WG 122 Meeting on Mechanisms of Sediment Retention in Estuaries

INSTAAR Boulder Colorado

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Biological factors responsible for sediment trapping in estuaries

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What is the impact of the biota on the retention of sediment in estuaries ?

- Depend on what time scale you are looking at
- Depend on the sediment textural composition
- May also depend on climate

Biofilm at mudflat

Biostabilization

An example of surface of cohesive sediment bed.

Hawkins Point, UK (from Paterson, ECSS, 1995).

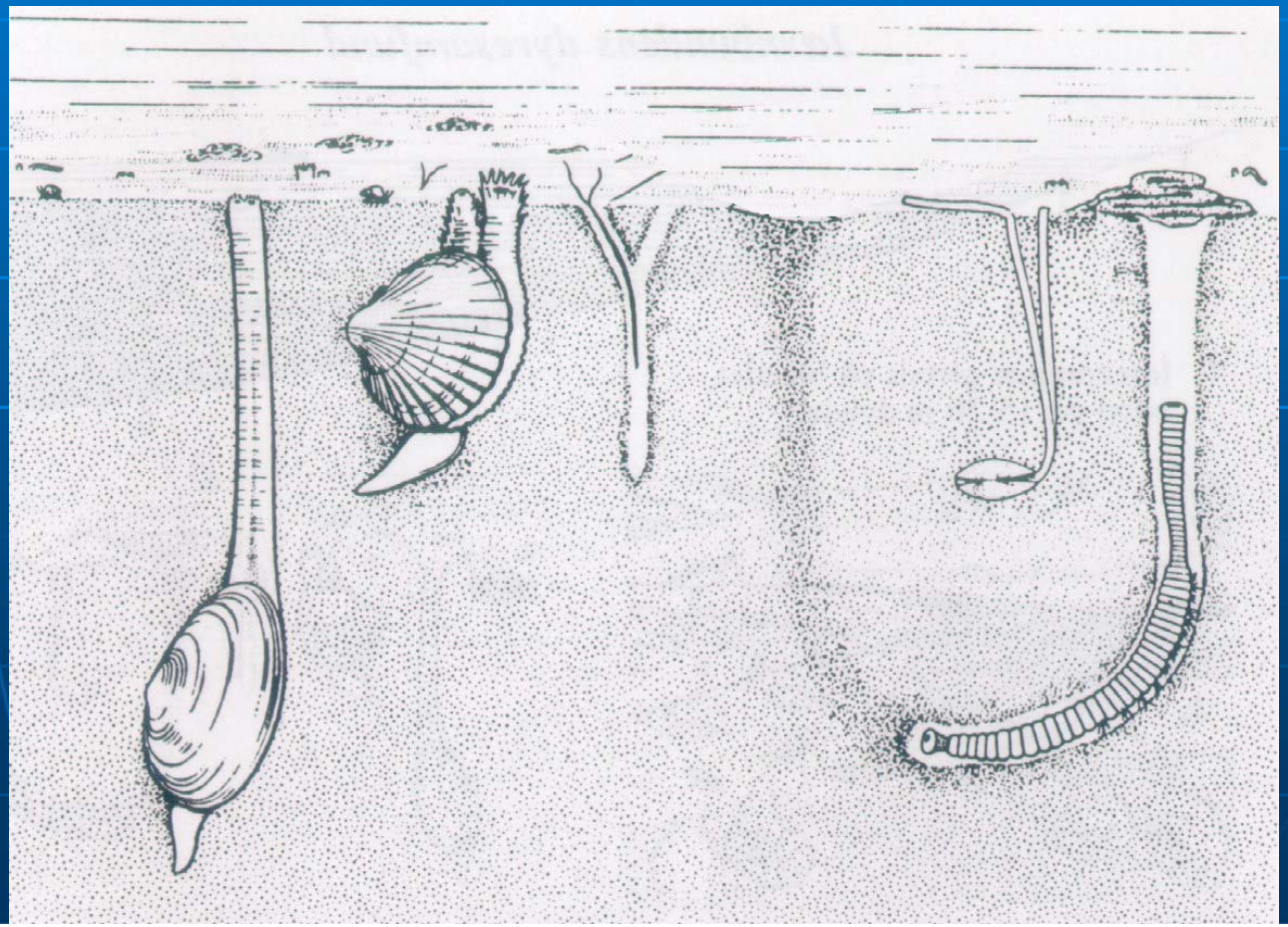
Numerous diatoms together with a few mineral grains are seen as well as strands of EPS binding the particles together.

Scale bar = 10 um.

Bio-destabilization

by benthic macro fauna

- Bioturbation (burrowing by e.g. worms, mussels and snails)
- Bioaggregation (e.g. fecal pellets and pseudo feces
- Changes the bed roughness (e.g. surface tracking, fecal pellet mounds) - generally increases the bed shear stress

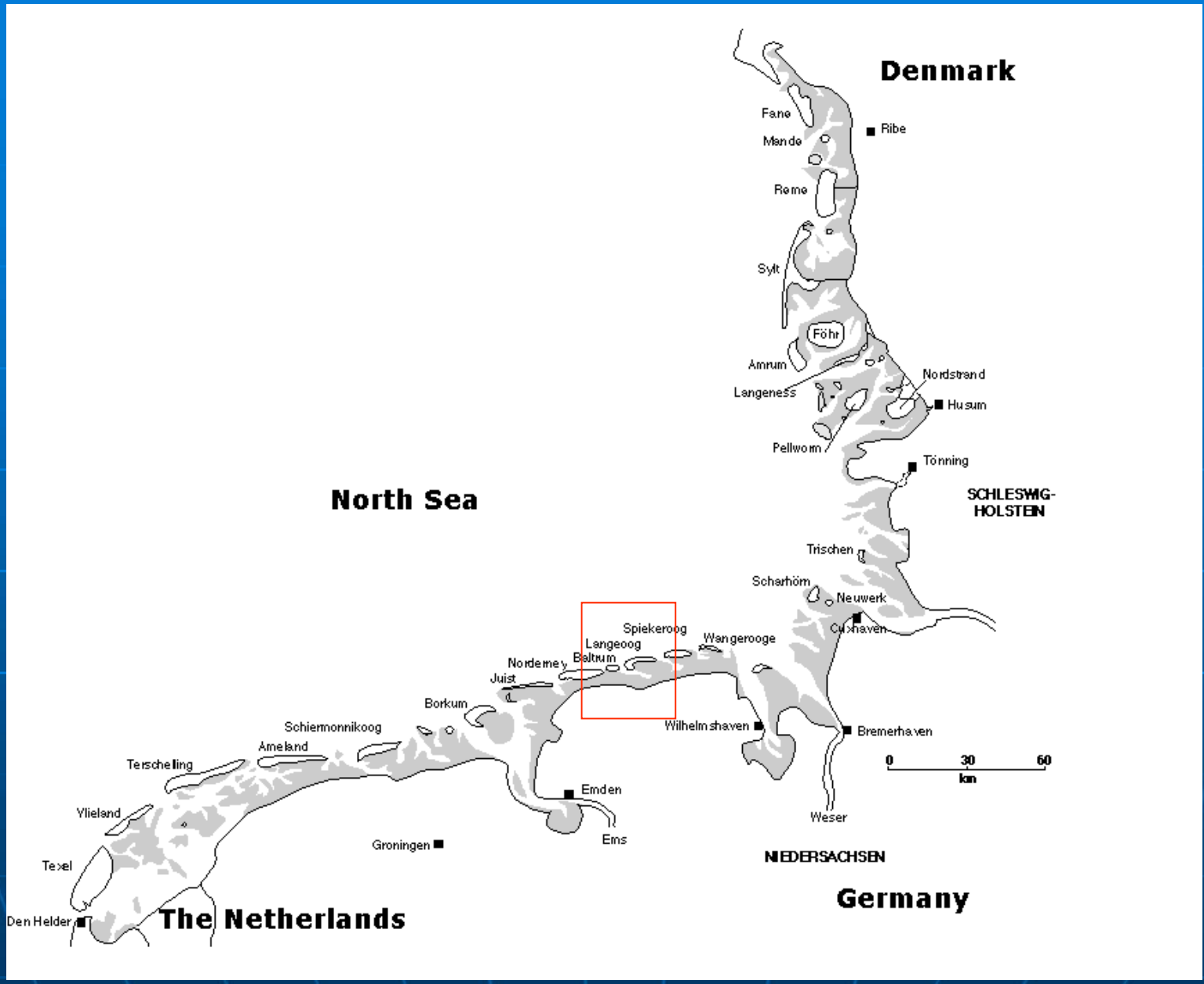


From left to right:

