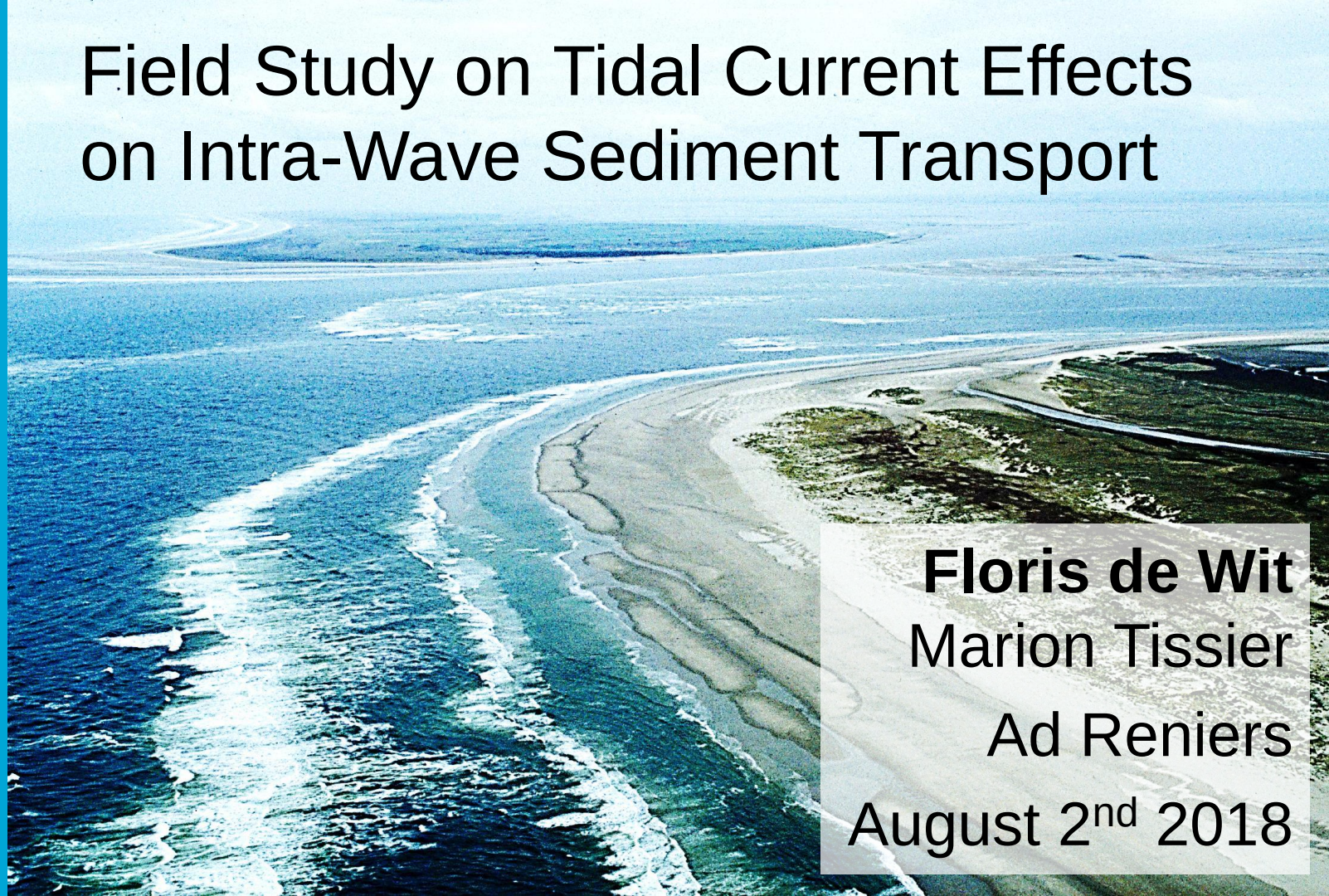
# Field Study on Tidal Current Effects on Intra-Wave Sediment Transport



**Floris de Wit**
Marion Tissier
Ad Reniers

August 2nd 2018

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## Introduction

- Retreating coastline
- Strategy: keep coastal sediment budget constant by nourishments
- Meganourishments

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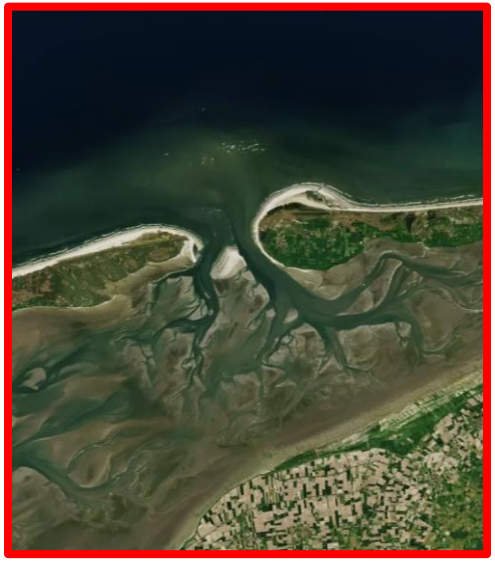
  - Ameland ebb-tidal delta



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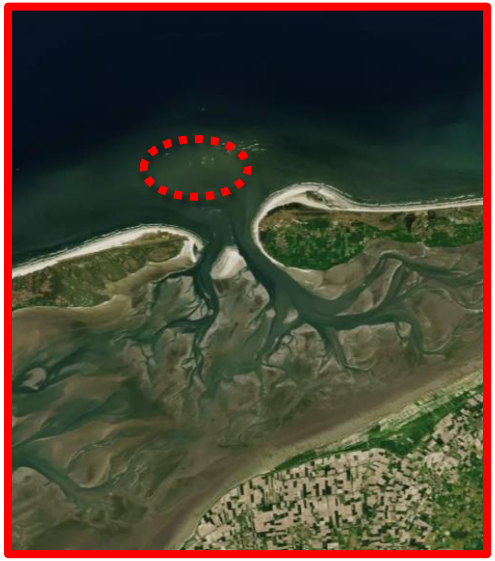
**SEAWAD: Sediment supply At the Wadden Sea ebb-tidal Delta**

- Investigate feasibility and efficiency of mega nourishment on ebb tidal delta and obtain system knowledge
- Interaction of waves, currents, sand, and fines
- Field Campaign September 2017: Ameland Inlet



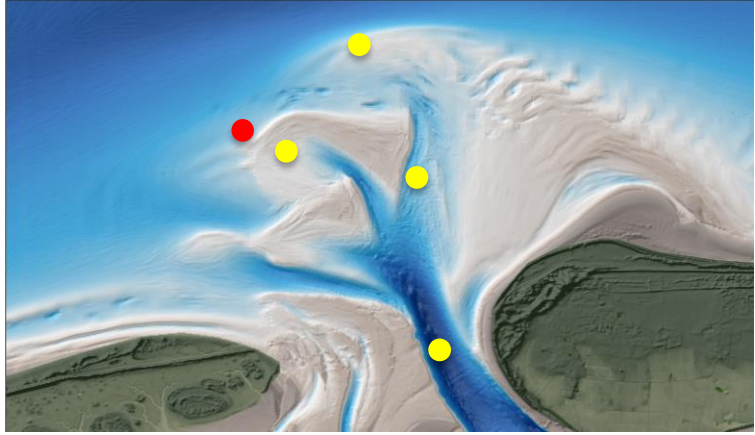
**PhD topic:**
Investigate influence of tidal currents on wave-induced sediment transport

**Here:**
First analysis of observed sediment concentration will be shown:

1. Time averaged
2. Instantaneous

## Field campaign

- September 2017
- 5 instrument frames and 8 pressure sensors
- Drifter deployments
- Sediment and water samples

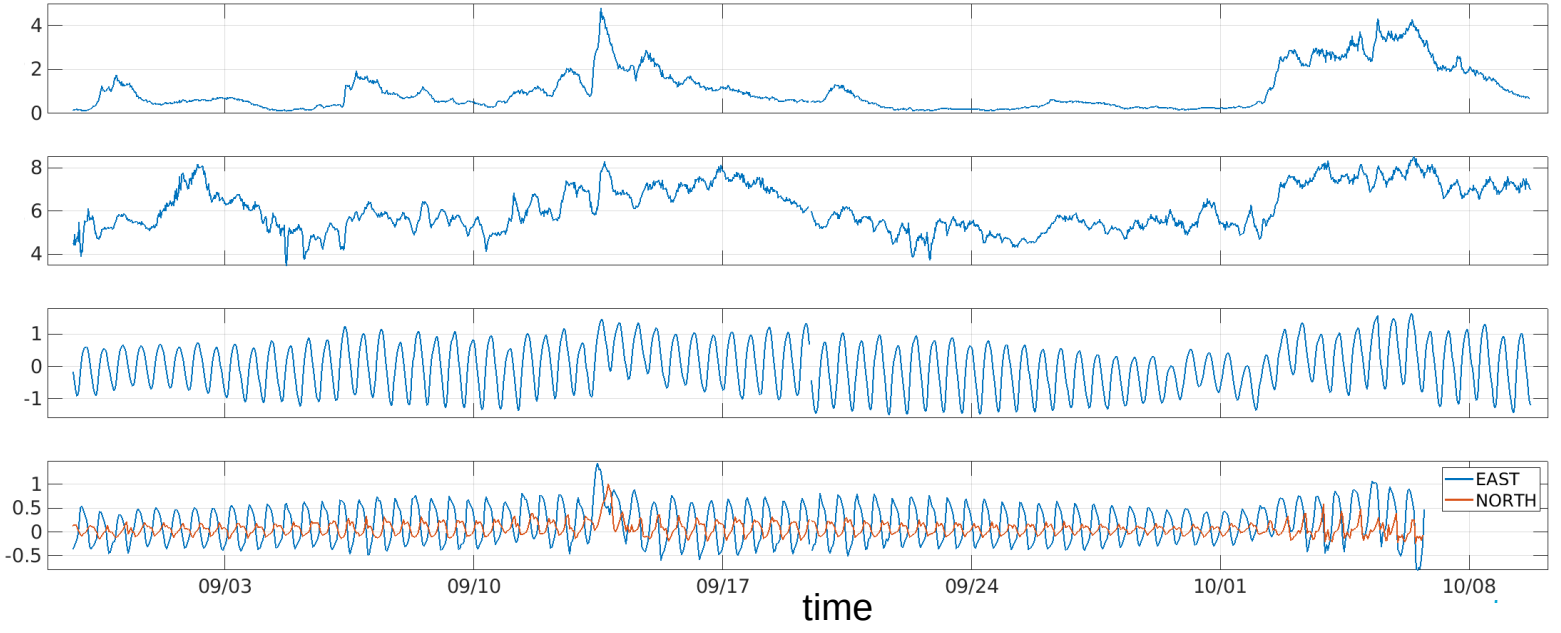


$H_{m0}$ [m]

