Universiteit Utrecht

Faculty of Geosciences
Physical Geography

Timothy Price
t.d.price@uu.nl

Morphodynamics of a double sandbar system

Timothy Price [1], Gerben Ruessink [1], Bruno Castelle [2]
1 Utrecht University, 2 Université de Bordeaux 1

Background

- Nearshore sandbars continuously change shape in response to wave conditions.
- In double sandbar systems the alongshore variations in inner-bar shape may be similar to those of the outer bar: morphological coupling (Fig. 1).
- Coupling may lead to localised beach and dune erosion.
- Angle of wave incidence θ likely affects morphological coupling, but unclear how.

Aim: To quantitatively understand the morphological coupling in double sandbar systems.

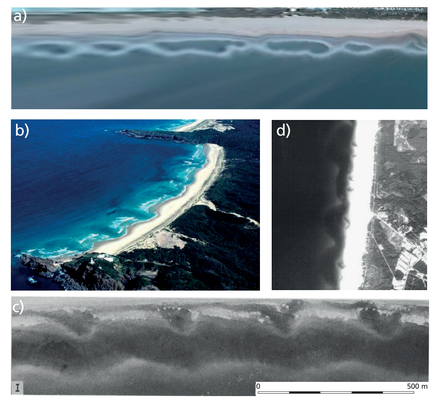
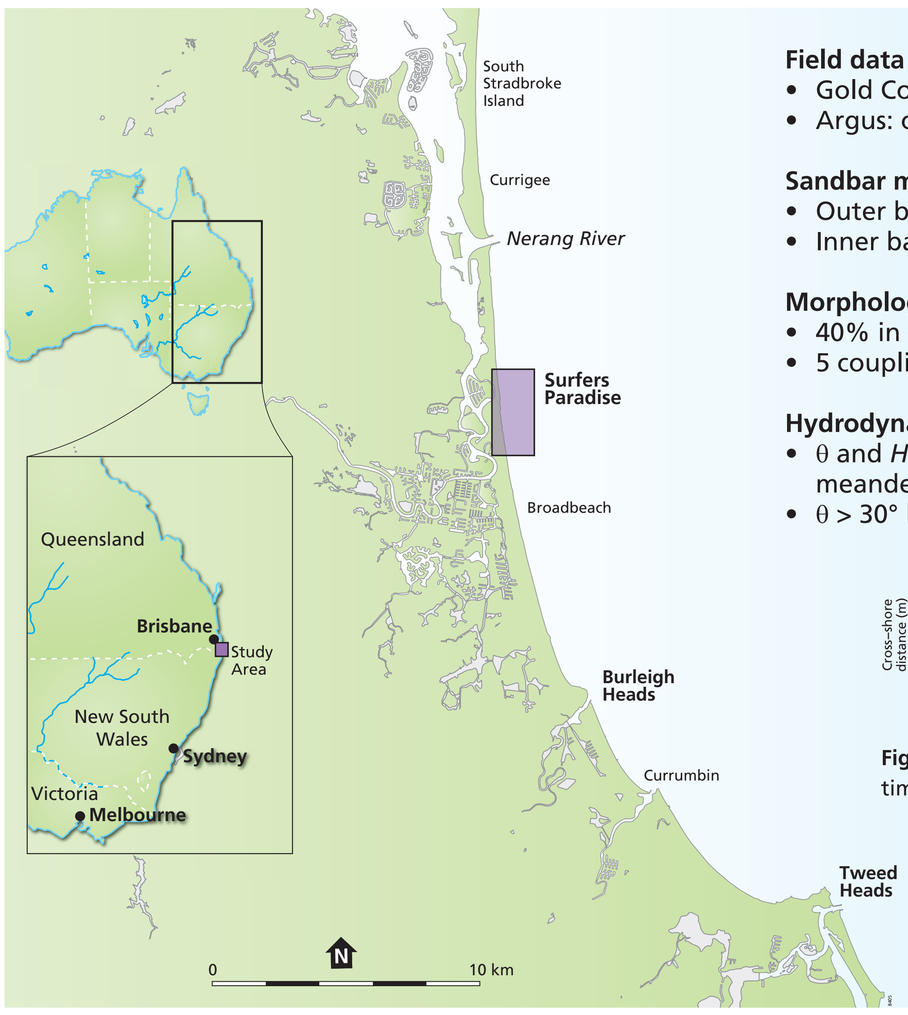


Figure 1 Examples of sandbar patterns from different beaches.