Mya arenia
Cerastoderma edule
Pygospio elegans
Macoma balthica
Arenicola marina

Case one :

Mixed intertidal flat with benthic diatoms

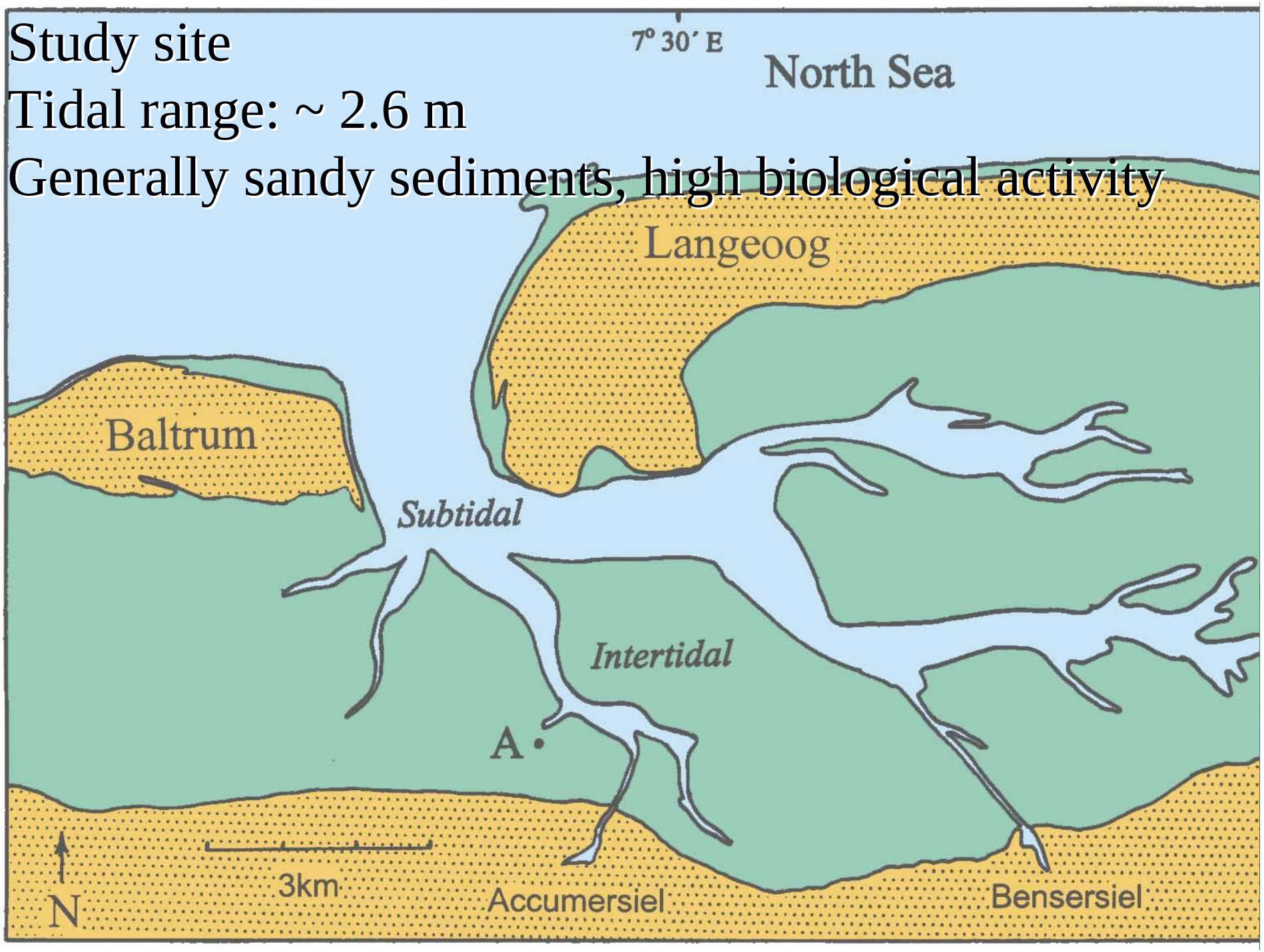


The European Wadden Sea

Study site

Tidal range: ~ 2.6 m

Generally sandy sediments, high biological activity



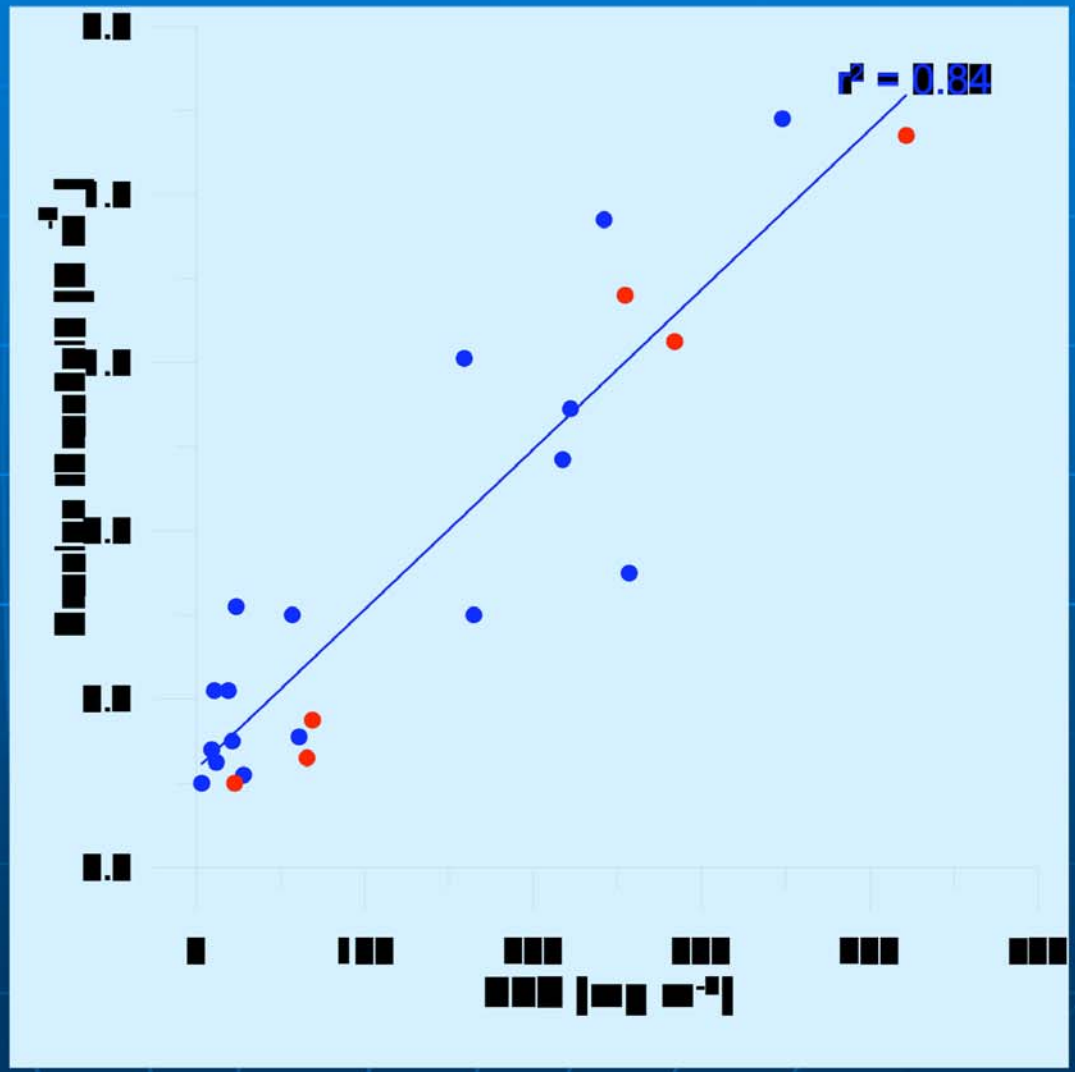
Biofilm formation at the site.

