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**Programme Area:** Marine

**Project:** ReDAPT

**Title:** Modelling Sub Project

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### Context:

One of the key developments of the marine energy industry in the UK is the demonstration of near commercial scale devices in real sea conditions and the collection of performance and environmental data to inform permitting and licensing processes. The ETI's ReDAPT (Reliable Data Acquisition Platform for Tidal) project saw an innovative 1MW buoyant tidal generator installed at the European Marine Energy Centre (EMEC) in Orkney in January 2013. With an ETI investment of £12.6m, the project involved Alstom, E.ON, EDF, DNV GL, Plymouth Marine Laboratory (PML), EMEC and the University of Edinburgh. The project demonstrated the performance of the tidal generator in different operational conditions, aiming to increase public and industry confidence in tidal turbine technologies by providing a wide range of environmental impact and performance information, as well as demonstrating a new, reliable turbine design.

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### Disclaimer:

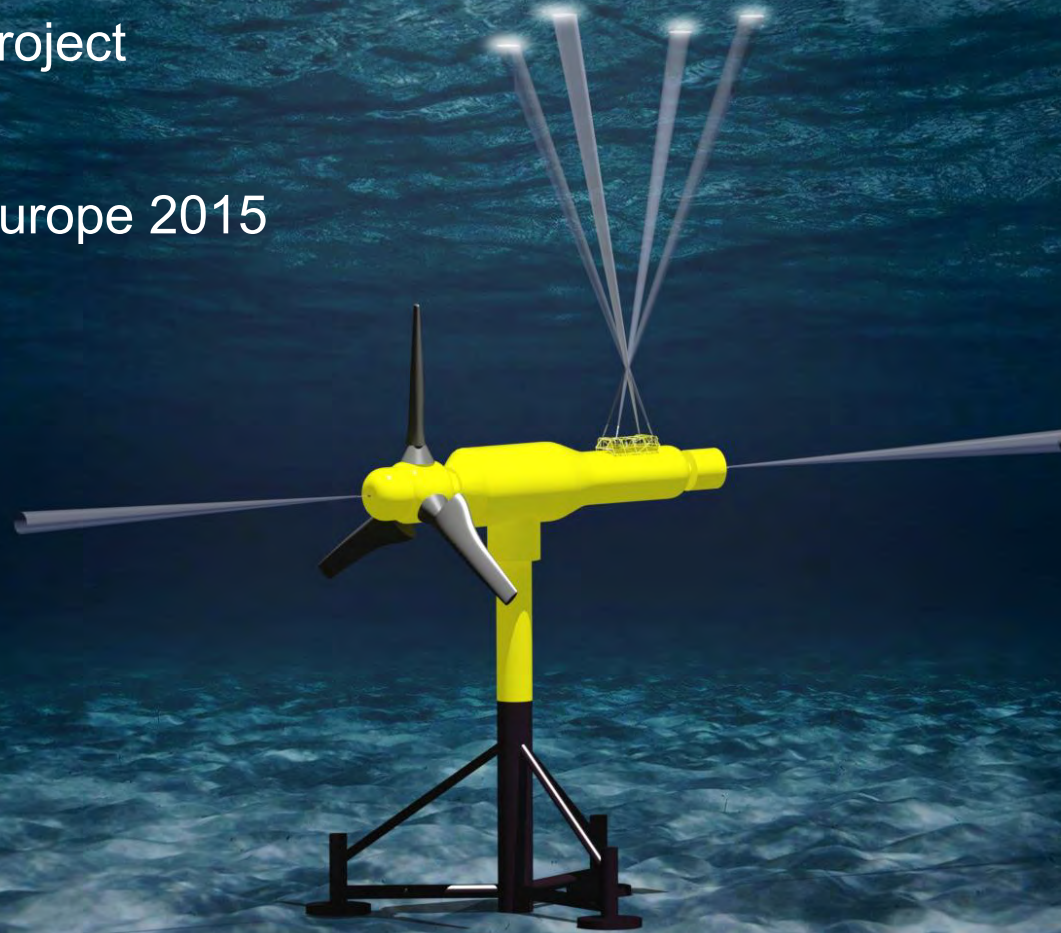
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# ReDAPT – Reliable Data Acquisition Platform for Tidal



ReDAPT  
Modelling Sub Project  
University of Edinburgh

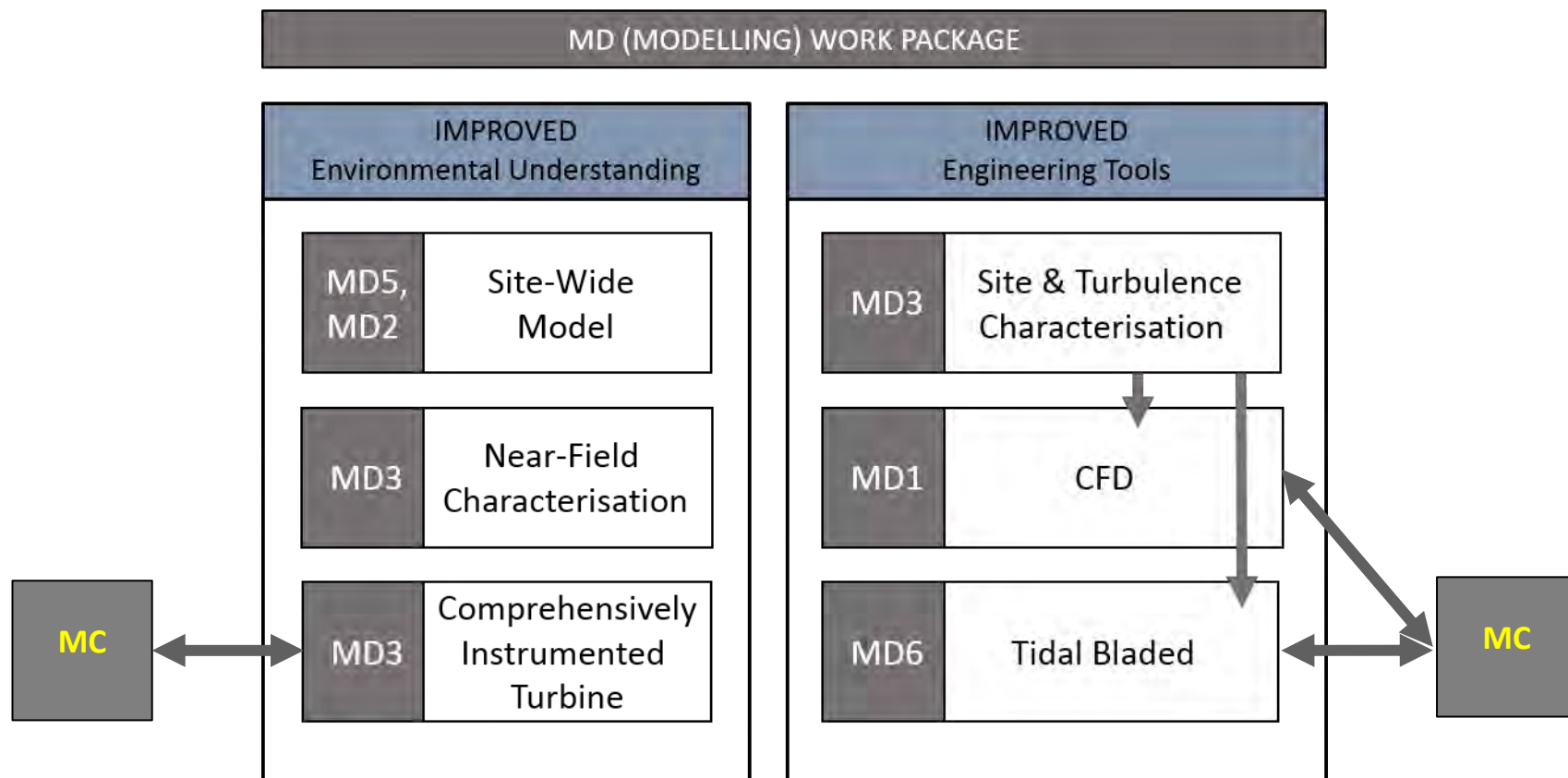
Ocean Energy Europe 2015  
Dublin, Ireland



