A novel solution for measuring Infragravity Waves using ADCPs

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Infragravity waves – Motivation

I have received one inquiry about processing of infragravity wave direction using AWAC or Signature Wave data from Dr. Jeong of KIOST.
Actually he has been using a lot of AWAC and Signature (more than 25 units) to monitor wave environment of coastal around Korea peninsula for more than 13 years.
According to his explanation, there should be the energy spectrum of 30 seconds~150 seconds of wave period to analyze infragravity wave direction.
He and I know AWAC600 & Signature 500 can measure 1~50 seconds of wave period.
However he said to me that he does not get energy spectrum data (value is zero) of over 30 seconds wave period when he review wds file.
I know if there would be any wave period which is longer than 30 seconds, there should be the energy spectrum data in wds file.
So I think he does not have energy spectrum data of longer than 30 seconds because there is no the long wave period of longer than 30s during deployment.
Is my understand right?

It is long period waves not just normal short period stuff that are important as well – periods of say 0.003 to 0.033Hz as well as traditional wind/swell frequencies. Might also require a longer sampling period to be analysed

I am interested in a quote on either AWAC 1Hmz, Signature 1000 or Aquadopp 300 for a proposal on measuring infragravty waves on ~35 m water depth.

Last week I was asked to assist in a measurement campaign aiming to detect infragravity waves (50-500 sec) and its direction.

I was wondering if the signature 1000 (waterdepth is 10 m) could be used and programmed to obtain wave bursts of 8092 samples with a duration of slightly more than 2 hours. Or even program to obtain data continuously with sample rate of 1 Hz.

I am not aware of a public tender, I got the question related to infragravity waves regarding a "mooring" related issue near a proposed Jetty in Brazil. I focused the engineering company (Royal Haskoning DHV) on an article in which use has been made of the AWAC in order to study the occurrence size and directionality of these long waves. I proposed to them to follow a double approach in which you Nortek Signature should be in the center of the measurement set up and spaced around it (distance 300-500 meter) 3 pressure gauges.

I just know that Dr. Jeong of KIOST has been working government project to review and correct existing numerical model of infragravity wave due to complaining of ports and coastal developer
He knows your software is focusing wind wave so OceanContour process wave period from 0.02Hz frequency.
Nevertherless, he was asking you if you can provide extended processing software function of OceanContour which can process long period wave which is lower than 0.02Hz (ex. 0.003Hz).

According to the manual, the AST method's period range is between 0.5-50 s. We are specifically interested in the measurement and detection of both gravity and infragravity waves. Given the potential for infragravity waves to have periods up to 300 s, we would like to understand the implications and potential limitations of this for our work.

