



Simulation, Visualisation + GeoSpatial Data:

A Demonstration of the
Power of Digital Twins and
Simulation in determining
Optimal Solutions Choice

8th SUT/MASTS workshop
Virtual Meeting 8th/9th October, 2020

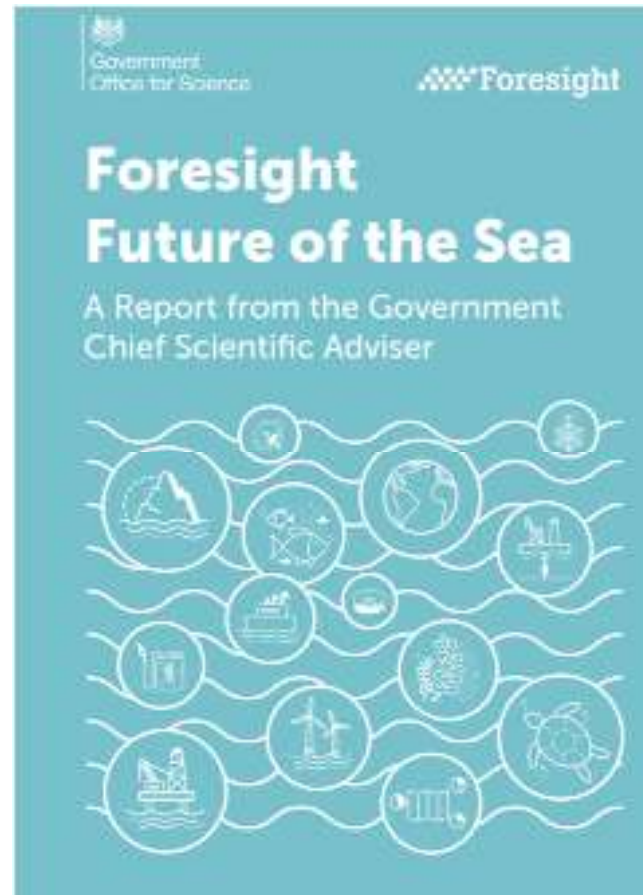


Work Shop: Main Theme: Consistent Decision Making



This builds on the recommendations of the **UK Foresight Future of the Sea Report (2018)**, the specific issue of fragmentation across government and regulatory bodies will be addressed:

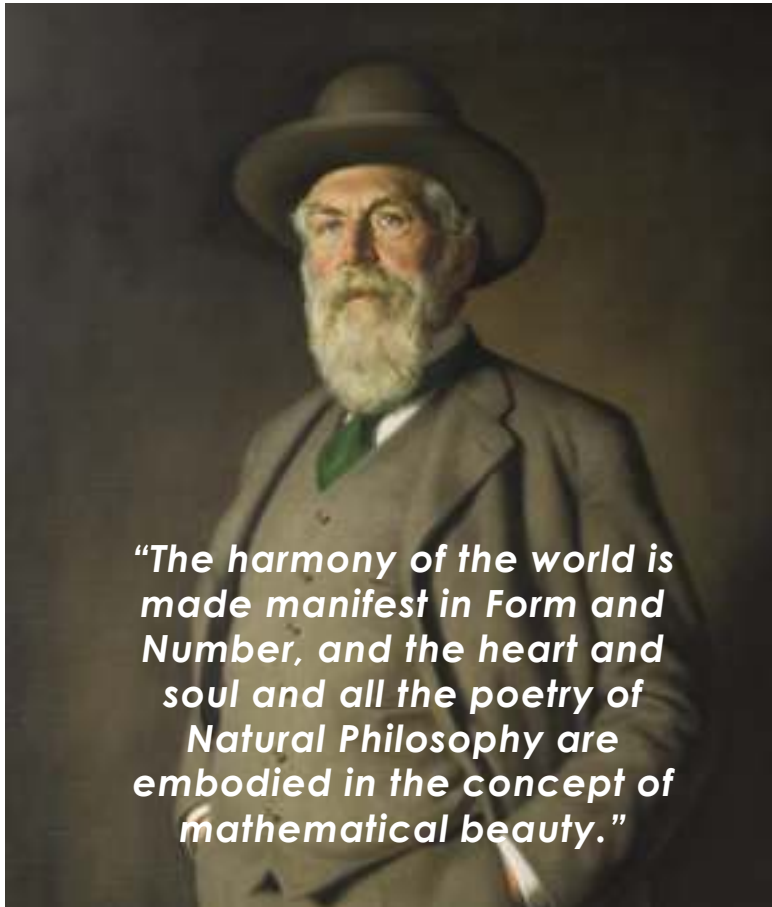
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/706956/foresight-future-of-the-sea-report.pdf



Recommendation 1

The UK should develop a more strategic position, with clear priorities, with regards to its marine interests. This would underpin all the other recommendations made in this report.

