THE IMPRINT OF WATER-COLUMN RESONANCE ON SECONDARY MICROSEISMIC SOURCE SPECTRA

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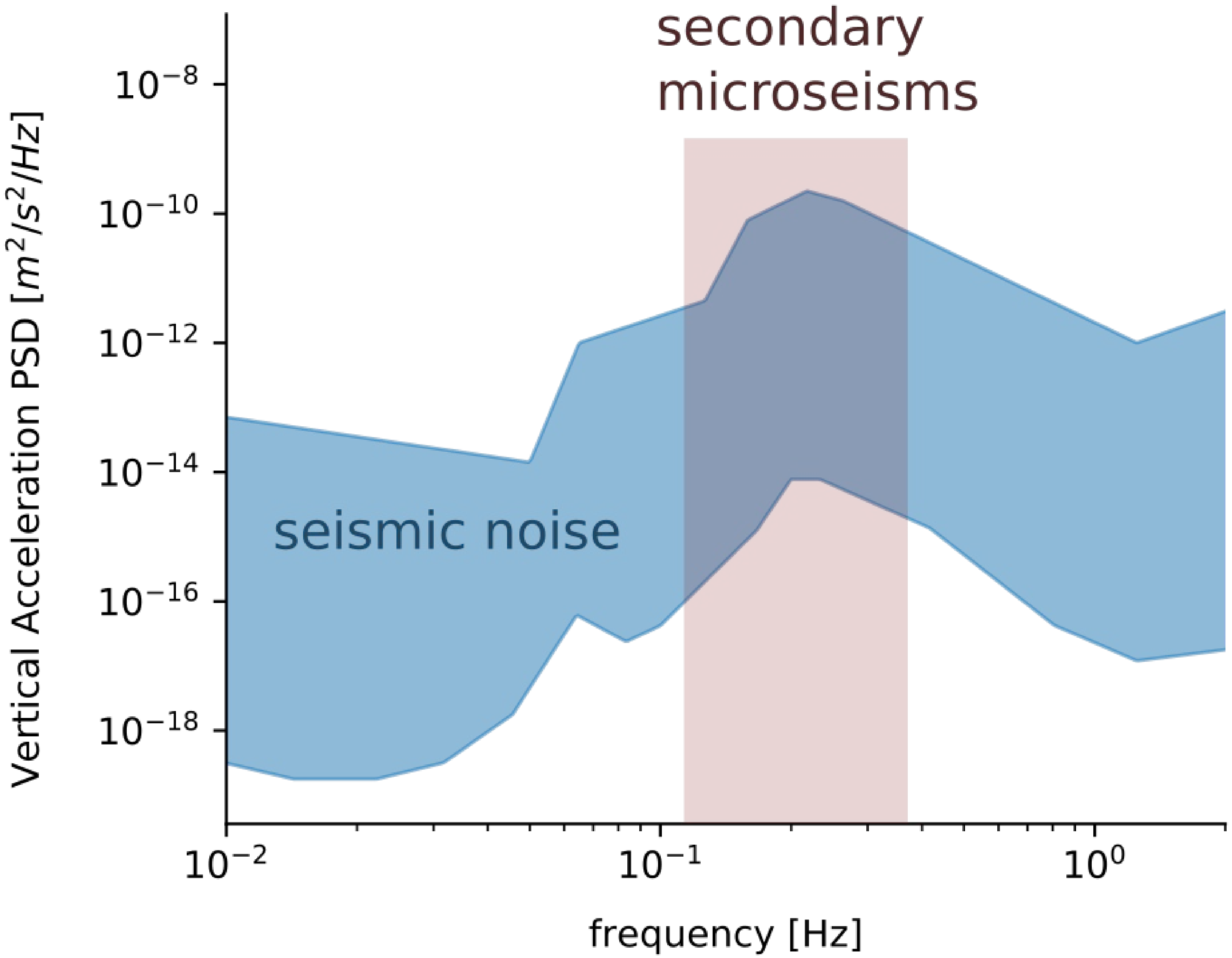
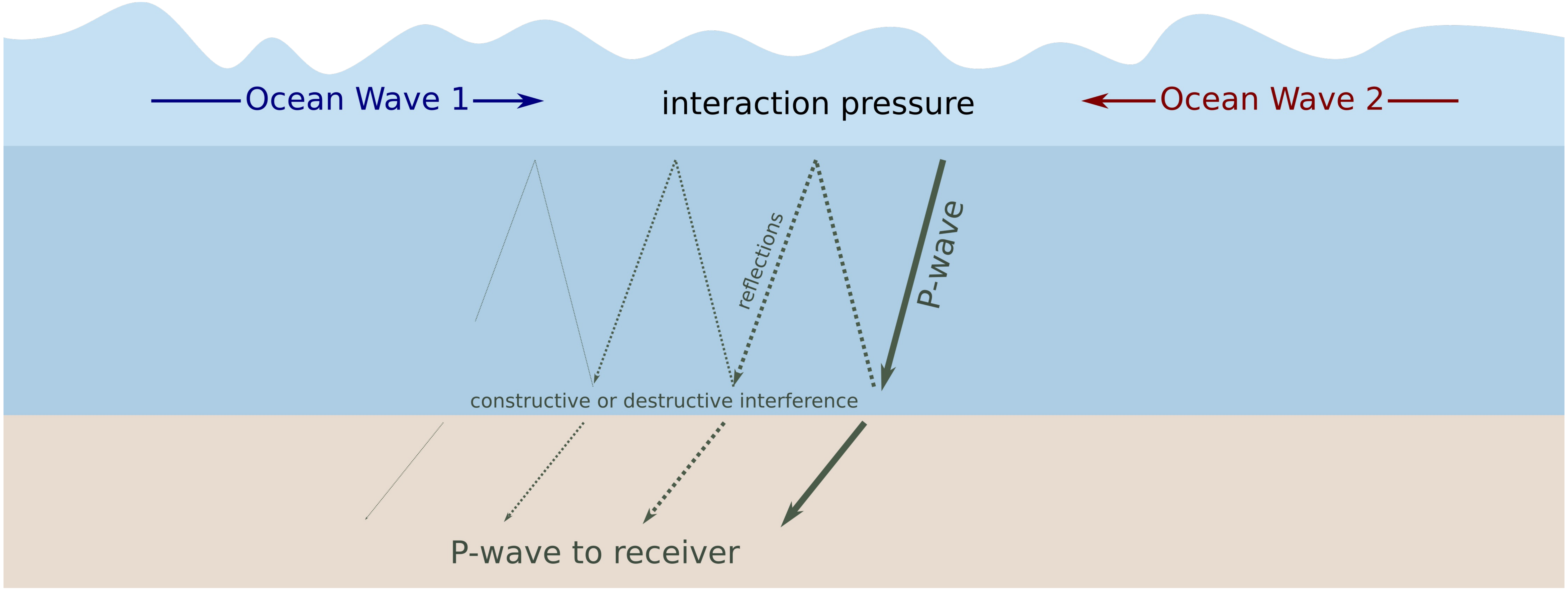
The Secondary Microseismic Frequency Band

