



The Importance of Getting Your Feet Wet: Field Measurements from the OPERA project

Sam Weller and Lars Johanning

Southampton 6th July 2017



Wind Turbine Development

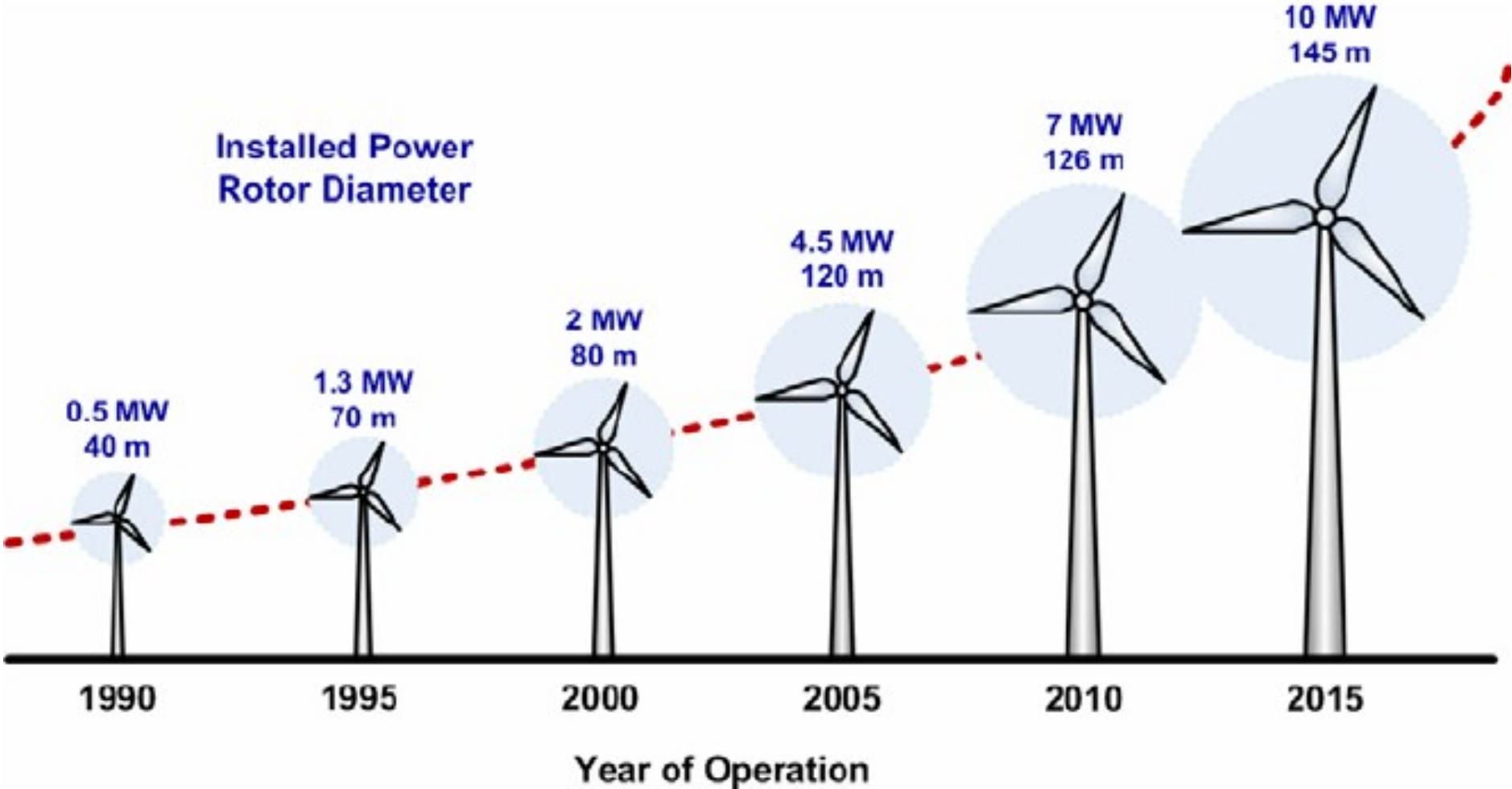
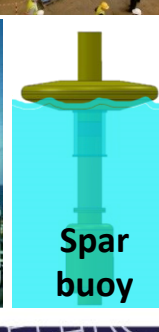
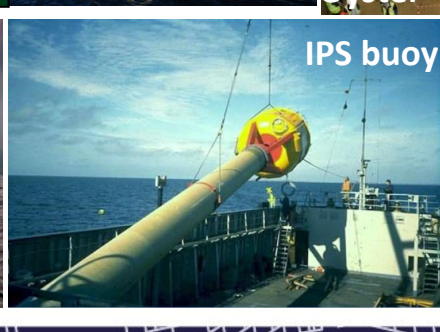
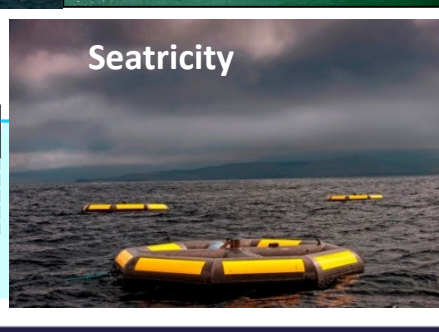
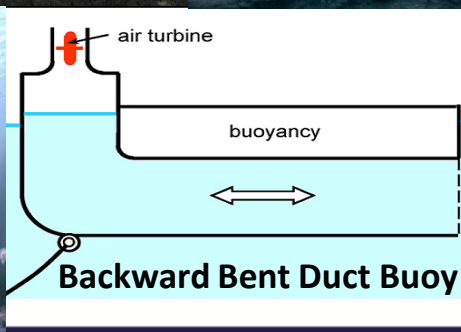
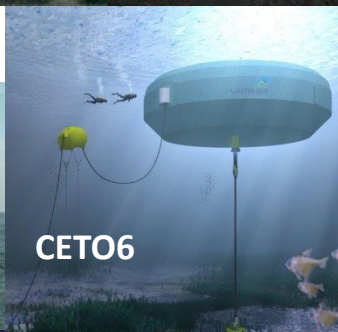
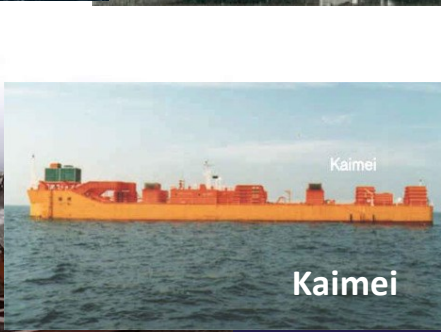
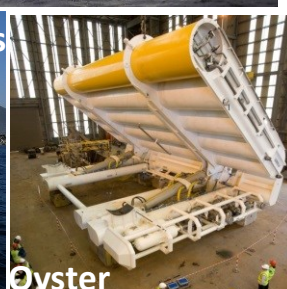
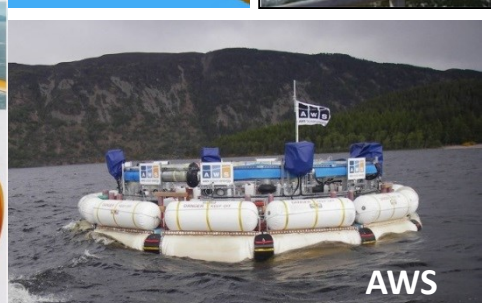
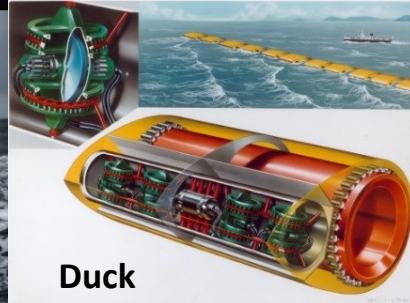
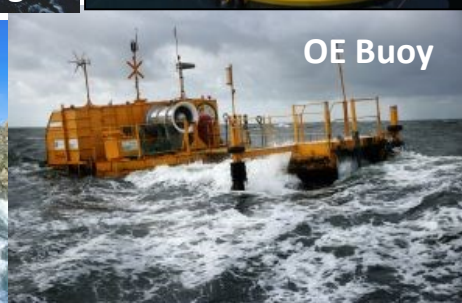
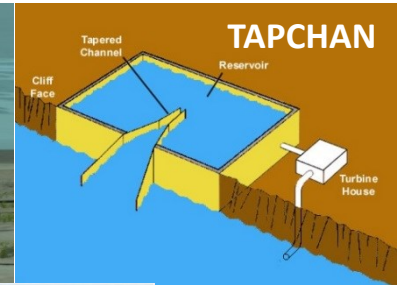
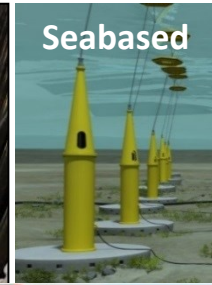


