Enabling a global comparison of coastline morphodynamics

Emma Vann Jones

Department of Geography, Durham University, UK e.c.vann-jones@durham.ac.uk

Introduction

Understanding the response of coastlines to sea level and climate change over the coming century requires knowledge of what governs the rate of erosion. However, because of the challenges of monitoring erosion and energy delivery by waves we still lack a framework to assess how marine processes impact rocky shorelines. The aim of this study is to establish best practice for quantifying dominant marine erosive processes using a novel combination of cutting-edge high spatial and temporal resolution monitoring of erosion, marine and sediment conditions at two contrasting sites: Oraka Point, Mahia Peninsula, New Zealand (micro-tidal, soft rock) (Fig. 1); and Staithes, North Yorkshire, UK (macro-tidal, hard rock).

The BSG grant was used to fund fieldwork at the New Zealand site, which has enabled the development of a new collaboration and skills transfer between the PI and colleagues (Dickson) at Auckland University. The data obtained will be used to develop a new transferable stock-flow model of marine-driven cliff erosion. The data and model will pump-prime a fellowship application to develop a novel model of rock coast response to future environmental change, calibrated at wave-dominated rock coasts in a wide-range of physiographic conditions.

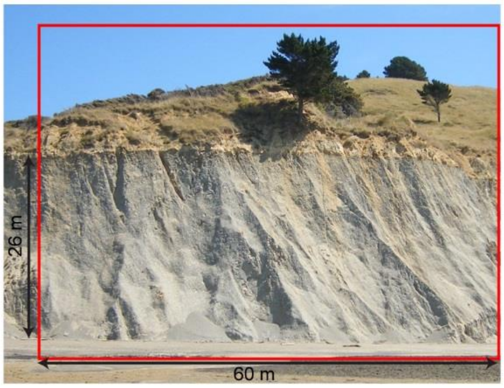


Figure 1: Photo of the monitored cliffs at Oraka. The red box delimits the monitored width of cliff (60 m). Average height of the monitored section of cliff was 26 m.

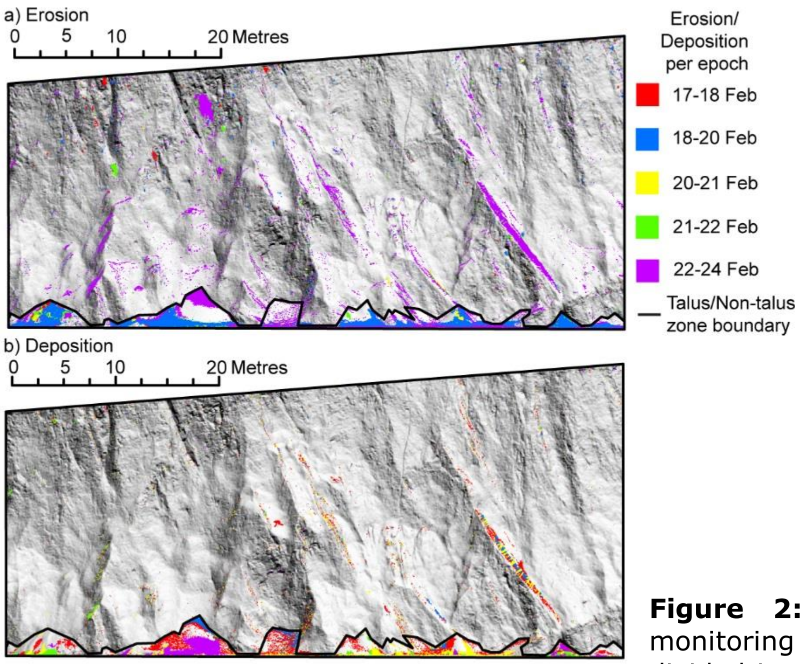
Field methods

Cliff erosion was monitored daily by terrestrial laser scanner at a resolution of 0.02 m. Three wave pressure sensors were installed on the foreshore: at the cliff toe; 30 m from the cliff; and 250 m from the cliff at the foreshore edge. Two current meters and a turbidity sensor were installed alongside the middle wave pressure sensor to monitor tidal flow and suspended sediment.

Initial findings

The high temporal resolution of scanning enables cliff response to concurrent marine conditions to be examined, and also connectivity between the cliff toe and the upper cliff to be examined.

During calculations of volume change the cliff was split into two zones: the talus zone, consisting of the upper beach and talus cones at the cliff toe; and the non-talus zone above (Fig. 2).



The beach level changed daily and had a significant impact on erosion/deposition volumes in the talus zone. However, during the average conditions experienced throughout the monitoring period, the presence of the talus cones appears to isolate the upper cliff from the effects of the sea and change in the upper cliff is independent to that at the toe. Individual scan epoch statistics show that the largest erosion and deposition volumes in the talus zone over one epoch were 13.7 m^3 and 3.71 m^3 respectively, compared to 2.84 m^3 and 0.88 m^3 in the non-talus zone (Fig. 2). Further exploring the connectivity across the cliff will be important for understanding how cliffs may respond to future marine changes.

Figure 2: Change of the cliff face during the monitoring period 17/02 – 24/02/16. The cliff has been divided into two zones: the talus zone at the cliff toe; and the non-talus zone above it. Areas of: a) erosion; and b) deposition, during each 1-2 day scan epoch.