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Wind-responsive diurnal sea skin temperature for large-eddy simulations

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The diurnal variability of sea skin temperature (SST) is suspected to play an important role for convective organization above the tropical ocean, from driving cumulus congestus convection to triggering the active phase of the Madden-Julian Oscillation. Recent cloud-resolving simulations demonstrate how imposed diurnal SST oscillations strongly impact mesoscale convective aggregation, particularly at fine horizontal model resolution. In spite of this, many idealized modeling studies of tropical convection either assume a constant, homogeneous SST or represent the upper ocean by a responsive slab with fixed thickness.

In this work, we show that such single-layer slabs are incapable of capturing the wind-dependence and time profile of observed diurnal warming. To address this, we present DiuSST, a simple one-dimensional model of diurnal temperature evolution in the upper few meters of the ocean, forced by atmospheric conditions. We implement this model in the System for Atmospheric Modeling (SAM), offering a more realistic interactive boundary condition for cloud-resolving simulations, and study the impact this additional feedback has on mesoscale organization.

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