Characterising the Tidal Resource

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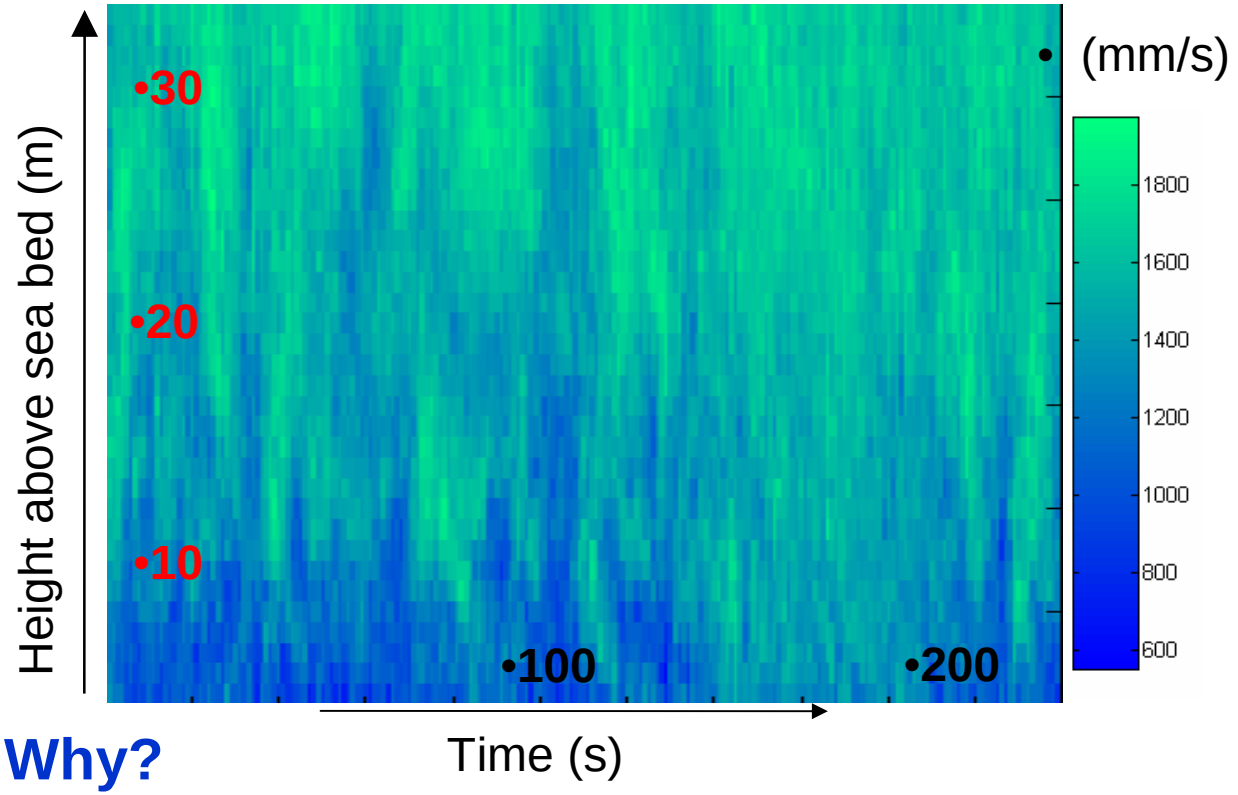
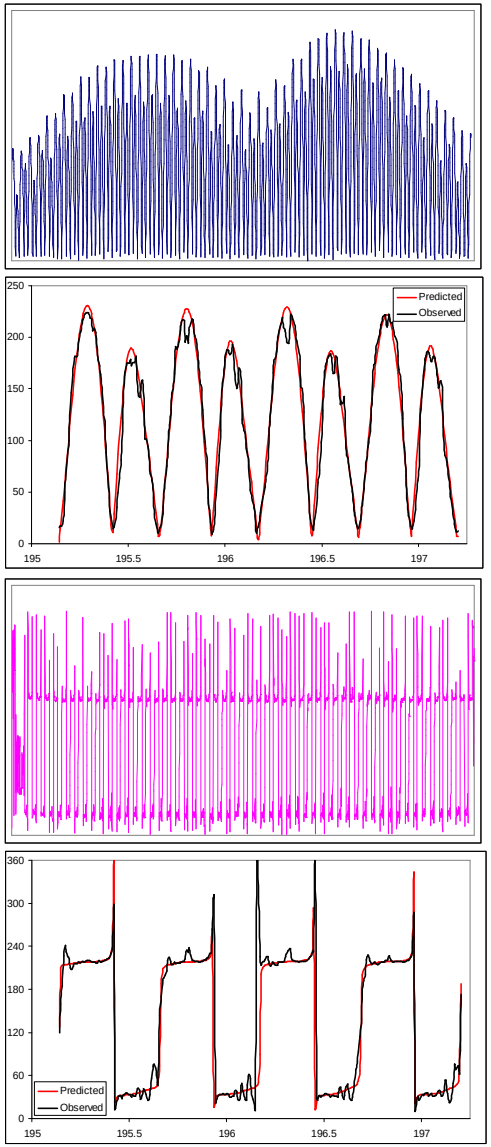
Overarching goal

