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Coláiste na Tríonóide, Baile Átha Cliath
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Biodiversity Implications of Coastal Climate Change Mitigation and Adaptation



Illustration @tonixlobet

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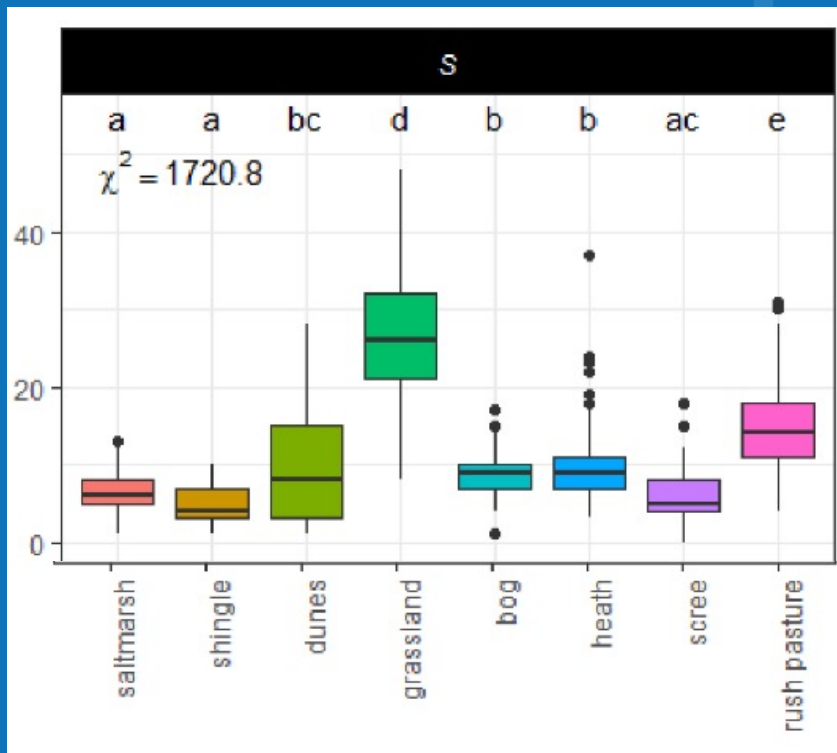
- ca 775 million dependent people (food supply to 500 million)
- Carbon sequestration = 2 x terrestrial forests
- Key to many migratory bird species
- 35-85 % reduction of coastal wetlands over recent centuries

Saunders et al. 2020

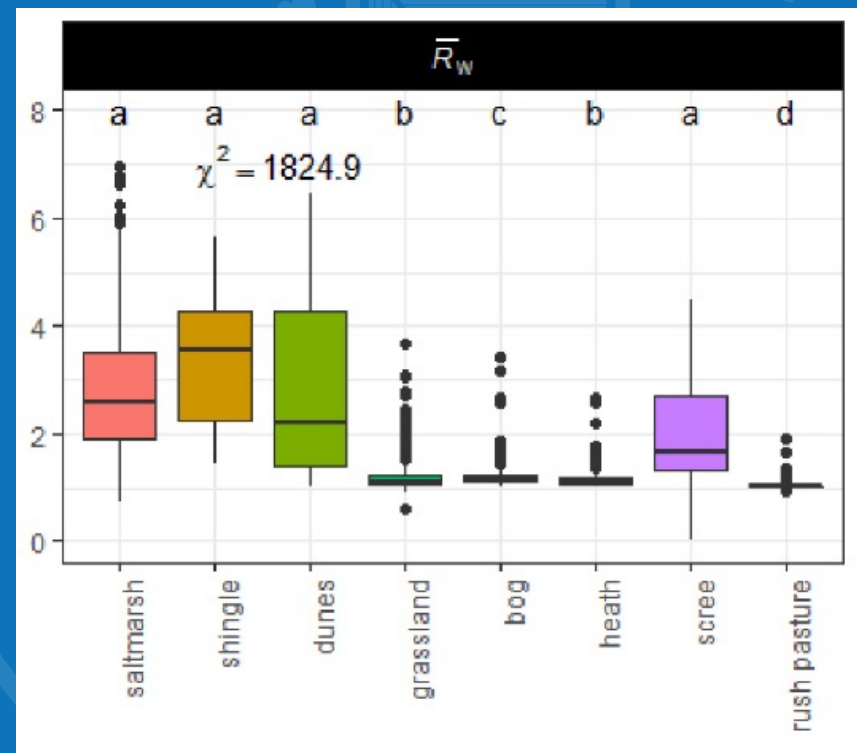




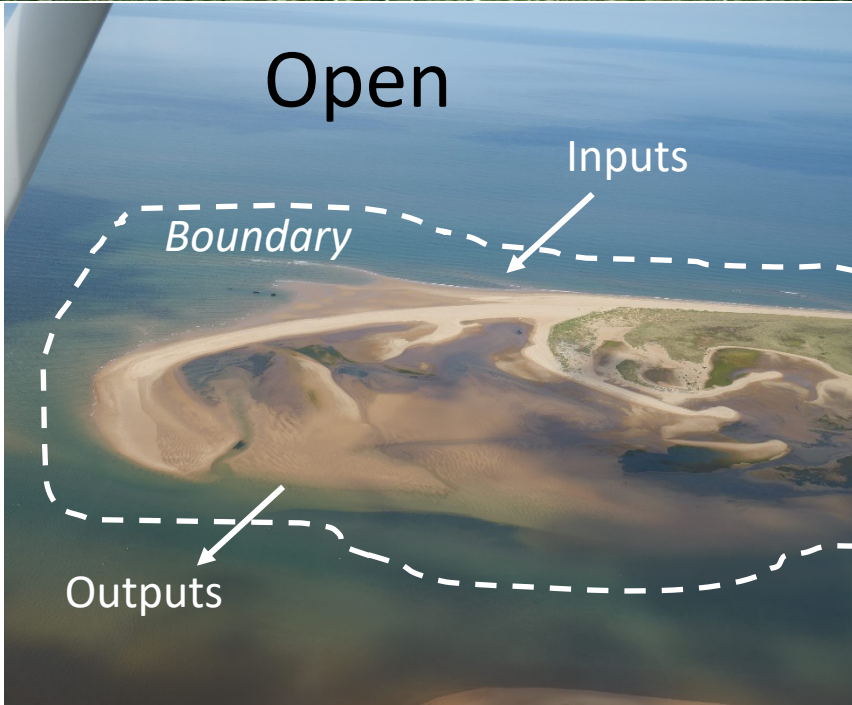
Coastal vs other Irish Ecosystems Biodiversity



