Strangford Lough Marine Mammal Monitoring – 3 years post installation

DoE Webinar Monday 29th August 2011

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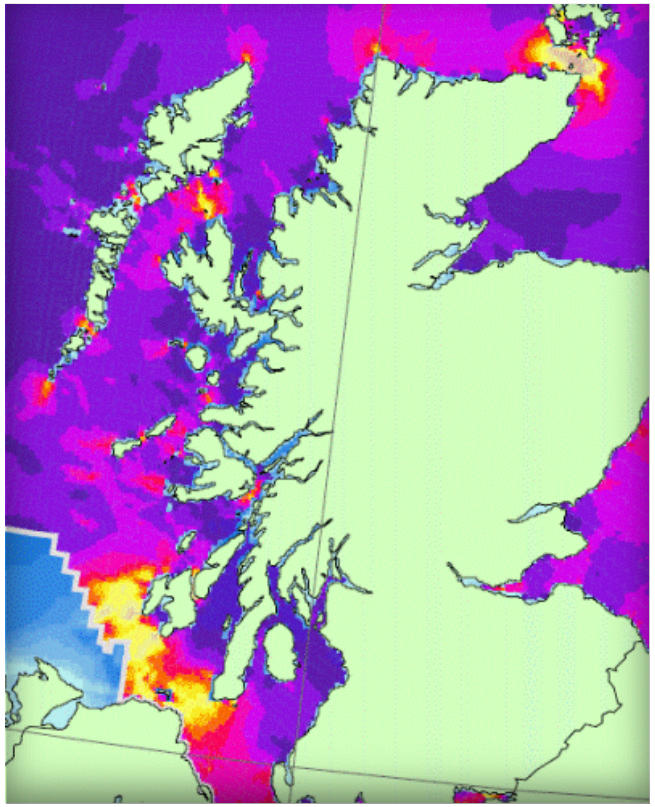
Introduction

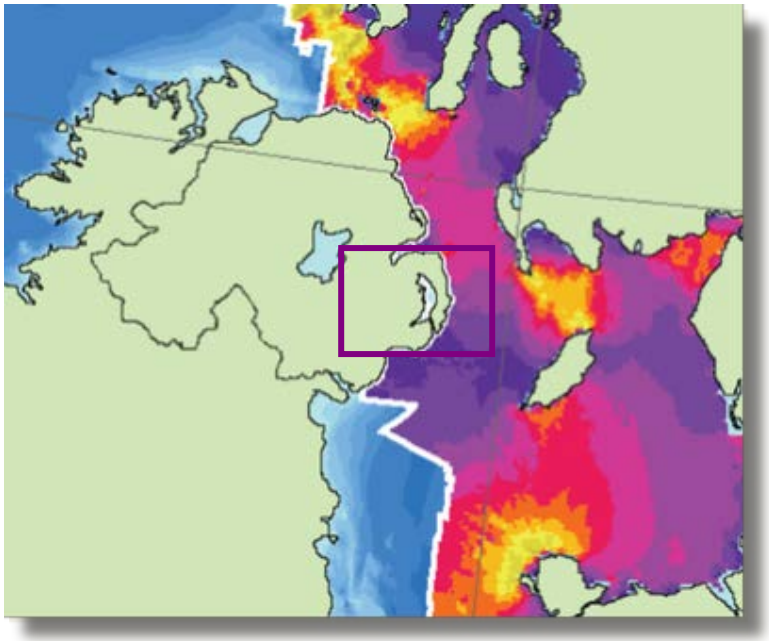
- Scotland's seas at the forefront of marine renewable energy potential, ambitious government targets
- uncertainty over effects on wildlife could provide barrier to industry growth
- Very few operational devices in Scotland's seas to learn from



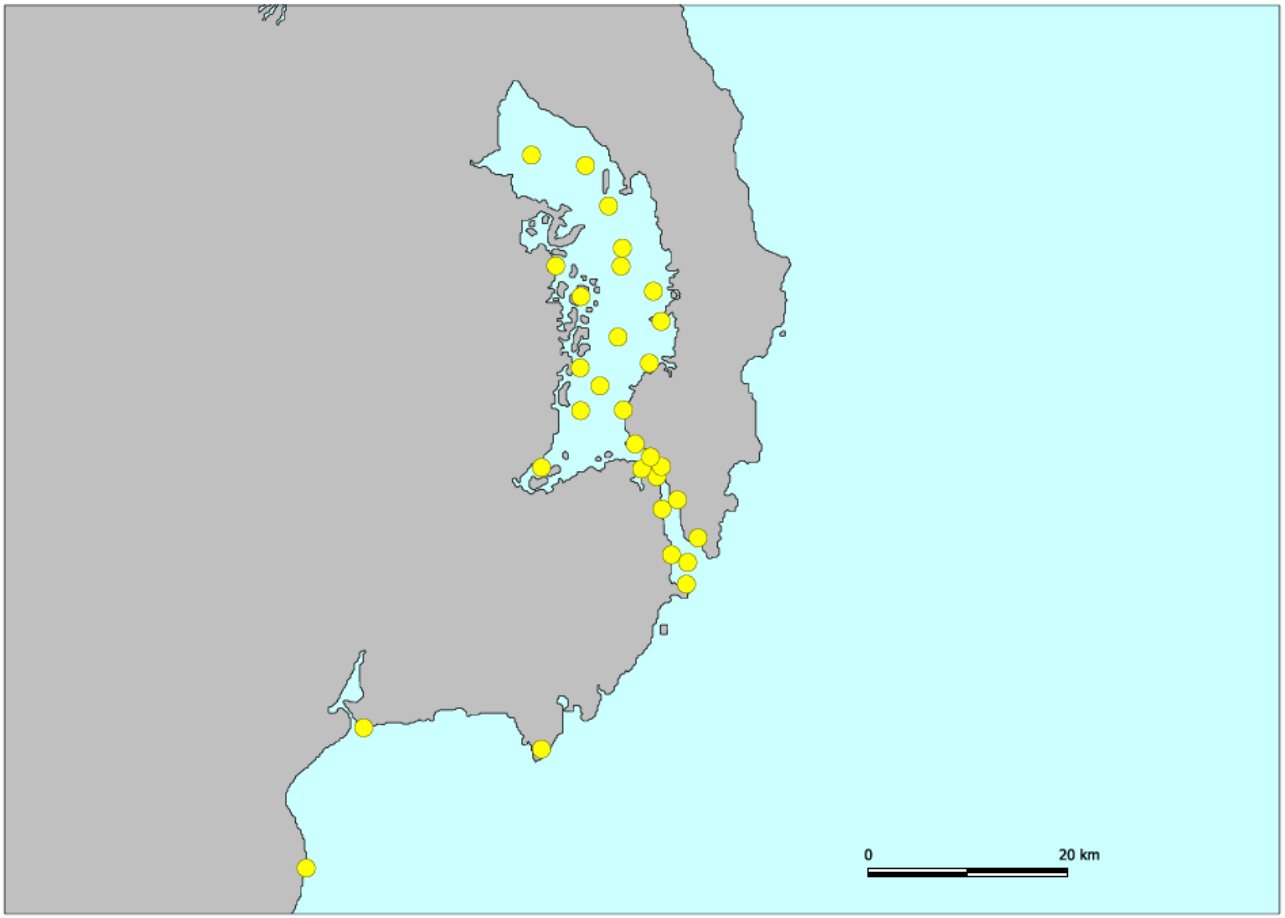
Introduction

- SMRU/SMRU Ltd involvement in Marine Current Turbines SeaGen installation in Strangford Lough, Northern Ireland.

- Providing scientific advice and monitoring services



Strangford Lough, Northern Ireland



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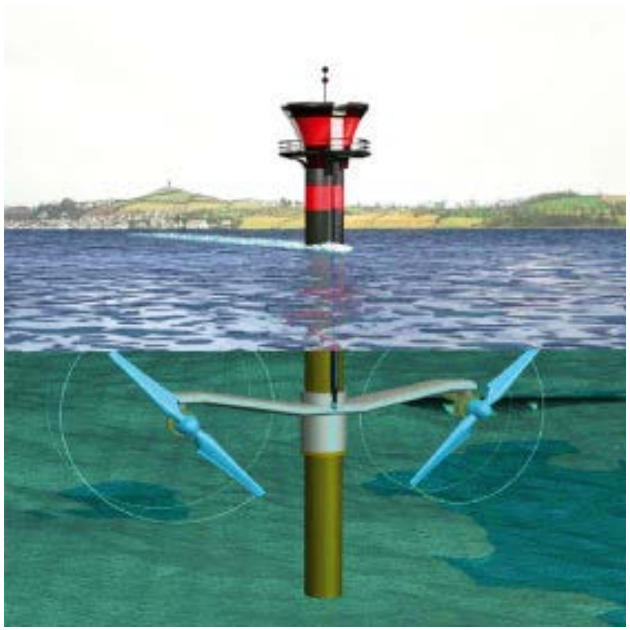
the turbine



- 1st Commercial scale marine current turbine to extract energy from UK tidal flows
- 1.2 MW, Tower height 40m above seabed, 3m diameter.
- Water depth: LAT 24m, MSL 26.2m, HAT 28.3m
- 16m diameter rotors
- Max rotor speed 14.3rpm, tip speed 12 $m.s^{-1}$
- Mean spring current 3.7 ms^{-1} or 7.2 knots
- Installed 2008

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Overview

Monitoring impacts at varying spatial and temporal scales:

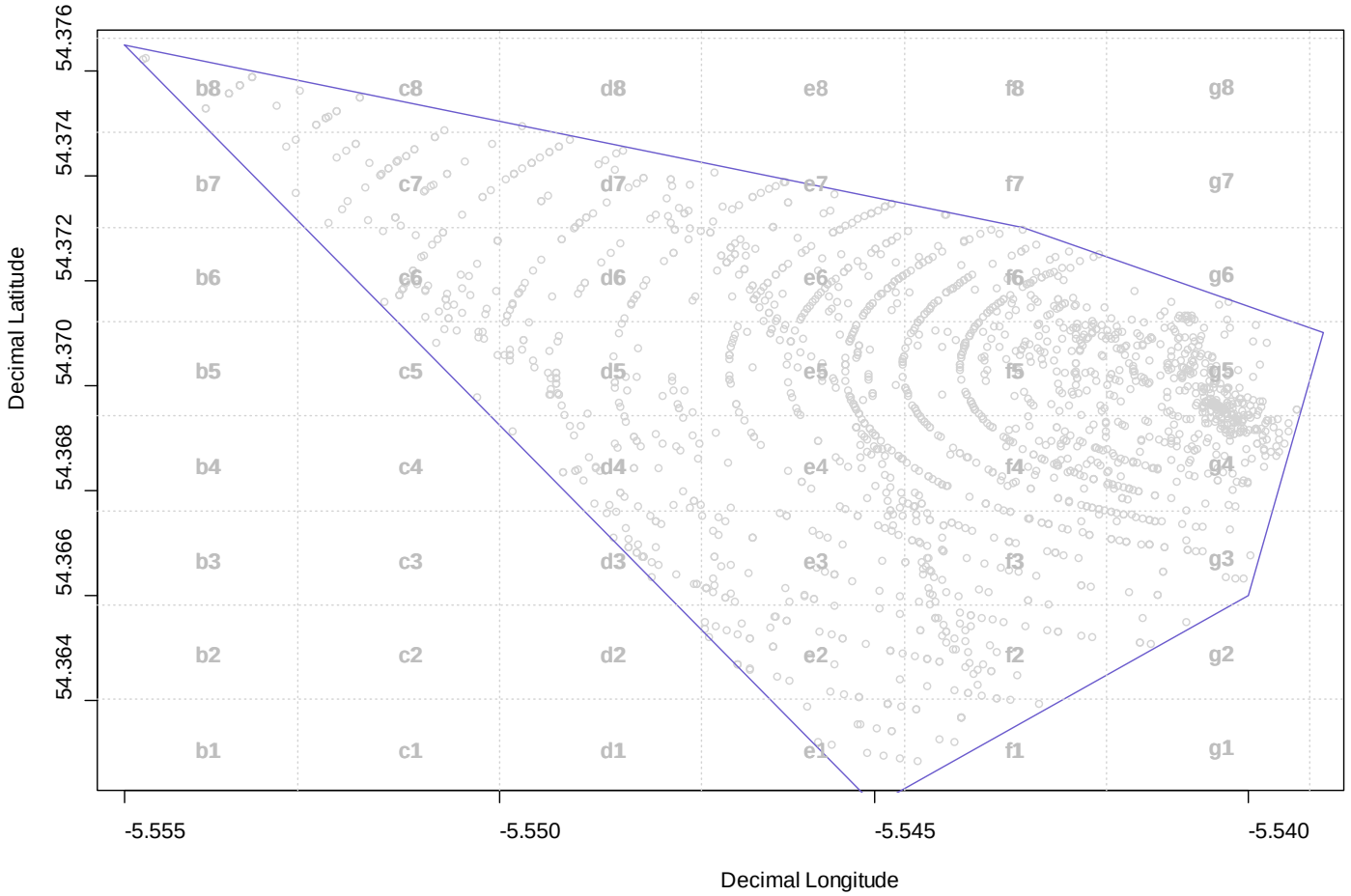
- Active Sonar mitigation
- Visual shore based surveys of animals around device
- Acoustic monitoring for Harbour Porpoise in narrows and inner Lough
- Seal telemetry
- Annual Aerial surveys of seal haul outs

