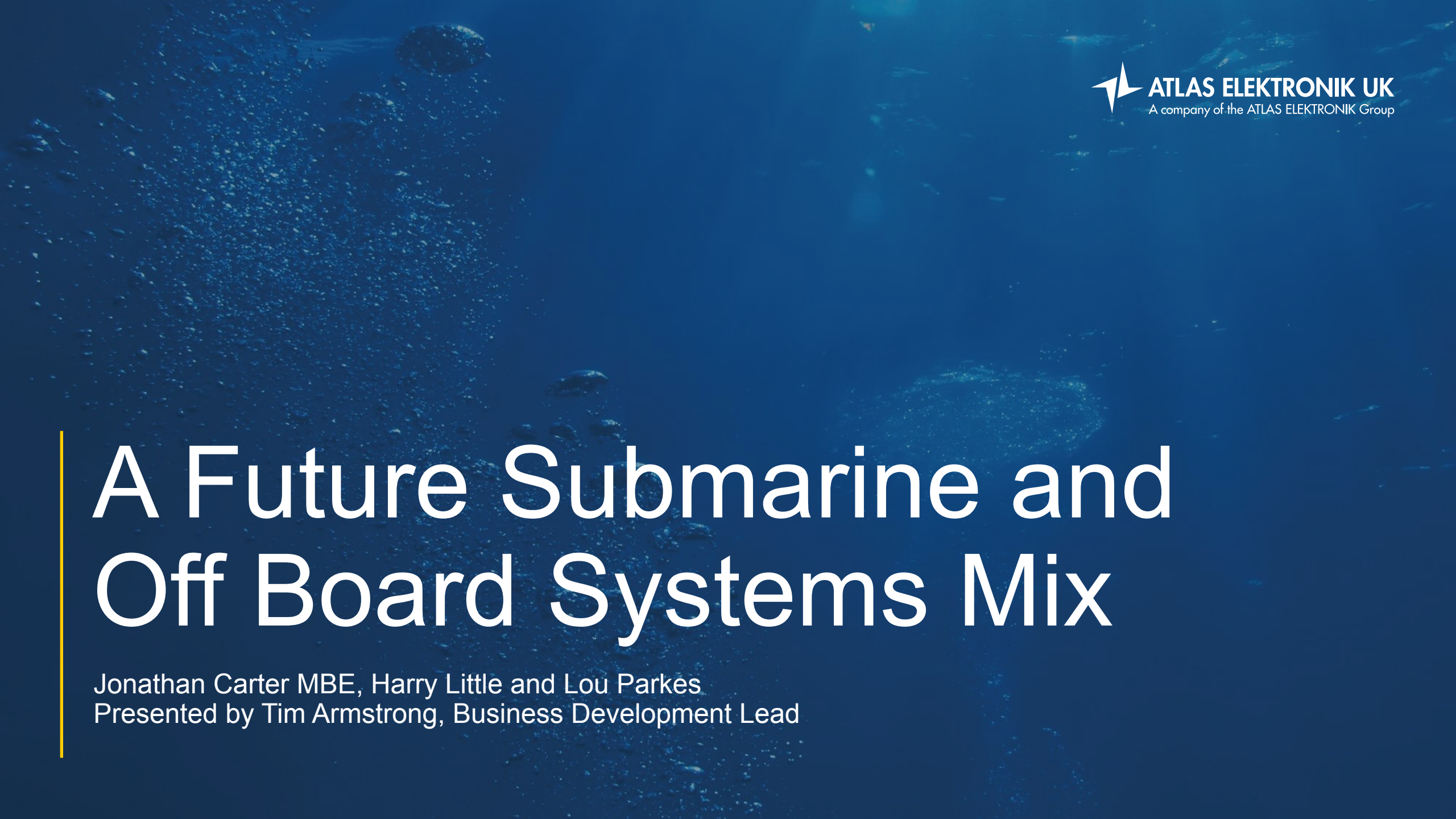

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A Future Submarine and Off Board Systems Mix

Jonathan Carter MBE, Harry Little and Lou Parkes
Presented by Tim Armstrong, Business Development Lead

