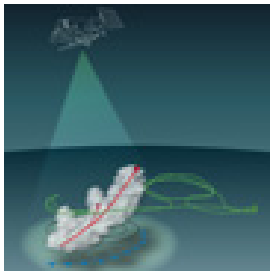

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Linking atmospheric rivers and warm conveyor belt airflows

Tuesday, 10 March 2020 15:30 (20 minutes)

Extreme precipitation associated with extratropical cyclones can lead to flooding if cyclones track over land. However, the dynamical mechanisms by which moist air is transported into cyclones is poorly understood. In this paper we analyze airflows within a climatology of cyclones in order to understand how cyclones redistribute moisture stored in the atmosphere. This analysis shows that within a cyclone's warm sector the cyclone-relative airflow is rearwards relative to the cyclone propagation direction. This low-level airflow (termed the feeder airstream) slows down when it reaches the cold front, resulting in moisture flux convergence and the formation of a band of high moisture content. One branch of the feeder airstream turns toward the cyclone center, supplying moisture to the base of the warm conveyor belt where it ascends and precipitation forms. The other branch turns away from the cyclone center exporting moisture from the cyclone. As the cyclone travels, this export results in a filament of high moisture content marking the track of the cyclone (often used to identify atmospheric rivers). We find that both cyclone precipitation and water vapor transport increase when moisture in the feeder airstream increases, thus explaining the link between atmospheric rivers and the precipitation associated with warm conveyor belt ascent. Atmospheric moisture budgets calculated as cyclones pass over fixed domains relative to the cyclone tracks show that continuous evaporation of moisture in the precyclone environment moistens the feeder airstream. Evaporation behind the cold front acts to moisten the atmosphere in the wake of the cyclone passage, potentially preconditioning the environment for subsequent cyclone development.

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