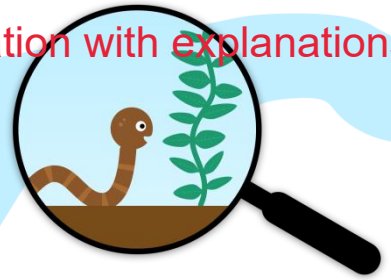
Universiteit Utrecht
Faculty of Geosciences
River and delta morphodynamics

Benthic species as mud patrol - modelled effects of bioturbators and biofilms on large-scale estuarine mud and morphology

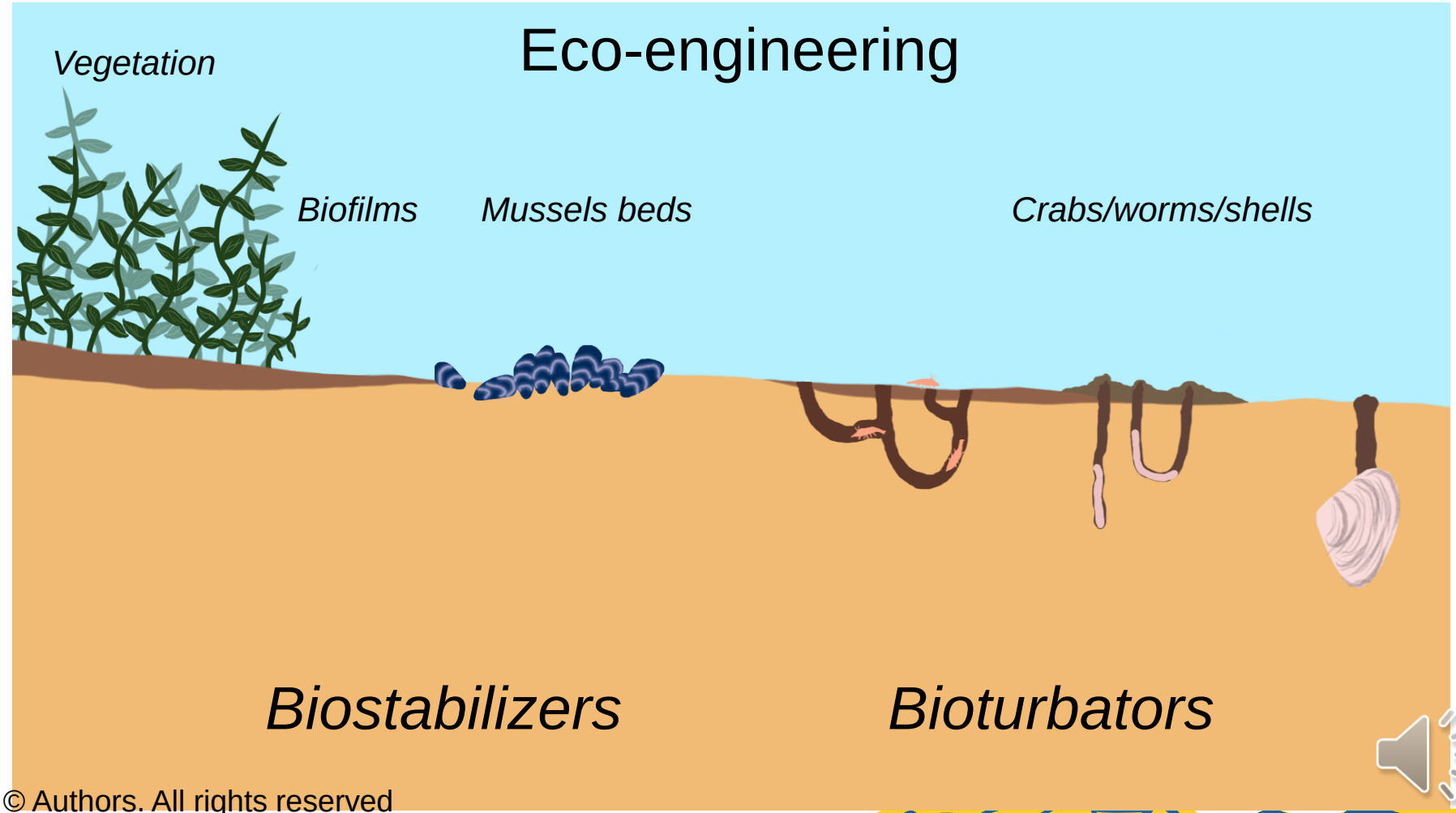
Muriel Z.M. Brückner, Christian Schwarz, Giovanni Coco, Anne Baar, Marcio Boechat Albernaz, Maarten Kleinhans

