SUBSEA CABLE RESILIENCE TO CLIMATE AND WAVE THREATS

National Oceanography Centre

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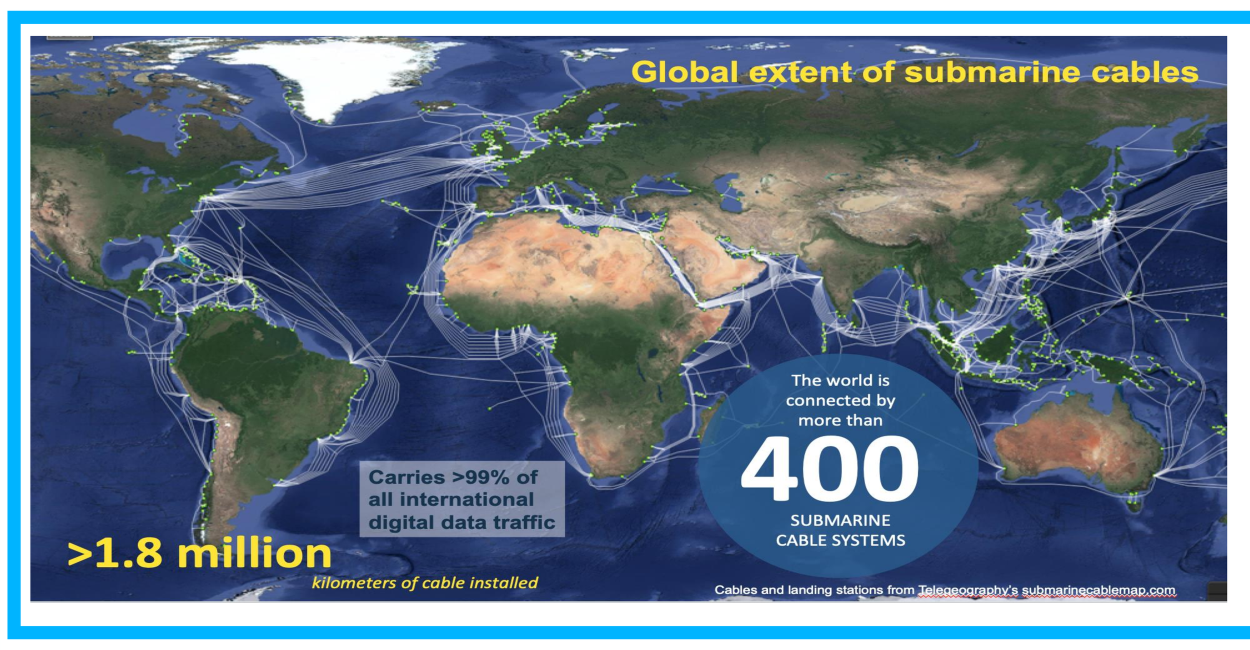
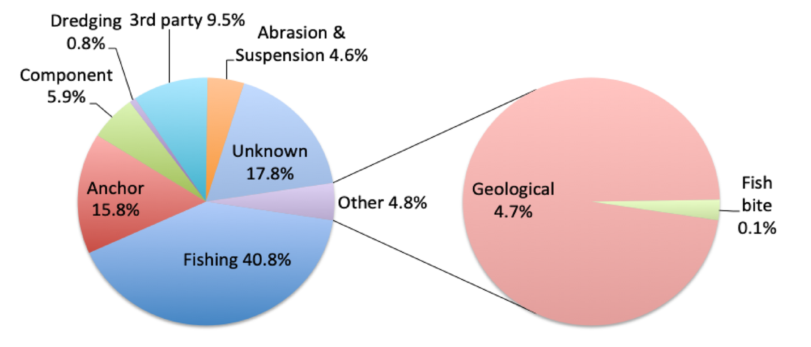


