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# Effects of closure of secondary basins on depths of estuaries: Insights from an observational and modeling study of the Western Scheldt estuary

## Motivation

Changes in depths of channels and shoals in estuaries are important from an economical and ecological point view:

**Economy:**  
Channels provide natural access to harbors

**Ecology:**  
Shoals and salt marshes stimulate local flora and fauna

## Observations

Since 1800, geometric shape of the Western Scheldt estuary (Fig. 1+2) has been drastically modified by land reclamations (e.g. closure of Sloe, Braakman and Hellega). Historical bathymetric data reveals that although the overall depth of the Western Scheldt has been roughly constant over the last 200 years (Fig. 3, top), since about 1900, however, increased deepening (shallowing) of channels (shoals) have occurred (Fig. 3, bottom). **The key hypothesis** in this study is that these changes can partly be attributed to closure of former secondary basins (Fig. 2).

## Research question

**Effects of closure of secondary basins on depth of channels and shoals in an estuary.**

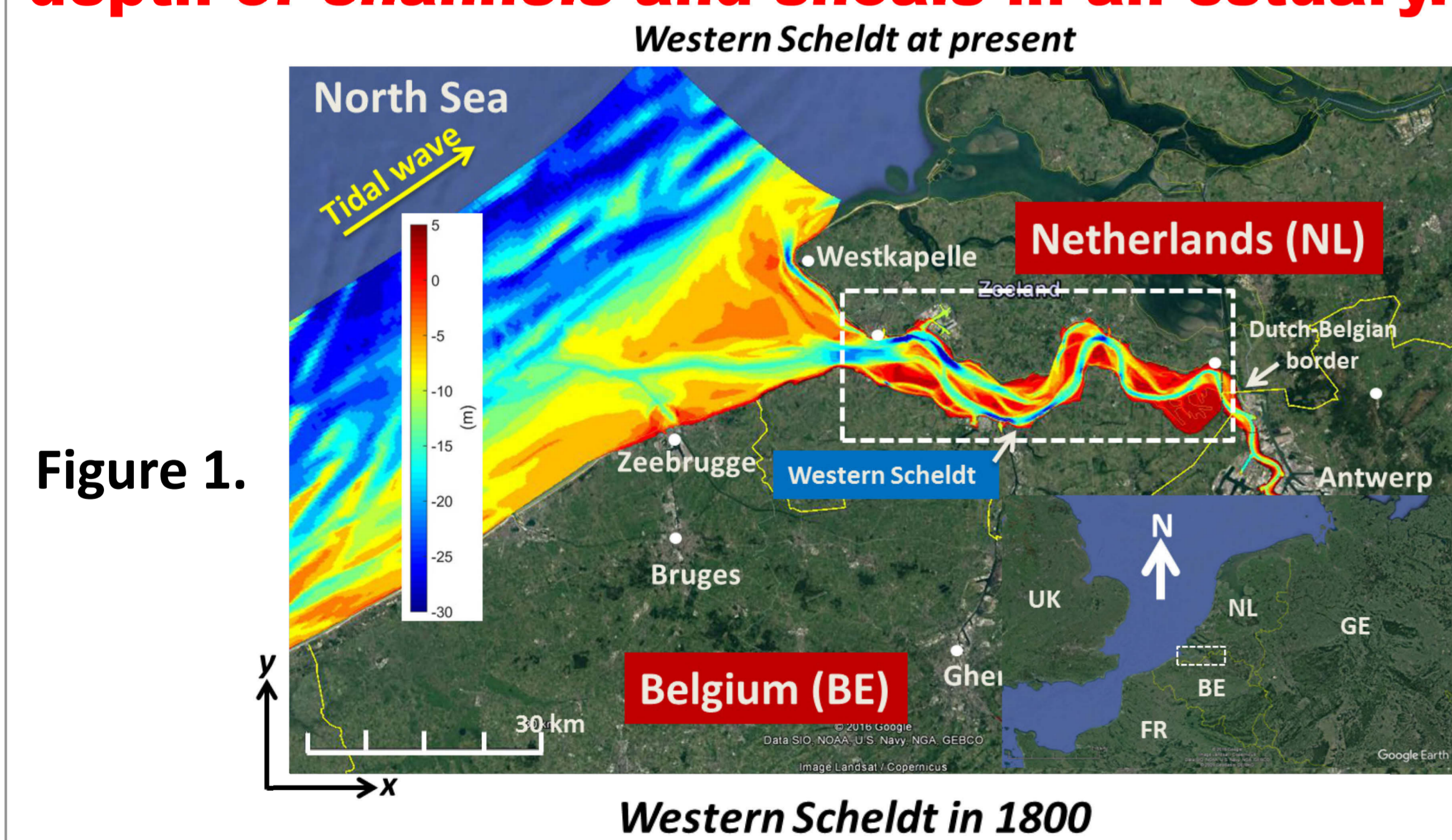


Figure 1.



