Measuring and Forecasting the Background Open Ocean Tsunami Spectrum

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Synopsis

We found that the background open ocean tsunami spectrum (BOOTS) slope varies from a reference power law of ω^{-2}, where ω is angular frequency. Our study shows that the BOOTS slope varies due to a combination of infragravity wave (IGW) effects brought on by meteorological forcings.

BOOTS meteorological variability is driven by:

- Extratropical cyclones in the North Pacific.
- Tropical systems off Central and South America.

Measuring the BOOTS slope helps to reduce aleatory variability and epistemic uncertainty in tsunami source models.

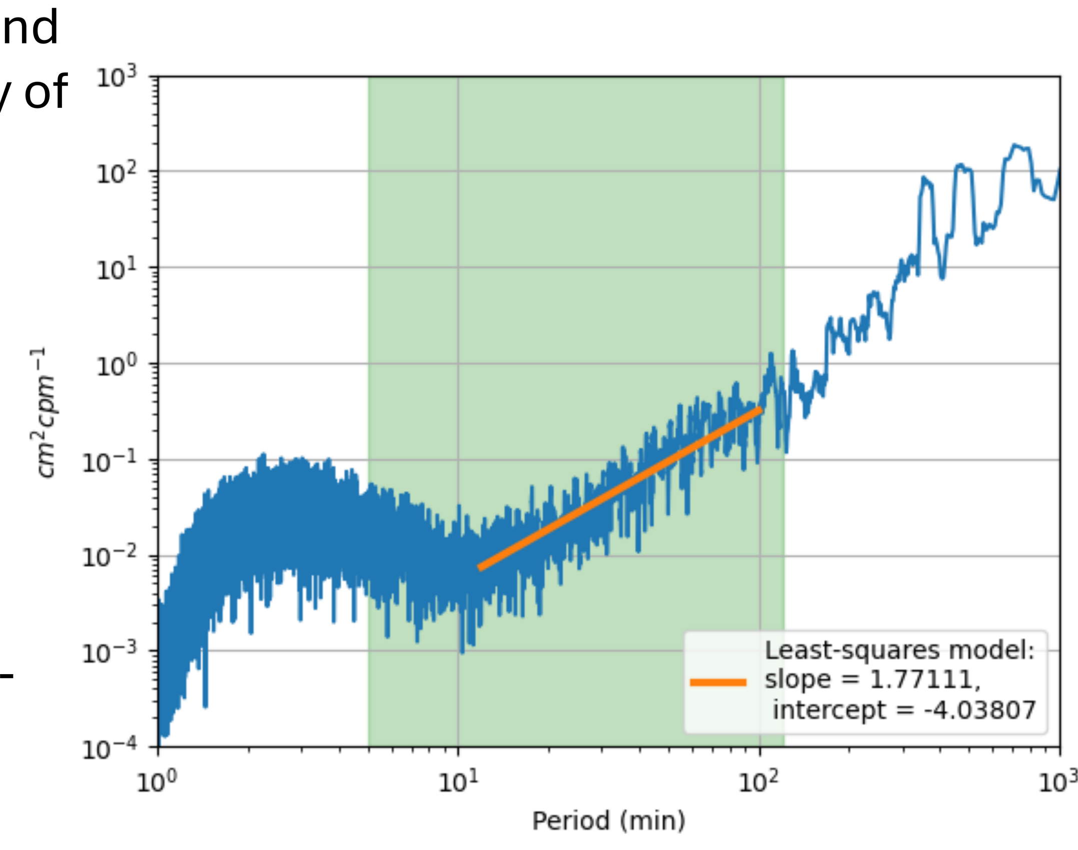
BOOTS Slope (ω^{-x}) Variability

The BOOTS is a measure of the background open ocean energy spectrum described by Rabinovich (1997) as:

$$S_o = \frac{1}{2\pi} E_o \omega^{-2}$$

Where $E_o = 10^{-3} - 10^{-4}$, depending on atmospheric activity. This spectrum is necessary to estimate the tsunami source function.

