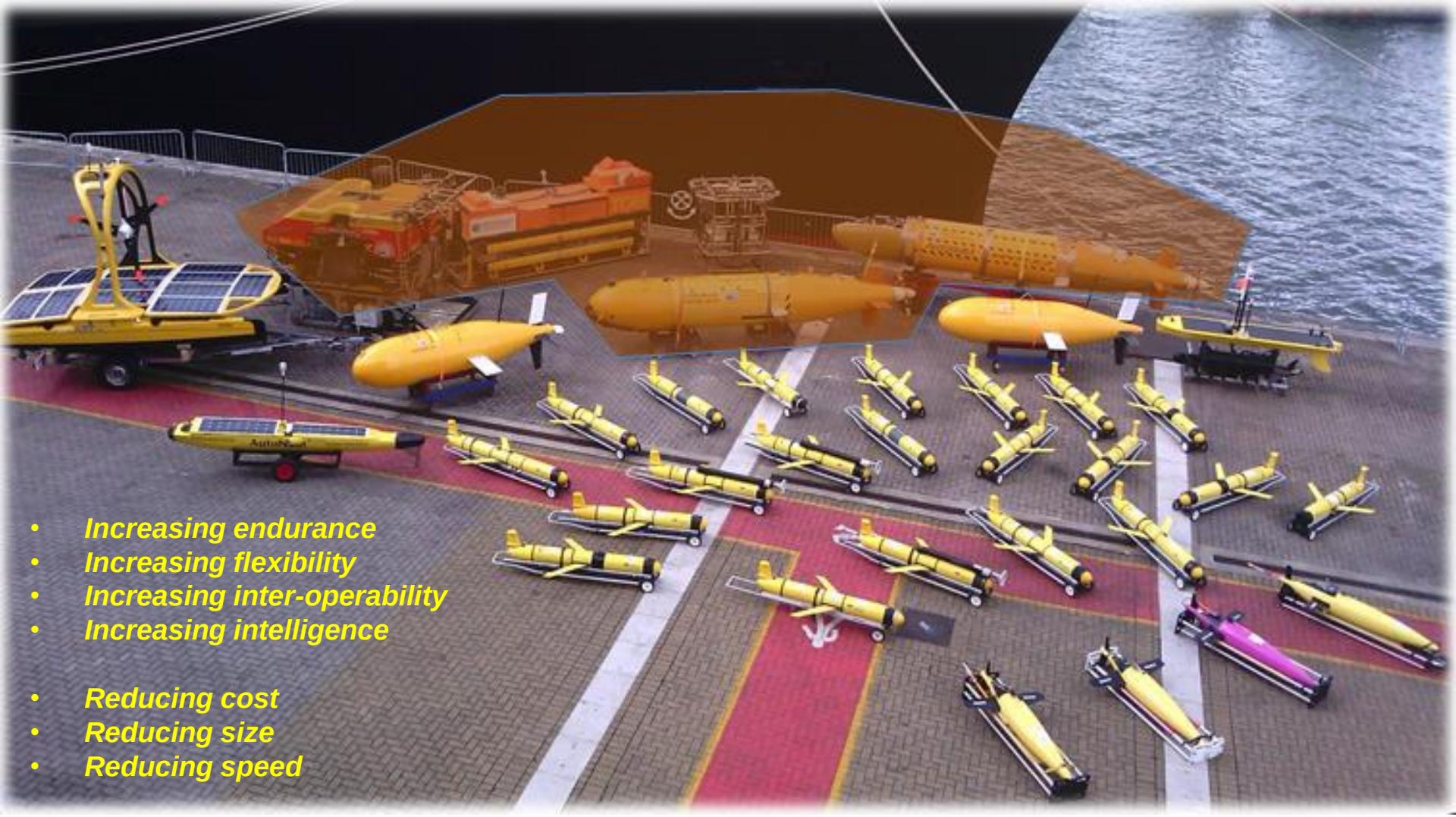
An update on the UK research fleet of Marine Autonomous Systems (MAS)

1. £25M of UK MAS capital investment into NMF-MARS
2. Driving innovation in MAS platforms, sensors and data
3. Clear trends in MAS characteristics and capabilities
4. New applications opening up across multiple sectors
5. Demonstrator missions for environment and defence

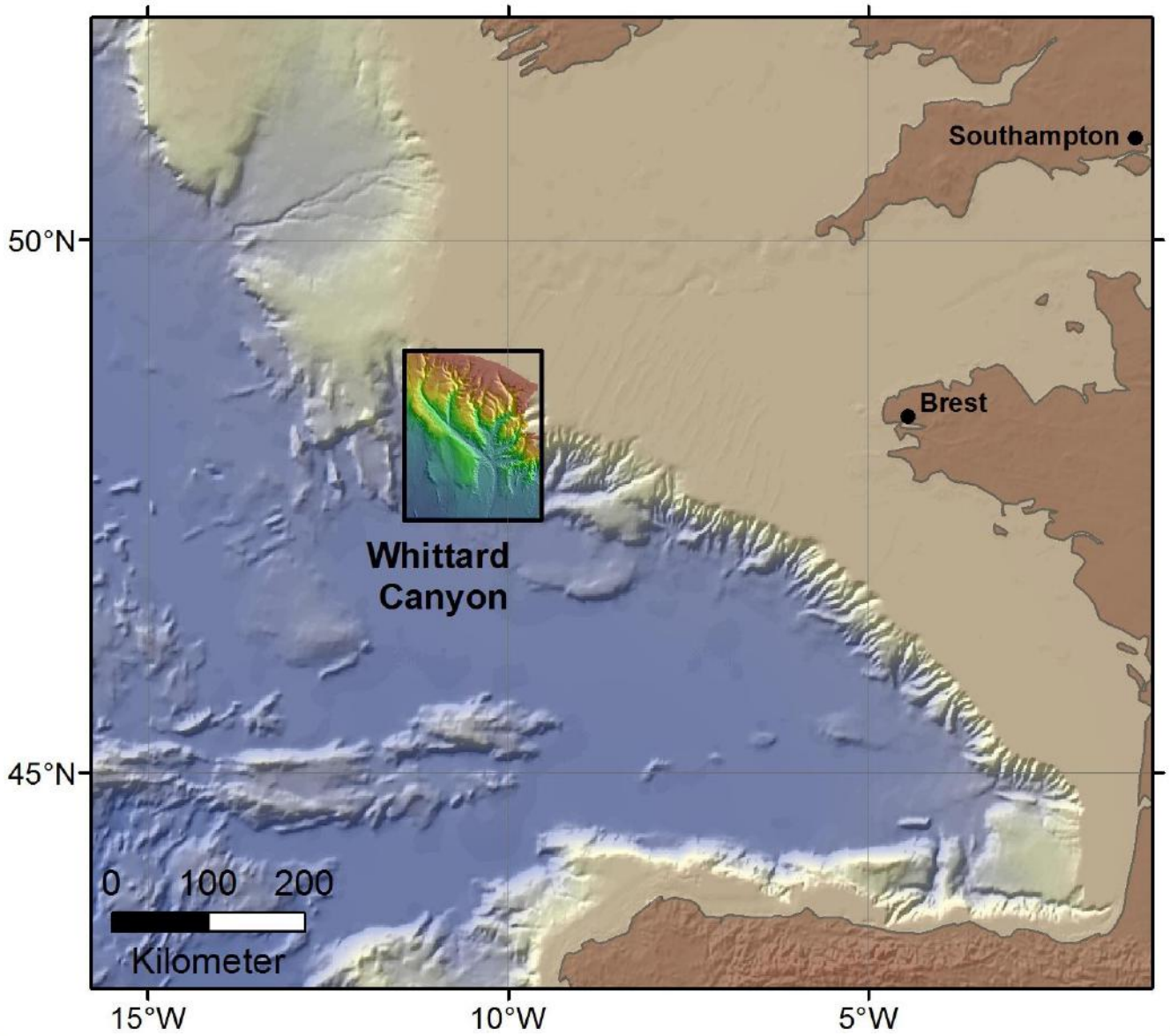
Prof Russell B Wynn (Chief Scientist, MARS)

The MARS fleet at NOC (additional assets operated from SAMS/BAS)

