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SIMEC ATLANTIS ENERGY

Environmental Monitoring at the Meygen Project Scotland

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(2) Simec Atlantis Energy, 139 Fountainbridge, Edinburgh, Scotland

(With Joe Onoufriou, Gordon Hastie, Carol Sparling, Laura Palmer, Jamie Macaulay and many others …)

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• MeyGen Project Construction Dates

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Licences and Consent

October 2010
Crown Estate Agreement Lease

September 2013
Section 36 consent granted

July 2012
Section 36 Consent and Marine Licence applications

January 2014
Marine Licence granted by Marine Scotland

Finance & contracts

July 2014
Generator's Licence issued by Ofgem

September 2014
Construction contracts concluded

August 2014
Funding conditions satisfied

Construction

July 2015
4 x HDD bore complete

January 2015
Onshore construction commenced

May 2016
AR1500 FAT or Nautilus test bed at OREC

October 2015
Export cables installed

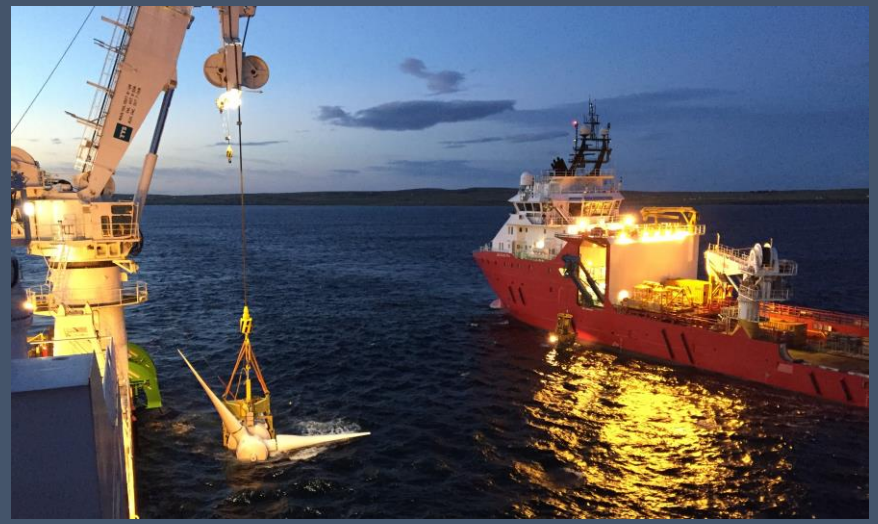
October 2016
Turbine support structures installed

June 2016
SHEPD energise 14.8km 33kV grid connection

November 2016
Turbine offshore installation works begin

O&M

April 2018
MeyGen Phase 1A 'officially' enters into operation



• MeyGen Array Generation

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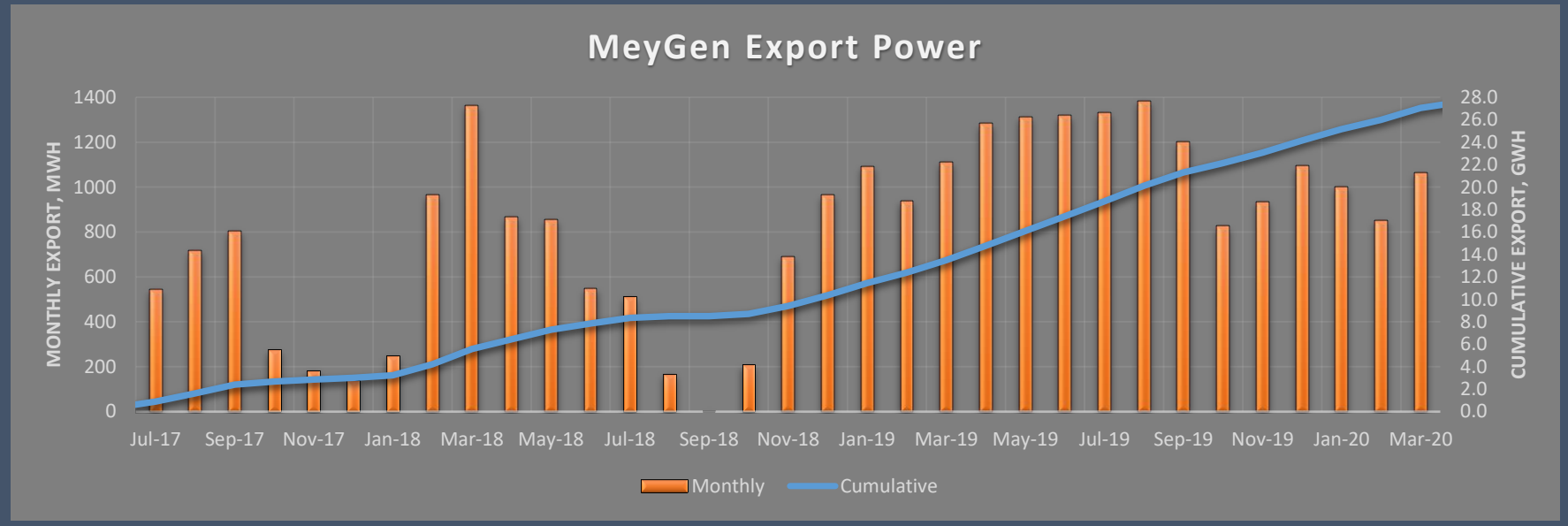
- Four horizontal axis turbines
- Approx' 200m separation
- Gravity mounts in ~38m
- Up to 10 knot current
- 1.5MW each
- 9m blade radius
- Up to 20 rpm (14 typical)
- Future plans up to 86MW