$T_{m01}$ [s]

η [m]

v [m/s]

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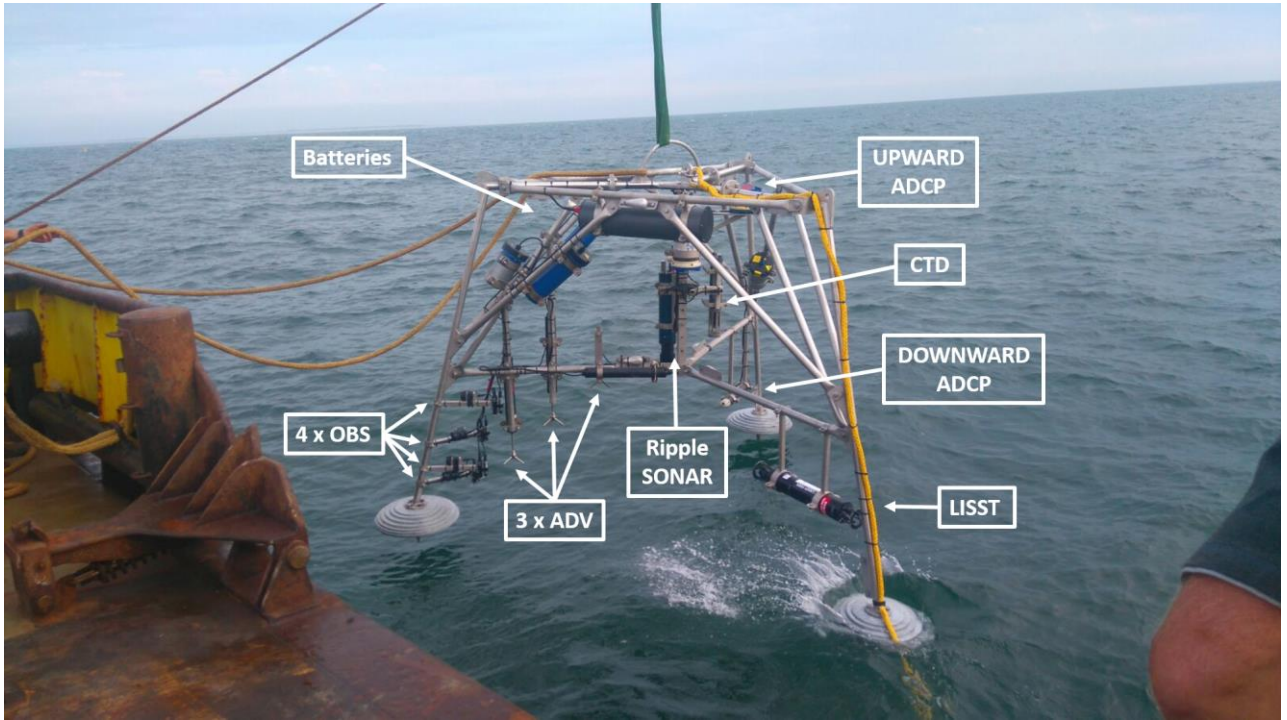
## Field campaign - frames

- 3x ADV, ADCP upward and downward: velocity
- 4x OBS: concentration
- LISST: particle size distribution
- SONAR: bed forms
- CTD: conductivity, temperature, density



## Processing of OBSs

- Optical BackScatter measures concentration
- 20, 30, 50 and 80cm above bed
- Calibration using locally retrieved sediment from the bed

## Processing of ADVs

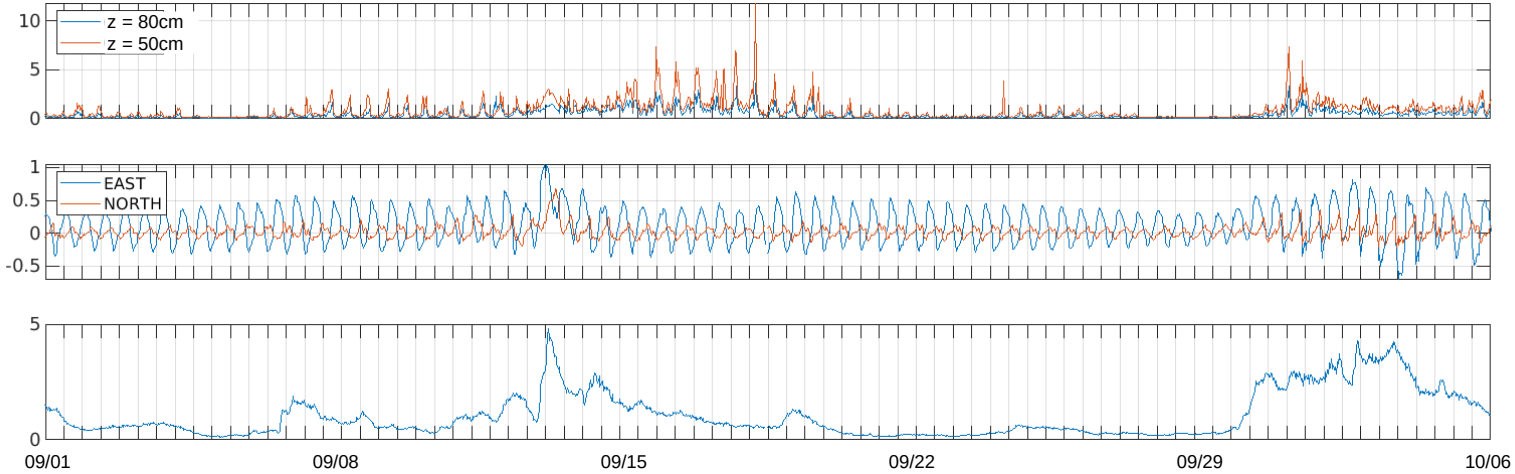
- Accoustical Doppler Velocimeter measures velocity
- 50cm above bed
- Filtered and despiked

# Sediment suspension – time-averaged

c [g/L]

v [m/s]

$H_{m0}$ [m]

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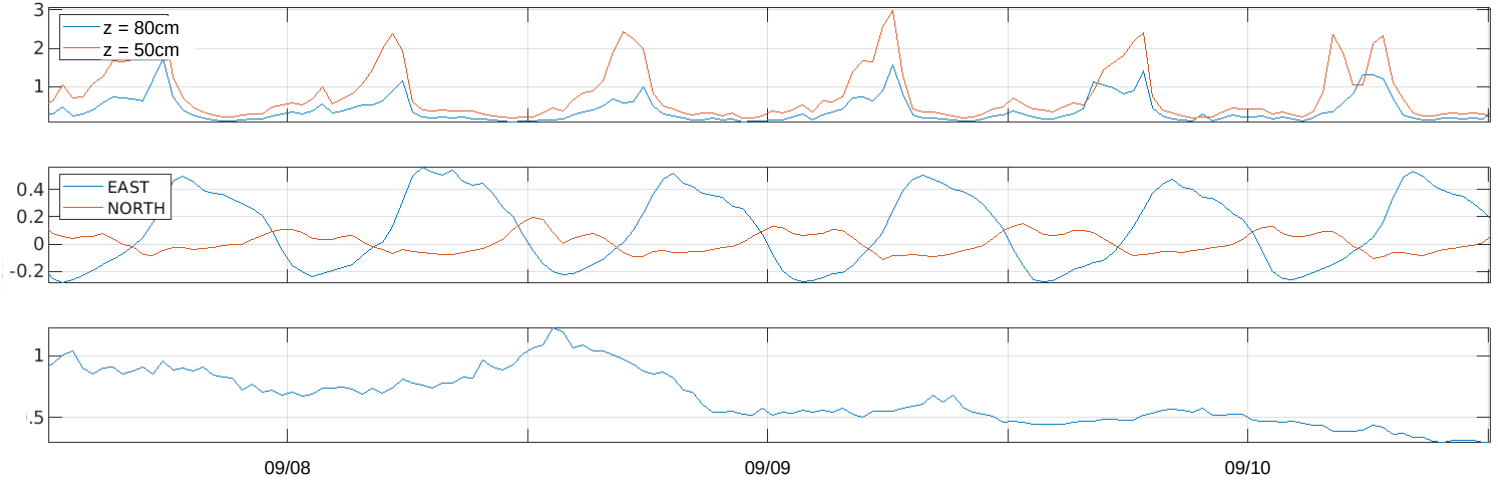

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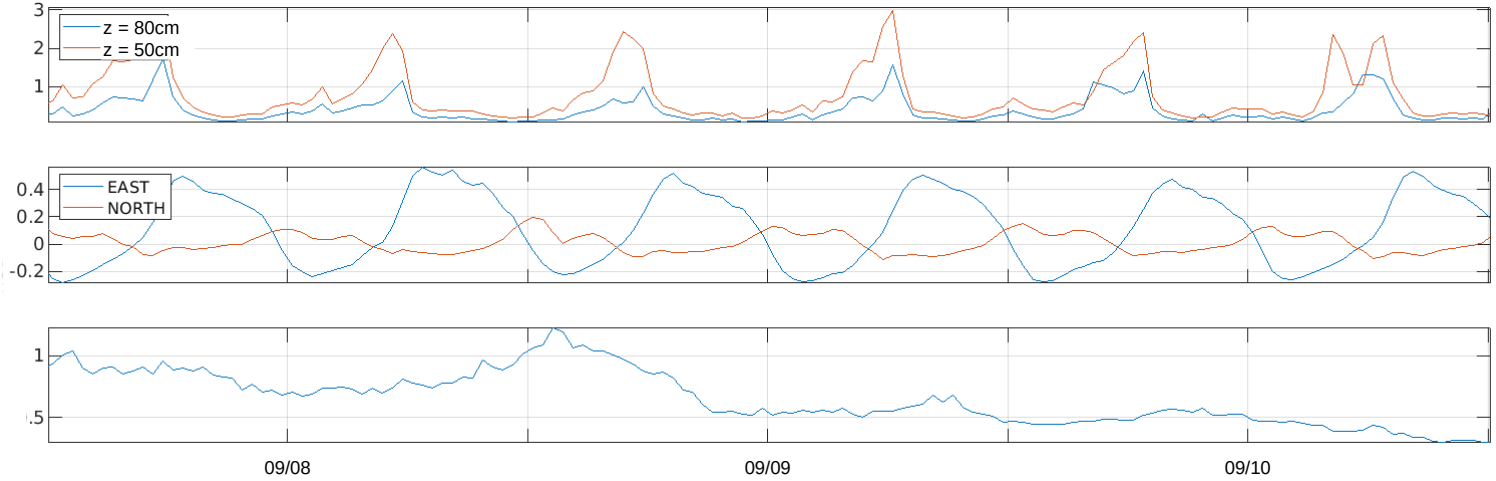


