The vertical structure of moisture transport within AR in the Antarctic coastal region

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Abstract

Recently, the Atmospheric River, characterized by strong moisture transport from lower latitudes to higher latitudes within a long, narrow structure, has been extensively studied in the Antarctic region. In East Antarctica, it is well known that the Atmospheric River plays a crucial role in the Antarctic surface mass balance through extreme snowfall. While it has been reported that moisture is transported from lower latitudes within the Atmospheric River in the Antarctic coastal region, the understanding of the vertical structure of moisture transport within the Atmospheric River remains insufficient.

To address this, we analyzed the vertical structure of moisture transport using radiosonde observational and reanalysis data. The observational data was obtained during the 64th Japanese Antarctic Research Expedition, conducted from November 2022 to March 2023. From radiosonde observation in the Antarctic coastal region, we found that the equivalent potential temperature below 1,500 m is close to the climatological mean, while above 2,500 m, it is higher than the climatological mean. To investigate moisture transport pathways, we conducted backward trajectory analysis on air parcels with both climatological and higher-than-average equivalent potential temperatures.

The analysis revealed that air parcels with higher equivalent potential temperatures follow nearly the same pathway as the Atmospheric River, while air parcels with lower equivalent potential temperatures take a significantly different route. Furthermore, the anomaly in specific humidity relative to the climatological mean is higher in air with higher equivalent potential temperatures than in air with lower equivalent potential temperatures. These findings suggest that moisture transport associated with higher equivalent potential temperatures is likely to play a crucial role in moisture transport within the Atmospheric River.

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