Environmental Data Analysis in the Anthropocene
RCSE 6860--FALL 2022

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Office Hours: Thursday 3:30–16:30pm or by appointment

Homework assignment number 5:

In this assignment we are going to analyze 20 tide gauge records in the Gulf of Mexico ('PSMSL_GoM_VLMcorrected_assignment5.mat') that can be downloaded from the shared Box folder in subfolder Assignment No. 5. It consists of 20 stations. Goal is to analyze the intra-annual to decadal variability in the records, correlation clusters, and to build regional indices. We focus on the 1950-2015 period!

1.) Load the PSMSL data. Please note that I already corrected each tide gauge record for vertical land motion (which is particularly pronounced along Louisiana and Texas coastlines).
   a. Correct all 20 tide gauge records for the global mean sea level (GMSL) by subtraction and create a GMSL corrected data matrix 'Mcl'.
   b. Linearly detrend Mcl to remove potential residual trends due to unaccounted vertical land motion and create a residual data matrix 'Mcldt'.
   c. Create a subplot that shows all 20 time series before and after applying the corrections in a and b. Use the tight_subplot.m function (same Box subfolder Assignment No. 5) and plot all time series with vertical offsets of 300mm. The yaxis should show the tide gauge location names. The left panel subplot should show the time series from the 'raw' Mc matrix. The right panel should show the time series after applying all corrections (i.e., 'Mcldt').

(30 points)

2.) Now we are going to analyze the variability with respect to the question how it varies throughout the Gulf of Mexico.
   a. Calculate the cross-correlation matrix for 'Mcldt'. Make sure that you ignore NaNs in the matrix, such that you get every matrix element filled with a correlation value.
   b. Calculate the standard deviation for each location in Mcldt.
   c. Plot the cross-correlation matrix (from a) as an image (left panel) together with the corresponding standard deviations (from b) (right panel). You can use the figure on slide 14 from the 'Bivariate Correlations and Correlation Clusters ppt presentation' as an example of how the plot should look like. Please describe the figure. How many correlation clusters do you identify? Are there locations that do not fall within larger clusters? Mark your major correlation clusters by black boxes in left panel of the subplot. Please consider the standard deviation in your argumentation.
   d. Built an average index for the clusters of your choice.

(70 points)

Please return this assignment no later than **April 30th 5pm CT**.