Title: Novel outside-the-box study on transitional environments for the conservation of geomorphic systems

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Proposal: The project is based on the collaboration with the Department of Chemical Sciences of the University of Naples Federico II for physical-chemical analyses, Instituto de Geociências, Departamento de Geografia - Universidade Estadual de Campinas (UNICAMP), Brazil, for geomorphological and morpho-sedimentary aspects, the Stazione Zoologica Anton Dohrn for the oceanographic and biotic data, and the Department of Physics of the University of Naples Federico II for the processing and treatment of Big Data and classification of transition environments through Deep Learning advanced models.

Research Program

Around 90% of beaches in the world are eroding, 5% are stable and 5% are prograding. The retreat speeds vary from a few meters to over 15 m/year. Beaches are a natural buffer between the aquatic environment and land, sometimes with dunes, rivers, lagoons, cliffs, and cities. There are many contributing causes of the deterioration of the current lagoon-dune-beach and river-beach systems, including poor management of the dam-river-coast systems. Urban and lake beaches show singular geomorphic, geo-naturalistic, historical, and tourist-recreational aspects: they are an excellent training ground for observing daily or seasonal changes for the meteomarine climax and climatic trends. In the coming years, these environments will be the subject of various research programs, as indicated in the IPCC report on the potential effects on islands, lagoons, and cities of the ongoing climate change, increase in flash floods, exceptional storm surges and tsunamis, with effects on biodiversity. There is a growing interest of researchers and territorial administrators for the knowledge of the geomorphic processes of these environments, little studied and classified: the morphological control on the dispersion in the basins of river-marine and lagoon sediments that generate depositional or erosional forms is scientifically proven. Allochthonous materials such as clay debris, bioclasts, pollutants (PAH, PCB, HM, REE, etc.), MPs, and MFs are bound to the fine deposits, which migrate along the shore, towards offshore or depocentre, enter the trophic chain and sometimes no longer in the coastal dynamics, with health problems, loss of huge sedimentary volumes and economic for the tertiary sector. The project involves geomorphic surveys and field sampling, and consultation of databases of satellite, cartographic, and meteomarine images for the production of geo-biothematic maps with GIS. This research would fill many gaps and direct towards the best-mitigating actions of erosion and pollution, following the recommendations of the EC on Marine Spatial Planning implemented by MITE, by the programmatic guidelines of the MUR on sustainability, adaptivity, urban safety, and health of geo-environments with ecosystems at high naturalness and biodiversity threatened by degradation, disappearance, invasion of alien species due to forced anthropization and global warming. The DiSTAR with UNICAMP, based on the international agreement, will select the areas to be studied, will carry out the geomorphological survey, sampling, and analysis of sediments of tropical-subtropical and Mediterranean environments with OSL dating, and will also carry out the fractal analysis of morphologies. The Department of Chemical Sciences (UNINA) will perform environmental physicochemical analyzes on MPs and MFs in the sediments. The Anton Dohrn Zoological Station will survey oceanographic data, biodiversity, alien species, and sea turtles. The Department of Physics (UNINA) will process Big Data with scalar Edge Detection and Deep Learning techniques, considering that, for each sample, thousands of mutually correlated physical, chemical, granulometric, morphoscopic, climatic, biotic, and anthropic data are recorded. This approach aims to

acquire new knowledge and multidisciplinary classifications of transition environments, to evaluate their resilience and adaptability to mitigate high-impact processes. The funds will be divided among the participants.

First year: collection of surface sediments, in cores and trenches of undisturbed sediment in emerged and submerged transition environments such as beaches, river mouths, and lagoons. Physico-chemical and morpho-sedimentary analyses: granulometry, morphoscopy, environmental chemistry, mineralogy, biodiversity. Dating of undisturbed sediments using the OSL (Optically Stimulated Luminescence) technique.

Second year: qualitative-quantitative analysis of physical, chemical, biotic, and anthropic environmental components, determination of pollution indices and sources (IPA, HM, MPs, MFs, etc.), and ecological analysis for the definition of the environmental status in geomorphic systems current tropical-subtropical and Mediterranean. Determination of the carrying capacity based on the impact of pollutants in sediments concerning morphodynamics, biodiversity, and attendance of transitional environments. Construction of two- and three-dimensional geo-biothematic cartography for risk mitigation and environmental conservation.

Third year: processing and treatment of Big Data, statistical analysis, fractal and with advanced models of Edge Detection and Deep Learning of multidisciplinary data. Seminars and publication of articles in international indexed journals.

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