Overview

Monitoring impacts at varying spatial and temporal scales:

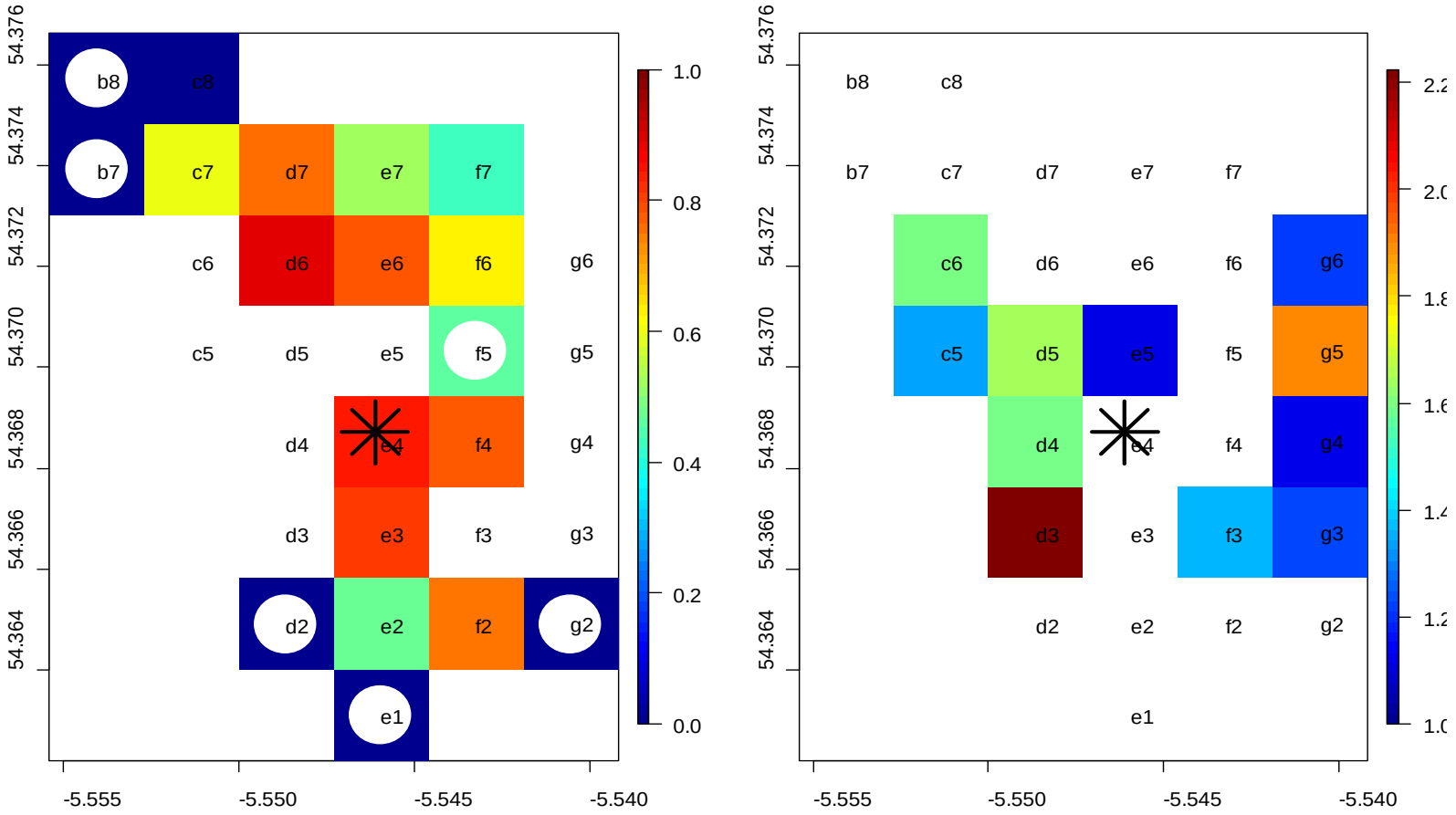
- Visual shore based surveys of animals around device
- Acoustic monitoring for Harbour Porpoise in narrows and inner Lough
- Seal telemetry

SHORE BASED OBSERVATIONS

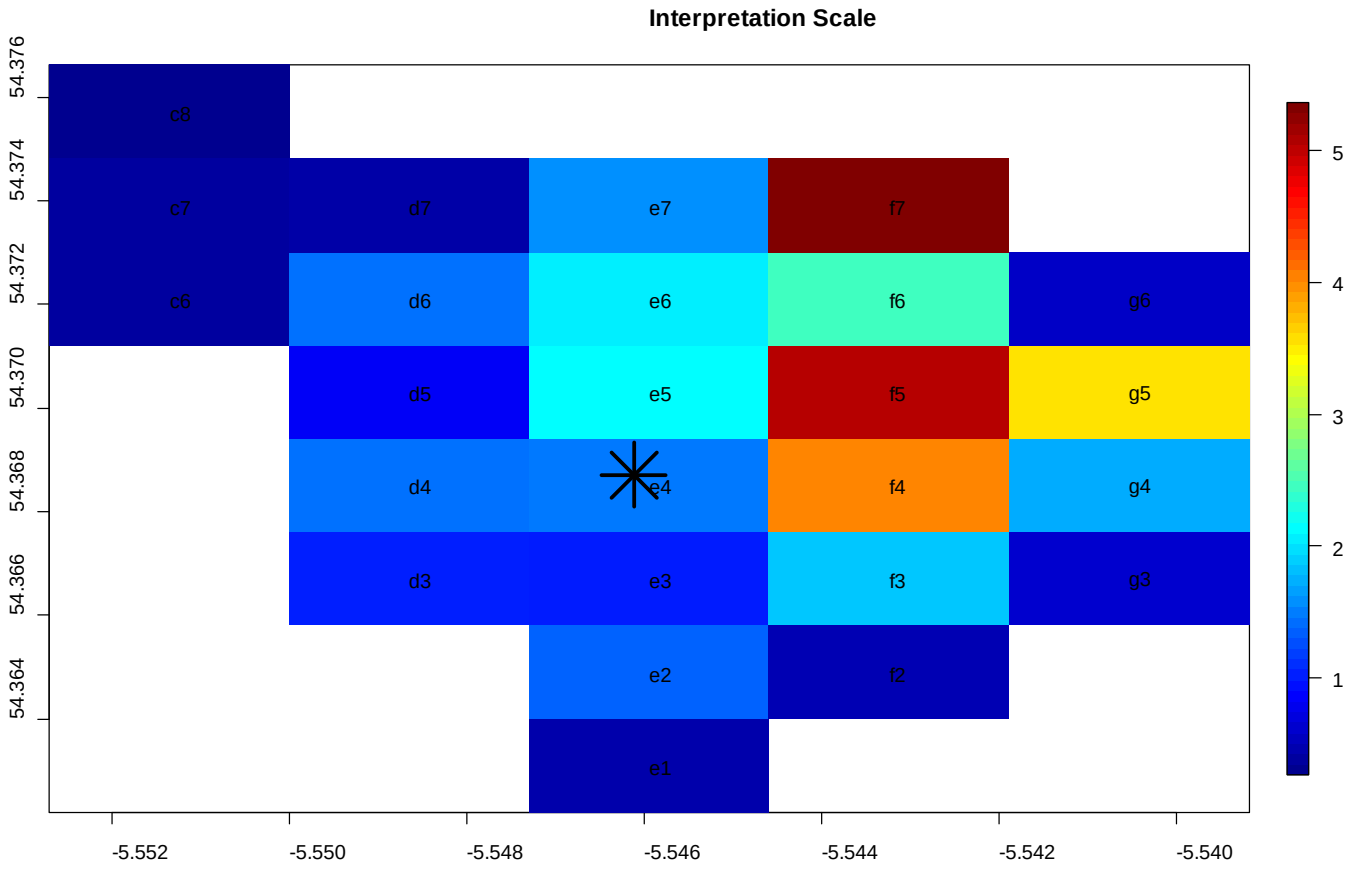


SHORE BASED OBSERVATIONS – Harbour Seals

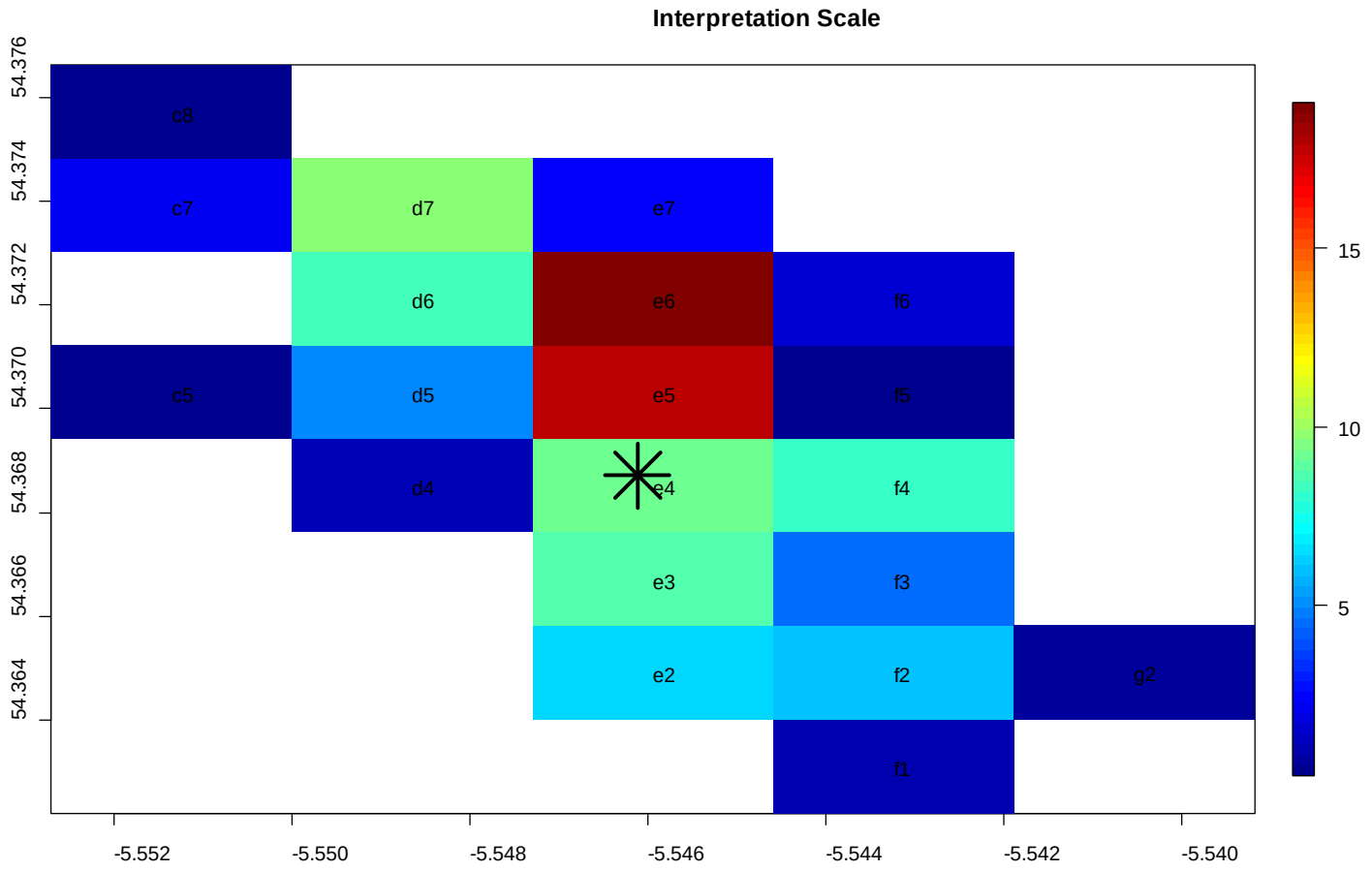
Change in distribution with turbine operation



