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Global assessment of maximum wave heights from model reanalysis

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In this study, we use reanalysis datasets to characterize the maximum crest, crest-to-trough and envelope heights of sea states, on a global and long-term scale. In particular, we rely on the ERA-Interim directional wave spectra, which are used to estimate the parameters of the probability distributions of wave maxima. To represent the typical single-point observations we use time extreme theoretical models, while to take the three-dimensional geometry and short-crestedness of ocean waves into account, we adopt a space-time extreme model. In order to assess the confidence limits of the reanalysis-based wave maxima we verify them against buoy and stereo-video wave observations collected in the North Pacific Ocean. We provide the global assessment of maximum crest, crest-to-trough and envelope heights during typical and extreme conditions, showing where the largest values are attained, that is in the mid-latitude storm belts, in particular in the North Atlantic Ocean. With respect to previous wave climate studies that focused on the significant wave height only, in this study, besides quantifying the maximum wave heights in magnitude, we also highlight the role of wave parameters such as wave steepness and kurtosis (measures of nonlinearity) and spectral bandwidth (measure of irregularity). Finally, we stress the relevant contribution of the short-crestedness, which should be taken into account in assessing wave maxima for the safety of navigation, ship routing and marine structural design.