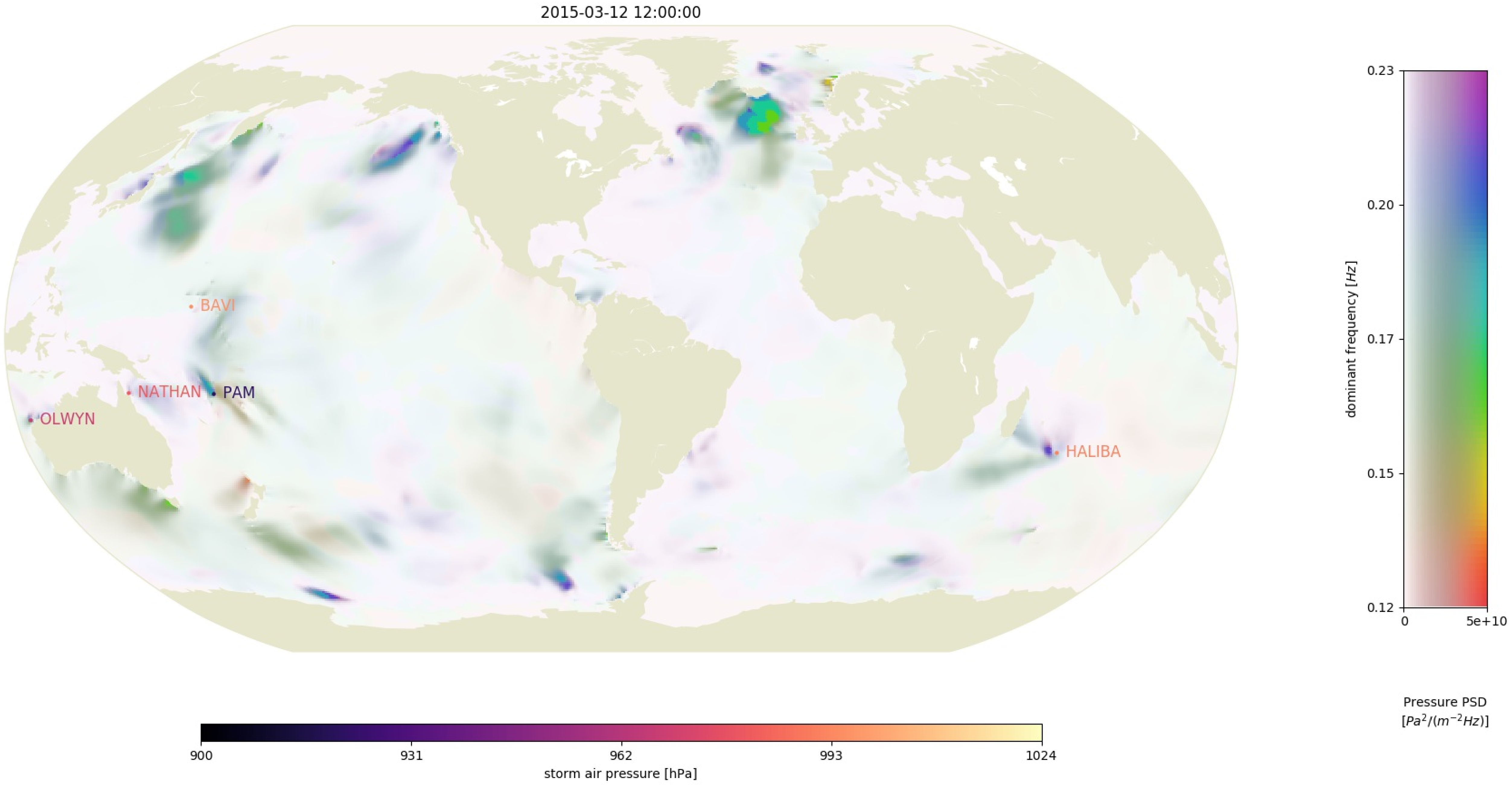


P-wave Generation from Interacting Ocean Waves



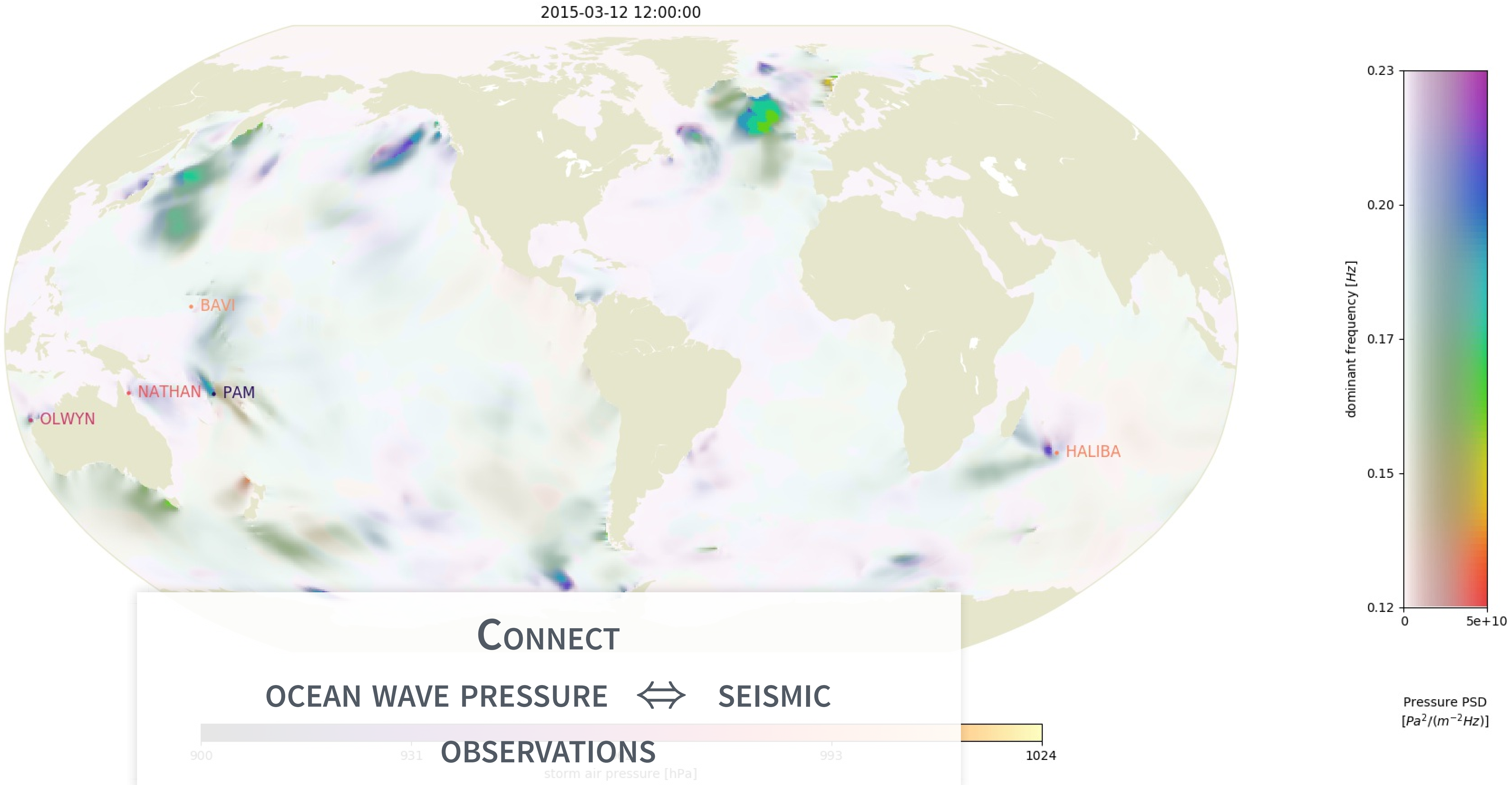
inspired by Gualtieri et al. (2014, 2015) and Ardhuin et al. (2013)

Secondary Microseism Pressure Models