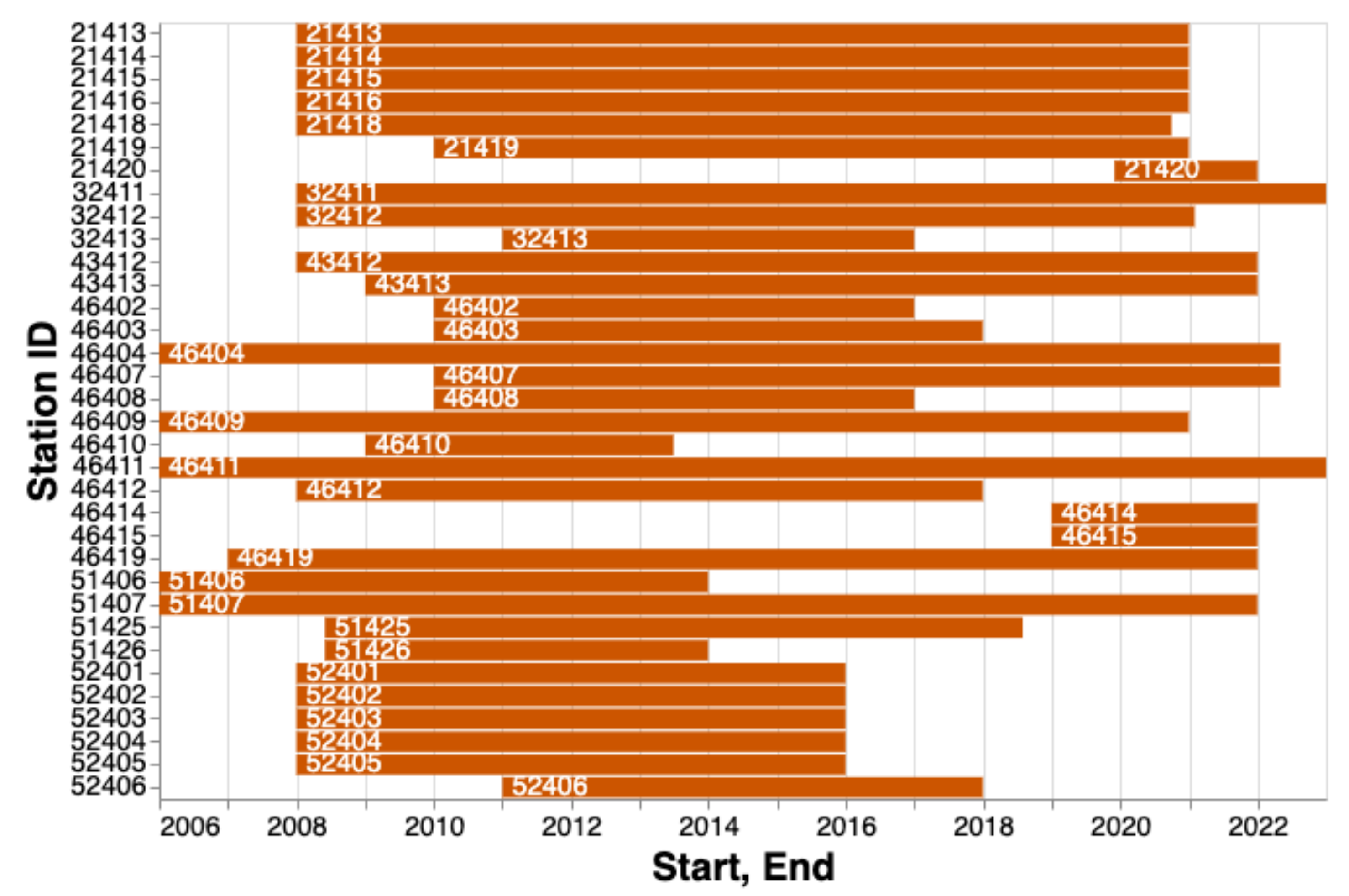
The BOOTS slope is calculated by using the multitaper power spectral density method from Prieto (2022) on two-week windows of bottom pressure recorder data from 34 Deep-ocean Assessment and Reporting of Tsunamis (DART) stations. We perform a linear regression over the period 11 mins - 100 mins to measure the BOOTS slope and Intercept (E_o) for the entirety of data available except when tsunamis are observed.



