Frontolysis in the Japan Sea using observational dataset with a focus on mixed layer processes

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Detailed mechanisms for reinforcement/relaxation processes of the sea surface temperature (SST) front, i.e. frontogenesis/frontolysis, in the Japan Sea region are investigated using observational dataset. Owing to larger (smaller) air-sea specific humidity difference south (north) of the front, latent heat release is stronger (weaker). The latent heat gradient leads to stronger (weaker) surface cooling in winter and weaker (stronger) surface warming in summer on the southern (northern) side, and thus the SST front is relaxed by surface heat flux gradient throughout the year. At the same time, in deepening phase of mixed layer by surface cooling, larger (smaller) entrainment velocity occurs because of the weaker (stronger) stratification south (north) of the front, and then a deeper (shallower) mixed layer is formed. Since the thicker (thinner) mixed layer is less (more) sensitive to surface cooling, the mixed layer depth gradient damps the frontolysis by the surface heat flux gradient. In shoaling phase, the thicker mixed layer on the southern side is less sensitive to shallowing work by shortwave radiation compared with the northern side. Furthermore, weaker (stronger) surface warming contributes to the formation of deeper (shallower) mixed layer in the southern (northern) region. Consequently, the deeper (shallower) mixed layer is formed south (north) of the front. Since the thicker (thinner) mixed layer in the southern (northern) side is less (more) sensitive to surface warming, the mixed layer depth gradient enhances the frontolysis by the surface heat flux gradient. Therefore, surface heat flux weakly (strongly) relaxes the SST front in winter (summer) because of the mixed layer processes.

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