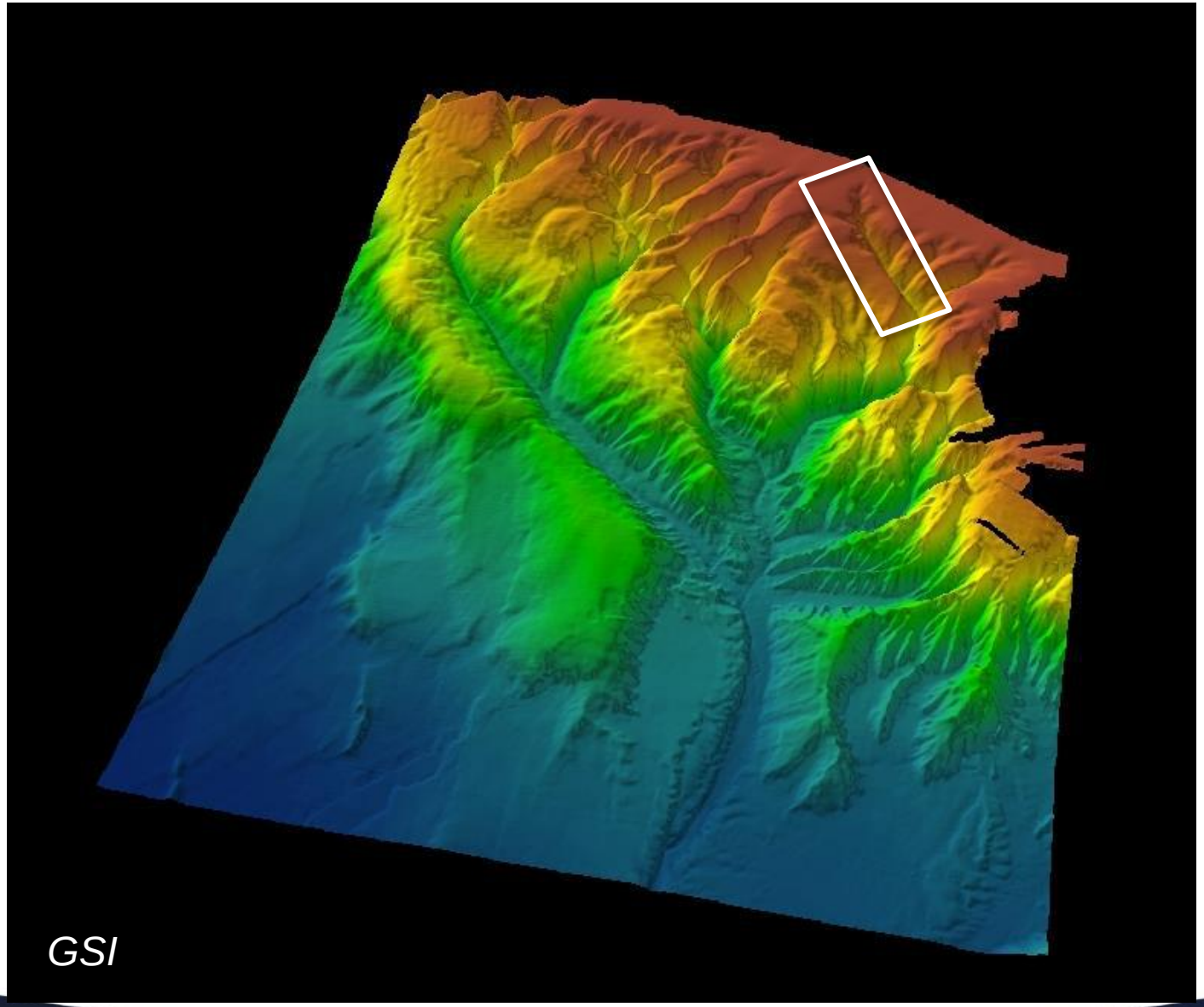


Short-range, high-power, ship-deployed vehicles highlighted

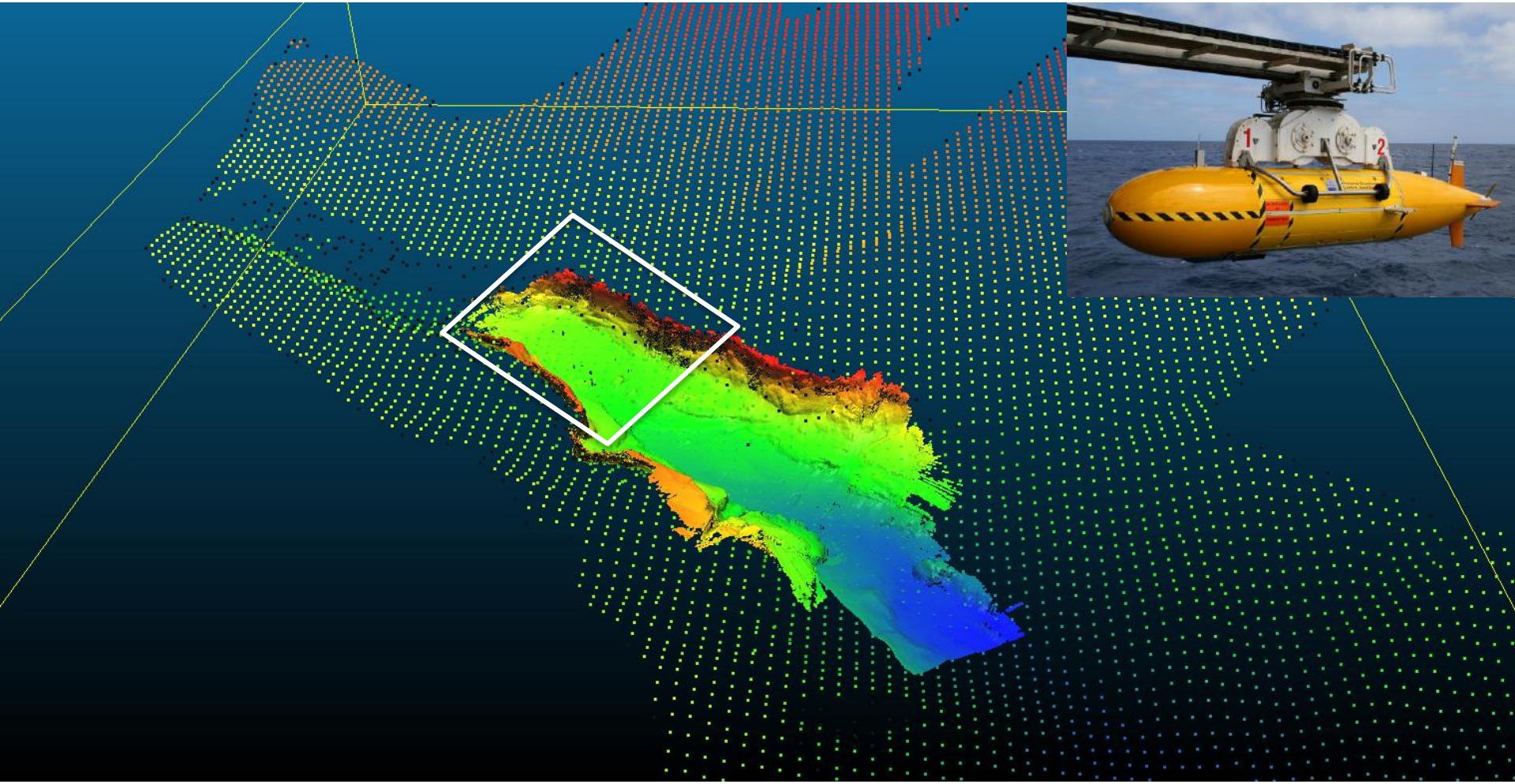
Multi-vehicle mapping and imaging of challenging environments



Vessel-based mapping of Whittard Canyon (resolution = >10-100m)

