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Numerical simulations of the turbulent flow over an ocean wavefield[1] DEVIN CONROY, LAURA BRANDT, JAMES ROTTMAN, Leidos — The air-sea dynamics for wind driven ocean waves are crucial for understanding and predicting the weather and global climate, as well as for predicting forces on ships and offshore wind farms for design and operation. The wind-wave problem has been an active area of research for many years, spanning observational, experimental, theoretical, and numerical studies. Here we leverage the Large Eddy Simulation technique with a sub-grid scale sea surface roughness model for the interfacial stress and an interface capturing Volume-of Fluid method to obtain highly accurate phase resolved simulations over a sufficiently large domain size. We investigate the dynamics of the air-sea interaction, starting with a JONSWAP spectrum, to understand the generation of turbulence, wind-wave growth, non-linear surface dynamics, and wave breaking on the overall energy budget. We find that the wind stress tends to add energy at small length scales ($< O(1m)$), due to the surface shear and turbulent pressure fluctuations in the air above the surface. Preliminary results also indicate that under strong wind forcing (or low wave age), air separation occurs near wave crests that later undergo wave breaking.

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Devin Conroy
Leidos

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