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ReDAPT
Modelling Sub Project
University of Edinburgh

Ocean Energy Europe 2015
Dublin, Ireland
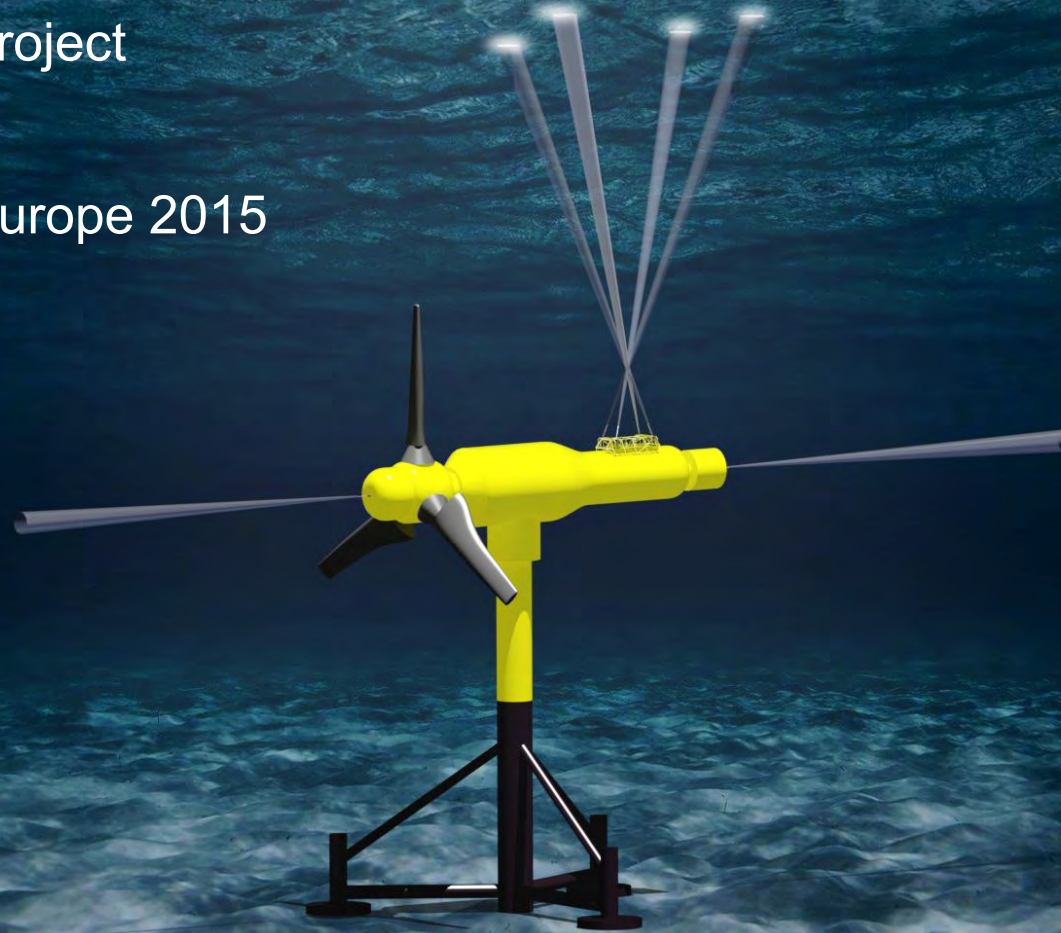
Brian Sellar
University of Edinburgh
Brian.Sellar@ed.ac.uk

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.
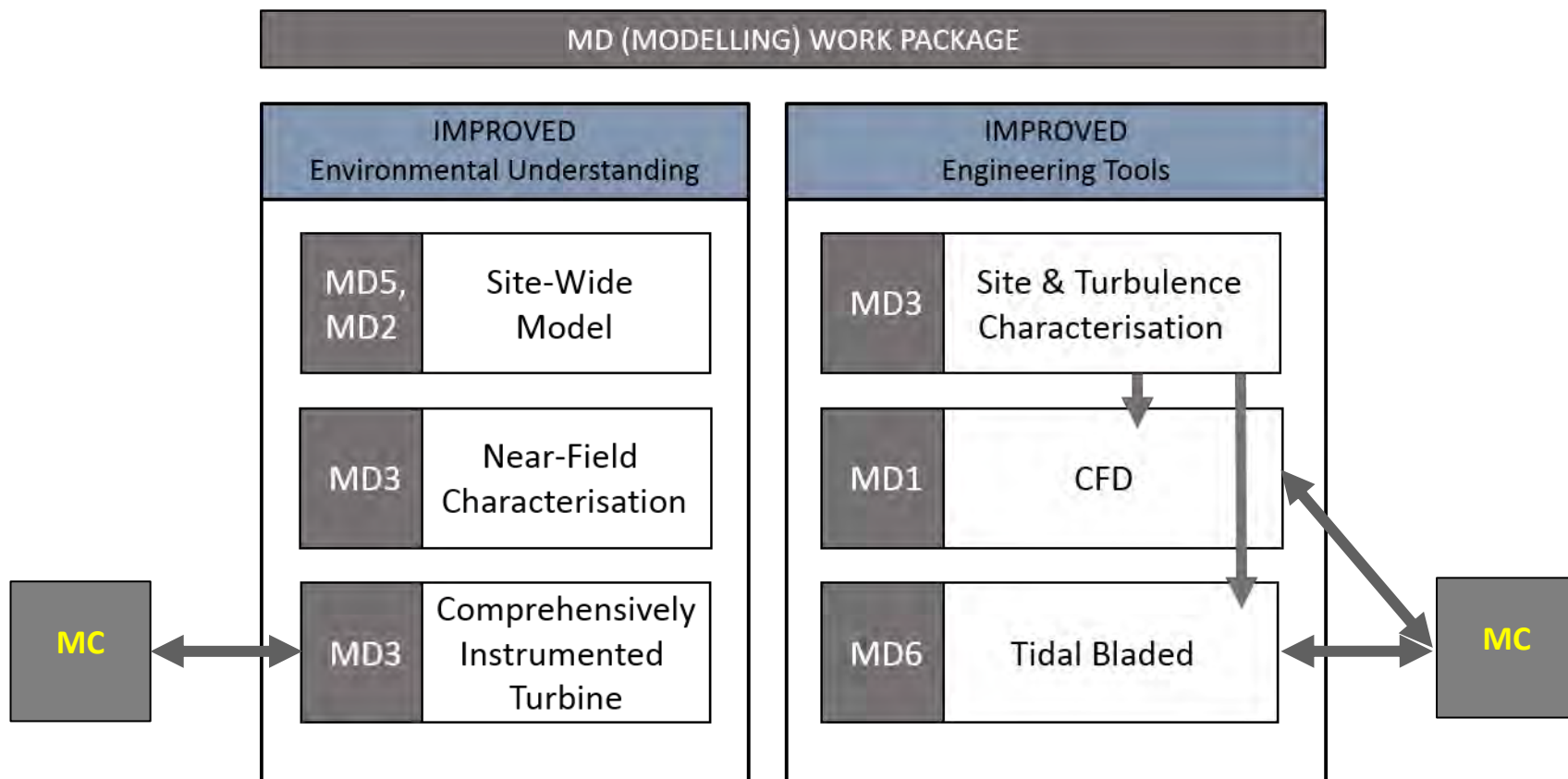
SUMMARY OF WORK MD2

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**
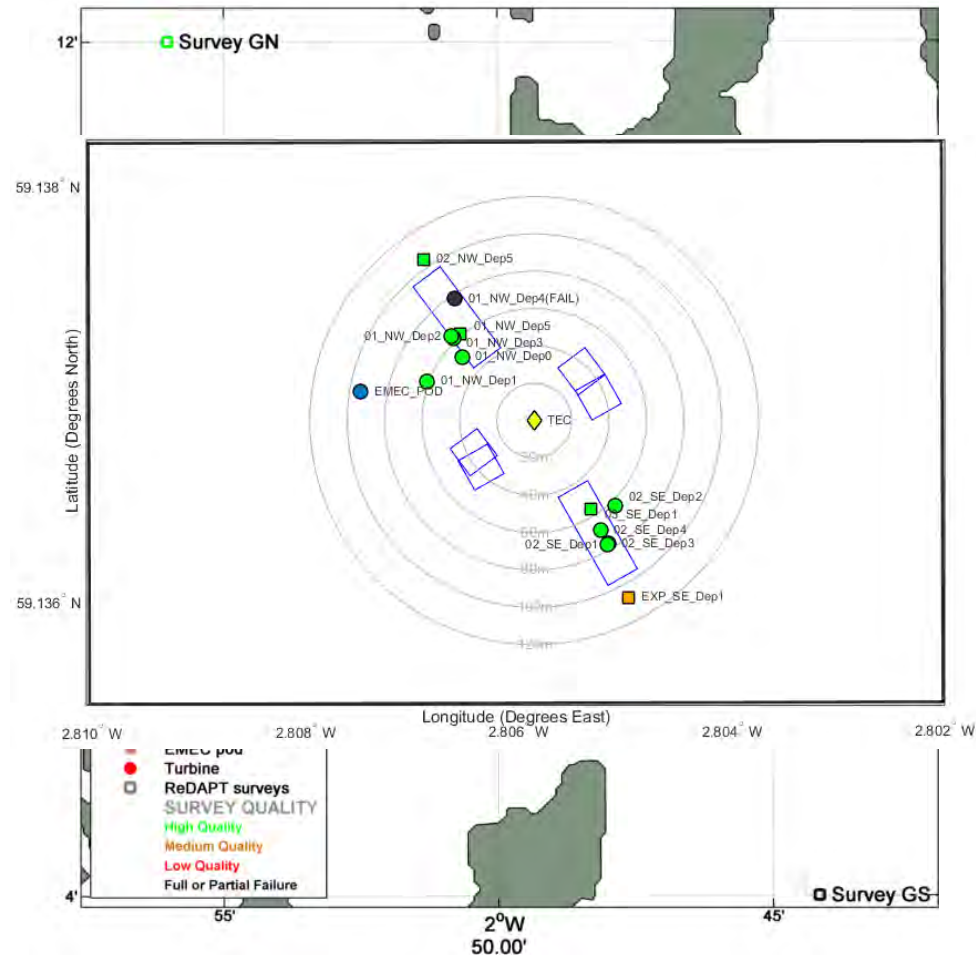