SHORE BASED OBSERVATIONS – Grey Seals



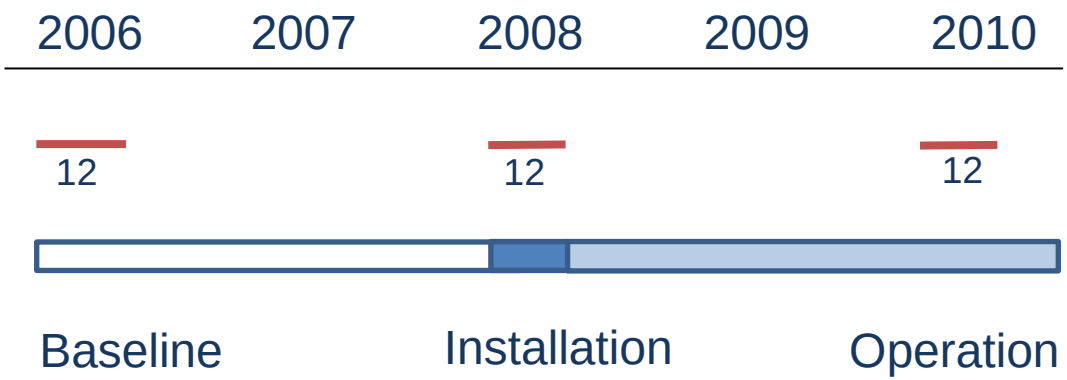
SHORE BASED OBSERVATIONS – Harbour Porpoise



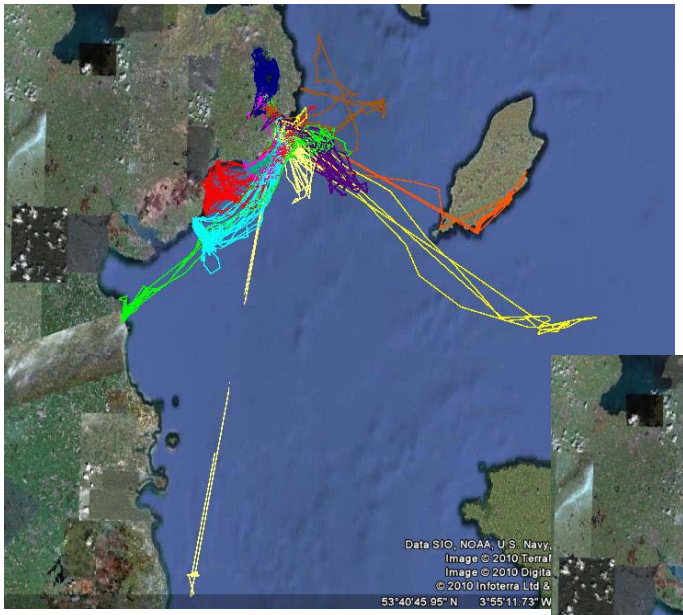
SHORE BASED OBSERVATIONS – Summary

- No turbine related changes in relative abundance for harbour seals, grey seals or porpoises (although power to detect effect low for latter 2).
- However there is strong evidence of redistribution of harbour seals in the survey area during turbine operation.
- Extent of this re-distribution is relatively small – within few hundred metres, unlikely to have significant biological consequences
- Corresponds with findings from telemetry

methods

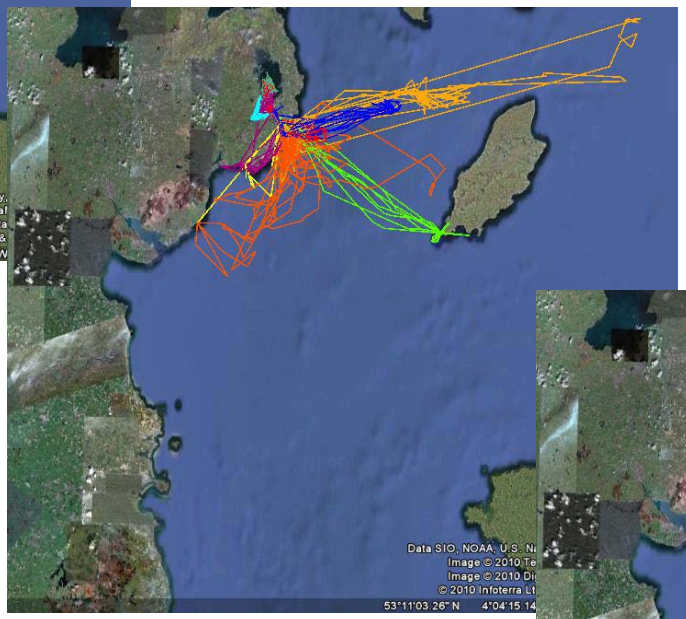

2006
2007
2008
2009
2010
12
12
12
Baseline
Installation
Operation

seal tracks

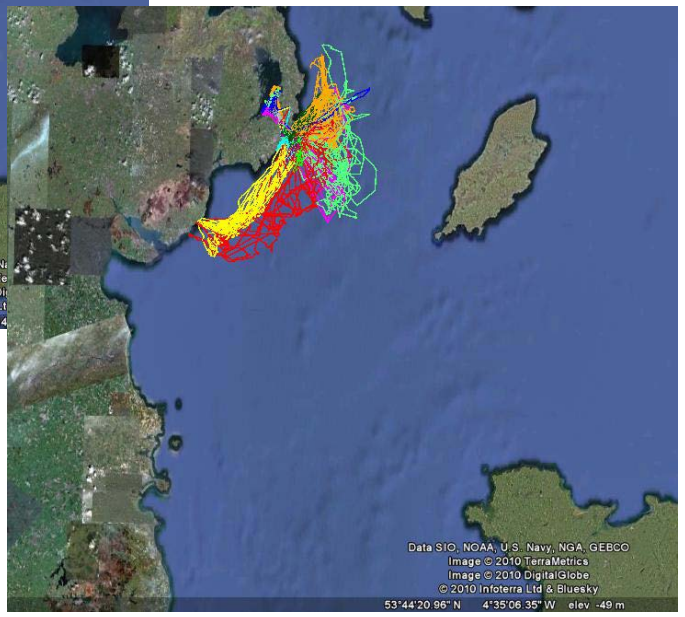


2006

2008



2010



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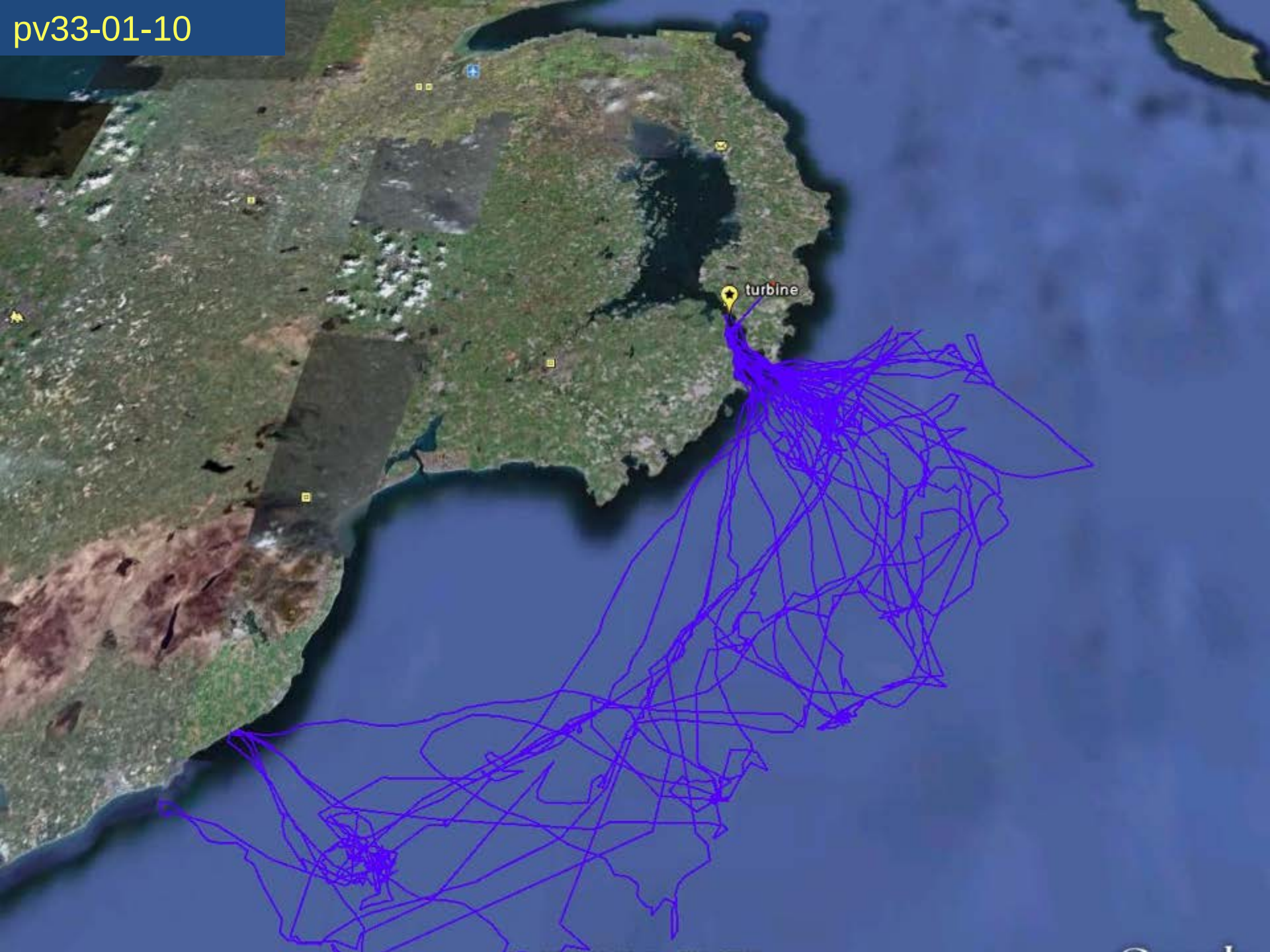
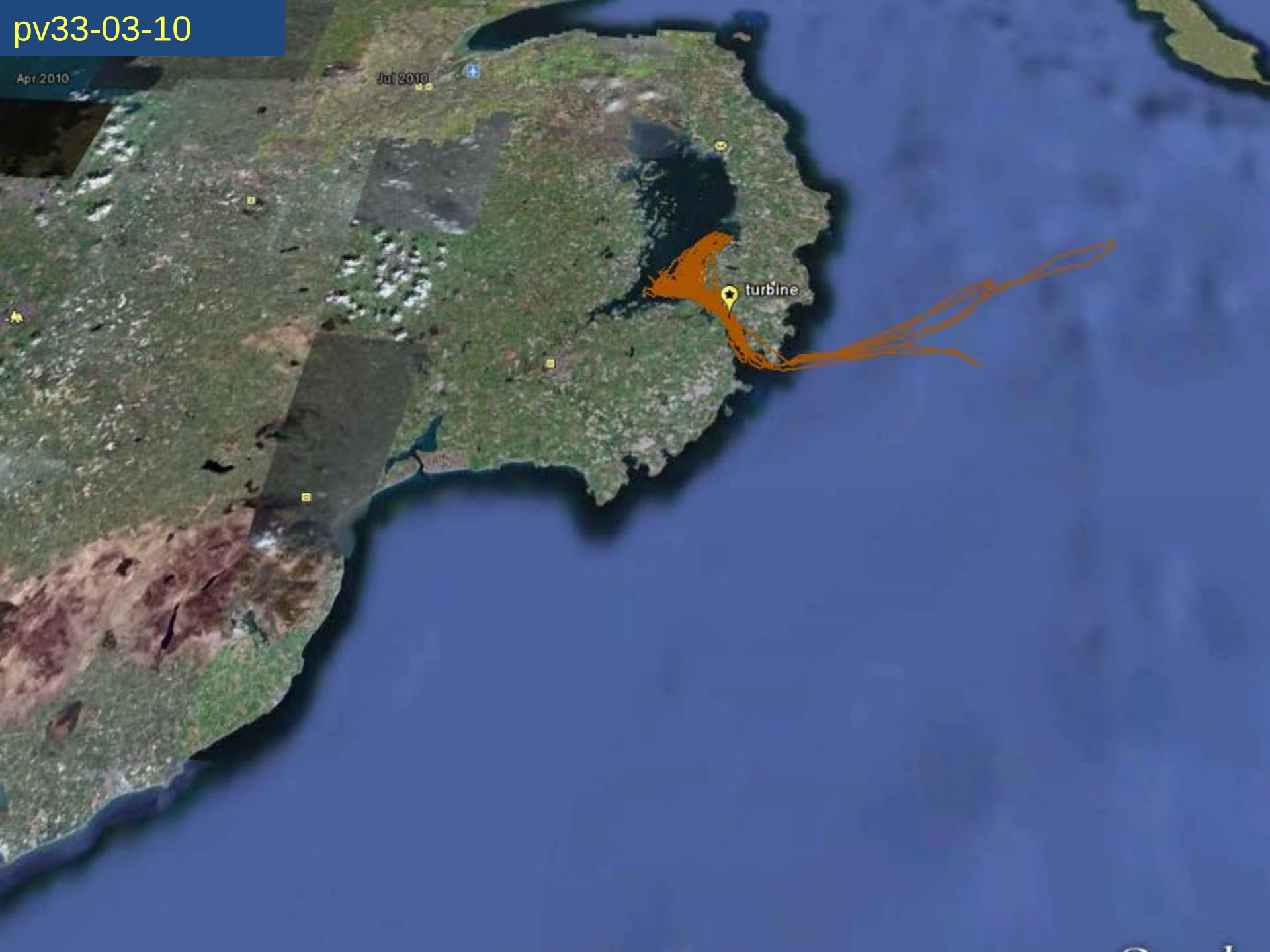

