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Recent shoreline evolution and erosion trends of the Molise coast (southern Italy) and their possible relation to natural and human-induced driving factors

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Coastal erosion represents a worldwide problem and one of the main environmental questions that politicians and administrators are presently asked to manage both at a local to global scale. Also the Italian peninsula, with its 7500 km of coast, is sensibly affected by this problem. Currently, ca. 22% of the Italian coast is affected by erosion, with percentages ranging from region to region between ca. 8% and 55%. Such percentages increase considerably when considering only its low coast sectors, reaching an average value of ca. 42% for the whole Italian coast and percentages between 13% (Friuli-Venezia-Giulia) and 90% (Molise) at a regional scale.
So the Molise coast, even if the smallest regional coast (36 km), is the most affected by recent erosion trends. It behaves altogether as a low coast system as its high coast sectors (ca. 13 km) are characterized by cliffs located between a few tens and some hundreds of meters from the shoreline and, therefore, beaches are present nearly all along the coast.
Aim of this study is to give a detailed frame of the recent evolution of the Molise shoreline considering the time-window 1954-2007 and taking in consideration some of the main possible, natural or human-induced, driving factors.
To determine shoreline variations in time, we calculated in GIS environment the differences between shoreline positions of various data along regularly-spaced transects (equidistance 100 m). Both, linear shoreline variations and related surface changes were calculated for the time window 1954-2007 and periods 1954-1992, 1992-1997, 1997-2000, 2000-2003 and 2003-2007, respectively. Data interpretation allowed to distinguish the Molise coast in nine coast sectors for which distinct shoreline trends in time were quantified.
With reference to time-window 1954-2007, the Molise coast was affected by a very consistent shoreline retreat which caused a total land loss of ca. 920.000 m2. Most sensible to erosion behaved the coast sectors including main river mouths (Trigno and Biferno river mouths) which underwent maximum retreats of ca. 220 and 350 m, respectively. A consistent acceleration of shoreline retreat with time emerged from the comparison of periods 1954-1992 and 1992-2003. From 1992 to 2003, erosion caused particularly elevated shoreline retreats in the sectors including the Trigno and Biferno mouths of 4.32 and 4.74 m/y, respectively, and a land loss of ca. 348.000 m2, i.e. 32% of the total one occurred during 1954-2003 (ca. 1088.000 m2). Erosion persisted also during the period 2003-2007, but was limited to the two river mouth sectors, highlighting their high degree of sensibility, and putting further emphasis on the importance of fluvial inputs to the coast, suitable for natural nourishment, and their consistent decrease in time. Such erosion, however, was largely compensated by progradation of the other sectors resulting in an overall positive shoreline balance ca. 167.000 m2).
The reconstructed overall erosion trend and the acceleration of erosion during 1992-2003 is in net contrast to the increasing protection in time of the coast by hard defence structures, which significantly contributed also to fragment the coastal system and its dynamics. Analyzing in detail this apparent incongruence and investigating on meteo-climatic influences allowed to highlight for the investigated periods consistent differences in average annual shoreline variations and percentages of coastal sectors in erosion, which strongly support the hypothesis that variations of meteo-marine conditions have significantly favoured erosion during the periods 1992-2003 and 2000-2003 in particular.