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Assessing the role of Climate Variability in the recent evolution of coastlines in southern Italy

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During the last century, Climatic Variability (CV) and change effects have generated a discernable impact on the world's coasts, most notably through changes in the frequency and/or magnitude of storm surges, flooding, coastal erosion and sea-level rise. This study explores CV signals and coastal responses along a 36 km stretch of coast in the Molise region of southern Italy on the Central Adriatic Sea.
Two dominant signals of CV in the Mediterranean region of Europe are characterized by the North Atlantic Oscillation (NAO) and the East Atlantic-West Russia (EAWR) patterns. The NAO is the leading mode of CV in the North Atlantic region and periods with positive NAO index values are typically associated with above average wind speeds across the mid-latitudes of the Atlantic and western Europe, with anomalously northerly flows across the Mediterranean region and enhanced trade winds over the sub-tropical North Atlantic. Although NAO is one of the most prominent patterns in all seasons, its relative role in regulating the variability of the European climate during non-winter months is not as clear as for the winter season. In contrast, the EAWR exerts strong influence on precipitation in the Mediterranean region such that, during the negative phase of EAWR, wetter conditions prevail across central Europe and the Mediterranean region, with precipitation extremes often occurring during these periods.
This study examines the effects of NAO and EAWR on coastline response in the Molise region, which has a microtidal regime (ordinary tidal excursions of 30-40 cm). GIS analysis of shoreline changes from historical aerial photography from 1954-2011 was performed and 20 years (1989-2008) of wave data were analysed from the nearby Ortona buoy to define trends and extreme event occurrence in the wave climate in the study area. Finally, statistical associations between NAO, EAWR, and other CV indices of possible influence (e.g. Arctic Oscillation, Scandinavia Pattern, or the East Atlantic pattern) and shoreline position changes were explored in order to identify linkages between CV forcing and coastal response in this region.
The study demonstrates that the recent evolution of the Molise coastline is responding to changes in the wave climate and increases in the frequency and intensity of storm surges in recent years. Coastal response in the region is also strongly controlled by engineering interventions, such as backwater structures and groynes (almost the 75% of coastline is characterized by offshore defenses, above all around Biferno and Trigno mouths and Termoli harbor), and the interaction of the river systems that feed the coastline. This condition may mitigate some of the impacts of CV events that are observed elsewhere along intervening stretches of coast.