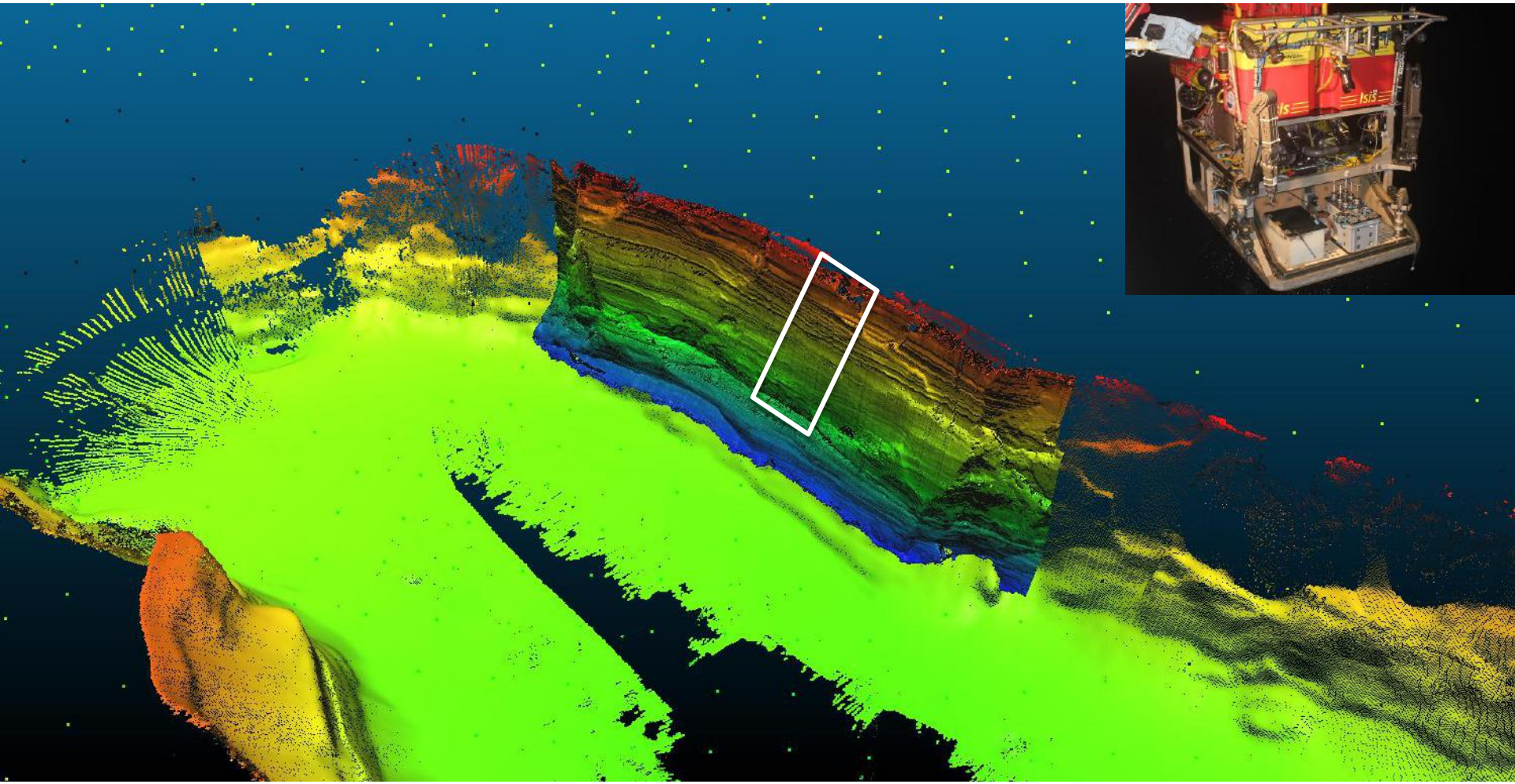


AUV mapping* of upper Whittard Canyon (resolution = 1-10m)



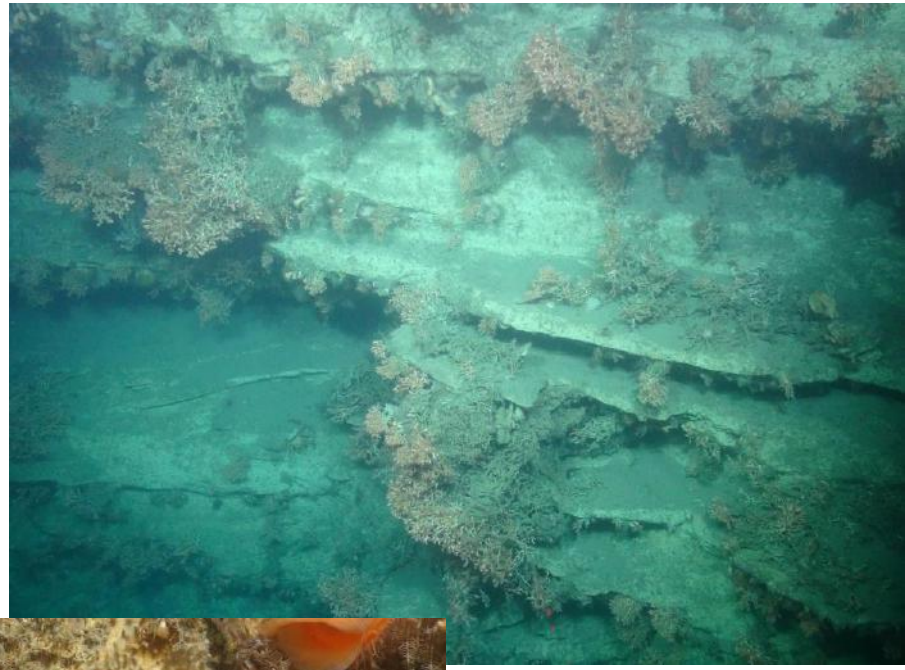
*includes sideways swath mapping

ROV mapping* of upper Whittard Canyon (resolution = 0.1-1m)



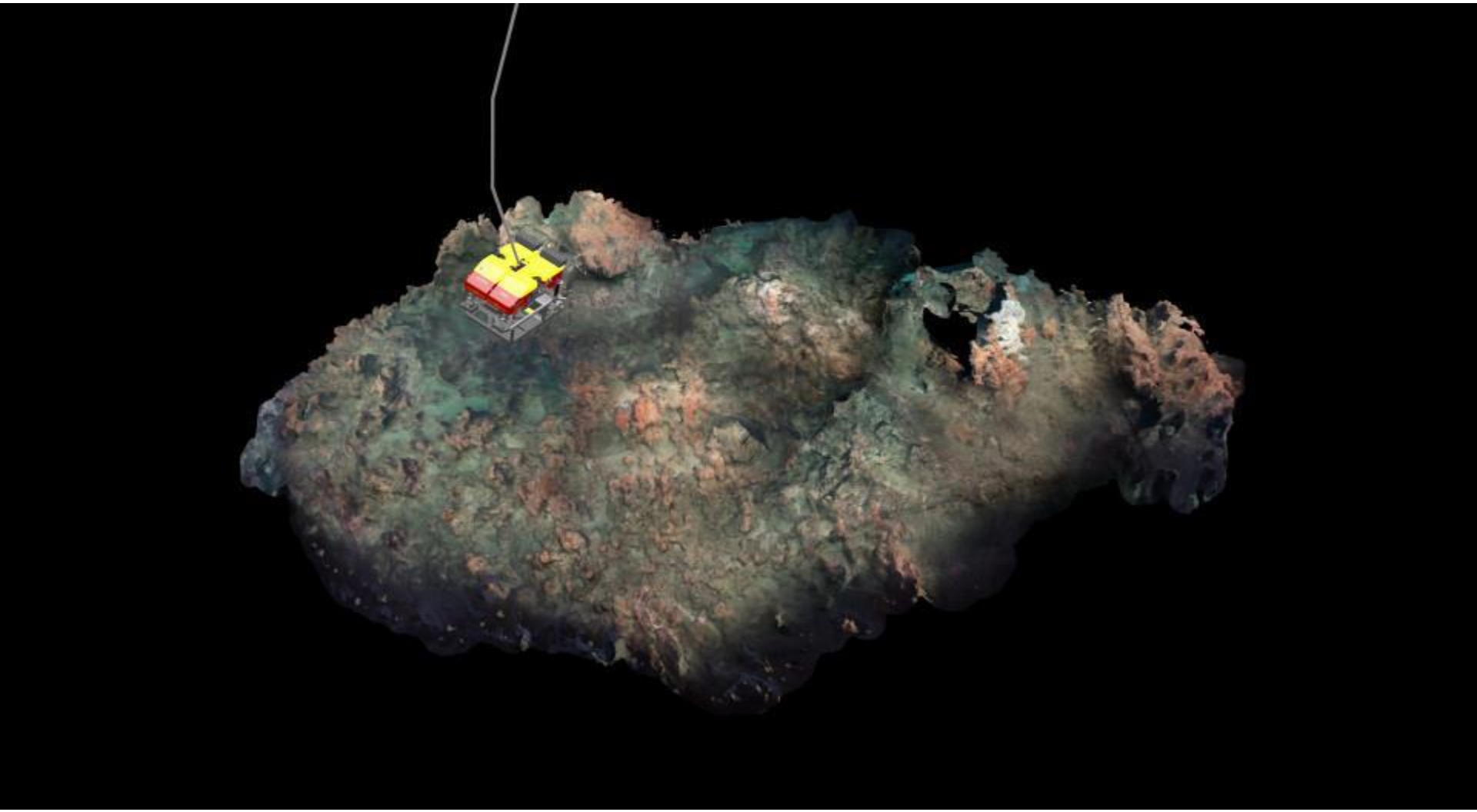
*includes sideways swath mapping

ROV imaging of upper Whittard Canyon (resolution = 0.1-1cm)

