

Synoptic and Orographic Control of Observed Drop Size Distributions (DSDs) during the OLYMPEX Field Campaign

Joe Zagrodnik

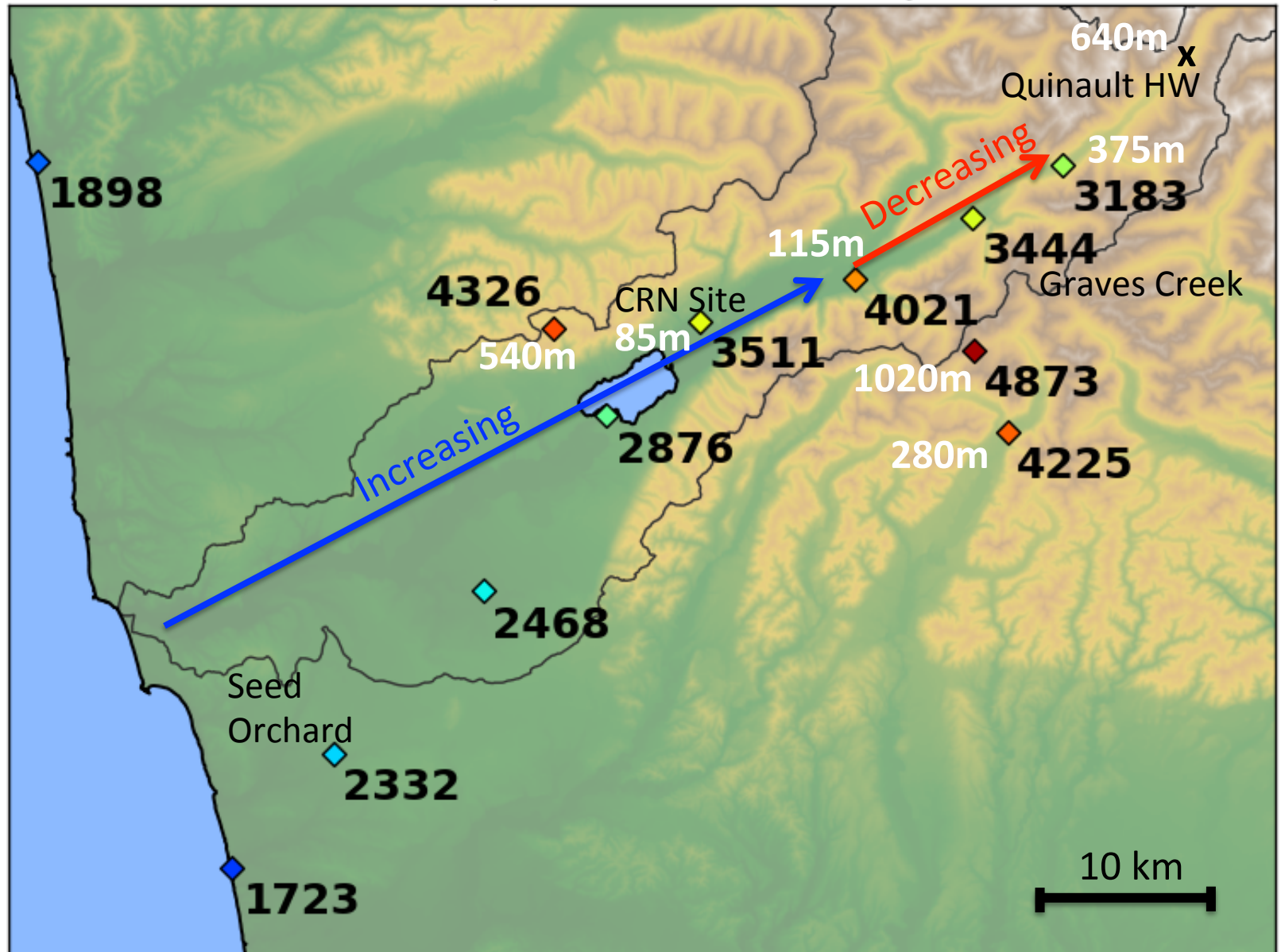
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17th Conference on Mountain Meteorology
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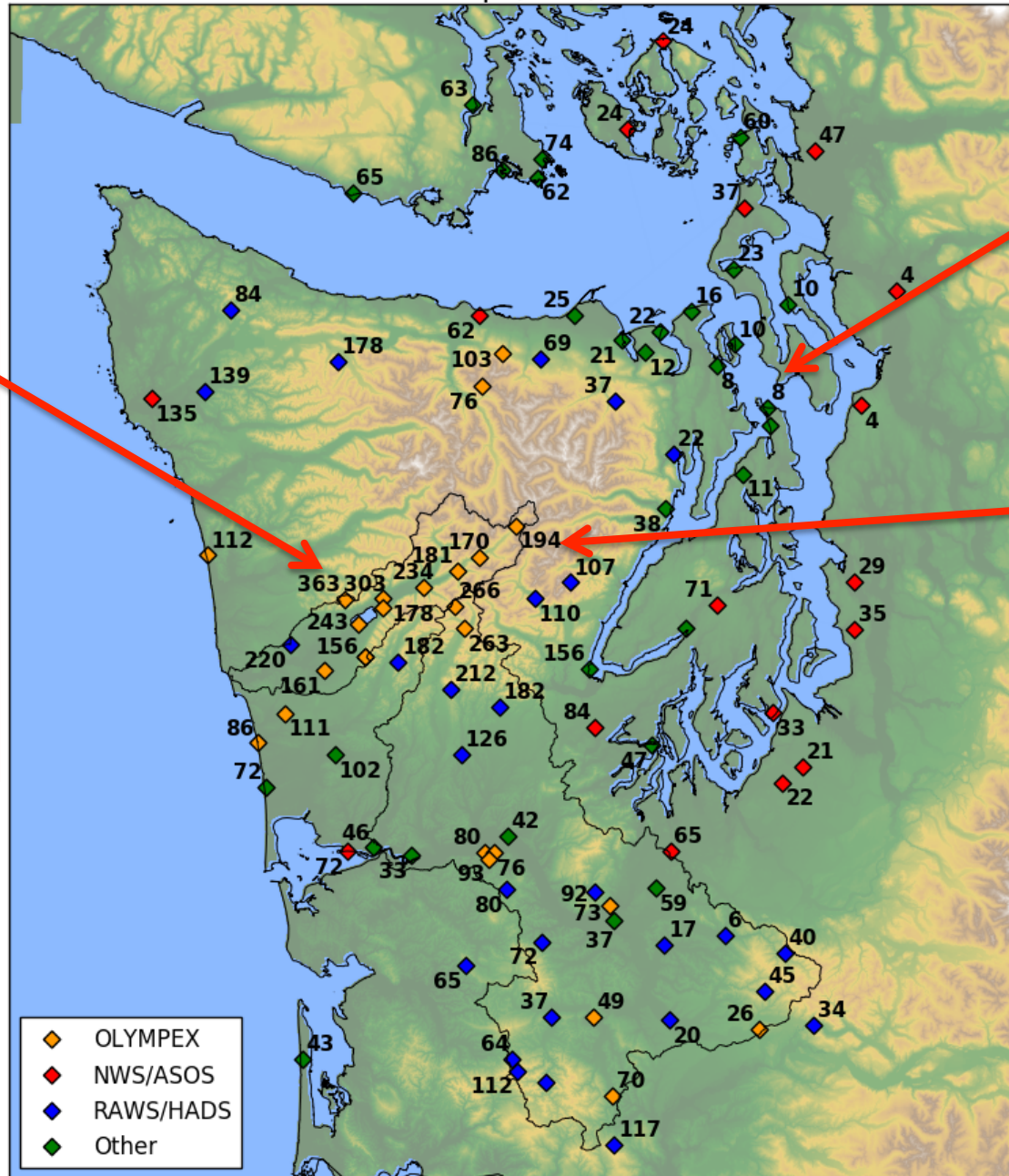
OLYMPEX Precipitation Totals