Benthic diatoms + cockles

The cockle maybe restricts the settlement of bioturbators and grazers → increased content of benthic diatoms

Content of EPS >< Erosion threshold (June + Sep data)

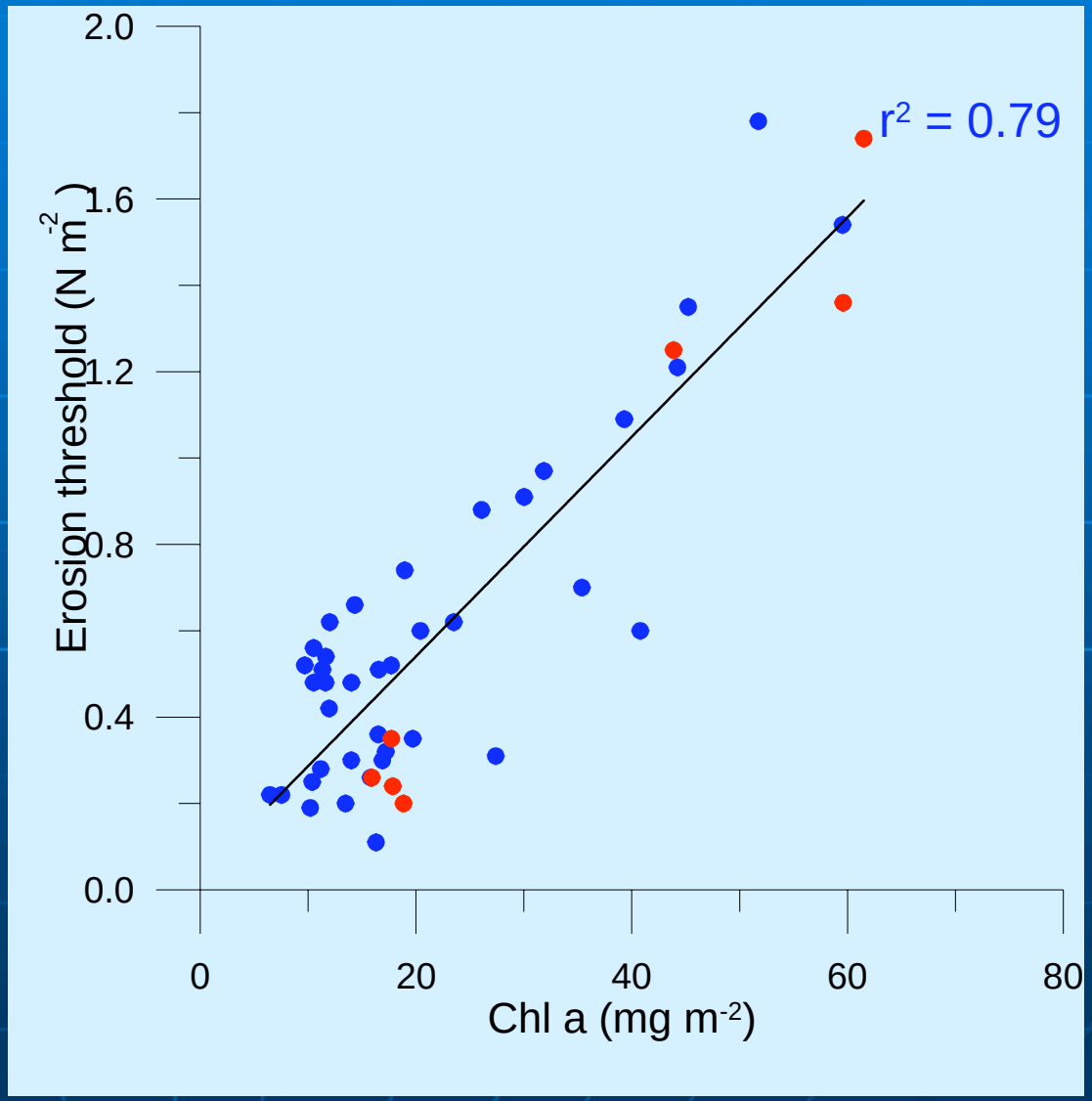
Good correlation → Erodibility mainly determined by content of extracellular polymeric substances



Chl a content >< Erosion threshold (data from all seasons)

Good correlation → Erodibility determined by microphytobenthos

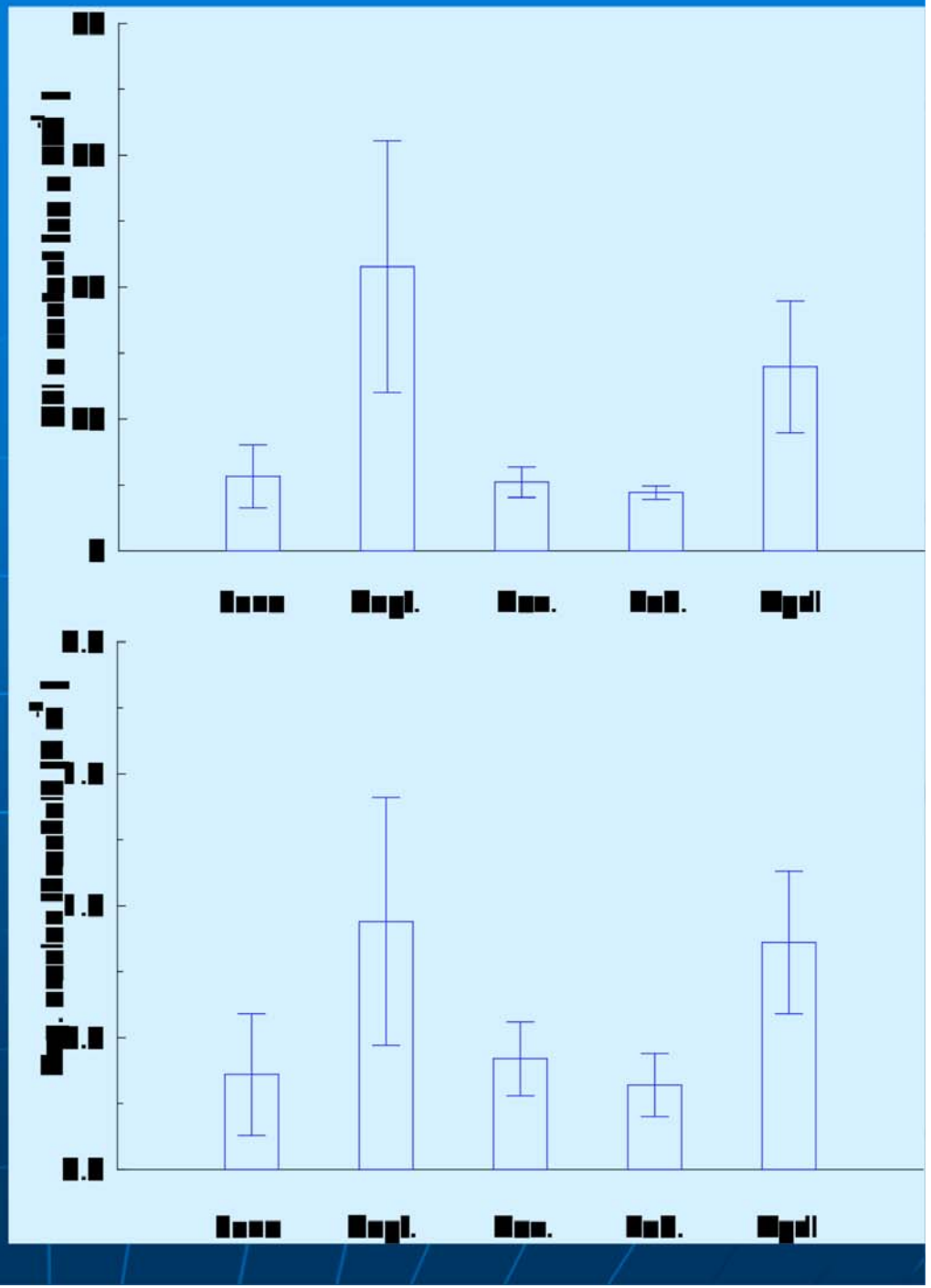
<u>One</u> paramerization covering all seasons may be used



