From multidisciplinary data to integrated information for coastal areas

Inspired by NatureCoast

Process Field data

- GPS drifters
- Topography: wheel & quad
- Algae analysis dune lake vs lagoon (Arnaud)
- Drone photogrammetry
- CTD

Integrating data and more!

Examples from NatureCoast

- Interdisciplinary hypotheses
- Multidisciplinary field campaign
- Data management
- Interdisciplinary research

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Morphology
Dune formation
Geochemistry
Hydrology
Terrestrial ecology
Hydro-dynamics
Marine ecology
Governance

Interdisciplinary work sessions

Exploring interdisciplinary hypotheses at IMARES Yerseke (feb 2014) and tuning of monitoring

Coastal zones:

- Dry beach + dunes (Marinka)
- Inter-tidal area (Max)
- Middle shoreface (Saulo)

Interdisciplinary themes:

- Remote sensing (Corjan)
- Sediment composition (Bas Hui)
- Hydrology / moisture (Sebastian)

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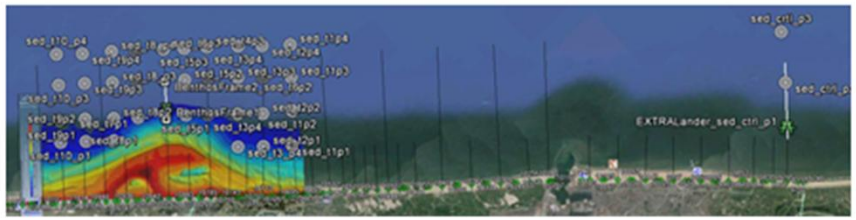
Interdisciplinary hypotheses

Middle shoreface

Items	Description
Hypothesis	The Sand Engine (Zandmotor) creates a discontinuity in the natural sand transport pathways which introduces a spatial heterogeneity in the bed composition. The resulting spatial heterogeneity in bed composition affects the benthos distribution along the Zuid-Holland coast.
Goal of the measuring campaign	- Hydrodynamics throughout the water column (including high resolution measurement near the bed). - Bed sediment characteristics. - Stratigraphy of the composition of the bed - Sediment concentration profile - Benthos distribution. - Benthos-induced hydrodynamics perturbation (bed roughness). - Change in sediment mobility due to biotic environment.
Describe the setup of the measuring campaign (incl. sketch)	

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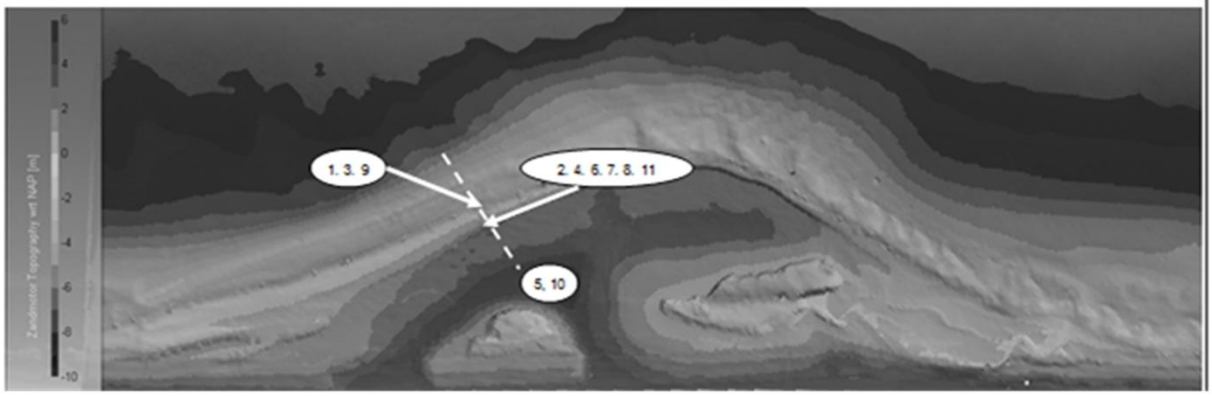
Interdisciplinary hypotheses

Intertidal zone

Items	Description
Hypothesis	In the intertidal zone, the main interaction between hydrodynamics and aeolian processes takes place through sediment sorting. Hydrodynamics supply, stir and sort sediment grains during high tide, such that fine grains become available for Aeolian transport during low tide.
Goal of the measuring campaign	1. Investigate the role of hydrodynamic and aeolian processes in sediment sorting 2. Investigate the influence of hydrologic conditions on the initiation of aeolian transport
Describe the setup of the measuring campaign (incl. sketch)	

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Interdisciplinary hypotheses

Terrestrial

MegaPex experiment on the Sandmotor

Interdisciplinary research on the Terrestrial part of the Sandmotor

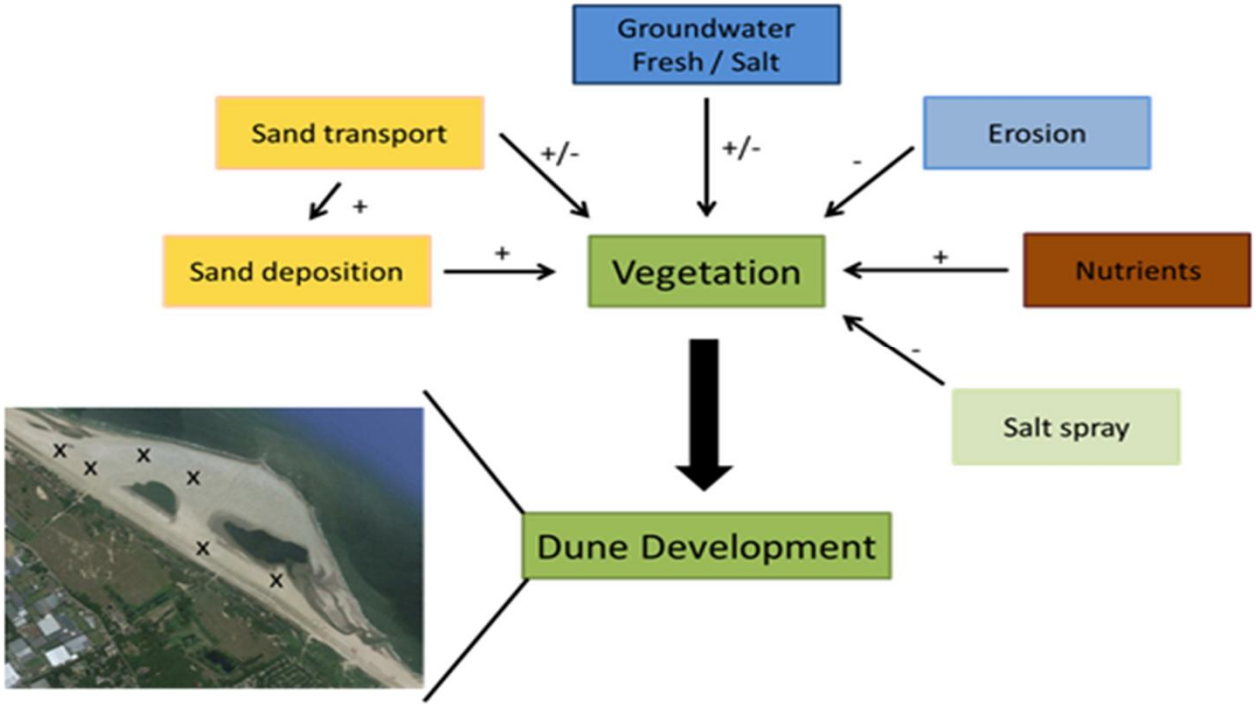

Figure 1 This scheme show the abiotic conditions that influence vegetation and can therefore influence dune development. On the Sandmotor all these different abiotic conditions will be measured and related to vegetation growth. From this data we can predict dune development and create a map where on the Sandmotor dunes could develop in the future.

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MEGAPEX2014

MEGA Perturbation EXperiment

- Multidisciplinary Experiment

  Coastal safety, dune formation, marine & terrestrial ecology, hydrology, geochemistry, and more…

- On, near, inside or above the Sand Engine

- September - October 2014

Sierd de Vries, Martijn Henriquez, Tim Price & Matthieu de Schipper

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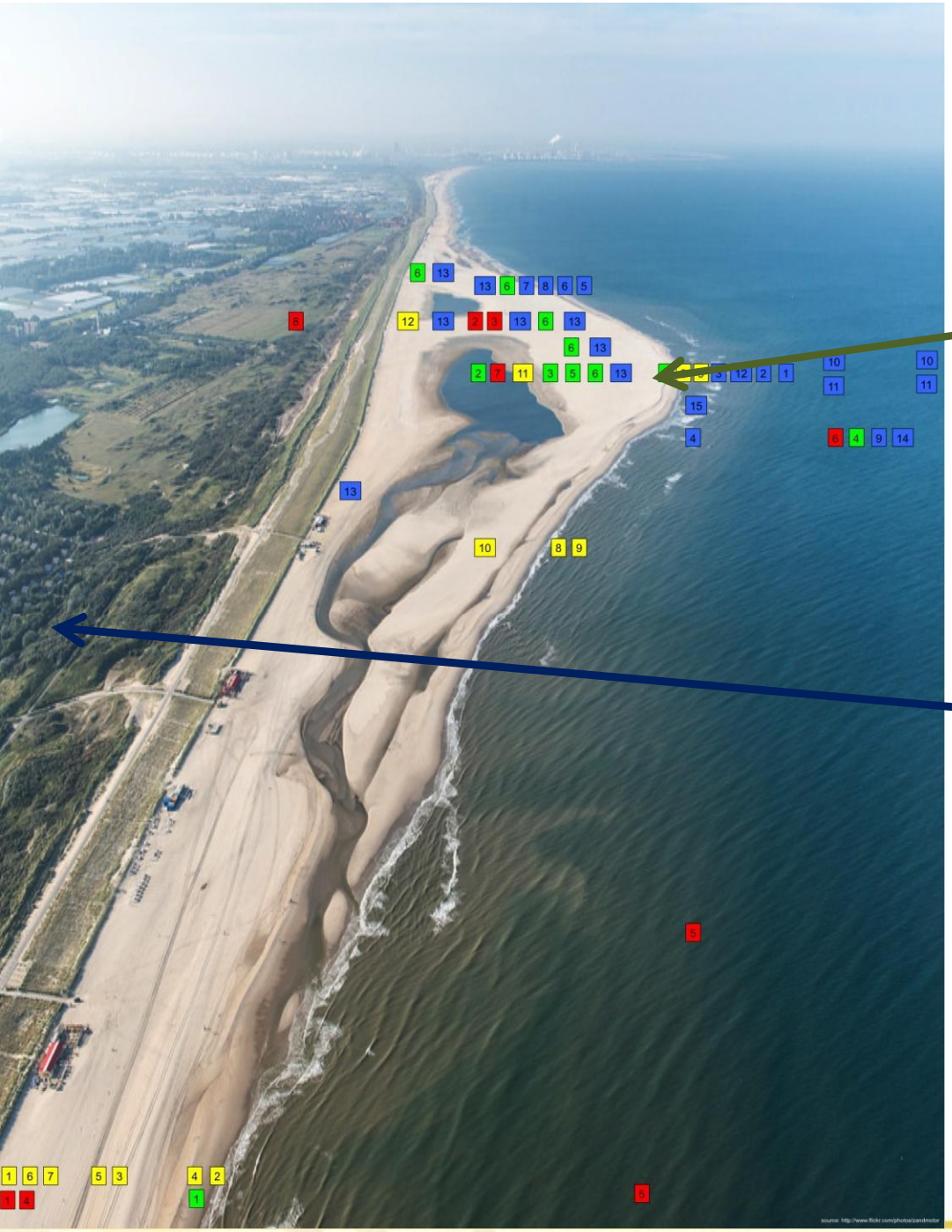