OLYMPEX Precip (mm) 10-Nov-2015 to 1-May-2016



Nov 12-13: Widespread extreme rainfall totals

OLYMPEX 48-h Precip (mm) 12-13 Nov 2015



Rain Shadow

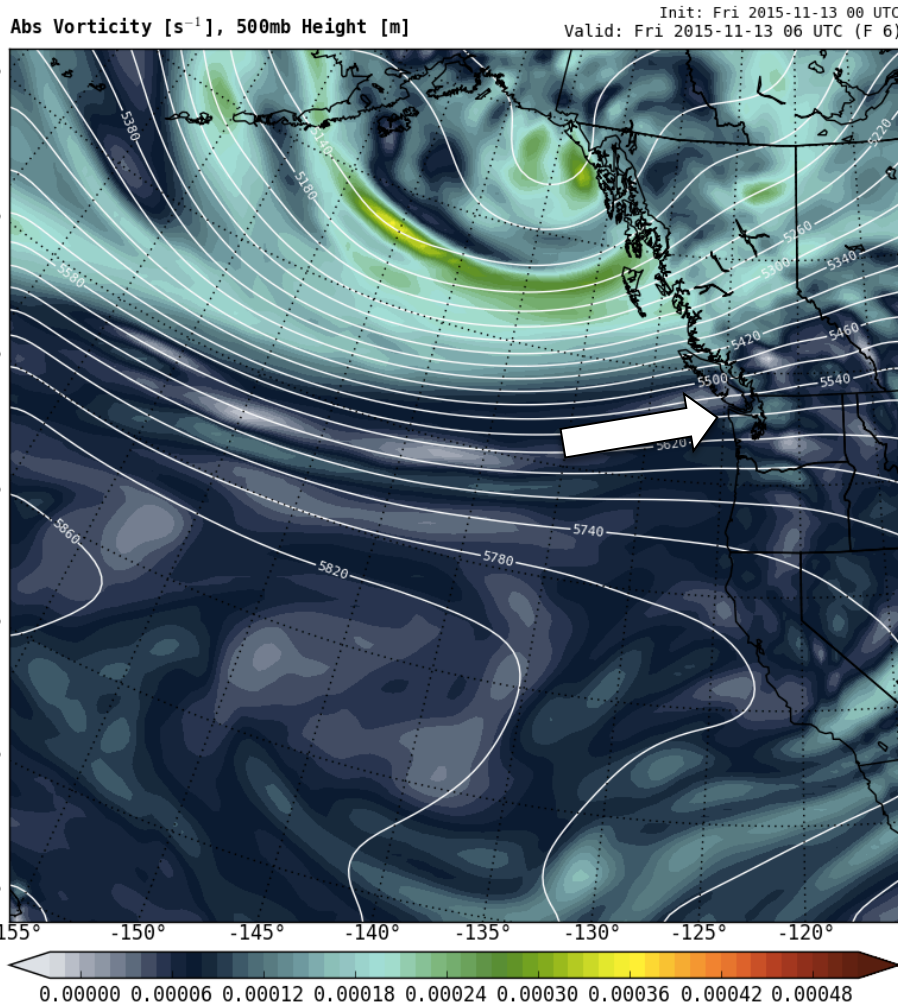
175-275 mm
farther up
Quinault Valley
and in
Wynoochee
high terrain

