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# Importance of latent heating in polar mesocyclones for the decay of cold air outbreaks: a case study from the Pacific sector of the Southern Ocean

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Marine cold air outbreaks (CAOs) provide the preferred environment in which polar mesocyclones form. While this relationship has been studied extensively in the literature, little is known about the impact of these small but prevalent vortices on the dynamical and thermodynamic evolution of CAOs. Here, we present a numerical process study of a CAO that occurred in the Pacific sector of the Southern Ocean. This CAO was accompanied by the development of a train of mesocyclones that formed along the CAO's baroclinic outer edge and were organized in a merry-go-round fashion around the CAO's core.

Using an isentropic framework, we show that the decay of the CAO is essentially driven by the circulation associated with these mesocyclones. The release of latent heat in the mesocyclone's warm sectors substantially ramps up the erosion of the CAO air mass. Sensitivity experiments with separately switched off fluxes of sensible and latent heat reveal further that the erosion of the CAO air mass depends substantially on the moisture supply via latent heat fluxes. In contrast, sensible heat fluxes have a less pronounced direct impact on the erosion but contribute indirectly by amplifying moisture uptake and, thus, the amount of latent heat released. Given the frequent occurence of mesocyclones in association with CAOs, our findings have implications for the representation of CAO evolution and the associated heat flux forcing of the ocean in coarse resolution climate models. This conclusion is corroborated by simulations at coarse resolution, where the mesocyclones are improperly resolved.