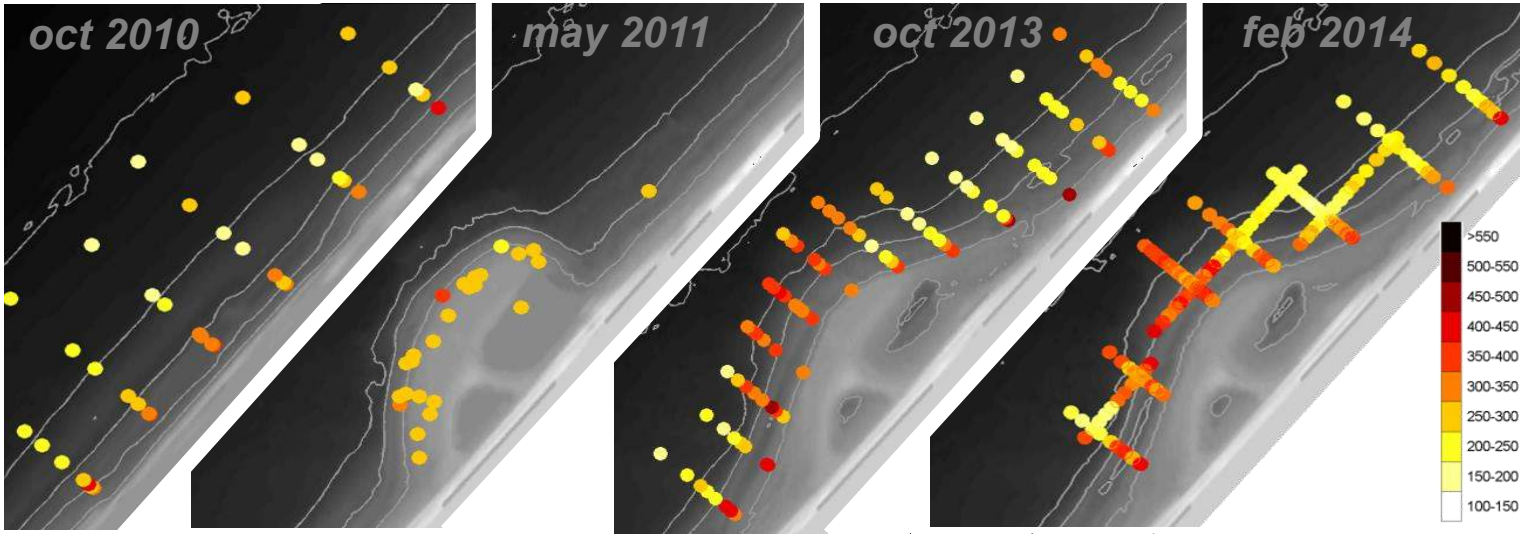
NEMO
Nearshore Monitoring and Modeling

# Suspension sorting at the Sand Motor

## *NCK theme day*

*B.J.A. Huisman*



# Context

**PhD research**

- Where do the sand grains go?
- Bed composition changes

**Case : Sand Motor**

- Big disturbance!

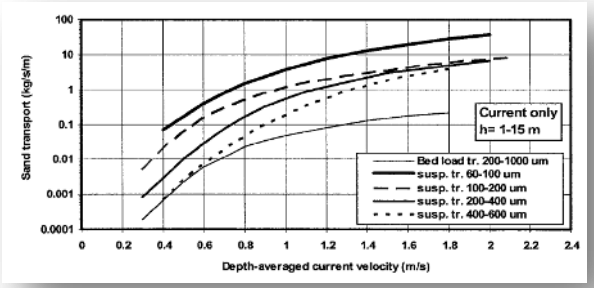
**Approach**

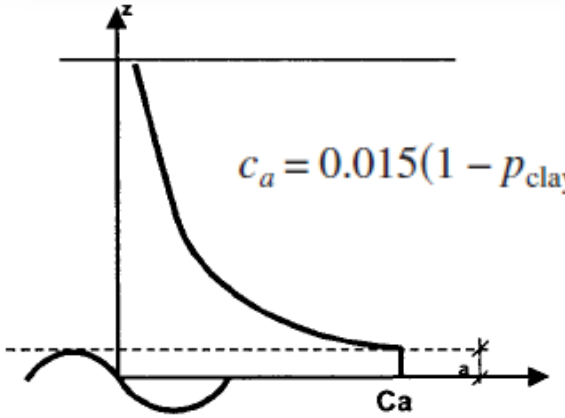
- Data -> Grab samples
- Models ->  Processes