Highest totals
(>300 mm) at
lower-elevation
sites near Lake
Quinault

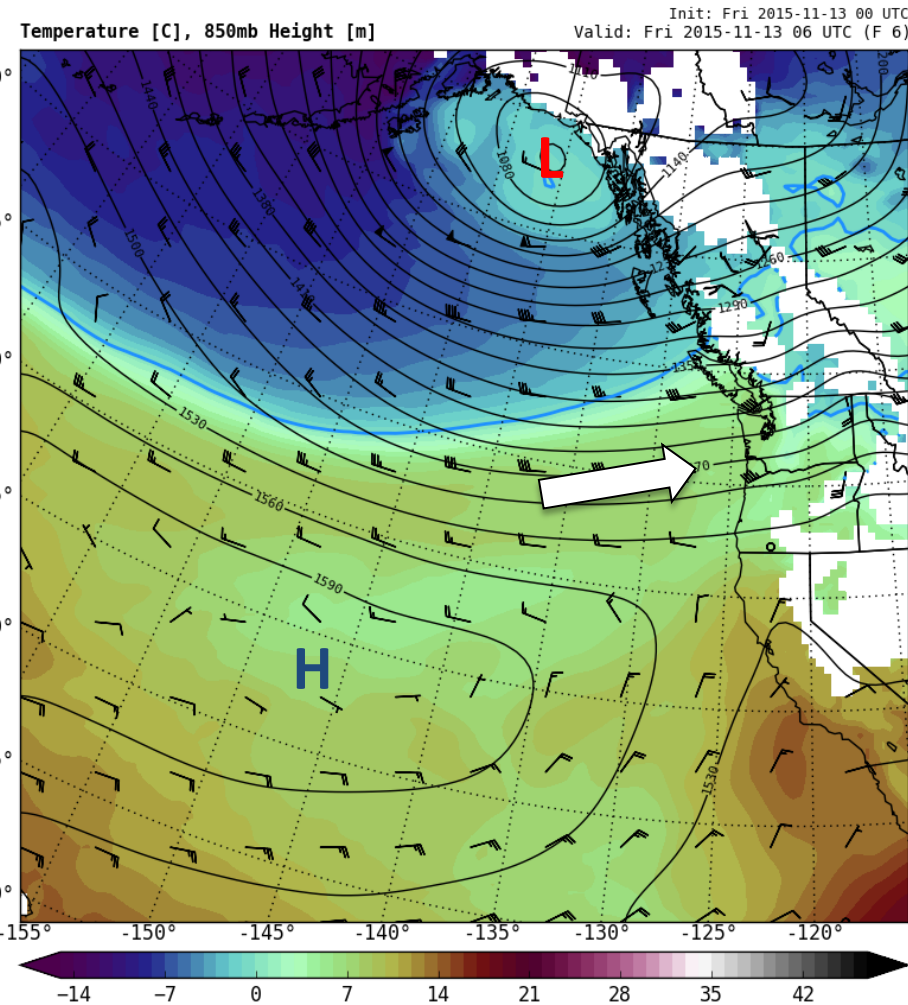
Up to 4 times
more than the
coast!

Nov 13 0600 UTC

500 hPa Height (contours), Vorticity (colors)



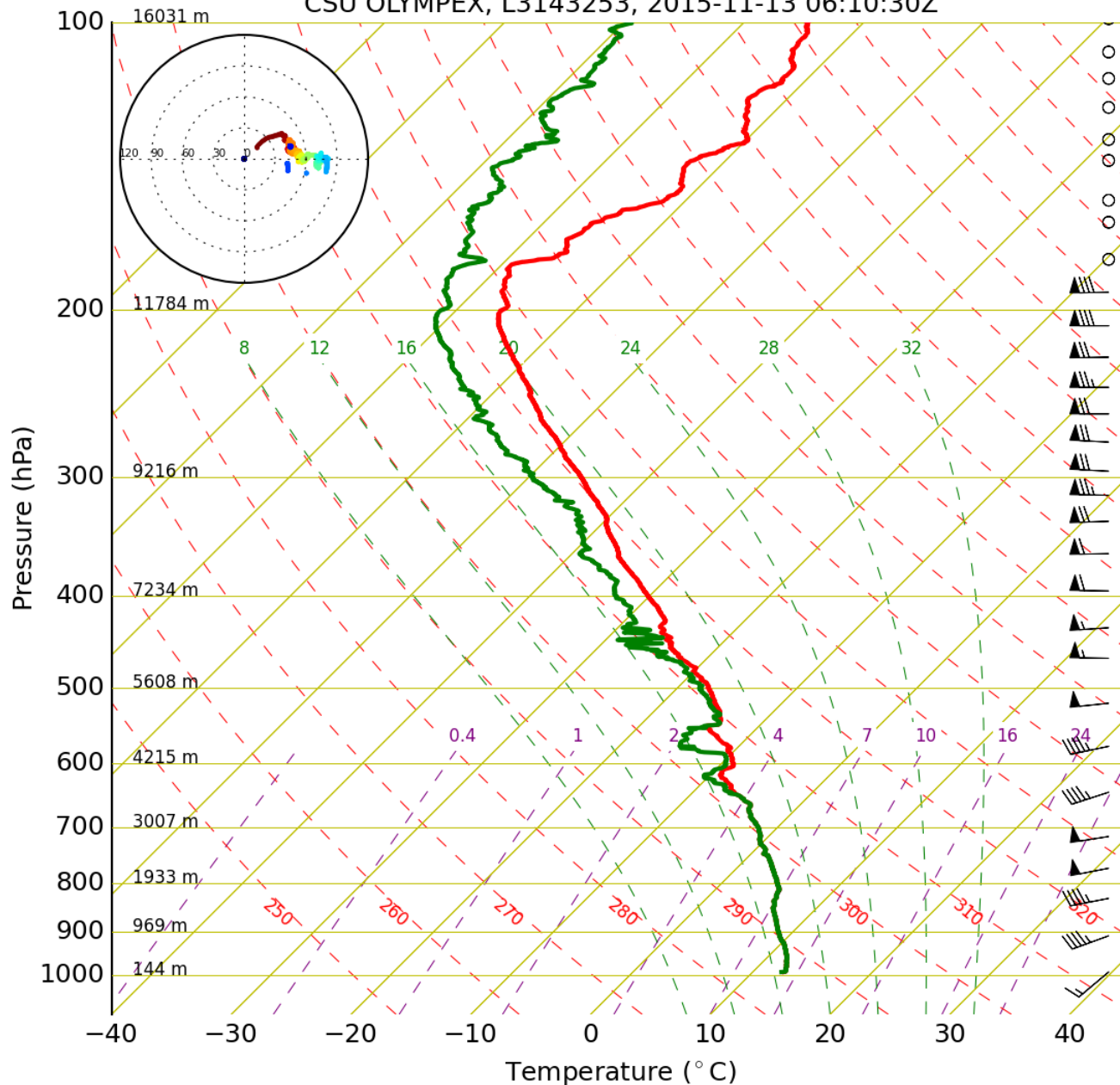
850 hPa Temp(colors), Height (contours)