[model by Ardhuin et al. (2011), distributed by IFREMER]

Secondary Microseism Pressure Models



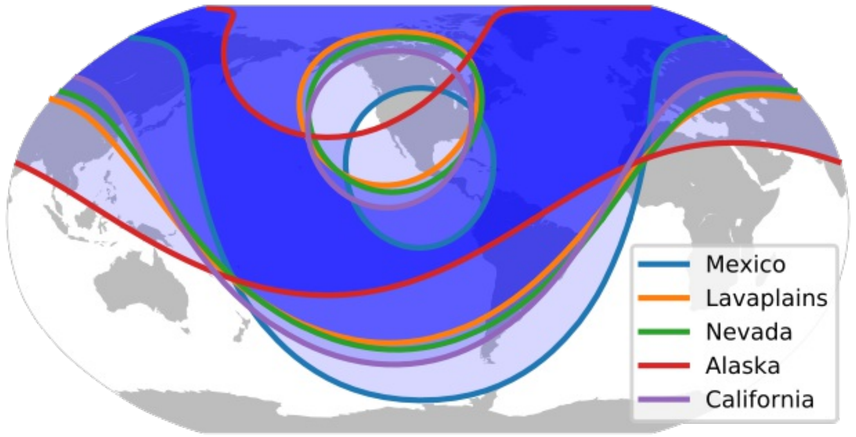
Connect

OCEAN WAVE PRESSURE ⇔ SEISMIC OBSERVATIONS

[model by Ardhuin et al. (2011), distributed by IFREMER]

