Title: Synoptic and Orographic Control of observed Drop Size Distribution Regimes in Atmospheric River events during the OLYMPEX field campaign.

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A dense network of rain gauges and disdrometers deployed in the 2015-16 OLYMPEX field campaign showed in unprecedented detail the drop size distributions (DSDs) associated with orographic precipitation enhancement in six Atmospheric River (AR) events. These six events accounted for 25-35% of the wet season (Oct-Apr) precipitation total both at the coast and in the interior/high elevations. A rain shadow was ubiquitous on the lee site. Favored sites for orographic enhancement received up to three times as much precipitation as the coast, although the exact degree of orographic enhancement was highly variable and was dependent on a several factors including storm sector (prefrontal, warm sector, frontal) and synoptic wind direction.

Analysis of the disdrometer and radar data reveals that both warm and cold orographic enhancement processes occur at different times and different locations when ARs impinge on mountains. Warm enhancement refers to rapid growth and fallout of large concentrations of small (< 1 mm) drops produced by condensation and collision/coalescence below the melting level. The warm process was dominant during the warm sector (between the warm and cold front passage) and was spatially correlated with the lifting of a low-level jet (LLJ) over the < 750 m foothills at the windward base of the Olympic Mountains. Cold enhancement refers to the growth of frozen hydrometeors by riming and/or aggregation. Disdrometers observed an increase in the size and concentration of large drops (> 2 mm) when cold enhancement was ongoing. The cold process was dominant around the time of frontal passages and was associated with regions of shear-induced turbulence viewed by dual-polarimetric radar RHI scans. This study evaluates the relative importance of warm and cold ororgraphic enhancement processes within ARs, how they manifest in DSDs, and how they are controlled by the synoptic situation (warm frontal, warm sector, cold frontal, and postfrontal).