Hydrodynamics and Suspended Matter Budget in an Intertidal Basin of the East Frisian Wadden Sea

Project supervisors: Flemming, B.W.[1] & Wolff, J.-O.[2]

Section: Depositional Processes and Seasonal Dynamics of Fine-grained Sediments in a Back-barrier Tidal Basin

Chang, T.S.[1] & Bartholomae, A.[1]

[1]Senckenberg Forschungsinstitut, Abt. Meeresforschung, Schleusenstrasse 39, D-26382 Wilhelmshaven
[2]Institute for Chemistry and Biology of the Marine Environment, Carl-von-Ossietzky-Strasse 9-11, D-26111 Oldenburg

Study Objectives

The basic objective of the study is to describe and quantify the composition, dynamics and depositional processes of fine-grained sediments in a back-barrier tidal basin of the German Wadden Sea. The study area is located along the East Frisian coast behind the island of Spiekeroog. Of particular interest is the seasonal response of the fine sediment fraction (<0.063 mm) to change in tidal and wave energy flux and temperature related fluctuations in the kinematic viscosity of the sea water in the course of a year. In addition, it will be investigated to what extent man-made structures such as protection seawalls and clay retention pits affect the textural composition and sediment budget of the tidal basin.

With the above objectives the study extends previous investigations on the basis of which a net export of fine-grained sediments from local tidal basins has been postulated since dike construction. Furthermore, the rate of muddy sediment depletion is expected to increase in the wake of the postulated acceleration in sea-level rise. However, to date neither the seasonal dynamics of suspended sediment transport (total flux, rate of deposition/resuspension) nor the transport pathways are well understood. As yet totally unknown are the effects of episodic storm events.

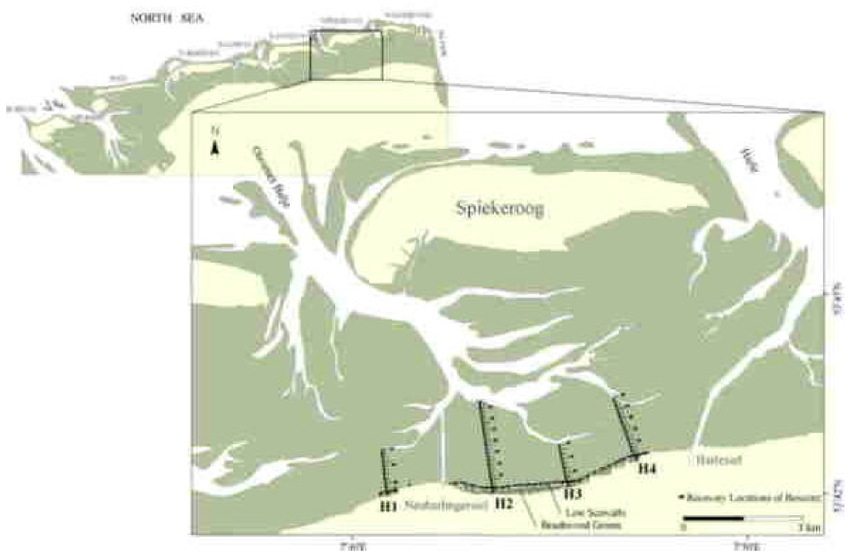
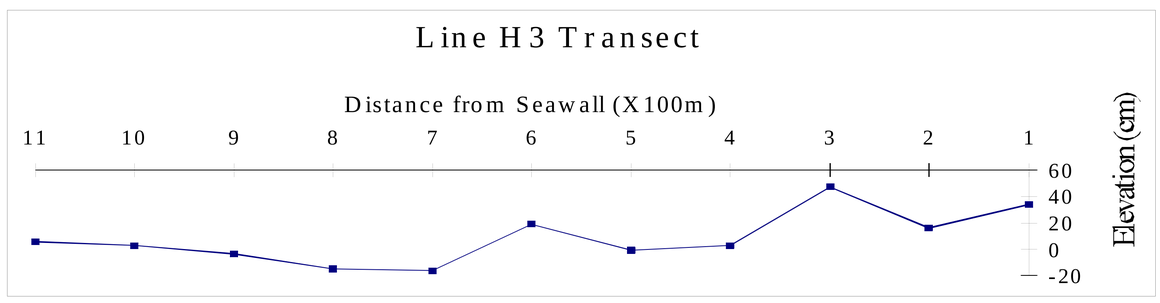


Fig. 1. Map of study area showing stations for surface sediment sampling, box-core acquisition, and sedimentation rate monitoring. Each line across the tidal flat is transected for long-term observation of sedimentation at regular interval of 100 m.



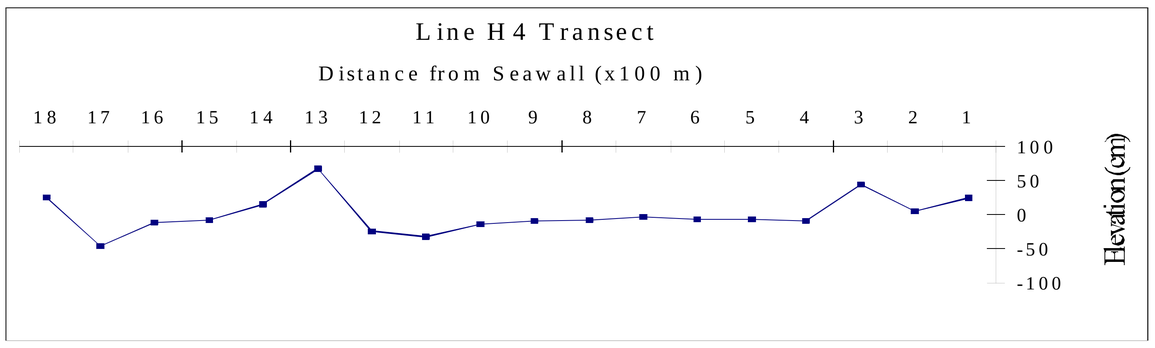


Fig. 3. Selected box-core examples and elevation of line H3 and H4 transects.