Building a Dataset

1 year of continuous data per array

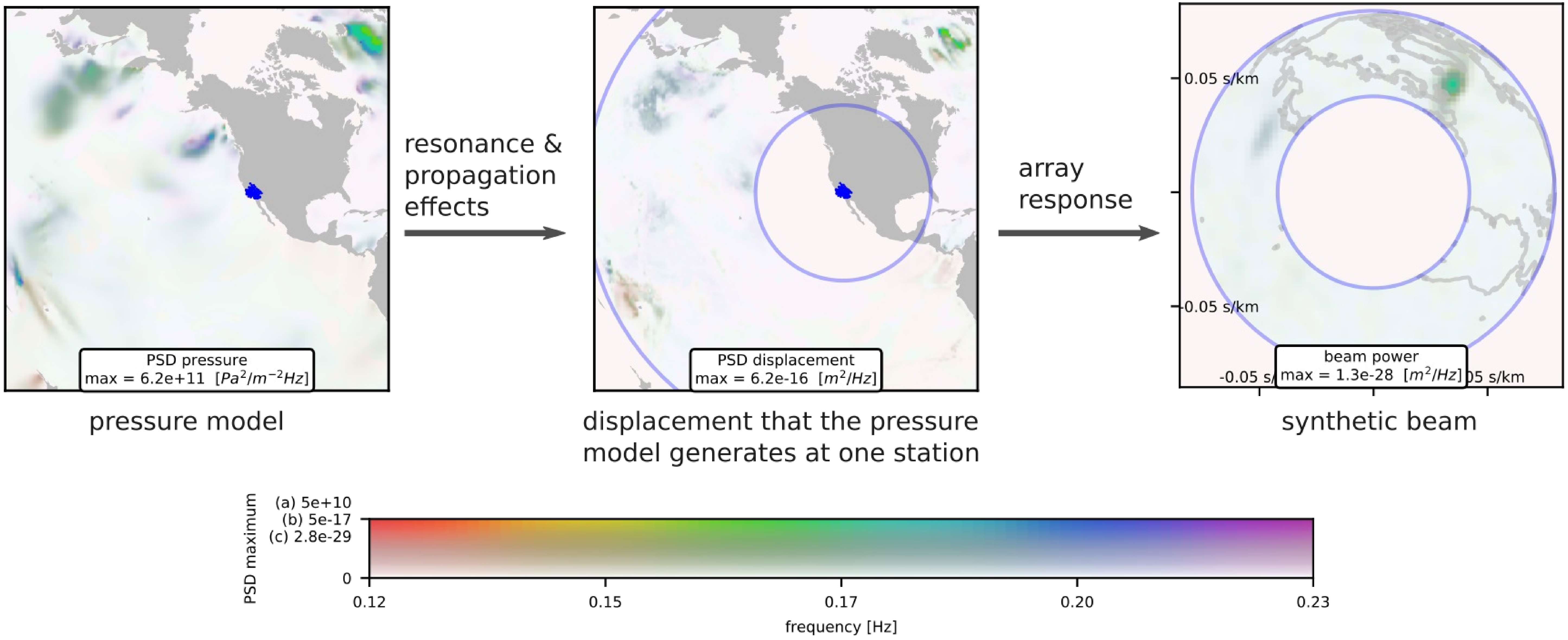


P-wave (30-90 degree) coverage

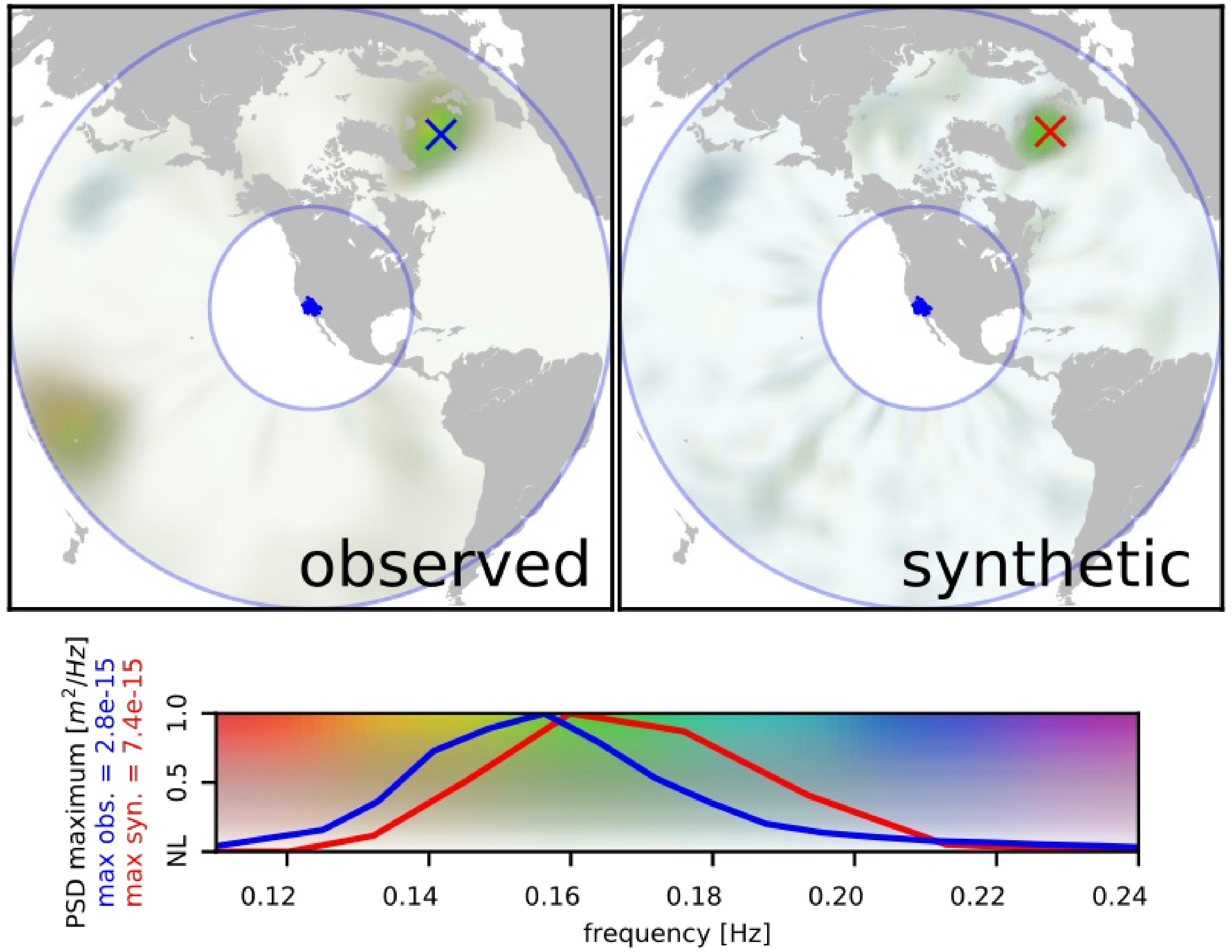
- five arrays (North-America)
- combined timespan of five years (2006, 2008, 2011, 2015, 2015)
- daily synthetic and observed beams for 3 models
  (1809 beams as a function of slowness and frequency)

