



36TH INTERNATIONAL CONFERENCE ON COASTAL ENGINEERING 2018

Baltimore, Maryland | July 30 – August 3, 2018

The State of the Art and Science of Coastal Engineering

PROCESSES LEADING TO INFRA-GRAVITY PERIOD OSCILLATIONS AND CURRENTS IN PORTS AND MARINAS

Prof Charitha Pattiaratchi PhD

Dr Sarath Wijeratne, PhD

Oceans Graduate School & The UWA Oceans Institute

The University of Western Australia



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Coastal Oceanography



Acknowledgements

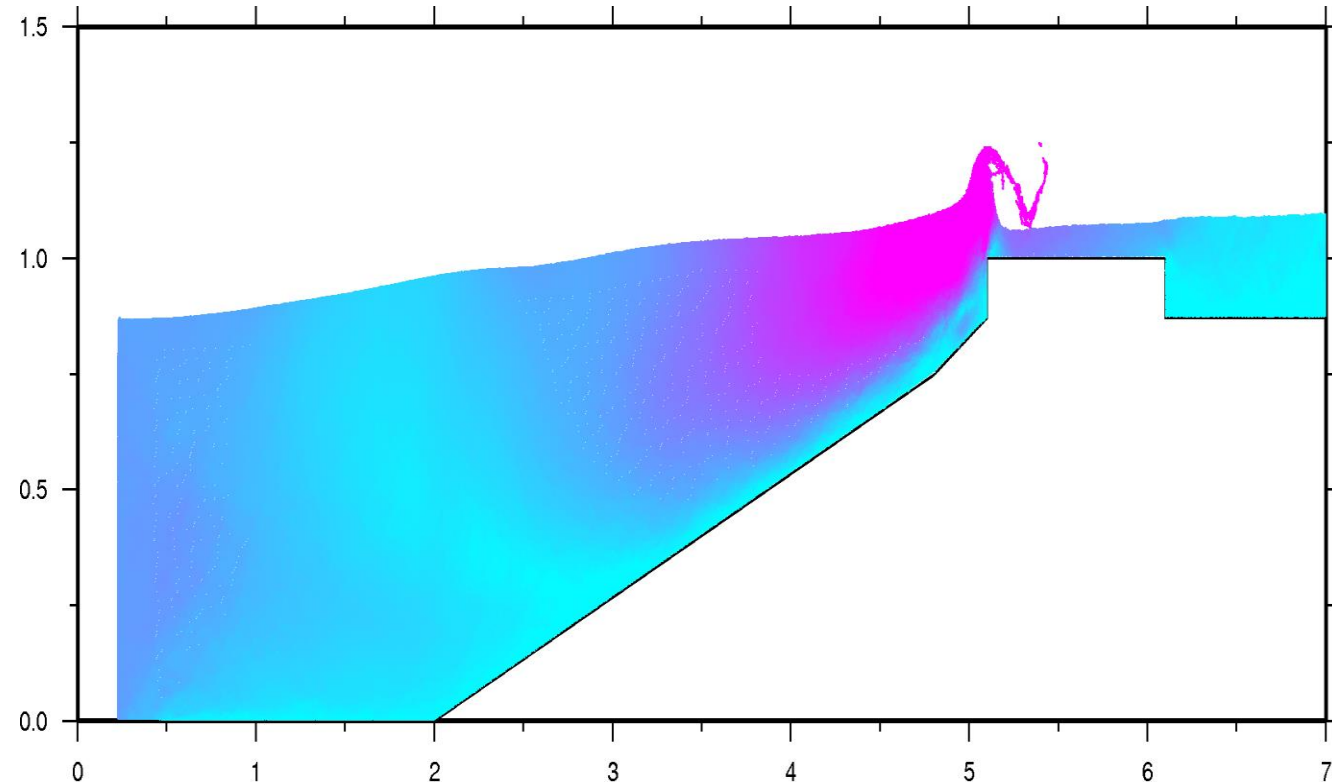


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Yasha Hetzel
Thomas Wernberg
Ulrich Flachsenberger
The University of Western Australia

Tony Lamberto
Dept of Transport, WA



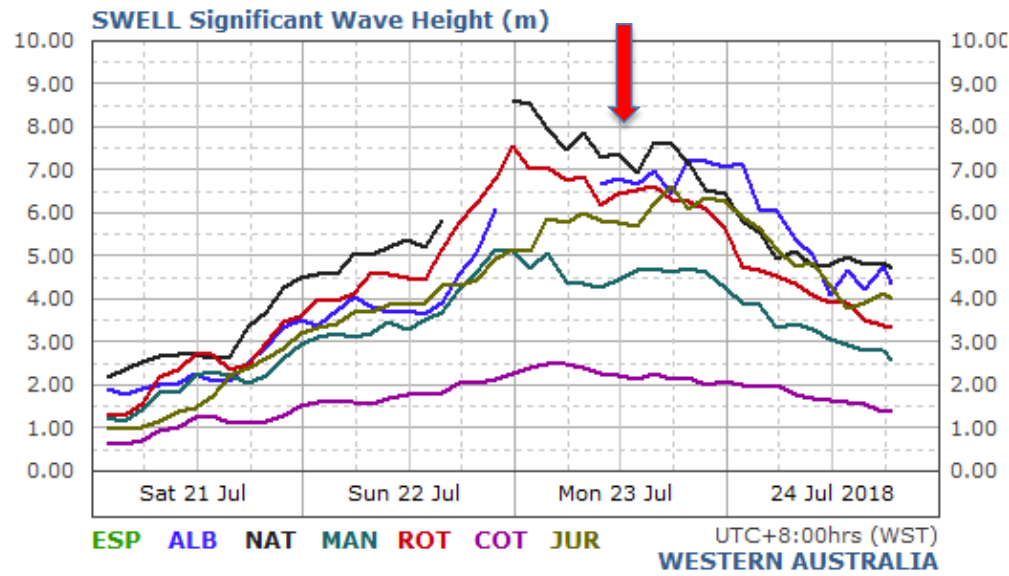
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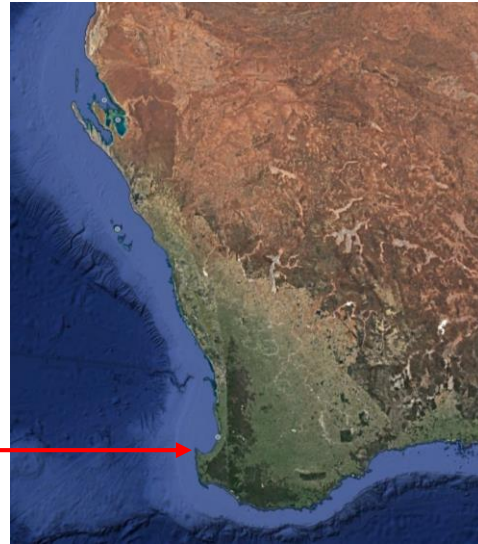


All Western Australian Swell Buoys



Images Courtesy: Coastal Data Centre

Cowaranup Bay







012 sec

Yasha Hetzel





024 sec

Yasha Hetzel





036 sec

Yasha Hetzel



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048 sec

Yasha Hetzel

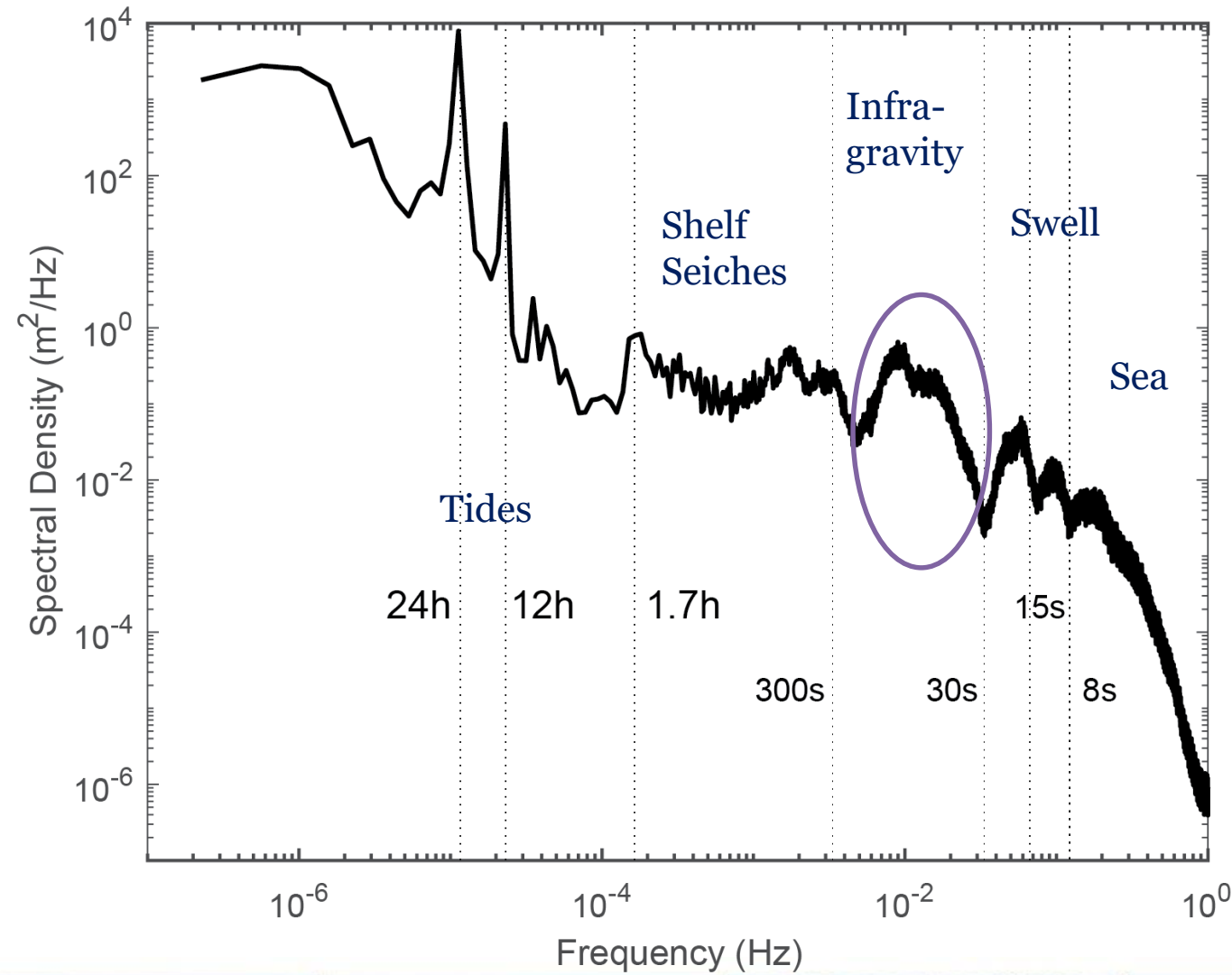


Water level Spectra



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Harbour Oscillations

- Strong periodic horizontal water motion within the harbour
- periods of oscillations - few seconds to minutes depending on the harbour geometry
- can be caused by:

Infra-Gravity (IG) waves (~ periods 30 to 300 s)

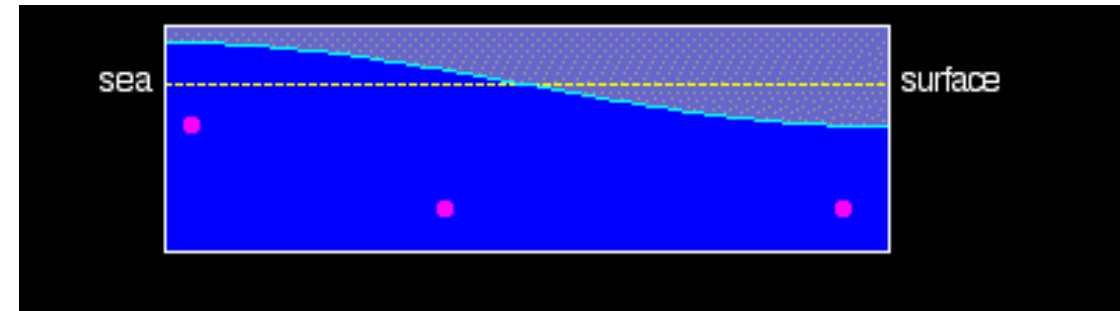
Tsunamis - seismic

Tsunamis - meteorological

} ~ periods 5 to 30 min

Merian Formula ('closed') system

$$T_n = \frac{2L}{n\sqrt{gh}} \quad L > l$$



$$T_{n,m} = \frac{2}{\sqrt{gH}} \left[\left(\frac{n}{L} \right)^2 + \left(\frac{m}{l} \right)^2 \right]^{-1/2} \quad L \approx l$$

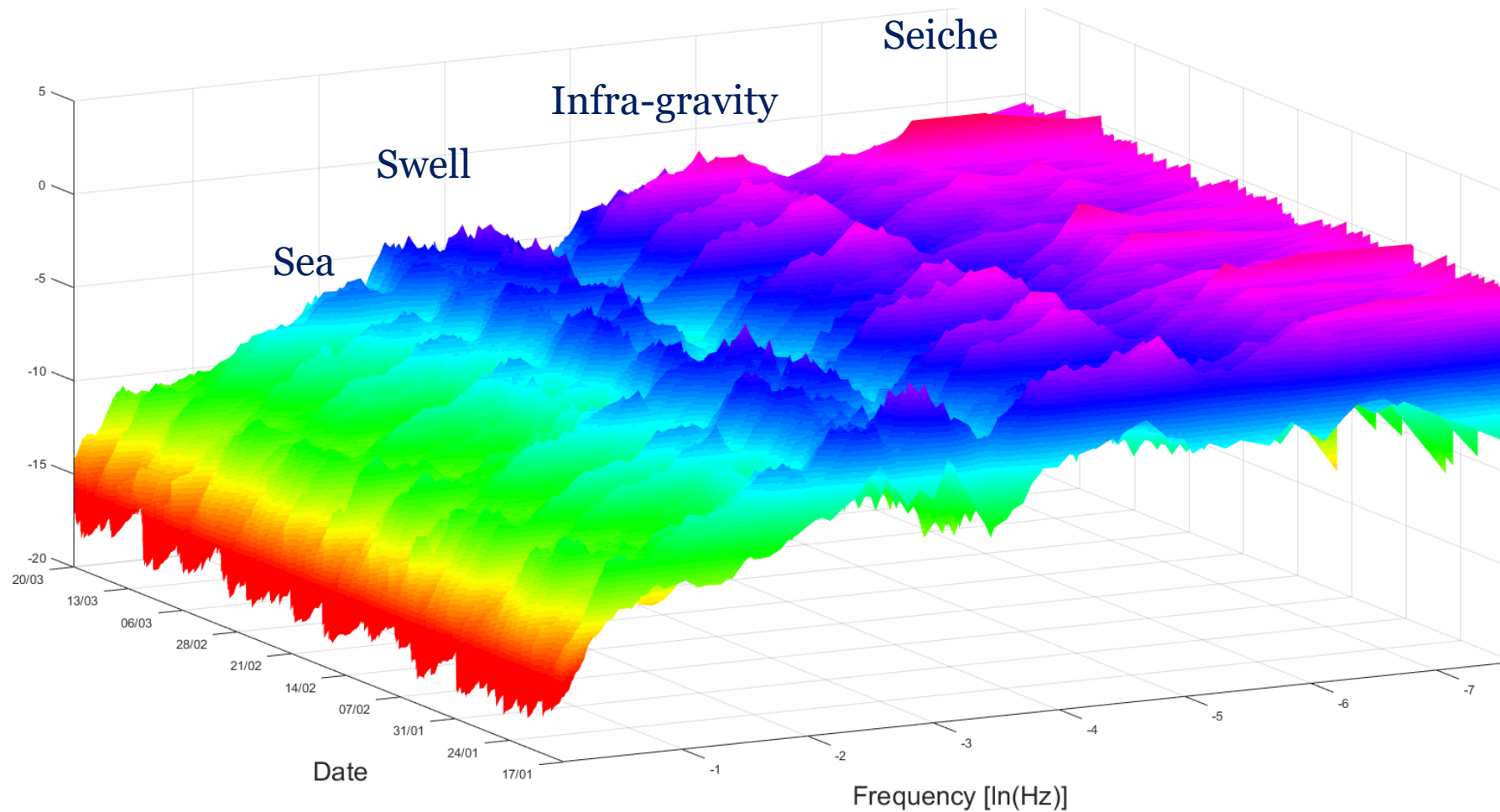


Frequency/time spectra



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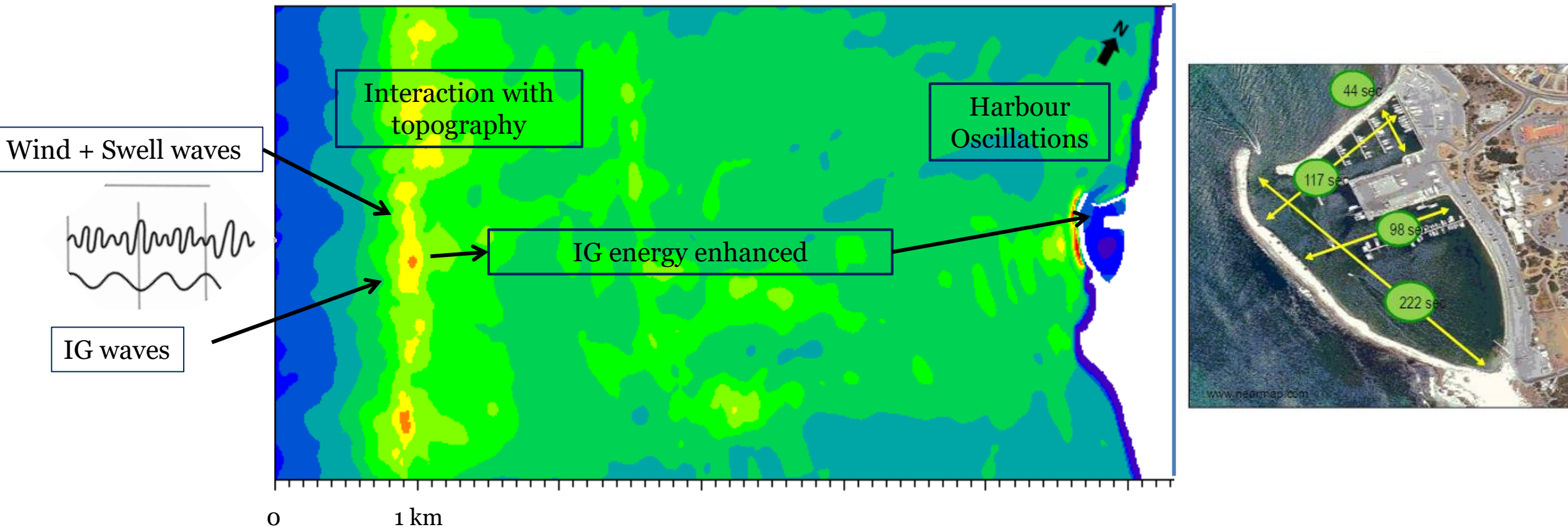
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Two Rocks marina: Thotagamuwage and Pattiaratchi (2014)



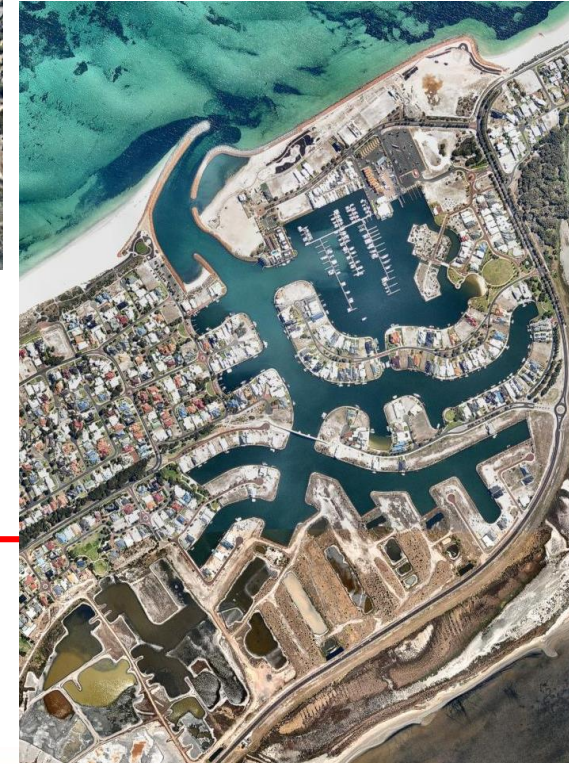
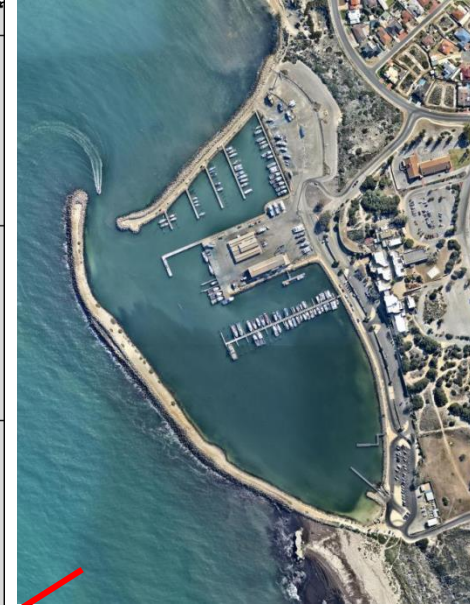
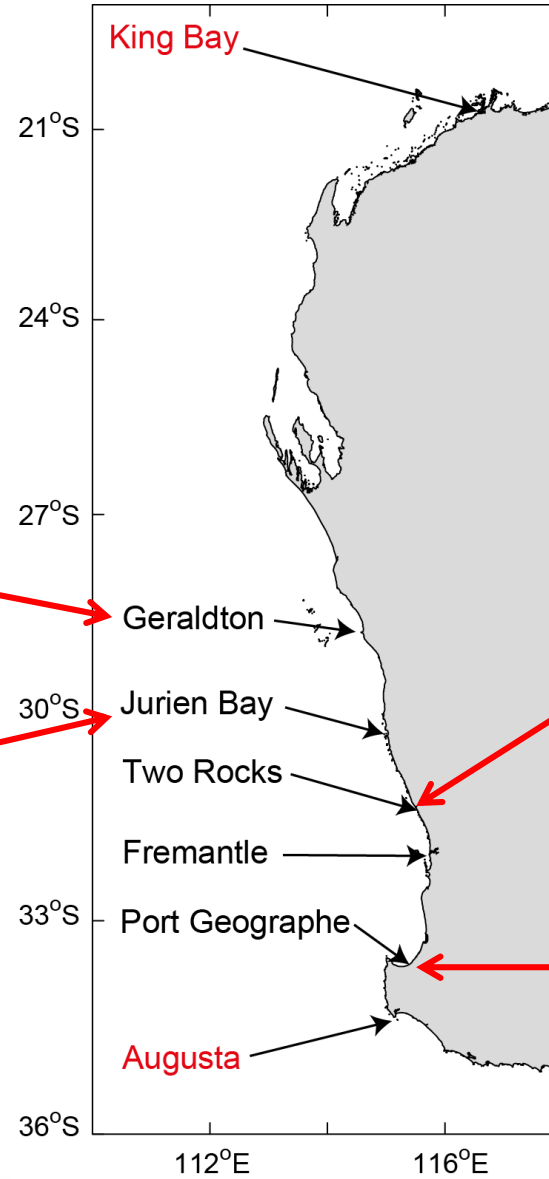
Forcing with ‘white’ noise generated oscillations inside the marina at the same frequencies