Please note that that full presentation with explanations is available under the vimeo link



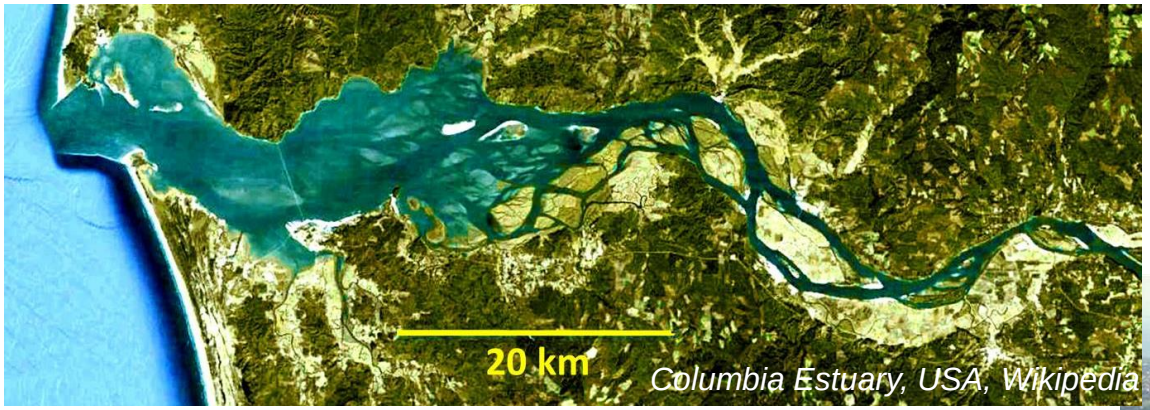
European Research Council
Established by the European Commission
Supporting top researchers from anywhere in the world

Eco-engineering

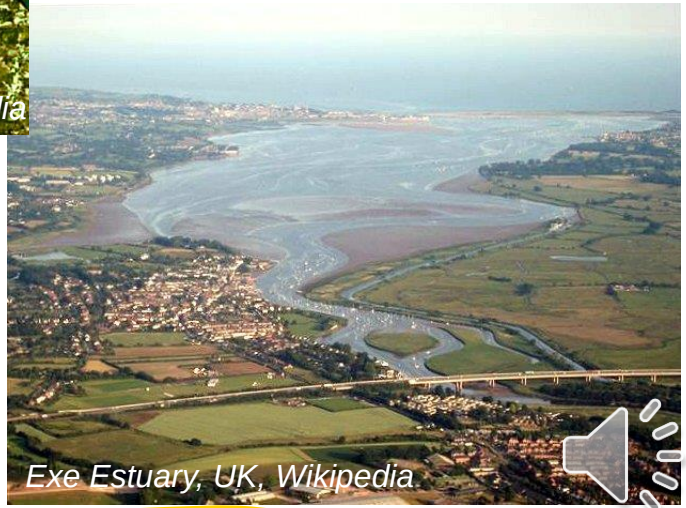


Hypothesis:

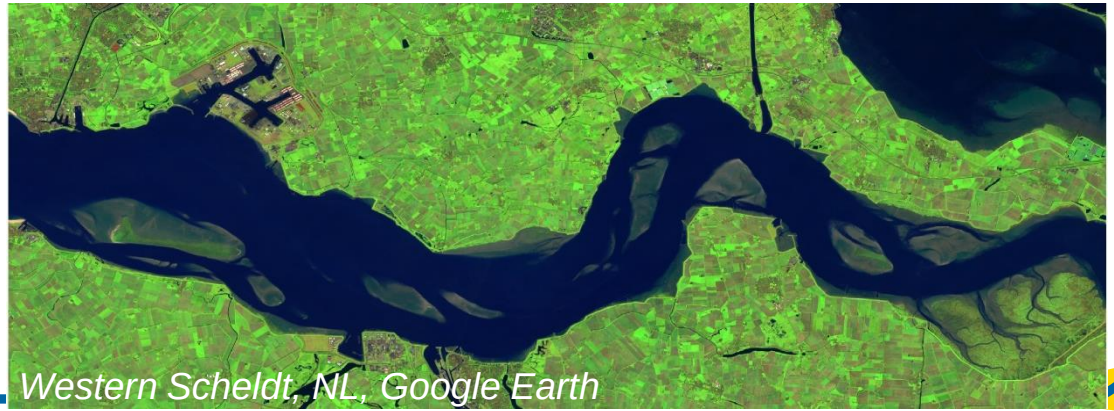
These morphologies are partly determined by benthos!