“Westerly Atmospheric River”

NPOL Sounding 0600 UTC 13-Nov

CSU OLYMPEX, L3143253, 2015-11-13 06:10:30Z



Sounding Params
0°C: 2680 m
-20°C: 5903 m
-40°C: 8530 m
LCL: 43 m
PW: 29.3 mm
6 km shear: 41 kts
Tropopause: 201 hPa

Surface
P: 993.0 hPa
Ht: 144 m
T: 12.6 °C
T_D: 12.4 °C
T_W: 12.5 °C

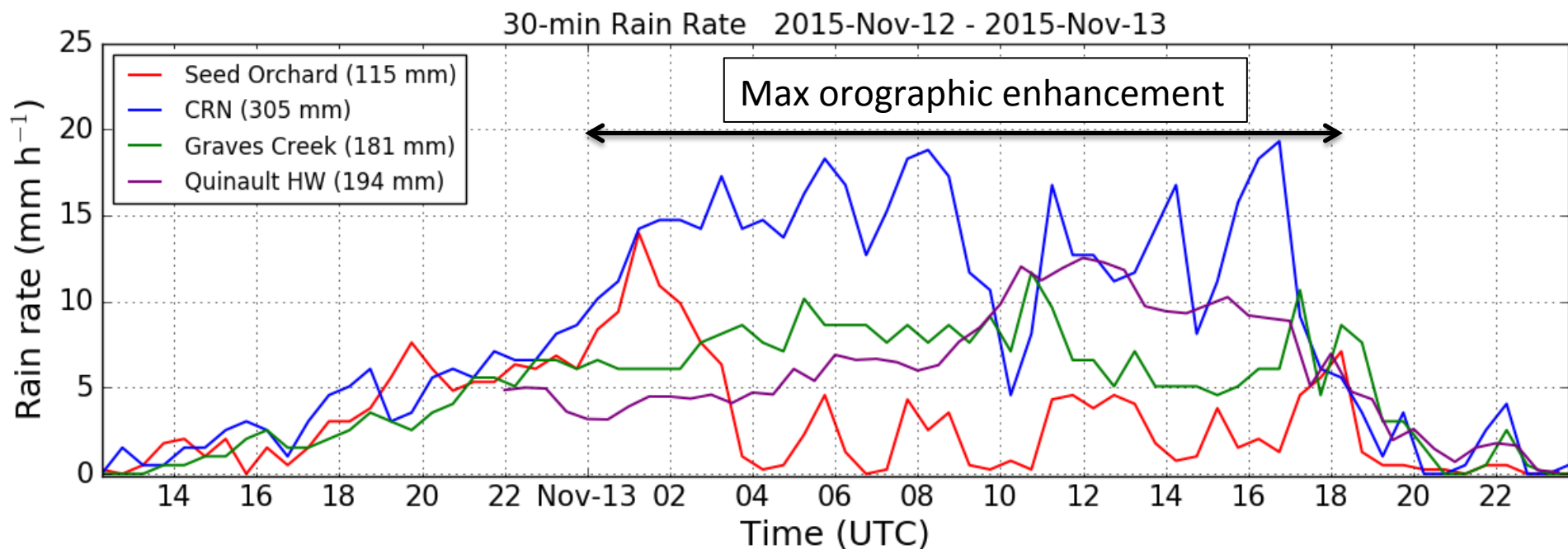
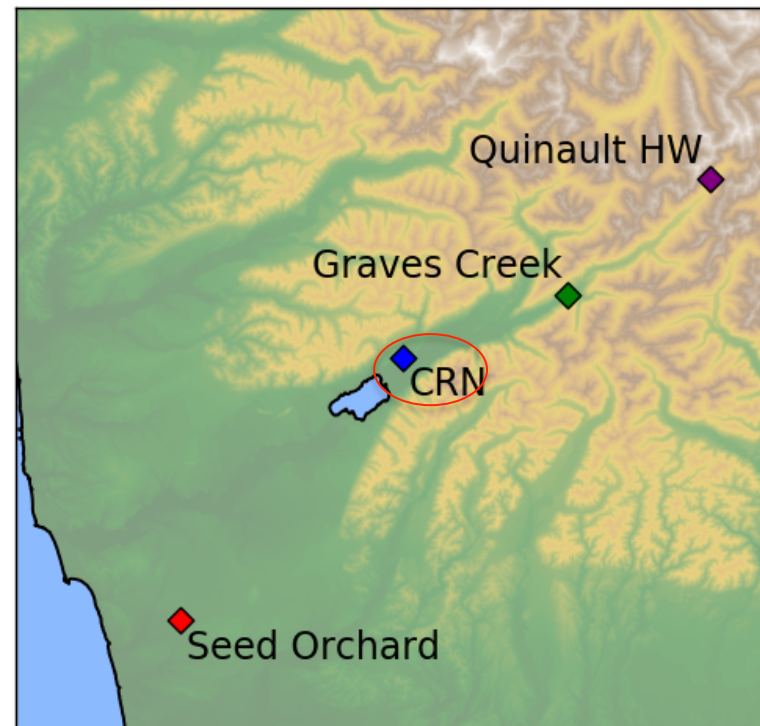
45 kt wind at
925 hPa

