

Initial development of a poorly sorted back-barrier beach nourishment

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Introduction

Construction of the Prins Hendrikzanddijk finished late 2019. It replaces the coastal safety function of the old sea wall behind it. This **dynamic solution**, however, has no natural supply of sand and will disappear over time if not actively maintained.

Coarse but **poorly-sorted sediment** was implemented to reduce dynamics in this **low-wave environment**, while the winnowing of fines was expected to form an **armour layer**, further limiting bed mobility.

This research aims to unravel the combined development of:

- 1) **morphology**
- 2) **sediment sorting**

Methods

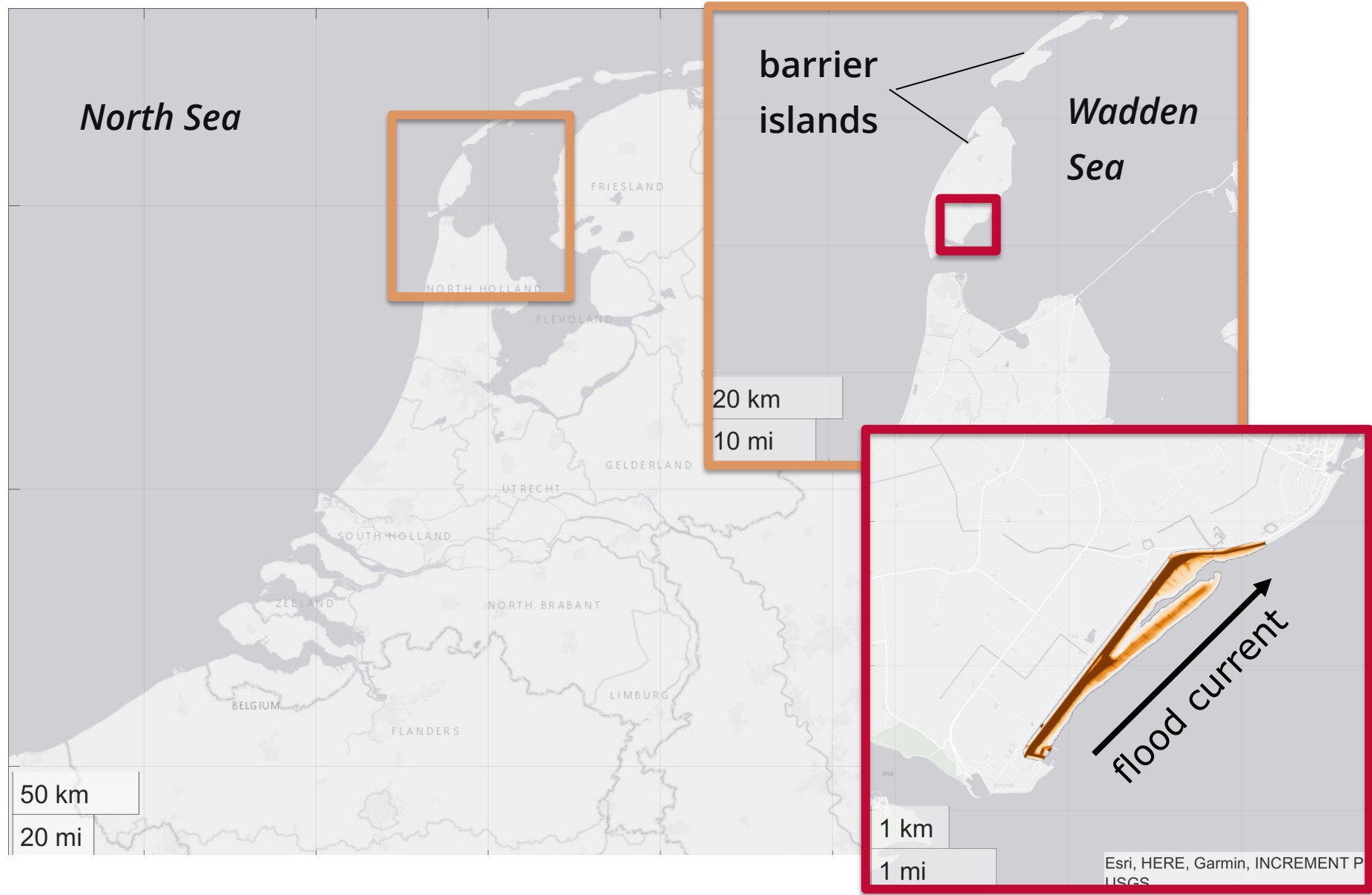
Monitoring

- every 2-4 months
- bed levels (LiDAR, RTK-GPS)
- sediment samples (sieve)