Locations



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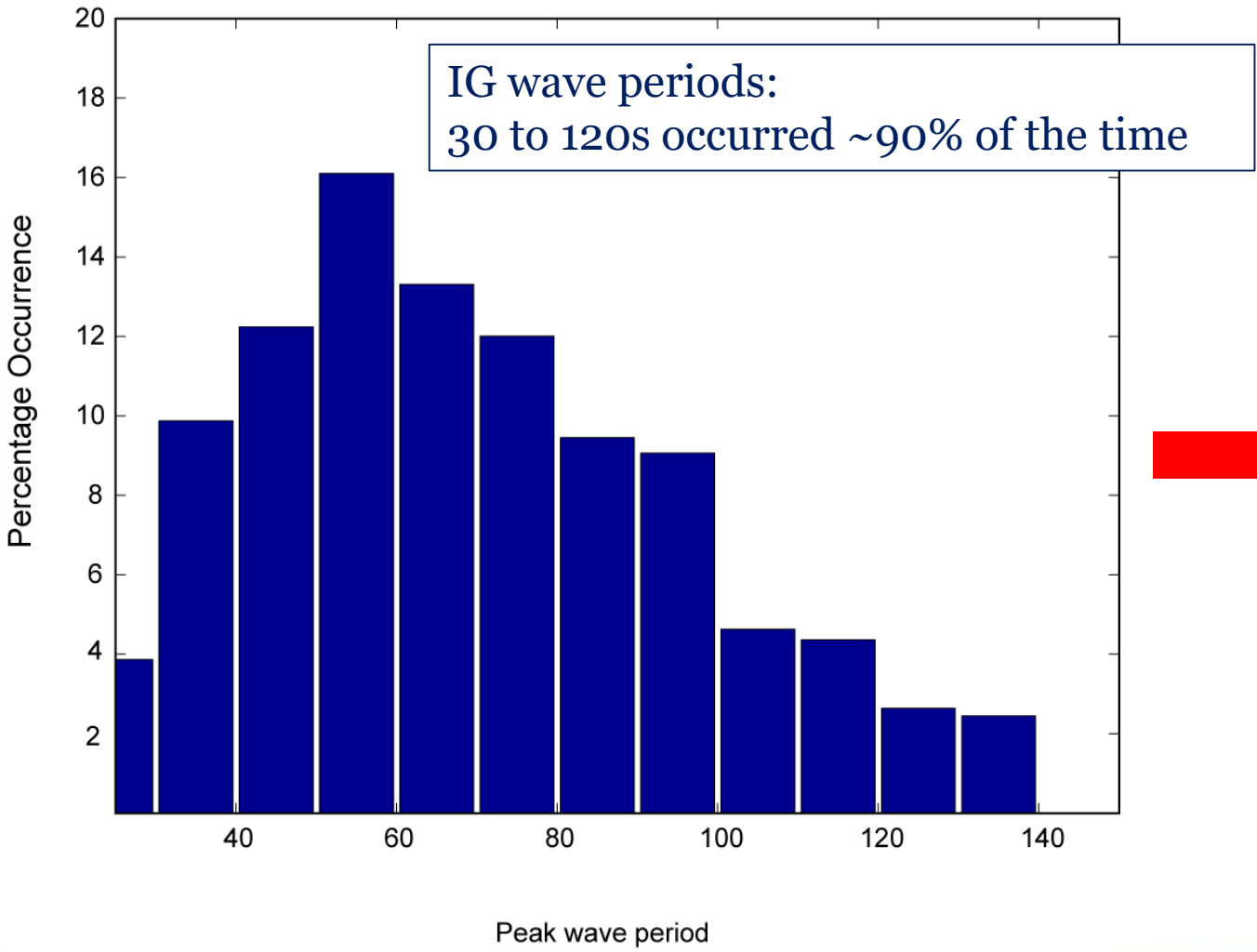


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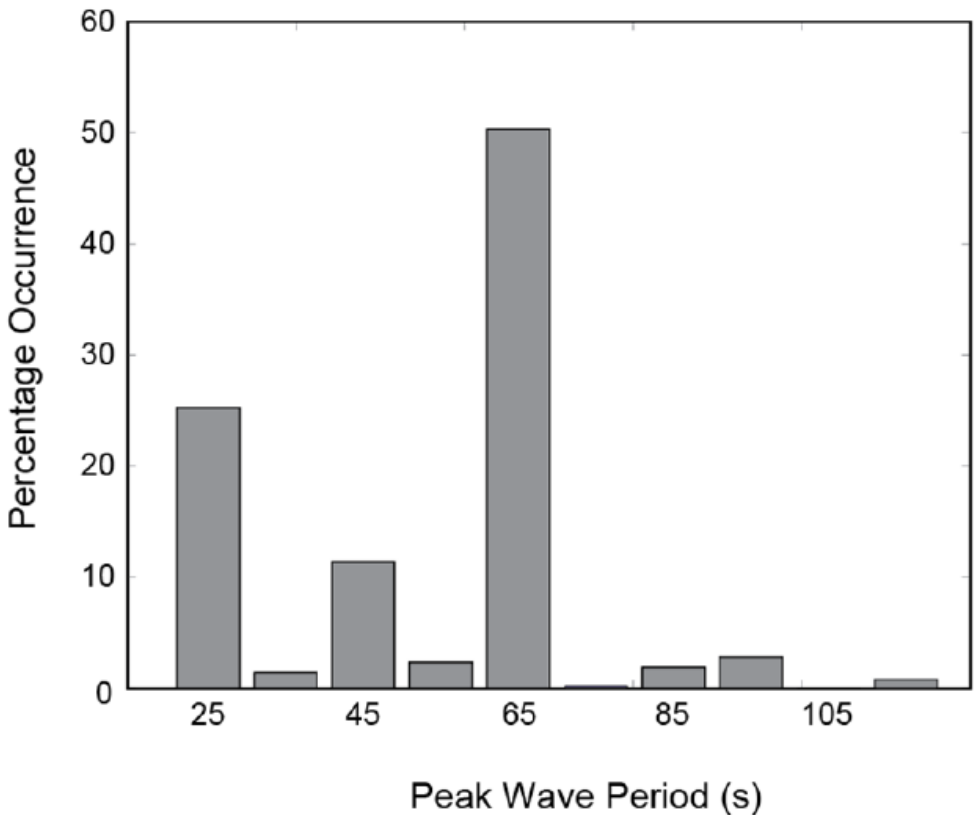
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Geraldton

incident IG Climate

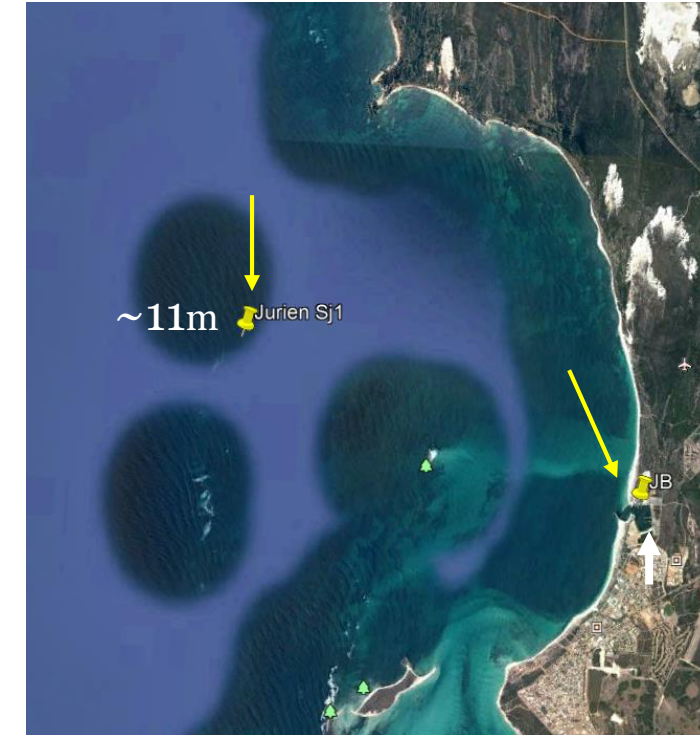
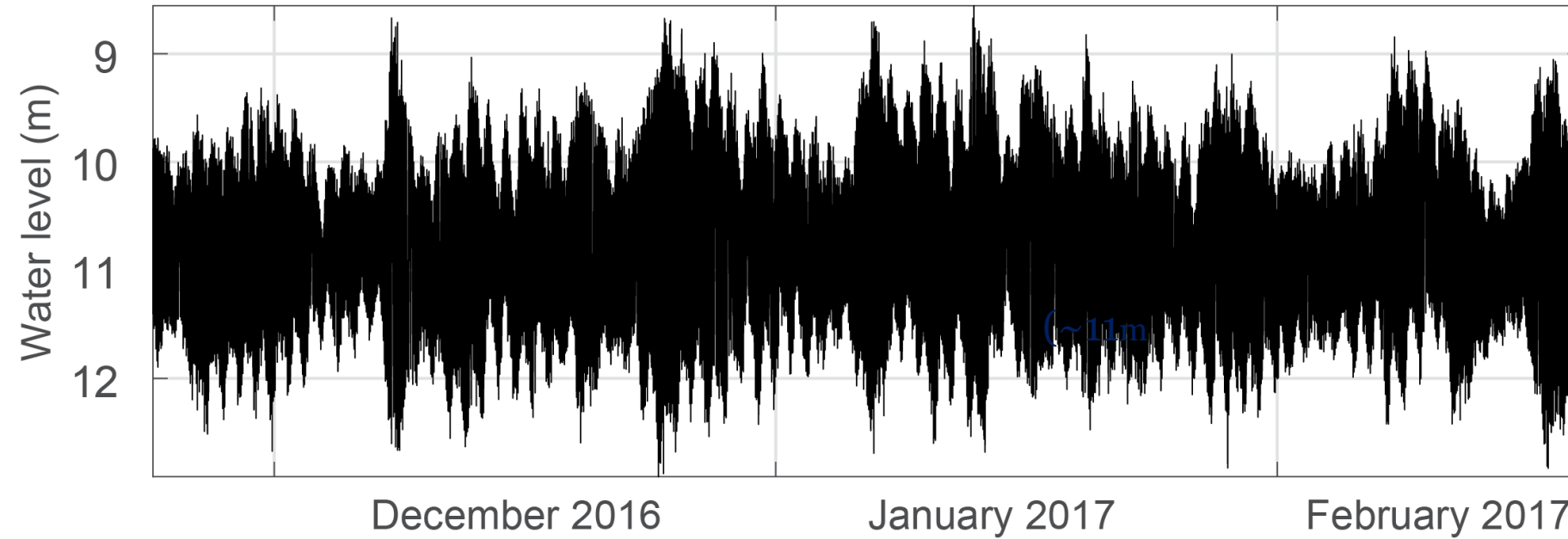


