

# Turning the tide: Effects of mud supply on large-scale estuarine morphology

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EGU2016-5618



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River and delta morphodynamics



## Project summary

Potentially, sandy river estuaries have great economic and ecologic values, but a better understanding is required about the effect of mud on large-scale morphodynamics to optimise maintenance strategies. Very few studies actually include the effects of mud on morphodynamics on decadal and centennial timescales due to model limitations and lack of spatially and temporally dense data of mud in the bed. Here we aim to isolate the effects of cohesive sediment supply on equilibrium estuary shape, bar-channel patterns and dynamics.

## Modelling results

Only sand

Marine mud supply

Fluvial mud supply

Fluvial and marine mud supply

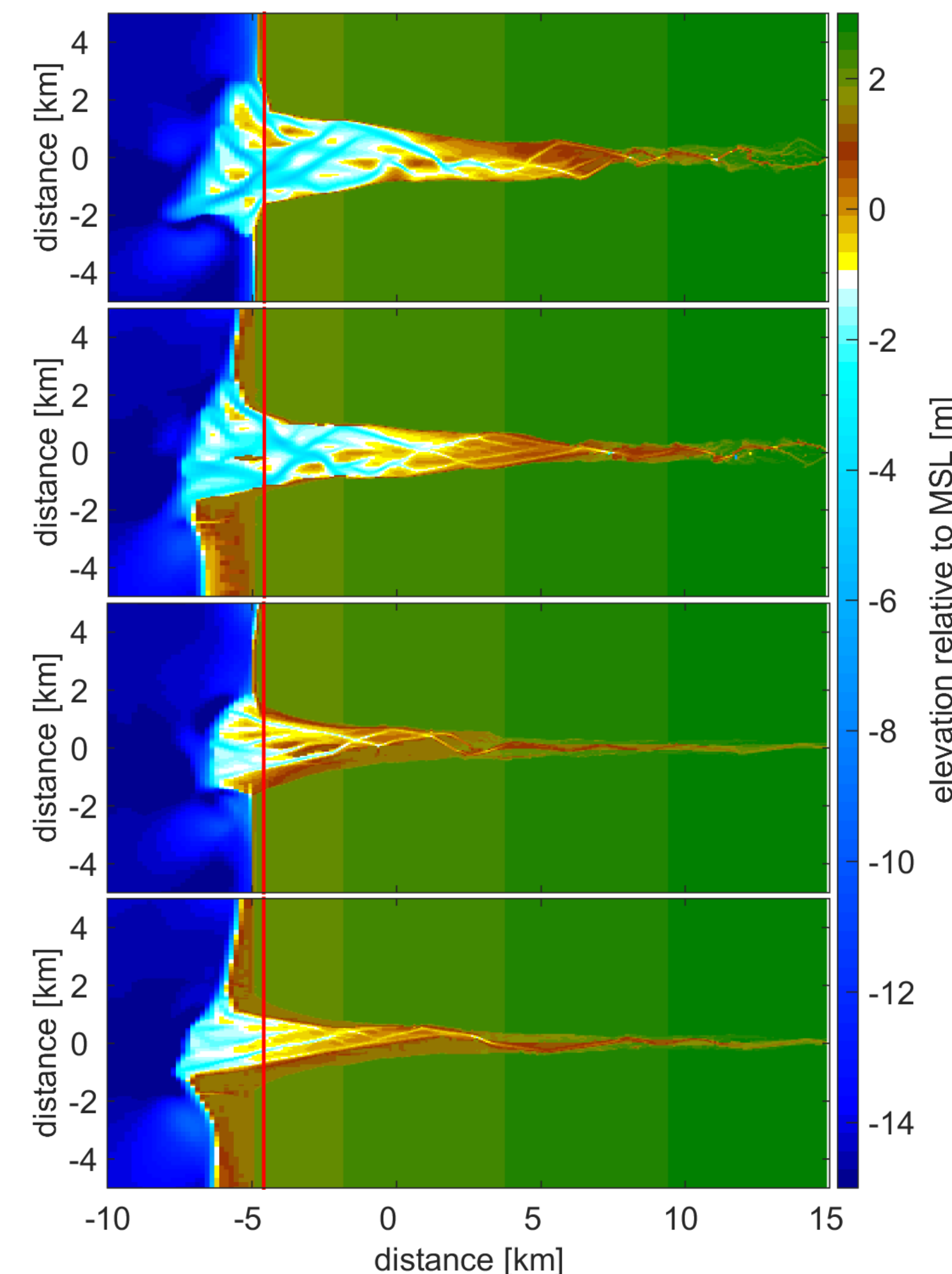


Fig. 1. Final bathymetries of model runs with and without mud supply from river or sea.

## Morphology

- Marine mud confines the estuary mouth and extends the coast
- Fluvial mud is spread through the whole estuary and has a stronger confining effect
- Channel width decreases with fluvial mud, but not with marine mud supply
- Estuary length decreases with fluvial mud supply
- Less meandering upstream with fluvial mud supply