pv33-01-10
turbine


pv33-02-10
Apr 2010
Jul 2010
turbine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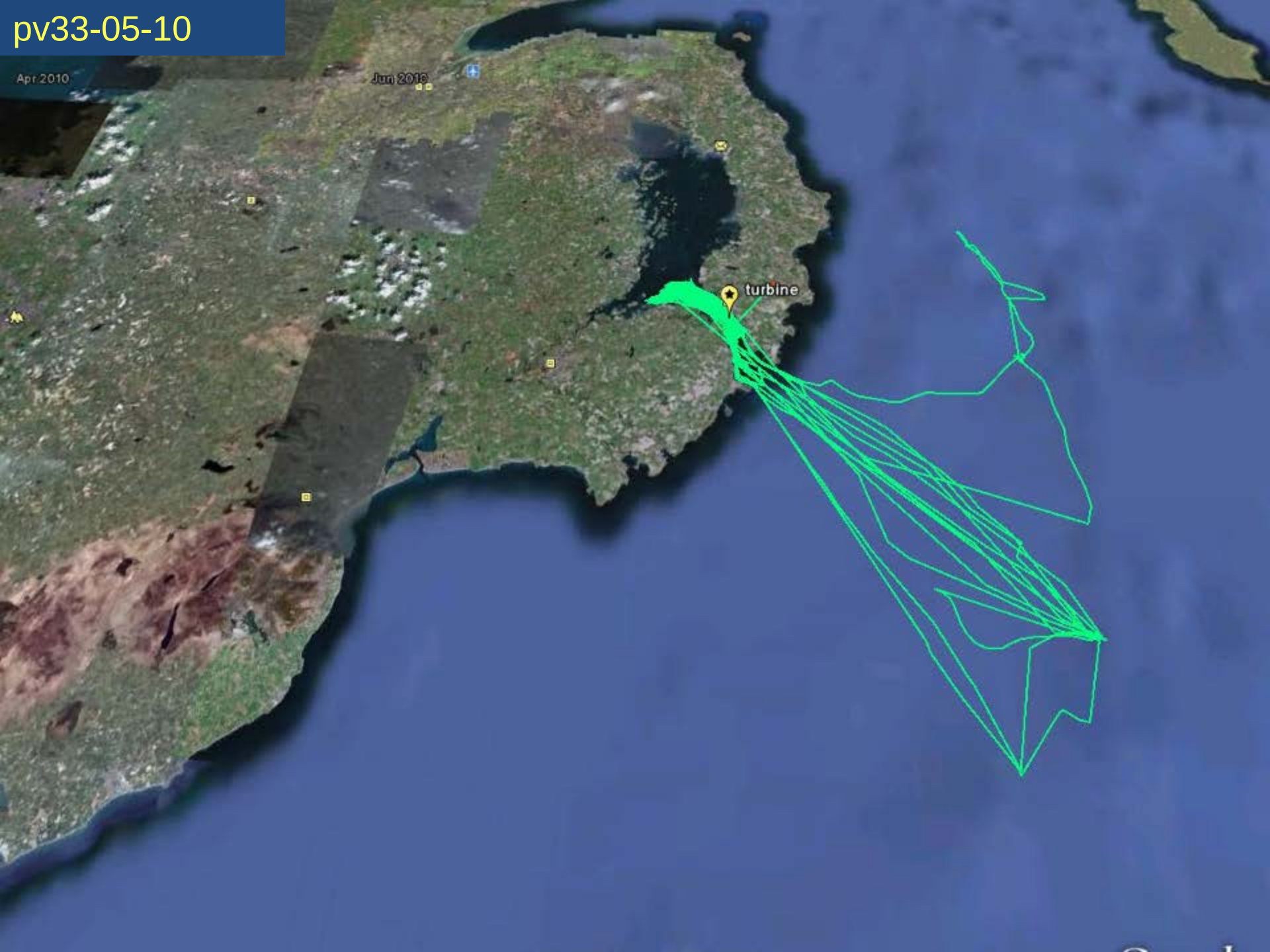
turbine