- this presentation:
  spectral characteristics of the strongest-sources

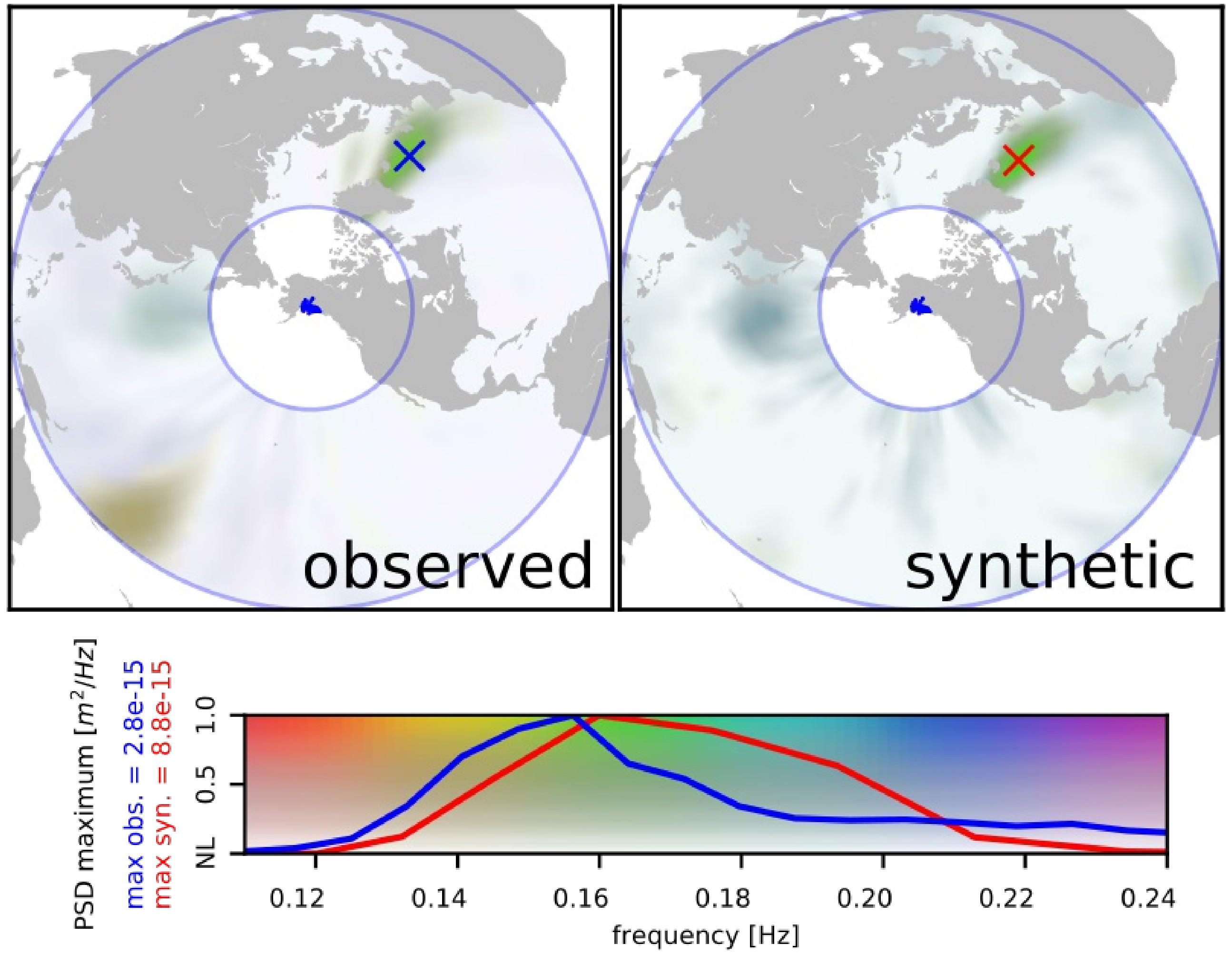
From Pressure Model to Synthetic Beam



Comparison of backprojected beams

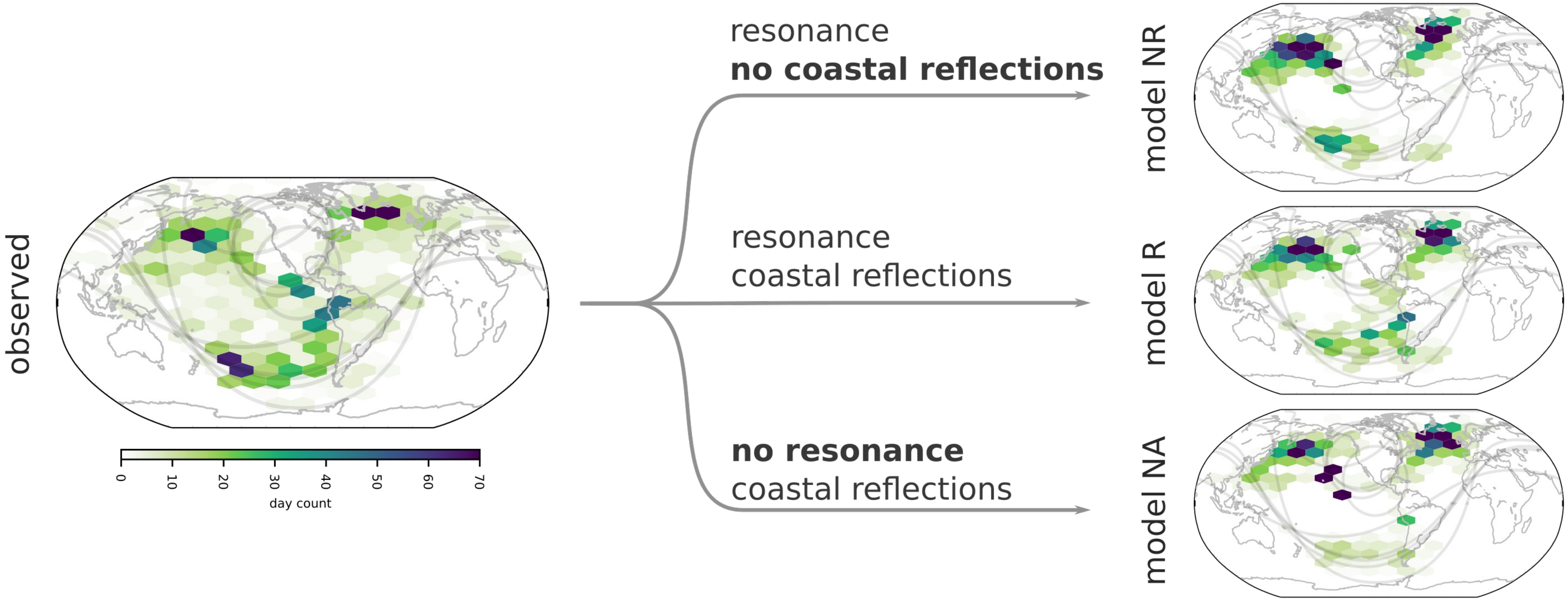


California array

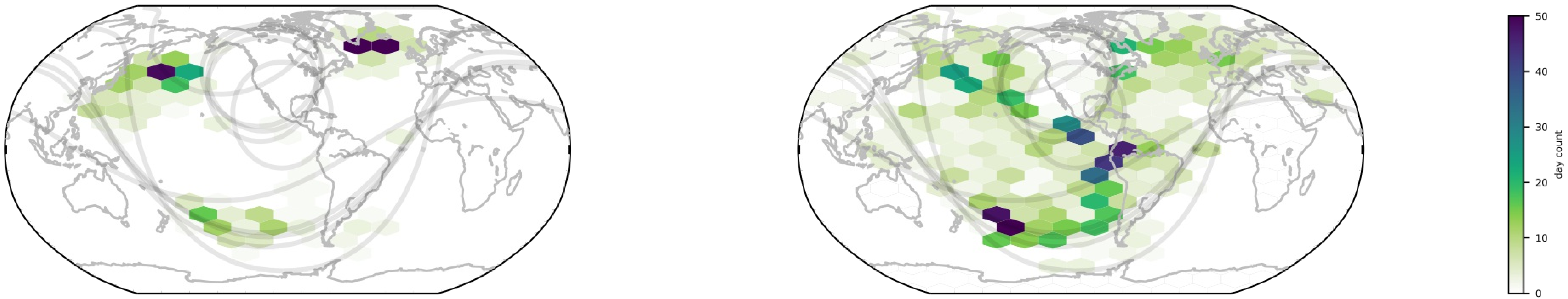


Alaska array

