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The role of coastal defense structures and decreased fluvial sediment inputs in coastal erosion dynamics

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Coastal erosion has extremely complex reasons and is related to both natural and anthropogenic factors. Sea level changes due to ongoing global climate change and/or soil subsidence are certainly among the most studied natural controlling factors. Nevertheless, anthropogenic causes are probably the most common ones. In fact, the coastal equilibrium is strongly conditioned by the reduction of sediment supply to the coast due to both direct and indirect anthropogenic interventions on river channels and catchments, and the construction of coastal defense and maritime structures, which interfere with the sediment transport towards and along the coast, and control sediment distribution.

In this study, the southern Molise coast, located along the central Adriatic coast and extending from the Termoli promontory to the Saccione River mouth, has been investigated. The analyzed coastline has been affected by intense erosion from the 1920s' onwards, with the destruction first of the Biferno River delta, followed from the mid-1950s onwards by a more extensive retreat that produced an elevated loss of land during approximately the last 65 years. Shoreline retreat mainly affected the coastal segment including the Biferno River mouth, which is characterized by average annual rates of almost -3 m/y in the long-term, but also several other coastal stretches in different periods. To contrast further retreat, rigid coastal defense structures such as groins, adherent and detached breakwaters (both emerged and submerged) were realized over time. Nevertheless, during the last twenty years erosion further accelerated, with maximum annual rates recorded for periods 1998-2004 and 2011-2016, involving increasingly the coastal segments located south of the one that includes the Biferno mouth.

An accurate analysis of the mid to short term shoreline evolution, considering the possible role played by the decrease of sediment inputs from the Biferno River, meteomarine forcing and coastal defenses, has been carried out. Direct observations of shoreline variations over time and numerical simulations, performed with the "one-line" numerical model GENESIS, showed that the coast was governed by the wave component 10°N. In fact, the consequent equivalent direction of solid transport, coupled with to a net decrease in sediment inputs from the main rivers and its interference with coastal defenses, has contributed to increase coastal erosion rates, recorded in particular around the Biferno River mouth. Moreover, obtained results show that the bimodality of the wave climate may has significantly influenced the recent beach dynamics with the more inclined wave components (coming from the NW and SE sectors) would be responsible for the genesis of

coastal instability which amplifies the erosion phenomena.