• MeyGen – Phase 1A environmental monitoring

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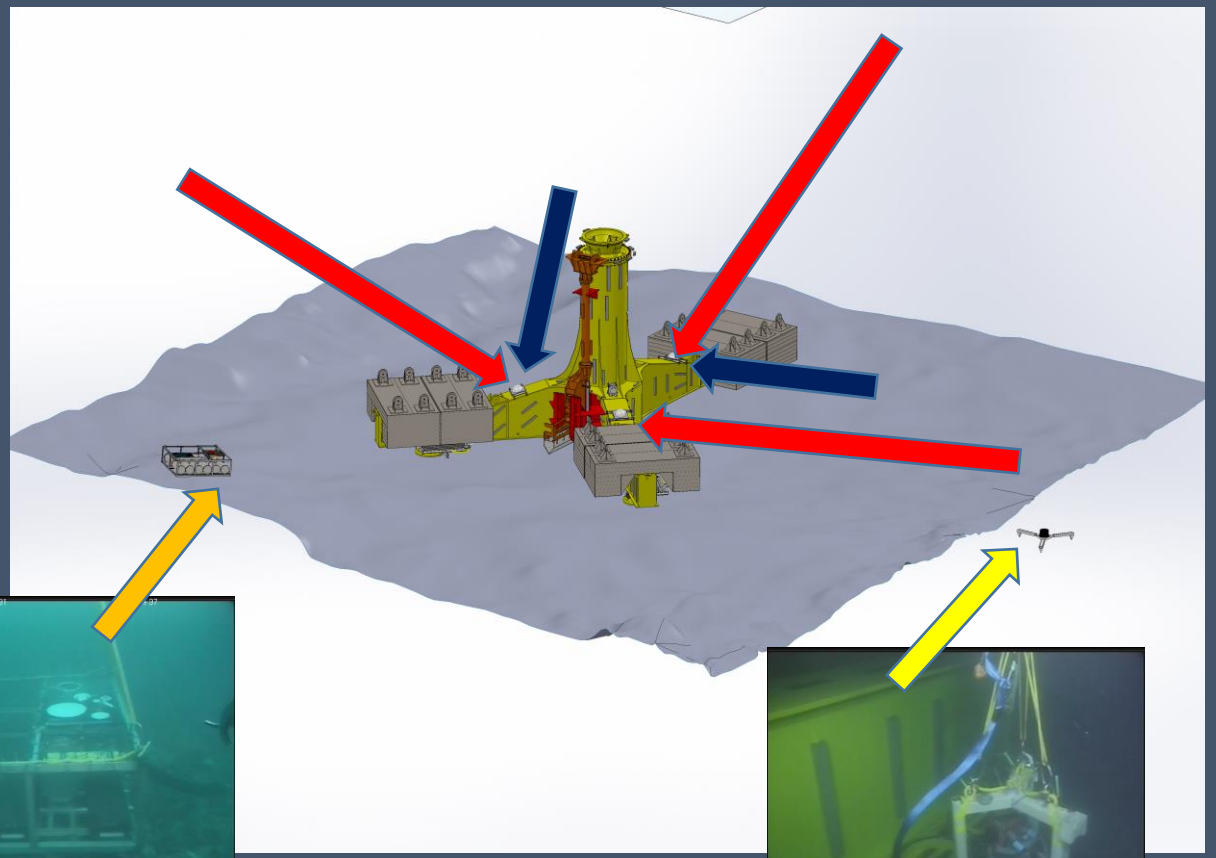
Five types of sensor deployed

1. Passive hydrophones – Small Cetaceans
2. Cameras
3. Multibeam active sonar – seals
4. Flowbec – Fish and general ecology

All sensors cabled to TSS prior to deployment

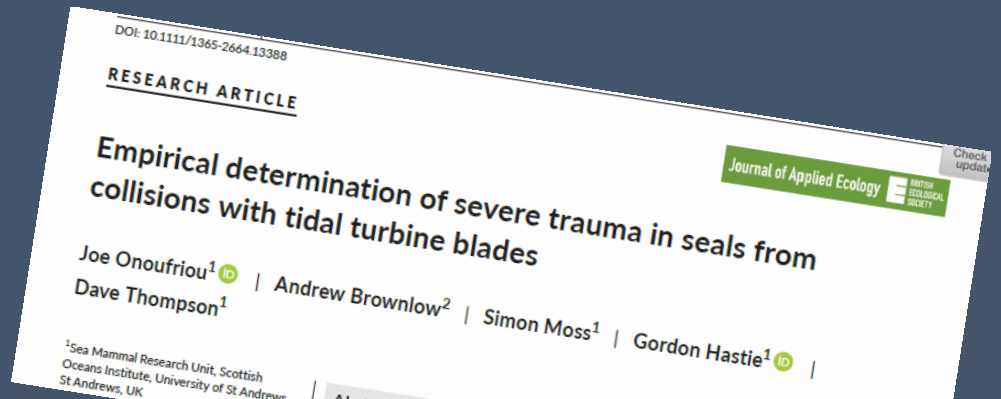
Power and comms via turbine export cable