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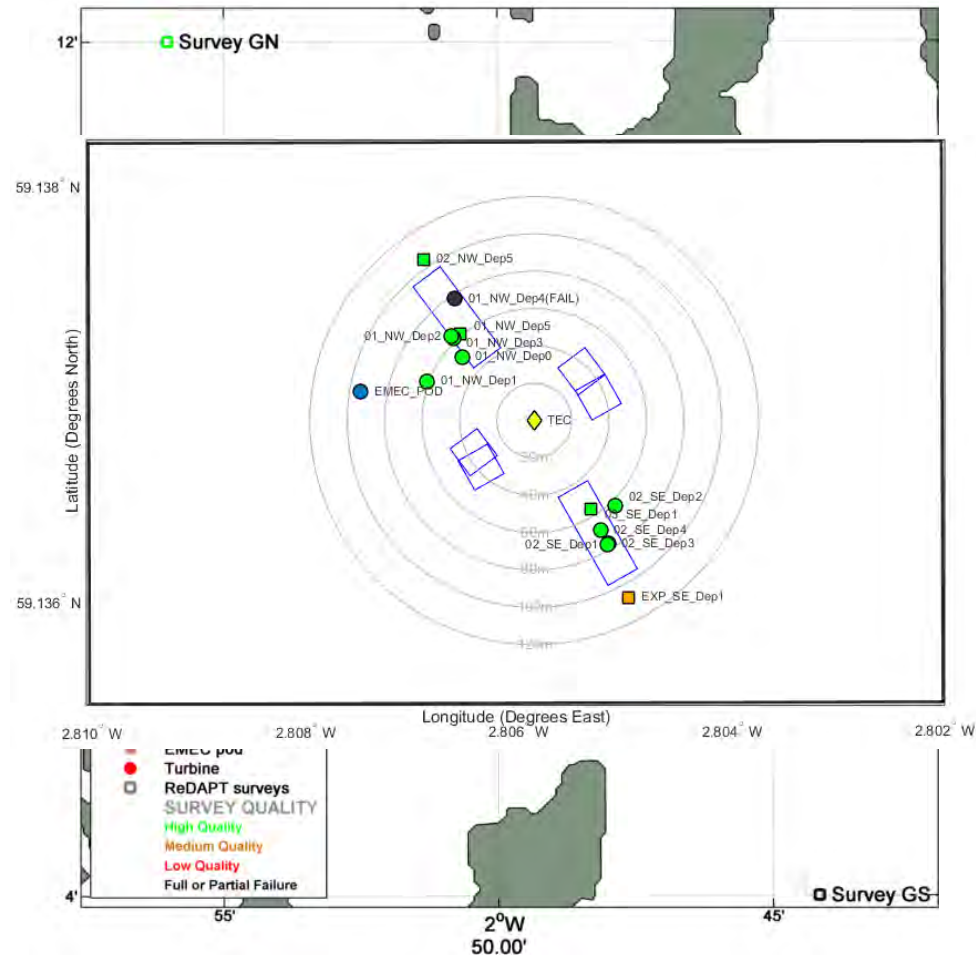
## MODELLING SUB PROJECT

- The Modelling (MD) work package centres around validation of engineering tools through comparison of predicted to experienced loads under measured and characterised environmental conditions.