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Lagoon

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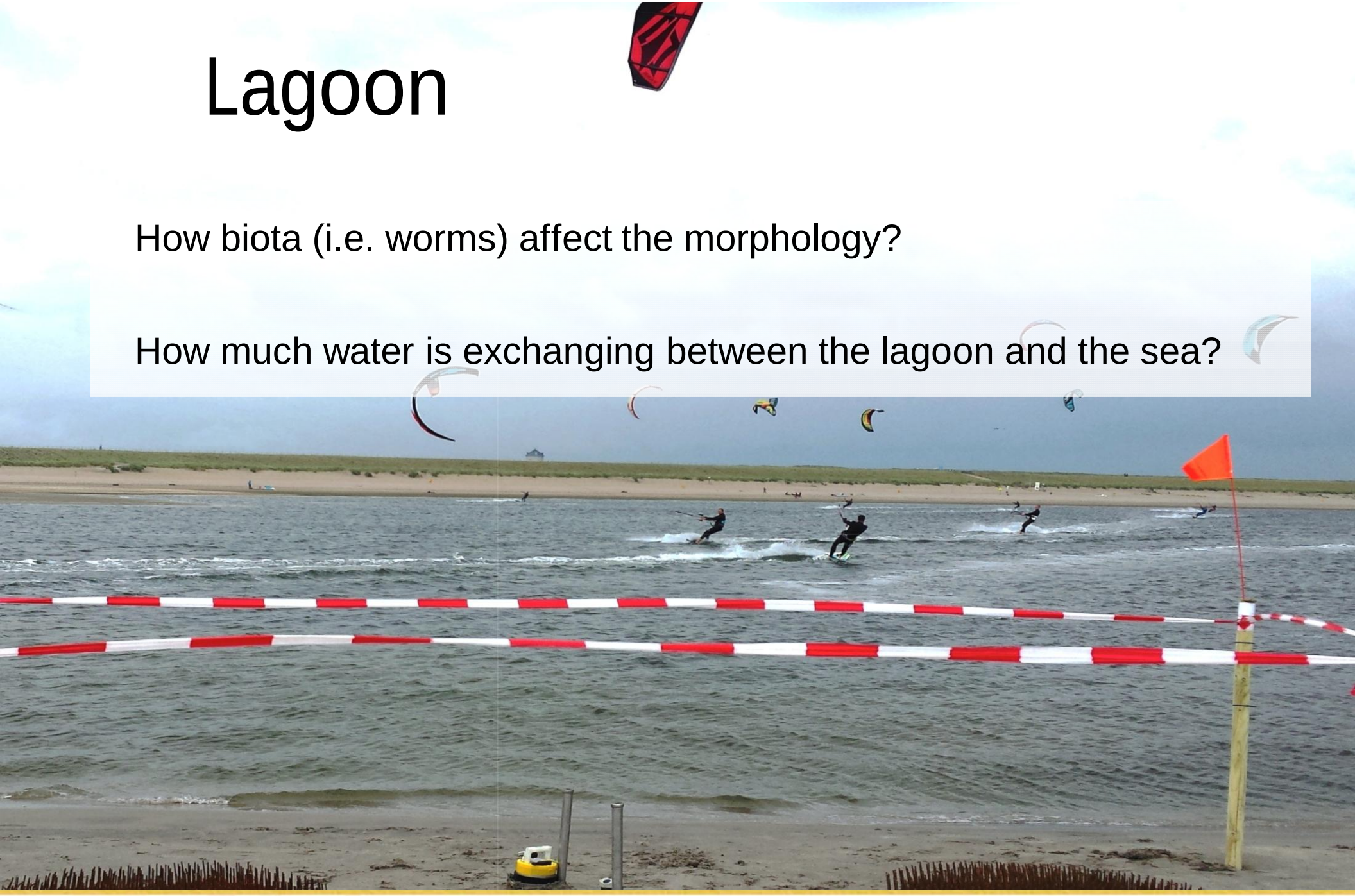
Lagoon

How biota (i.e. worms) affect the morphology?

How much water is exchanging between the lagoon and the sea?

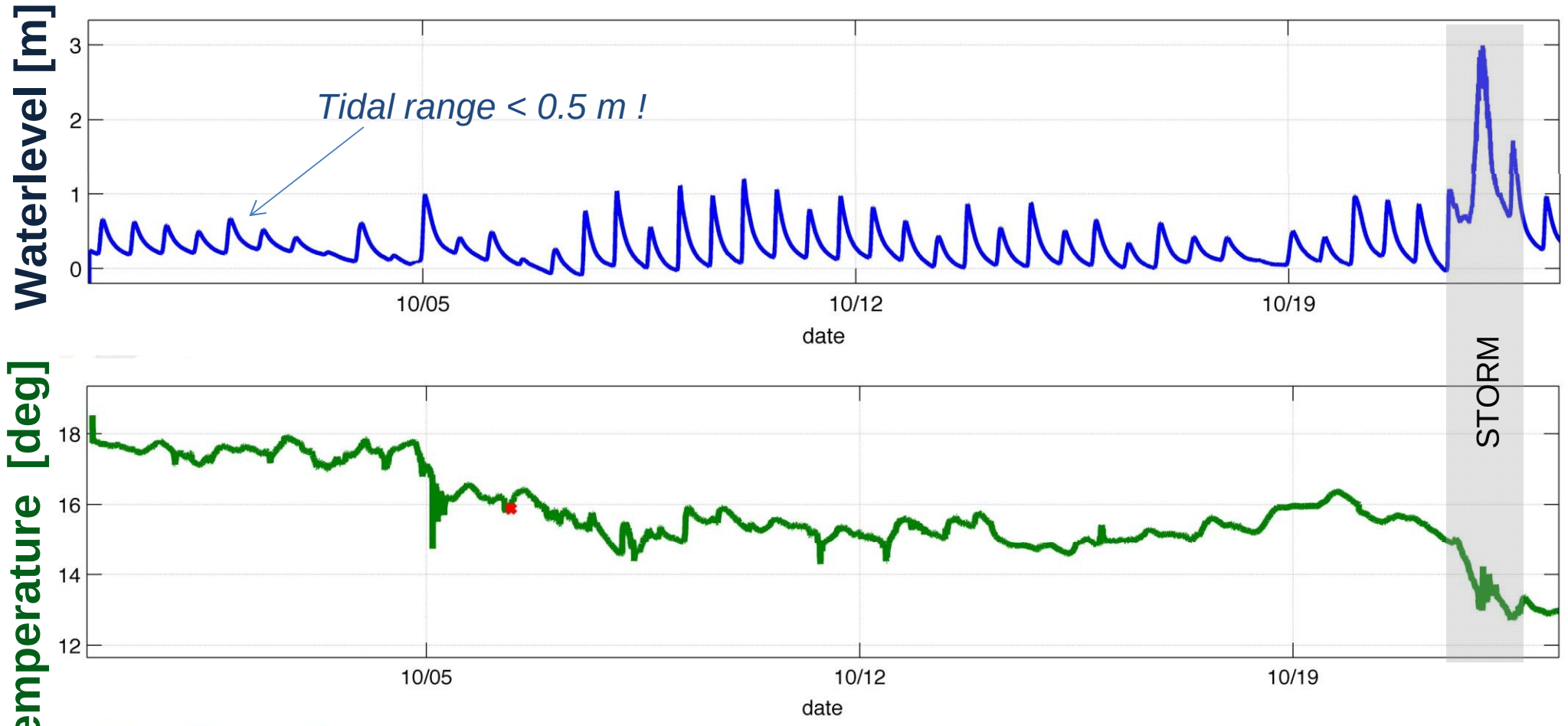


Lagoon

Artificial tube building worm field

Lagoon

Waterlevel, Salinity & Temperature



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Offshore

It the transport on the lower shoreface onshore or offshore?

What is the influence of the Rhine fresh water plume?

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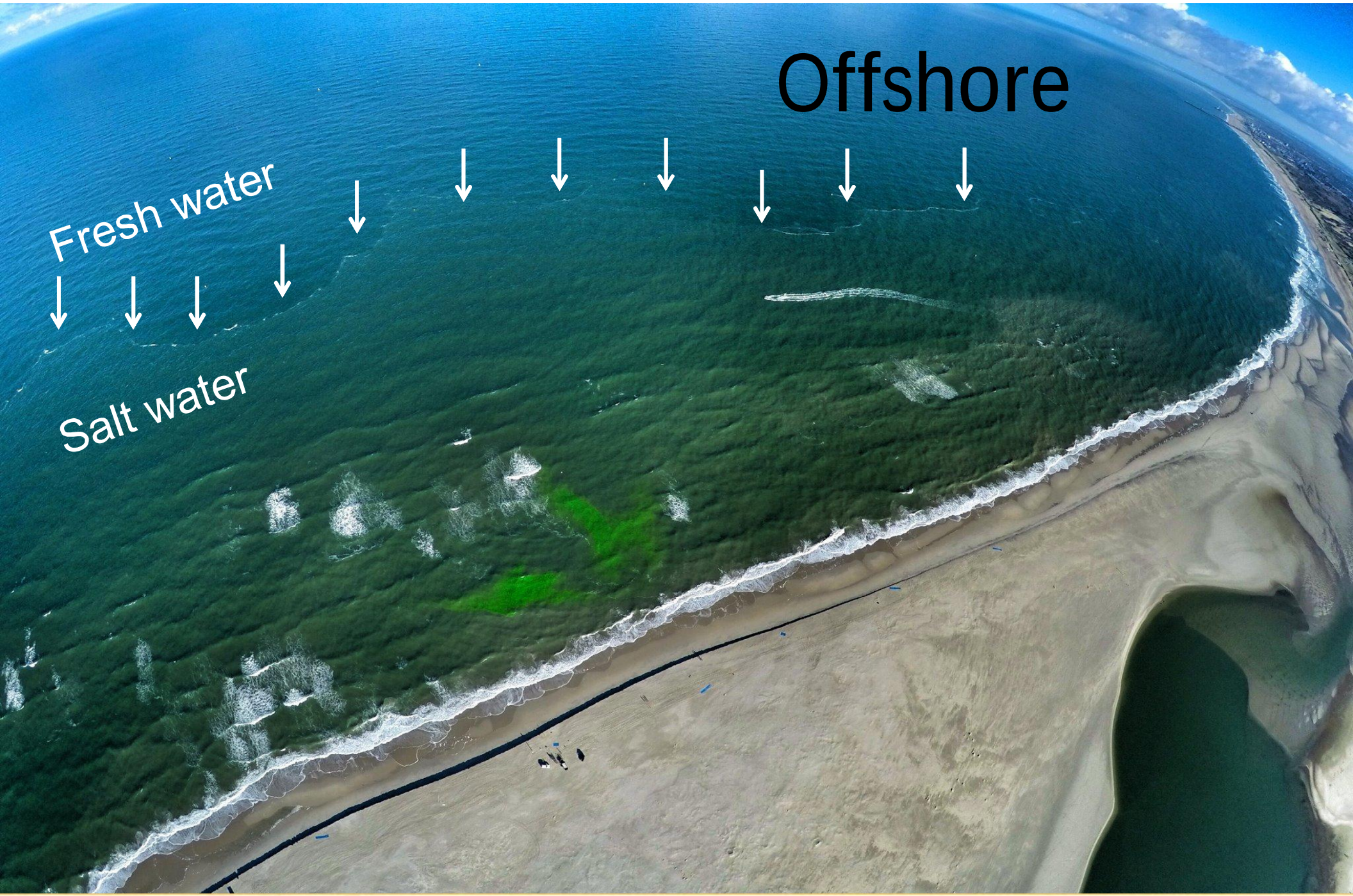