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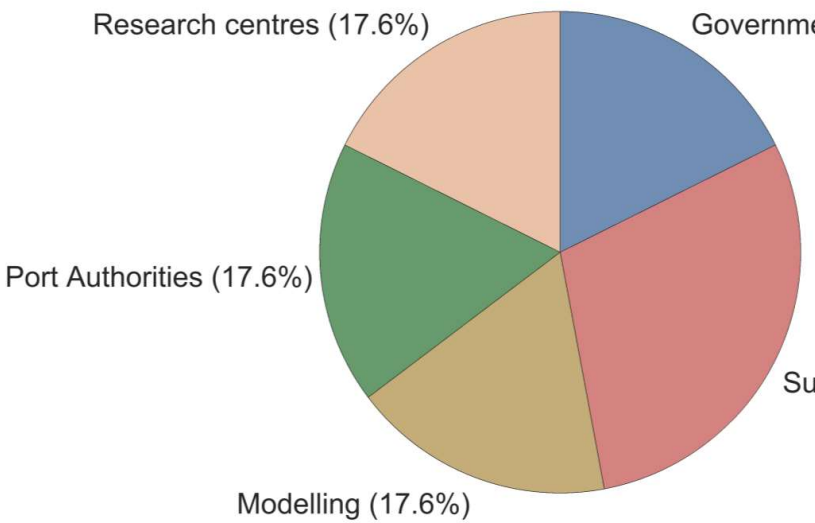
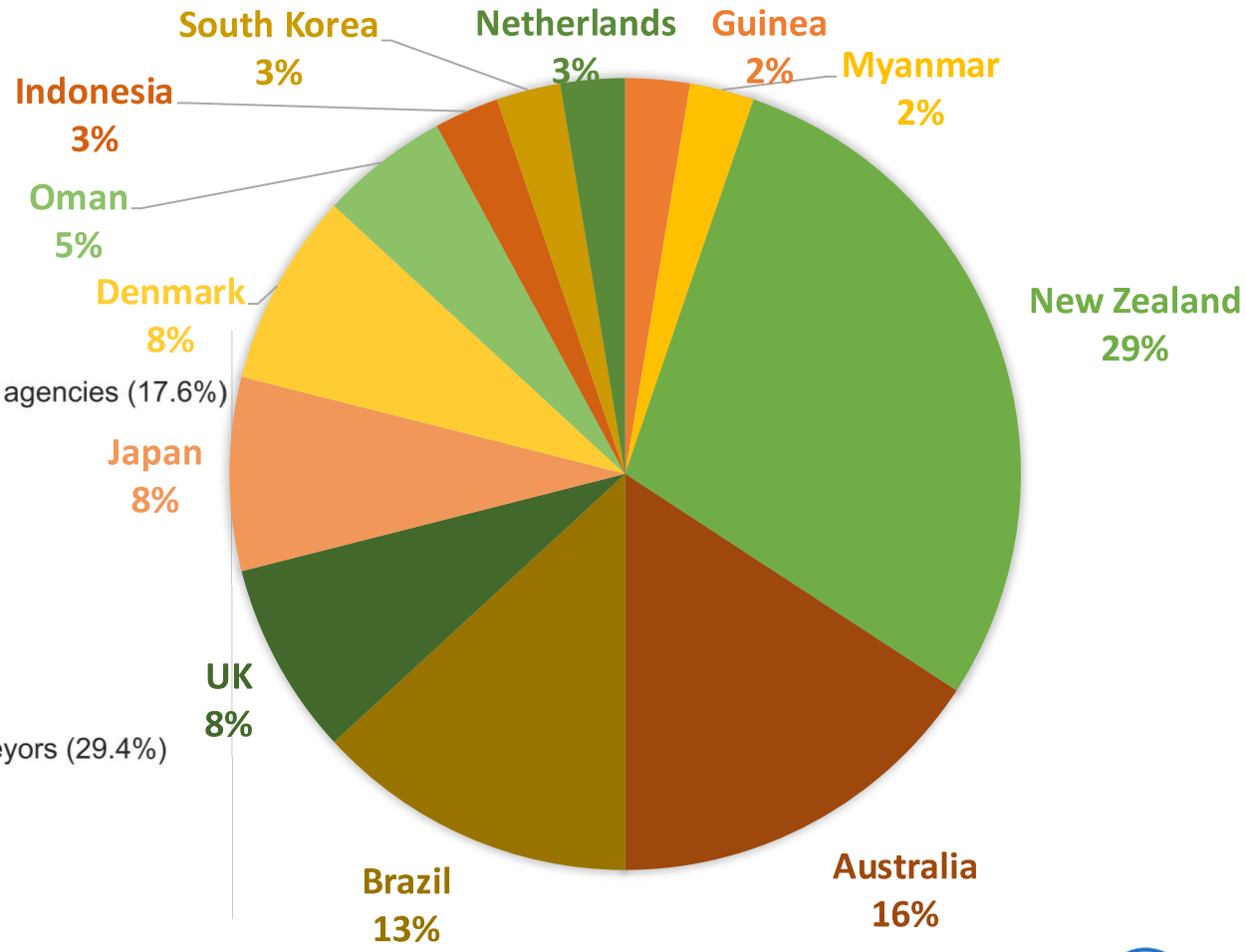
Clients