GPA Berths 3-4 - Measured T_p : 26 May 2010 to 22 Nov 2013



Jurien Bay (~11m depth)

~ 3 months data, continuous at 2Hz = 15.3 million data points

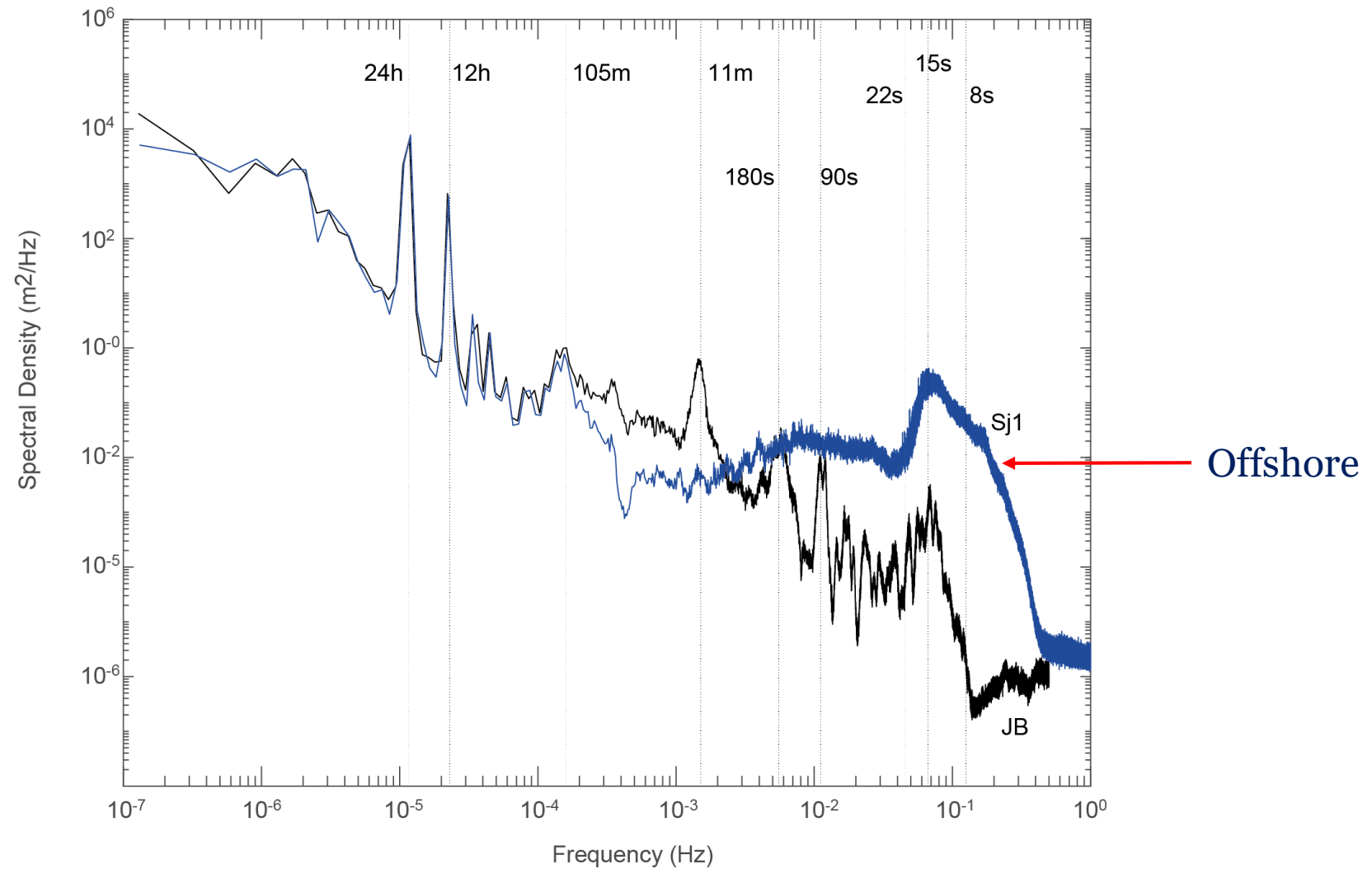


Water level Spectra: Jurien



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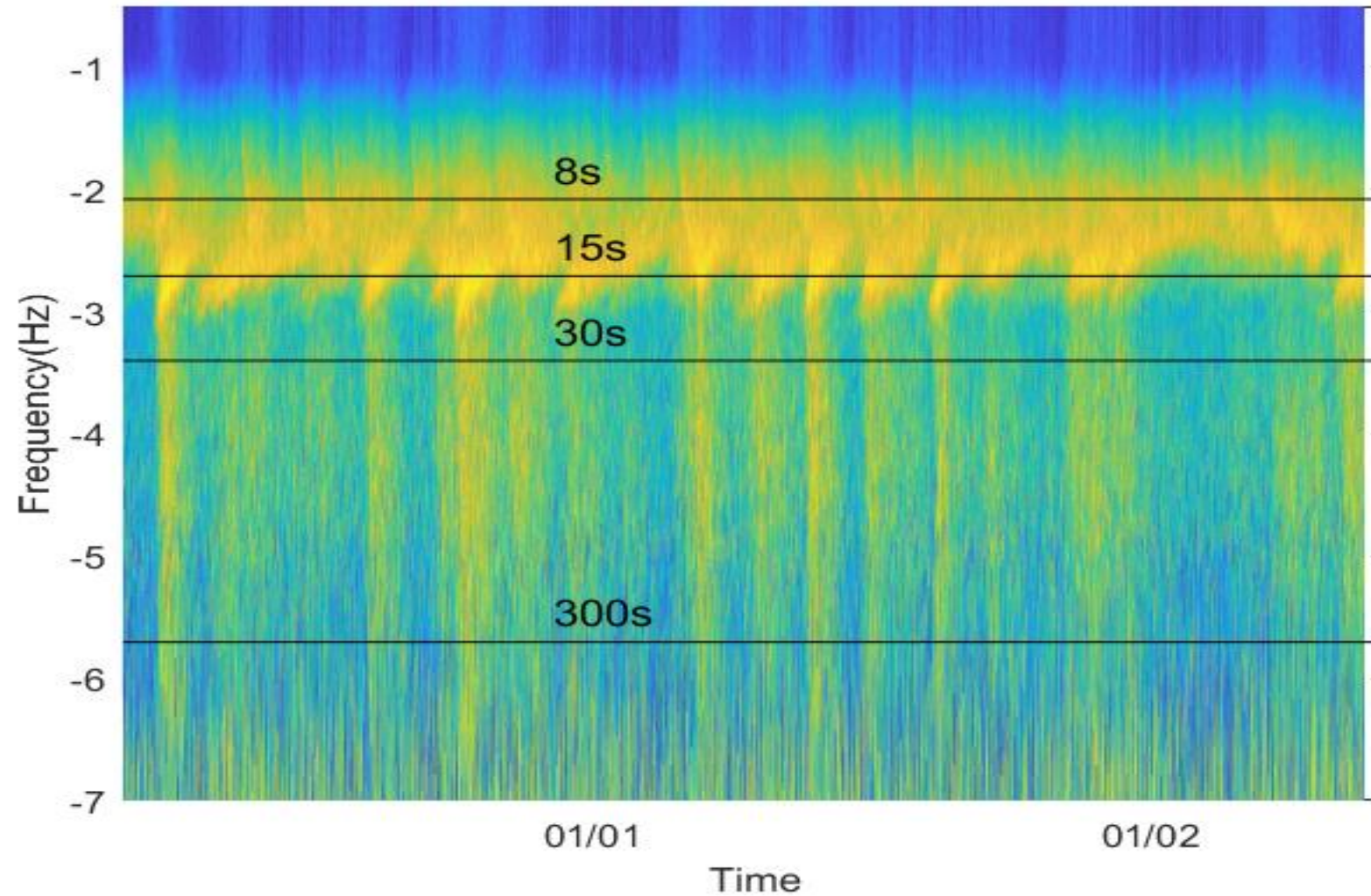
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Jurien Bay (11m)



