

Interaction between fluid mud and salinity – Results of a field survey in the Ems River, Germany

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Results of a field survey in the Ems River, Germany

8th workshop 'Seabed Acoustics'

11/2017



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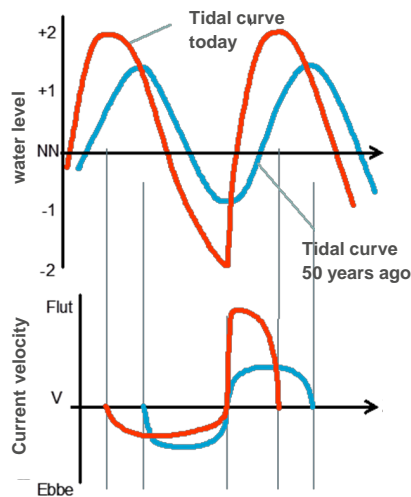
outline

- Study area "**Ems River**" → one of the muddiest rivers in Europe
- Vertical **gradients of salinity** under Fluid Mud conditions → CTD / OBS – data
- **Formation of Fluid Mud** during a tidal cycle → SES survey data
- How are these **two effects correlated** ? → Main message
- **conclusion**

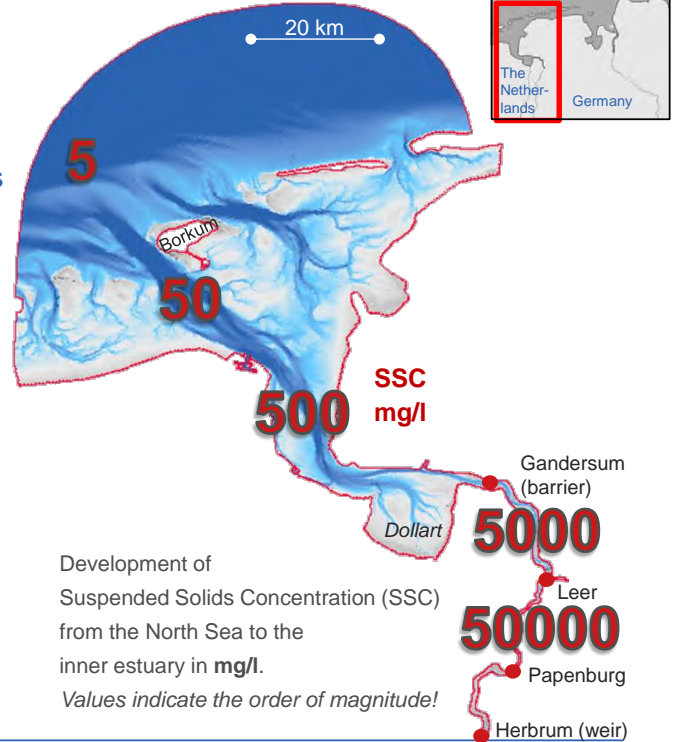
The Ems: A hyper turbid estuary

Suspended Sediment Concentration from the North Sea to the inner estuary

- strong tidal asymmetry
- flood - oriented transport of sediment
- salinity intrusion reaches far upstream
- formation of contiguous fluid mud layers