pv33-04-10
turbine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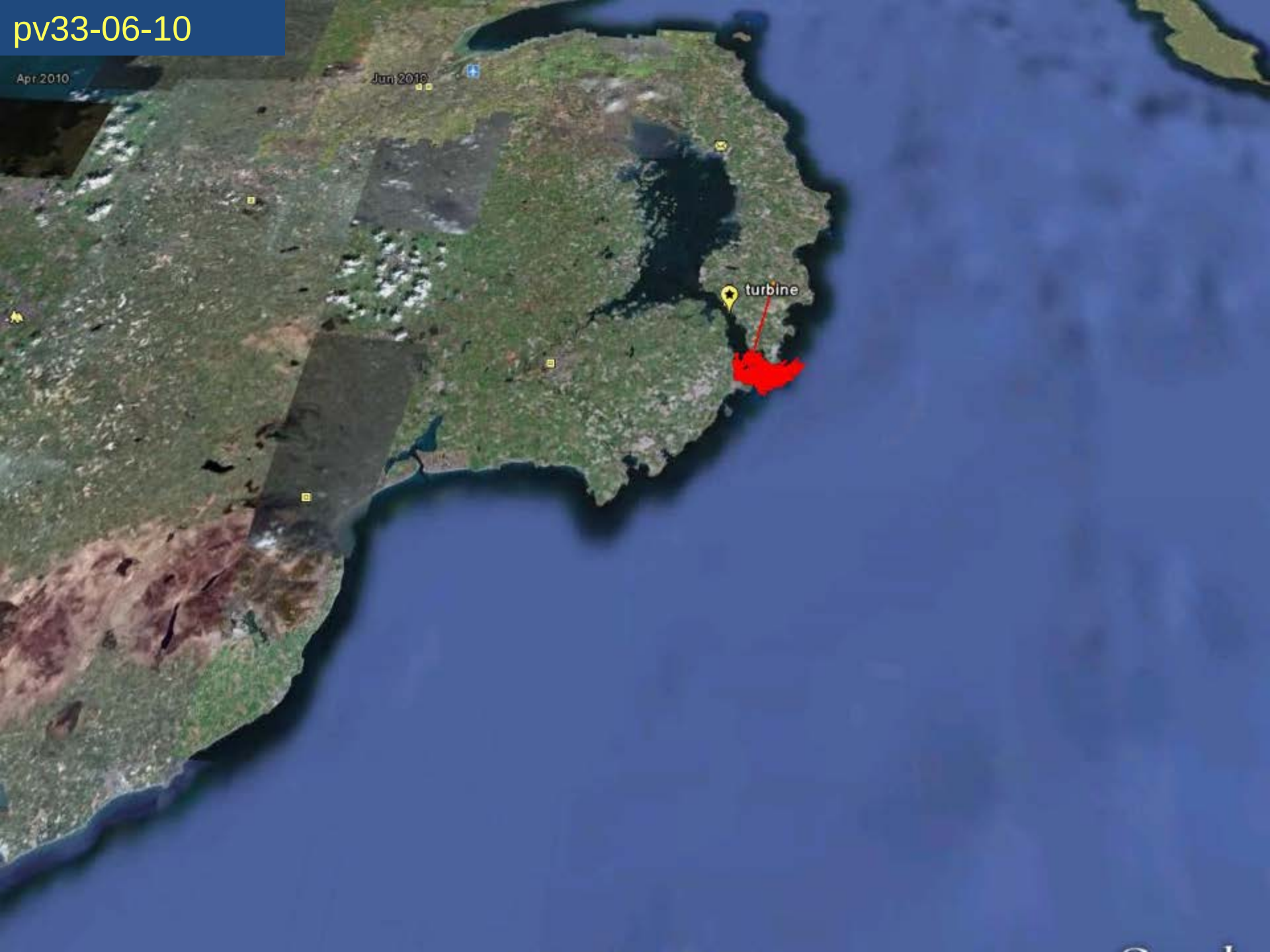
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pv33-07-10
Apr 2010
Jul 2010
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pv33-08-10
Apr 2010
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pv33-09-10
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pv33-10-10
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pv33-12-10
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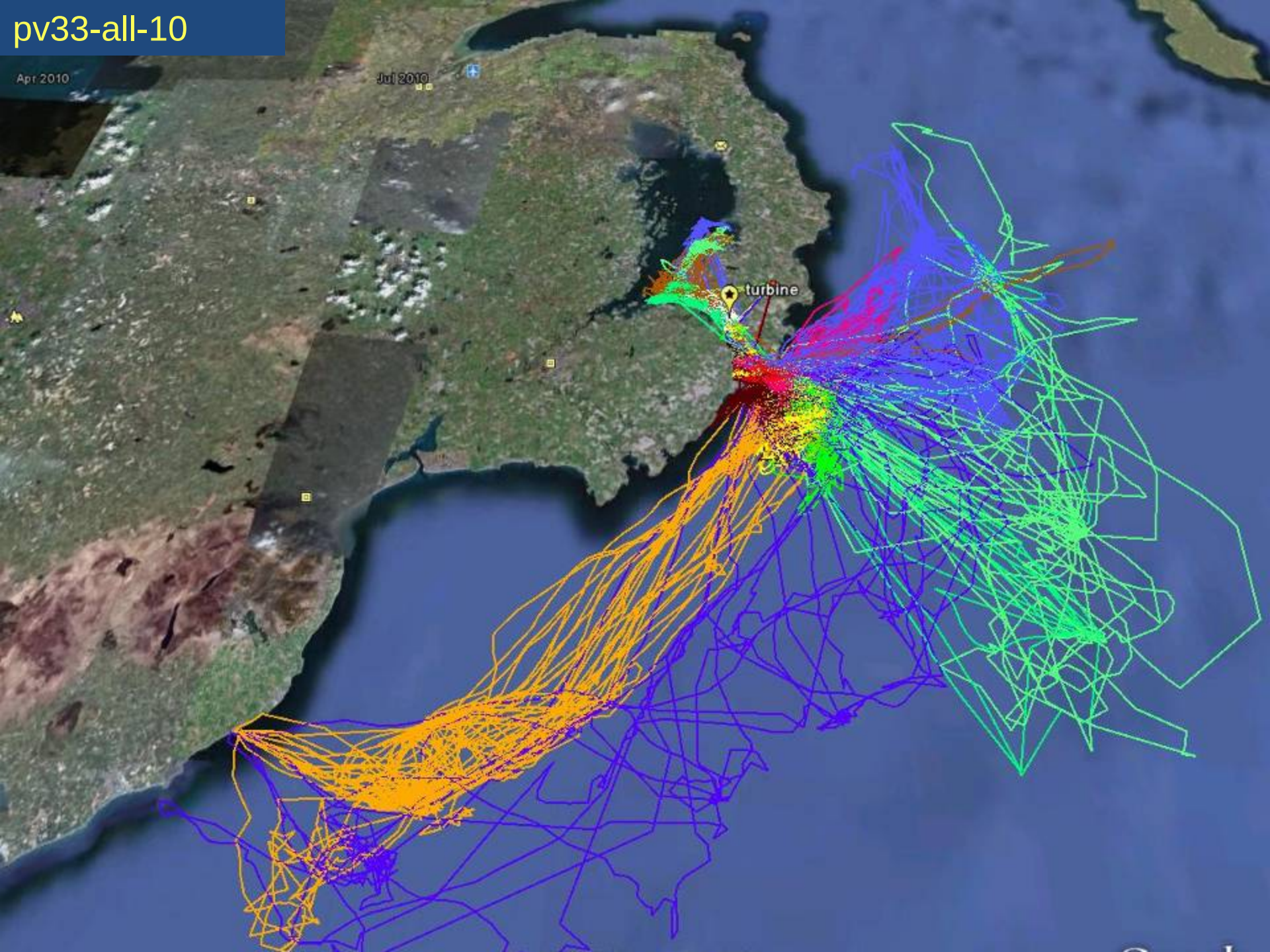
pv33-all-10
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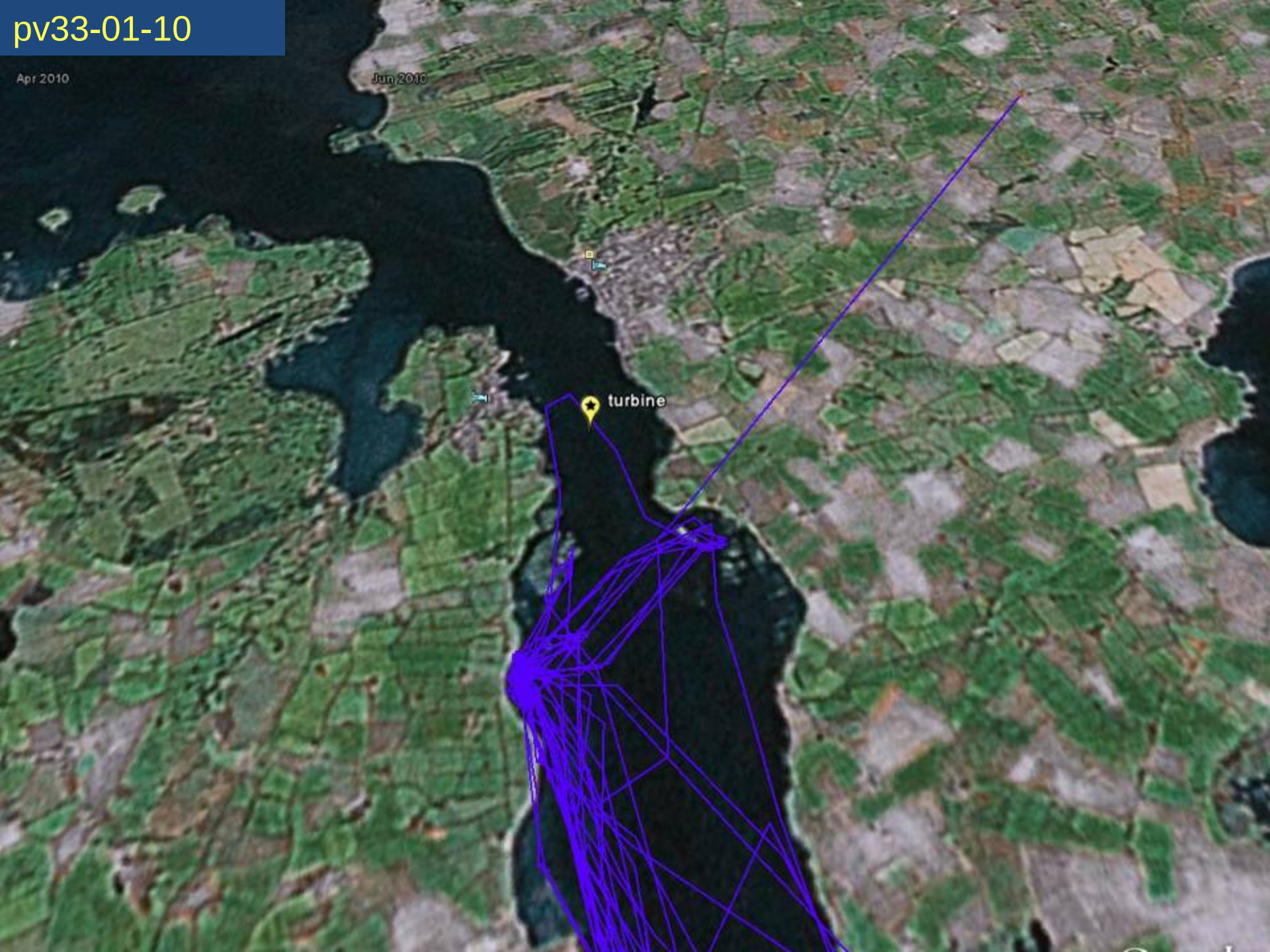
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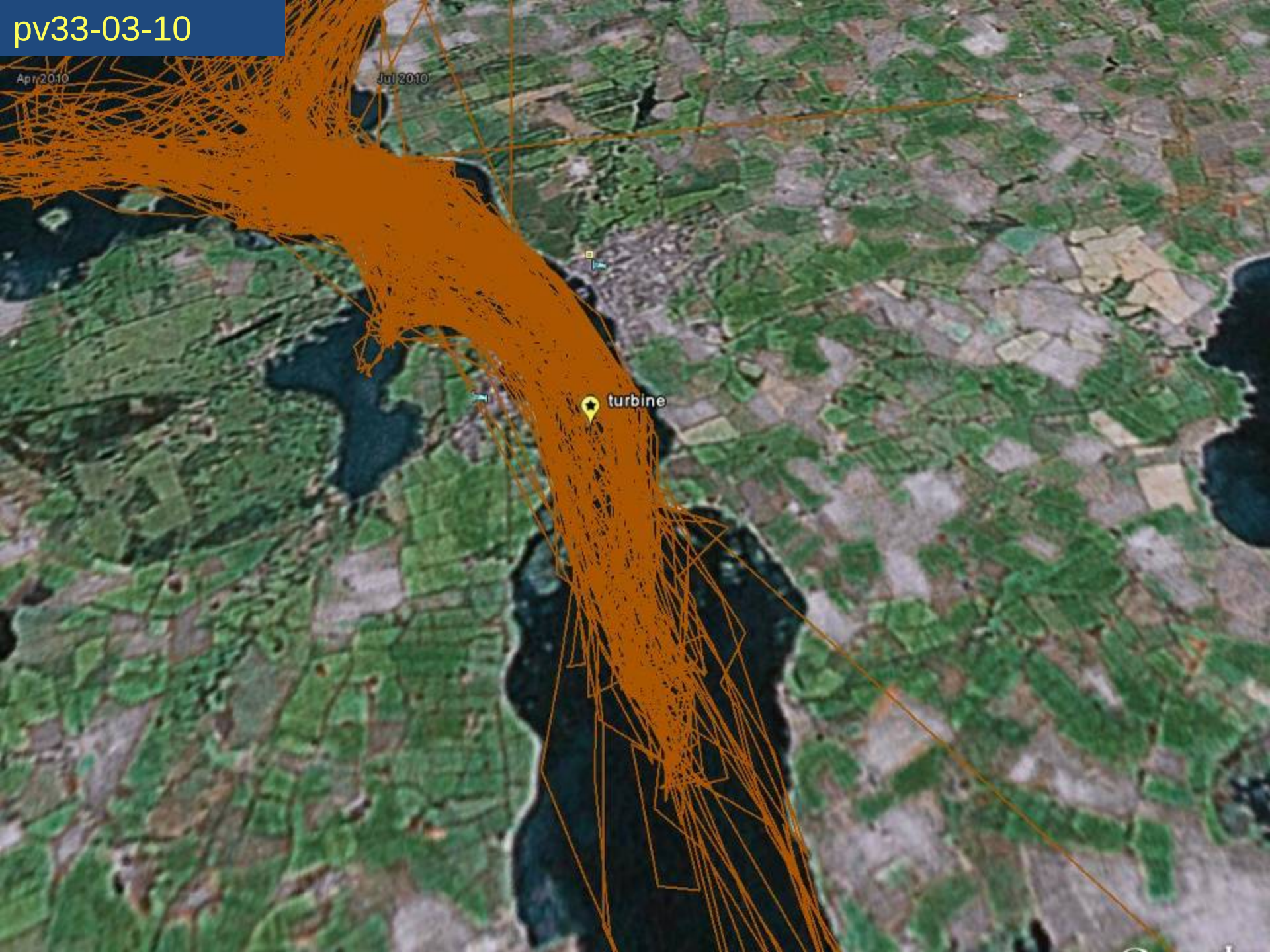
