

# Can Intertidal Flats Grow Faster Than Sea Level Rise?

A data analysis from the world's largest channel-shoal system

## Motivation and Relevance

Intertidal flats serve e.g., as natural protection with low maintenance, natural carbon sinks, and unique habitats. Defending them against sea level rise is imperative to maintain our coastlines. We assessed annual bathymetries in the period of 1996 to 2016 in the world's largest channel-shoal environment for mean intertidal height changes to understand their current development.

## Study Site

- Location
  - Northwestern Europe
  - North Sea
  - Germany, the Netherlands
- Site features:
  - 11,000 km<sup>2</sup> (4400 miles<sup>2</sup>)
  - 500 km (310 miles) in length
  - Shallow shelf sea
  - Macrotidal
  - 3 major estuaries

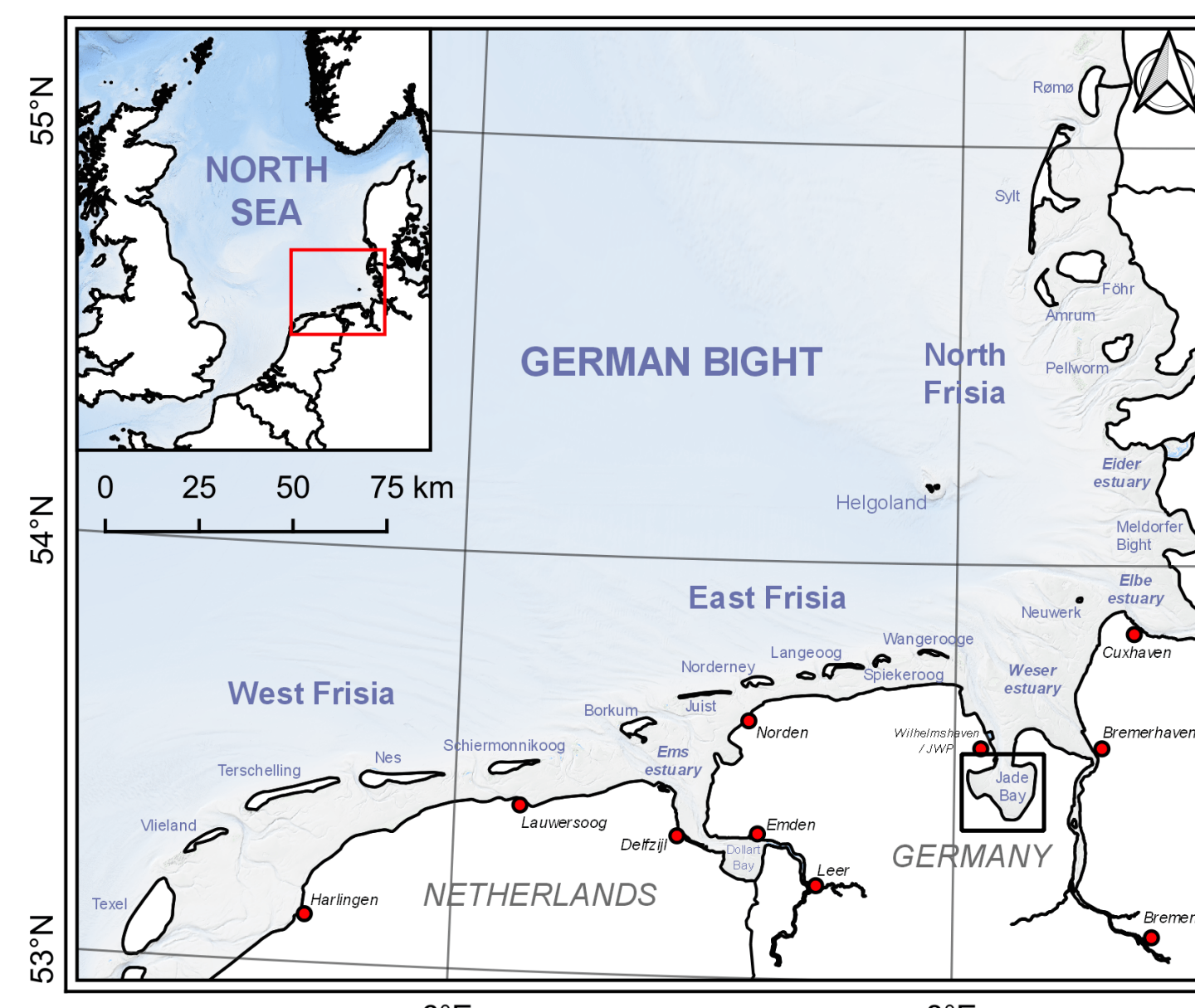


Fig. 1: Map of the study site in the European North Sea

## Methods

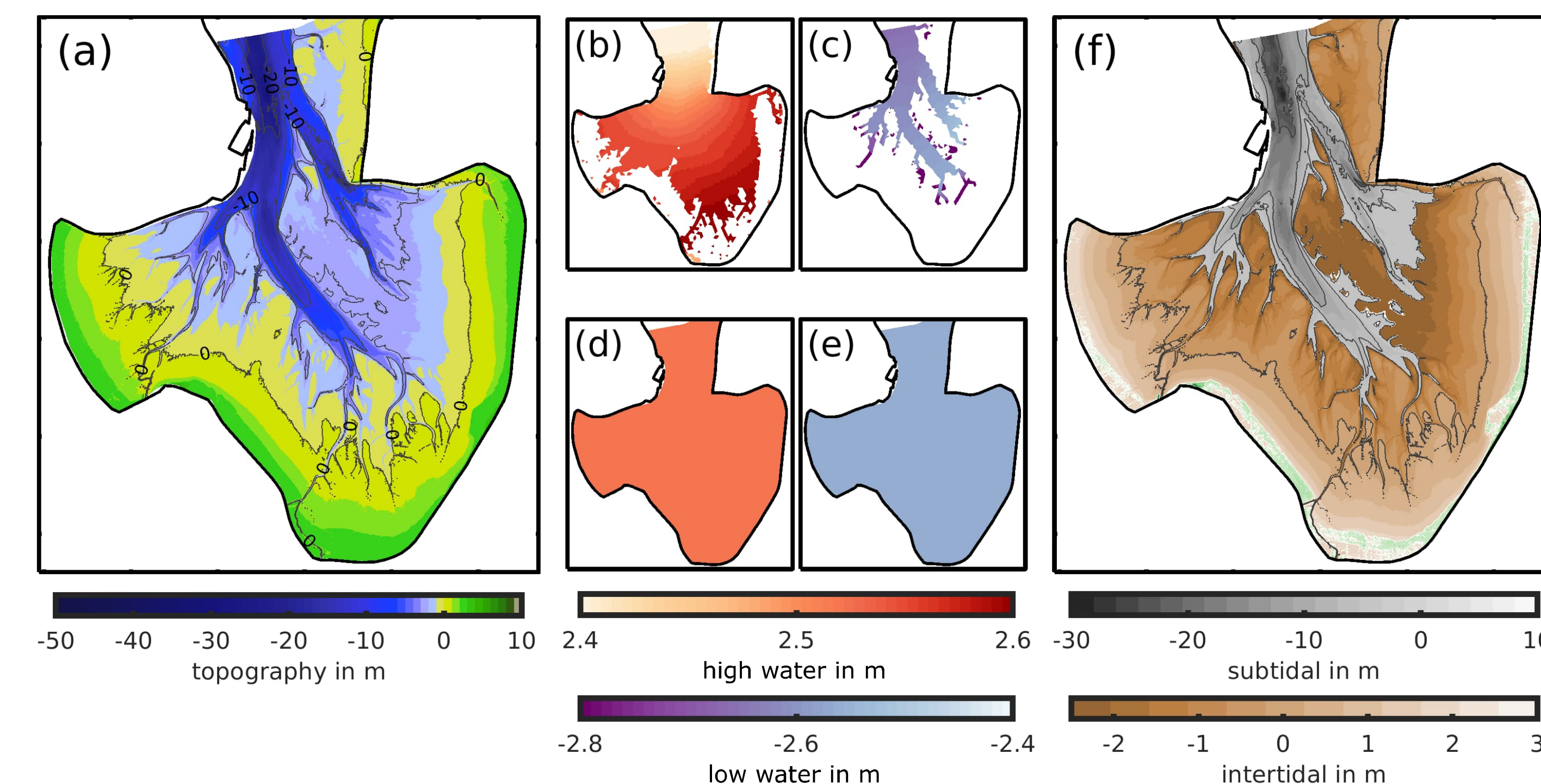


Fig. 2: A workflow to classify the subtidal and intertidal zone from high-resolution bathymetry data.

Intertidal flat accretion  
can **exceed** current  
sea level rise **manifold**.



Fig. 3: Aerial photograph of intertidal flats in the eastern outer Weser estuary of the German Wadden Sea.

