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Climatology of Westerly Wind Events in the Lee of the Sierra Nevada

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Owens Valley is a narrow valley in eastern California, approximately north-south oriented and bounded by the highest portion of the Sierra Nevada to the west and by the White-Inyo Range to the east. There is abundance of anecdotal evidence for the occurrence of downslope windstorms in Owens Valley, in particular on the eastern slope of the Sierra Nevada. Indeed, the area has been the theatre of two major research efforts and several field campaigns, including the Sierra Wave and Jet Stream Projects in the 1950s and the Sierra Rotors Project (2004) and the Terrain-induced Rotor Experiment (2006) in the mid 2000s. However, existing climatological studies of strong wind events in this region reveal hardly any signature of westerly winds.

In the present contribution, a climatology of westerly wind events in Owens Valley is derived from data measured by a mesonet of sixteen automatic weather stations. Compared to previous climatologies, which have primarily used measurements from stations located along the valley's main axis, this paper presents the analysis of data from stations placed along several cross-valley transects that reach a significant distance up the western slope. Data from these stations conclusively demonstrate the frequent occurrence of westerly downslope windstorms in the valley.

Thermally driven up- and down-valley flows (from the South and North, respectively) are found to account for a large part of the wind variability in the area. However, a significant fraction of high wind speed events observed on the western side of the valley deviates from this basic pattern by showing a higher percentage of westerly winds. Strong westerly wind events tend to be more persistent and to display higher sustained wind speeds than winds from the other quadrants. Although the highest frequency of westerly wind events is found in the afternoon hours from April to September, the intense episodes can happen at any time of the day throughout the year. The key dynamical driver of westerly wind events in Owens Valley is conjectured to be the downward penetration of momentum associated with the Sierra Nevada mountain waves. The peak frequency from late spring to summer, however, points to the role of thermal forcing as an additional driving mechanism during the warmer part of the year.