

PhD Thesis

Understanding Extreme Nearshore Wave Events through Studies of Coastal Boulder Transport

Host: University College Dublin (Frédéric Dias)

(in partnership with Williams College, US, and Queen's University Belfast, UK)

This PhD thesis will be conducted within a project co-funded by Ireland (SFI), the US (NSF) and Northern Ireland (DELNI). The PhD student will be based in the School of Mathematical Sciences of University College Dublin. The wave group has an international reputation in the study of waves and computational fluid mechanics.

High-energy coastal waves cause massive infrastructural damage, and the bigger the storm the greater the effect. There is evidence that both frequency and intensity of coastal storms are increasing, raising questions about sustainability of coastal settlements and infrastructure. At the same time, investment in such infrastructure is rising, both for coastal protection and development of marine renewable energy sources. To develop risk assessment models for coastal storm damage, and to understand the magnitude of forces likely to act on structures deployed along the coast and in the shallow ocean, we need to be able to quantify the upper limits for storm wave power.

Surprisingly, we lack data putting upper limits on forces exerted by storm waves impacting the coast. This hole in our understanding is illustrated by debates about whether very large boulders (VLB) can be moved by storm waves, or not. Some workers use hydrodynamic calculations to argue storm waves cannot move VLB, because the force: mass ratio is too small. Others argue that existing equations are not fully descriptive, and cite field evidence for VLB having been moved during storms. But there is no consensus about masses that can be transported by storm waves, which means that it has not been possible to fully model or predict the effects of storm waves on coasts.

The present project will change that situation decisively, and is made possible in large part by data collected on the Aran Islands after the 2013/2014 winter's storms.

The PhD student will model wave amplification across uneven submarine topography with a combined global- and local-scale approach. The modelling will be computationally intensive. The PhD student will be in close contact with Queen's University Belfast, where experiments will be performed.