D'Arcy Thompson



Sir D'Arcy Wentworth Thompson, reputedly one of the last, great polymaths of the 20th Century, whose career was largely spent between Dundee and St Andrews.

Key elements of his thinking are harnessed in the Simulator Centre that bears his name; not least the fundamental precept that animals, vegetables, minerals and engineers employ the same repeating patterns as 'design solutions', because they are forced to, by the laws of Nature.



Shared Vision/Multiple 'Languages'



The D'Arcy Thompson Simulator Centre's goal is the rapid implementation of Innovation and change in balance with Nature.

We see our **SIMULATION-LED SUSTAINABILITY ASSURANCE** as a cost-effective methodology, because it improves understanding and communication through visualisation, supported by numbers.

By placing people within the UN SDG circle, as if it were an immersive simulation sphere, we emphasise that 'language' varies, even if the vision is shared.



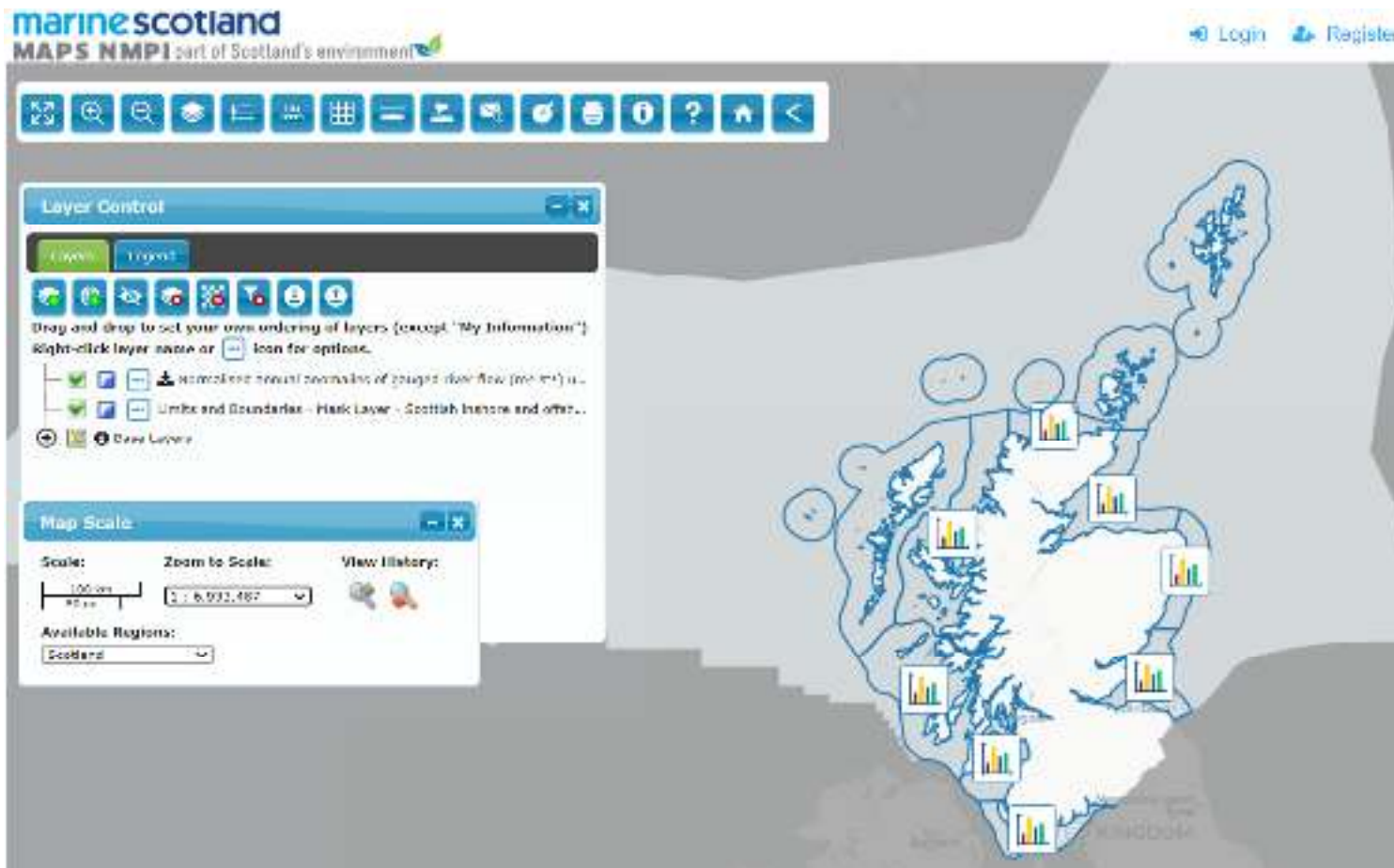
Scotland's Marine Atlas



In words...

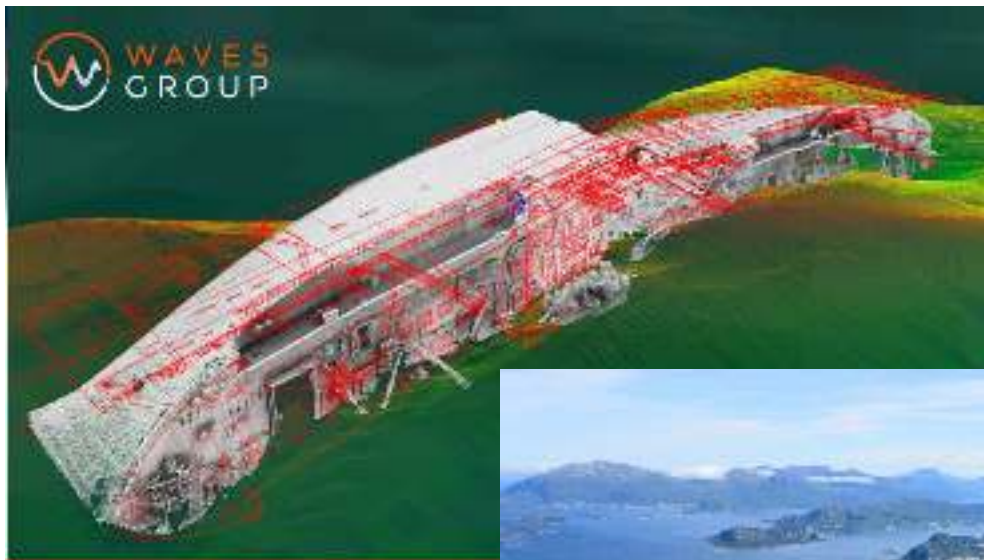
“Scotland's vision is for clean, healthy, safe, productive, biologically diverse marine and coastal environments, managed to meet the long term needs of nature and people.”

National Marine Plan Interactive



Digitally, on a screen...Marine Scotland's National Marine Plan Interactive (NMPI) is a wonderful resources, but the picture it gives is still flat.

Environmental Functional Mock-Up Interface (E-FMI)