OBJECTIVES OF WORK PACKAGE
MD3 (UOE)

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

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
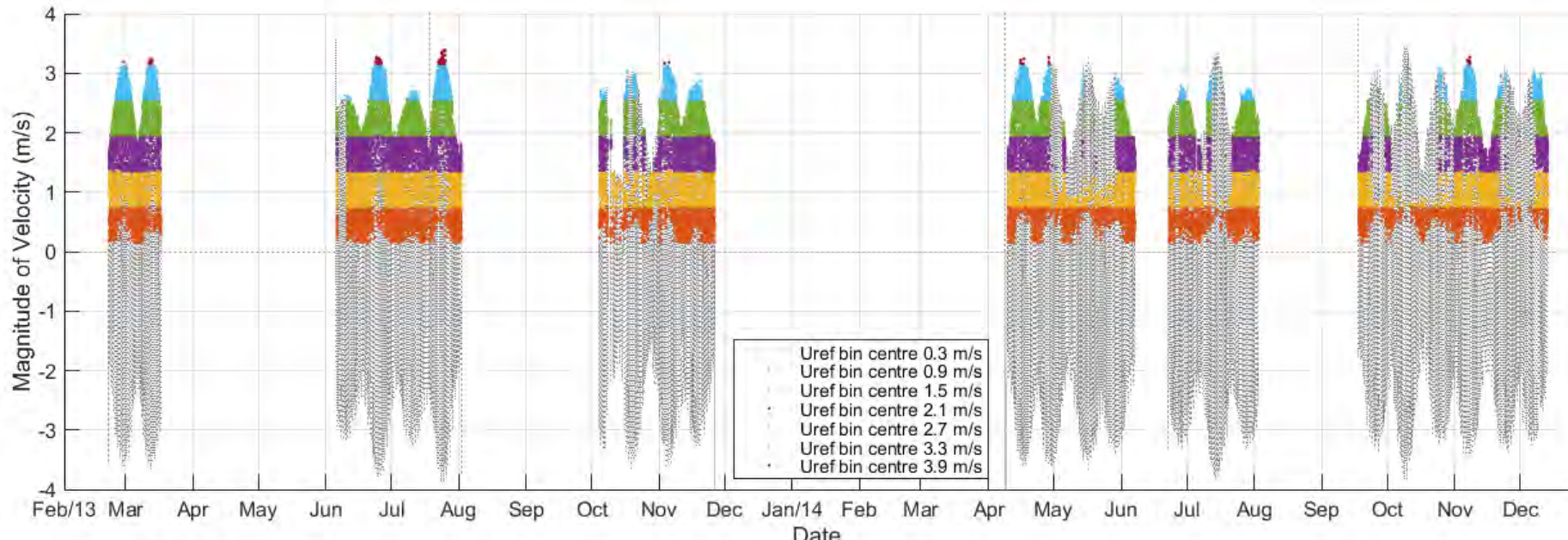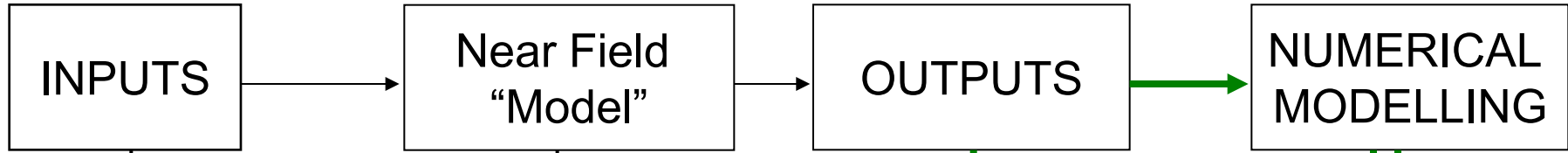### **MD3 (UOE)**

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

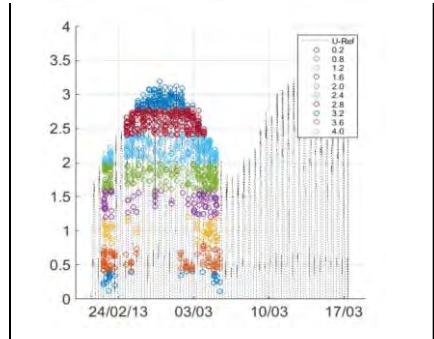# INTERFACING WITH MC WORKPACKAGE / DESIGNING MULTIPLE INSTRUMENTATION SUB-SYSTEMS