Seasonal variation

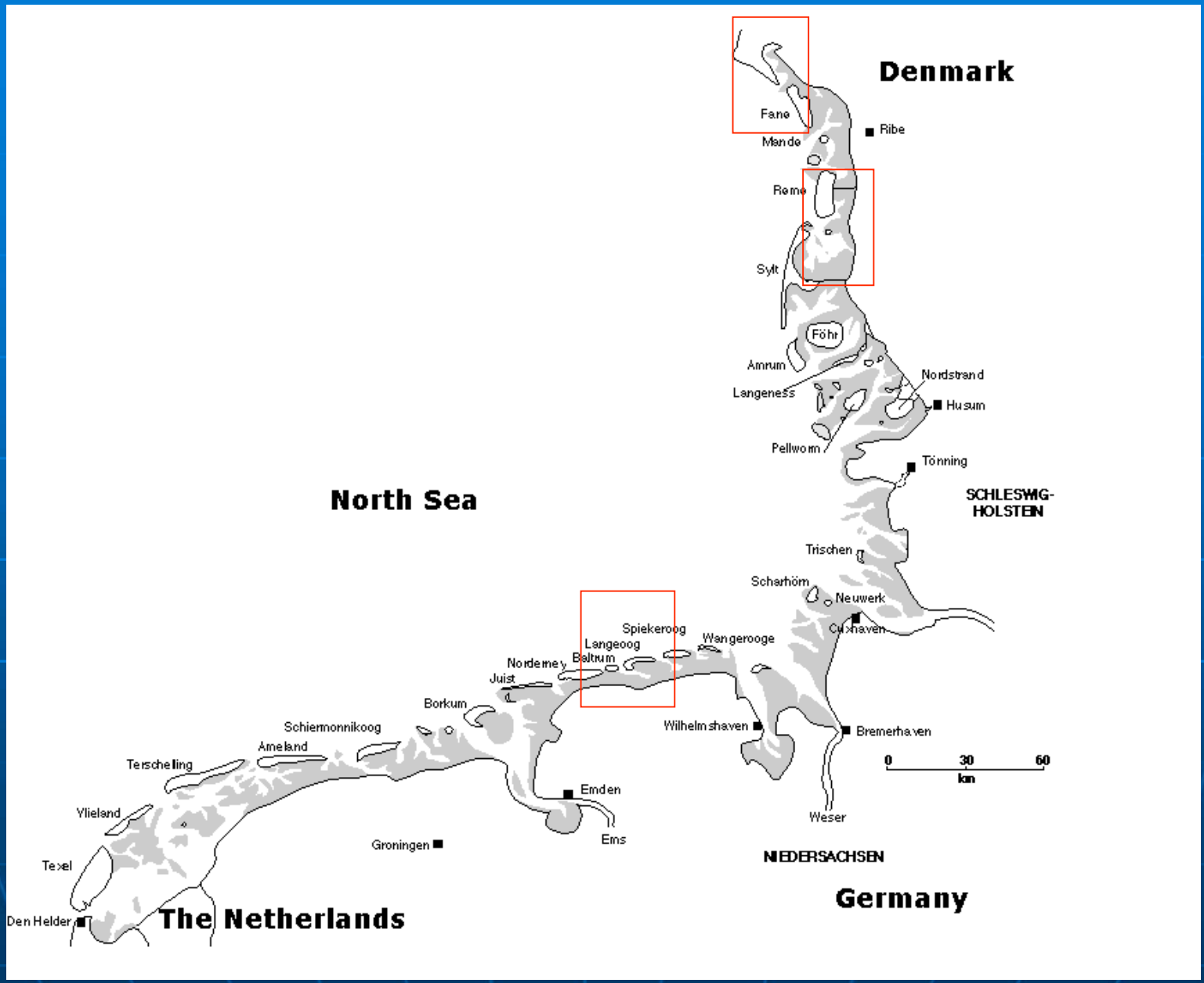
High contents of chl a in autumn and spring

High erosion thresholds in the same periods



Case two :

Mudflat dominated by macro-zoobenthos



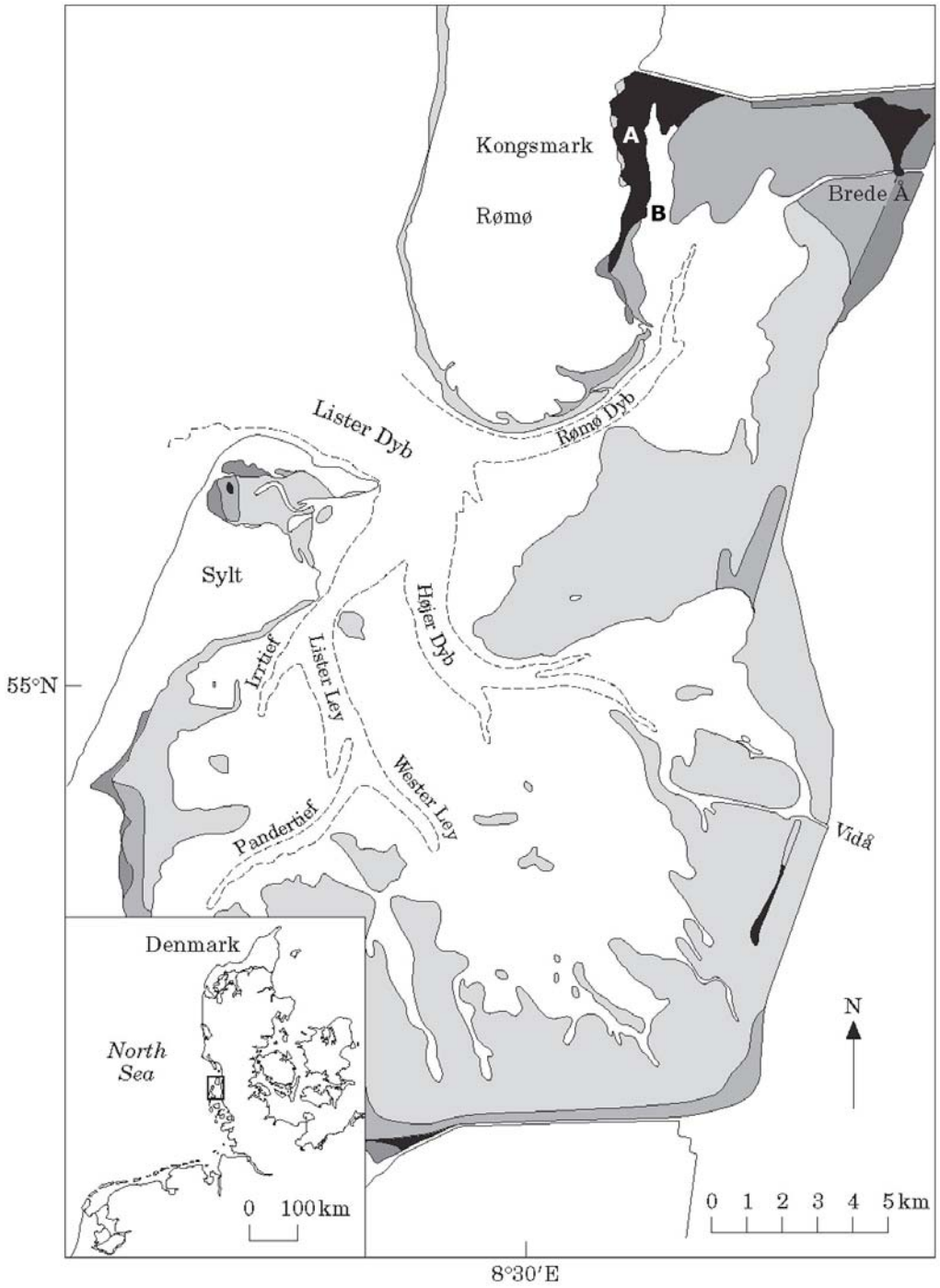
The European Wadden Sea

Study site

Mudflat at kongsmark,
Lister Dyb tidal basin

Very fine-grained,
micro-tidal mudflat
Sand content less than 2%
Tidal range ~ 2m

Dominated by:
Hydrobia ulvae,
C. Edule,
Microphytobenthos




Mudsnails on tidal flat
Up to about 200.000 indv. m-2
Fecal pellet content up to 80 %

