

# Tidal energy resource assessment combining fixed and mobile ADCP measurements

E. Droniou<sup>1</sup>✉, M. Huchet<sup>1</sup>, L. Perez<sup>1</sup>, F. Johnson<sup>2</sup>, A. Baldock<sup>3</sup>, C. Boake<sup>4</sup>

<sup>1</sup> DynamOcean, France; <sup>2</sup> SAE Renewables, UK; <sup>3</sup> Baldock Energy, UK; <sup>4</sup> Applied Renewables Research, UK.  
✉ eloi.droniou@dynamocean.com

## Introduction

- In this TIGER-funded study, we tested a new technique to characterize current velocities at potential turbine locations (named T2xx) across the MeyGen tidal project site.
- The aim is to assess the spatial variability of current velocities, while avoiding the high costs associated with deploying multiple seabed-mounted Acoustic Doppler Current Profilers (ADCPs), as is usually recommended [1].
- The technique is adapted from the **measure-correlate-predict** method commonly used in the wind energy sector. So far, its adaptation for the tidal stream energy case has only been discussed on a theoretical basis [2].

## Correlation results

- Validation (not shown): velocity data obtained from VMADCP and SMADCP measurements closely agree, for flood and ebb.
- Correlation results show a good linear fit between SMADCP at T00 and VMADCP at T2xx: example in Fig. 3 for T204, the furthest location from T00 reference station.
- Slope coefficients differ between flood and ebb events (Table 1). This is mostly due to the inhomogeneity of the tidal asymmetry between flood and ebb across the site, with the asymmetry being stronger in the Eastern part.

## Method

### Measure

- Seabed-mounted (SM) ADCP dataset at T00 reference station: 37 days, extended to 18.6 years using harmonic analysis & prediction.
- Semi-stationary vessel-mounted (VM) ADCP datasets collected at each T2xx potential location during spring tides: ~5-minute intervals every hour, for 12 hours. Vessel kept its position around nominal location (Fig. 2).
- For validation purposes: 1 VMADCP dataset collected continuously for 12 hours at T00, directly above the SMADCP.

### Correlate

- Compare rotor disk averaged velocities obtained from SM- and VMADCP datasets, separately for flood and ebb events. Evaluate linear fit  $V_{T2xx} = \alpha V_{T00}$ .
- Validate VMADCP against SMADCP at T00.
- Correlate VMADCP at T2xx with SMADCP at T00.

### Predict

- Apply correlations to obtain 18.6-year time series at T2xx.

## Conclusion

- The method used proved effective (high  $R^2$  values). To the authors' knowledge, this is the first time a method of this kind has been field tested.
- It could provide tidal predictions at sites of interest where only short-term measurements are available.
- This method has been incorporated into the new draft of IEC's guidelines for tidal energy resource assessment (Part 201), under the name "Hybrid mobile-stationary method".

## References

- [1] IEC. (2015). Marine energy—Wave, tidal and other water current converters. Part 201: Tidal energy resource assessment and characterization.  
[2] Xu, T., Haas, K. A., & Gunawan, B. (2023). Estimating annual energy production from short tidal current records. *Renewable Energy*, 207, 105–115.

