



A projection of 21st century winter wave climate change for the North Pacific

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A 160-year (1940-2099) wave model simulation has been conducted using 6-hourly wind data from the National Center Atmospheric Research (NCAR) Community Climate System Model (CCSM) model. The CCSM wind data come from one member of ensemble simulations covering the late 20th century (1940-1999) using historical radiative forcing, and continuations of these runs into the 21st century under the IPCC SRES A1B scenario. A companion wave model simulation using wind data from the National Centers for Environmental Research (NCEP) / NCAR Reanalysis Project (RA) was conducted over the period 1949-1999. Results from other four other CCSM ensemble members using the same (historical-A1B) radiative forcing, available as monthly and seasonal averages (not 6-hourly data), are also used in analyses. The wave simulations were conducted with the WAVEWATCH III model.

The research addresses three main questions. First, how well do the wave climates from simulations using CCSM and RA wind products agree over the late 20th century? Second, what are the projected 21st century changes in winter wave climate? Third, how well do statistical downscaling techniques based on seasonal average circulation statistics (e.g., seasonal mean sea level pressure) perform in reconstructing wave model simulations? Regarding the first question, the results show that the CCSM- and RA-derived wave model climates agree very closely over the period 1949-99 with respect to winter average 95th percentile significant wave height (SWH), dominant direction and dominant period. The results for the 21st century show only small changes in “extreme” (90th and 99th percentile SWH) wave climate for the A1B scenario runs with CCSM but large amplitude decadal variability. This result is obtained both from the CCSM-forced wave model, and from statistically-derived projects based on winter mean sea level pressure. For the third question, the results show that for winter

North Pacific wave climate and the model data described above, and for the particular statistical modeling methods used, the application of statistical models derived from different portions of the CCSM simulation [i.e., from seasonal mean sea level pressure and 90th (or 99th) percentile SWH], or from the RA results, provides only qualitative accuracy for the actual simulated wave climate variability found in either set of wave model results.