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On the global assessment of the coastal wave storminess

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Coastal storms represent powerful and damaging episodes involving climatic variables such as wind, precipitation, sea level and ocean wind waves. Particularly, ocean wind wave storms (or simply wave storms) have a high potential for coastal damage by acting as a major driver of impacts like shoreline erosion and flooding. Wave storms represent extreme wave events significantly exceeding the mean local wave climate conditions, hence impacting the coast by altering the mean equilibrium. This study assesses, for the first time, the global wave storminess based on a high resolution hindcast covering a 42-year period (1979-2020) with hourly time resolution, forced with wind fields from ERA5 reanalysis.

Here, wave events are classified as wave storms by using a unique global criterion based on exceedances over the 95th percentile of the significant wave height. This threshold is selected due to its widespread use in the scientific literature and its flexibility to adapt to local wave conditions, a basic requirement for working at global scale. Additionally, a minimum storm duration of 12 hours and a wave storm independence interval of 48 hours are considered to define the storms. For completeness, an independent analysis of the most severe wave storms reaching the coast is performed. For that matter, wave storms are classified as severe wave storms if the significant wave height exceeds the 99th percentile for more than 6 hours.

The computation of several statistics and indices allows the analysis of the main characteristics of wave storms, such as frequency, duration and intensity. In addition, the mean significant wave height, mean wave direction and energy flux during wave storms are analyzed. Other secondary storm characteristics, such as swell and wind-sea dominance of the storm energy, and wave height and wave period dominance in the energy transport are also examined to complete the analysis. Results show a global coastal wave storminess pattern strongly characterized by a latitudinal gradient in which the coasts at higher latitudes are stormier than those at lower ones. The higher latitudes show the greatest mean wave heights during storms, reaching over 6 meters in western Ireland or southernmost Chile, and a high number of events per year. The tropical coasts are characterized by lower wave heights and longer storm durations, even exceeding 4 days in some stretches bordering the Arabian Sea. The most relevant exceptions to this behavior in the tropical region are the areas affected by TCs, which can be impacted by storms with very high wave heights.