Overview

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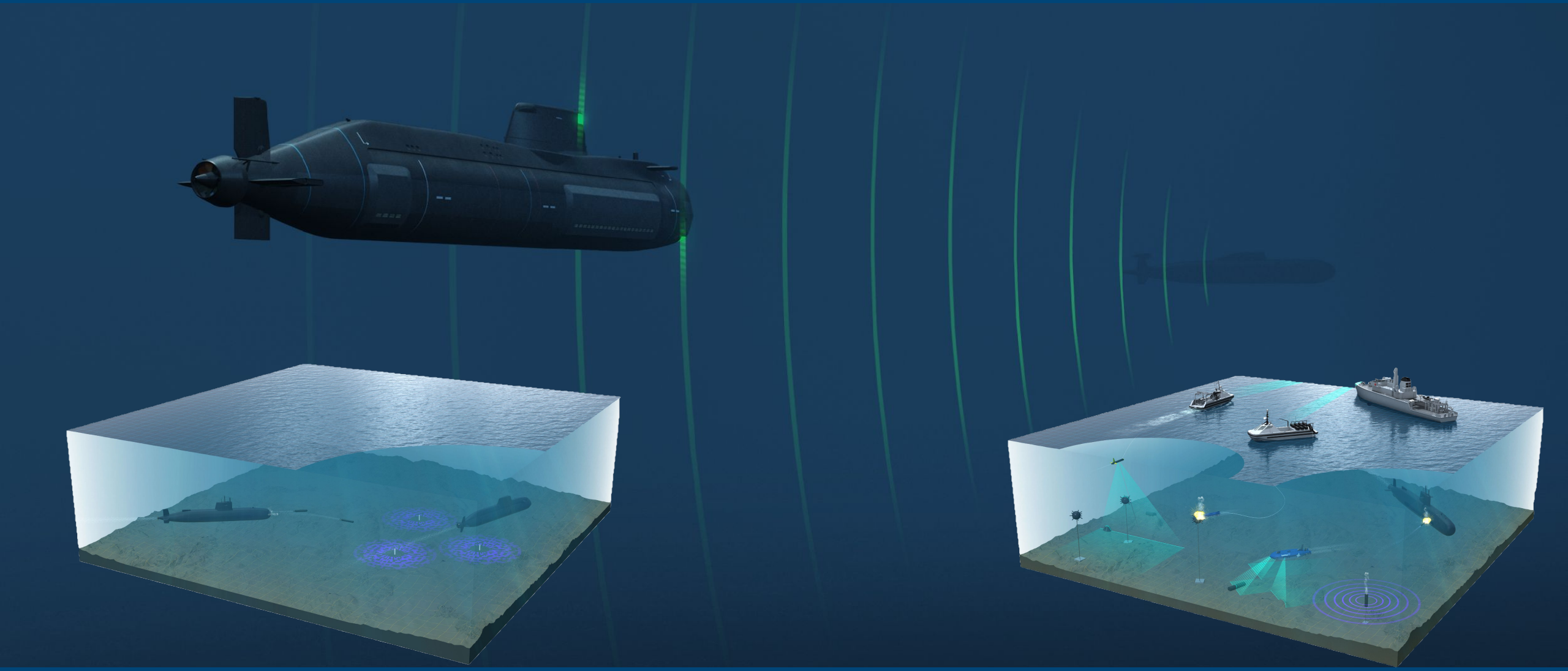

Mission Scenario

96 >95 %

85 80-94%

79 <80 %

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Some questions

- What force mix to employ – how many, what type?
- Where to employ them – location and depth?
- What duration mission is required?

AEUK's SIGMA tool used to help answer these questions

- % probability mission success
- How many Blue platforms would be needed to defeat Red with 95% chance of success?
- How many Blue platforms need for a different probability of mission success?

