Preparations for Tests in Strangford Lough

1. Test Site Locations
   - EVOPOD
   - Wave Energy Converter (WEC)

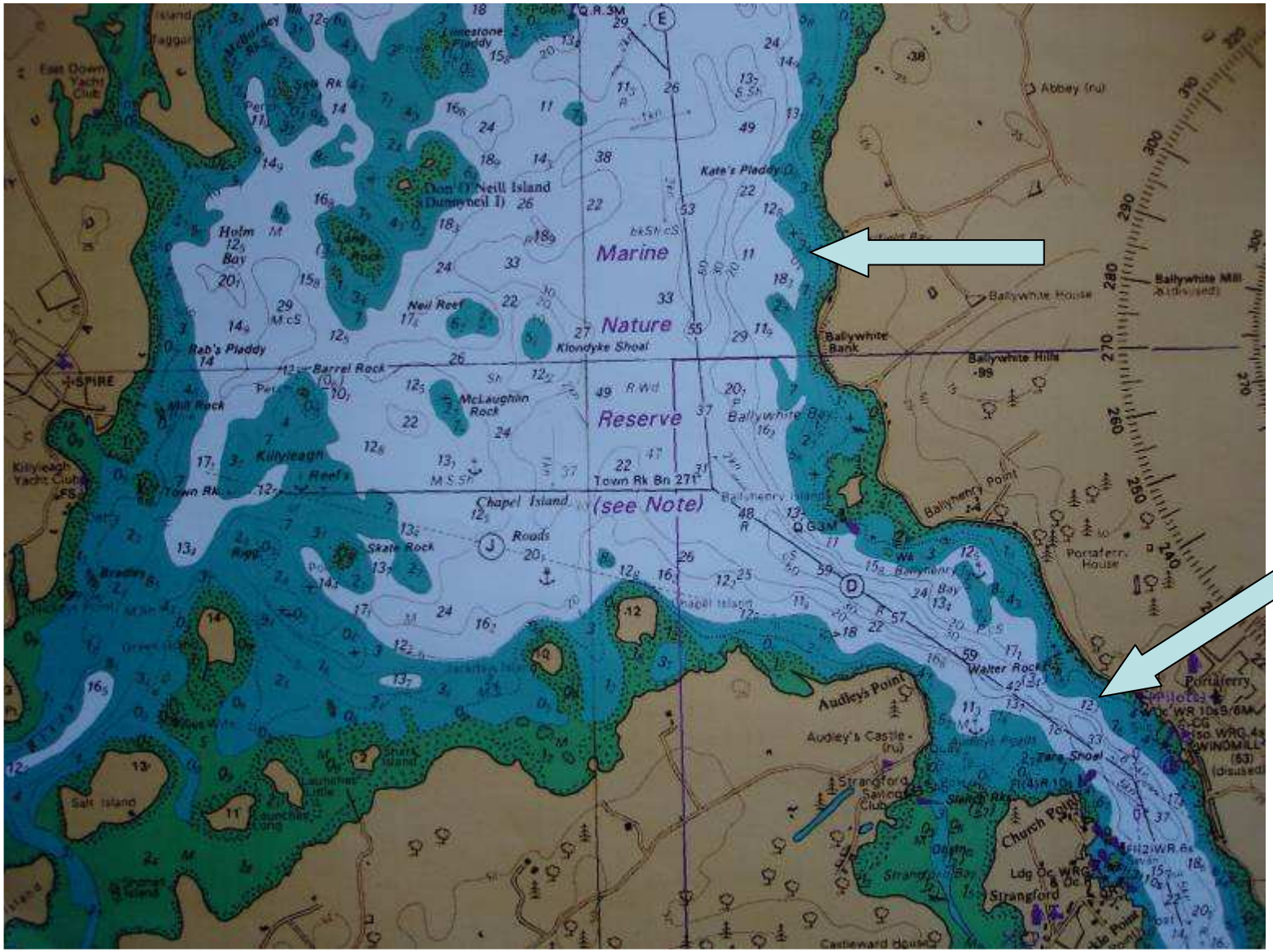
2. Preparations for Open-Water Tests
   - Instrumentation package
   - Tests at Heriot-Watt

