Trends and variability in modeled wave climate detected using projections of an Earth system model

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Abstract

Surface waves in the ocean respond to changes and variability in atmospheric circulation and climate states. Indeed, observations and modeling studies indicate trends in wave height over the past decades. Nevertheless, it is currently impossible to disentangle whether these trends are resulted by climate variability or climate change. Earth system models, such as those used within the 5th Phase of the Coupled Model Intercomparison Project (CMIP5) provide long (several hundreds of years) and internally consistent datasets of climate parameters. Together with wave models, these datasets are useful tools to investigate signals and shifts in wave climate. We used the output of an Earth system model (EC-Earth) produced within CMIP5 to force a global wave model (WAM) in order to study the response of waves to different climate regimes. First, we calculated a control simulation to study the internal unforced model variability in waves modeled by the model WAM. Then, we compared this control simulation to waves calculated under different (forced) climate regimes over the historical period (1850-2010) and for a future climate change scenario RCP8.5. We analyze the response of ocean waves to climate change and variability particularly focusing on global patterns and regional shifts. Using statistical tools, we project time frames when the calculated trends in ocean waves are discernible from internal model variability (detectable) and can be attributed to climate change.