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Characteristics of Wintertime Daily Precipitation over the Australian Snowy Mountains

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The relationship between orographic precipitation, low-level thermodynamic stability, and the synoptic meteorology is explored for the Snowy Mountains of southeast Australia. A 21-yr dataset (May–October, 1995–2015) of upper-air soundings from an upwind site is used to define synoptic indicators and the low-level stability. A K-means clustering algorithm was employed to classify the daily meteorology into four synoptic classes. The initial classification, based only on six synoptic indicators, distinctly defines both the surface precipitation and the low-level stability by class. Consistent with theory, the wet classes are found to have weak low-level stability, and the dry classes have strong low-level stability. By including low-level stability as an additional input variable to the clustering method, statistically significant correlations were found between the precipitation and the low-level stability within each of the four classes. An examination of the joint PDF reveals a highly nonlinear relationship; heavy rain was associated with very weak low-level stability, and conversely, strong low-level stability was associated with very little precipitation. Building on these historical relationships, model output statistics (MOS) from a moderate resolution (12-km spatial resolution) operational forecast were used to develop stepwise regression models designed to improve the 24-h forecast of precipitation over the Snowy Mountains. A single regression model for all days was found to reduce the RMSE by 7%and the bias by 75%.A class-based regression model was found to reduce the overall RMSE by 30% and the bias by 85%.