



Trinity College Dublin
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The University of Dublin

Coastal saltmarshes as nature-based flood and erosion risk components

The Evidence Base



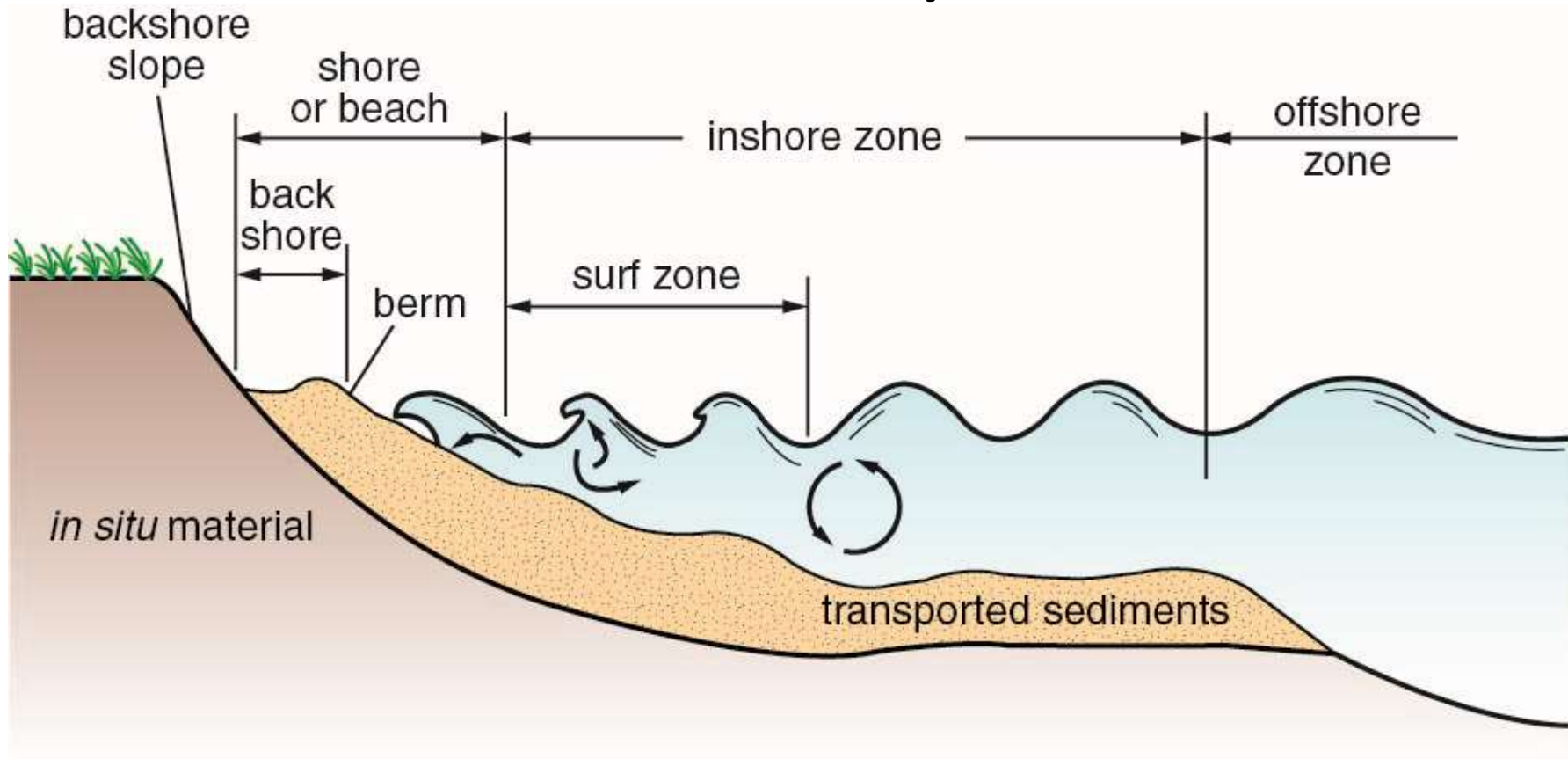
Image: Orplands, Essex. J Tempest

Prof Iris Möller, Department of Geography
School of Natural Sciences
Trinity College Dublin

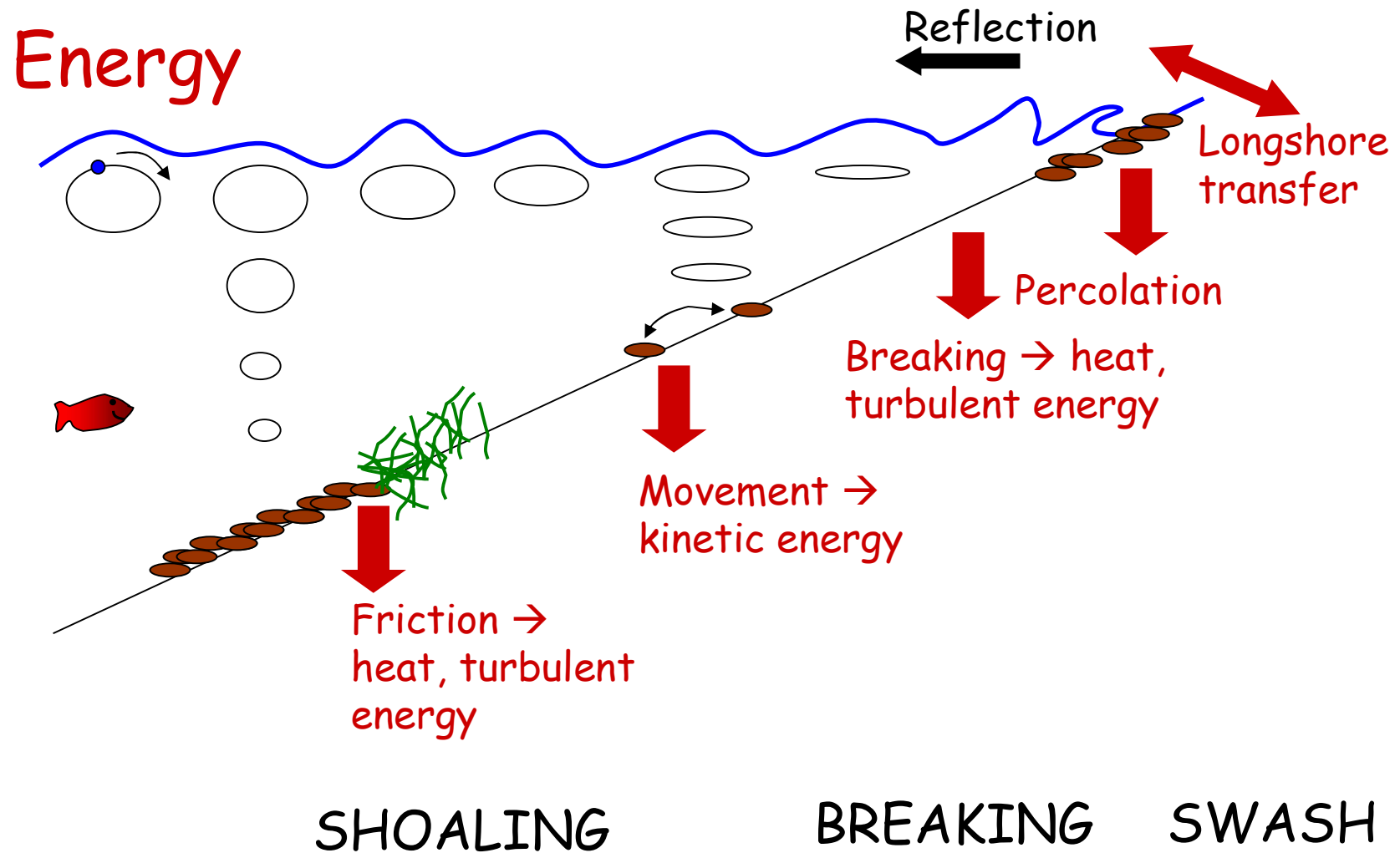


@im_coasts
moelleri@tcd.ie

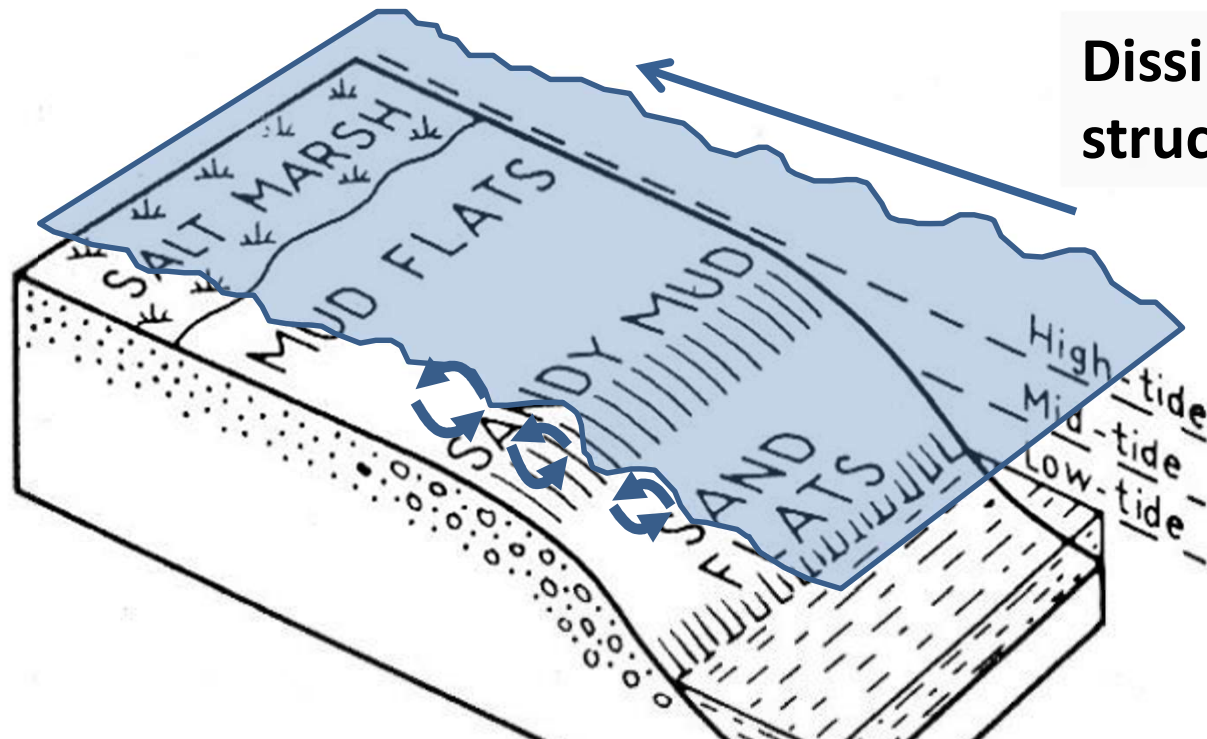
Soft-sediment coasts dissipate energy naturally



