Midterm Problems Week 7-8

Due Tuesday, November 21, 2017

This problem set is to be completed independently, without collaborating with your classmates. At the top of your problem set, please write and sign the following statement: "I certify that this represents my own work and that I have not worked with classmates or other individuals to complete this assignment." If you have questions, you may e-mail me.

For this set of problems, we'll consider atmospheric and ocean temperatures from the Stratus XIV mooring at 19°49'S, 84°44.4'W in the Pacific Ocean. This deployment extended from April 2015 through June 2016. You can download the high resolution surface meteorological from here:

http://uop.whoi.edu/currentprojects/Stratus/stratusarchive.html

And the specific NetCDF file that you need is here:

http://uop.whoi.edu/currentprojects/Stratus/data/OS_Stratus_2015_D_M.nc

or retrieve it from TritonEd (in the Lecture 11 folder). The goals of this exercise are to show that you can compute spectra of real data and carry out some basic interpretation.

1. **Inspect the data. (10 points)** Retrieve the data, plot time series of sea water temperature (T_o, identified as 'TEMP') and surface air temperature (T_a, identified as 'AIRT'), with appropriately labeled axes. Be sure to check for values that might be flagged as bad data and treat them as NaN. Are there gaps in the data? (If so, replace missing values (NaN) with the mean of nonmissing values (nanmean(data)).) What do you notice about the data?

2. **Compute the spectra for T_o and T_a. (30 points)** Use the segmenting approach that we discussed in class to compute the spectra. Please follow the "best" practices that we have discussed and explain your approach. Be sure to do the following:

   a Verify Parseval's theorem.
   b Be attentive in labeling your x axis.
   c Be attentive in labeling your y axis.
   d Provide an uncertainty estimate.
   e Compute the Nyquist frequency.
   f Identify the frequency resolution.
   g Identify and discuss the spectral peaks.
   h Ignoring spectral peaks, roughly what is the spectral slope for each variable?

   What are the differences between the two spectra?

3. **Show a variance preserving version of your spectra. (20 points)**

   a Be attentive in labeling your x axis.
   b Be attentive in labeling your y axis.
   c Provide an uncertainty estimate.

d What is highlighted by the variance preserving spectrum?

4. **Bonus: Compute the autocovariance of your data and use this to produce spectra. (up to 20 points)** What are the pros and cons of using the autocovariance rather than the original data?