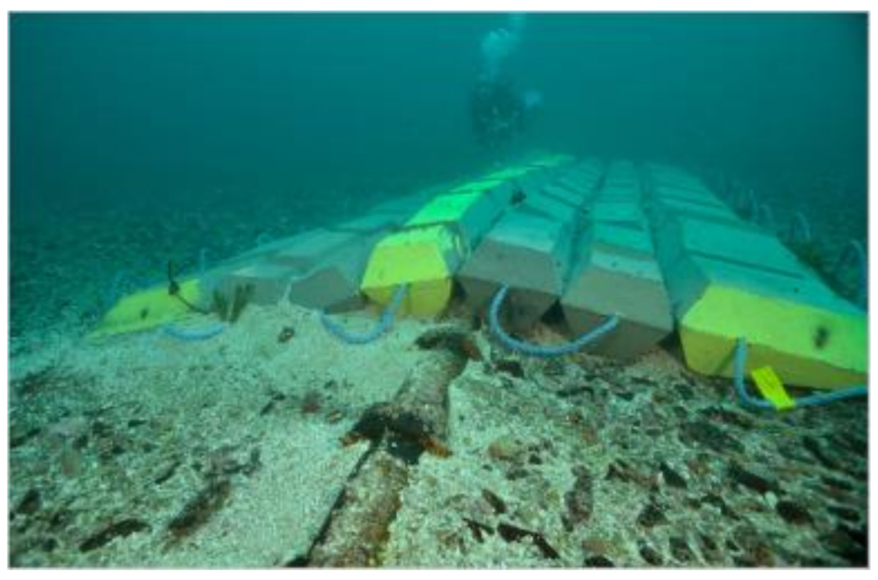


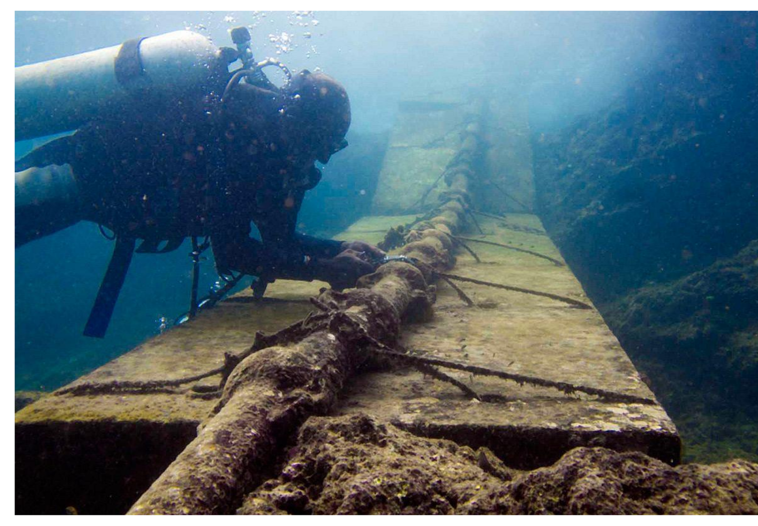
Natural hazards-related faults include geological, abrasion, and suspension faults; the latter primarily relating to the effects of seabed currents. Damage related to fish bites has not occurred since 2006 as a result of revised cable designs

