Flow & Benthic Ecology 4D
(FLOWBEC)

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Summary

Using developments in high resolution physical modelling and state of the art observation systems, we aim to identify the physical conditions influencing the behaviour of fish and their predators and also benthic communities by concurrently measuring hydrodynamics and biology at 3 different wet Marine Renewable Energy test sites.

Funding of £1.2M over 3 years – started September 2011

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Paper 885 – EIMR, Stornaway, 28th April – 2nd May 2014
Progress:

- Activities related to EMEC tide and wave sites
- Activities related to Wave Hub
- Activities related to Strangford Lough
- Application of FLOWBEC related techniques to commercial sites
Activity at EMEC wave and tidal sites

At the surface:
• Marine Radar monitoring (currents, roughness, bird tracking)
• Bird Observations & linkages with measured and modelled hydrodynamics (James Waggitt’s talk – combined work with RESPONSE)

Under water:
• 5 deployments of the FLOWBEC sonar frame (Benjamin Williamson’s talk)

FVCOM modelling (PML)
Radar Flood and Ebb Currents at EMEC tidal site
Survey & Radar derived bathymetry
Small Target (Bird/Beastie) Tracking

Target tracks in a single five minute radar record

colour = speed (m/s)

Images by David McCann (NOC)
Confirmed Orca Tracks (breaching) captured on radar June 18th 2013

A: FLOWBEC frame deployment vessel

B: support vessel

C: maintenance vessel

D: OpenHydro Test platform

Orca Tracks

Bird Tracks
FVCOM modelling – Orkney area

Images: Ricardo Torres & Pierre Cassenave, PML
FVCOM M2 Ellipses (ORKM POLPRED in red)
Investigating currents & turbulence

FVCOM – turbulence

Marine radar
Wave Hub

• In situ wave and current measurements – focussed on understanding spatial variability (Ian Ashton’s Talk)

• HF Radar measurements of currents and wave height – spatial variability of wave height & currents

• FVCOM modelling of hydrodynamics – validation against various datasets
Arrays of wave measurements

High spatial variability in wave measurements from four wave buoys – not artefacts

~10% variation in wave power across 500m square area in open sea

Wave buoy

Acoustic Doppler Current Profiler picture from Ian Ashton – Exeter University
Wave Hub HF Radar Installation

- Work ongoing to improve empirical algorithms for wave height determination.
- Use of in-situ buoy measurements to develop a site specific correction.
- Progress in understanding the factors that can affect wave height measurements.
Figure 6. Comparison between two surface current snapshots of the Wave Hub region from the WERA HF radar (right) with FVCOM current predictions at the same times and locations (left). The colour scale indicates current speed, and the box represents the Wave Hub site.
Planned comparison of FVCOM currents with earlier radar data

WaveHub surface currents

Radar derived, current resolved water depth map, 17-Sep-2011 00:00:06

Radar derived current vectors, 17-Sep-2011 00:00:06

Maximum surface velocity

2 ms\(^{-1}\)

0 ms\(^{-1}\)
Strangford Lough

• Drop down video surveys of benthic environment – see Jack O’Carroll’s poster

• CFD modelling of turbine wake – Angus Creech, U. Edinburgh

• Investigate association between turbulent wake and spatial variability in benthos
- Actuator line-modelled rotors and solid supporting structure
- Two contra-rotating rotors
- Based upon Seagen device operating in Strangford Lough
- Additional turbulence generated by structure

Images by
Angus Creech
U. Edinburgh

- Tip vortices and vortex sheets generated
- Also from tower / beam structure
PentlandX – Radar deployments at Meygen site
Demonstration at Meygen Ltd
planned tidal turbine array site,
Inner Sound of Stroma in the
Pentland Firth

Paul Bell & David McCann,
NOC Liverpool
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