Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Space-time characteristics of wind turbulent pressure field at wave surface XUANTING HAO, LIAN SHEN, University of Minnesota — The wind pressure field at the wave surface, with fluctuations several orders of magnitude smaller than the mean atmospheric pressure, has a notable impact on the wave energy growth. The time-variant and irregular wave field poses great challenge to the full space-time measurement of the surface pressure. We present a simulation-based study of the space-time characteristics of the surface pressure field. The numerical tool is a combined turbulence solver and wave-phase-resolved model, where the wind turbulence is simulated with large-eddy simulation and the nonlinear wave field simulated using a high-order spectral method. The joint probability distribution of the surface pressure and the vertical surface velocity is found to resemble that of turbulent flows over a compliant wall. We also conduct spectral analysis on the surface pressure field to obtain the wavenumber-frequency spectrum. While the turbulent pressure fluctuations have a convection velocity comparable to turbulent flows over a fixed flat wall, a distinct wave effect is identified. The wavenumber/frequency peak of the wave-coherent pressure field is found to deviate from that of the wave field, suggesting nonlinearity in the turbulence-wave interactions.

Xuanting Hao
University of Minnesota

Date submitted: 27 Jul 2019 Electronic form version 1.4