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Major Surface Melting over the Ross Ice Shelf, Antarctica

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West Antarctica (WA), especially the Ross Ice Shelf (RIS), has experienced more frequent surface melting during austral summer over the past three decades. Surface melting will jeopardize the stability of ice shelves and cause potential ice loss in the future. We investigate four major melt cases over the RIS via Polar WRF simulations driven by ERA5 reanalysis data and MODIS observed albedo. Direct warm air advection, recurring foehn effect, and cloud/upper warm air introduced radiative warming are the three major regional causes of surface melting over WA. Warm marine air can warm the ice surface directly. With significant moisture transport occurring over more than 40% of the time during the melting period, the impact from net radiation can be amplified via the formation of low-level liquid water clouds. Consequently, extensive downward longwave radiation favors the melting expansion over the middle and coastal RIS. Also, for 3 of 4 melt cases, more than 50% of the melting period experiences foehn warming, which can cause a 2 – 4 ºC increase in surface temperature. Isentropic drawdown is usually the dominant foehn mechanism and contributes a 14 ºC temperature increase, especially when strong low-level blocking occurs on the upwind side. Foehn clearance and decreasing surface albedo respectively increase the downward shortwave radiation and decrease the upward shortwave radiation, significantly contributing to surface melting in areas like western Marie Byrd Land. Moreover, frequent foehn cases can enhance the turbulent mixing on the leeside and benefit sensible heat transfer when Froude number is around 1. With better understanding of the regional factors for the surface melting, the prediction of the future stability of West Antarctic Ice Shelves will be improved.