To reliably interpret and predict tidal energy resource characteristics and data.





Why?

Impacts on all areas of technology and project development including energy yield assessment and device design specification.

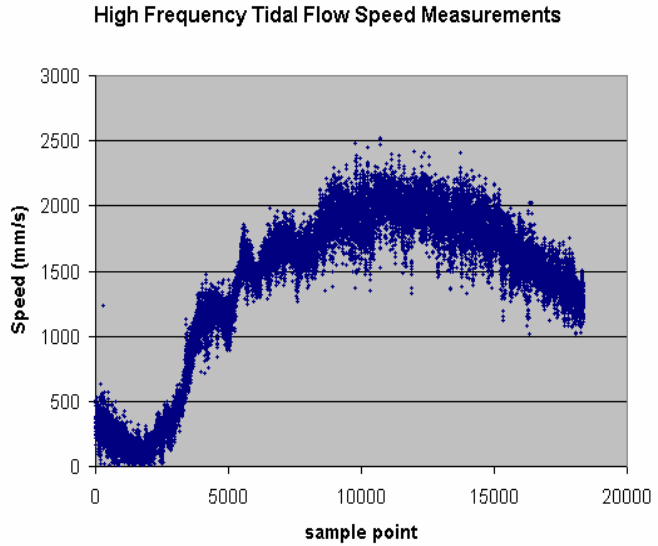
Areas of significant progress

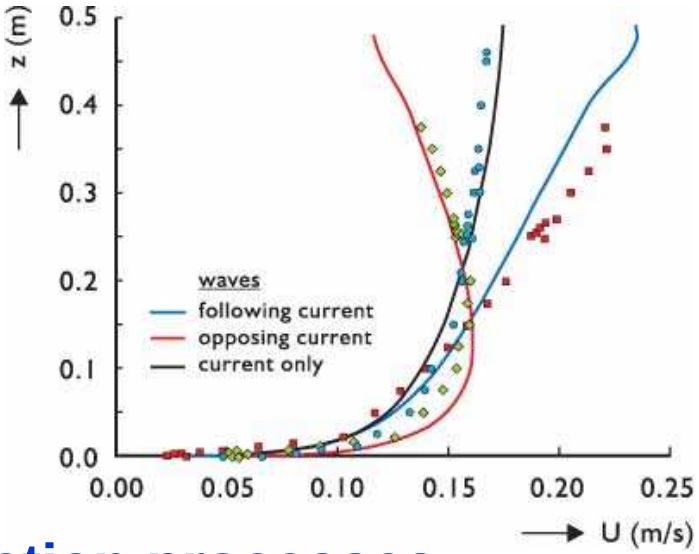
- **Wave-current interaction monitoring and analysis procedures:**
  - **Critical for device design (extreme and cyclic loadings).**
- **Sediment transport modelling:**
  - **Environmental impact (benthic creatures, water quality).**
  - **Longer-term, fundamentally alters tidal flow physics.**
- **Quantification of tidal resource (at variety of scales):**
  - **Used to select development sites and device locations.**
  - **Necessary to derive energy yield and project economics.**
  - **Drives policy – national resource assessment.**