Introduction

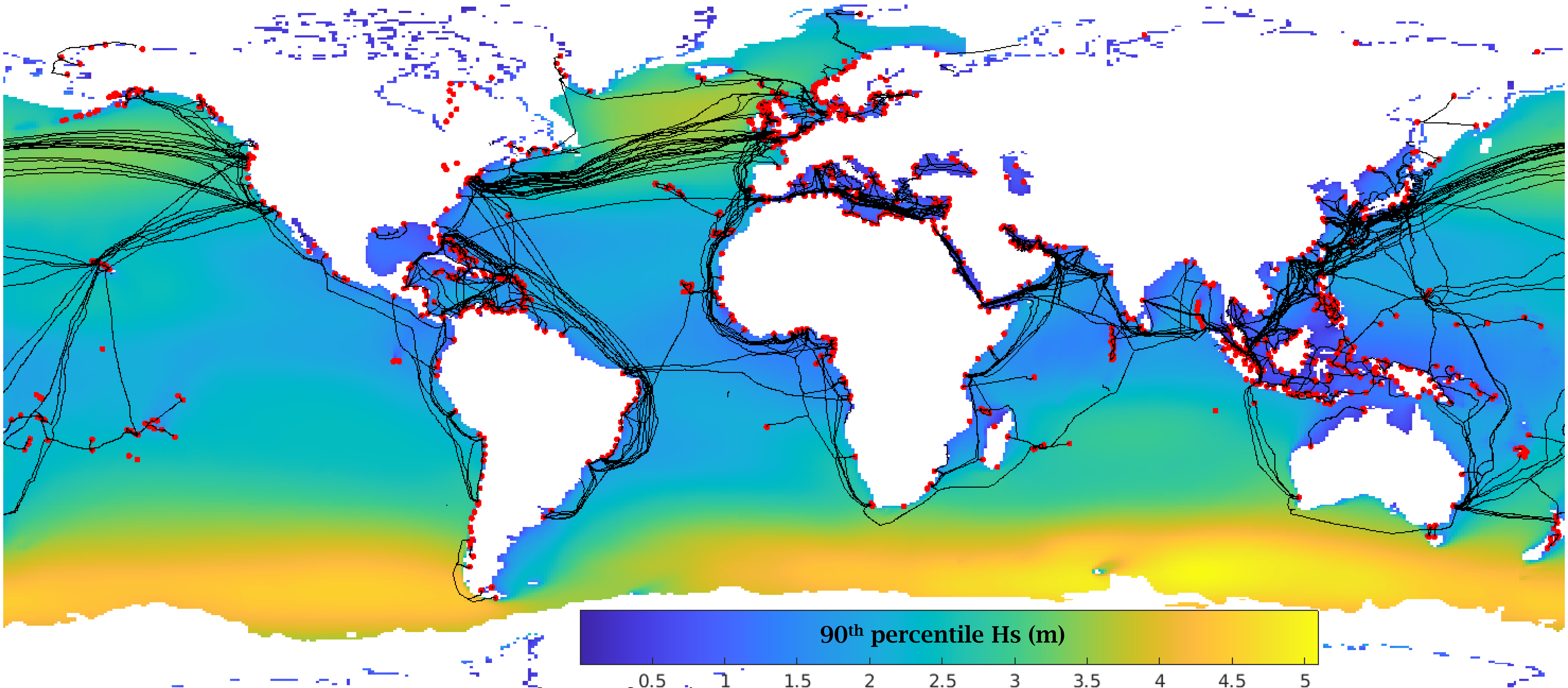
Despite their importance, subsea cables are vulnerable to damage by natural hazards, including storms, beach erosion, underwater landslides, and human activities (e.g. fishing and shipping). Natural hazards are particularly significant as they can synchronously damage multiple cable systems across large areas, isolating whole regions.

Storm surges in 2012 knocked out Internet connections in New York, tropical cyclones offshore Taiwan in 2009 halted financial trading, while extreme river flooding 'crippled' internet connections across W Africa during 2020's COVID-19 lockdown.





Average significant wave height (Hs) and locations of subsea cables (black) and landing stations (red)



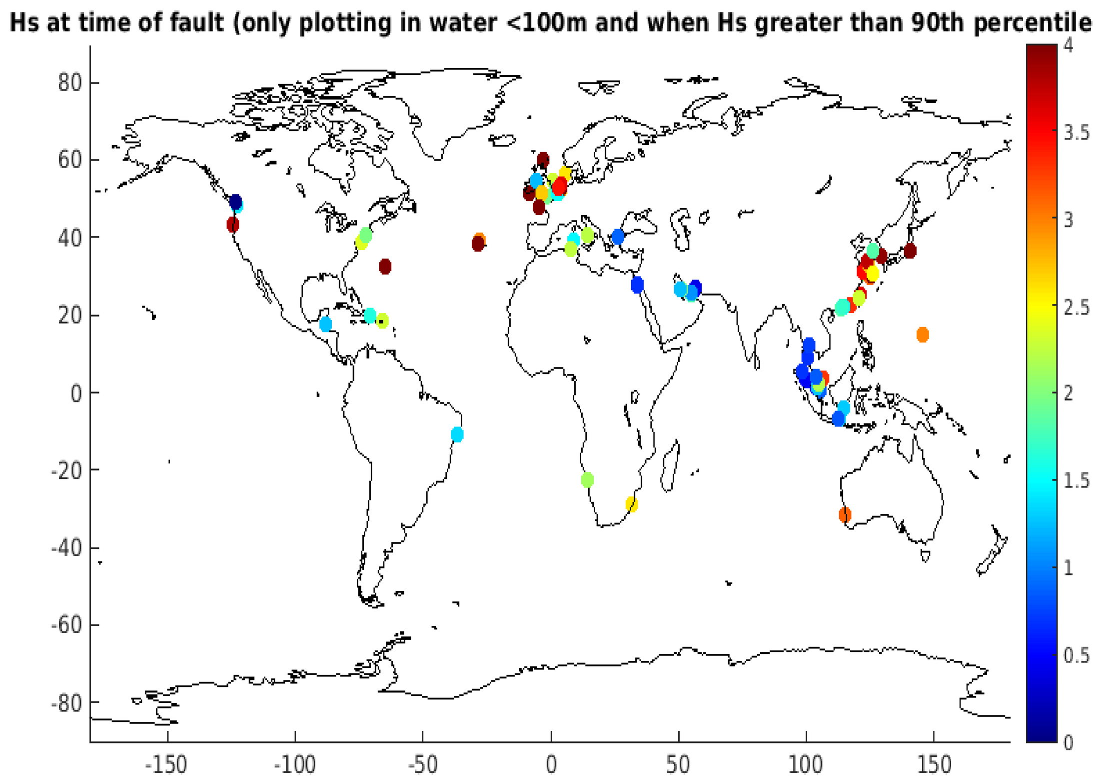
Attribution: could it have been the waves?