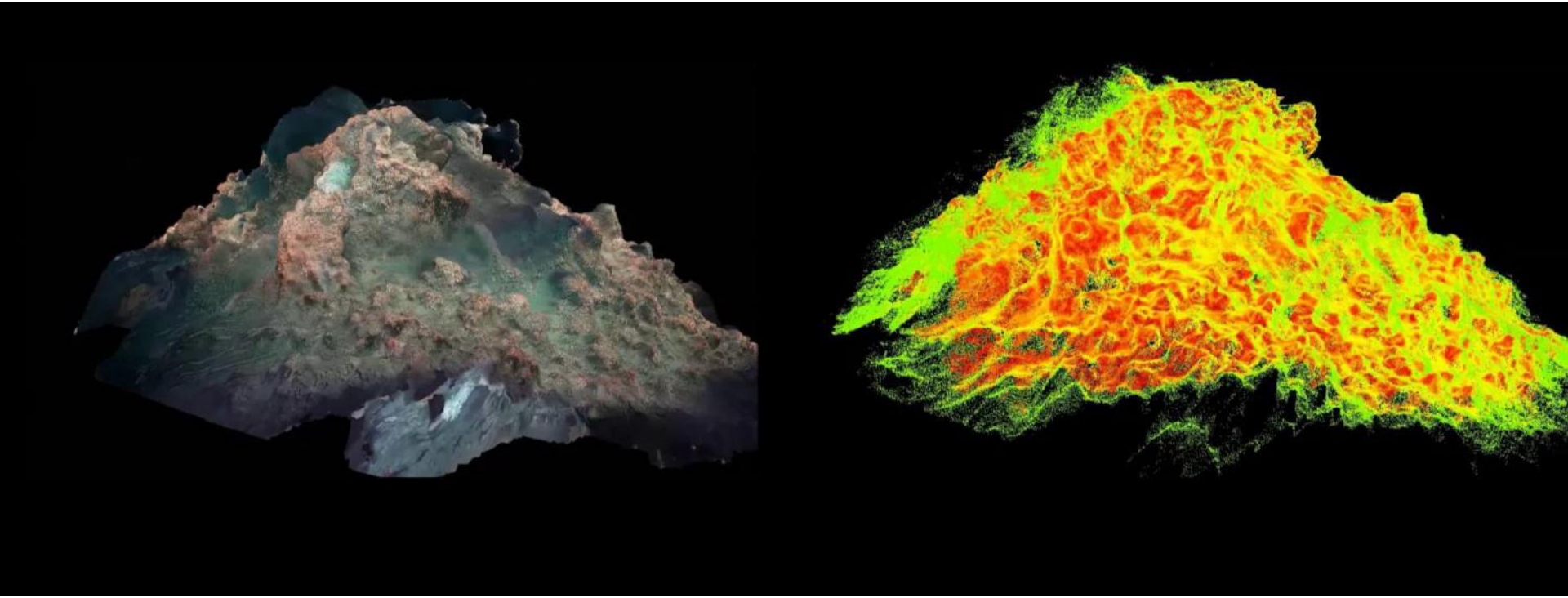


Photogrammetry - structure-from-motion (Katleen Robert)

1 hr HD ROV video = ~2000 frames; coral mound = 25 x 15 m



Photogrammetry - structure-from-motion (Katleen Robert)
Coral mound showing ultra-high-resolution imagery and terrain descriptors



defra
Department for Environment
Food and Rural Affairs

CODE MAP

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

noc.ac.uk

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Science & Environment

Arctic crossing planned for 'Boaty' sub

By Jonathan Amos
BBC Science Correspondent

24 minutes ago | Science & Environment Share

The UK's favourite new yellow submarine, Boaty McBoatface, is in training for a grand challenge.

Marine Robotics Innovation Centre


SCIENTIFIC RESEARCH
AutoNaut
ASV
www.asvglobal.com
National Oceanography Centre

AutoNaut

...the wave propelled unmanned surface vessel (USV)

AutoNaut secures investment as Seiche takes majority stake

2nd August 2016

AutoNaut has secured investment from the Seiche Group to advance R&D aims, assure long-term growth and develop business across UK and international markets.

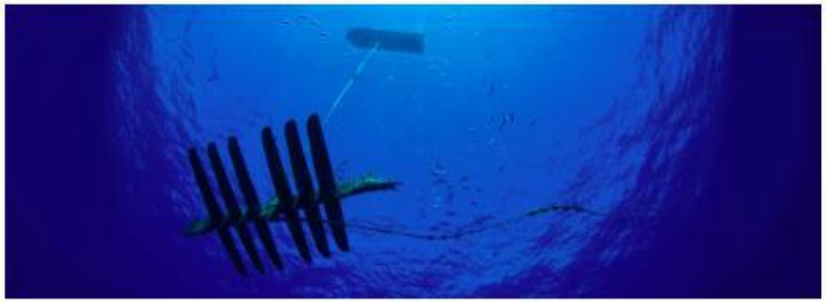
In September 2015, Seiche agreed its first investment in AutoNaut and this new deal sees them take a majority stake in the company. AutoNaut Ltd is the new name for the company previously trading as MOST (Autonomous Vessels).

Directors David Maclean and Mike Poole will continue to run the company from their Chichester base, concentrating on Technical and Marketing/Sales activity respectively. The investment from Seiche will provide additional resources for R&D and manufacturing as well as administrative support. Seiche will also help to expand all sales and marketing activity. As one of the fastest growing companies in the marine technology sector, Seiche will provide a springboard for AutoNaut into a number of commercial markets.

Roy Wyatt, MD of Seiche, comments: "AutoNaut is set to be the go-to marine data collection hub of the future. AutoNaut can independently operate offshore for months fitted with a suite of cutting edge sensor technologies. AutoNaut complements and completes Seiche's portfolio of monitoring, mitigation and measurement products and services."

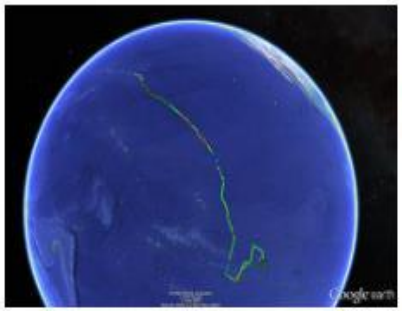
LIQUID ROBOTICS.

Wave Glider Swims 2,808 Miles Home After Helping Fight Illegal Fishing in the South Pacific



The Wave Glider® swam 2,808 nautical miles home to the Big Island of Hawaii after successfully completing a 4-month patrol mission of the Pitcairn Island Marine Sanctuary for the UK Foreign & Commonwealth Office (FCO). This achievement represents a fundamental enabling capability.

- Customers can avoid the high cost and risk of deploying manned vessels for research, commerce, or defense
- Customers can deploy sensors in the most remote locations without sending a large ship for recovery
- Surveillance and patrol are now possible in large expanses of oceans previously inaccessible



The Journey Home

After successfully completing its mission, the Wave Glider was remotely piloted more than 2,800 nautical miles home. During the journey home it:

- Swam through strong equatorial currents, doldrums, and challenging sea states
- Collected 9,516 measurements of meteorological, oceanographic, and marine biodiversity data

Altogether, the Wave Glider was continuously at sea, untouched, for 213 days while traveling a total of 7,205 nautical miles at an average speed of 1.73 knots.

Read more about the journey home here.