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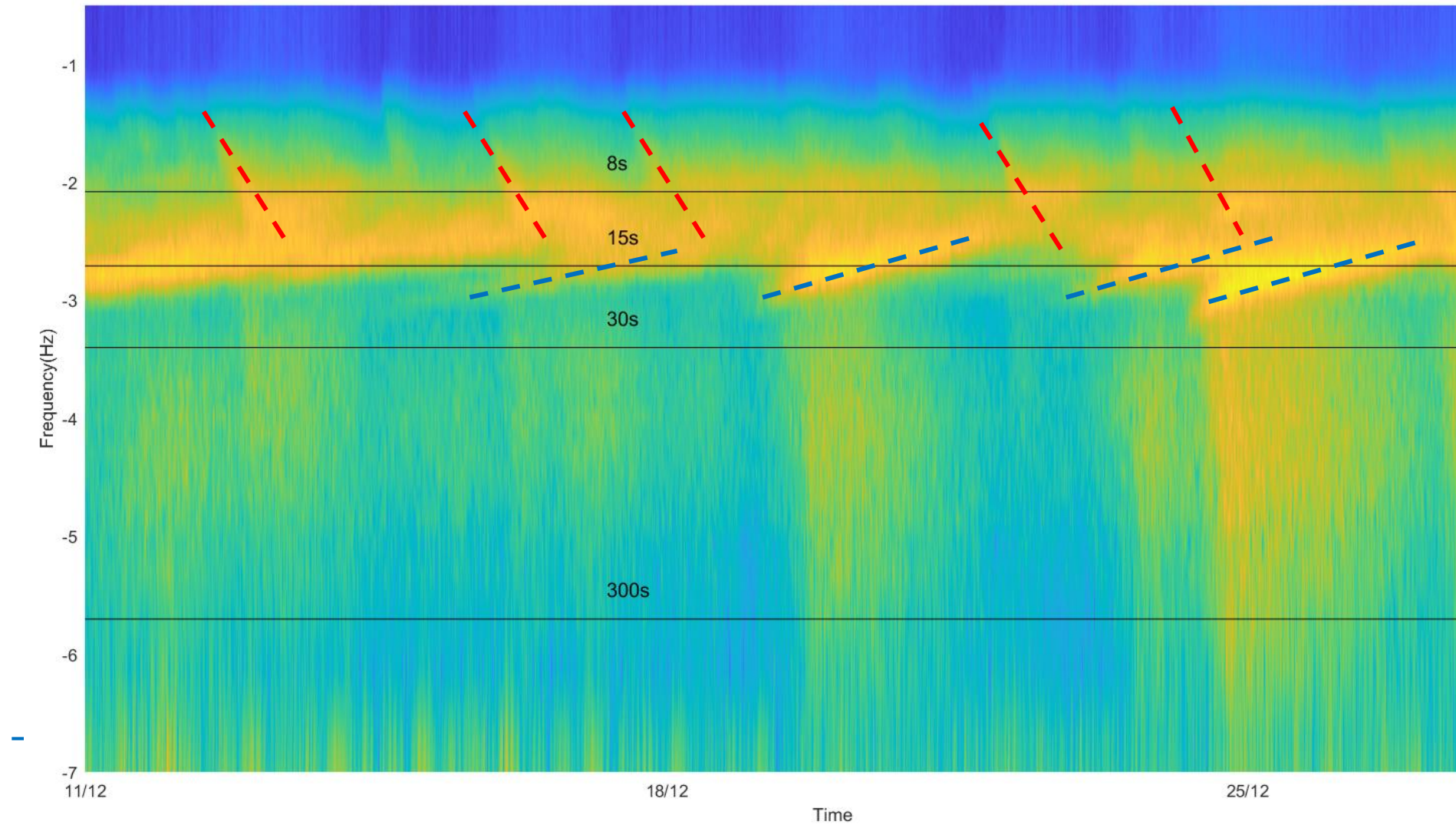
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Jurien Bay



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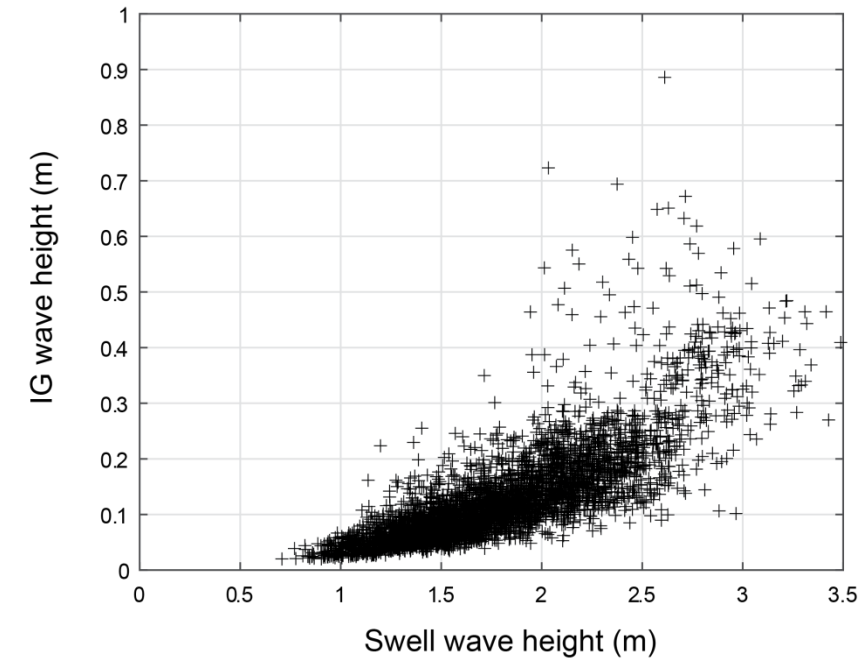
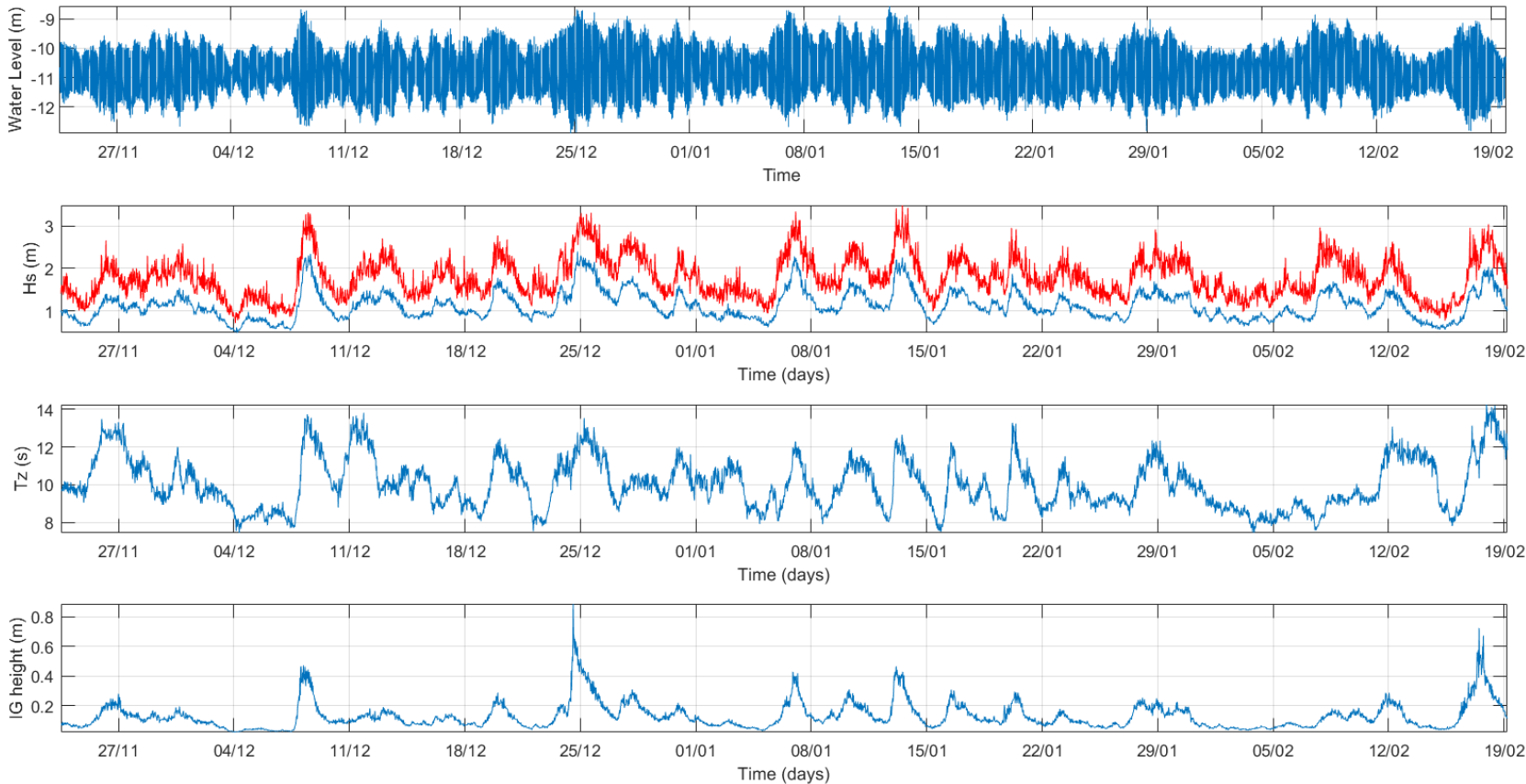
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Jurien Bay (~11m depth)



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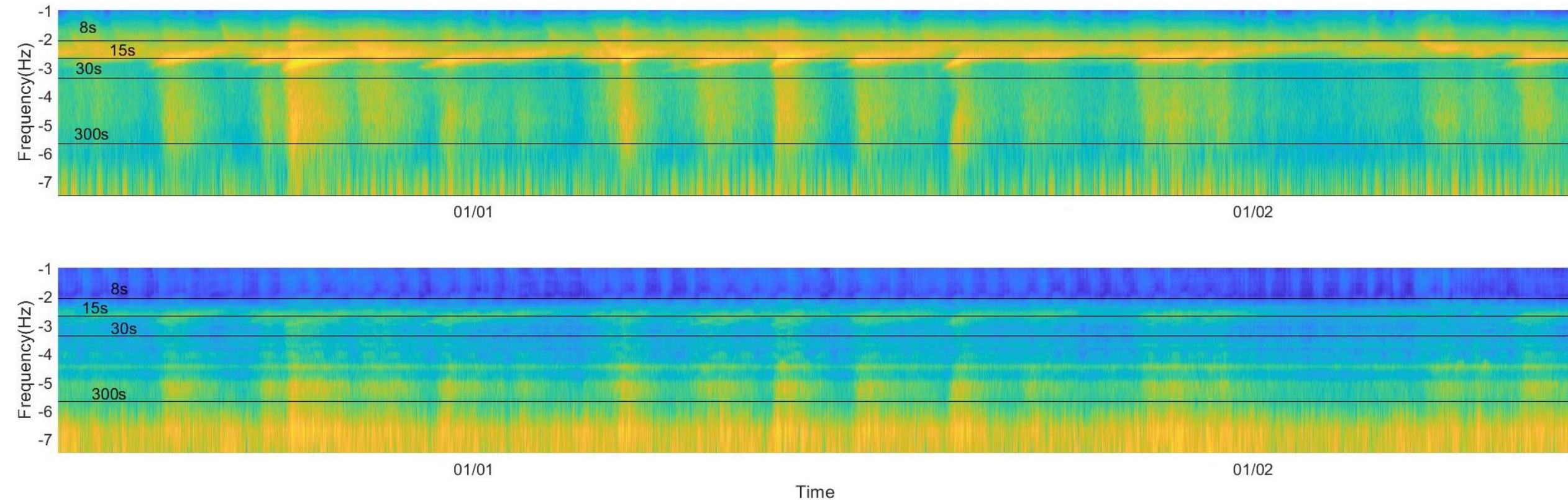
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Jurien Bay (Offshore & Marina)



