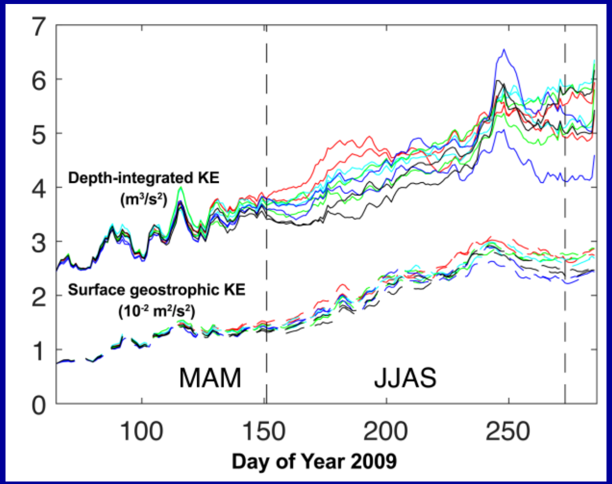
Wind drift and surface-current coupling in regional coupled ocean-atmosphere simulations of the northern California Current System

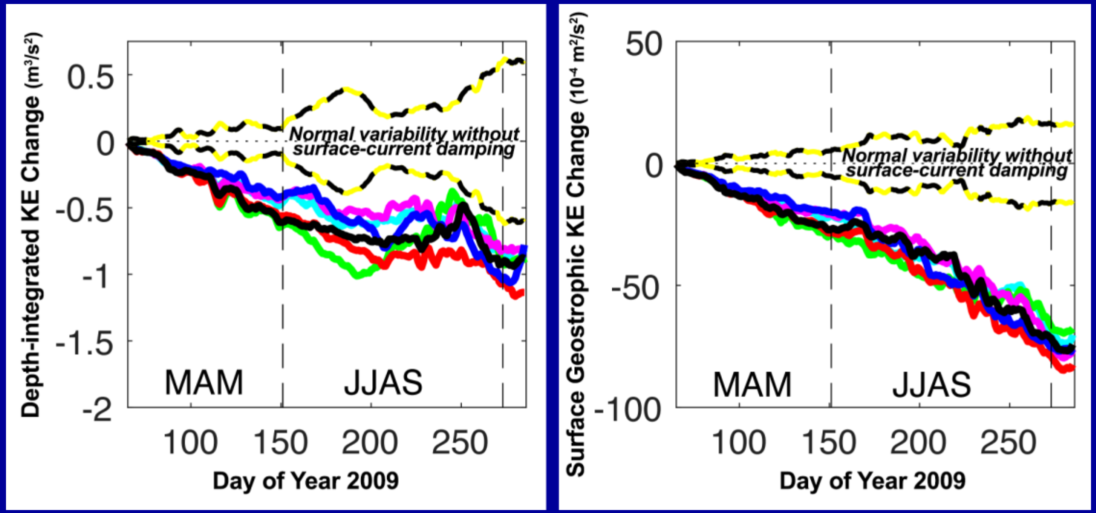
Ocean currents and atmospheric winds are coupled by the exchange of momentum across the air-sea interface, the strength of which depends on the difference between the surface wind and surface current. The surface-current contribution to this coupling has a damping effect on ocean kinetic energy. We examined the dependence of this damping effect on representations of the surface current in a coupled ocean-atmosphere model of the northern California Current System.

Depth-integrated and surface geostrophic kinetic energy (KE) *without* surface-current coupling



New surface-current coupling schemes that include near-surface wind and wind-wave drift currents show large (20%-40%) surface-current damping of ocean kinetic energies, confirming results from previous models that neglected wind and wind-wave drift.

Changes in depth-integrated (left) and surface geostrophic KE (right) *with* surface-current coupling



Previous model predictions of ocean kinetic energy damping from surface-current coupling used idealized representations of surface current that neglected near-surface wind and wind-wave drift. The present results confirm that these important effects of the surface current persist in the presence of wind and wind-wave contributions to the surface current.