Wave-current interaction (i)

Critical for device design (extreme and cyclic loadings).

In the field, resource is highly complex.





Existing understanding of interaction processes:

Demonstrate importance, but inappropriate for application -

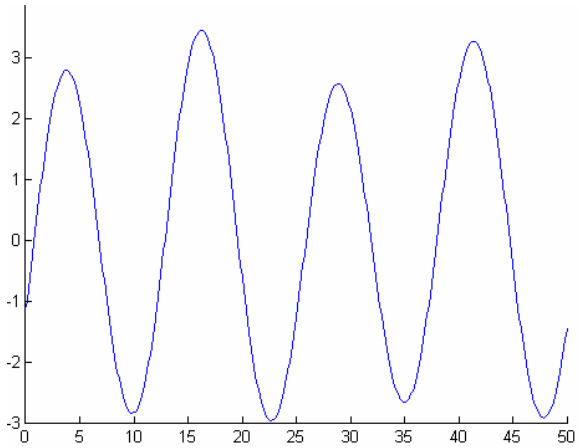
Extremes of tidal current not considered.

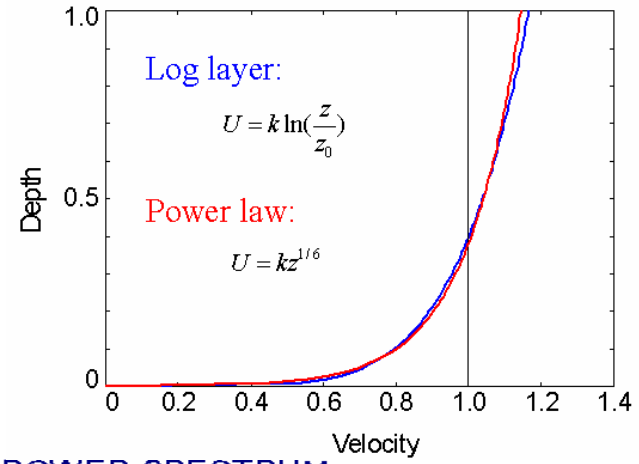
Different time-scales and impacts of engineering interest.

Don’t separate or identify individual processes in the field.

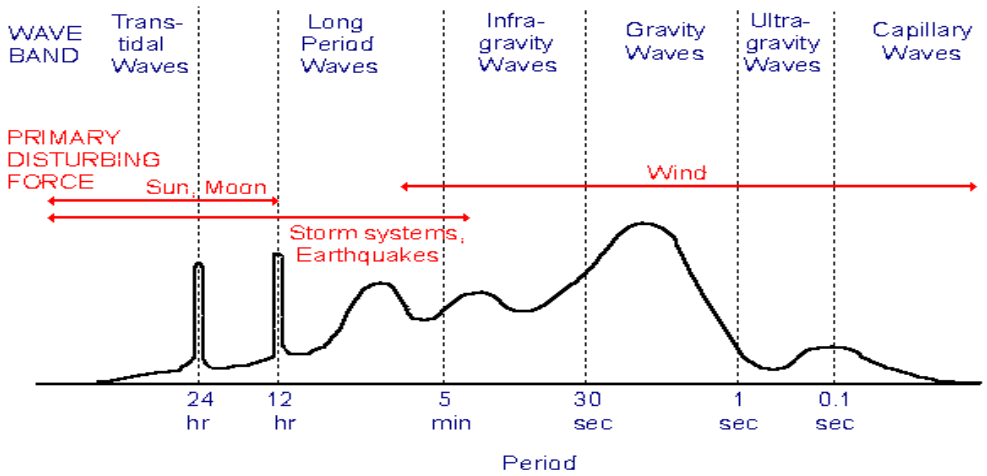
Wave-current interaction (ii)

Existing desk-based generic resource assumptions over simplify.





