

Fluid Mud Dynamics Derived from ADV Altimetry, Belgian Coastal Zone

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Cohesive sediment in coastal systems

eg. fluid mud/HCMS

(high-concentration mud suspensions)

Depending on

- sediment properties,
- meteo-hydrodynamic conditions,
- availability of the sediment.

Aim of study?

- evaluating the **probability for detecting fluid mud formation** by means of an **ADV** (acoustic Doppler velocimeter) mounted on a tripod frame (Figure 1)
- correlating observed sea bed level changes with hydro-meteo conditions

In the southern North Sea

Belgian Continental Shelf

Characteristics

- macrotidal regime (tidal amplitude maximum of 4-5 m),
- occurrence of moderate wave conditions (0.5-2 m of significant wave height).

Study area?

- near-shore/west off Zeebrugge harbor
- shallowness, maximum current velocities up to 1 m/s,
- highly energetic hydrodynamic conditions,
- Fettweis and Van den Eynde (2003): highly turbid with mean SPM concentrations (50 - 1000 mg/l), occurrence of **turbidity maxima** and **mud fields**.

A tripod frame mooring during winter of 2007 (28 days), see Figure 3

- **ADV**,
- **OBS** (optical backscatter sensor),
- **LISST** (Laser In-Situ Scattering and Transmissometry)

SonTek ADV/Ocean (5MHz)

(besides flow measurements)

distance between **probe tip** and nearby physical **boundary** within range

→ "detecting the spike in signal strength corresponding to the reflection of the acoustic pulse from that boundary" (Velasco and Huhta 2005), see Figure 2.

IMPORTANT:

Pitch and roll variations of probe are taken into account
→ settling of the tripod frame causes biased **sediment levels**

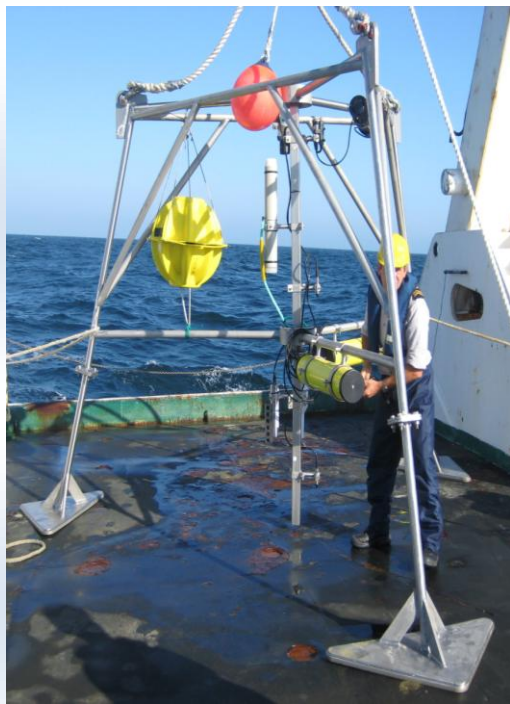


Figure 1

Conclusions:

ADV altimetry reveals depositional and erosional events
Storms (significant wave height > 2m) + spring tide (day 1-9)

Delivery of sediment in suspension

Bed level accretion during neap tide

=
Long-term occurrence of fluid mud (day 9-22)

Erosion as result of remobilization
during accelerating tidal flow (day 19-22) and/or storm passage

and so on ...

Observation of short-term accretional events
during slack waters

=
Rapid siltation from saturated mud suspension conditions
(Winterwerp et al 2001)

Entrainment during accelerating tide

Observation of erosional events
dependent on meteorological conditions

Ebb currents more erosive
than flood (day 10-11) for
for westerly wind

Resuspension of all sediments
remaining a 'harder' sea bed surface
(day 23-28) for easterly winds

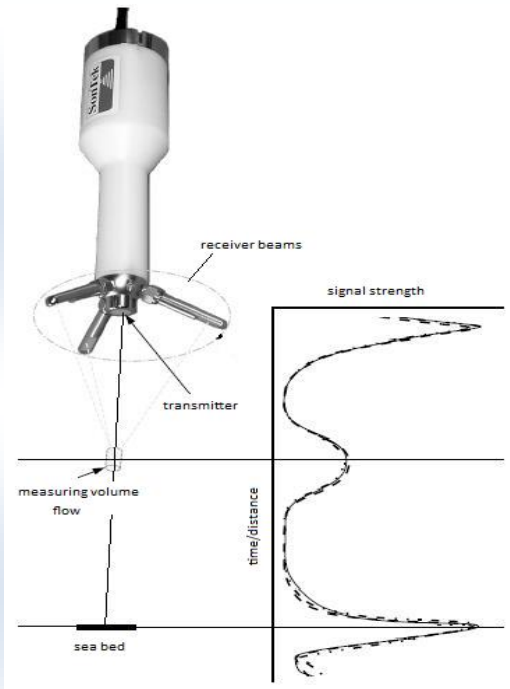


Figure 2

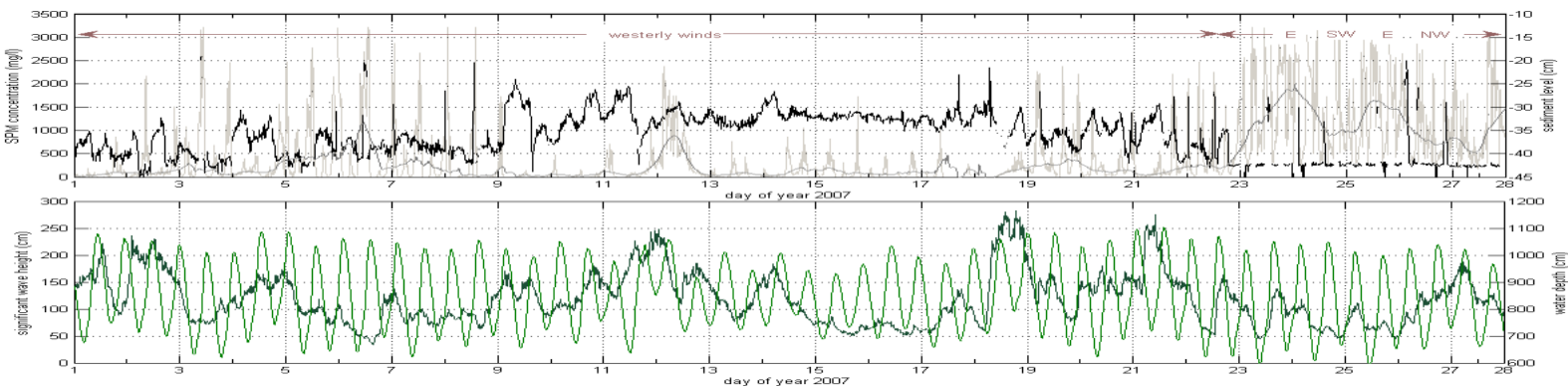


Figure 3

References: Fettweis, M. and Van den Eynde D. 2003. "The mud deposits and the high turbidity in the Belgian-Dutch coastal zone, southern bight of the North Sea." *Continental Shelf Research*, 23, 669-691

Velasco D.W. and Huhta C.A. "Experimental verification of acoustic Doppler velocimeter (ADV) performance in fine-grained, high sediment concentration fluids." *SonTek/YSI report*. 23 pgs.

Winterwerp J.C., Uittenbogaard, R.E. and de Kok, J.M. 2001. "Rapid siltation from saturated mud suspensions." *Intercoast Conf.* '98. 22 pgs.

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