The Role of Seabed Mapping in Ocean Science: An Improved Understanding of Sediment Dynamics

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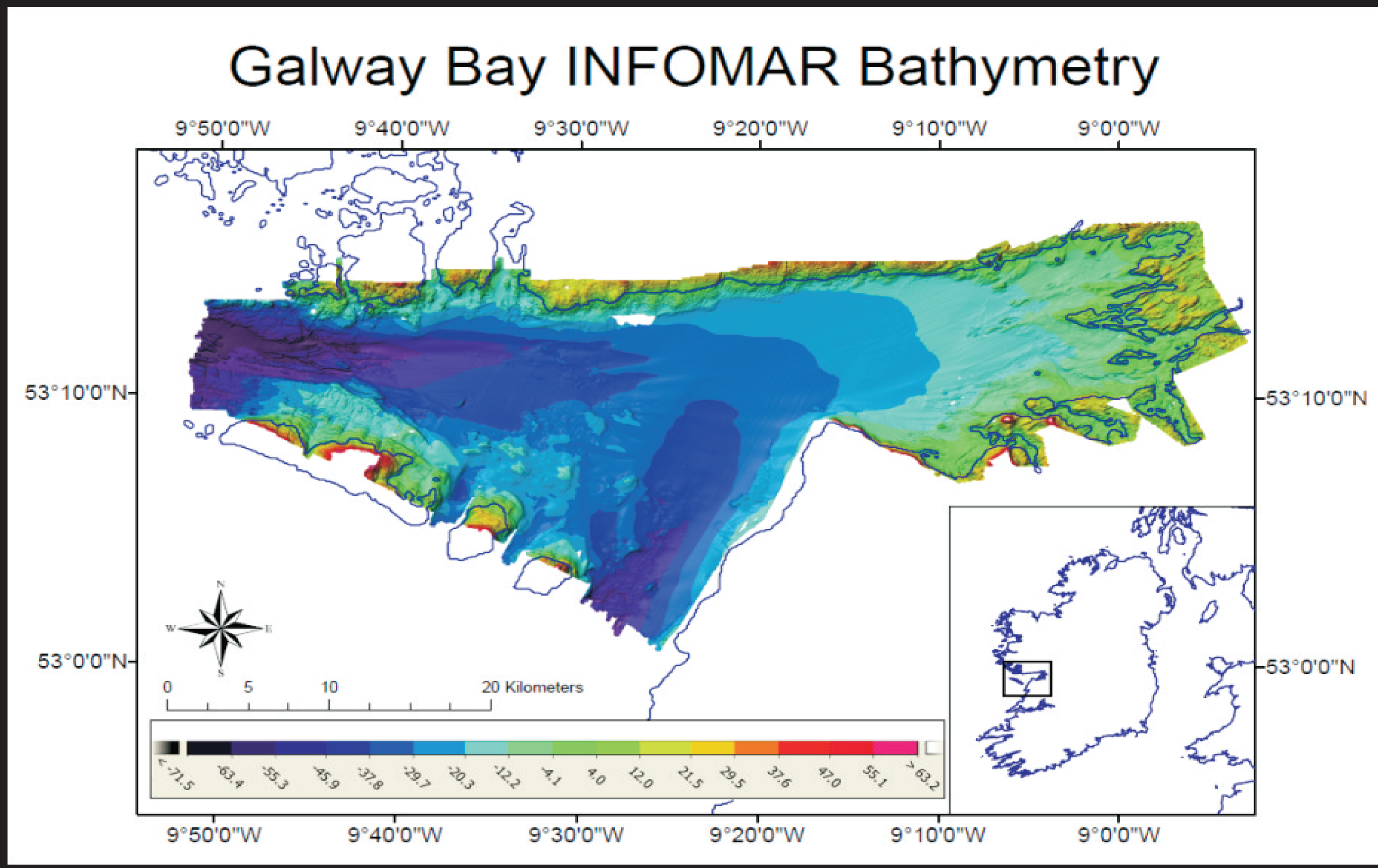
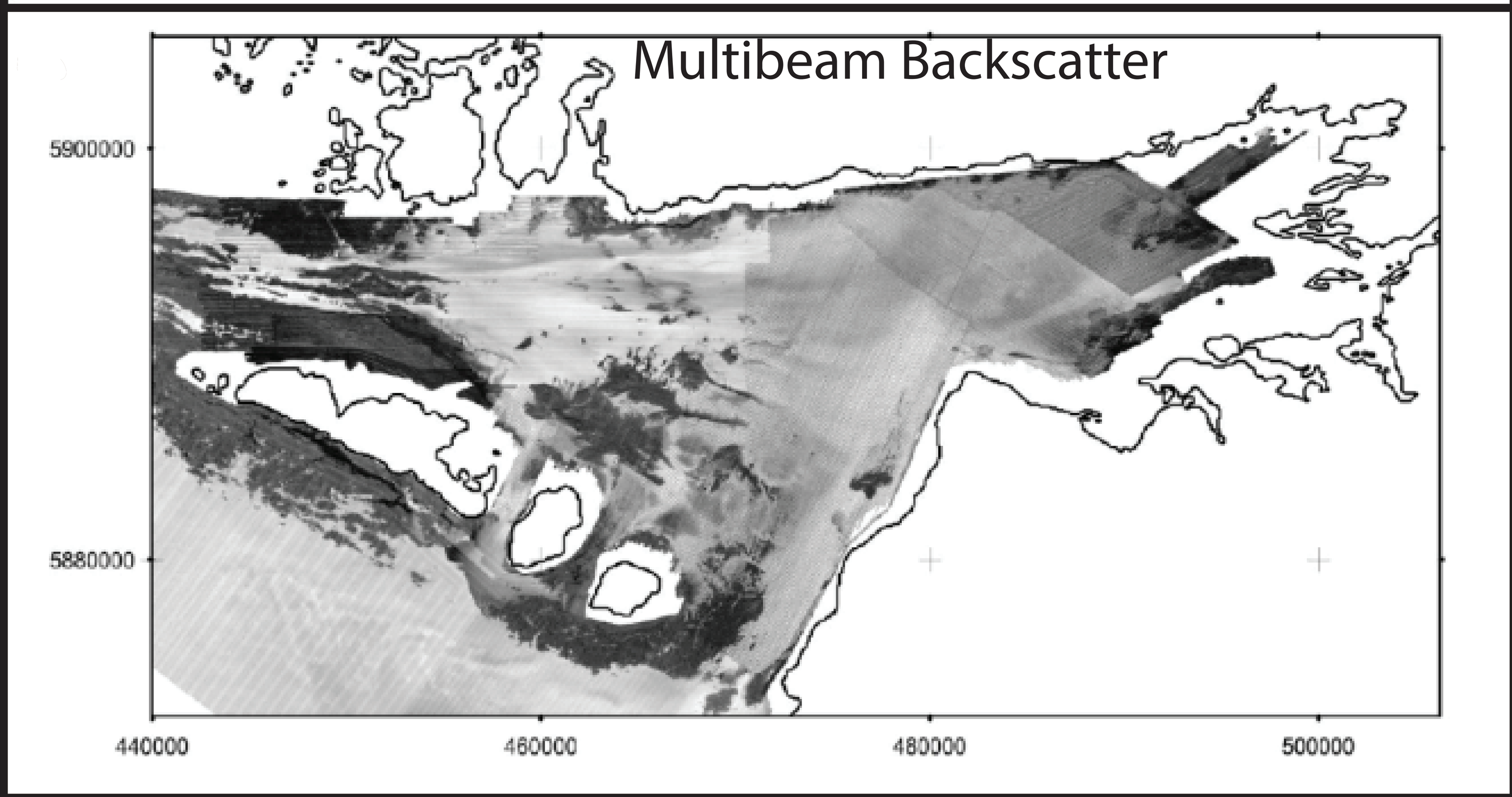
Royal Society Seabed Mapping Workshop

Seabed mapping data from national seabed mapping programs such as Ireland's INFOMAR program provides a high resolution image of the continental shelf. Multibeam echo-sounder and LiDAR data provide detailed bathymetric data as well as backscatter maps of the seabed. By utilising coupled numerical modelling, this case study from Galway Bay obtained detailed understanding of the sediment dynamics of the region under a combined wave-current hydrodynamic regime.

