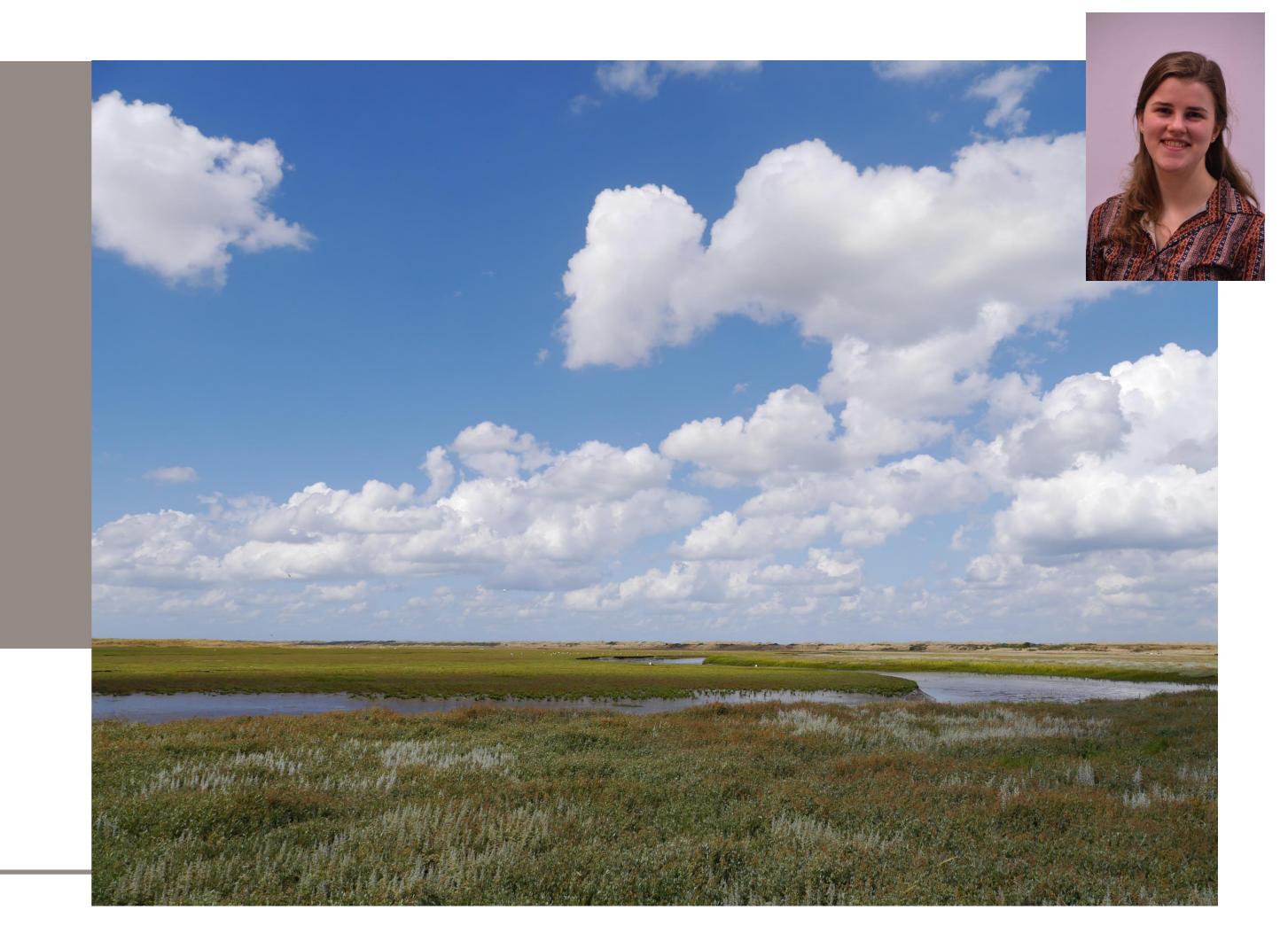# Salt marsh response to 32 years of relative increase in sea level

