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Shoreface morphodynamics along the Danube Delta coast

Florin Tatui and Alfred Vespremeanu-Stroe

Faculty of Geography, University of Bucharest, 1st N. Balcescu blv., 010041, sector 1, Bucharest, Romania (florin.tatui@geo.unibuc.ro)

The shoreface has an important long-term contribution to the coastal sediment budget as it behaves as either a sink or source of sediment from/to the active zone (Hinton and Nicholls, 2007). Hence, it modulates the long-term shoreline movement. However, the shoreface behaviour remains poorly understood and such studies are scarce especially because of the lack of extensive long-term good-quality data.
The objective of this study is to examine and explain the shoreface morphodynamics along the Danube Delta coast. The shoreface morphodynamics has been investigated over the medium- and large-scales (decades to centuries). This is a wave-dominated, low-lying coastline interrupted by river mouths and, sometimes, by engineering structures (jetties). This work uses historical and modern maps (since 1856) and bathymetrical measurements (2008 and 2014) extending along the whole Danube Delta coast (both Romanian and Ukrainian sectors) to water depths of approximately 20 m; sectorial seasonal and annual bathymetries of the upper shoreface (2003 – 2014); LIDAR data (2011), recent high resolution satellite images, ortophotos and GPS surveys for shoreline extraction, which were comparatively analysed (volume changes, profile to profile evolution) by means of GIS techniques in order to explain the morphological and volumetric evolution of the shoreface.
The large scale coastal behaviour of Danube Delta coast (expressed in terms of shoreface sediment volume and spatial distribution pattern of cells) is linked to climatic forcings (storminess), Danube river sediment supply changes, longshore sediment transport distribution and impact of hard coastal engineering structures. Significant increase of shoreface volume in the last century is related to active deltaic lobes (Chilia) or developing barrier islands (Sacalin), while decreasing shoreface volumes are related to the presence of Sulina jetties which blocked the longshore sediment transport and induced severe erosion downdrift. In the last three decades, we can observe an important reduction of the shoreface volume due to the significant decrease of Danube river sediment input as a result of the construction of dams and other human activities.
On many coastal sectors, the upper shoreface represents the bar zone, characterised by the presence of nearshore longshore sandbars which exhibit a multi-annual net offshore migration with various rates, depending on environmental characteristics of each sector (mainly nearshore slope and wave climate). By the process of bar decay, these morphological features supply the lower shoreface with important volumes of sediment during stormy intervals (in accordance with the findings of Aagaard, 2011).
Our results should provide a better understanding of coastal processes along the Danube Delta coast, absolutely necessary in the context of sustainable coastal management and planning.