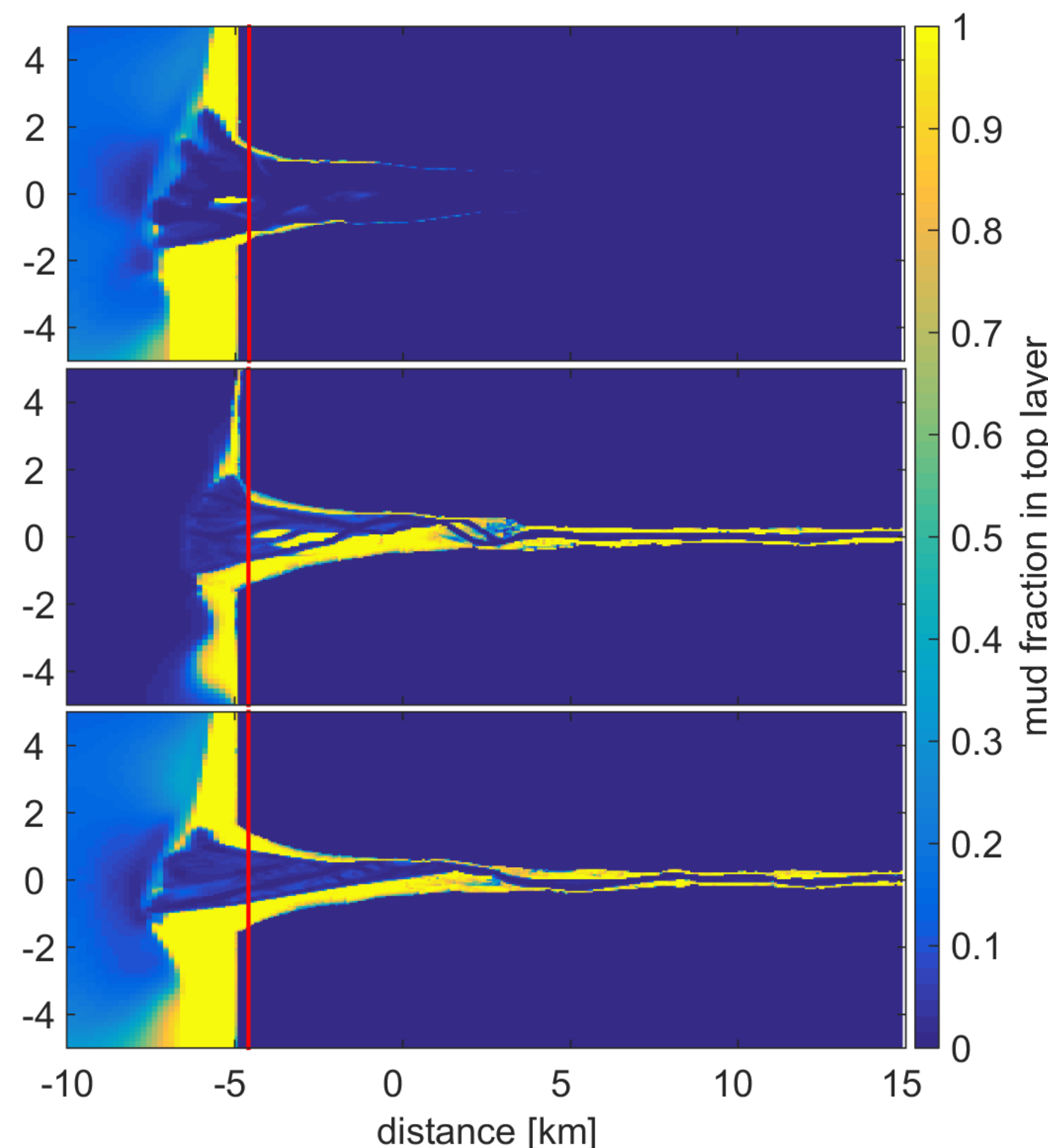


Fig. 2. Final mud deposits of model runs with mud supply from river or sea.

