Using Unmanned Aerial Vehicles (UAVs) for environmental monitoring of tidal energy sites

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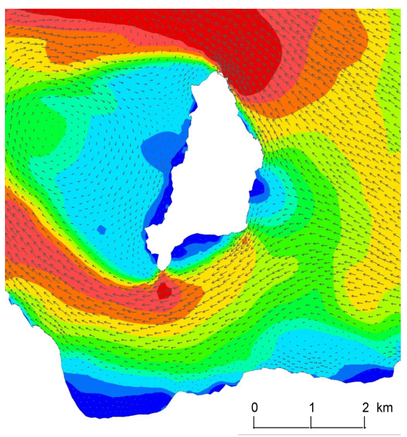
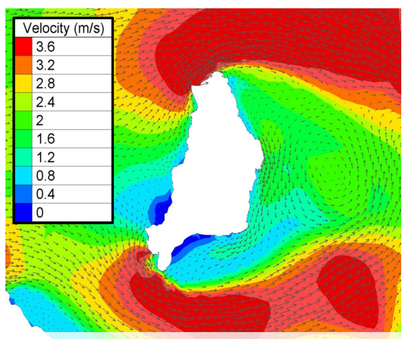
INTRODUCTION

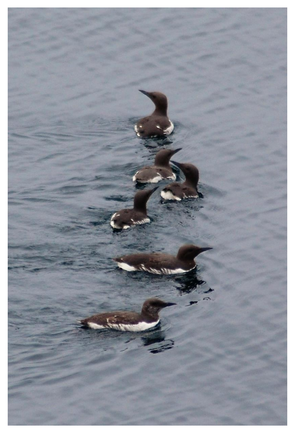
Diving seabirds forage in tidal stream sites [1]. High flow speeds, upwelling or shear may enhance prey availability and foraging efficiency [2]. **We need to measure the distribution of seabirds to understand potential interactions with tidal energy developments.**

Existing survey techniques use costly (so infrequent) vessel or aeroplane surveys which limit understanding of seasonal trends. Shore-based vantage point surveys suffer from reduced detectability of seabirds with distance from the observer.





UAV survey techniques are being trialled in the Inner Sound of the Pentland Firth, Scotland, the site of the MeyGen tidal energy array (left-ebb, right-flood).



AIM

This project is investigating the use of Unmanned Aerial Vehicles (UAVs) for environmental monitoring of tidal energy sites. **UAVs allow animal distribution and fine-scale hydrodynamic surface characteristics to be measured, to investigate the behavioural associations between seabird foraging and hydrodynamic features.**

METHODOLOGY

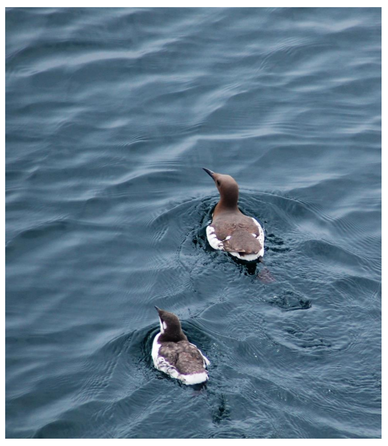
The UAV gathers georeferenced images of seabirds and hydrodynamic surface characteristics:

- 12 MP images, 1 Hz at 60 m altitude.
- Flights are against the tide to avoid double-counting.
- Validation to ensure no audible / visual effect of UAV on bird behaviour.
- Images are mosaiced using image registration and overlap.

MRV Scotia followed the UAV:

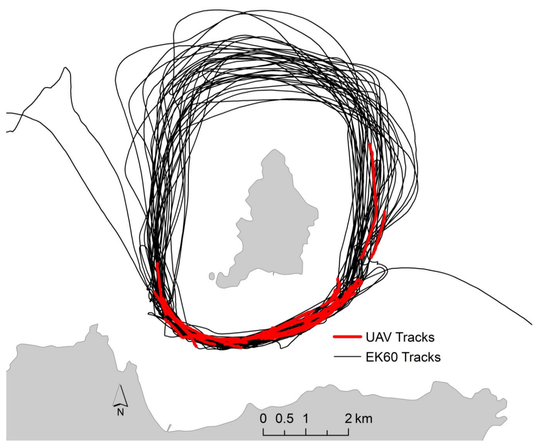
- Observers record seabirds and sea-state.
- EK60 echosounder records fish (prey) and turbulence characteristics [3].
- ADCP measures flow velocity.
- Meteorological data collected to investigate the detectability of birds.