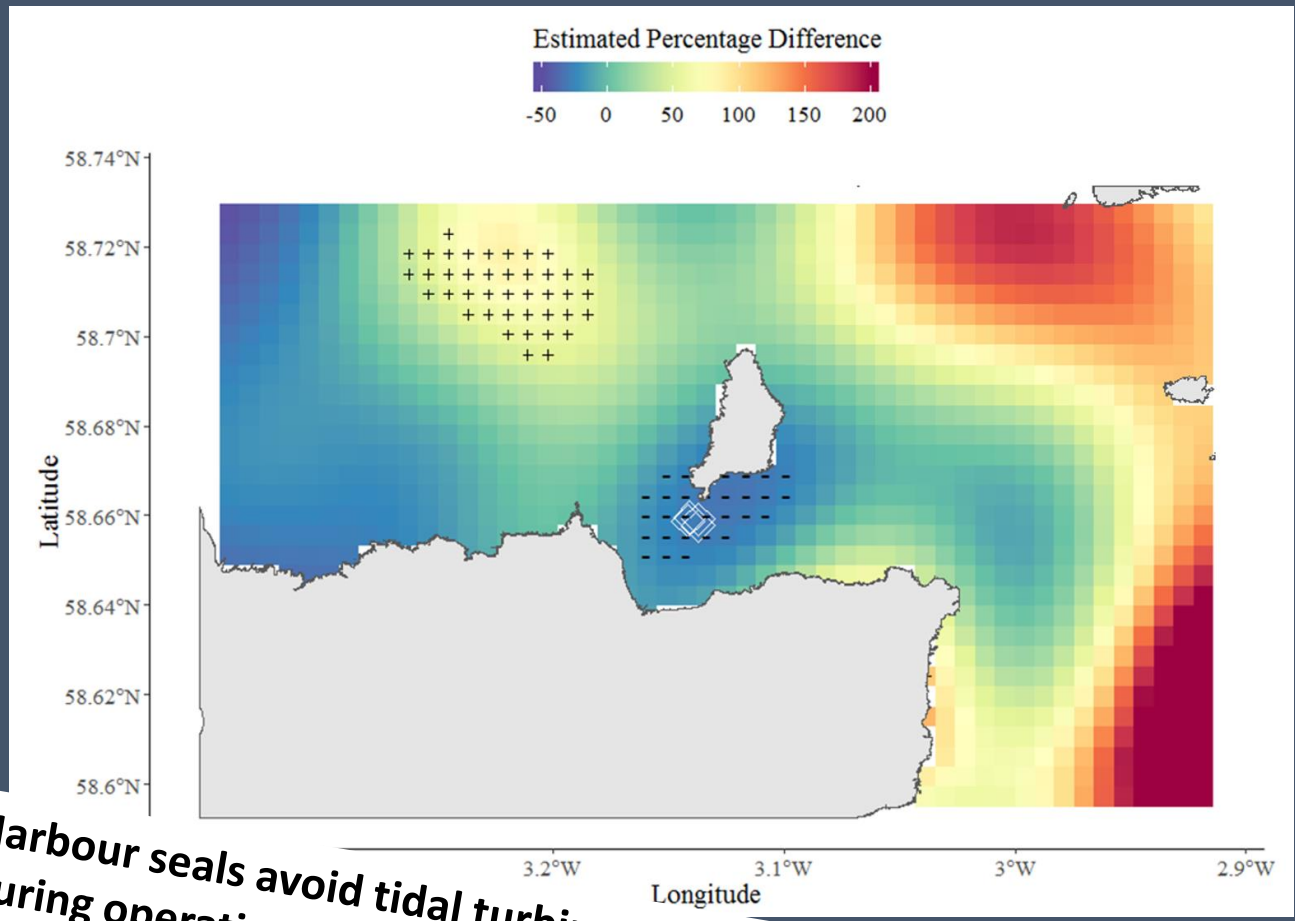


5. GPS Seal tags

• Seal tagging results

- Seal distribution primarily driven by tidal dynamics
- Did not change with installation of the turbines
- Did change with operation of the turbines
- Seals are actively avoiding the turbines when they're operating but continue to use the site during no-operational periods.
- Overall, movement behaviour does not appear to be hindered by the presence of the turbines suggesting that pre-installation foraging sites have not been significantly obstructed





Harbour seals avoid tidal turbine arrays during operations

Joe Onoufriou et al.

