EGU24-22091, updated on 26 Jan 2025
https://doi.org/10.5194/egusphere-egu24-22091
EGU General Assembly 2024

Automatic analysis of shoreline dynamics on Sentinel-2 datasets using CoastSat software toolkit

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Shorelines, as interfaces between land and water, are subject to continuous transformation due to various natural phenomena and human-induced activities. Natural processes, such as erosion and sedimentation play an important role in shaping coastal areas, while human activities, like urban expansion, also exert a significant stress on coastal areas. An illustrative instance of human-induced changes is exemplified by the Mamaia beach enlargement project, which was initiated along the coast of Romania at the Black Sea by the end of 2020 and executed throughout 2021. The analysis of this coastal transformation started in 2020, preceding the actual implementation of beach enlargement, and extended until late 2023. This timeframe was selected to capture the entirety of the dynamic changes that can be observed in the study region. Utilizing the advanced multi-temporal CoastSat toolkit, the analysis involved a detailed examination of 130 high-resolution images acquired by Copernicus Sentinel-2 satellites. Implemented within a Jupyter notebook environment using Python, CoastSat showcased its efficacy in extracting shorelines from the multi-temporal dataset, enabling a thorough understanding of the coastal dynamics observed in the Mamia beach enlargement project. The analysis reveals an expansion of over 200 m on the southern part of Mamaia beach. This transformation underscores the significant impact of human activities, emphasizing the need for sustainable coastal management practices in the face of evolving environmental challenges.