DEVELOPMENT AND DYNAMICS OF SEDIMENT WAVES IN A COMPLEX MORPHOLOGICAL AND TIDAL DOMINANT SYSTEM: SOUTHERN IRISH SEA

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GDG Gavin & Doherty Geosolutions
Irish Research Council An Chomhairle um Thaighde in Éirinn
iCRAG Irish Centre for Research in Applied Geosciences
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Hypothesis:

1. Mobile independent sand wave assemblages, and sand bank associated sand wave assemblages, are supported by independent sediment transport systems.
2. Linear sand banks do not exhibit a closed circulatory transport system yet reveal a semi-closed circulatory transport regime.

Study aims:

1. Describe the morphological characteristics of sand waves and their spatio-temporal evolution in a tidally-dominated shallow shelf sea setting;
2. Investigate whether there is a relationship between sand banks and independent sand wave assemblages.

1. Time-lapse bathymetry datasets

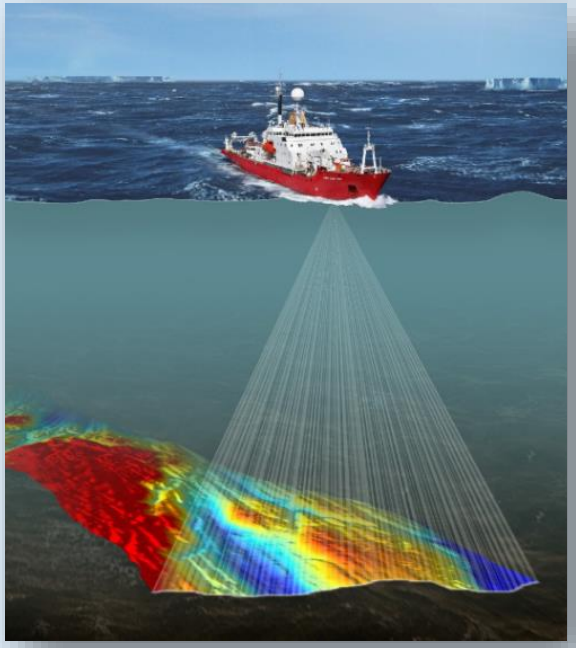
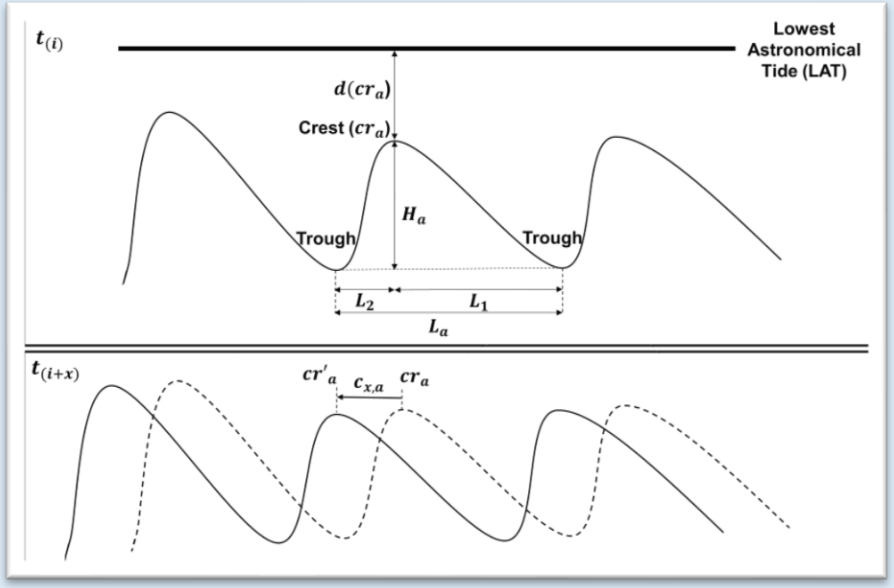


Image Source: https://www.isurvey-group.com/services/seabed-surveys/seabed-mapping

Data collection and processing



Cross-sectional bathymetry profile of sand wave migration

2. Environmental parameters:

- water depth
- grain size
- numerically modelled (DHI MIKE 21) currents and bed shear stress

