

A SEVEN-YEAR SYNOPTIC CLIMATOLOGY OF HEAVY WINTER OROGRAPHIC PRECIPITATION EVENTS OVER THE SUBTROPICAL CENTRAL ANDES (30°-37°S)

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ABSTRACT

This study investigates the synoptic conditions during the 46 heaviest winter (Apr-Sep) orographic precipitation events from 1970 to 1976 over the Central Andes (30°-37°S). Four to five heavy winter events account for most (~70%) of the winter total precipitation, which in turn represents more than 90% of the total annual precipitation. Consequently, heavy orographic precipitation events play a crucial role in the regional water cycle on central Chile and central-western Argentina, supplying water and generating in some cases floods, avalanches and road blocking. Based on the ERA-40 reanalysis and rawinsonde data, the dominant and key pattern for these events was a long (>2000km) and narrow (<1000km) plume of large Integrated Water Vapor (IWV) with strong low-level northwesterly winds, along the cold-front surface in the warm sector of extratropical cyclones moving eastward over the Pacific Ocean. These IWV plumes, called “atmospheric river” in previous studies on the western coast of North America, made landfall on south-western South America discharging large water vapor amounts as precipitation over the Andes by orographic lifting mechanisms. Moisture flux and IWV fields of two sub-groups of 46 heavy precipitation events revealed that extreme (i.e., daily precipitation into the 95%-100% percentile) and intense events (i.e., into the 75%-95% percentile) were associated with atmospheric rivers in 91% and 75% of the cases, respectively. Consistently, anomalous low-level northwesterly winds predominated in heavy events, exceeding 2σ from winter climatology in 70% of 46 cases. Deeper cyclones and stronger atmospheric rivers against the Andes occurred with extreme than intense events, suggesting more accentuated upslope moisture flux raining out over the mountains. The results of this study indicate that atmospheric rivers greatly modulate winter precipitations over the subtropical central Andes.