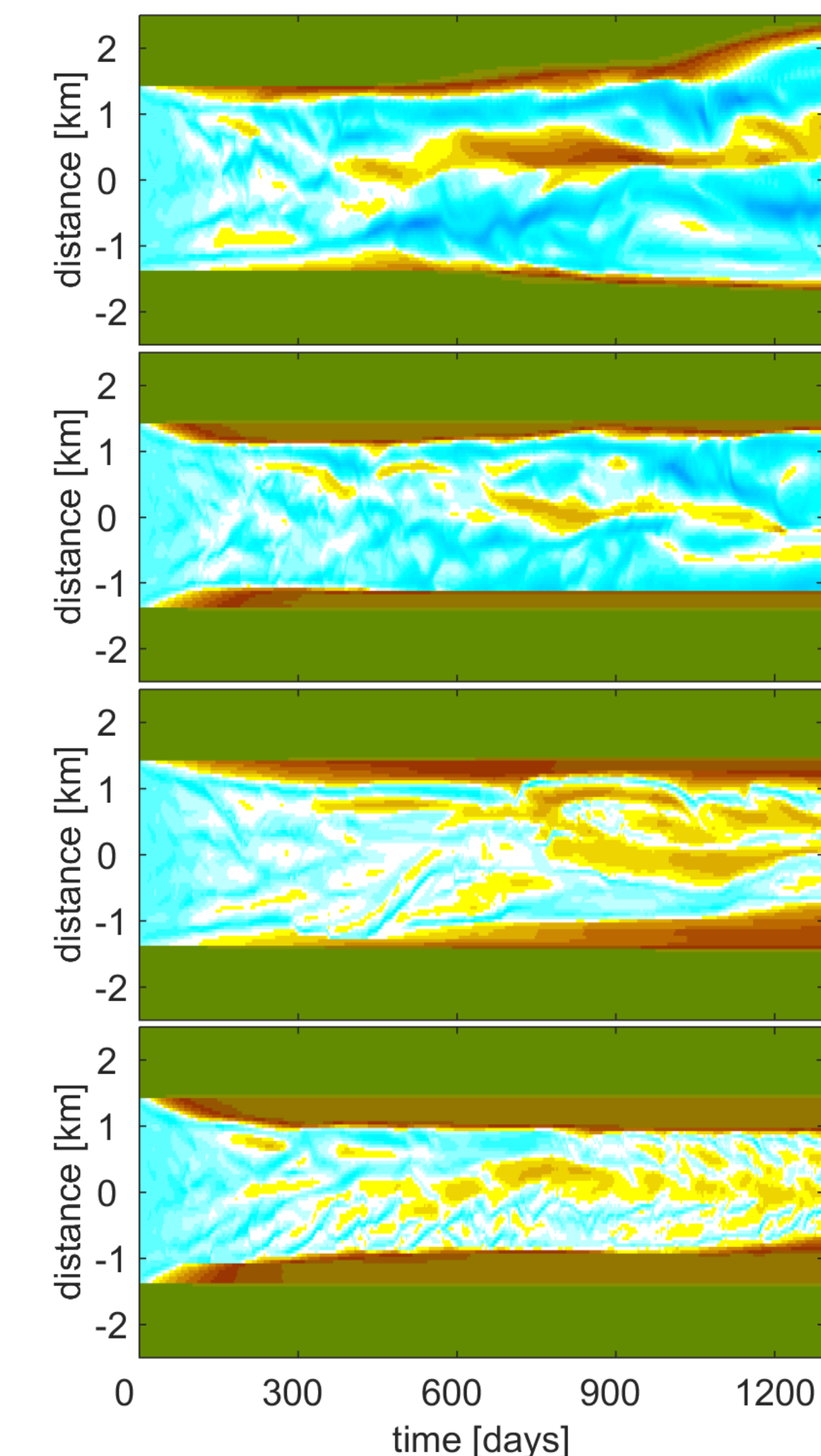


Fig. 3. Bathymetry timestack of cross section near the mouth of model runs with and without mud supply from river or sea.

## Dynamics

- Widening with sand, narrowing with mud
- Mud leads to smaller channels
- Mudflats are quickly formed
- Less migration of channel with mud supply