Mudsnails, tracks and pellets

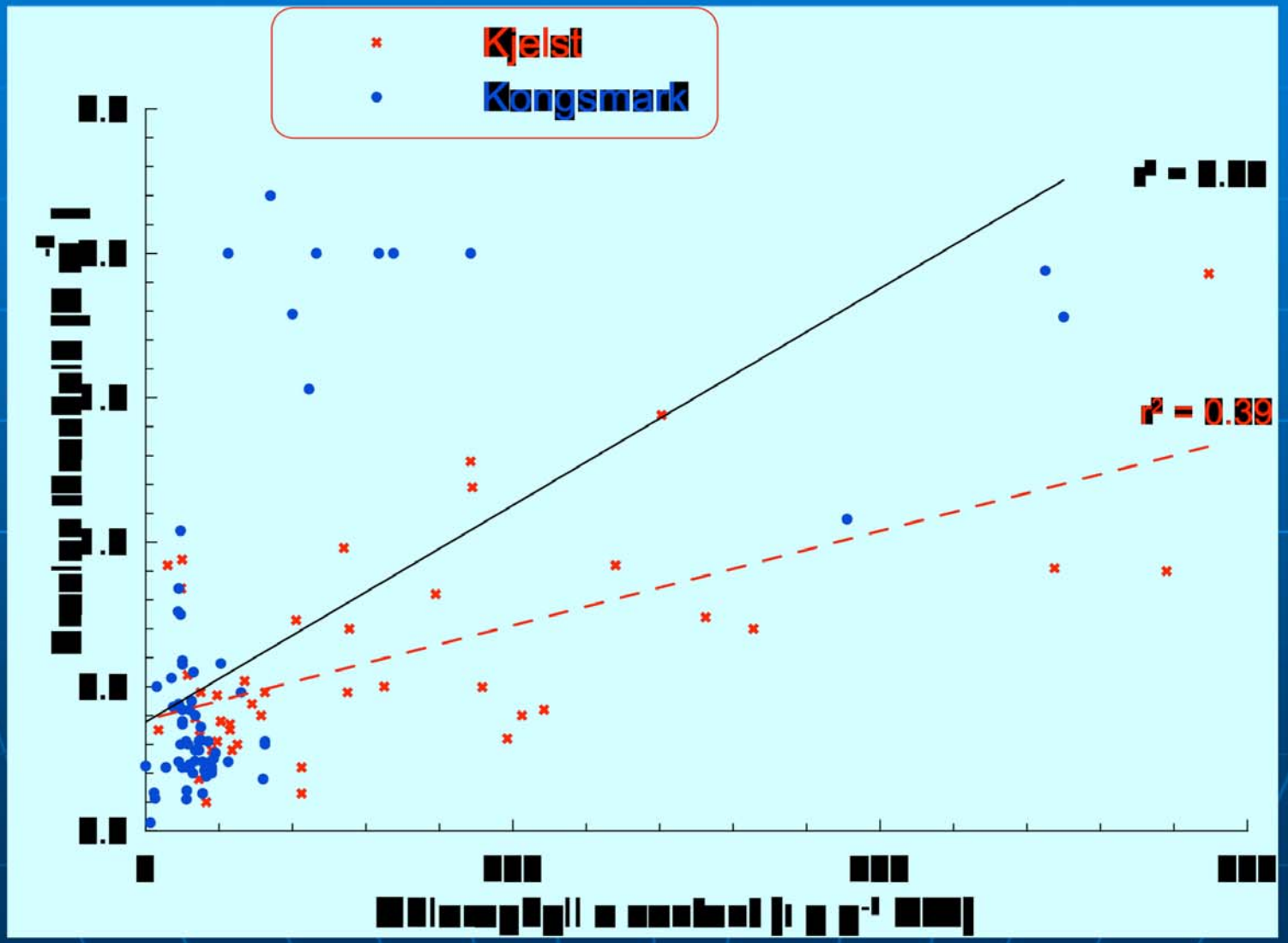
Bio-flocculation

Hydrobia ulvae

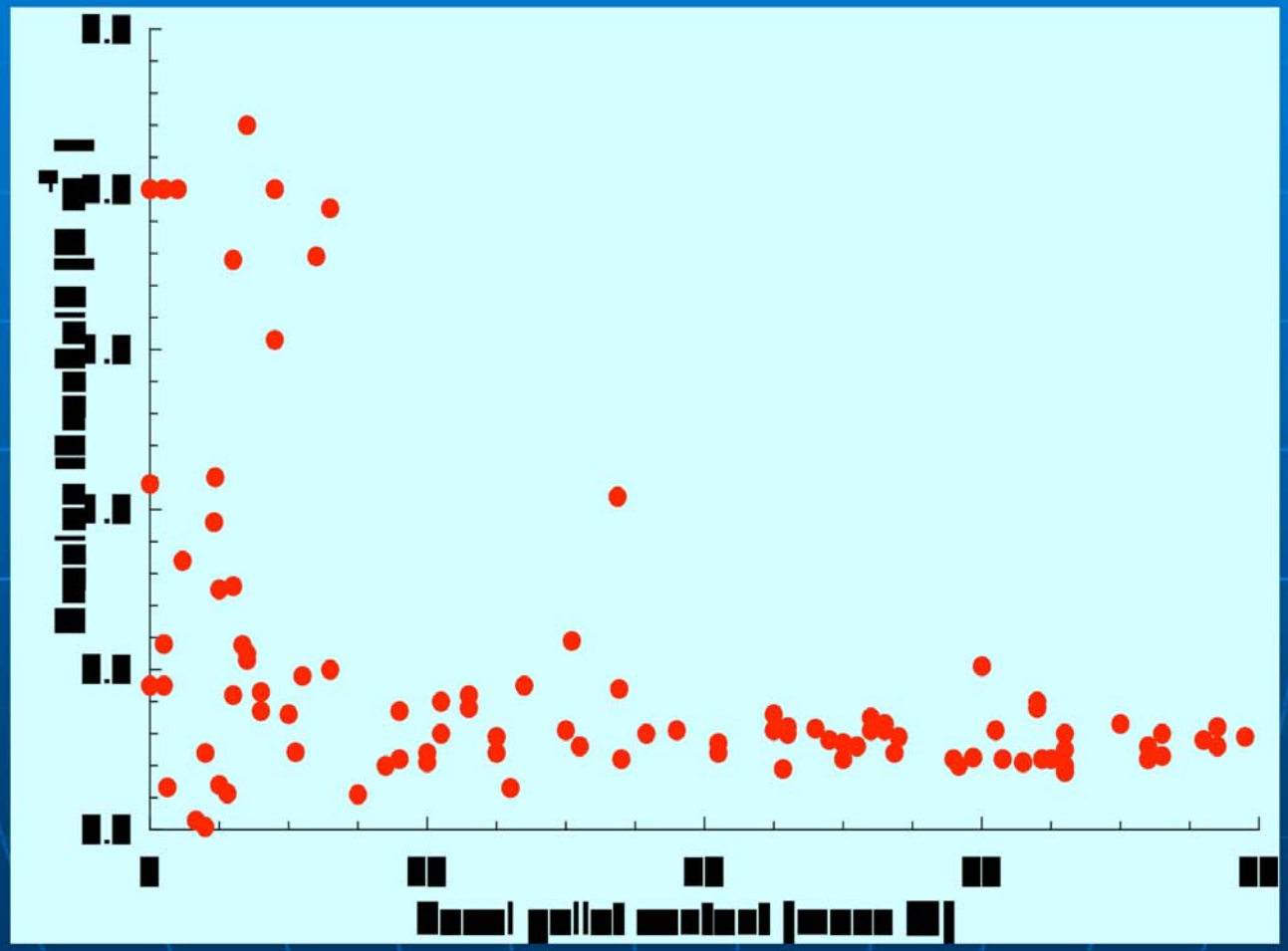
Fecal pellets

Chl a content >< erosion threshold, Danish mudflat

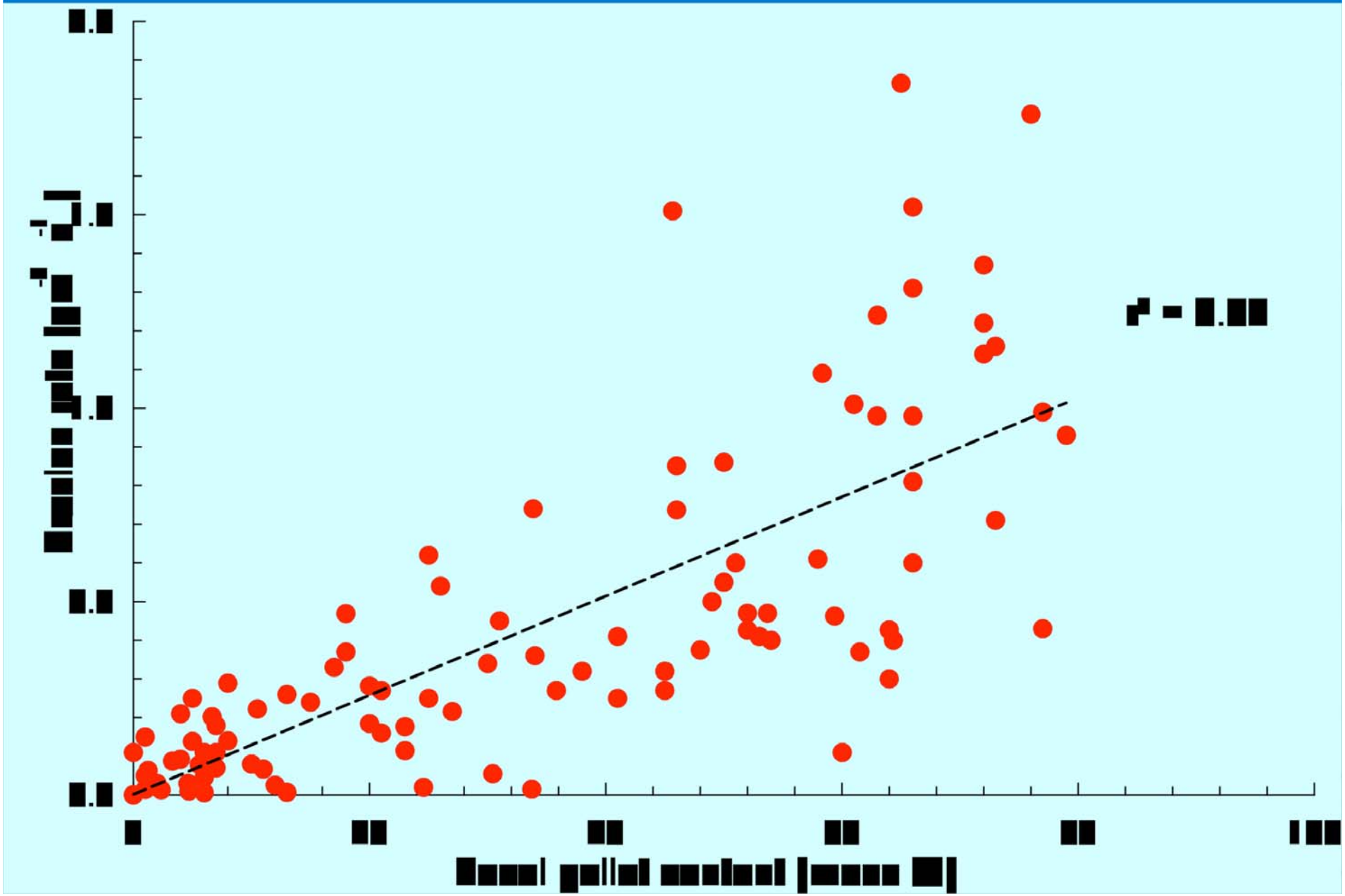
Poor correlation – what is controlling erosion threshold ?



