

PHY499: Introduction to Python for Scientists

Homework Assignment 6 (4 Nov, 2016)

(NOTE: This assignment will be graded!)

Send your code to `michael.mommert@nau.edu`.

1 Dust Storms

Dust storms regularly occur during Arizona's monsoon season. In order to measure the amount of dust that has moved as a result of a dust storm, scientists put up dust counters. During one of such dust storms, a dust counter that measures the dust mass added to an area of 1 m^2 in 1 min, provides the following sequence of data in units of g min^{-1} :

[0, 0, 1, 2, 4, 7, 4, 8, 12, 14, 11, 6, 3, 1, 0]

The interval between the individual measurements is 5 min.

Use a cubic Spline interpolation to estimate the rate of dust accumulation in Minute 43.

Assuming that this dust storm affected a total area of 10^6 m^2 , what was the total mass of dust that has been moved over the duration of the storm in (metric) tons?

Hint: Integrate the cubic Spline function over the duration of the storm (e.g., using `scipy.integrate.quad`) and scale it appropriately to the total area.

2 Global Temperature Changes

The NASA Earth Observations program (http://neo.sci.gsfc.nasa.gov/view.php?datasetId=MOD11C1_M_LSTDA) supplies global temperature maps of Earth for the past 15 years. The two files `earth.temperatures.200107.csv` and `earth.temperatures.201607.csv` in the assignments folder of our github website represent such maps for July 2001 and July 2016. Download these files. Each file consists of an ascii table with the shape (180, 360); each cell represents the average temperature in a $1 \text{ deg} \times 1 \text{ deg}$ cell on the globe. 'nan' values in the tables represent missing data (mostly oceans).

Derive the residual temperatures between 2016 and 2001 and plot them. This map shows the world-wide temperature changes between 2001 and 2015. Use the 'jet' colormap for this task and add a labeled colorbar (see Figure 1).

Display the average global temperature residual and its standard deviation on the screen. Did the surface of the Earth get significantly warmer in the last 15 years?

Display Flagstaff on the map as a black circle (note that you have to transform Flagstaff's latitude and longitude into 'pseudo-latitudes' and 'pseudo-longitudes' that are map-specific). What is the temperature residual in the Flagstaff area?

Finally, what is the largest positive and the largest negative temperature residual? Where are those spots on the map? Indicate that place that heated up (cooled down) the most with a red (blue) circle.

The resulting map should look like Figure 1.

Hint: In order to deal easily with the nan values in the table, use numpy's nan function (e.g., nanmin, nanmax, nanmean, nanstd).

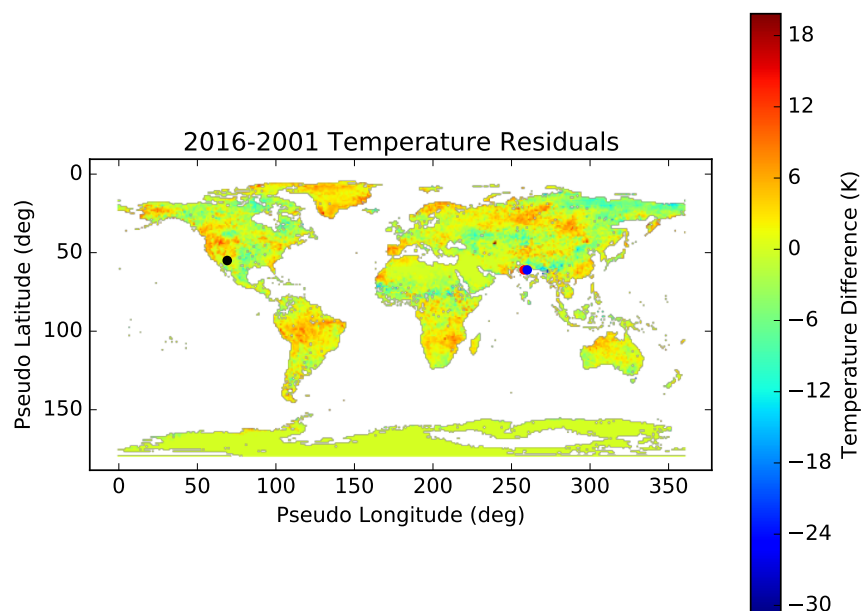


Figure 1: Global temperature changes between 2001 and 2016. The black circle indicates the location of Flagstaff; the red and blue circles those locations with the largest positive and negative temperature changes, respectively.

If you want this assignment to count into your final grade, please submit it to
`michael.mommert@nau.edu` before 18 Nov, 23:59!