Nov 12-13

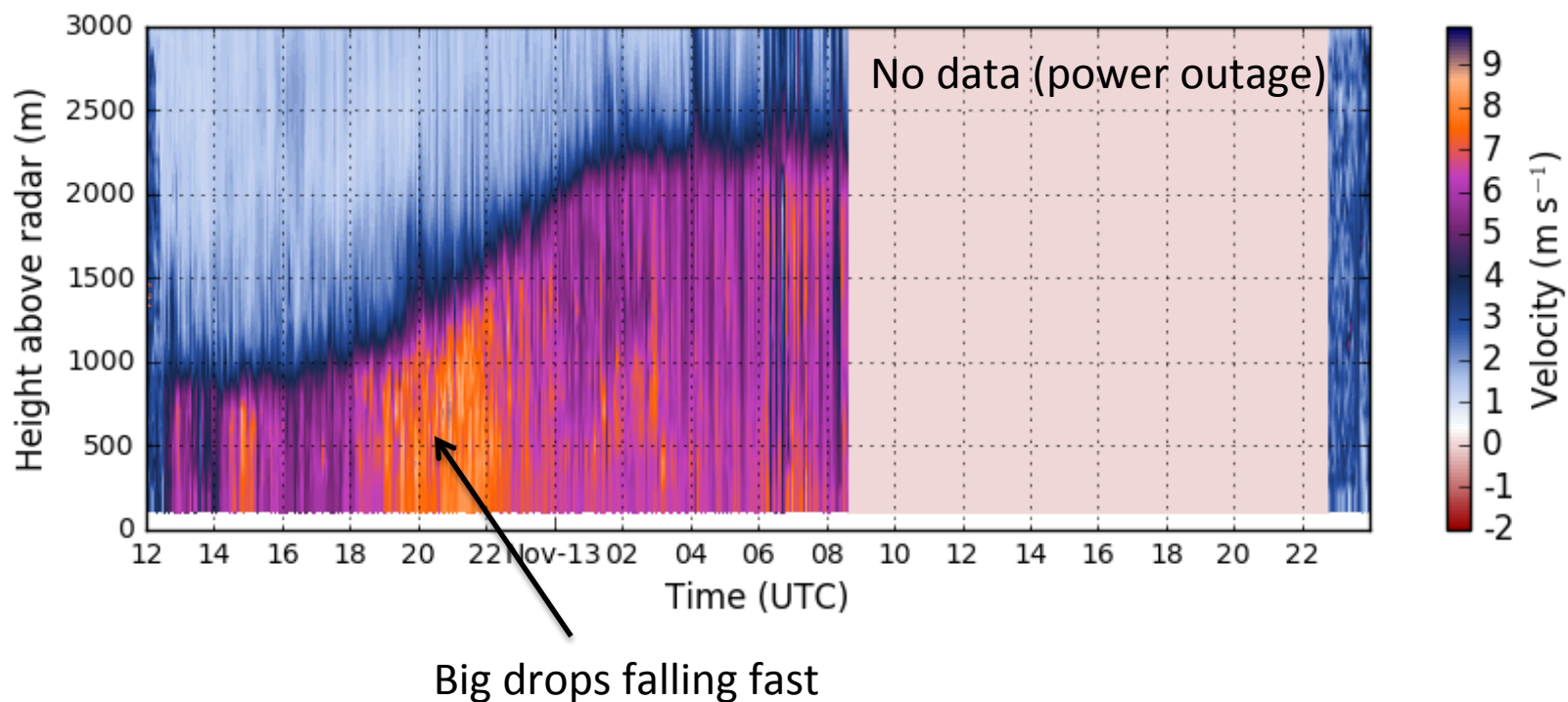
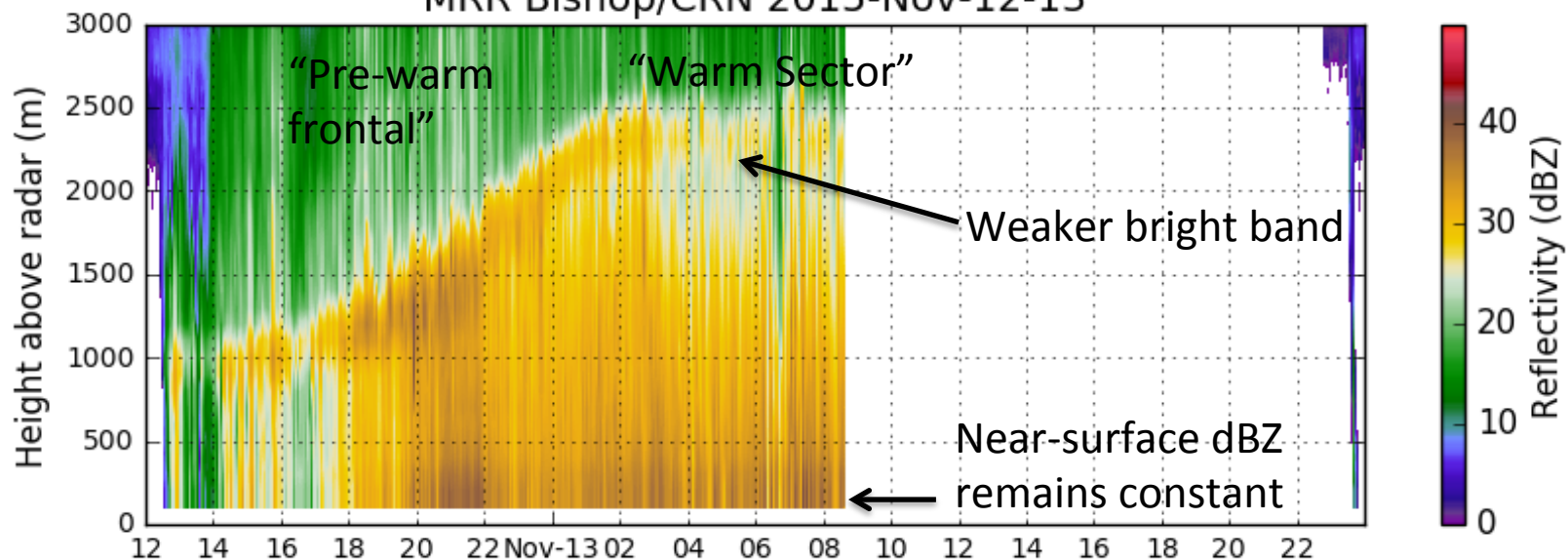
Rain rates