# Literature

## Transport of a sediment mixture

**Qs = - f (D50)**
**<suspended load>**



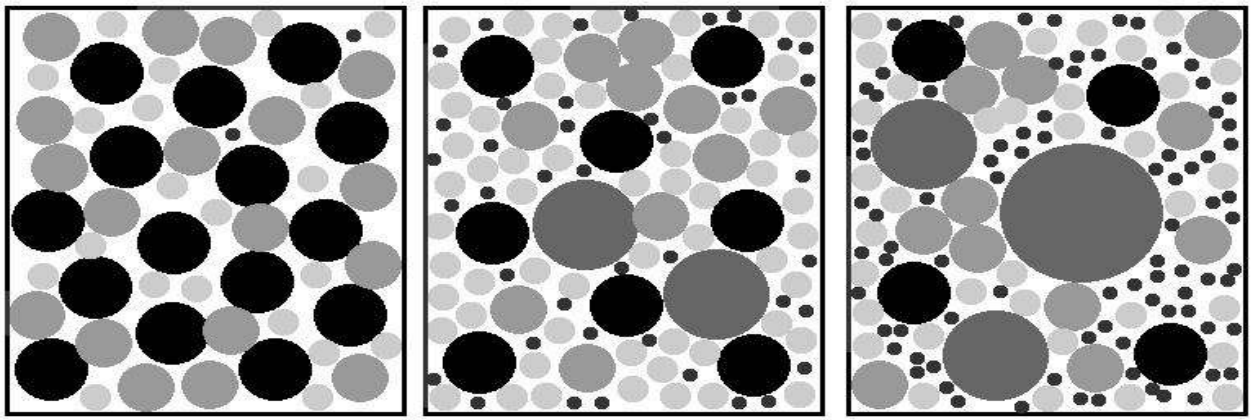

$$c_a = 0.015(1 - p_{clay}) f_{silt} \frac{d_{50}}{a} \frac{T^{1.5}}{D_*^{0.3}}$$

# Literature

**What happens with individual grains in a mixture?**

- **Equal** transport all grains?
- **Fine grains move quicker**?
- **Coarse grains** transported more?

**Depends on the conditions!**



# Literature

**What happens with individual grains in a mixture?**

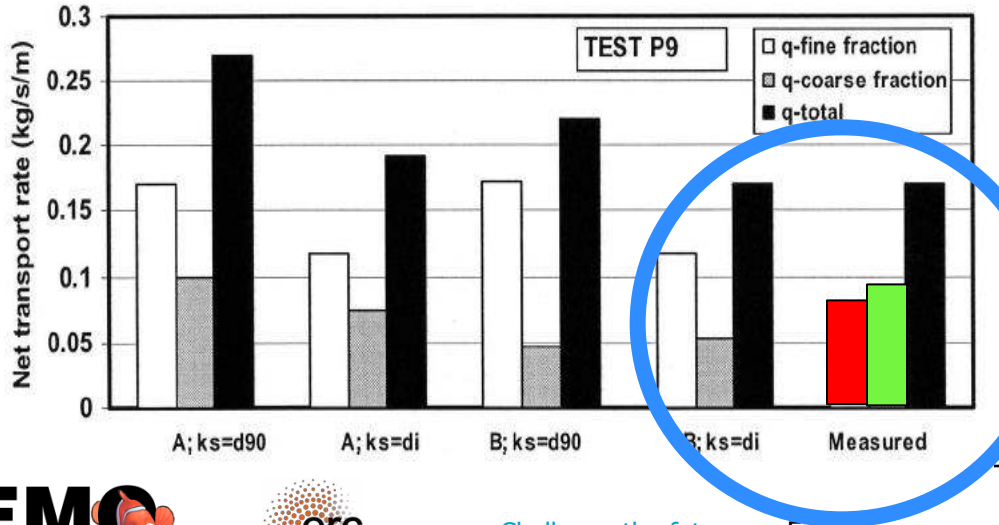
## Specific case : bed load / sheet flow