Image: Molina (2011) Modelling and Control Design of Pitch-Controlled Variable Speed Wind Turbines



Wave Energy Converters



Barriers to Development

Context: High levels of risk



Barriers to Development

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Lack of wave energy design convergence



Commercial competitiveness and IP concerns



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Little or no knowledge or data sharing



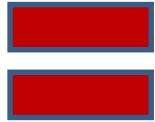
Barriers to Development

Context: High levels of risk

Lack of wave energy design convergence



Commercial competitiveness and IP concerns



Little or no knowledge or data sharing

Result: Lack of progress, similar pitfalls



Image: Pinterest



Open Sea Operating Experience to Reduce Wave Energy Cost


- 42 months
- €8M
- 4 innovations
- 2 years of data
- 50% cost reduction target



Images: OPERA project



Open Sea Operating Experience to Reduce Wave Energy Cost

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opera



MARMOK-A5 oscillating water column

- 5m diameter (max)
- 41.8m long
- ~160 Tonnes
- Currently with 2x 15kW turbines, 1x 30kW to be installed April/May 2018
- 85m water depth

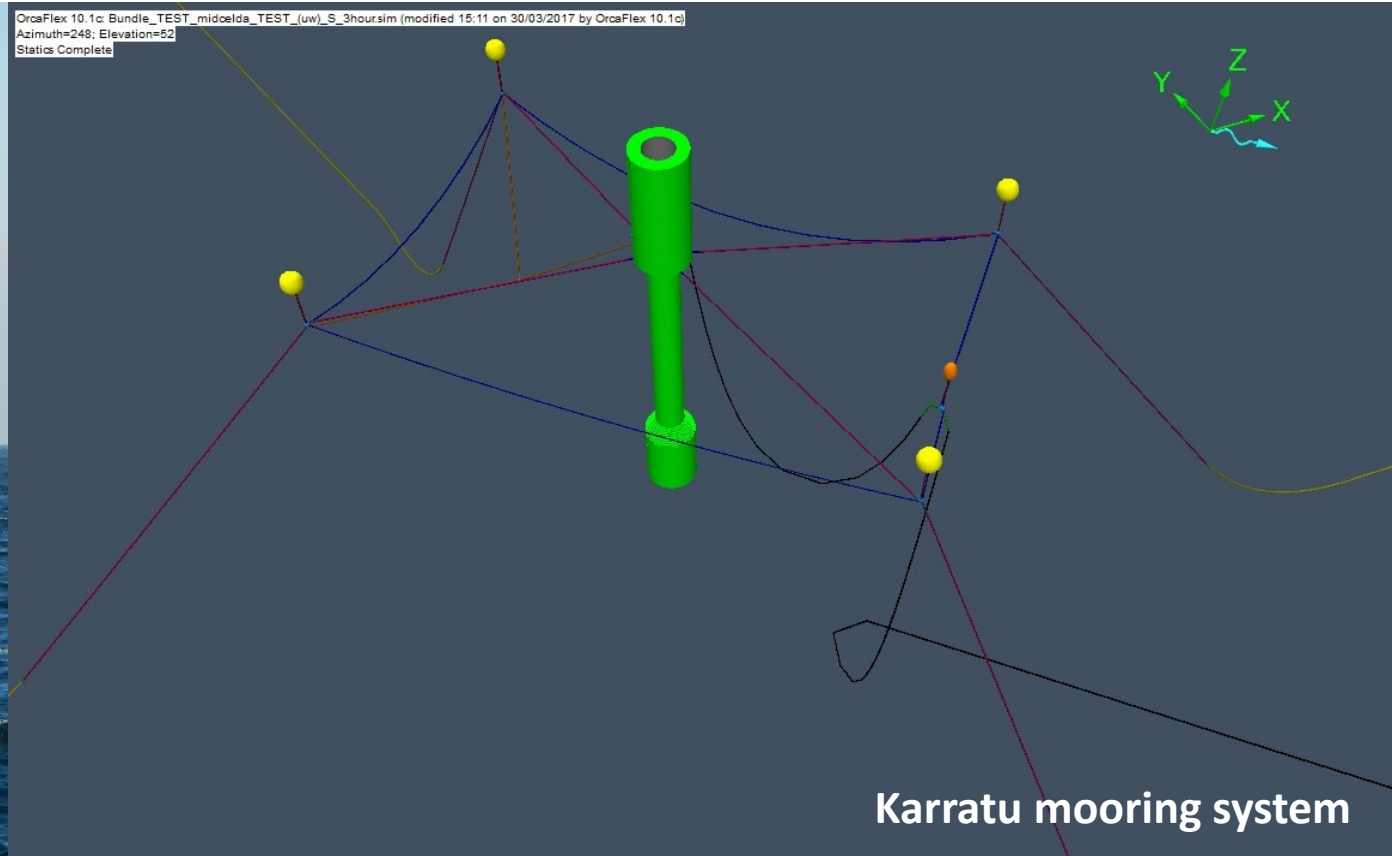


Image: Bilbao Marine Energy/ Twitter

Work Package 2: Mooring loads assessment and reduction, shared mooring validation