Operational Advantage in the North Atlantic

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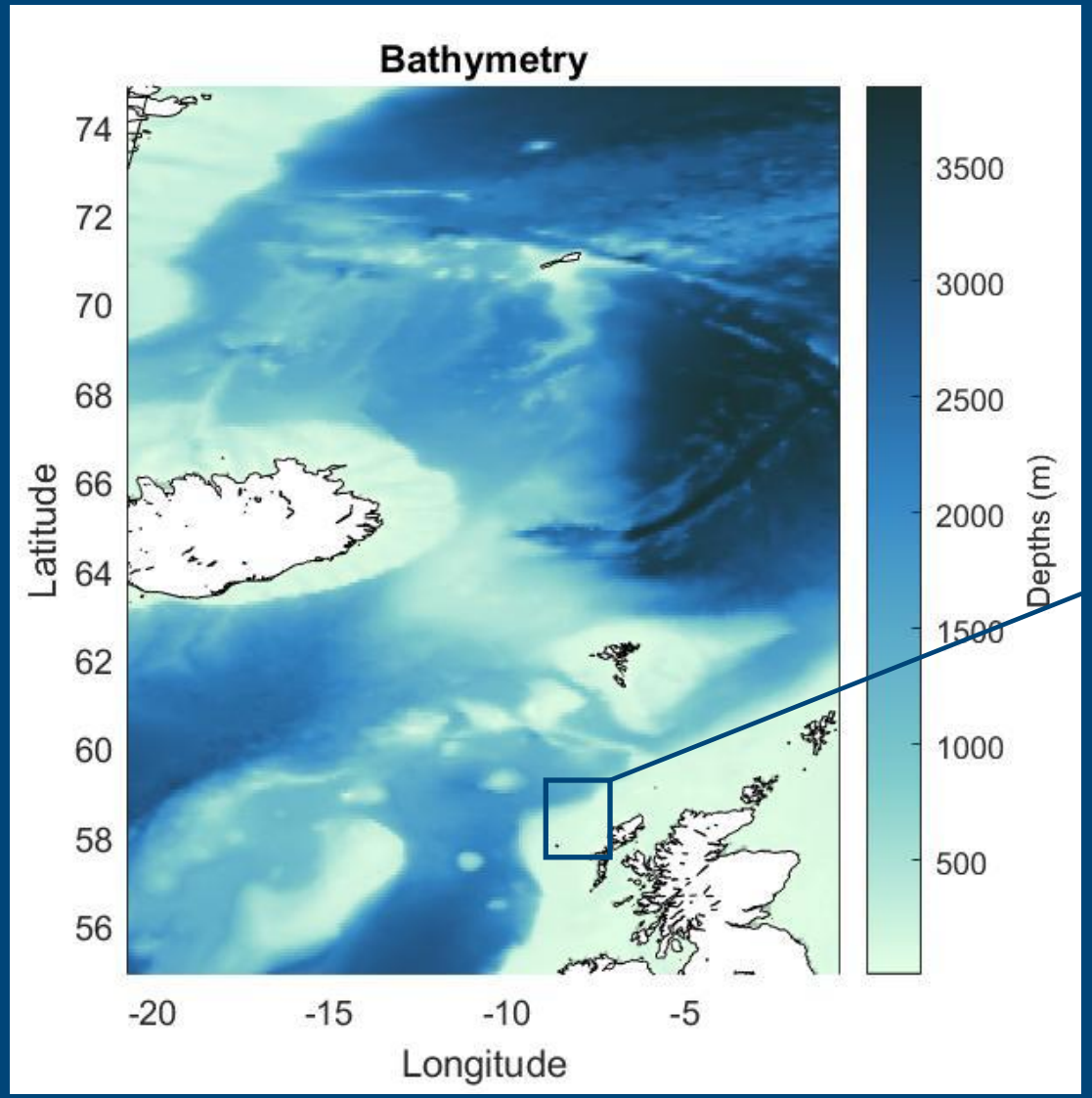
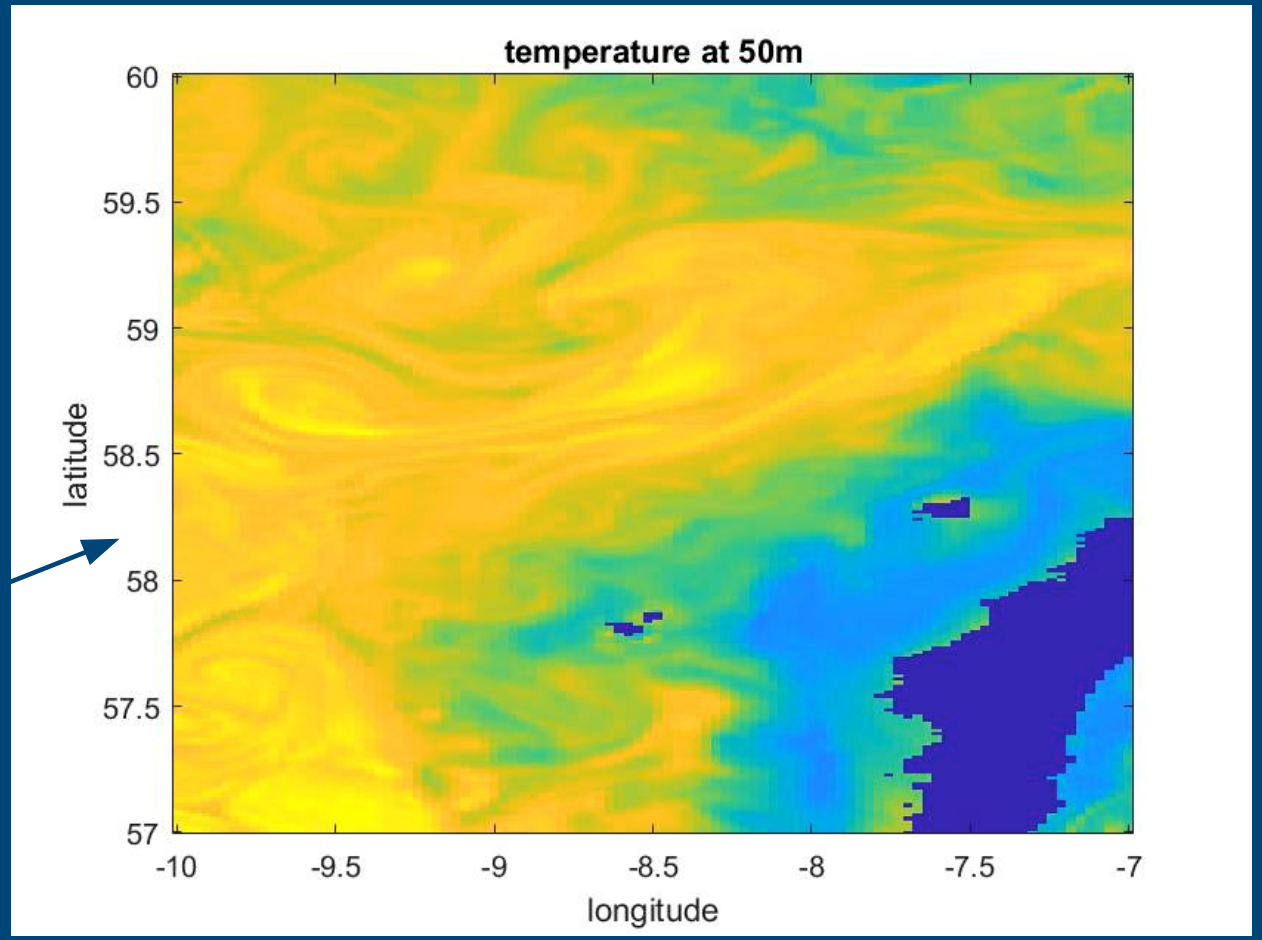
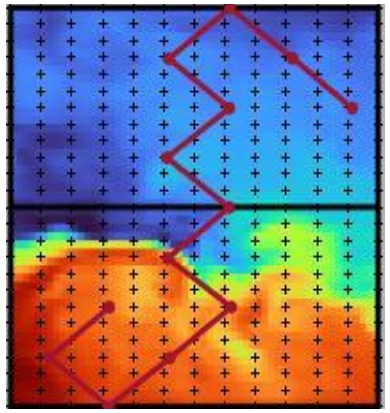