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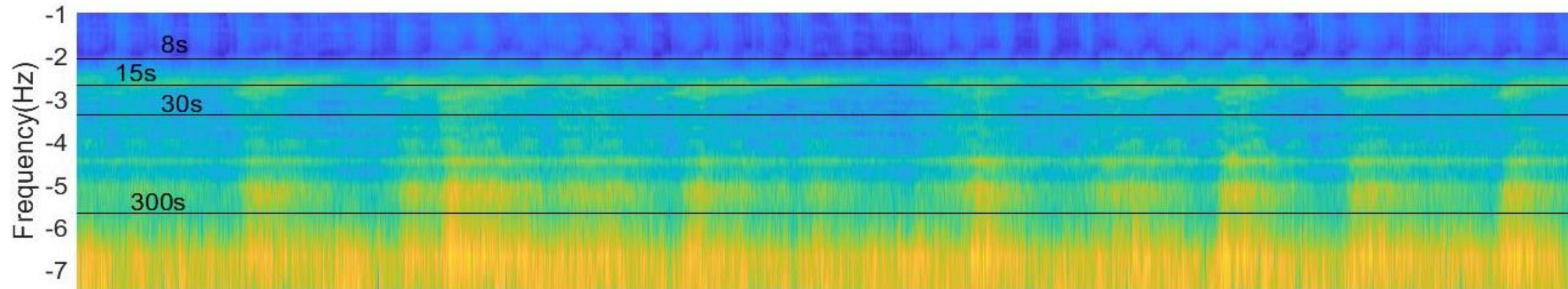
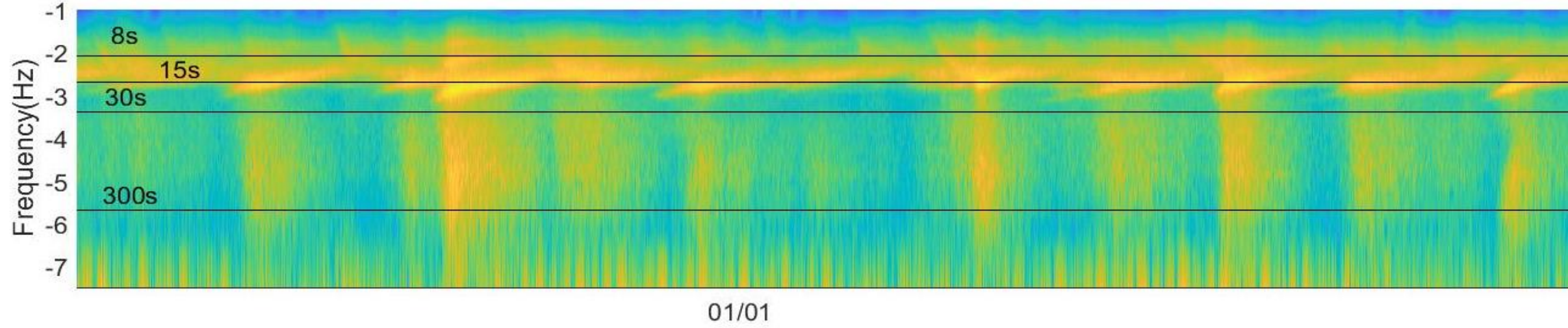
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Jurien Bay (Offshore & Marina)



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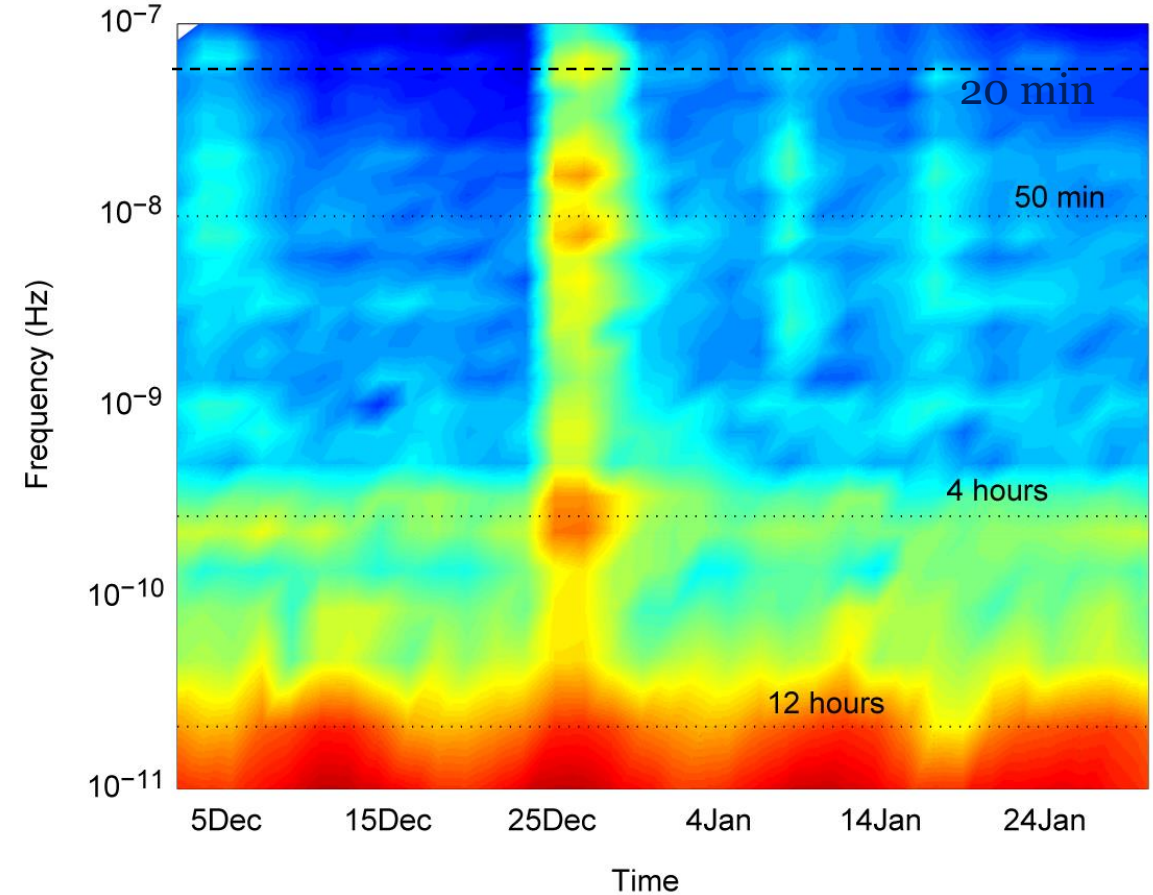
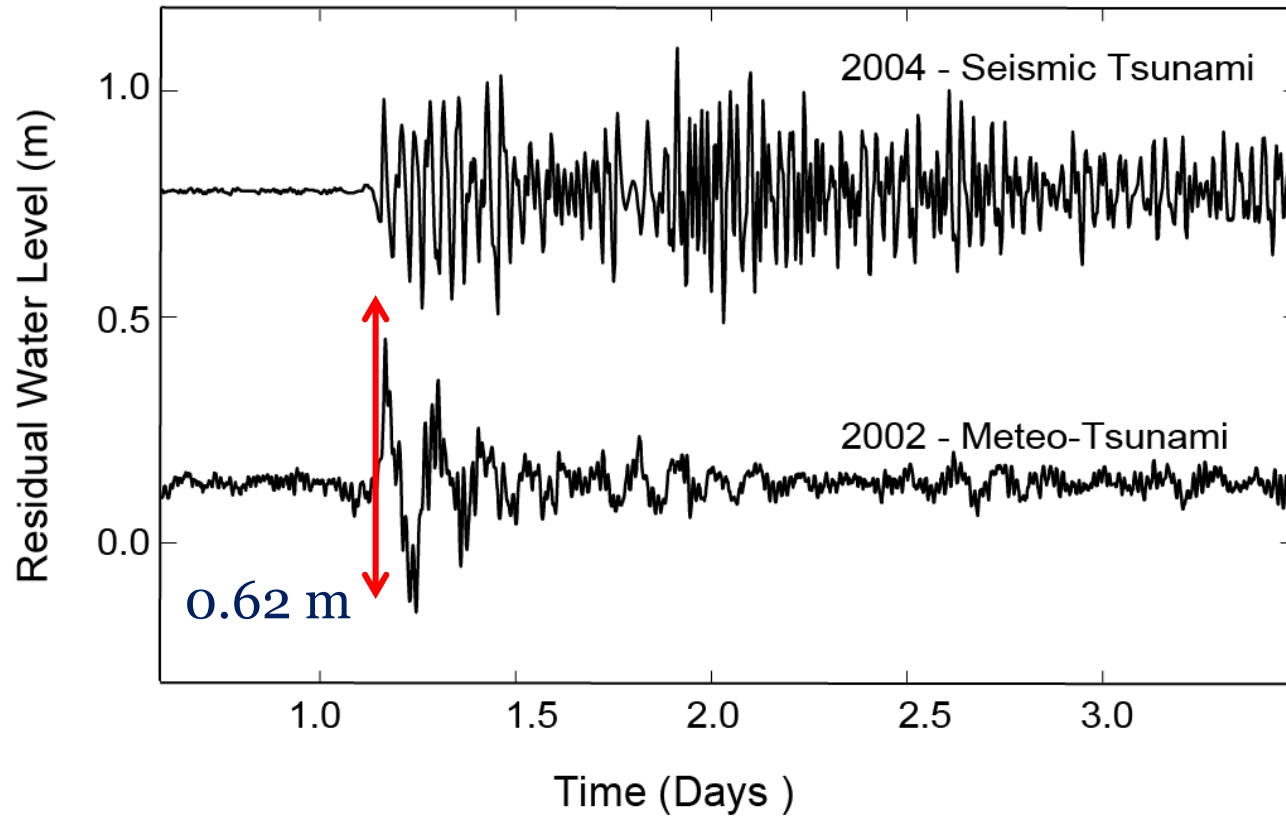
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Tsunamis: Seismic and Meteorological



