Geophysical Research Abstracts
Vol. 18, EGU2016-2281, 2016
EGU General Assembly 2016

Effects of ocean surface gravity waves: on turbulence, climate, and frontogenesis

Baylor Fox-Kemper and Nobuhiro Suzuki

Dept. of Earth, Environmental, and Planetary Sciences, Brown University, Providence, Rhode Island, United States (baylor@brown.edu)

Surface waves affect turbulence of the upper ocean on a variety of scales, with impacts from the meter scale to the global. This talk will review simulations and theory quantifying and elucidating these effects.

This presentation will first touch upon the best understood wave influence–Langmuir turbulence–concluding with a quantification of the importance of Langmuir turbulence on global climate. This quantification is based on prognosis of wave statistics using WaveWatch-III as a component of the Community Earth System Model. These statistics are used to enhance mixing in the K-Profile Parameterization consistently with scalings based on Large Eddy Simulations of the Wave-Averaged, or Craik-Leibovich, equations. In this system, all of the wave effects arrive via Stokes forces–rectified forces proportional to the Stokes drift which exchange properties between waves and turbulence.

The second major portion of the talk will address the importance of Stokes forces on oceanic fronts. High resolution simulations and observations of the ocean surface boundary layer have revealed 100m to 10km frontal structures in temperature and other properties worldwide. The formation and evolution of these features, through frontogenesis, instability, and frontolysis is an important and often poorly-simulated part of the climate system, yet fronts and filaments dominate the transport of energy, momentum, dissolved gasses, oil, and pollutants over a wide range of scales. Large Eddy Simulations of the the Wave-Averaged Equations spanning the scales from 5m to 20km will illustrate the theory of frontogenesis–including the leading order effects of Langmuir turbulence and surface waves which imbue the fronts with ageostrophic and nonhydrostatic character.