Figure 2.

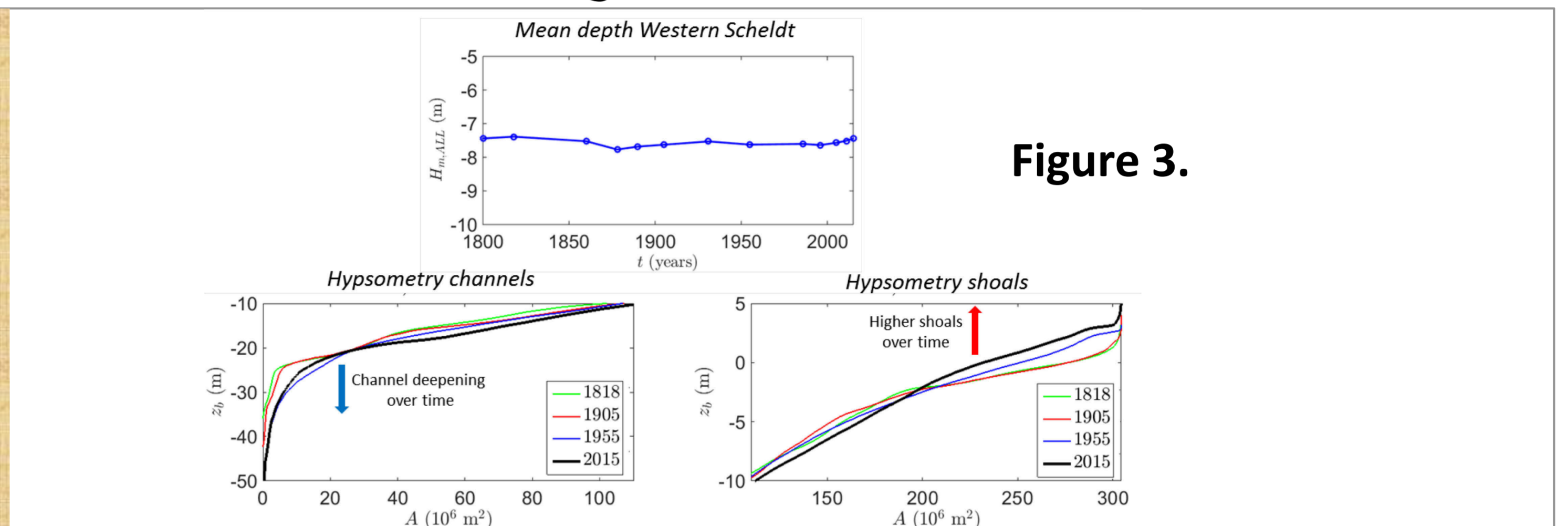


Figure 3.

## Methodology

Idealized modeling approach using Delft3D:

- Alongshore propagating wave (M2+M4+M6) south-north imposed at seaward boundaries (Fig. 4);
- Initial bathymetry: Flat bed;
- Engelund & Hanson transport formulation, ( $d_{50}=0.2$  mm);
- Timestep=0.25 min, Morfac=100; Total simulation time = 600 years.

Experiments:

1. "With SB": Present geometric shape + 3 Secondary basins (SB). Fig. 5.
2. "Without SB": Remove SB after 300 years.