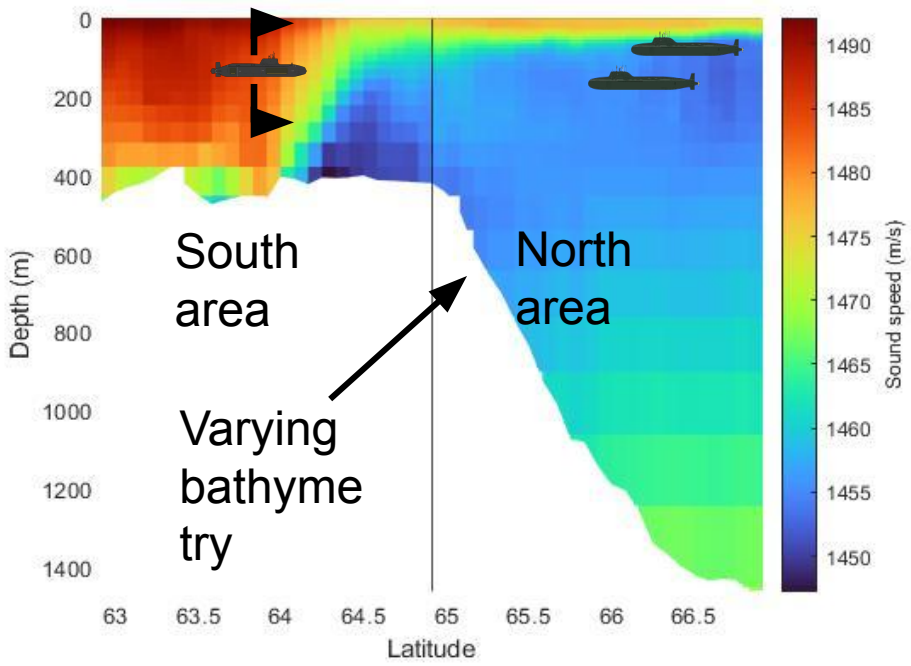
Scenario Modelling



North area

South area

Possible Red Track



Slice/section/transect across front

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Scenario

- Red progressing at 5 kt (example shown)
- Blue in water space 300 NM x 300 NM centred about the frontal axis
- Blue mission duration tied to 36 hr and 48 hr

Environment representation

- Environment sampled on 15 NM grid
- Acoustic models run at about 20 frequencies for sources at 50 m and 150 m
- Red operating shallow and deep (equal time)
- Blue operating over intended depth bracket

Results:
Individual Asset Performance

36 Hour Mission Success %	AUV	XLAUV	SSN
North	9	47	61
South	15	63	93

Number for 95 % Mission Success	AUV	XLAUV	SSN
North	30	5	3
South	18	3	1

48 Hour Mission Success %	AUV	XLAUV	SSN
North	12	52	73
South	25	78	98

Number for 95 % Mission Success	AUV	XLAUV	SSN
North	23	4	2
South	10	2	1

Numbers rounded to sensible integers

- Extending the endurance of autonomous assets is important
- C2 of multiple assets must be considered

Results:
Mission Success with a Force Mix

36 Hour Mission Success %				
	AUV	XLAUV	SSN	SSN + XLAUV
North	9	47	61	79
South	15	63	93	98

48 Hour Mission Success %				
	AUV	XLAUV	SSN	SSN + XLAUV
North	12	52	73	89
South	25	78	98	99

- A single SSN is almost adequate in the South
- To improve missions success North, operate SSN and XLAUV
- Augmenting the force mix with XLAUV assets makes a significant difference to mission success
- With longer duration mission, Blue probability of success is improved
- Extending the endurance of XLAUV important
- Asset placement for best effectiveness: distribution of assets across the operational area – balancing risk, intel, C2, cost, time

Assumptions

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Integration with operational C2

Deployment and recovery assumed achievable

Ownership of capabilities and risk is left open

- Sense – Decide – Act: all done by RN?
- Risk appetite? Attrition? Recovery by threat? Weapon effectors?