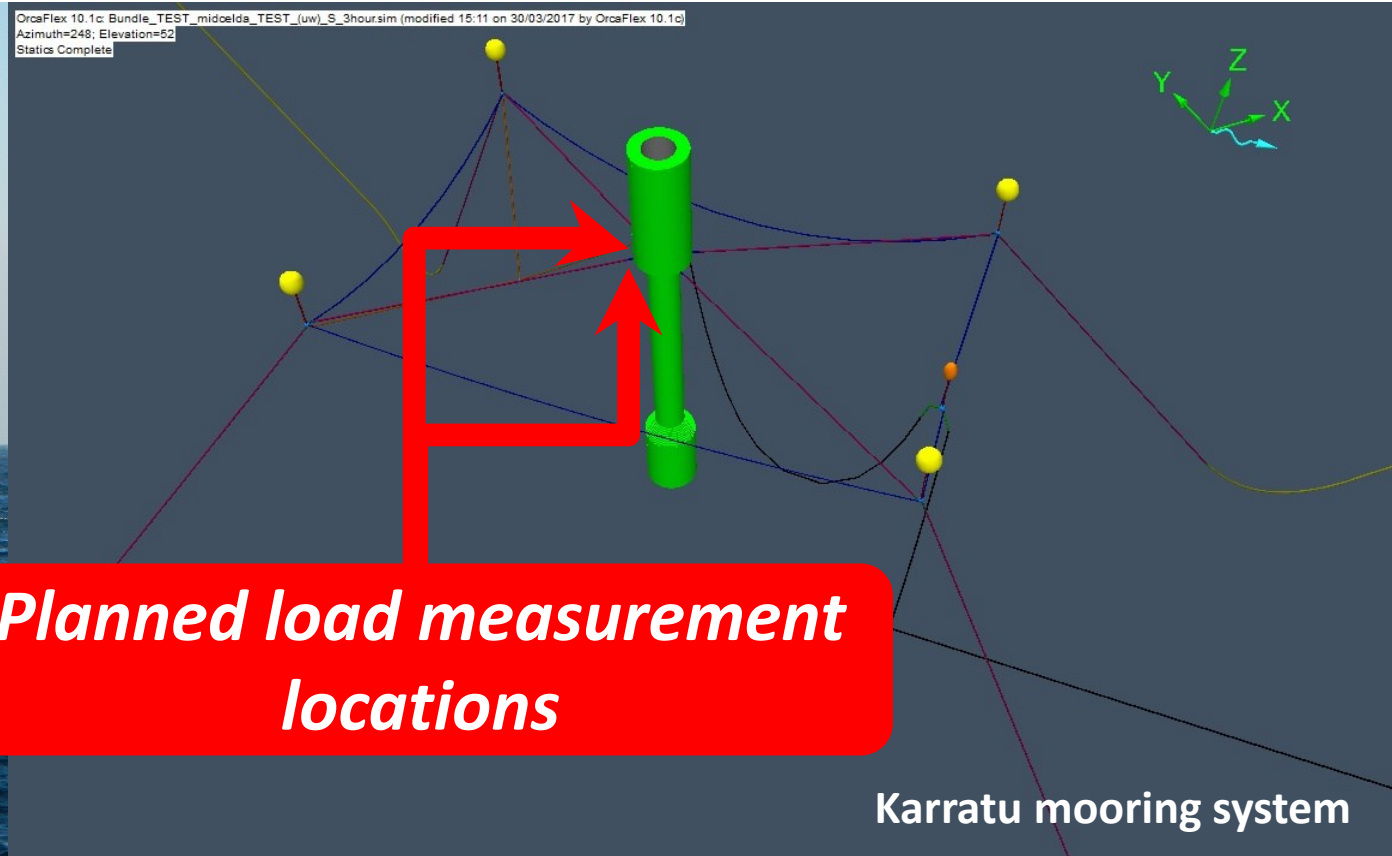


MARMOK A5 device at BiMEP

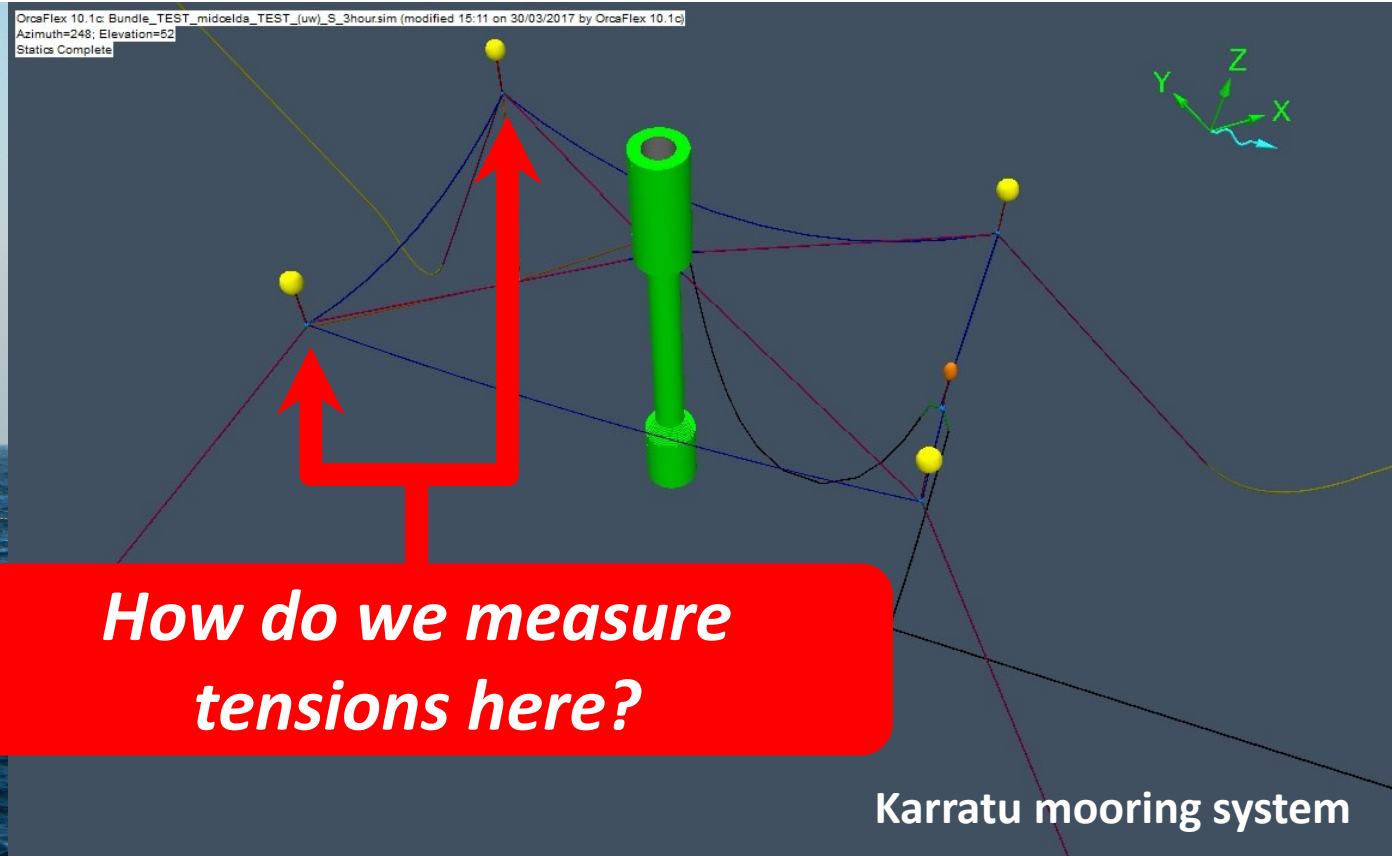


Karratu mooring system

Work Package 2: Mooring loads assessment and reduction, shared mooring validation



