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Estimates of Construction-Related Extreme Winds Using Dynamical Downscaling Method with the WRF model

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Large and expansive infrastructure projects require reliable regional climate change information to minimize risks of extreme weather events and to optimize construction costs. Narrowing the gap of climate information usability is becoming increasingly important. In this study, extreme surface winds are estimated by dynamical downscaling the Norwegian Earth System Model (NORESM1-M) climate realizations using the Weather Research and Forecasting Model (WRF) at the construction site of Hardanger Suspension Bridge in western Norway. This region has very complex terrain. It encompasses a coastal line and high peak mountains, with the North Atlantic Ocean at the west. The WRF model was used to downscale NORESM data from 2.7°x 1.8° to 1 km x 1 km horizontal grids. Simulations were performed for two time periods, the 1990s and the 2050s. Future projection was made under the RCP8.5 radiative forcing scenario. Monthly extreme winds were analyzed for Sotra Bridge, at coastal area, and Hardanger Bridge, near mountains. Statistic analysis results were compared with observations at nearby observation stations for a warm period, a cold period, and a whole year period to account for seasonal effect. The extreme wind distribution from simulation has good agreement with observed distribution at coastal area, but systematically higher at mountain area due to unrealistically smoothed terrain in the model. The intense wind directional analysis was also carried out, and compared the distribution pattern to the results from 20 year observations at coastal area. It is difficult to compare at mountain area due to missing data. Extrapolation method was used to project extreme wind in the early and late of the 21 century. Comparison of simulated extreme wind between the 1990s and the 2050s shows that future extreme winds are likely to sustain with slight modifications by local terrain forcing.