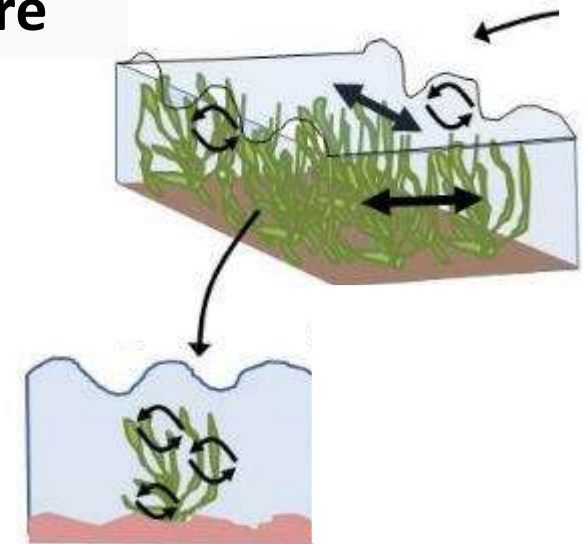
Energy dissipating processes



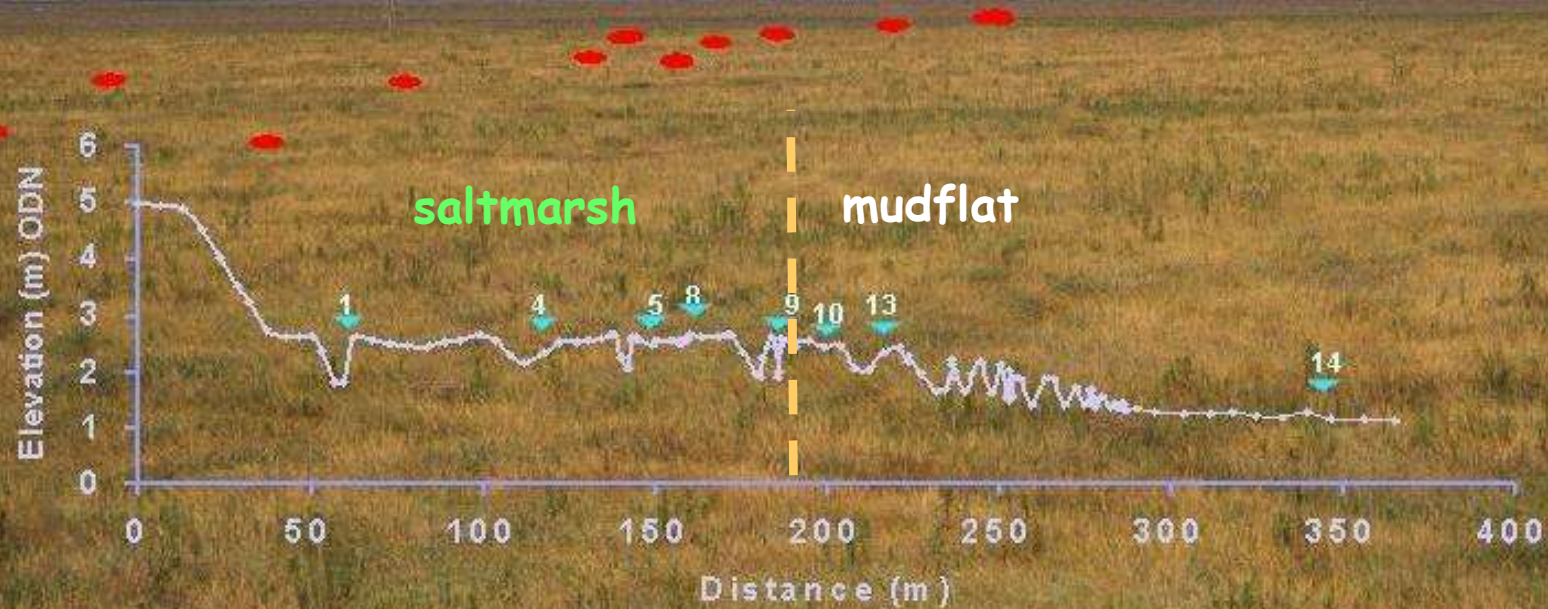
Saltmarshes ...