Conclusions

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SIGMA can rapidly asses force mix utility.

Always consider sensor, signature and environment

Autonomous system endurance is critical

Implement within a System of Systems architecture

Couple Sigma with conventional OA to inform, Decide and Act phases.

Questions

What are the current blockers to large scale exploitation of Maritime Uncrewed Systems (MUS) by Defence?

- Understanding the force mix to achieve the required effect from that Capability
- Organisation: No single MUS authority to own the Operational requirement, risk, delivery
- Also budget will need to come from somewhere…

What can Defence do to accelerate the operational exploitation of MUS?

- Take some risk: operate a Capability based upon MUS, at scale, end-to-end (integrate into Operations) – mature your thinking by doing for real.

What can Industry do to increase the operational maturity of MUS?

- Industry can take care of the technology integration (and any development needed) but need to understand the required effect


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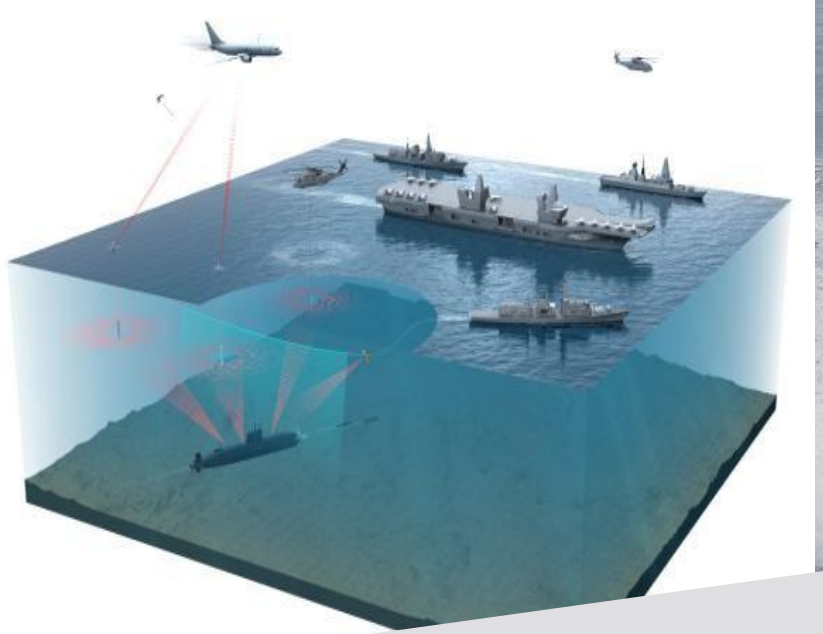
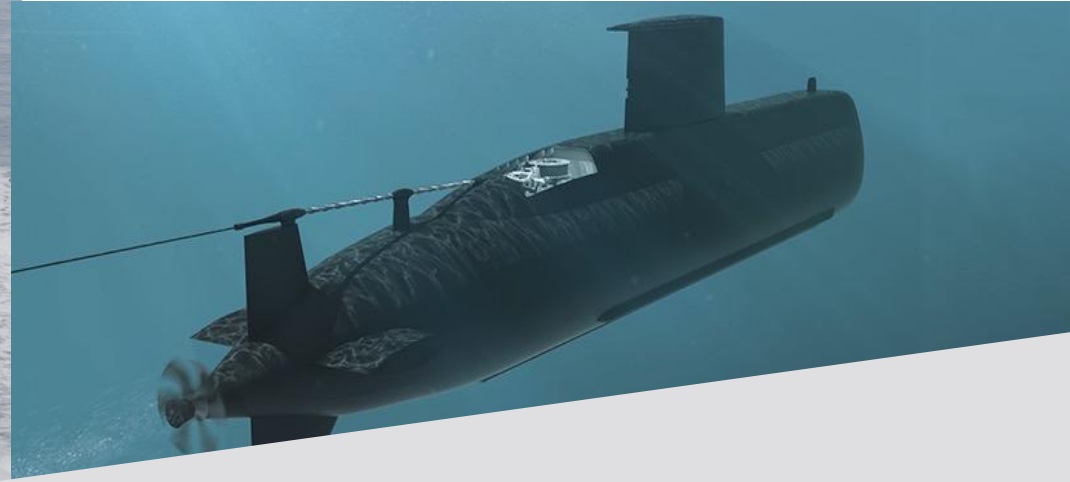




