Long-term dynamics of multiple inlet systems
An idealized modelling approach

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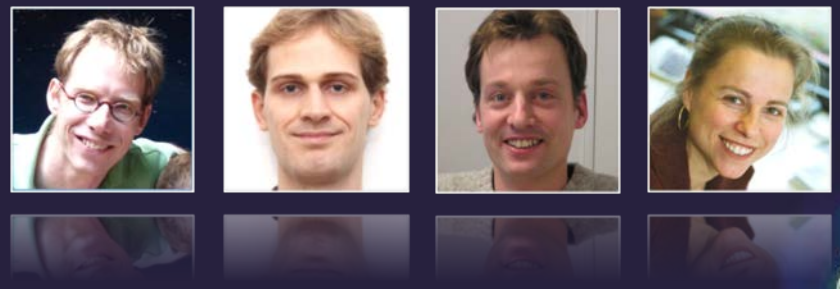
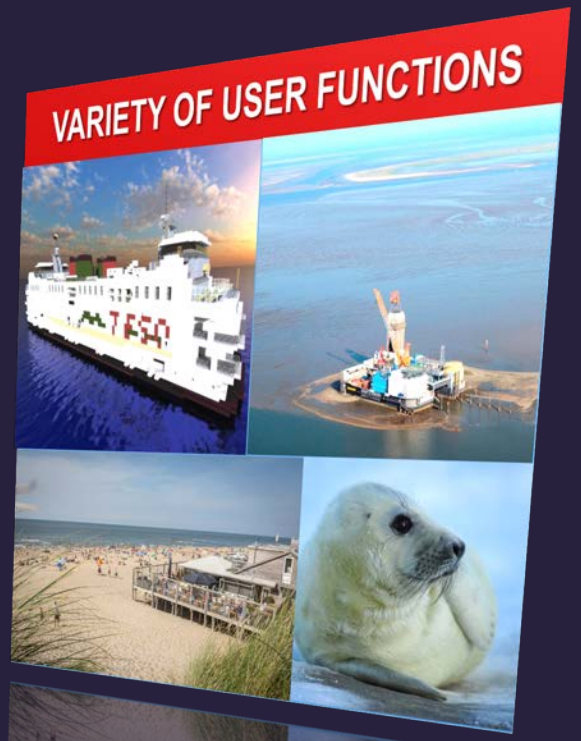
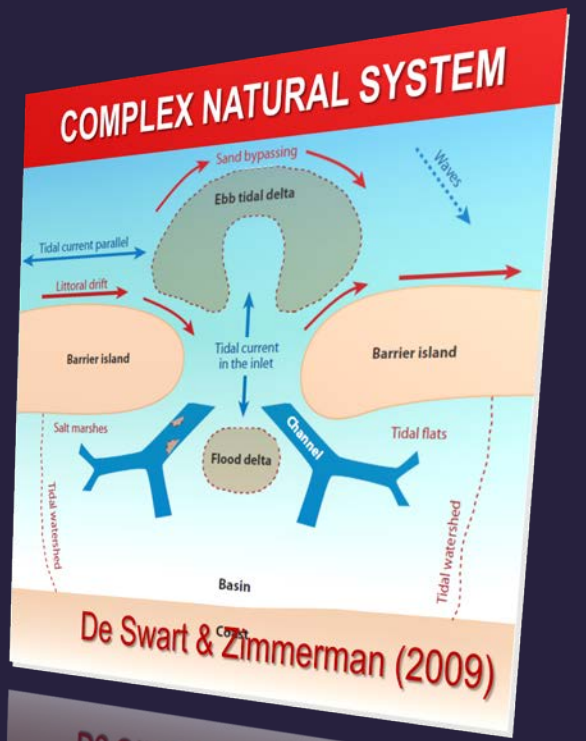
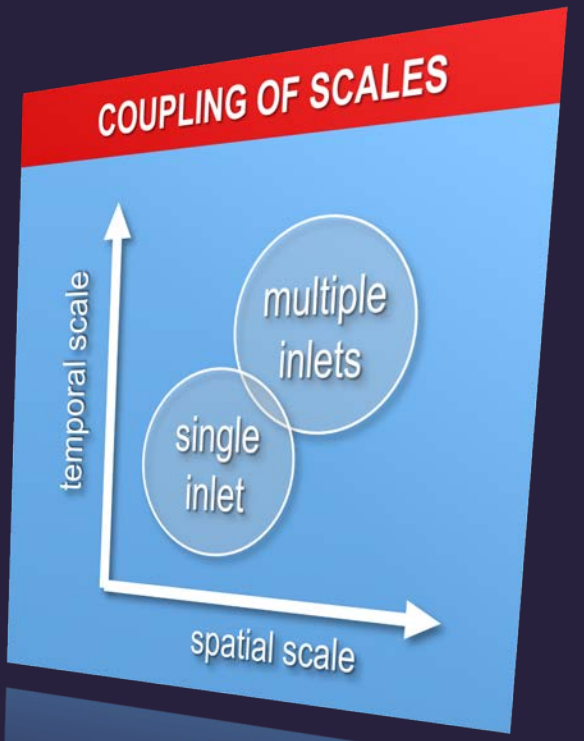
Theme-day Morphodynamics of the Wadden Sea, 17 May 2019