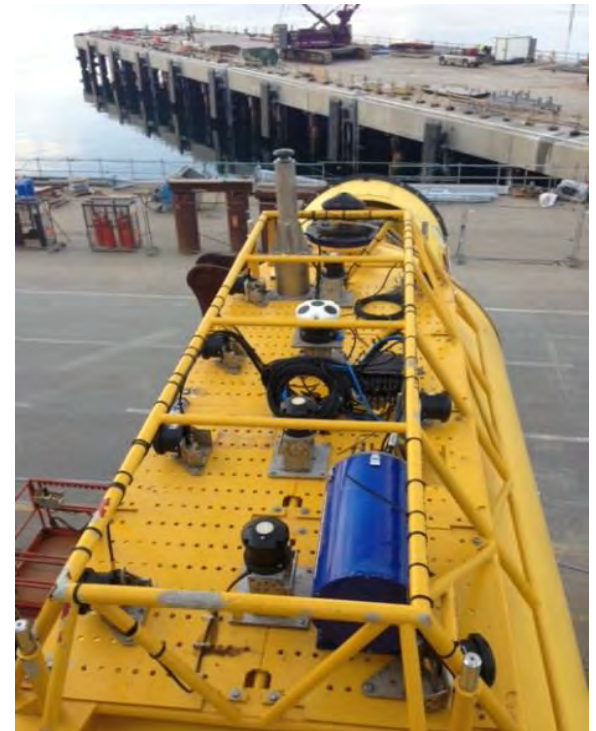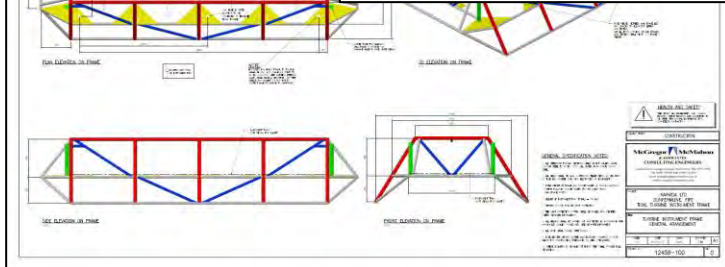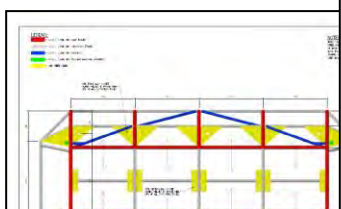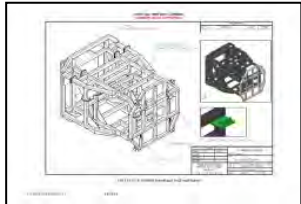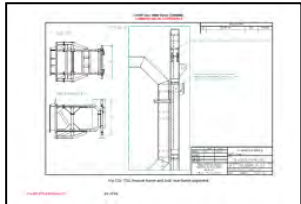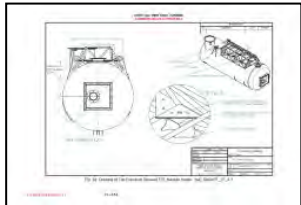
Iterative, time consuming and multi-disciplinary activity

DATA PROCESSING METHODOLOGY

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┌─────────┐     ┌──────────┐     ┌─────────┐     ┌────────────┐