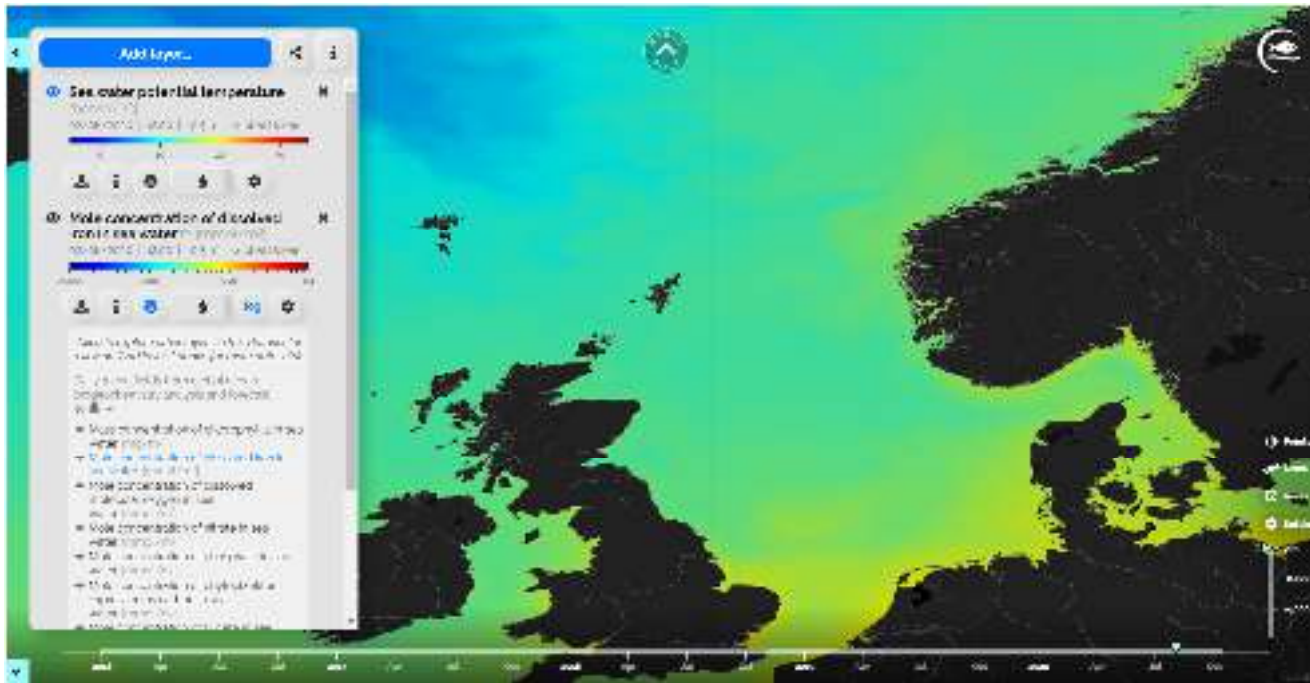


The goal is – live, in real time and in multiple dimensions – is to get natural phenomena and human activity to faithfully interact.



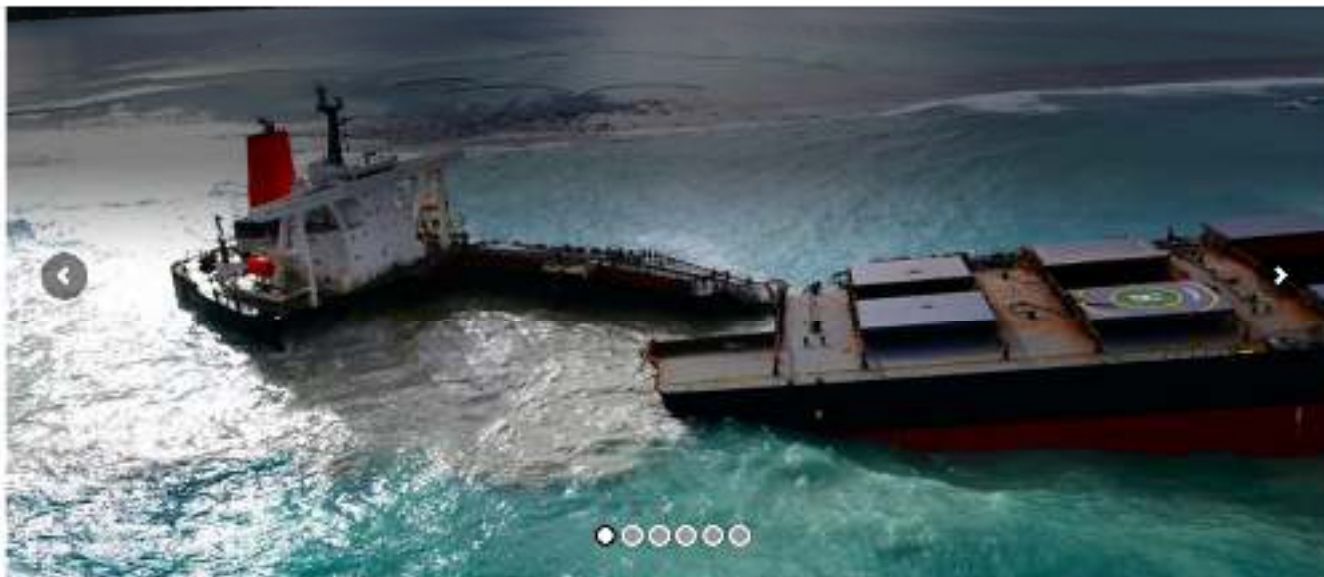
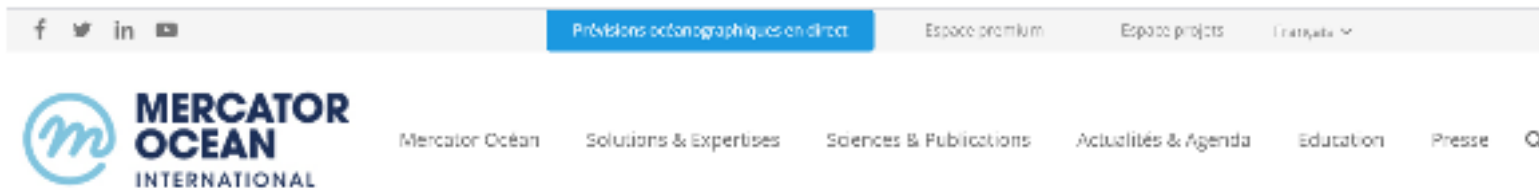
This requires method and rigour in data collection, sound method in fusion, and state of the art visualisation and graphics.