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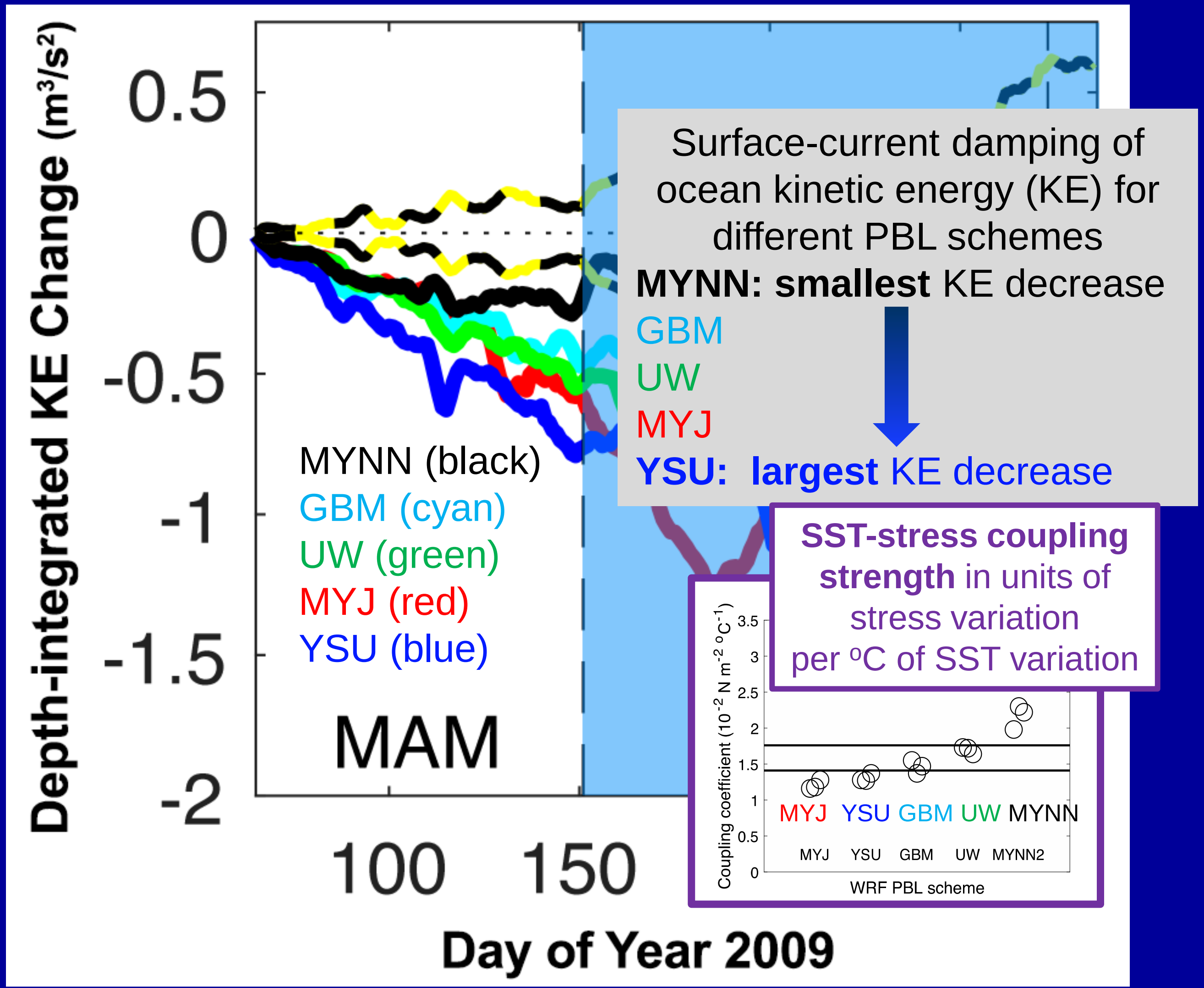
Dependence of surface-current (relative-wind) damping of ocean currents on marine atmospheric boundary turbulence characteristics

In atmospheric models, turbulence in the planetary boundary layer (PBL) is modeled by PBL schemes. In coupled ocean-atmosphere simulations of the northern California Current System, we found that surface-current damping (the decrease in ocean kinetic energy with surface-current coupling relative to without surface-current coupling") **depends systematically on the PBL turbulence scheme** used in the atmospheric component of the coupled model.

This dependence on PBL **scheme was opposite to the dependence of the coupling of wind stress to sea-surface temperature (SST)** for the same set of PBL schemes.



This result suggests that surface-current damping is stronger when vertical mixing in the marine atmospheric boundary layer is weaker, and weaker when vertical mixing is stronger, a previously unrecognized aspect of air-sea coupling.

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