Exploring controls on coastal overwash morphology in natural and built environments

Hannah E. Williams[1], Luke A. Taylor[1], Evan B. Goldstein[2], Eli D. Lazarus[1]

1. Environmental Dynamics Lab, School of Geography and Environmental Science, University of Southampton, Southampton, SO17 1BJ, UK
2. Department of Geography, Environment and Sustainability, University of North Carolina at Greensboro, Greensboro, NC, USA

8th May 2020

UNC GREENSBORO

UNIVERSITY OF Southampton

Introduction

- Low-lying barrier islands provide protection from storms to coastlines around the world.
- Overwash is a key mechanism controlling the flux of sediment from the front of a barrier island to the top and back of an island during storm events.
- Overwash is an essential process for barrier environments to maintain their height and width relative to sea level.
- Overwash flow, and therefore sediment deposition, is influenced by the spatial characteristics of the floodplain, or the floodplain “fabric”.

Aim

- To quantitatively compare barrier floodplain controls across a range of spatial "fabrics“.

EGU General Assembly

LEVERHULME TRUST

UNC GREENSBORO

UNIVERSITY OF Southampton

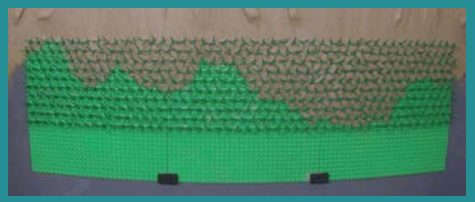
Methodology

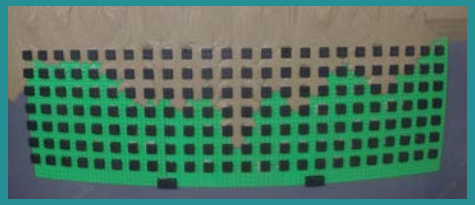
Empirical

- Post-storm satellite imagery
- Historic overwash deposits identified using Google Earth

Physical

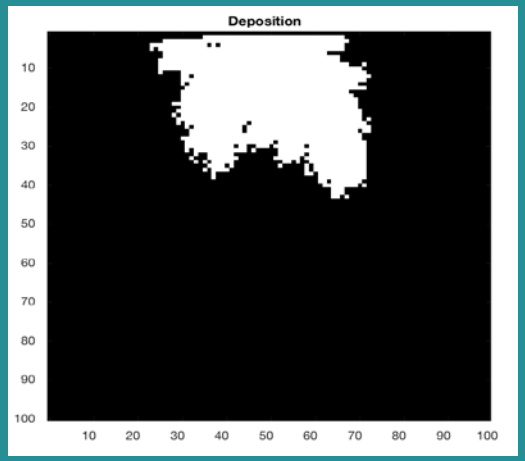
- Analogue Model
- Small experimental basin (1.5mx1m)
- Vegetation and Buildings represented with Lego





Numerical

- Simple cellular numerical model
- Erodible barrier
- Driven by water height variation on seaward side
- Varying topography as representative of nature



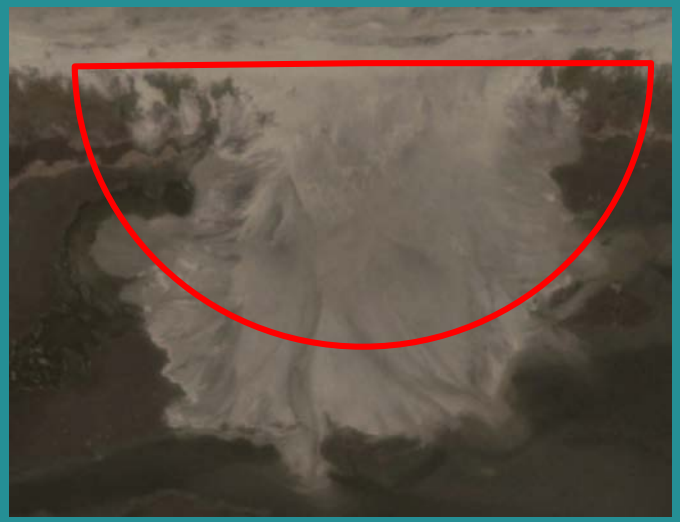
EGU General Assembly

LEVERHULME TRUST

Methodology

- Individual deposits identified via all three methods.
- Area and perimeter of deposit measured.
- Distortion index calculated to allow comparison between different overwash deposit geometries.
- Ideal perimeter calculated based on measured area, assuming perfect semi-circular deposit.
- Distortion Index= $\frac{\text{Measured Perimeter}}{\text{Ideal Perimeter}}$