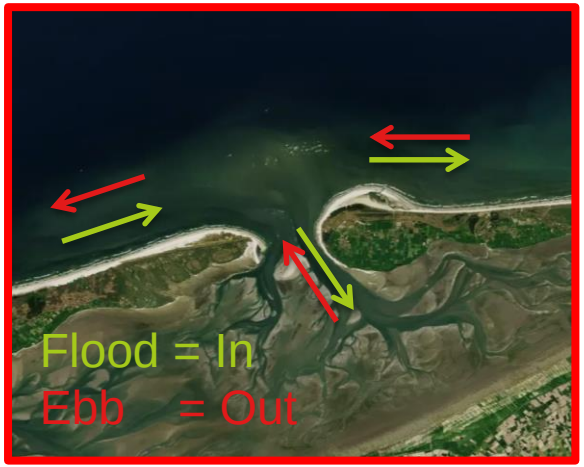

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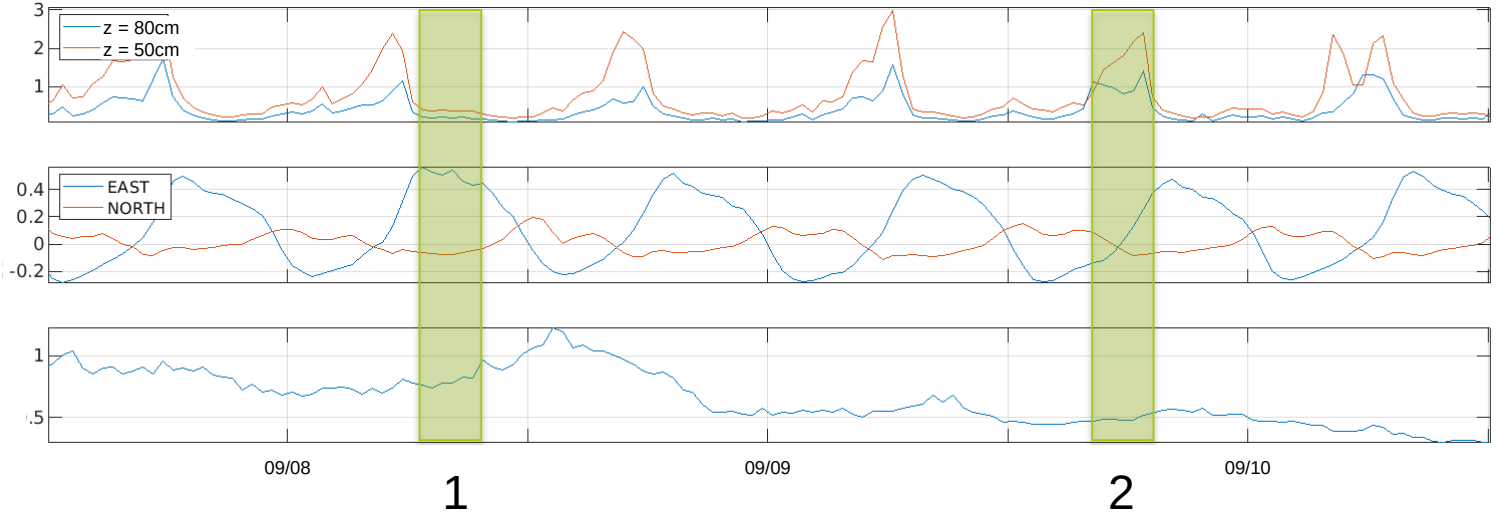


1: waves and currents -> no suspension
2: no waves, no currents -> suspension

So suspension cannot be explained by hydrodynamics only

# Sediment suspension – time-averaged

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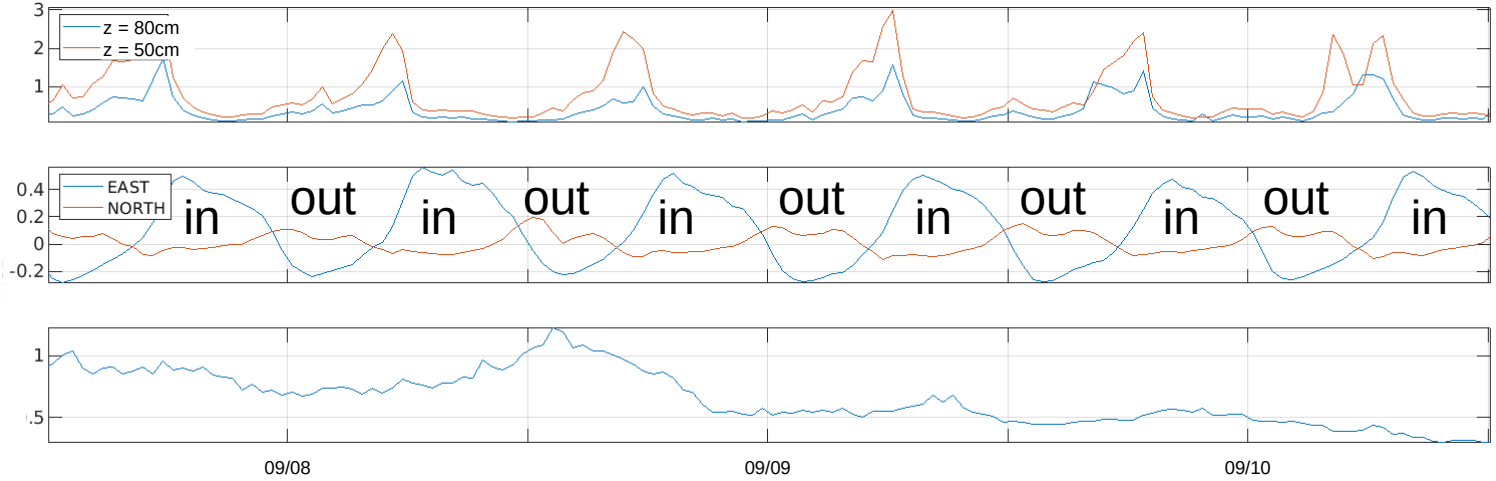
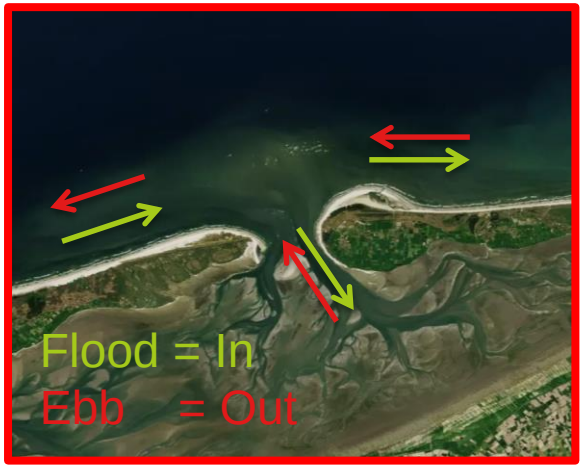
$H_{m0}$ [m]



# Sediment suspension – time-averaged

c [g/L]

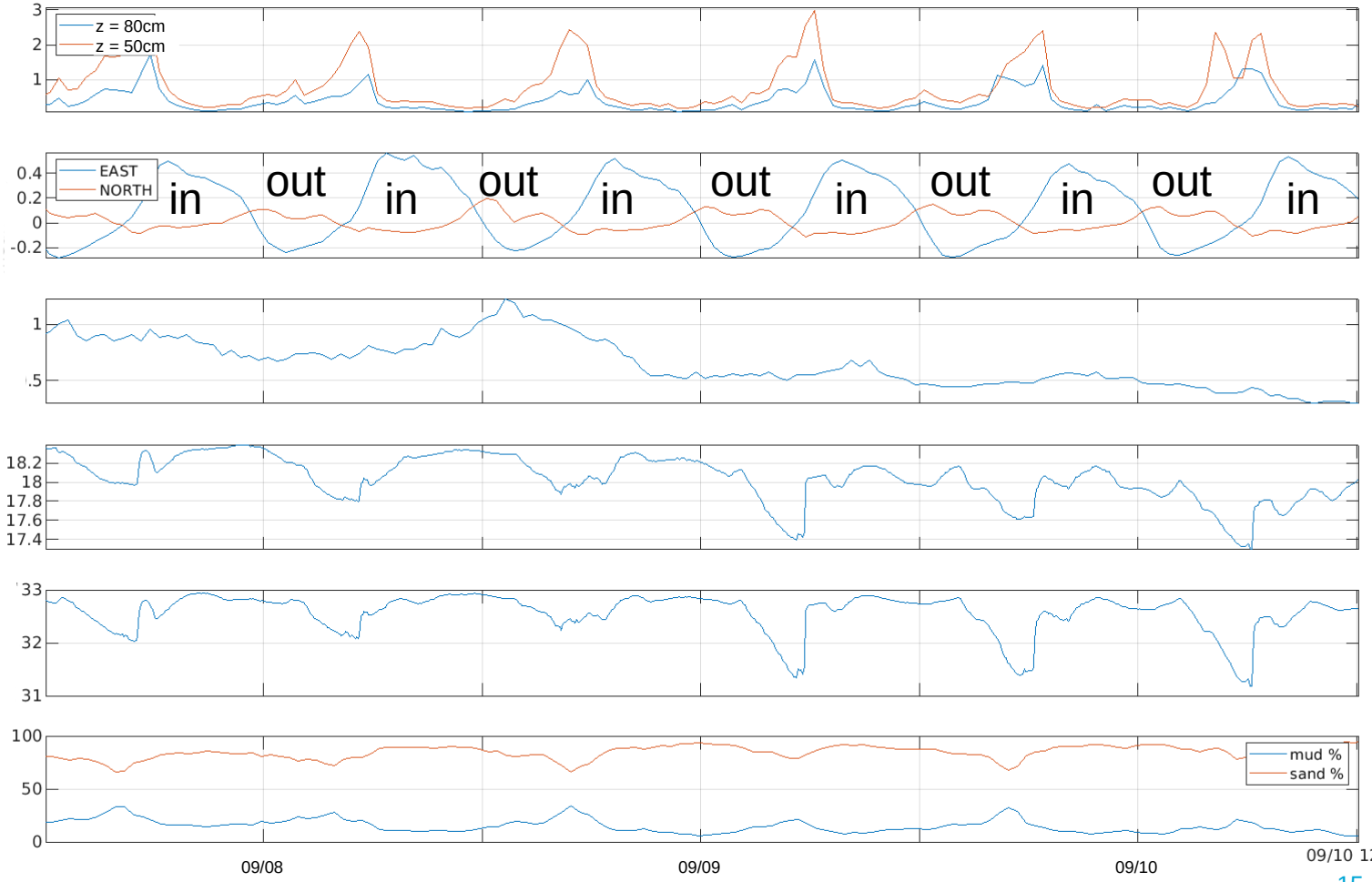
v [m/s]