~18 hour period of orographic enhancement

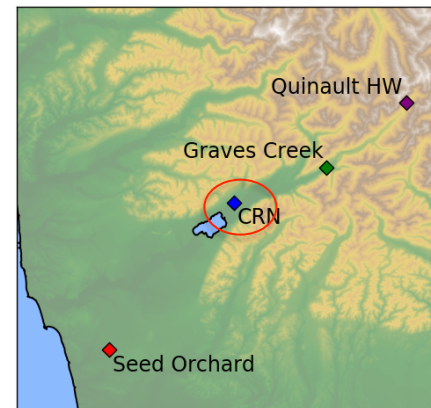
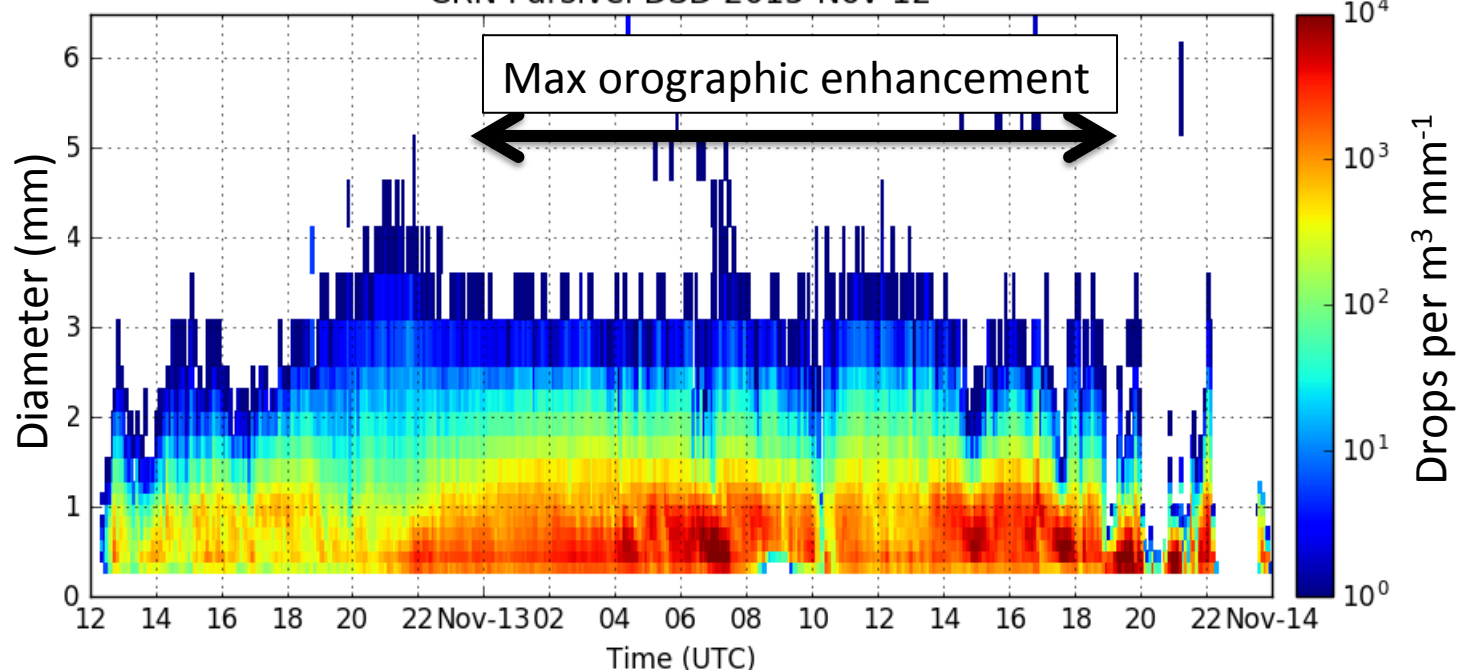
More rain at low-elevation CRN site compared with interior/higher elevation sites