GOAL: SYSTEM KNOWLEDGE & MODELLING TOOLS

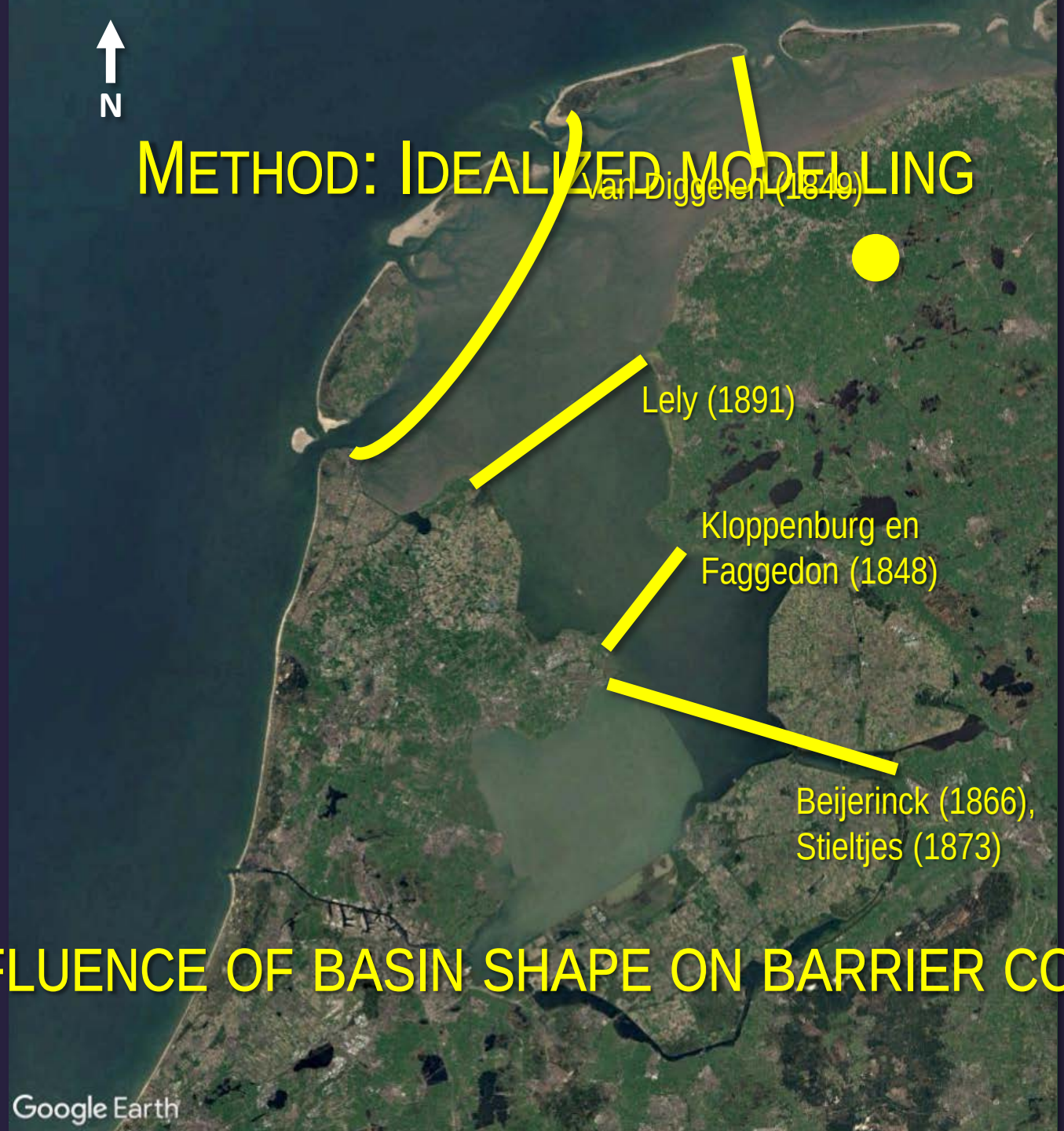






QUESTION: INFLUENCE OF BASIN SHAPE ON BARRIER COAST DYNAMICS?