3. Summary and Conclusions

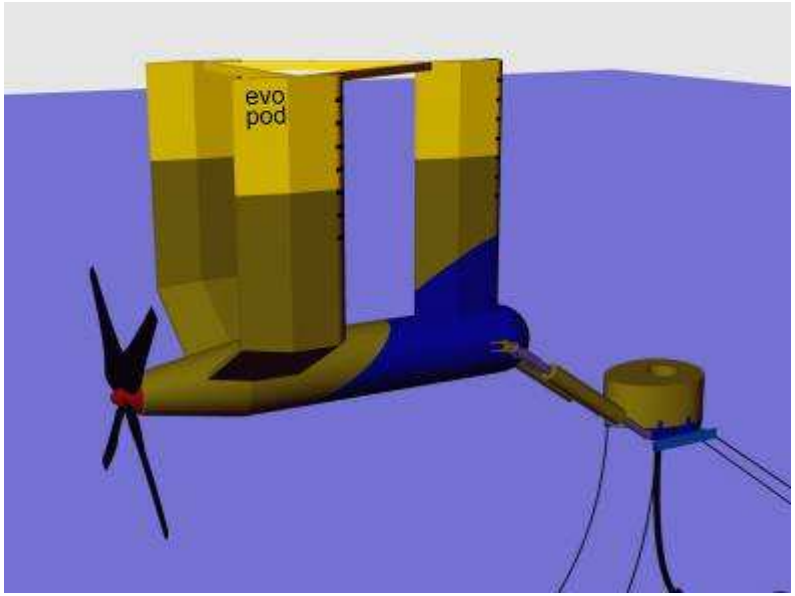
Supergen Annual Assembly Nov 2010

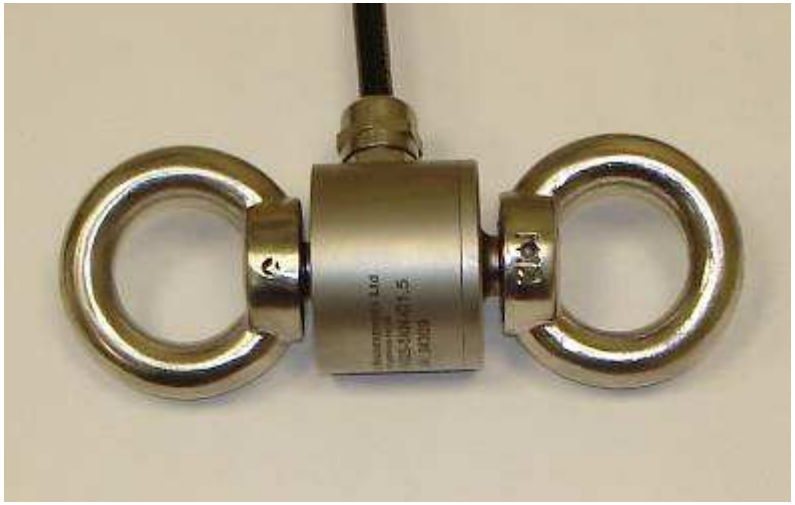
Strangford Lough

Test sites around Strangford Lough



EVOPOD mooring loads

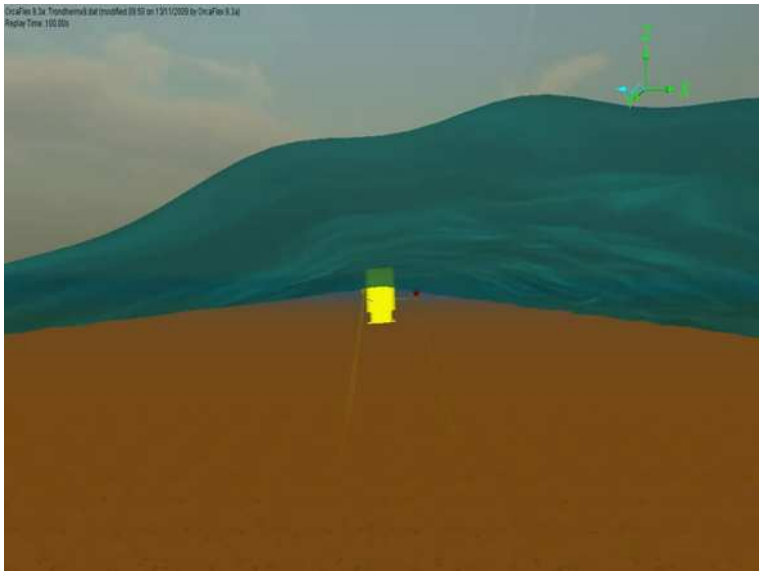




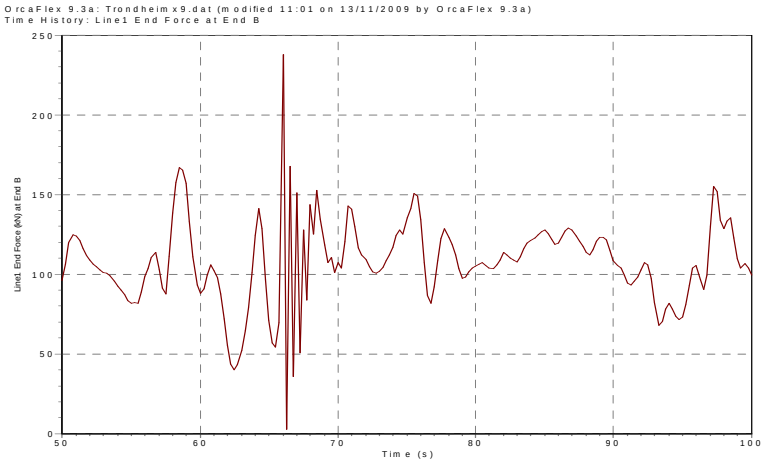
Preparations for WEC Deployment

- Instruments in a vertical stainless steel cylinder
- Negotiations of permissions in advanced stage
- Onboard data storage

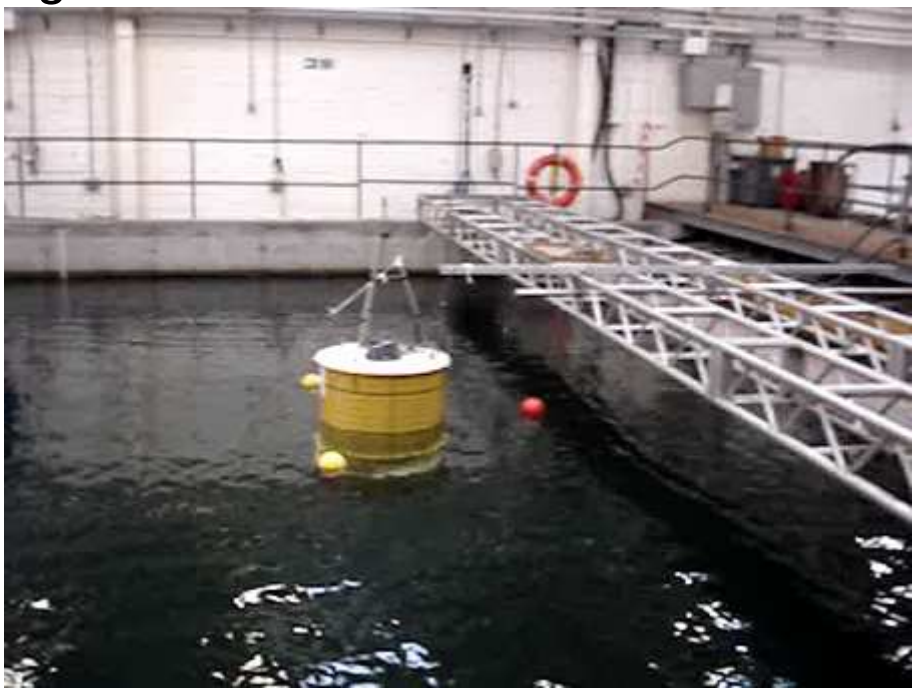
Preparations: Laboratory Tests and Simulation Modelling