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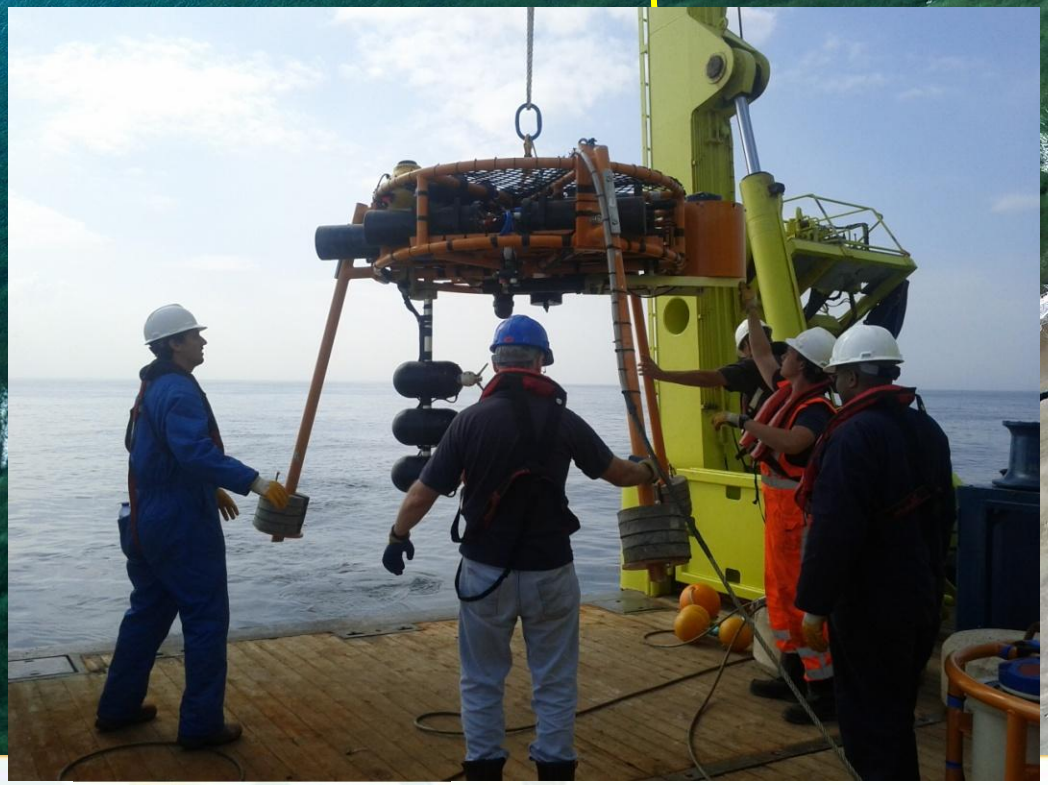
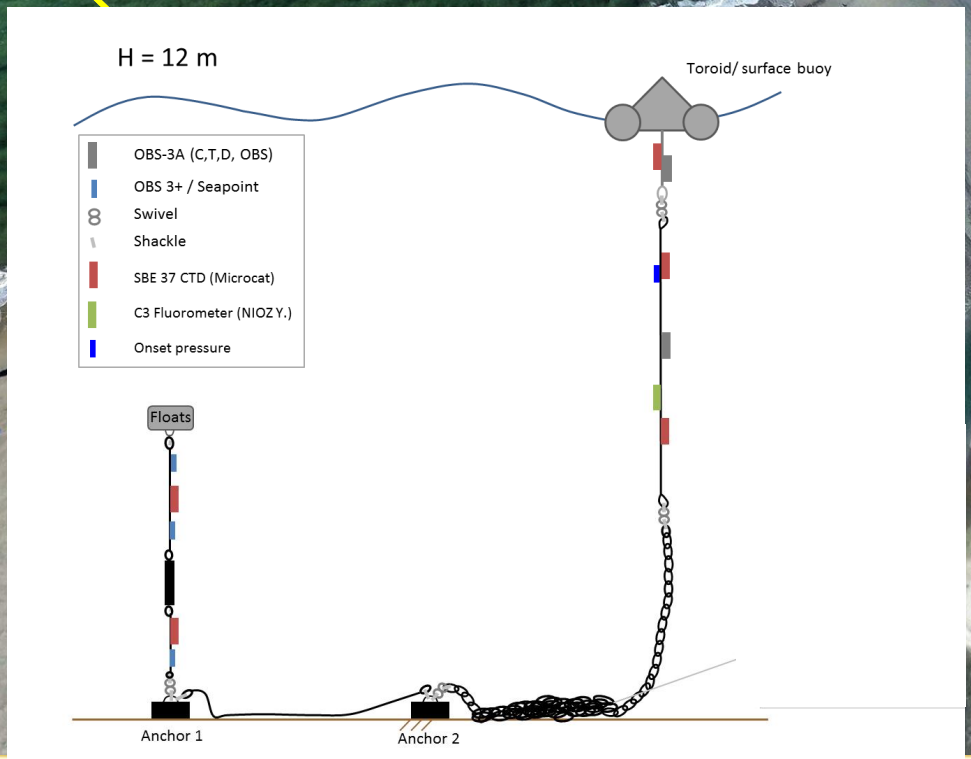
Offshore





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NATURAL ENVIRONMENT RESEARCH COUNCIL

UNIVERSITY of WASHINGTON

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Nearshore

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Nearshore

Are large circulations or eddies present at the Sand Engine?

How do seafloor ripples change under different conditions?

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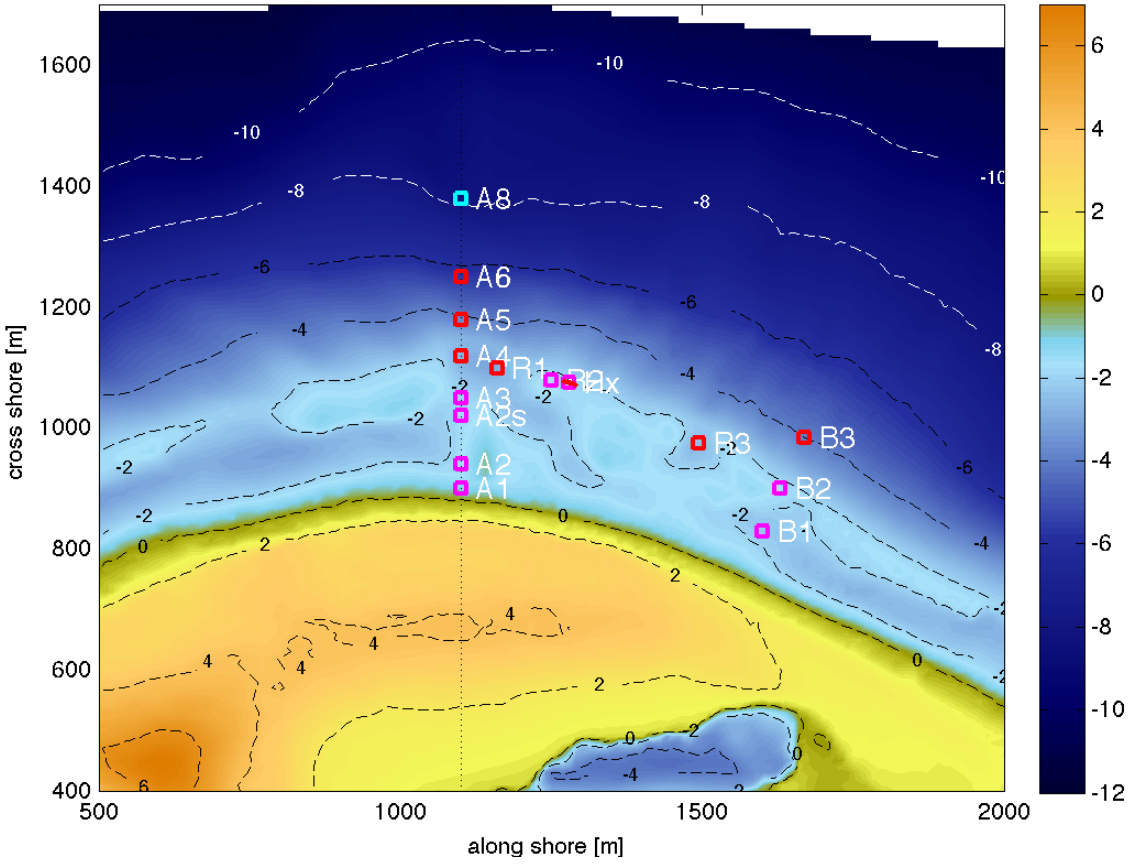
Nearshore

Flow around the tip



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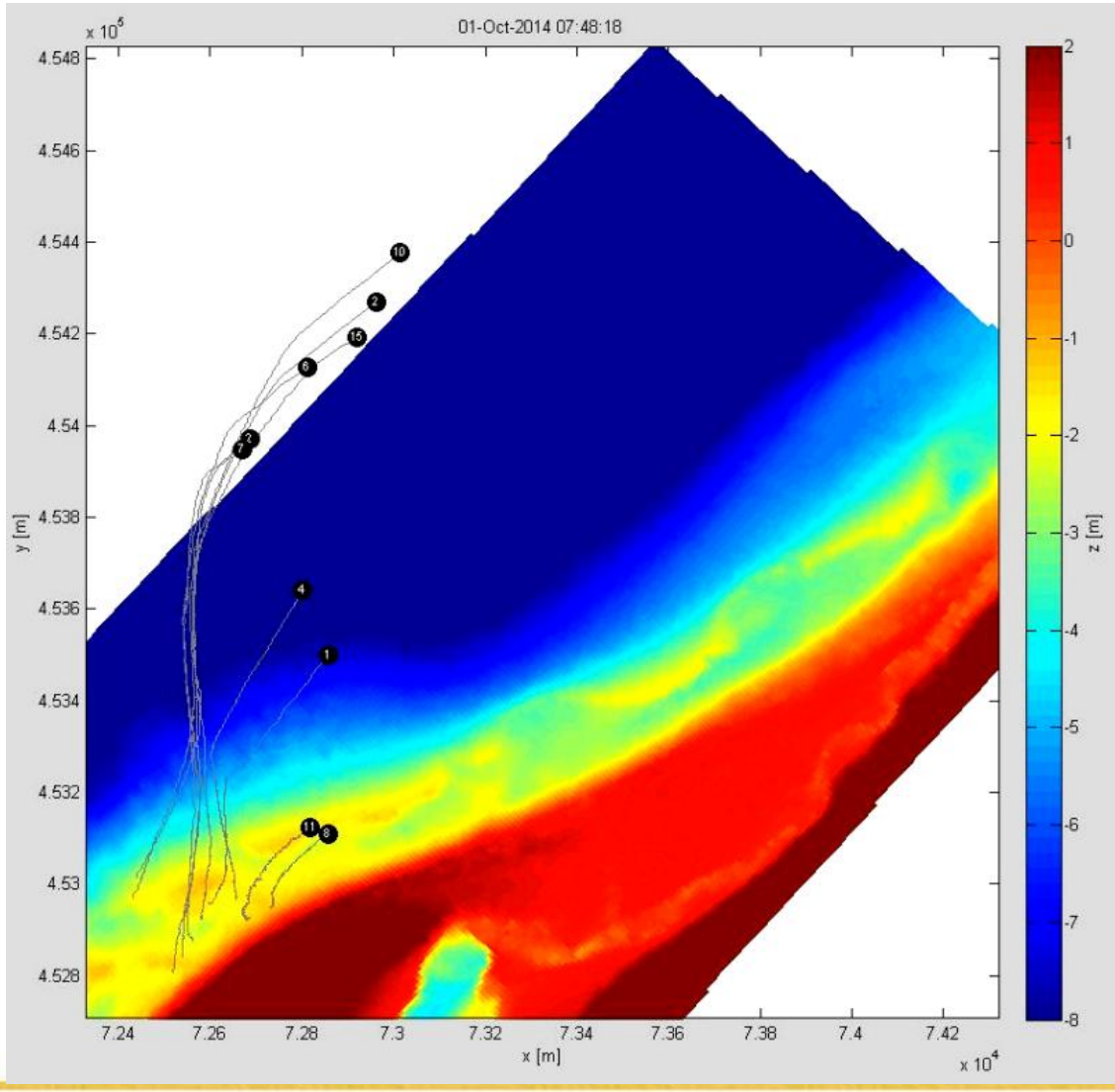
Nearshore

Flow around the tip

Are there large scale eddies?