$H_{m0}$ [m]

Temp [°C]

Salilinty [PSU]

Mud content [%]



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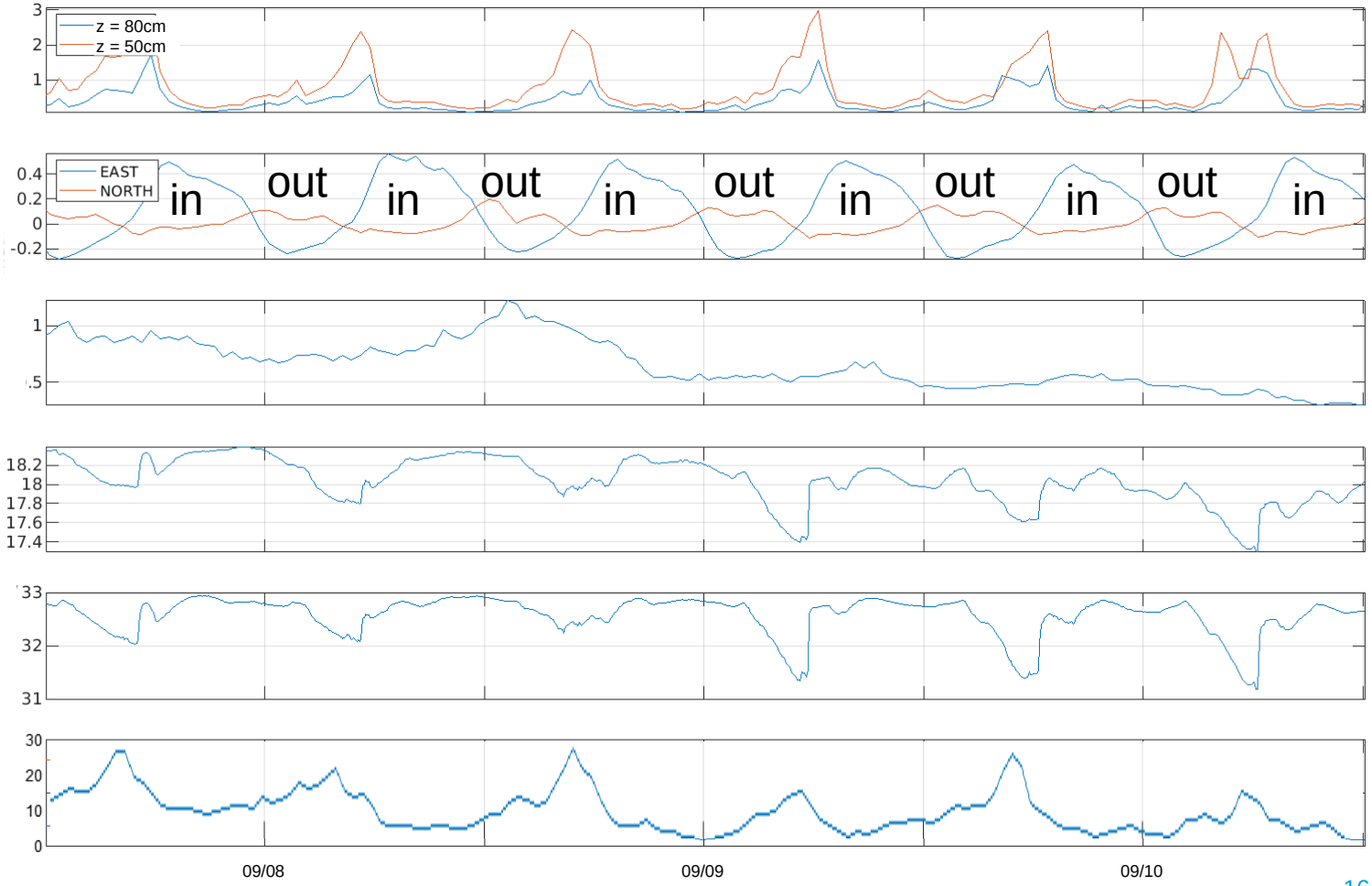


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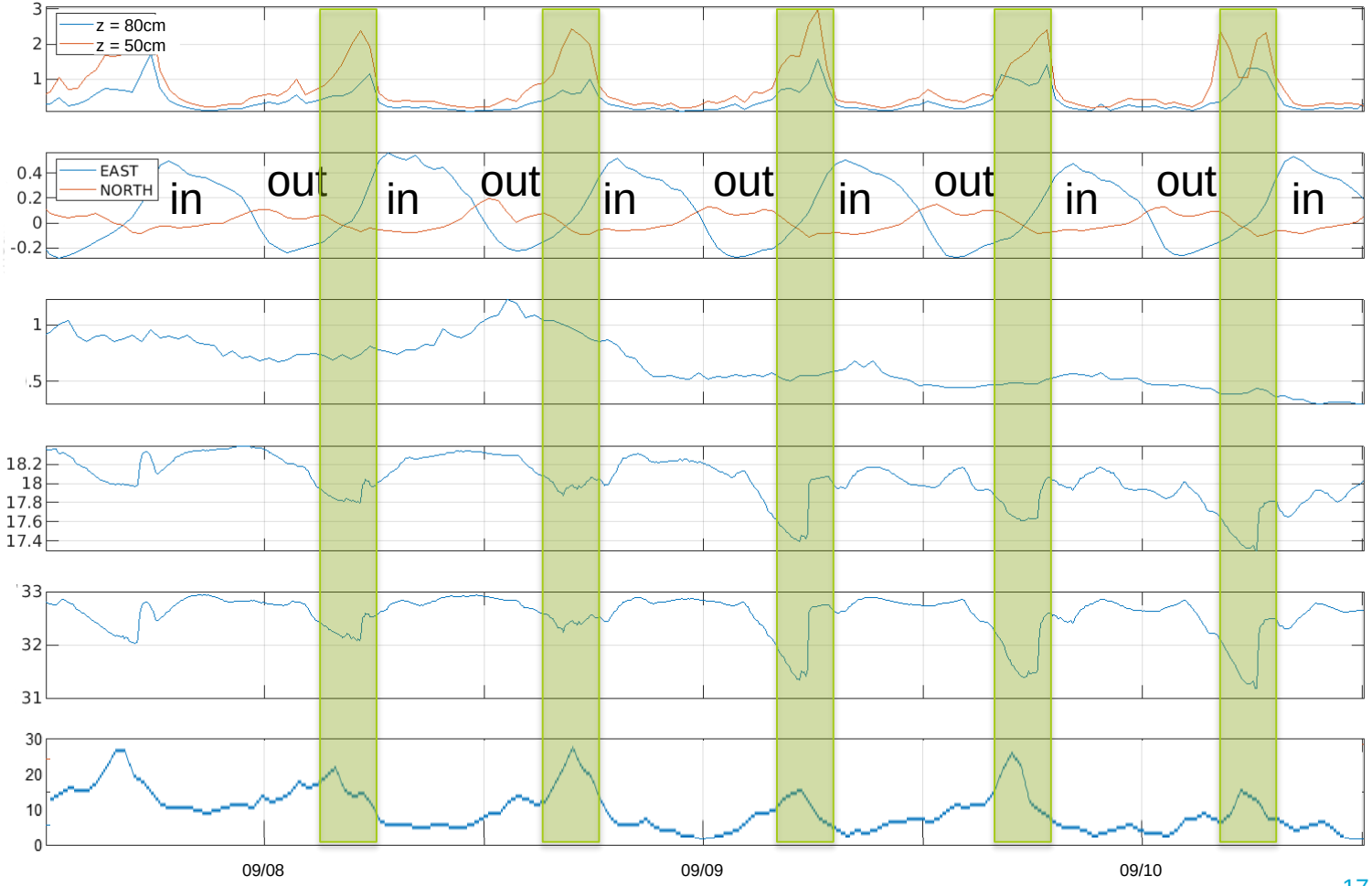