In addition, we made Probabilistic Power Spectral Density (PPSD) models for each DART following the method described by McNamara & Buland (2004) without removing tsunami signals.

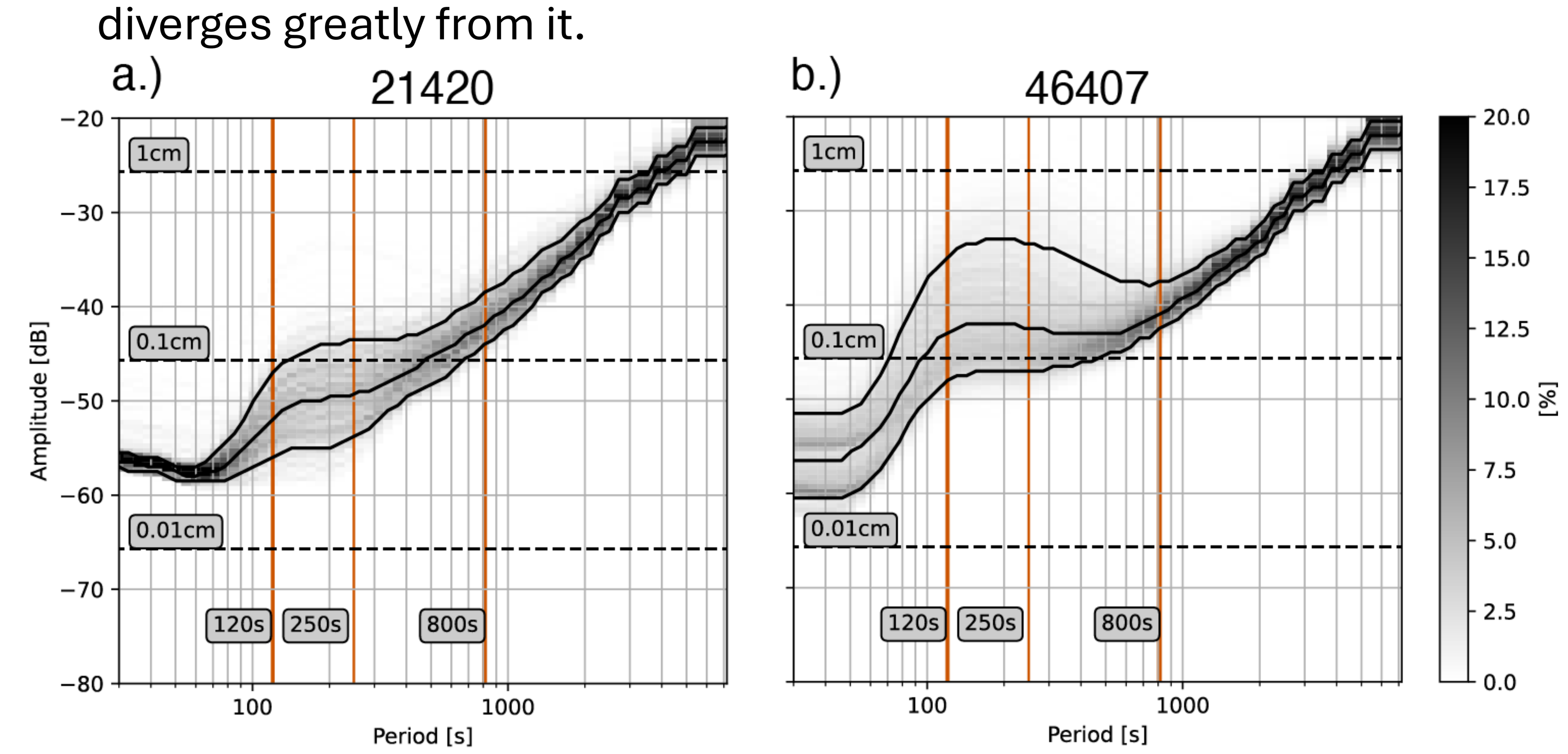
DART Bottom Pressure Recorder Dataset

We used 2-10 + years of DART bottom pressure recorder (BPR) data available from the National Centers for Environmental Information (NCEI) with 15 s sampling rates ((Deep-Ocean Assessment and Reporting of Tsunamis (DART(R)), 2005). BPR data with sampling rates > 15 s or of poor quality were excluded from our analysis.



