Quiz navigation

1 2 3 4 5 6
7 8 9 10 11 12
13 14 15 16 17 18
19 20 21 22 23 24
25 26 27 28

Finish review

Started on	Friday, August 19, 2022, 7:00 PM
State	Finished
Completed on	Sunday, August 21, 2022, 8:11 AM
Time taken	1 day 13 hours
Marks	24.79/28.00
Grade	**88.54** out of 100.00

Question 1
Correct
1.00 points out of 1.00
Flag question

In this activity we will demonstrate use of ObsPy to investigate a key part of the Kilauea eruption in 2018 (we provided a link to a nice webinar on this full sequence on the main Moodle page). The key part of the eruption we will focus on in this assignment is when the floor of the volcanic cone Puu Oo collapses, the swarm of seismicity associated with lava flowing after that, and the eventual eruption in lower Puna. You can read about these features here, with special attention to the 2018 eruption:

https://en.wikipedia.org/wiki/Pu%CA%BBu_%CA%BB%C5%8C%CA%BB%C5%8D

https://en.wikipedia.org/wiki/2018_lower_Puna_eruption

Kilauea eruptions are particularly interesting in that volcanologists have some ideas about the lava tube plumbing and hence can explain how the collapse of Puu Oo is due to lava draining from this area of the volcano and moving to the lower east rift zone. We will use some seismic recordings in the lower east rift zone to estimate how quickly the lava flows in this case. To start, we need to identify the location of Puu Oo. What is the latitude of Puu Oo? Note that Wikipedia lists latitude and longitude for many noteworthy locations, but you may need to click on it to get them in decimal numbers.

Answer: 19.386389 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 2
Correct
1.00 points out of 1.00
Flag question

What is the longitude of Puu Oo?

Answer: -155.105 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 3
Correct
1.00 points out of 1.00
Flag question

What is the latitude of the lower Puna Eruption?

Answer: 19.463 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 4
Correct
1.00 points out of 1.00
Flag question

What is the longitude of the lower Puna Eruption?

Answer: -154.899 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 5
Correct
1.00 points out of 1.00
Flag question

Next we will look at the details of when these events took place. You can read the key daily update on May 1, 2018 from the Hawaii Volcano Observatory here:

http://www.users.miamioh.edu/brudzimr/classes/Kilauea.1May2018.report.pdf

Based on the HVO daily update, at approximately what date and local time did Puu Oo begin several episodes of collapse?

Select one:

- a. 12:00 pm on April 30, 2018
- b. 2:00 am on May 1, 2018
- c. 2:00 pm on May 1, 2018
- d. 12:00 am on May 1, 2018
- e. 12:00 pm on May 1, 2018
- f. 2:00 pm on April 30, 2018 ✓
- g. 12:00 am on April 30, 2018
- h. 2:00 am on April 30, 2018

Check

Correct
Marks for this submission: 1.00/1.00.

Question 6
Correct
1.00 points out of 1.00
Flag question

Seismogram recordings are always in UTC (universal) time, so we will need to convert to UTC time. The `UTCDateTime` function in the ObsPy library can help with this, but we need to know what time zone Hawaii local time is. Which of the following is the offset of Hawaii time relative to UTC? (You may need to do a web search to determine this).

Select one:

- a. +10
- b. -3
- c. +3
- d. +6
- e. -6
- f. -10 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 7
Correct
1.00 points out of 1.00
Flag question

Now you can use UTCDateTime to convert the local date and time into UTC date and time. You will likely want to refer to the UTCDateTime manual to review how to do this:

https://docs.obspy.org/packages/autogen/obspy.core.utcdatetime.UTCDateTime.html

How would you load the UTCDateTime() function to use it by name only?

Answer: from obspy import UTCDateTime ✓

Check

Go ahead and run `from obspy import UTCDateTime` now.
Correct
Marks for this submission: 1.00/1.00.

Question 8
Correct
1.00 points out of 1.00
Flag question

After loading UTCDateTime, you can input the local date and time with a time zone adjustment to UTCDateTime (described in the manual) and save the output to a variable called starttime. Then you can print the value of starttime to see the date and time in UTC. What is the approximate date and time in UTC time when Puu Oo collapsed?

Answer: 2018-05-01T00:00:00.000000Z ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 9
Correct
0.00 points out of 1.00
Flag question

Next we can request a seismogram to see the seismic activity following the collapse of Puu Oo. We can use the FDSN webservices client for ObsPy like we did in the last assignment. How would you load the Client library into Python and set it to pull data from the IRIS webservices?