QUALITATIVE WAVE POWER SPECTRUM



Tendency in engineering design to treat both systems separately.

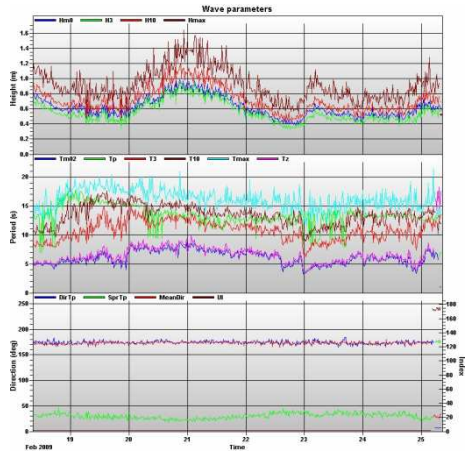
Wave-current interaction (iii)

Procedures developed and ready for testing that:

- **Separate wave and tidal signals.**
- **Analyse wave and tidal characteristics.**
- **Derive turbulence parameters.**
- **Provide inputs to structural loading calculations.**

Field programme to generate appropriate data:

- **Wave dominated site (Billia Croo).**
  - **ADCP vs. wave-buoy comparisons.**
  - **December – April (min. 2 deployments).**
- **Tide dominated site (Falls of Warness).**
  - **March – October (min. 4 deployments).**



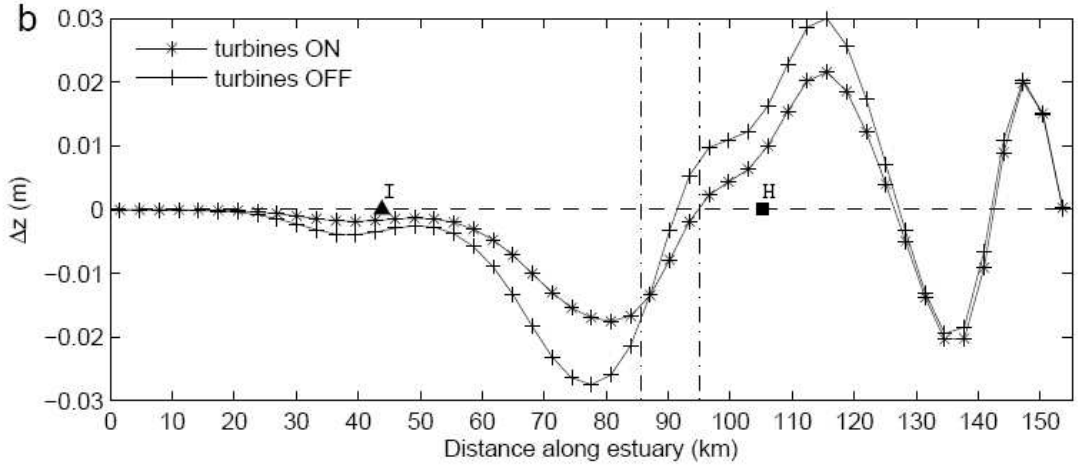
Sediment transport (i)

Environmental impact (benthic creatures, water quality).

Longer-term, fundamentally alters tidal flow physics.

Collaboration with School of Ocean Sciences, Bangor University.

