

A GLOBAL DATABASE OF GEOPHYSICAL, HYDRODYNAMIC AND SOCIOECONOMIC INDICATORS AT THE COAST

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INTRODUCTION

Around 10 percent of the global population lives in low-lying coastal areas (MacManus, 2021). Several economic activities also develop in these areas. At the same time, they are home to some of the richest ecosystems. Coastal zones are quite susceptible to extreme storms and sea level rise driven by climate change (IPCC, 2021). During the last couple of years, a high number of global datasets have become available, describing different aspects of the earth's surface such as land-elevation, land-use, waves, water-levels and more. However, for studies focusing in the coastal zone, it is important that this type of information is available directly at coastal locations and in a consistent manner. Previous research (Athanasiou, 2019) has shown the importance of the spatial variability of the input geophysical data when assessing coastal hazards at large spatial scales. In this research we present a Global database of Coastal Characteristics (GCC) with 80 indicators that span the geophysical, hydrometeorological and socioeconomic environment at the coast (Figure 1). These indicators are extracted using the latest freely available global datasets and a newly created global high-resolution transect system. Even though these indicators are derived from global datasets, they can be valuable for coastal screening studies, especially for data-poor locations.

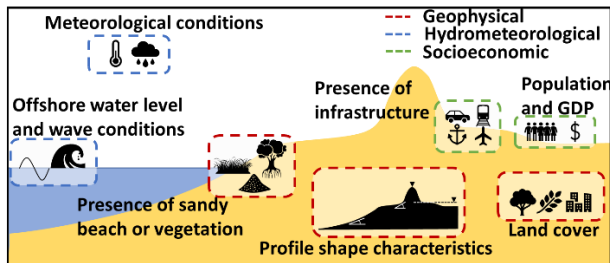


Figure 1 - Overview of indicator groups extracted per transect.

APPROACH

A global transect system was generated using a spacing of 1 km along the global ice-free coastline, which resulted in almost 730,000 transects globally (Figure 2). The transects extended 4 km in the landward and 4 km in the seaward directions. A large number of available datasets were sampled at the location of the transects using various GIS techniques. All datasets that were used to extract the coastal indicators were open-access and had global coverage. Profiles of elevation and land-cover were extracted at all locations using global Digital Elevation

Models (DEMs), and land-cover maps. Using the extracted elevation profiles, various geophysical indicators were derived that can be important for estimating the severity of coastal hazards like flooding or erosion. This included indicators of the nearshore and backshore slope, coastal maxima, mean hinterland elevation and others. Additionally, hydrometeorological indicators, e.g., extreme wave heights and water levels, were extracted at each transect location by using the closest grid points from global hindcasts. Furthermore, information on local population below different elevation thresholds was extracted using global population maps, combined with the DEM data. The presence of critical infrastructure in the proximity of the transects was assessed as well, using global data on road and railway networks, and port and airport locations.

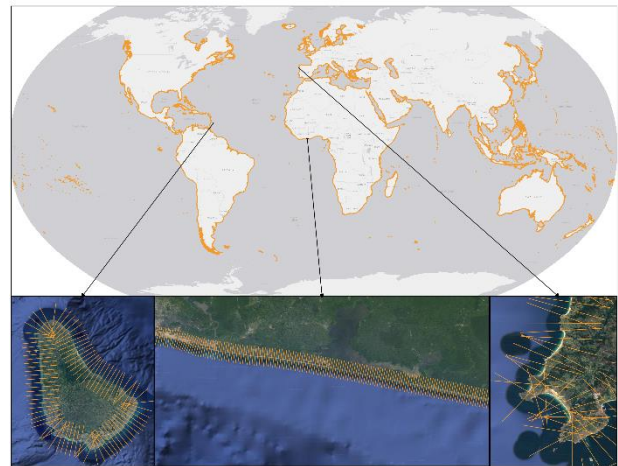


Figure 2 - Overview of the global transects (shown with orange) and zoom-in areas at Barbados, Ghana and Spain.

RESULTS

The aforementioned analysis resulted in a global database of 80 indicators describing different aspects of the local geophysical, hydrometeorological and socioeconomic environments at almost 730,000 locations along the global coastline. For example, the coastal maxima (Figure 3), which is defined as the highest elevation peak landwards of the shoreline, can be an important indicator of protection against coastal flooding from extreme marine storms (Almar, 2021). The produced indicators can be directly used for coastal screening studies assessing coastal hazards and impacts or could be used for coastal classification purposes. To showcase the latter, a k-means clustering of the global transects was performed, using a selection of geophysical

indicators in order to group the global coastal transects in groups with similar characteristics. The results showed a good grouping of similar types of coastlines based on their geomorphological shape. However, supervised classification techniques could potentially produce more accurate results and should be tested in the future. Furthermore, the presented dataset can provide initial insights of the local coastal characteristics at data-poor locations. The dataset created herein can be updated in the future, as more accurate and higher-resolution global datasets become available.

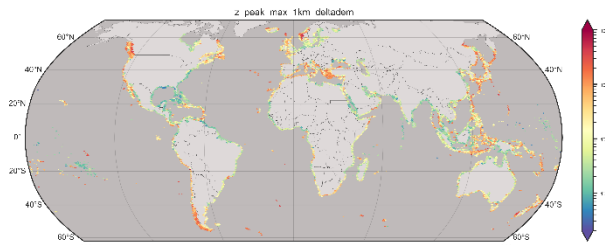


Figure 3 - Global map of the Coastal maxima (red colors indicate higher values).

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