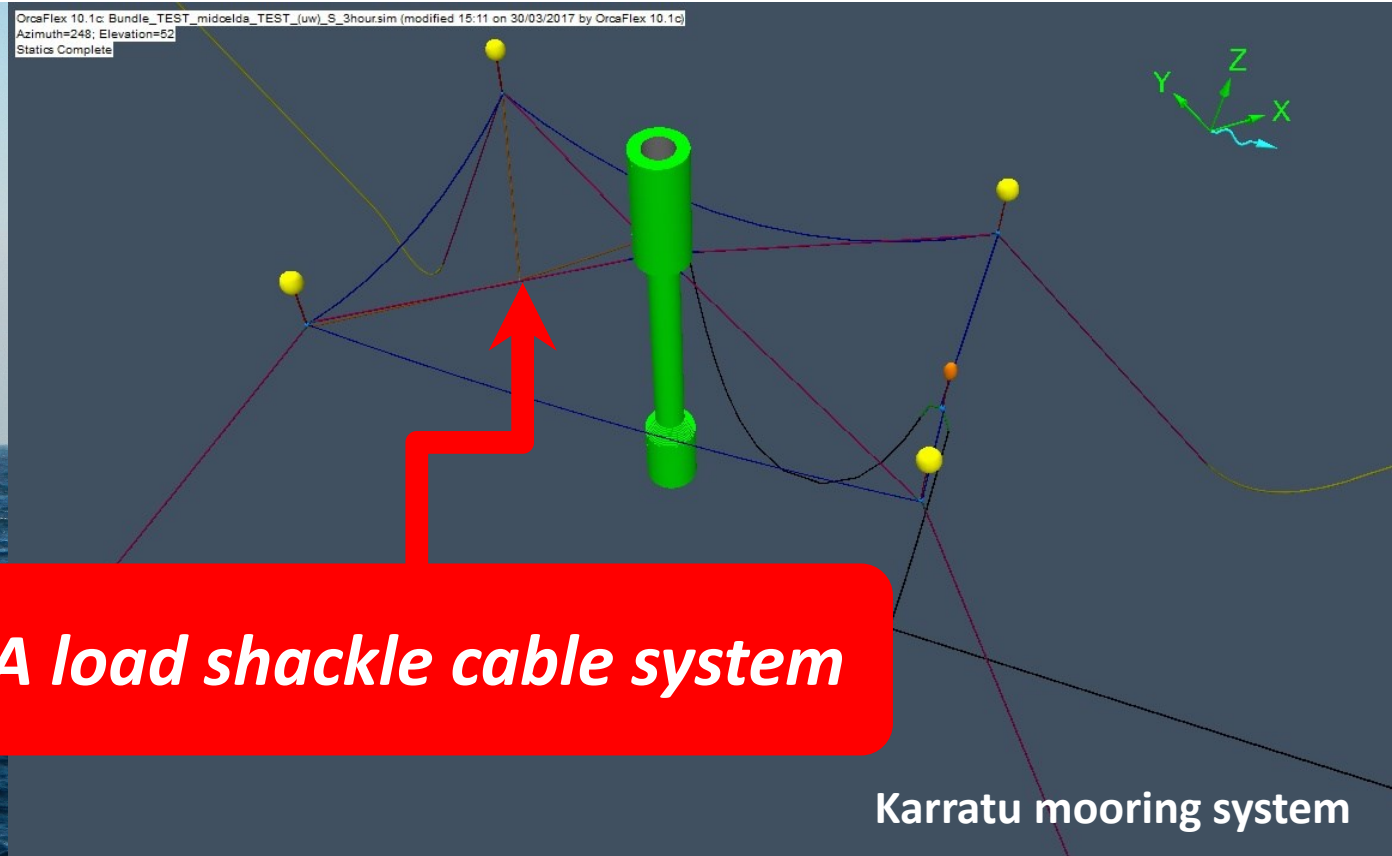
Work Package 2: Mooring loads assessment and reduction, shared mooring validation



How do we measure tensions here?



Work Package 2: Mooring loads assessment and reduction, shared mooring validation



