Managing and monitoring coastal erosion in Greece with satellite and in-situ EO data assimilation

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SUMMARY

Due to the combined effects of climate change and human activities, hazards and natural disasters are becoming more frequent and severe, with impacts on the environment, the economy, and human lives. In this sense, an increasing number of institutions and political and organizational structures shift away from emergency response towards disaster risk reduction and planning. Such is the case of the Manging Authority of the Region of Central Macedonia (RCM) who funded the project “Monitoring climate change induced coastal erosion in the region of Central Macedonia with satellite and in-situ data” project, in which collocated Earth Observation and in situ data have been used to develop algorithms and models to assess hazard exposure and vulnerability to erosion for the entire coastal area of RCM.

The methodology applied included three main phases, referring to the design of the web GIS application that hosts the observatory, its services, and derived datasets (Phase A), the creation of the algorithms and tools for the calculation of all the necessary indicators (Phase B) and the evaluation of the current state and the proposal of alternatives for risk management (Phase C). The spatial databases, being re-evaluated throughout the project, host digital products created by applying specialized algorithms that processed optical images from the Sentinel-2 and Landsat-8 satellites to create timeseries of mulitiple indicators such as Chl-a and coastline alterations, Sentinel-1 SAR acquisitions to extract a low resolution Surface Deformation Rate model and OCN Component Extractor Speed and Direction; satellite altimetry observations from the Cryosat-2, Jason1/2/3, SARAL and Sentinel-3a/3b missions for monitoring Sea Level Anomalis and the variations of the Sea Surface Temperature. Over areas with high vulnerability, in-situ geodetic and bathymetric observations of the coastal area have been collected to calculate high-resolution models of the topography and bathymetry employing GNSS, UAV mapping, and echo sounding.

The developed databases and indicators were not only used to estimate the correlation between the gradual change of the derived indicators with the human activity, but also to calculate 50- and 100-year simulation indicators of the vulnerability of the coastal areas of RCM to erosion under the pressure of tidal waves. Moreover, a tool for determining passive flood mapping in the case of four different sea level rise scenarios using the bathtub approach has been developed. All the information was integrated in a web GIS application, conventionally named “Integrated Observatory System for Preventing and Managing the Risk of Coastal Erosion due to the Impact of Climate Change through the Utilization of Earth Observation Data”, designed to ensure interactivity, interoperability and exchange of information, support decision making and evaluate alternative coastal zone development strategies, fully compatible with the national Integrated Coastal Zone Management (ICZM). The observatory is used by the Department of Environment and Industry, Energy & Natural Resources of the Region of Central Macedonia since 2021. Networking activities between stakeholders and public authorities have already been carried out, regarding erosion problems highlighted from the project’s results, while alternative and sustainable prevention measures have been presented to local stakeholders.