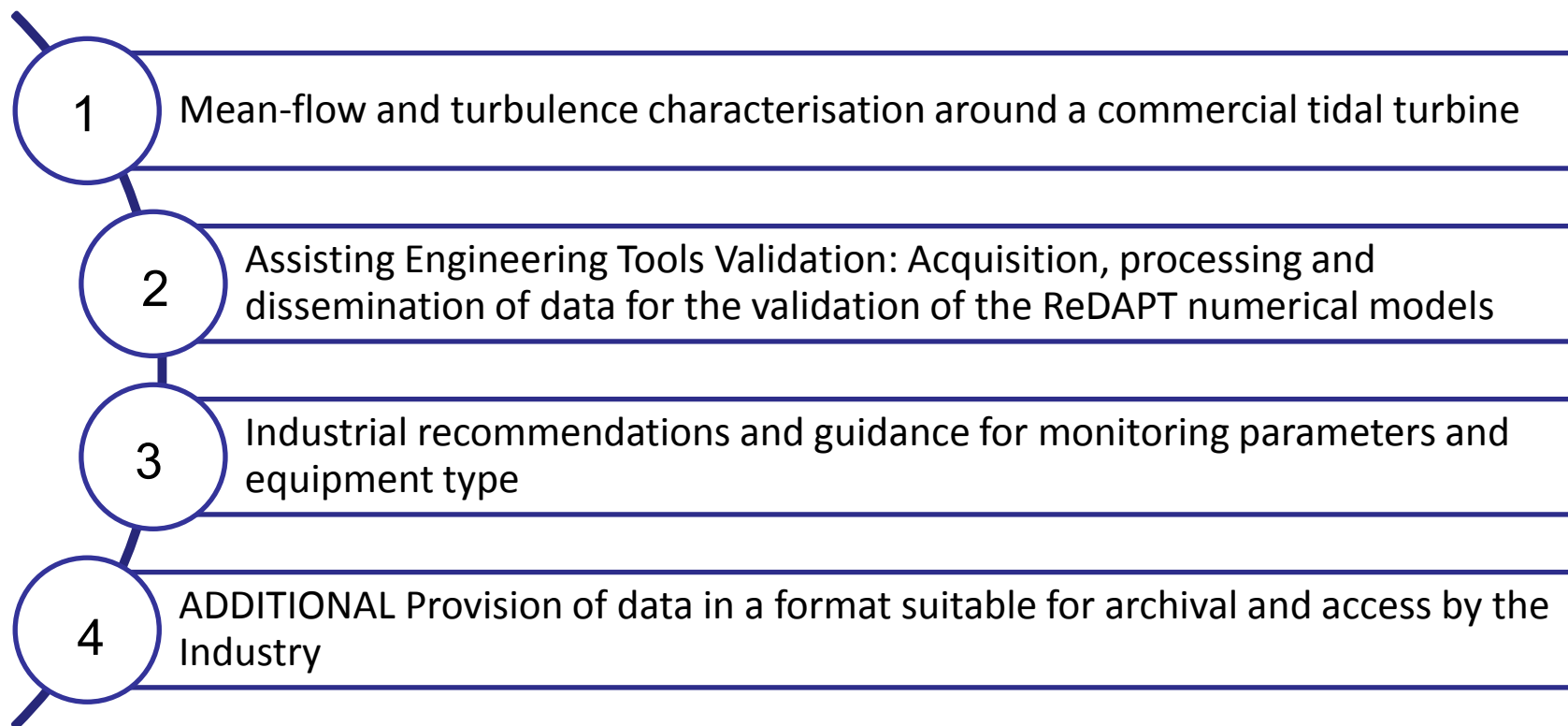
## SUMMARY OF WORK MD2

1. Field measurement campaigns were successfully designed and implemented.
2. Subsequent modelling was carried out successfully
3. Modelling work highlighted research areas which were incorporated into MD3
4. See MD5.2 report for further information



## OBJECTIVES OF WORK PACKAGE MD3 (UOE)

Three primary activities were originally identified with a fourth added during project review:

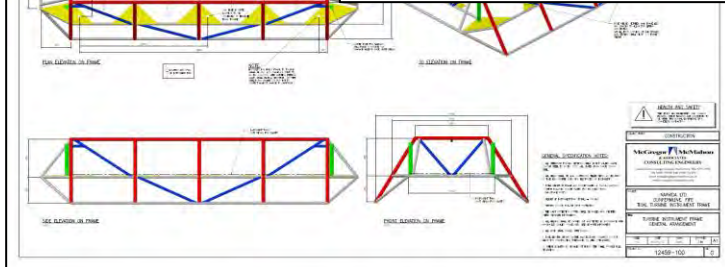
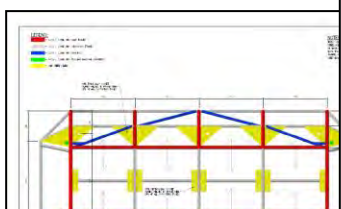
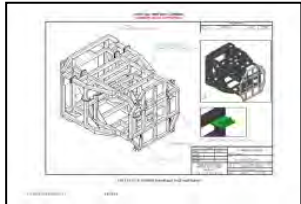
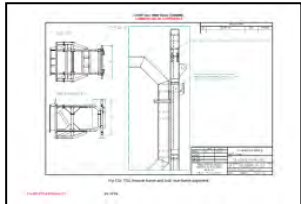
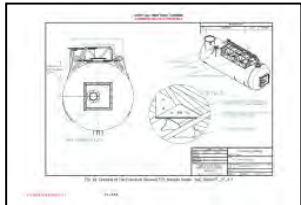
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- 1 Mean-flow and turbulence characterisation around a commercial tidal turbine
  - 2 Assisting Engineering Tools Validation: Acquisition, processing and dissemination of data for the validation of the ReDAPT numerical models
  - 3 Industrial recommendations and guidance for monitoring parameters and equipment type
  - 4 **ADDITIONAL** Provision of data in a format suitable for archival and access by the Industry

