PHYS 411 <u>Term project</u>   Fall 2019. J. Gemmrich

DUE: 14 December 2019

Outline

The project will be to analyze temperature data from the UVic School Weather Network
(http://www.victoriaweather.ca) , and to submit this as a written report.
Two types of data are to be considered:

a) Minute-resolution data

Data files for following stations can be found on CourseSpaces:
DeepCove, DiscoveryElementary, Helgesen, JamesBay, Keating, UVicSCI, and JohnMuir
These files contain only the temperature data. at 1-minute resolution. In Matlab, these data can be read-in
with the load command. E.g.
InT = load('DeepCove_temperature.dat');
The time stamps have to be generated from the start time *tt_start* (1st number), end time *tt_end* (second
number) and total number of data points *NT* (3rd number).

In Matlab this can be done as follows:
tt_start = InT(1); tt_end = InT(2); NT = InT(3);
tt = linspace(tt_start,tt_end,NT);

Note, *tt_start, tt_end, tt* are given as decimal days (as discussed below). data points 4 to NT+3 contain the
temperature in degrees Celsius. The time reference for these minute-resolution data sets is UTC.

Present the data, and characterize it using techniques discussed in class. Obvious things to do are just plot
the time series, find means, PDFs, spectra. More involved projects will present correlations between the
different stations (that's why you have data from several stations!). What differences and patterns can you
find between the stations, and can you explain using your knowledge of the local climate?

<u>Handling dates:</u>
Times are given in decimal days, starting on 01/01/00. In Matlab, these dates can be manipulated with the
commands "*datestr*" and "*datenum*". If *d* is a date, then *datestr(d)* will return a nice string with the date.To
convert a date string into a number use *datenum*. E.g. *datenum(2017,1,1)* will return 736696.0. For plotting,
its OK to simply plot decimal days (say days from 1 Jan 2010), or to use *datetick('x')* to make
date-formatted ticks.

b) Hour-resolution data

One-hour resolution temperature data are taken from a larger set of **35 stations** in Greater Victoria. (All
stations are combined in a single data file, to be found on CourseSpaces). These data are on an even time
grid, from 2008-01-01 00:00 PST to 2017-08-31 00:00 PDT, with each row representing temperature at a
given time, and each column at a given station. The first two rows are the longitude (degrees E) and latitude
(degrees N) of each station. The first column gives the time stamps (common to all stations). (Note: The
time stamps of the minute-resolution data are given in UTC. The time stamps of the hourly data are local,
PST/PDT).

First, it would be nice to replicate the map on UVic School Weather Network. Use some sort of 2-D
interpolation to put the sparse data on a lon/lat grid, and then plot. Indicate station locations. A file
containing data for the coastline (2 columns: longitude, latitude) is provided here: Coast line data. Note the
islands, etc are missing.

Then use this data set to look for spatial patterns of variability between the stations (i.e. calculate the
Empirical Orthogonal Functions, or Principal Components). Plot the strongest modes of variability and
indicate what fraction of the variance they represent. Plotting time series of the modal amplitudes is also
very effective way of thinking about the system. Again, spend a couple of paragraphs explaining the patterns
you found, and indicate if those patterns might have a physical meaning. Looking at the seasonality of the
amplitudes may help.

Dealing with geographic data
A data file with the coastline is given above, to be used for your maps. One thing to keep in mind is that 1
degree of latitude is 60 nautical miles (110 km), but 1 degree of longitude is only 60*cos(lat) nautical miles,

so it is useful to scale your x and y axis so the aspect ratio is [1 cos(lat)], where "lat" is some latitude that is on the center of your plot. This area is small enough that this approximation will be good enough - for larger areas you would need to choose a projection from a sphere onto a map (i.e. the "Mercator", "Azimuthal" etc projections).

The Project

The final project is to submit a written a report. This report should consist of a very brief introduction, a short description of how the data were collected, and then sections that present your observations/analysis. I'd expect that you will have around 20 plots. You should describe in the text the most important observations that you make about your data. In making these statements, hopefully you will come up with other analyses to try.

Project grading

Complete set of plots: 20%

- make sure you plot enough of the data to explain it, and that you do the "basics".

Well-made and easy to follow plots: 20%

- proper captions - proper labels - economical use of space (20 plots, one to a page, where the same info could have been in 1 plot will not get you full marks)

Complete prose: 20%

- explains data analysis techniques: not in gory detail, but enough that someone who had taken this class will know what you did. - Explains salient features of the data concisely and in such a way as to point out to the reader the importance of what they are seeing. Don't describe plots line by line, but summarize what the plot tells us.

Well-organized and -written: 20%

- Good grammar - paragraphs that have a topic sentence, and keep to that topic. (Saving the point of the paragraph for the last sentence is great for mystery novels, terrible for expository writing).

Go the extra mile: 20%

- show that you've thought about the data to some extent and done an extra analysis or two to dig into it more than just applying the basic techniques of the course.

Late Policy: 10% per day.