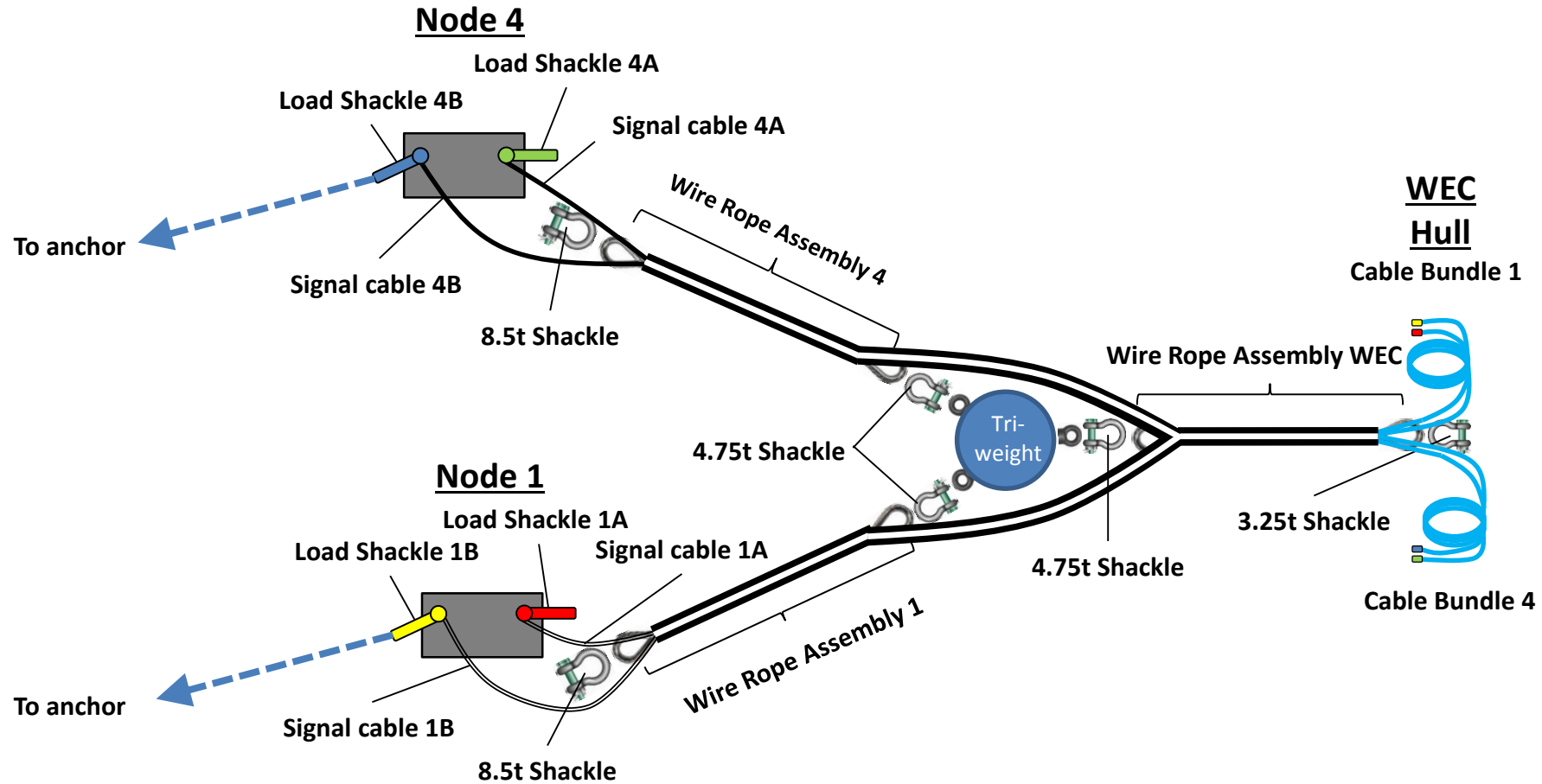
A load shackle cable system

Karratu mooring system

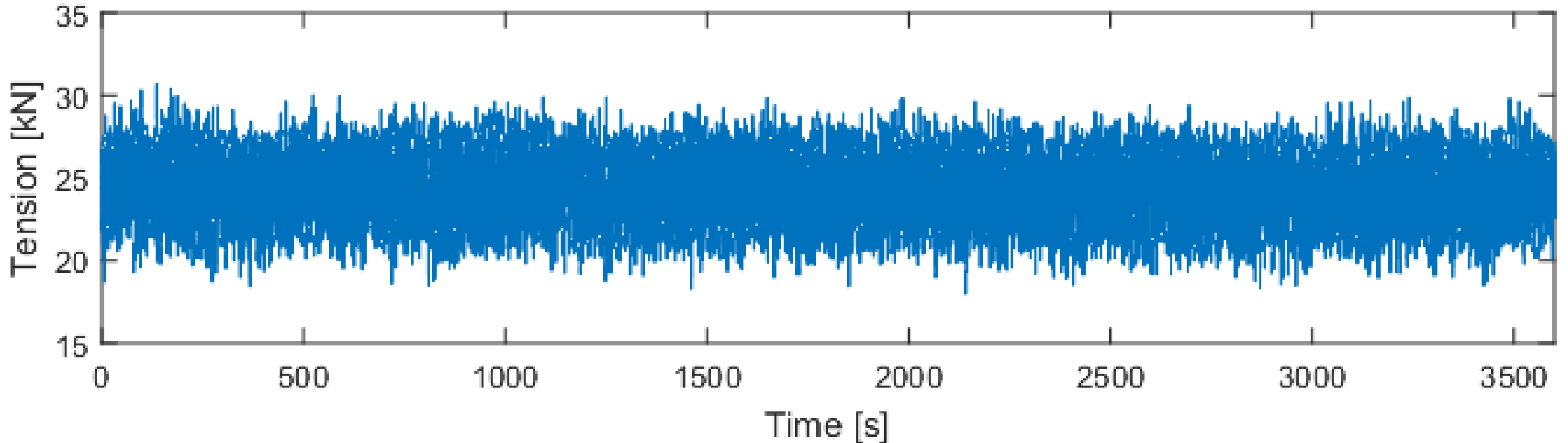


Load Shackle Cable System + device instrumentation

**DGPS
and 3DoF
IMU**



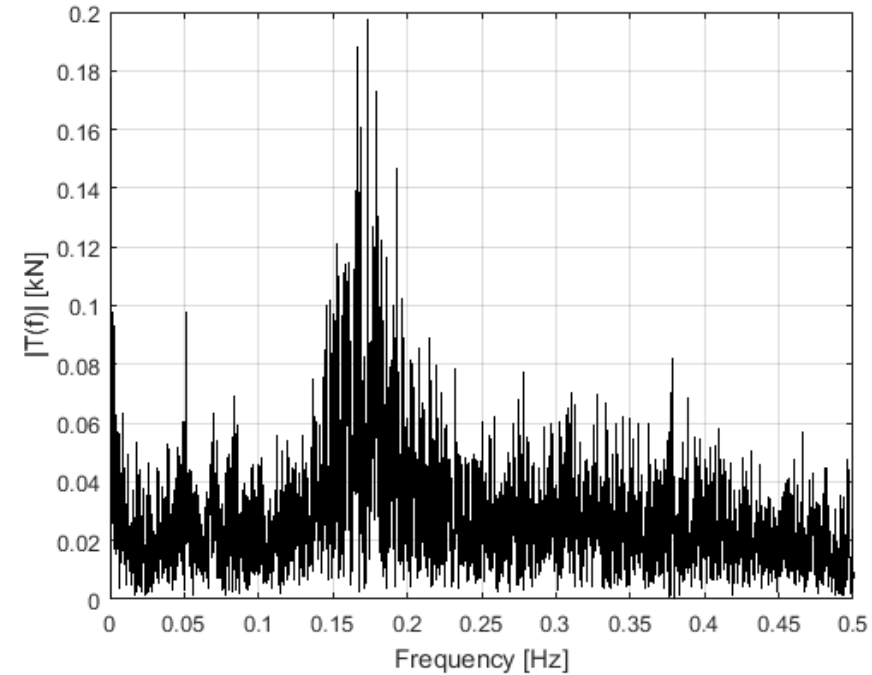
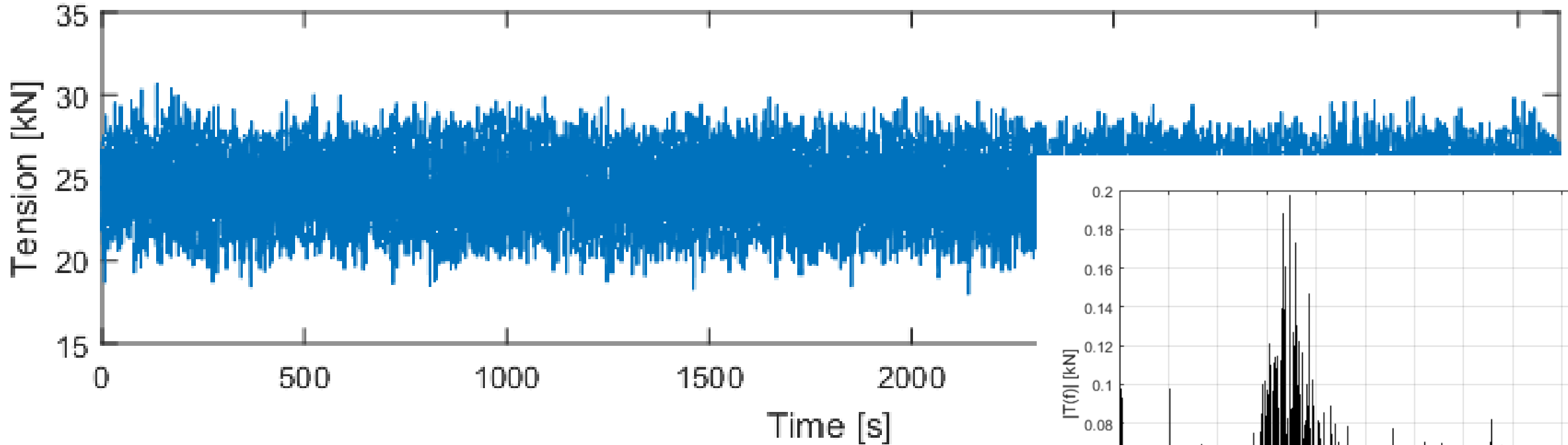
Measured tension time-series: Calm before the storm