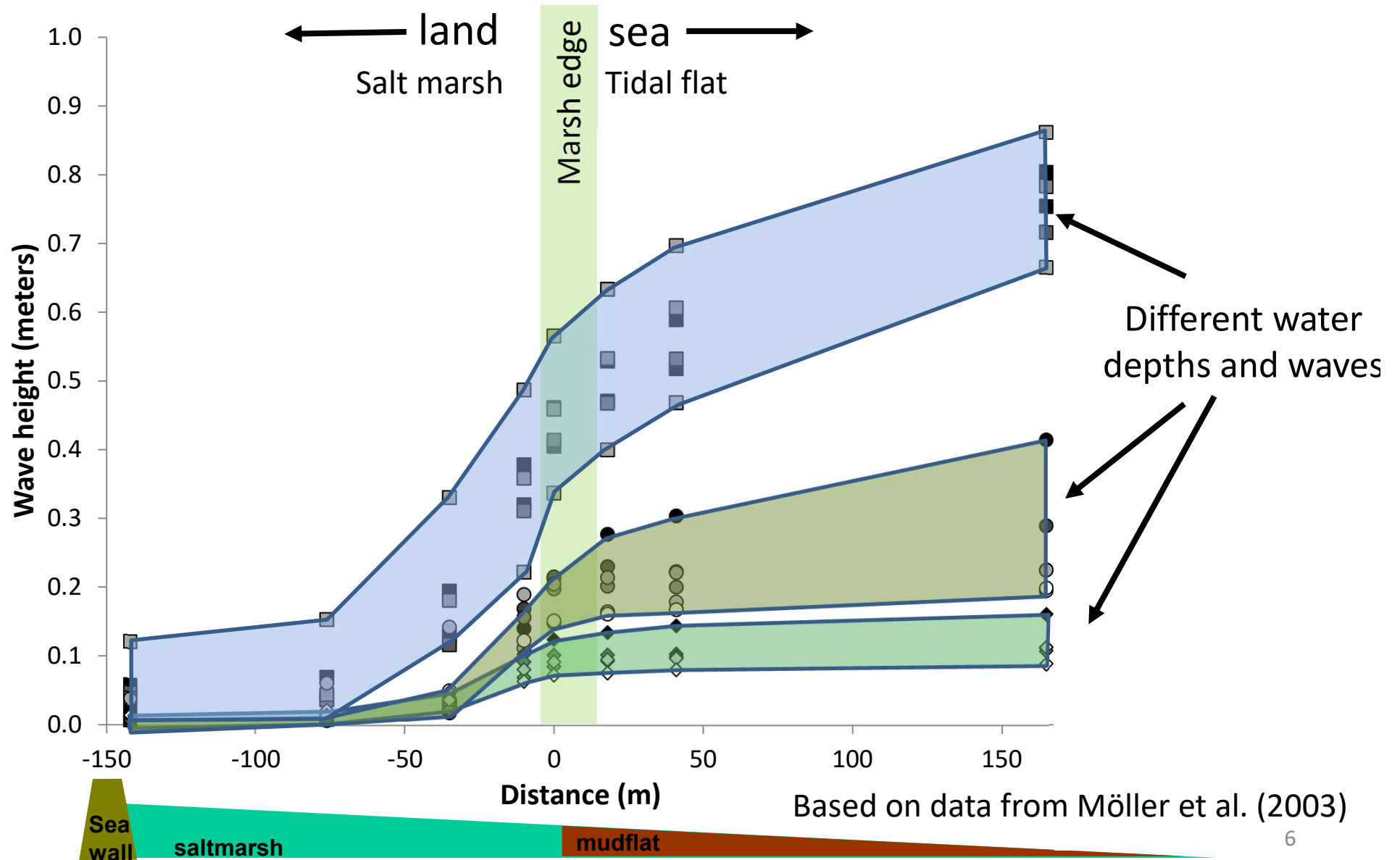
Dissipative structure



Field Evidence



Field wave reduction evidence



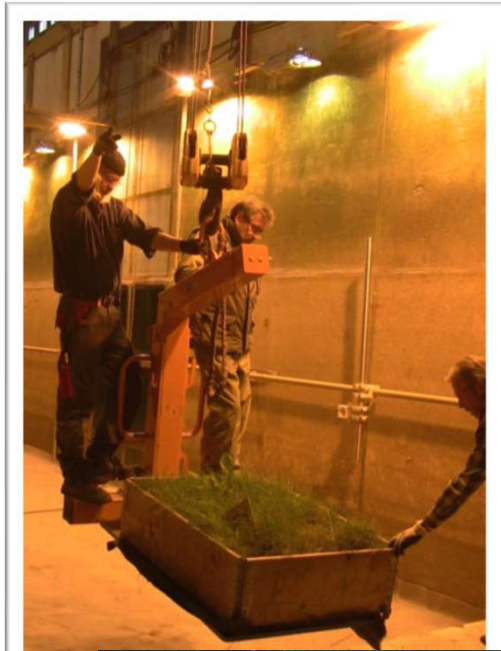
Laboratory evidence

Large Wave Flume (GWK) Hannover



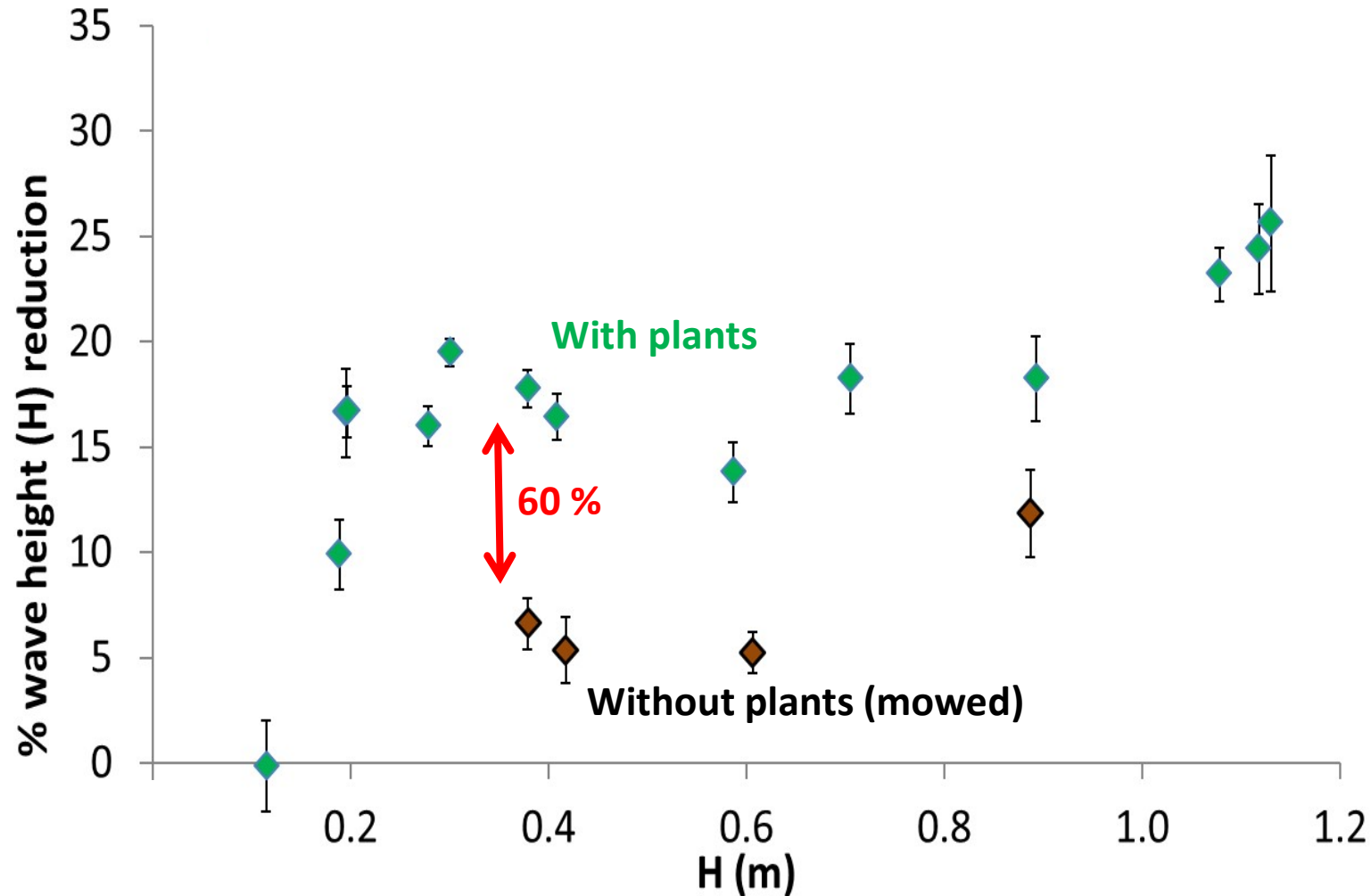
www.thesaltmarshexperiment.org

Video: James Tempest (CCRU)



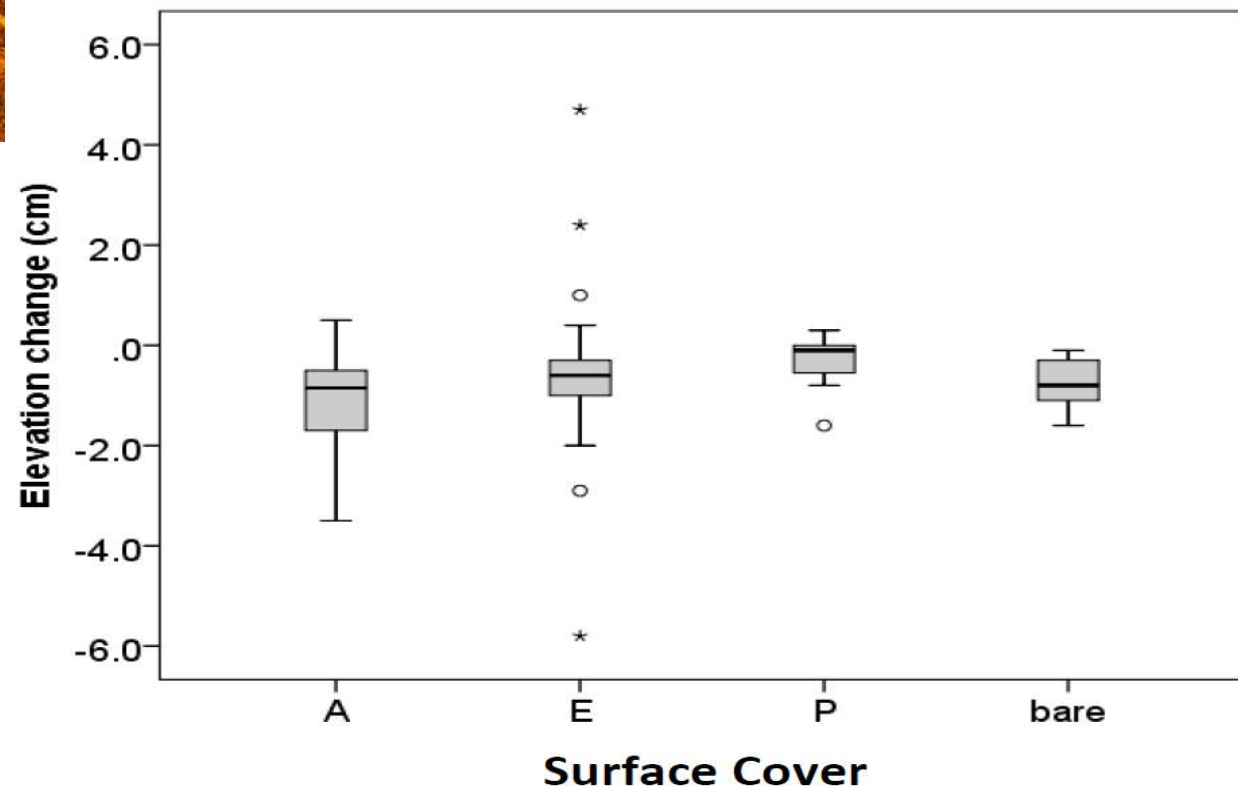
Möller, et al. 2014. *Nature Geoscience* 7, 727-731
www.thesaltmarshexperiment.org

Under 2m water, 40 m distance \rightarrow \sim 15 % wave height reduction





**‘Storm’-induced
erosion minimal and
depends on plant
species...**

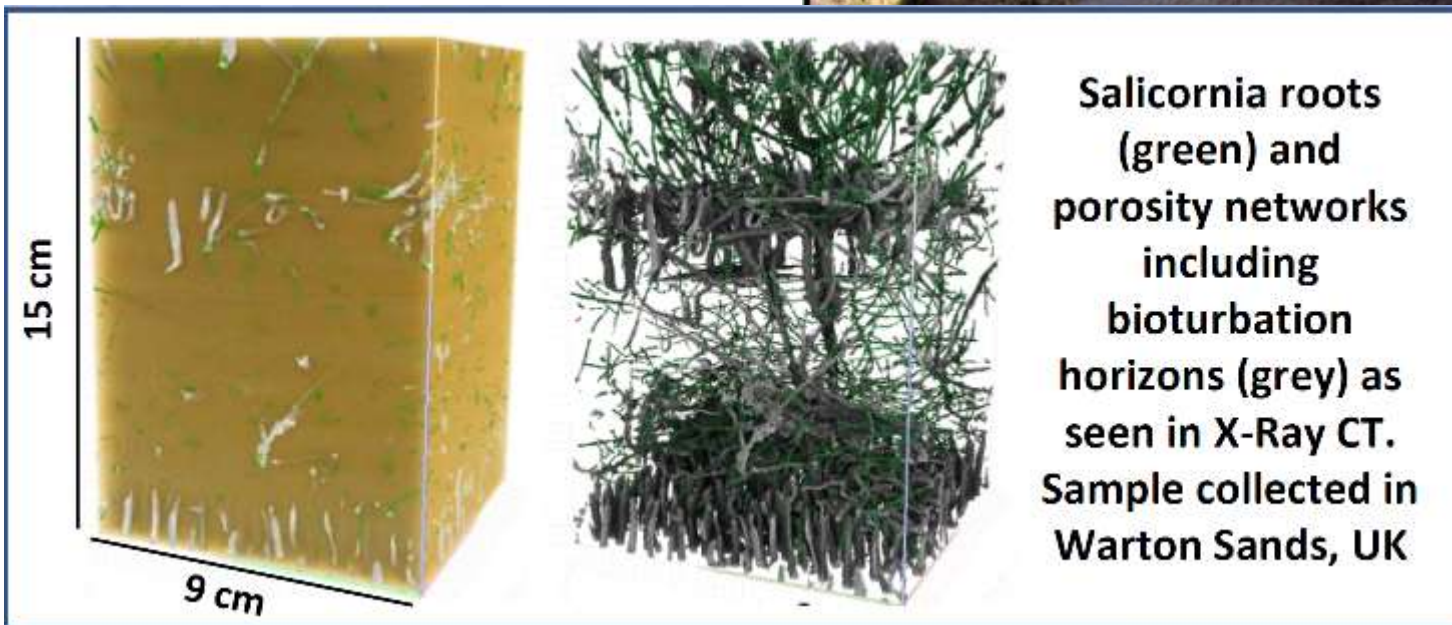


Spencer *et al.* (2015) ESP&L
Special Issue

State of Science

Resistance of salt marsh substrates to near-instantaneous hydrodynamic forcing

Helen Brooks,^{1*} Iris Möller,² Simon Carr,³ Clementine Chirol,⁴ Elizabeth Christie,¹ Ben Evans,¹ Kate L. Spencer,¹ Tom Spencer¹ and Katherine Royse²



Chirol *et al.*, 2021
Geoderma 387

Hard structures ...