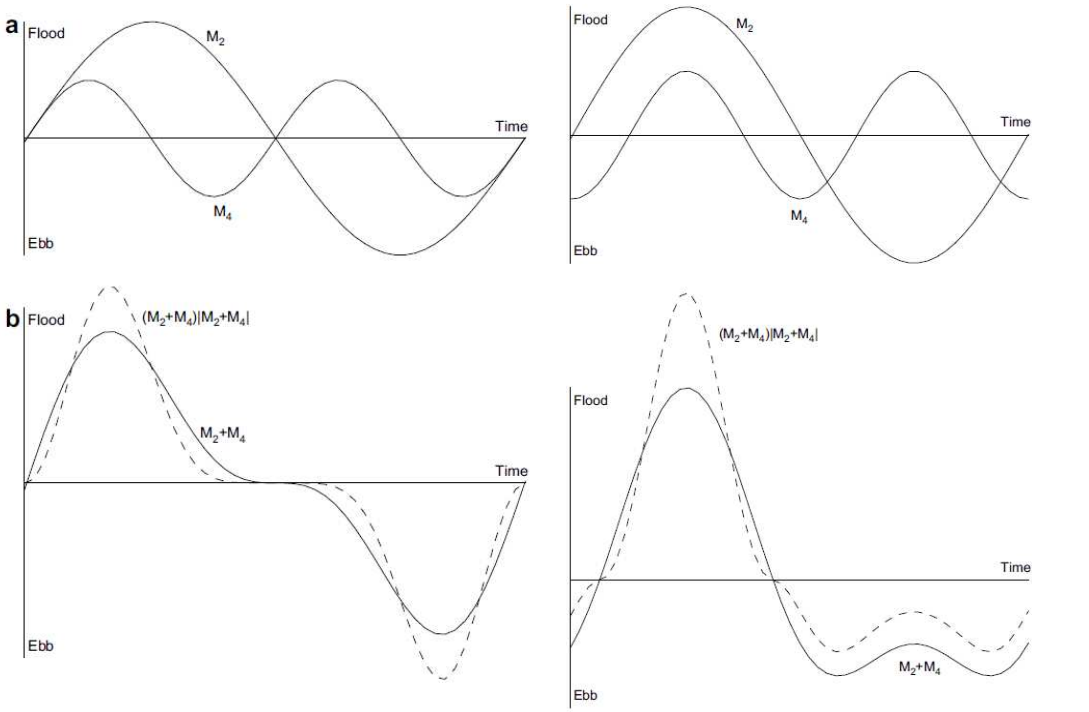
- **Developing numerical modelling tools 1D, 2D + 3D (ongoing).**
- **Environmental response non-linear and case specific.**
- **Impact measurable over a considerable distance.**
- **Energy harvesting reduces overall sea bed level change.**



- **Impact of energy harvesting on bed level change (29 day simulation)**

Sediment transport (ii)

Effects of tidal asymmetry potentially enhanced by harvesting:



TIDAL SYMMETRY TIDAL ASYMMETRY

Generates bedload parting and convergence zones

Project developers expressing strong interest in application of tools being developed to their specific sites of interest.

Quantifying the tidal resource (i)