OrcaFlex Simulation: Hs 3.5 Tp = 8s

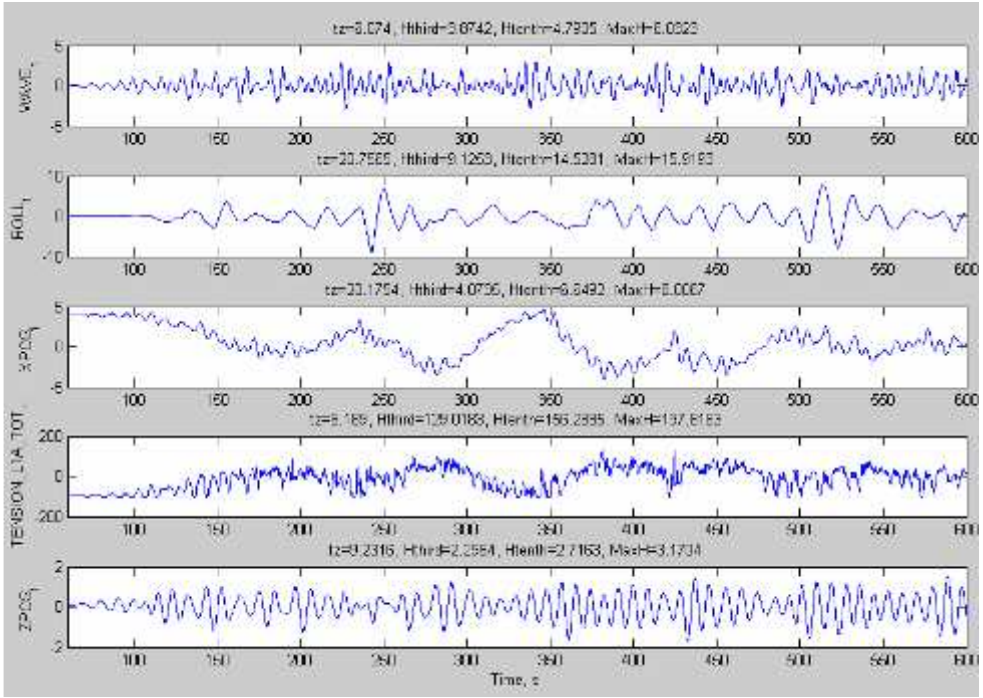


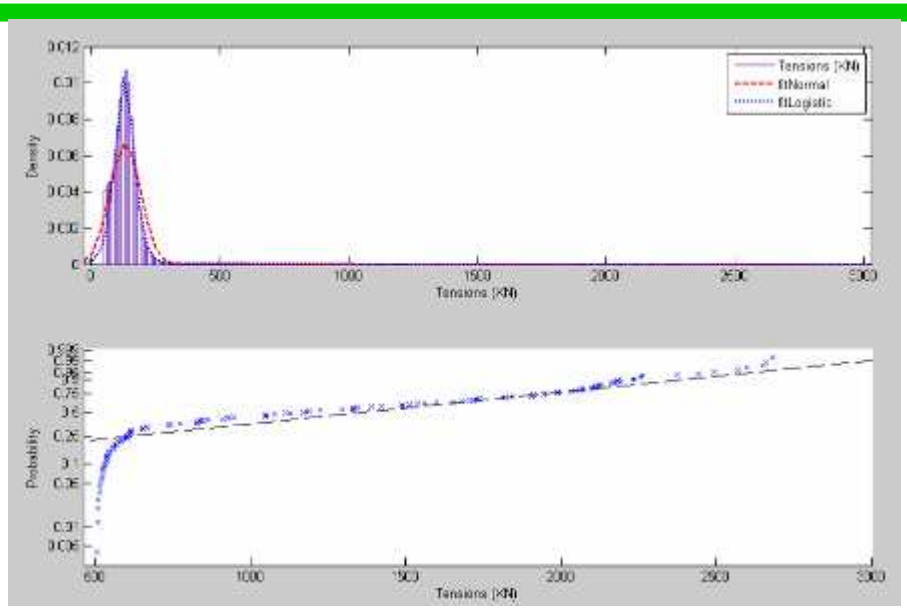
- The results of Trondheim experiment have been complemented by tests on a single WEC in HW
- Orca Flex model compiled to simulate tensions on mooring lines
- Good agreement between the two sets of data and reasonable agreement with the numerical model