Mudsnails and erodibility

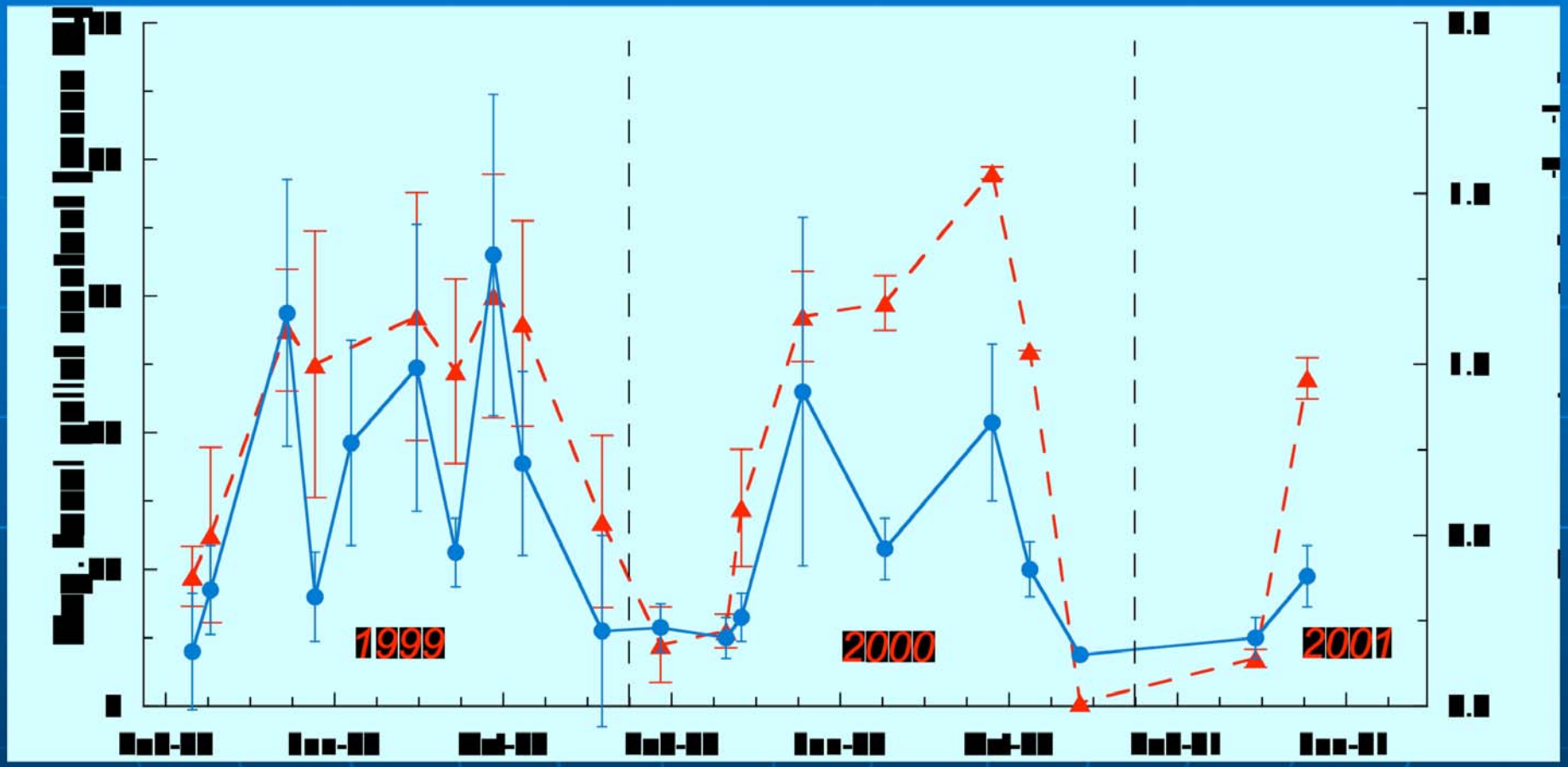


Mudsnails and erodibility



Mudsnails and erodibility

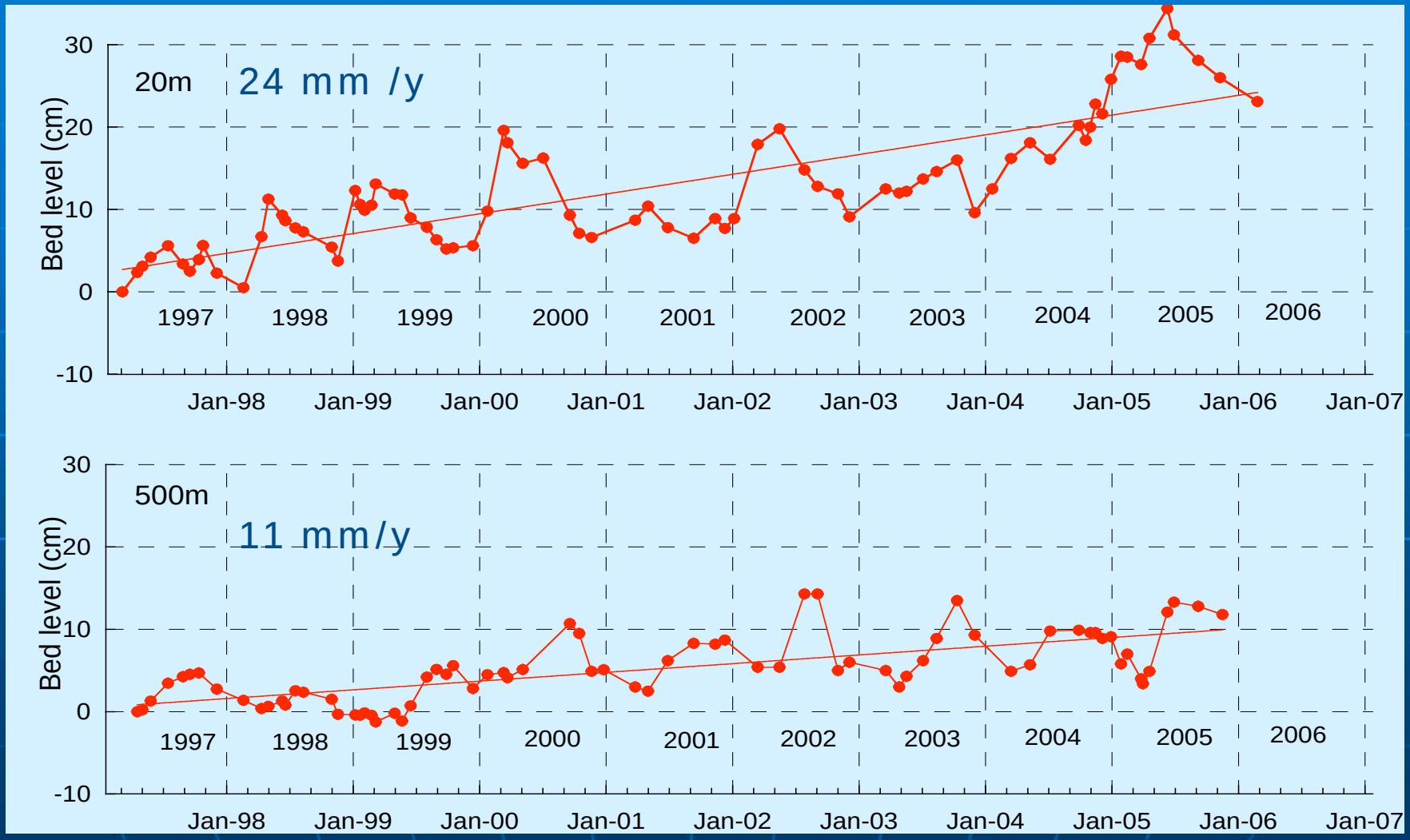
- seasonal variation



-Climatic control on coastal sedimentation may also be due to changes in biological community structure