Columbia Estuary, USA, Wikipedia



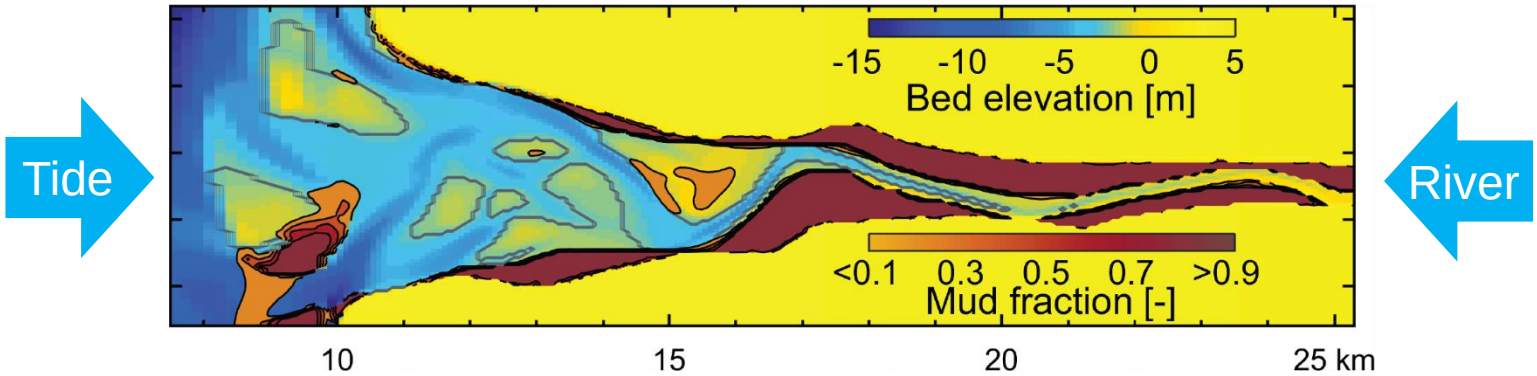
Exe Estuary, UK, Wikipedia



Western Scheldt, NL, Google Earth

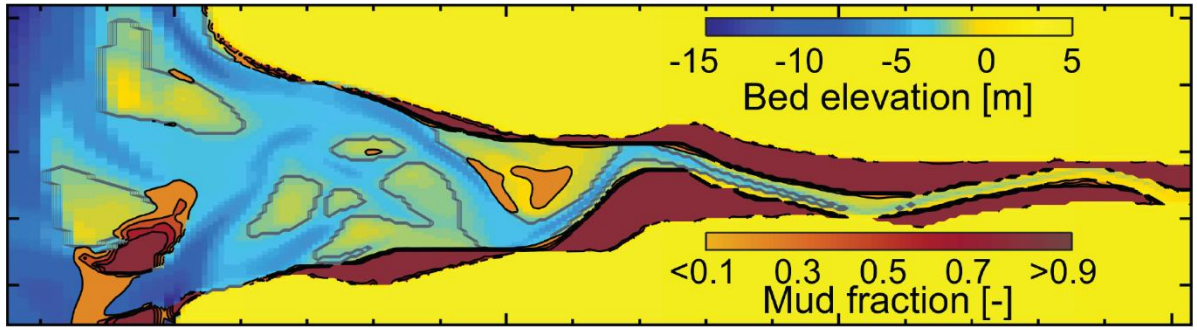
The eco-morphodynamic model

Idealized hydro-morphodynamic estuary in Delft3D



The eco-morphodynamic model

Idealized hydro-morphodynamic estuary in Delft3D

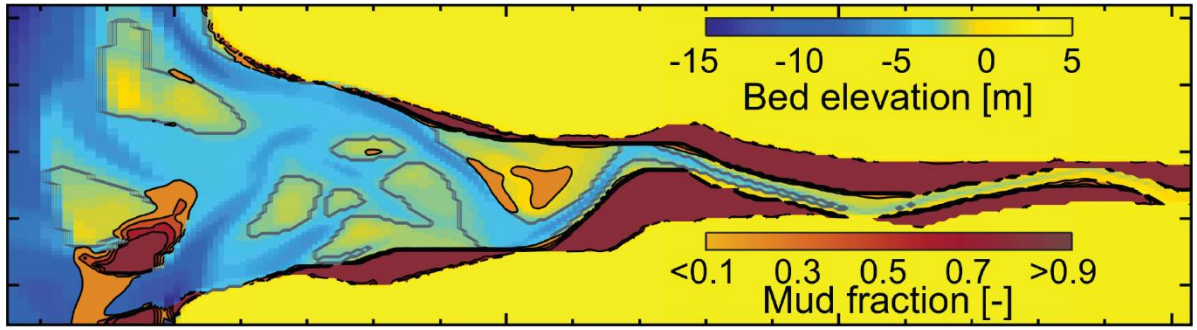


Coupling every M2-tide

Ecological model in MATLAB

The eco-morphodynamic model

Idealized hydro-morphodynamic estuary in Delft3D



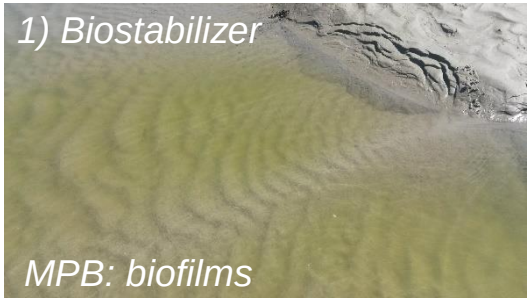
Species distribution affects erodibility of mud:
- *crit. bed shear stress*
- *erosion parameter*

Coupling every M2-tide

New hydro-morphology affects species distribution:
- *Inundation*
- *Flow velocity*
- *Mud content*