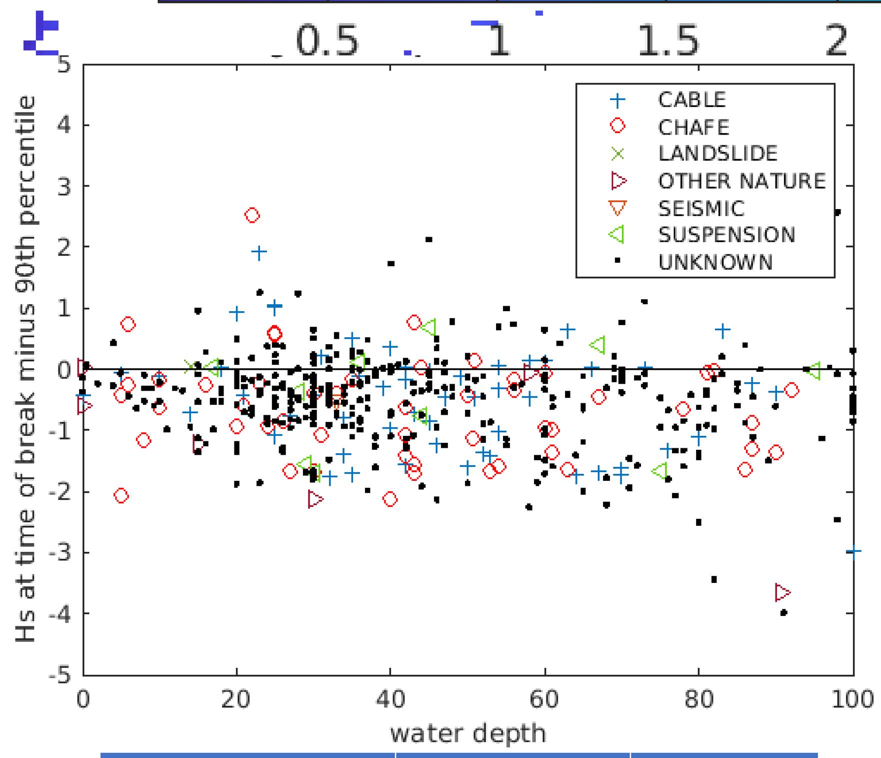
We had access to a new data base of 5817 cable break events. Method to select candidates:

- Water shallower than 100m
- Waves bigger than local 90% Hs

Corresponding to 17% of those classified as 'cable fault' and 9% of 'unknown' origin