## OBJECTIVES OF WORK PACKAGE MD3 (UOE)

### ACTIVITIES CONT....

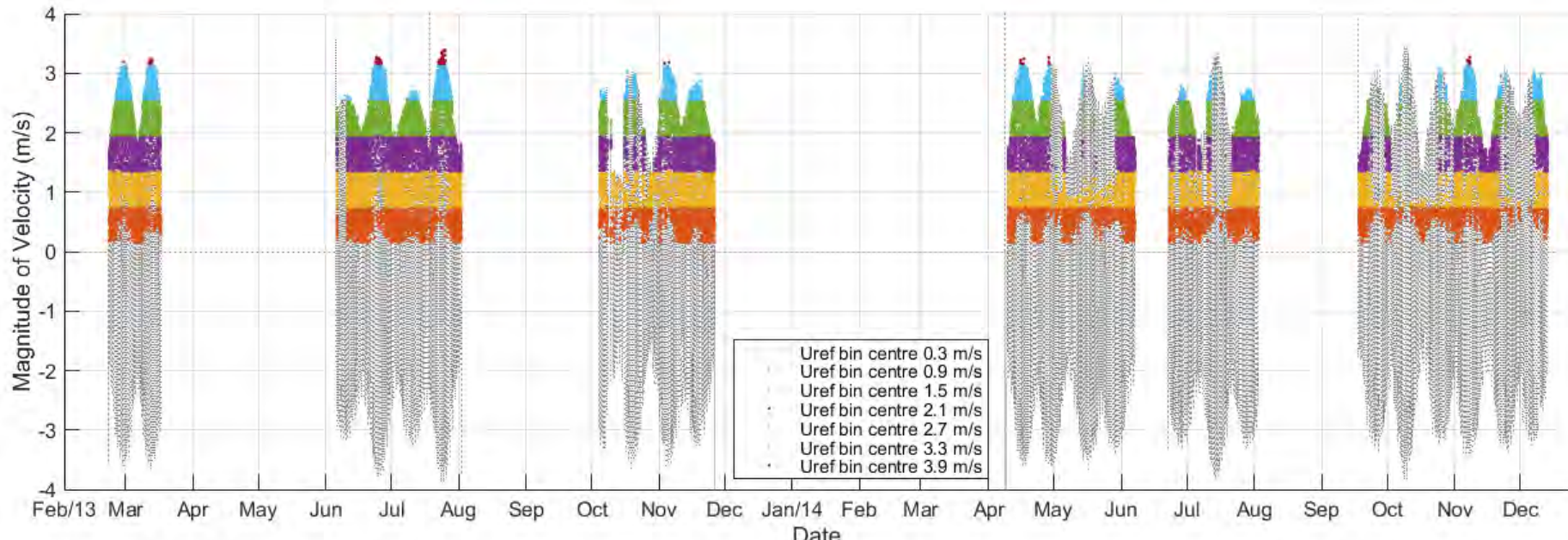
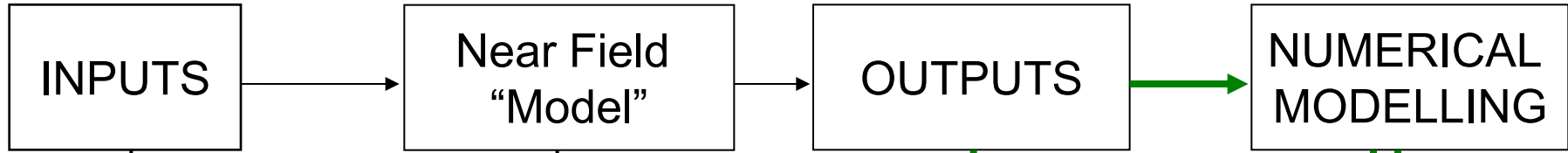
1. Two Instrumentation platforms designed, built, commissioned and installed (ESIP-1) and (ESIP-2)
  - a) These bespoke frames performed well and survived long deployments.
  - b) Comprehensive electrical and mechanical integration with turbine carried out.
2. Three separate seabed mounted instrumentation platforms designed, built, commissioned and repeatedly deployed and retrieved.
3. 8 Field measurement (turbine and multiple seabed) campaigns across summer and winter months were successfully designed and implemented.
4. Field measurement campaigns were carried out safely in challenging conditions.
5. Combined data duration of approx. 20 months
6. Over 20 site visits to Orkney
7. Bespoke software and hardware designed and implemented.
8. Extensive liaison with instrument manufactures to feedback experiences and pull in upgrades

# INTERFACING WITH MC WORKPACKAGE / DESIGNING MULTIPLE INSTRUMENTATION SUB-SYSTEMS

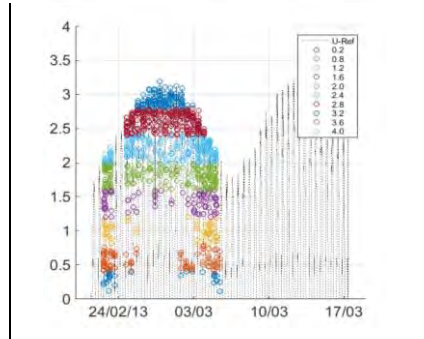


Iterative, time consuming and multi-disciplinary activity

# DATA PROCESSING METHODOLOGY



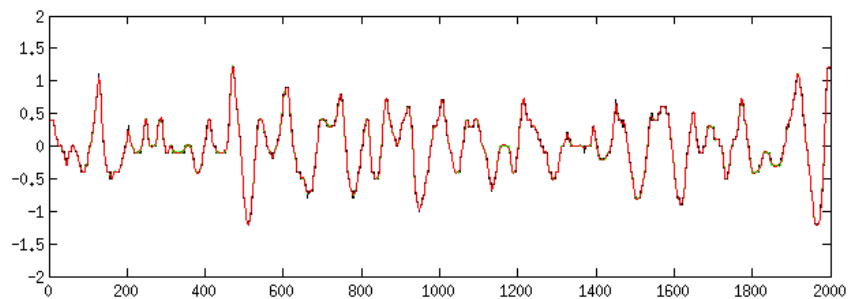
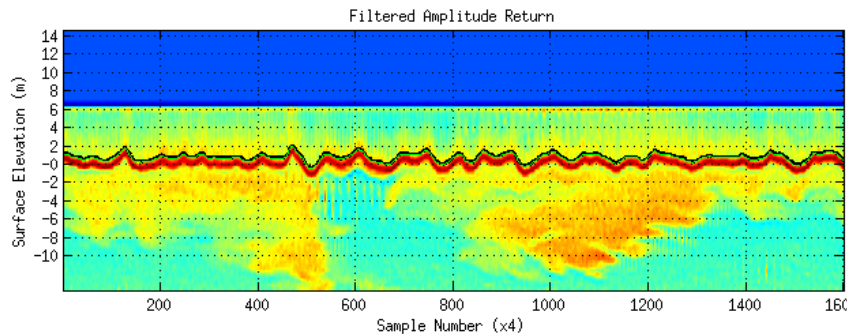
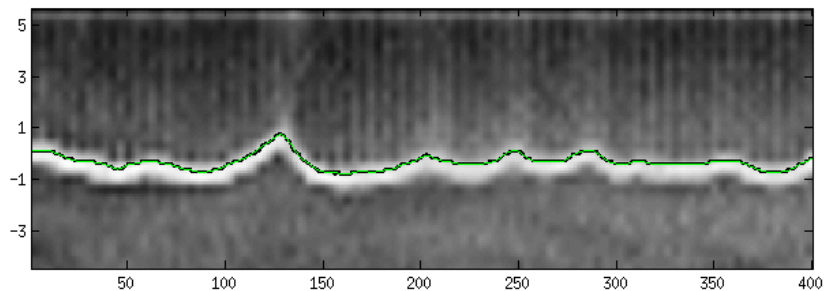
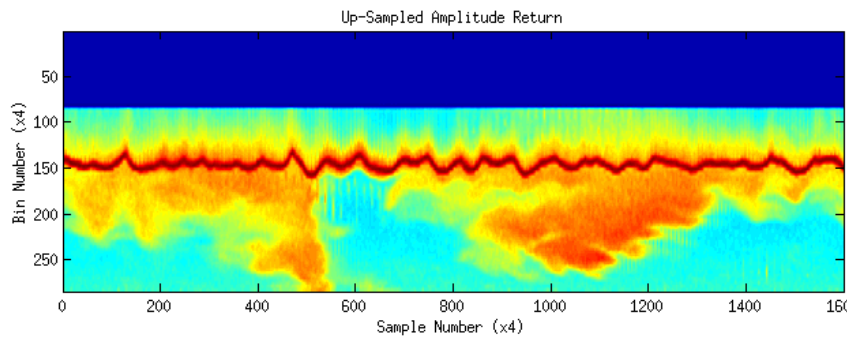
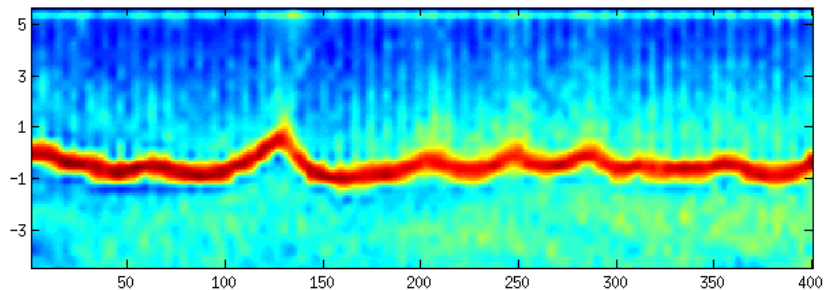
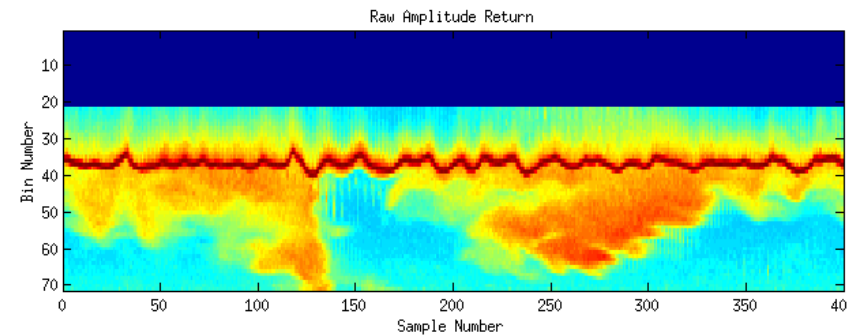
- Wave Steepness
- Bathymetric Variation
- Water Depth
- Wave & Current Interaction