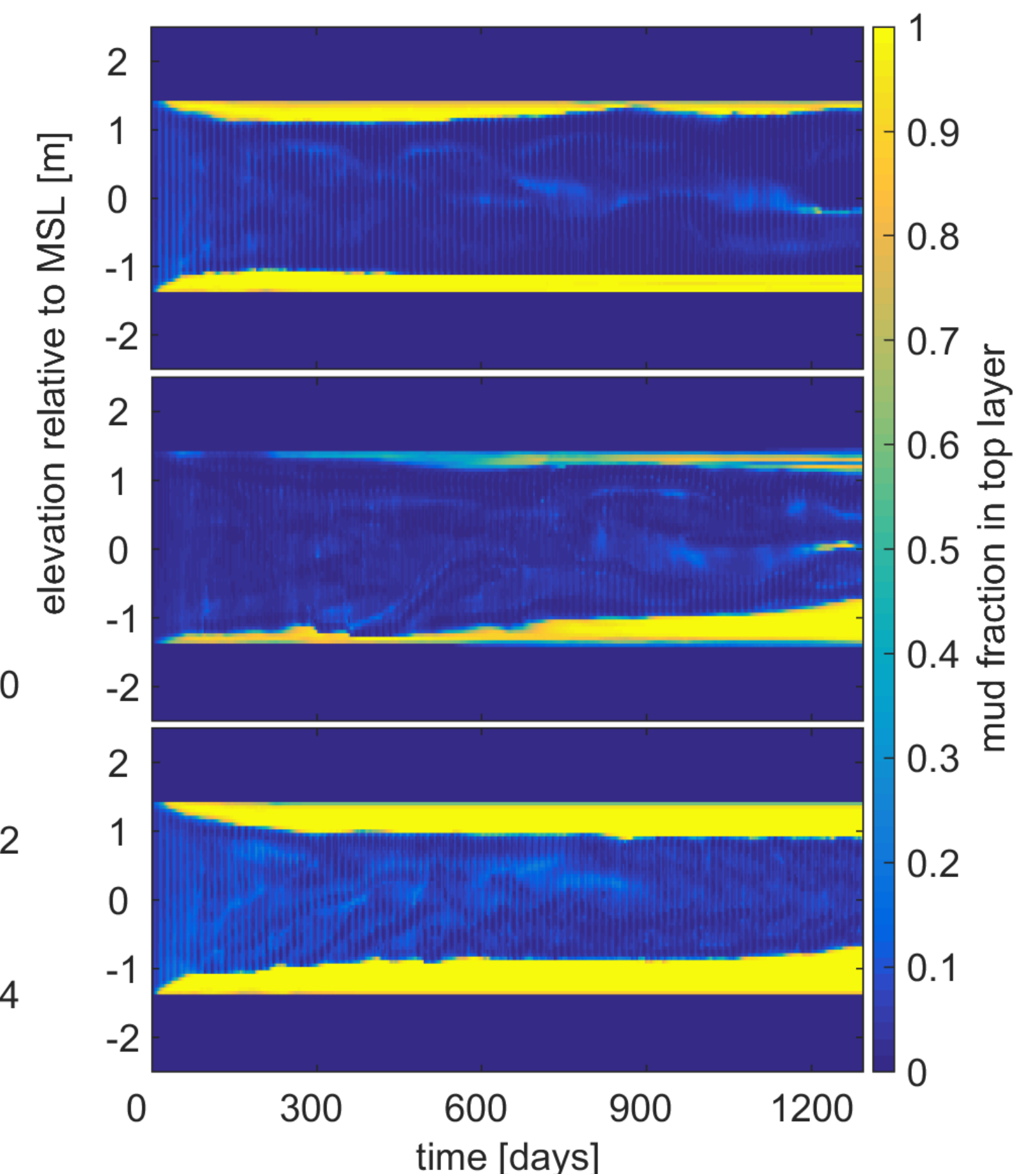


Fig. 4. Mud deposit timestack of cross section near the mouth of model runs with mud supply from river or sea.