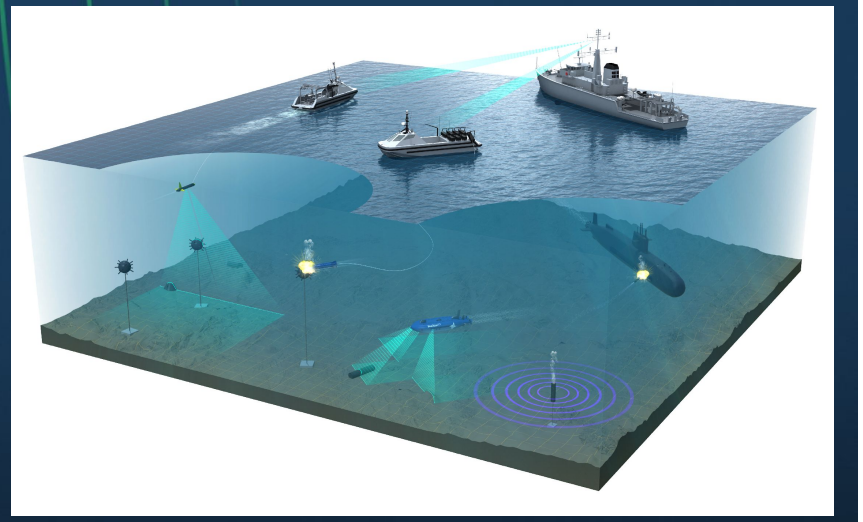
CNE 2023 – The Benefits of a Force Mix

Harry Little, Lou Parkes and Jonathan Carter MBE

Presented by Tim Armstrong, Business Development Lead

AEUK/2023/170
5
May 2023

Overview



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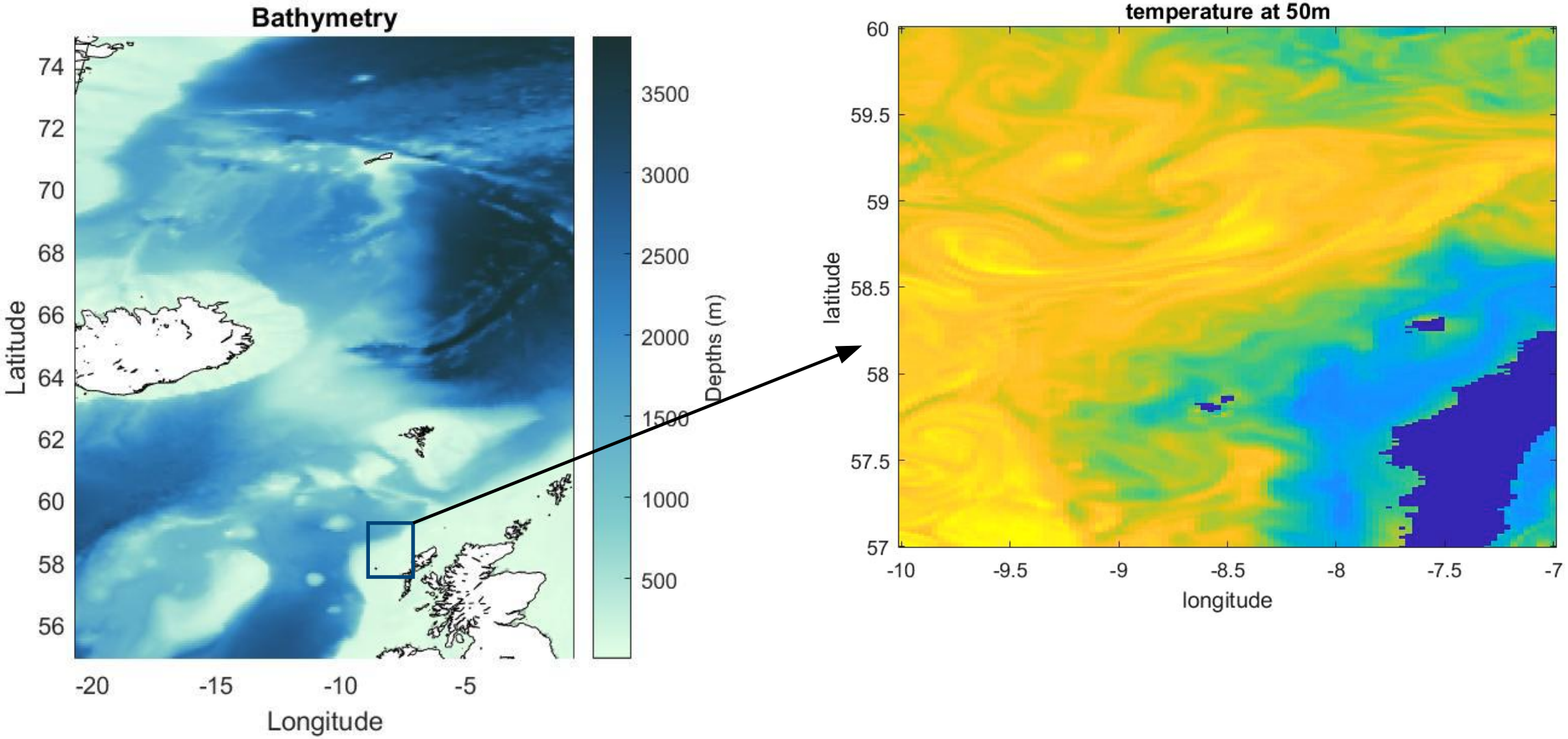

Mission Scenario

Some questions

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Where to employ them – location and depth?

