ROCKY COASTS
Approaches to monitoring rock coast erosion

Danielle Holly Buchanan, Dr Claire Earlie, Dr Matthew Eyre, Dr TC Hales, Dr Nick Holder, Dr Martin Hurst, Dr Larissa Naylor, Dr Robin Shail, Dr Wayne Stephenson.

BuchananDH@cardiff.ac.uk
@dhbuch
Why measure rock coast erosion?
Aim: quantify the long-term (78-years) volumetric rates of platform erosion by block-detachment from stratigraphic layers.

- Combined historical aerial imagery with modern UAV
- Assessed erosion patterns and timing across two layers
- Highlighted the importance of meso-scale block detachment for rock coast evolution
Method for quantifying platform erosion

- **UAV-derived DEMs**
  - Two high-resolution UAV surveys: November 2017 & March 2018
  - SfM photogrammetry & georeferencing using Pix4D Mapper Pro
  - DEMs allowed us to quantify multi-decadal to seasonal scale platform erosion within ArcGIS...

- **Historical data**
  - Orthorectified historical **aerial imagery**
  - **Cliff-top & ground photographs**
  - **dGPS**
    - 2009
Using **NEW** data to modify **OLD**

- Historical aerial & cliff-top images were georeferenced
- Georeferencing corrected the orientation and referencing system to look at change through time.
- At least 20 GCPs per time-step across the domain
Quantifying platform erosion

- Stratigraphic layers were then digitised within ArcGIS to calculate change.

- A positional uncertainty $\delta_{xy}$ was derived for each time step by incorporating error in dGPS ($\delta_{GPS}$), geo-rectification ($\delta_{gr}$), and user digitising ($\delta_{dig}$):

$$\delta_{xy} = \sqrt{\delta_{GPS}^2 + \delta_{gr}^2 + \delta_{dig}^2}$$

  Buchanan et al. (in review).

- Area polygons were created & planform erosion was calculated as the difference in area between two time-steps ($\pm \delta_{xy}$).

- Volumetric erosion = planform erosion * mean bed thickness ($\pm \delta_z$).
Site A: 78-years of platform erosion
Site B: 78-years of platform erosion
Average erosion rates for site A and B over the 78-year period were 2 and 5 \((\pm 0.6/0.9) \text{ m}^3 \text{ yr}^{-1}\).
Summary of platform erosion

- The time series for shore platform erosion was possible due to high-resolution orthomosaics and SfM-derived DEMs.
- Average rates over the full 78-year record were 2-5 m$^3$ yr$^{-1}$.
- The rates of erosion via block detachment are two orders of magnitude larger than locally measured surface lowering rates.
- We highlight that meso-scale platform erosion via block detachment can potentially dominate shore platform erosion across seasonal to multi-decadal timescales.
Rock coast geomorphology: unlocking the key to our archaeological heritage

Aims

1. Reconstruct the past landform
   - Archaeological data & maps
   - Historical OS maps (last c.100 years)
   - LiDAR data (last c.10 years)

2. Capture current processes operating
   - Landscape: UAV, Terrestrial Laser Scanner & Seismometers
   - Waves: Wave buoy data & in-situ pressure transducers

3. Model the future evolution of the coast
Overall summary

- Though there are many misconceptions, rocky coasts are actively eroding!
- Erosion of cliffs threatens cliff-top infrastructure and can pose a harm to human lives
- Combining geomorphology and archaeology will enable us to understand how to conserve coastal heritage for future generations
- Modern technology is allowing us to capture previously unobtainable data...
Any questions?

Danielle Holly Buchanan
PhD researcher
Cardiff University

BuchananDH@cardiff.ac.uk
@dhbuch