pv33-02-10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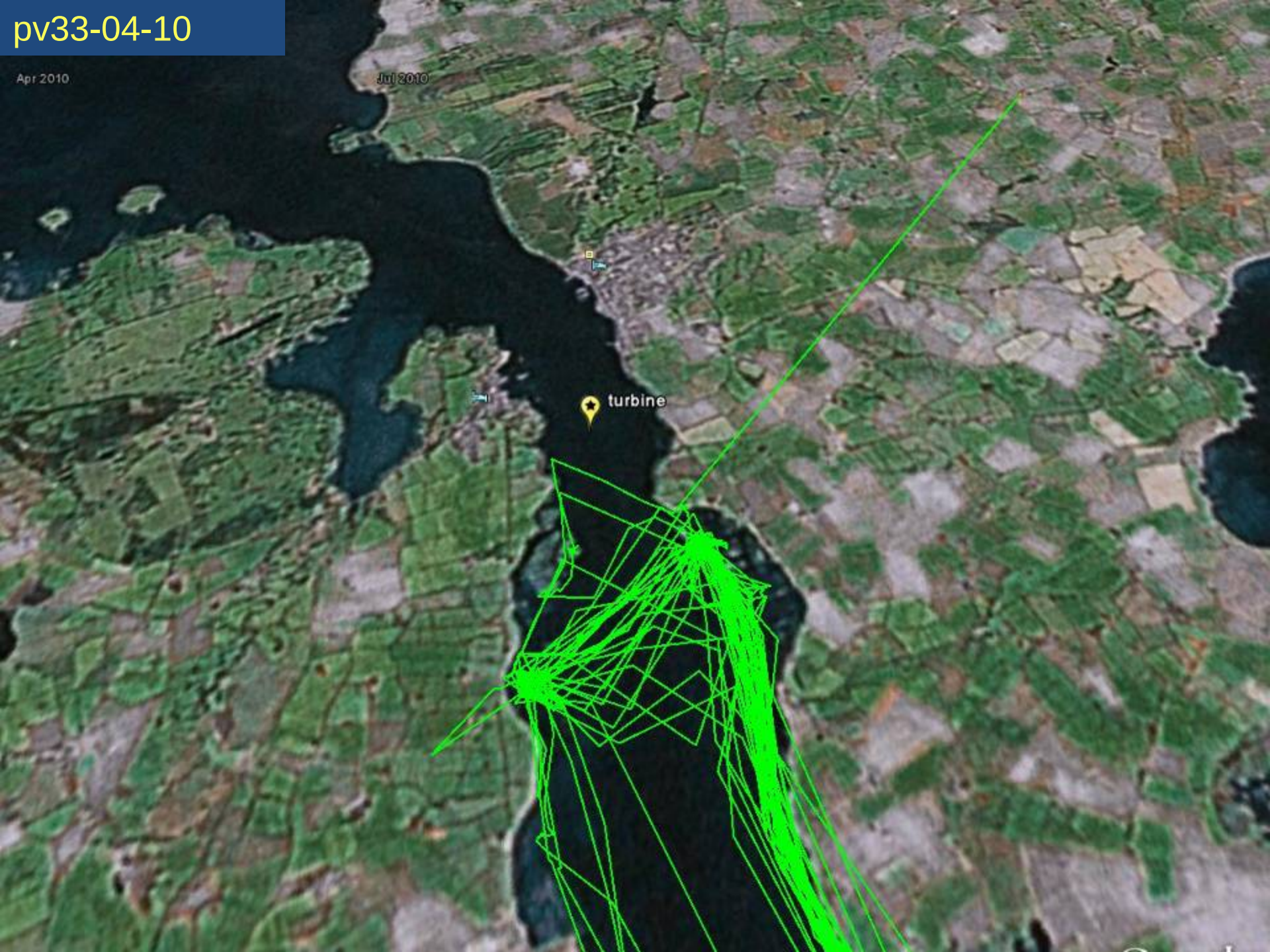
pv33-04-10
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pv33-08-10
Apr 2010
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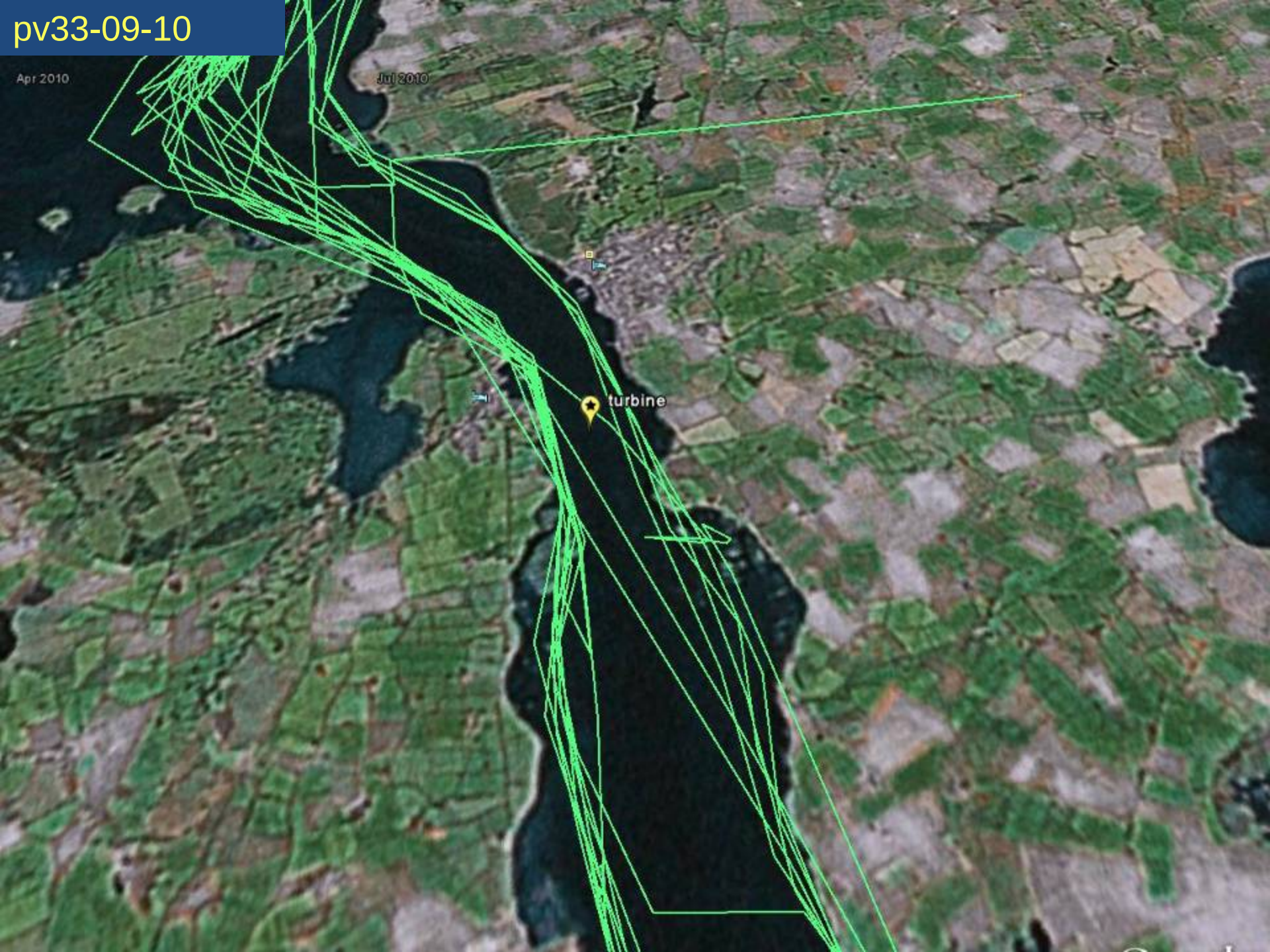
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pv33-10-10
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pv33-11-10
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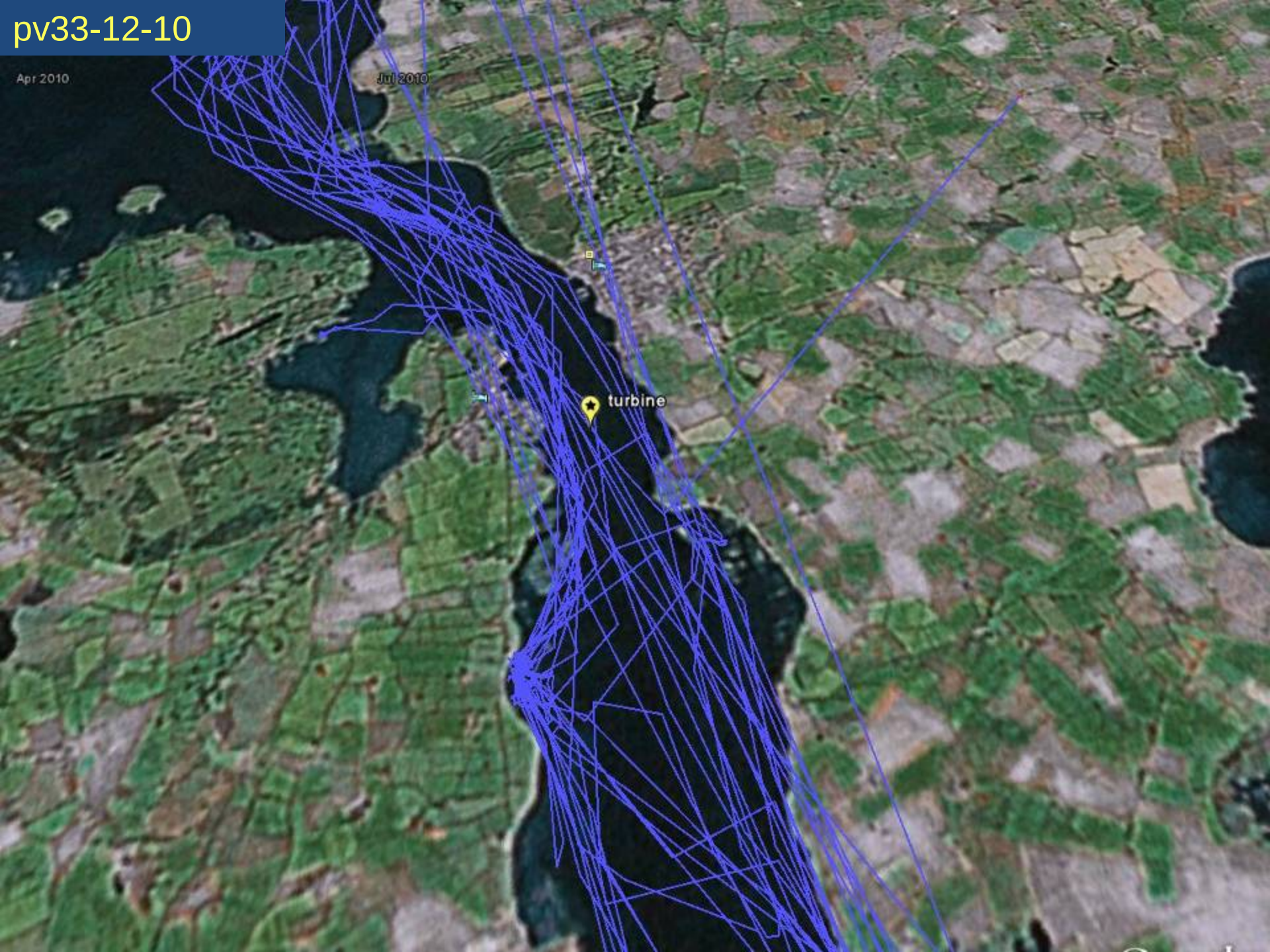
Jul 2010
turbine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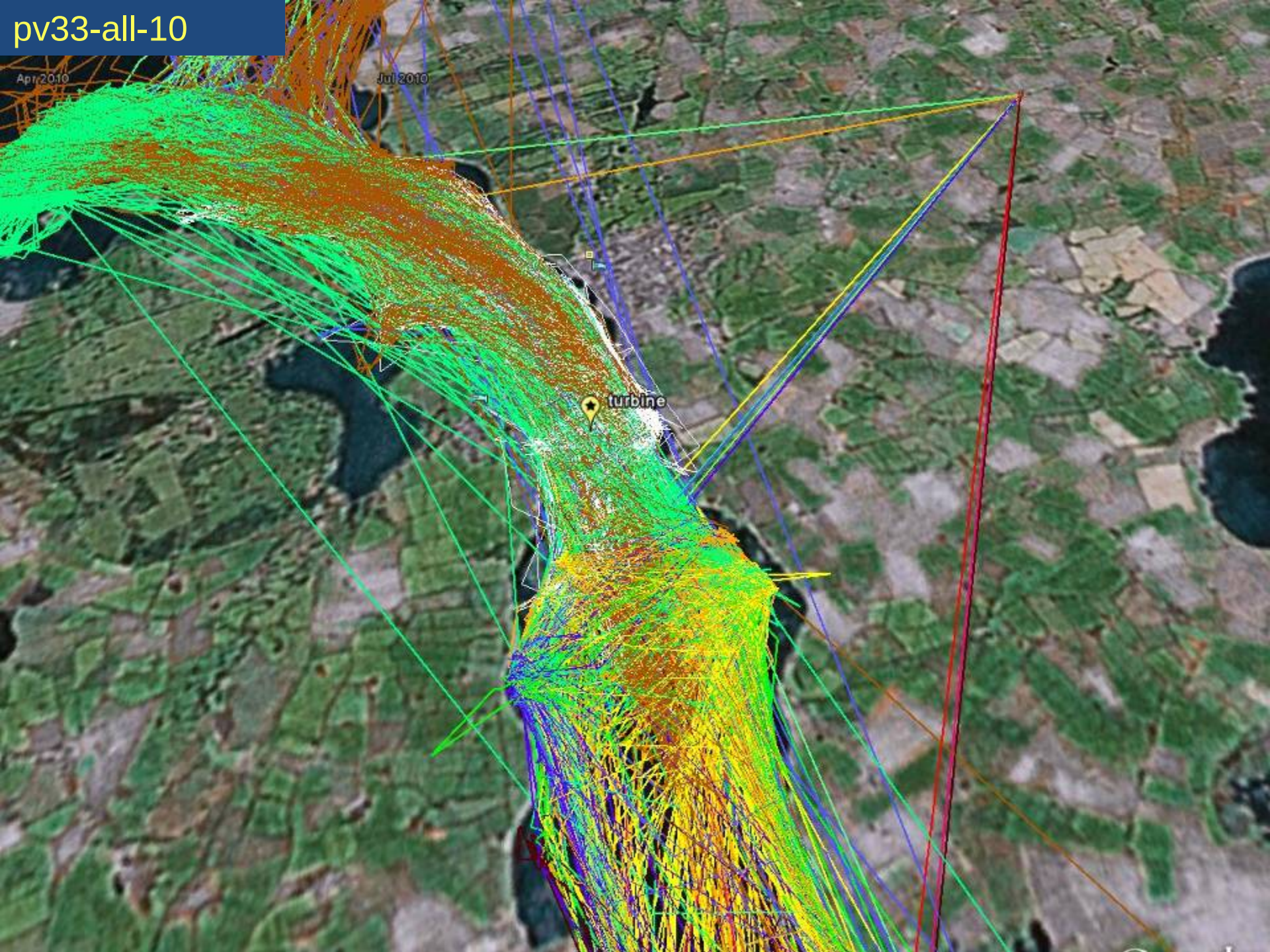
pv33-all-10
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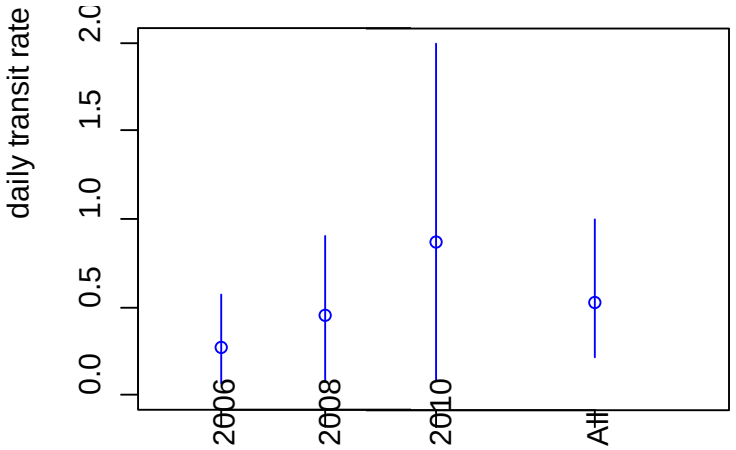
turbine

