Suspended particulate matter dynamics in coastal turbidity maximum areas

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Coastal turbidity maximum?

Turbidity is a measure of water clarity (optical property of the water) and contains colored dissolved organic matter and Suspended Particulate Matter.

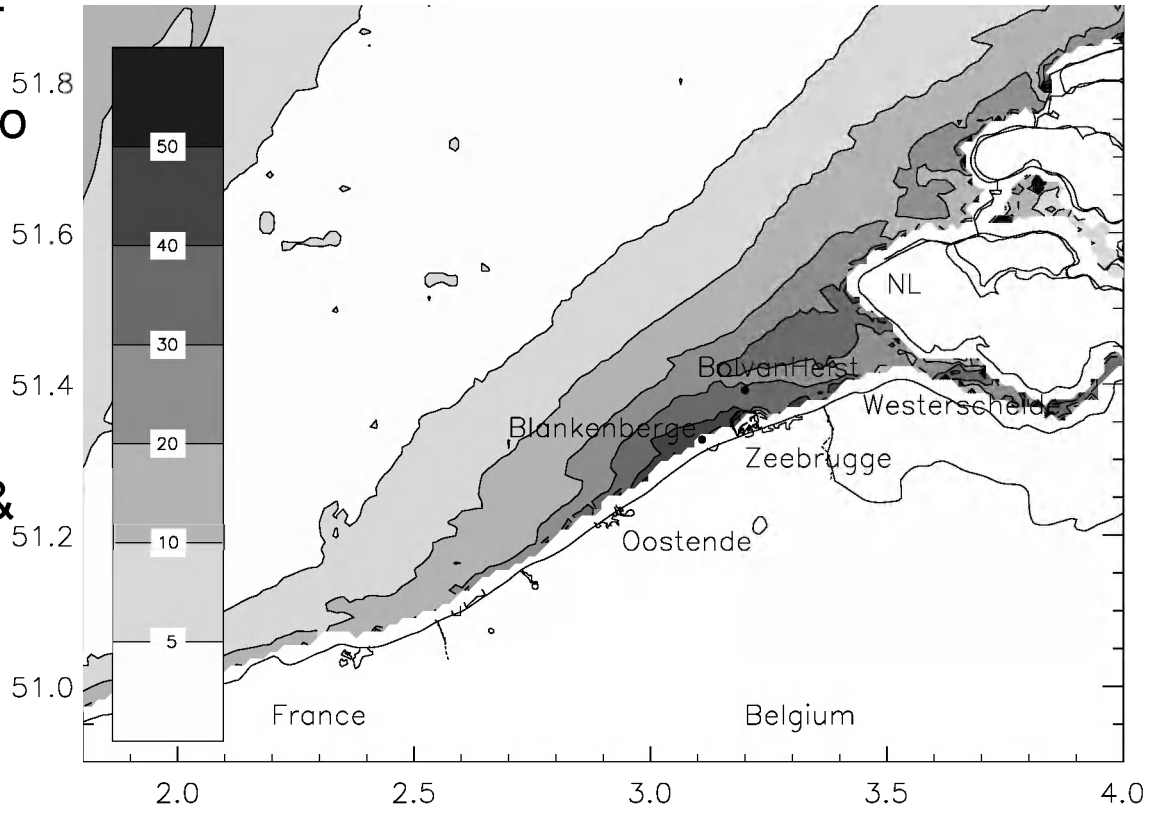
Turbidity maximum occurs in coastal waterways (river plume, estuaries) and is caused by tidal forcings resulting in trapping and flocculation of SPM at the salt-fresh water wedge (salinity is 2 ppt)

Coastal turbidity maximum !

Sediment supply (clays, cabonates,..) from English Channel and local erosion.