Select one:

- a. from obspy.Clients.fdsn import Client
  client = Client(IRIS)
- b. from obspy.clients.fdsn import client
  Client = client("IRIS")
- c. from obspy.clients.fdsn import Client
  Client = client(IRIS)
- d. from obspy.clients.fdsn import Client
  client = Client(IRIS)
- e. from obspy.Clients.fdsn import client
  Client = client(IRIS)
- f. from obspy.Clients.fdsn import Client
  client = Client("IRIS")
- g. from obspy.Clients.fdsn import client
  client = Client(IRIS)
- h. from obspy.clients.fdsn import Client
  Client = client("IRIS")
- i. from obspy.clients.fdsn import Client
  client = Client("IRIS") ✓ Correct. Run this command now.
- j. from obspy.clients.fdsn import client
  client = Client("IRIS")

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.00/1.00**.

Question 10
Correct
1.00 points out of 1.00
Flag question

We will use the dayplot option to review our seismogram once we have it, so we will need to calculate an end time a day later than our starttime variable. Which of the following would set a endtime variable a day later than the starttime?

Select one:

- a. endtime=starttime + 24:00
- b. endtime=starttime + "24:00:00"
- c. endtime=starttime + 24 * 60 * 60 ✓ Correct. Run this command now.
- d. endtime=starttime + 24
- e. endtime=starttime + 24:00:00
- f. endtime=starttime + "24:00"
- g. endtime=starttime + 1

Check

Correct
Marks for this submission: 1.00/1.00.

Question 11
Correct
1.00 points out of 1.00
Flag question

Now we will use the get_stations() function to retrieve an inventory of stations, so you may want to review how you used this function in the last assignment. For this assignment, you will retrieve stations in the Hawaii Volcano Observatory network (code: HV). Since these will be local, generally small earthquakes, EHZ will be a good choice for the channel. Which of the following would be needed to get all of the stations operating on this day and store the information down to the channel level in an object named inv?

Select one or more:

- a. inv = ✓ 1 of 8 answers
- b. channel="EHZ", ✓ 1 of 8 answers
- c. client.get_stations(✓ 1 of 8 answers
- d. station="*", ✓ 1 of 8 answers
- e. inventory=inv,
- f. get_stations(
- g. endtime=endtime) ✓ 1 of 8 answers
- h. level="channel", ✓ 1 of 8 answers
- i. network="HV", ✓ 1 of 8 answers
- j. starttime=starttime, ✓ 1 of 8 answers

Check

Run the full command now: `inv = client.get_stations(network="HV", station="*", channel="EHZ", level="channel", starttime=starttime, endtime=endtime)`
Correct
Marks for this submission: 1.00/1.00.

Question 12
Correct
1.00 points out of 1.00
Flag question

You should check to see what this command returned into the inv object by printing it:

```
print(inv)
```

How many stations did it retrieve?

NOTE: If you ran into trouble running `print(inv)` try this:

```
len(inv.get_contents()['stations'])
```

Like the `print(inv)` command, `inv.get_contents()` retrieves the contents of the object inv. `['stations']` specifies that we want the array containing the names of the stations. Encompassing the whole command with the `len()` command tells Python that we want the length of the array of stations, giving us the number of stations.

Answer: 31 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 13
Correct
1.00 points out of 1.00
Flag question

How do you plot a map of the stations restricted to just the area where the stations occur?

Select one:

- a. inv.plot()
- b. plot(inv)
- c. inv.plot(projection="ortho")
- d. inv.plot(projection="local") ✓ Correct. Run this command now.
- e. plot(inventory=inv, projection="ortho")
- f. plot(projection="ortho")
- g. plot(inventory=inv, projection="local")
- h. plot()
- i. plot(projection="local")

Check

Correct
Marks for this submission: 1.00/1.00.

Question 14
Correct
0.67 points out of 1.00
Flag question

Now we need to decide which station is closest to where the lower Puna eruption will take place.

As we learned in the previous assignment, it may be tempting to use the magnifying glass button in the plot window to zoom in near where the eruption occurred, but we have found that this may cause the OSL to freeze, requiring it to be restarted. So, we are going to use the get_stations function again, but we are going to specify a smaller area to download stations from. We are going to look at an area surrounding the eruption:

```
inv = client.get_stations(network="HV", station="*", channel="EHZ", level="channel", starttime=starttime, endtime=endtime, minlatitude="19.25", maxlatitude="19.75", minlongitude="-155.22", maxlongitude="-154")
```

Run this command and then `inv.plot(projection="local")` to view the stations in the area that we specified.

