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Modelling reference conditions for the upper limit of Posidonia oceanica meadows: a morphodynamic approach

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The upper portion of the meadows of the protected Mediterranean seagrass Posidonia oceanica occurs in the region of the seafloor mostly affected by surf-related effects. Evaluation of its status is part of monitoring programs, but proper conclusions are difficult to draw due to the lack of definite reference conditions. Comparing the position of the meadow upper limit with the beach morphodynamics (i.e. the distinctive type of beach produced by topography and wave climate) provided evidence that the natural landwards extension of meadows can be predicted.
Here we present an innovative predictive cartographic approach able to identify the seafloor portion where the meadow upper limit should naturally lies (i.e. its reference conditions). The conceptual framework of this model is based on 3 essential components:
i) Definition of the breaking depth geometry: the breaking limit represents the major constrain for the landward meadow development. We modelled the breaking limit (1 year return time) using the software Mike 21 sw. ii) Definition of the morphodynamic domain of the beach using the surf scaling index ε; iii) Definition of the P. oceanica upper limit geometry. We coupled detailed aerial photo with thematic bionomic cartography.
In GIS environment, we modelled the seafloor extent where the meadow should naturally lies according to the breaking limit position and the morphodynamic domain of the beach. Then, we added the GIS layer with the meadow upper limit geometry. Therefore, the final output shows, on the same map, both the reference condition and the actual location of the upper limit. It make possible to assess the status of the landward extent of a given P. oceanica meadow and quantify any suspected or observed regression caused by anthropic factors.
The model was elaborated and validated along the Ligurian coastline (NW Mediteraanean) and was positively tested in other Mediterranean areas.