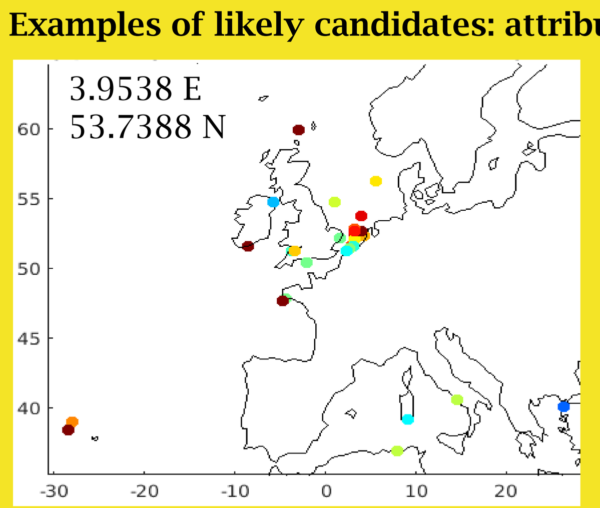
Hs at time of fault (only plotting in water <100m and when Hs greater than 90th percentile

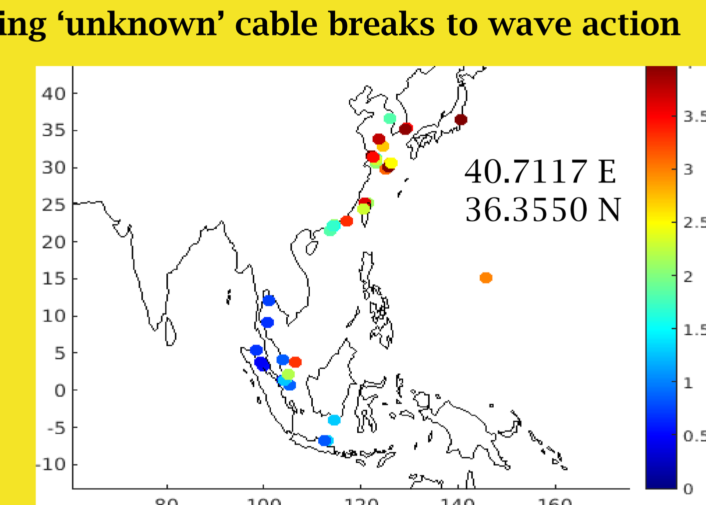




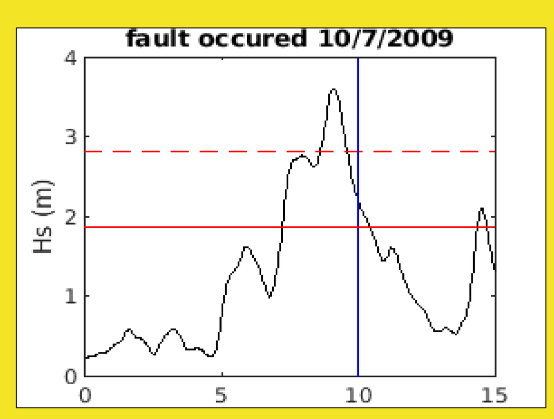
Category	Total analysed	Meets criteria
Cable	106	18
Chafe	154	7
Landslide	37	1
Other nature	49	1
Seismic	172	0
Suspension	49	4
Unknown	777	67

Examples of likely candidates: attributing 'unknown' cable breaks to wave action

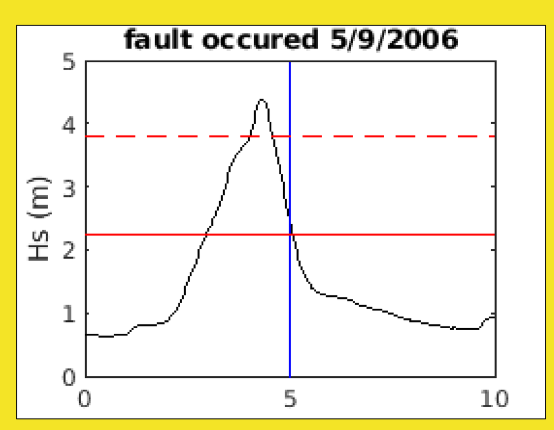




Significant wave height at time of cable breaks: Fault 383 left and 349 right)

