Multiannual behavior of nearshore bars on Danube Delta coast – preliminary results

Universiteit Utrecht

Florin Tatui[1,2] and Alfred Vespremeanu-Stroe[1]

1) Faculty of Geography, University of Bucharest, Bucharest, Romania, Sfântu Gheorghe Marine and Fluvial Research Station, Danube Delta, Romania

2) Utrecht University, Department of Physical Geography

Introduction

Two-dimensional longshore bars are uniform, straight bars oriented parallel to the shoreline. In the international literature the dynamics of these nearshore bars on virtually tideless beaches has received very little attention. Danube Delta's tideless environment can offer valuable information in understanding nearshore bar behavior under the control of waves and currents induced by wave breaking.

Our analysis focuses on the multiannual morphodynamics of the nearshore longshore bars on Sulina – Sfantu Gheorghe beach – Danube Delta coast.

Study area

The study area is a low-lying beach located within the central and southern part of the interdistributary Sulina – Sfantu Gheorghe coast (Danube Delta) – 16 km from Sf. Gheorghe arm mouth to the north (Fig. 1). It comprises 2 sectors: i) Sf. Gheorghe beach (7 km to the north of the arm mouth) is in a meta-stable equilibrium – reversible oscillations with respect to a stable position since the beginning of the 20th century, and ii) northern part (km 7 to 16) – prevailing erosive processes, more intense to the north (shoreline retreat of 1.8 m/yr – km 7 to 5.5 m/yr – km 16 for 1979-2009 period).