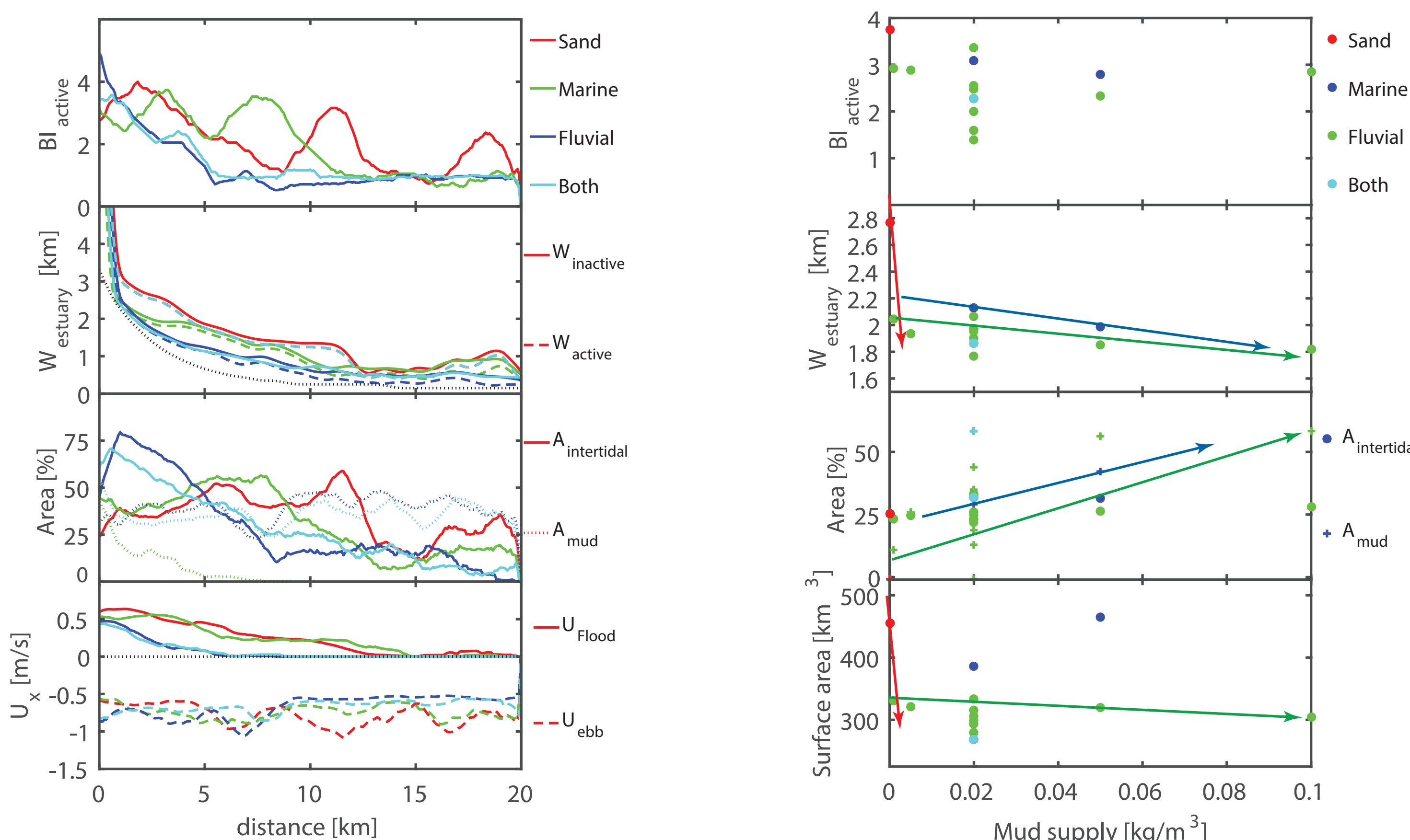


Fig. 5. Braiding index, estuary width, area and velocity along estuary for runs with no mud, marine supply, fluvial supply and both.