Trapping due to hydrodynamics & meteo effects: Residual transport is reduced resulting in a congestions of the SPM in the coastal zone

Strong tidal currents and slack waters stimulate flocculation and thus settling & deposition of SPM



Aim of Q4D SPM research: SPM dynamics and human impact

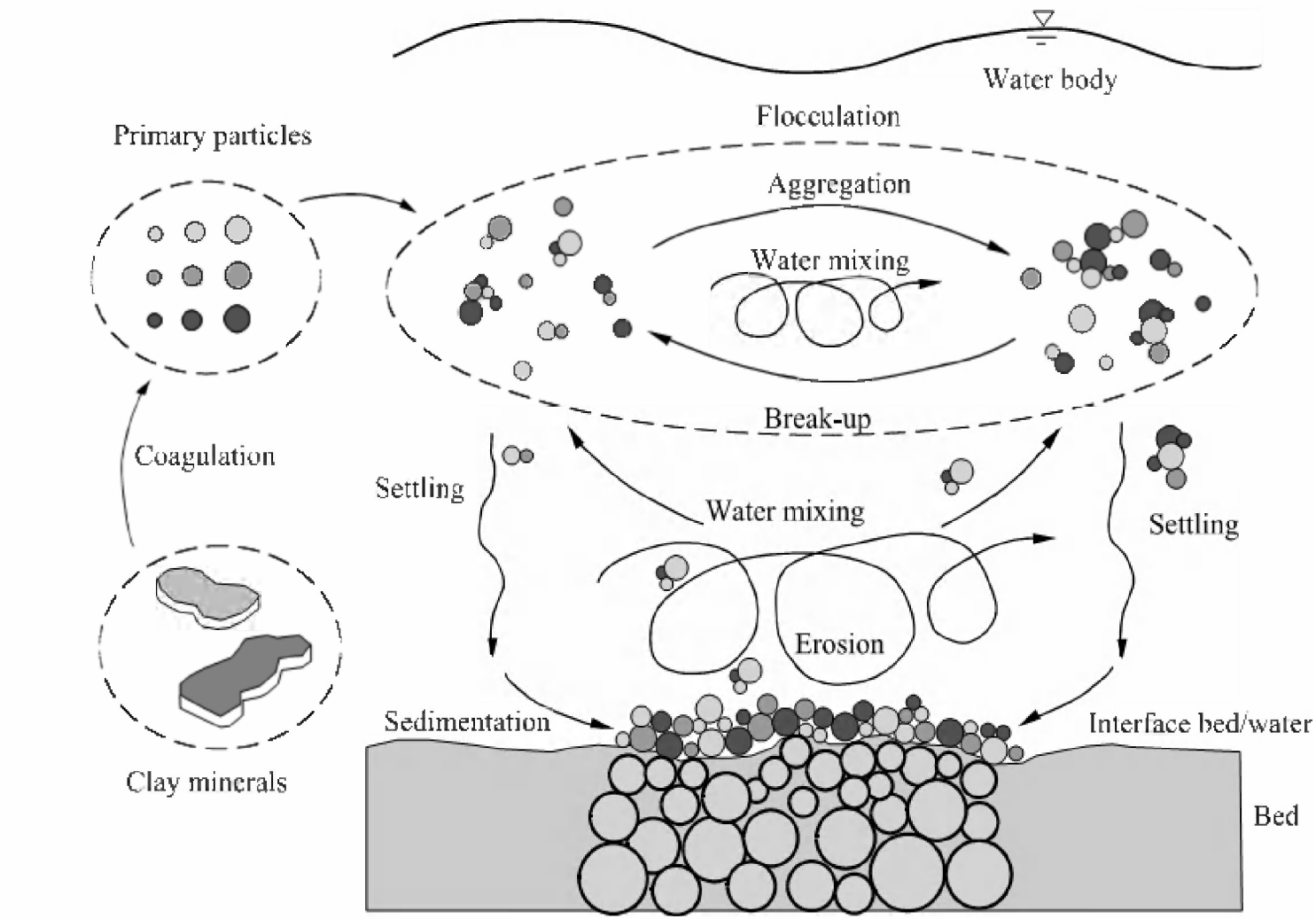
1. Natural variability (see mainly next presentation)
   - **Near bed processes: high concentrated mud suspensions and fluid mud**
   - Extreme events (storms)
   - Meteorological and climatological effects

2. Instrumentation
   - Multiparametric sensors to investigate SPM dynamics: optical and acoustic backscattering, laser diffraction

3. Statistical properties and sampling methods
   - Evaluation of in situ and remote sensing (MODIS) techniques
   - **SPM concentration as indicator to detect changes in the environment**