Species Richness



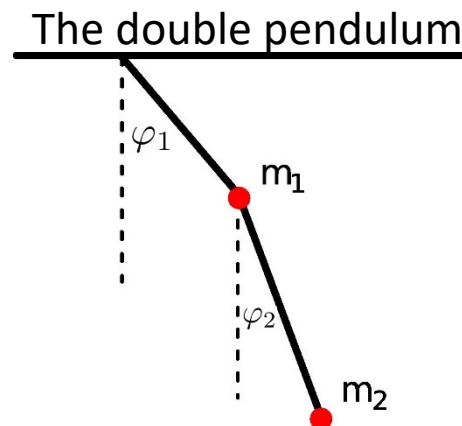
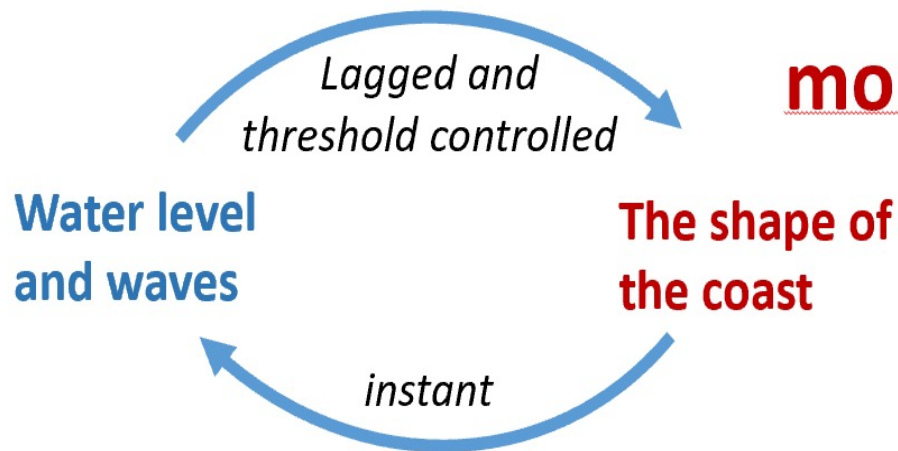
Abundance-weighted mean rarity index



“... a non-linear dynamic system, dissipative and with a continuous energy input, randomly forced at a wide variety of spatial and temporal scales, and exhibiting free as well as forced behaviour.”

‘On the Prediction of Aggregated-Scale Coastal Evolution’ (H. J. de Vriend, 2003)

morphodynamics



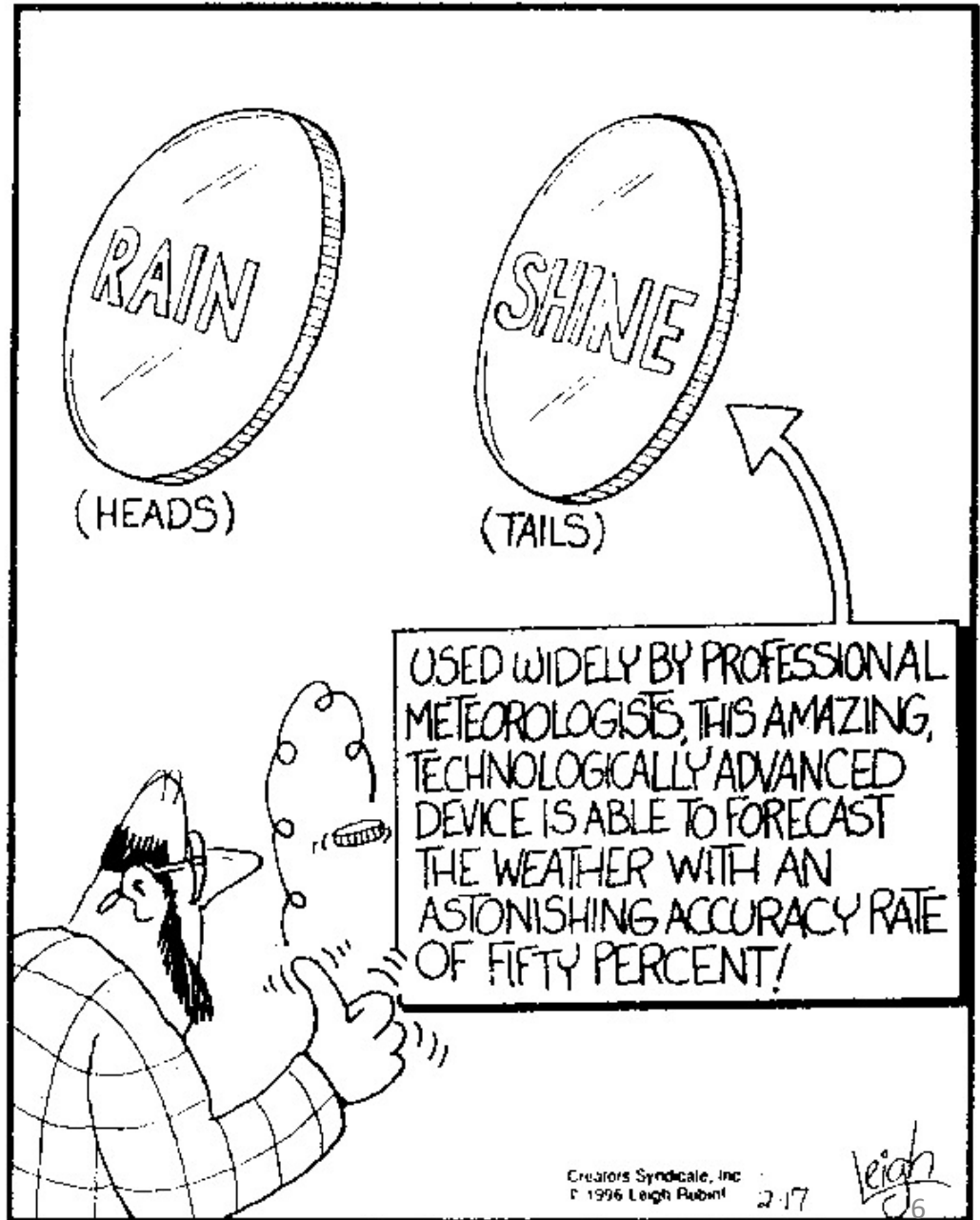
Not unlike the weather...