│ INPUTS  │ ──▶ │Near Field│ ──▶ │ OUTPUTS │ ──▶ │ NUMERICAL  │
│         │     │ "Model"  │     │         │     │ MODELLING  │
└─────────┘     └──────────┘     └─────────┘     └────────────┘
```


Uref bin centre 0.3 m/s
Uref bin centre 0.9 m/s
Uref bin centre 1.5 m/s
Uref bin centre 2.1 m/s
Uref bin centre 2.7 m/s
Uref bin centre 3.3 m/s
Uref bin centre 3.9 m/s
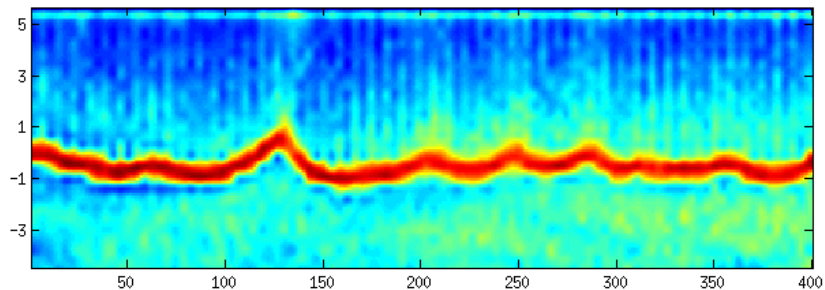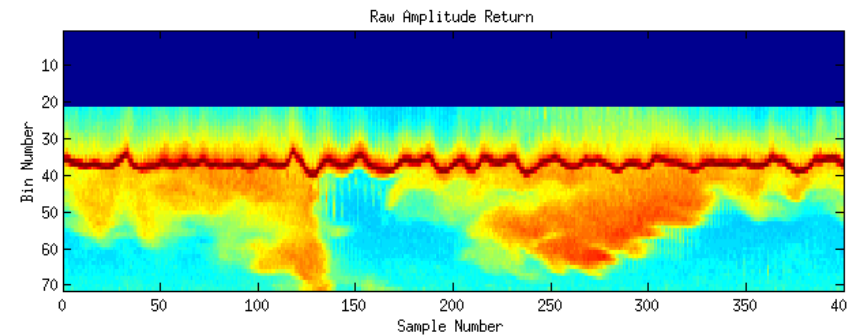