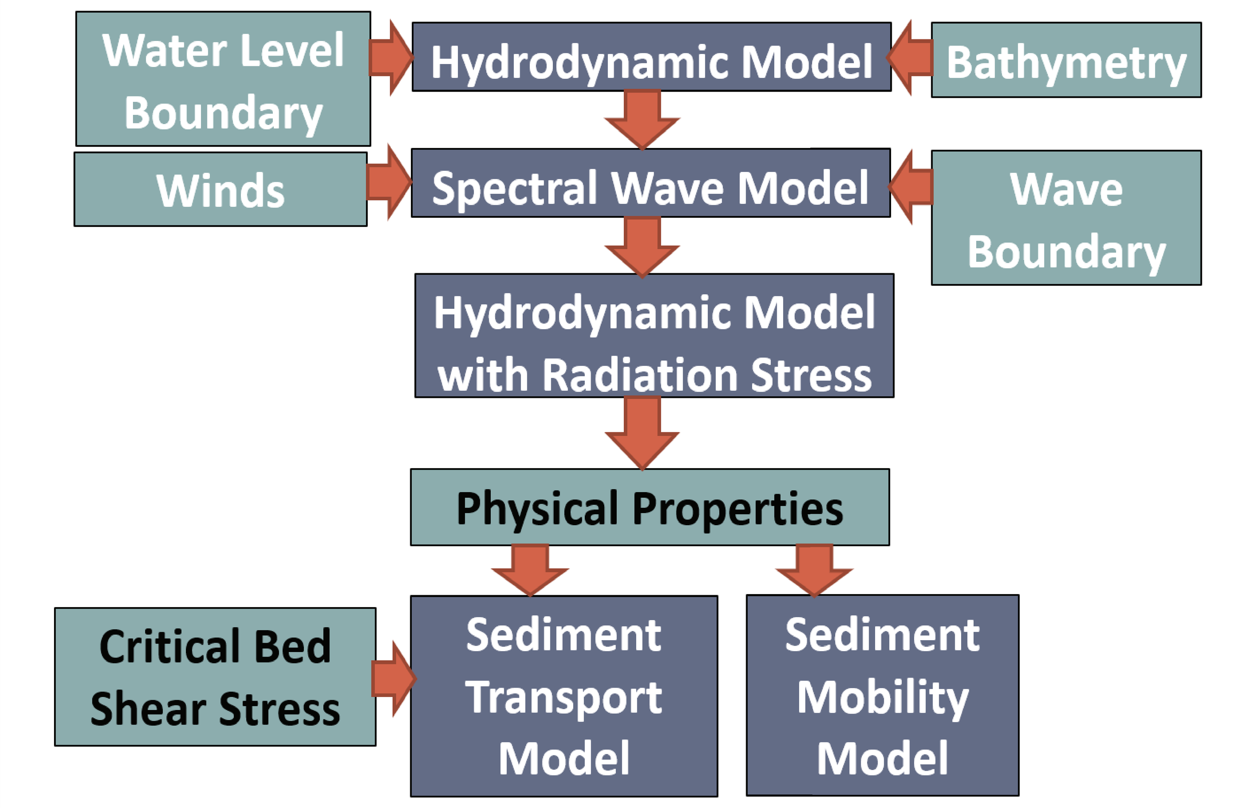
The main outputs include the sediment mobility indices during calm and storm conditions (for combined wave-current regime), the sediment transport model outputs showing the bed level change and rate of sediment transport in the region. Residual currents map shows that the maerl or rhodolith coralline alga are found at the periphery of the residual current gyres.

Furthermore, by utilising the grain size database of the region, supervised classification machine learning techniques utilising the multibeam