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Enabling explicit wave-atmosphere coupling in the Weather Research and Forecasting model using immersed boundary methods ZHAO WU, JEFFREY D. MIROCHA, ROBERT S. ARTHUR, DAVID J. WIERSEMA, KATHERINE A. LUNDQUIST, Lawrence Livermore National Lab, PEIYUN ZHU, OLIVER B. FRINGER, Stanford University — Immersed boundary methods (IBMs), implemented into the Weather Research and Forecasting (WRF) atmospheric model for complex terrain and urban applications, have been extended to represent moving objects, such as sand dunes or water waves. Validation of the moving IBM implementation is presented, comparing the impacts of moving cylinders, hills and waves on the flow against published experimental and simulation results. Comparisons are also made to simulations using WRFs native terrain-following grid, and stationary WRF-IBMs (Lundquist et al. 2012; Bao et al. 2018; Wiersema et al. 2020; Arthur et al. 2020). Sensitivities to different IBM formulations, including velocity and shear stress reconstruction approaches, as well as the type of wave boundary condition, are also presented. Utilization of moving IBMs in atmospheric large-eddy simulations to support offshore wind energy application is also discussed, including coupling with a prognostic wave model to provide realistic evolving wave height and velocity information.

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