Atmospheric River Dynamics from Energy and Momentum Perspectives

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ABSTRACT

In this study, we provide a large-scale dynamical analysis of Atmospheric Rivers (ARs) and their interactions with other climatic phenomena. The goal of this study is to better understand the mechanism of ARs impinging on the west coast of North America. In this purpose, we used the NCEP final analysis data set to analyze 13 remarkable cases of ARs in cold seasons.

ARs have important roles in both global climate and water cycle. Strong meridional transport of moisture from tropical/ subtropical regions to the mid-latitudes occurs through AR events causing remarkable precipitation. Diagnostic analyses indicate that Pacific (Atlantic) ARs originate from tropical (subtropical) regions correlated with the position of the jet streams.

Energetic and momentum perspectives give us further insight to understanding the mechanism of ARs and their impact on climate variability. From momentum point of view, calculation of extended Eliassen-Palm flux (E) for high-pass, low-pass, and non-filtered transient eddies suggest that Pacific ARs are high frequency transient eddies which have a positive feedback onto the mean flow. ARs amplifying over the downstream of storm track are associated with Rossby wave breaking. One of the other important results revealed by eddy energy budget computations is that remarkable ARs are accompanied with convergence of eddy energy flux. Significant core of eddy kinetic energy (EKE) is associated with AR propagations over the downstream of Pacific storm track.