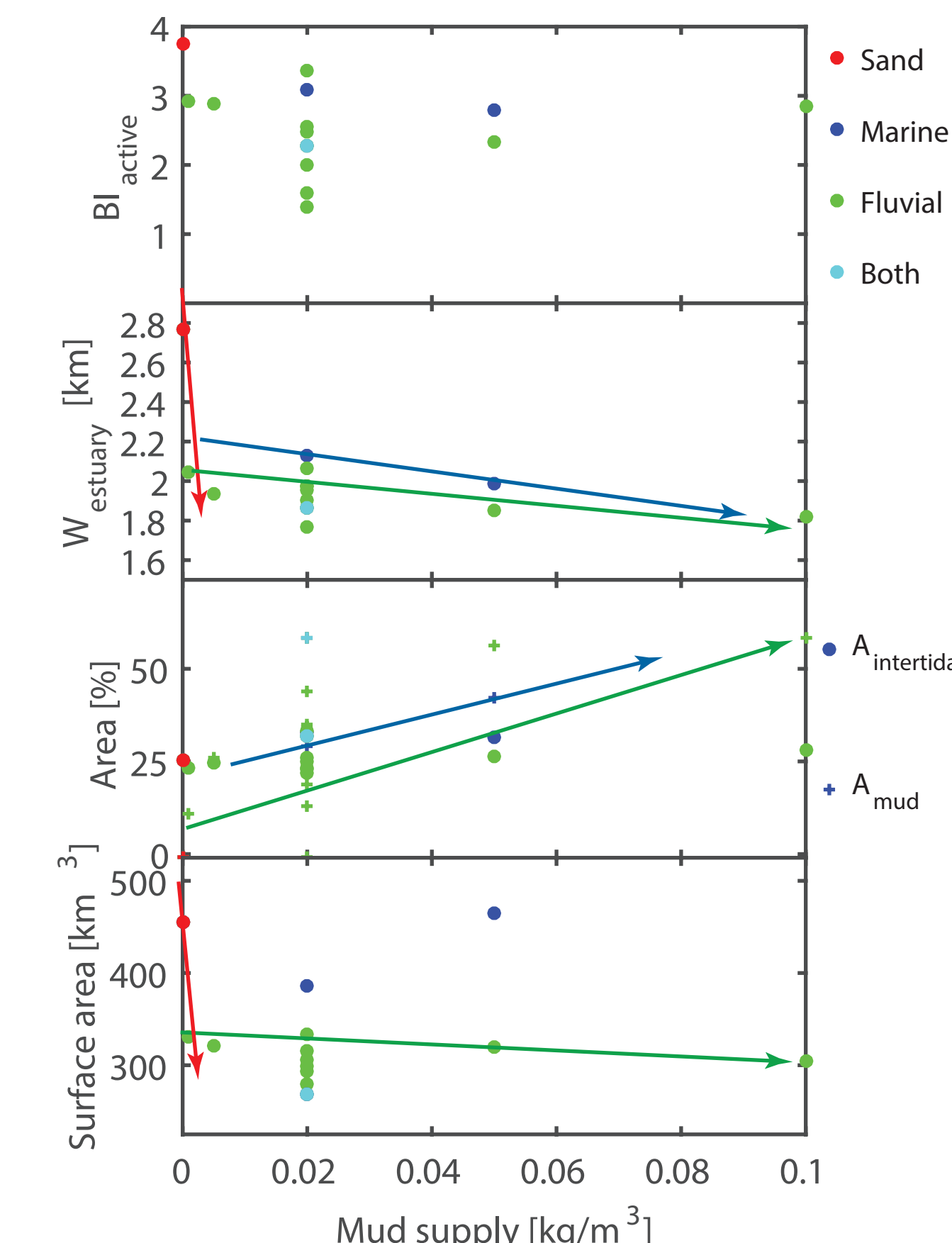


Fig. 6. Mud supply plot against braiding index, estuary width and surface area. All model runs represented as one point.