**- Coarse fraction more mobile than the fine fraction?**

**- No effect of addition of 30% coarser sediment**

**Roughness**

**Hassan at al. (1999, 2005)**
**Van Rijn (2007)**

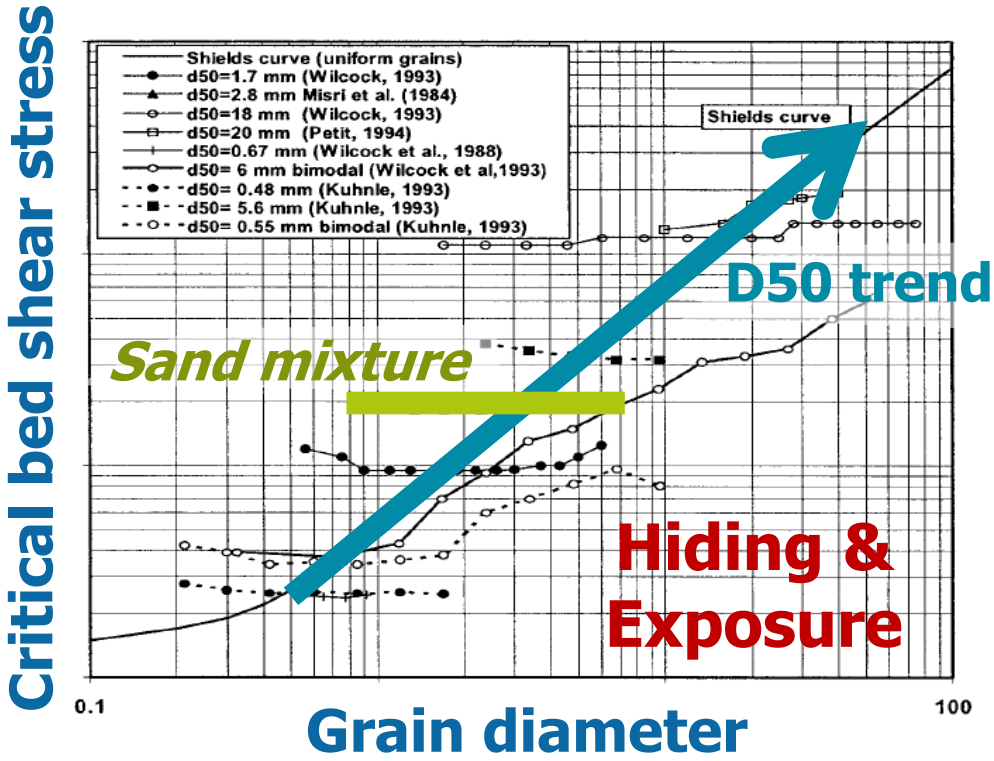


# Literature

**What happens with individual grains in a mixture?**

**Close to initiation of motion**

**Individual grains of 1 mixture move at same threshold**



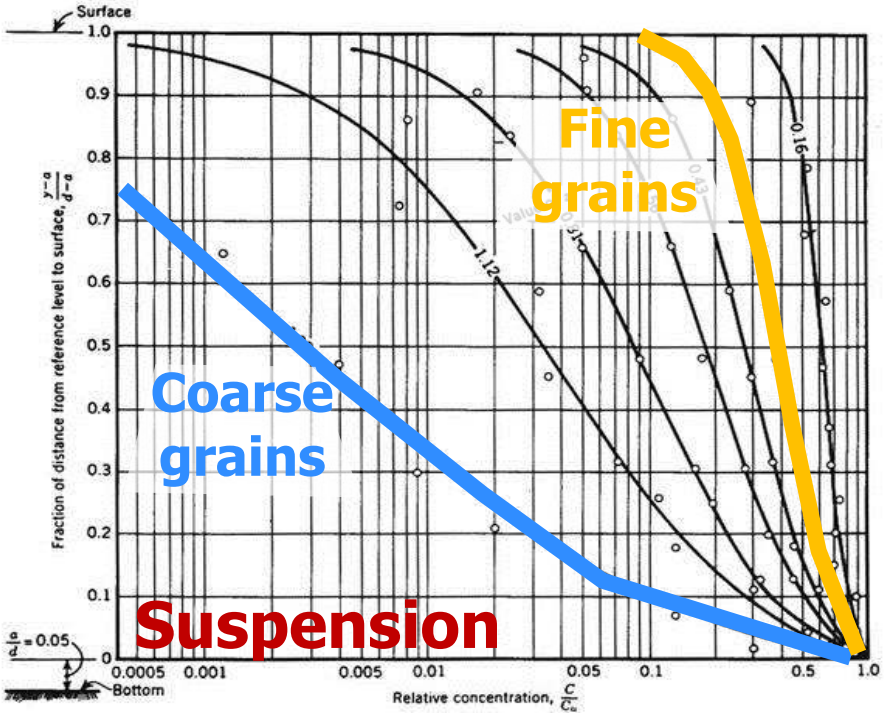

Wilcock (1993)
Van Rijn (2007)