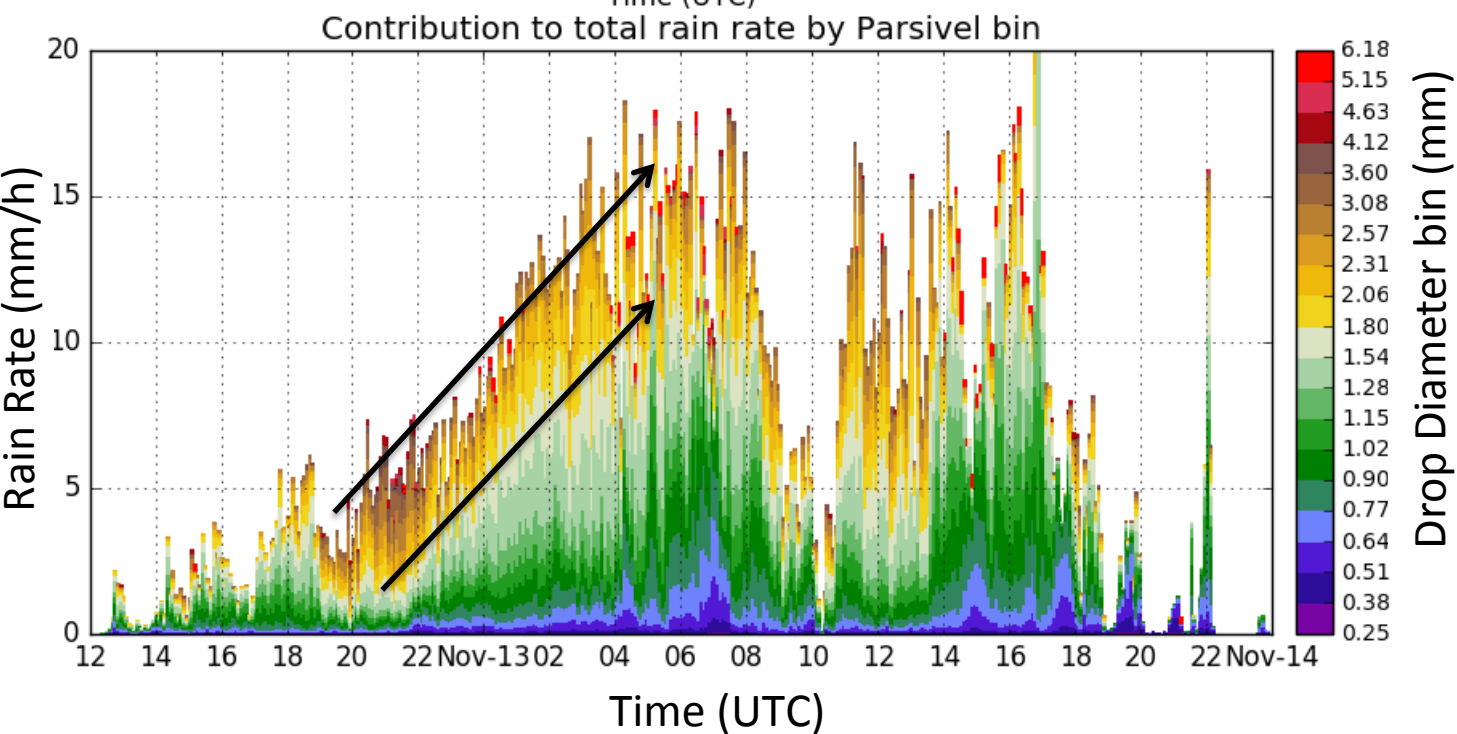
MRR Bishop/CRN 2015-Nov-12-13



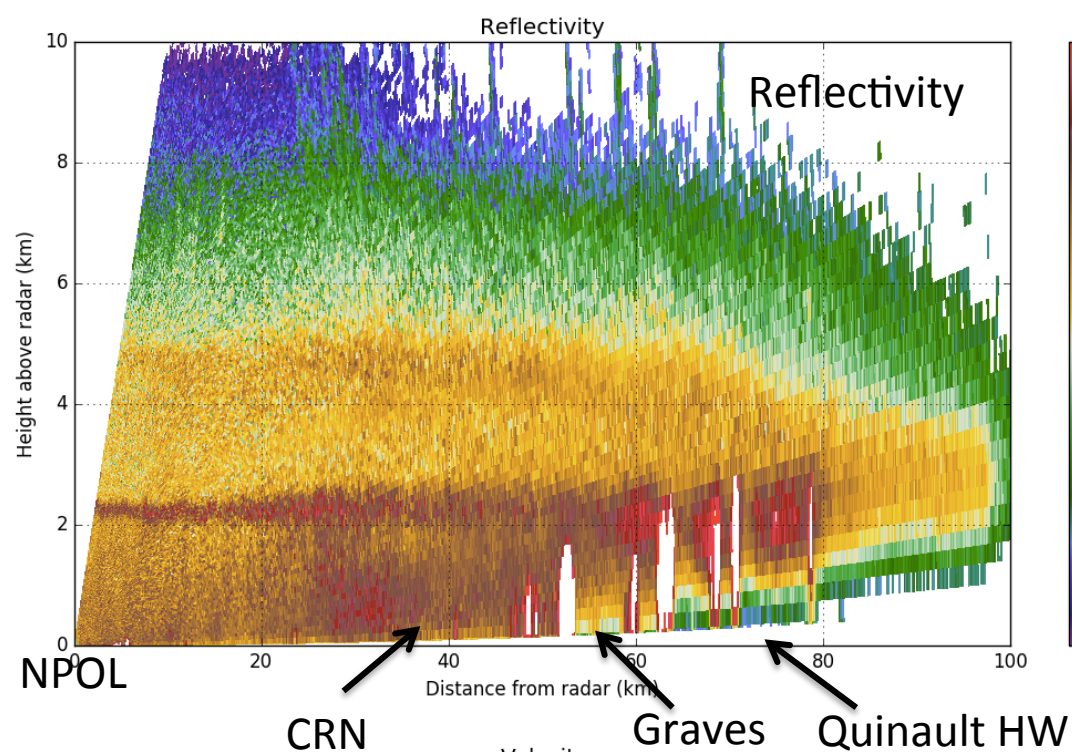
CRN Parsivel DSD 2015-Nov-12



Orographic enhancement associated with large quantities of $< 1.5 \text{ mm}$ drops