Research centres (17.6%)
Government agencies (17.6%)
Port Authorities (17.6%)
Surveyors (29.4%)
Modelling (17.6%)


South Korea
3%
Netherlands
3%
Guinea
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Myanmar
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Indonesia
3%
Oman
5%
Denmark
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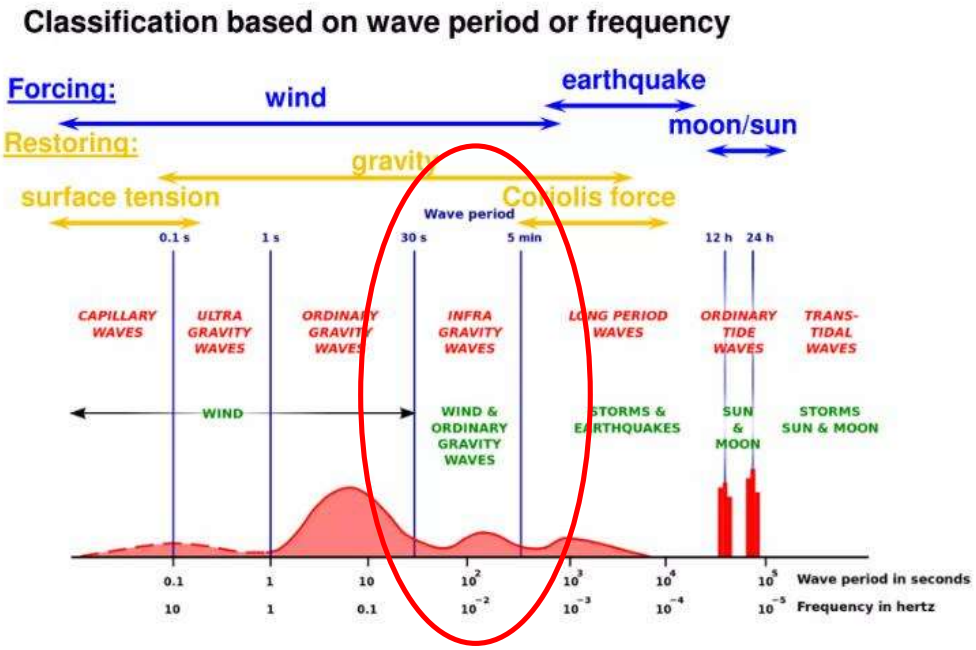
New Zealand
29%
Japan
8%
UK
8%
Brazil
13%
Australia
16%

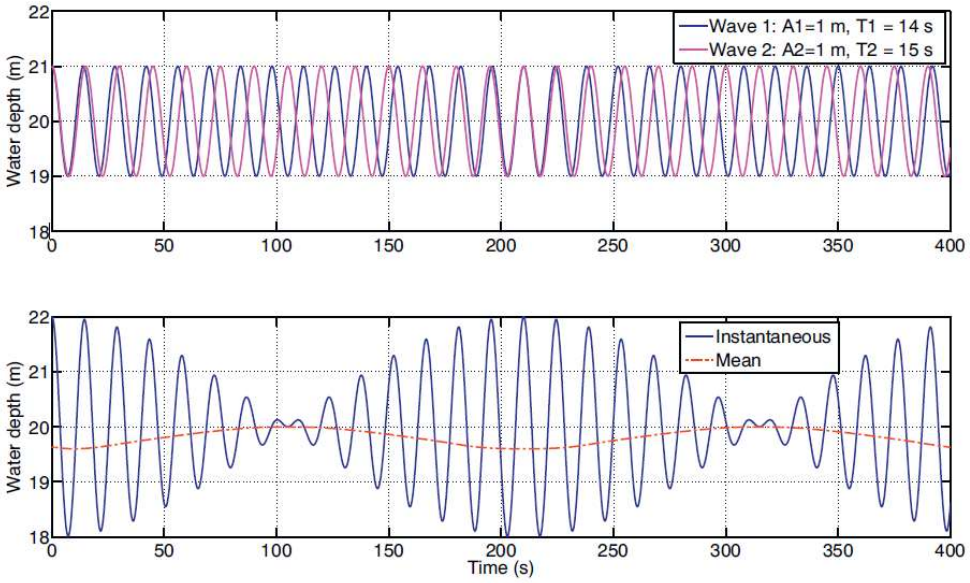
Infragravity waves – what are they?