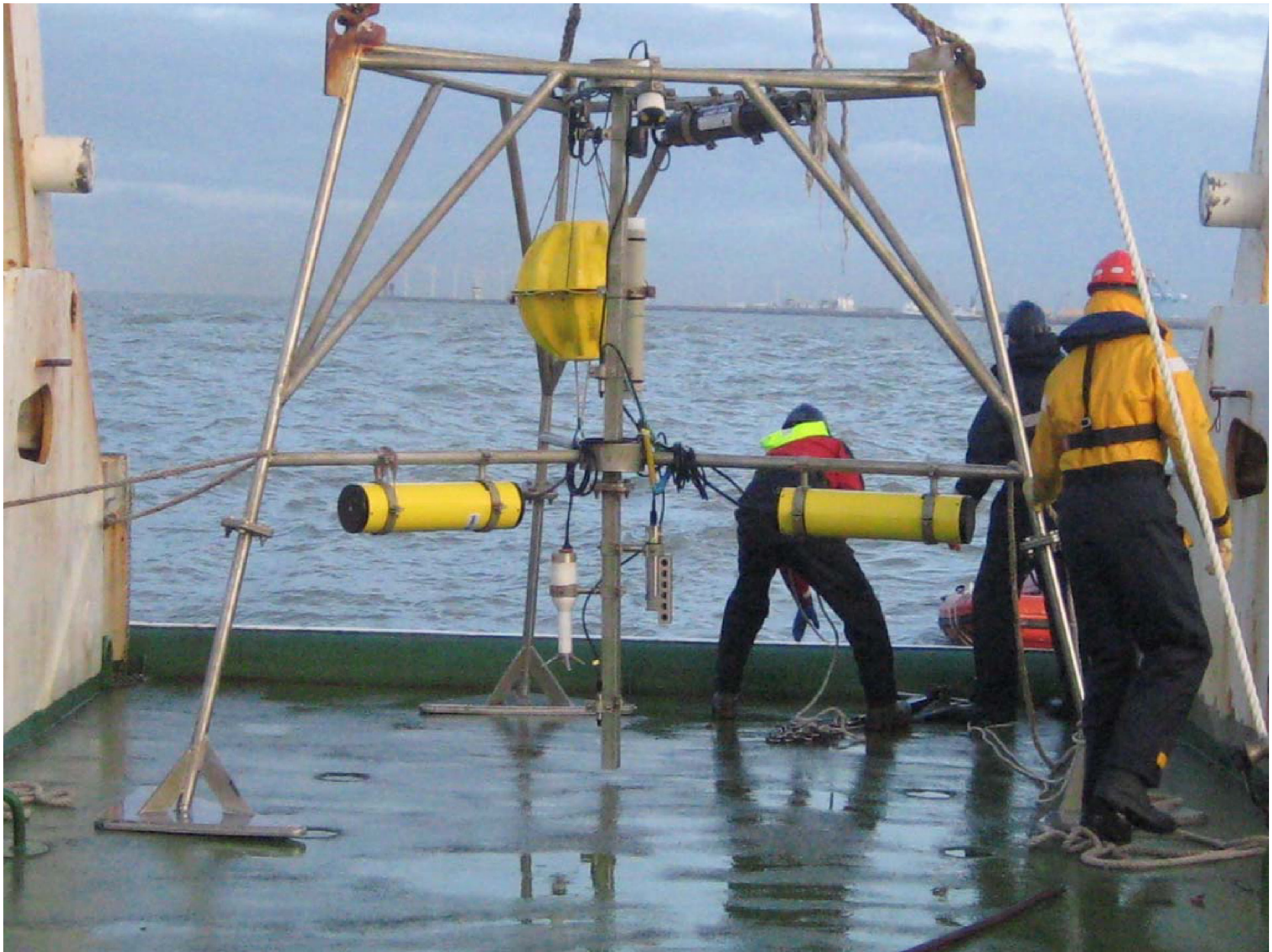
4. Case study of human impact
   - **Disposal of dredged material and SPM concentration**
   - Long term changes in SPM concentration and mud deposits