The Strongest-Source Distribution



observed source time and location ...

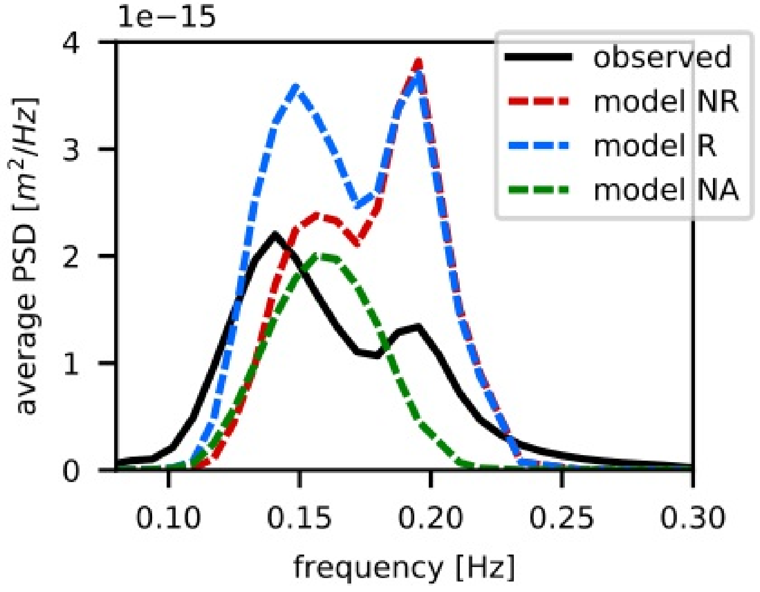


... match with model R

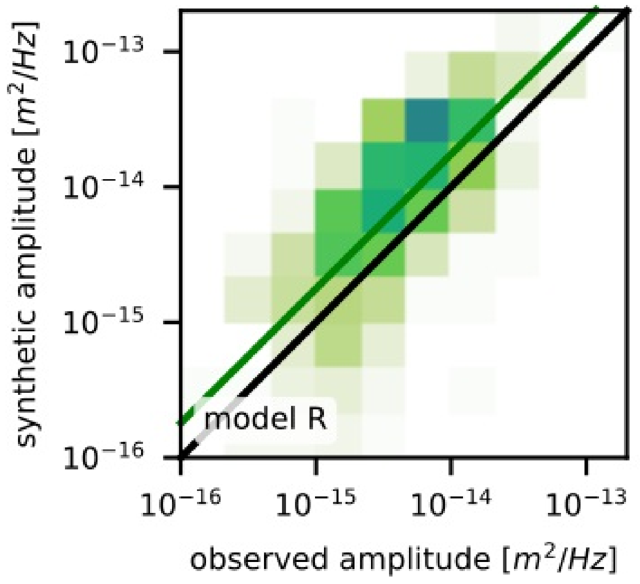
... don't match with model R

- On 26% (467/1809) days the strongest-sources match
- non-matching sources are mostly microseisms as well

