Longshore variation in coastal foredune growth on a megatidal beach from UAV measurements

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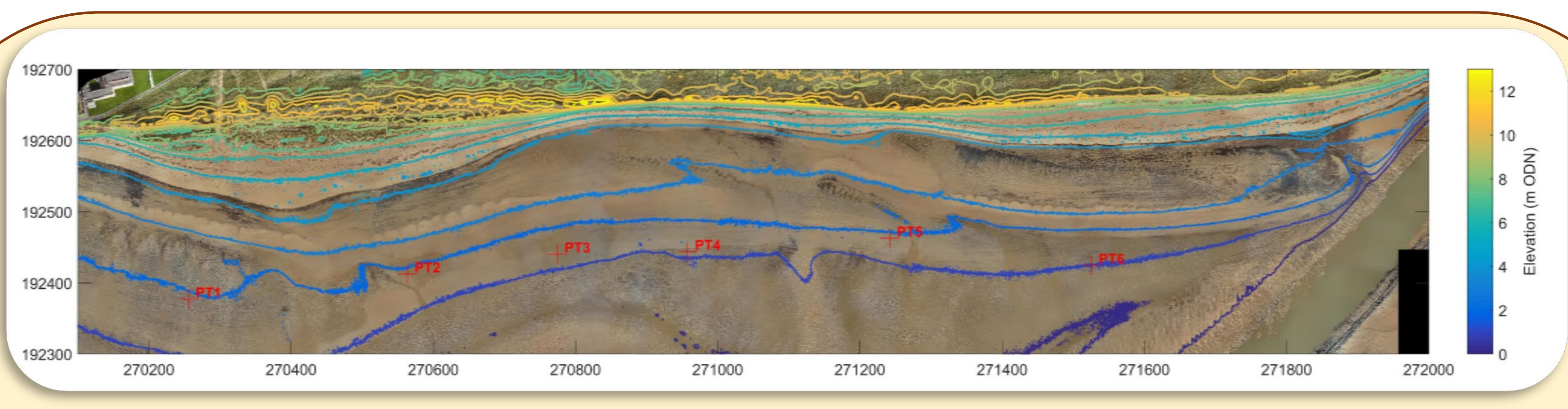

Fig. 1: Orthomosaic of Crymlyn Burrows study site with drone derived topography overlaid as contours from October 2018. Near dune pressure transducers locations are also marked

Introduction

- Dunes important for society and ecology
- Complexities of dune evolution not fully understood, especially for megatidal environments
- Study site at Crymlyn Burrows, Swansea, UK (Fig 1)
  - Megatidal environment (MSR = 8.46)
  - Wind and wave roses in fig 2; wind predominantly alongshore.
- Surveys conducted using eBee RTK drone between Oct. 2018 and Dec. 2019.
  - 4 overlapping flights to cover area; 5-6 GCPs per flight.

