Effects of Surface Waves on Upper Ocean Transport during Hurricane Isaac (2012)

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Motivation: Surface waves significantly contribute to horizontal material transport on the ocean surface, especially in extreme wind conditions such as in hurricanes and winter storms. However, it is difficult to observe and unrepresented in most ocean models.

Goals: To quantify the impact of the Stokes drift and Eulerian currents on the ocean transport at the surface using a fully coupled Atmosphere-Wave-Ocean (AWO) model and data from 300+ Lagrangian drifters.

Approach:
2. Quantify the simulated surface transport at drifter locations, with and without Stokes drift.
3. Estimate the impact of waves in Hurricane Isaac and validate against drifter measurements.

Conclusions:
1. Surface waves have a significant impact on the upper ocean transport. Stokes drift is of the same order of magnitude as Eulerian currents in hurricane force winds. As a result, surface transport is typically underestimated by ocean circulation models in high wave conditions.
2. During Hurricane Isaac passage, the wave-induced Stokes drift adds a cyclonic component to the trajectories on the left side, and anti-cyclonic on the right side of the storm track. This pattern is likely present in all tropical cyclones, but may change depending on storm size, intensity and translation speed.
3. Including the Stokes drift in the calculation of ocean surface transport improves the model simulated trajectories. In addition, Stokes drift improves the magnitude of surface velocities, and is in excellent agreement with GLAD data at the time of high wind forcing.

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