Cefas

Cefas Scientists complete world's first "on-demand" autonomous marine water sampling

26 September 2016

In what is believed to be a world's first in the scientific community, **Cefas** (Centre for Environment, Fisheries and Aquaculture Science, UK) and **Liquid Robotics**(R), USA have successfully deployed, tested and recovered a remotely piloted **Wave Glider**(R) which allowed scientists to measure water characteristics and selectively collect samples in near real-time.

The Wave Glider called "Lyra" was deployed in the southern North Sea about 60km off Lincolnshire, UK coastline by *RV Cefas Endeavour* and spent 48 days at sea before being recovered successfully by Trinity House's vessel *Alert*, 20 miles off Lowestoft. Whilst deployed, the Wave Glider was remotely piloted 24/7 by the Liquid Robotics Operations Team from their California headquarters almost 9000 km away and covered over 2700km at sea.

MASSMO2 (2015-16) MAS for environmental and defence research

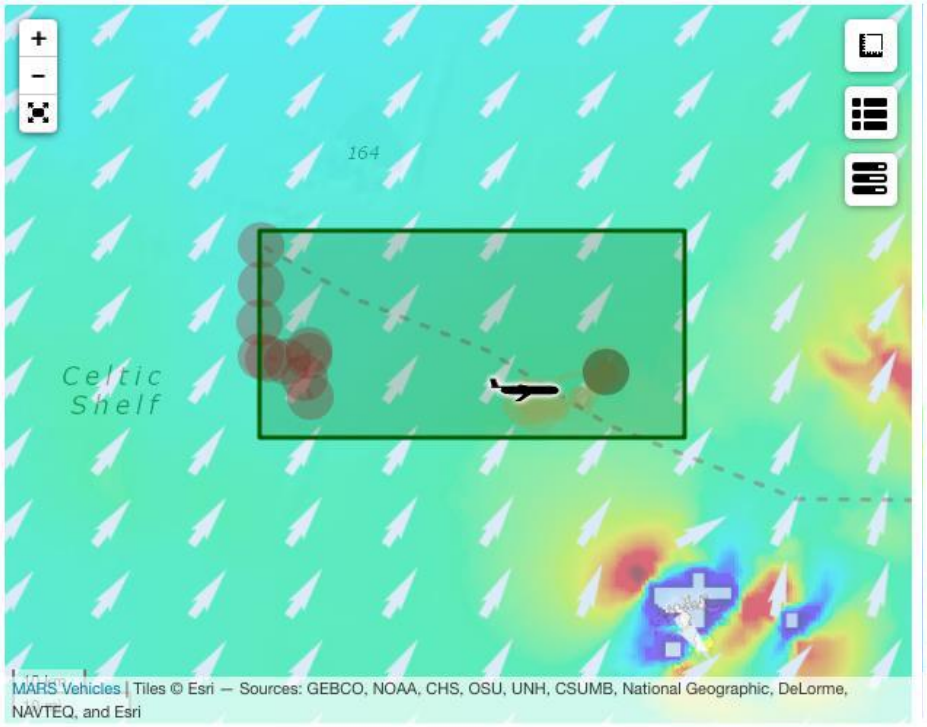
NMF Vehicles | Browse | Help | Login

C-Enduro Thomas on mission MASSMO 2A-2

- **Public vehicle**
- Serial Number 996
- Operated by NOC on the MASSMO project
- Current Status: Deployed

C-Enduro Camera Feed

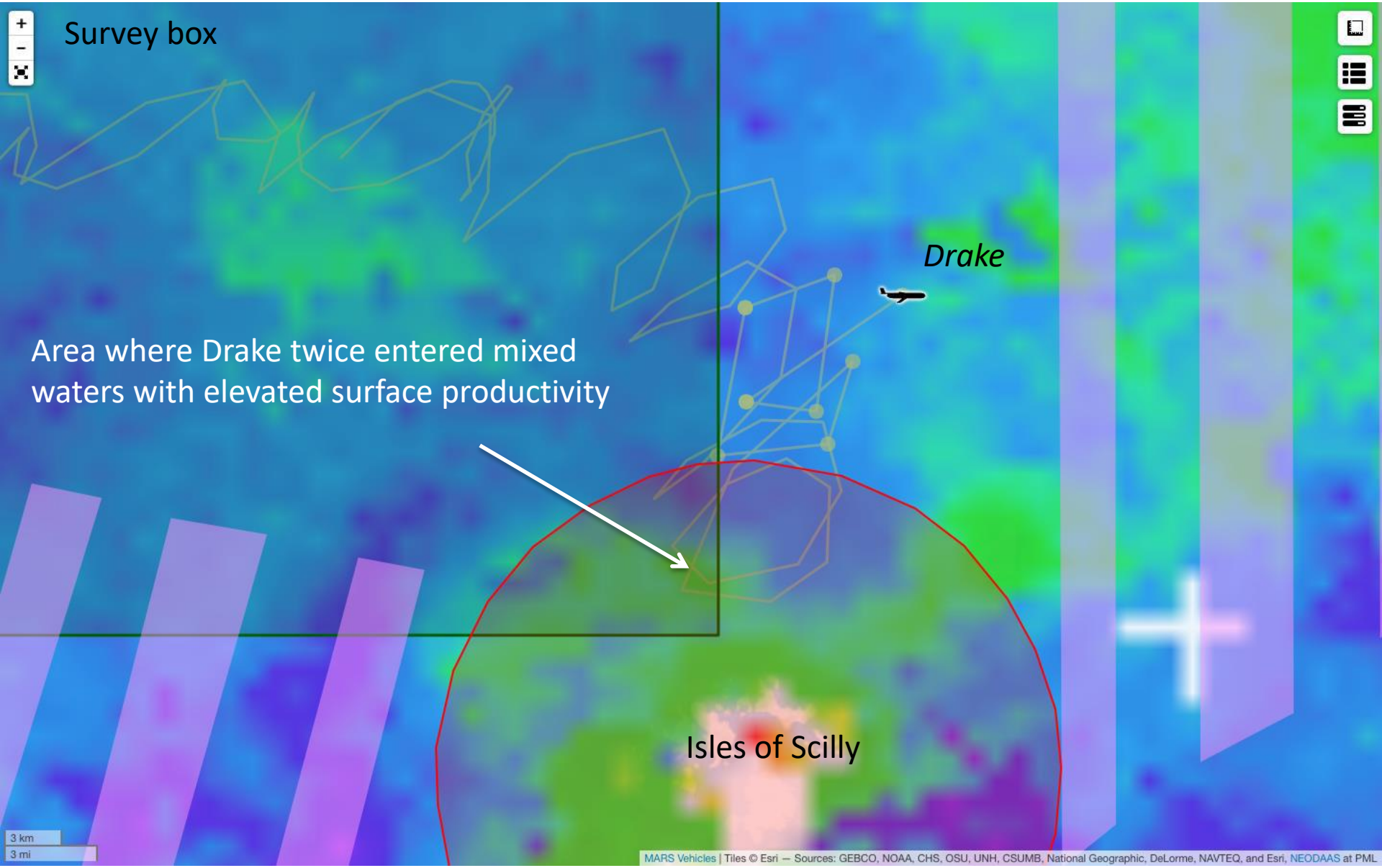
- **Deployed:** 2016/05/22 00:00:00 UTC (15 days ago) by David White
- **Time at Sea:** 15 days
- **Profiles Performed:** 118