Ongoing Field Measurements and Analyses

Precision leveling of the surrounding tidal-flat surface along each cross section was carried out accurately, using a high precision leveling laser distance measuring instrument in order to document and quantify larger-scale morphological changes.

The topmost several millimetres of tidal-flat sediments were taken using a spatula in order to understand the sediment properties. The sampling procedure was regularly repeated along representative transect lines on a two month interval. Grain-size analyses of surface sediments were performed by sieving and with a SediGraph 5100 particle analyser for the sand and mud fractions, respectively. Dried sand fractions were analyzed using Ro-Tab Sieve Shaker with 0.25 phi sieve interval.

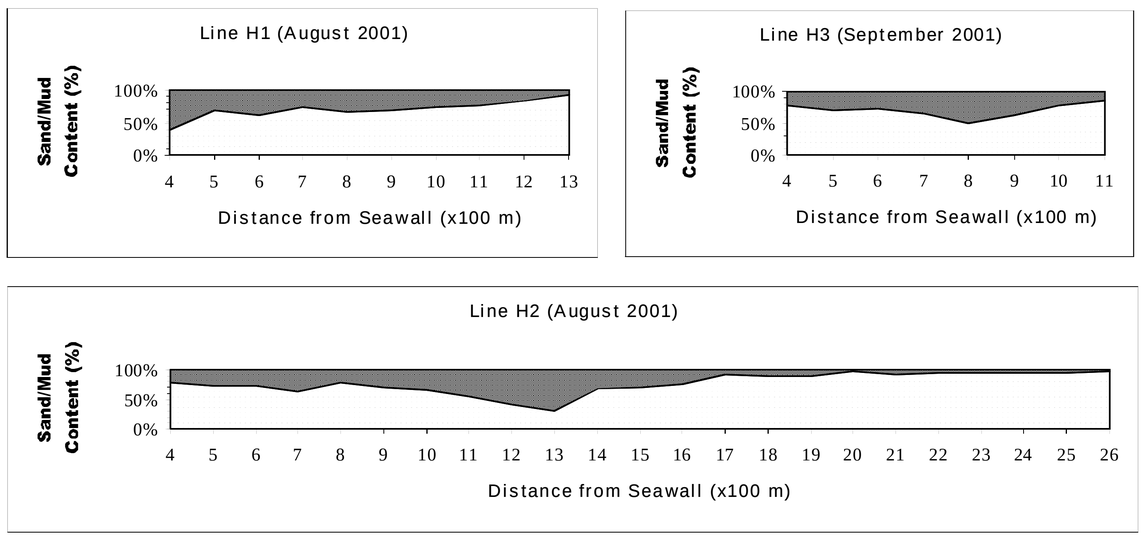
Sedimentation rates were obtained by initially burying reference poles and periodically measuring the changing heights of metal poles to assess net accumulation/erosion rates.

Box-cores were collected to document sedimentary structures and facies in response to the dynamic processes such as bedform generation and bioturbation. Each sample was made in sediment peels using epoxy.

Planned Field Campaigns

- Collection of longer vibro-cores for the reconstruction of the stratigraphic evolution of the tidal basin.
- Measurements of temporal and spatial variations of moisture and organic contents to understand mudflat development.

Fig. 2. A) Photograph showing collecting performance of box-core on lower sand flat. B) Sand ripples at station 5. In summer this area was covered muds, no ripples.



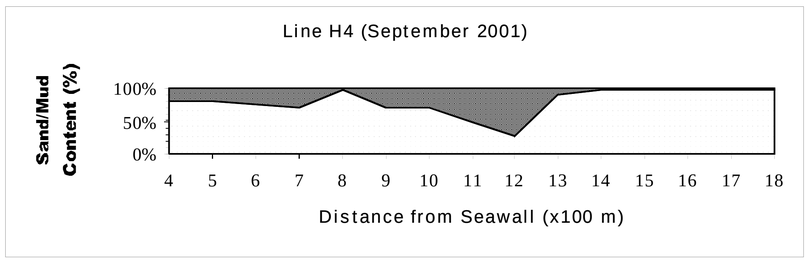


Fig. 4. Lateral variation of textural composition.

Accumulation Rate (mm)				
	9-10/2001	11-12/2001	Cumulation (mm)	Sedimentation Rate (mm/4 months)
Line H1	-237	-76,9	-313,9	-78,5
Line H2	-299,4	77,2	-222,2	-55,6
Line H3	-186,3	-21,3	-207,6	-51,9
Line H4	-93,7	14,6	-79,1	-19,8
Average	-816,4	-6,4	-822,8	-205,8

Table 1. Averaged accumulation rate only for 4 months.