Satellite Data



As many of us aware, there are now burgeoning data sets from satellites in space, and the challenge is how best to utilise them to achieve the breadth and depth required to make good onsite decisions.

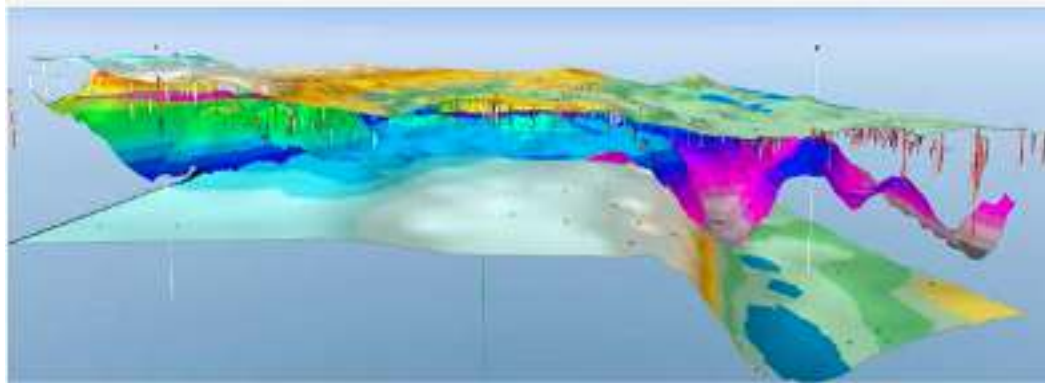
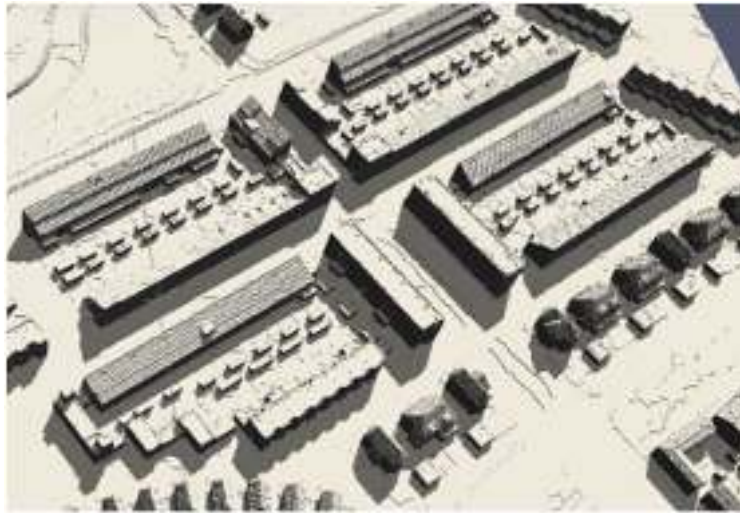
Copernicus/Mercator



Some of which, particularly in marine salvage and wreck removal have immense implications to local and regional flora and fauna. This also means financial liability...