Schematic diagram



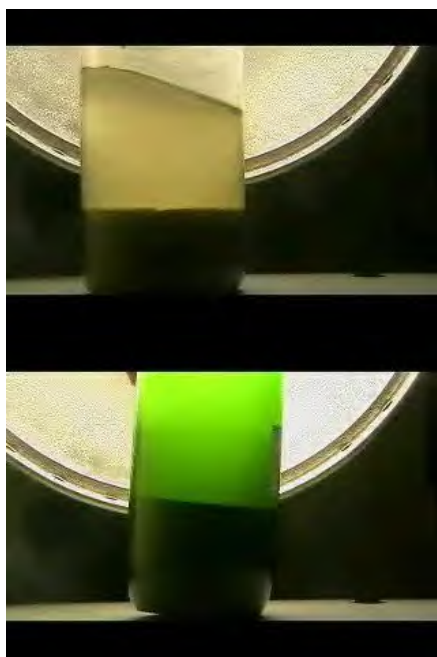
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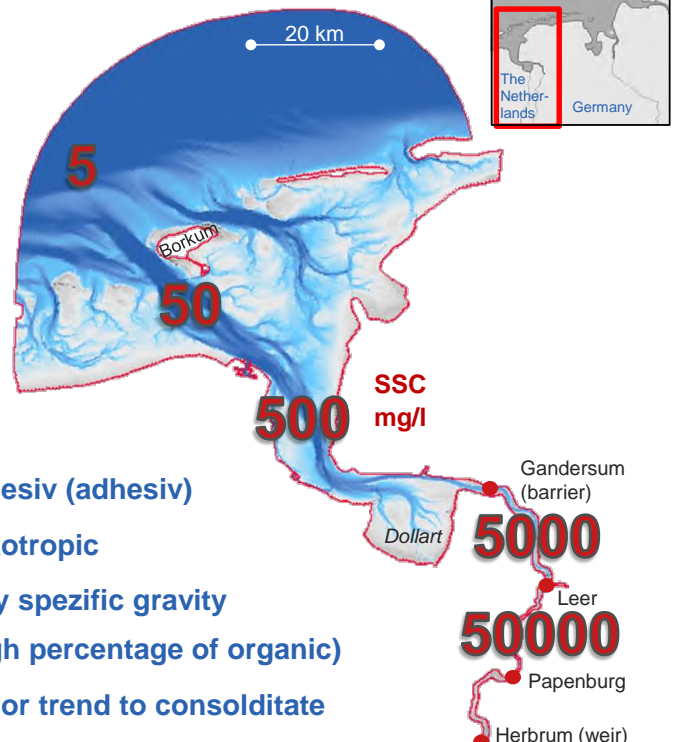
The Ems: A hyper turbid estuary

Suspended Sediment Concentration from the North Sea to the inner estuary

Fluid Mud



- cohesive (adhesive)
- thixotropic
- little specific gravity
(high percentage of organic)
- minor trend to consolidate

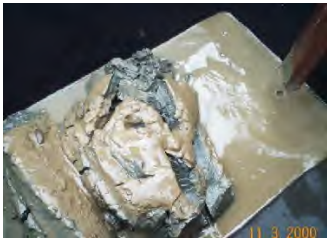


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Motivation

- Improvement of the ecological state
(European Commission / Masterplan Ems2050)
- Enhancement as an economic factor
 - Waterway, Ship Yards, Harbours
- Maintenance (dredging)



Knowledge gaps of
fundamental processes

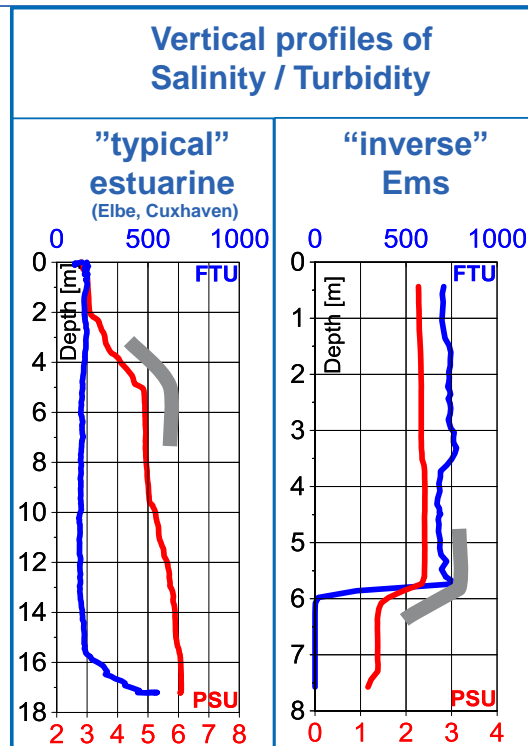


Interaction between Fluid Mud and
salinity intrusion into the estuary

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CTD – Longitudinals: -
salinity measurements in fluid mud

