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Data I

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HW 10

1. I chose to take two spatial records. I am using glider data from the California Current that have been objectively mapped in space for discrete times. The objectively mapped product has a spatial sampling length of 5 km. The variable that I am looking at is the geostrophic velocity, which since the glider transect is perpendicular to the coastline, is a measurement of the alongshore current velocity, with positive values denoting poleward flow and negative values denoting equatorward flow. I took the geostrophic velocity from 80 m depth and from 200 meters depth. Sample transects are plotted together in the first figure, as well as all of the data end to end. It is apparent that there are sinusoidal patterns in the spatial geostrophic velocity data.

The spectra demonstrate that there is the most energy at low wavenumbers, so most of the pattern with higher current velocities is concentrated in large-scale phenomena. The energy is much larger for scales greater than 25 km (1/0.03947 km per cycle). The spectra are red for geostrophic velocities at both depths. Due to the large number of segments that I have (373), the error bar is quite small. I plotted spectral slopes of k-2, k-11/3, and k-5 for both depths. They represent the expected spectral slope for internal waves, surface quasi-geostrophic turbulence, and interior quasi-geostrophic turbulence.

1. The two spatial records are coherent across all wavenumbers. This is a surprising result, but I have ruled out that it is a mistake in the code or method. Of interest, the threshold value for statistically significant coherence is very low due to the high number of segments that I used. Very interestingly, the phase relationship is zero or close to zero for all wavenumbers.
2. I expected that there would be some peaks in the wavenumber spectra. I expected that there would be coherence at low wavenumbers only. Both of my assumptions were wrong. In terms of conclusions, the coherence means that for the most part, the current structure is similar in the region from 80 to 200 meters. I believe my hypothesis was incorrect because I did not take into account that variations in current amplitude are disregarded in the coherence analysis. This can be understood from the equation for coherence by assuming the amplitude is a constant and noticing that after Fourier transforming and computing the spectral density and cross-spectral density, the coherence squared is a ratio where the amplitudes of the two variables cancel. Further, though I do not know the exact method of calculation for the velocities, the usual way to calculate a geostrophic velocity is to assume a reference depth where all velocities are zero. Thus, the velocities already have potentially the same structure near the reference depth. It would be interesting to check the coherence at 80 versus 400 meters depth.

Some variability in the relationship between the two depths is more apparent at certain wavenumbers. This result varies with and without applying a Hanning window. Without windowing the coherence is higher across intermediate wavenumbers. The patterns on the edges seem to matter. Though the best practice is to use a Hanning window, I could explore the argument that since at least one of the edges is a physical barrier in the real world, I should include the pattern on the edges. I chose to present the results with the Hanning window.