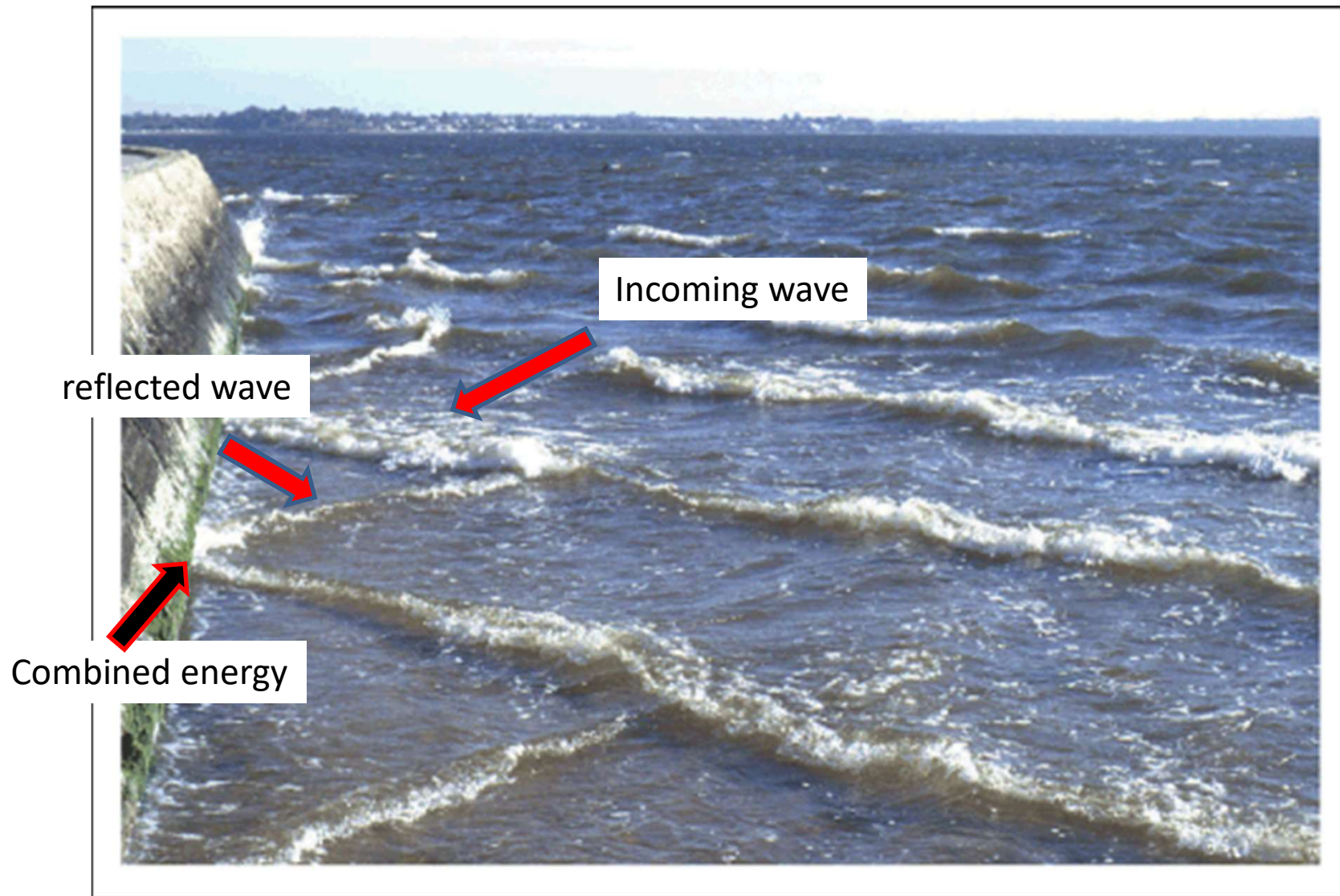
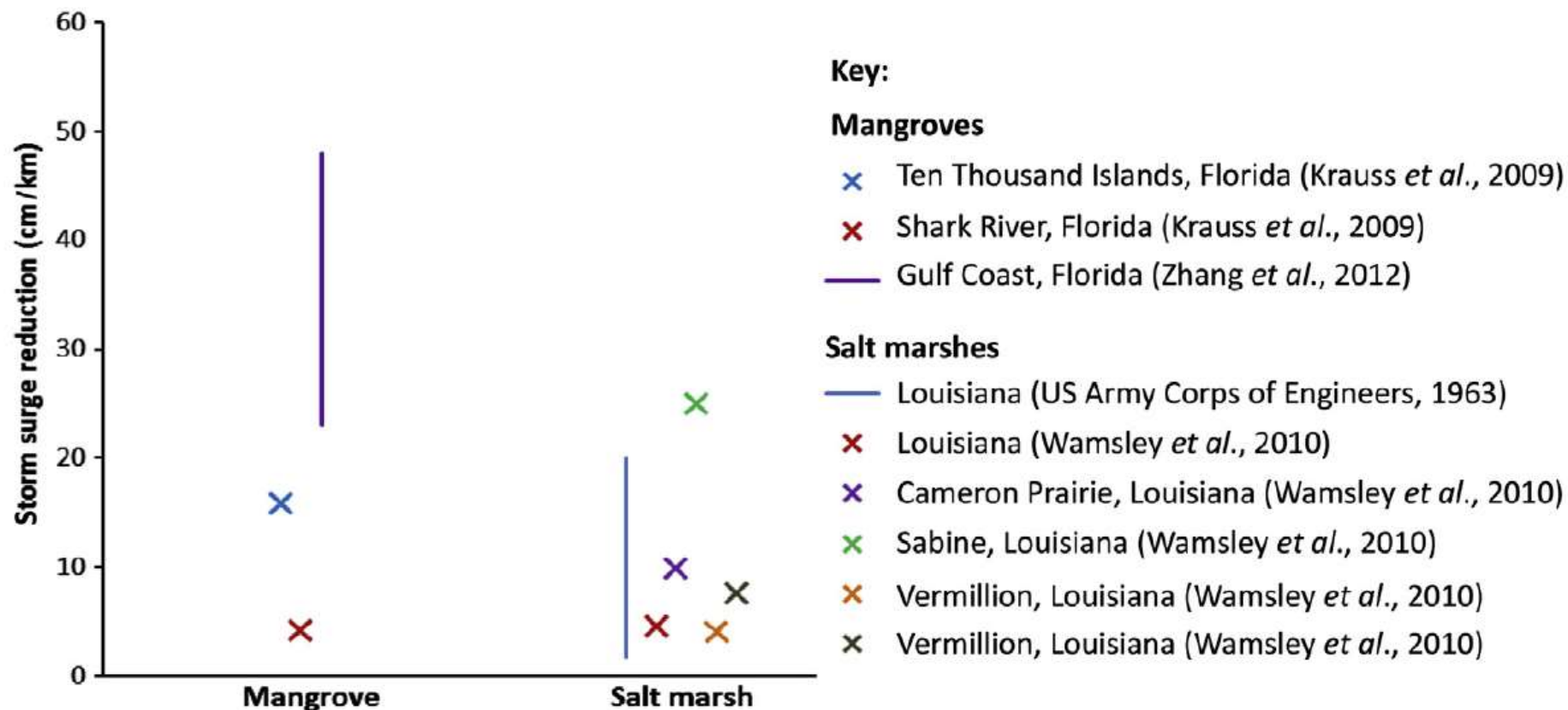


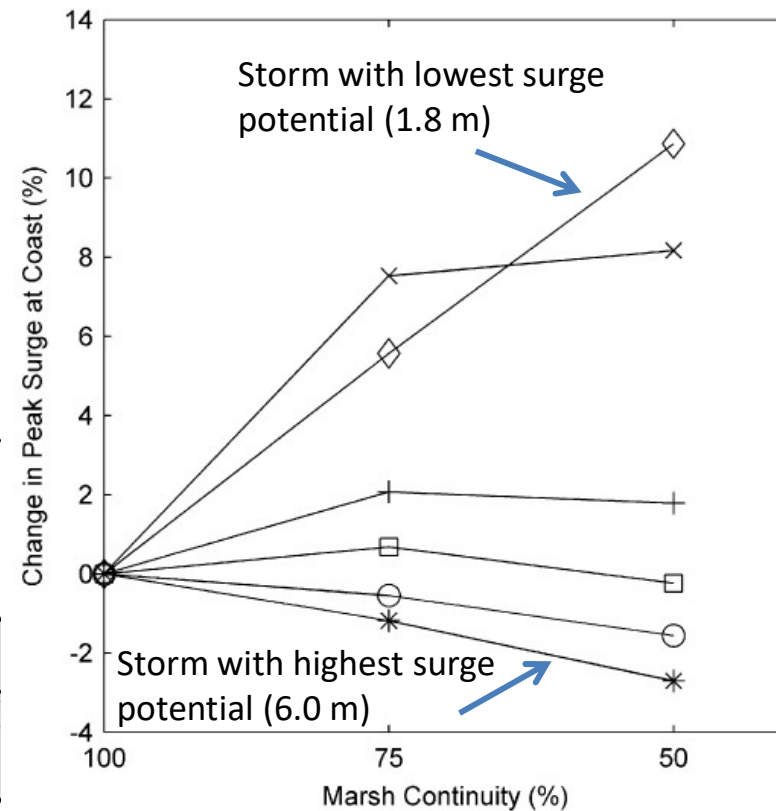
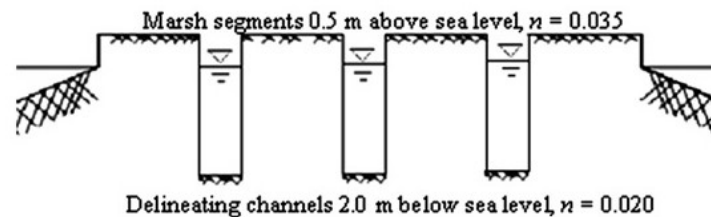
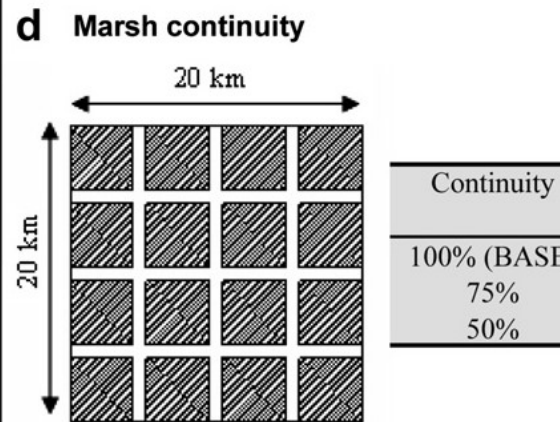
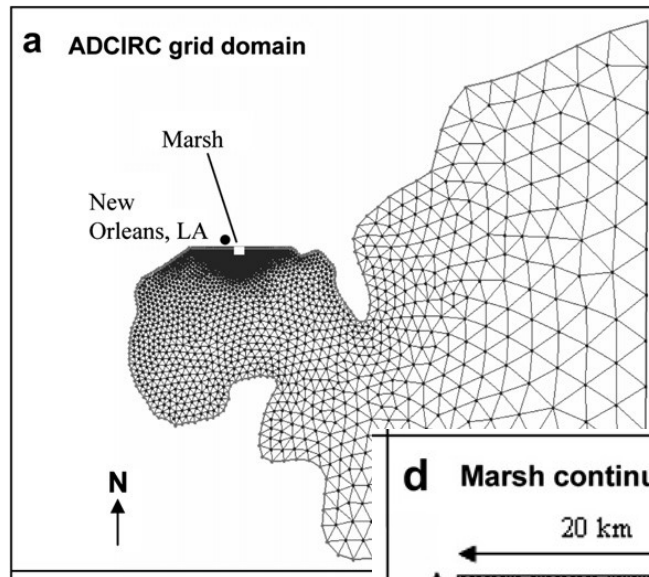
Figure 15.13 Reflection of breaking waves at the vertical face of a seawall giving rise to a criss-cross wave pattern.