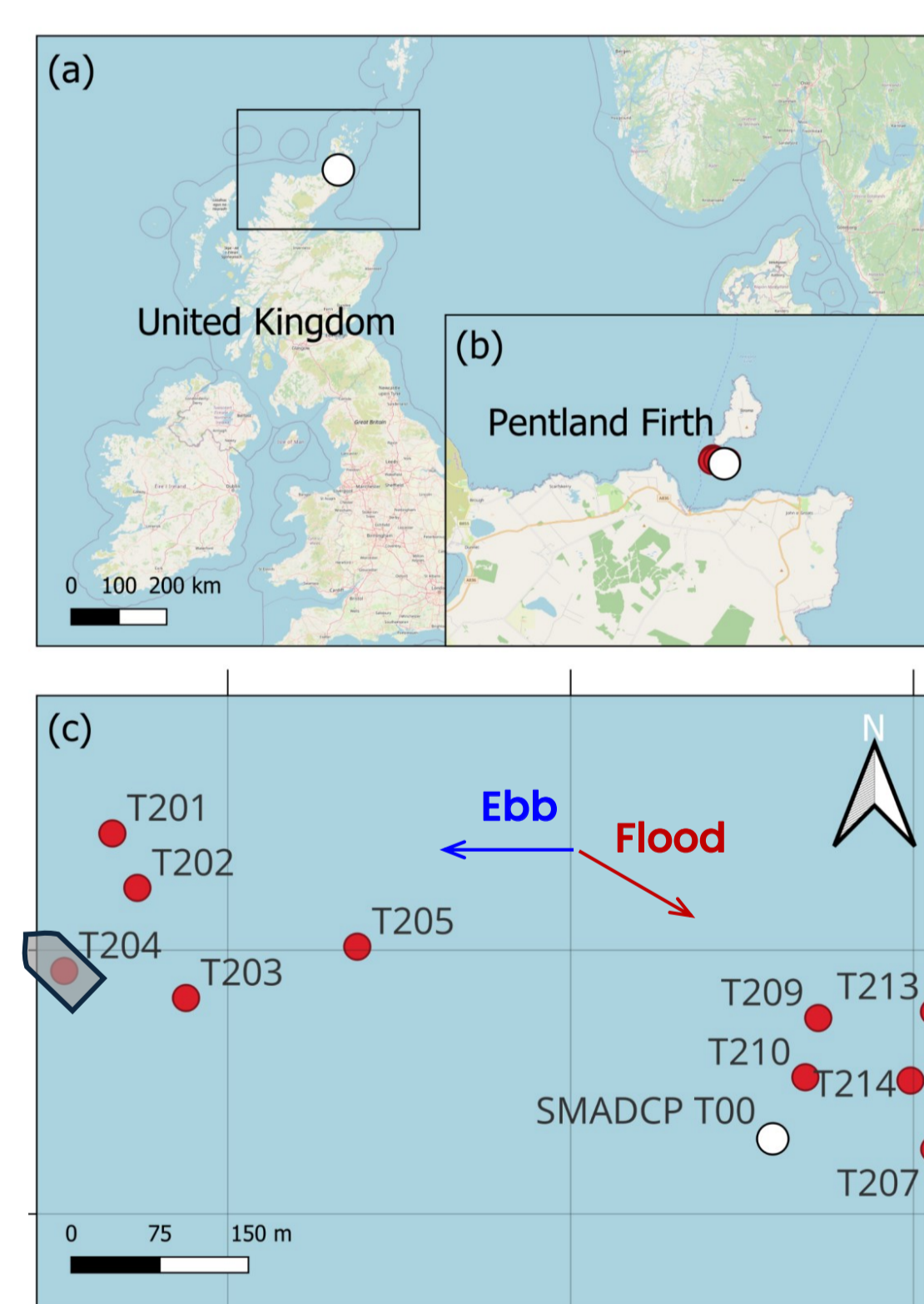


Fig. 1. MeyGen Project location within (a) the UK, (b) Pentland Firth. (c) Top view of measurement stations. White dot: reference SMADCP station (T00); red dots: VMADCP measurement locations for future turbines (T2xx).