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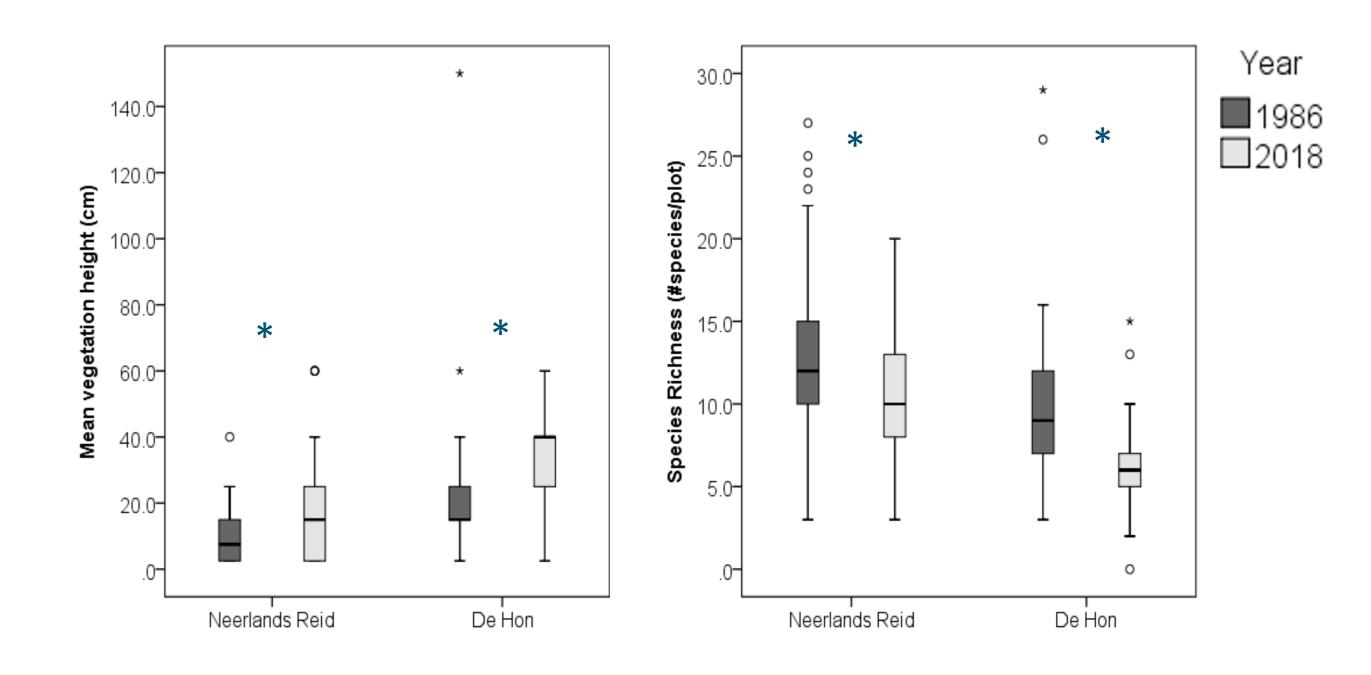UNIVERSITY & RESEARCH

Background

- Salt marshes are threatened by climate-change induced sea level rise (SLR).[1,2]
- Vegetation shifts towards wetter vegetation in response to SLR have been observed[3,4] but empirical research remains rare.
- We assessed effects of *relative* SLR on salt marsh sedimentation and vegetation to explore adaptive capacity of salt marshes.

Methods

- Natural experiment of soil subsidence due to natural gas extraction at Dutch barrier island (Ameland)
- *Relative* SLR 7 mm/yr over the last 32 years; comparable to predicted future rates of SLR[5]
- 84 2x2 m plots were assessed in 1986 and 2018
- Analysing:
  - Sedimentation
  - Vegetation changes
    - Indicator species presence & cover
    - Species richness, vegetation height

Results

Sedimentation partly compensated for relative SLR

Sedimentation partially compensated for the soil subsidence (fig. 1), but not completely, since most plots decreased in elevation since 1986 (fig. 2), particularly close to the Wadden Sea. Sedimentation decreased with distance to the Wadden Sea (r = -0.30, ρ = -0.36, p < 0.05 for both).