Surge water level reduction evidence

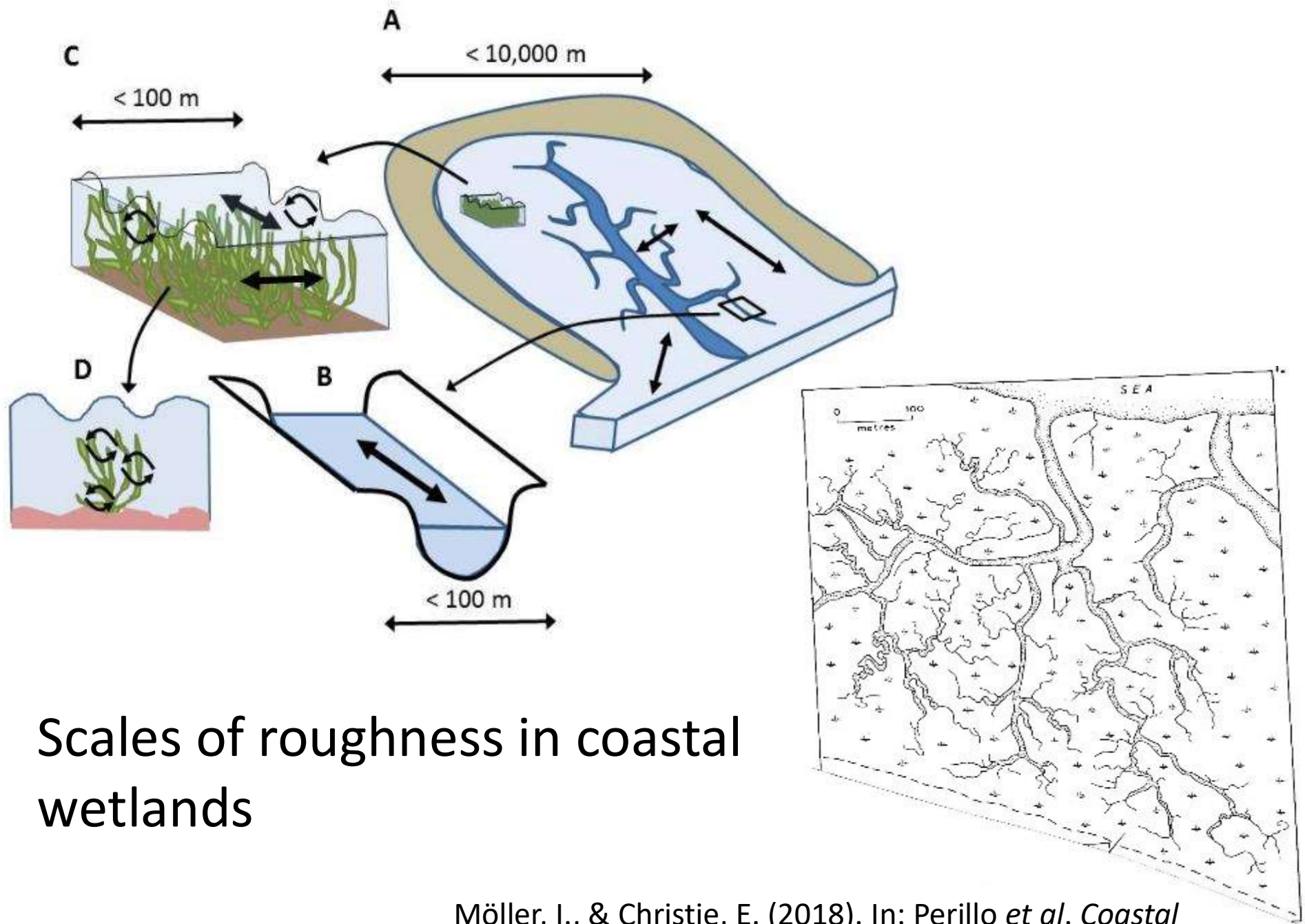


McIvor et al. 2015. Mangroves, Tropical Cyclones, and Coastal Hazard Risk Reduction. Chapter 14 in: Shroder et al., (eds) '**Coastal and Marine Hazards, Risks, and Disasters**'. Elsevier

New Orleans: storm surge attenuation



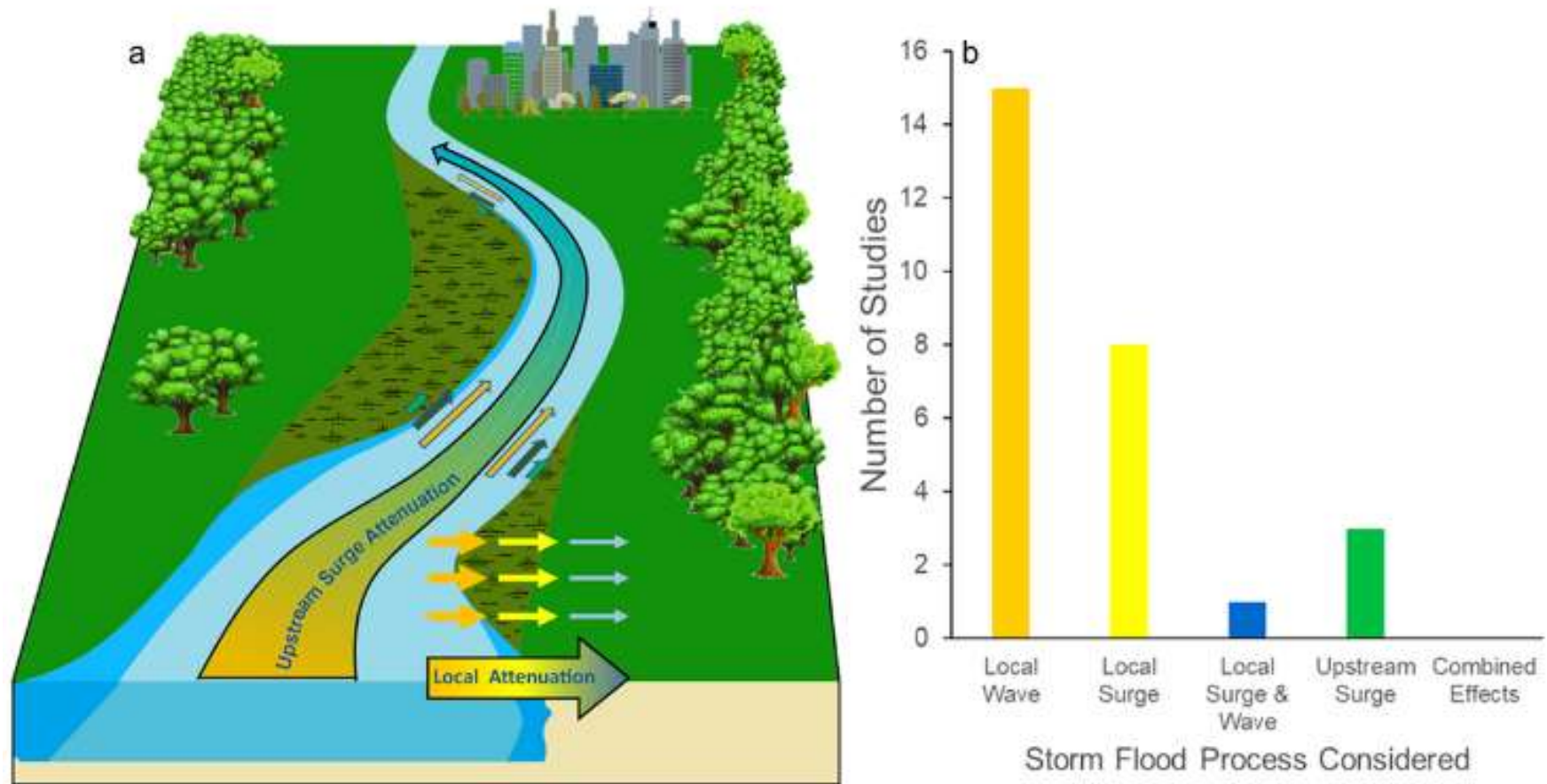
Loder et al. 2009
Estuarine, Coastal and Shelf Science, 84(4), 625–636.