Wave Steepness

Bathymetric Variation
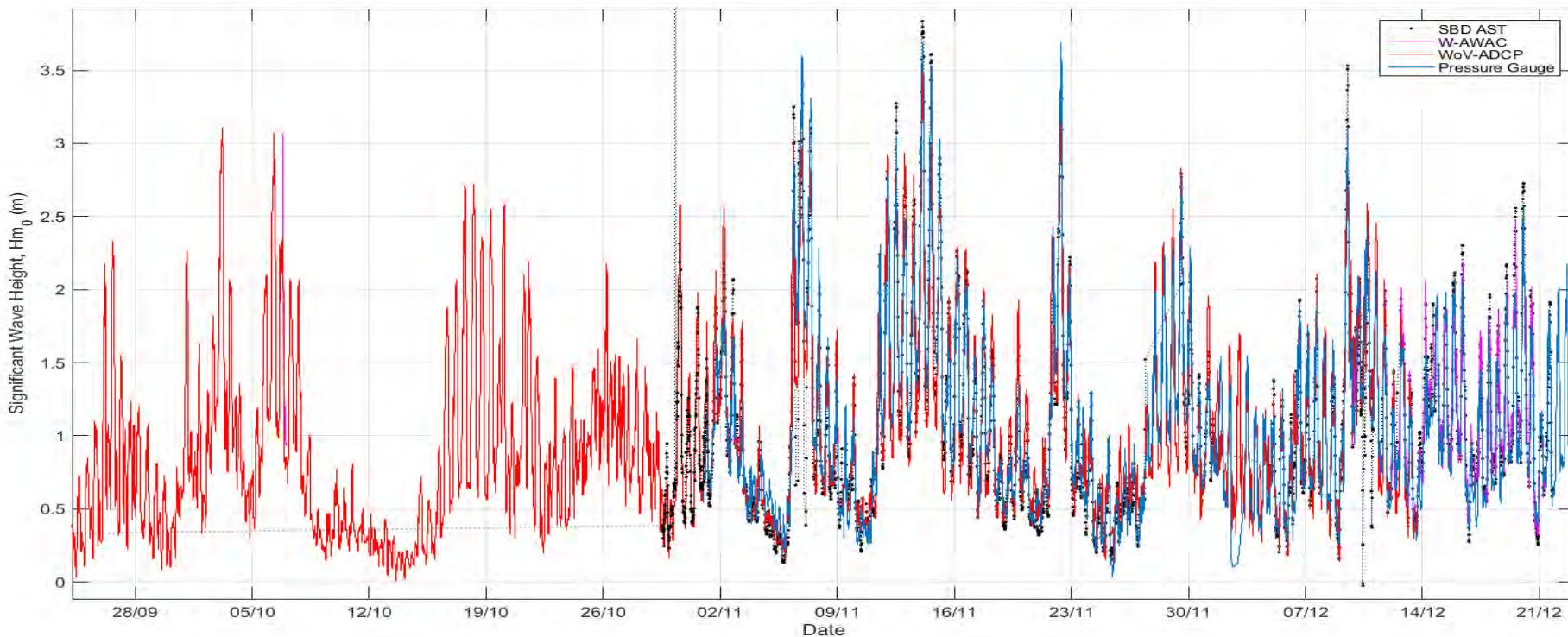
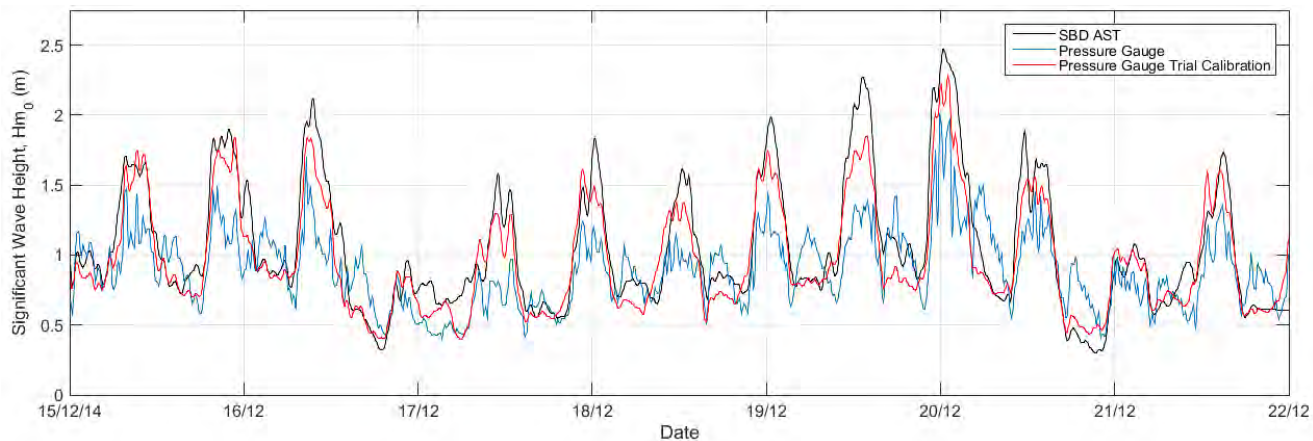Water Depth

Wave & Current Interaction

Turbulent Kinetic Energy

Depth Profiles / Mid Depth Detail

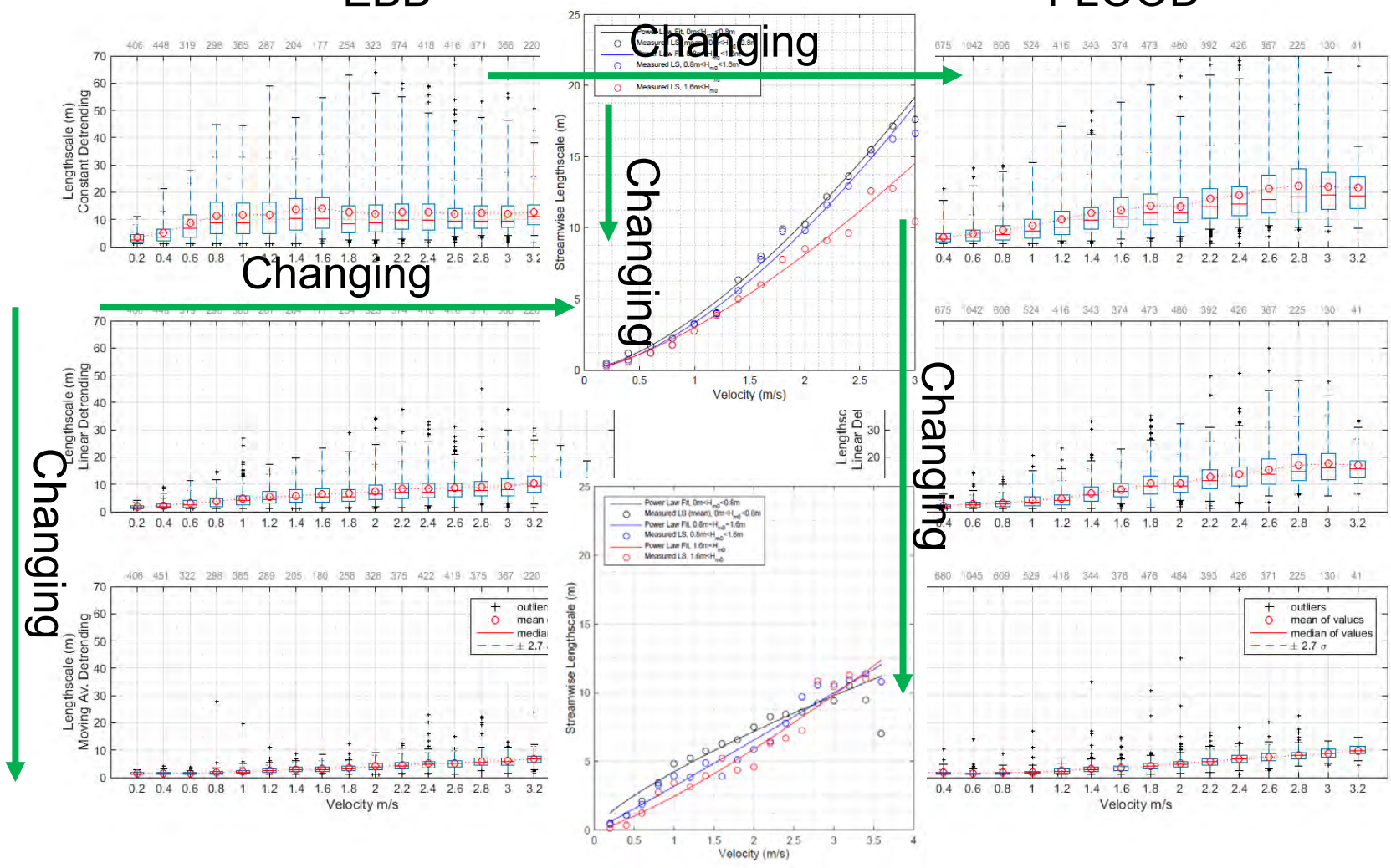# SUMMARY OF OUTCOMES: WAVE ANALYSIS IS CRITICAL AND NEEDS TO BE FULLY INCORPORATED
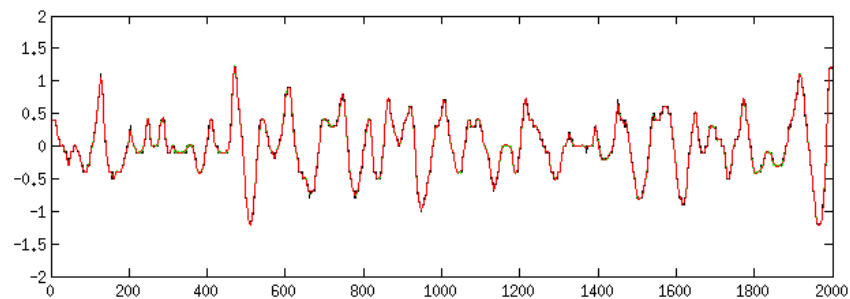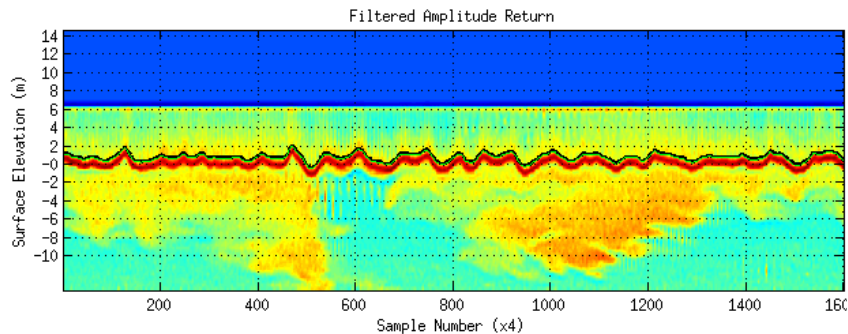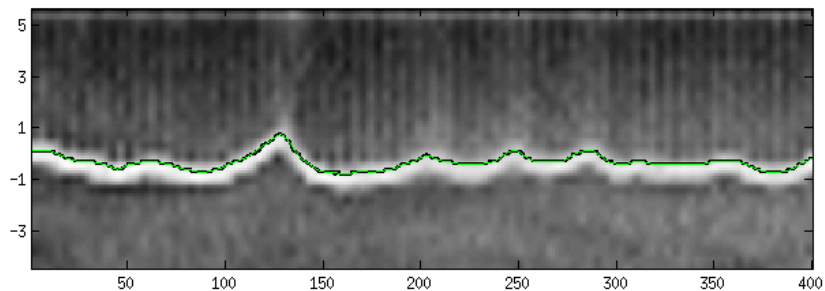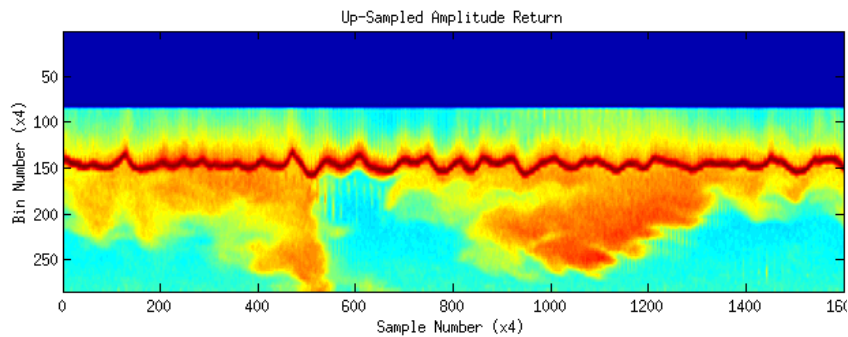