# Literature

**What happens with individual grains in a mixture?**

**What about conditions well above the threshold for motion?**

**-> most likely situation**




Bagnold (1966)
Baba & Komar (1981)
Komar (1987)

# Application at Sand Motor

## Relevance at the Sand Motor?

# Application at Sand Motor

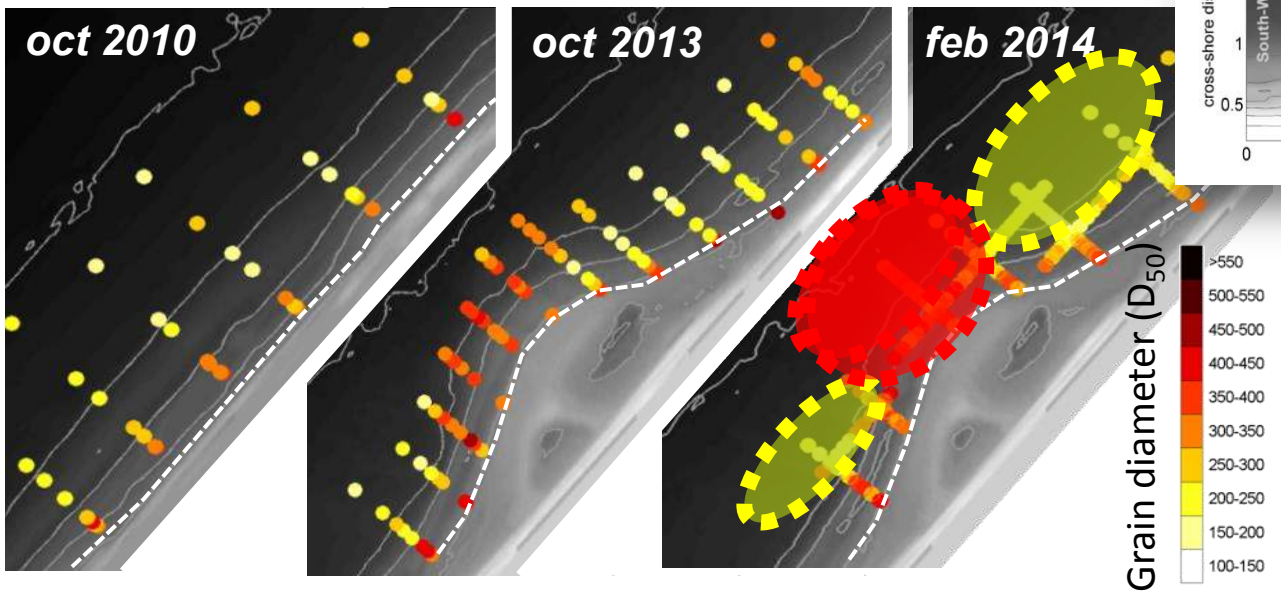
**Relevance at the Sand Motor?**

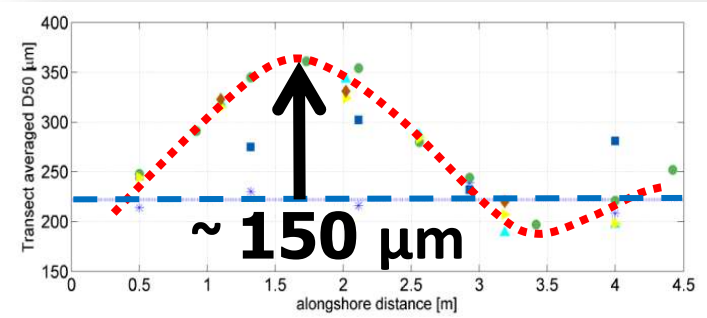
**Initial thoughts?**

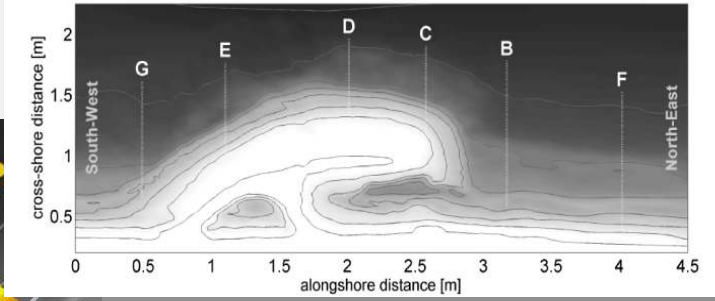