Transit rates between years



no significant changes between years in mean transit rate

but low power: change > x5 to be detected

No Barrier effect – transits still occurring with frequency

transit rates 2010

Seal	Transit rate (per day)		
	Turbine on	Turbine off, (not slack water)	**Ratio on/off**
Pv33-01-10	0.03	0	-
Pv33-02-10	0	0	-
Pv33-03-10	1.22	2.58	**0.47**
Pv33-04-10	0	0	-
Pv33-05-10	1.45	1.70	**0.85**
Pv33-06-10	0	0	-
Pv33-07-10	0.02	0	-
Pv33-08-10	0	0.07	-
Pv33-09-10	0.17	0.13	**1.31**
Pv33-10-10	0	0	-
Pv33-12-10	0.30	0.40	**0.75**
Pv33-11-10	7.21	8.17	**0.88**
Overall Mean (95% CI)	0.87 (0.09-2.10)	1.09 (0.09-2.55)	**0.80 (0.51-0.90)**

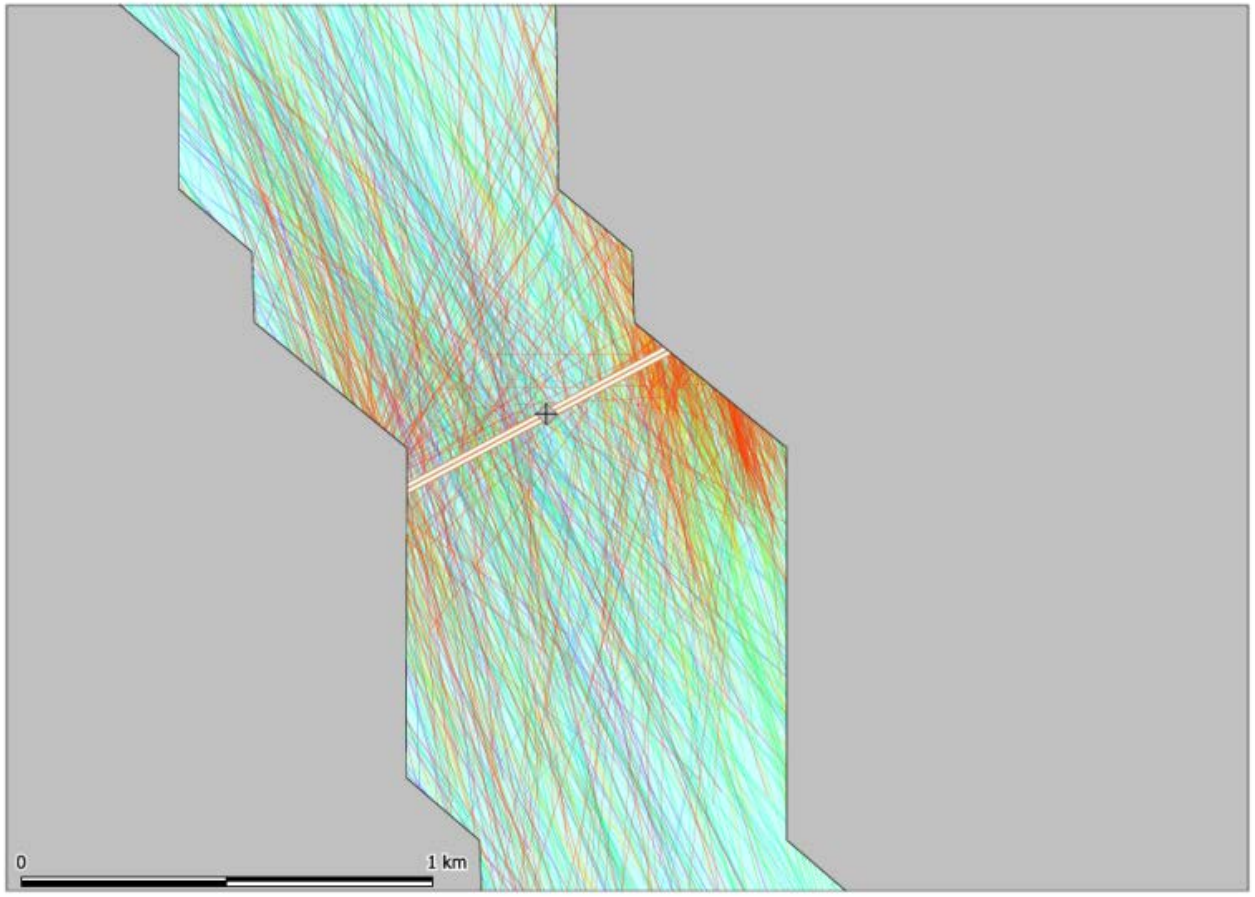
ratio of transits turbine ON / OFF:

mean 0.8

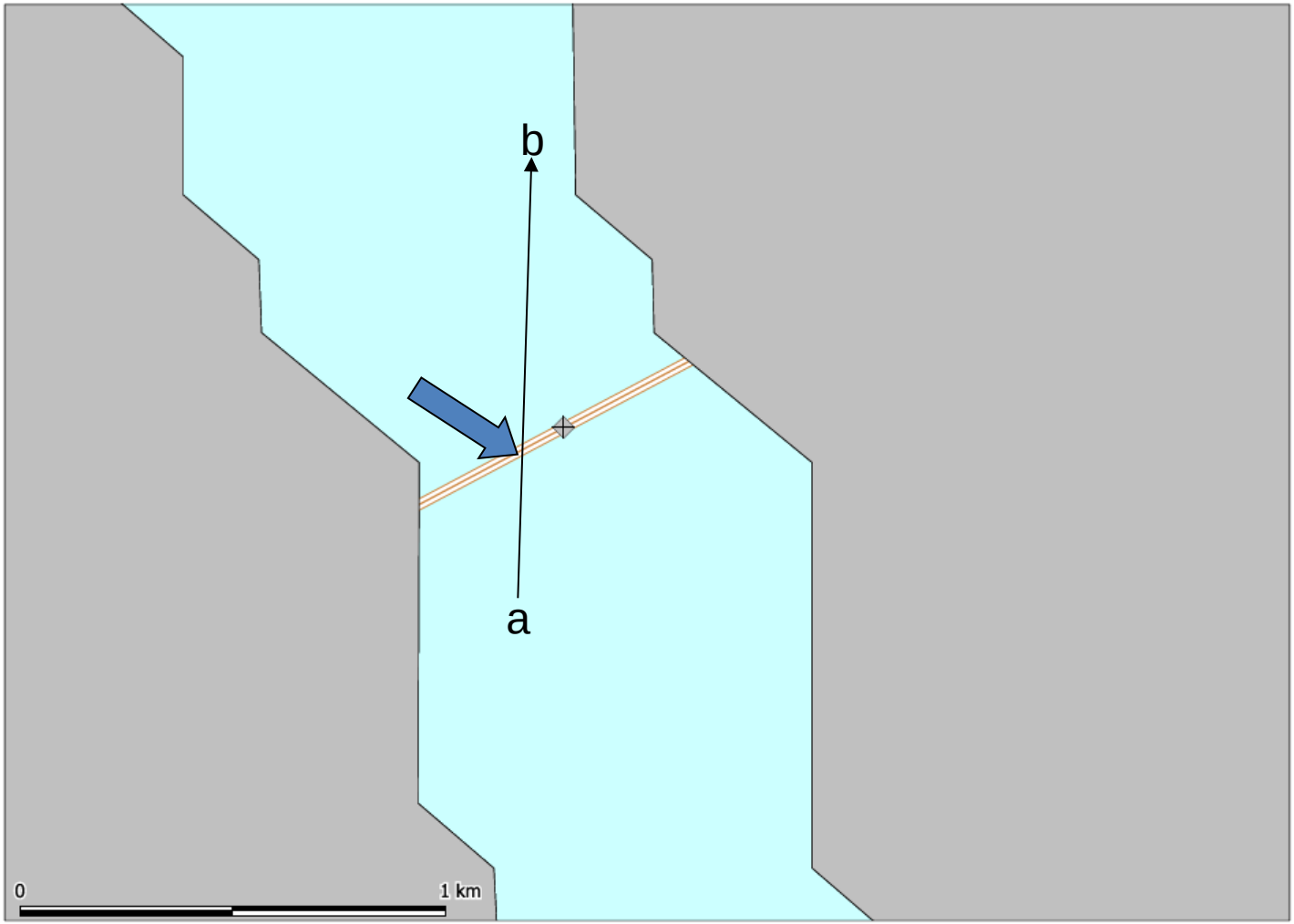
95% CI 0.51 - 0.90

ie a reduction in transit rate when turbine ON of 20% (±10-50)

transit location



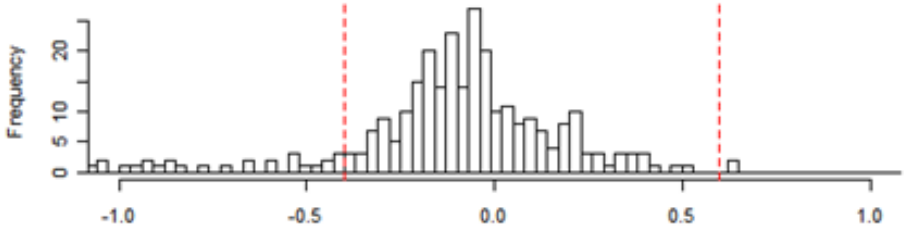
transit location and timing estimation



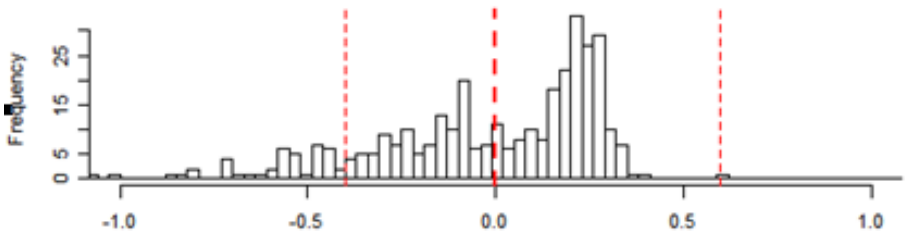
transit locations

no significant effect of year, but very low power to detect a change given lack of independence and high inter individual variation