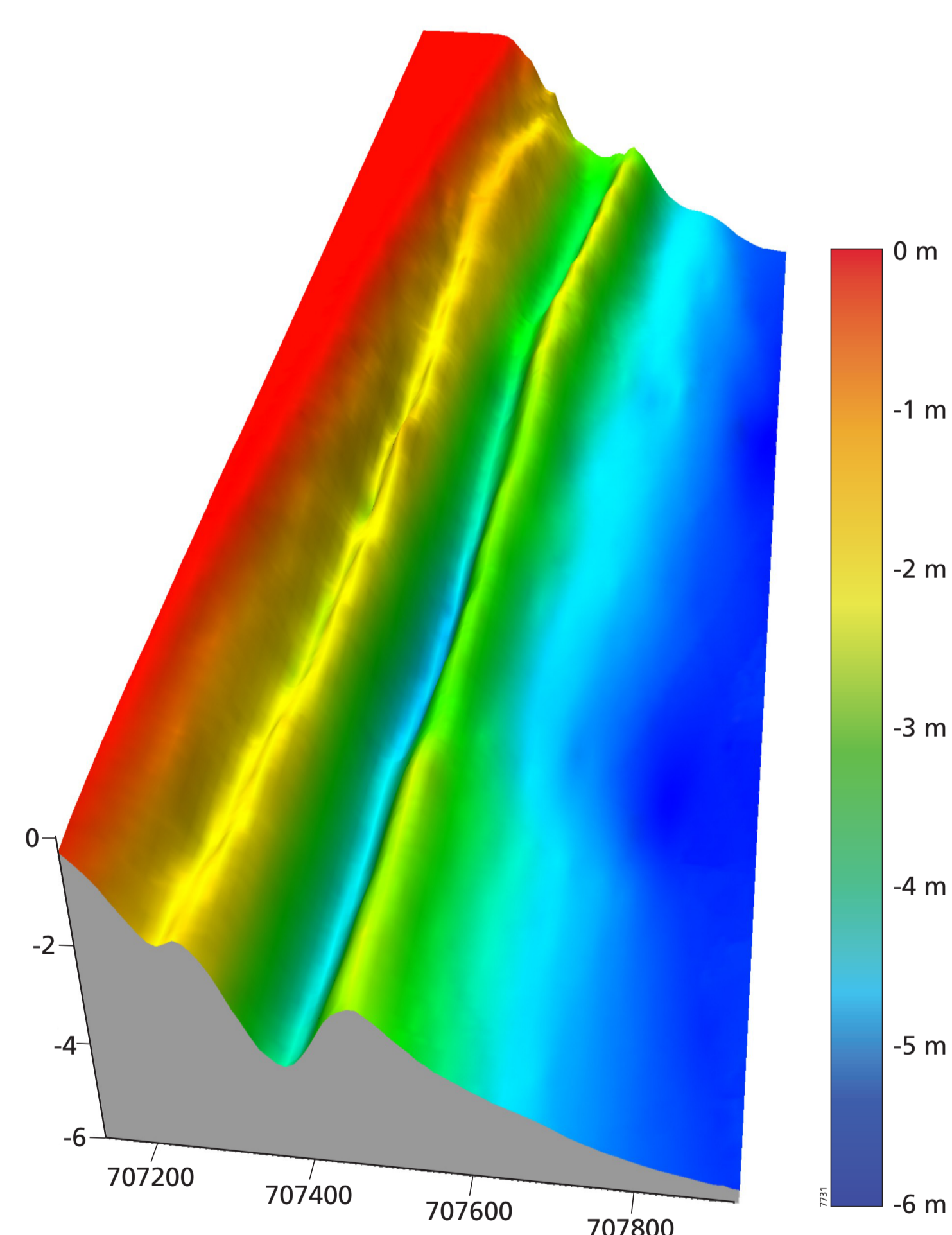*Figure 1. Location of the study site*

Figure 2. Digital elevation model (August 2006) of P4-P7 sector

Data

Our data comprise 6 years (September 2003 – October 2009) of seasonal or annual bathymetric surveys carried on 18 cross-shore profiles with longshore spacing of 200 m – 1 km.

Preliminary results

The seasonal behavior of nearshore bars clearly indicates a pronounced offshore movement during winter (due to intense storm activity) and a slow onshore movement in the summer – Fig. 4.

At the multiannual scale, the longshore nearshore bars migrate net offshore, just as along the Dutch coast. On the prograding sector (profiles P1-P2), nearshore bars have the lowest offshore migration rates (20-30 m/y) and largest cycle return periods (~ 5.5 years); on the stable sector (profiles P3-P8), bars move offshore with rates of 30 to 37 m/y, while on the erosive northern sector (P9-P18), the rates increase up to 40-50 m/y and cycle return periods drop to ~ 2.8 years.
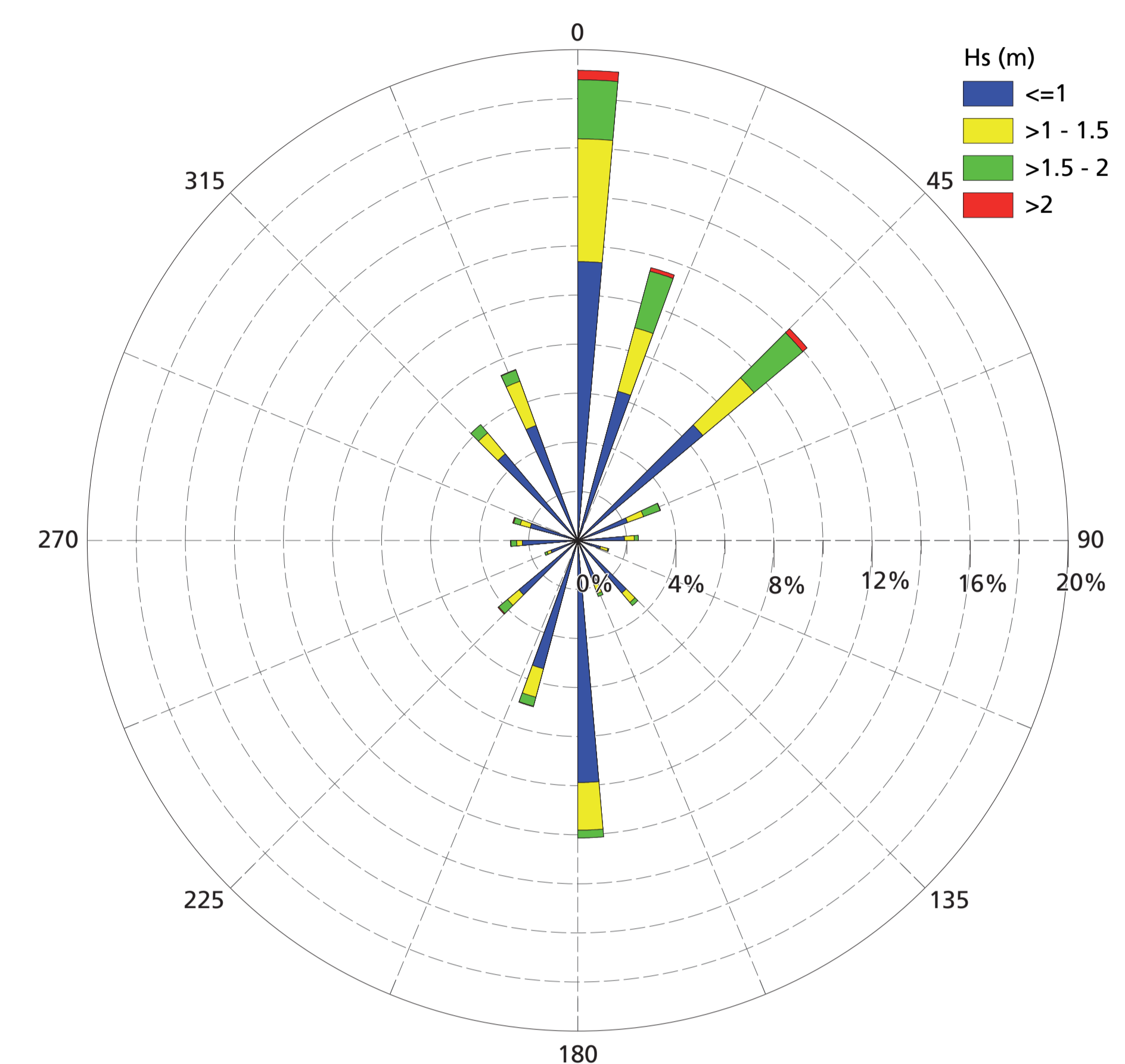