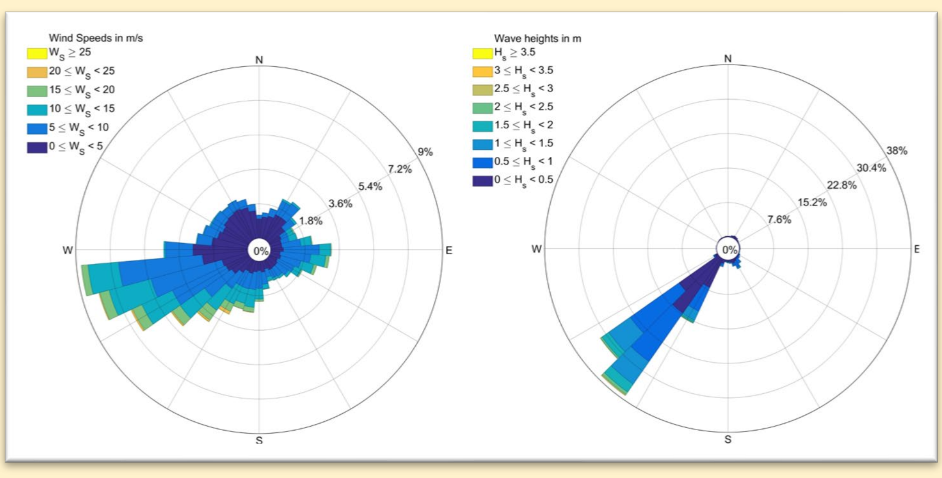

Fig. 2: Wind and wave roses from stations within Swansea Bay

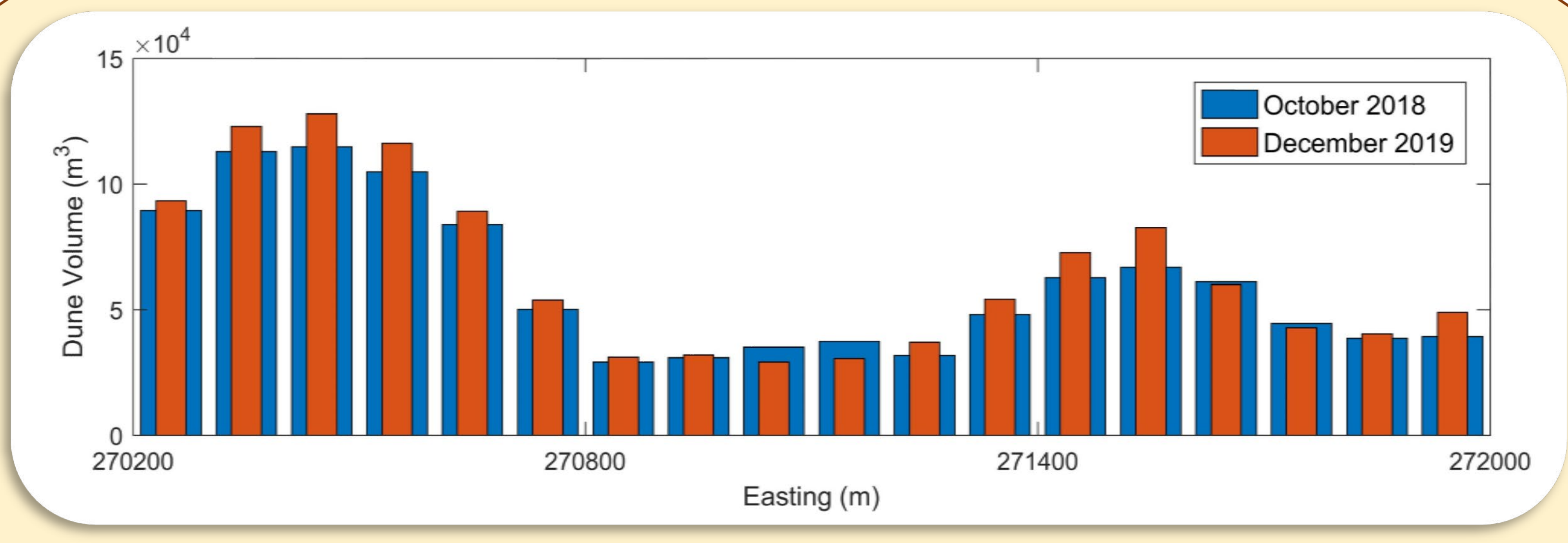

Fig. 3: Foredune volumes (between HAT and frontal dune crest) per 100m for first and last surveys

Drone derived morphology

- Surveys show longshore variation in foredune morphology and evolution (Fig. 1 and Fig. 3)
  - Healthy dune profile, greater dune volume and accretionary trend in eastern and western portions
  - Persistently cliffed, lesser volume and static or erosive trend in central portion.
- No obvious relationship between dune volume or volumetric change and mid-upper intertidal beach volumes or change (Figure 4)