METHOD: IDEALIZED MODELLING



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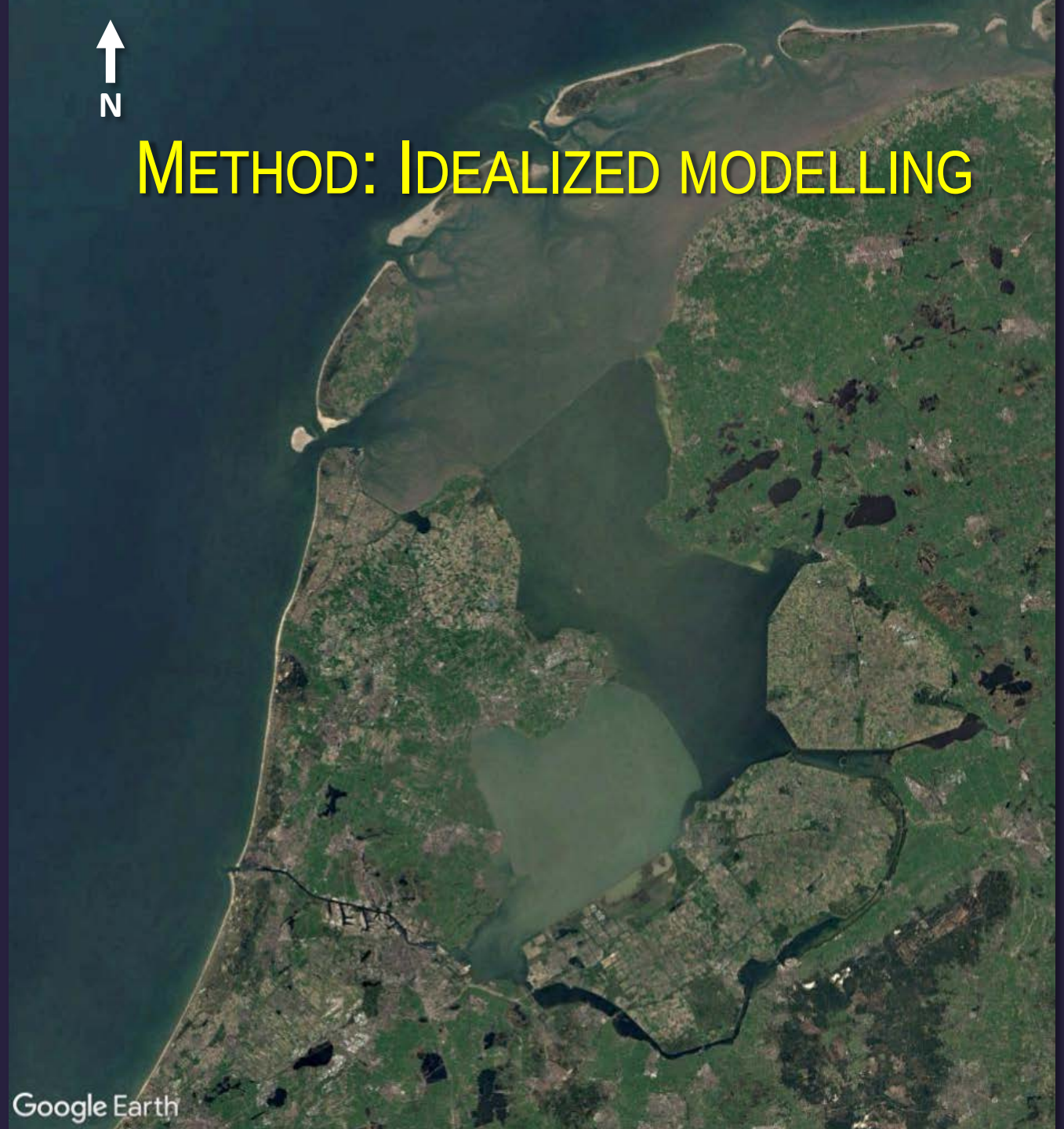