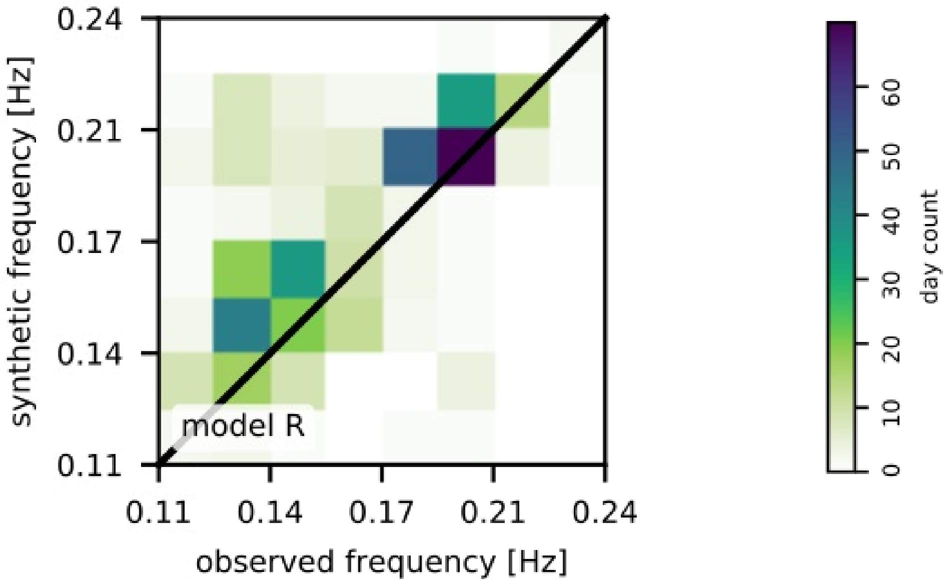
The Spectral Double Peak



average spectra



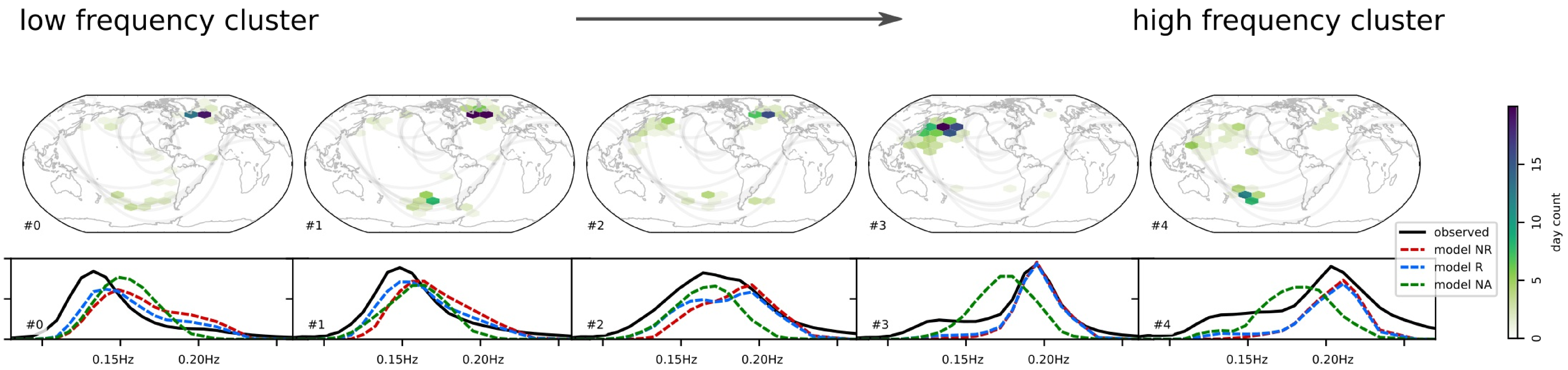
amplitude comparison



frequency comparison

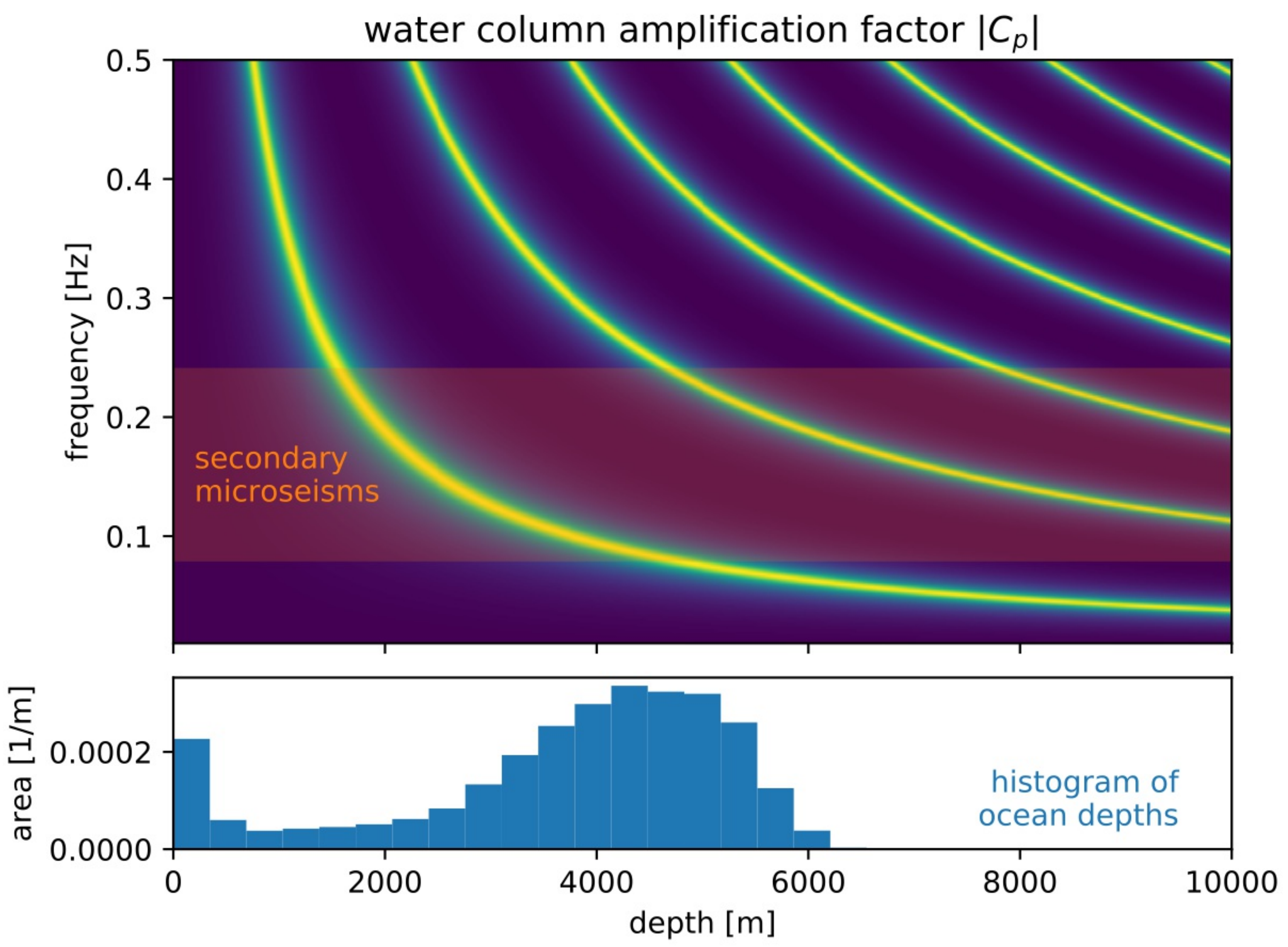
- Spectral double peak in observation and models with resonance
- Amplitudes are predicted within factor of 0.5 - 6 (1 std)
- peak frequencies are either low or high