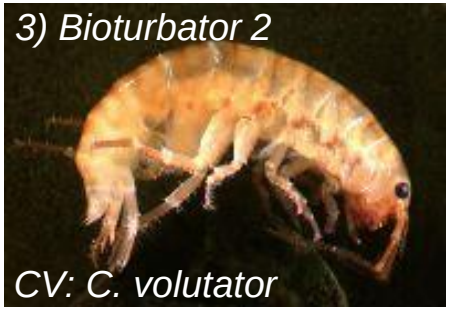
Ecological model in MATLAB

Typical species in NW-Europe



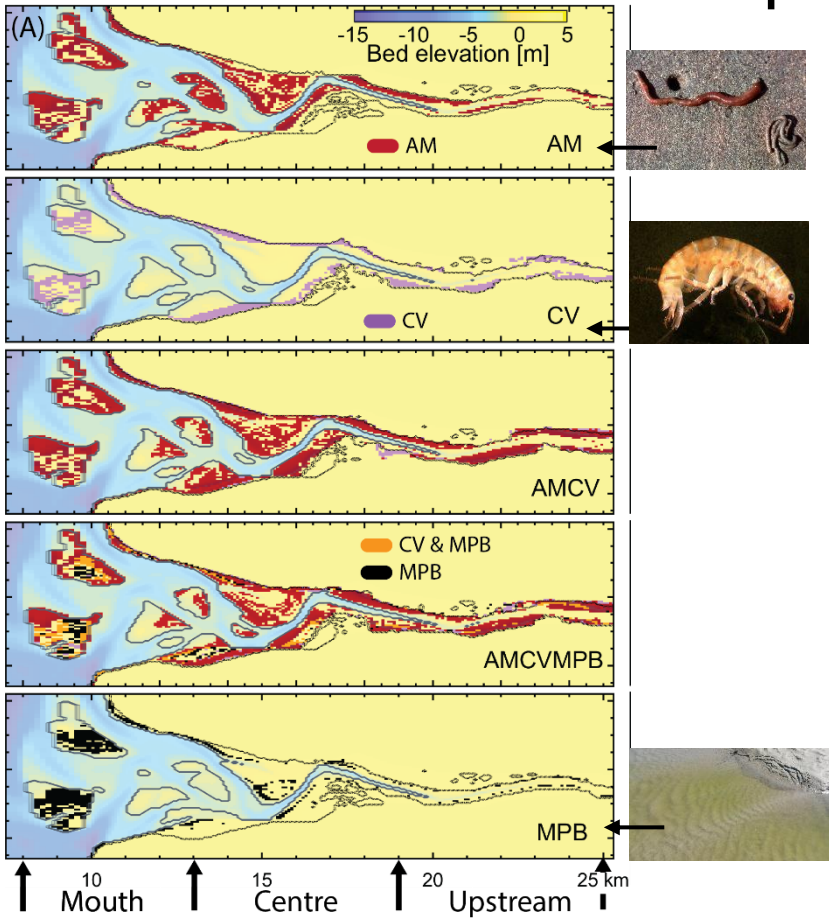
- Muddy and calmer environments

- Sandy and dynamic environments
- Low bioturbation potential



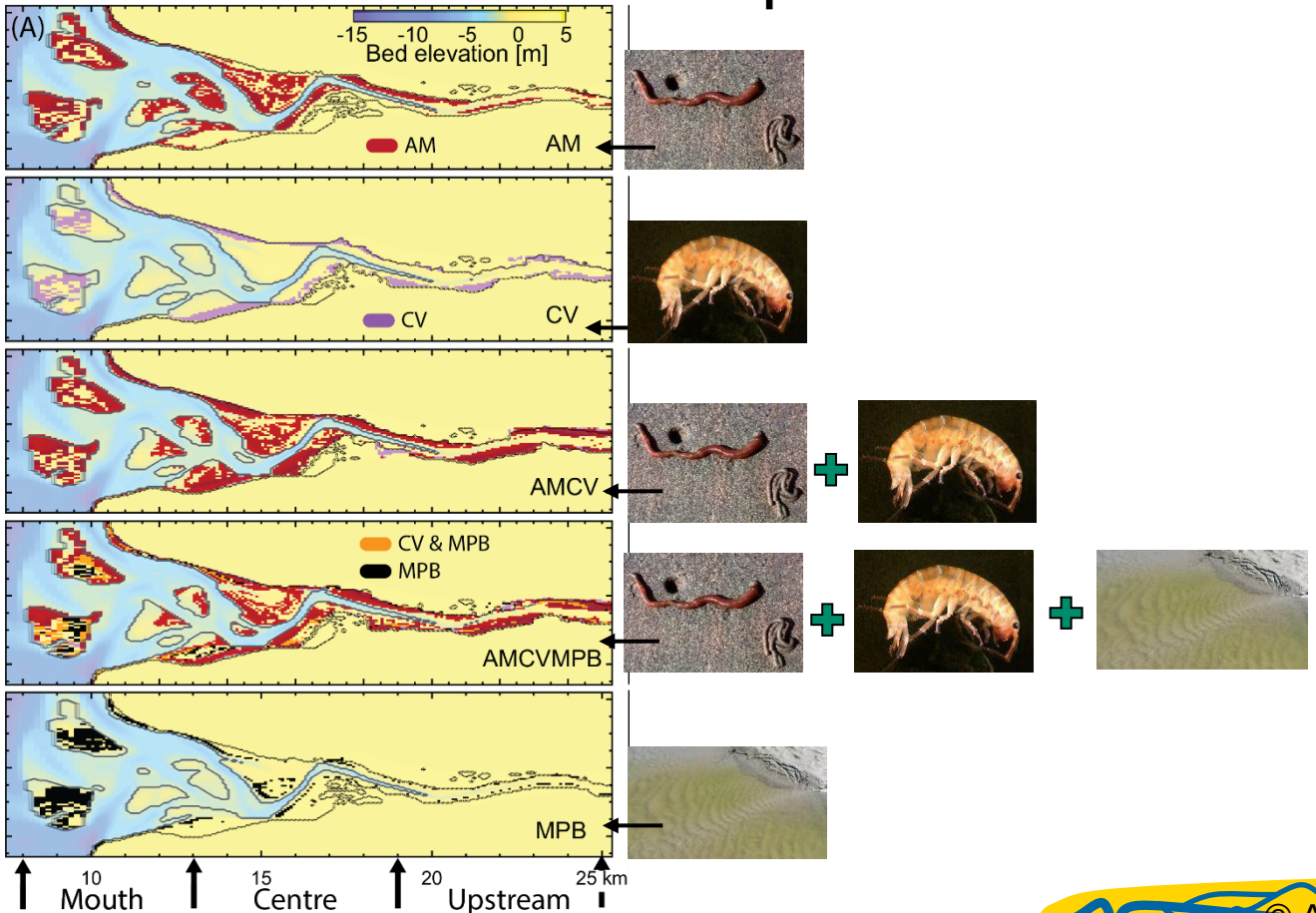
- Muddy and calmer environments
- High bioturbation potential