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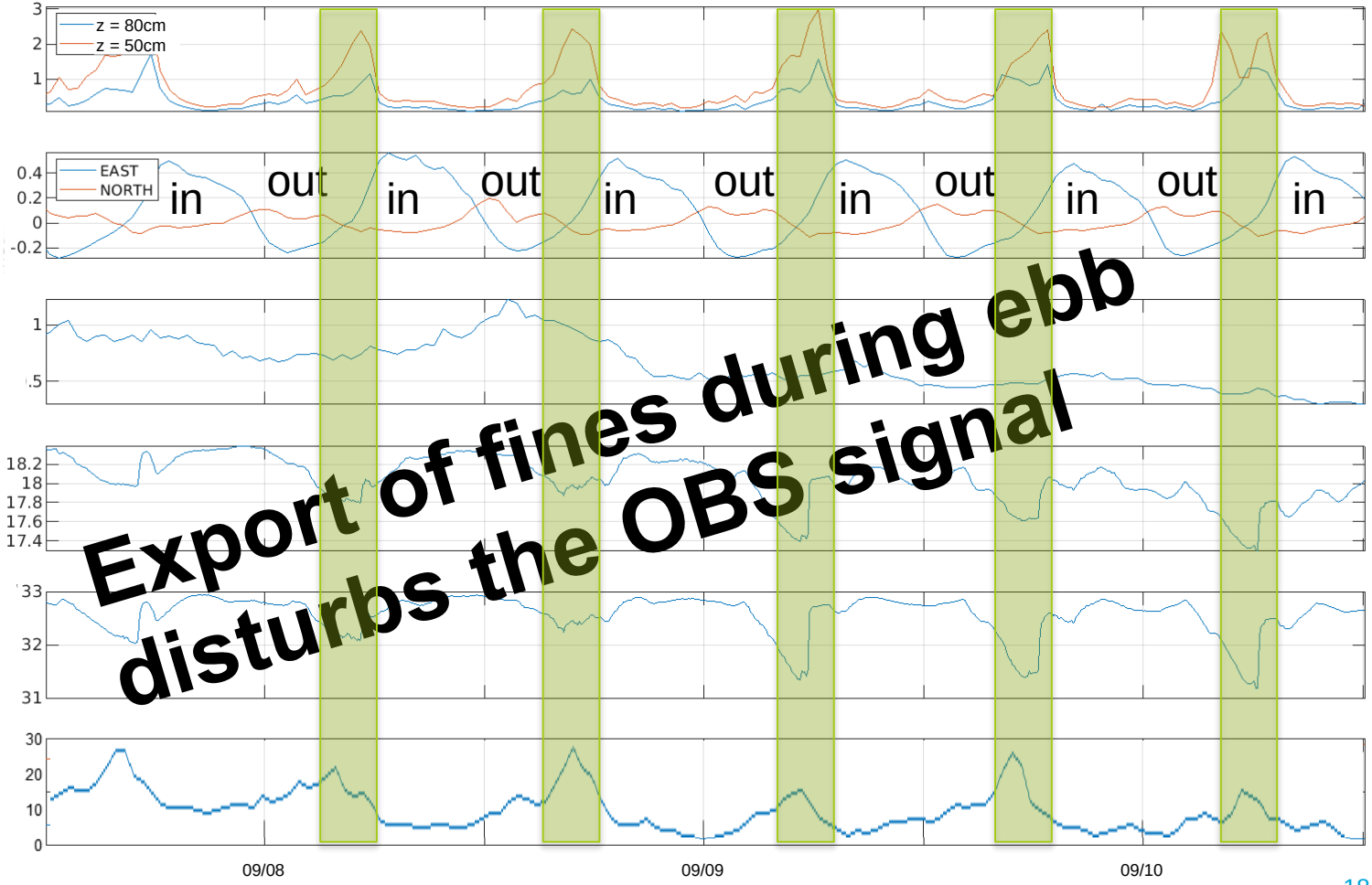


**Export of fines during ebb disturbs the OBS signal**

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# Sediment suspension – time-averaged

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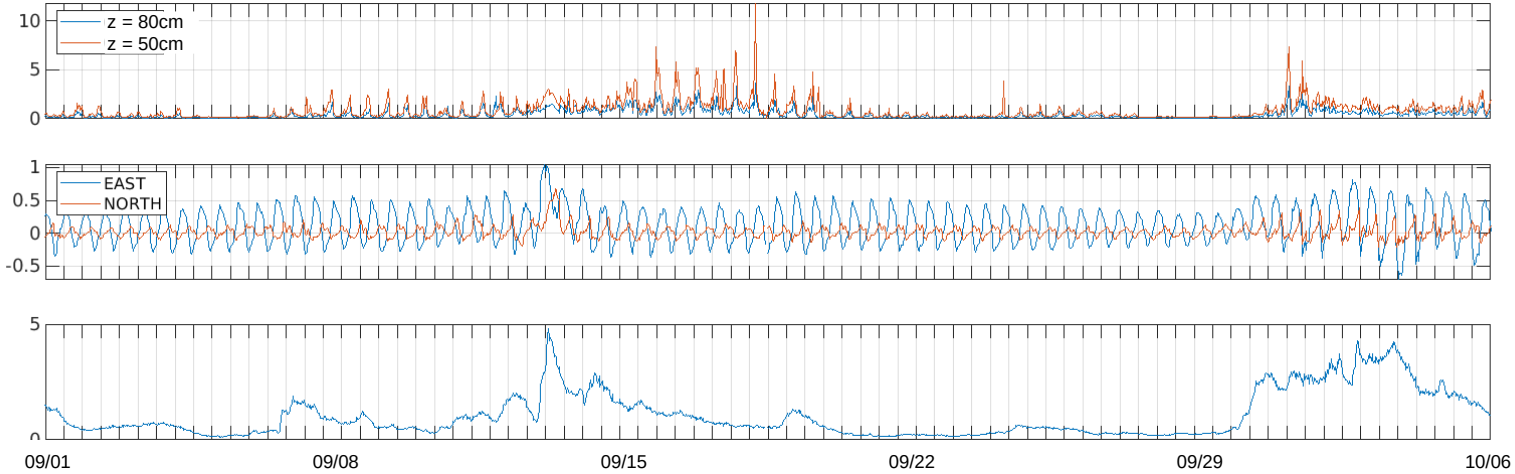
v [m/s]

$H_{m0}$ [m]



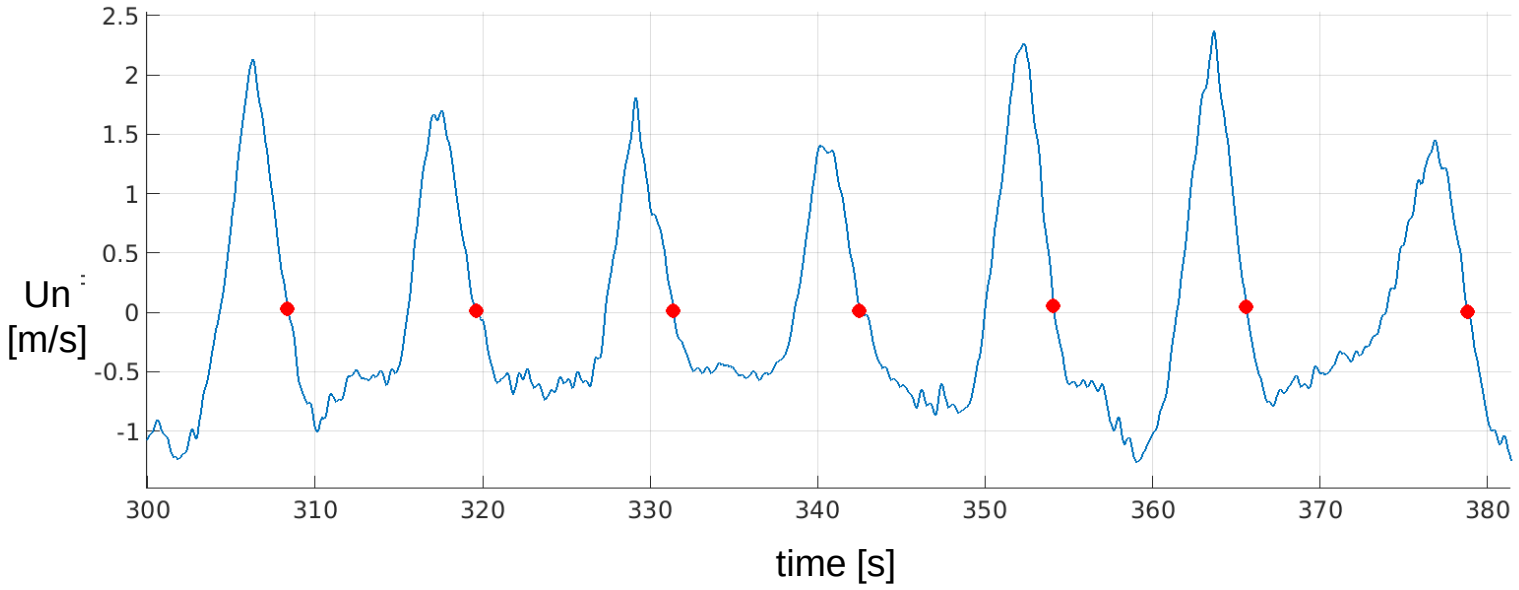

- Export does not happen every tide
- Highest concentration does not correspond to highest waves

Hypothesis:

- Export only if there were significant waves in the past days
- Fines stirred up by waves inside the basin and transported out of the basin by ebb tide
- Amount of exported fines is not a function of local and present conditions but of larger scale (basin and weekly) conditions

## Sediment suspension – instantaneous

- Case selection:
  - Short duration (no changes in sediment and water mixture)
  - Storm conditions
  - Low amount of fines
- Zero-down-crossing analysis on near-bed velocity to specify waves