## Methods (continued)

The bathymetry classification is explained in Figure 2:  
(a) Load your bathymetry data in a predefined space (i.e., a unit)  
(b) Extract a characteristic high water (e.g., from a model)  
(c) Extract a characteristic low water  
(d-e) Average spatial data from (b) and (c)  
(f) Classify each bathymetry sample with the boundary from (d-e)

This procedure was repeated annually (gray dots in Fig. 4) for a number of units (tiles in Fig. 4) with a linear regression (blue lines in Fig. 4).

Height changes were expressed by  $h_{2016} - h_{1996}$  from linear regression.

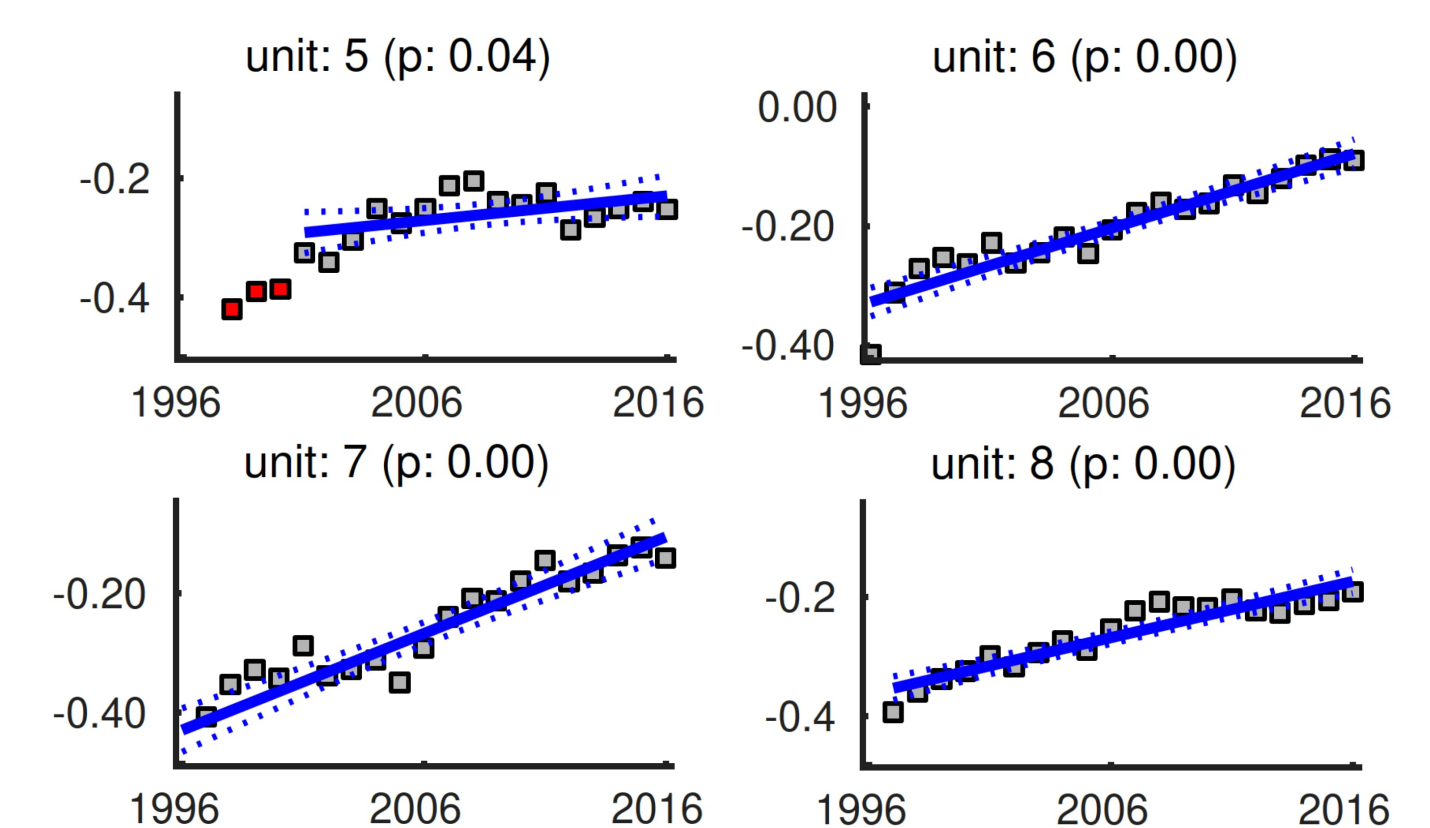


Fig. 4: Linear trend assessment (blue line) of the mean intertidal height (gray squares) in the period of 1996 to 2016 (21 yr).