# Field evidence

- Coarsening of $D_{50}$ at peninsula
- Fining of the bed at the flanks

- Reduction of coarsening due to storms

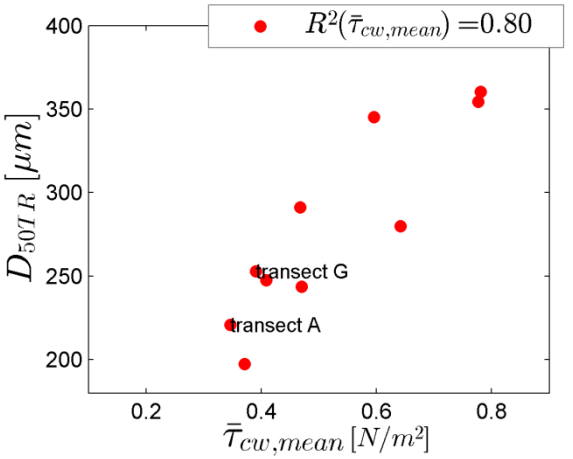


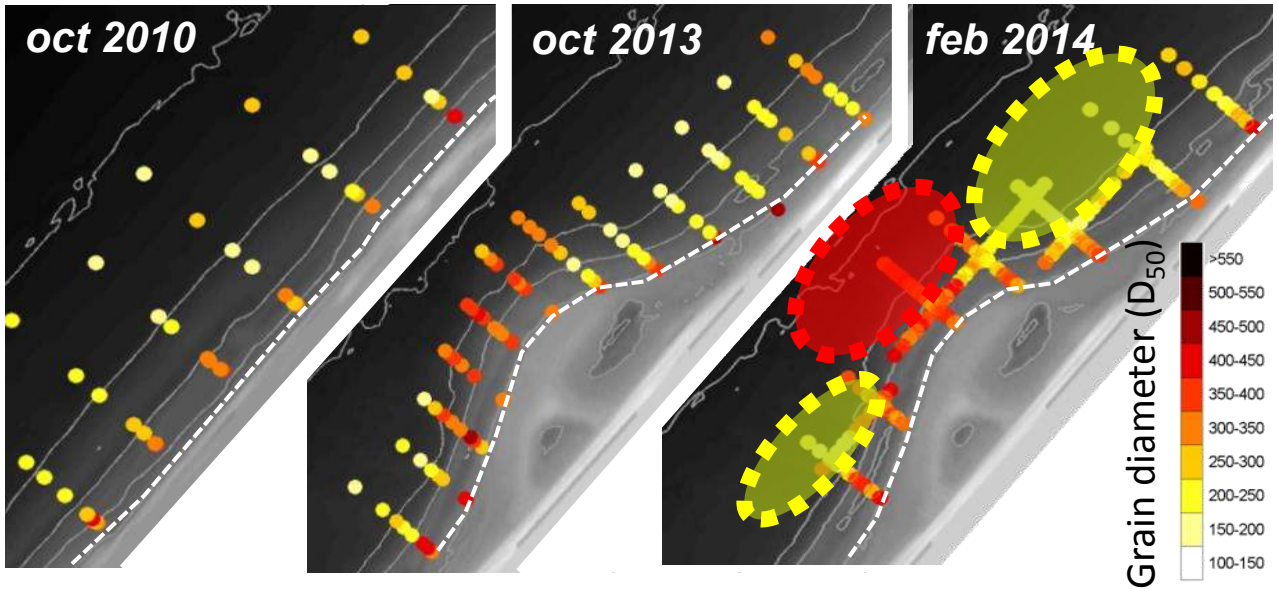




**Huisman et al. (2016)**

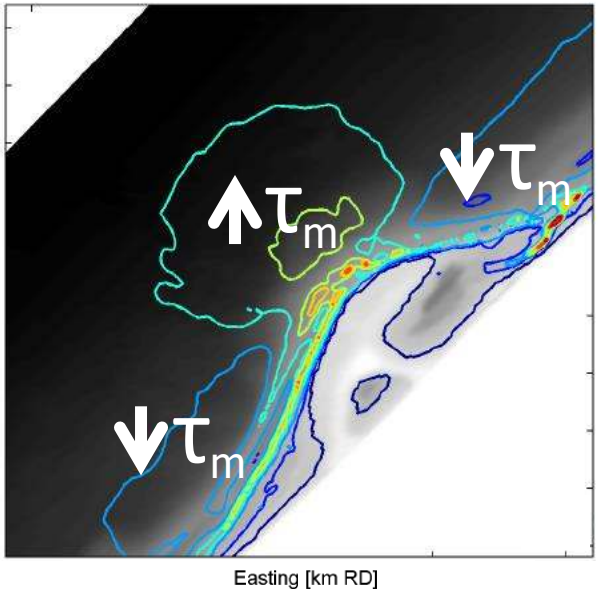
# Field evidence




- Coarsening of $D_{50}$
  - Outside surfzone till MSL-15m
  - $A_{coarse\ bed} > A_{sandmotor}$
  - Reduction of coarsening due to storms




*Mean bed shear stress* ($\tau_m$)




- Related with hydrodynamics ($\tau_m$)