You dont´t get sleeping across the mudflats

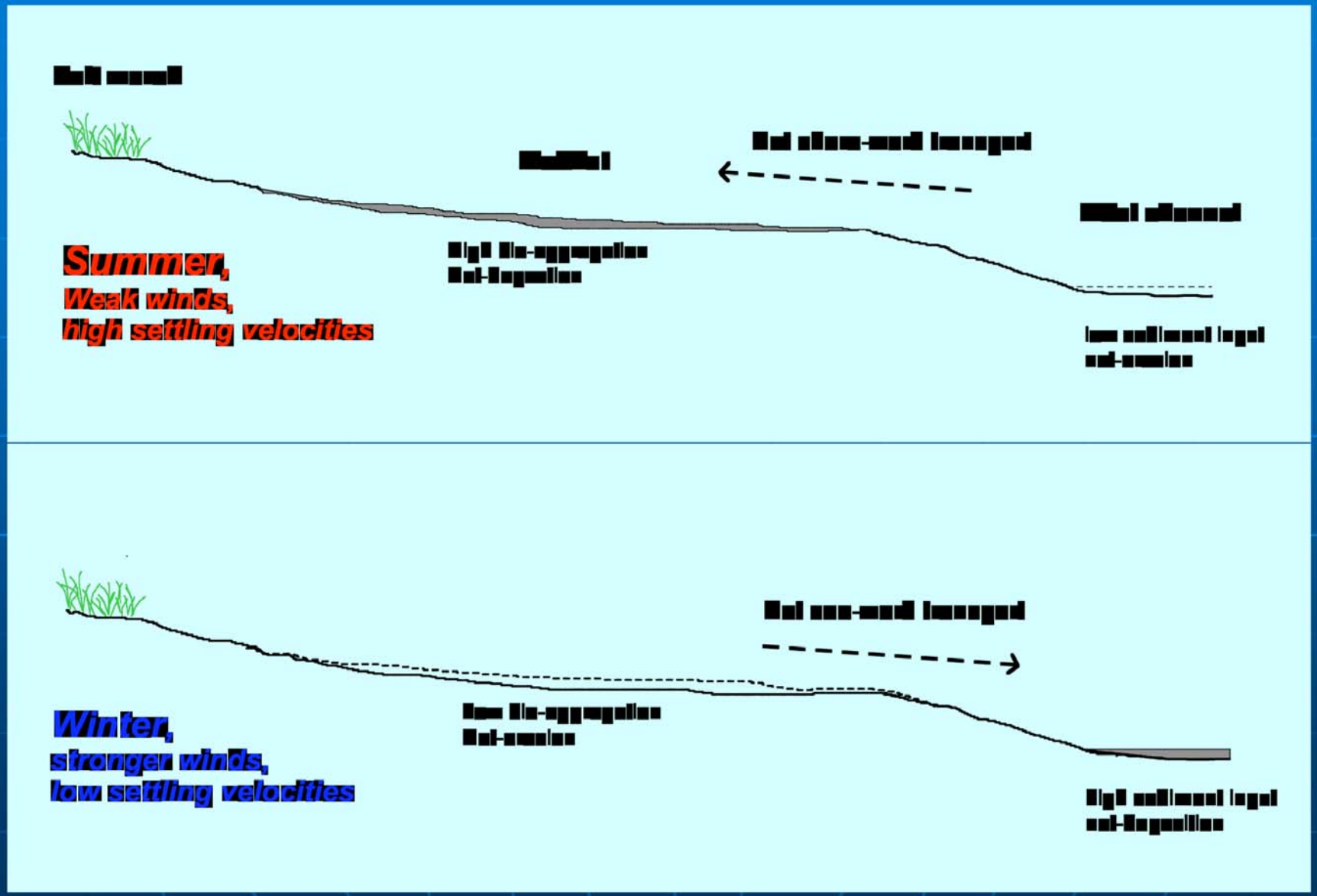
Sedimentation at an intertidal mudflat, Danish Wadden Sea



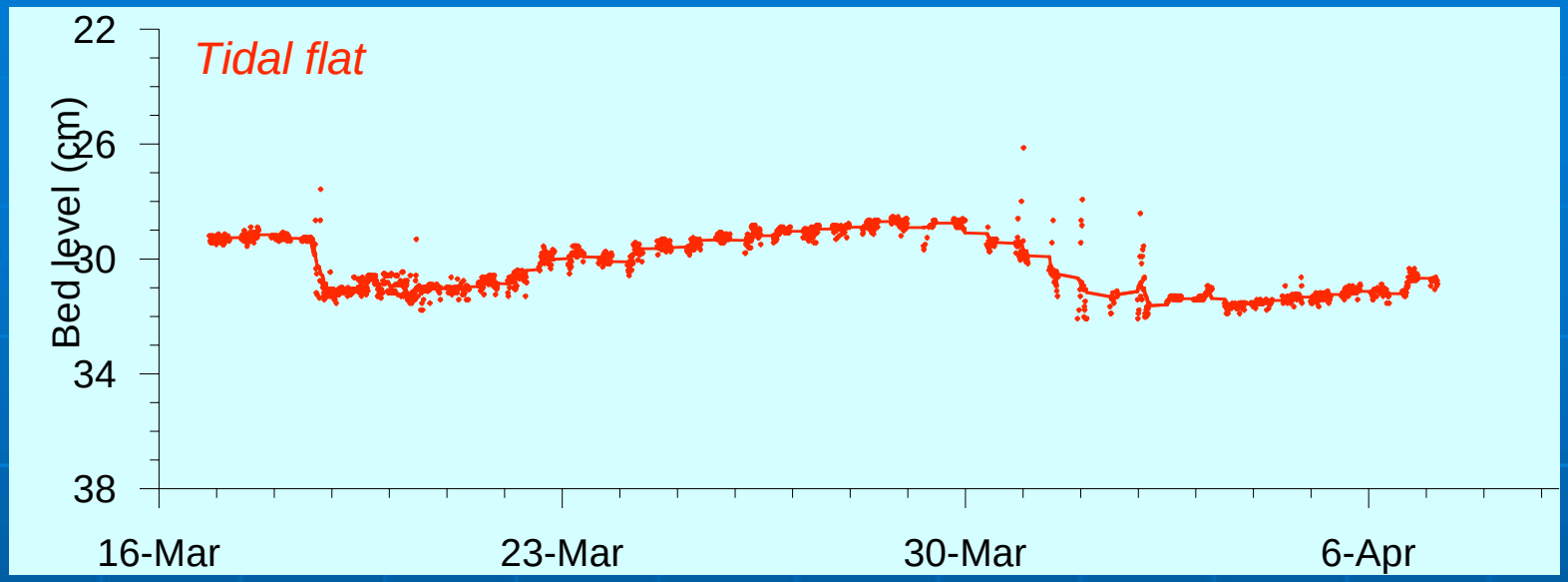
What determines the sedimentation rate and seasonal variation?