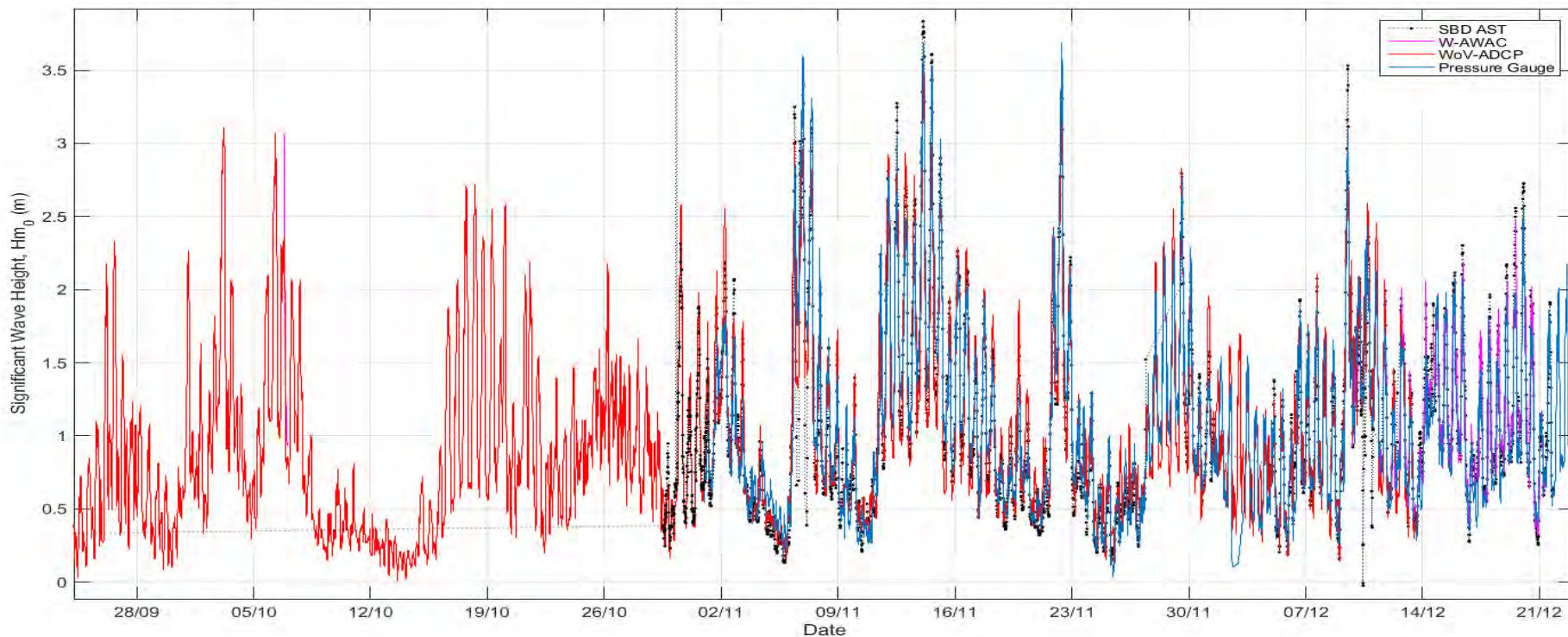
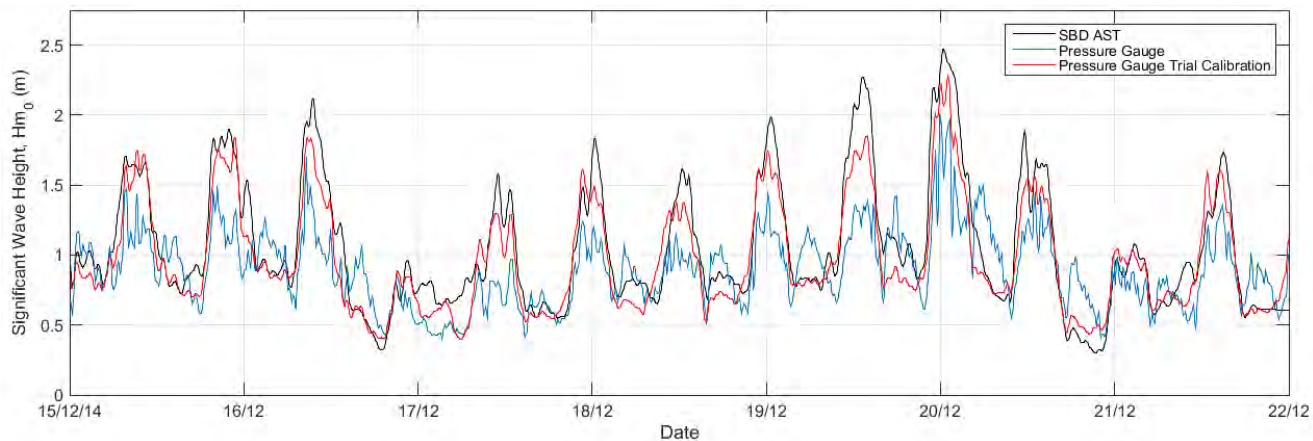
- Turbulent Kinetic Energy
- Depth Profiles / Mid Depth Detail