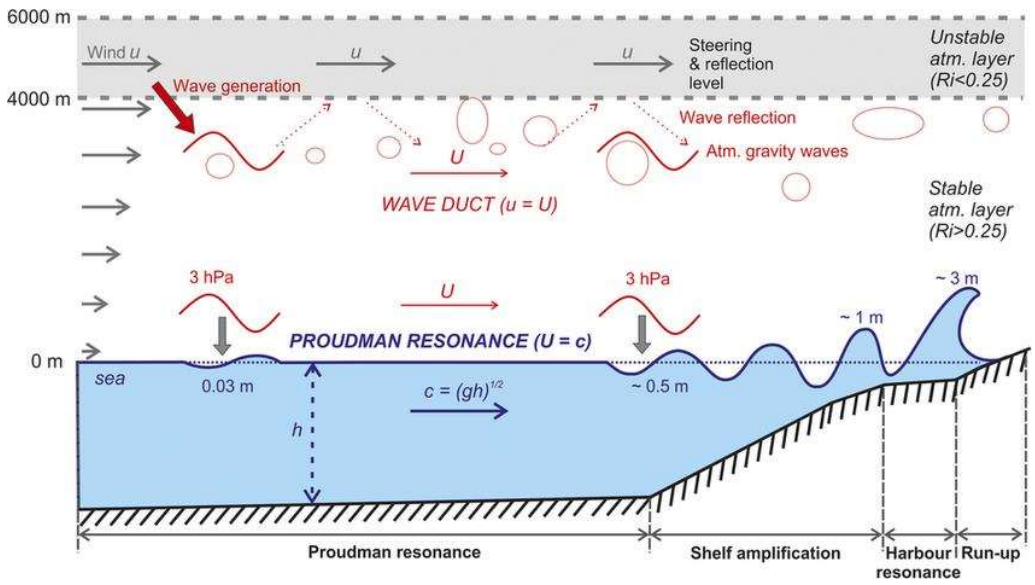
Low frequency waves, long waves, subharmonic gravity waves, bound waves, surf beat, seiches

Infragravity waves – what are they?