Associating spectral shapes with geographical regions



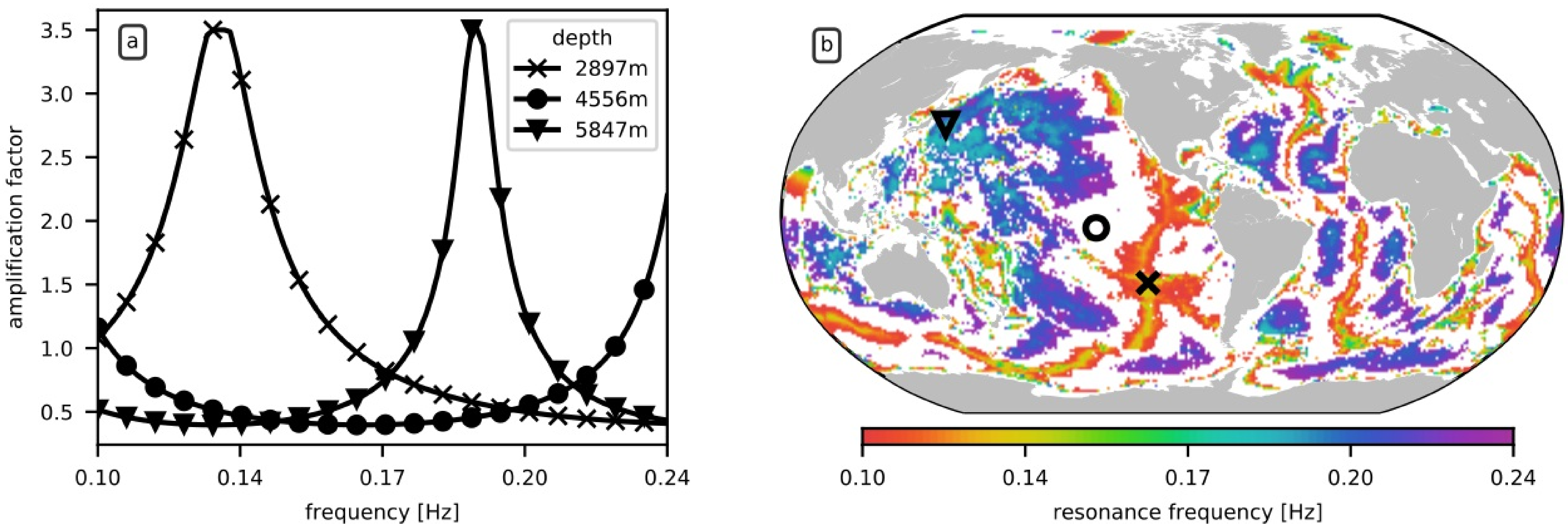
- Spectral Shape and Geographical Region are related
- Low frequency peak is broader than the high frequency one
- High frequency spectra are better modeled

Source Site Resonance



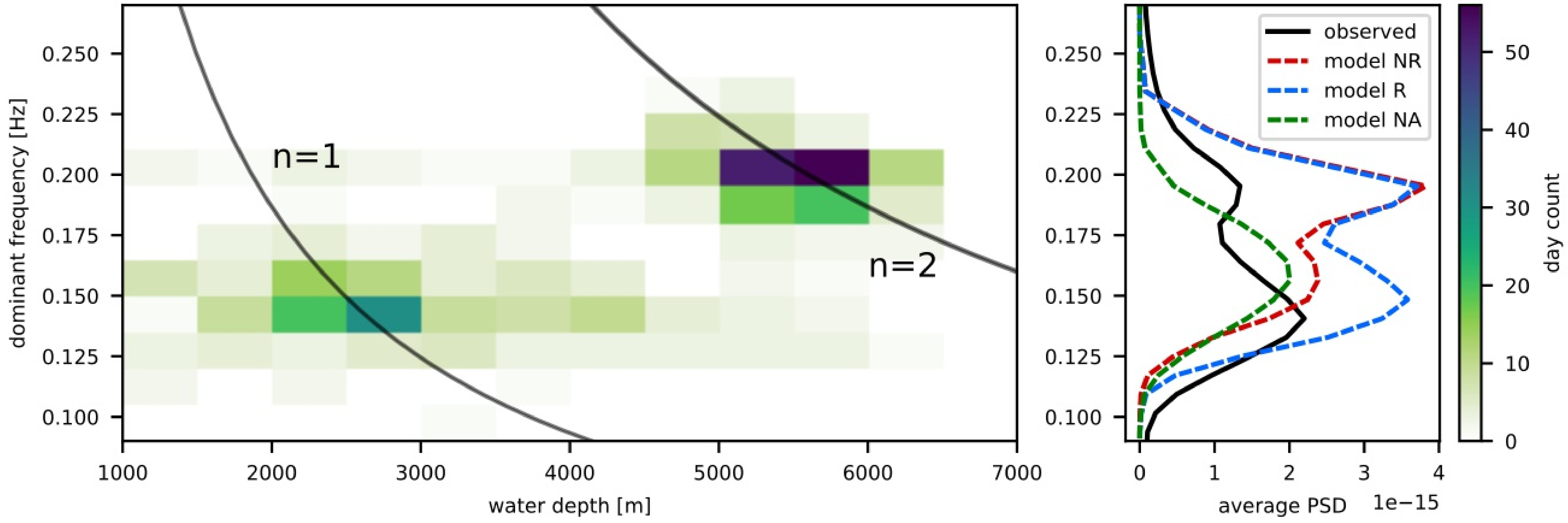
- resonance when $2h/\lambda + 1/2 = n$
- $h = 1/4\lambda,\ 3/4\lambda,\ 5/4\lambda, \ldots$
- $n = 1$ (shallow ocean) and $n = 2$ (deep ocean) most important for secondary microseisms

Source Site Resonance Map



- n=1 in shallow ocean [cross]
- no resonance from 0.10 - 0.24Hz [circle]
- n=2 in deep ocean [triangle]

Conclusions



- P-wave spectra can be quantitatively predicted from ocean wave models
- water column resonance deceisive for spectral shape
- bathymetry favours resonance at 0.15 and 0.20Hz (first and second harmonic)