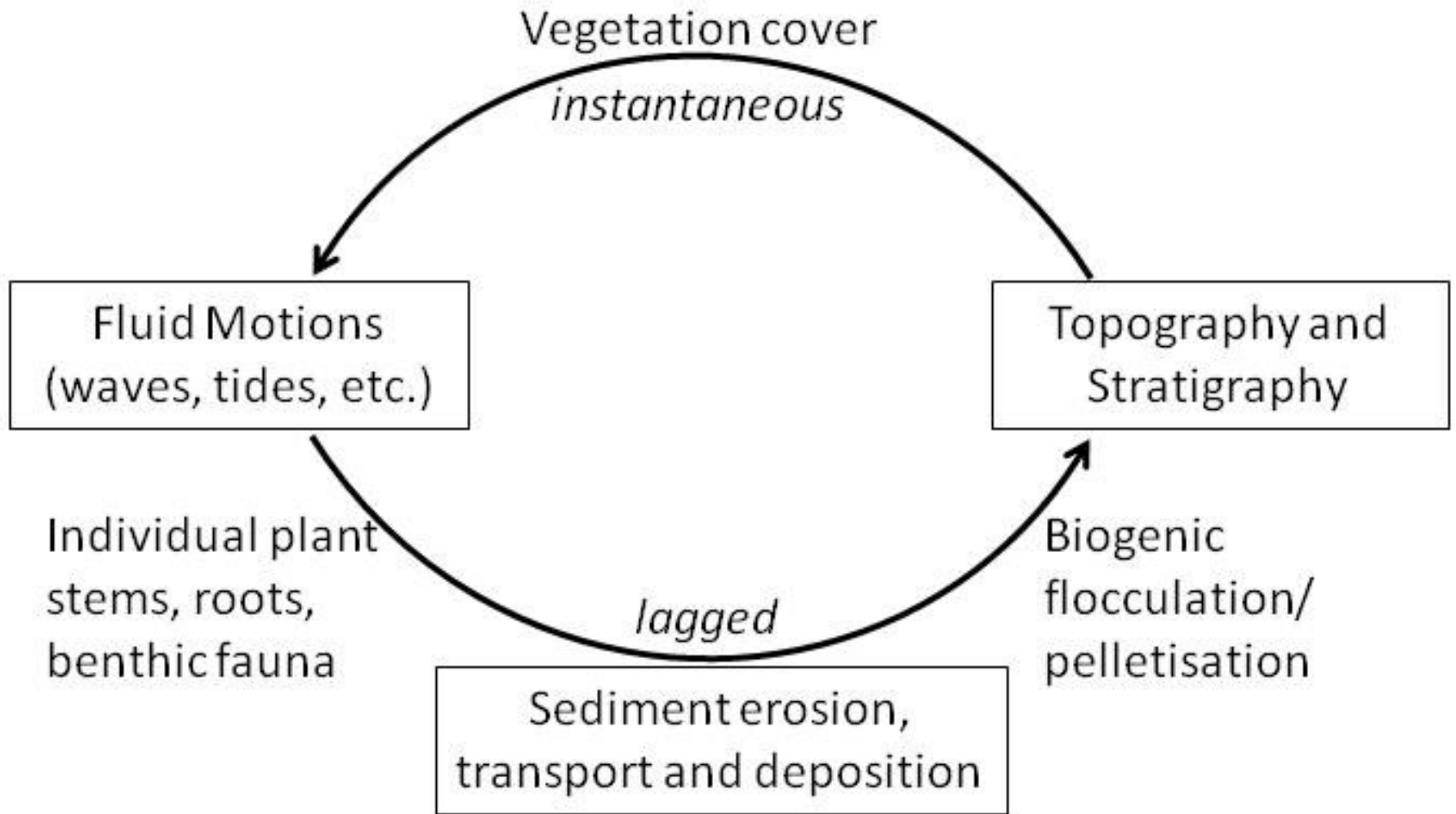
"Those who have knowledge, don't predict. Those who predict, don't have knowledge."