Wave-wave interaction



Meteorological tsunami



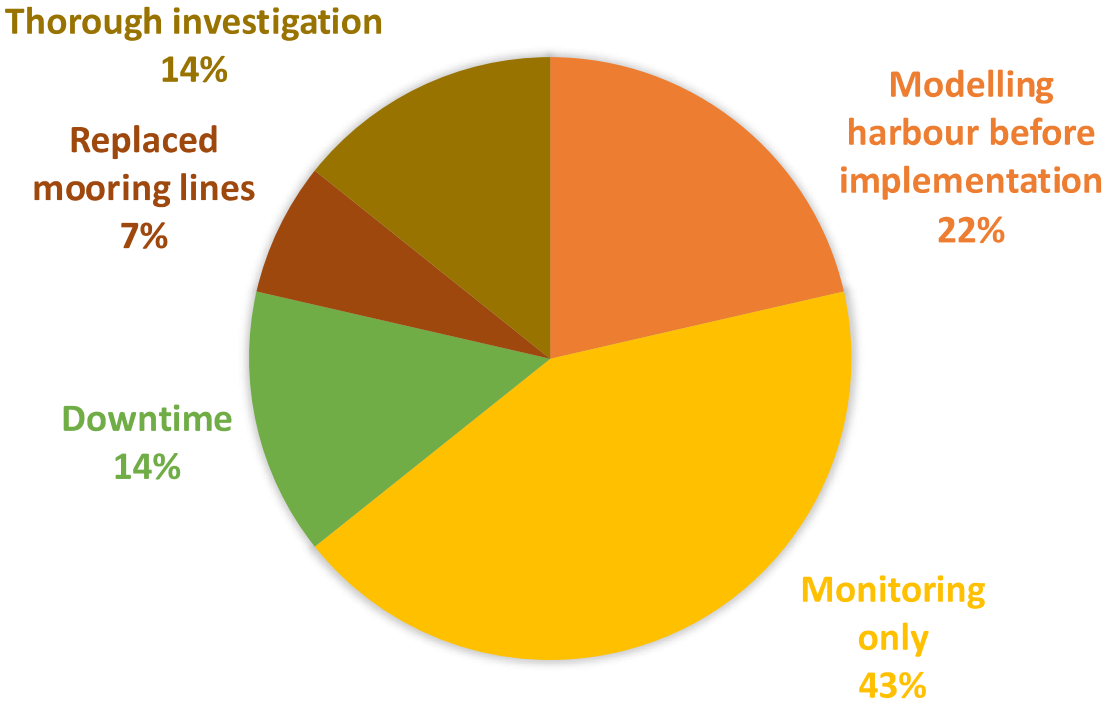
Infragravity waves – why should we care?

- Nearshore hydrodynamics
- Sediment transport
- Dune and barrier breaching
- Development of seiche in harbours – mooring lines
  - Amplification if the period is close to the resonant period of the harbor
  - “Many studies suggest that mooring lines break mainly because of motions caused by infragravity waves (Lopez and Iglesias, 2014; van Deyzen et al., 2015)“

How have you identified IG as being an issue?

- The client reported “something was wrong”, “wave anomaly”
- Mooring line snapped
  - Death report related to a sudden wave
  - Downtime to investigate broken cables cost estimated at $1 mil
- Forecast not matching observation
  - Tidal discrepancy
- Pipeline and mooring unpredicted instability

How do you deal with IG waves in your harbour?



- Investigation
  - Machine learning
  - Predict downtime with onshore/offshore sensor
  - Berth alert
- Mooring lines
  - ShoreTension®
  - MoorMaster®

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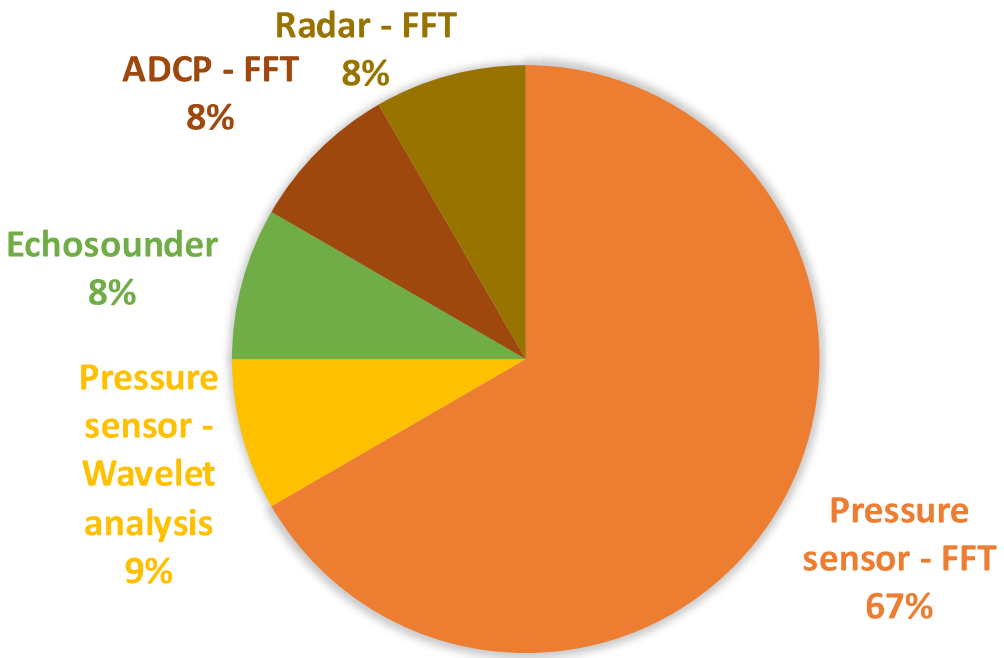
How do you measure IG waves?