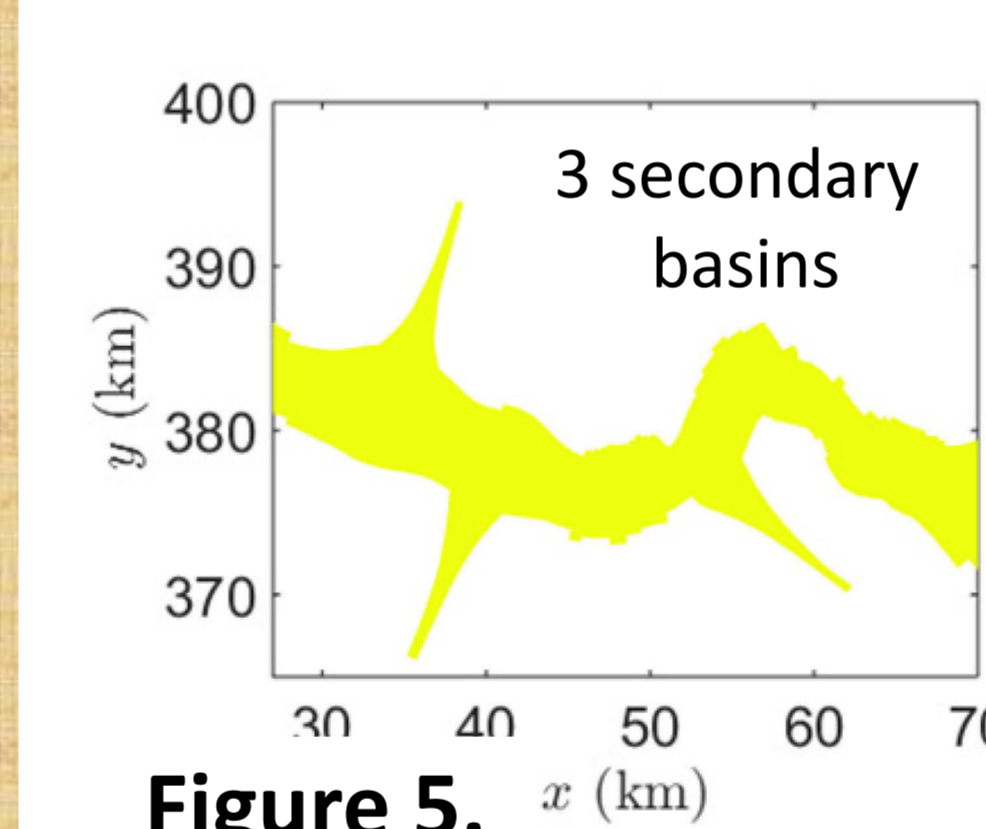


Figure 5.