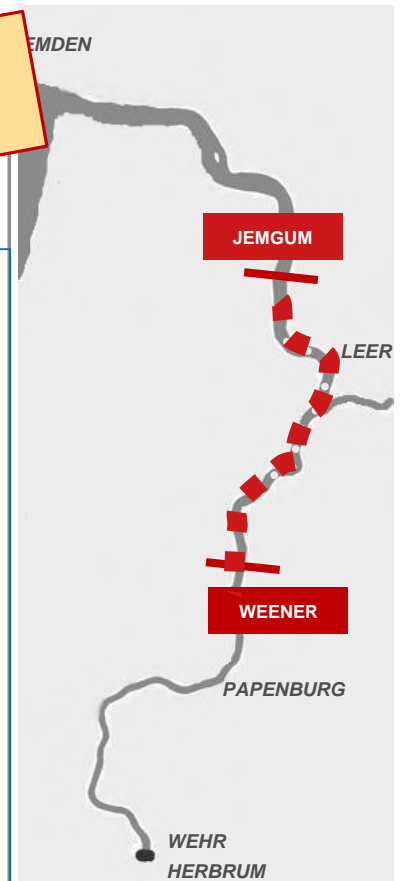
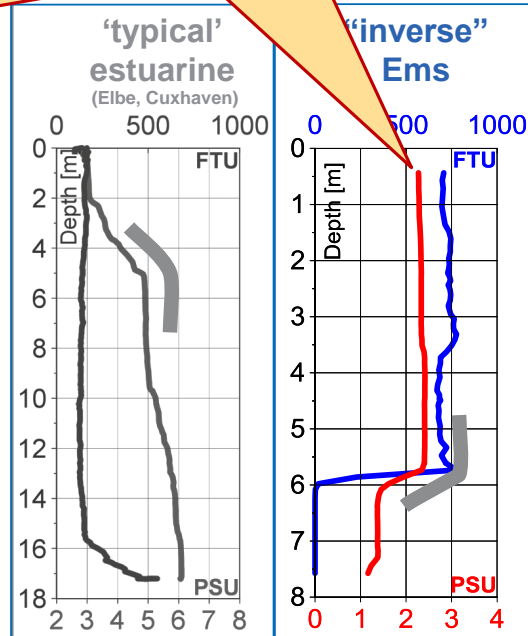


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CTD – Longitudinals: -
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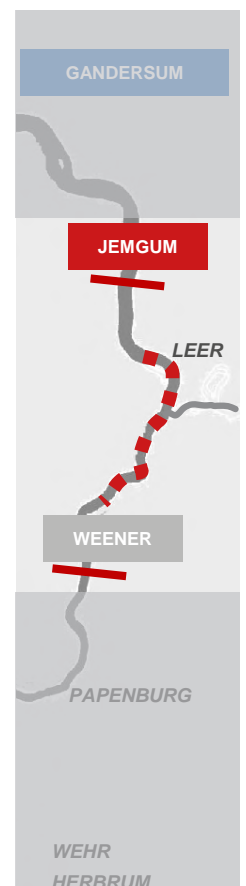
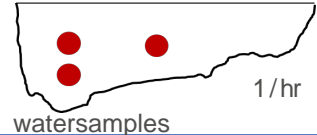
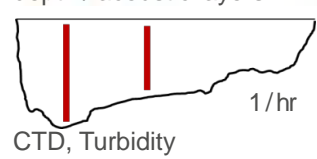
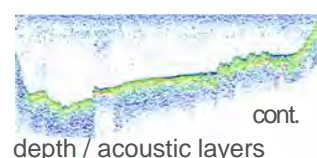
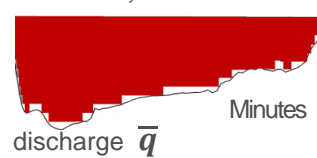
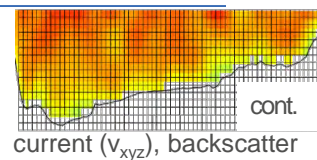
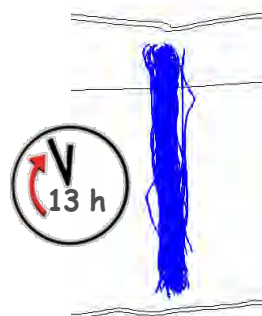
What is the mechanism behind
these inverse salinity profiles?