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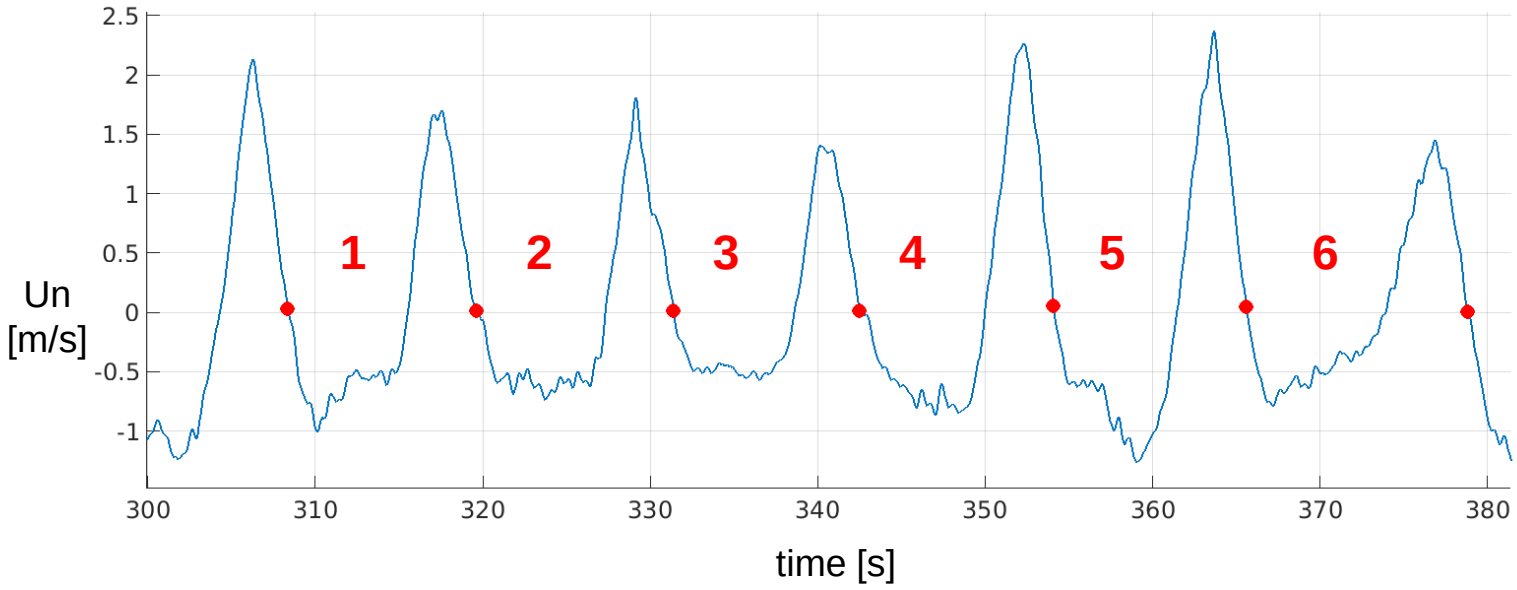

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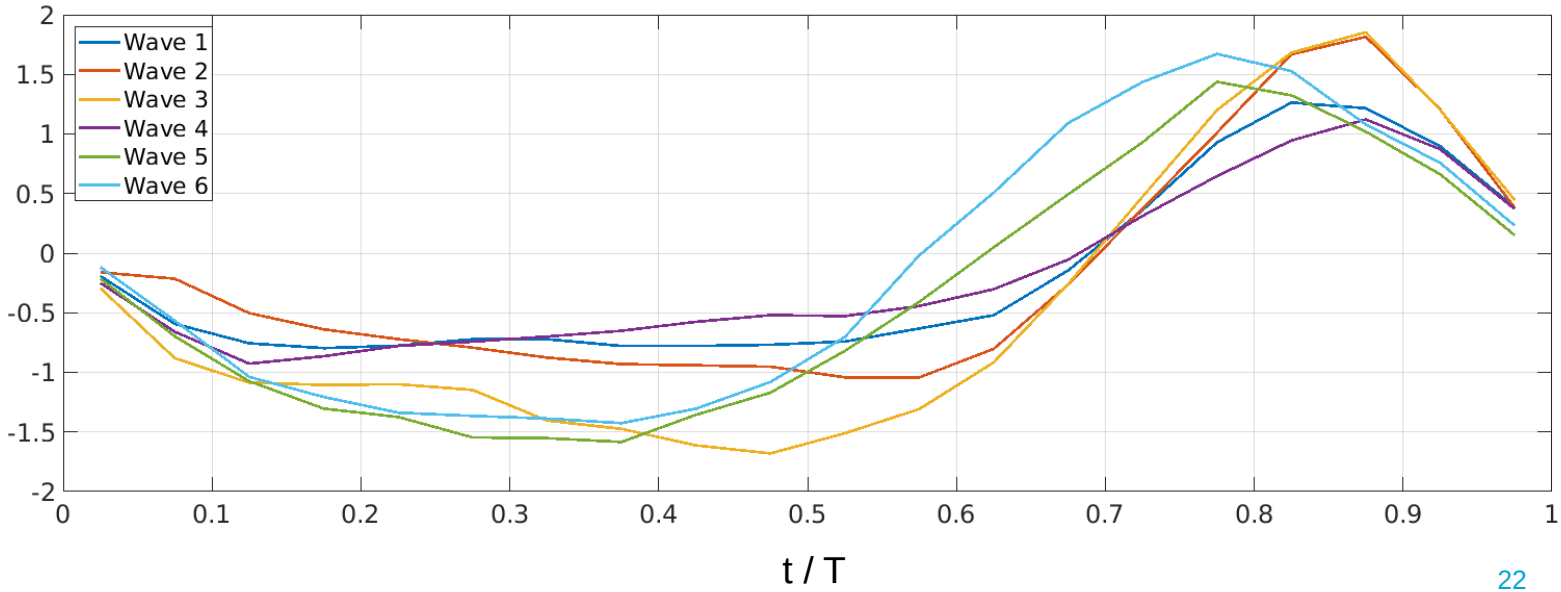
- Waves normalised by wave period




Un [m/s]

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- Case selection:
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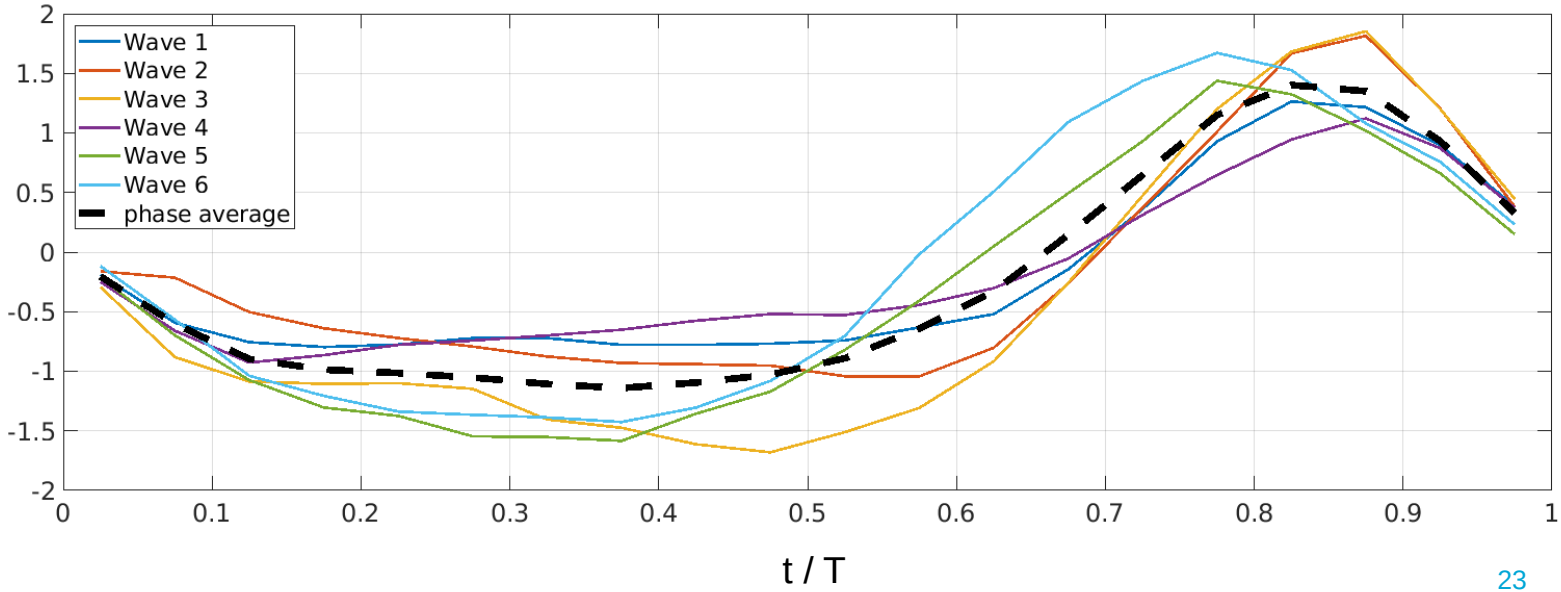
- Zero-down-crossing analysis on near-bed velocity to specify waves
- Waves normalised by wave period and phase averaged




Un [m/s]

# Sediment suspension – instantaneous

η [m]

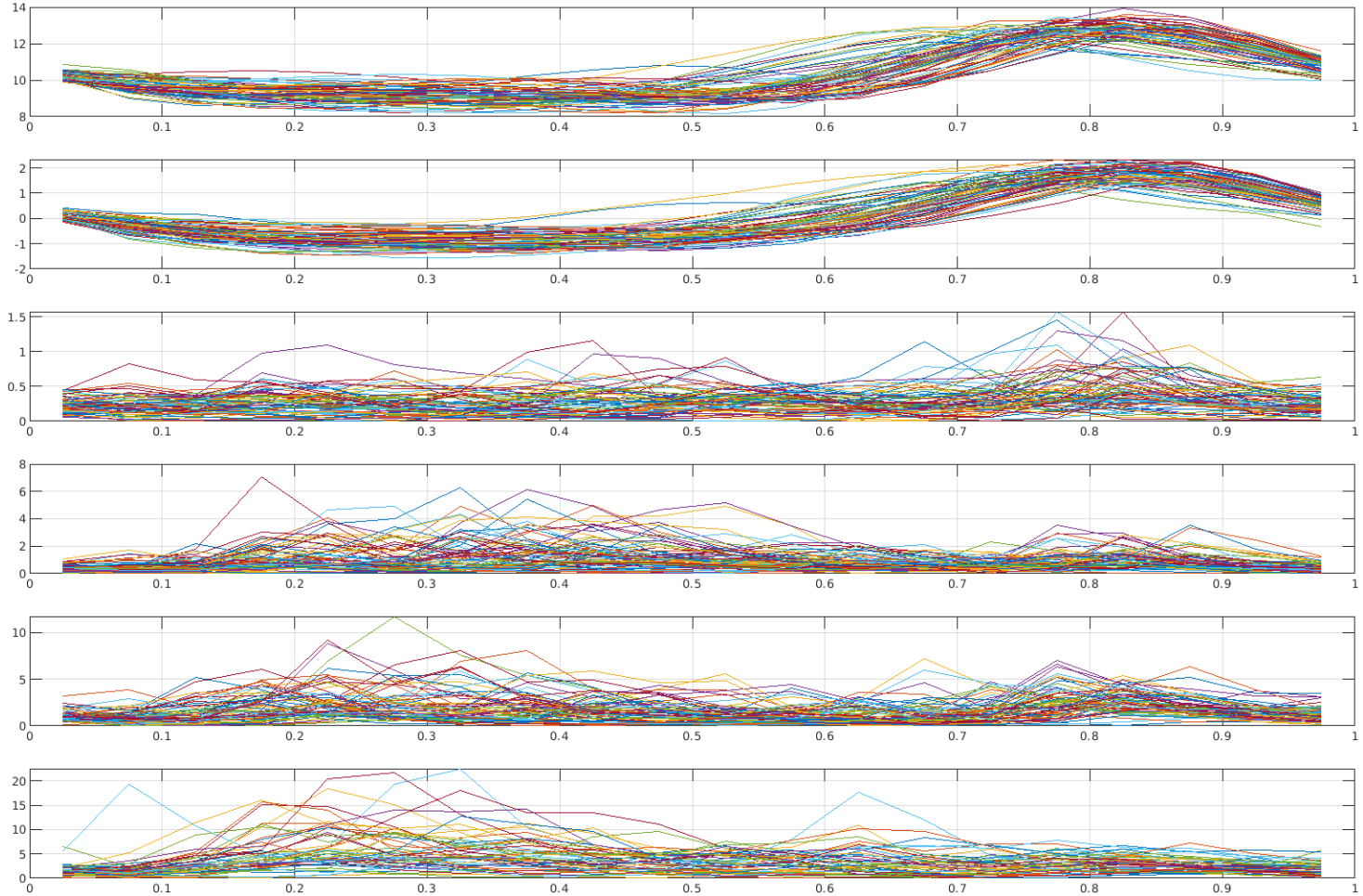
Un [m/s]

