Evolution of a new tidal river bifurcation:

numerical modelling of an avulsion after a catastrophic storm surge

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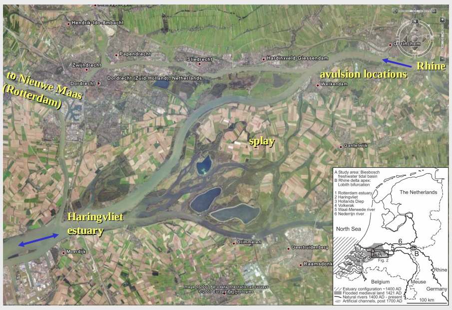
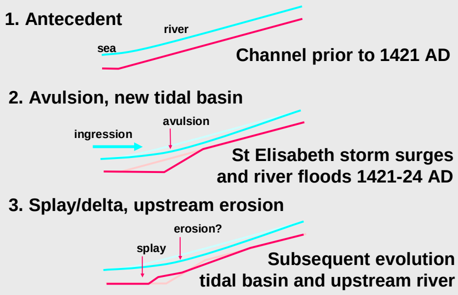
Innundation was caused by a combination of storm surges, river floods and poor dike maintenance. Here we address:

- **How does an avulsion splay develop?**
- **Is there simultaneous erosion upstream in the feeding channel?**

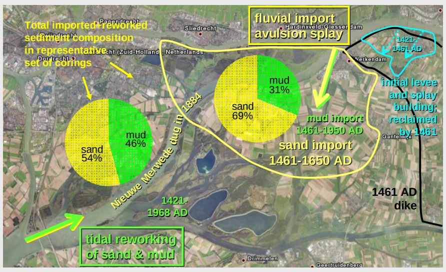
Biesbosch area, The Netherlands



Hypothesis (Kriele et al. 1998):

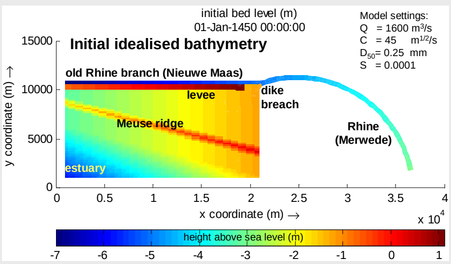


Prelim sediment budget 1461-1650



- Total *imported and reworked* sediment budget 650×10^6 m³ (30x10 km, 2m thick, 50/50 sand/mud)
- Splay sediment: 280×10^6 m³ sand+mud in 200 yr
- Fluvially *imported* sand: 180×10^6 m³ = ~900,000 m³/year
- For comparison: modern upstream channel transport rate = ~560,000 m³/year

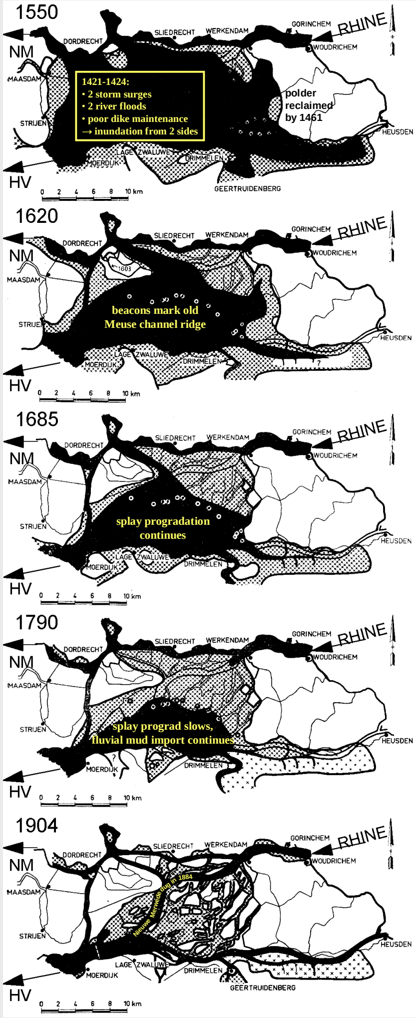
Idealised 3D splay modelling



- deep (4m) / shallow basin (2m) / no basin
- no tides / tides (M2, O1): about 2 m range
- simple basin / antecedent relief
- Engelund-Hansen / Van Rijn

Reconstructed splay development

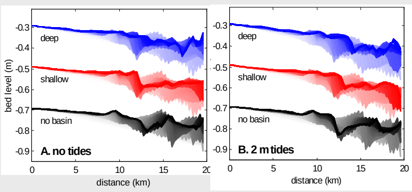
(Zonneveld 1960)



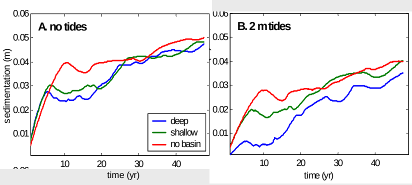
Setting:

- Shallow lake (2-4 m)
- Freshwater input
- Tides? 2 m range in 19th/20th century

Modelled adaptation of upstream channel for 6 scenarios

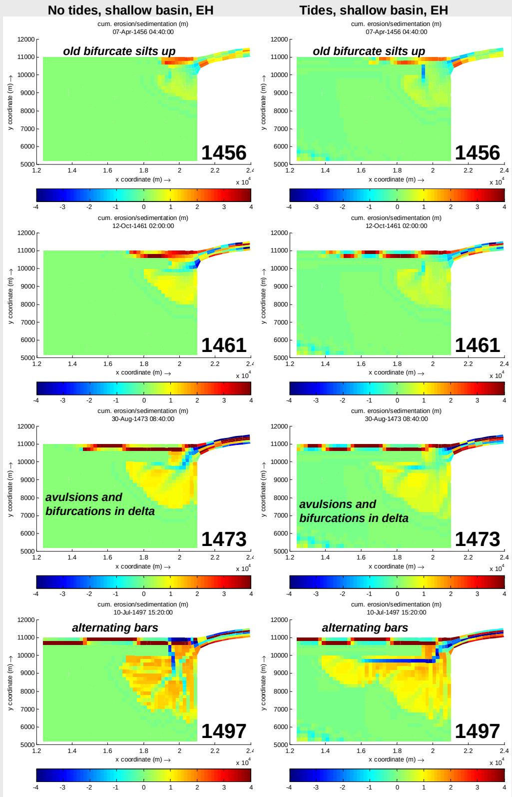


- No backward erosion in upstream channel

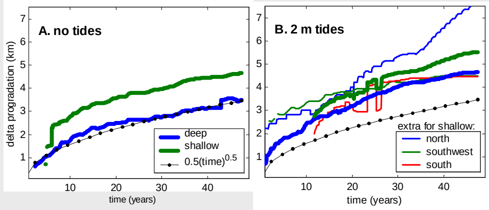


- After year 5 constant sedimentation

Modelled splay development:



- Delta-like progradation; with bifurcations/avulsion
- Tides affect overall planform



- Progradation depends on basin depth
- General declining progradation rate due to semi-circle expansion in constant sediment feed

Conclusions

- Model agrees with reconstructed splay progradation rates and sediment budget
- Sandy delta progradation faster with tides and in shallow basin
- Entire sediment load of upstream river captured in splay
- No erosion in upstream channel→ no upstream impact of avulsion!

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