ON THE PHYSICS BEHIND COASTAL MORPHODYNAMIC PATTERNS

F. Ribas[1], A. Falqués[1], H. E. de Swart[2], N. Dodd[3], R. Garnier[4] & D. Calvete[1]
[1]*Department of Physics, Universitat Politècnica de Catalunya, Barcelona, Spain*
[2]*Institute for Marine and Atmospheric research Utrecht, Utrecht University, Utrecht, the Netherlands*
[3]*Faculty of Engineering, University of Nottingham, Nottingham, UK*
[4]*Instituto de Hidráulica Ambiental Cantabria, Universidad de Cantabria, Santander, Spain*

Key words coastal morphodynamic patterns, nearshore sand bars, beach cusps, sand ridges, sediment transport, self-organization

The focus of this contribution is to understand the physical processes behind the development of a number of coastal morphodynamic features that have an alongshore rhythmic pattern: beach cusps, surf zone transverse and crescentic bars, and shoreface-connected sand ridges. We will present a formulation and methodology, based on the knowledge of the depth-averaged currents and the depth-averaged sediment concentration (DASC, which equals the sediment load divided by the water depth), that has been successfully used to understand the characteristics of these features ([1] and references therein). These sand bodies, relevant for coastal engineering and other disciplines, are located in different parts of the coastal zone and are characterized by different spatial and temporal scales (Figure 1) but the same technique can be used to understand them. Since they occur in the presence of depth-averaged currents, the sediment transport approximately equals a sediment load times the current. Moreover, it is assumed that waves essentially mobilize the sediment, and the current increases this mobilization and advects the sediment. In such conditions, knowing the spatial distribution of the DASC and the depth-averaged currents induced by the forcing (waves, wind, and pressure gradients) over the patterns allows inferring the convergence/divergence of sediment transport. Deposition (erosion) occurs where the current flows from areas of high to low (low to high) values of DASC. The formulation and methodology are especially useful to understand the positive feedback mechanisms between flow and morphology leading to the formation of those morphological features, but the physical mechanisms for their migration, their finite-amplitude behavior and their decay can also be explored.

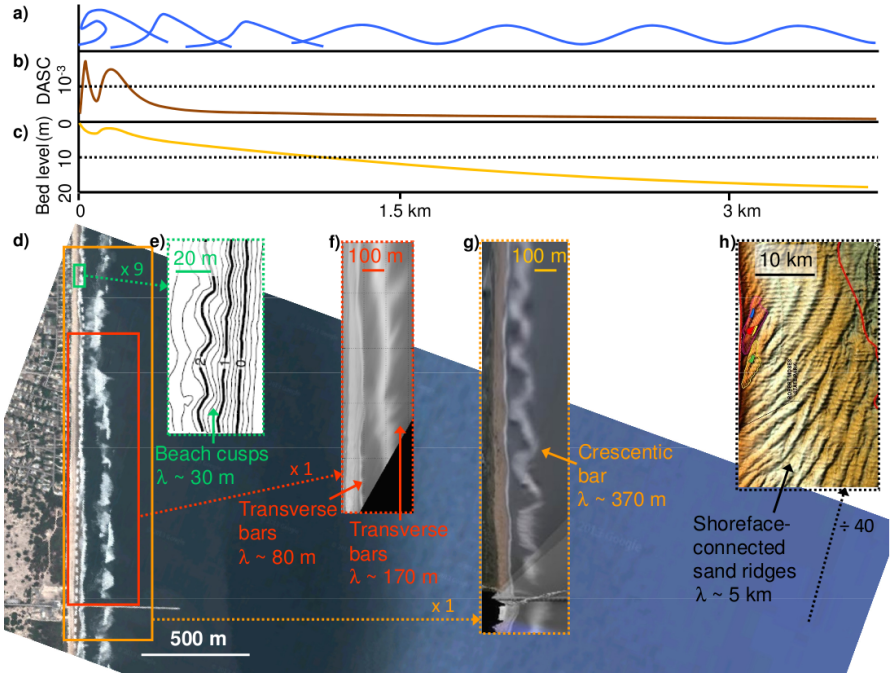

Figure 1. Illustration of the (a) incoming waves, (b) depth-averaged sediment concentration profile (DASC), and (c) bed level on the coastal zone. (d) Satellite image of the coastal zone in front of Duck, North Carolina, USA. Superimposed to it, examples of (e) beach cusps, (f) surf zone transverse and (g) crescentic bars, and (h) shoreface-connected sand ridges. Figure from [1].

References

[1] Ribas, F., A. Falqués, H. E. de Swart, N. Dodd, R. Garnier & D. Calvete (2015), *Understanding coastal morphodynamic patterns from depth-averaged sediment concentration*, Rev. Geophys. **53**, 362–410, doi:10.1002/2014RG000457.