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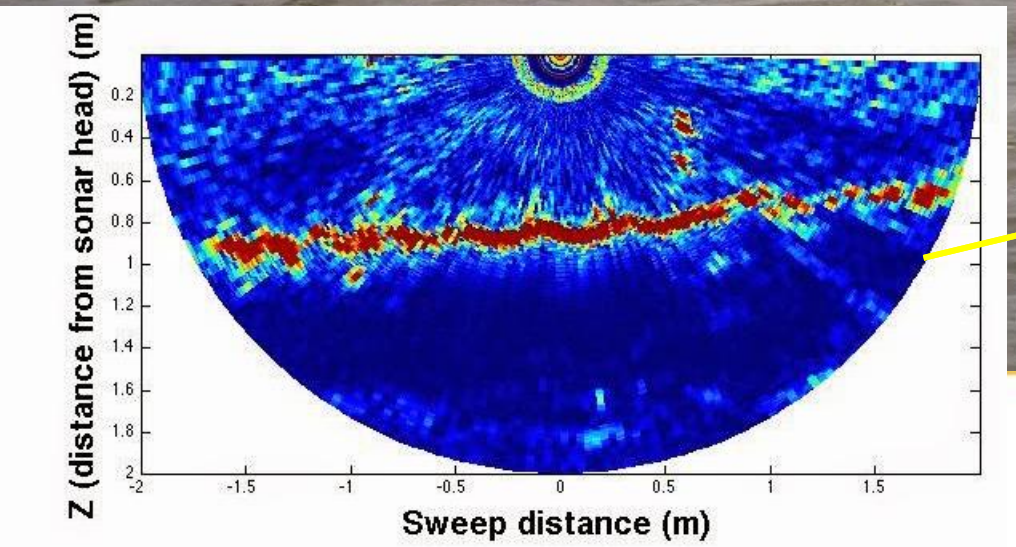
Nearshore

Ripple behavior



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Intertidal zone

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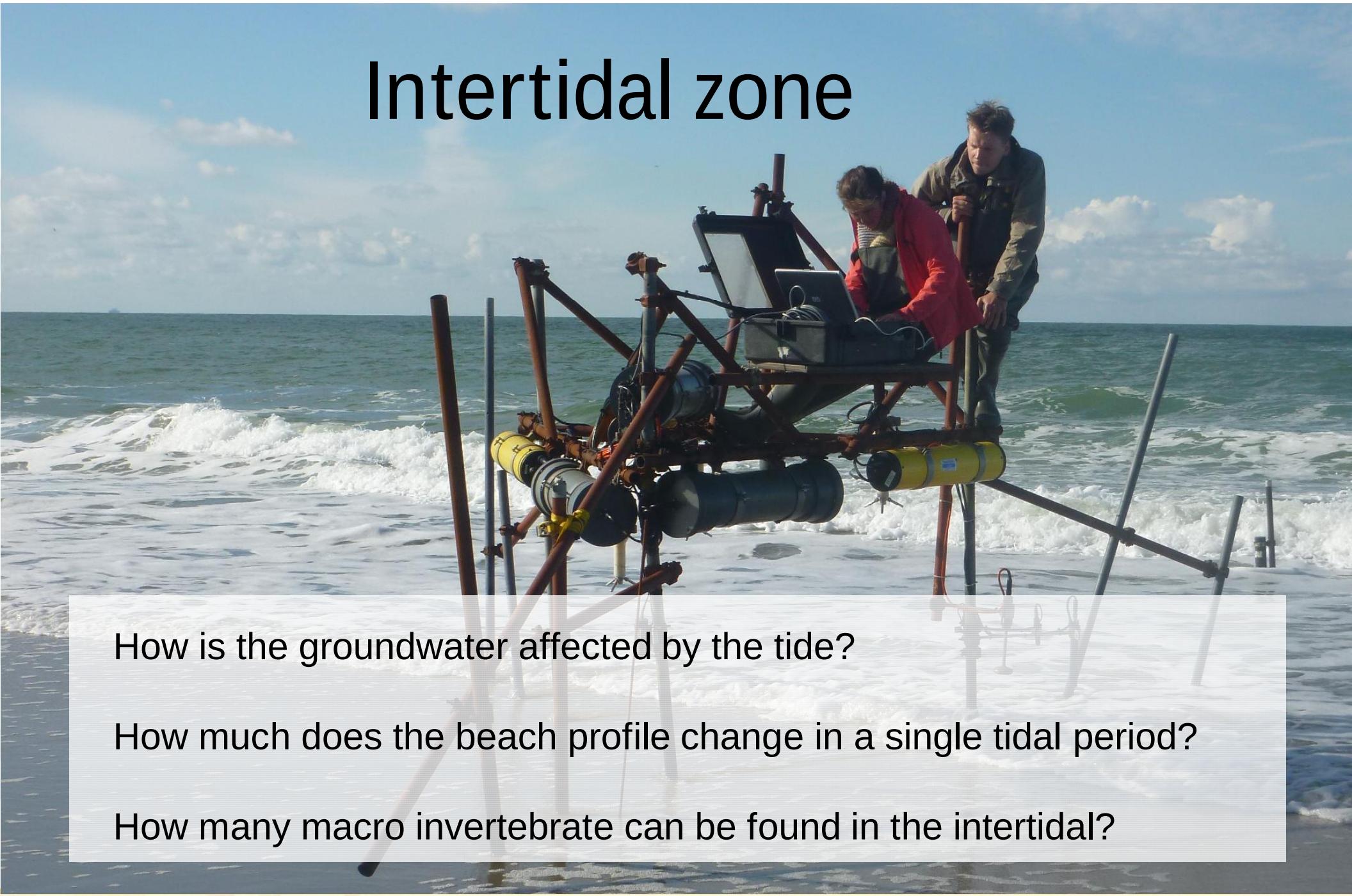
Intertidal zone



How is the groundwater affected by the tide?

How much does the beach profile change in a single tidal period?

How many macro invertebrate can be found in the intertidal?

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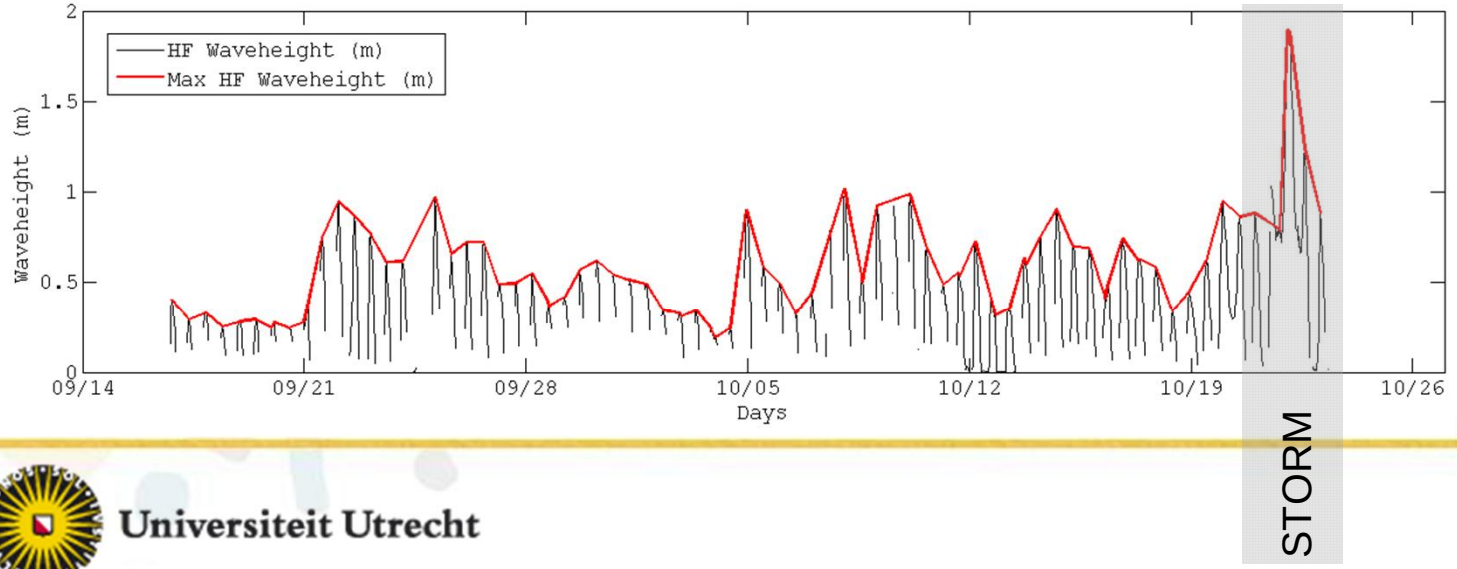
Intertidal zone

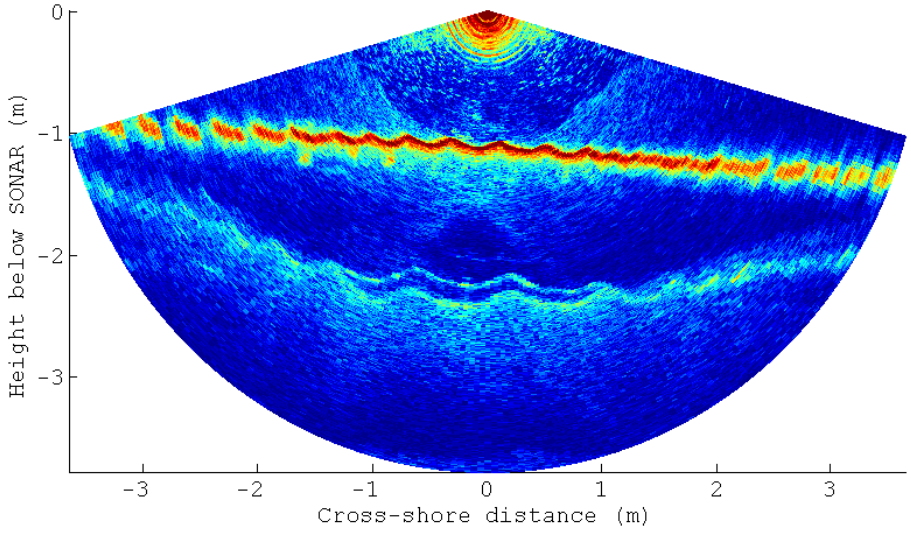
Measurements of cross-shore hydrodynamics and sand suspension in the intertidal zone



<u>During the storm</u>: waveheight in the intertidal zone up to 1.8m, infragravity waveheight up to 60cm!!