Cohesive sediment dynamics

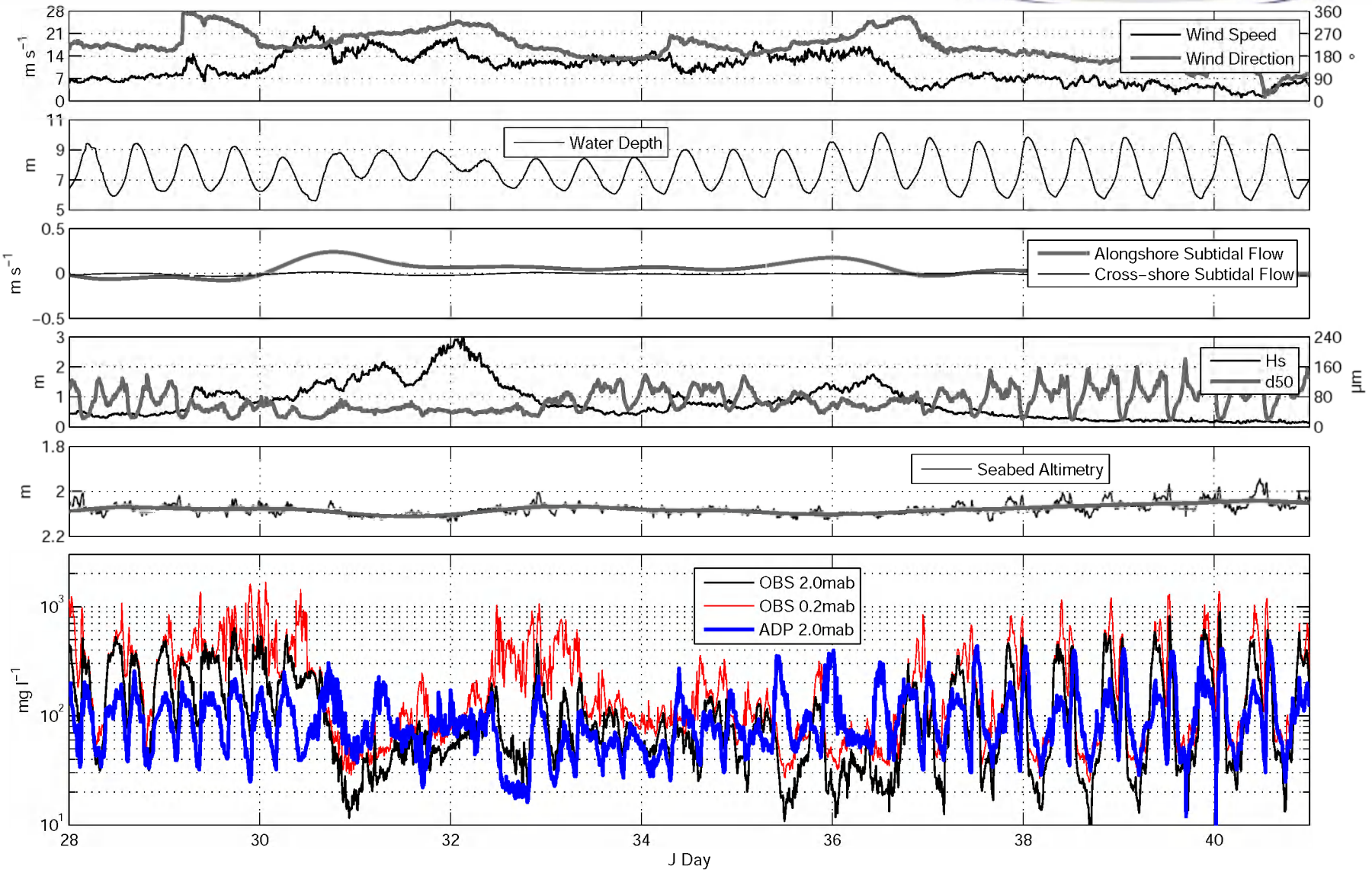


Highly Interdependent Processes : Deposition, Erosion, Sedimentation, Resuspension, Aggregation, Breakup, and so on. (Maggi, 2005)