Lao Tzu, 6th Century BC Chinese Poet

RUBES *by LEIGH RUBIN*



Resistance ≠ Resilience in Coastal Wetland Systems



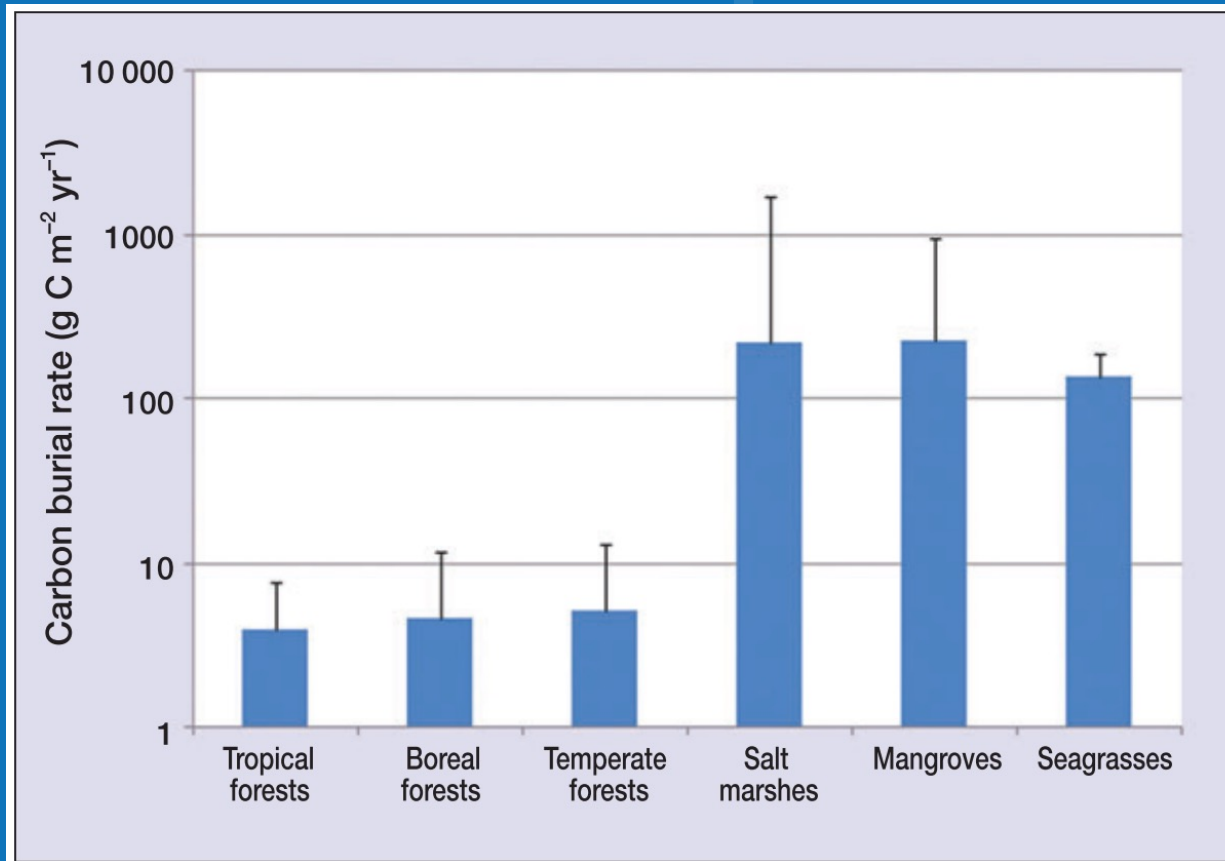


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Annual carbon burial rate in coastal *versus* terrestrial systems



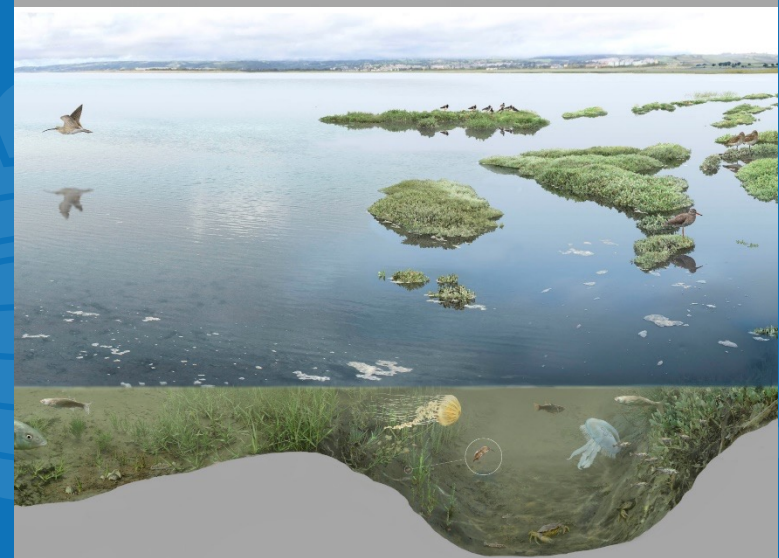
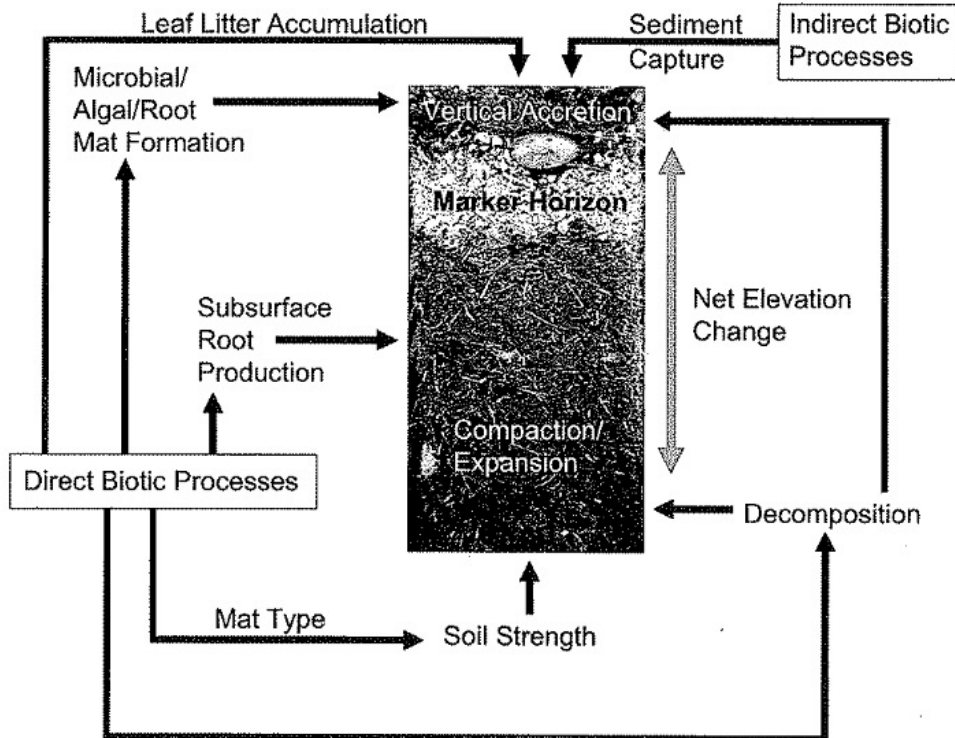
NB: Very high range