backscatter and grab samples are used for extrapolation of the geological habitats. Novel work integrating the sediment mobility models and the seabed classification using supervised machine learning suggests that sediment dynamics is very important in governing the distribution of maerl/rhodolith habitats.

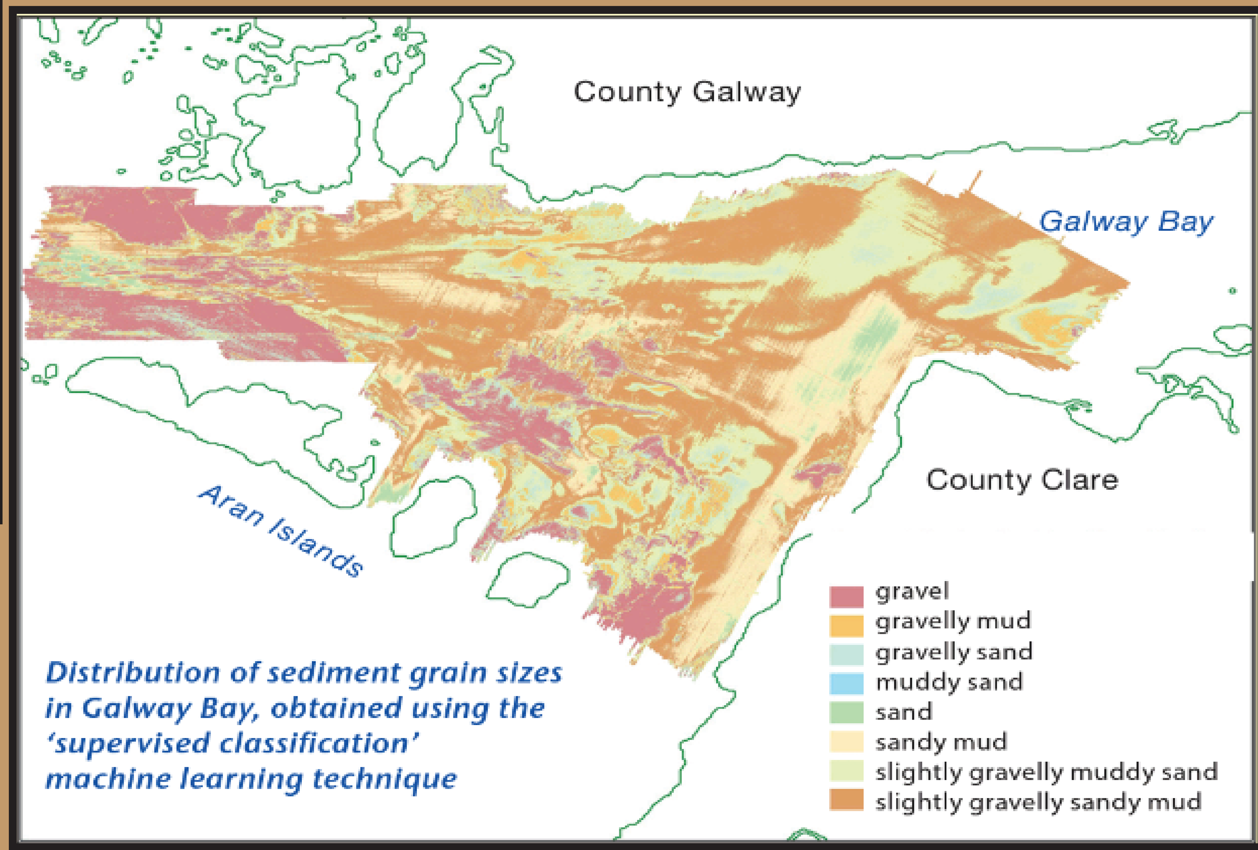


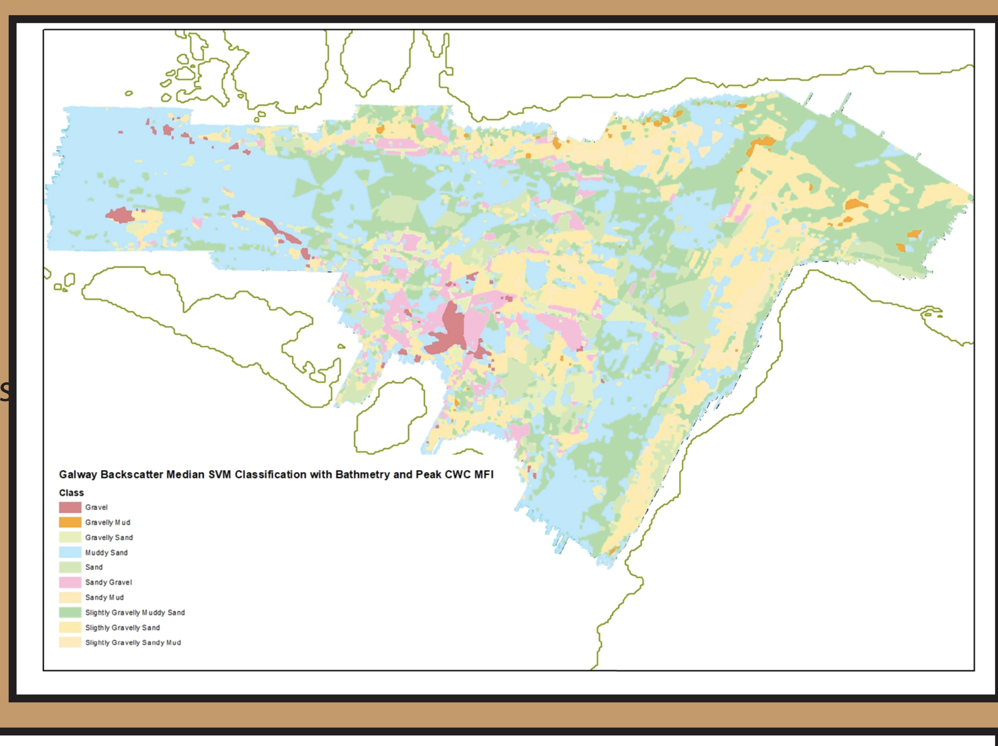


Coupled Modelling Methodology

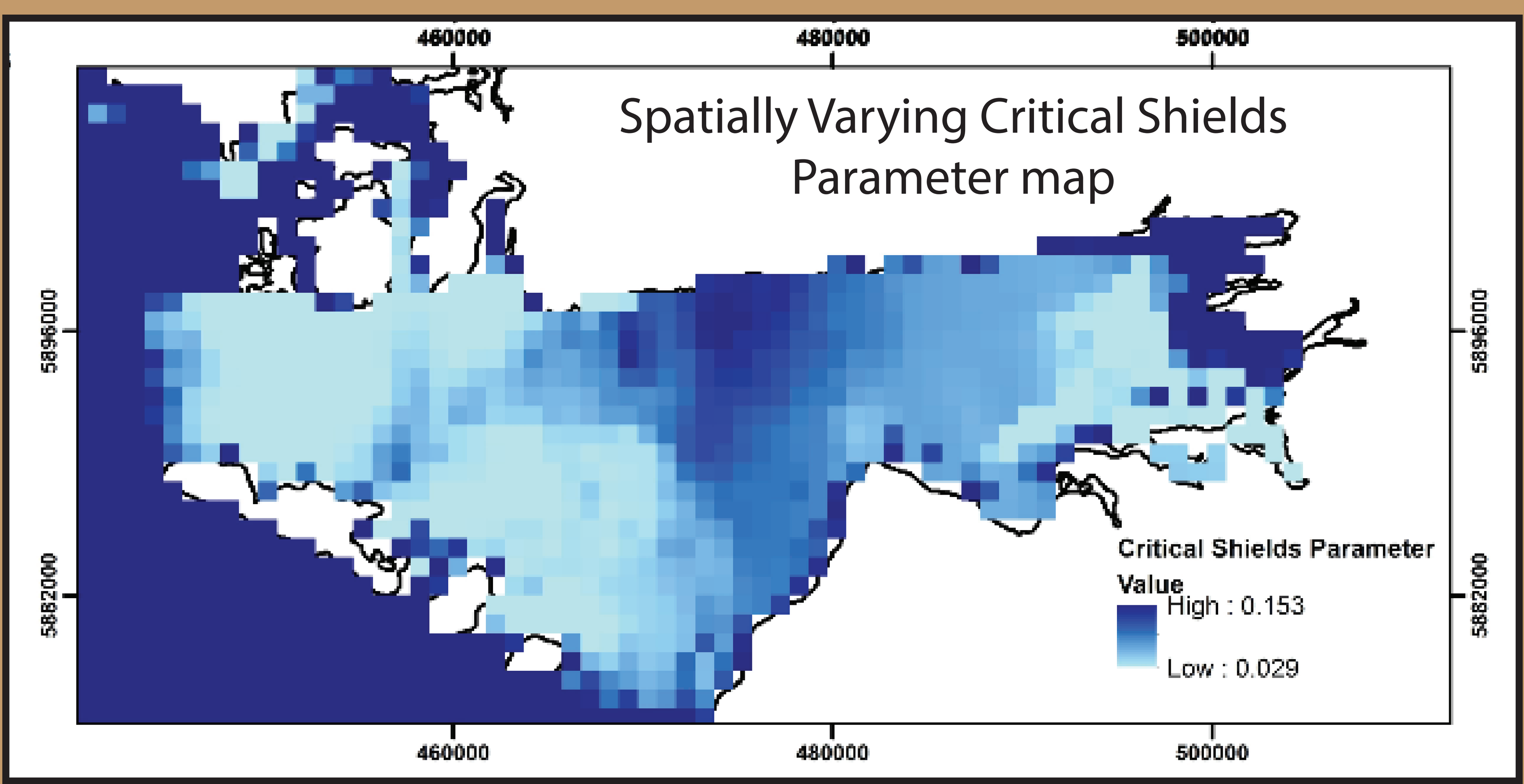


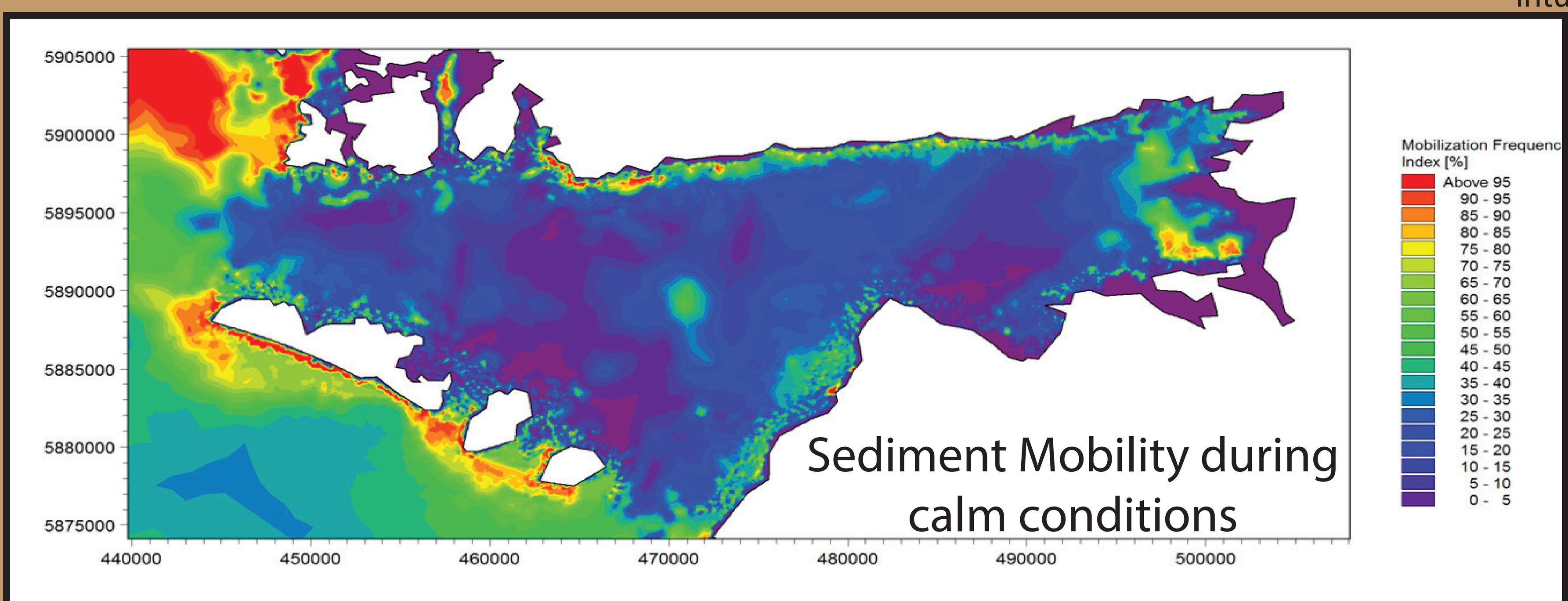