Intertidal zone

Detailed measurements of
turbulence and sediment suspension
beneath breaking waves
and above ripples



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Intertidal zone

Morphology



Surface moisture content


Intertidal variability in groundwater levels and surface moisture content
- *measured using groundwater wells,*
- *manual conductivity probes and*
- *laserscans*

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Intertidal zone

Macro invertebrate sampling

Beach & Dunes

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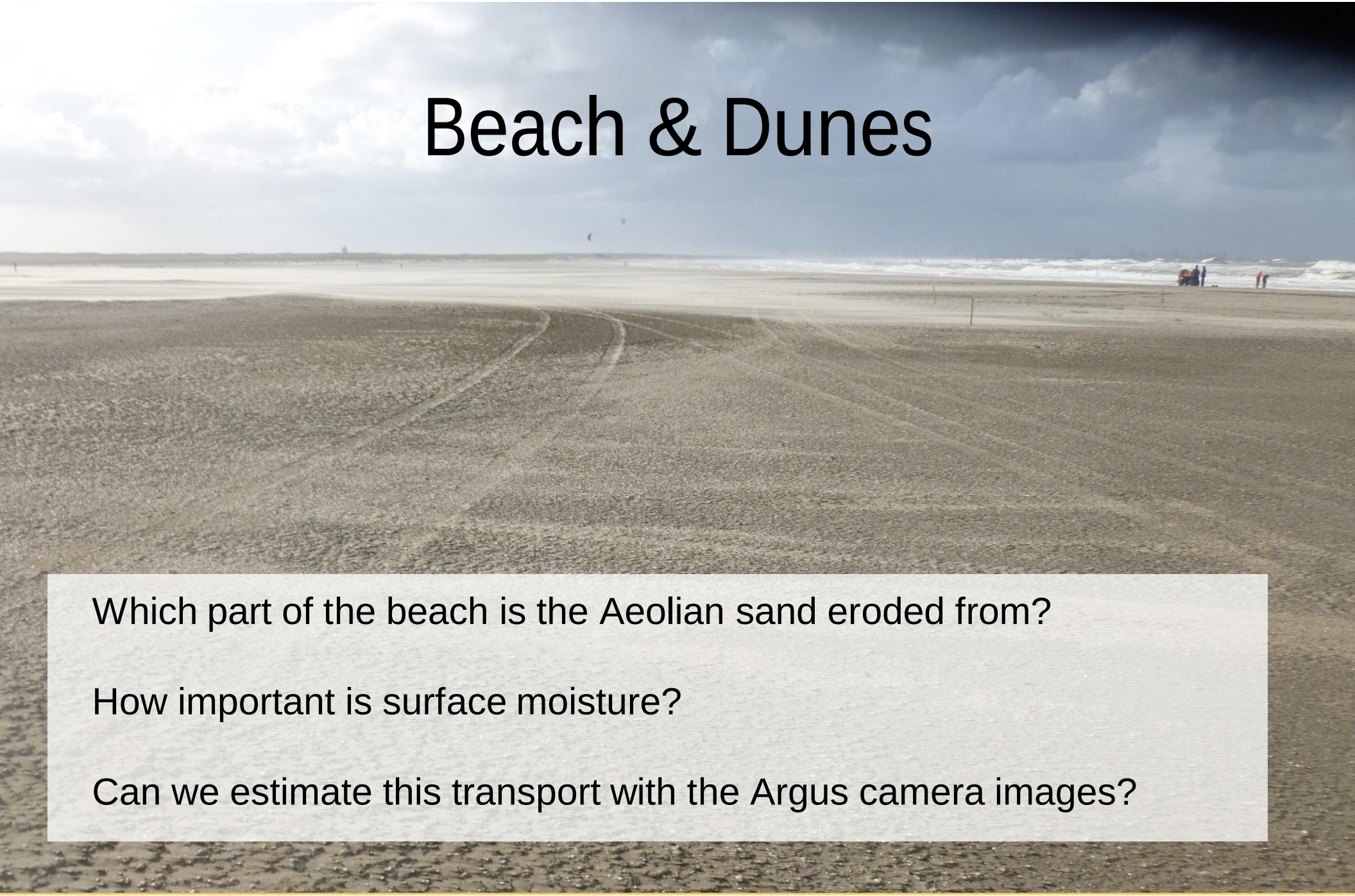
Beach & Dunes



Which part of the beach is the Aeolian sand eroded from?

How important is surface moisture?

Can we estimate this transport with the Argus camera images?

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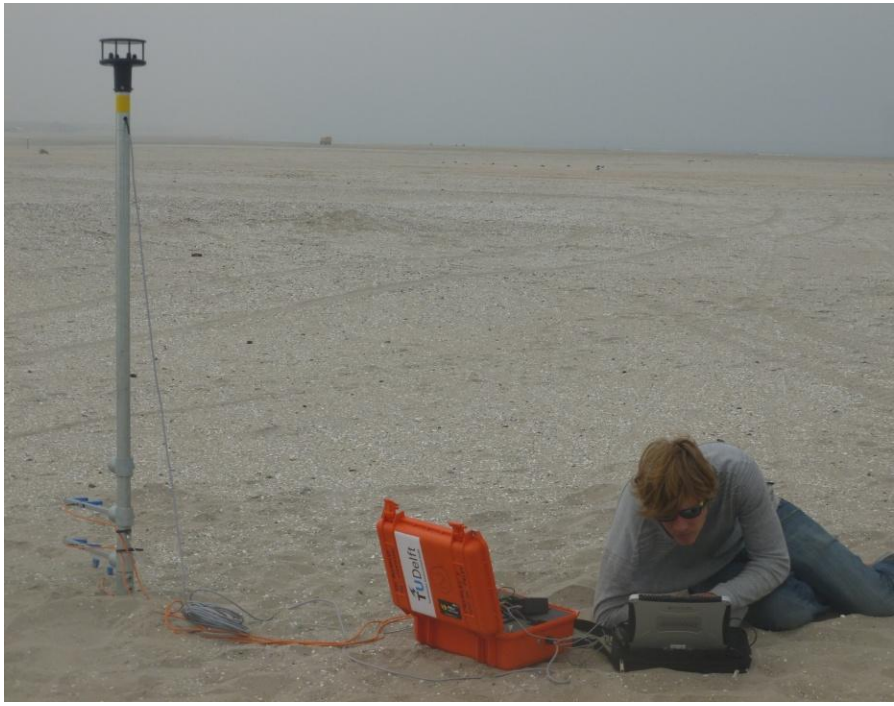
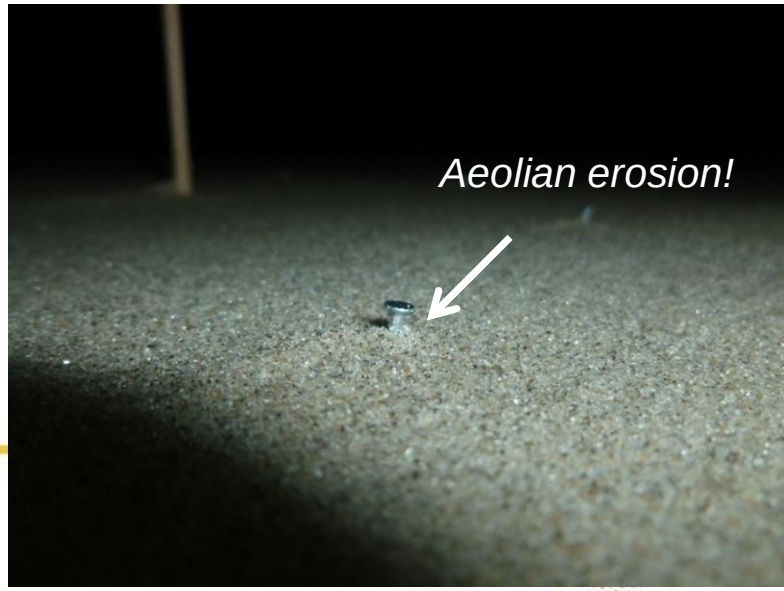
Beach & Dunes

Sediment transport measurements across the beach



Beach & Dunes

Erosion rates in a tidal cycle



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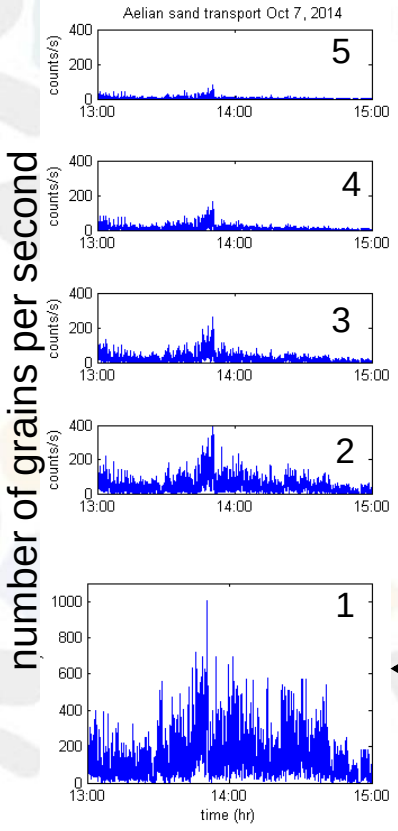
Beach & Dunes

Connection camera images and in situ measurements of transport

in situ transport data

Argus video imagery



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Dune vegetation - Aeolian dynamics