GeoSpatial Visualisation

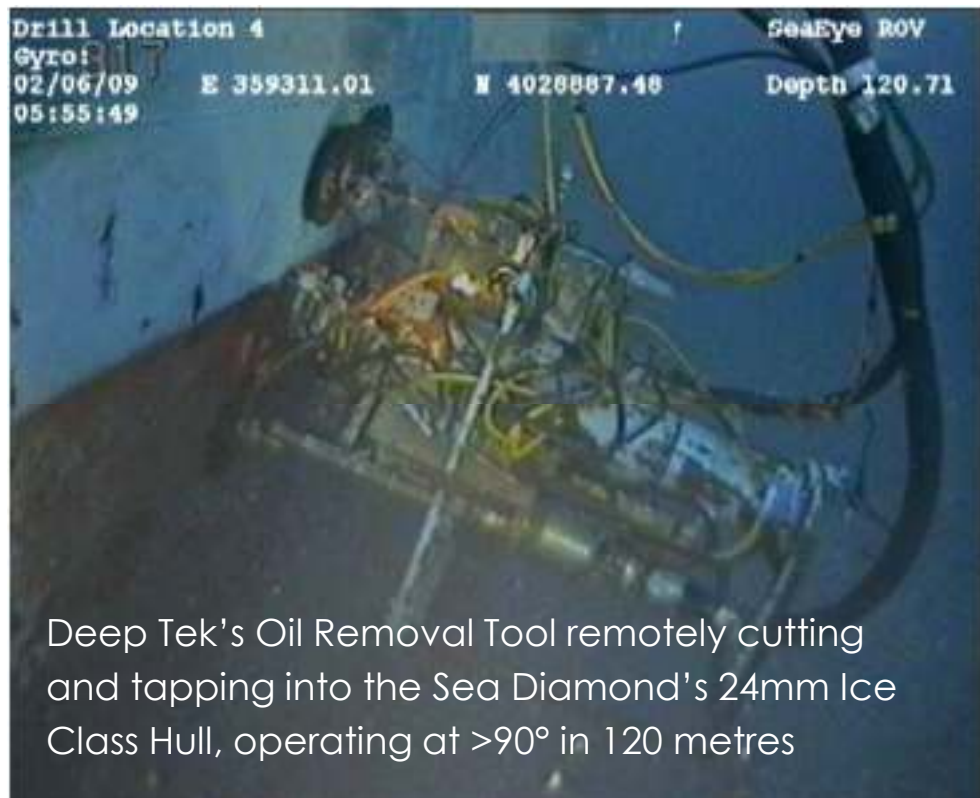
...and the impact on everyday lives.



...there is also the challenge of interfacing with other, existing ground-breaking software, whilst maintaining both fidelity and traceability.



Aim: Reliable, Safe, Responsible + Efficient Onsite Operation



The aim being to improve the chances of reliable, safe, responsible and efficient onsite operation, using a minimal amount of energy and materials to do a maximal amount of work.

Ironically, this very practical quest starts with something completely imaginary – co-ordinates...



Co-ordinates

**73.7238N,
13.2662E**

<https://www.youtube.com/watch?v=64CrpkdluUY>



Indicative position of loss of a number of Soviet and US Nuclear Submarines (note: all except the bow section of the Kursk was raised)



With this beautifully simple and age old code, made up of a handful of letters and numbers, we can begin to focus on any number of things:

- +/- ecosystem impact (over time);
- the delivery of function in designated service in design (aka rapid virtual prototyping);
- operational planning;
- salvage and subsea emergency response; or as here,
- here, legacy AMMOSS* legacy issues.

*Anthropogenic Matter, Materials, Objects, Structures and Substances

Soviet Submarine, Komsomolets



NOTE: underwater, one can only see a portion of the submarine, at a time.



In assessing the potential impact of the this wreck, research with respect to radioactive nuclides in the Arctic led to the dumped nuclear reactors off Novaya Zemlya and the nuclear weapons facility at Mayak:

<https://en.wikipedia.org/wiki/Mayak>



Mayak: 55.7125° N, 60.848056° E



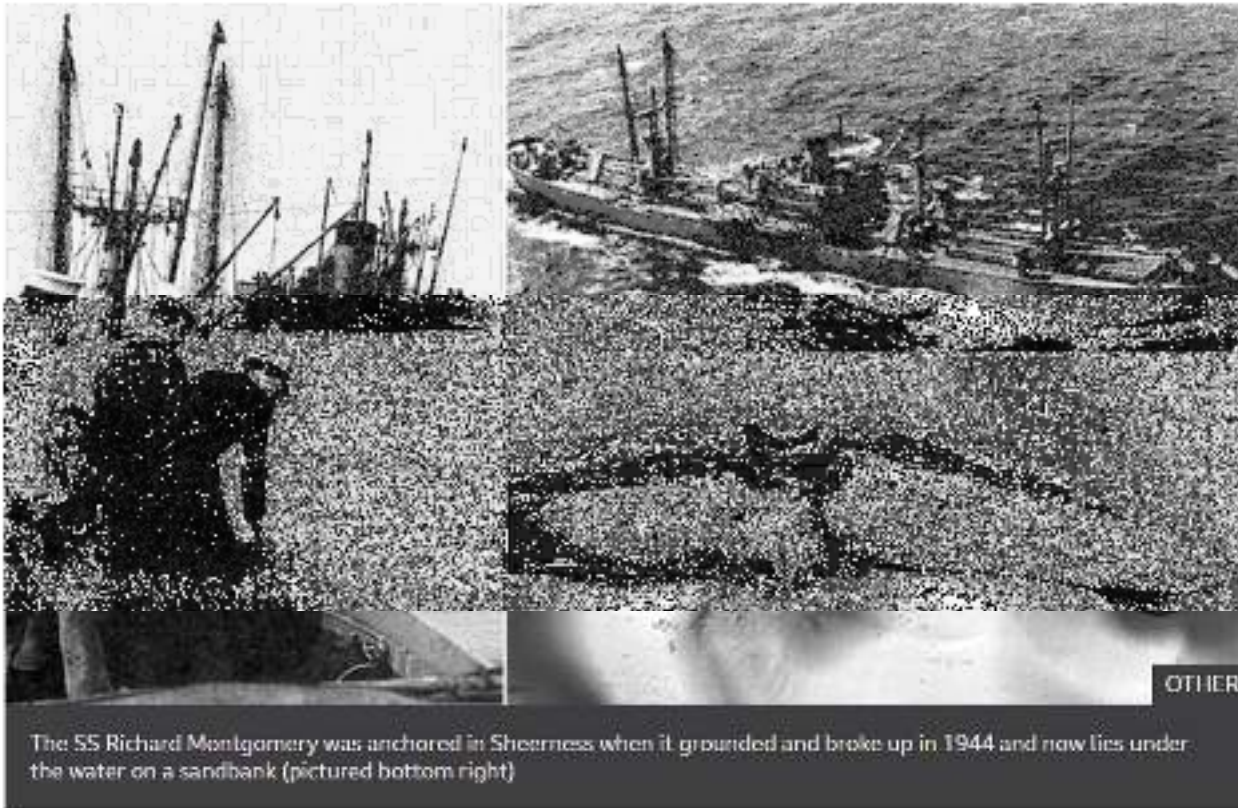
One of the most polluted places on earth.



In its early years of its operation, the Mayak plant directly discharged high-level nuclear waste into several small lakes near the plant, and into the Techa River, whose waters ultimately flow into the Ob River. **Mayak continues to dump low-level radioactive waste directly into the Techa River today.**

UK Issues

ss Richard Montgomery: 51.465833N, 0.786667E



The SS Richard Montgomery was anchored in Sheerness when it grounded and broke up in 1944 and now lies under the water on a sandbank (pictured bottom right)

The masts are set to be cut from a wartime shipwreck in the Thames Estuary that is packed with 1,400 tonnes of explosives.

Courtesy: BBC News



Beaufort's Dyke

Bombs dumped in Irish Sea make bridge plan 'too dangerous'

Experts pour cold water on Boris Johnson's idea for Scotland-Northern Ireland link



▲ Second world war bombs recovered in Germany in 2020. Photo

Courtesy: The Guardian

Courtesy: New Scientist



UK Issues

Motor Tanker Pecten: Co-ordinates?



Loss Position given as $56^{\circ} 22'N, 7^{\circ} 55'W$, but she has never been found. **Cargo: 9,546 tons of Admiralty fuel oil**



HMS Royal Oak:
 $58.928889N, -2.98583E$



The munitions on HMS Royal Oak are also a concern; a fact made extremely sensitive due to the loss 834 lives, when she was sunk.

'Solutions Options/Solutions Choice'



There are literally thousands of wrecks, all over the world, owned by the UK Government. Most will decay slowly over the decades and centuries, with no long term, significant, negative ecosystem impact - but not all.

The question for these 'potentially polluting elements' (identified in AMMOSS) **is how do we deal with them openly, transparently and consistently?**