Rotor disk averaged velocity magnitudes at T204  
Rotor diameter = 23 m

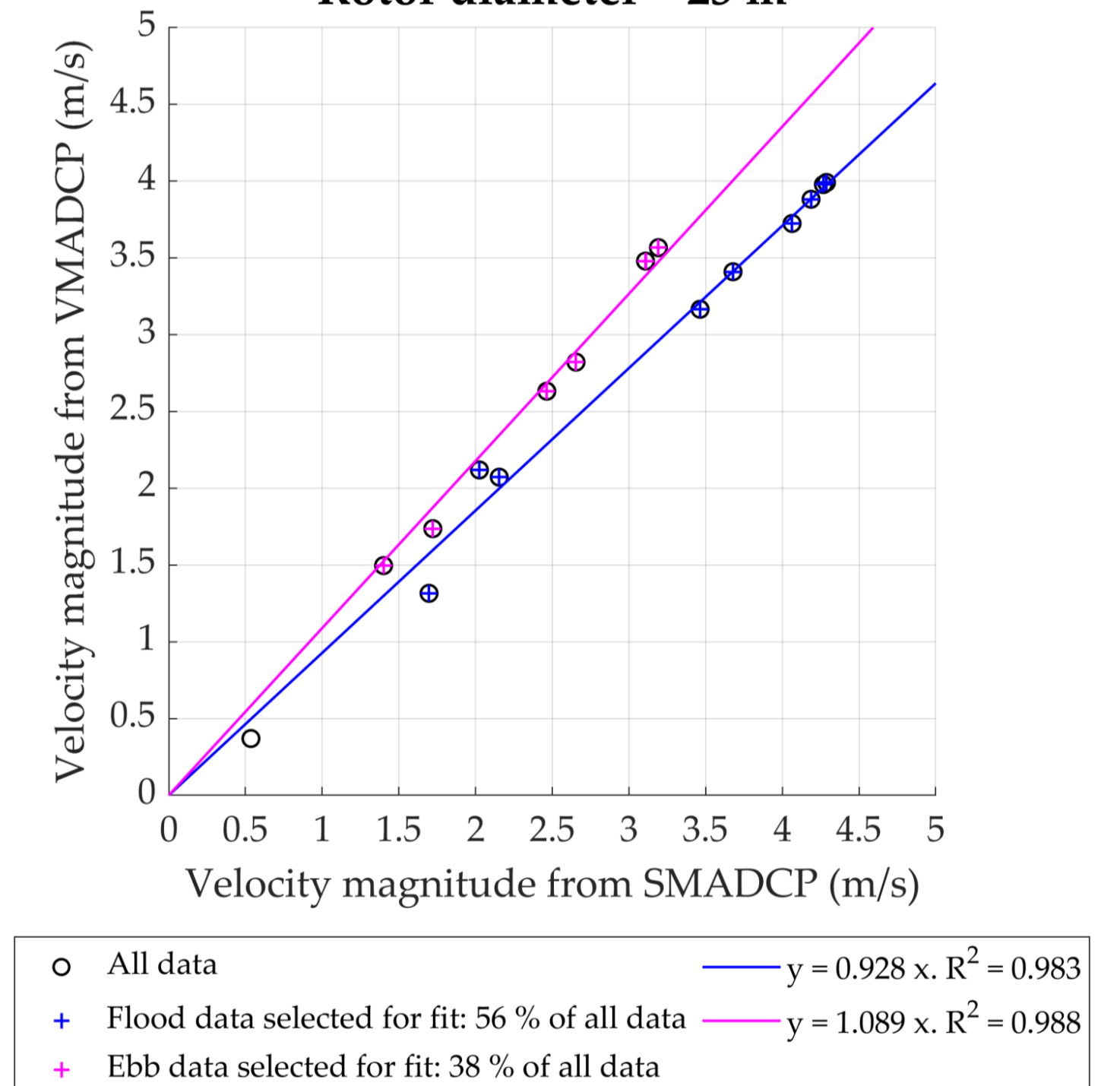


Fig. 3. Correlation between vessel-mounted data at T204 and seabed-mounted data at T00

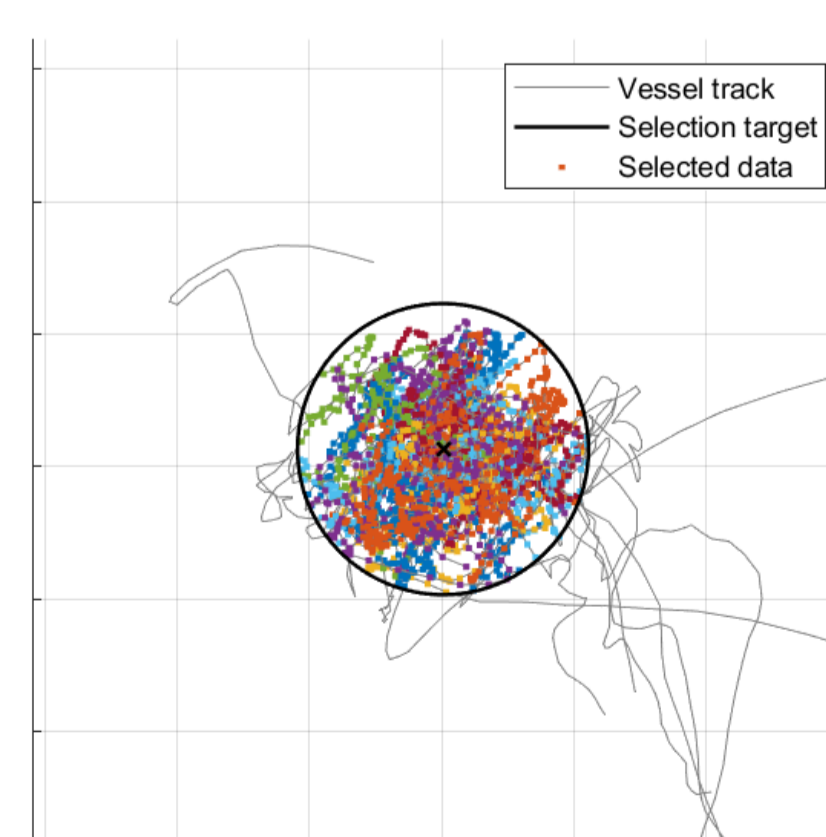


Fig. 2. Example of selected VMADCP data throughout the multiple 5-minute stops over a T2xx station. Target radius is 11 m.

Station	Distance to SMADCP T00 (m)	Flood		Ebb	
		$\alpha$	$R^2$	$\alpha$	$R^2$
T201	614	0.97	0.97	1.22	0.94
T202	577	0.97	0.98	1.22	0.94
T203	509	0.96	0.96	0.94	0.94
T204	614	0.93	0.98	1.09	0.99
T205	386	1.01	0.99	1.18	0.99
T207	137	1.01	0.98	0.96	0.98
T209	109	1.08	0.98	0.99	0.98
T210	59	1.04	0.98	0.97	0.98
T213	173	1.11	0.99	0.98	0.98
T214	126	1.04	0.98	0.99	0.98

Table 1. Results of correlation study between VMADCP at T2XX stations and SMADCP at T00