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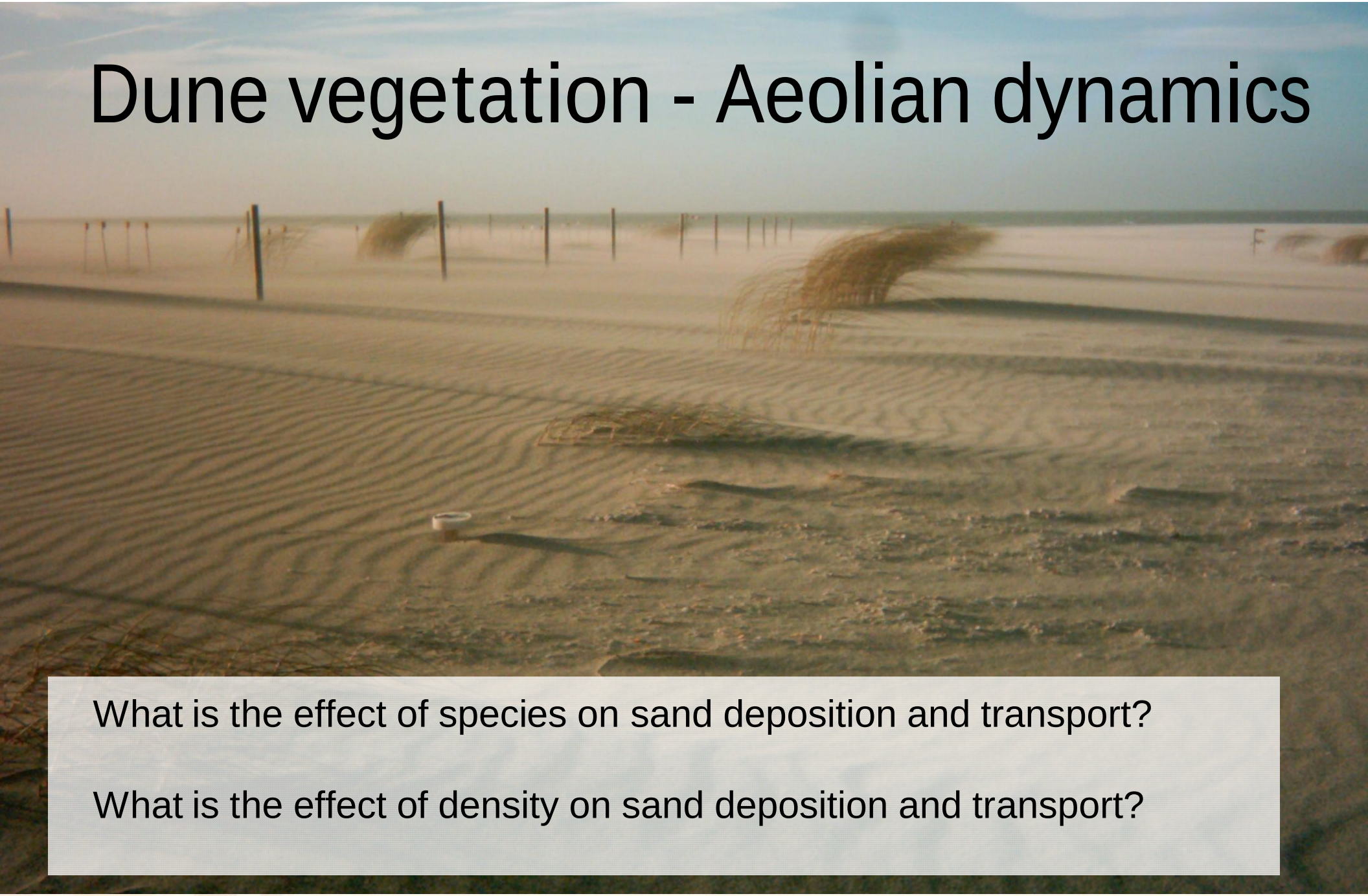
Dune vegetation - Aeolian dynamics

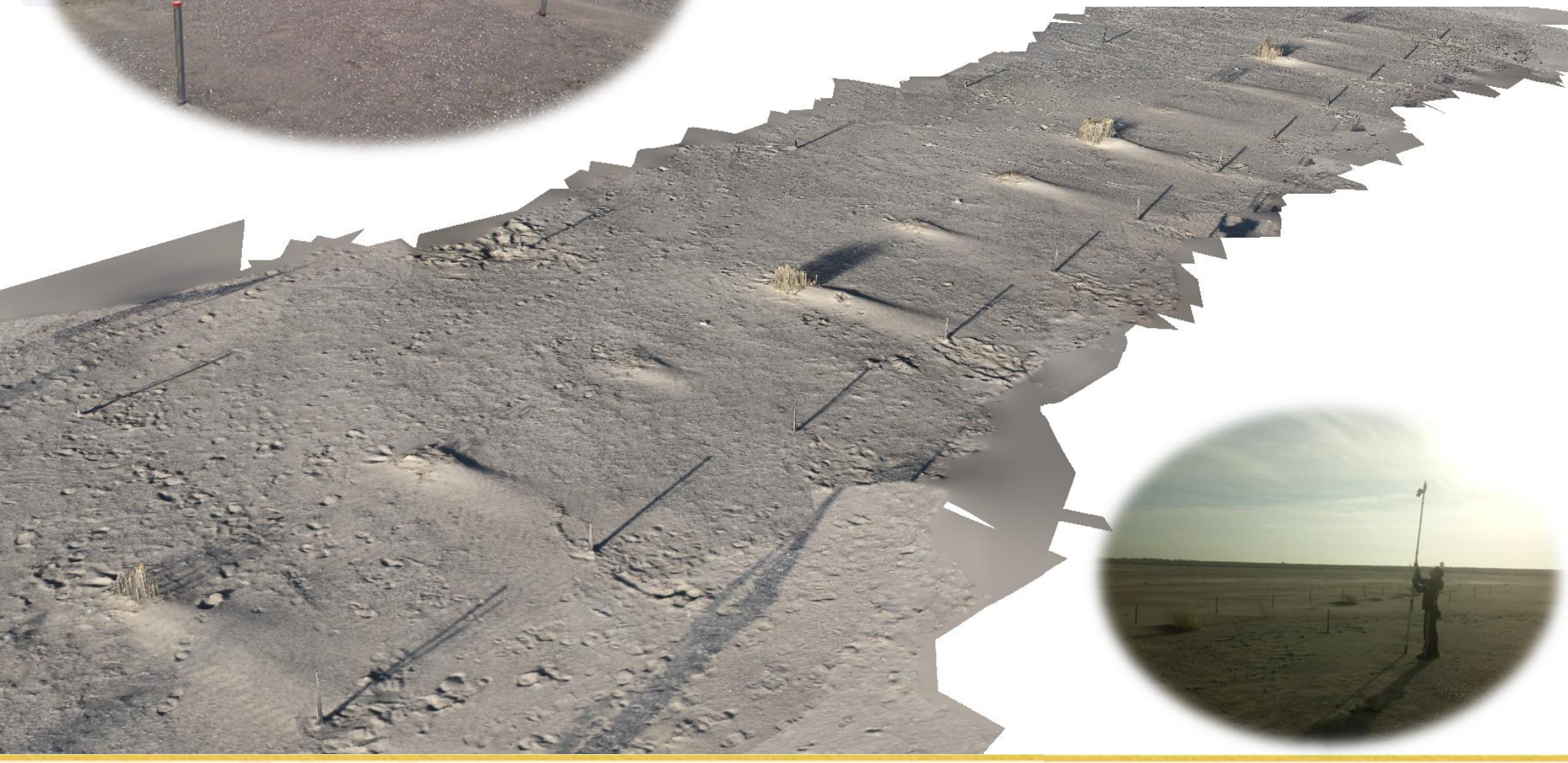


What is the effect of species on sand deposition and transport?

What is the effect of density on sand deposition and transport?

Methods

- Erosion pins
- Sand traps
- Photogrammetry



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Beach & Dunes

Mapping the beach & dunes

With:

- Drone
- Small plane

and

- Kite

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OSU Oregon State University

UNIVERSITY OF MIAMI

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Moreover

- Numerous other experiments (Sorry, if I passed over yours!)
- Intensified camera tower observations with Argus (with Rob Holman)
- Raw Radar data recordings
- Extra Rijkswaterstaat measurements : Wave bouy, 2 ADCPs, 13h ADCP cruise

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Science Integration - MegaPEX

Unique collaboration

Multi-disciplinary data set

>40 researchers

48 Days and 1 big storm!

STW

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UNIVERSITY OF MIAMI

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TU Delft

NIOZ

IMARES WAGENINGEN UR

UNESCO-IHE Institute for Water Education

UNIVERSITY of WASHINGTON

NH

SCRIPPS INSTITUTION OF OCEANOGRAPHY UC San Diego

LUND UNIVERSITY

OSU Oregon State UNIVERSITY

National Oceanography Centre NATURAL ENVIRONMENT RESEARCH COUNCIL

Rijkswaterstaat Ministerie van Infrastructuur en Milieu

Witteveen+Bos

Deltares

Shore Monitoring & Research

EMS ENVIRONMENTAL MAPPING & SURVEYING

Collaboration

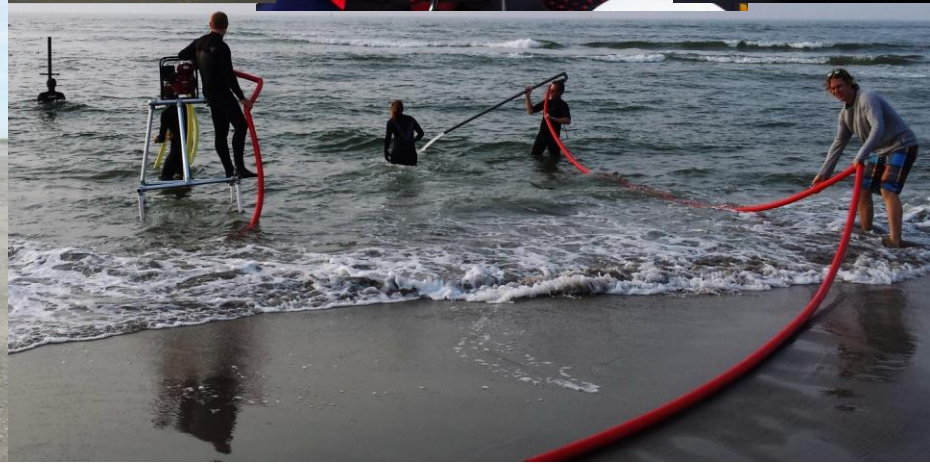




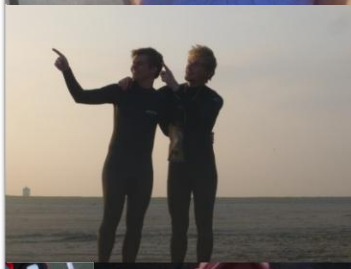


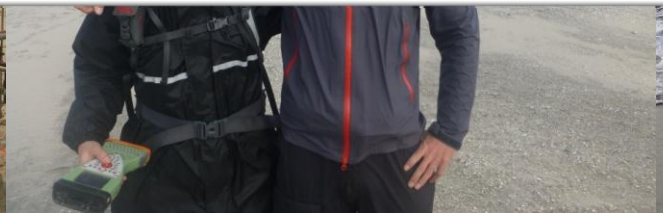






Collaboration





A lot of (media) attention

- Brochure
- Excursions
- Web blogs
- Newspapers
- Radio broadcasts
- TV documentary
- Nature coast MegaPEX movie