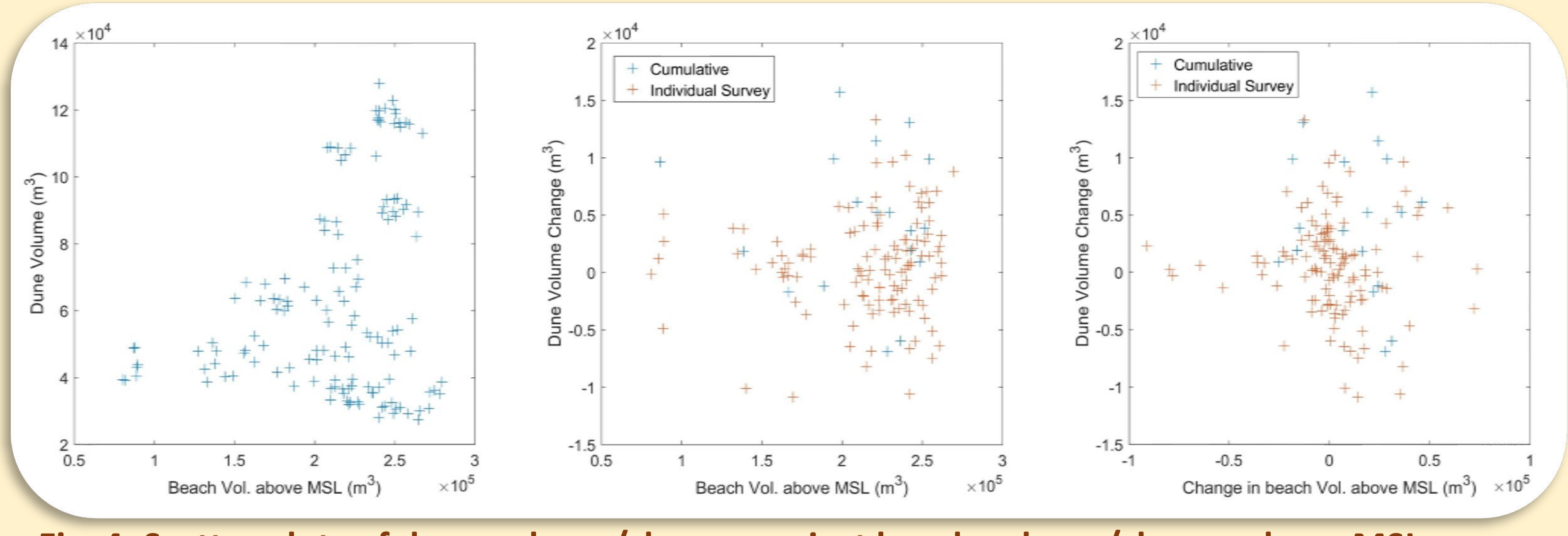

Fig. 4: Scatter plots of dune volume/change against beach volume/change above MSL