# SUMMARY OF OUTCOMES: WAVE ANALYSIS IS CRITICAL AND NEEDS TO BE FULLY INCORPORATED



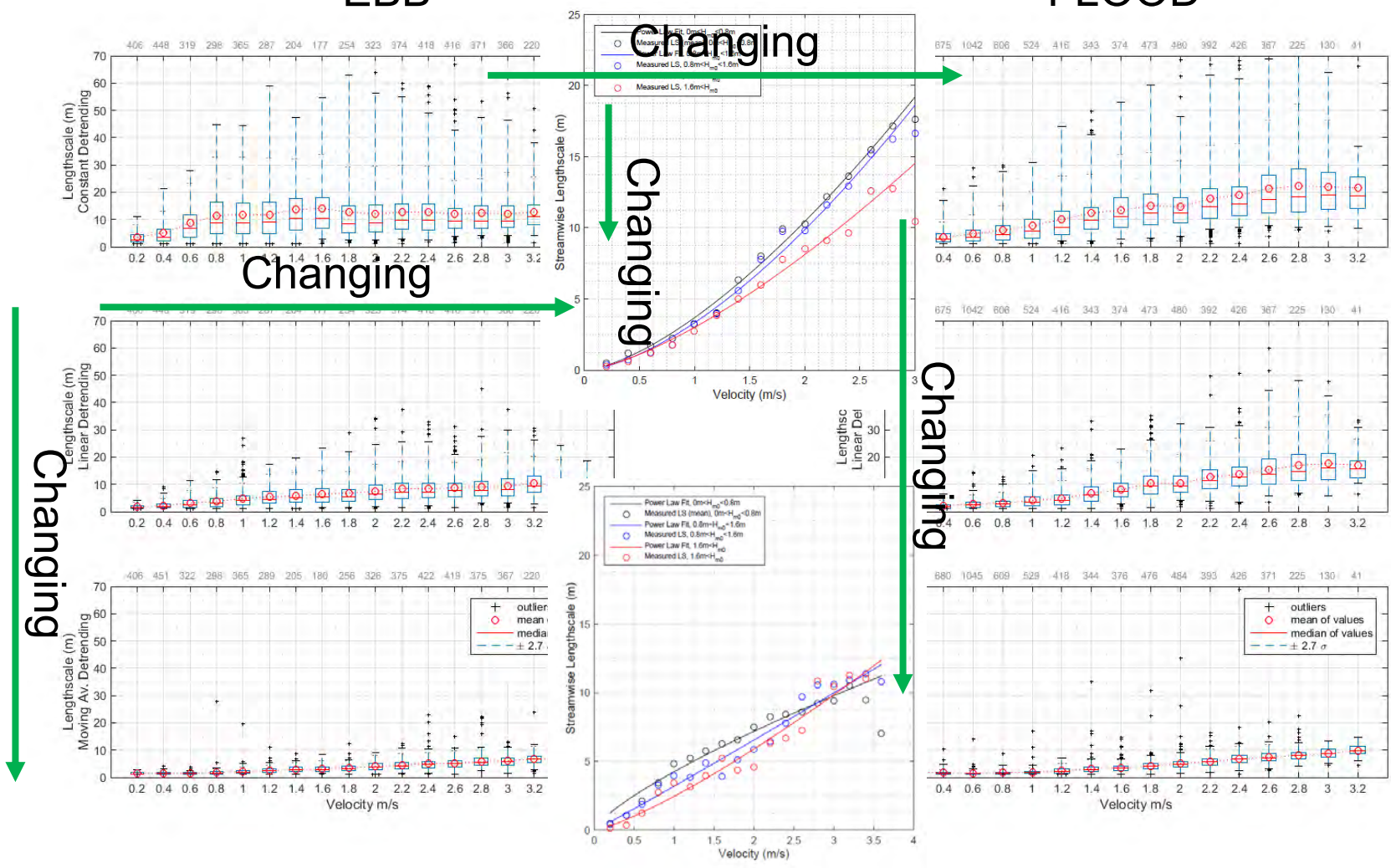
# EXTRACTING SENSIBLE WAVE DATA NEEDS CAREFUL WORK



# TIDAL METRICS (e.g., LS) VARY WITH ANALYSIS METHOD, VELOCITIES, BATHYMETRY AND WAVES

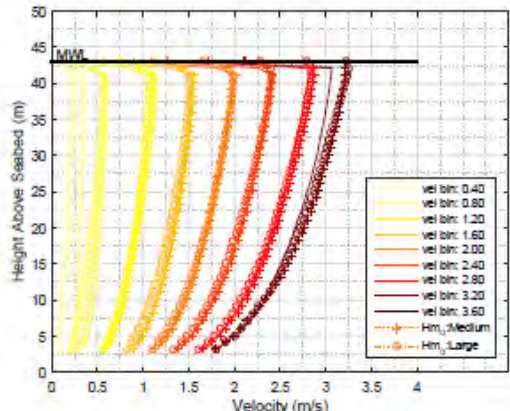
EBB

FLOOD

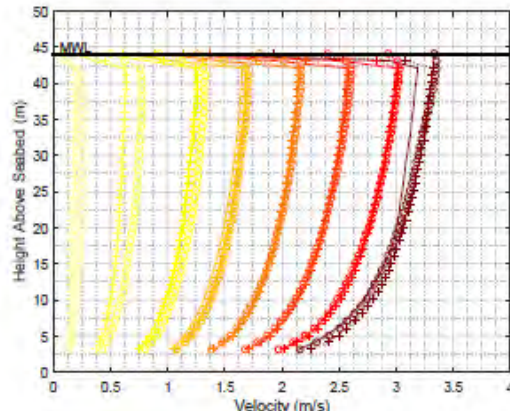


SPATIAL-VARIATION LEVELS OF TIDAL METRICS (e.g., DEPTH PROFILE OF U) VARY WITH TIDE

FLOOD



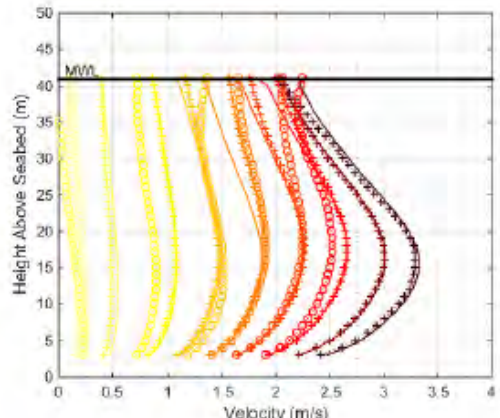
(a) ADCPTD7-01-Dep1



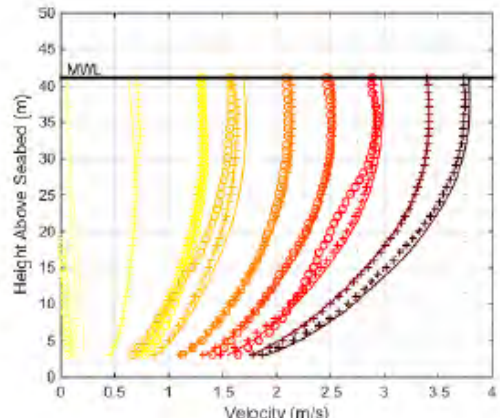
(b) ADCPTD7-02-Dep1

Figure 3.55: Depth profiles of velocity (m/s) for seabed ADCPs upstream of flood tidal flow

