Fluid Mud Dynamics Derived from ADV Altimetry, Belgian Coastal Zone

Matthias Baeye[1], Michael Fettweis[2], Frederic Francken[2], Vera Van Lancker[2]

[1]Department of Geology and Soil Science, Renard Centre of Marine Geology, Ghent University, Krijgslaan 281, B-9000, Gent, Belgium. Matthias.Baeye@UGent.be.

[2]Department VI of the Belgian Royal Institute of Natural Sciences, Management Unit of Mathematical Models North Sea, Gulledelle 100, B-1200 Brussels (St Lambrechts-Woluwe), Belgium. Michael.Fettweis@mumm.ac.be, Vera.VanLancker@mumm.ac.be, Frederic.Francken@mumm.ac.be.

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**

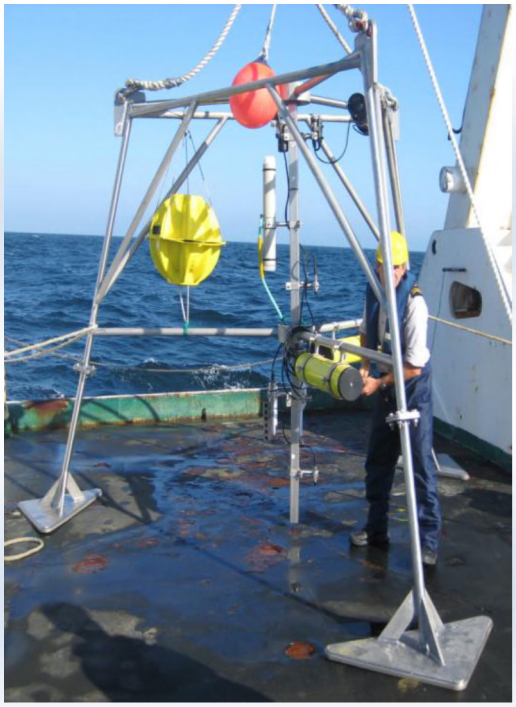

Figure 1

Conclusions:

ADV altimetry reveals **depositional** and **erosional events**

Storms (significant wave height > 2m) + spring tide (doy 1-9)

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Delivery of sediment in suspension

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Bed level accretion during neap tide

=

Long-term occurrence of fluid mud (doy 9-22)

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Erosion as result of remobilization during accelerating tidal flow (doy 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

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

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

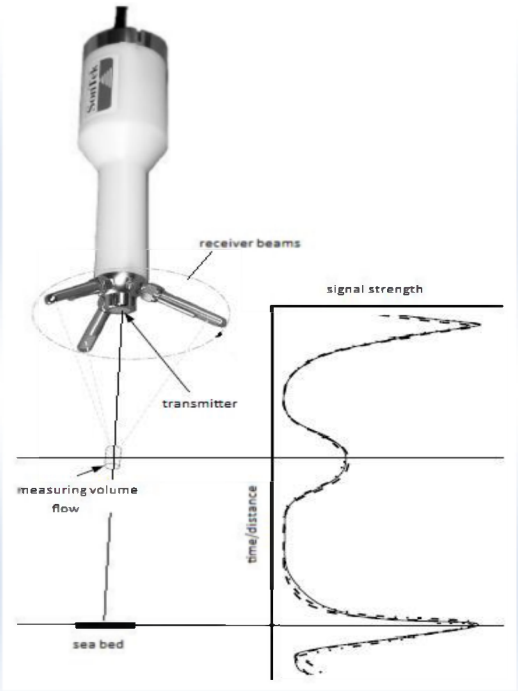

Figure 2

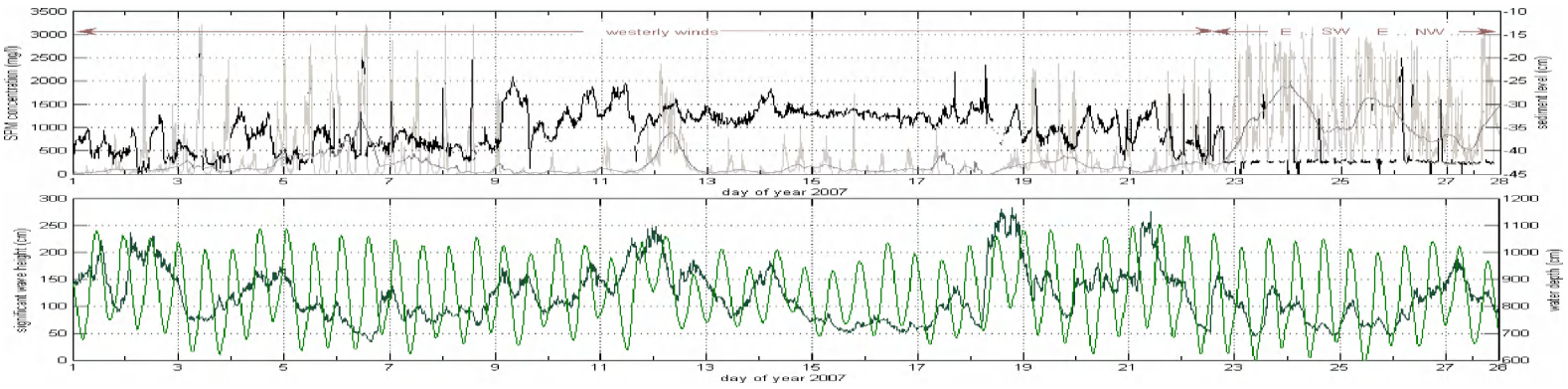

Figure 3

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." Intercoh Conf. '98. 22 pgs.

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