**Huisman et al. (2016)**

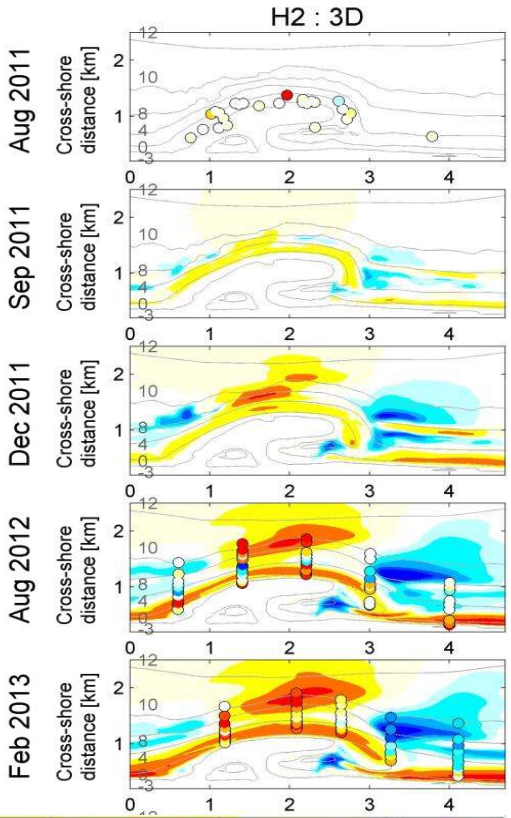
# Field evidence

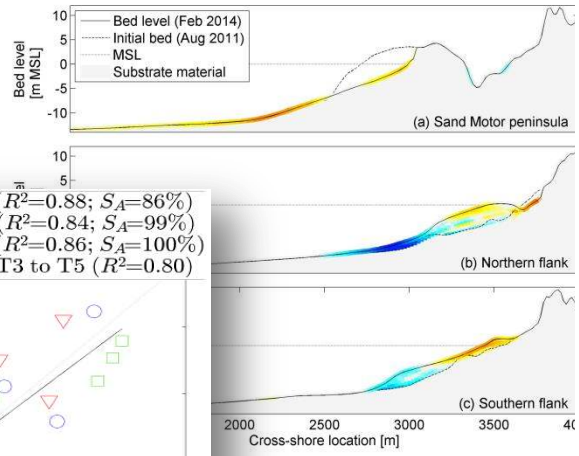
## Relevance at the Sand Motor?

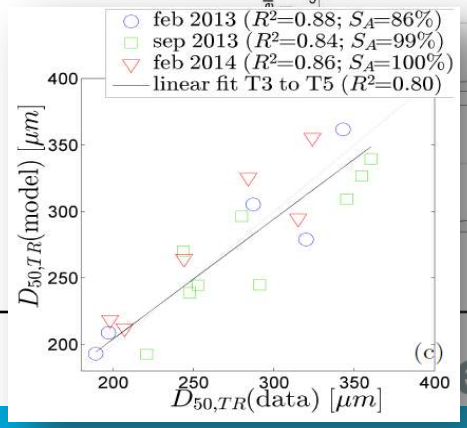
**Observed**

# Model predictions

- Predictions with Delft3D (Huisman et al., 2018)
  - Using Delft3D 12 layers (Lesser et al., 2004)
  - 2.5 year hindcast
  - Tide + Wave time-series
  - Sediment : 5 fractions
  - Transport : 5 seperate computations
  - Multi-layer bed administration