## Results

The intertidal zone of several units in Figure 5 (blue bars) grew much faster than sea level rise (dotted black line). Conversely, some units exhibited no noteworthy vertical accretion and only few adapted similarly to sea level rise.

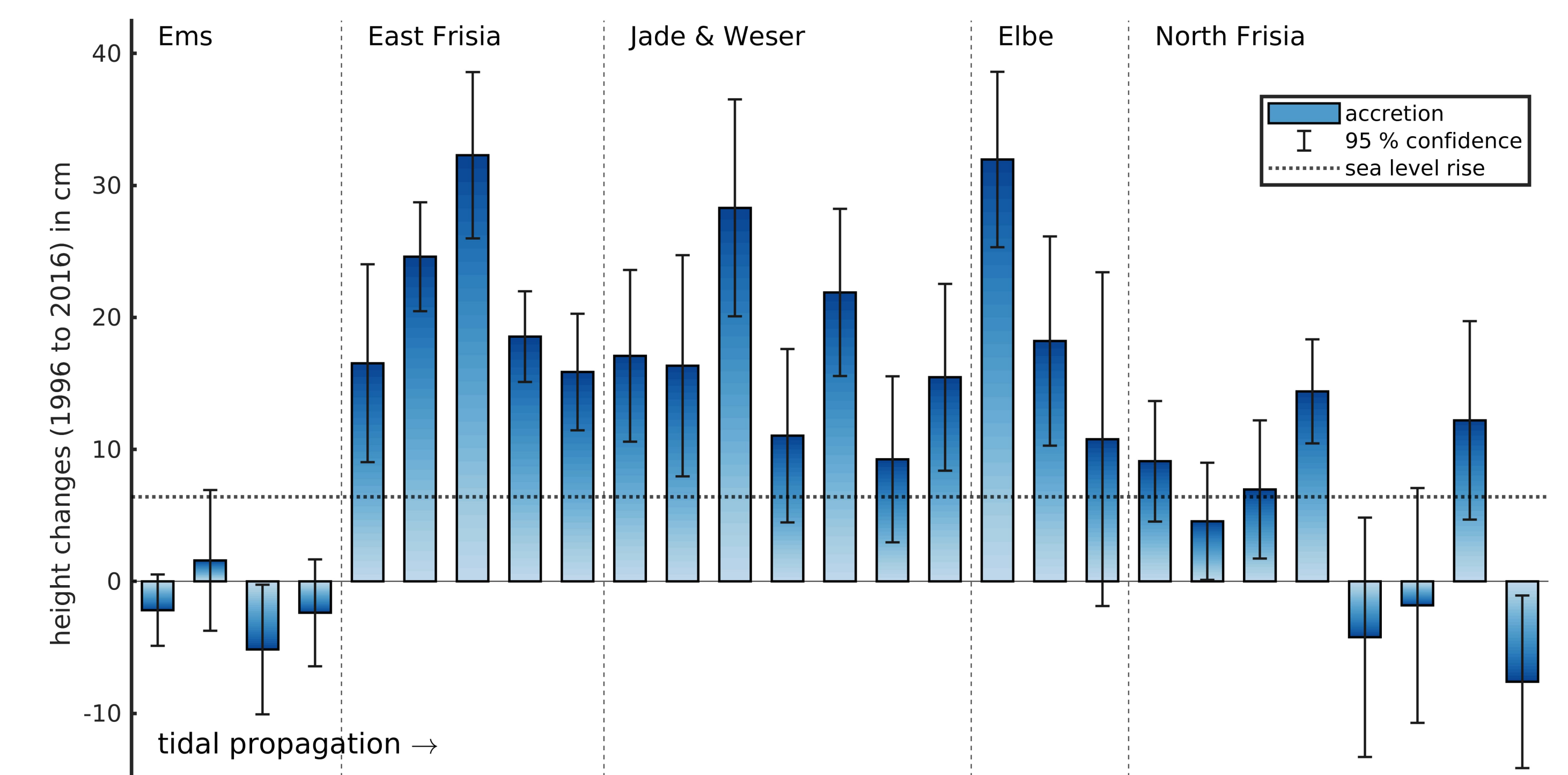


Fig. 5: Intertidal height changes in the period of 1996 to 2016 with blue bars indicating height changes, errorbars 95% confidence, and the horizontal dotted line estimated sea level rise (3.2 mm/yr x 21 yr).