SPM concentration as indicator of anthropogenic impact: long-term data set

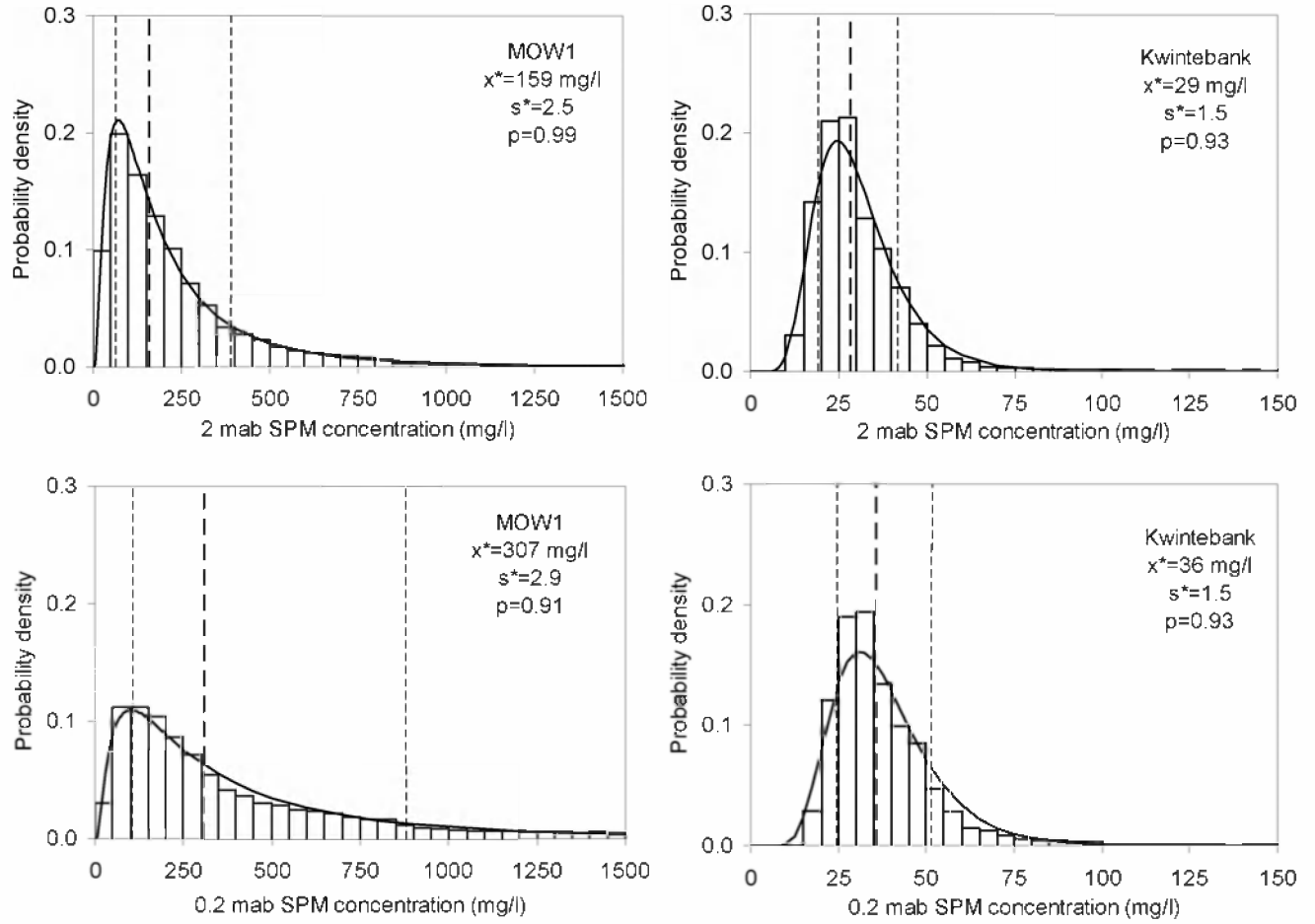


Time series



Variation in SPM concentration is related to tides, storms and also seasonal changes and human impacts.

SPM concentration: log-normal distribution



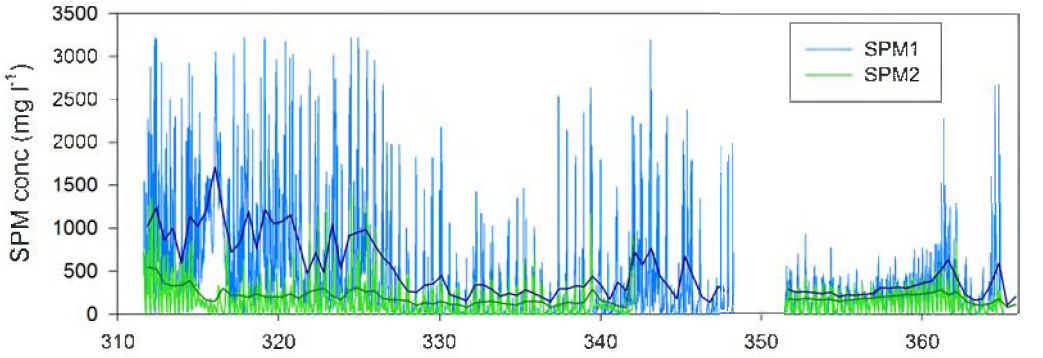
SPM concentration can be defined as a statistical population.