Max range for salt marshes

18-1713 g m⁻² yr⁻¹

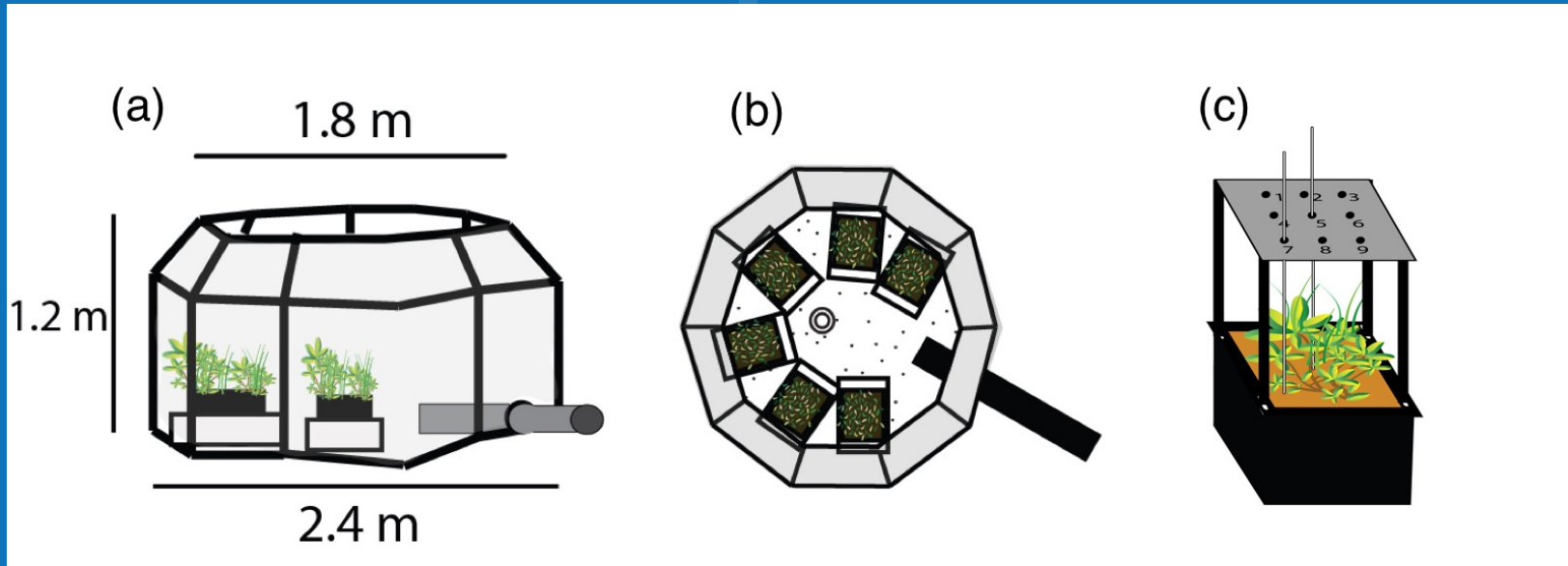


Elevation is critical & processes complex





Elevated CO₂ (800 vs 400 ppm) may affect resilience

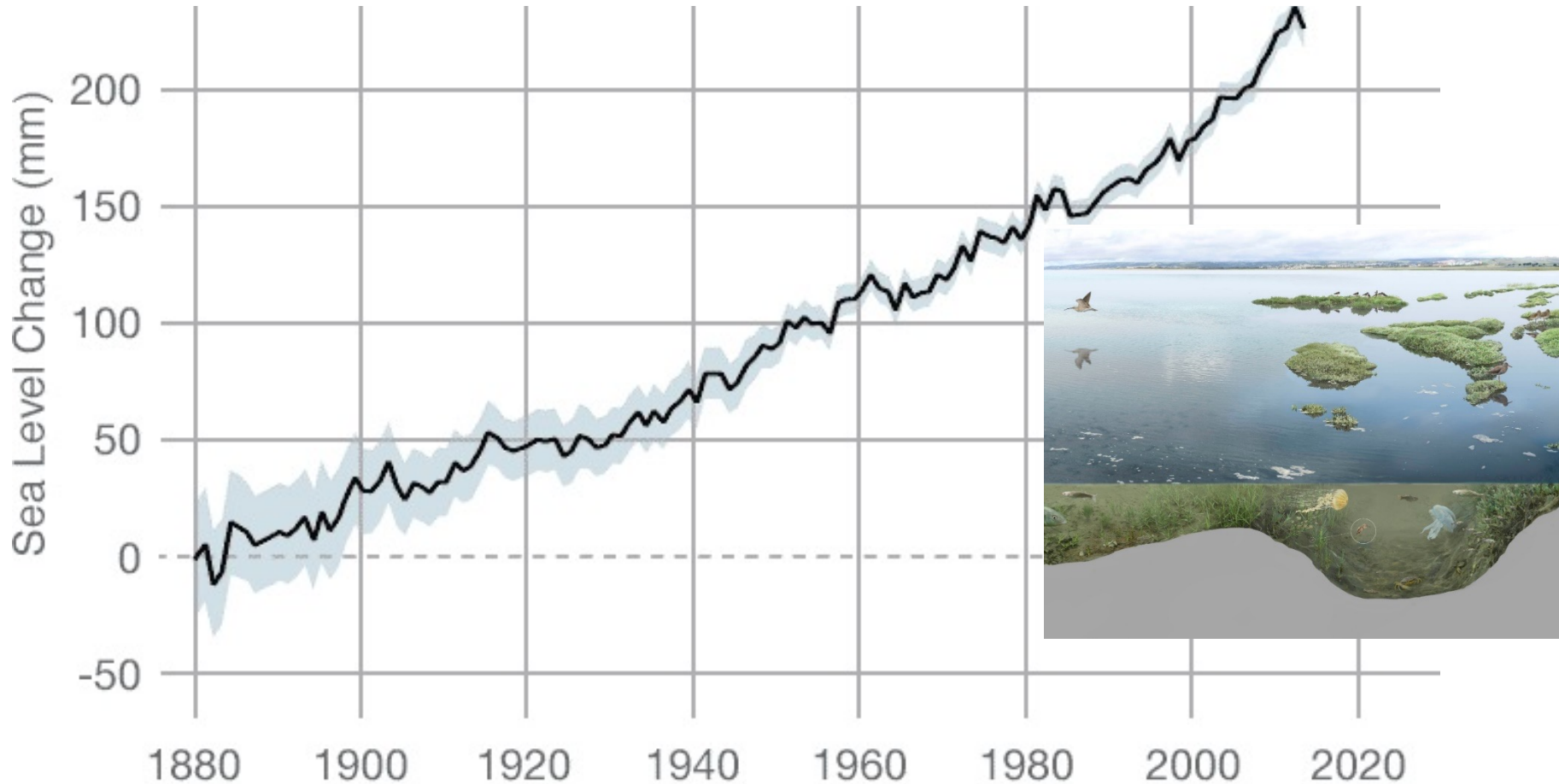


- 3.4 mm surface elevation gain (one growing season) (global sea level rise ~ 3.7 mm/year)
