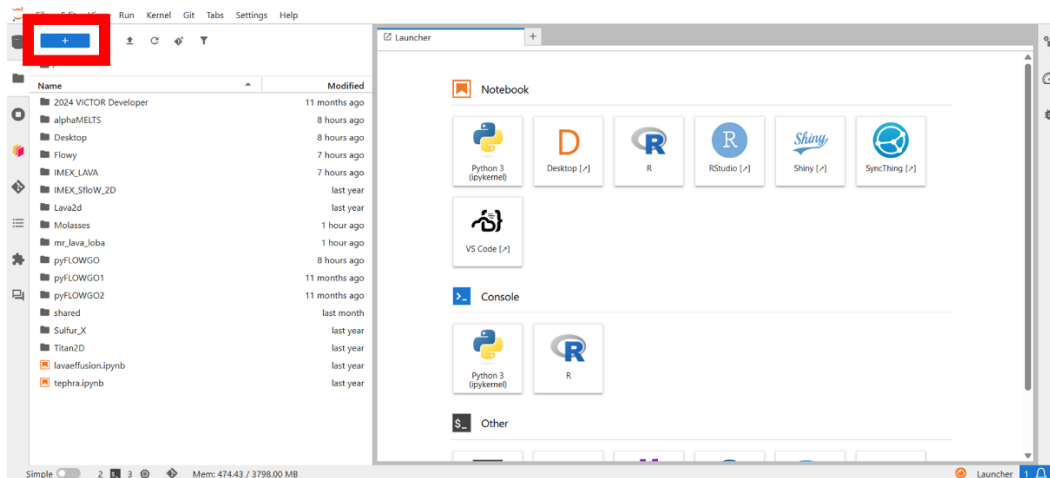
3. You may choose among various server options. For this activity, select: CPU only; Image: Victor Notebook; Resource Allocation: 3.7 GB RAM, upto 3.7 CPUs.

Server Options

A screenshot of the 'Server Options' form. It has two main sections. The first section, 'CPU Only', is selected with a radio button. It contains two dropdown menus: 'Image' set to 'Victor Notebook' and 'Resource Allocation' set to '3.7 GB RAM, upto 3.7 CPUs'. The second section, 'NVIDIA Tesla T4, ~16 GB, ~4 CPUs', is unselected. It contains a description 'Start a container on a dedicated node with a GPU' and an 'Image' dropdown set to 'Victor Notebook'. At the bottom is a large orange 'Start' button.

It will take a few minutes to boot up

4. You should be looking at a launcher screen; if not click the blue plus in the top left corner to open one.



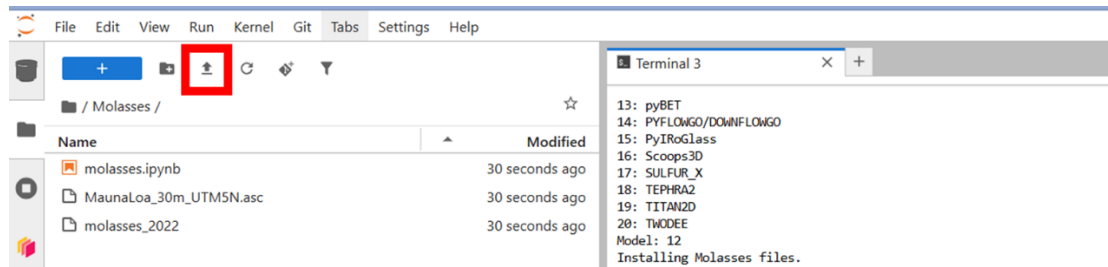
- a. For this activity, we will use the MOLASSES model. To open and create a local working copy of the model in your personal workspace, within the launcher window on the right go down to "Other" > "Terminal". Once you have the terminal open type in "victor setup" and hit enter.
- b. The list of currently available models within VICTOR will populate below the "victor setup" text you entered. To select a model to make a personal working copy of in your directory enter the number (example: if you want to work with MOLASSES type 12 and hit enter).

