



## TerraceM 3.0: Advancing marine terrace mapping using worldwide open satellite altimetry of the ICESat-2 mission.

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TerraceM is an open-source software for mapping and analysing marine terraces. One of the primary challenges in accurately mapping marine terraces is the limited availability of digital elevation data with the resolution necessary to capture the subtle and ephemeral morphology of these geomorphic features. Recent advancements in remote sensing, such as NASA's ICESat-2 satellite mission, offer new opportunities to address this limitation. The ICESat-2 was designed to study Earth's polar ice, land canopy, and bare-earth topography using its Advanced Topographic Laser Altimeter System (ATLAS), a laser-based instrument similar to a LiDAR sensor, providing highly accurate surface elevation measurements in the form of geolocated photons along profiles. While the data are not continuous, the mission has completed thousands of orbits, densely covering most of the world's coastal areas with photon profiles, making it possible to achieve highly accurate mapping of marine terraces.

The latest version of TerraceM introduces new scripts and graphical user interfaces (GUIs) to efficiently interact with ICESat-2 photon data. These features enable users to select, download, preprocess, and map marine terraces interactively. Preprocessing capabilities include filtering canopy signals and reconstructing nearshore bathymetry, allowing the analysis of both subaerial and submarine terraces. Additionally, the new version of TerraceM supports MATLAB and Python, broadening its accessibility to a wider range of users. TerraceM-3 delivers advanced modelling and mapping functionalities, empowering researchers and students involved in marine terrace studies. By leveraging ICESat-2 data, TerraceM significantly extends our ability to analyse past sea-level changes and understand the interplay between tectonics and climate processes in coastal environments.