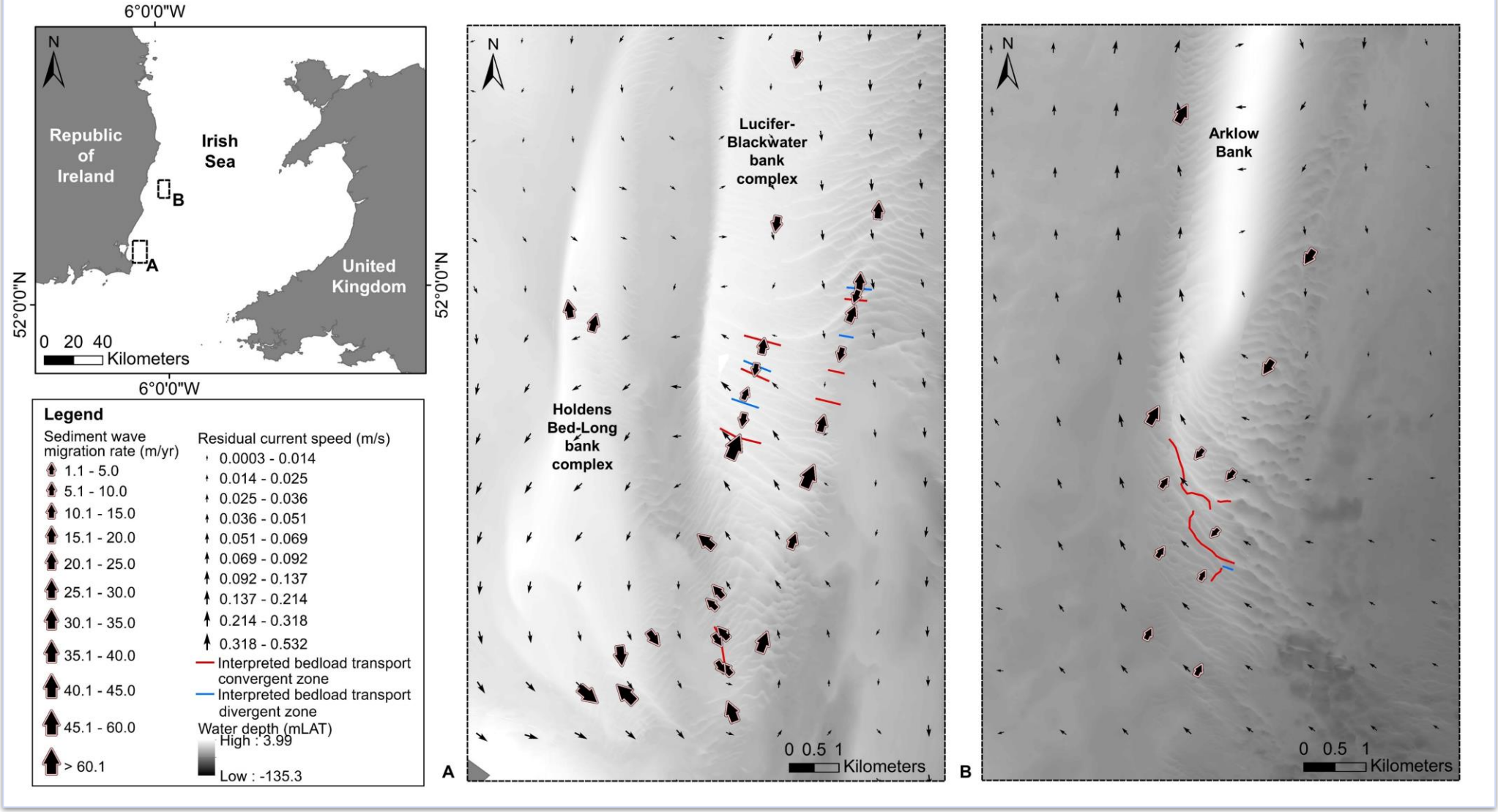
3. Processed based parameters:

Rouse number, P, which indicates the mode of sediment transport

$$P = \frac{w_s}{1 \times 0.40 \times u_*}$$

Where w_s is the particle settling velocity u_* is the shear velocity

- Bedload transport is dominant when $P > 2.5$
- Suspended load transport is the dominant mode when $0.8 < P < 1.2$.