c [g/L]
at z = 80cm

c [g/L]
at z = 50cm

c [g/L]
at z = 30cm

c [g/L]
at z = 20cm



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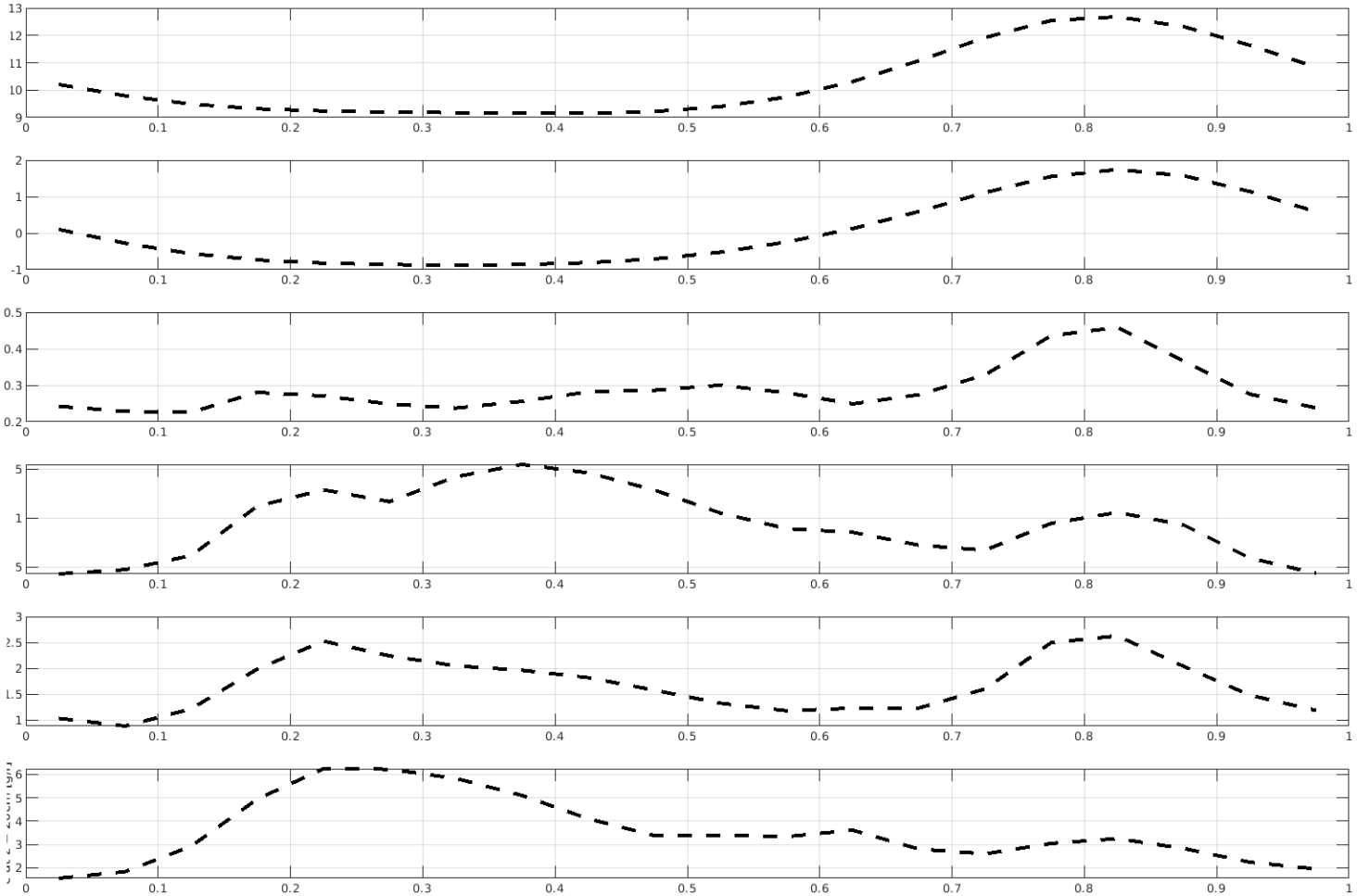
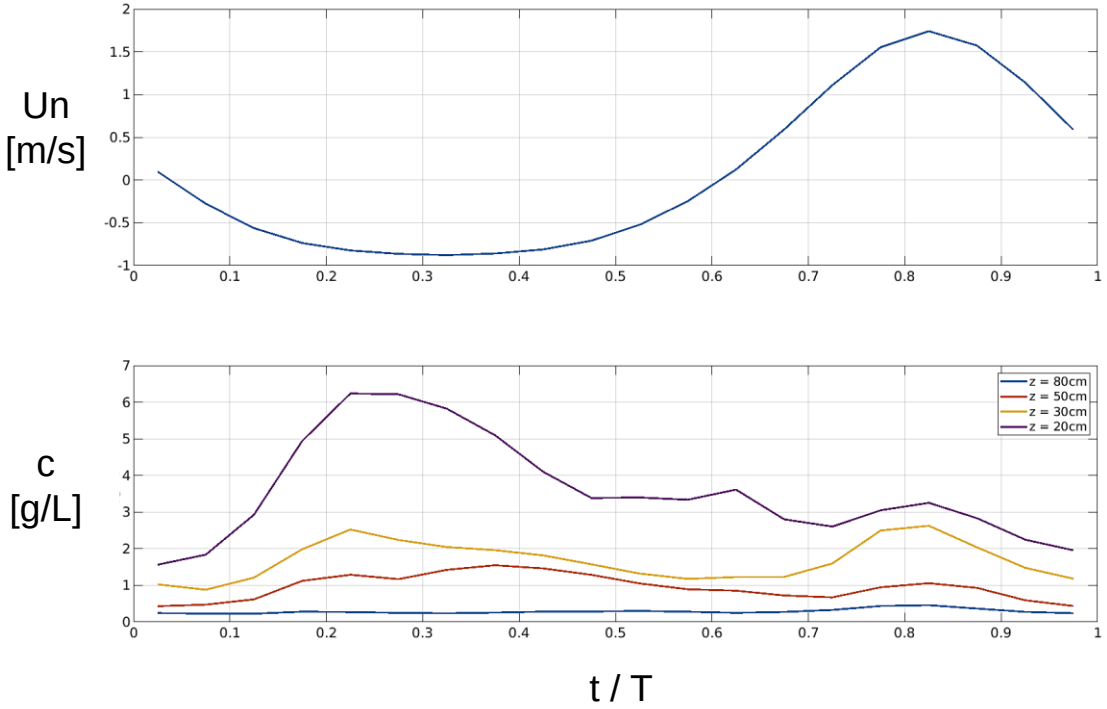


## Sediment suspension – instantaneous

- Suspension beneath wave crest and wave trough
- Close to the bed: suspension trough > suspension crest
- Higher in the water: suspension crest > suspension trough
- Difference in vertical distribution of turbulence?



## Conclusion

- Strong variations in mixture of sand and fines over the tidal cycle complicates using OBS concentration
- Difference in suspension is observed between wave crest and trough in intra-wave analysis

## Follow up:

- Extension to other frames
- Look at acoustical backscatter combined with OBS and LISST data
- Check velocity profile close to bed with ADCP to further investigate suspension events