- Issues with pressure sensor
  - Drifts over time
  - Non-directional
  - Not real time
  - Hard to recover
  - Indirect measurement – transfer function
- Issues with radar
  - Non-directional
  - Lots of bad data
  - Subject to good weather
  - Expensive

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What would you like from us?

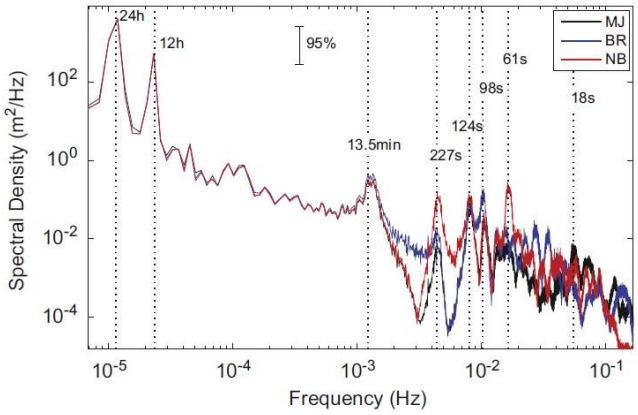
1. Sensor: non-drifting, reliable, cost effective, low-maintenance
2. Software: Fully processed data, visualisation tools
3. Hardware: Real-time data
4. Processing methods: Time-series analysis, FFT and wavelet analysis
5. Others:
    1. Strain analysis on mooring lines
    2. Directionality
    3. Nothing

What we can offer

1. Sensor: direct measurement of water elevation (η)
2. Software: Storm/Ocean Contour
3. Hardware: Prolog
4. Processing methods

