# Self-Formed Meandering and Braided Channel Patterns in a Numerical Model

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**River and delta morphodynamics**

**Braiding   Meandering**



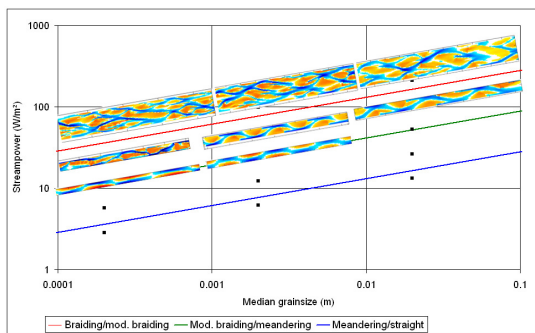**Research question: How can we model the emergence of a specific river pattern?**

## Method

- Comparison between empirical relations, linear stability analysis and numerical modeling
- Empirical relation:
  - River pattern = $f$(discharge Q, width/depth, bed slope and grainsize)
- Numerical model:
  - Physics-based
  - 2D-morphodynamic model Delft3D
  - Autogenetic bar development
- Boundary conditions for numerical model:
  - Initial flat bed
  - Discharge, channel width and bed slope based on empirical classification
  - Small random perturbation in discharge and initial bed level
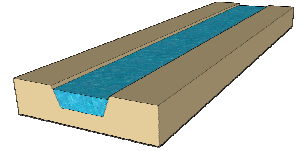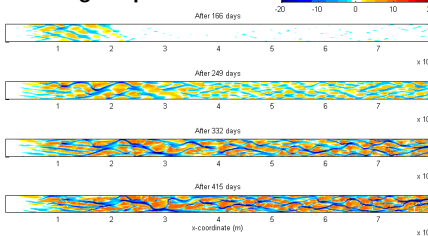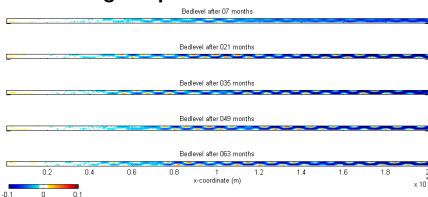


## Results

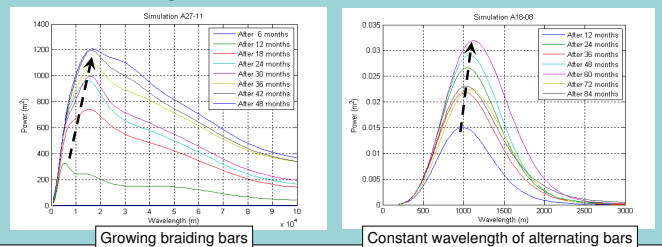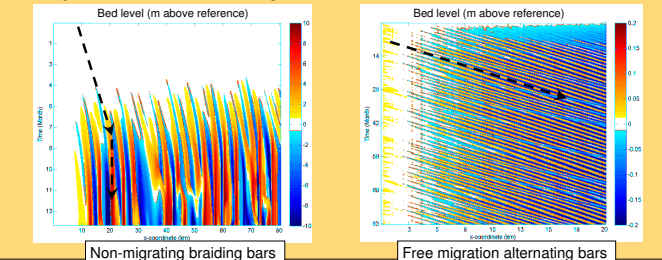### Model vs. empirical relation (Kleinhans & van den Berg, 2010)



Braiding/mod. braiding — Mod. braiding/meandering — Meandering/straight

- Good agreement with empirical relations for channel pattern
- Reasonable agreement with linear stability analysis
- Non-migrating braiding bars emerge at high stream power
- Free migrating alternate bars emerge at lower stream power
- Alternate bars continuously migrate downstream
- Bar mode of braiding channel decreases over time

### Braiding bar pattern



After 166 days
After 249 days
After 332 days
After 415 days

### Alternating bar pattern



Bedlevel after 07 months
Bedlevel after 021 months
Bedlevel after 035 months
Bedlevel after 049 months
Bedlevel after 063 months

### Modeled bar length



Simulation A27-11
Simulation A16-08

Growing braiding bars | Constant wavelength of alternating bars

### Bar dynamics in time and space



Bed level (m above reference)
Bed level (m above reference)

Non-migrating braiding bars | Free migration alternating bars

### Model vs linear stability analysis (Crosato & Mosselman, 2009)



Bar mode
Bar length

Alternating + braiding bar patterns
Linear relations with 25% confidence interval
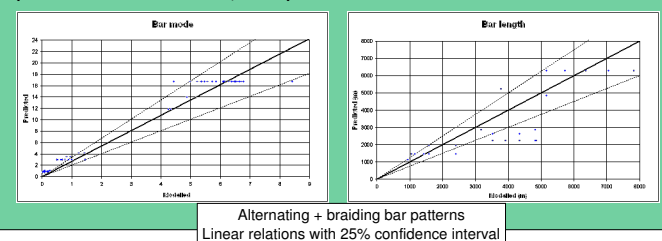
## Conclusions

- Concept of bar patterns is well reproduced by Delft3D
- Emergence of braiding bar patterns is conform empirical relation
- Emergence of alternate bar patterns is conform empirical relation
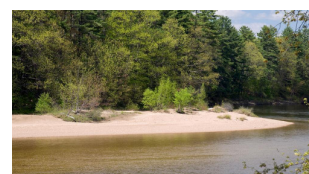- Alternating bars are not able to initiate meandering by bank erosion:

Necessary?



Starting from alternating bars, bank erosion result is a braiding channel pattern

### Vegetation



- Entrapment of sediment
- Adding strength to bars

Flow — Morphology — Vegetation
Steering — Sediment transport — Tolerance — Resistance — Settling — Bank erosion + Floodplain sedimentation