METHOD: IDEALIZED MODELLING

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BARRIER COAST MODEL (1/2)

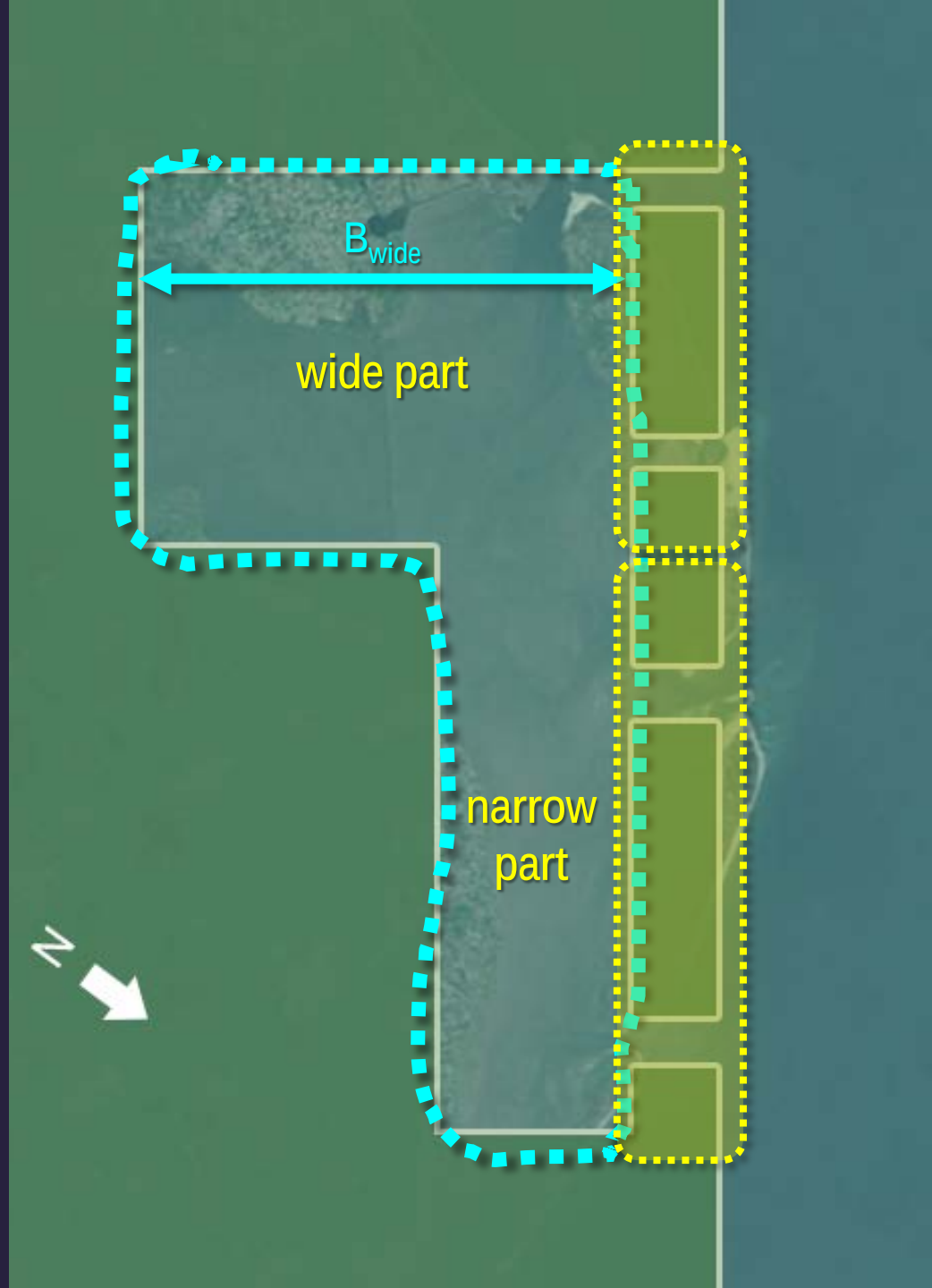
- Meso-tidal barrier coasts (Roos et al., 2013)
- Geometry: outer sea, inlets and basin
  - NEW Arbitrary plan view shape of basin
- Morphodynamics: inlet evolution only
  - Tidal amplitude U vs U_{eq} (Escoffier, 1940)
- Hydrodynamics: idealized process-based
  - Linearized shallow water equations
  - Radiative damping from inlets
  - Forced by tidal wave in outer sea