Date	Time range	Hs [m]	Tp [m]	Direction [deg]
31/1/17	10:20-11:20	1.1-1.2	9.1-10.5	292-298



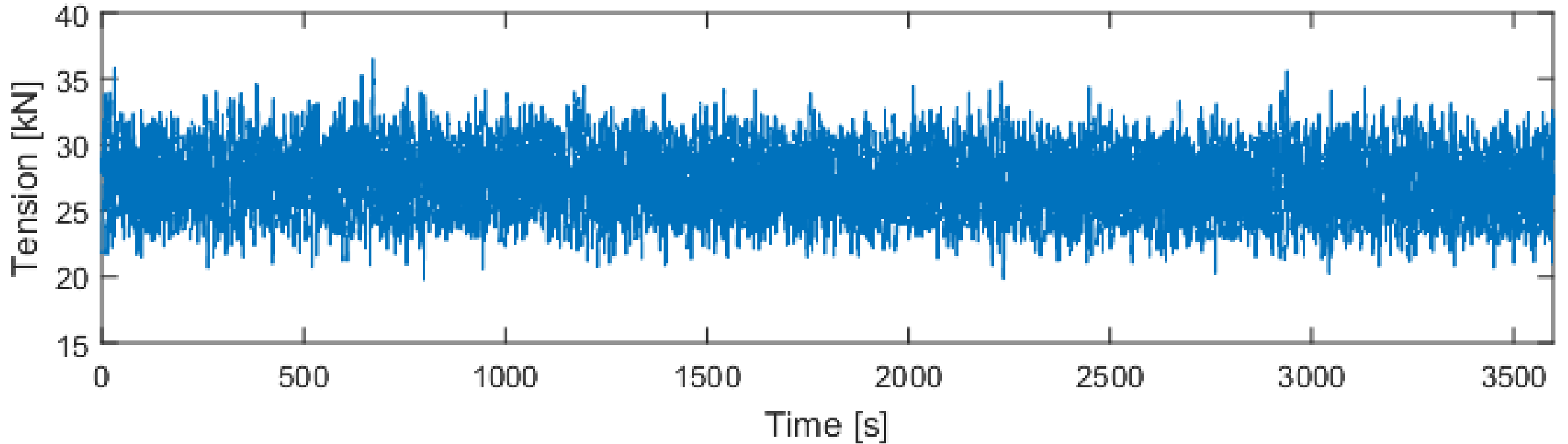
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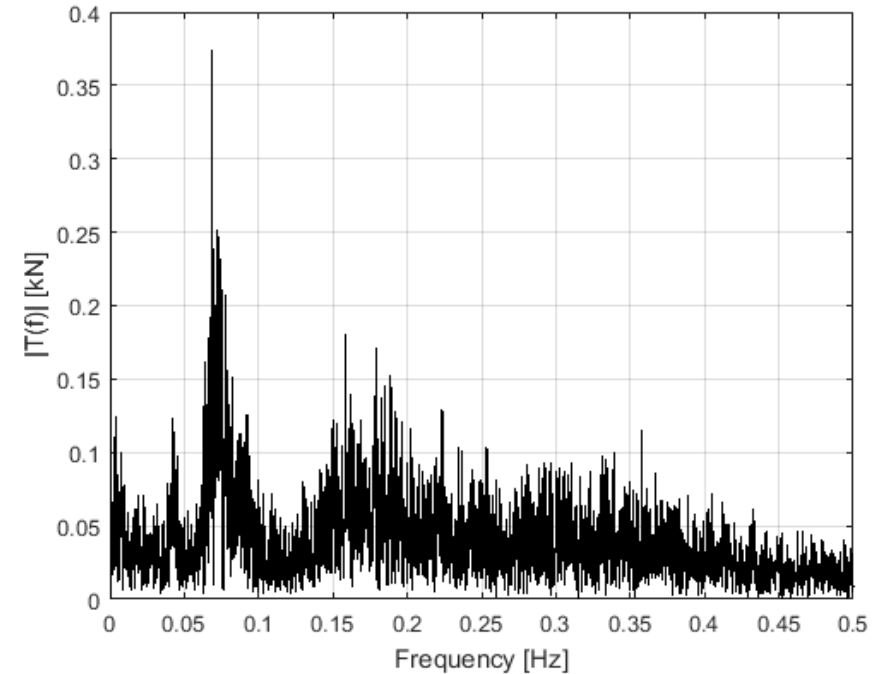
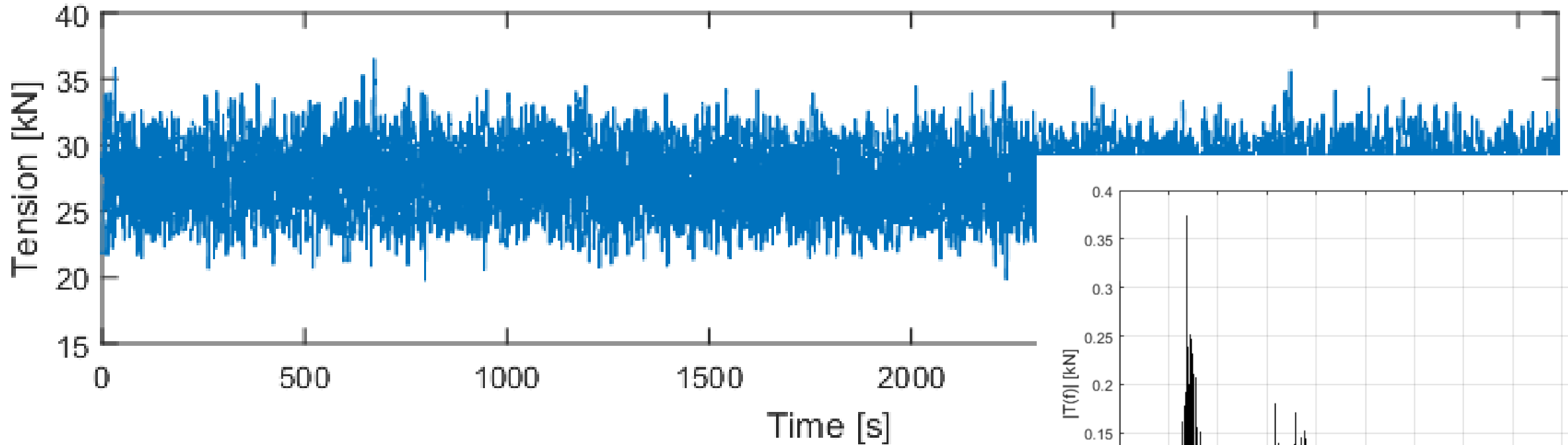
Measured tension time-series: Storm build up



