TRANSITIONAL IMPACTS OF ENSO ON WAVE CLIMATE IN COASTAL REGIONS

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INTRODUCTION

Amongst all the factors involved in coastal risk assessment, climate variability is key, due to its potential for modifying the coast, particularly through increased seasonal risk of erosion-flooding on the coast (Toimil *et al.* 2020; Wahl and Plant 2015). The principal driver of interannual variability of the wave climate around the world is El Niño-Southern Oscillation (ENSO). Many researches have focused on the analysis of this phenomenon globally (Stopa and Cheung 2014), its impacts on regional wave climate (Barnard et al. 2015, 2017; Odériz et al. 2020; Reguero, Méndez, and Losada 2013) and their local coastal effects (Mortlock and Goodwin 2016). This interest in ENSO impacts in wave climate is motivated by its capacity to cause coastal erosion (Barnard et al. 2015). Particularly, the temporal and spatial transition of ENSO is nowadays a current issue (Ha et al. 2012). On the world´s coasts, the ENSO impacts delay is not yet fully understood, nor integrated into engineering practices.

This work aims to identify the maximum influence and delays of ENSO in the local wave climate of the world coasts. This study is focused on local wave climate effects, more than on ENSO transition physics, although it is based on it. These maps of coastal hazards can be used as the path to predicting the intensity, and duration of the ENSO effects on the world's coasts.

METHODS

The study used the wave hindcast data of ERA5 reanalysis (ERA5 Reanalysis, 2017), with a 0.5° x 0.5° spatial resolution, and hourly data from 1979 to 2018.

The composite anomalies of atmospheric (SLP) and ocean (Dir_m and P_w) configuration were computed for the positive and negative phases of the phenomena. El Niño y La Niña were identified using the Oceanic Niño Index (ONI). Monthly time series of wave parameters on the world´s coasts were extracted for each grid cell. For each cell, cross-correlation was calculated between the MEI (Multivariate ENSO index) and Dir_m and P_w. While ONI identifies neutral, positive and negative phases, MEI only identify the last two phases mentioned. But MEI was selected as optimal climate index to analyse wave power and wave direction globally, based on previous analysis of the robustness of ENSO climate indexes (Odériz et al., submitted).The lags of cross-correlation were computed from 0 to 7x12 months. These lags were selected for covering the duration of both ENSO types, quasi-biennial (QB), and Low frequency (LF) (Yun et al. 2015). Monthly R-maps (Correlation Coefficient) were generated as can be seen in Figure 1, where R values for the 0-month lag is shown. The maximum R and its corresponding lag were obtained. As well, the duration of ENSO impacts was calculated.

The results show effects 0-4 months after started in the Pacific Basin and 5-6 MONTHS Western Indian Ocean, followed by the Eastern Indian Ocean (9-10 months). The ENSO effects in wave power were found in the Atlantic Ocean after 9-12 months. The Extratropics Bands of all the basins showed the higher values of correlation with P_w, showing that the Tropical-Extropical is the strongest teleconnection induced by ENSO in the wave systems. As it is well-known El Niño reinforces the Westerlies Winds (Wang, Wu, and Lukas 1999; Yun et al. 2015). The wave direction responds almost immediately in the Indian Ocean and Pacific Ocean following the limits of the Hadley Cells.

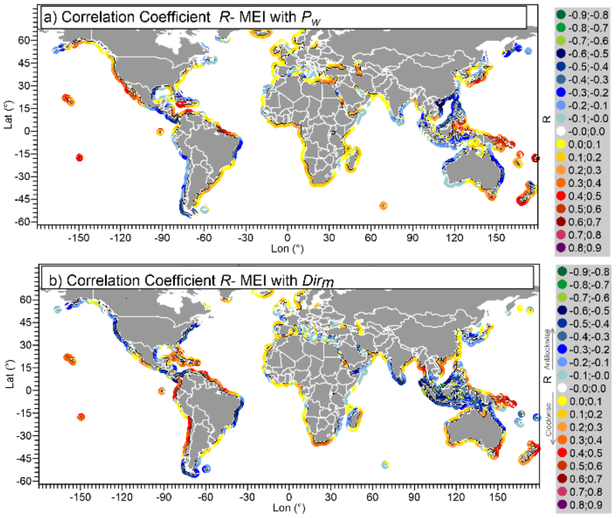

Figure 1 - Correlation Coefficient R of MEI for lag 0 month with mean direction and wave power on the world´s coasts.

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