- Potential reasons:
 - 10% reduction in microbial soil activity
 - Reduced rates of water usage
 - Below-ground root production (species dependent)

Global Mean Sea Level

- **1.4 mm yr⁻¹** 1901–1990 → **2.1 mm yr⁻¹** 1970–2015 → **3.2 mm yr⁻¹** 1993–2015 → **3.7 mm yr⁻¹** 2006–2018

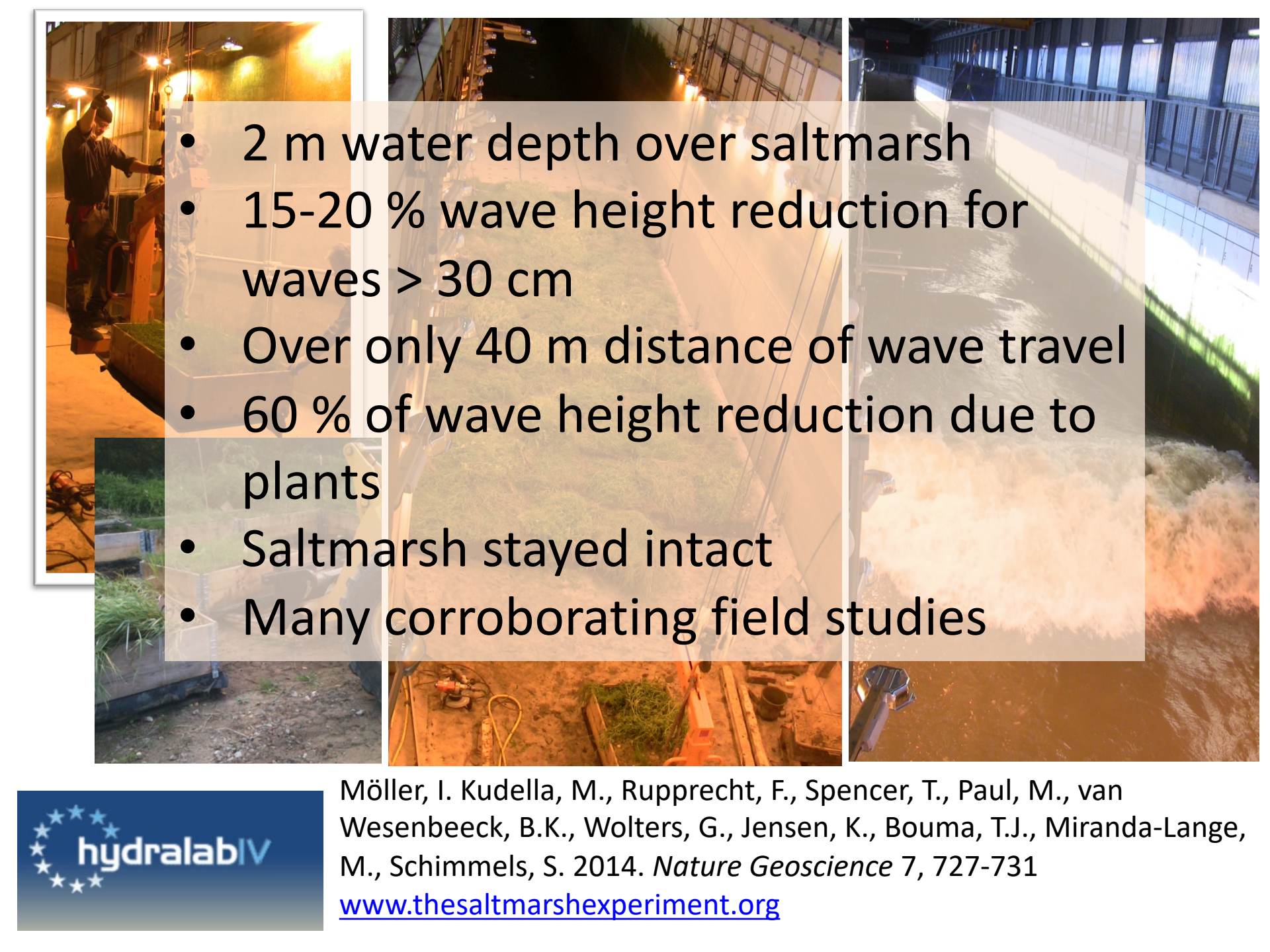
(IPCC AR6)