In Prep

• System performance

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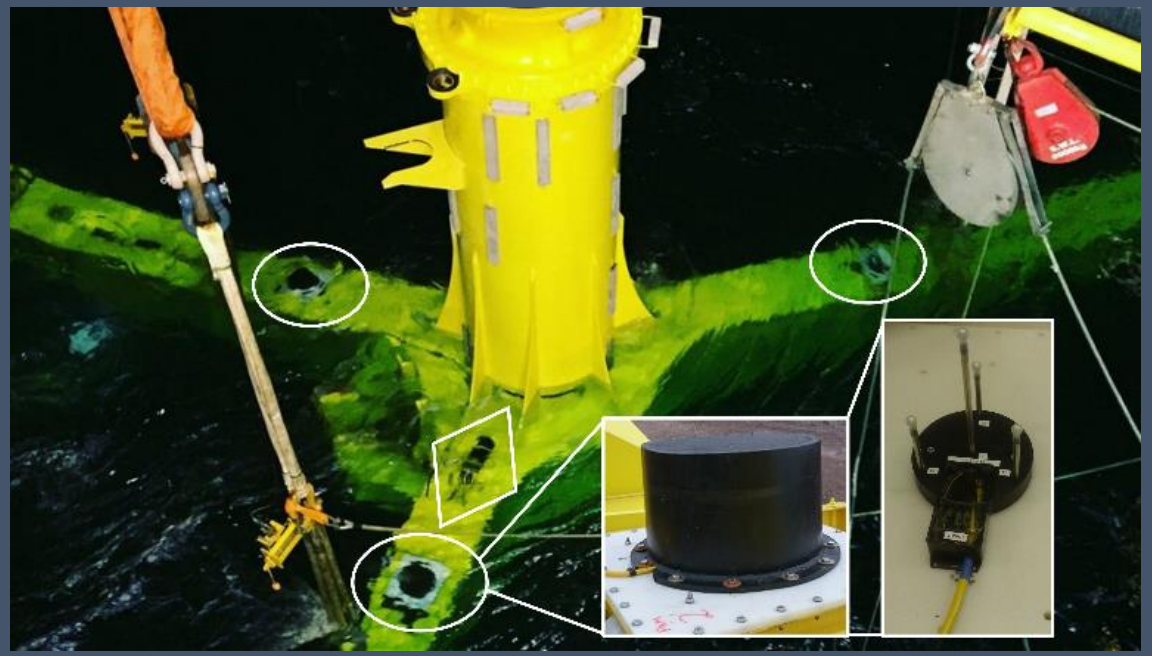
- October 2016 to October 2017: Power problems prevented data collection
- October 2017 onward. Continued power problems for Flowbec (no Flowbec data)
- Multi-beam sonars and camera connections corroded and failed (No multi-beam or camera data)
- Passive Acoustic system operated successfully until decommissioned in October 2019 (two years of PAM data)



• PAM System Design

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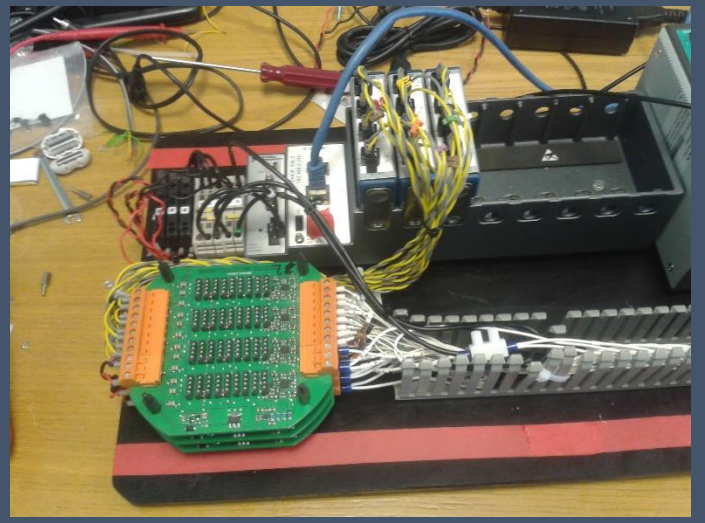
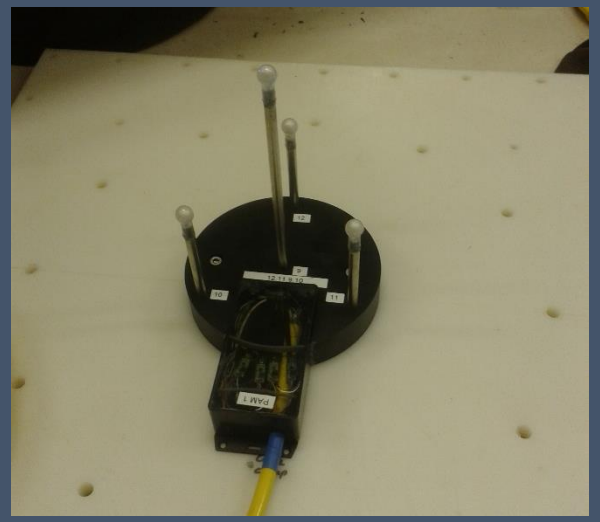
- PAM system mounted directly on TSS foundation
- Twelve hydrophones in three tetrahedral clusters
- Protected by polyethylene ‘hard hats’
- High 500kHz sample rate system mounted close to hydrophones
- Data streamed to shore via Ethernet to PAMGuard for real time processing
- Watchdog program ensured 24/7 operation (99% reliability)
- Data validated offline and clicks localised using Time of Arrival algorithms