EXTRACTING SENSIBLE WAVE DATA NEEDS CAREFUL WORK

9

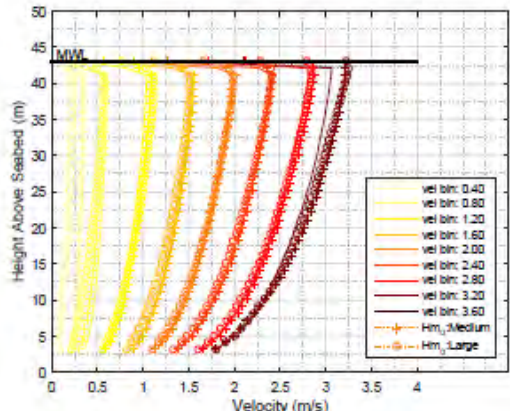# TIDAL METRICS (e.g., LS) VARY WITH ANALYSIS METHOD, VELOCITIES, BATHYMETRY AND WAVES

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

FLOOD

EBB
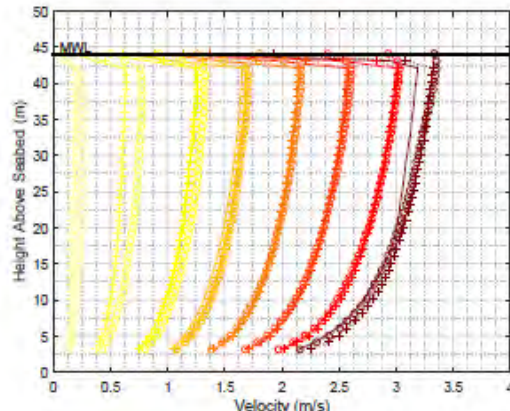
Figure 3.55: Depth profiles of velocity (m/s) for seabed ADCPs upstream of flood tidal flow