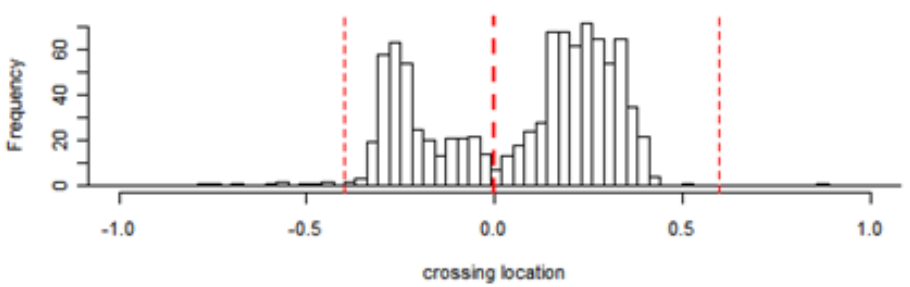
2006



2008

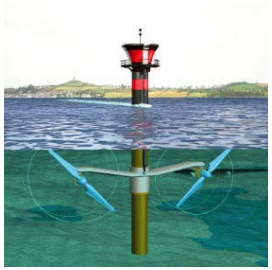


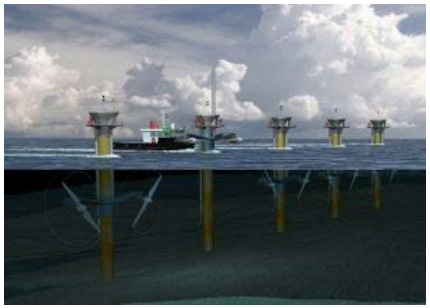
2010



Telemetry

- Significance/implications of changes in these metrics?
  - Decrease in transit rate - All transits equal?
  - Preferential transit locations/local avoidance? – non-uniform distribution in channel – parameterise collision risk models?
- Scaling up to arrays?





Telemetry

- Resolution of data does not give very fine scale information on movements around the turbine – no info on evasion or avoidance responses

- Future developments to give movements on a finer scale around turbines:

  acoustic receiving arrays and ‘pinger’ tags (local only)

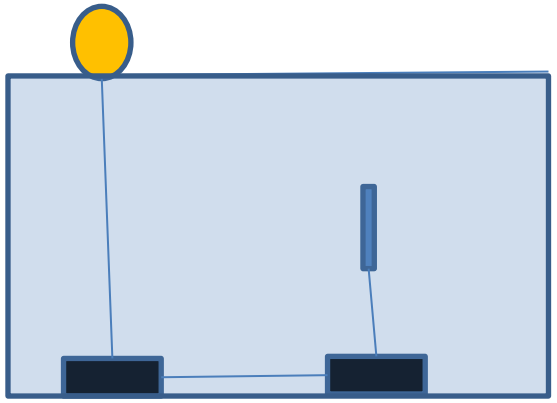
  locally triggered 3D accelerometry tags

- High inter-individual variation in behaviour – needs very large sample sizes to have ability detect change or make population level inferences

- Intermittent operation provided unique and powerful opportunity to look for effects

TPODS

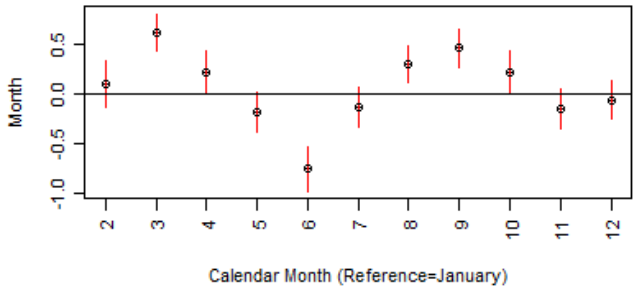
PODs are fully automated, static, passive acoustic monitoring devices that detect porpoises, dolphins and other toothed whales by recognising the trains of echo-location clicks they make to detect their prey, orientate and interact.

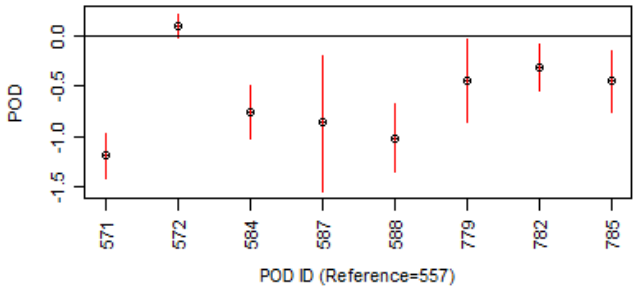


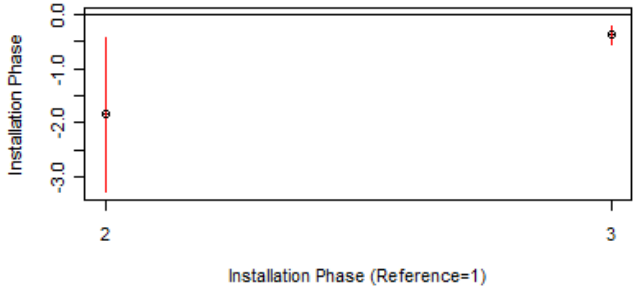
TPODS

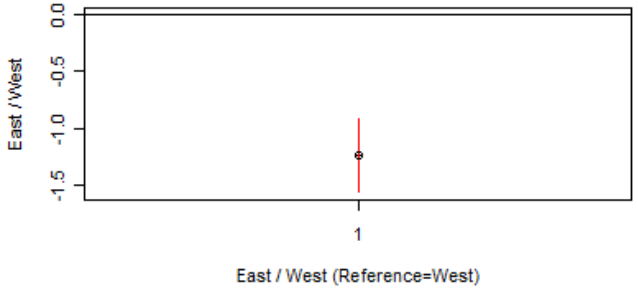
- Map of TPOD deployments

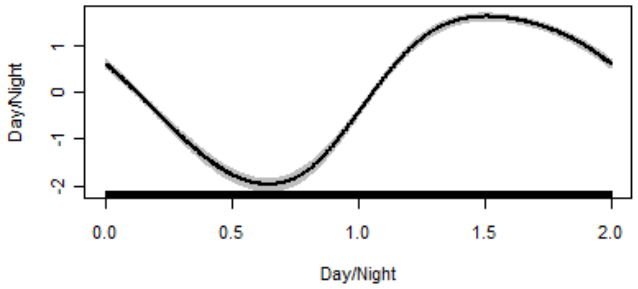
TPODS – Narrows

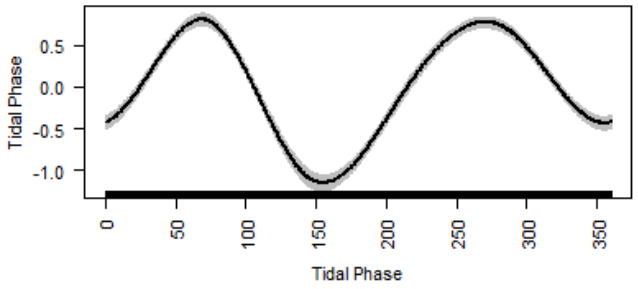




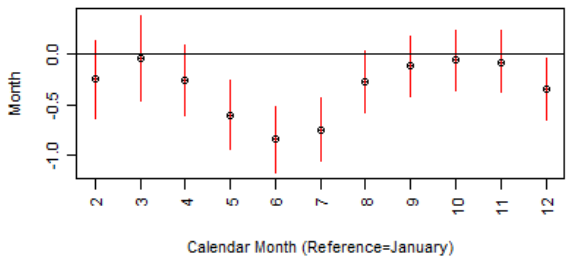


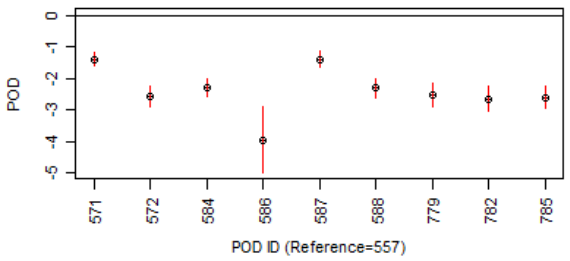


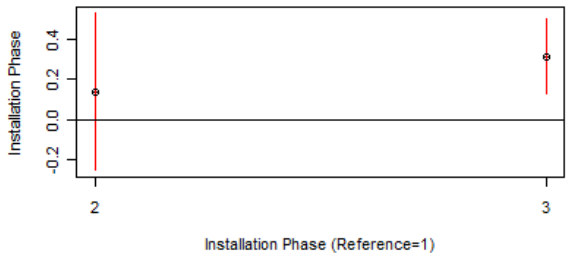


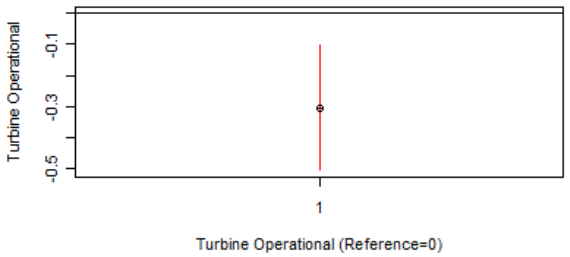


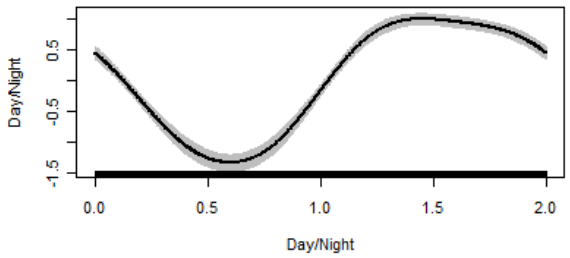
TPODS – Inner Lough

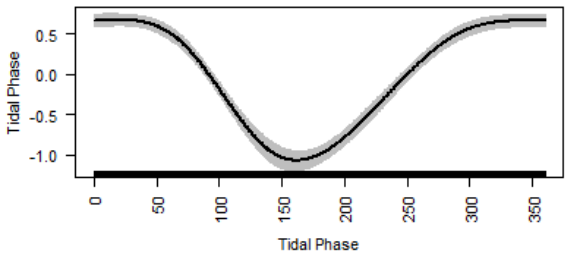












Acoustic monitoring - summary

- Time of day, TPOD, region, installation phase, tidal phase, all significantly affected porpoise detections
- In Narrows, detections decreased during installation of SeaGen, recovered but then remained slightly lower than baseline during operational phase (but no effect of turbine off/on)
- Slight increase in detections in Inner Lough in operational phase compared to baseline
- Significant effect of turbine operation in Inner Lough – slight decrease in detections when turbine is on
- Magnitude of changes related to SeaGen are low relative to other sources of variation

What we have learned about marine mammals and SeaGen

- Generally low impact – some evidence of local redistributions in presence of operating turbine but no declines in abundance
- Local redistribution of harbour seals
- Small reduction in seal transit rate while turbine operating
- Variation in harbour porpoise acoustic detections in relation to installation and operation, operational changes small

What we have learned about monitoring at MHK devices

- Static passive acoustics – issues with moorings, POD loss and high ambient noise in high energy environments
- Active sonar targets identification challenging – reliant on development of systems and accurate target recognition and species id.
- We still know very little about actual collision risk
- Often poor ability to detect change from shore based visual observations
  - Analysis methods need to take into account spatial and temporal autocorrelation
  - Definition of significant impact
- Telemetry studies need to be finer scale and individual variability an issue for detecting change

Thanks…

Ian Boyd, Gordon Hastie, Cormac Booth, Bernie McConnell, Mike Lonergan, Alice Mackay, Beth Mackey, Callan Duck, Andrew Murray, Simon Northridge.

David Ainsworth at MCT

Marine Current Turbines

UK Department for Energy and Climate Change (DECC)

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