Möller, I. Kudella, M., Rupprecht, F., Spencer, T., Paul, M., van Wesenbeeck, B.K., Wolters, G., Jensen, K., Bouma, T.J., Miranda-Lange, M., Schimmels, S. 2014. *Nature Geoscience* 7, 727-731
www.thesaltmarshexperiment.org

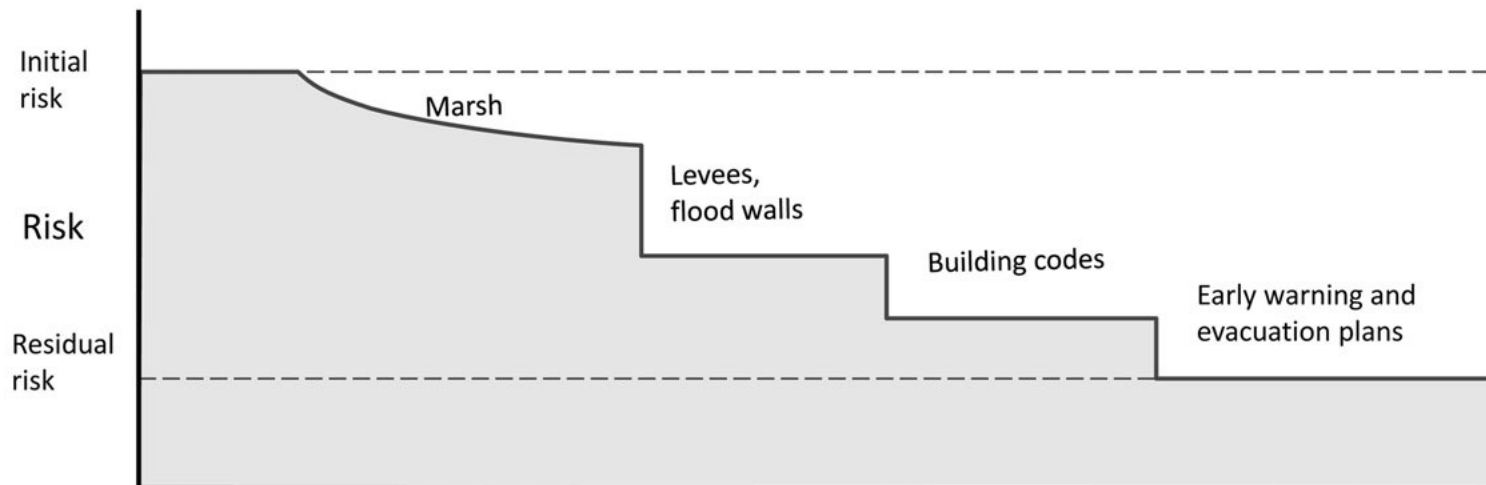
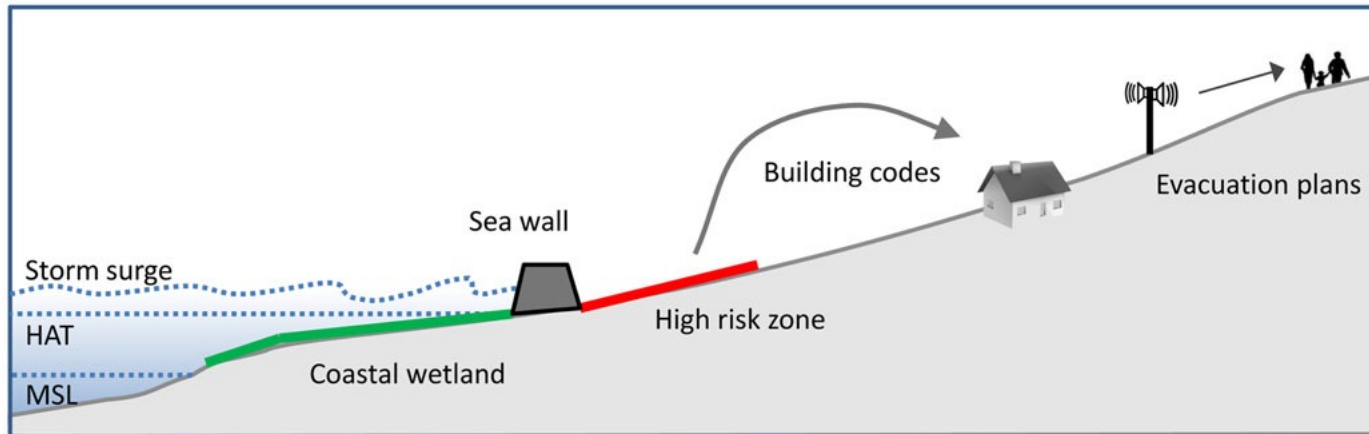


- 
- 2 m water depth over saltmarsh
 - 15-20 % wave height reduction for waves > 30 cm
 - Over only 40 m distance of wave travel
 - 60 % of wave height reduction due to plants
 - Saltmarsh stayed intact
 - Many corroborating field studies

Möller, I. Kudella, M., Rupprecht, F., Spencer, T., Paul, M., van Wesenbeeck, B.K., Wolters, G., Jensen, K., Bouma, T.J., Miranda-Lange, M., Schimmels, S. 2014. *Nature Geoscience* 7, 727-731

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Accommodation Space is needed for: Biodiversity, Dynamic Coasts, Climate Mitigation and Adaptation