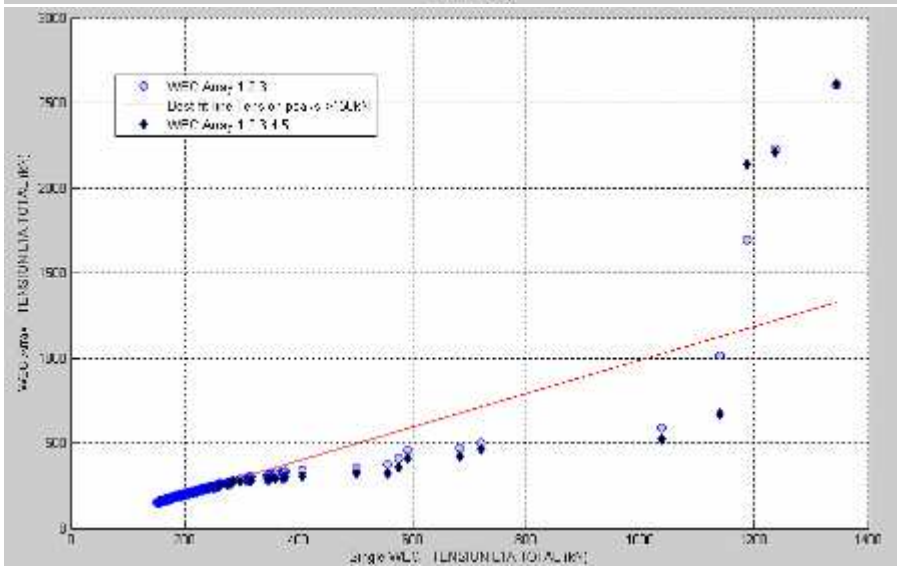


Testing in Irregular Waves

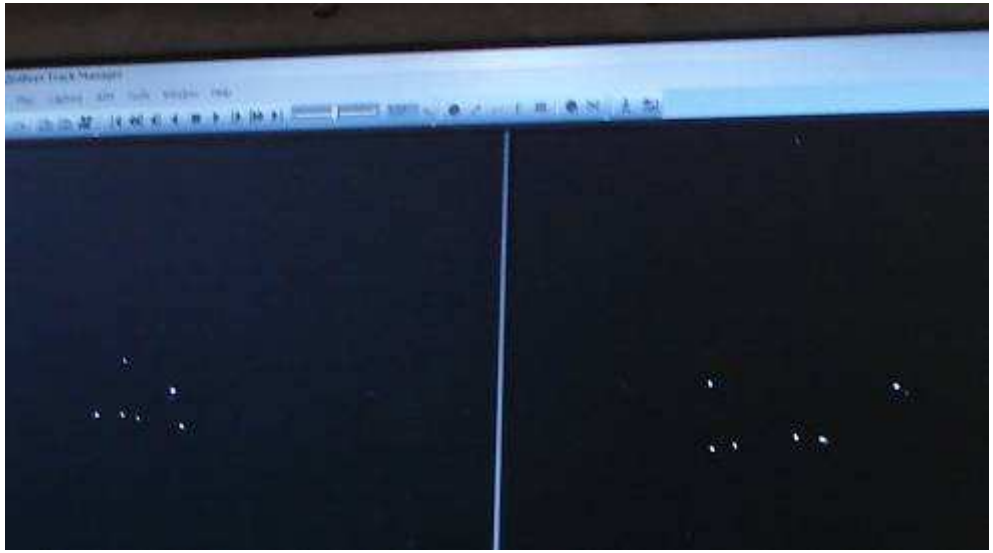
- Complex interplay between high and low frequency motions
- Bulk of loads conform to normal and logistic distribution, right tail to extreme value distribution
- Peak mooring loads in the leading mooring line were approximately doubled in comparison to those in a single device