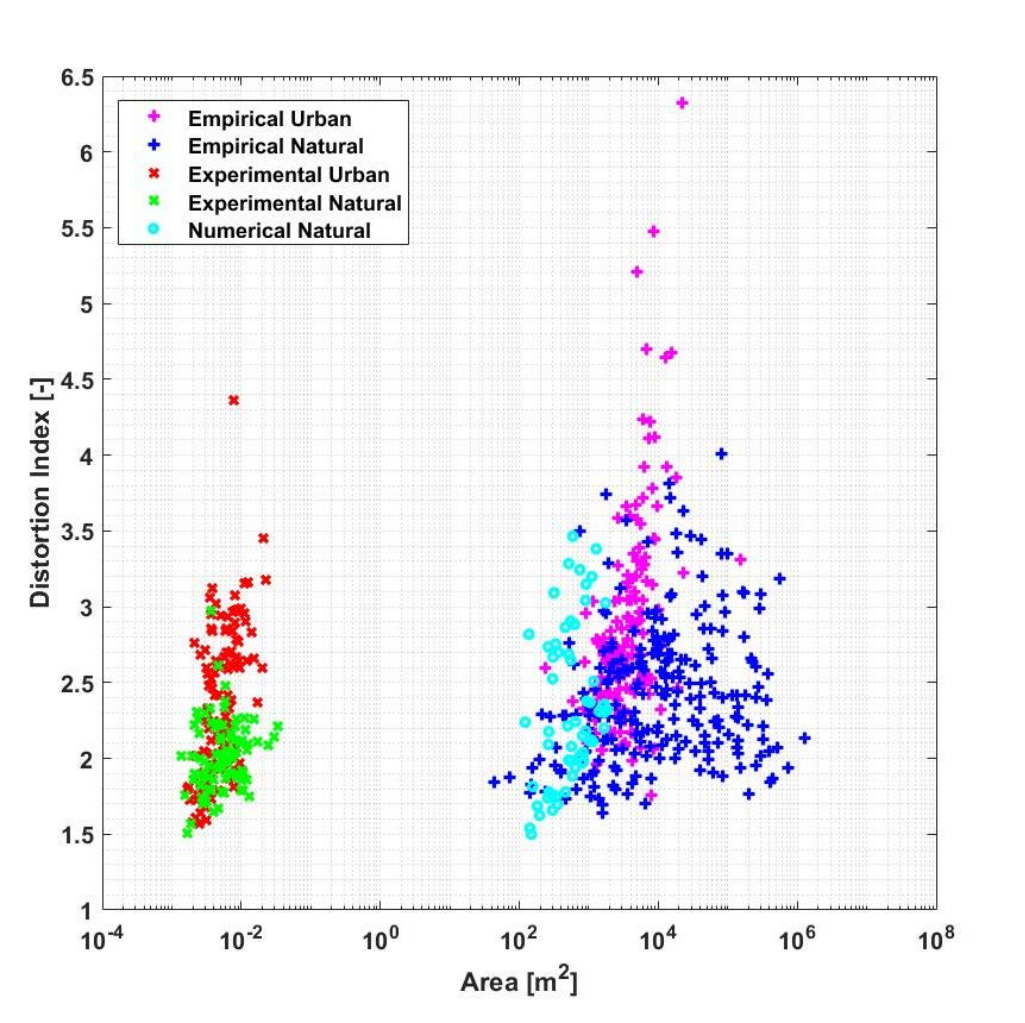
Measured Area & Measured Perimeter



Measured Area & Ideal Perimeter

Results

- Similarity in overwash morphology across methods (empirical, physical experiment, numerical model)
- Greater distortion evident in built environments.