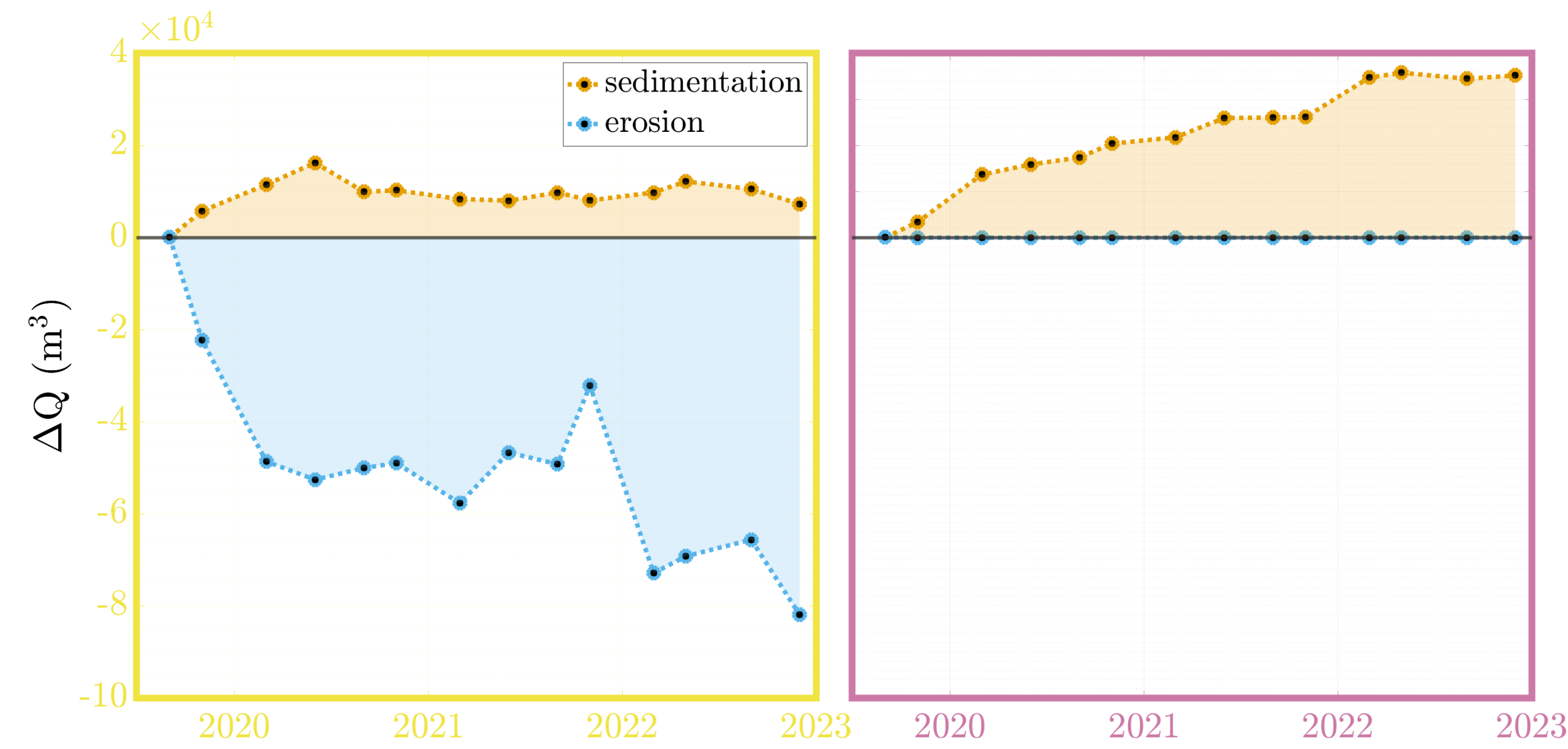
Field campaign

- 6 weeks; < daily measurements
- sediment samples
- hydrodynamics
- bed levels

Study site

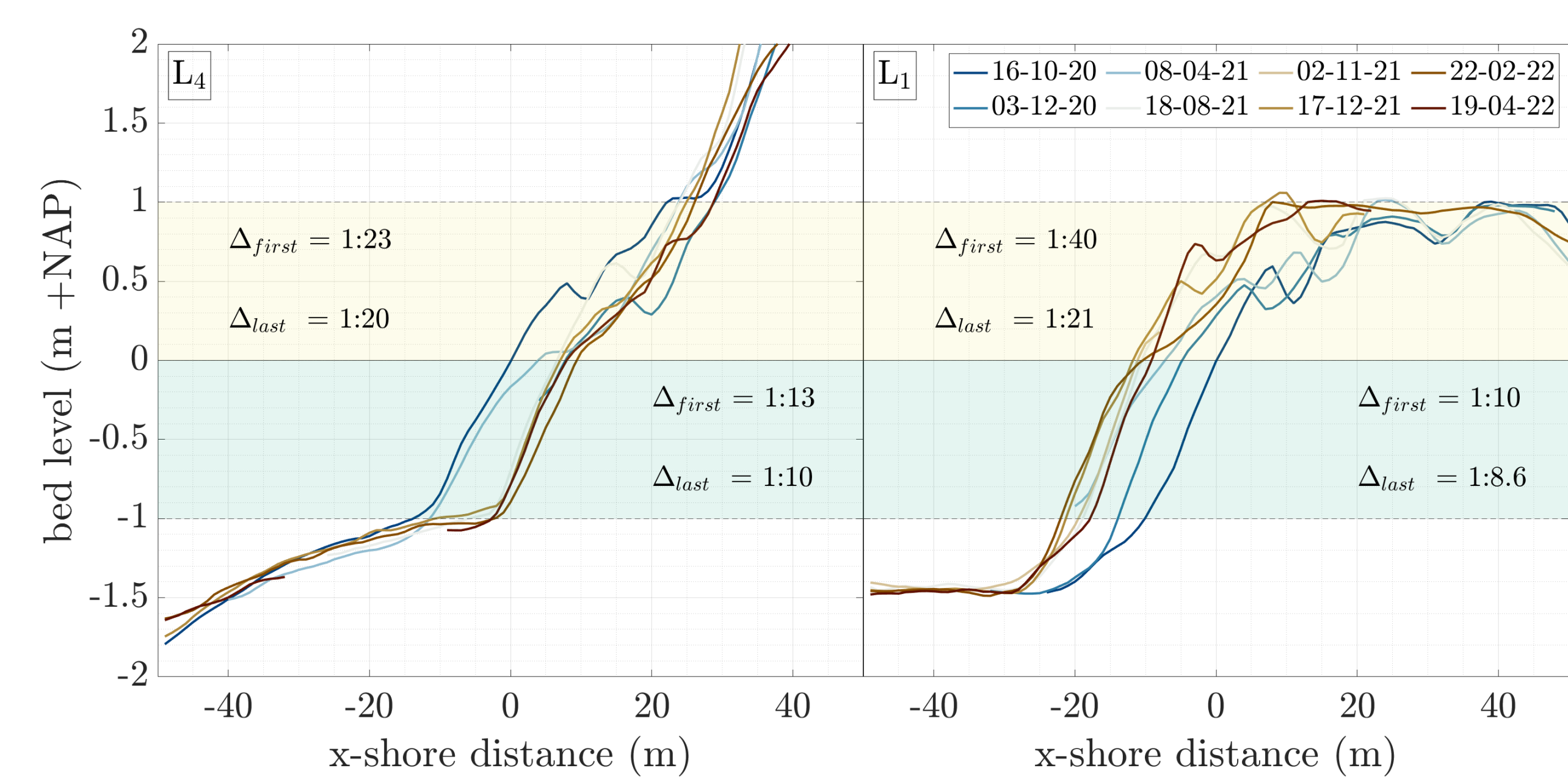


Volume change