Figure 1. Measured vs. predicted plot elevation. + and ● indicate different salt marshes. Deviation from 1:1 line indicates sedimentation (above) or erosion (below).

Figure 2. Elevation of plots at salt marsh 'Neerlands Reid' in 1986 (open symbols) and 2018 (filled symbols).

Vegetation succession continued

Figure 3. The same plot at the salt marsh of Neerlands Reid in 1986 (left) and 2018 (right).

[1]Craft *et al.* (2009) Forecasting the effects of accelerated sea-level rise on tidal marsh ecosystem services. Frontiers in Ecology and the Environment.
[2]Crosby *et al.* (2016) Salt marsh persistence is threatened by predicted sea-level rise. Estuarine, Coastal and Shelf Science.
[3]Warren & Niering (1993) Vegetation change on a northeast tidal marsh: interaction of sea- level rise and marsh accretion. Ecology.
[4]Field *et al.* (2016) Forest resistance to sea-level rise prevents landward migration of tidal marsh. Biological Conservation 201:363–369.
[5]Intergovernmental Panel on Climate Change. 2014. Summary for policymakers. Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

Over the 32 years, vegetation height increased and species richness decreased (fig. 4). Most of the species not found in 2018 were already not reported in 2016, so this loss of species richness was not a singular event, suggesting species loss due to continued succession.