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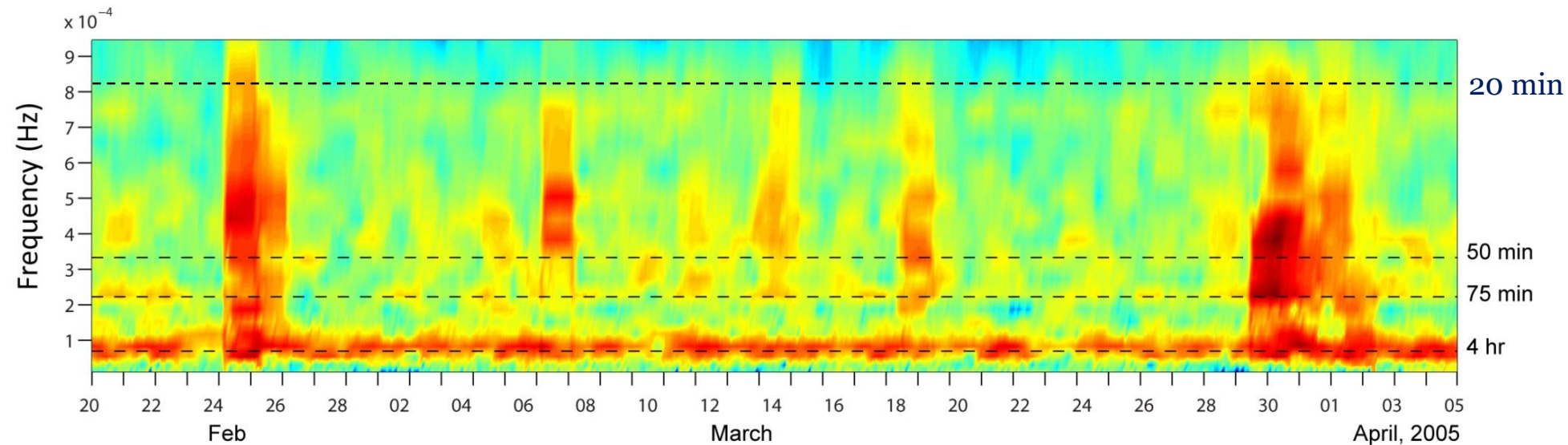
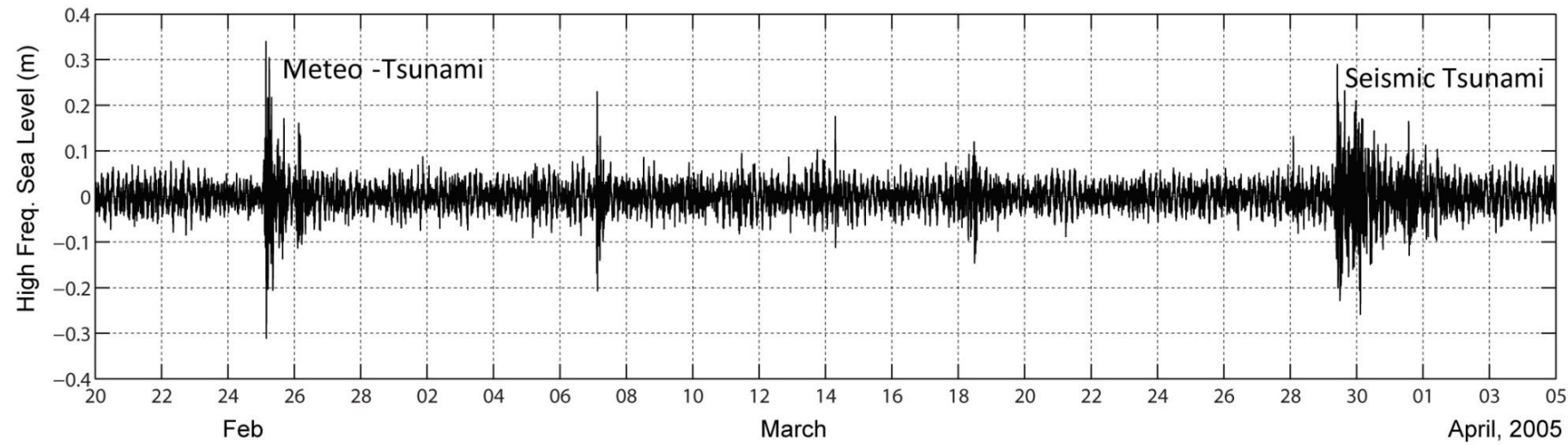
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Tsunamis: Geraldton



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Meteorological Tsunamis



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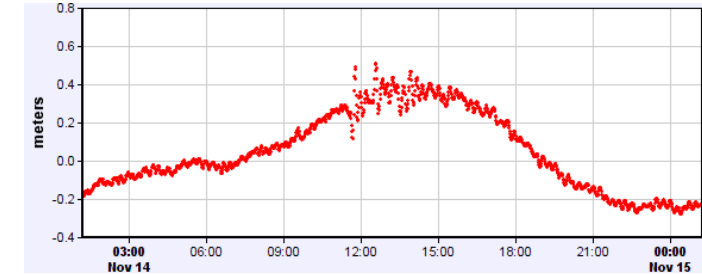
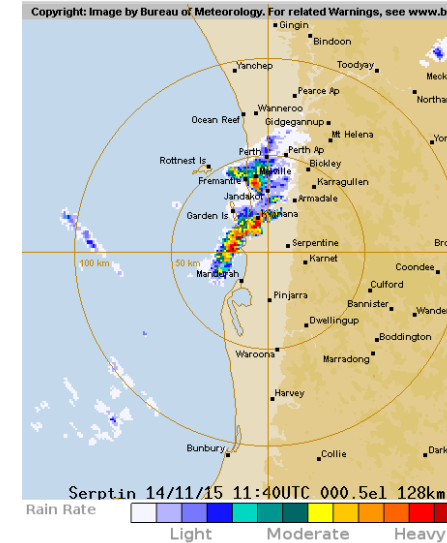
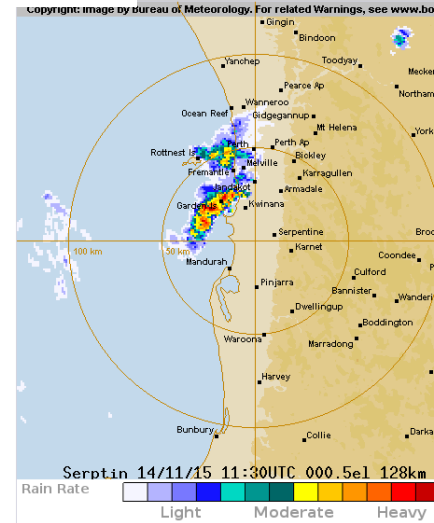
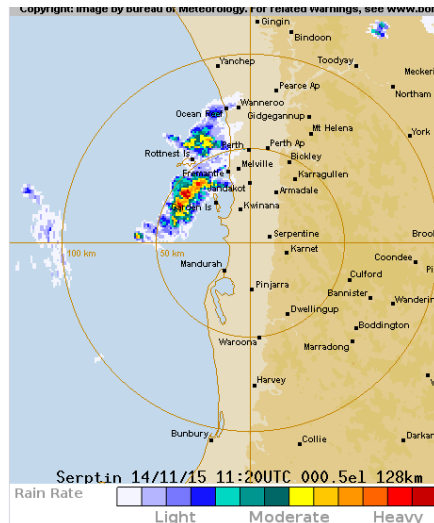
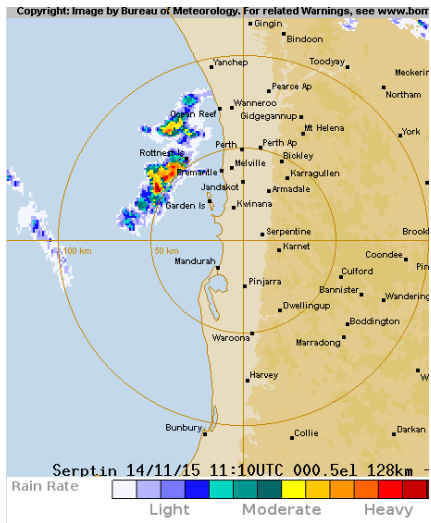
Meteorological Tsunamis



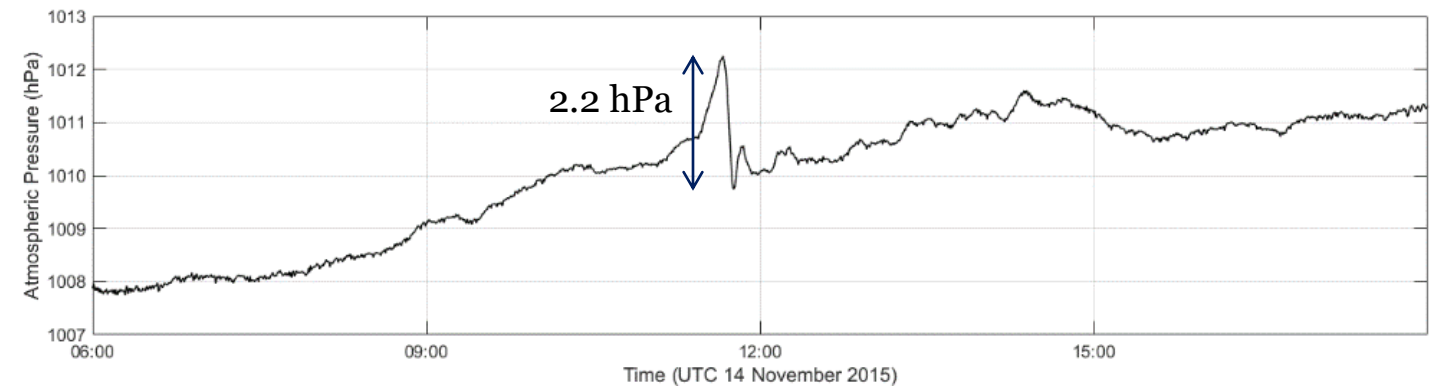
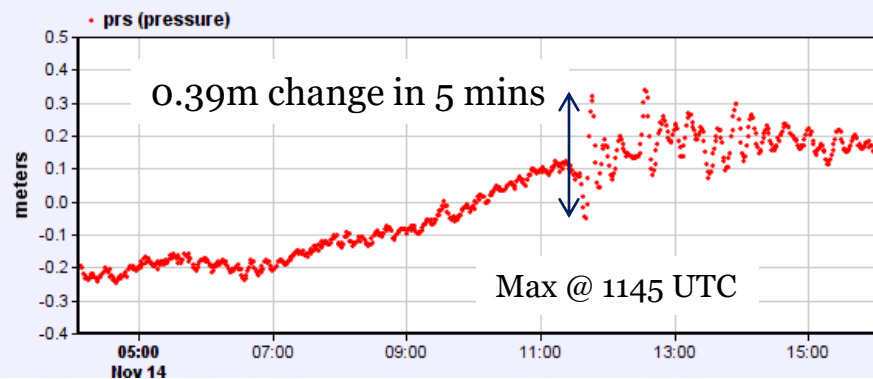
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Meteotsunami – Perth region: 14 November 2015: 1145 UTC



Sealevel at Hillarys_Harbor_AU station (offset: 0.914 m)