BARRIER COAST MODEL (2/2)

- Outline of simulations
  - Start with large number of inlets
  - Simulate evolution to equilibrium
  - Analyze properties of equilibrium
  - Create ensemble by randomizing initial inlets

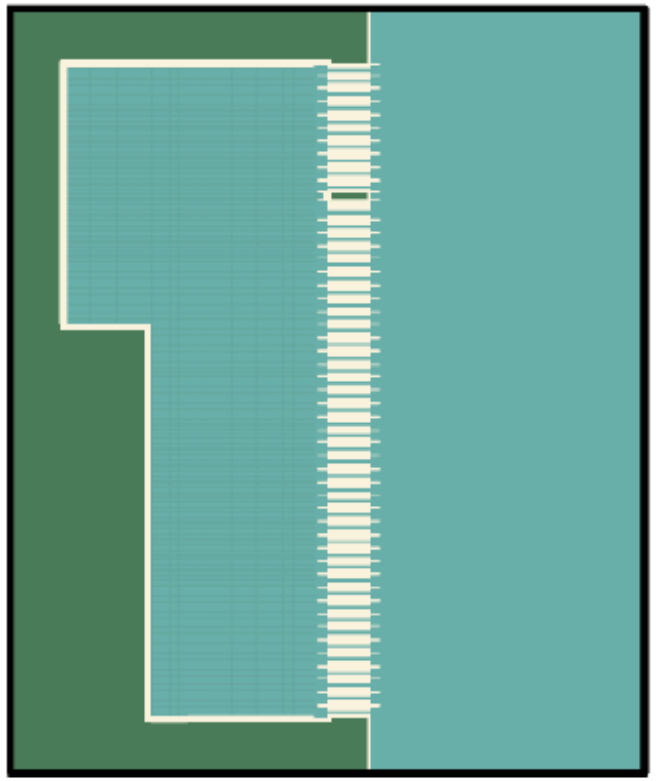
NEW

- Influence of plan view shape of basin
  - Metric: sum of inlet widths (wide, narrow, total)
  - Systematically vary B_{wide}
  - Example of human intervention: basin reduction