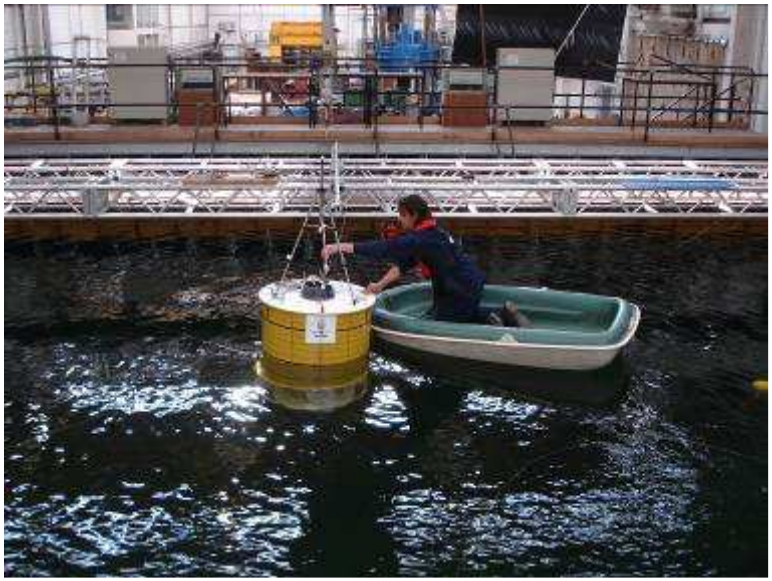






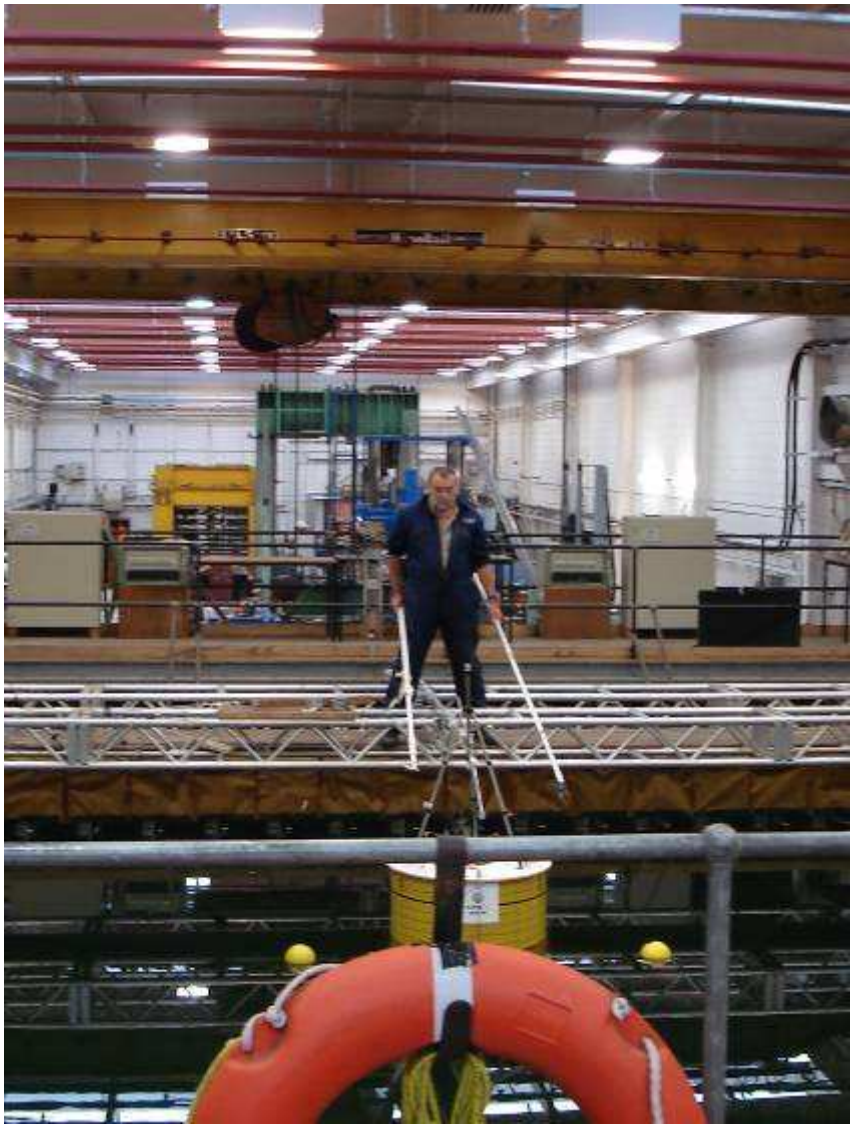
Further Tests at Heriot-Watt : Cooperation with Exeter University





Further Tests at Heriot Watt : Cooperation with Exeter University

- RAO tests in monochromatic waves
- Tests in waves coming with an angle
- Pull tests
- Damp decay tests for surge, heave, pitch, sway and yaw
- Results are contributing towards developing of further mathematical models by Exeter University (A. Vickers)