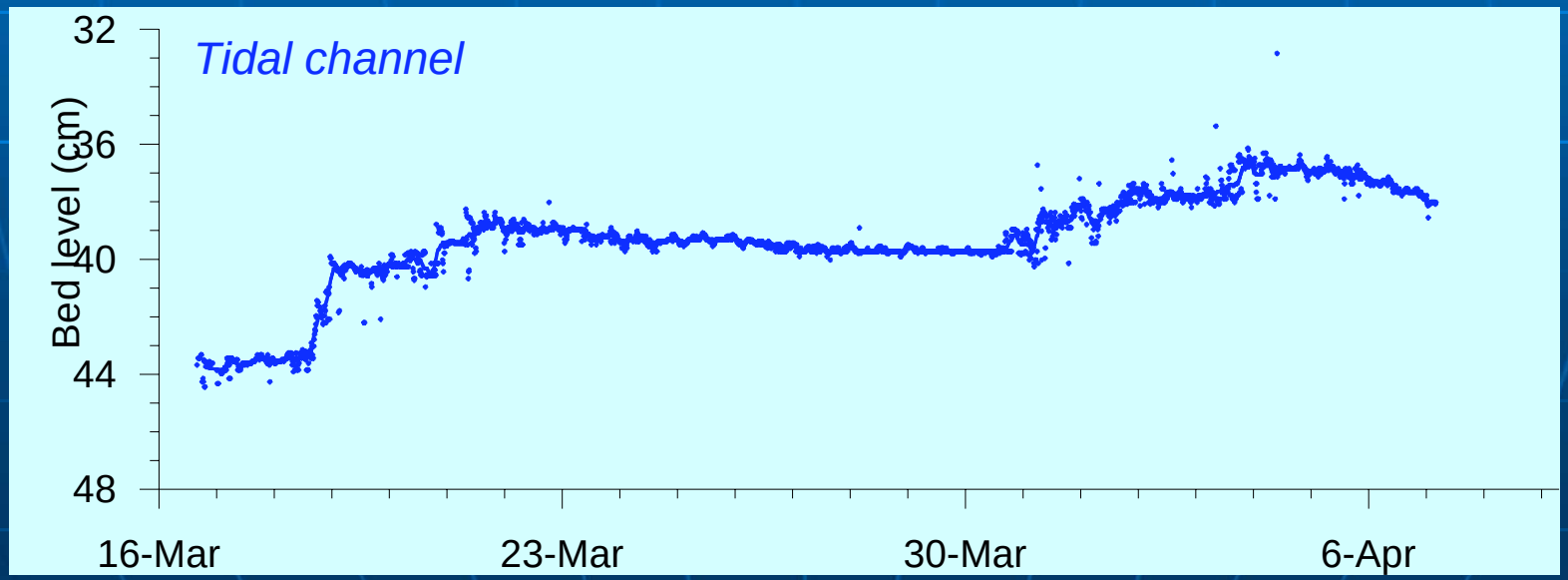
Bio-stabilization of intertidal mud flat

Conceptual model

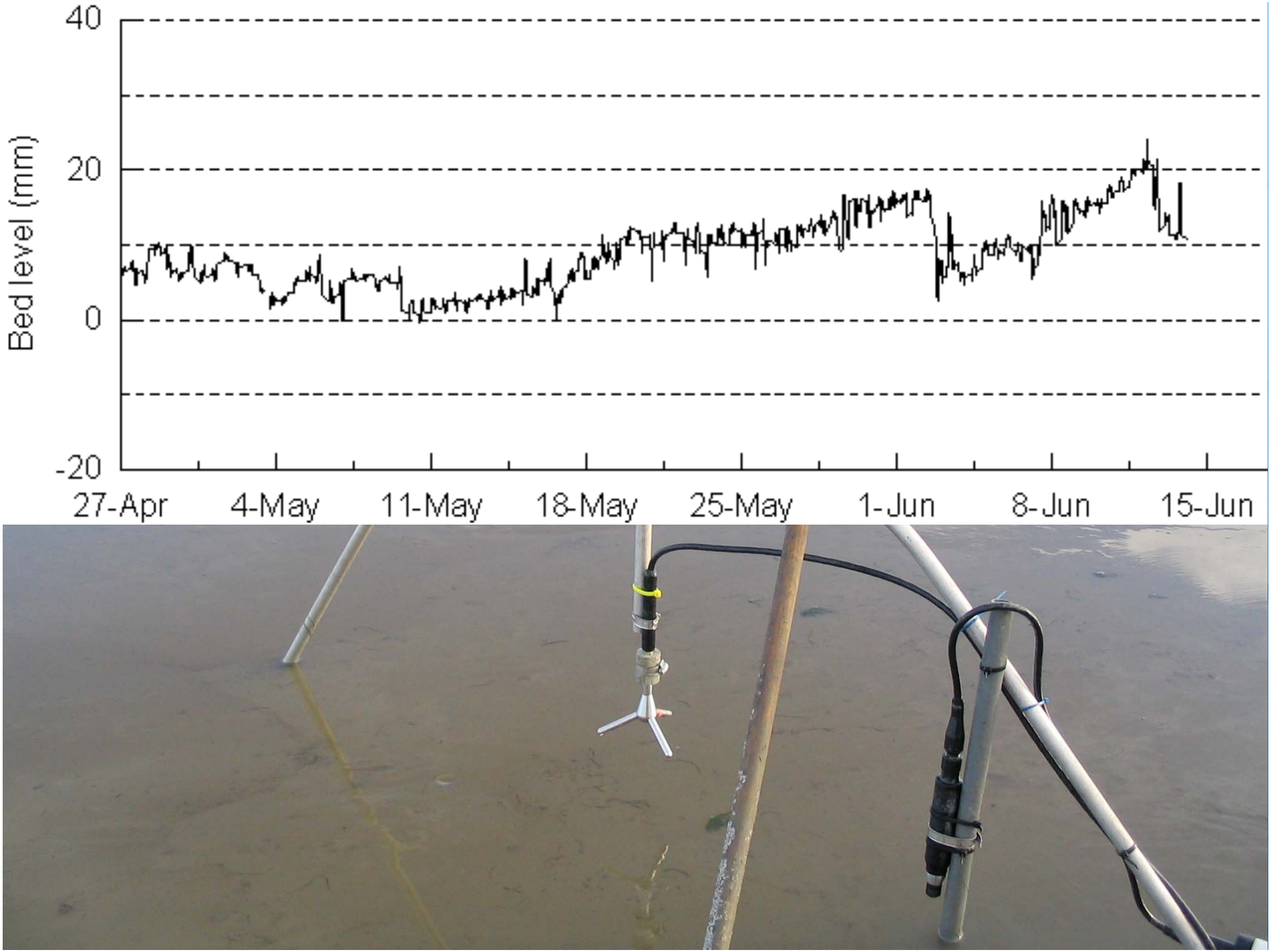


Coupling between Intertidal and subtidal areas





Sediment accumlation during the last 12 hours


40
20
0
-20
Bed level (mm)
27-Apr
4-May
11-May
18-May
25-May
1-Jun
8-Jun
15-Jun

Biological impact on sediment retention in estuaries

- Short-term – yes: Diffenately
- Long-term?

Sediment accumulation in the Wadden Sea described over different periods

- Millennia
- Decades
- Years
- Months
- Hours

Sediment accumulation in the Wadden Sea described over different time periods

- Millennia 1-3 mm/y
- Decades 2-5 mm/y
- Years 12-17 mm/y
- Season 20-100 mm/3month
- Hours 2-4 mm/tidal period

Thank you for your attention !