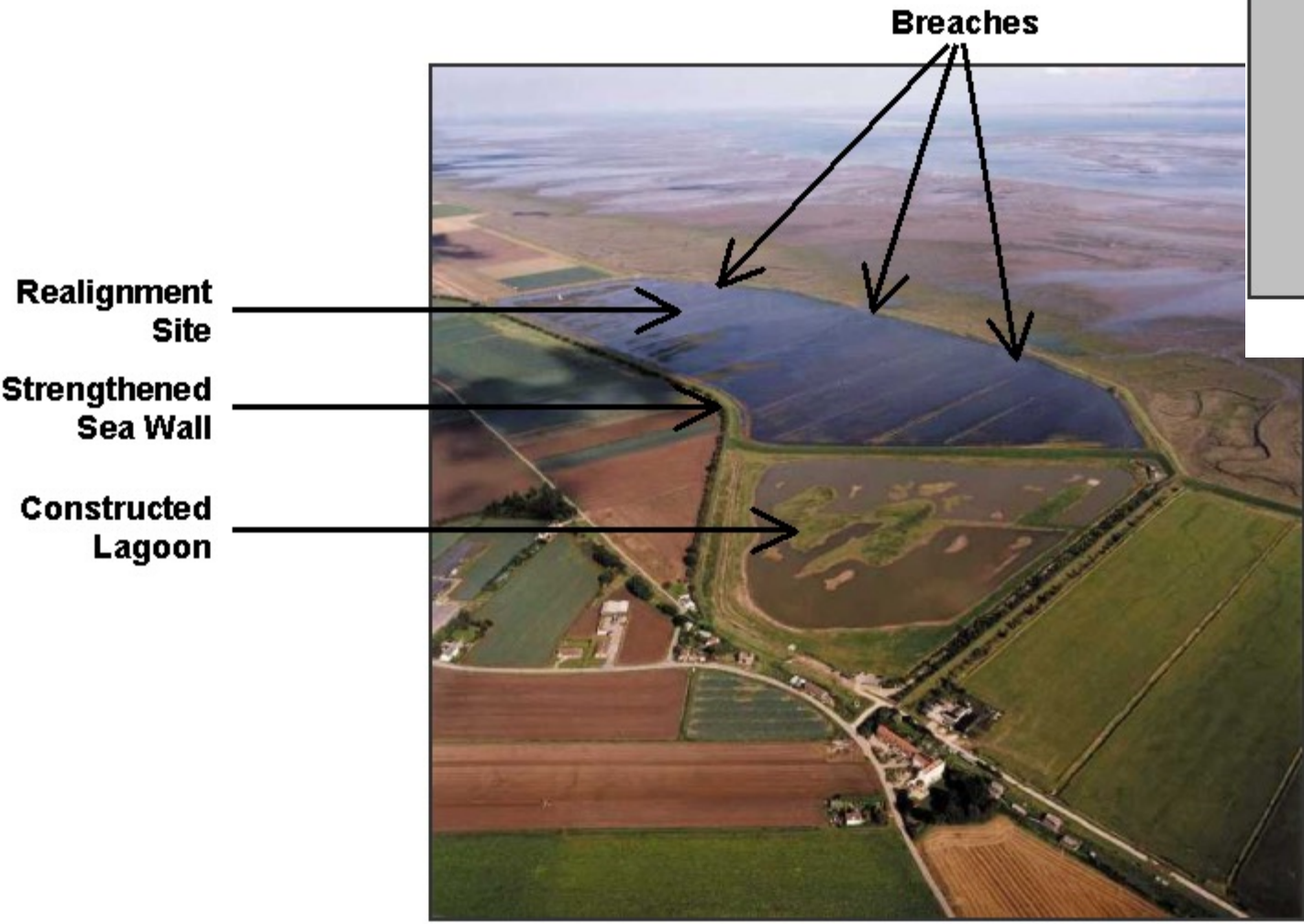
Cumulative interventions

Spalding et al. 2013 *Cons. Letters*, 1-9

Landward of existing defences: Managed Realignment...



Figure 2.2 – Location of Wash Banks
Source: Thomson et al. 2004



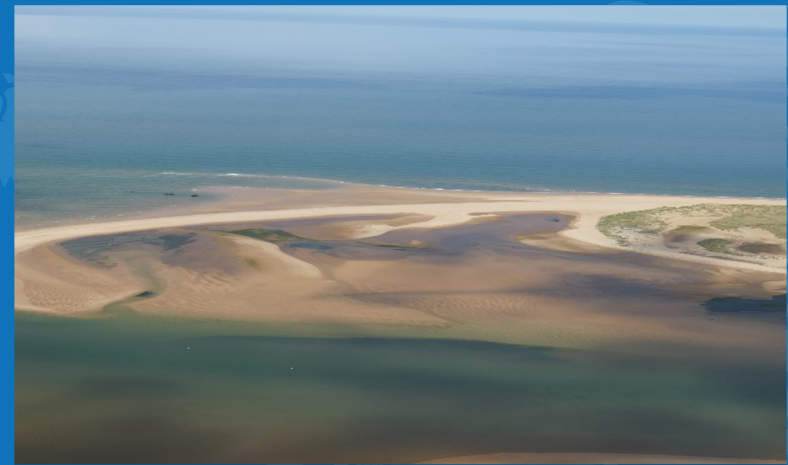
Freiston Shore
managed
realignment,
Lincolnshire, UK

78 ha, breached
Aug/Sep 2002

Figure 2.3 – The Freiston Shore Field Site
Photo by Environment Agency



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Coasts in summary...

1. Biodiversity indices are key: implications of mitigation measures manifest mainly at landscape / global scales
2. No substrate, no biodiversity
3. Highly dynamic → short(er) timescales of 'fixed' existence of any features
4. Carbon storage potentially high but see point 2 & 3
5. Sea level rise makes '**accommodation space**' critical
6. Mitigation and adaptation can scarcely be separated



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