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Projected future wave climate along Australia's eastern margin

Mark Hemer (1), Kathleen McInnes (2), and Roshanka Ranasinghe (3)

(1) CSIRO, Marine and Atmospheric Research, Hobart, Australia (mark.hemer@csiro.au), (2) CSIRO Marine and Atmospheric Research, Aspendale, VIC 3195, Australia, (3) UNESCO-IHE and Technical University of Delft, The Netherlands

The study explores three sources of uncertainty in regional wave climate projections for the east Australian coast, where spectral wave models (SWAN nested in WW3) have been forced with climate model derived winds for time-slices 1981-2000, 2031-2050 and 2081-2100. The first uncertainty in future climate projections is the way the climate system will respond to greenhouse gas concentrations, which is often assessed through the comparison of different GCM model responses to a particular emission scenario. To explore this level of uncertainty, a 3-member ensemble where CSIRO's stretched grid downscaling model CCAM is forced by three different GCMS (CSIRO Mk3.5, GFDLcm2.0 and GFDLcm2.1) is considered. The second of these uncertainties is the uncertainty in the future emissions of greenhouse gases, which is addressed in the wave model simulations by applying wind forcing from the CCAM simulations forced with plausible future scenarios of greenhouse gas emissions (SRES A2 and B1). The third level of uncertainty surrounds how biases in forcing wind data (which were found between the CCAM downscaled GCM winds and observational/reanalysis winds) are treated. Three different methods of applying wind forcing to wave models to develop future wave climate projections were tested. The first method was the direct application of uncorrected climate model winds (referred to as the no-correction or NBA method). This approach assumes that the source of the biases in the current climate affect the future climate in the same way and are therefore largely eliminated when changes between the two climates are evaluated. In the second method, a technique that corrects both directional components of the wind, referred to as bivariate quantile adjustment, was developed and used to evaluate the differences between modelled and observed current climate. These differences were then applied as a bias correction to both present and future climate winds (referred to as the bias correction or BA method). The third method was to use the bivariate quantile procedure to evaluate the differences between present and future climate winds and use these to adjust the observed winds to represent the future climate winds (referred to as the perturbed observations or PP method).

The ensemble of wave model runs for the 2081-2100 time-slice project a robust decrease in mean significant wave height, Hs, (the highest one third of waves) along the east Australian coast relative to present climate conditions. The magnitude of the projected change was relatively small (less than 0.2 m), but significant, and increased northwards along the NSW coast. A relatively small ($\sim 5^{\circ}$) anticlockwise rotation in mean wave direction is projected to occur over the same period. This limited but not exhaustive investigation of three contributions to uncertainty has found that the different method of applying winds from a climate model to the wave model introduce the largest uncertainty in the final results.