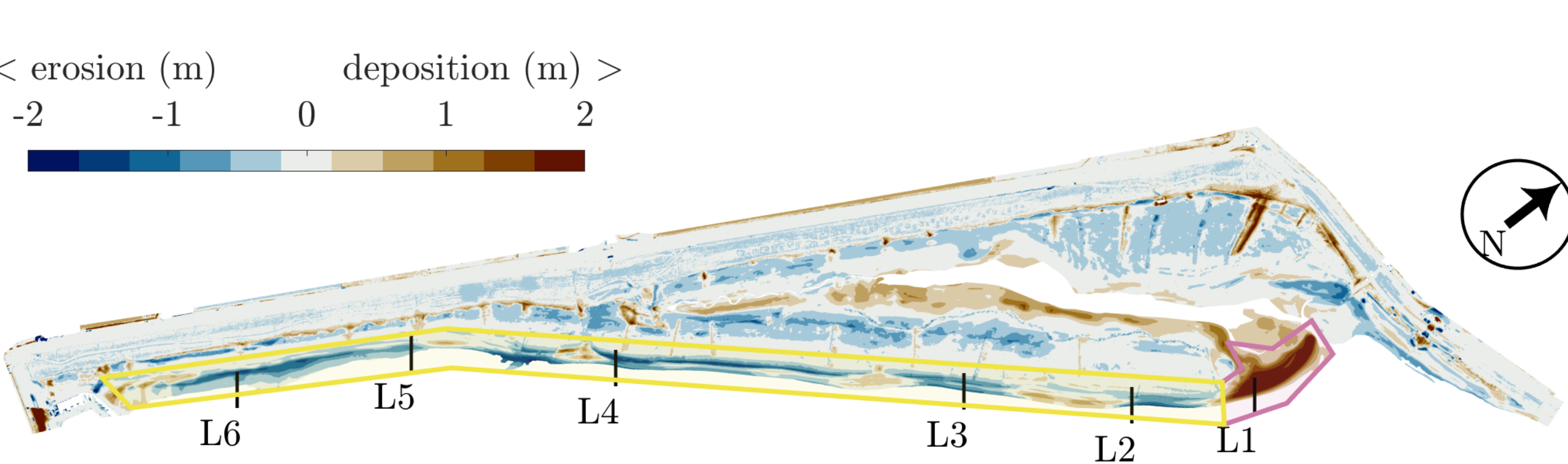
Cumulative volume change between the +2 m and -1 m NAP contours of the beach face (yellow) and the accretive zone at the northern end of the spit (purple). The total area considered indicates net erosion. Not all sediment ends up in the depositional zone. Erosion and deposition rates were highest in the first year, steadily becoming less in subsequent years.

