Midterm AOS/EPSS M71 Fall 2020

Introduction to Computing for Geoscience Types

Thursday, November 19th; 10am - 11:50am.

<u>Big Picture</u>: Identify the three most important things in your life. Note that none of them are this exam… **Takeaway**: Breath out, relax, and take the exam.

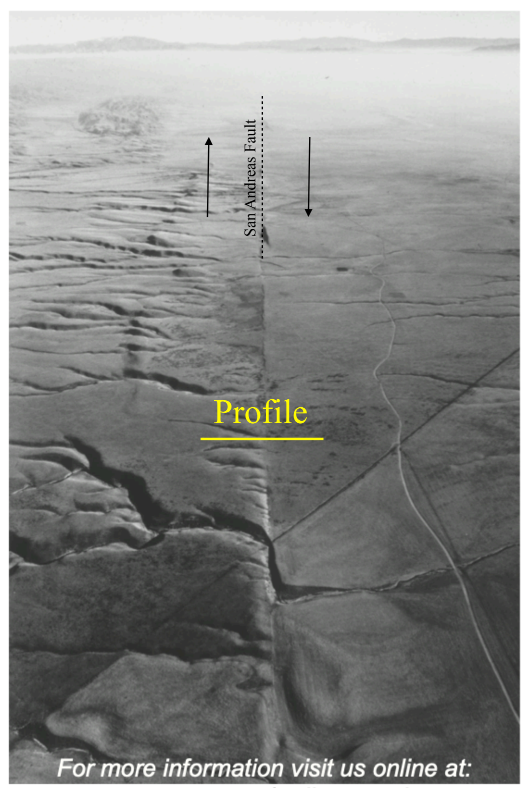
<u>Rules:</u> This exam is open book, open notes, open computer, open web access; closed email; closed texting, no GroupMe, no GoogleDocs, **no funny stuff**.

The exam is worth **12 points** total. Grading is based on your coding results as well as on our ability to follow what you have done. Thus, in addition to your code, please include markdown cells and comments as necessary. These will give your ipynb structure and allow us to better follow the logic of your coding.

After completing the exam, please upload the input data file (CarrizoFault.txt), your Python solution notebook (*YourLastName*_MdtrmF20.ipynb), the PDF of your ipynb (*YourLastName*_MdtrmF20.pdf), and your 150 dpi output figure (*YourLastName*_MdtrmF20.png). (We reserve the right to take off up to 4 points for each missing file, and up to 2 points for each mis-labeled file.)

Problem: San Andreas Fault Scarp

For today's exercise, you will make a 3-panel subplot using surface elevation data across the segment of the San Andreas fault located in the Carrizo Plain (which is about 3 hours from here). The data is from a profile taken perpendicular to the fault just south of Wallace Creek.