Results: Species distribution



- AM larger abundance
- CV and MPB limited abundance

Results: Species distribution



- AM larger abundance
- CV and MPB limited abundance

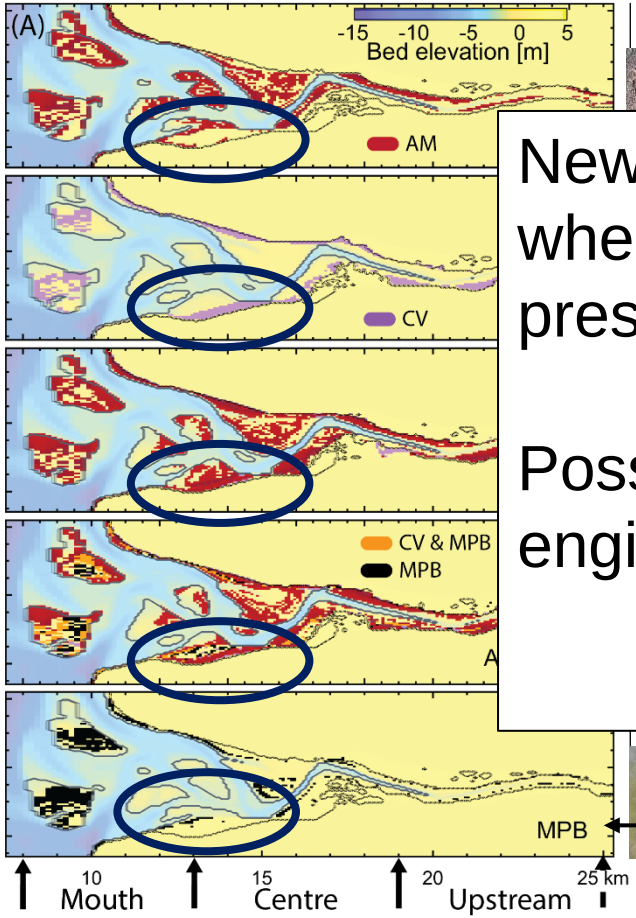
AMCV:

- CV reduces

AMCVMPB:

- CV increases
- MPB reduces

Results: Species distribution



New species distributions when several species present!