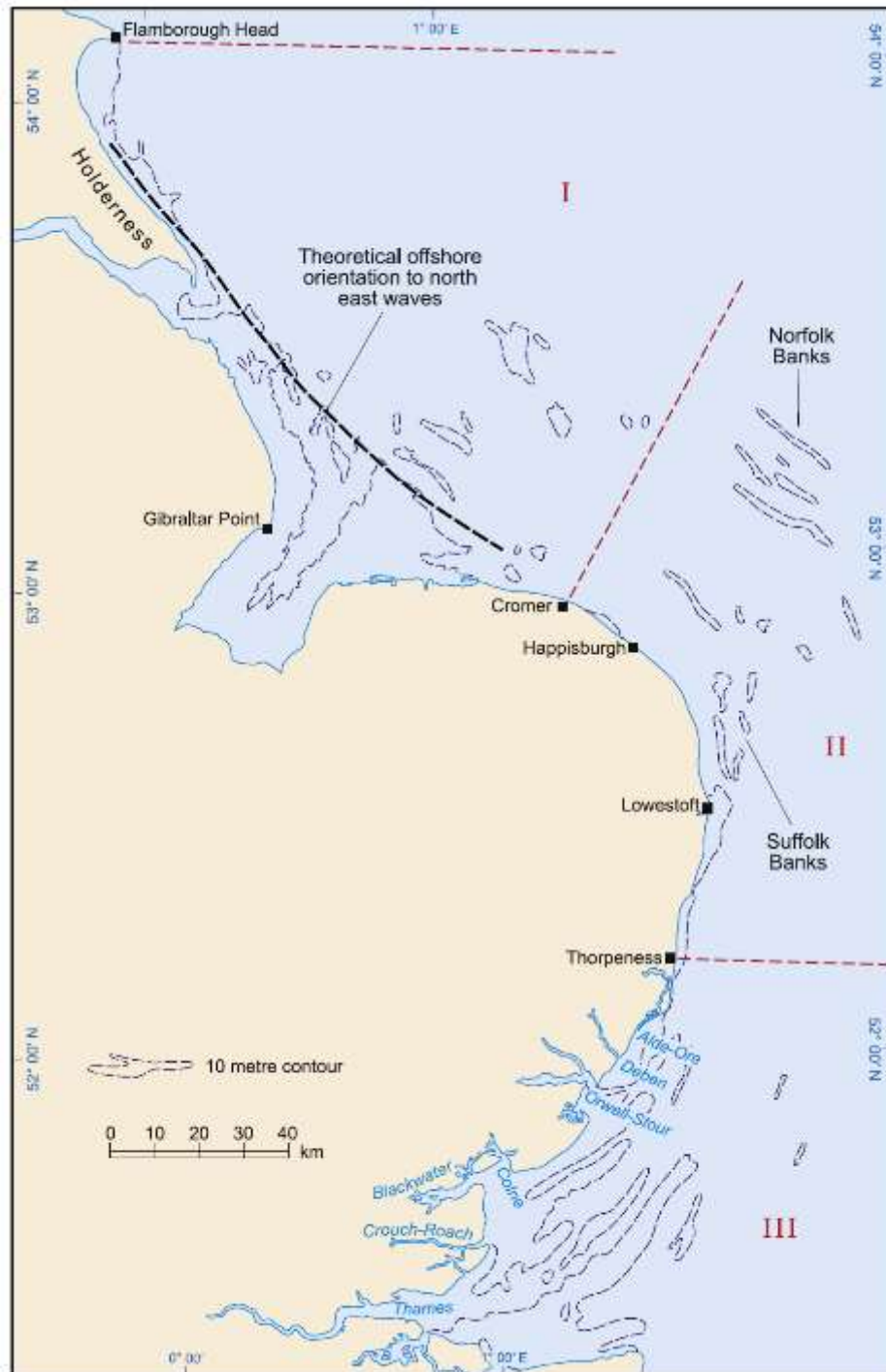
Scales of roughness in coastal wetlands

Möller, I., & Christie, E. (2018). In: Perillo *et al.* *Coastal Wetlands. An integrated ecosystem approach.*

Combined surge/wave attenuation



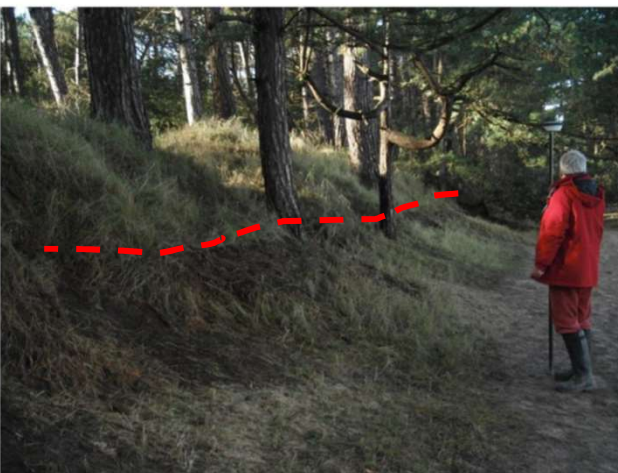
Fairchild et al. (in review) – preview: <https://www.researchsquare.com/article/rs-244327/v1>



Storm surges

- Complex seabed topography
- Complex surge dynamics
- Complex nearshore bathymetry

➔ Wave and surge water level dissipation



2013 Surge Impacts

- Complex seabed topography
- Complex surge dynamics
- Complex nearshore bathymetry