Date	Time range	Hs [m]	Tp [m]	Direction [deg]
1/2/17	06:00-0700	2.1-2.6	13.3-14.3	304-306



Measured tension time-series: Storm build up

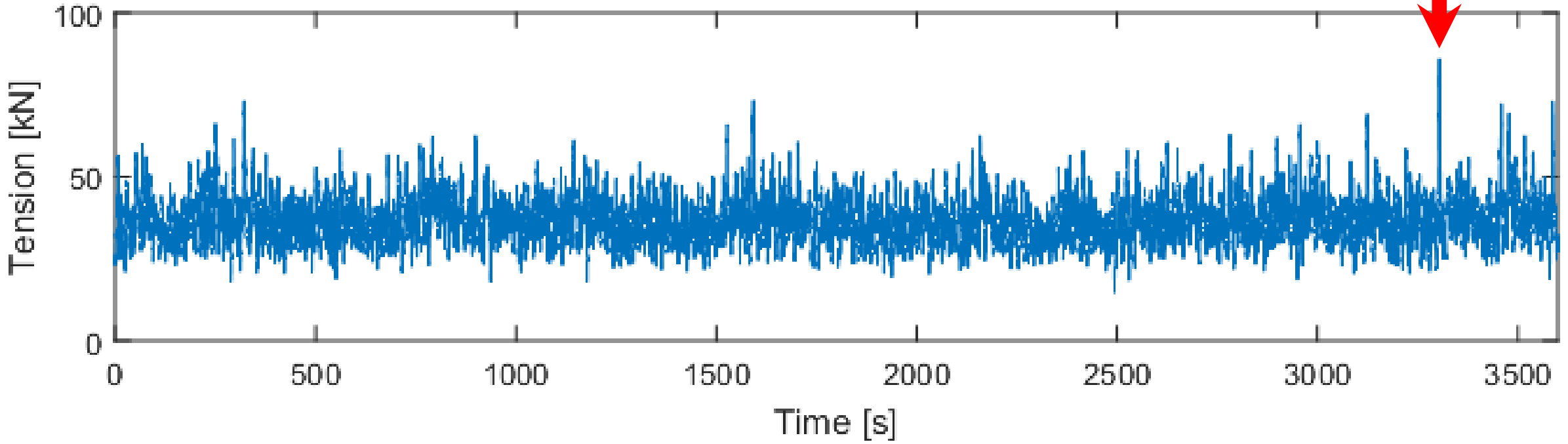


Date	Time range	Hs [m]	Tp [m]	Direction [deg]
1/2/17	06:00-0700	2.1-2.6	13.3-14.3	304-306