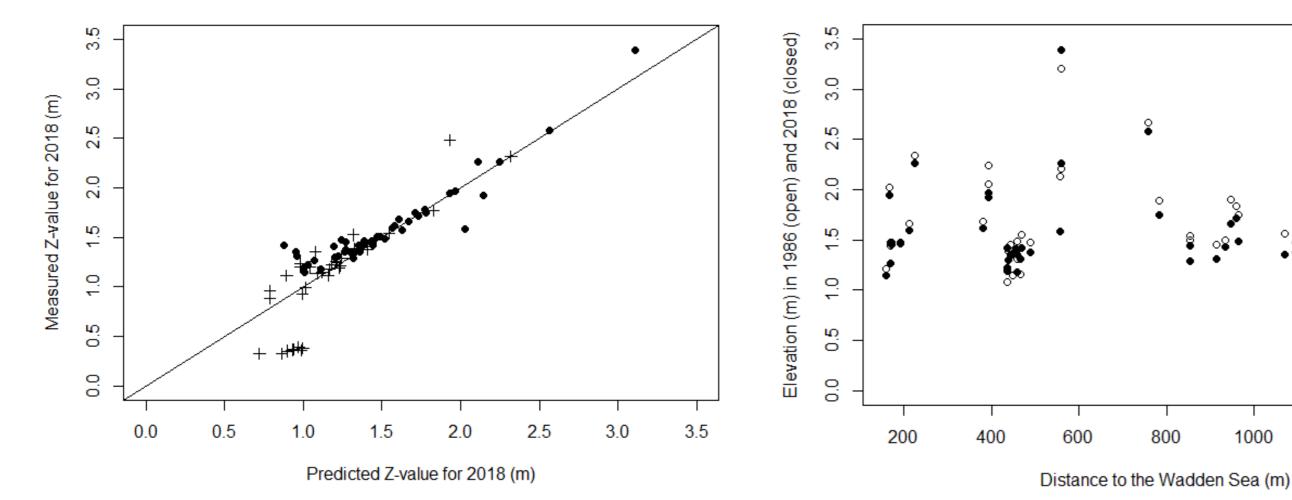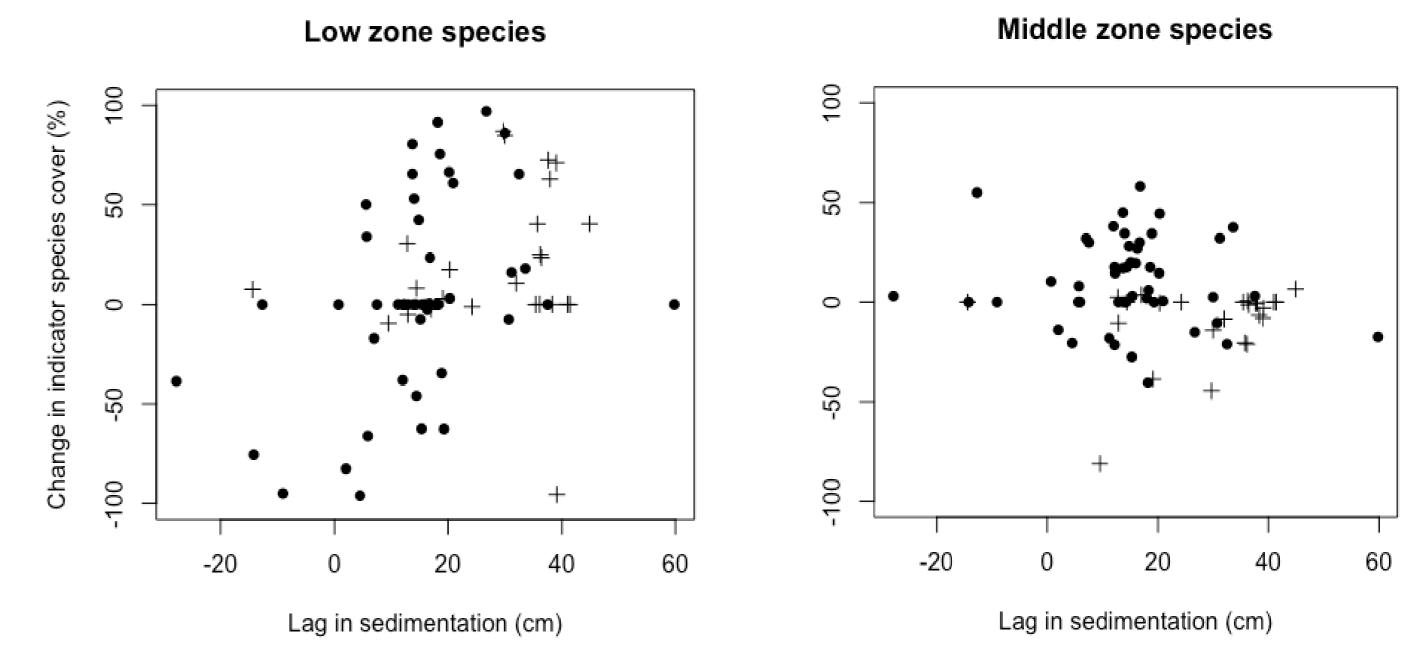

Figure 4. Change in average vegetation height and species richness in the plots after 32 years. Dark grey = 1986, light grey = 2018. Asterisks (*) indicate significant changes according to Wilcoxon's signed rank test.

Indicator species typical for the lower part of the salt marsh increased when there was a lag in sedimentation. Species of the middle part decreased when there was a lag and increased when there was an advance in sedimentation (fig. 5).

Figure 5. Change in indicator species cover vs. lag in sedimentation. + and ● indicate different salt marshes.

Conclusions

- In this study area, sedimentation could partly keep up with a *relative* SLR comparable to predicted future rates of SLR.
- In reaction to a lag in sedimentation, vegetation composition changed, especially at the lower part of the salt marsh.
- Where succession was not limited by soil subsidence, the species richness decreased and vegetation height increased.
- The salt marshes studied do not seem to be at risk of drowning and thus, their coastal protection function is not at risk.

Acknowledgements

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