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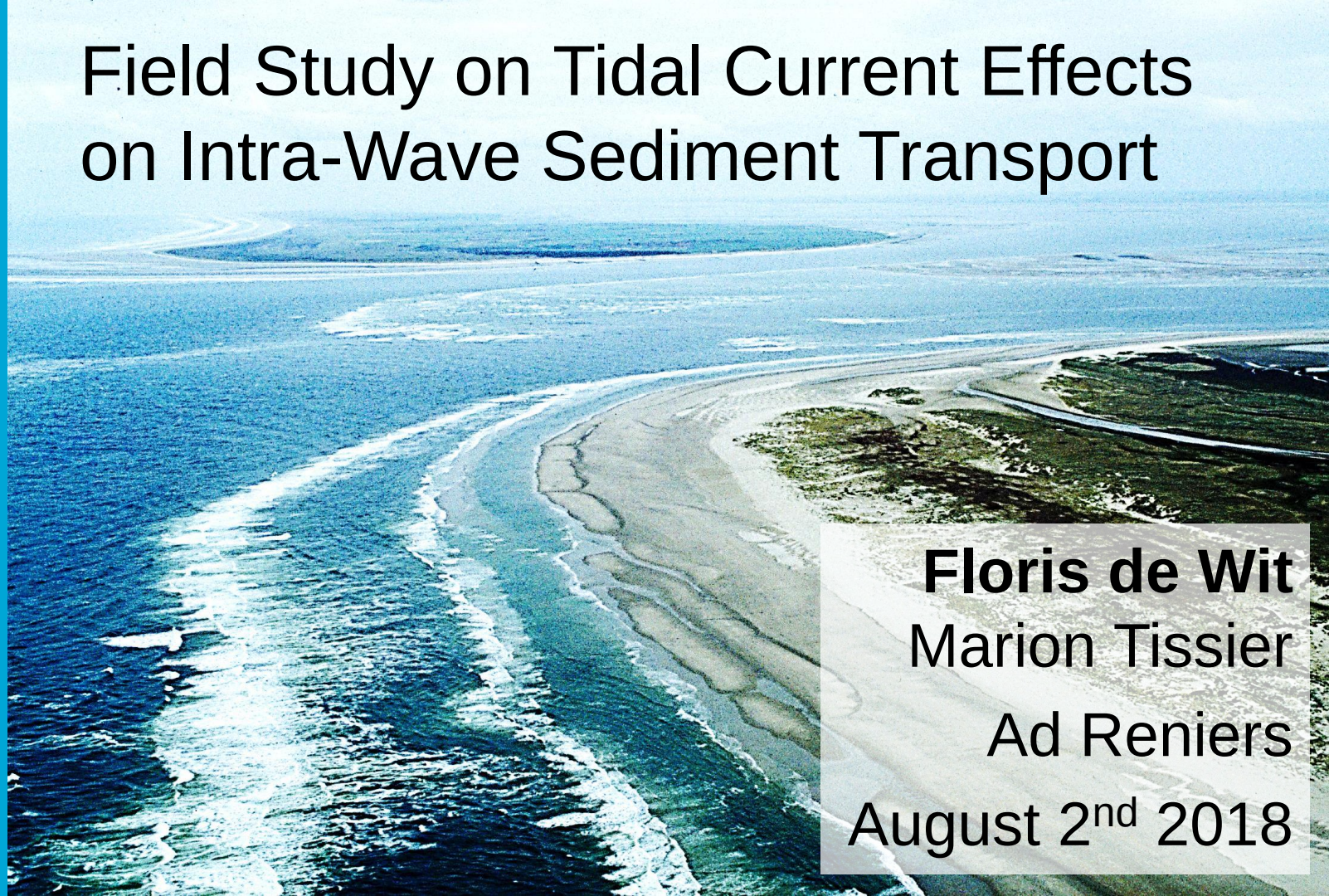

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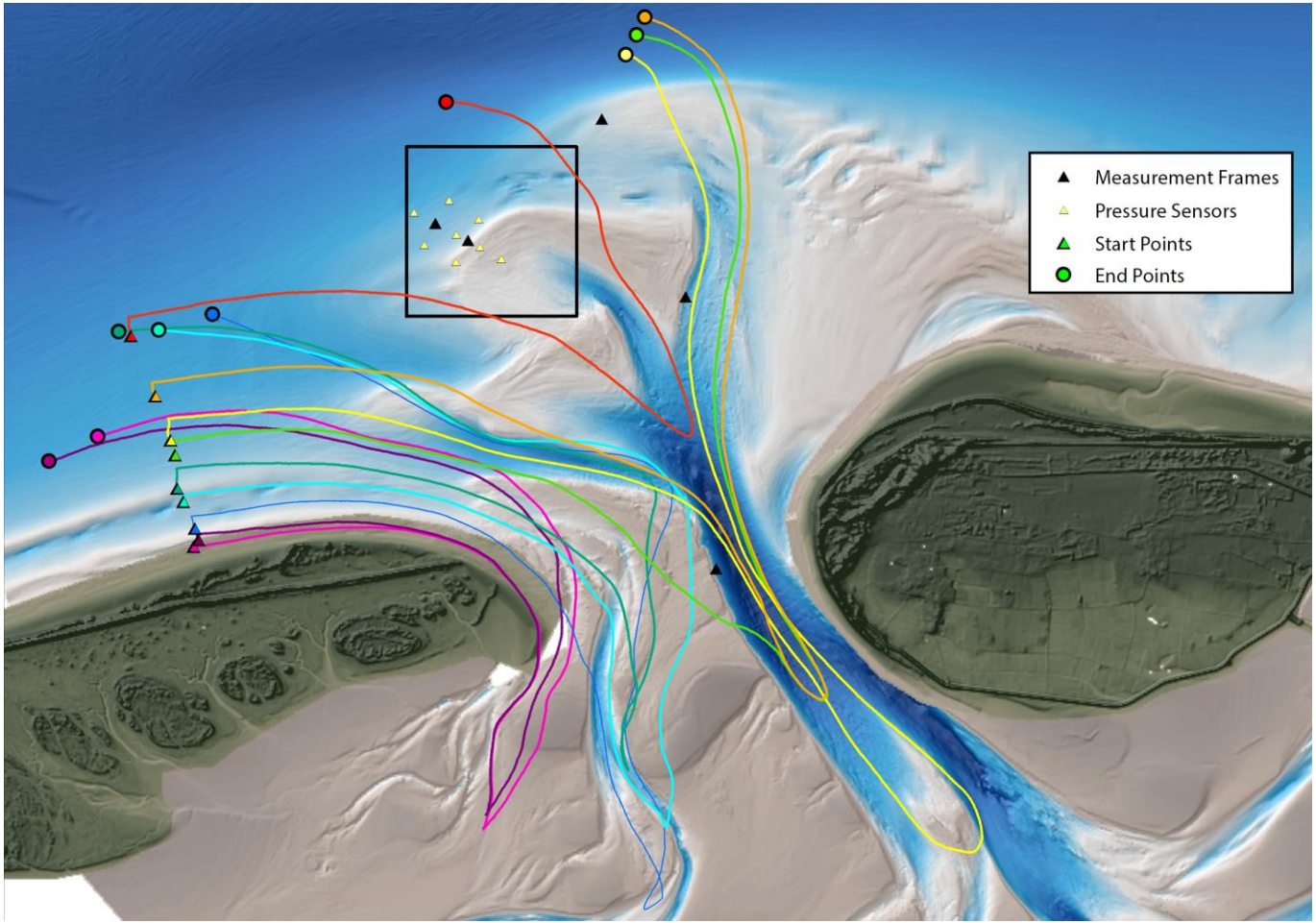
# Field Campaign



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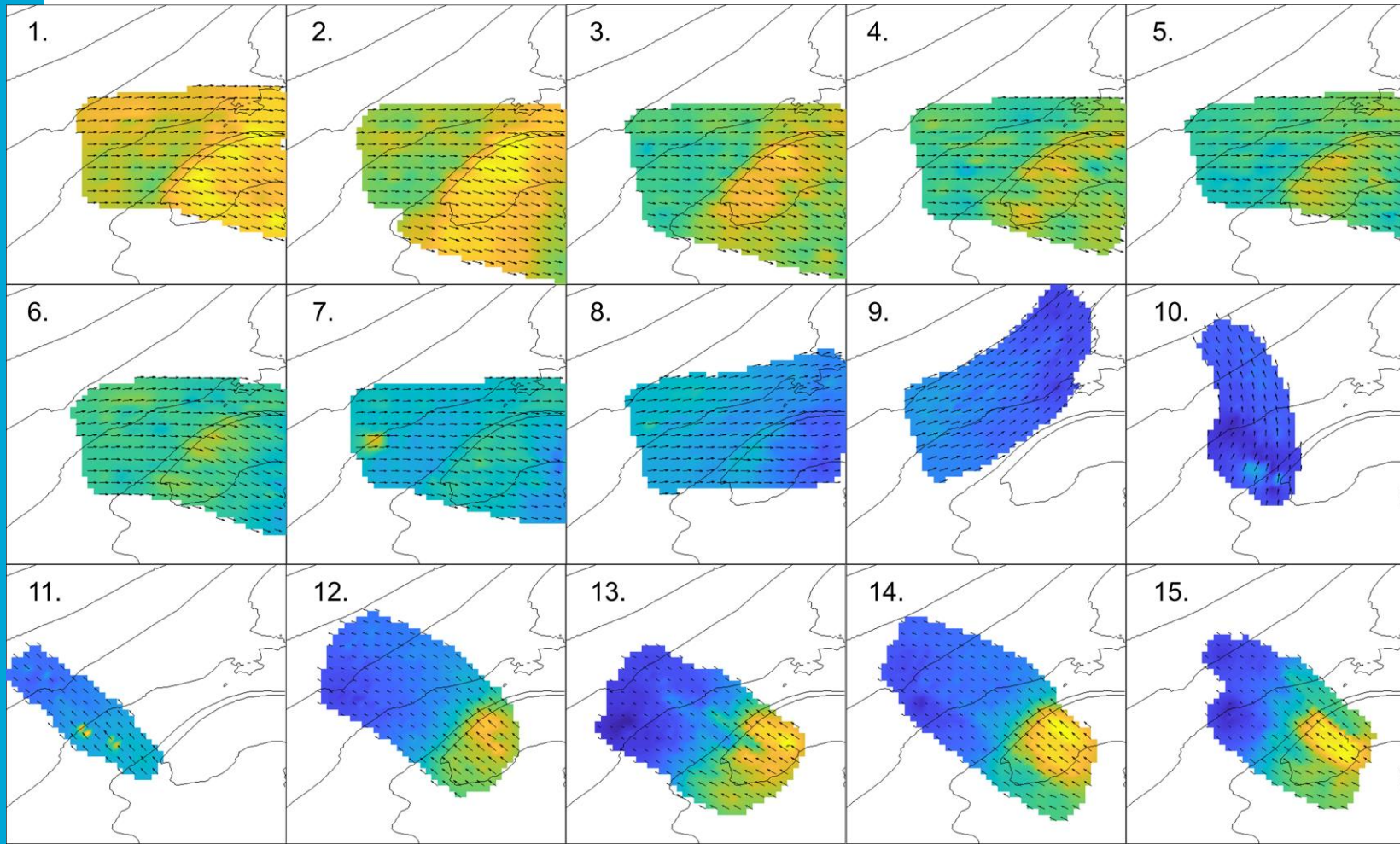


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