• PAM Results

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- 1516 logged porpoise encounters
- Strong seasonal and diurnal variation

- Porpoises are more likely to be present in winter and at night
- (so single season daytime surveys are a poor way of estimating overall risk)

- Porpoises are less likely to be present when the turbine is operating
- (good – so long as they aren't entirely excluded from the area)

• PAM Tracking

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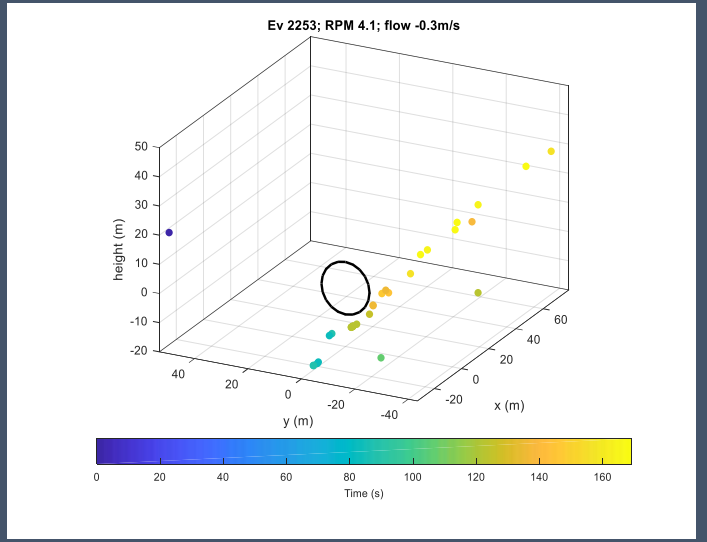
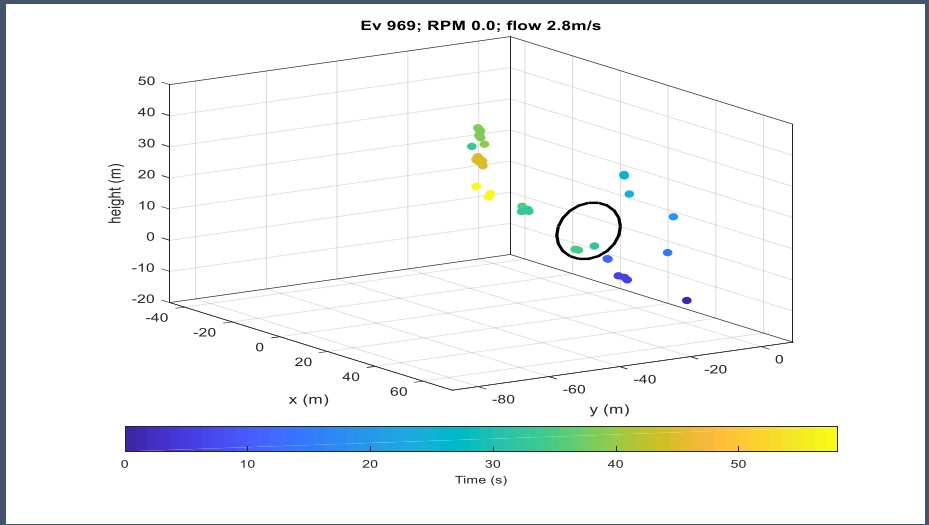
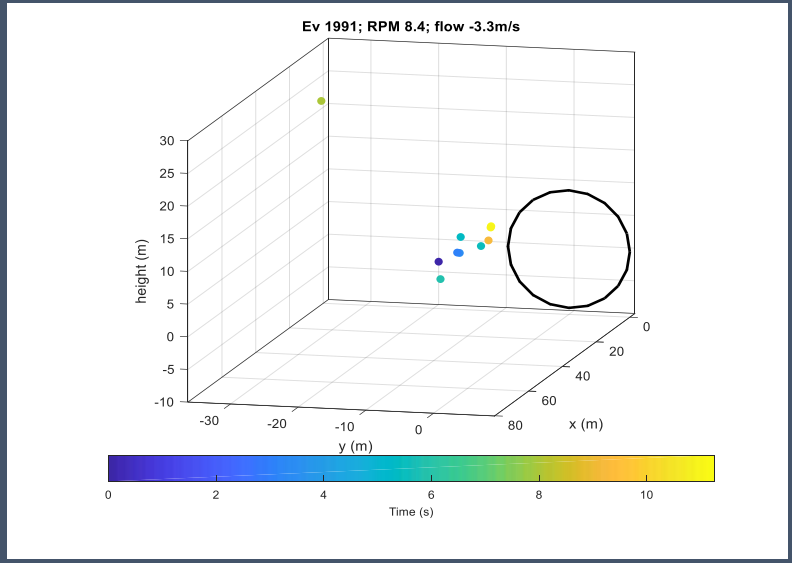
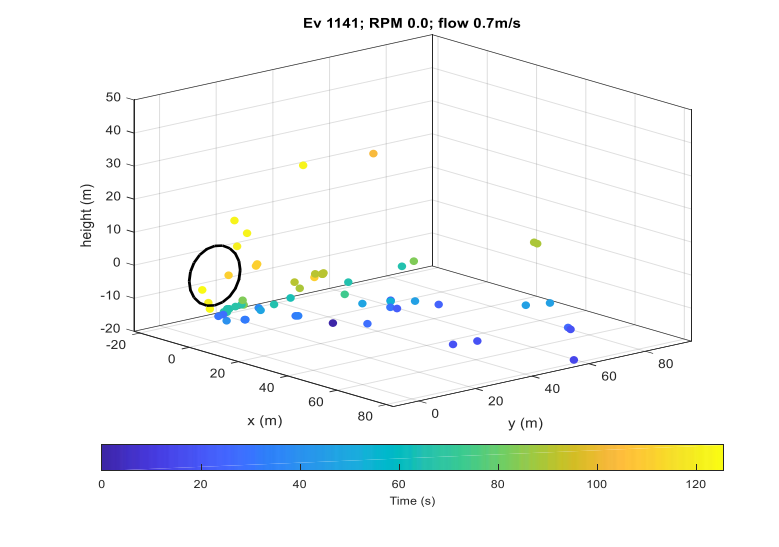
- In 451days of processed data a single porpoise passed through the rotor disk
- The rotors were stationary at the time

