1. Introduction

The Olympic Mountains Experiment (OLYMPEX), a NASA GPM ground validation project occurring fall 2015 – winter 2016, provided a unique opportunity to investigate precipitation processes as winter-time mid-latitude cyclones encounter complex terrain. The extensive instrument assets deployed during the field campaign upstream and across a range of elevations of the Olympic Mountains allowed for documentation of orographic enhancement of precipitation in a variety of synoptic events. As part of this observational network, ground-based dual-polarization Doppler radars operated nearly continuously on the coast, windward interior valley, and leeward of the mountains. These data provided unprecedented detail to illuminate the role of terrain on microphysical and dynamical processes associated with this precipitation enhancement. Additional details on microphysical processes are available through in situ aircraft data, including spirals through the radar sectors.

2. OLYMPEX Data

- **NPOL**: NASA’s S-band dual-polarization, Doppler radar
  - Operated from coast (Quinault Nation)
  - Collected high-resolution RHIs over ocean and inland over Quinault Valley

- **DOW**: CSWR’s X-band, dual-polarization, Doppler on Wheels radar
  - Located at Lake Quinault beneath NPOL beam
  - Collected high-resolution RHIs in Quinault Valley and over windward slopes

- **PNNL Citation**
  - LWC (King Hot Wire Probe)
  - CPII (CWC, CWC, TWC, NIVS-3, 2DC)
  - Parsivel (2D-S, Cloud DSD)
  - Additional details on microphysical processes are available

- **MRRs**: snow water equivalent

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3. 12 November 2015 Case Study

- **1945 UTC**: Time of DOW RHI above, ~3.5 km, ~7°C, large aggregates (increase Z, decreasing ZDR)
- **1945 UTC**: In between DOW and NPOL RHIs above, ~5 km, ~13°C, aggregates, pristine stellar, sector plate (in region of locally enhanced ZDR aloft)
- **1955 UTC**: Time of NPOL RHI above, ~5 km, ~20°C, smaller, irregular (low Z)

- **Upstream influence of mountains (air rising before mountain, NPOL)**
- **Shallow down-valley flow (DOW)**
- **Bending of brightband toward terrain**
- **Very little to no liquid water or rime ice encountered**
- **Secondary maxima in ZDR aloft with increasing reflectivity below**
- **Rise in melting level with time, increasing enhancement and warm-rain processes (see Joe Zagrodnik’s poster)**

4. 5 December 2015 Case Study

- **Spiral near 3 km (no aggregates just before mountain, NPOL)**
- **Large aggregates (~3.5 km)**
- **November 5th**: bullet rosettes, capped columns (~4.5 km)
- **5.5-6.5 km: column aggregates, small crystals**

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- **Monticello Icing Probe**

5. Conclusions

- **Two cases with different synoptic/environmental conditions, varying melting levels with respect to time and distance to terrain, upper-level enhancement over mountains (waves in 5 Dec case), little to no liquid water observed in spirals**
- **Observations of dendrites and capped columns in region of upper-level ZDR enhancement, with large aggregates observed below as ZDR decreases, increase providing confidence in microphysical inferences from radar when in situ data not available**
- **Future work to investigate dynamical processes related to upper-level enhancement, role of K-H waves in modification of microphysics, further classification of Citation data (e.g., LWC) as a function of T for additional cases**