PPSD Variability

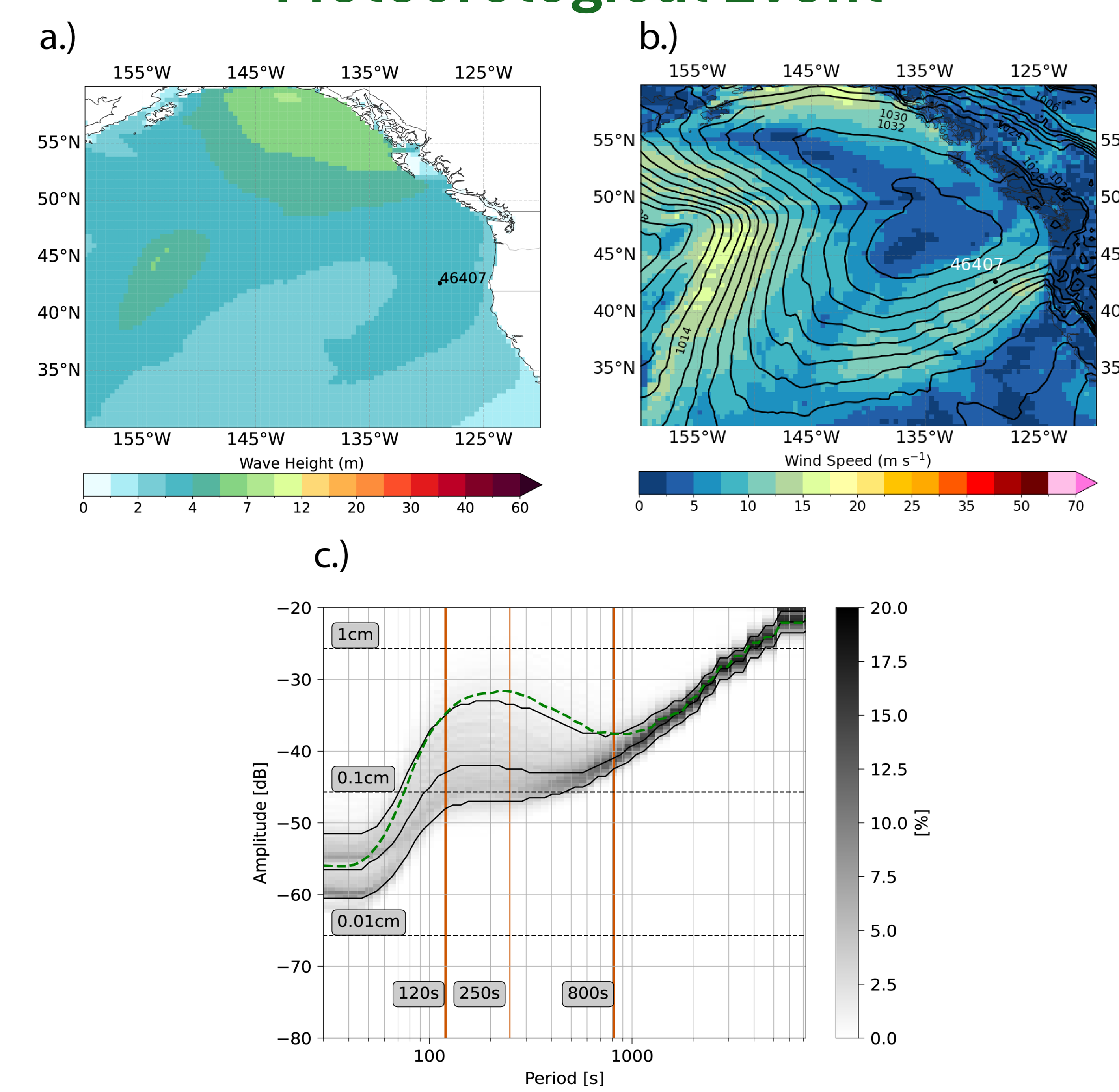
PPSD models of the DART stations were made using the BPR data without tsunami events. PPSDs fall into a spectrum between two noticeable behaviors: enceinte (slight bulge) and dromedary (humped). Enceinte behavior is emblematic of the reference power law, while dromedary behavior is emblematic of behavior that diverges greatly from it.