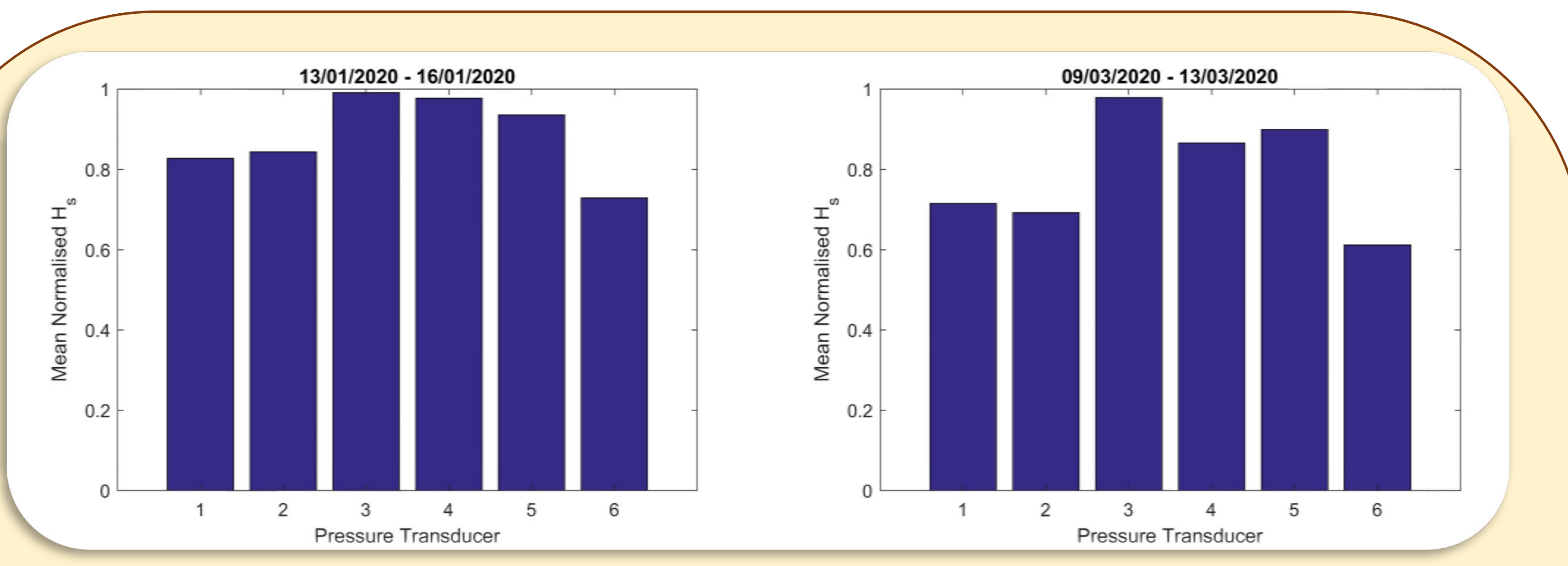

Fig. 5: Significant wave heights normalised by maximum wave height per high tide and averaged over all high tides in a deployment for two deployments in Winter 2020

Near dune wave conditions

- Six RBR Virtuoso pressure transducers (PTs)were deployed at 200-300m spacing on a longshore line just below the neap high tide line (1.7m ODN ± 0.02m) in order to investigate longshore variation in wave conditions that would act upon the dunes (Figure 1).
- Over two deployments covering spring tides and storm conditions, average high tide wave heights were lower for PTs 1,2 and 6 compare to the central PTs (Figure 5)
- Spectral shape also varied alongshore (Figure 6); with greater spectral peakedness recorded by pressure transducers in central region.

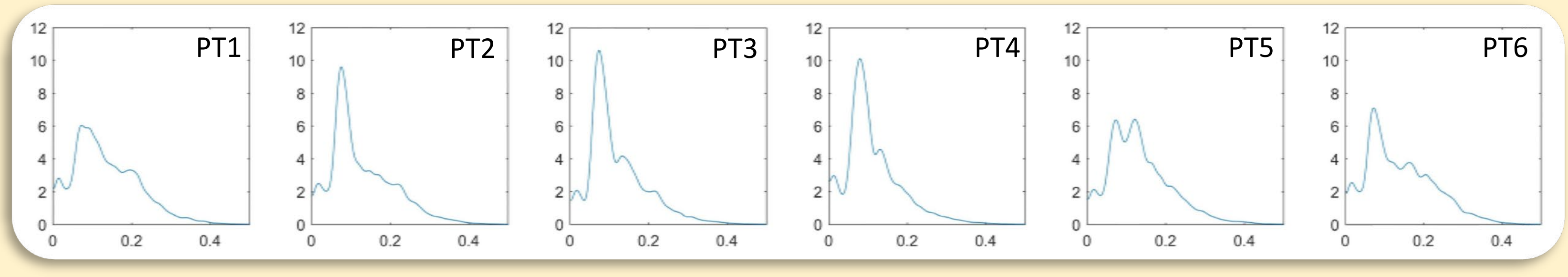

Fig. 6: Mean spectral shape at high tide for the 13/01/2020 deployment. Spectra normalised by total energy.

Discussion and Conclusions

- No obvious relationship between dune volumes and intertidal volumes
- Clear differences in near-dune wave conditions which possibly impacts dune erosion
  - Longshore variation in nearshore waves postulated to be linked to longshore variation in sheltering by intertidal bars (see https://www.youtube.com/watch?v=LRnSjeAJ0EA)
- Hypothesized that predominantly longshore wind direction combined with antecedent cliffed morphology and increased wave energy inhibits proto-dune formation and prevents recovery in central section.

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