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A metric for surface heat flux effect on horizontal SST gradients: Application to mid-latitude SST fronts

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Understanding what controls horizontal sea surface temperature (SST) gradient is crucial for air-sea interaction. Although various oceanic effects play an important role in reinforcement/relaxation of SST gradients, the role of surface heat fluxes is an important factor. The contribution of surface heat fluxes to surface frontogenesis/frontolysis depends not just on their gradients, but also on the horizontal distribution of mixed layer depth (MLD) controlling the effective heat capacity of the upper ocean. We here propose a new metric quantifying the relative importance of horizontal gradients in surface heat fluxes and MLD, and this metric is applied to SST fronts in the Kuroshio Extension and Agulhas Return Current regions. In the former, it is found that the MLD gradient is dominant and the surface heat flux effect contributes to frontogenesis in boreal winter and frontolysis in boreal summer. This is because deeper (shallower) mixed layer to the equatorward (poleward) side of the SST front is less (more) sensitive to wintertime cooling and summertime heating by surface heat fluxes. On the other hand, the surface heat flux gradient is dominant in both austral summer and winter and the surface heat flux effect relaxes the SST front in the latter.