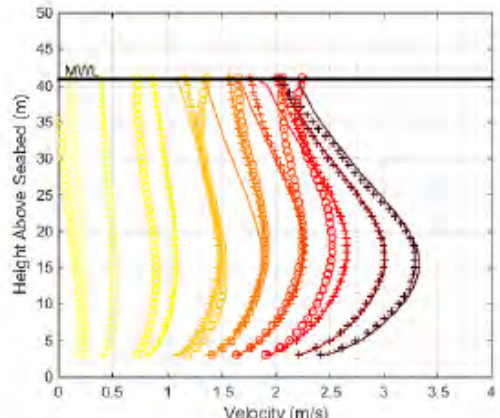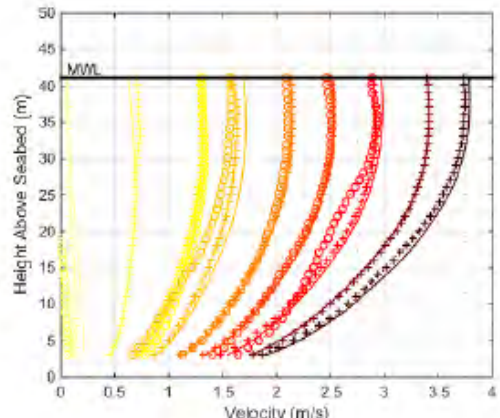
NEW INSTRUMENTATION IS NEEDED TO FURTHER TURBULENCE STUDIES
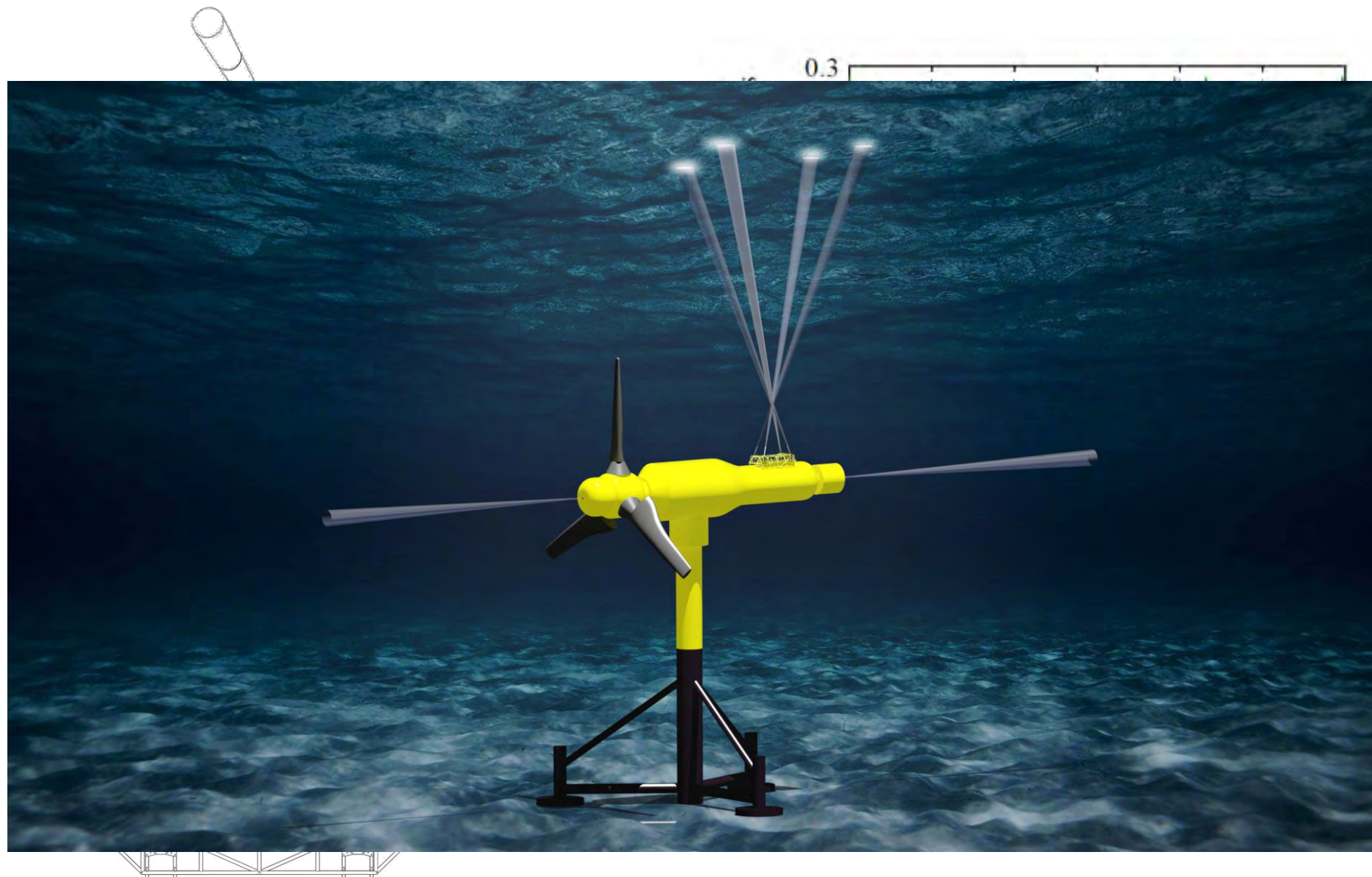
SUMMARY OF OUTCOMES: LINING EVERYTHING UP IS CHALLENGING
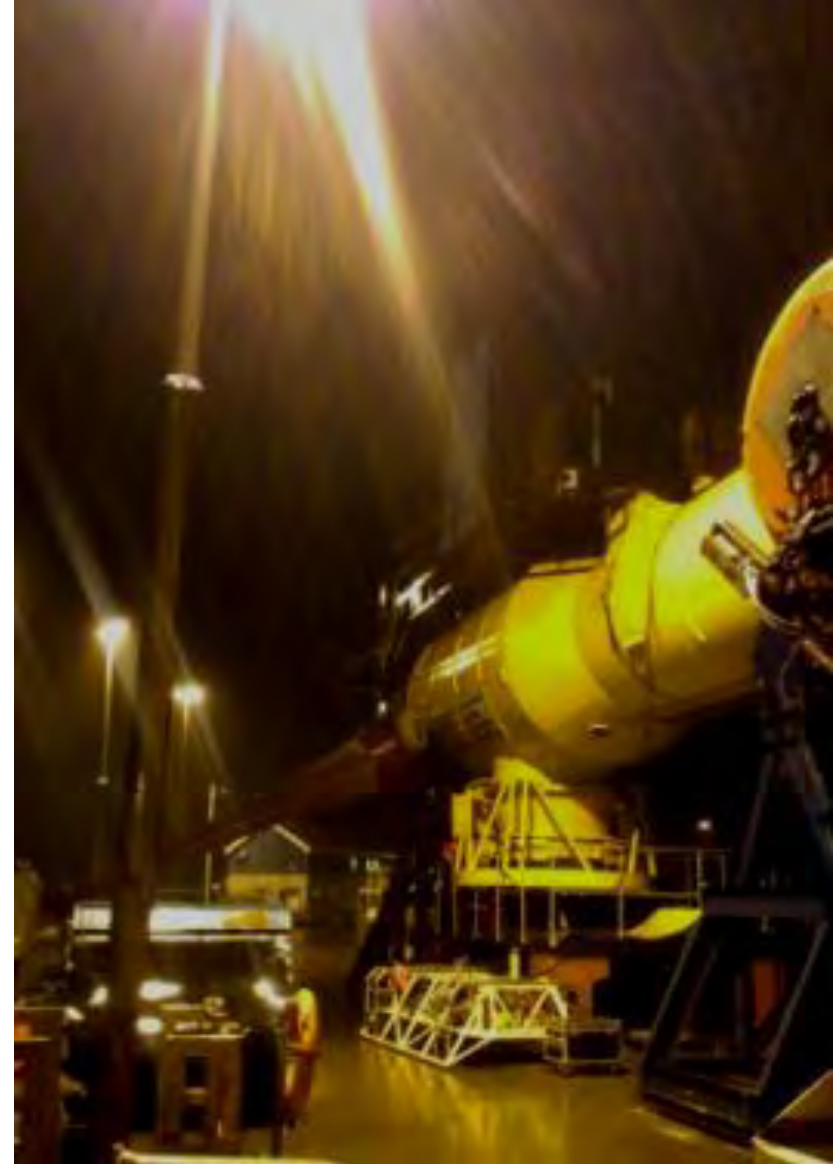
SUMMARY OF OUTCOMES: LINING EVERYTHING UP IS CHALLENGING

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

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.