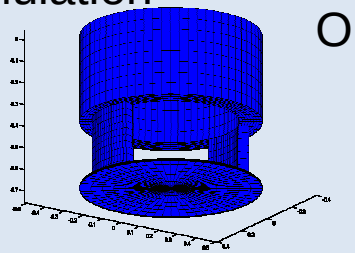


Experimental RAO data

Trondheim data
Heriot Watt data
a)Single device
b)Array

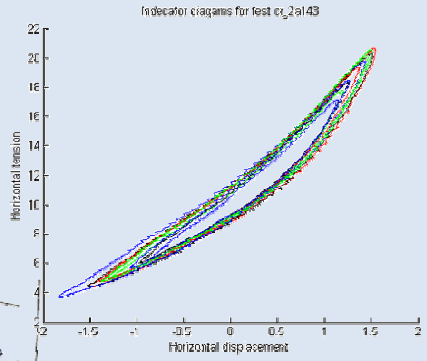
Numerical Mooring simulation

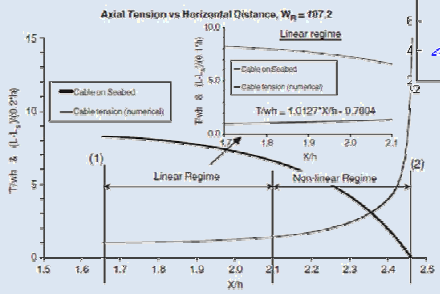
OrcaFlex



SUPERGEN MARINE

Damping and Stiffness mooring data

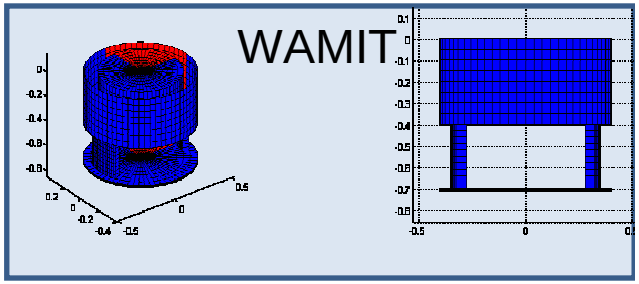




Orkney Data

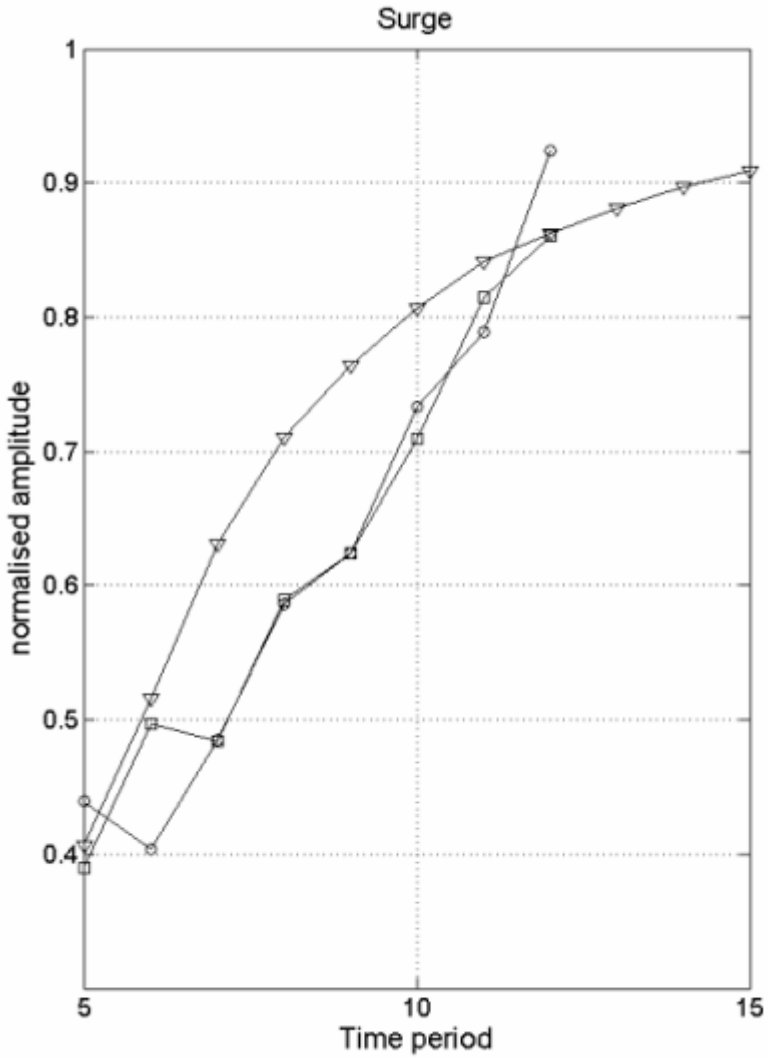
Numerical RAO data

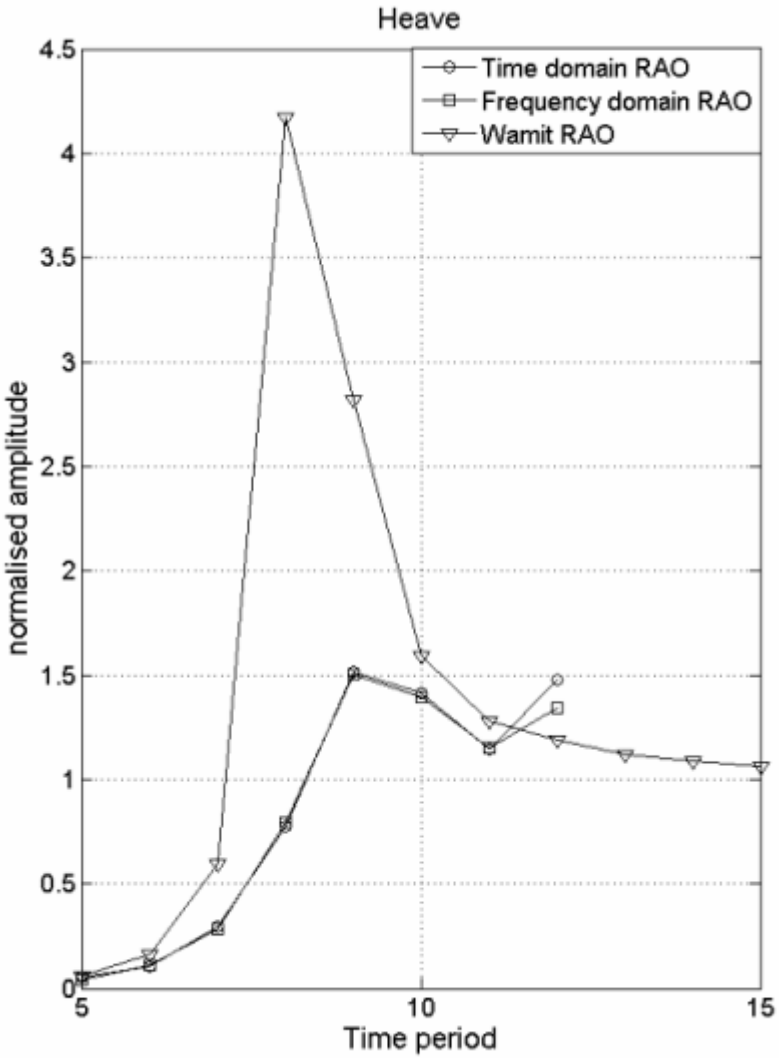
WAMIT



Experimental	Numerical Simulation
Single device	a) Numerical RAO
	b) Experimental RAO
	c) Calibrated with damping and stiffness

Comparison of Experimental Results & Preliminary Simulation of Unmoored Device by A. Vickers





Summary and Conclusions

- The results of tests in Heriot-Watt University are in agreement with Trondheim results and with Orcaflex simulations
- The majority of loads on the mooring lines appeared to be consistent with normal and/or logistic distribution, whilst the right tail conform to an extreme value distribution
- In short crested seas, the extreme peak mooring loads in the leading mooring line were approximately doubled in comparison to those in a single device
- Potential increases in mooring loads in an array should be considered whilst designing any moored wave energy installations
- Preparations for the tests at Strangford Lough are well advanced