EBB

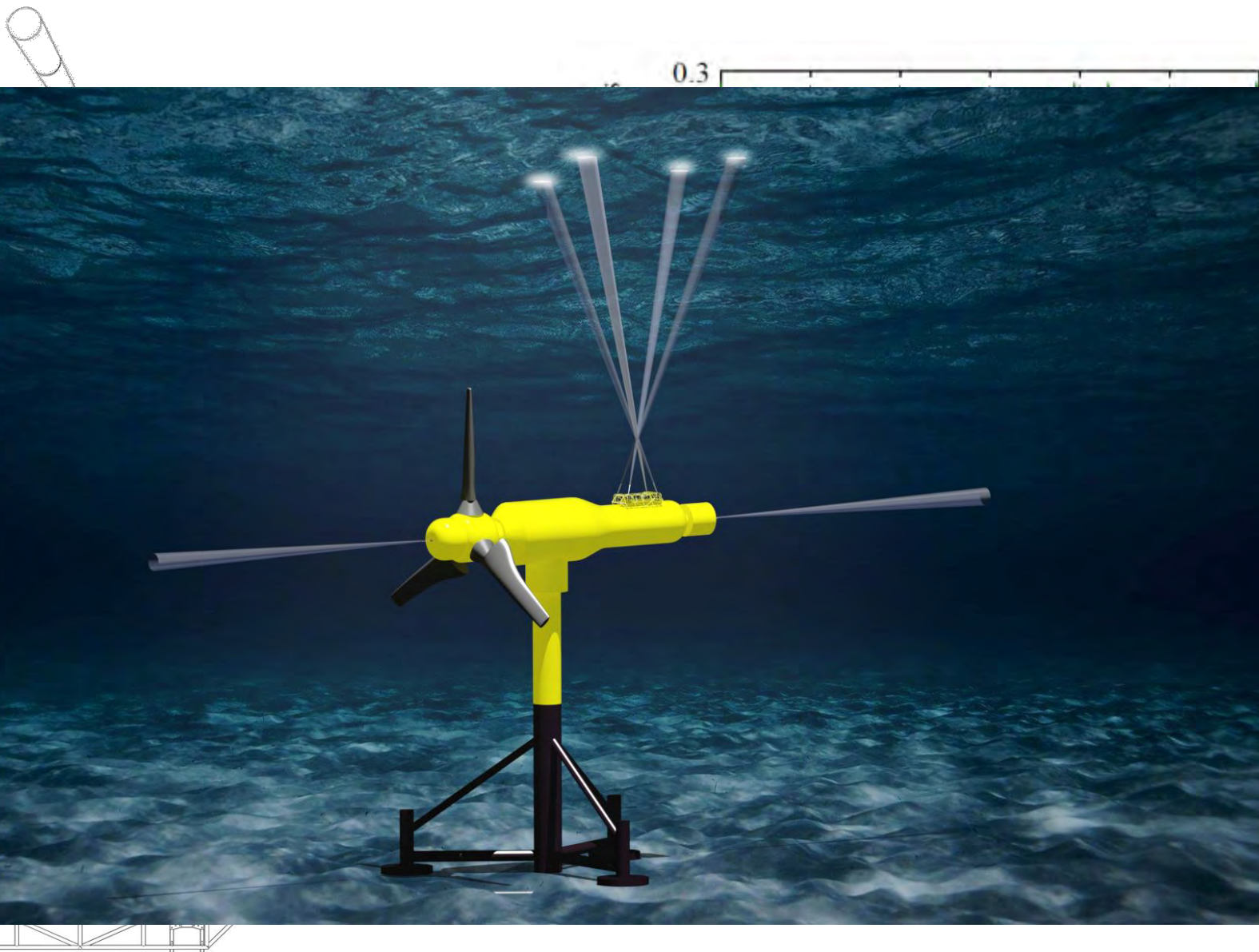


(a) ADCPTD7-01-Dep1

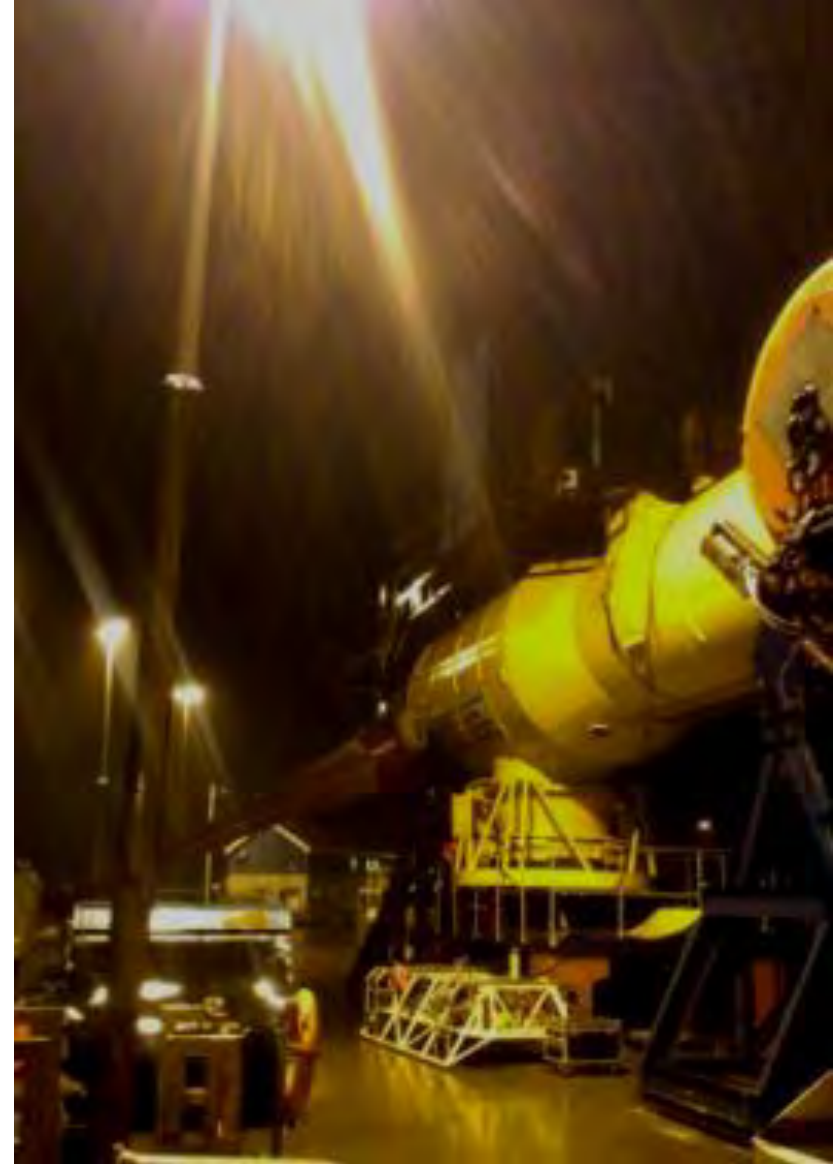


(b) ADCPTD7-02-Dep1

# NEW INSTRUMENTATION IS NEEDED TO FURTHER TURBULENCE STUDIES



## SUMMARY OF OUTCOMES: LINING EVERYTHING UP IS CHALLENGING



## SUMMARY OF OUTCOMES: LINING EVERYTHING UP IS CHALLENGING



12:00



13:30

## LESSONS LEARNED (selection of)

1. DATA SYNCHRONISATION, STANDARDISATION AND DATA VOLUME ALL CHALLENGING AND TIME CONSUMING
2. O&M NEEDS MORE WORK
3. INSTRO CHOICE AND CONFIGURATION IMPORTANT
4. WAVE-CURRENT INTERACTION COULD BE KEY AT SITES



## FURTHER WORK

1. We need to commence new (beyond ReDAPT scope) MD3 analysis in terms of DNV's MC8 package: there is a big opportunity here and UoE want to help.
2. Site to Site Variability
  1. Investigating New Projects with data from other sites
3. Wave-Current Interaction
  1. Testing at FloWave
  2. Re-analysis of Acquired Data
4. Making Next Gen instrumentation and deployment methods Industry-Ready
5. What's driving the variations: bathymetry, wave-current interaction etc.
