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Impact of Potential Vorticity intrusion on the precipitation over the west coast of North America during the YOTC winter of 2008-2010

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North Pacific storm tracks and the precipitation characteristics over the west coast of North America are investigated during the Year of Tropical Convection (YOTC) winters (December-February, 2008-2010) using trajectory model calculations based on GMAO MERRA reanalysis, Atmospheric Infrared Satellite (AIRS), and CPC precipitation data. The calculated air parcel trajectories are classified based on a k-mean clustering analysis, which are used to identify trajectory pathways. This classification is in turn adopted to detect the storm events corresponding to the different pathways. The PV (Potential Vorticity), low-level air temperatures, water vapor flux, and large-scale circulation patterns corresponding to individual trajectory groups are well distinguished from each other. There are clear differences in the trajectory pathways between two winters. In 2008/2009 (weak La Nina), there are weak mid-latitude jet allowing strong planetary wave to intrude into the mid-latitude and subtropics over the west coast of the North America. This induces the large amount of moisture transport ahead of intrusions. On the other hand, in 2009/2010 (strong El Niño), the mid-latitude jet is very strong, and this prevents the upper level cold air from intruding into the mid-latitude and the subtropics. And this results in warm air coming from the warm pool near the equatorial western Pacific, causing less PV related precipitation than those in 2008/2009 (La Nina). In both years, there are high correlation (> 0.6) between upper level PV and precipitation averaged over Sierra Nevada area. In summary, this study shows that intense precipitation events in the Sierra Nevada region have different trajectory patterns and precipitation characteristics. In 2008/09 (La Nina) precipitation is highly influenced by upper level cold air intrusion (PV intrusion) from the mid-latitude eastern Pacific, while in 2009/2010 (El Niño), precipitation is mainly related to strong low-level water vapor transports into the region from the tropical western Pacific. The planetary wave motions and transport patterns are largely modulated by the location and intensity of the mid-latitude and subtropical jet.