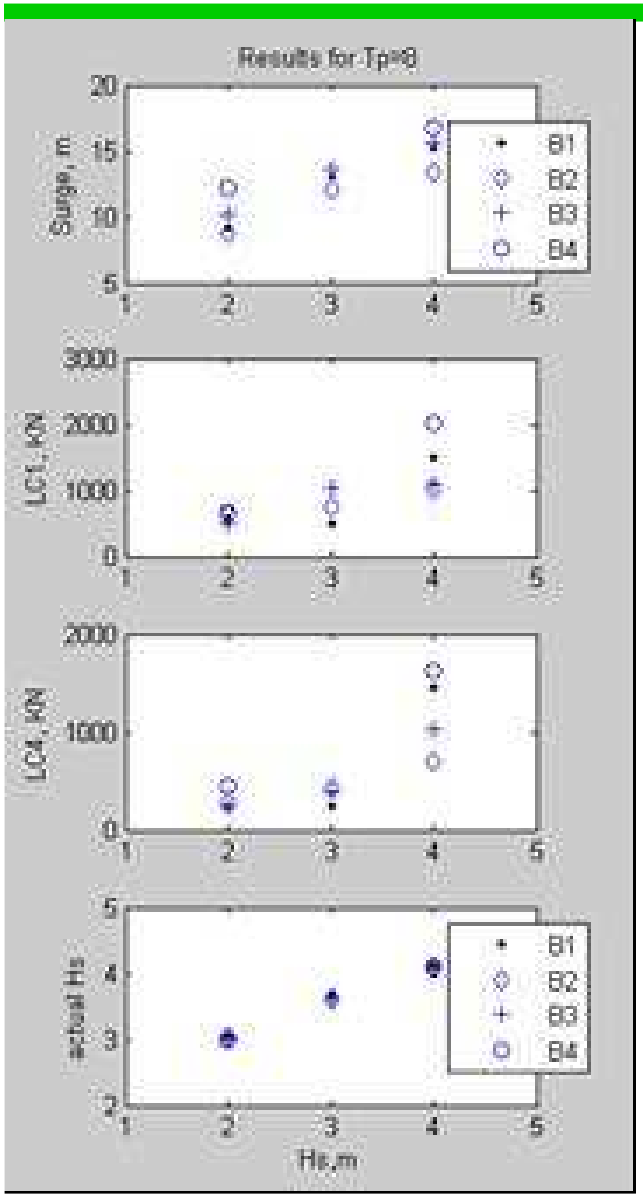
Further Work

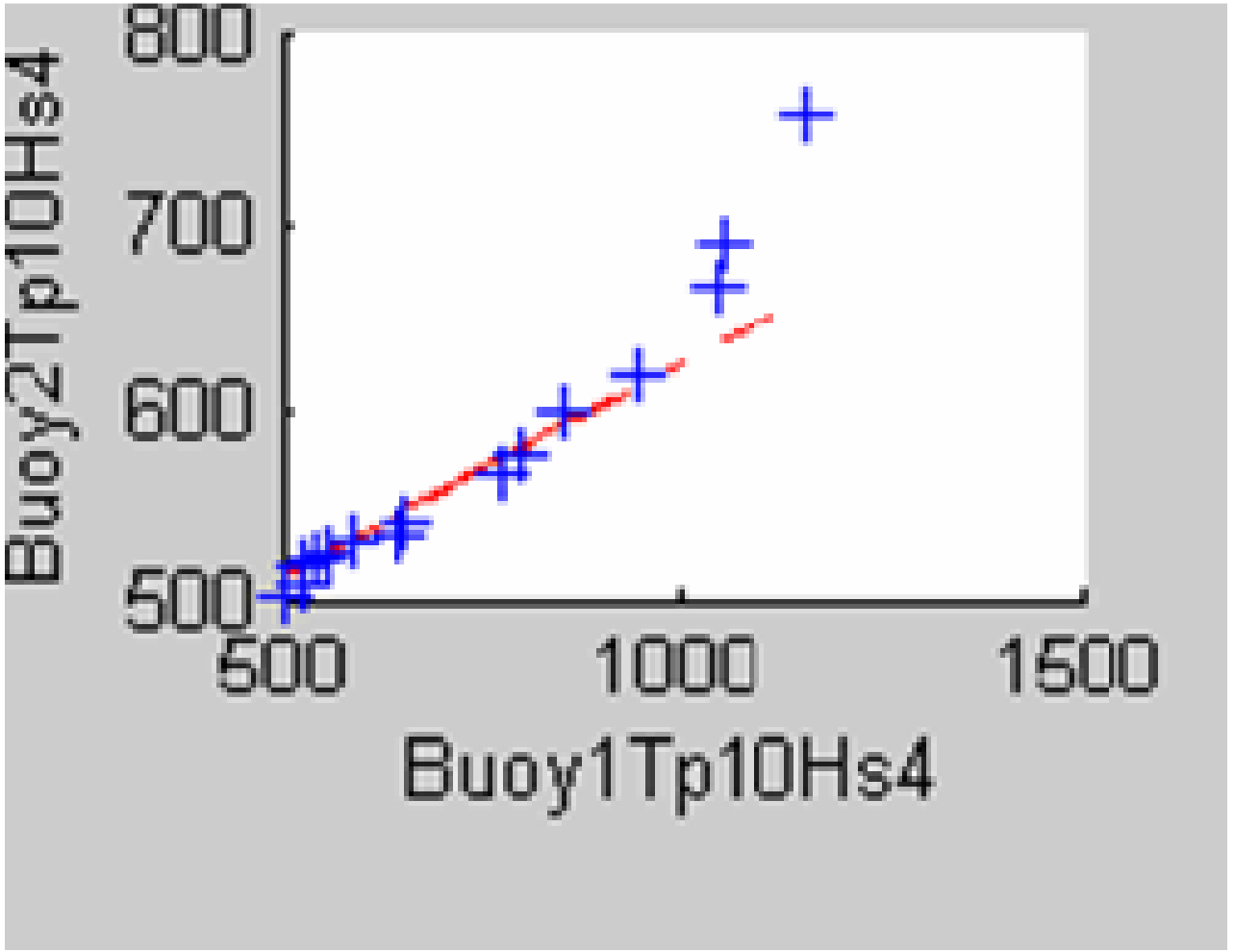
- Strangford Lough deployments
- Mathematical models (OcaFlex, WAMIT) are being developed to describe the relationships between mooring forces and parameters of the wave field
- Further work in HW intends to test an array of 3 devices
- Further trials of mooring equipment configurations (e.g. ground chain)
- All plans are subject to time and logistical constraints