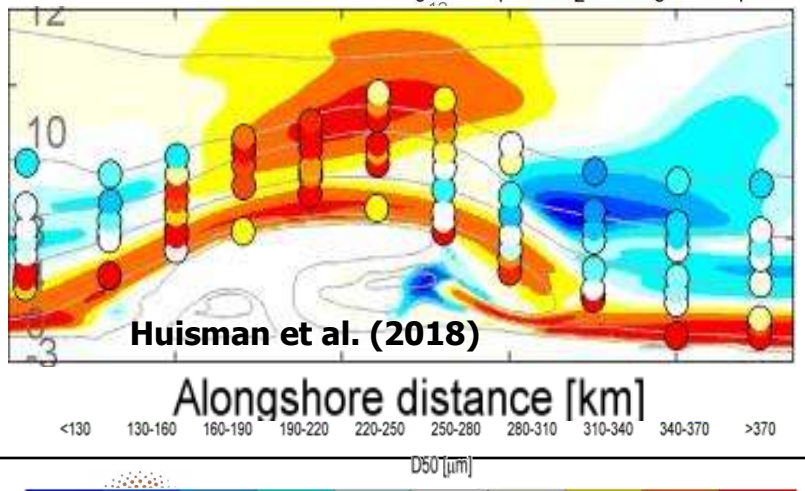


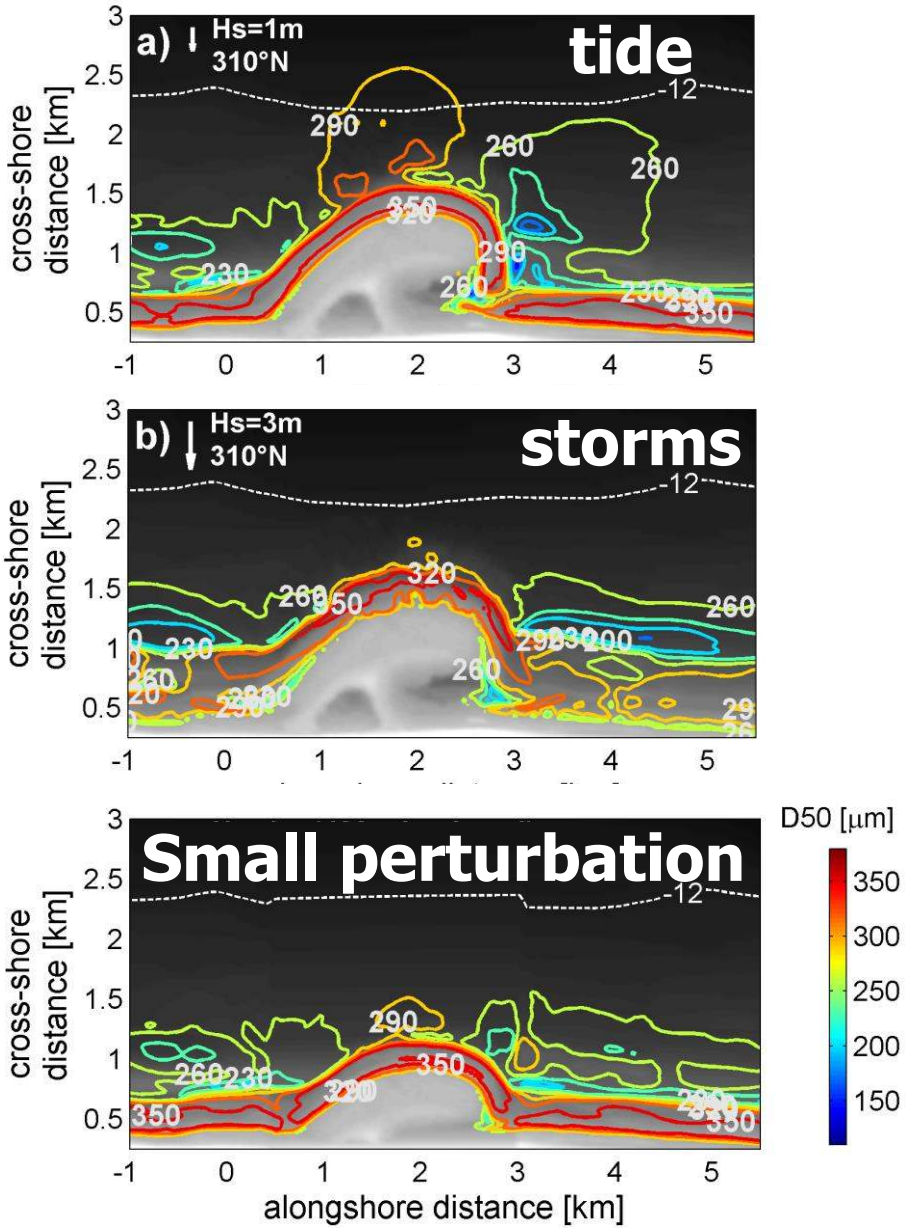

Oct 2013

Cross-shore distance [km]