Measured tension time-series: Mild storm

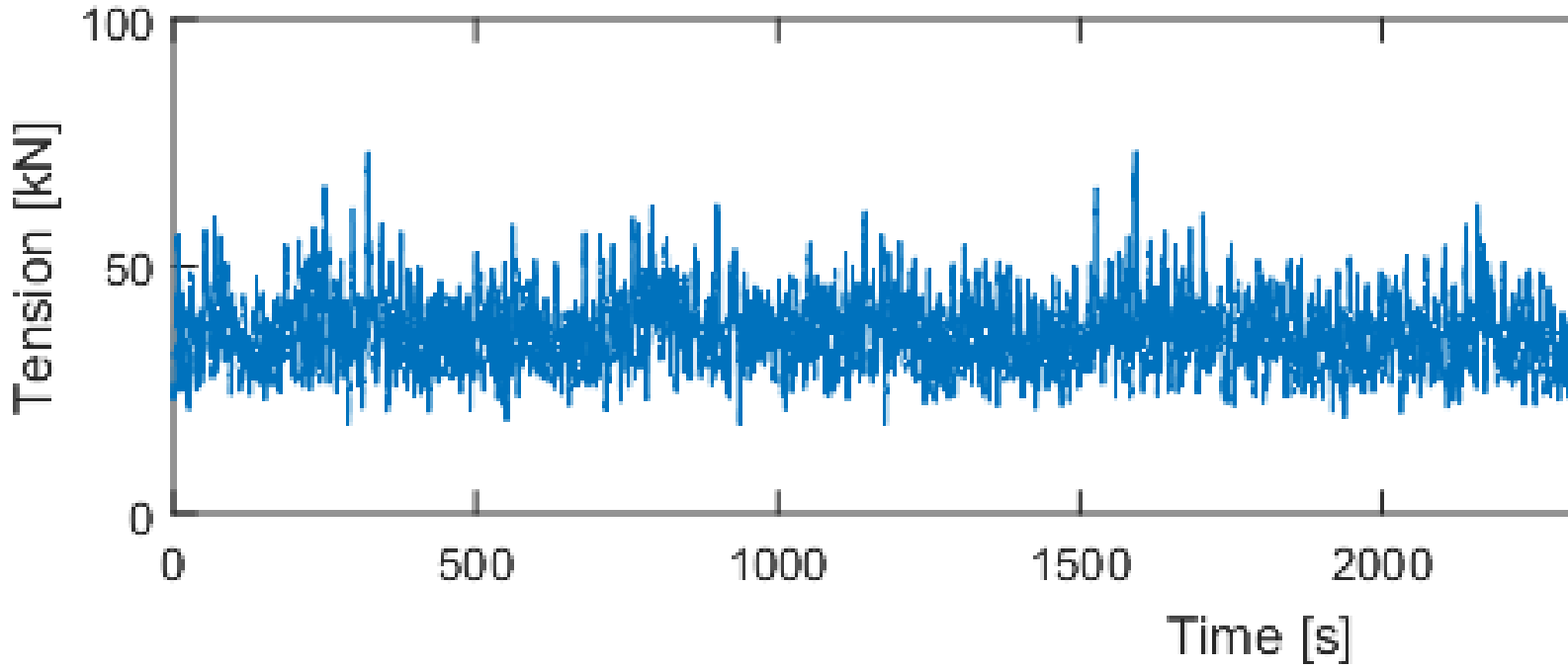
86kN



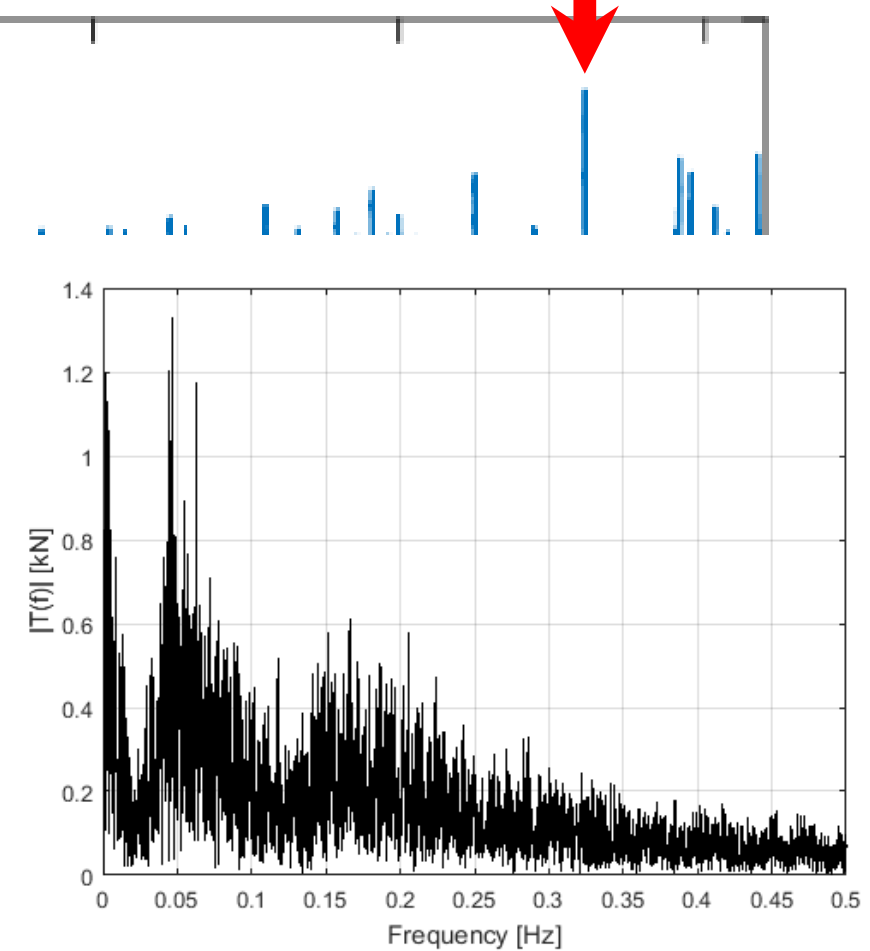
Date	Time range	Hs [m]	Tp [m]	Direction [deg]
3/2/17	13:00-1400	4.2-4.8	8.2-9.4	304-305



Measured tension time-series: Mild storm



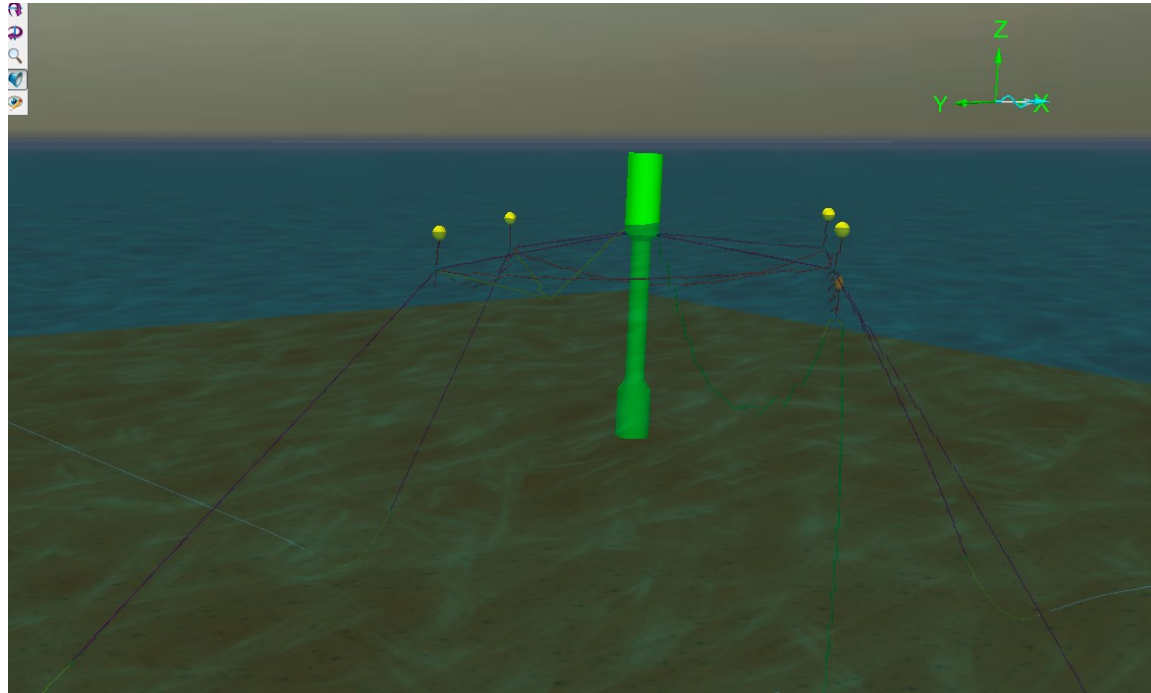
86kN



Date	Time range	Hs [m]	Tp [m]	Direction [deg]
3/2/17	13:00-1400	4.2-4.8	8.2-9.4	304-305



Simulated responses: Mild storm



Date	Time range	Hs [m]	Tp [m]	Direction [deg]
3/2/17	13:00-1400	4.2-4.8	8.2-9.4	304-305



The Importance of Getting Your Feet Wet

- Wave energy conversion is currently perceived as being high risk
- Progress in the sector has been hampered by a lack of knowledge and data sharing
- The OPERA project aims to address this by testing shore-based and offshore devices and publishing the results
- Numerical simulations can only go so far and models need to be validated by long-term field data.



Acknowledgements

The work is part of the OPERA (Open Sea Operating Experience to Reduce Wave Energy Cost) project which is funded from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654.444.

Further info

Weller SD et al. (2017) *Open sea OWC motions and mooring loads monitoring at BiMEP*. Proceedings of the 11th European Wave and Tidal Energy Conference, Cork, Ireland

S.Weller@exeter.ac.uk

+44 1326 259414