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AEUK's SIGMA tool used to help answer these questions

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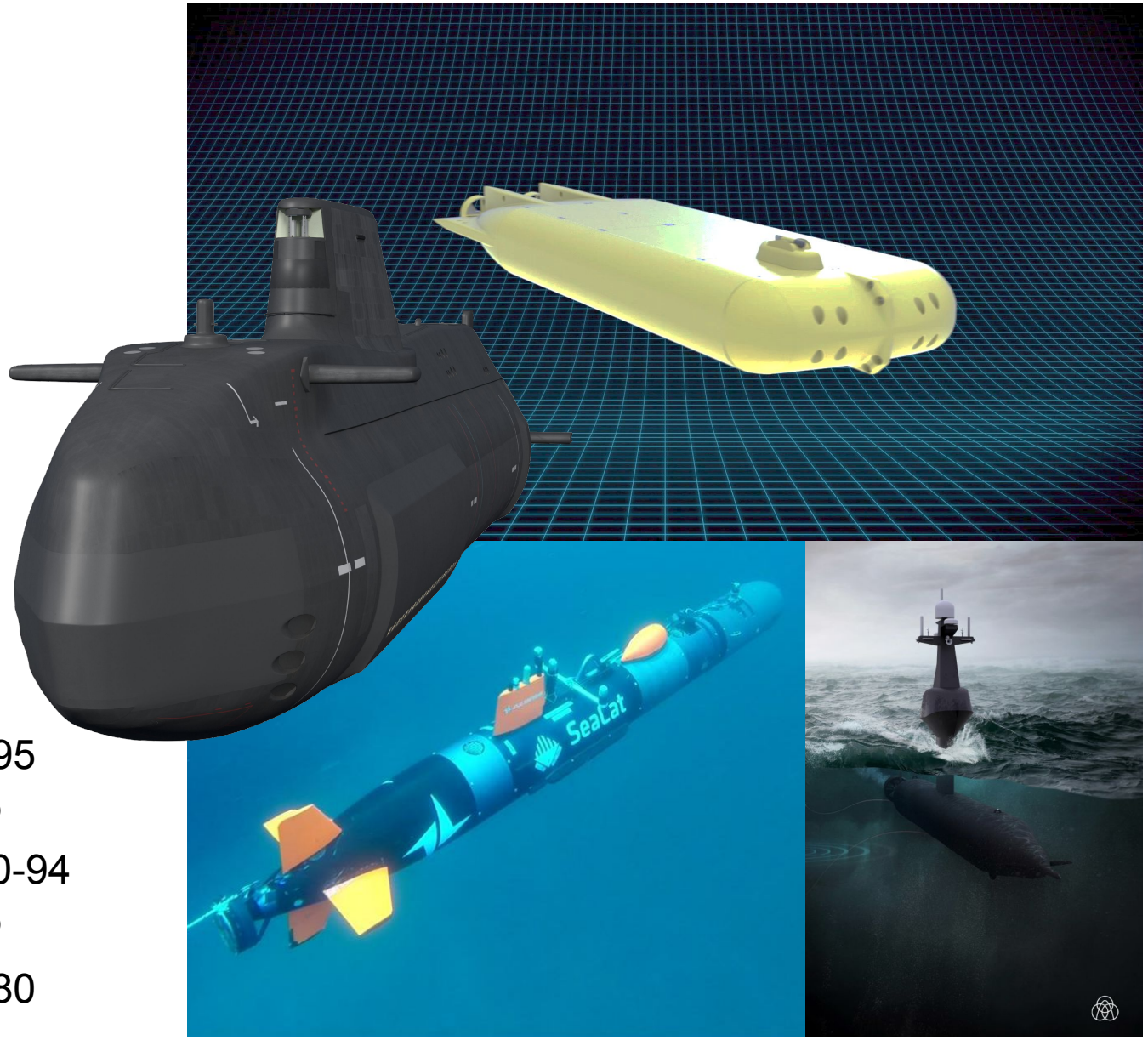


Scenario Modelling

Transit

Variability across locations

Red progressing at 5 kt in a moving haven 35nm x 20nm (example shown)