Further Tests at Heriot Watt : Trials of Different Buoys

- Tests in Long Crested Waves
- Hs of 2, 3 and 4 m
- Tp of 12, 10 and 8 s
- Larger Buoy provides softer moorings (e.g. B2 vs B1)
- Possible nonlinear effects to be addressed by further analysis

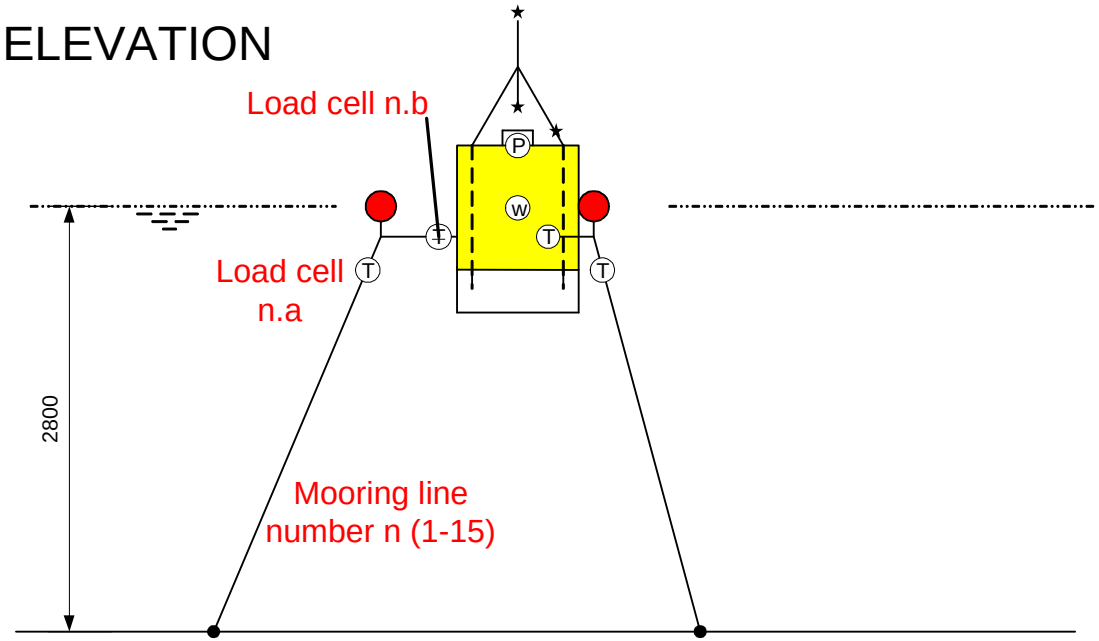
Further Tests at Heriot-Watt : Trials of Different Buoys

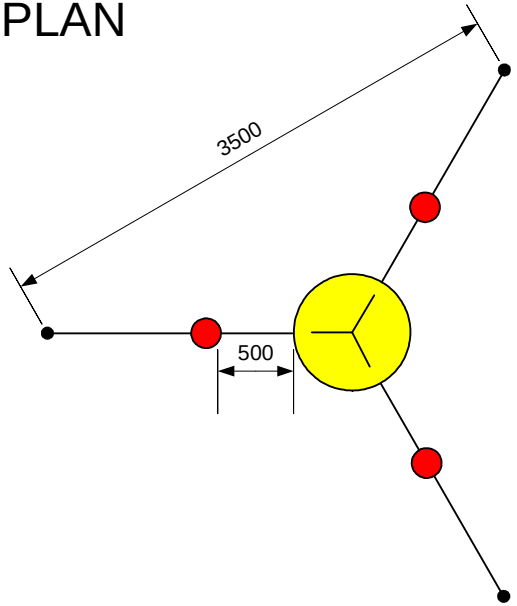


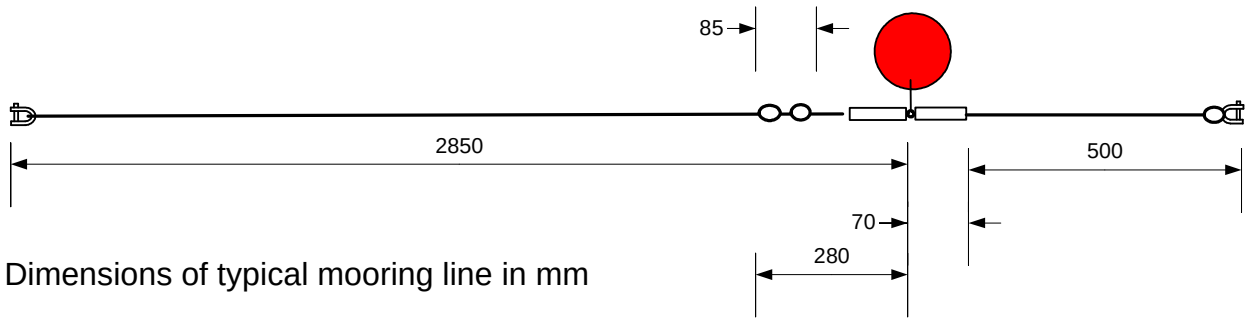


Trondheim Basin –80m x 50m x10m

Mooring System







Dimensions of typical mooring line in mm