Figure 3. Significant Wave Height (Hs) Rose

- *Medium-energy wave climate (long-term H_s = 1.09 m)*
- *Dominance of shore-oblique, low-angle waves from the northeastern directions*
- *Consequence: strong net longshore sediment transport of 0.85-1×10^6 m^3/yr*
- *Mean wave period = 5-6 s*
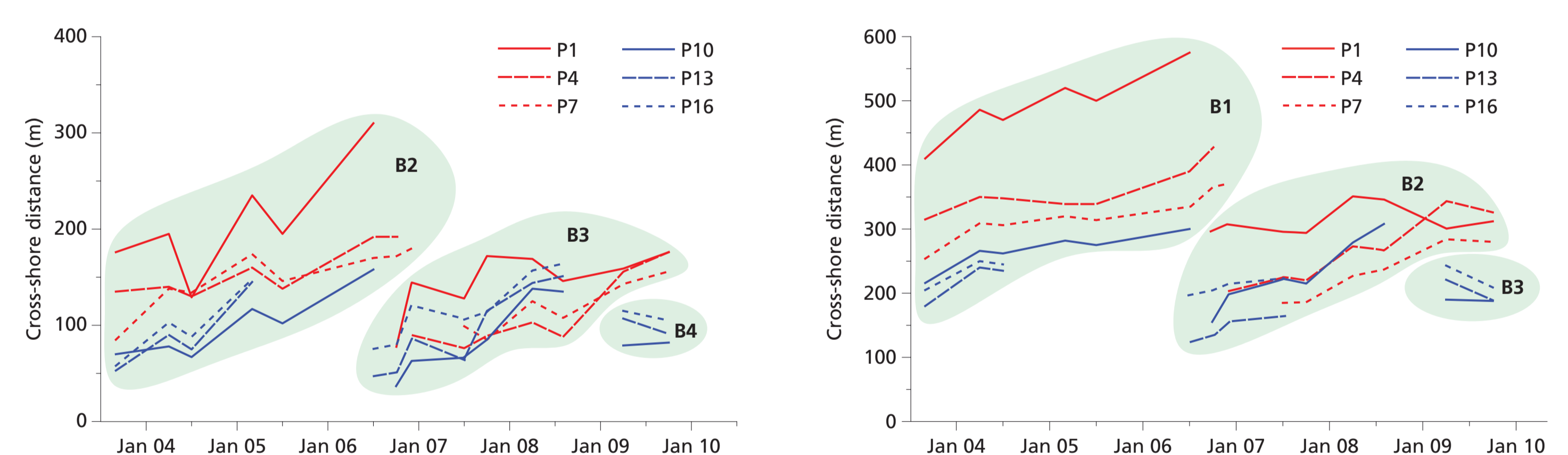- *Virtually tideless coast-maximum tidal range of 0.12 m at spring tide*

