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Wave climate projections off coastal French Guiana based on high-resolution modelling over the Atlantic Ocean

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Global warming is altering the atmosphere and ocean dynamics worldwide, including patterns in the generation and propagation of ocean waves, which are important drivers of coastal evolution, flood risk, and renewable energy, among others. In French Guiana (northern South America), where most of the population is concentrated in coastal areas, understanding future wave climate change is critical for regional development, planning and adaptation purposes. The most energetic waves typically occur in boreal winter, in the form of long-distance swell originating from the mid-latitude North Atlantic Ocean. However, existing high-resolution wave climate projections that cover the French Guiana region focus on the hurricane season only (summer-fall).

In this study, a state-of-the-art basin-scale spectral wave model and wind fields from a high-resolution atmospheric global climate model were used to simulate present and future winter (November to April) wave climate offshore of French Guiana. The model performance was evaluated against wave data from ERA5 reanalysis, satellite altimetry and coastal buoys between 1984 and 2013. A statistically significant overall projected decrease (~5 %) in wintertime average significant wave height and mean wave period was found for the 2051-2079 period under the RCP-8.5 greenhouse gas emission scenario, together with a ~1° clockwise rotation of mean wave direction and consistent reductions in extreme wave heights and frequency. The results suggest that these decreasing trends are primarily driven by changes in large-scale patterns across the Atlantic that counteract an expected increase in local wind speed. Such results are further discussed using the limited available data from a multi-model ensemble of global wave projections.