- Several animals passed close to the rotors while they were operating
- Clear tracks above, below and to the side
- Often not at all clear what was happening









• Spatial distribution of localised clicks

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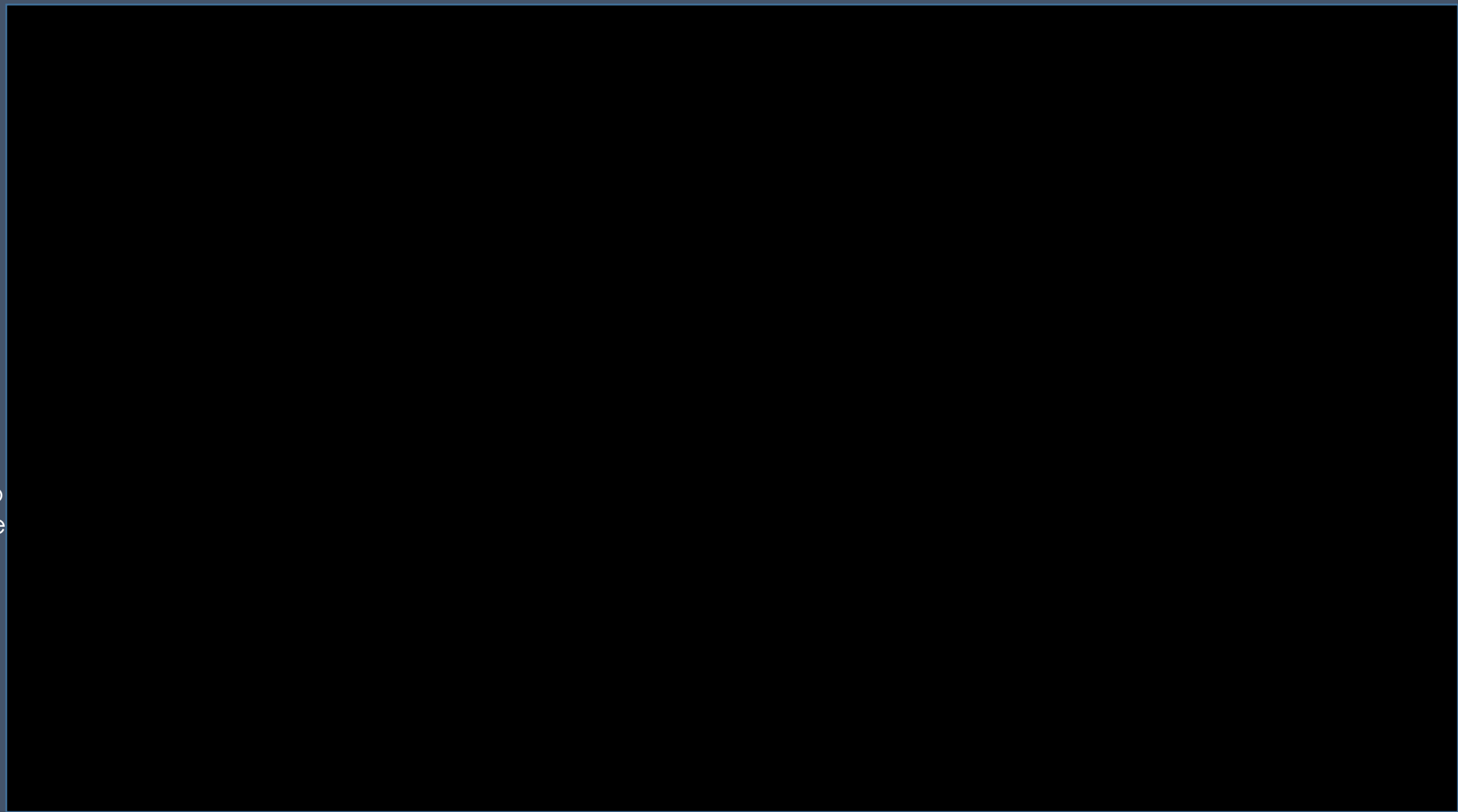
- Viewing straight into the turbine.
- Individual plots show the distribution of points in a 5m slice in front of or behind the turbine
- Porpoises are clearly avoiding the area close to the rotors
- Porpoises seem to be "hanging out" close to the base of the turbine