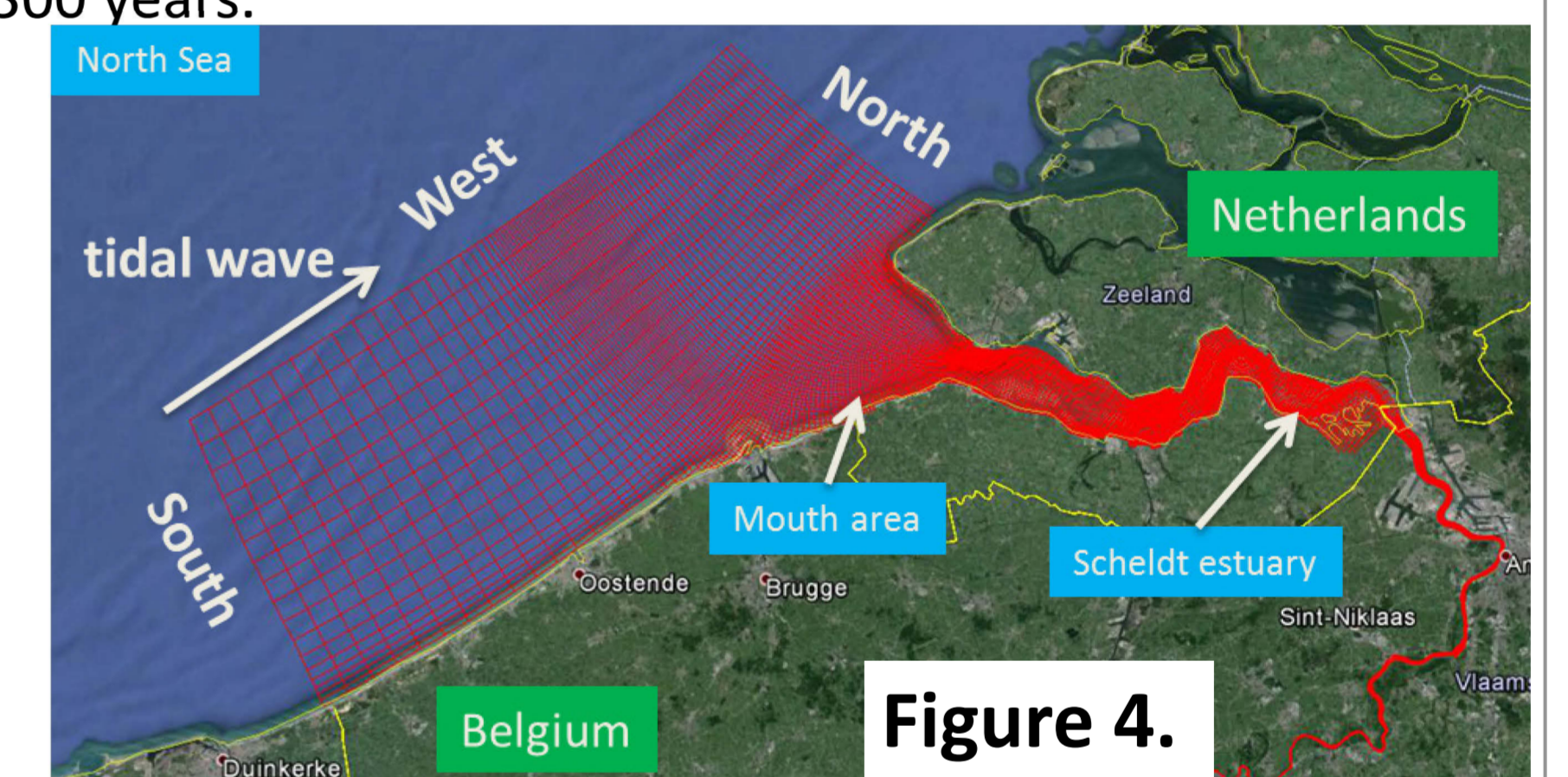


Figure 4.

## Results and Discussion (work in progress)

Figure 6 → After removing the SB at 300 years:

- Channels become deeper compared with the case with SB.
- Shoals become higher, but only after long time scales.
- These changes are attributed to internal redistribution of sand.
- Closure basins took place gradually and not abruptly.
- No sea-level rise; important on time scales considered in this study

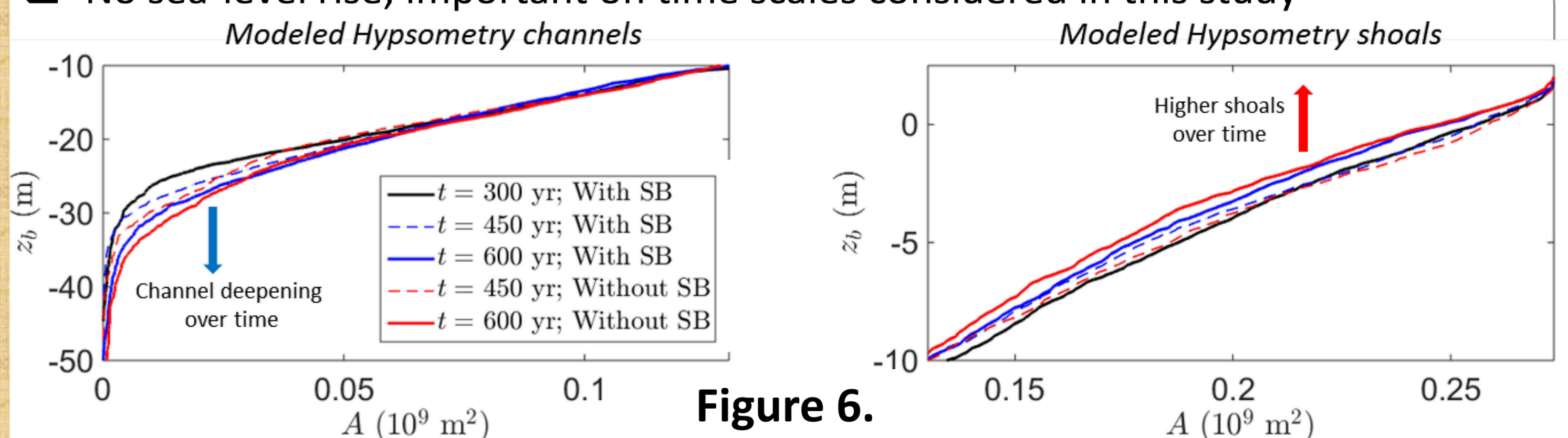


Figure 6.

## Conclusion

**Model results suggest that the observed deepening (shallowing) of channel (shoals) since 1900, can partly be attributed to closure of former secondary basins that started since 1800.**