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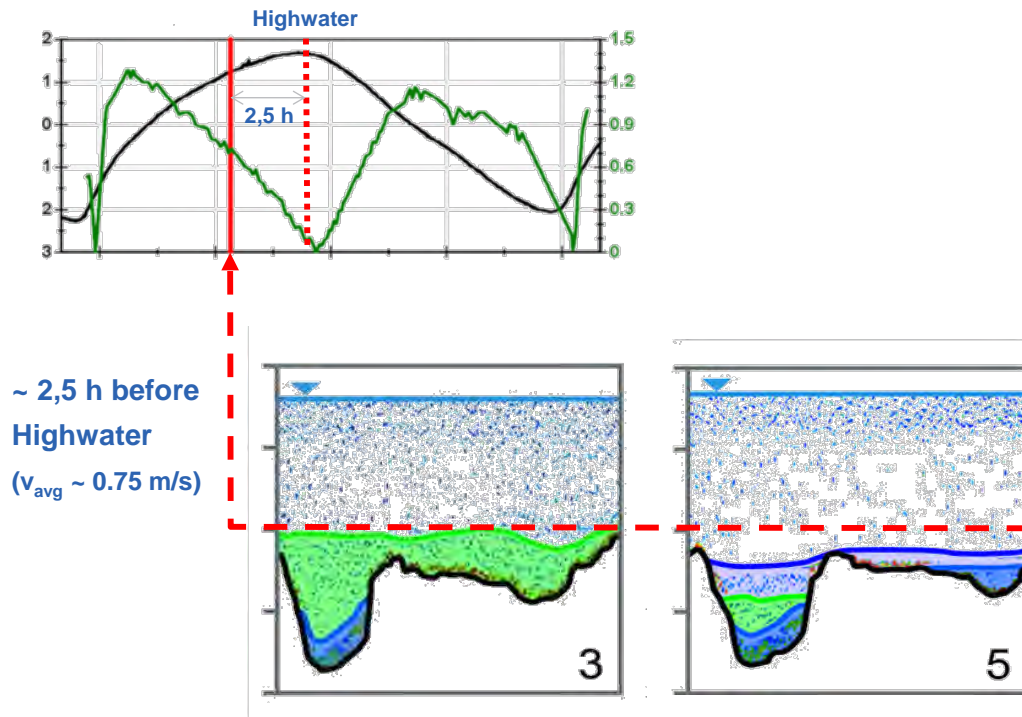
Tidal cycle measurements on cross sections



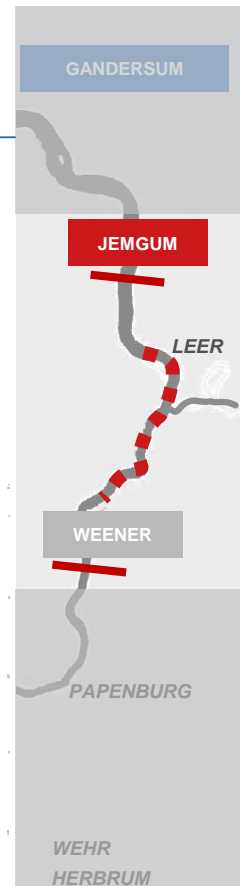
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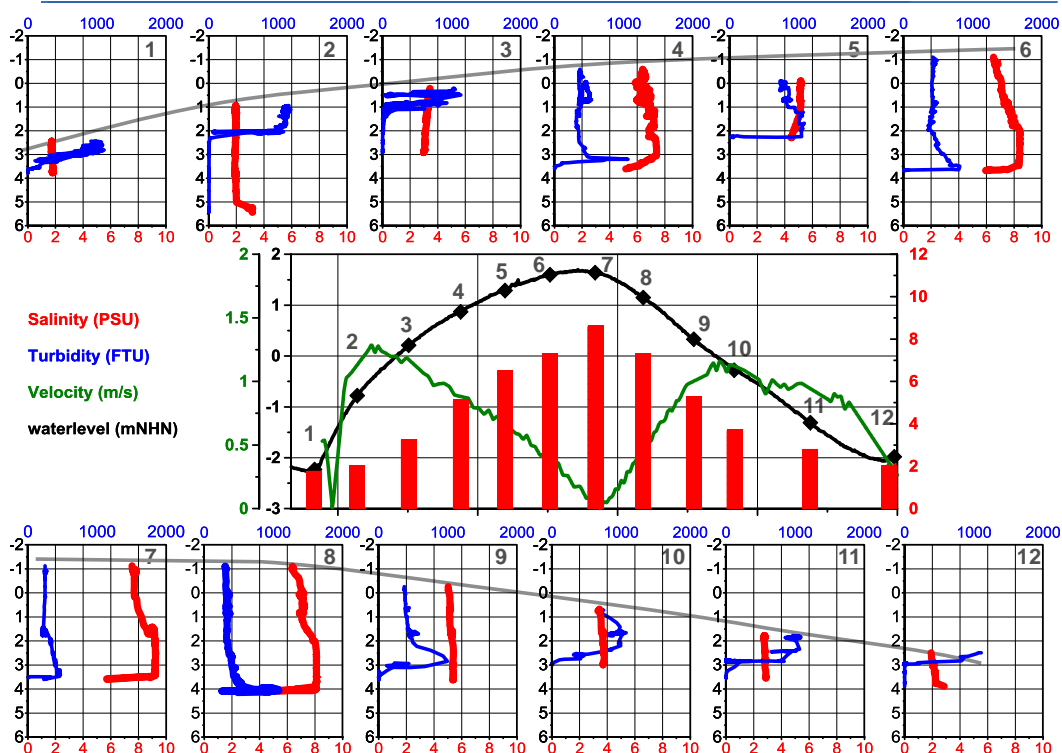
Formation of a fluid mud layer at Jemgum