• Summary

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- Successful PAM Monitoring of an operational turbine for two years
- Strong seasonal variation in rates of animal encounter
- Reduction in porpoise presence when the turbine is operating
- Evidence that harbour porpoise evade the immediate vicinity of the turbine rotors
- Evidence that seals reduce their usage of the area when turbines are operating

• Project outputs

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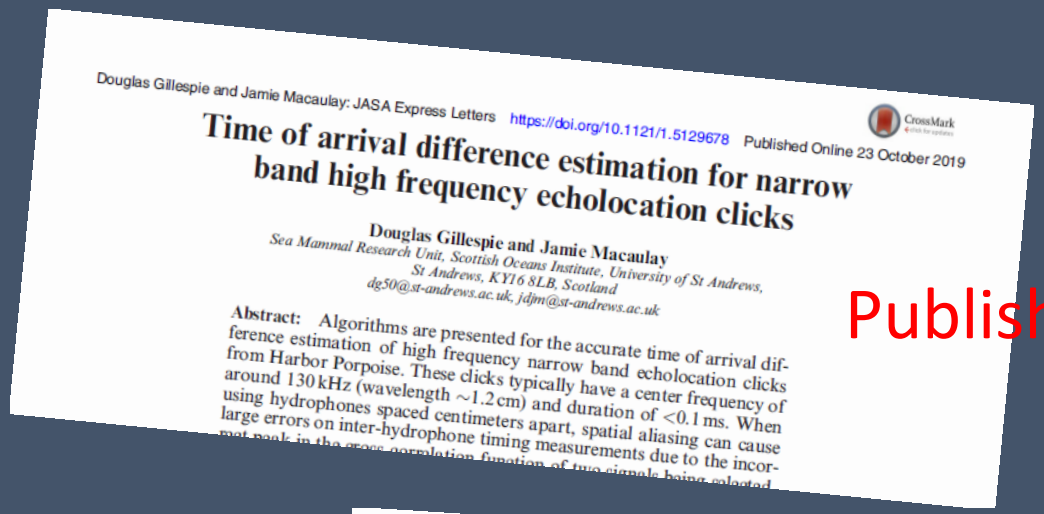
Coming Soon

Laura Palmer et. al. **Harbour porpoises (*Phocoena phocoena*) avoid operational tidal turbines**



Douglas Gillespie and Jamie Macaulay: JASA Express Letters https://doi.org/10.1121/1.5129678 Published Online 23 October 2019

Time of arrival difference estimation for narrow band high frequency echolocation clicks

Douglas Gillespie and Jamie Macaulay

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Abstract: Algorithms are presented for the accurate time of arrival difference estimation of high frequency narrow band echolocation clicks from Harbor Porpoise. These clicks typically have a center frequency of around 130 kHz (wavelength ~1.2 cm) and duration of <0.1 ms. When using hydrophones spaced centimeters apart, spatial aliasing can cause large errors on inter-hydrophone timing measurements due to the incor-

Published

Fine Scale results …

Harbour porpoises exhibit localised evasion of tidal turbines

Douglas Gillespie, Laura Palmer, Jamie Macaulay, Carol Sparling , Gordon Hastie

Passive acoustic methods for tracking the 3D movements of small cetaceans around marine structures

Douglas Gillespie, Laura Palmer, Jamie Macaulay, Carol Sparling, Gordon Hastie
doi: https://doi.org/10.1101/2020.01.30.926659

This article is a preprint and has not been certified by peer review [what does this mean?].