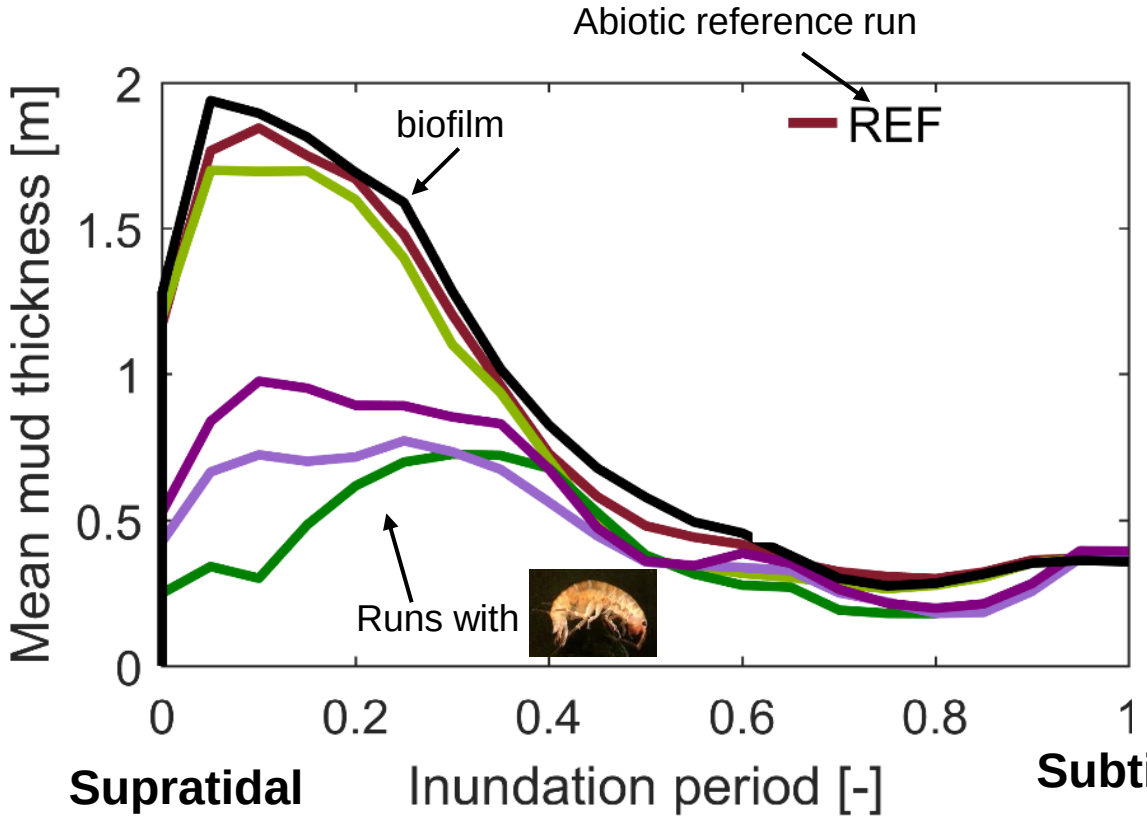
Possibly because of eco-engineering?