Cross-shore profiles



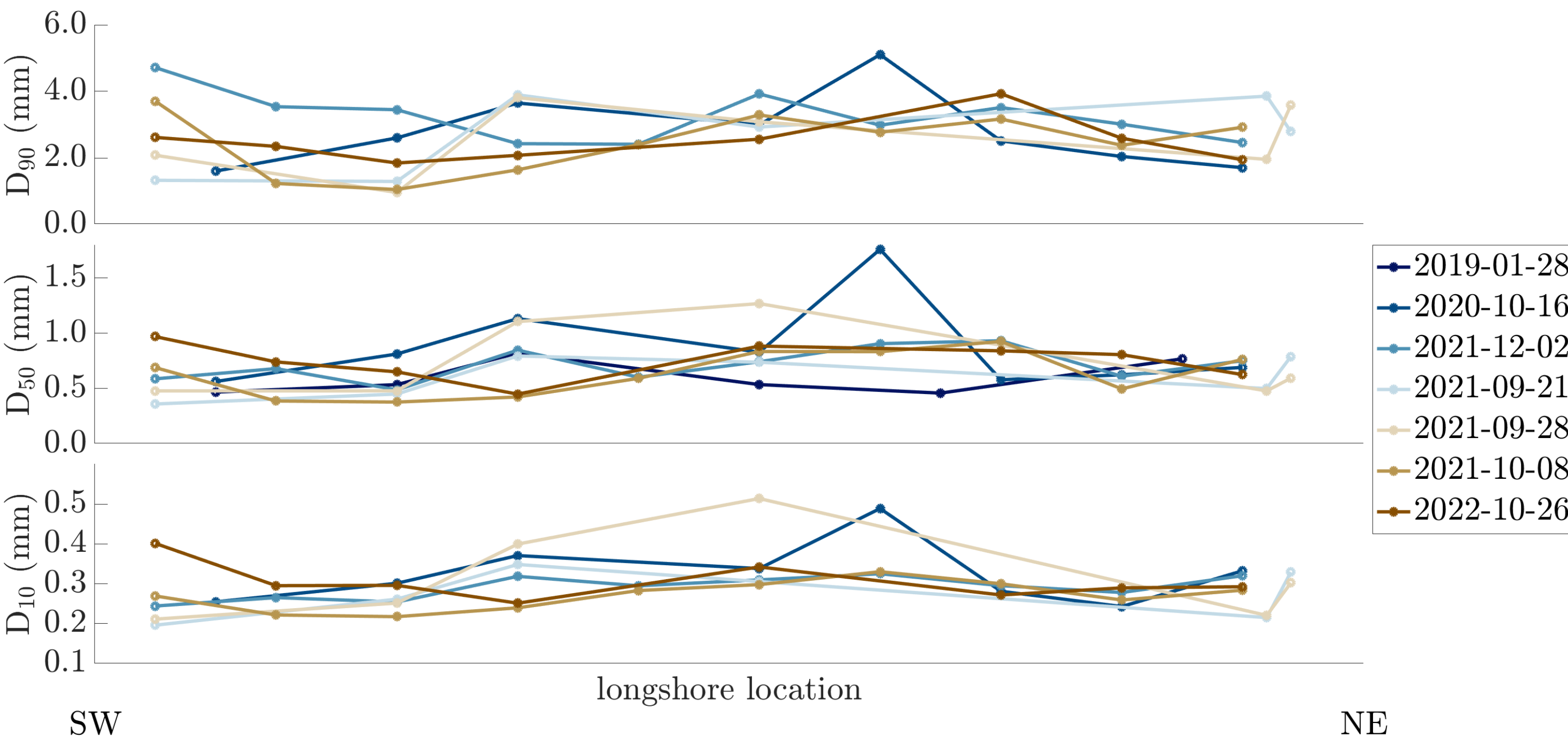
Development of the cross-shore profiles at L4 and L1. Slopes of the shaded areas are given for first and latest surveys. Stable platform levels indicate little cross-shore sediment exchange, hence predominantly longshore transport. Regression (L4) and transgression (L1) strongest in the first year.