Abstract | Full Text | Info/History | Metrics | Preview PDF

Abstract

A wide range of anthropogenic structures exist in the marine environment with the extent of these set to increase as the global offshore renewable energy industry grows. Many of these pose acute risks to marine wildlife; for example, tidal energy generators have the potential to injure or kill seals and small cetaceans through collisions with moving turbine parts. Information on fine scale behaviour of animals close to operational turbines is required to understand the likely impact of these new technologies. There are inherent challenges associated with measuring the underwater movements of marine animals which have, so far, limited data collection. Here, we describe the development and application of a system for monitoring the three-

In review

Published

Characterisation of underwater operational sound of a tidal stream turbine

Denise Risch, Nienke van Geel, Douglas Gillespie, Ben Wilson

• MeyGen – 86MW array

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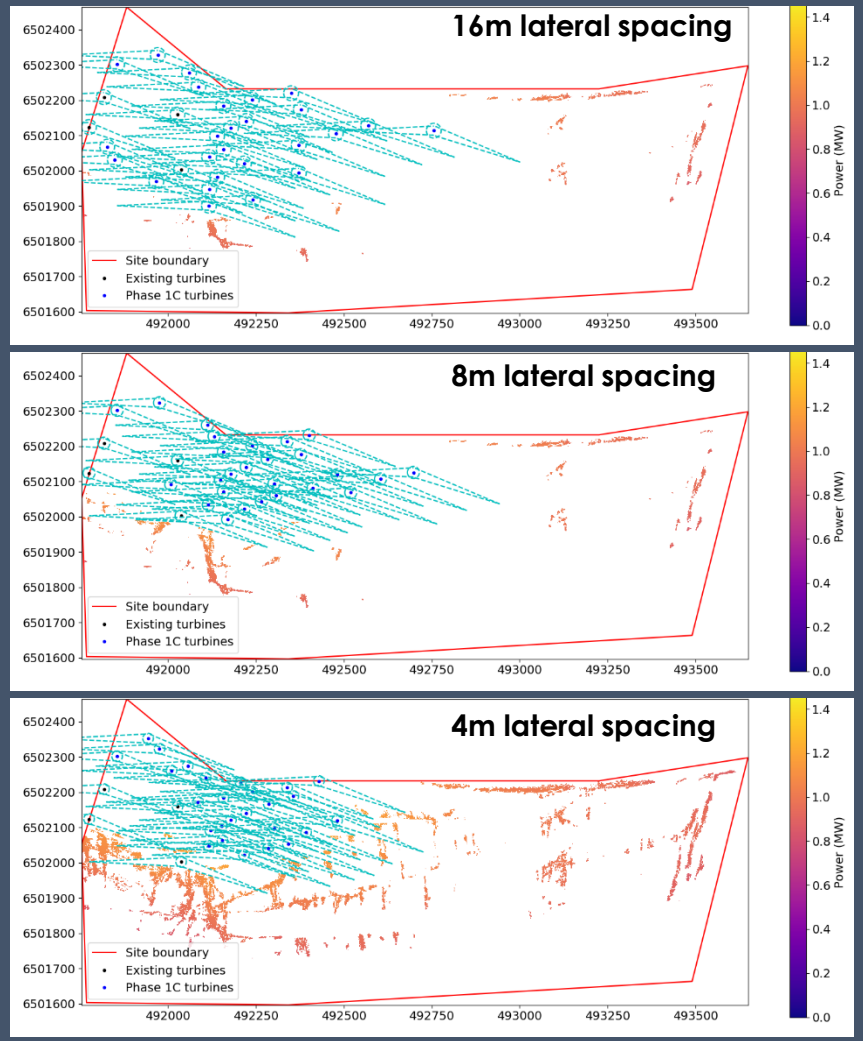
- Tidal array are not likely to be arranged in neat rows as is typical of offshore wind
- Site specific array layout to assess turbine location and array yield based upon:
  - Maximising array yield
  - Environmental limitations:
    - Flood and ebb flow direction
    - Lateral spacing, tip to tip
    - Rotor diameter
    - Clearance to the seabed and surface
    - Stream wise spacing
- Inform array risk with regards to consent and to inform the impact assessment with regards to site specific turbine spacing



Outstanding Questions:

- Fine scale movement of seals ?
- How will animals respond to an array of turbines ?
- They seem to avoid one turbine, but will they be able to pass safely between many closely spaced turbines ?
- Will the noise exclude them from the entire area ?

• Thanks …

- The Scottish Government for funding for the environmental monitoring

- Many co workers at the Sea Mammal Research Unit (Carol Sparling, Gordon Hastie, Joe Onoufriou, Laura Palmer, Jamie Macaulay, Sophie Smout, Debbie Russell, Simon Moss, Steve Balfour, and Matt Bivins (among others)

- The engineering team at Simec Atlantis who enabled the project and integrated the environmental monitoring system into their turbine (Lorna slater, Bruce Mackay and many others)

- Scot. Gov. steering group: Elaine Tait (MSPaP), Paul Thompson (UoA), Kelly Macleod (JNCC), Janelle Braithwaite (MSPaP), Roger May (MSLOT), Ian Davies (MSS), Ross Culloch (MSS), John Armstrong (MSS), Jared Wilson (MSS), Ewan Edwards (MSS), Denise Risch (SAMS), George Lees (SNH), Erica Knott (SNH), Chris Eastham (SNH), Karen Hall (SNH), Cara Donovan (Atlantis), and Lily Burke (MSPaP)

- Benjamin Williamson (Flobec / ERI/ UoA);

- All software is open source and freely available

- See tomorrows presentation by Gordon Hastie who will tell you what we're planning next …