Blue in water space 300 nm x 300 nm centred about the frontal axis

Blue mission duration tied to 36 hr and 48 hr

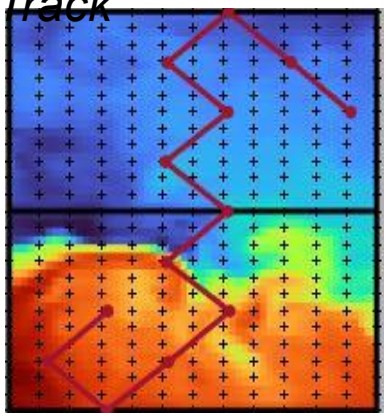
Environment sampled on 15 NM grid

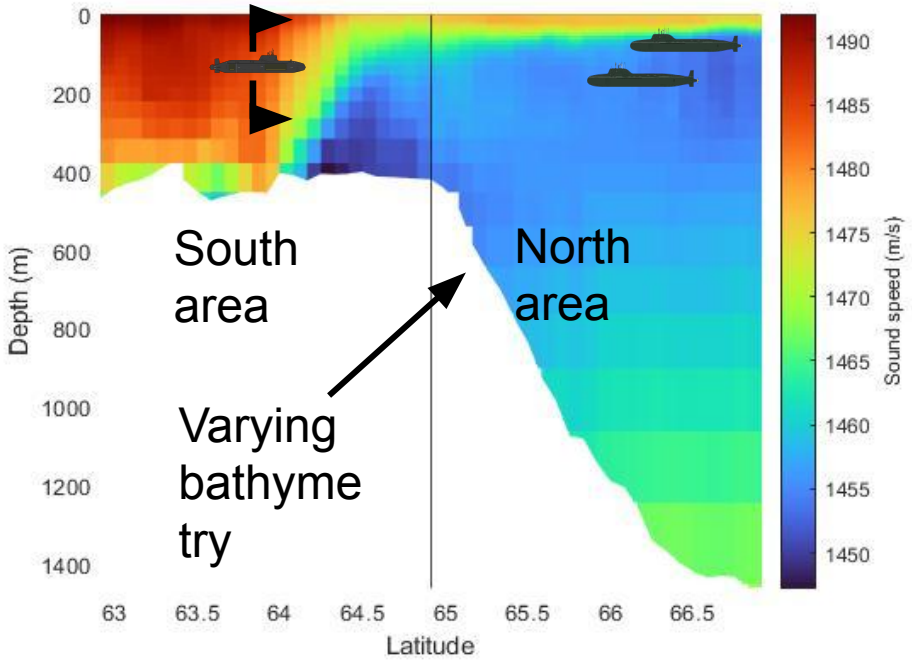
Acoustic models run at about 20 frequencies for sources at 50 m and 150 m

Red operating shallow and deep (equal time)

Blue operating over intended depth bracket

Case 1 – Possible Red Track





Slice/section/transect across front

Results: Case 1 – Mission Success with One Platform

36 hour mission

Mission Success %	UxV	XLUxV	SSN	SSN + XLAUV
North	9	47	61	79
South	15	63	93	

48 hour mission

Mission Success %	UxV	XLUxV	SSN	SSN + XLAUV
North	12	52	73	89
South	25	78	98	

Key Points

- A single SSN is almost adequate in the South (water more homogeneous)… Blue sonar and processing could be better than portrayed
- If SSN and XLAUV both available, It is better to use SSN in North as it is 52% more effective than the XLAUV ((93-63)/63) whereas the SSN is only 34% more effective ((61-47)/47) than the XLAUV in the South
- To improve missions success North, operate SSN and XLAUV
- With longer duration mission, Blue probability of success is improved
- Extending the endurance of XLAUV important

Results: Case 1 – How Many are Required

36 hour mission

Mission Success %	UxV	XLUx	SSN
North	9	47	61
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Number for 95 % Mission Success	UxV	XLUxV	SSN
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Number for 95 % Mission Success	UxV	XLUxV	SSN
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Numbers rounded to sensible integers

Key Points

- Lower capability UUV would be required in significant numbers and a combination of cueing and/or remotely deployable method can be achieved
- Higher Mission Success requires more platforms - for 98%, an additional XLAUV is required in both locations
- Extending the endurance of XLAUV important

Note on assumptions

Modelling approach was designed to assess quickly whether there could be utility in (XL)AUVs used in consort with SSNs

- Operational assumption about detections integrated with C2
- Deployment and recovery assumed achievable
- Ownership of capabilities and risk is left open
- Sense – Decide – Act: all done by RN?
- Risk appetite? Attrition? Recovery by threat? Weapon effectors?

Summary

Force mix with SSN and XLAUV likely to be a route to mission success at tolerable risk

Placement of ASW assets should be done from a mission perspective including sensor, signature and environment

Autonomous system endurance is critical to quantity required

AEUK's SIGMA tool can be used to quantitatively inform force mix

Use in conjunction with ODIN to inform C2

Beyond the 2030s

Threat likely to be more prevalent, more stealthy and with better sonars

Environment likely to be even more complex and more varied – Indo-Pacific, Arctic

However,

Blue sensors and processing improving – a bit larger, better processing, more automation

Onboard 'all sensors' and satellite sensing will improve along with data fusion

Blue signature likely to be further improving and signature management much more mature

David Burton Questions

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