Enceinte

Dromedary

Effects on the BOOTS from a Meteorological Event

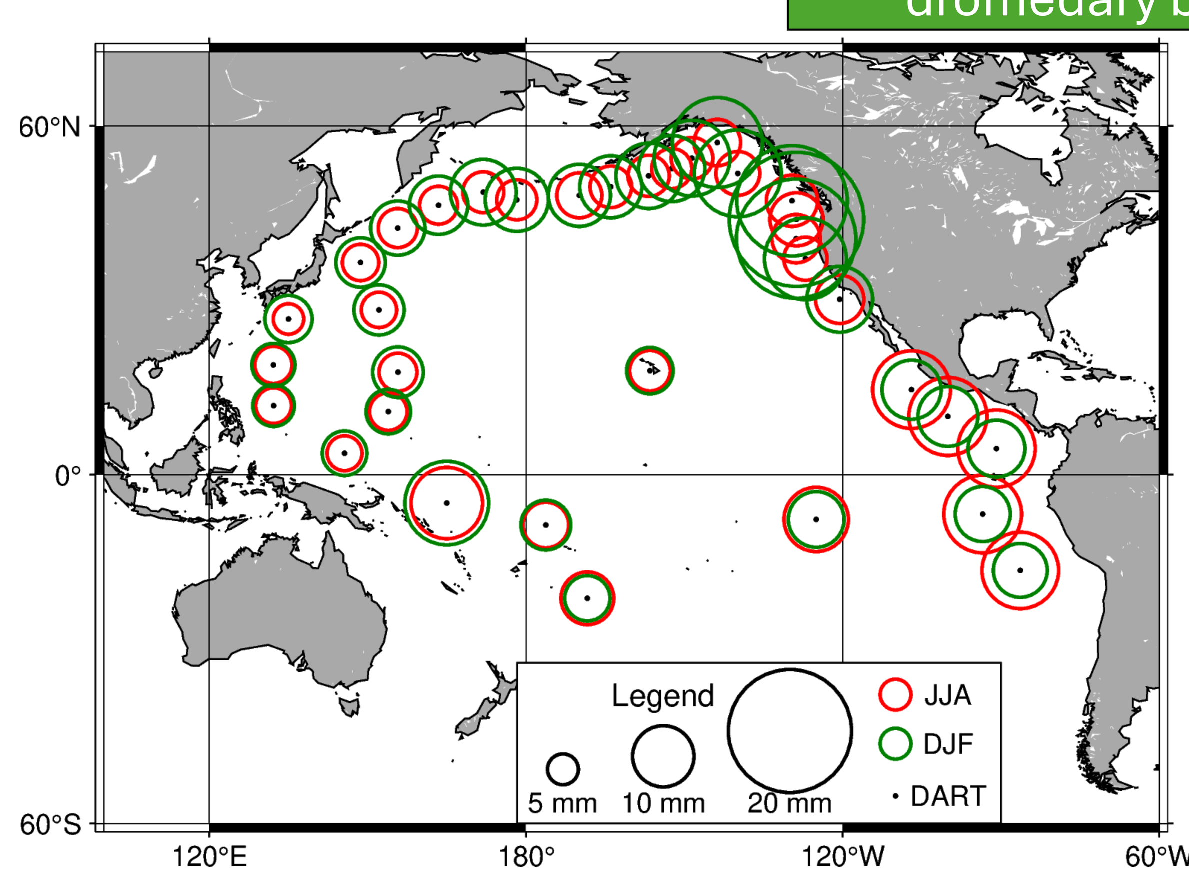


Infragravity Wave Heights for the Pacific

The following figure shows the average IGW heights for the DART stations for:

- June, July, and August (JJA)
- December, January, February (DJF)

Large IGW height differences between JJA and DJF correspond to areas of dromedary behavior!



Scan for copy of poster!

Poster #179

References

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