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Transport and Behavior of Non-Spherical Particles in Waves

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Plastic pollution in the ocean breaks down and persists as small particles, or microplastics. Accurately assessing microplastics sources and sinks requires a thorough understanding of the transport and dispersal of microplastics in the ocean. In this talk, I consider microplastics transport in surface gravity waves, as waves control many transport processes at the ocean surface and along the coasts where plastic pollution is abundant. Of particular interest is how the characteristics of microplastic particles, such as their size and shape, affect their transport. Particle shape couples to transport through particle orientation. Using a finite-amplitude correction, I show how spheroidal particles tend to a preferred orientation under waves. This orientational behavior is a consequence of how the particle samples the wavy flow and is the angular analog of Stokes drift. The mean preferred orientation is shown to be solely a function of the particles shape. The implications of this theoretical result were explored with both numerical and laboratory experiments, and the effects of the waves and the particle characteristics are shown to be non-trivial in the modelling of microplastics transport.