SPM concentration time series are sub-samples of the whole population

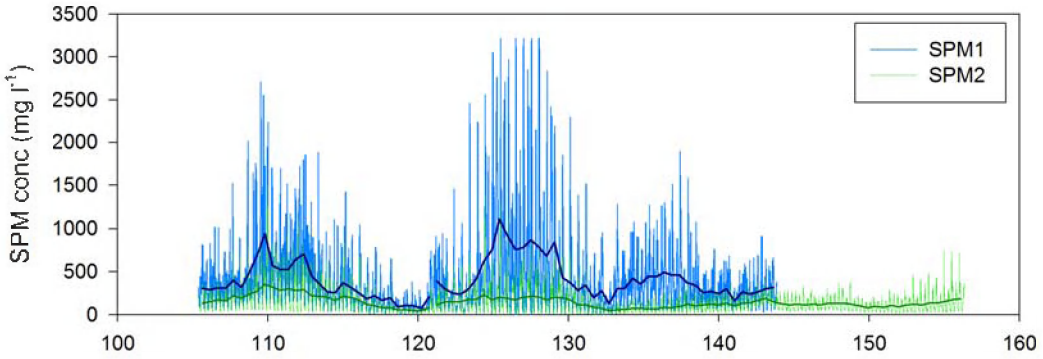
Monitoring the effect of disposal of dredged material Differentiating between natural and anthropogenic induced signal using statistical techniques

experiment conducted by Maritime access division

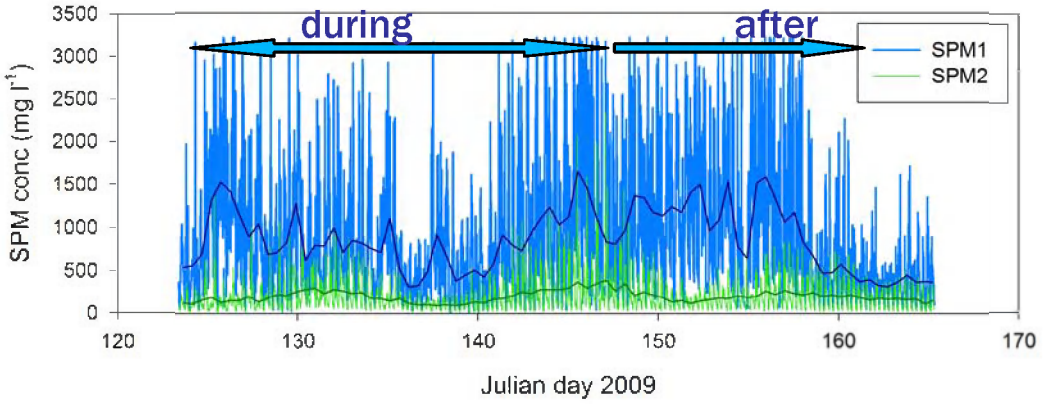
Time series of SPM concentration at 0.2 m above bed (SPM1) and 2 mab (SPM2)



