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Turbulent Mixing Processes in the Upper Ocean during Solar Heating and Rain

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Solar radiation causes diurnal variation in sea surface temperature, and the formation of a stratified layer at the top of the ocean mixed layer. Rainfall over the ocean can also result in the formation of a stably stratified layer below the ocean surface. Rain-induced freshwater lenses have a highly variable spatial and temporal occurrence, whereas diurnal warm layers are regularly occurring in low and mid-latitude regions. The occurrence and impact of both phenomena are also highly dependent on ambient atmospheric conditions.
Freshwater lenses and diurnal warm layers get dispersed by the intermittent wind-driven turbulent mixing at the surface. However, the stratifying density gradient is also seen to change the turbulent mixing in the near-surface layer of the ocean. These changes have a direct impact on the vertical transport of heat, mass, and momentum in the ocean surface mixed layer, and on the interaction of the ocean-atmosphere system.
Observations of the turbulent dissipation rate in and below stratified surface layers are presented. These result from series of vertical profiles made with the Air Sea Interaction Profiler (ASIP). This upwardly-rising autonomous profiler, and quasi-Lagrangian float, was deployed during several diurnal warming cycles in the subtropical North Atlantic, as well as during several rainfall periods. Simultaneous observations of microstructure temperature and salinity variance over the depth of the rain induced salinity anomalies and the diurnal warm layers are used to analyse the vertical divergence of scalar fluxes.