# Model predictions

- Predictions with Delft3D
  -> influence of conditions
  (Huisman et al., 2018)
  - Sensitivity to tide
    + moderate waves
  - Storms hardly impact D50
  - Small Sand Motors
    have hardly and effect

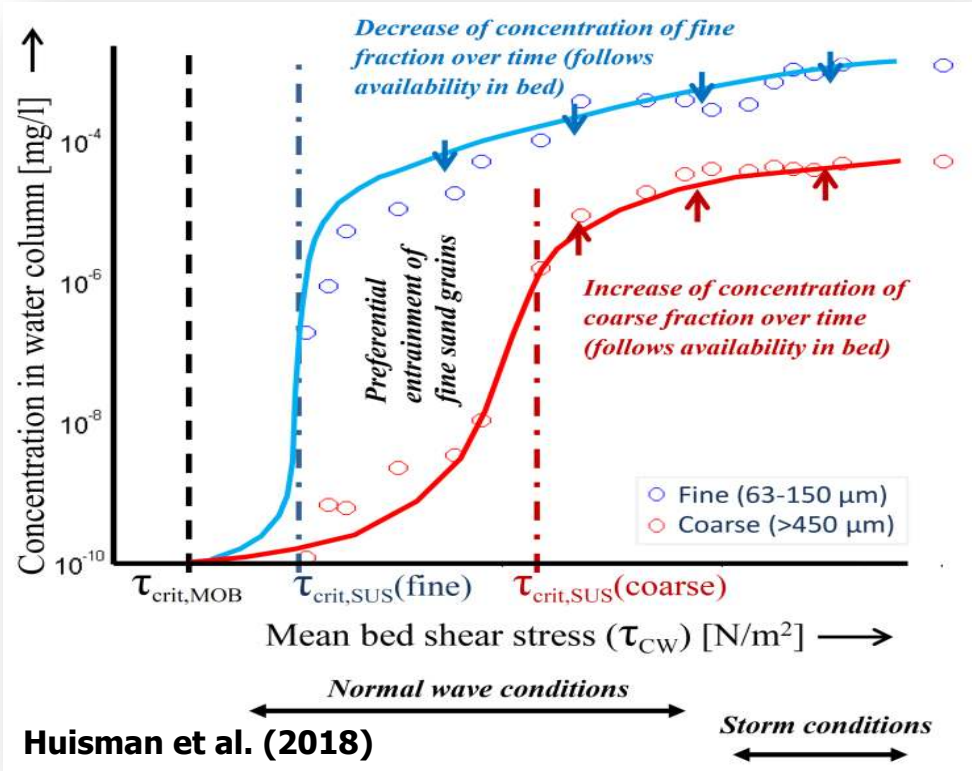


# Principal processes

- What does it tell us?
  - Process is captured with physics in model

- Suspension behaviour of coarse sand!

- The difference in suspension behaviour is largest at intermediate shear stress regimes (Huisman et al., 2018)



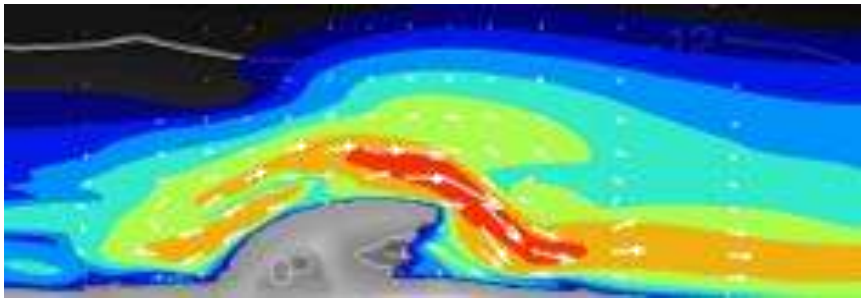
**Huisman et al. (2018)**

# Relevance

- Similar bed composition & habitat changes at any coastal structure!

Design :
- Models available to predict
- Possible to build nature!
  (cross-shore extent / Fine sediment)

Science :
- Check hydrodynamic regime
  -> potential for sorting
- Morphology outside the surfzone
- Infer knowledge from bed sediment composition -> model validation



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