Local effects on max water levels

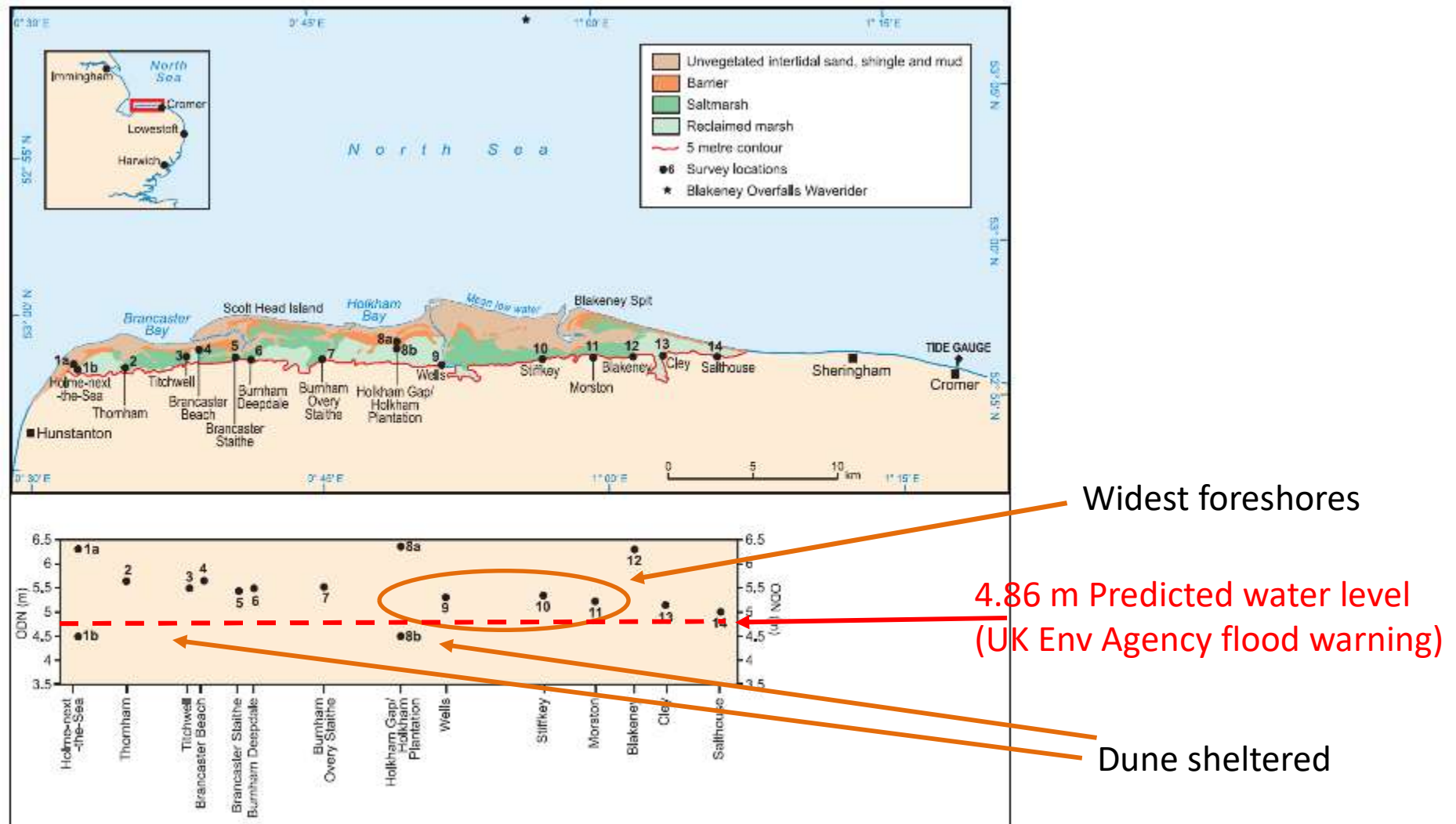


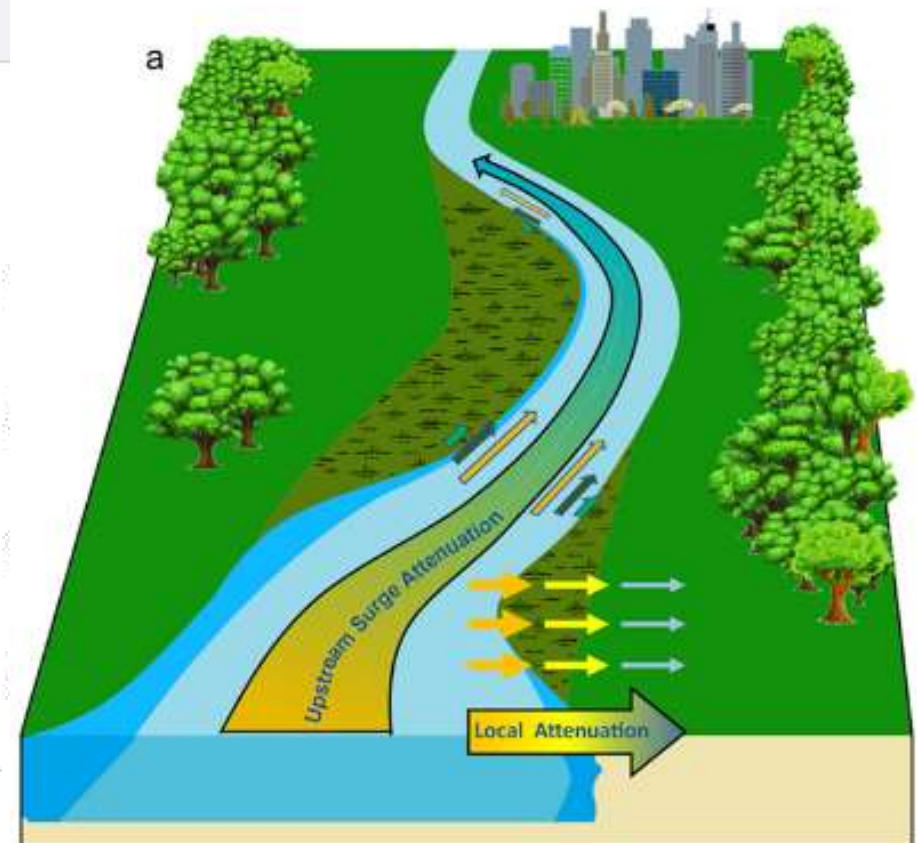
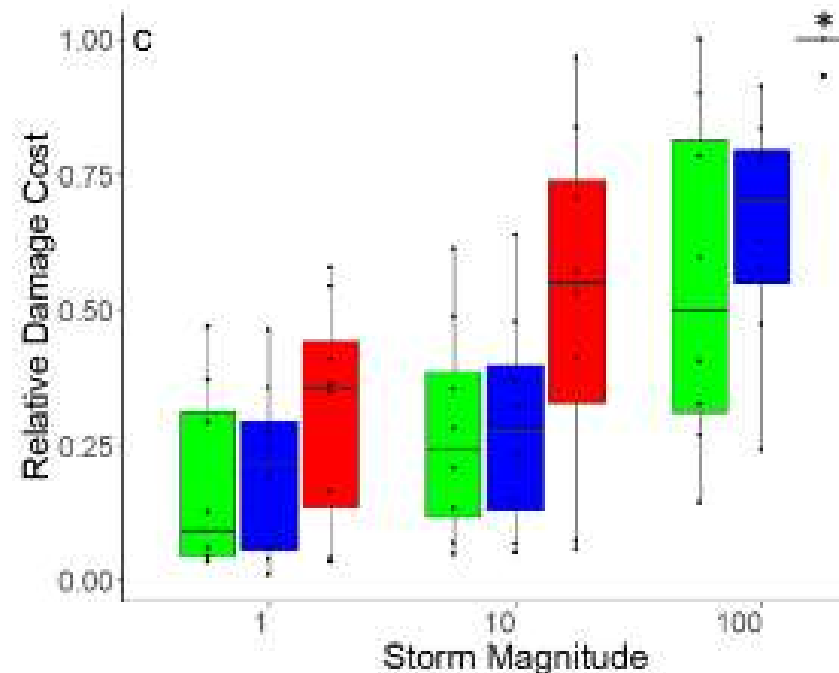
Fig. 1. Alongshore variation in maximum water levels reached during the storm surge of 5 December 2013 on the barrier coastline of North Norfolk, eastern England (ODN = Ordnance Datum Newlyn, where 0.0 ODN approximates to mean sea level).

ARTICLE

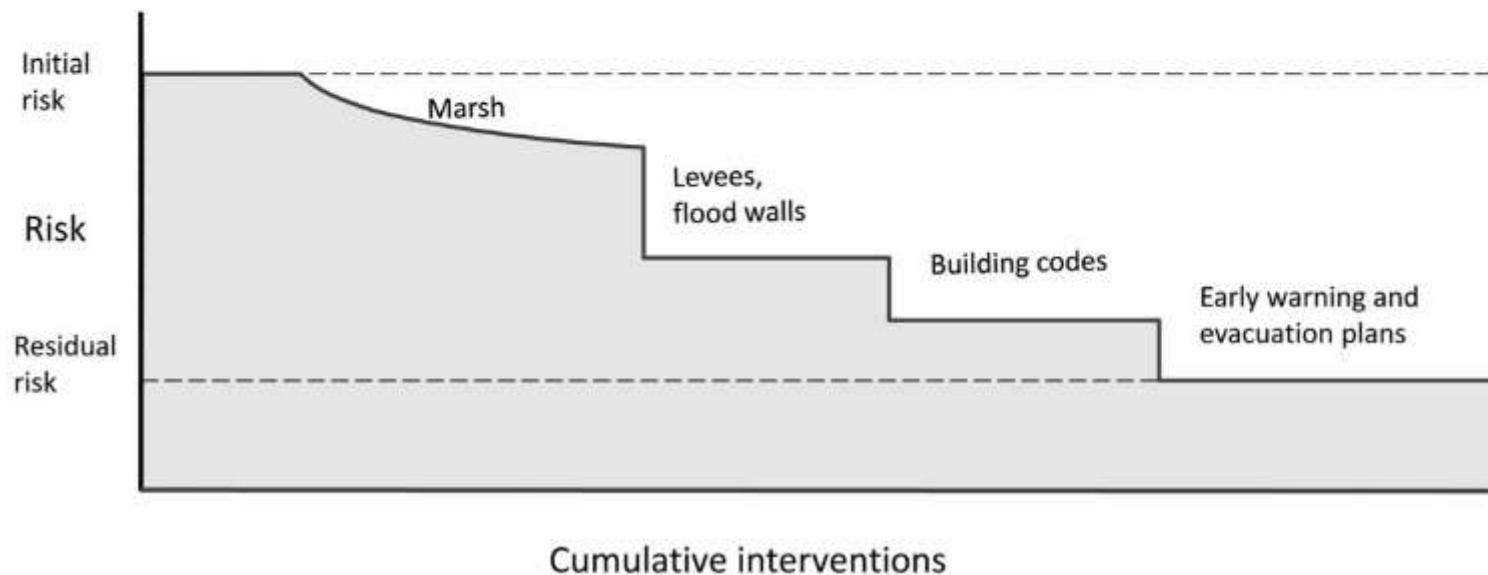
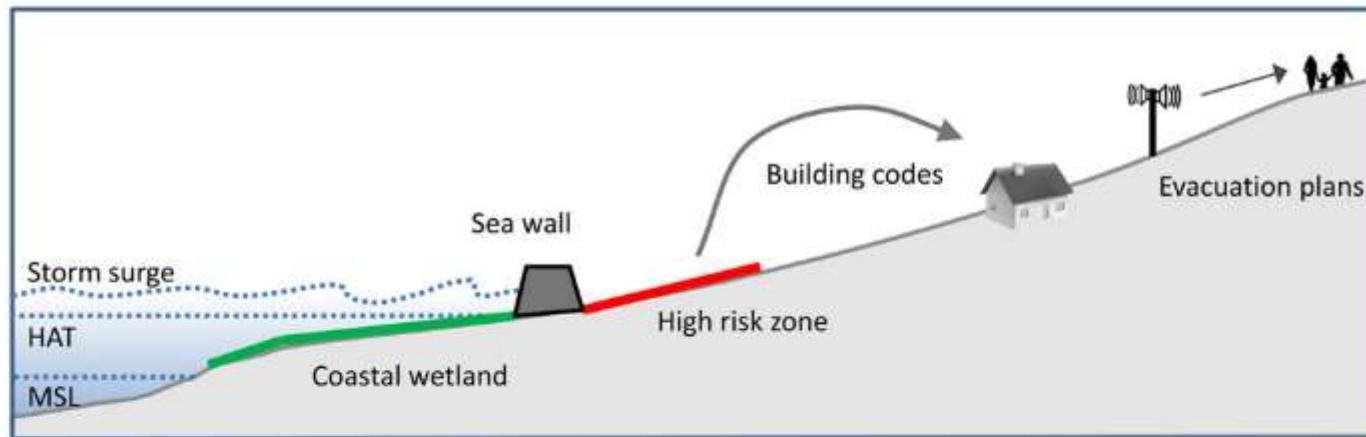
Coastal wetlands mitigate storm flooding and associated costs in estuaries

Tom Fairchild, William Bennett, Greg Smith, Brett Day, Martin Skov, Iris Möller, Nicola Beaumont, Harshinie Karunarathna, John Griffin

DOI: 10.21203/rs.3.rs-244327/v1 [Download PDF](#)



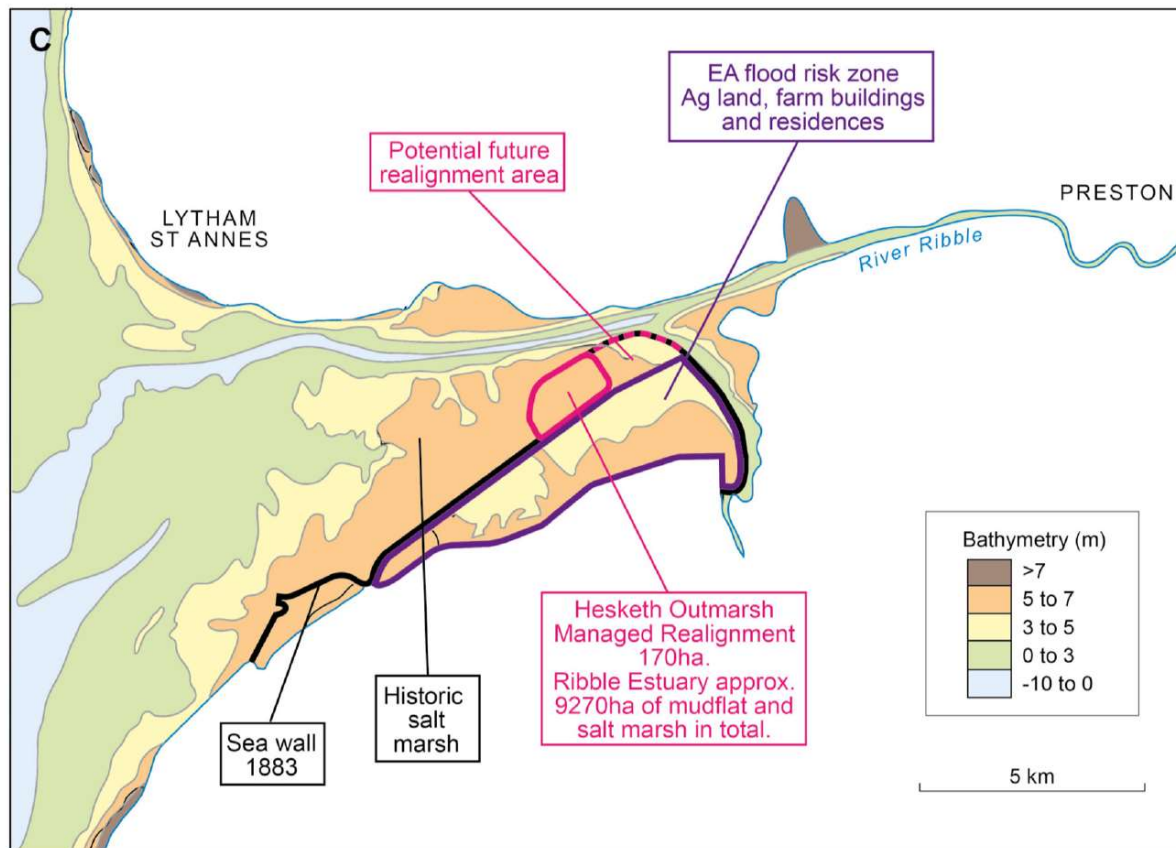
Coastal landforms & ecosystems as critical elements of our solutions





Hesketh Outmarsh West Managed Realignment UK

180 ha



2008/2009: x 4
breaches in outer
seawall

New seawall +
saltmarsh protect
1260 ha farmland
74 residential
properties
100 farm buildings



Implementation challenges

- Requires space we don't have...
- Nature = inherently variable
- No perceived fixed future
- Context dependency
- No specified 'design life'
- No 'easy' costing model
- No 'project end' date...