Observations



Field data
- Gold Coast, Queensland, Australia
- Argus: over 9 years of daily time-exposure images (Fig. 2)

Sandbar morphology
- Outer bar → 66% in time alongshore variable
- Inner bar → 44% in time shore-attached terrace

Morphological coupling
- 40% in time
- 5 coupling types (Fig. 3)

Hydrodynamics
- θ and *H* affect current patterns (cell-circulation vs. meandering alongshore current) and type of coupling.
- θ > 30° leads to sandbar straightening and de-coupling.

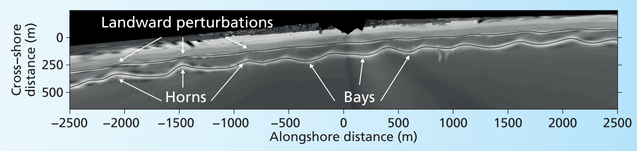


Figure 2 The dominant coupling type, as seen in an Argus time-exposure image from the Gold Coast.

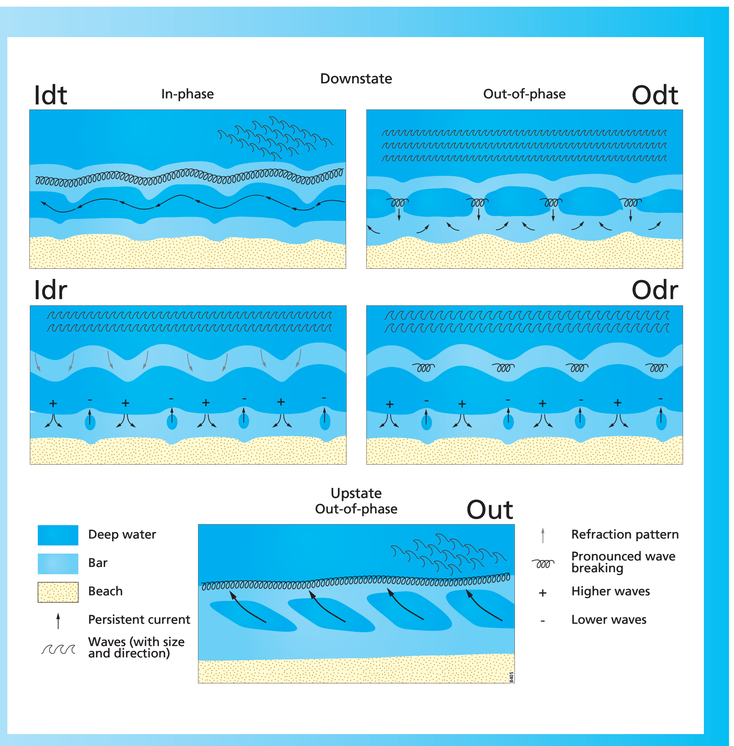


Figure 3 Conceptual model of the 5 observed coupling types.

Modelling

Model
- 2DH morphodynamic model [a]
- Constant (averaged) wave forcing
- Crescentic outer bar
- Alongshore-uniform inner bar
- Realistic bathymetrical data, assimilated from video images (Fig. 4)

Flow patterns inner bar
- Small θ (Fig. 5) → Circulation patterns with rip channels (coupling types Idr, Odr and Odt)
- Increasing θ (Fig. 6) → Meandering alongshore current (coupling types Idt & Out)
- Quantification: Swirling strength

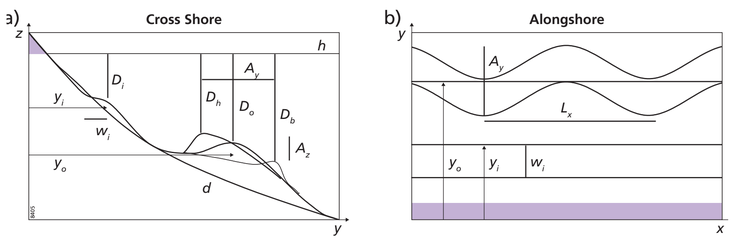


Figure 4 We derived the (a) cross-shore and (b) alongshore bathymetric parameters from video images to use a realistic bathymetry for the model.

