ADVANCES ON THE USE OF SATELLITE DERIVED PRODUCTS TO DETECT COASTAL CHANGES: DEMONSTRATION CASE ON THE COAST OF SPAIN

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INTRODUCTION

Regular and efficient monitoring of coastal changes is necessary to inform coastal management decisions. In this regard, recent developments based on Google Earth Engine (Gorelick et al., 2017) enable the automatic detection of coastal changes using satellite data (Turner et al., 2021) However, such tools are usually calibrated with limited information and, consequently, they may lead to significant errors when applied to beaches with different conditions than those considered in the calibration data sets.

In this work, we evaluate the capability to monitor changes in coastal morphology at various temporal and spatial scales using satellite-derived data obtained from an automatic processing method that includes site-specific information. These method was developed within the framework of the *Coastal Erosion from Space Project* (https://coastalerosion.argans.co.uk/) that brought together experts from several countries with different backgrounds, such as Earth Observation, Geology, Engineering and Management, to develop satellite products to monitor coastal change based on end-user requirements.

METHODS

The data used here included i) satellite-derived waterlines (SDW) - instantaneous interface between water and sand, ii) satellite-derived shorelines (SDS) - datum-based lines derived from the SDWs and iii) satellite-derived bathymetry (SDB) - developed from the empirical correlation between satellite spectral information and the depth of the water column (Figure 1).

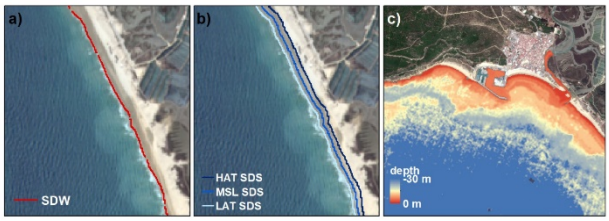

Figure 1 - Example of satellite derived products used in this work: a) SDW, b) SDS and c) SDB.

The accuracy and skill of SDWs, SDSs and SDBs were assessed at several pilot sites selected in the coast of Spain to challenge satellite-derived remote sensing skills with diverse marine climate and tidal range conditions. Accuracy was tested by comparing satellite-derive data and in-situ measurements and skill was assessed for several morphodynamic processes at diverse temporal and spatial scales.

RESULTS

The accuracy assessment of SDWs and SDSs indicated high horizontal accuracy, with errors on the order of half of the pixel size.

On the other hand, the skill assessment of SDWs and SDSs confirmed the ability to detect long-term shoreline changes at various spatial scales, as the erosion rates obtained from the whole set of satellite images that spans for 23 years (1995-2018) showed to be in agreement with the erosion observed at one beach (local scale) and along the coast of a whole province (regional scale). Short-term erosion following a storm and changes derived from beach re-nourishment works were also properly estimated using pre and post-event SDSs. Finally, seasonal beach rotation was detected although not quantified due to the lack of in-situ measurements.

Regarding the SDBs, a high correlation with in situ measurements was observed (R^2 = 0.83) and the majority of the dataset (84%) presented errors ranging between -1 and 1 m. However, the ability to detect the sea bed morphology from SDBs was limited and results showed a clear underestimation of depth values. Furthermore, issues regarding sediment concentration and cloud cover reduce significantly the amount of data available in SDB time series.

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