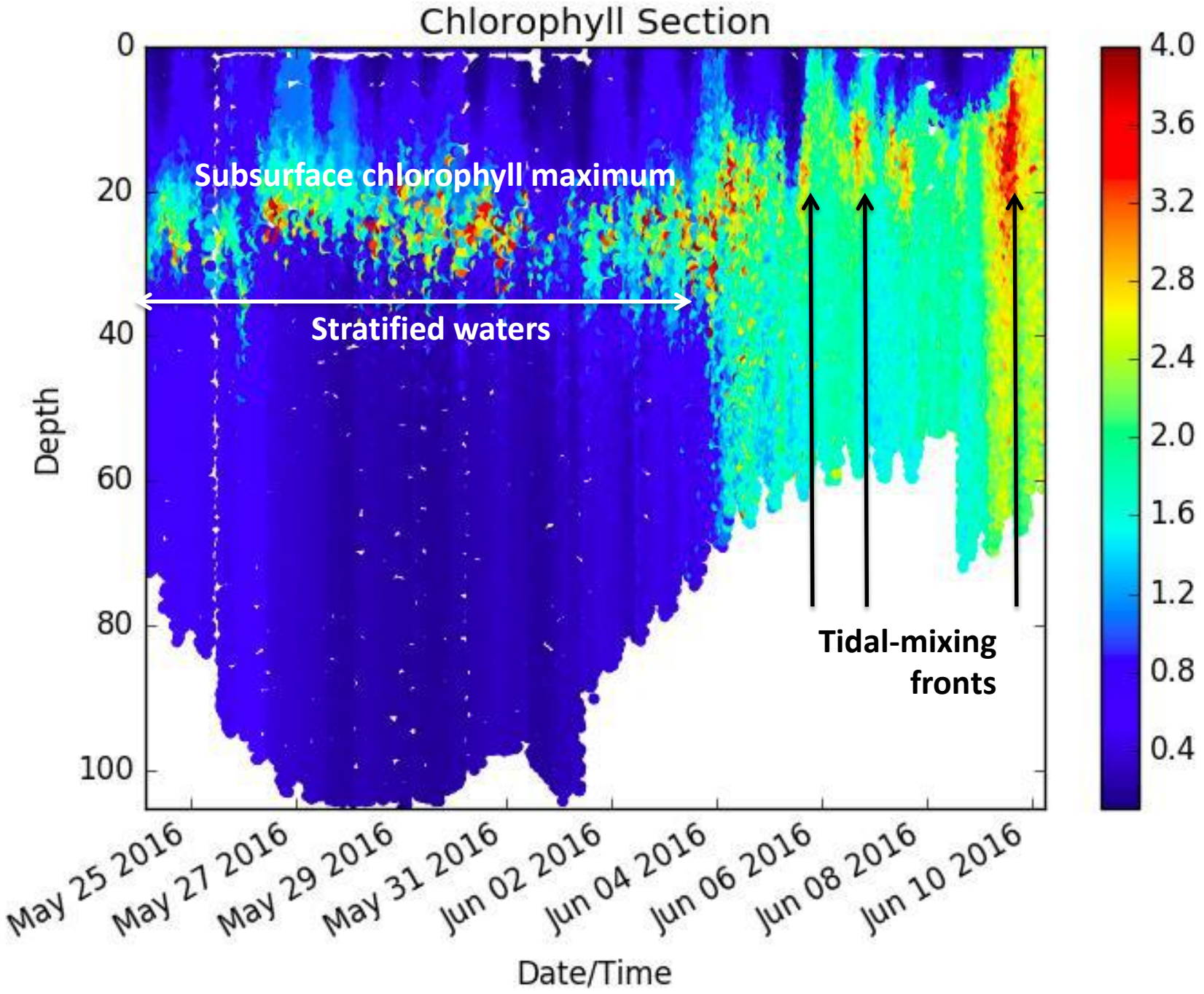


WWF

[dstl]

Targeting surface features with a submarine glider using satellite imagery



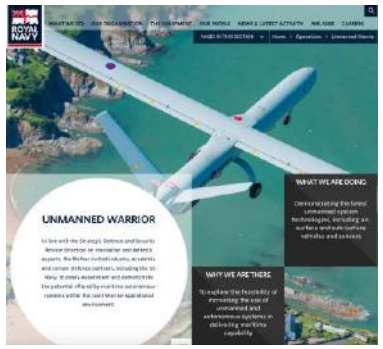

Chlorophyll Section
Subsurface chlorophyll maximum
Stratified waters
Tidal-mixing fronts
Depth
0
20
40
60
80
100
May 25 2016
May 27 2016
May 29 2016
May 31 2016
Jun 02 2016
Jun 04 2016
Jun 06 2016
Jun 08 2016
Jun 10 2016
Date/Time
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4

