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PROBABILISTIC ASSESSMENT OF EXPOSURE TO COASTAL HAZARDS AT A NUCLEAR POWER STATION DEVELOPMENT SITE IN THE UK

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Evaluating risks from external hazards is crucial for the safety of nuclear power stations throughout their lifecycle. In coastal areas, these hazards stem from complex meteorological, oceanographic, and geomorphological processes that act on varying spatial and temporal scales. The assessments of coastal hazards usually require considering both the local wave and water level variations and the associated weather conditions. In this research, we apply a weather typing method to downscale from regional atmospheric circulation to local wave climate and storm surge conditions at the Hartlepool nuclear power station. Model validation is conducted to assess the method's ability to downscale multivariate wave climate and storm surge. A sensitivity analysis is performed to identify key factors influencing the downscaling process, such as the choice of predictor parameter, special domain definition, and the number of weather types used. Beyond downscaling local variables, the weather types can link local sea state variability with large-scale climate oscillation patterns, providing insights into the impact of interannual climate variability on a regional scale. Additionally, the sea state conditions associated with each weather type will be further downscaled using process-based dynamical models to evaluate potential flooding and erosion hazards at the coastal nuclear facility. This hybrid downscaling approach establishes the connection between atmospheric conditions and potential coastal threats, offering a valuable tool for proactive hazard preparedness and risk management in nuclear power and other critical infrastructure sectors.