The coupled modelling methodology flow chart shows how the DHI MIKE suite of modelling tools were coupled under both calm and extreme storm conditions. Novel experimental work on maerl or rhodolith beds has been incorporated into the sediment mobility model to take account of the unique sediment dynamic properties of this biogenic geological habitat type.

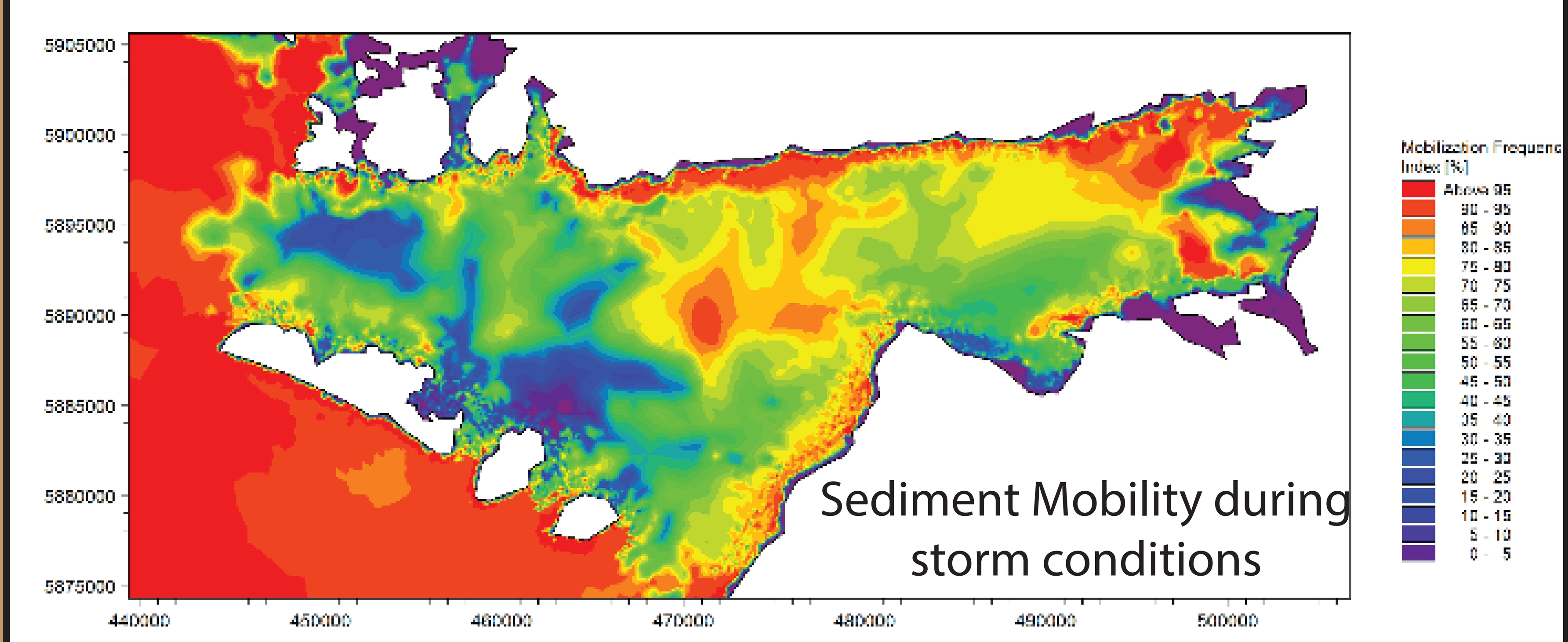


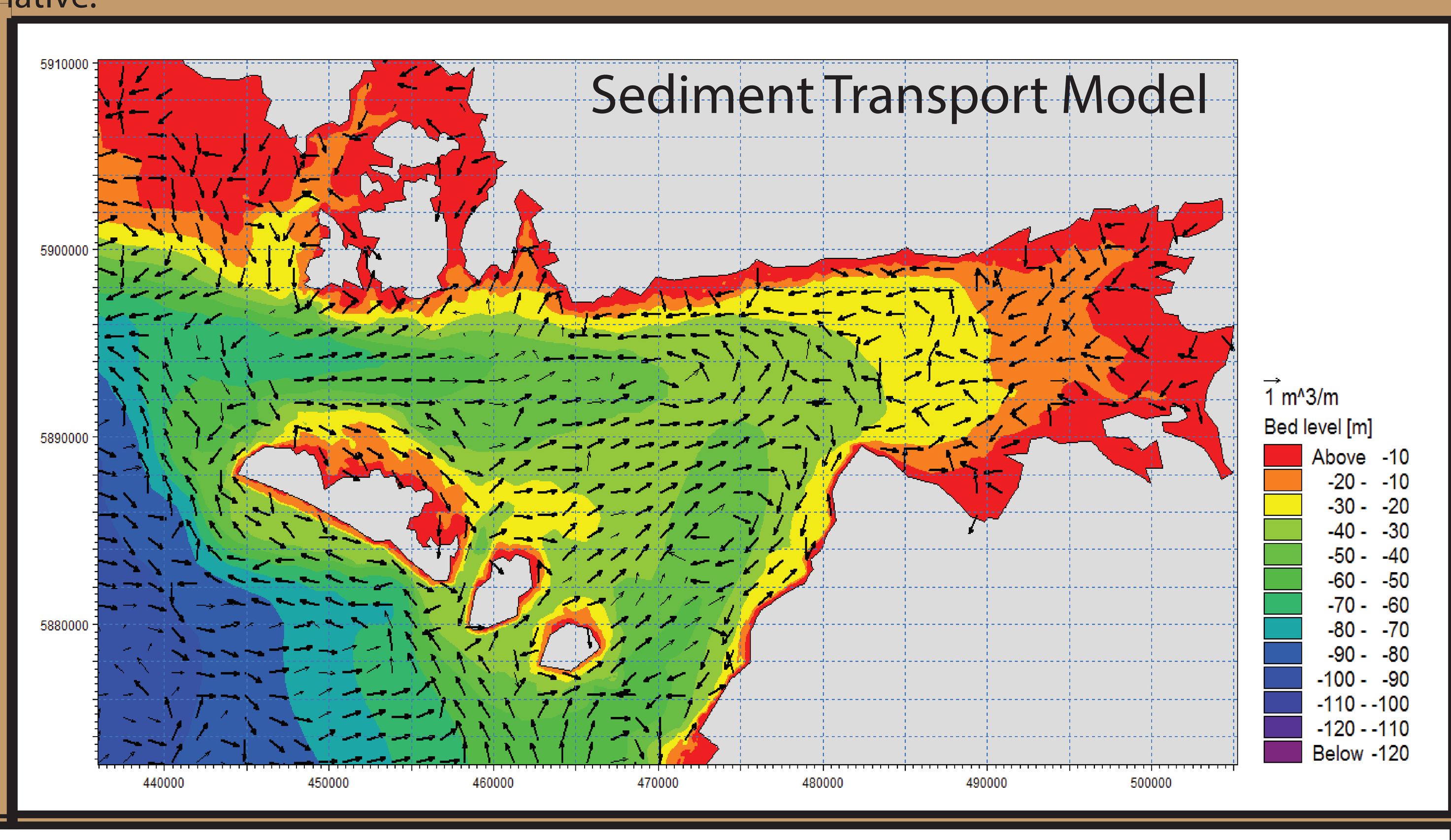


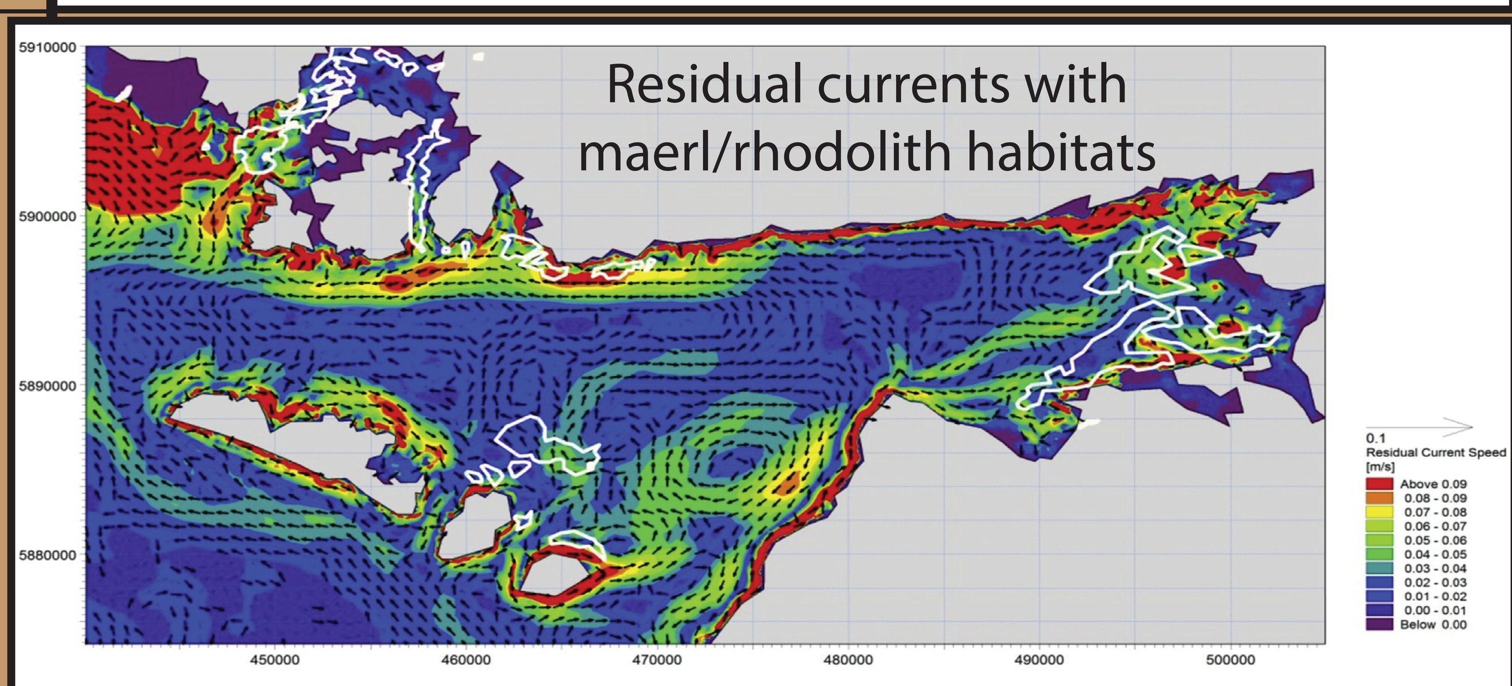
Sediment mobility indices are derived from coupled hydrodynamic- wave - sediment transport