Problems # 7

Due Tuesday, November 18, 2021

1. **Aliasing.** The Surface Water and Ocean Topography (SWOT) satellite is due to launch in a year, on November 15, 2022. 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

How will the following tidal frequencies be aliased by the satellite orbit? How long should the satellite operate in each orbit in order to separate these frequencies?

Symbol	Name	period (hours)
S_1	Solar diurnal	24.00
$2N_2$	Second-order elliptical lunar	12.9054
N_2	Larger elliptical lunar	12.6583
M_2	Principal lunar	12.4206
S_2	Principal solar semidiurnal	12.00
K_2	Declinational solar	11.9672

2. **Spectra of aliased signals.** Use the same wind speed time series that you used for problem set #5, with the same gap filling and 60-day segments.

   a Subsample the data set ever 40 data points (6.667 hours) and recompute the spectrum.

   b Compare the resulting spectrum with the spectrum that you obtained for the full data set by overlaying the subsampled plot over your earlier result.

   c What is the resolution of the subsampled data set, and what is the Nyquist frequency?

   d Are the spectral peaks at the same frequencies as for the full record? Where should the alias frequency of the semi-diurnal peak occur for the sub-sampled data?

   e 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.)