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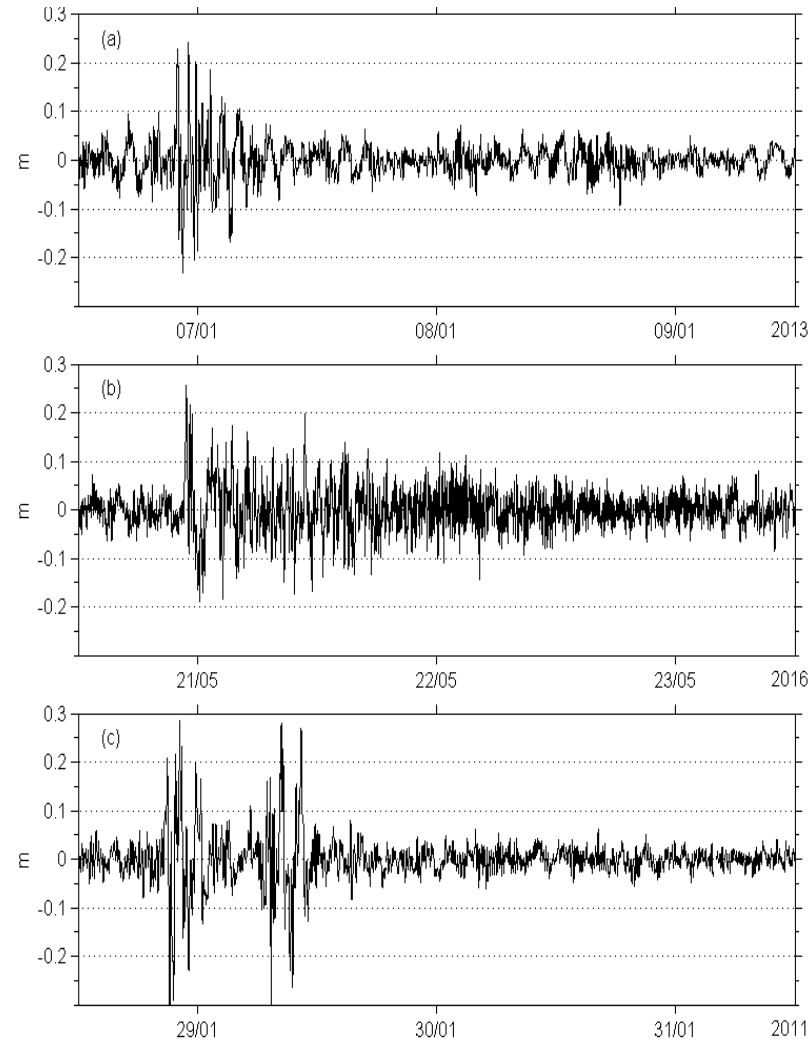
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Meteotsunami events:



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Thunderstorm

Cold Front

Tropical Cyclone



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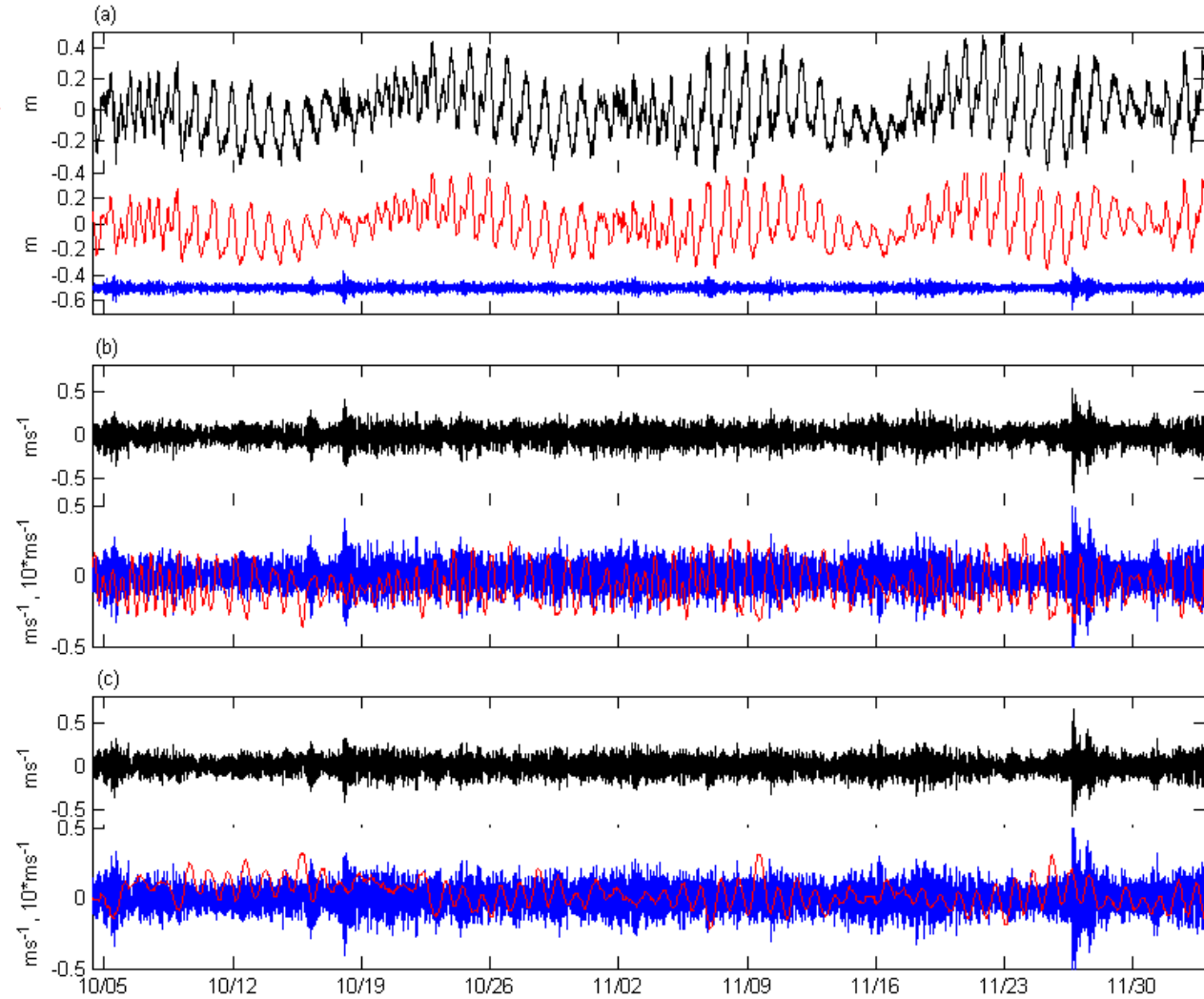
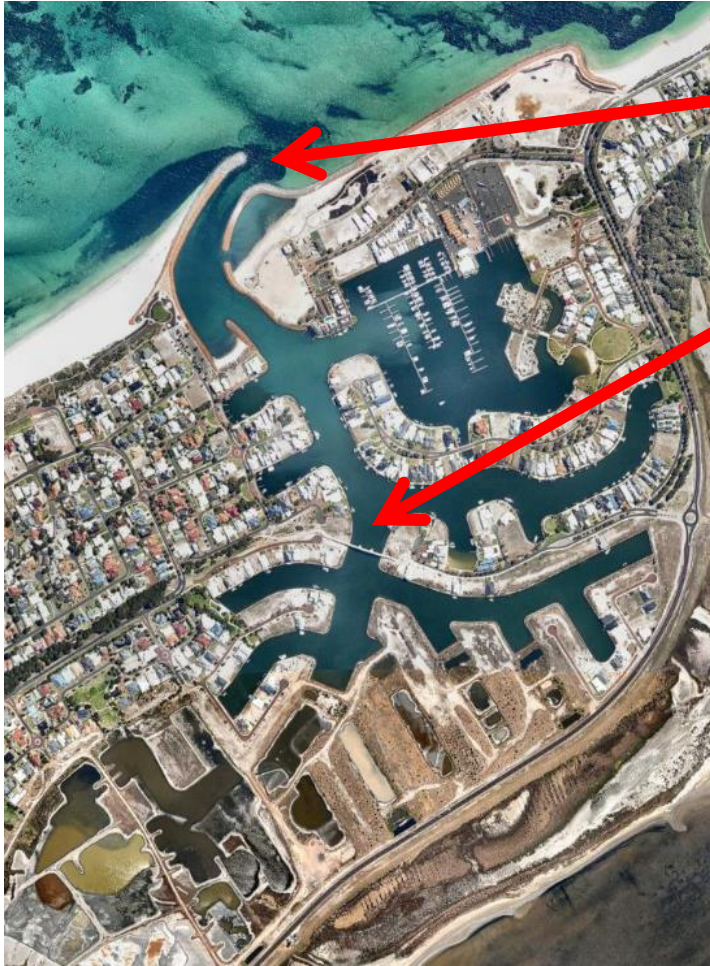
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Port Geographe



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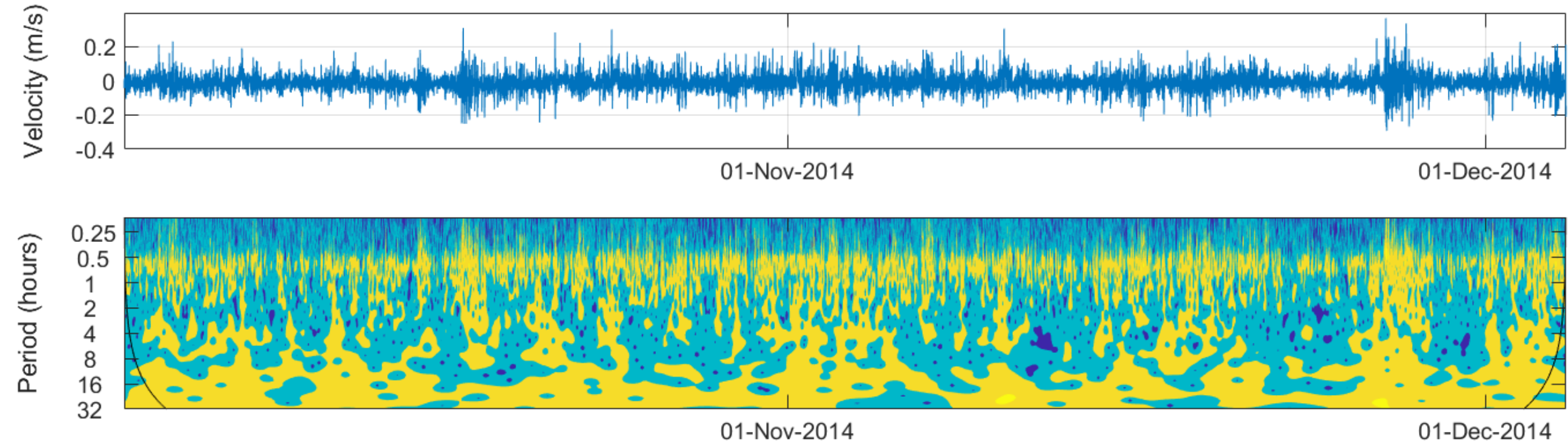


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Summary



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Offshore

- IG events occur ~10 per month
- Longer, higher IG energy events during winter
- IG wave heights ~10% of incident swell waves
- Local storm waves ($< 8s$) do not result in IG wave energy
- Long period swell ($> 15s$) generate IG wave energy
- Long period swell ($> 15s$) + swell ($< 15s$) + local storms generate maximum IG wave energy
- Tsunamis (seismic and meteorological) provide energy for oscillations

Inside port and harbours

- Oscillations independent of incident conditions; natural period of oscillations



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Thank You



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13-18 September 2020
International Convention Centre
Sydney, Australia



KEY DATES

Abstract Submissions Open	1 Apr 2019
Abstract Submissions Close	15 Sep 2019
Registration Opens	13 Apr 2020
Earlybird Registration Closes	3 Jul 2020



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