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Terminal 2
Activating profile: /srv/conda/etc/profile.d/conda.sh
(notebook) jovyan@jupyter-emrechuiti:~$ 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: Flowy
5: HAZMAP
6: HYSPLIT
7: IMEX (Lava)
8: IMEX_SFlow2D_V2
9: LaharZ
10: LAVA2D
11: MR LAVA LOBA
12: MOLASSES
13: pyBET
14: PYFLOWGO/DOWNFLOWGO
15: PyTroGlass
16: Scoops3D
17: SULFUR_X
18: TEPHRA2
19: TITAN2D
20: TWODEE
Model: 

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- c. A folder named Molasses will appear on the left. Open that to find the Jupyter Notebook called "molasses.ipynb". The notebook is heavily annotated with instructions on what parameters need to be changed and which to run without changes.
5. Download the DEM file (bigdem_raleigh.asc) from the Moodle class page.
- a. To upload the Raleigh DEM (bigdem_raleigh.asc file) use the underlined-up arrow (boxed in red). It will appear on the left.



6. In the block of code called "Key Parameters", change the DEM name to reflect the campus DEM we are using (bigdem_raleigh.asc)
7. In the block of code called "Key Parameters", also change the flow input parameter as follows:
 - a. Thickness of Lava Flow at Rest (Residual thickness – meters) = 10
This is a viscosity proxy: the higher the residual thickness, the higher the implied viscosity; 10 is a reasonable value for a basaltic flow.
 - b. Total Volume of effusive eruption (meters³) = 10,000,000; 50,000,000; 100,000,000 in separate runs
 - c. Pulse Volume of Lava Flow (Fraction of Total Volume – meters³) = 1000
This is a momentum proxy; it makes virtually no difference in output, but if smaller than the total volume by more than 3 orders of magnitude it will take the model a very long a time to run.
 - d. DEM file = "bigdem_raleigh.asc"
 - e. UTM location of event location = "easting,northing"
This is your vent location, i.e. where the eruption will start.
 - i. Group A at Hunt Library = "2095983,735095"
 - ii. Group B at Talley Student Union = "2097632,740374"
 - iii. Group C at Miller Fields = "2096587,739951"
 - iv. Group D at Memorial Bell Tower = "2099800,741220"
 - f. Runs = [] leave this empty
8. To run the model, select Run > Run All Cells from the upper ribbon menu. The model may take several minutes to run. In the bottom ribbon, it will say either "busy" (if still running) or "idle" (if in between tasks or completed).
 - a. In between runs, select Kernel > Restart Kernel and Clear Output of All Cells from the upper ribbon menu.
 - b. To export the map right click on it and select "Copy Output to Clipboard"; you can then paste it into a Word document. [1 pt for each of the 3 runs]

Analysis

Answer the following questions for your scenario (A, B, C, or D):

1. Draw a hazard map. Consider all possible hazards. [1pt]
2. Should Jordan Hall remain open during the eruption? Why or why not? [1pt]
3. You live in Wolf Village. Can you safely get to Jordan Hall? If so, how? [draw your perspective route on the map]. Why? [1pt]
4. Hunt library is closed. Can you go to Hill library instead (from Wolf Village)? Why or why not? If yes, how? [draw your perspective route on the map] [1pt]

5. Geology Club had planned a picnic at Pullen Park shelter #6. Should they cancel it? Why or why not? Can you walk there from Jordan Hall? Why or why not? If yes, how? [draw your perspective route on the map]. [1pt]
6. The University has set aside a generous budget to divert the flow through earthen berms. Which assets would you recommend they focus on protecting? Which geometry would you recommend to achieve that goal? [draw your perspective barriers on the map] [1pt]

Talk to one person from each of the other groups. Compare your answers and answer the following question:

1. Which eruption scenario is most disruptive to you, as a student living in Wolf Village, attending classes in Jordan Hall, studying at Hill library, and participating in social activities at Pullen Park? Why? [1pt]