Reviewing the latitude and longitude of the eruption from earlier in the assignment, and comparing to the map, which 4 letter station is closest to the eruption?

NOTE: If you there is an error message and the plot doesn't load, try entering these import commands in Python:

```
import matplotlib
matplotlib.use('TKAgg')
```

and loading the plot again

Answer: KLUD

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.67/1.00**.

Question 15

Correct

1.00 points out of 1.00

Flag question

We will request the seismic data for this station, but you can use the station inventory you printed earlier to identify the network.station.location.channel information for this station. What is it?

NOTE: If you ran into trouble running `print(inv)` try this:

```
inv.get_contents()['channels']
```

Like the `print(inv)` command, `inv.get_contents()` retrieves the contents of the object inv. `['channels']` specifies that we want the array containing the full names of the stations, including the channel code. The resulting array gives the network.station.location.channel codes for each station.

Select one:

- a. KLUD.HV..LHZ
- b. HV.KLUD.00.LHZ
- c. HV.KLUD.00.EHZ
- d. HV.KLUD..LHZ
- e. KLUD.HV..EHZ
- f. KLUD.HV.00.EHZ
- g. KLUD.HV.00.LHZ
- h. HV.KLUD..EHZ ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 16

Correct

1.00 points out of 1.00

Flag question

You can also use this network.station.location.channel information to retrieve the station location coordinates from the inventory object. You can review the syntax for doing this with the get_coordinates() function at this webpage:

https://docs.obspy.org/packages/autogen/obspy.core.inventory.inventory.Inventory.get_coordinates.html

Using this function, what is the latitude of this station?

Answer: 19.455728

Check

Correct
Marks for this submission: 1.00/1.00.

Question 17

Correct

1.00 points out of 1.00

Flag question

Using this function, what is the longitude of this station?

Answer: -154.918443

Check

Correct
Marks for this submission: 1.00/1.00.

Question 18

Correct

0.54 points out of 1.00

Flag question

Now we will use the get_waveforms() function to retrieve a day-long seismogram for this station. You may want to review how you used this function in the last assignment. For this assignment, which of the following would be needed to retrieve a day-long seismogram and store it in an object named stream?

Select one or more:

- a. "KLUD", ✓ 1 of 8 answers
- b. stream = ✓ 1 of 8 answers
- c. get_waveforms(
- d. client.get_waveforms(✓ 1 of 8 answers
- e. location="",
- f. station="KLUD",
- g. endtime) ✓ 1 of 8 answers
- h. "EHZ", ✓ 1 of 8 answers
- i. "HV", ✓ 1 of 8 answers
- j. "", ✓ 1 of 8 answers
- k. starttime, ✓ 1 of 8 answers
- l. channel="EHZ",
- m. network="HV",

Check

Run the full command now: `stream = client.get_waveforms("HV", "KLUD", "", "EHZ", starttime, endtime)`

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.54/1.00**.

Question 19

Correct

1.00 points out of 1.00

Flag question

Now we will use the plot() function but with the dayplot option selected to let us view up to a full day of data. Reviewing the plot() manual from the last assignment, which of these would accomplish the dayplot view, adjusting the amount of time plotted per line to 60 minutes?

Select one:

- a. stream.plot(type="dayplot", interval=60) ✓ Correct. Run this command now.
- b. plot(type="dayplot", interval=60)
- c. plot("dayplot", interval=60)
- d. stream.dayplot(interval=60)
- e. dayplot(interval=60)
- f. stream.plot("dayplot", interval=60)
- g. plot(type=dayplot, interval=60)
- h. stream.plot(type=dayplot, interval=60)

Check

Correct
Marks for this submission: 1.00/1.00.

Question 20

Correct

1.00 points out of 1.00

Flag question

Hopefully this plot clearly illustrates how the seismicity rate changes over the course of the 24 hours after the lava drains from Puu Oo. To help quantify this, I would like you to estimate how many earthquakes can be seen per hour at several different points in the day. At this long of a time frame, it is hard to see the details of what is happening in a given hour, but it is fair to assume at this station that noticeable bursts of energy are the earthquake events we should include in our rate estimate. This is certainly an approximation and there are more quantitative ways to calculate this, but it is an important skill to estimate seismicity rates qualitatively before employing more detailed techniques to get more quantitative. So how many events are visible in the first hour (time: 00:00 to 01:00)? To help with consistency of estimating, I would recommend not using the zoom tool on your dayplot for this and the next few questions.