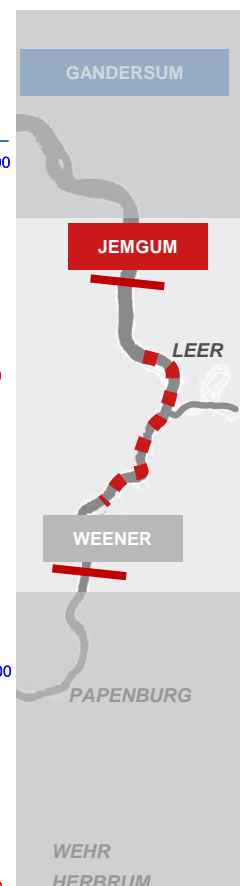
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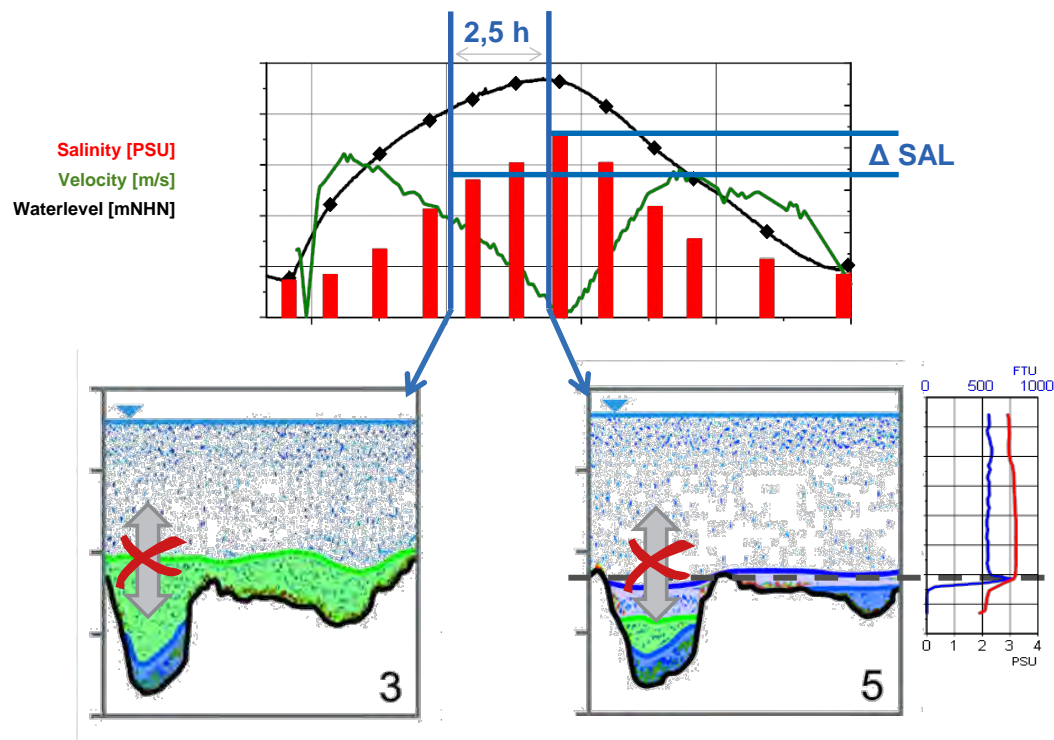
Cross section Jemgum - salinity / tidal cycle