Erosion & deposition



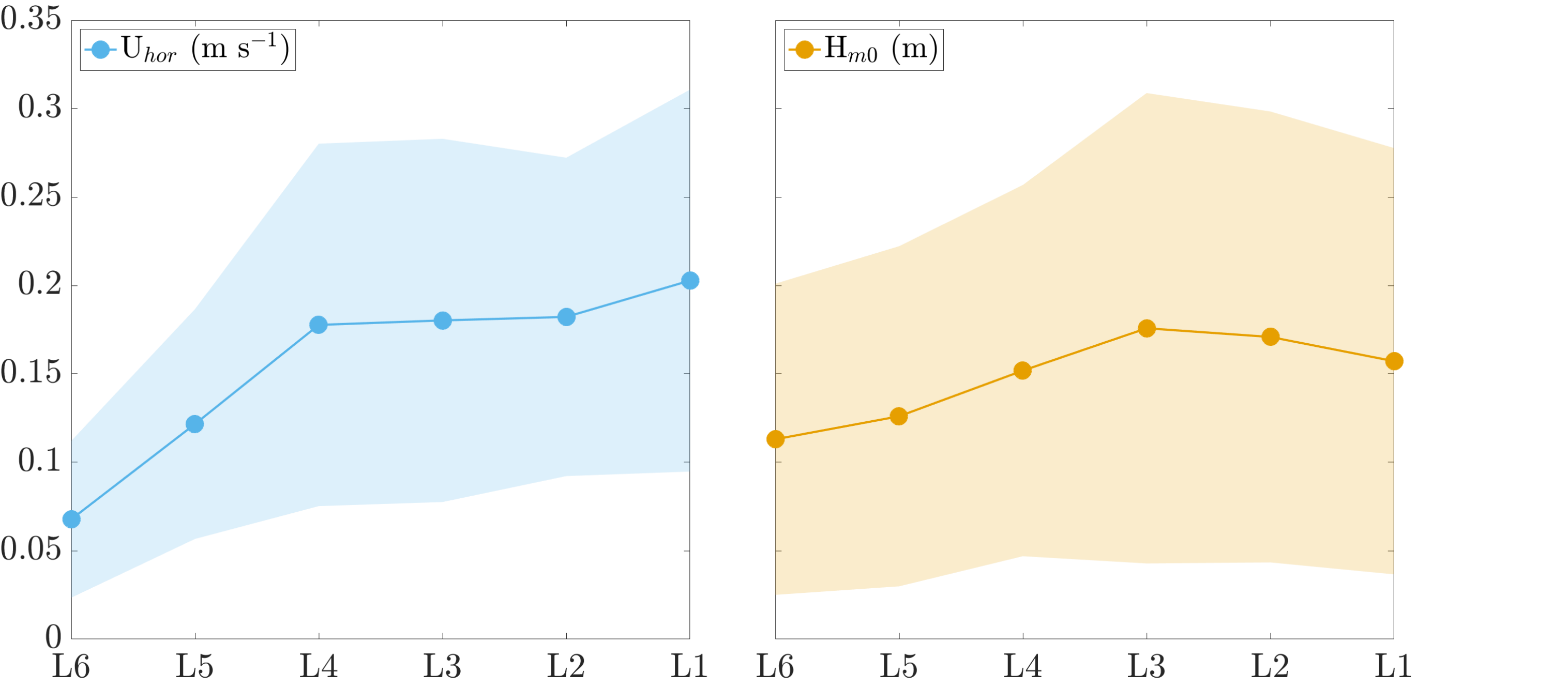
Net bed-level change from summer 2019 to 2022. An initially persistent depositional zone at the northern end of the spit has received much of the sand from the largely erosive upstream beach face.

Grain-size distribution



Longshore distribution of 3 grain-size percentiles through time, acquired from sets of (3 to 6) surface samples (top ~5 cm) sampled across the intertidal beach. The time evolution of longshore mean grain-size patterns is highly variable and is not suggestive of long-term sorting processes. Development of a stable armour layer does not appear to materialise.

Currents & waves



Longshore distribution of current velocities and wave heights measured at NAP - 0.75 m and averaged over 5 weeks. Time-averaged longshore gradients in currents and waves do not appear to correlate with erosional/depositional patterns, nor with the time evolution of longshore grain-size distribution.

Discussion & implications

Initially dynamic beach, reducing over time.

- Dynamic equilibrium: profile shape & alongshore transport.

Spit sedimentation rates level off sooner than beach face erosion rates.

- Sand deposited beyond spit.

No formation of stable long-term sorting patterns.

- Strong and frequent bed-surface **remixing** probably enables continuous preferential transport of fines.

Longshore hydrodynamics distribution ≠ longshore grain-size distribution ≠ morphological change

- Continuous remixing of nourished sand.

Acknowledgements

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