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Influences of Ocean Thermohaline Stratification on Arctic Sea Ice

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The Arctic Ocean's surface mixed layer constitutes the dynamical and thermodynamical link between the sea ice and the underlying waters. Wind stress, acting directly on the surface mixed layer or via wind-forced ice motion, produce surface currents that can in turn drive deep ocean flow. Mixed layer temperature is intimately related to basal sea ice growth and melting. Heat fluxes into or out of the surface mixed layer can occur at both its upper and lower interfaces: the former via air-sea exchange at leads and conduction through the ice, the latter via turbulent mixing and entrainment at the layer base. Variations in Arctic Ocean mixed layer properties are documented based on more than 16,000 temperature and salinity profiles acquired by Ice-Tethered Profilers since summer 2004 and analyzed in conjunction with sea ice observations from Ice Mass Balance Buoys and atmospheric heat flux estimates. Guidance interpreting the observations is provided by a one-dimensional ocean mixed layer model. The study focuses attention on the very strong density stratification about the mixed layer base in the Arctic that, in regions of sea ice melting, is increasing with time. The intense stratification greatly impedes mixed layer deepening by vertical convection and shear mixing, and thus limits the flux of deep ocean heat to the surface that could influence sea ice growth/decay. Consistent with previous work, this study demonstrates that the Arctic sea ice is most sensitive to changes in ocean mixed layer heat resulting from fluxes across its upper (air-sea and/or ice-water) interface.