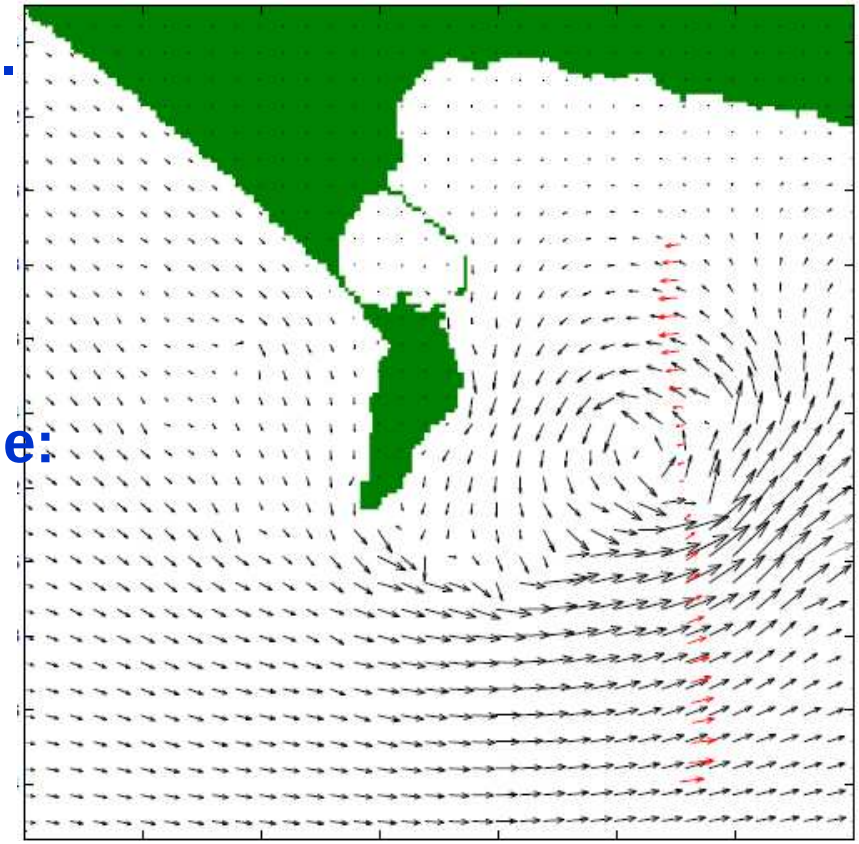
Used to select development sites and device locations.

Necessary to derive energy yield and project economics.

Drives policy – national resource assessment.

Building upon developments in Supergen Marine phase I:

- **Methodologies continually evolving.**
- **Different approaches required dependent on scale of interest.**
- **Site specific approaches.**
- **Comparing with data where available:**
  - **Investigating data reliability.**
  - **Cross-comparisons between datasets identifying issues.**



Quantifying the tidal resource (ii)

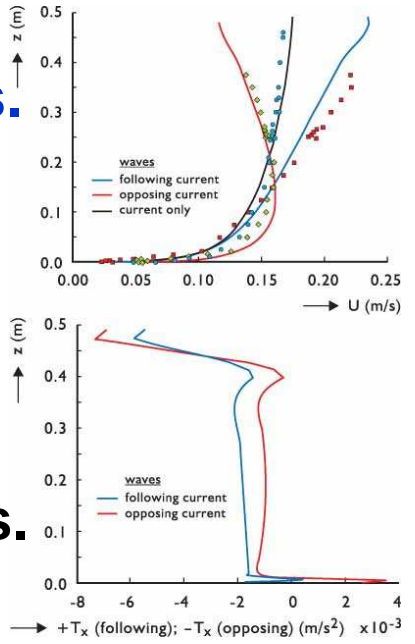
Important to differentiate between basis of resource assessments:

- **Theoretical, technical, practical and economic resource.**
- **Important to remain conservative – uncertainties remain.**
- **Updated practical Pentland Firth resource 20TWh/year.**
  - **≈ 5% of UK annual energy demand.**
- **Large-scale field experience still required to verify theories.**

Working formally and informally in this area with many organisations, e.g: IEC TC114, Black & Veatch, Natural Power, EMEC, Supergen FlexNet consortium, Bangor University, DECC.

Summary

- **Wave-current monitoring and analysis procedures.**
  - **Developed and ready for field testing.**
- **Consideration of sediment transport implications.**
  - **First specific journal publication on subject.**
  - **Developing tools and understanding of impacts.**
- **Evolution of quantification of tidal resource.**
  - **Robust, defendable scientific understanding.**
  - **Improved large-scale resource assessment.**



INFORMING AND DEVELOPING BEST PRACTICE