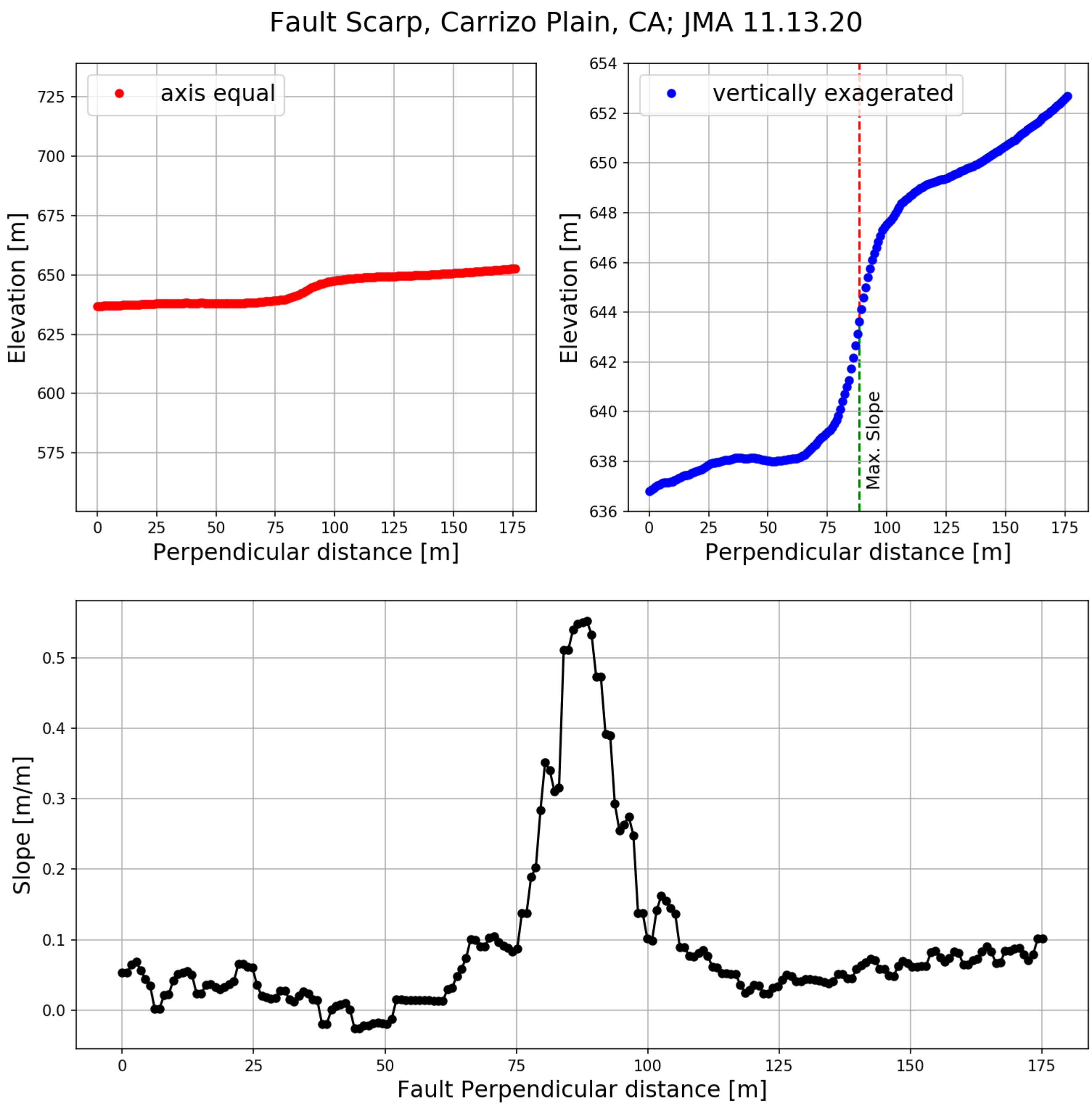


www.scec.org/wallacecreek

1) Go onto the M71 CCLE page and download the zip file in the Week 7 folder, MIDTERM-M71F20.zip. It contains this file as well as a two column data file "CarrizoFault.txt".

2) (1 point) Load the data in "CarrizoFault.txt" into your Python notebook into two arrays, *dist* and *el*. The left column in "CarrizoFault.txt" contains distance along the ground, *dist*, measured in meters perpendicular to the fault scarp. The right column is surface elevation above sea level, *el*, also in meters.

- Check, by printing to the screen, whether or not the two arrays *dist* and *el* each have the correct number of points, which is 200.
- This data comes from Prof. Seulgi Moon who studies geomorphology and neotectonics in EPSS.



Three Panel Subplot of Fault Scarp Data:

3) **(**2 points**) Upper left panel.** Plot fault perpendicular distance *dist* along the x-axis and elevation *el* along the y-axis. Figure out how to make the plot have equal axis ratios, such that the same scale is employed on the horizontal (x) and vertical (y) axes.

- Include a grid (plotted behind the *dist-el* data), labels and legend, as shown.

4) **(**3 points**) Lower row panel.** Use *numpy.diff* to measure the surface slope s as a function of distance, where slope is estimated by the change (Δ) in elevation for a given change in distance, $s = \Delta dist/\Delta el$. This operation is similar in style to our measurement of velocity in the Balloon Data problem, but there we estimated velocity v as $v = \Delta alt/\Delta t$.

- Plot the data as black circles with solid lines connecting them.
- Include a grid (plotted behind the data) and axis labels, as shown.
    - NB: *numpy.diff* outputs an array that is one element shorter than the length of the input array.

5) **(**5 points**) Upper right panel.** Plot the distance versus elevation data as blue circles *without* using equally scaled axes (just let Python autoscale it). This autoscaling vertically exaggerates the data (aka, it stretches it vertically), allowing one to far better see the structure of the fault scarp.

- Include a grid (plotted in the back), axis labels, and a legend, as shown.
- Fix the y axis limits to range from 636 to 654 meters.
- Using Boolean addressing (do not insert numbers "by hand"), place a dashed line at the *dist* location that has the maximum surface slope.
    - Make the dashed line green below the *el* value at that *dist*, and make it red above that *el* value. Plot the dashed line(s) behind the fault scarp data, but in front of the grid.
    - Place the text "Max. Slope" just to the right of the dashed green line.

6) **(**1 point**)** Include a title above the subplot that contains your name (I lazily just put my initials). Save the plot to a 150 dpi png file, and save your ipynb to a pdf file.

- Make sure that the title is not cut-off in the png. Mine was at first.

7) Load your ipynb, pdf and png image onto the CCLE exam upload page. Nice work!: You. Are. Done.

Apres Exam: I got this profile from Prof. Seulgi Moon, who generated it using the open source "scarplets" package https://scarplet.readthedocs.io/en/latest/examples/scarps.html, which contains Python and Matlab tools for automatically detecting fault scarps in digital elevation models (DEMs). The first example on that page is indeed the Carrizo Plain. The digital elevation data they used was, in turn, harvested from https://opentopography.org. **Takeaway**: The atmospheric, climatological, geological, geophysical and oceanic data is out there. And we are building up the tools, the skills, and the attitude to analyze and interpret it.