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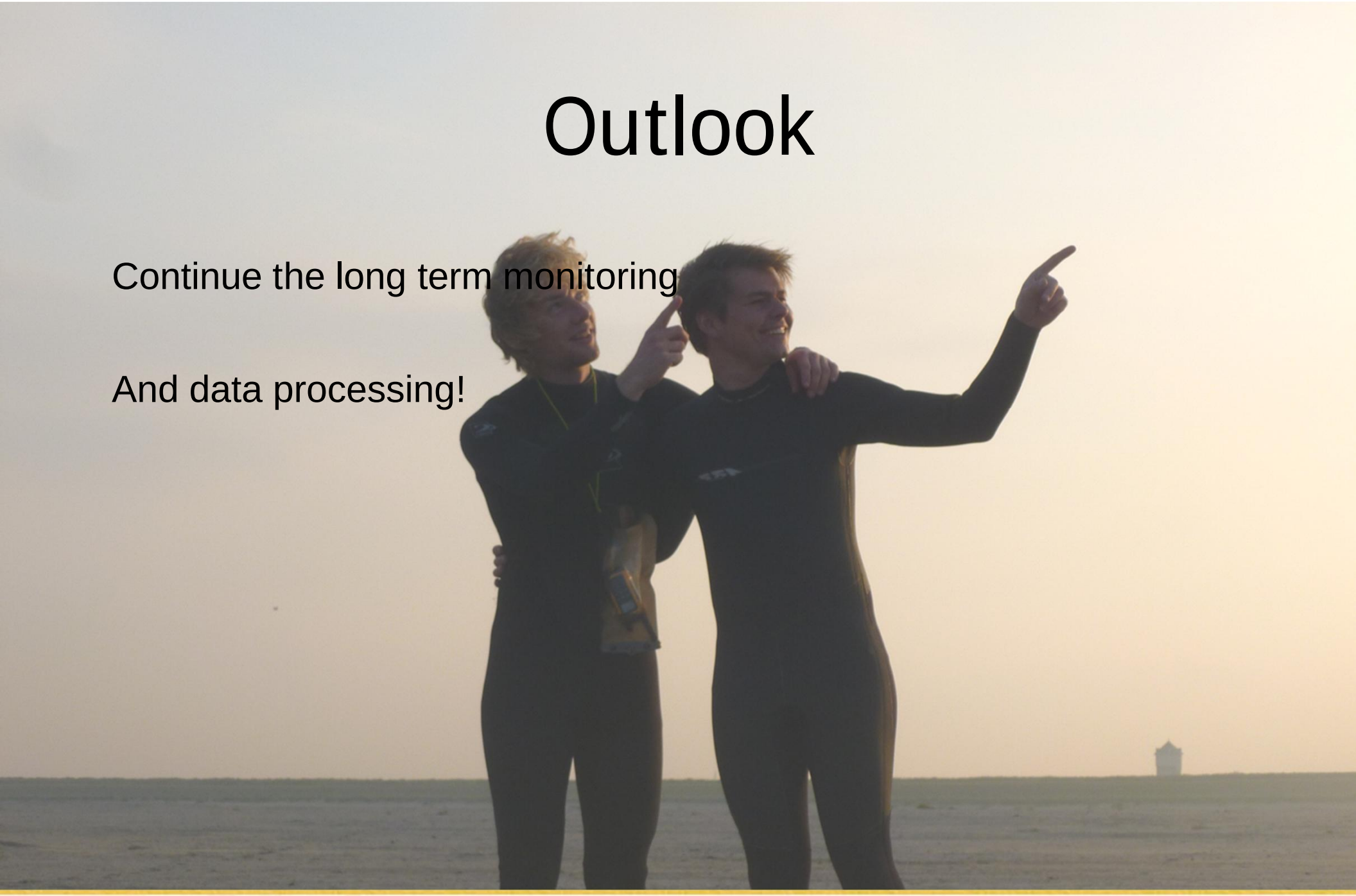
Outlook



Continue the long term monitoring

And data processing!

Sierd de Vries, Martijn Henriquez, Tim Price & Matthieu de Schipper

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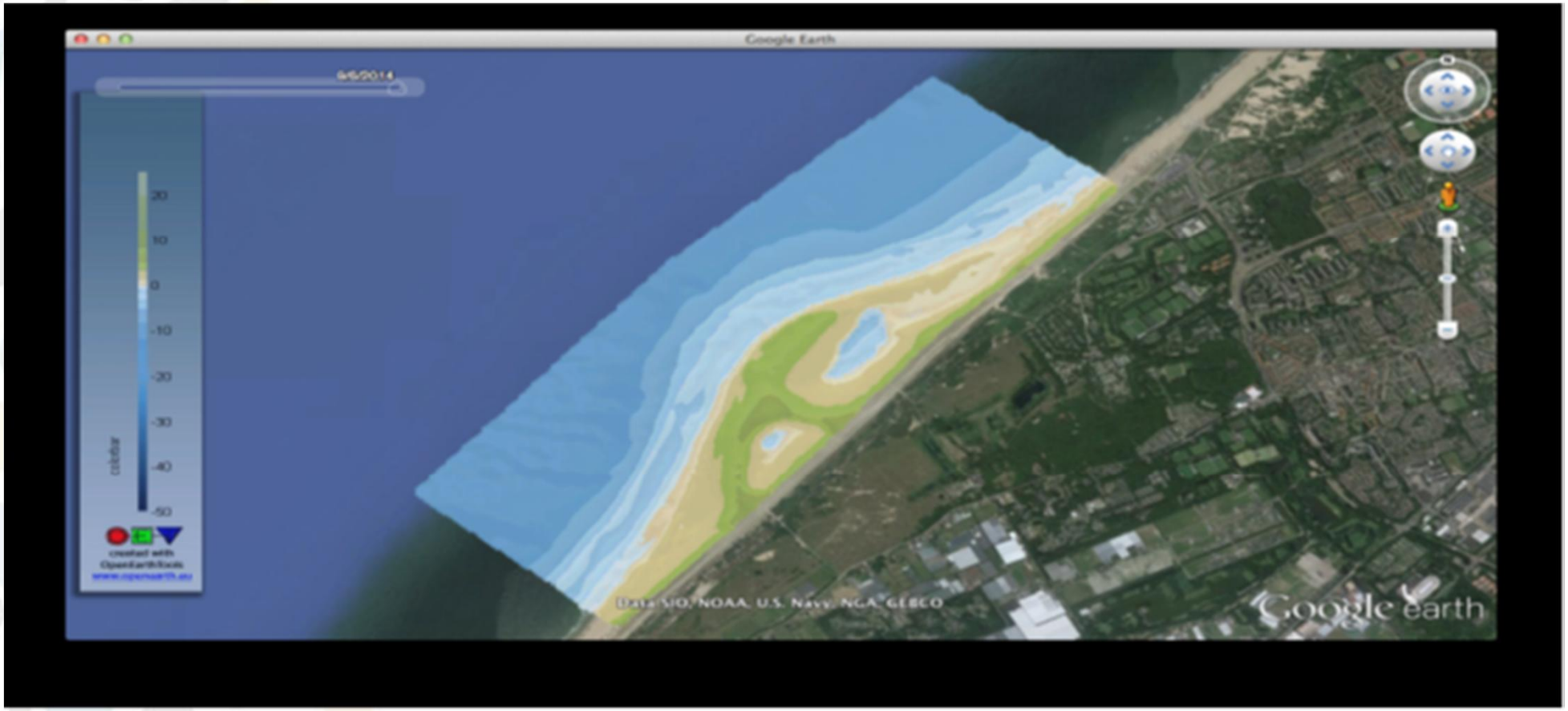
Data portal



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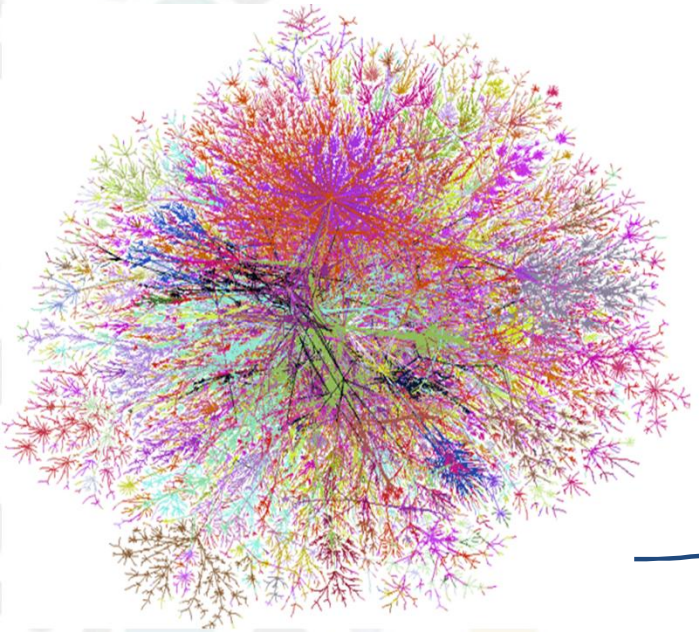
Interdisciplinary research

Big data

1. Behavioral data
2. Process data



Interdisciplinary knowledge development

End-user ambitions that require generic knowledge usable for design

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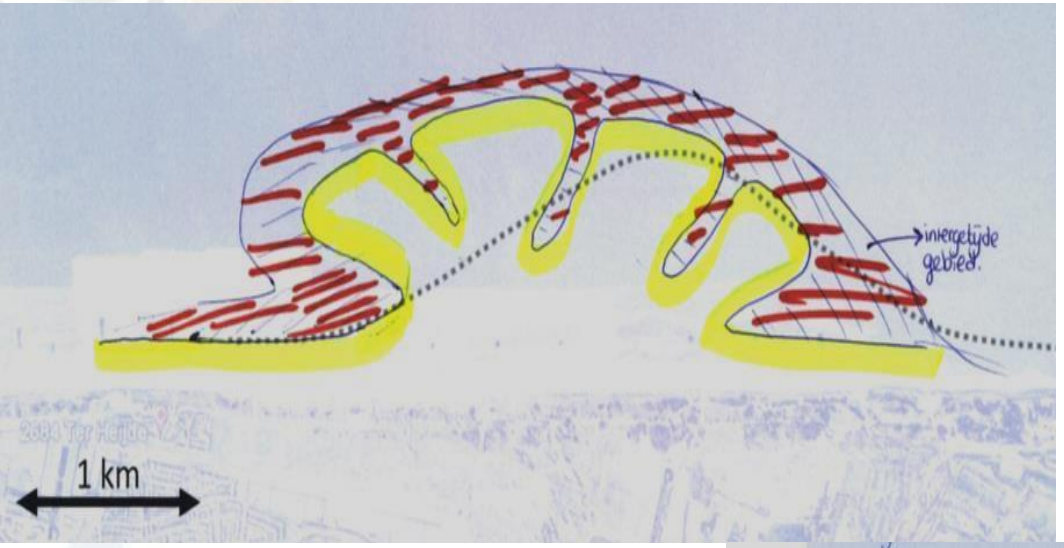
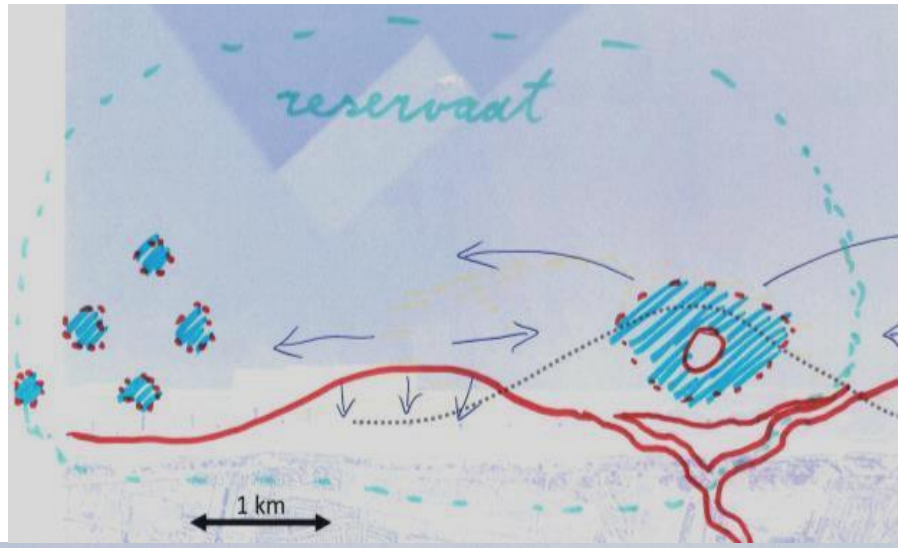
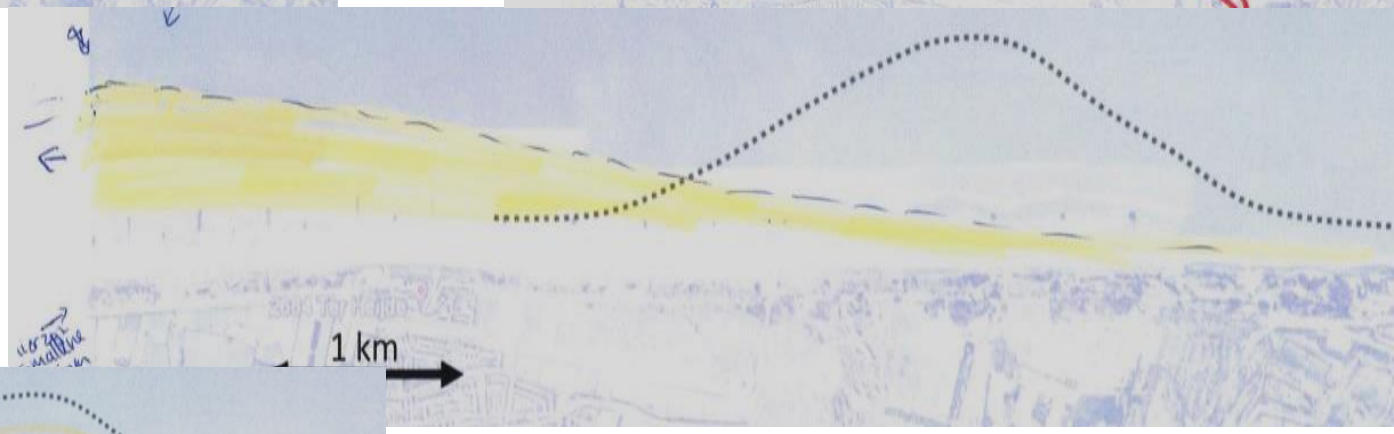
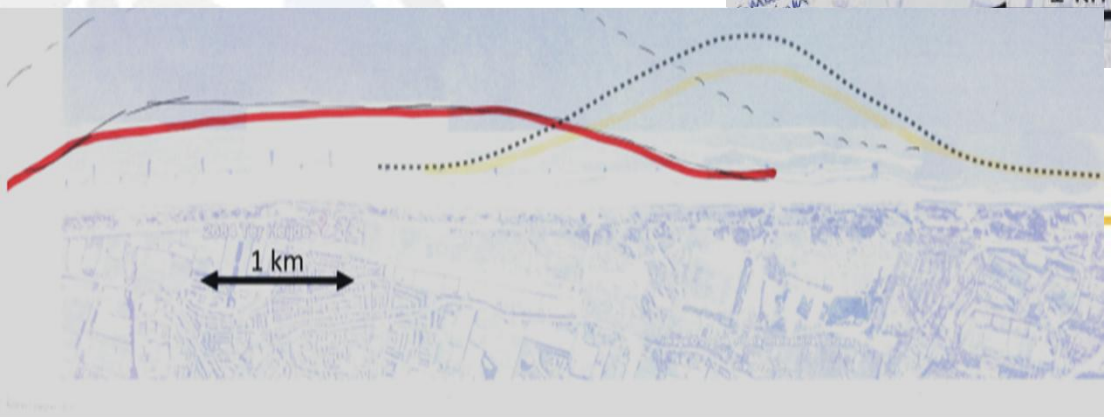
Design: building blocks of Sandy Solutions