Project funding

Promoting innovation

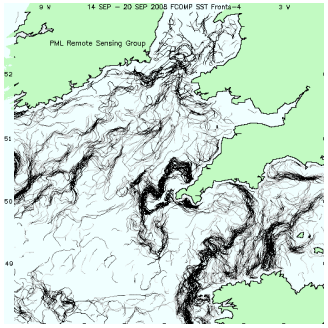
Joint operations

Public engagement



Data management

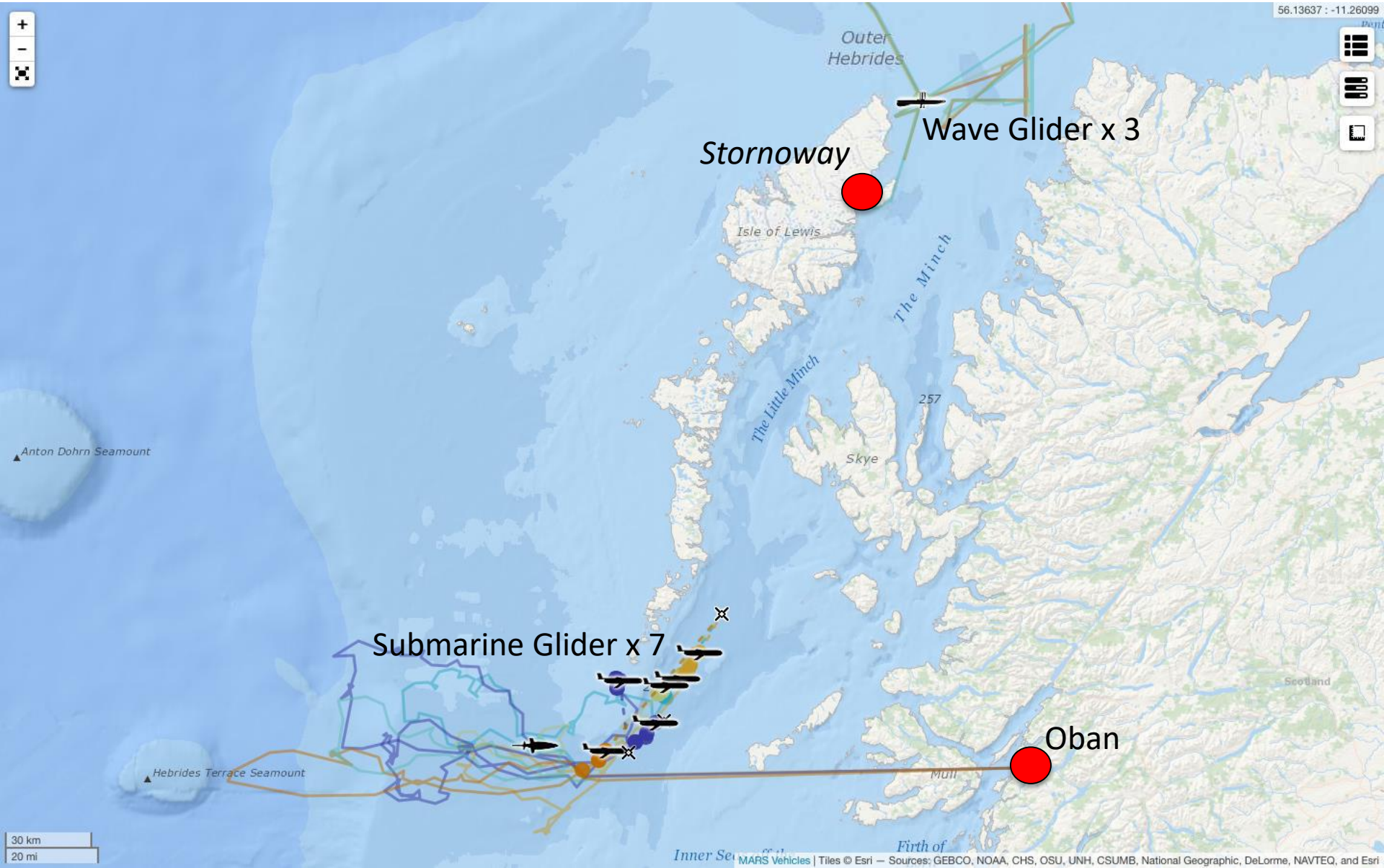
Operational products

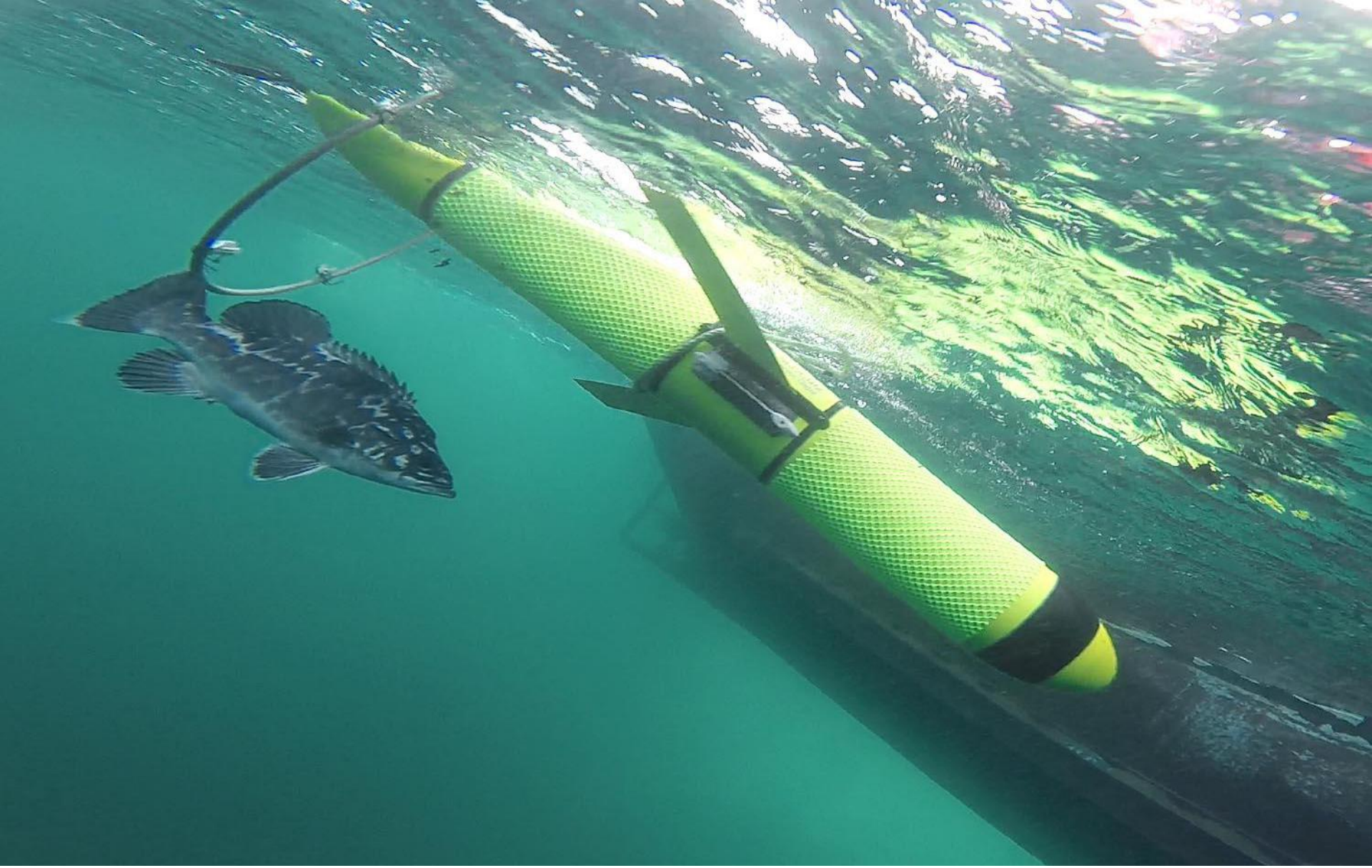


MASSMO3
Autumn 2016

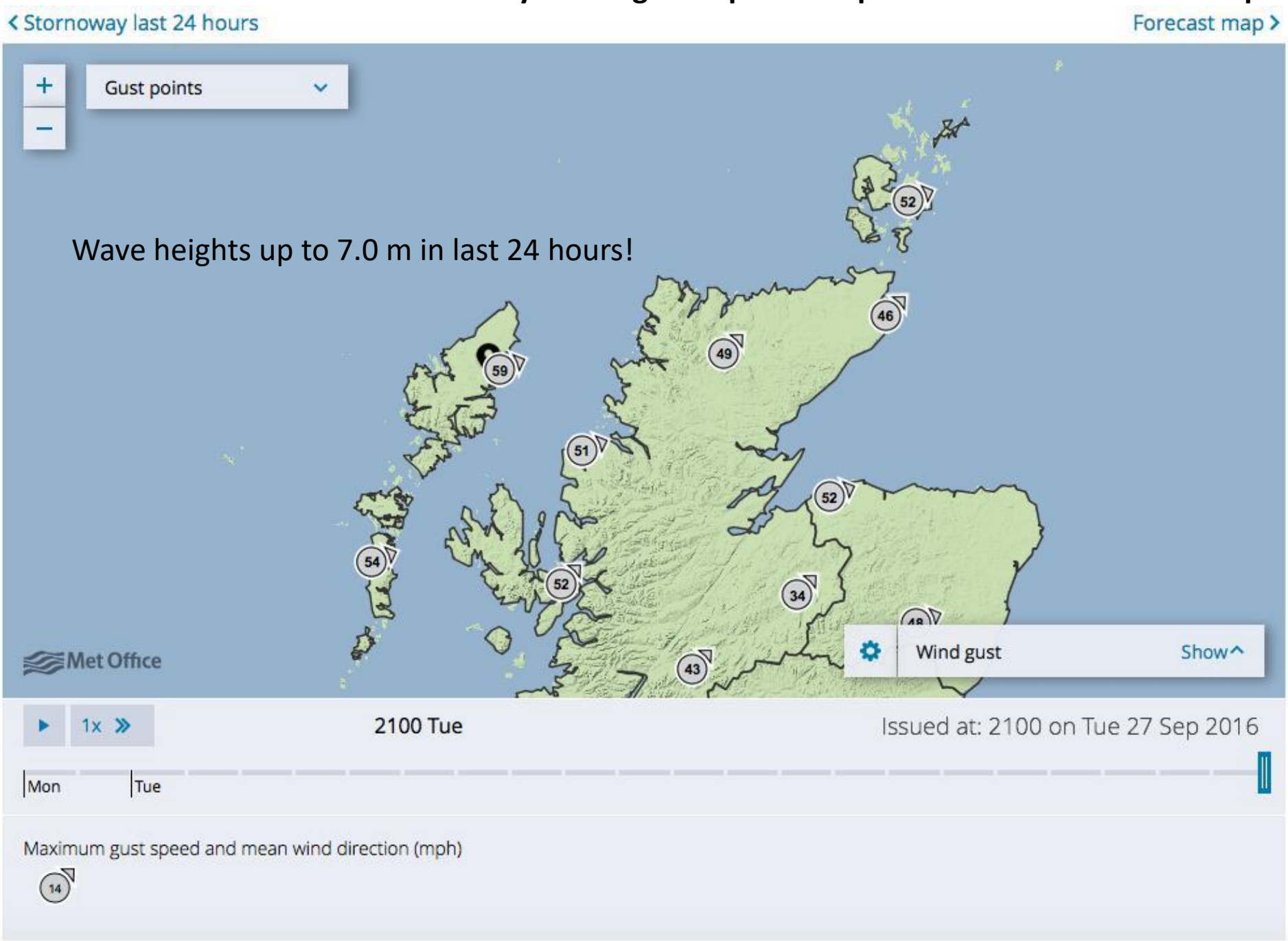
The MASSMO3 fleet at 0820 hrs on 01 Sept 2016