  1. Tank Testing
  2. Numerical Modelling

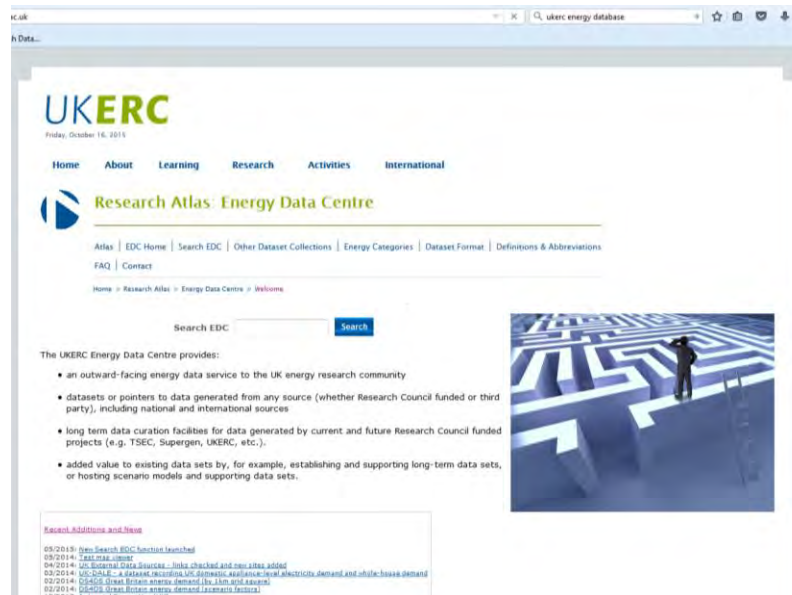
UoE is proposing to bring together an Horizon 2020 LCE-07-2016 project:

### **RealTide: Advanced PTO and Control Systems for TEC in Unsteady, Highly Turbulent Tides under Wave Loading**

*One of the proposed\* 5 Work Packages would be built upon work conducted within ReDAPT*

## DISSEMINATION

1. MD3.8 has been accepted (pending an update to the Appendix) and will be made available online on the ETI website
2. Paper on C-ADP (Sellar) is available to download
3. Multiple conference papers available (EWTECs, ICOE)
4. “Review” paper in preparation on the site characterisation at FoW.
5. **Environmental Data available online (free for anyone).**
  1. **Hosted by UKERC Energy Data Centre from 1<sup>st</sup> December.**
  2. **ADCP data may be available sooner (under testing at the moment)**



Thank You

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University of Edinburgh

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