Answer: 0

Check

Correct
Marks for this submission: 1.00/1.00.

Question 21

Correct

1.00 points out of 1.00

Flag question

How many events are visible in the hour from 05:00 to 06:00?

Answer: 4

Check

Correct
Marks for this submission: 1.00/1.00.

Question 22

Correct

0.50 points out of 1.00

Flag question

How many events are visible in the hour from 11:00 to 12:00? You may find it easiest to count the number of clear events in the first 15 minutes and multiply to get an estimate of the number for the full hour.

Answer: 32

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.50/1.00**.

Question 23

Correct

0.75 points out of 1.00

Flag question

How many events are visible in the hour from 23:00 to 24:00? You may find it easiest to count the number of clear events in the first 15 minutes and multiply to get an estimate of the number for the full hour.

Answer: 80

Check

I allowed a wide range for this considering it is difficult to estimate exactly how many.

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.75/1.00**.

Question 24

Correct

0.67 points out of 1.00

Flag question

I would hope the pattern in the seismicity is clear now: increasing substantially as the lava flows through the subsurface. In some ways, we think of the seismicity rate increase as an indication of stress increase: the flowing lava is pushing on the solid rock and causing it to slide along faults that cause earthquakes. We can use this seismicity rate change to get some estimate of how quickly the lava is flowing through the subsurface. Since we know the lava drained from Puu Oo at approximately 00:00 UTC, we can see when sizable earthquakes started occurring near this seismic station to estimate the time it took lava (or potentially lava pressure) to flow in the subsurface. When did the first sizable (many times larger than the background noise) earthquake occur in our day plot (UTC time)?

Select one:

- a. 04:35
- b. 03:34 ✓
- c. 03:04
- d. 04:03
- e. 00:40
- f. 00:33

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.67/1.00**.

Question 25

Correct

1.00 points out of 1.00

Flag question

Approximately how many seconds is there between the lava draining and the first sizable earthquake?

Answer: 12840

Check

Correct
Marks for this submission: 1.00/1.00.

Question 26

Correct

1.00 points out of 1.00

Flag question

If we assume that this earthquake occurred at the seismic station (not a bad assumption, but typically seismologists can do better than this), then we can estimate the distance the lava traveled from Puu Oo to the earthquake source area. To do this, we can use another function in ObsPy that allows us to access the distaz IRIS webservice:

https://docs.obspy.org/packages/autogen/obspy.clients.iris.client.Client.distaz.html

To make this work, we will need to load the specific IRIS client and then label it iris, because we already have the FDSN client labeled as client.

I know this is a bit confusing, but there are two ways to use IRIS webservices: directly through IRIS, or through FDSN and then to IRIS. The latter is what we have been doing up to this point. It may seem like an extra step, but it is recommended to do it this way because you can change the data provider from IRIS to another global provider very easily because they have standardized according to the FDSN interface. However, the distaz and other webservices like timeseries are specific to IRIS, so we need to go directly to them for this.

The following commands will set up a direct IRIS client with the name **iris**:

```
from obspy.clients.iris import Client
iris = Client()
```

Now you can calculate the distance using this format:

```
result = iris.distaz(lat1, lon1, lat2, lon2)
print(result)
```

provided you put in the latitude and longitude values of Puu Oo and the seismic station for `lat1, lon1, lat2, lon2`. Note that the result will show the distance in both degrees and meters. Using this approach, what is the distance between Puu Oo and the seismic station in meters?

Answer: 21042.85785

Check

Correct
Marks for this submission: 1.00/1.00.

Question 27

Correct

1.00 points out of 1.00

Flag question

Now using the distance and the time estimates, what is the approximate speed the lava (or lava pressure) travels through the subsurface in meters per second?

Answer: 1.63885185748

Check

Correct
Marks for this submission: 1.00/1.00.

Question 28

Correct

0.67 points out of 1.00

Flag question

That speed probably seems rather fast for lava. You can read about how fast Hawaiian lava typically flows in this article from the USGS:

https://www.users.miamioh.edu/brudzimr/classes/HowFastHawaiianLavaFlow.pdf

How does the speed we estimated compare to the range discussed on that webpage?

Select one:

- a. Our estimated speeds are faster than the range discussed on the webpage
- b. Our estimated speeds are slower than the range discussed on the webpage
- c. Our estimated speeds are within the range discussed on the webpage ✓
- d. There is no way to compare our estimated speeds with those on the webpage

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.67/1.00**.

Finish review