Session 3: *Tidal flats and salt marshes*

**“Winds of Opportunity”**: the influence of wind on tidal flat morphology

Irene Colosimo, Bram van Prooijen, Bas van Maren, Lodewijk de Vet, Marin van Regteren, Han Winterwerp, Ad Reniers,

I.Colosimo@tudelft.nl
Content

❖ Field Measurements
❖ Highlights of our findings
Where?

Dutch Western Wadden Sea

Vlieland

Terschelling

Ameland

source: DEMOS satellite
Field Measurements

Vlie Basin 2016, Wadden Sea (NL)

5km

Vlie Tidal Inlet

MLW

Harlingen Harbour

Koolhuis

MHW
Field Measurements

Vlie Basin 2016, Wadden Sea (NL)

Koehool

Westhoek
Spring 2016 – 1.5 months

Spring 2017 – 1.5 months

Vlie Basin 2016, Wadden Sea (NL)
Winter 2018 – 2 months
Other highlights...

1. The muddier the harder!
2. Support is essential in and out the mud!
3. It can be as challenging as funny!
Content

❖ Field Work
❖ Highlights of our findings
Deterministic Forcing vs. Stochastic Forcing

- **TIDE**
- **WIND**
- **W.L. Gradient**
- **Waves**
- **Flow**

Waves are not necessarily erosive
Highlights of our findings

Deterministic Forcing vs. Stochastic Forcing

TIDE

WIND

W.L. Gradient

Waves

Flow

Tide-Wind-Interaction (TWI)
Analytical Model

Dataset 2016

1. Momentum Balance Equation (1D)

Wind-induced shear stress ≈ Bed shear stress

2. Tide-Wind interaction

\[ \tau_{bed,tw} = \tau_{bed,t} + \tau_{wind} \]

\[ u_t = u_{t0} \sin \left( \frac{2\pi}{T} t \right) \]
Highlights of our findings

Model & Data

Tide-Averaged alongshore flow

1 marker = 1 tide

Wind speed

Lower mudflat

Higher mudflat
• The effect of the wind increases for decreasing tidal flow amplitude

• On the higher portion of the mudflat (elevation > MSL) the residual transport is a function of wind speed and direction
Higher mudflat (elevation > MSL)

The Windows of Opportunity for accretion depends on stochastic processes

(Relevant to understand how tidal flats can cope with sea level rise)
The highlights of our findings:

The tidal flat accretion is controlled by wind speed/direction (Stochastic forcing)

Long-shore vs Cross-shore processes: interaction is important;

Bed level change is a function of Sediment Fluxes in the higher mudflat; this is not the case in the lower mudflat;

Waves are not necessarily the eroding factor, tides are not necessarily importing sediment;

The effect of wind on the flow is higher where the tidal flow amplitude is smaller (TWI);

The sediment concentration is a function of wind, and its interaction with tidal flow and basin geometry.
Future challenges

.... Is it still valid on longer time-scales?

...what is relevant to be included in the modelling?

.... what are the consequences on the large scale morphology?
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