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Data I

October 19, 2017

HW 3

1. The plot of pressure from Scripps Pier for the full year 2015 shows some data gaps, especially in mid-November and for the first half of December. The difference between successive measurements is 6 minutes and 1 second for most of the measurements. The median of the sample measurement increments is 6 minutes and 1 second. However, there appear to be periodic deviations from this measurement increment, around every month or so, during which the increment between measurements is longer. Either the sensor is being cleaned or calibrated, or the sensor stops working. A time period with consistent sample is in the beginning of 2015, from December 31, 2014 to February 4, 2015, roughly 36 days.
2. The mean is 3.49. The total amplitudes are 0.1686 for O1 the principal lunar diurnal tide, 0.3715 for K1 the luni-solar diurnal tide, and 0.5274 for M2 the principal lunar tide.
3. For a period between June 15 and July 15, the tidal amplitudes are 0.1699 for O1 the principal lunar diurnal tide, 0.3799 for K1 the luni-solar diurnal tide, and 0.5258 for M2 the principal lunar tide. The tidal amplitudes are off by 0.0013 for the principal lunar diurnal tide, 0.0084 for the luni-solar diurnal tide and 0.0015 for the principal lunar tide. The luni-solar diurnal tide is the most different from winter to summer. This may be because of the difference seasonally in the distance the Earth is from the sun, which varies the force the sun exerts on the tides. Thus, the amplitude of the sun’s tidal force may vary seasonally.
4. For three functions, the chi squared misfit of my least squares fit was 361,465, which is a large number. I used a variance, σi 2 , estimated from one hour of measurements at high tide, which was a small number for the variance, around 0.0009 db. When fitting 5 tidal frequencies, the chi squared misfit was 66,053, which is a smaller number but still too large. I expect N-M which is the number of data points, N, and M, the number of columns of the matrix A or twice the number of tidal frequencies plus one. Thus, I expect 8,312-7 = 8,305 or 8,312-11 = 8,301. Both of the misfits are too large for the gamma function to calculate a meaningful probability. In both cases, the probability is 1 that the misfit is too large. I varied σi and found that at 0.09, the fit with three tidal frequencies had probability 1 that the misfit was too large and that the fit with five tidal frequencies had probability 3e-24 that the misfit was too large. Thus, the σi value we used was either incorrect to use, or another type of statistical benchmark tool is needed to evaluate the chi-squared misfits using the calculated σi. I would guess that fitting 5 tidal frequencies instead of 3 improves the least squares model’s fit because the chi squared value is closer to N-M.