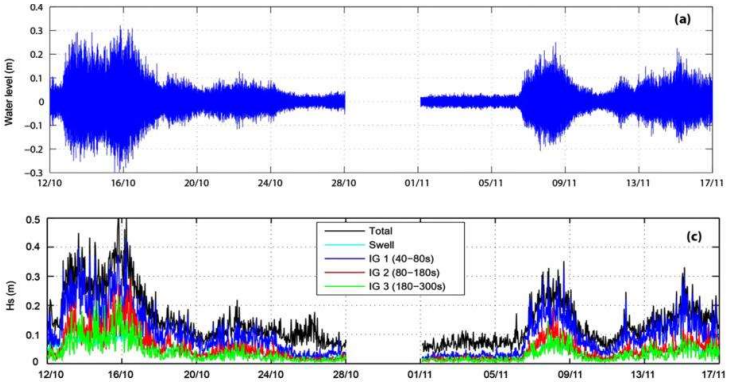
Infragravity waves – what we can offer

Spectral analysis



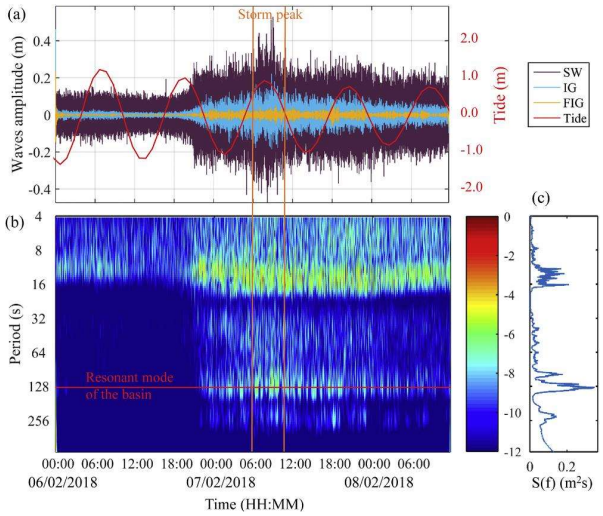
Frequency domain

Zero-crossing



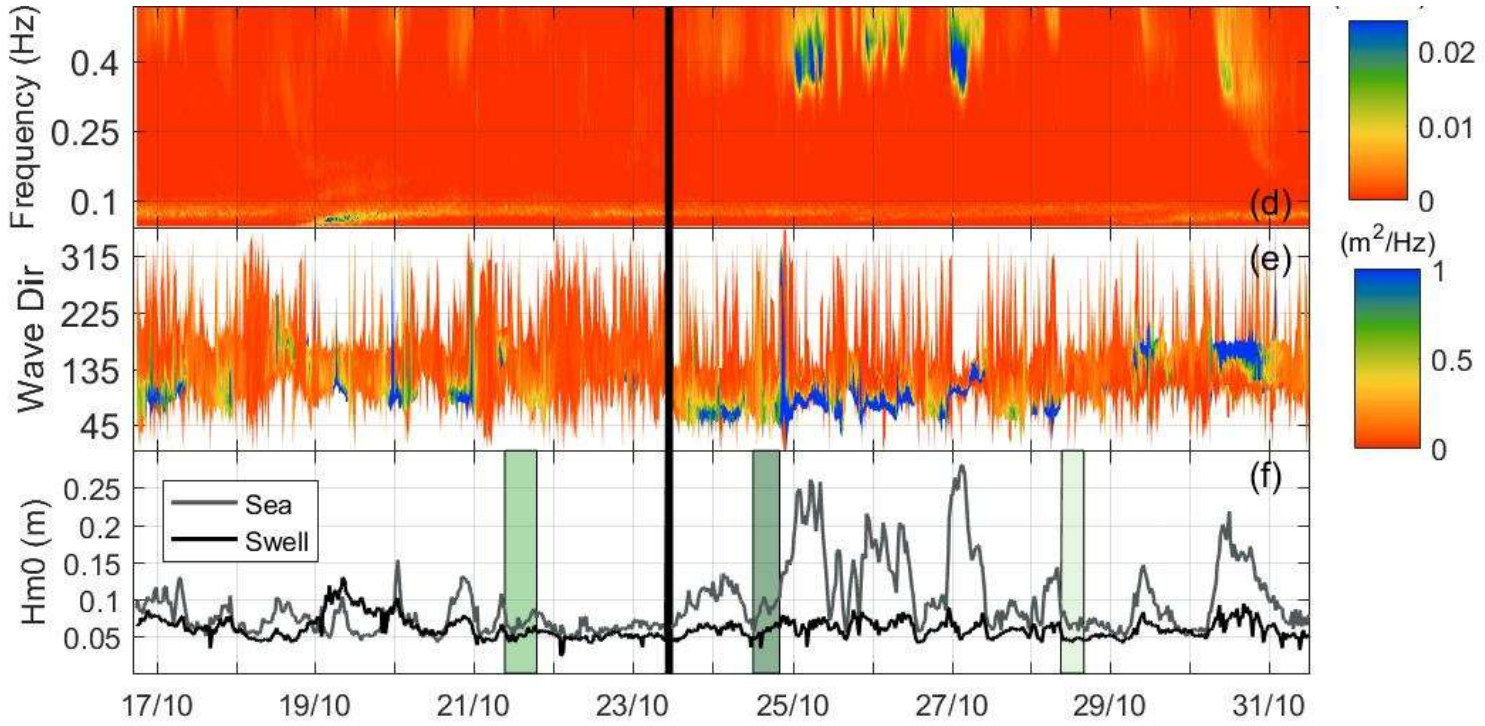
Time domain

