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## Drumming the waves: conveying coastal geoscience with rhythm

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It is difficult to educate the public about geoscience and to create a message that will be heard in a noisy world. Coastal geoscience in particular—despite its growing importance as sea-level rises and storminess increases—has not penetrated effectively into the public sphere. High-energy coasts attract increasing numbers of visitors, most unaware of hazards related to stochastic wave behaviour. Photo-seekers in the Instagram era are driving up accidents in extreme environments, and it's increasingly common for people to be caught off guard and dragged into the ocean by rogue waves. Creative ways are needed to build awareness of the hazards, as well as the beauty, of high-energy coasts.

"Drumming the Waves", a musical representation of wave interactions with boulder beaches, is an NSF-funded musician-geoscientist collaboration. Informed by the shared physics of sound and water waves, the composition will showcase how mutual interference among wave sets gives rise to chaotic seas, rogue waves, and ocean swell; and how waves can be amplified unpredictably in the coastal zone. Minimalist compositional techniques are employed to overlap and superimpose multiple series of small and seemingly inconsequential rhythmic and melodic musical events, leading to composite results that are unpredictable, sometimes chaotic, and occasionally extreme.

A visceral artistic approach helps capture the 'feeling' of coastal waves and the impact of their interaction with boulder beaches, conveying sea states from serene calm to extreme chaos. Audio samples recorded at coastal locations in Ireland and the UK, both in air and beneath the ocean surface, are interwoven in the soundscape. We use wave sounds both in their natural audio state and in processed form. Creating new sounds by interacting field recordings of waves with electronic audio processors provides an artistic representation of the ubiquitous power and energy present in coastal environments. The temporal and erratic nature of coastal waves informs the musical structures on a macro level, exploring the contrast between the simple rhythm of tides and swell, and the irregular ephemerality of turbulent sea conditions. On a micro level, parallels between ocean and audio waves shapes are exploited to create novel musical events by shaping LFO (low frequency oscillator) and noise gates to mimic two-dimensional coastal wave models. Periodic emergence of unexpectedly large sound events mimics hazardous rogue wave generation.

We will build educational content around the music, to contextualise and explain it, and to draw attention specifically to boulder beaches, wave hazards, and the science of high-energy coasts.

Simple worksheets showing wave spectra will be paired with percussion rhythms and melody that can be layered by students, either drumming and singing together, or mixing audio loops within a DAW (Digital Audio Workstation) such as GarageBand. This will permit students to build complex spectra from simple underlying wave forms. PowerPoint slides and explanatory text, pitched at the appropriate level, will be distributed to teachers for combined music/science learning. Using music to convey the science of wave interactions and wave amplification opens new doors and prospects for engaging and educating the public.