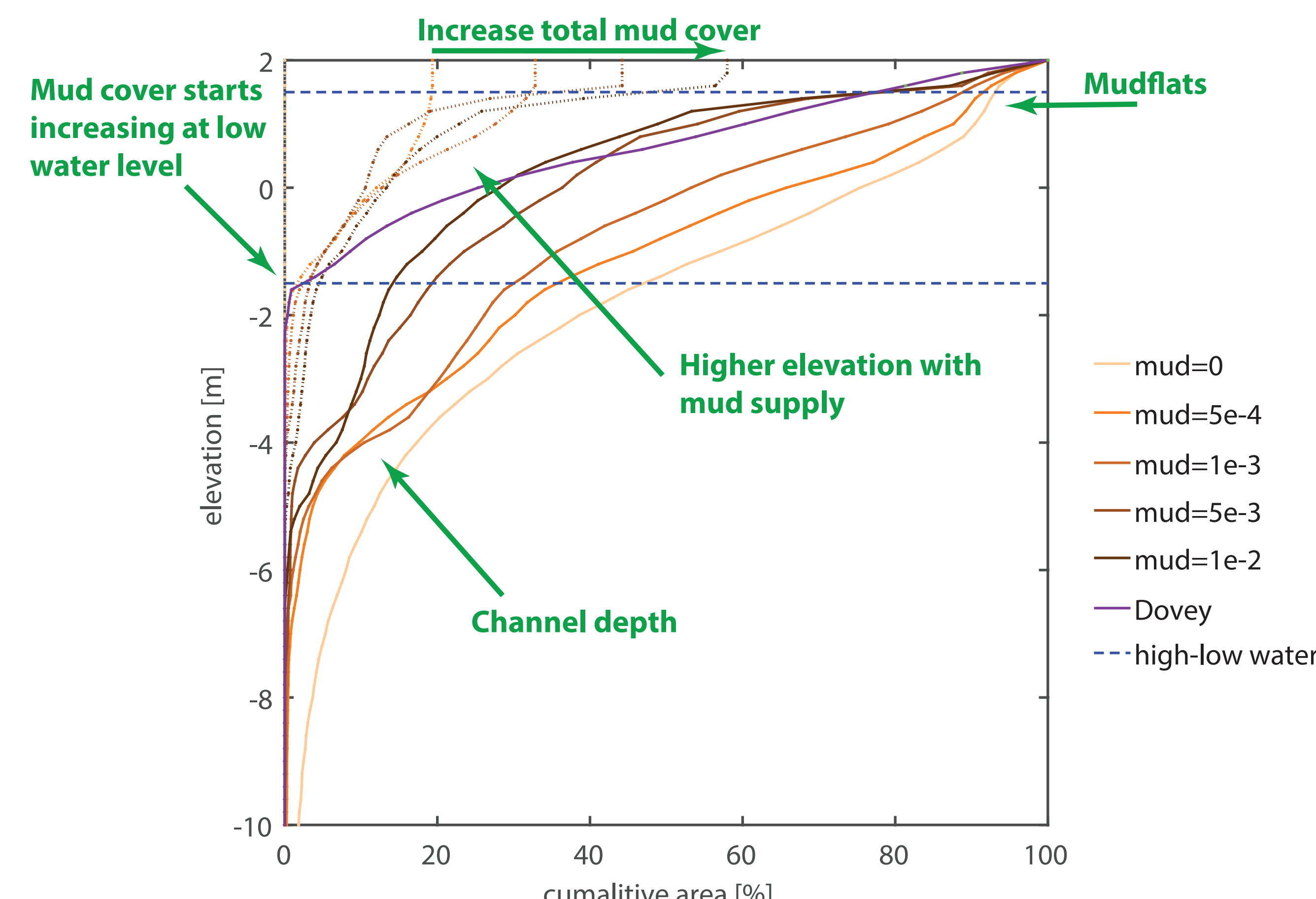


Fig. 7. Hypsometric curves for a range of fluvial mud supply. Dotted lines are the cumulative percentages of surface area covered with mud of the total area.

## Future experiments

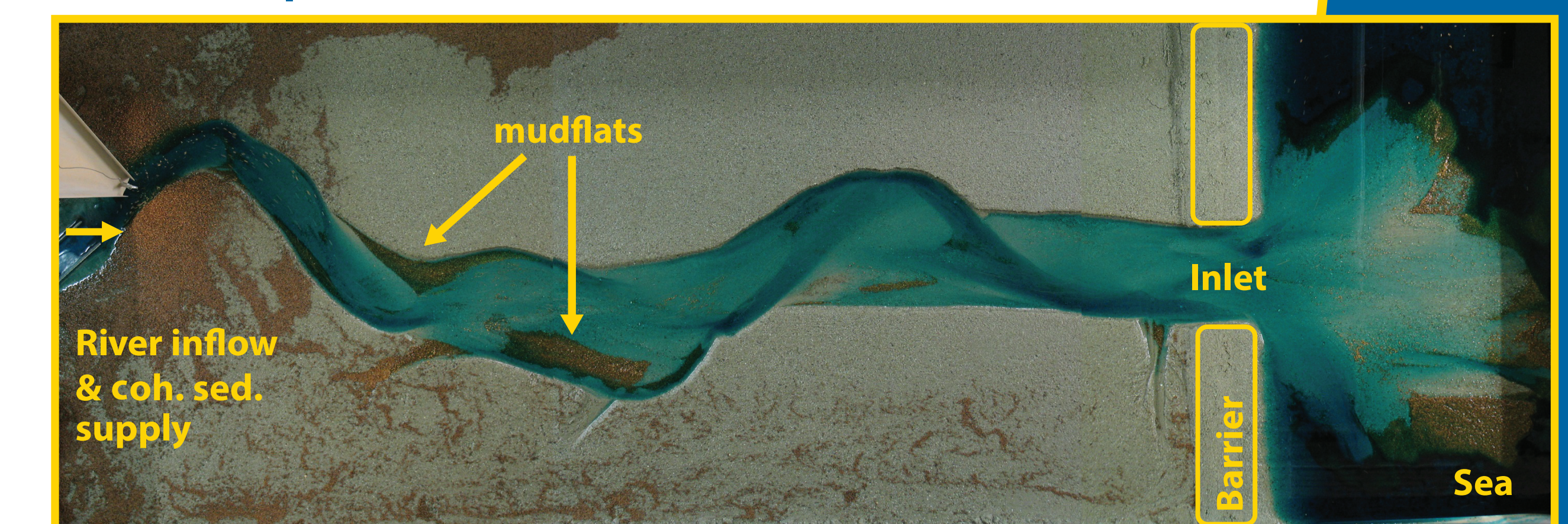


Fig. 8. Pilot experiment in small tilting flume with nutshell acting as cohesive sediment.

## Conclusions

- Mud supply confines estuaries
- More area is covered with mud for higher supply concentrations.
- Marine mud supply narrows the estuary mouth and has limited effect upstream.
- Fluvial mud is distributed over the whole estuary and had therefore a stronger effect by confining the whole estuary.
- Less estuarine dynamics are observed with an increase in mud supply.