models utilising multibeam and airborne LiDAR bathymetry data. The Mobilization Frequency Index (MFI) is the percentage of time the sediment is mobile during the spring-neap tidal cycle and can be considered to be an indicator of the disturbance of the seabed. It is calculated utilising the spatially varying map of the Critical shields parameter (including maerl/rhodolith habitats). The sediment is considered to be mobile if the critical Shields parameter is exceeded by the observed Shields parameter (derived using the combined wave-current bed shear stress as an output from the numerical model) This sediment mobility model can be compared to the sediment transport model as an intuitive alternative.











About the Author: Dr Siddhi Joshi is an independent marine biogeoscientist and oceanographer, with a PhD from National University of Ireland Galway. She is a council member of Challenger Society for Marine Sciences coordinating its Early Career Researcher Network in the UK. She specialises in utilising national seabed mapping datasets to obtain innovative derived data products about the seabed and its marine habitats such as maerl/ rhodoliths beds. Utilising bathymetry data as part of hydrodynamic-wave- sediment transport models; and multibeam backscatter data for marine habitat mapping, Siddhi's research specialises in developing novel, scientifically-robust data products from national seabed mapping datasets to obtain a detailed understanding of sediment dynamics. She has an IHO Category A accredited MSc in Hydrographic Surveying from University College London and BSc Honours degree from NOC, Southampton.