The 'sand motor', The Netherlands

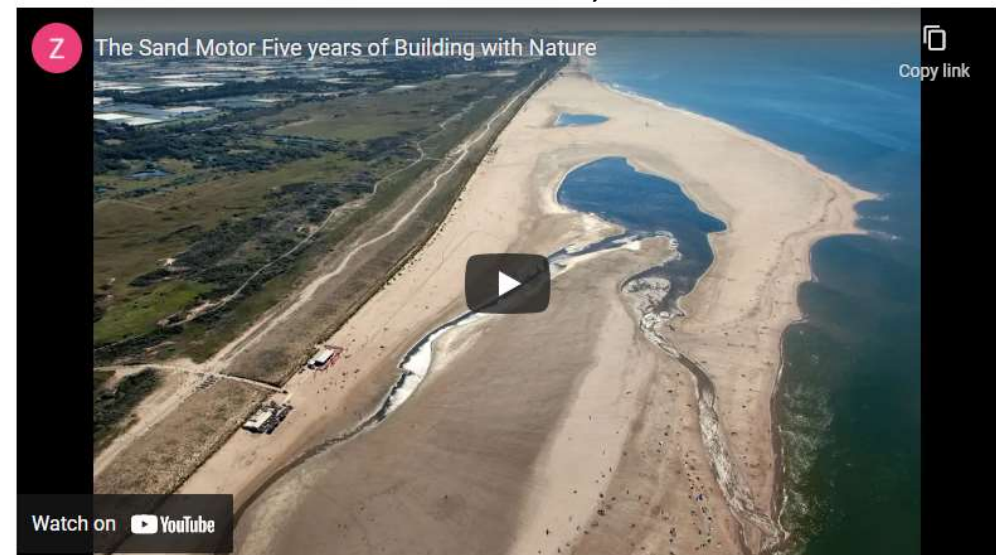


Image: J Tempest

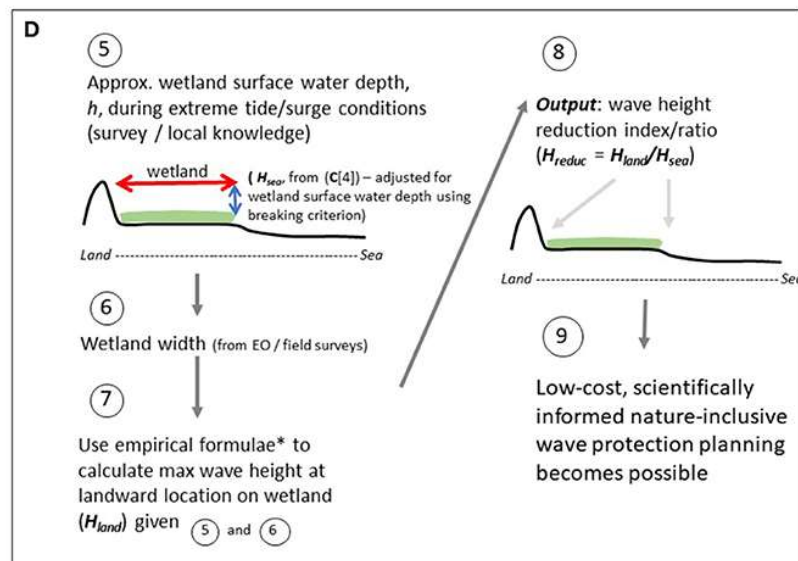
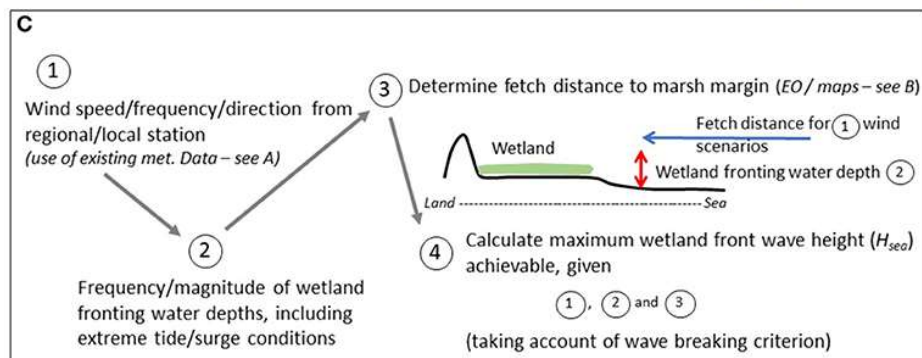
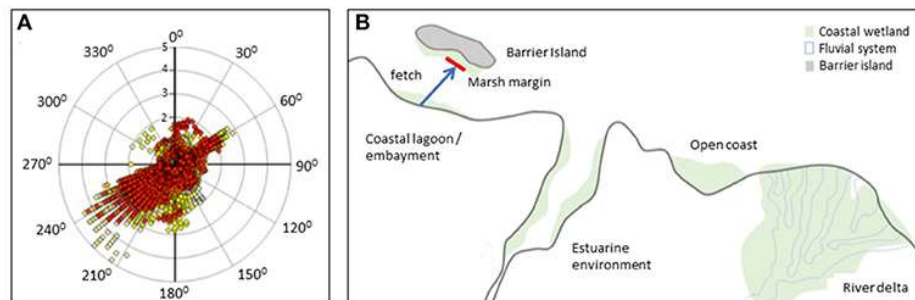


Advantages & Opportunities

- Self-adjusting dynamic system
- Building respect for nature
- Empowering communities / individuals
- Building knowledge / scientific understanding



Image: J Tempest



* Using Möller et al. (2014), it can be assumed with certainty (95% probability of assuming correctly) that the marsh will reduce wave heights by **at least 15%** for as long as it retains > 40 m width.

Möller 2019, *Front. Environ. Sci.* 24 April 2019

TESSA – Toolkit for Ecosystem Service Site-based Assessment

BirdLife International

WHO WE ARE WHAT WE DO WHERE WE WORK SUPPORT US DONOR ZONE

Assessing ecosystem services - TESSA

Overview

The Toolkit for Ecosystem Service Site-based Assessment (TESSA) has been developed through a collaboration of scientists with input generously provided by scientists and practitioners from multiple disciplines. The toolkit provides accessible guidance on low-cost methods for how to evaluate the benefits people receive from nature in particular sites in order to generate information that can be used to influence decision-making.

TESSA is primarily aimed at conservation practitioners, although the methods may be applicable to a wider range of users, including natural resource managers (e.g. forestry, fisheries, water management), land-use planners, development organisations (e.g. for poverty alleviation), and the private sector.

- Discover how TESSA is different to other tools.
- Download the Toolkit for Ecosystem Service Site-based Assessment.
- TESSA Publications.
- Case studies: Examples of TESSA from around the world.
- Webinars: learn how to use the TESSA (video available in the archive).
- TESSA Training.

The methods in the toolkit are designed to be applicable to users from developing and developed countries, and across all terrestrial and wetland habitats (currently excluding marine areas). The current version (2.0) includes a preliminary scoring apparatus and further methods for the following services:

- Carbon sequestration
- Cultural goods
- Culture services
- Genetic resource regulation
- Recreational and goods
- Non-timber forest products
- Provision
- Water provision, quality, and flood control

The toolkit includes:

- An overview of ecosystem services, key concepts and datasets.
- Guidance on conducting a preliminary scoring appraisal at a user's site to understand the important services provided by a site and to whom.
- Decision trees (flow charts) to lead the user to the most appropriate methods according to the characteristics of the site.
- Methods for measuring the ecosystem services listed above.
- The valuation of an alternative site in order to compare a current and alternative site of the site and hence estimate the impact of potential.

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Advantages & Opportunities

- Self-adjusting dynamic system
- Building respect for nature
- Empowering communities / individuals
- Building knowledge / scientific understanding
- Lower cost in the long run
- Realisation of multiple benefits

<https://www.theccc.org.uk/publication>

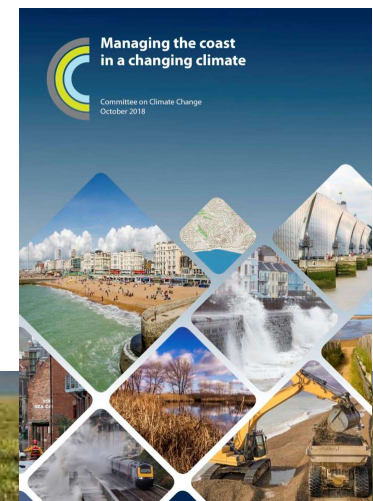
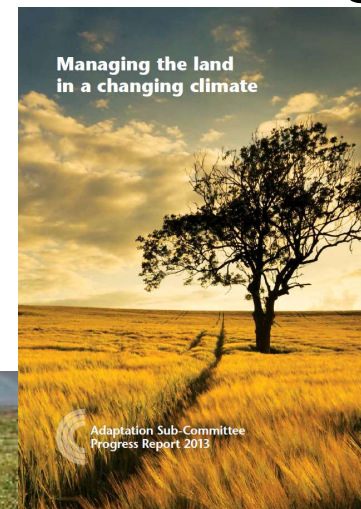


Image: J Tempest



Conclusions: Saltmarshes as NBS

- We have the evidence base for both all of erosion resistance, water level and wave reduction ***and more!***
- Implementation has to be context specific
- Implementation challenges our traditional planning models & expectations
- Long-term benefits are clear and evidenced
- Clear policies now need to follow...



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Image: J Tempest



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Thank you!



<https://www.pml.ac.uk/CoastWeb/Home>

Illustrations by @tonixllobet