Figure 4. Cross-shore sandbars movement: (left) median bar and (right) outer bar
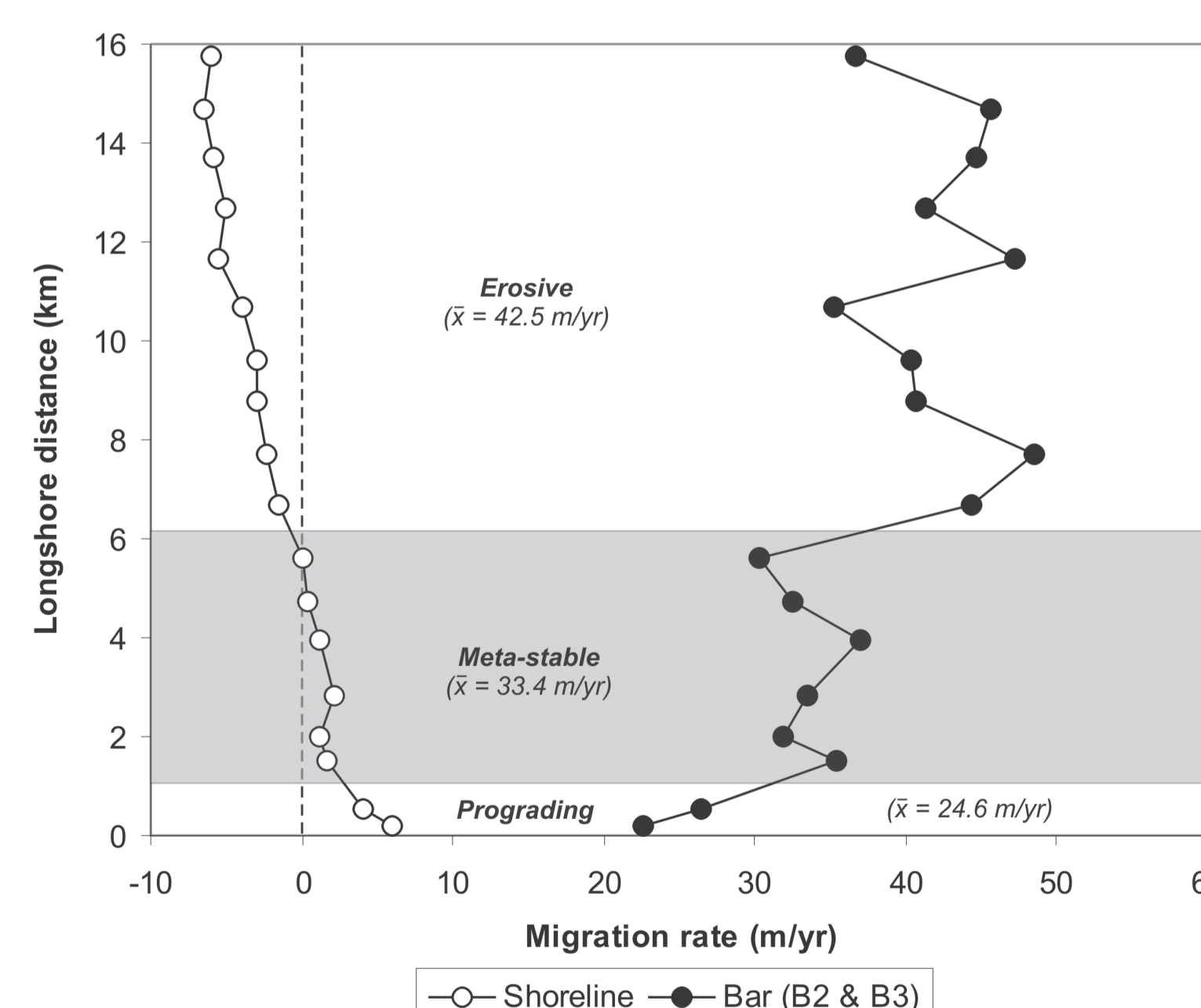

Figure 5. Shoreline mobility and nearshore bars offshore migration rates (2003-2009)

Geosciences