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storing of (lower) salinity concentration in the fluid mud layer

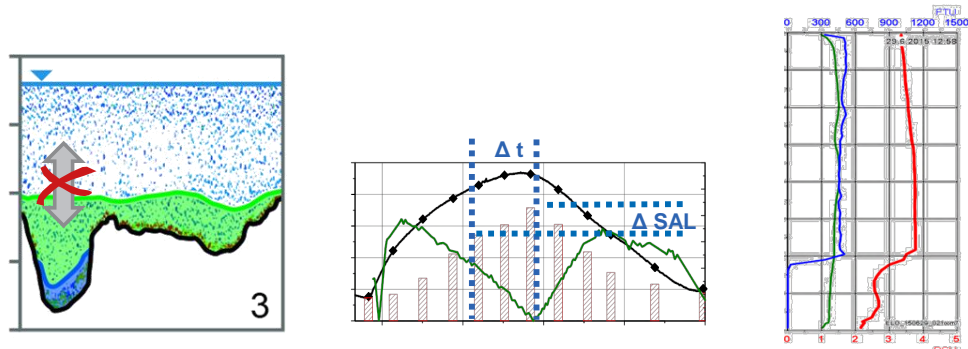


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summary

- Fluid mud layers start to form at ~ 2,5 h before highwater
→ vertical mixing is inhibited
- Salinity was not full developed at this time
(intruded into the estuary)
- Fluid mud layers are storing (lower) salinity concentration

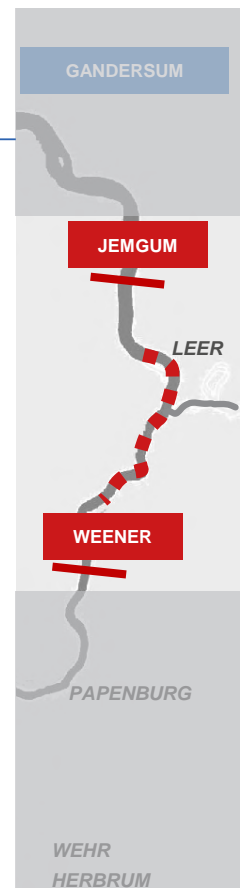
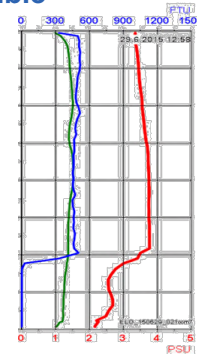
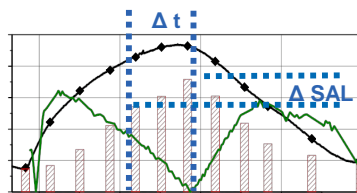
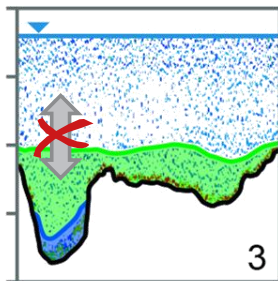


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conclusions

- This is an important contribution to the understanding of estuarine physics under hyper turbid conditions
- The sediment induced stratification has to be taken into account to improve numerical transport modelling significantly
→ „Fluid Mud Model“
- Without consideration of these effects the implementation of „sediment management strategies“ will not be possible



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