Title: Integrated analysis of transition environments on climate, geoenvironmental, and anthropogenic changes during the Quaternary

Tutor: Prof. Carlo Donadio

Co-tutor: Prof. Michele Arienzo

Research project

Around 90% of the beaches in the world are in erosion, 5% are stable and only 5% are prograding. The retreating speed varies from one area to another from a few meters to over 15 m a year, especially in Mediterranean-type morphoclimatic systems. The beaches represent a natural buffer between the water environment and the mainland, where sometimes dunes, watercourses, lagoons, and cliffs, as well as cities, are present. Many factors contribute to the degradation of the Quaternary lagoon-dune-beach systems, among these the poor management of dam-river-coast systems. However, amongst various beach morphotypes, sandy-pebbly urban and lacustrine beaches represent a stimulating and new research topic. They show unique geomorphological, morphosedimentary, geonaturalistic, historical, and tourist features. Beaches are also an excellent training gymnasium for observing seasonal or daily morphological and sedimentological variations due to changing weather and climate trends. In some areas, beaches developed where before there was an artificial seafront only after the construction of other maritime works (ports, barriers, groins), while other beaches disappeared, at the same boundary conditions, for reasons yet to ascertain. In the light of these elements, in the coming years, these particular transition environments will be the subject of various national and international research programs, as indicated by the recent IPCC report on the potential effects of in-progress climate change on islands, lagoons, and cities considering the increase in flash floods and sea storms.

Proposal for a Ph.D. position

Recently, a great interest of researchers and local authorities in understanding the geomorphic processes of transition environments is evident. It has been scientifically ascertained that there is a morphological control over the dispersion in basins of fluvial-marine and lacustrine sediments which contribute to the formation of depositional morphologies (dunes, submerged bars, fans, hummocky structures), or erosional forms (deflation shapes, underwater incisions). These fine deposits could associate with allochthonous materials such as clay debris, benthic bioclasts, microplastics, pollutants (PAHs, PCBs, heavy metals, rare earth elements, etc.), then migrate offshore and do not return into coastal dynamics with loss of large sediment amounts and consequently economic deficit for the tertiary sector. Therefore, it is of fundamental importance to know the evolutionary dynamics of such environments, in particular, the urban beaches and lagoons both for their emerged and submerged sectors in which allochthonous elements accumulate, taking into account their significant geonaturalistic and tourist value. There is a great geomorphological interest because these singular environments, formed even close to or between artificial barriers or within ports and coastal lakes, have not yet been well studied and classified.

The project will be carried on through targeted geomorphological surveys and sediment sampling, eventually through boreholes, using satellite images, cartographic and meteo-marine databases, with geothematic map processing with a GIS. The activation of specific research on this new topic would allow filling most of the gaps and at the same time identify the best actions to mitigate erosion and pollution processes, following the EC recommendations for Marine Spatial Planning, implemented by the Italy's Ministry of the Ecological Transition, from the programmatic guidelines of Ministry of University and Research on sustainability, resilience, adaptivity, urban security and health of those geo-environments with ecosystems at high naturality threatened by degradation or endangered.