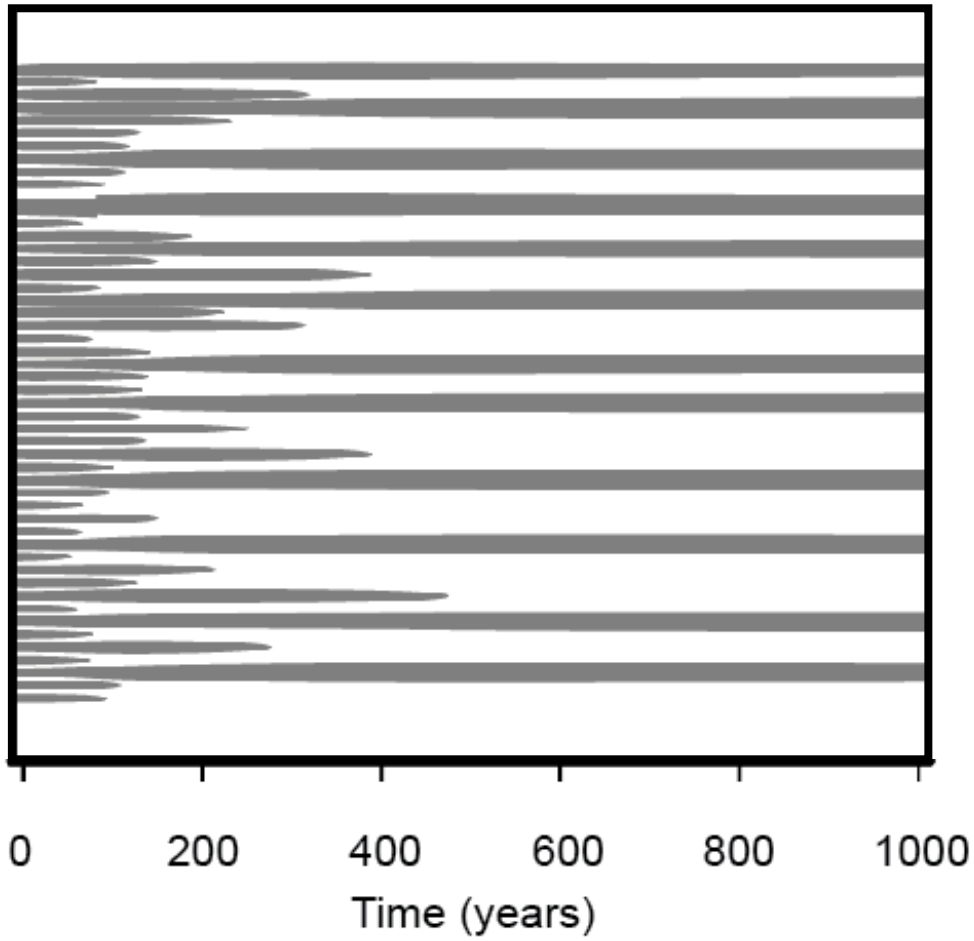


EXAMPLE SIMULATION

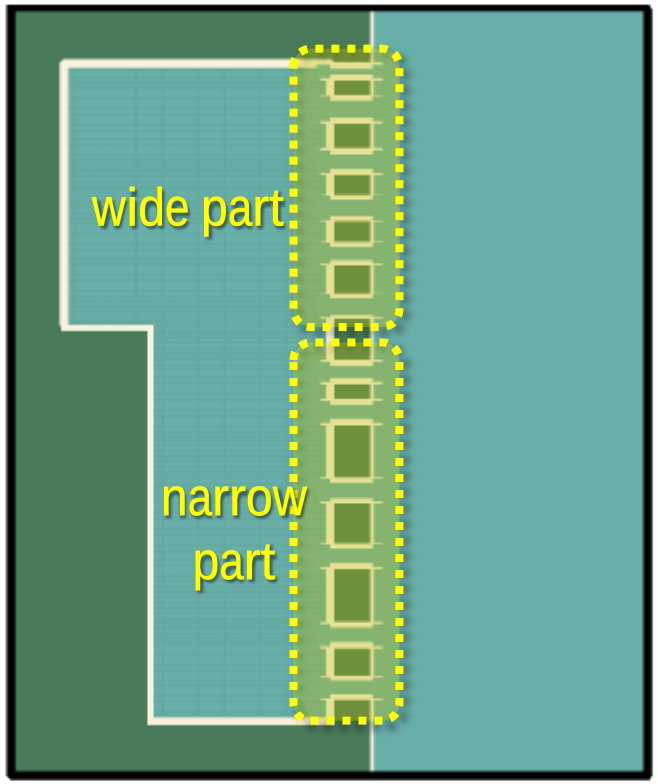
A: Initial configuration



B: Evolution

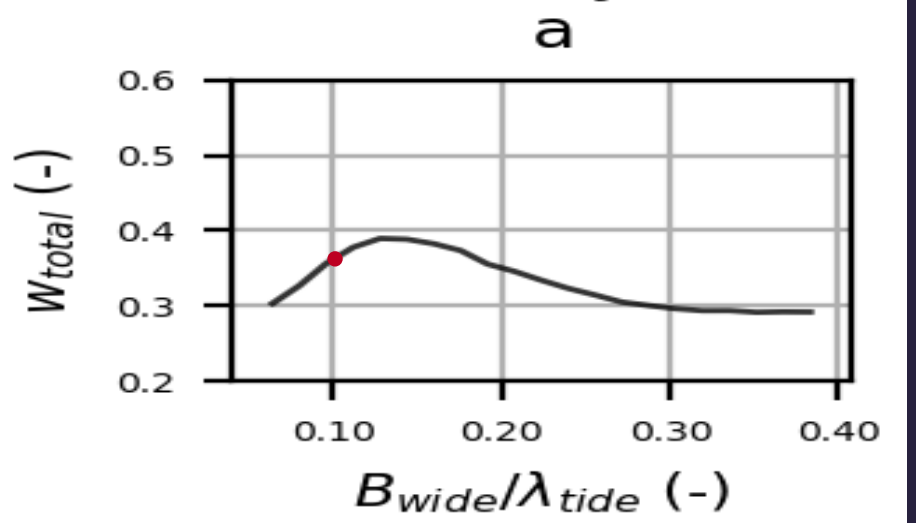


C: Equilibrium configuration



Model results

- Metric: sum of inlet widths per km barrier coast
  - For entire barrier coast: w_{total} (vertical axis)
- Plotted against basin width in wide part
  - Scaled vs tidal wavelength: B_{wide}/λ_{tide} (horizontal axis)



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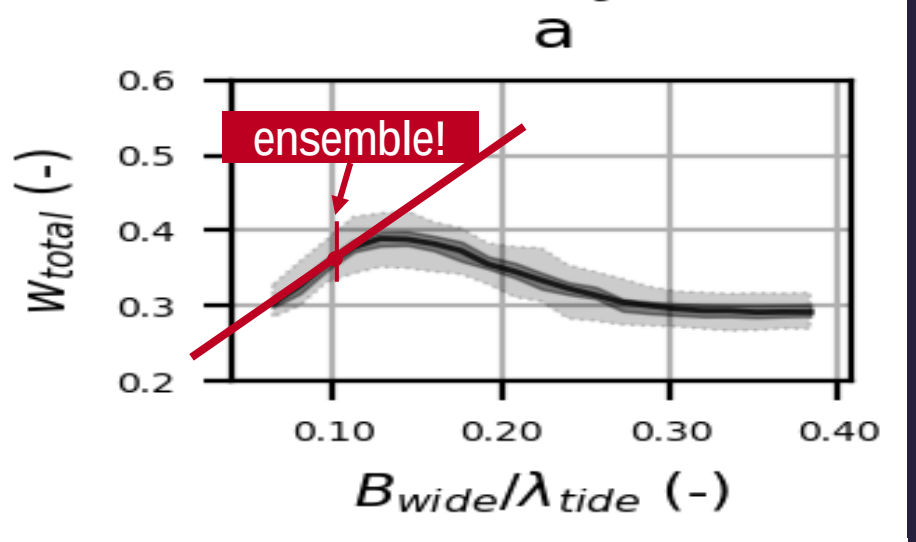

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  - For entire barrier coast: w_{total} (vertical axis)
- Plotted against basin width in wide part
  - Scaled vs tidal wavelength: B_{wide}/λ_{tide} (horizontal axis)
- Same for wide and narrow part only: w_{wide}, w_{narrow}
- Plan view basin shape affects equilibrium
  - More inlets in the wider part
  - Inlets in narrow part also affected → interaction!
  - Resonant response (with damping)

LONG-TERM DYNAMICS OF MULTIPLE INLET SYSTEMS
AN IDEALIZED MODELLING APPROACH

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amics of
zanne J.M

Idealized barrier coast model with arbitrary basin shape!

Shape of basin affects equilibrium configuration of tidal inlets!

Large-scale basin reduction in one part also affects other parts of the system!