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Design for what, for whom?

- Grain size
- Height, slope
- Shape, orientation
- Chemistry of sediment
- Volume, frequency
- Ground water salinity

- ➢ Dune development
- ➢ Safety
- ➢ Recreation, Nature
- ➢ Innovation

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Ecosystem services not targeted

- Fresh water provision
- Nursery for flatfish (and other animals?)
- Many different forms of recreation
- Inspiration for art
- Excursions to quintessentially Dutch location

The Sand Motor is (also) a cultural landscape

Towards engineering the Ecosystem Services (& other goals) of the Sand Motor (& beyond)

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

EcoShape

provincie ZUID HOLLAND

Kansen voor West
G4P4

STW
Nieuwe technologie mogelijk maken

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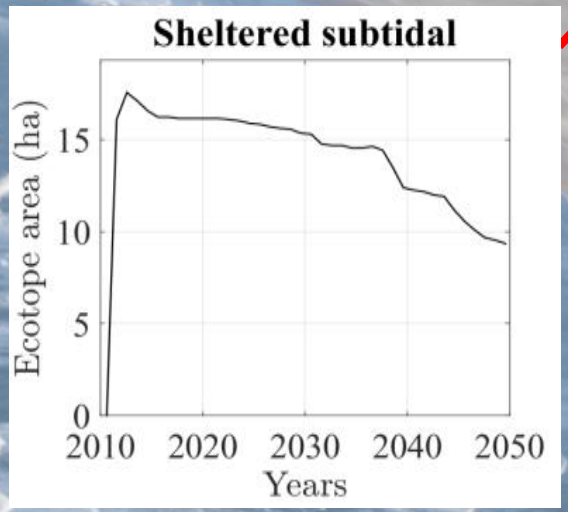
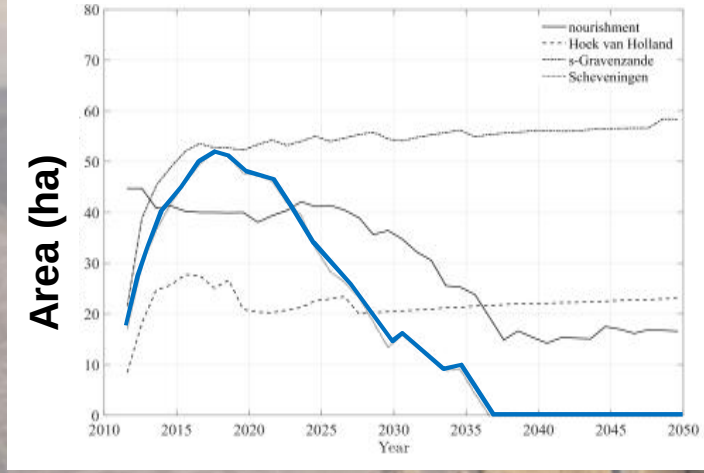
Integrated tools for ESS quantification

Towards engineering the ecosystem services of a mega-nourishment

- Coastal protection
- Recreation:
  - * kite surfing,
  - * strolling,
  - * sunbathing
- Habitat provision
  by dynamic ecotope mapping



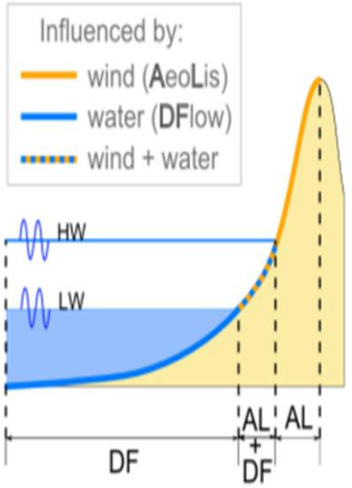
Suitable sunbathing area
60 < beach width < 200

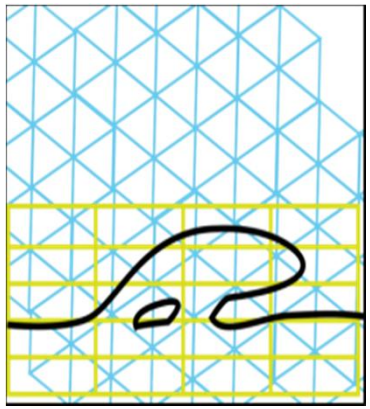


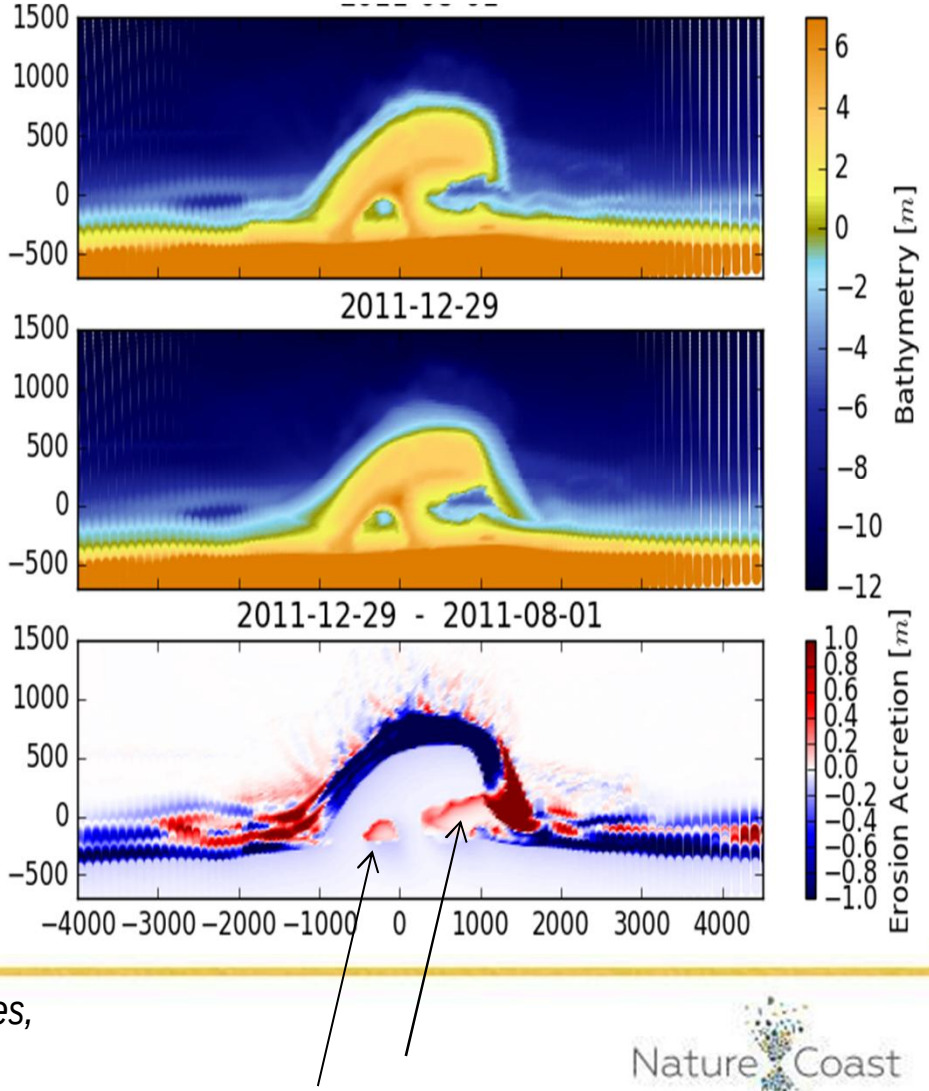
Integrated morphodynamic model

for the dry beach and subaerial

- Intertidal area is resolved by Delft3D and AeoLiS model
- Deposition of dune lake and lagoon is now incorporated in the morphological simulation.







Arjen Luijendijk, Bas Hoonhout, Rufus Velhorst and Sierd de Vries, Coastal Dynamics, 2017

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Room for improvement

- Bridge governance & other NC research
  - Socio-economic research should be strongly embedded
- Emphasis on design (implications) earlier on
  - Key chapter for each PhD researcher
  - Actively involve end-users, sessions organized by them

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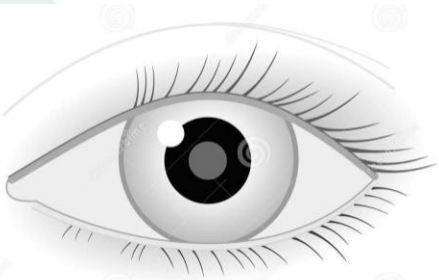
Monitor



Understand

Create