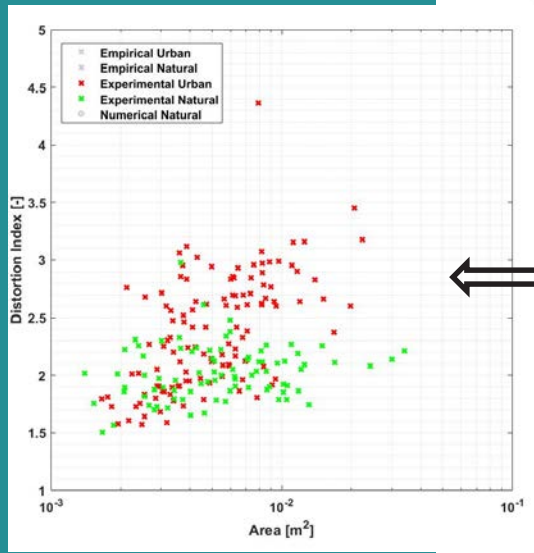


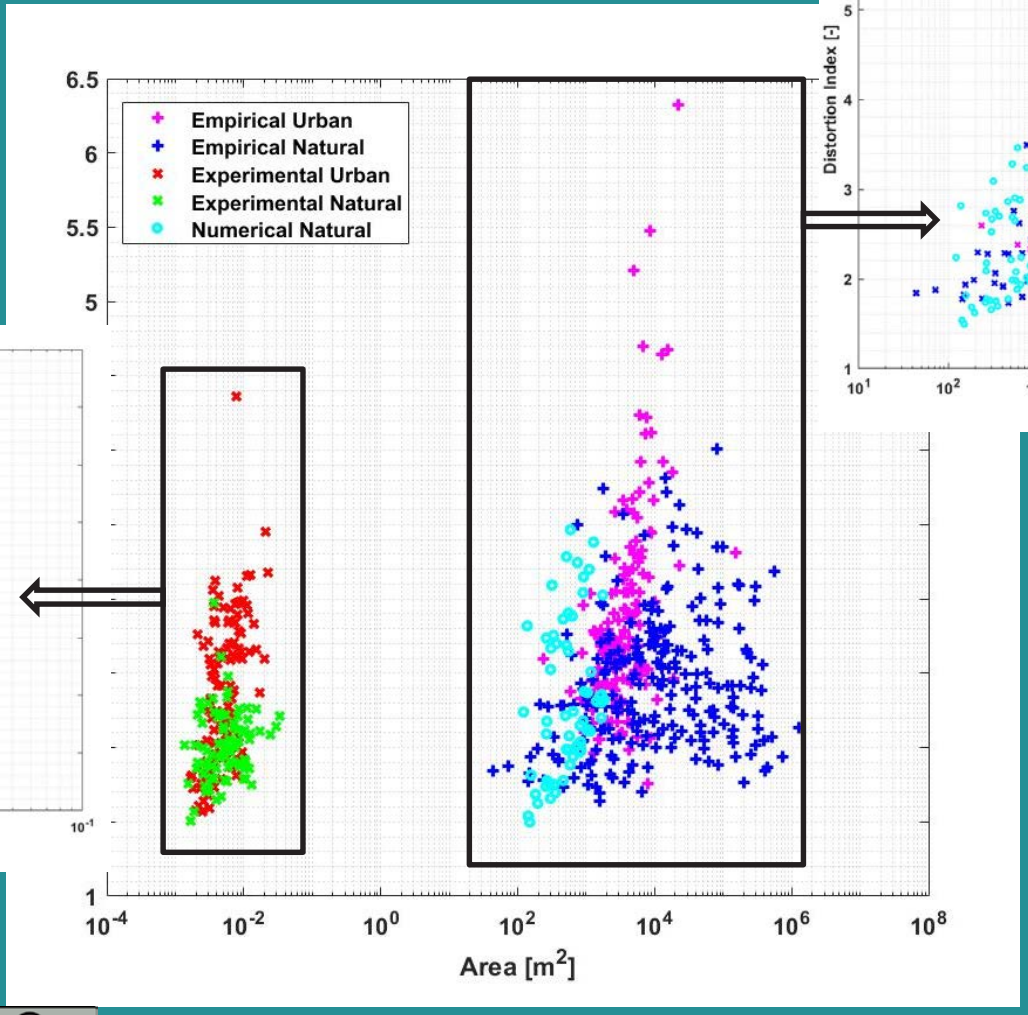
UNC GREENSBORO

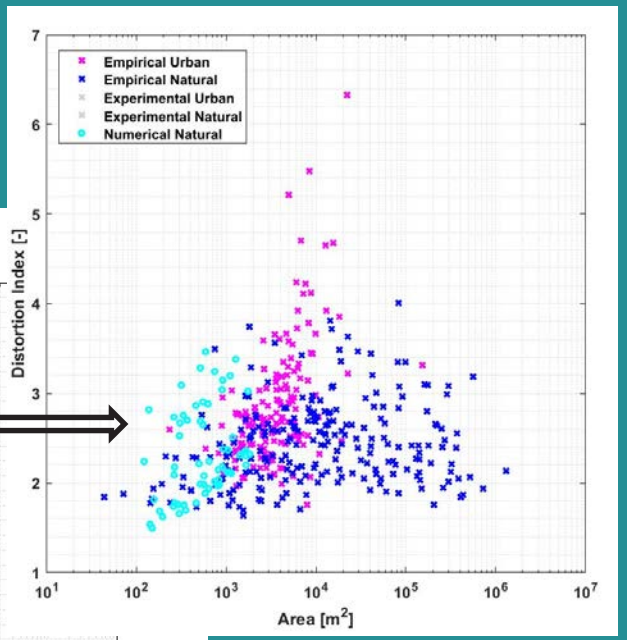
UNIVERSITY OF Southampton

Results

- Urban distortion > natural distortion (for a given area)







EGU General Assembly

LEVERHULME TRUST

Conclusions

- The findings illustrate a continuum in overwash pattern formation between endogenous self-organisation and exogenous forcing templates (such as topography, vegetation, infrastructure and buildings).

- This sets up further inquiry into the dynamics of flood deposition in both natural and built environments.