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Numerical investigation of energy transfer in coupled wind and wave system XUANTING HAO, LIAN SHEN, University of Minnesota — Energy transfer in the wind-wave system is one of the key physical processes in air-sea interactions. In open oceans, the wind input, nonlinear wave interaction, and wave dissipation are three key mechanisms of energy transfer that govern the wave field evolution. In this study, we conduct a series of high-fidelity numerical experiments using dynamically coupled large-eddy simulation for the turbulent wind and high-order spectral simulation for the waves. By directly analyzing the wave statistics data obtained from our wave-phase-resolved deterministic simulations, we monitor the spectral evolution of the wave field. We observe the frequency downshift phenomenon and the self-similarity of the wind-forced nonlinear wave field throughout the numerical experiment. Further analysis quantifies the wind input, nonlinear wave interaction, as well as wave dissipation. The nonlinear wave interaction is found to be dominant over the wind input and wave dissipation locally in the spectral domain despite its overall energy-conserving property.

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