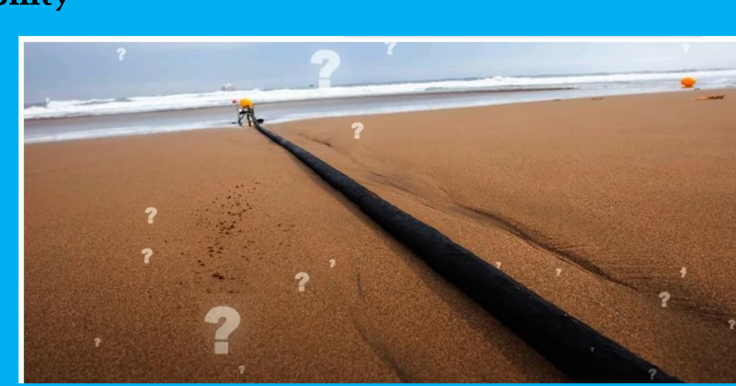


Wave height time series. The local 90th percentile (solid line) and 99th percentile dashed line



How can we increase network resilience?

- Know where the vulnerabilities are (mapping) and where they might change in future (climate projections)
- Calculate combined wave & current bed stresses Project (armour / anchor / bury) and reroute cables where possible
- Better knowledge of changing sea-levels, combined with changing storminess will inform maps of seabed vulnerability



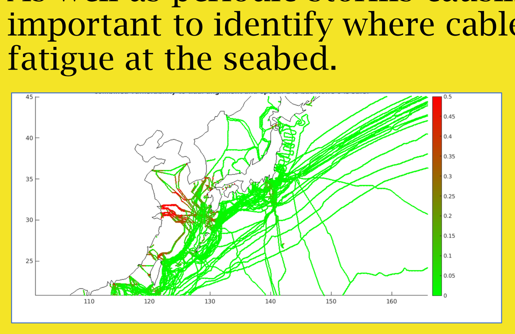
Climate Change threats

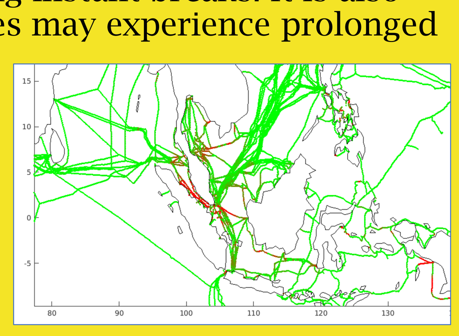
As well as changing storm impacts at the seabed, sea-level rise can lead to inundation of data centres, power stations, landing stations and terrestrial cables.

Changing erosion and sediment transport pathways can expose, suspend and abrade previously buried cables, undermining shore-based infrastructure

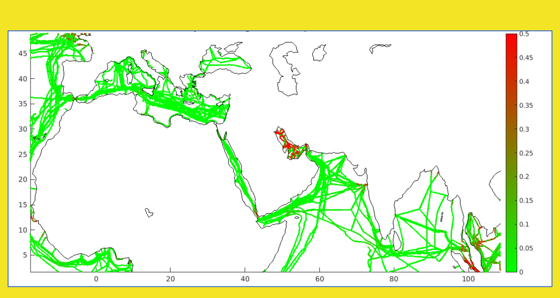
Fatigue from tidal currents

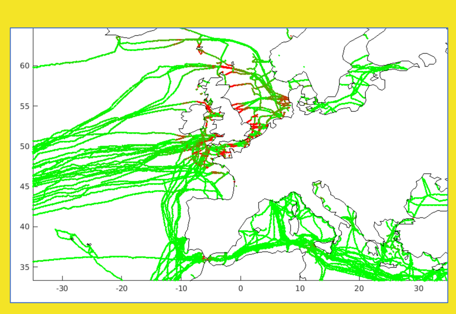
As well as periodic storms causing instant breaks. It is also important to identify where cables may experience prolonged fatigue at the seabed.





In areas of strong tides, fast currents move across cables. These maps show red 'hot spots' where tidal currents are both fast and orthogonal to subsea cables





Further reading

Clare, M., Isobel Yeo, L. Bricheno, Yevgeny Aksenov, J. Brown, Ivan David Haigh, Thomas Wahl, Josh Hunt, Clarence Sams, Jason D. Chaytor, Brian J. Bett and Lynne M. Carter. "Climate change hotspots and implications for the global subsea telecommunications network." *Earth-Science Reviews* (2022)