Bathymetry source: https://www.infomar.ie/

Complex hydrodynamics drive sand wave migration:

A. *Lucifer-Blackwater and Holdens Bed-Long bank complexes:* continuous recycling of material between the two bank complexes and associated sediment waves

B. *Arklow bank:* anti-clockwise residual semi-closed sediment transport cell

Source and sink mechanism:

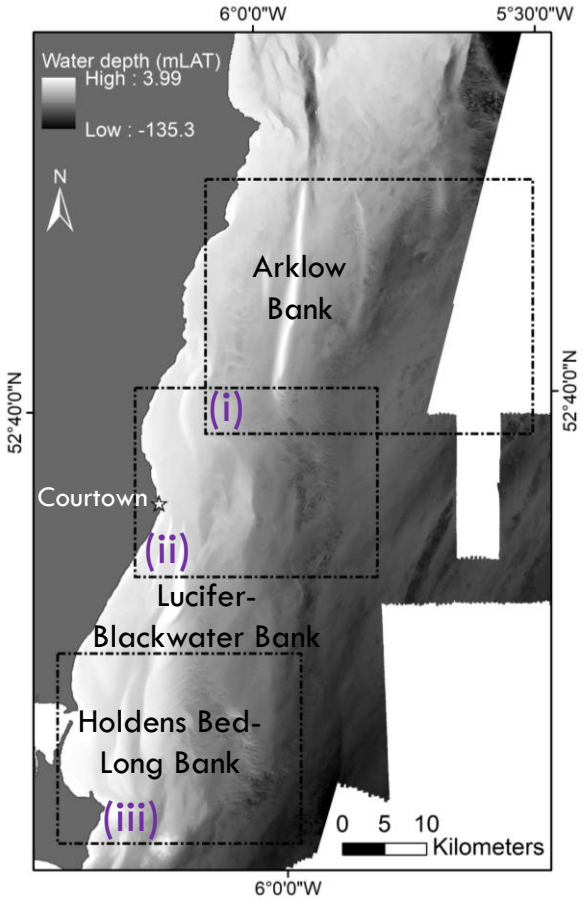
a) Recycling of sediment between sand banks and offshore sand deposits

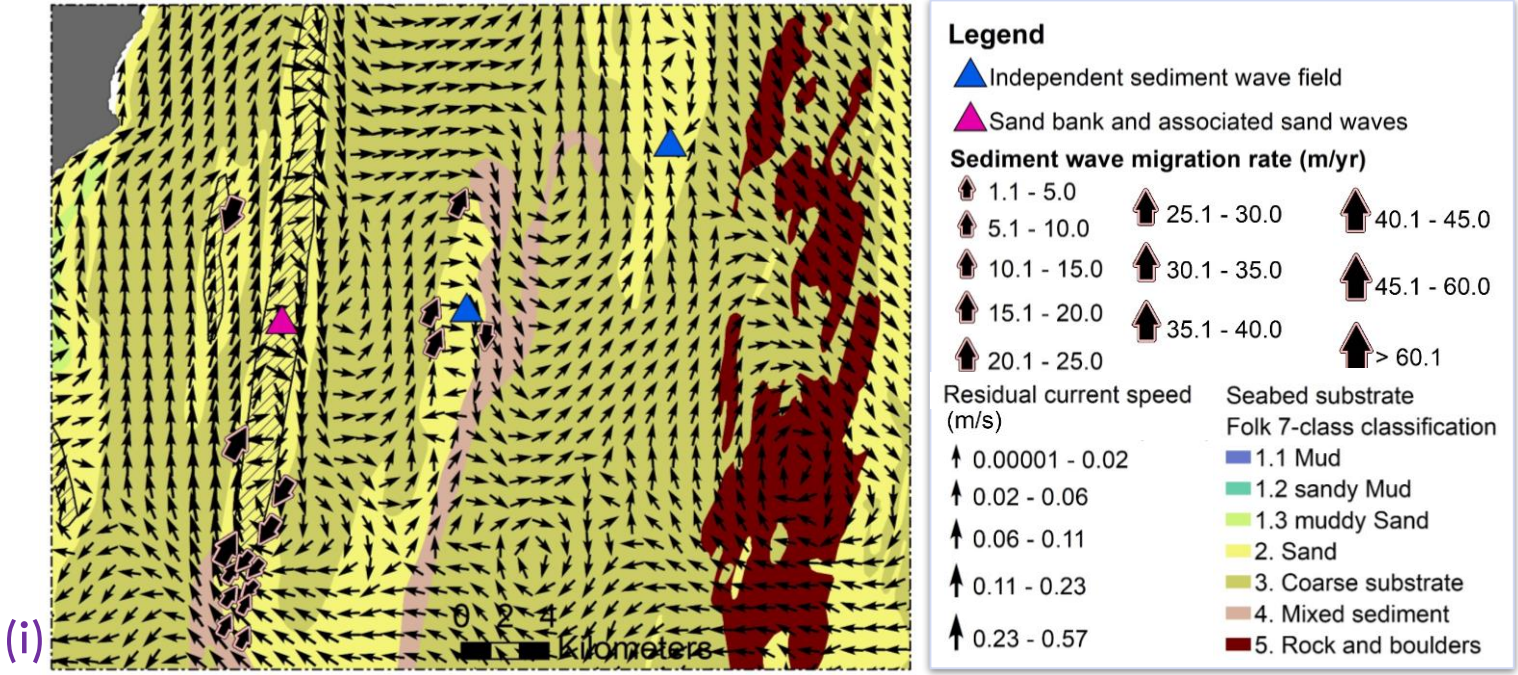
b) Offshore independent sand wave fields act as intermediary transport zones to sand wave fields in deeper waters.