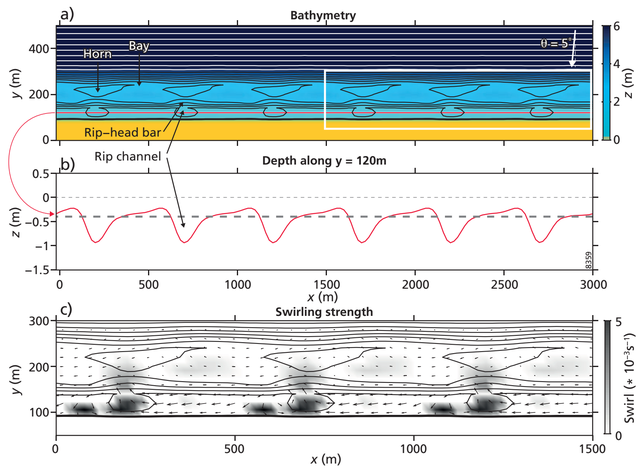


Figure 5 Modelled flow patterns during coupling for θ = 5°, showing (a) the bathymetry, (b) the depth along the inner bar, and (c) the swirling strength.

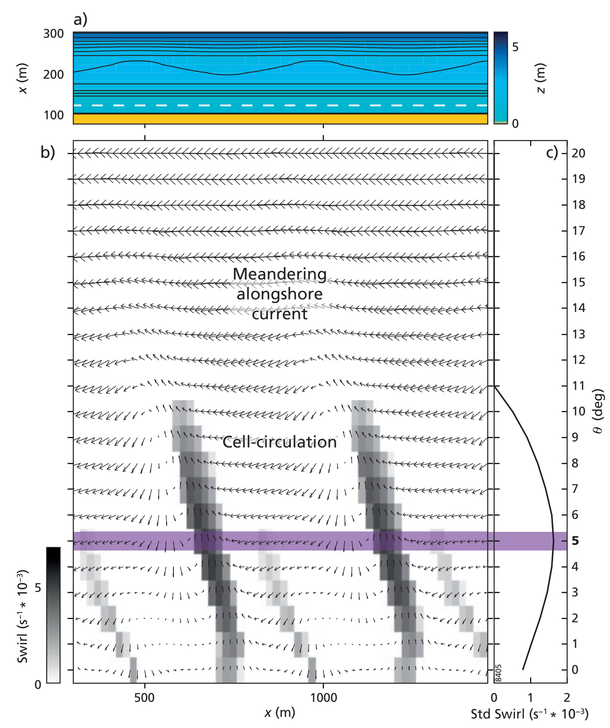


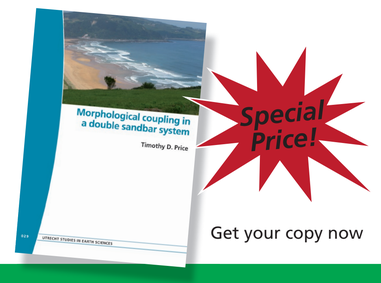
Figure 6 Modelled flow patterns over inner bar for different angles of wave incidence, with (a) the initial bathymetry, (b) the flow patterns and swirling strength over the inner bar, and (c) the std. dev. of the swirling strength.

Conclusions

- Morphological coupling is an integral part of double sandbar systems.
- Type of coupling controlled by wave angle-dependent flow pattern and degree in alongshore variability of outer sandbar.

Note

a Castelle, B., Ruessink, B.G., Bonneton, P. Marieu, V., Bruneau, N., Price, T.D., 2010. Coupling mechanisms in double sandbar systems, Part 1: Patterns and physical explanation. ESPL, 35:476-486



Get your copy now