Investigation of the Olympic Peninsula rain shadow using radar and in situ observations from the Olympic Mountains Experiment (OLYMPEX)

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During the 2015-2016 Olympic Mountains Experiment (OLYMPEX) in Washington State, ground-based radars were deployed on the windward and lee sides of the Olympic Mountain range. RHI sector scans were conducted over the ocean (NASA’s NPOL radar), over the windward slopes (NPOL, DOW), and towards the climatological location of the leeside Olympic rain shadow (Environment Canada (EC) X-band). These data collected together with airborne radars and in situ aircraft microphysical measurements are used to explore precipitation processes in this mountainous region. Reflectivity data from the ground-based radars and from airborne radar transects from the windward slopes to the lee side show a consistent picture of windward enhancement and leeside diminishment of precipitation. A windward upper-level enhancement in reflectivity was observed in the ice layer, typically 4-6 km above ground level. This enhancement preferentially occurred in the warm sectors of approaching wintertime frontal systems, characterized by deep southwesterly flow, coincident with high precipitation rates at the surface along the windward slopes. In situ aircraft probe data showed a variety of ice particle habits within this enhanced layer, including bullet rosettes and rimed dendrites. During warm sector conditions, the leeside rain shadow was less prominent, most likely due to spillover of hydrometeors that originated on the windward slopes. Particle size distribution (PSD) data collected in the leeside high terrain revealed that the PSDs were much more homogeneous compared to PSDs on the windward slopes possibly due to the fallout of the larger particles.

The nature and variability of the rainshadow is further explored from a ground-based radar perspective using the longer data record of the EC X-band radar from the full winter season during OLYMPEX. This presentation shows results of this radar-based statistical comparison, placed within the context of upstream environmental conditions to describe the synoptic controls on the leeside precipitating cloud structure. Additionally, in situ airborne probe data on the windward side of the mountains for representative cases will be presented to describe the microphysical processes that contribute to radar observations on the leeside.

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