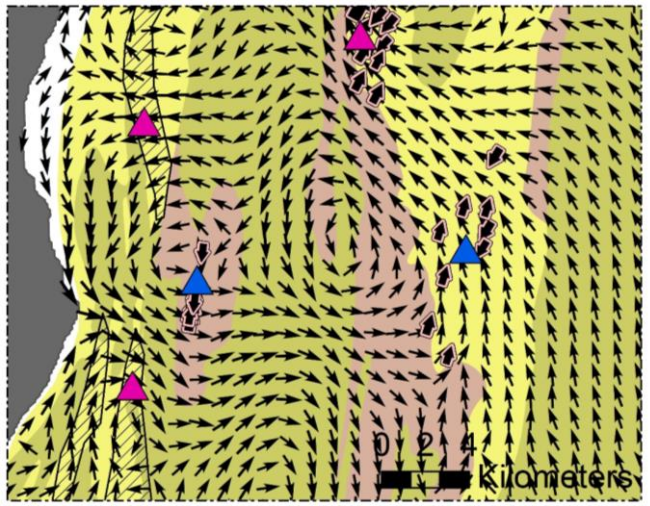
Controls on sand wave growth and development:

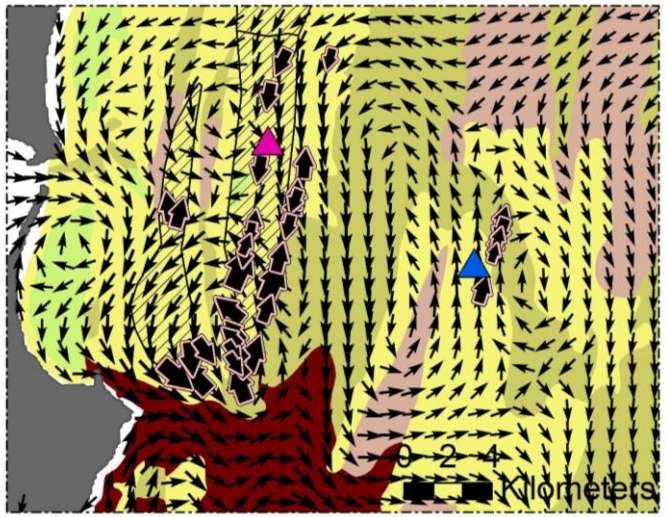
a) Residual currents

b) Mode of sediment transport









Main outcomes:

1. Singular environmental parameters are proven to be unreliable indicators of sediment wave growth, yet process based parameters such as the Rouse number, indicating the mode of sediment transport, is highly useful.

2. Similarly, evidence provided here suggests residual tidal current could be considered a controlling factor for sediment wave growth.

3. Source and sink mechanisms for offshore linear sand banks and offshore independent sand wave assemblages in the Irish Sea are highly linked

4. Novel methods, datasets and concepts produced by this study improves knowledge of seabed morphodynamics in tidally-dominated shelf seas which has direct implications for offshore renewable developments and long-term marine spatial planning.

Thank you!

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