EGU22-11376
https://doi.org/10.5194/egusphere-egu22-11376
EGU General Assembly 2022

Experimental study of wave-turbulence interaction

Benjamin K. Smeltzer, R. Jason Hearst, and **Simen Å. Ellingsen**
Norwegian University of Science and Technology, Department of Energy & Process Engineering, Trondheim, Norway

Turbulence is ubiquitous in the uppermost layer of the ocean, where it interacts with surface waves. Theoretical, numerical, and experimental works (e.g. [1,2,3] respectively) predict that motion of non-breaking waves will increase turbulent energy, in turn leading to a dissipation of waves. Waves are believed to contribute significantly to the turbulence in the ocean mixed layer, yet additional measurements are needed to validate and distinguish between models and theories [4].

In this work we study the modification of turbulence by surface waves using experimental measurements of turbulent flows in the presence of waves. The measurements were performed in the water channel laboratory at NTNU Trondheim [5], able to mimic the water-side flow in the ocean surface layer under a range of conditions. An active grid at the inlet allowed the turbulence intensity and length scale to be varied while maintaining an approximately constant mean flow. The flow field was measured in the spanwise-vertical plane by stereo particle image velocimetry for various background turbulence cases with waves propagating against the current. The turbulence characteristics are compared to cases without waves, and the turbulence level is found to be increased after the passage of wave groups. The results are discussed considering predictions from rapid distortion theory [1].

[1] Teixeira M. and Belcher S. 2002 “On the distortion of turbulence by a progressive surface wave” *J. Fluid Mechanics* **458** 229-267.

[2] McWilliams J. C., Sullivan P. P. and Moeng C-H. 1997 “Langmuir turbulence in the ocean” *J. Fluid Mechanics* **334** 1-30.

[3] Thais L. and Magnaudet J. 1996 “Turbulent structure beneath surface gravity waves sheared by the wind” *J. Fluid Mechanics* **328** 313-344.

[4] D’Asaro E.A. 2014 “Turbulence in the upper-ocean mixed layer” *Annual Review of Marine Sciences* **6** 101-115.

[5] Jooss Y., et al. 2021 “Spatial development of a turbulent boundary layer subjected to freestream turbulence” *Journal of Fluid Mechanics* **911** A4.