The vessel data are used to ground truth seabird and hydrodynamic observations from the UAV.



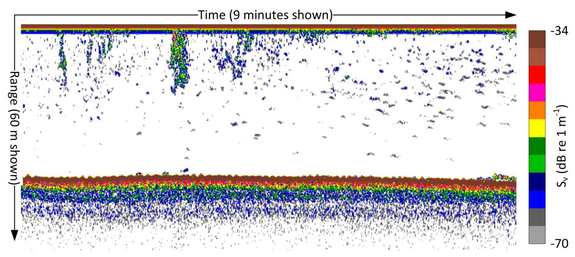
RESULTS

Proof-of-concept surveys were completed in June 2016, prior to installation of the MeyGen tidal turbines.

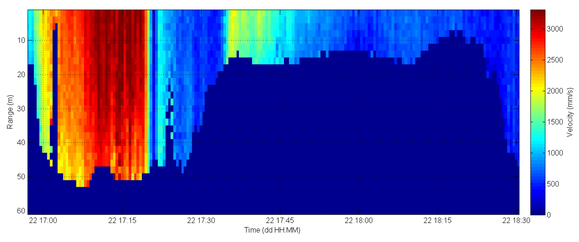


40+ ***MRV Scotia*** **transects** around Stroma (black lines) were completed gathering EK60/ADCP and observer data.

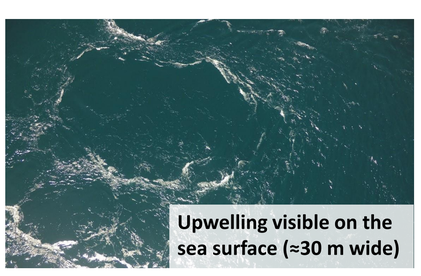
UAV surveys (red lines) focused on the Inner Sound over the MeyGen tidal energy site.



EK60 data measured fish schools and turbulence characteristics, to link to UAV images of surface characteristics.

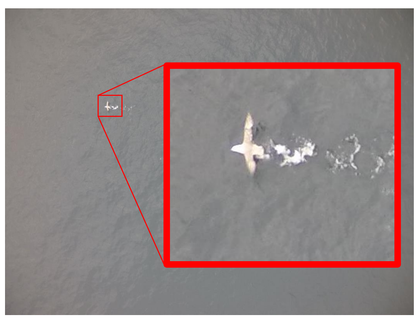


ADCP data measured flow velocity, to ground truth UAV measurements.



Upwelling visible on the sea surface (≈30 m wide)

UAV images measured hydrodynamic surface features (left) and a variety of seabirds.



CONCLUSIONS AND FUTURE WORK

Surveys in 2016 demonstrated the feasibility of UAVs to detect seabirds at tidal energy sites, while gathering concurrent images of surface hydrodynamic features. Concurrent surveys with *MRV Scotia* provided a novel above-water, on-water and under-water dataset. Surveys will be repeated in 2018 to compare pre-installation seabird and hydrodynamic conditions (from 2016) with data now that the MeyGen turbines are operational. The aim is to use the ground-truthing information to allow future surveys to be carried out using just the UAV.

Ongoing work includes:

- Improve the camera system to support species classification.
- Trial multi-spectral / thermal cameras to improve detection of seabirds and surface features.
- Develop automated detection of birds and hydrodynamic features.
- Investigate the detectability of birds given sea state, glare, altitude.

REFERENCES

[1] J. Waggitt *et al.* (2016), "Quantifying pursuit diving seabirds' associations with fine-scale physical features in tidal stream environments" *Applied Ecology*.
[2] S. Benjamins *et al.* (2015), "Confusion Reigns? A Review of Marine Megafauna Interactions with Tidal-Stream Environments" *Oceanography and Marine Biology*.
[3] S. Fraser *et al.* (2017), "Automatic active acoustic target detection in turbulent aquatic environments" *Limnology & Oceanography: Methods*.

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MRV Scotia image from VesselFinder.