- AM larger abundance
- CV and MPB limited abundance

AMCV:
- CV reduces

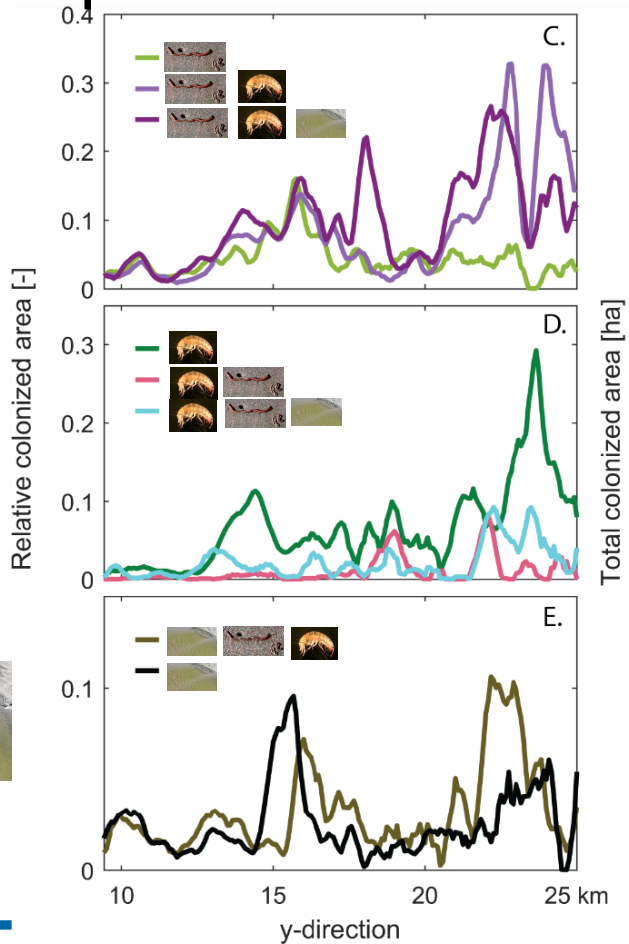
AMCVMPB:
- CV increases
- MPB reduces

Mean mud thickness along intertidal gradient



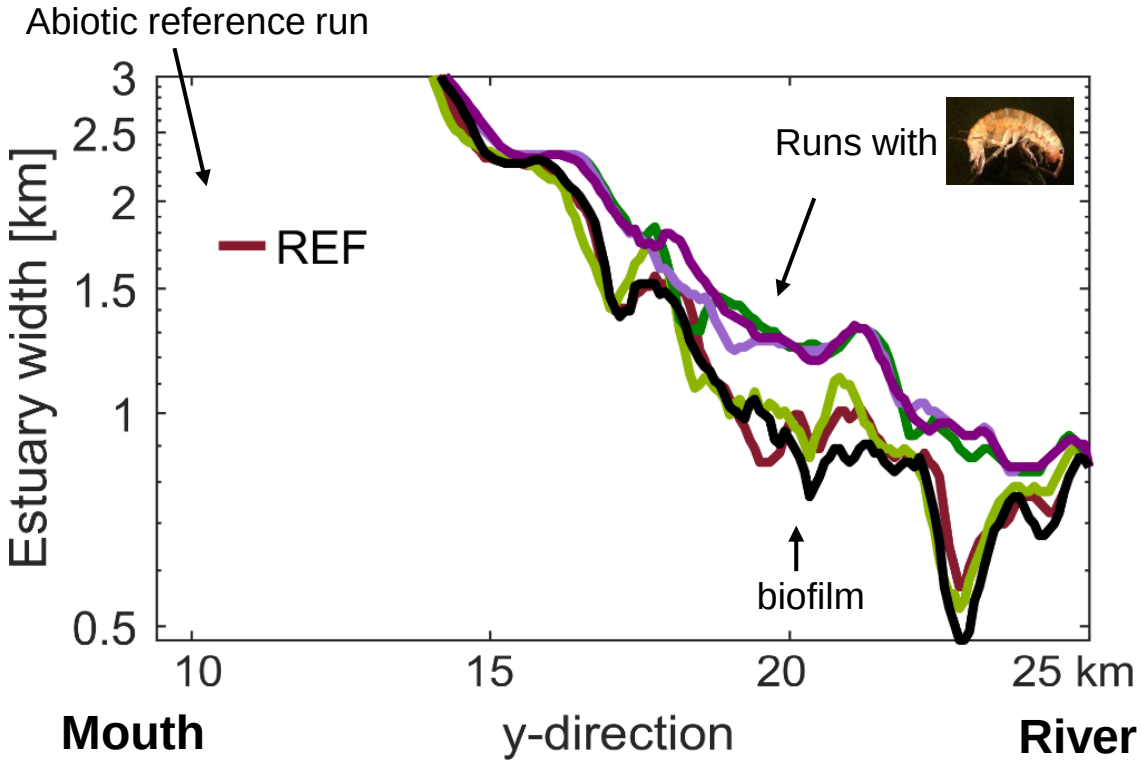
- CV determines mud thickness – species type is important
- Bioturbators export mud from the system, biofilms enhance mud
- New habitat for co-existing species

New species distributions along and across estuary



- AM can expand with several species
- CV reduces with several species
- MPB shifts

Estuary width along estuary



- Bioturbators (especially CV) widen the estuary
- Biofilms confine the estuary

Conclusions

1. Benthic organims determine mud content, estuary width and intertidal area extent

2. Effect depends on the type of species

3. Species communities have new distributions and different effects on morphology

- The model is published on github and freely available (https://github.com/Mbruckner42)

Brückner, M. Z., Schwarz, C., Coco, G., Baar, A., Boechat Albernaz, M., & Kleinhans, M. G. (2021). Benthic species as mud patrol-modelled effects of bioturbators and biofilms on large-scale estuarine mud and morphology. *Earth Surface Processes and Landforms*.

m.bruckner@exeter.ac.uk