Characteristics and processes of wintertime precipitation over the Australian Alps

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Precipitation over the Australian Alps constitutes an important source of water to south-eastern Australia, supplying fresh water for agriculture, industry, and domestic use. This is most evident over the Snowy Mountains where the Murray, Murrumbidgee and Snowy River catchments meet, and water is stored and transferred between reservoirs to generate hydroelectric power and increase the stream flow into the Murray-Darling basin. As such, accurate estimates and predictions of precipitation both spatially and temporally are essential for efficient water management.

The current precipitation forecasts available for this region have been shown to have notable biases, with underestimation of precipitation most pronounced along the windward slopes. Earlier studies suggest that a better understanding of the unique environment and physical processes that underpin the precipitation is essential to improving precipitation forecasts and estimates. Specifically, satellite and ground-based observations have repeatedly found the common presence of mixed-phase clouds through the winter season. Accordingly, a dedicated field experiment was carried out over the Snowy Mountains during the 2018 winter, which for the first time provides a comprehensive dataset particle morphology at ground level and a range of measurements in various locations. The campaign consisted of three sites at different altitudes in the windward slope of the mountain range, supported by a dense network of rain gauges as well as an array of in-situ and remote sensing instruments that provided synergistical observations of clouds and precipitation properties.

Data from this campaign allow us to investigate the evolution of the air masses as they cross the range and to elucidate the specific dynamical and microphysical processes that produce precipitation over these mountains. Highlights from the experiment include the enhanced precipitation associated with the orography, the variety of precipitation types and their corresponding thermodynamic environments, the pristine condition that was often characterized by the presence of supercooled liquid water / freezing rain, as well as the mesoscale convective cells that produced steady snowfall under unstable conditions. The dependence of the observed / retrieved cloud and precipitation properties on the environmental conditions and the nature of transitions between different case studies will be discussed.