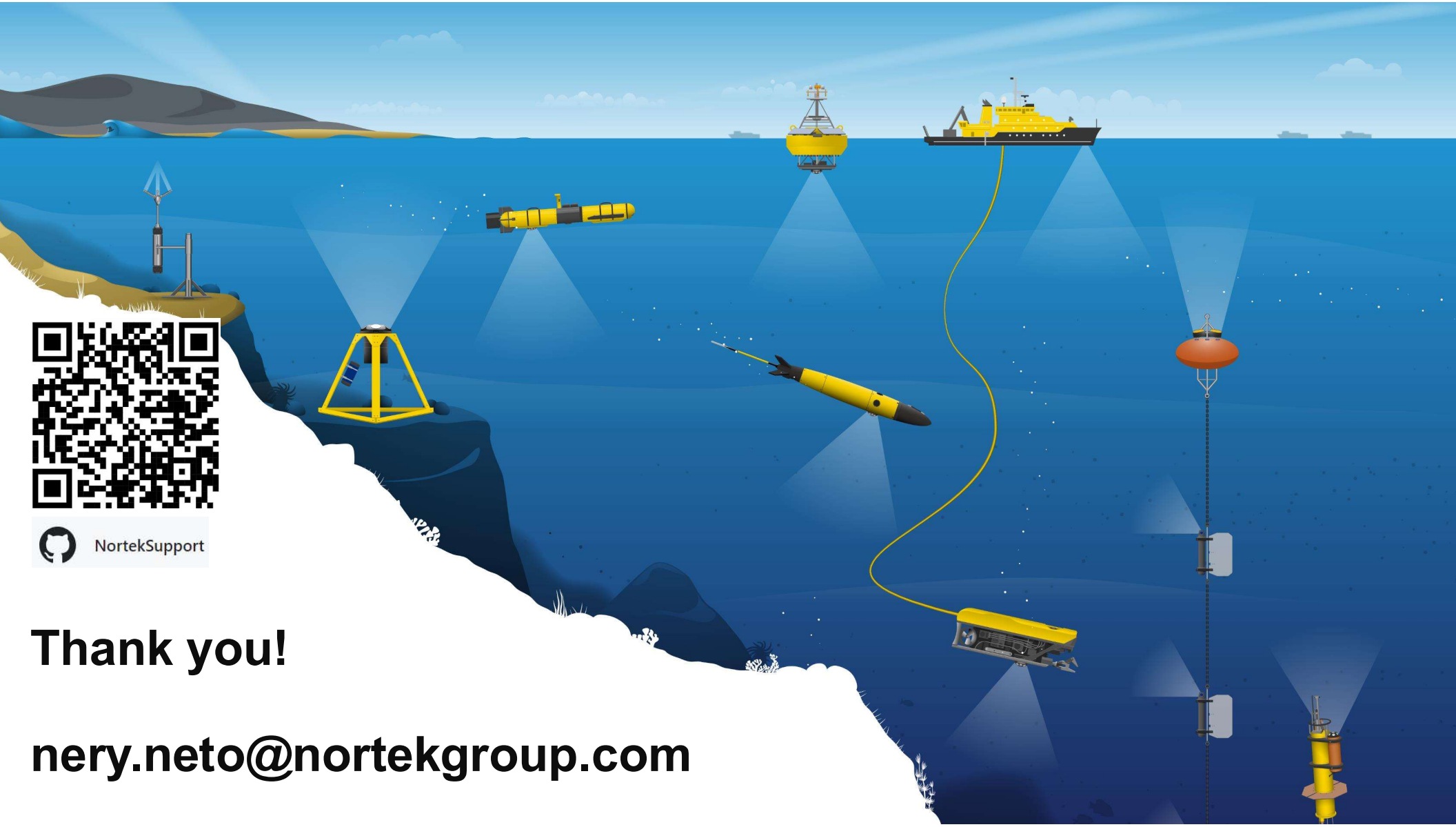
Wavelet



Time-frequency domain

Infragravity waves – directionality





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Thank you!

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