Problems Week 5

Due Monday, November 5, 2018

1. **Aliasing.** The Surface Water and Ocean Topography (SWOT) satellite is due to launch in 2021. It has two planned orbits. The initial calibration and validation will be carried out with a fast-sampling orbit, with an exact repeat of about a day, and the subsequent science mission will have about a 21-day repeat. Specific time periods are listed in the table below:

Orbit	period (days)
Fast-sampling	0.99349
Science	20.86455

What is the alias period for each of these orbits for the lunar semi-diurnal (M2) and solar diurnal (S1) tidal cycles? How long should the satellite operate in each orbit to provide multiple realizations of the tidal amplitude?

Symbol	Name	period (hours)
S1	Solar diurnal	24.00
M2	Principal lunar	12.42

2. **Spectra.** Download the bottom pressure record from 1994-1996 at site SD2 in the Southern Ocean:
https://www.bodc.ac.uk/data/hosted_data_systems/sea_level/international/bpr_data/netcdf/b0530105.zip
(The web site for these data is here:
https://www.bodc.ac.uk/data/hosted_data_systems/sea_level/international/bpr_data/

   a Read the variable identified as 'pressure_sea_relative_1'. Subdivide the data into overlapping segments that are each 10,000 points long. (You should have 13 segments.) Compute a spectrum. Use the 'time' variable to set the frequency. What is the time step between observations? Follow best practices that we've discussed in class. What peaks do you identify in your spectrum?

   b Now subsample the data every 40 data points. What is the new time step between observations? Compute a spectrum, again using 13 overlapping segments. Are the spectral peaks at the same frequencies as for the full record? If not, why not? (Where should the alias frequencies occur for the sub-sampled data?

   c How do the spectral energies compare? (To compare the subsampled spectra to the full spectrum, you will need to make sure that your nomralizations are correct. Effectively you need a factor of 40 difference between the simple un-normalized spectra.)