Nov – Dec 2006

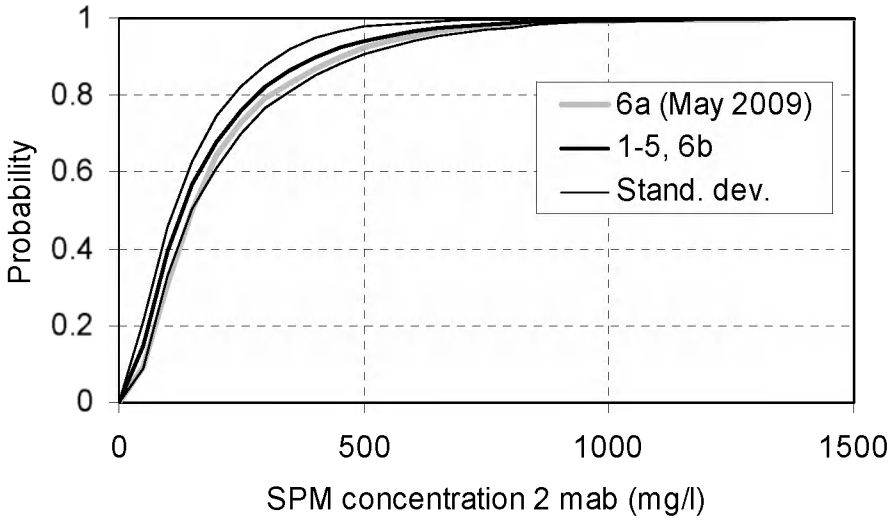


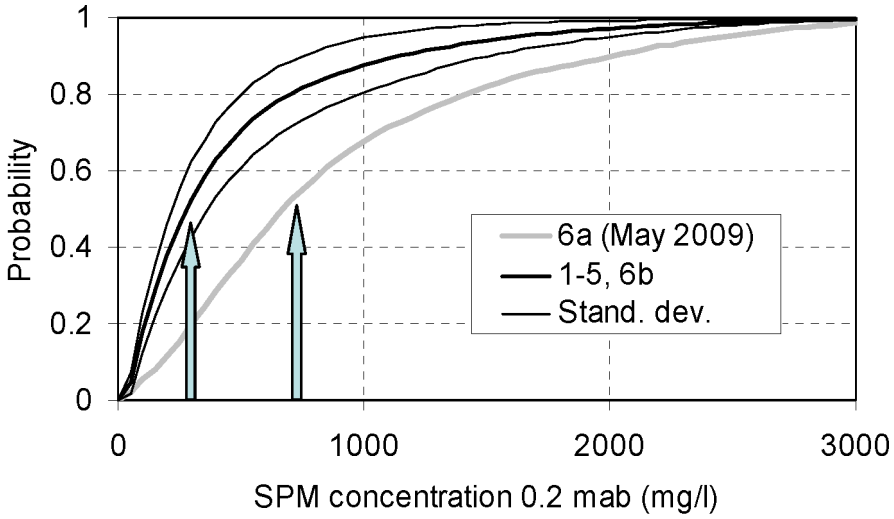
May – Jun 2008



May – Jun 2009

Cumulative probability distribution of SPM concentration measured at 2 mab and 0.2 mab





6a: during dredging experiment

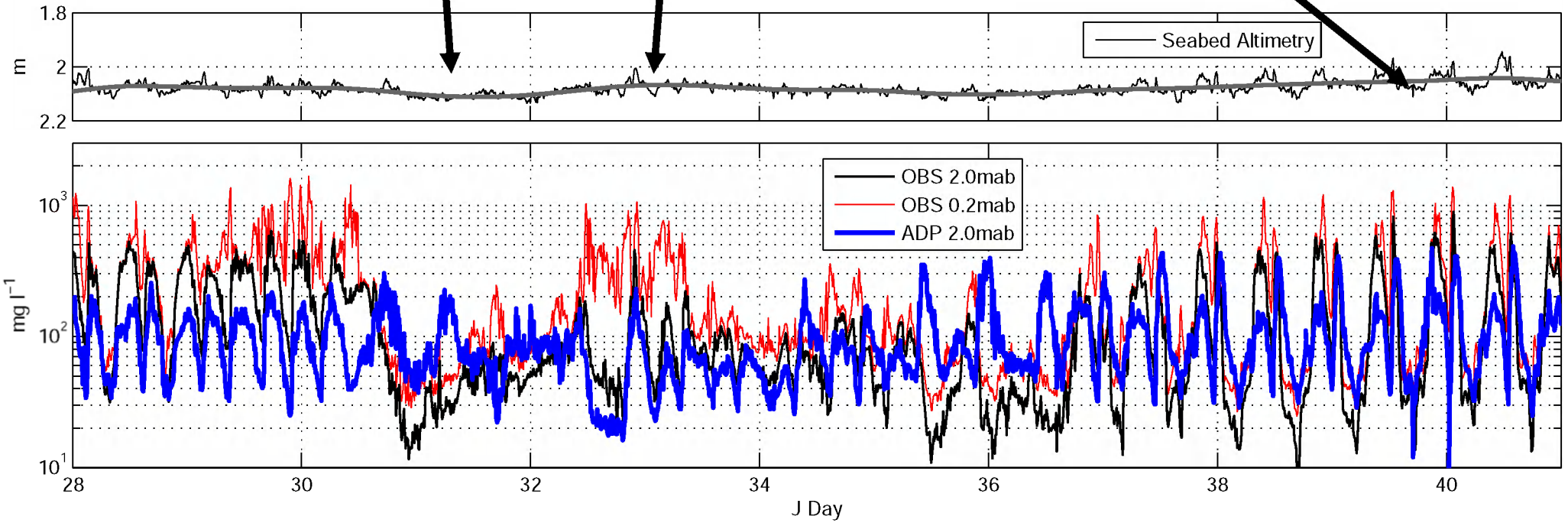
Significant increase in near bed bottom layer → formation of HCMS layers