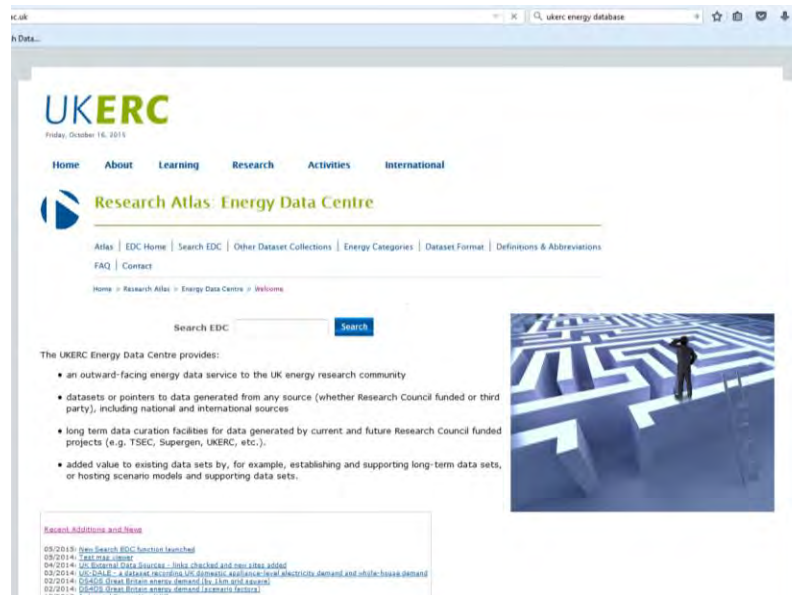   1. Tank Testing
   2. Numerical Modelling

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

16

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 1st December.**
   2. **ADCP data may be available sooner (under testing at the moment)**

Thank You

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School of Engineering
University of Edinburgh

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