ON THE APPLICABILITY OF EMPIRICAL FORMULAE FOR SALIENTS TO SOUTH SARDINIA (ITALY) BEACHES

Andrea Sulis[1]

[1] Department of Civil and Environmental Engineering and Architecture
University of Cagliari, via Marengo 2, 09124 Cagliari, Italy
E-mail: asulis@unica.it

Most commonly an offshore obstacle, such as a reef or breakwater, creates a salient of sediment deposition in its lee. While considerable work has been done on shoreline response to breakwaters along the Mediterranean coasts, the effects of natural obstacles, both submerged structures and emergent reefs or islands, have not been systematically investigated yet. Nowadays, the performance of coastal area morphological models has not reached a level high enough to yield a reliable prediction of long-term (months to decades) shoreline evolution, especially where bathymetry and evolving dynamic is complex as in the lee of a natural obstacle. In reference to that, additional use of empirical predictive formulae can be seen as complimentary tools that could lead to preliminary reliable results to respect to the shoreline evolution of a salient.

Black and Andrews (2001) defined empirical relationships to describe the morphology of salient and their geometry as a function of position and size of reefs and islands by visually inspecting aerial photographs of the coastlines of south eastern Australia and New Zeeland and without taking into account the variations in wave climates on different beaches. In their paper, Black and Andrews highlighted the need of further investigation of the effects of reef depth, reef width and reef morphological complexity in the context of local wave climates. Headland-bay beaches in static equilibrium are the most stable landform under persistent swell and can be predicted empirically using the wave direction alone (Hsu and Evans, 1989). The parabolic quation (Hsu and Evans, 1989) has received recognition in the new Coastal Engineering Manual to calculate the ideal static equilibrium shoreline of a headland-bay beach. The parabolic equation has been also applied to salients in the lee of offshore emergent breakwaters and island To avoid a manual tedious application of the parabolic model, the MEPBAY software package was developed that significantly reduces the computational time needed for practical applications (Klein et al., 2003).

Within a broader research program funded by the Sardinia Government on coastal erosion, the Department of Civil and Environmental Engineering and Architecture at the University of Cagliari (Sardinia, Italy) has been verifying the validity in the Sardinia coastlines of formulae for salient description from the Black and Andrews' study and of the parabolic equation.

All the shoreline positions were collected in field surveys by walking the length of the beaches using a Real-Time Kinematic Global Positioning System (RTK GPS). Salients appear as an smooth and regular departure from the existing natural shoreline and sometimes it was difficult to define where the shoreline adjustment begins to diverge from the undisturbed shorelines. Through the standard definition for the main geometrical properties of the salients proposed by Atzeni and Sulis (2009), geometrical properties of the salients were collected. Figure 1 shows the application of the standard definition sketch to Tuerredda beach (latitude φ=38°53'40''N; longitude λ= 8°48'47''E).

The main geometrical properties of the salients were compared to Black and Andrews relationship that predict amplitude (Y) and basal width (D) of the salient from non-dimensional variables (S-Y)/B and S/B. Results from the 8 salients were found to be in good agreement with results by Black and Andrews in the coastlines of south eastern Australia and New Zeeland. Then, the condition of salient stability was assessed through the MEPBAY software that allows a user to automatically trace static equilibrium profile (SEP). The SEP were found to be a good approximation of the salient planforms with

maximum errors significantly lower than previous applications of SEP to headland-bay beaches along the western Mediterranean coast.

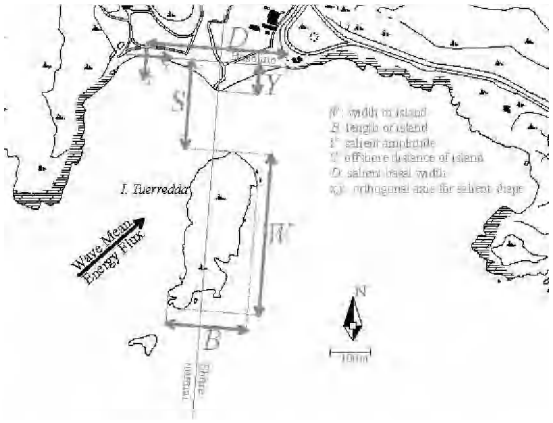

Figure 1. Standard definition sketch of geometrical properties of salients at Tuerredda beach

Figure 2. Application of MEPBAY to SEP at Sa Mesa Longa beach

Results suggest that this assessment of natural stability should be the first step in any proposal for man-made utilization of beaches that include these fragile morphologies, in order to avoid or minimize possible negative environmental impacts.

References

Atzeni A. and Sulis A. 2009. Morphology of the salient of Su Giudeu beach (Sardinia, Italy) and hydrodynamic along the shoreline. Proceedings of the 4th SCACR – International Conference on Applied Coastal Research, Barcelona, Spain.

Black K.P. and Andrews C.J. 2001. Sandy shoreline response to offshore obstacles. Part 1: Salient and tombolo geometry. Journal of Coastal Research, SI 29, 82-93.

Hsu J.C.R. and Evans C. 1989. Parabolic bay shapes and applications. Inst. Civ. Eng., Proc., London, England 87, 556-570 (Part 2).