Median at 0.2 mab is very high during disposal exp. (612 mg/l) this is about 240 mg/l higher than during winter and 330 mg/l higher than during spring 2008)

HCMS layers

Acoustic detection layer via altimetry of ADV & ADP: the signal is reflected at high SPM concentration → decrease in sea level

erosion of HCMS




FWG – Kiel
Germany
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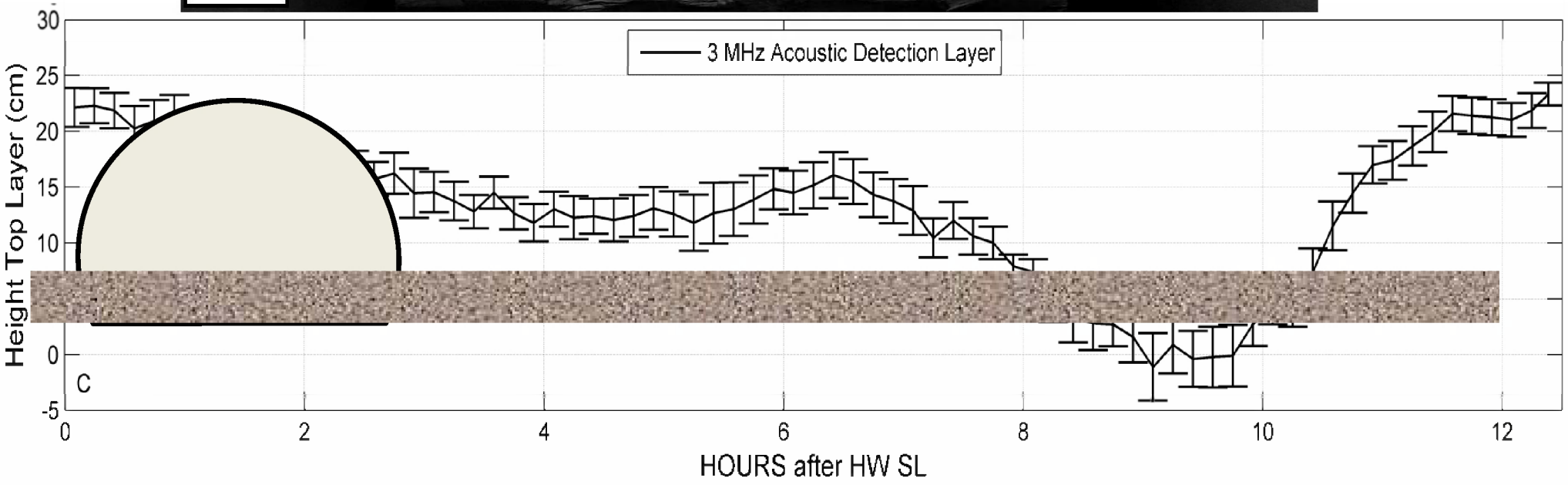
Germany
HCMS layers


3 MHz Acoustic Detection Layer
Height Top Layer (cm)
HOURS after HW SL
C
30
25
20
15
10
0
-5
0
2
4
6
8
10
12

Take Home Messages

SPM concentration distribution can be used as indicator for environmental changes

High concentrated mud suspension have been identified thanks to combination of different instrumentation

SPM dynamics is governed by near-bed processes: New sensors, measuring techniques are needed (see this afternoon)