The Impact of Ocean Surface Currents on Global Eddy Kinetic Energy via the Wind Stress Formulation

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A more complete wind stress formulation takes into account the ocean surface currents, while the conventional wind stress popularly used in ocean circulation models is only a function of 10-m winds. A pair of 12.5-year (July 2002 –December 2014) HYbrid Coordinate Ocean Model (HYCOM) simulations that only differ in the wind stress formulation are used to study the impact of ocean surface currents on global Eddy Kinetic Energy (EKE). The model results (2004-2014) show that including ocean surface currents in surface wind stress formulation reduces global EKE by more than 40%. To understand the mechanisms behind the large difference, we calculate the global EKE budget using the standard Reynolds averaging procedure. The direct impact of surface wind stress on EKE is through surface wind work. The indirect impact is through changes in the mean circulation that affect the shear production, buoyancy work, and bottom friction. Model Results indicate that the reduction of global EKE is primarily due to the buoyancy work and shear production. Even though the surface eddy wind work is one order larger than buoyancy work, and two orders larger than shear production, it is mainly balanced by bottom friction and thus not the main contribution for the EKE differences.

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