The largest simultaneous deployment of operational MAS in UK waters to date

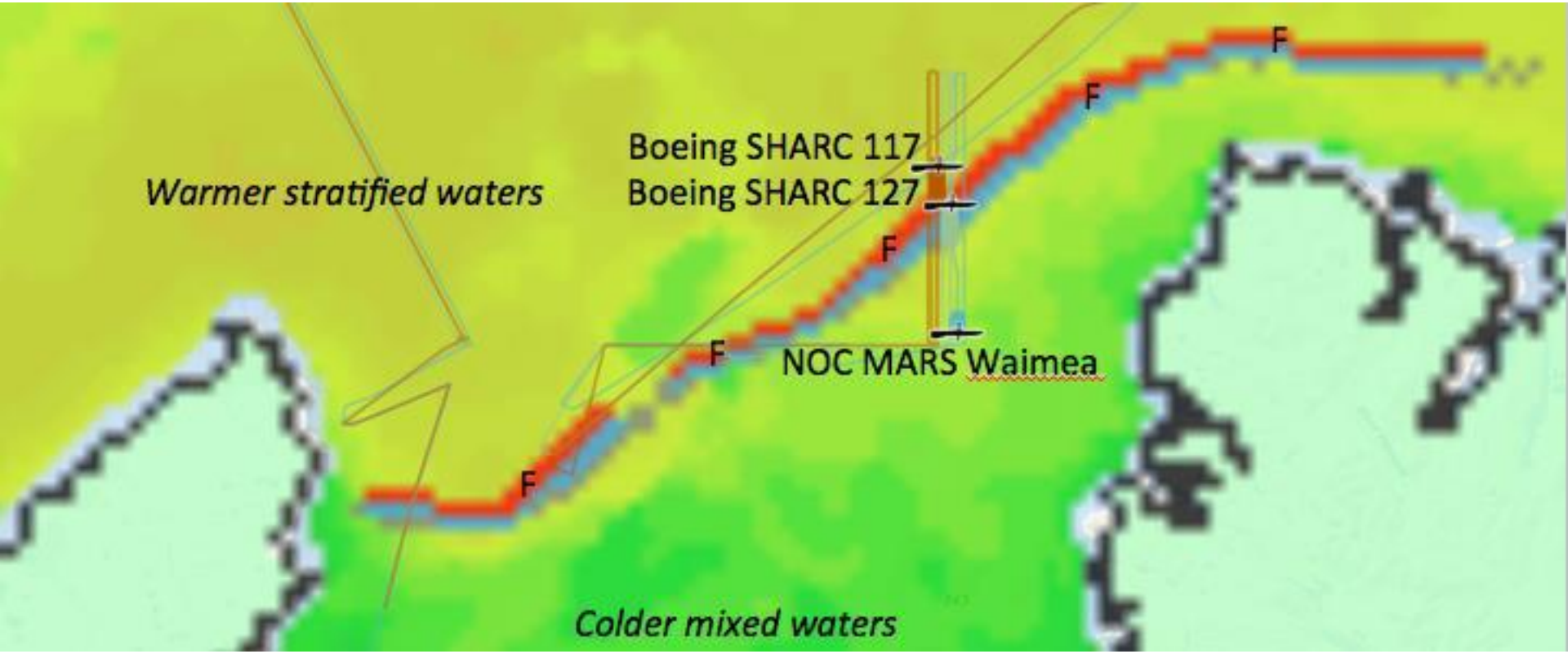


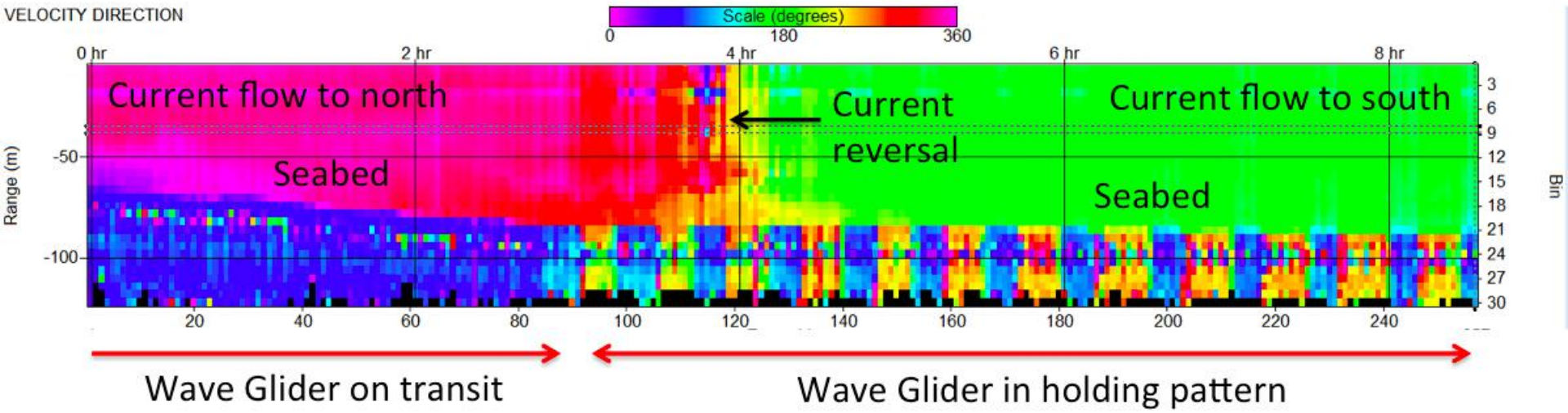


Stornoway - wind gusts up to 60 mph at 2100 hrs on Tues 27 Sept

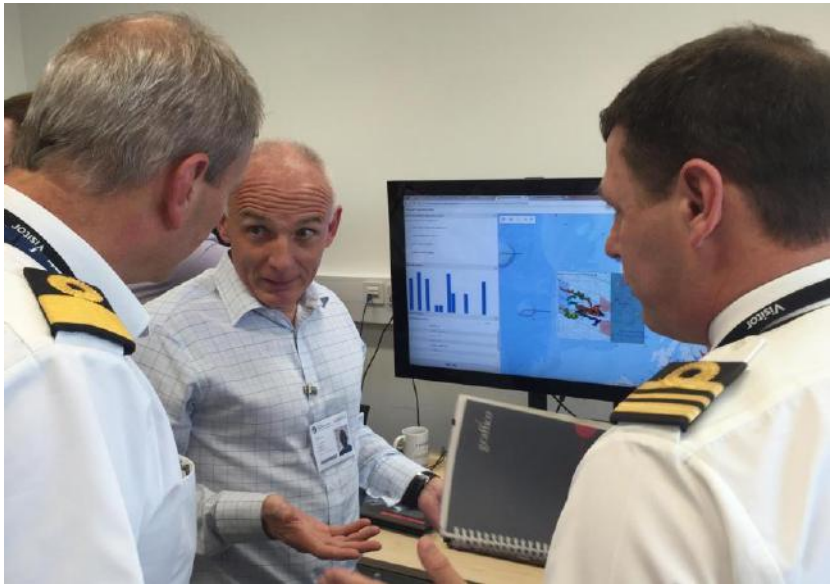


Wave Glider data showing front crossings and tidal current reversal in northern Minch





MASSMO3 – Royal Navy VIP visit day to NOC Operations Room



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Large-scale deployment of robots in sea off Scotland

1 November 2016 | Highlands & Islands

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The 10 robots were deployed during a two-week research mission in October

The largest simultaneous deployment of marine robots yet attempted in UK waters was achieved last month, scientists have said.

A fleet of 10 marine robots collected information on ocean temperature, tidal currents and wave conditions off Scotland's north west coast.

The work involving Oban's Scottish Association for Marine Science was done during the inaugural **Unmanned Warrior**.

Held by the Royal Navy, Unmanned Warrior tested military robotics.

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UK's Marine Robots Mission Complete

A fleet of ten marine robots has completed two-week mission off northwest Scotland.

The mission comprised the largest simultaneous deployment of marine robots in UK waters, with seven submarine gliders and three surface Wave Gliders operating in waters around the Outer Hebrides, National Oceanography Centre (NOC) explained.

The robot fleet was collecting a variety of marine environmental data including ocean temperature, salinity, oxygen, turbidity, tidal currents, and surface weather and wave conditions.

As NOC explained, the submarine gliders surveyed an area of over 5000 km2 during the two-week deployment, venturing up to 125 km offshore of the island of Barra into waters over 1000 m deep. The Wave Gliders ventured up to 150 km north of the island of Lewis, each covering a distance of more than 300 km.

The mission was co-ordinated by the National Oceanography Centre (NOC) in partnership with the Scottish Association for Marine Science (SAMS), and involved over 20 industry and government partners. The UK Defence Science and Technology Laboratory (Dstl) was the primary sponsor of the mission, which was in support of the Royal Navy's 'Unmanned Warrior' programme, and all of the collected data will be archived at the British Oceanographic Data Centre and made available for future scientific research.

Professor **Russell Wynn** of NOC, who was chief scientist of the mission, said: *"This mission benefited hugely from the local knowledge at SAMS and the offshore expertise provided by the Royal Navy, which enabled us to safely deploy and recover the ten vehicles in difficult conditions; it also highlighted the ability of marine robots to continue collecting high quality data in sea states that would have hampered or even terminated traditional vessel-based observations."*

Email: rbw1@noc.ac.uk

https://www.youtube.com/watch?v=faZw3IFJOXs