These small-medium sized drops are responsible for the majority of the increase in rain rate

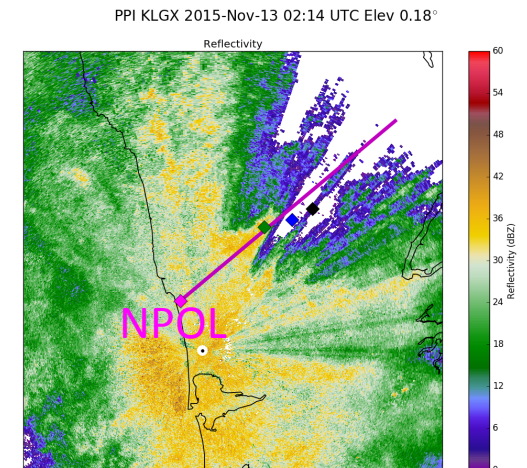
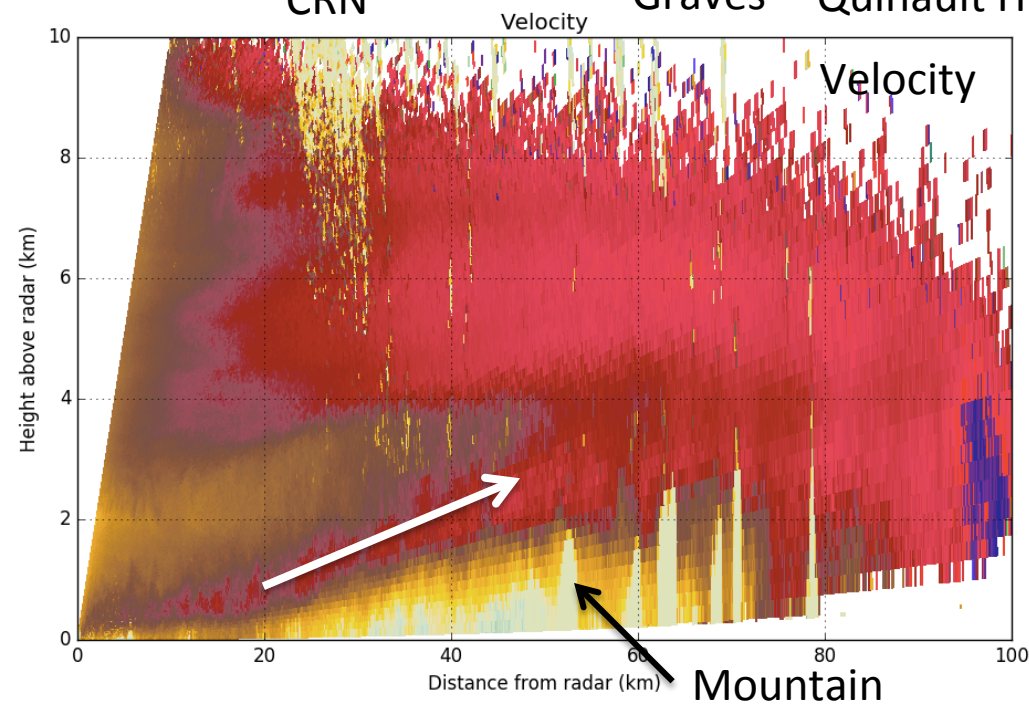


NPOL RHI 13-Nov 02:12 UTC 50° Azimuth

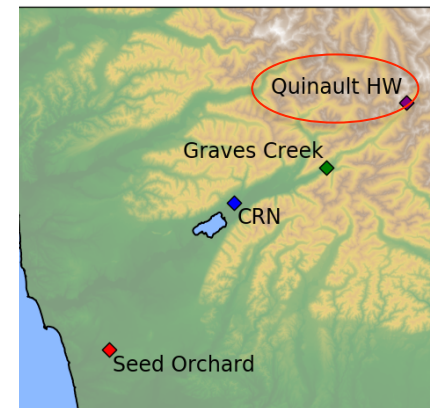
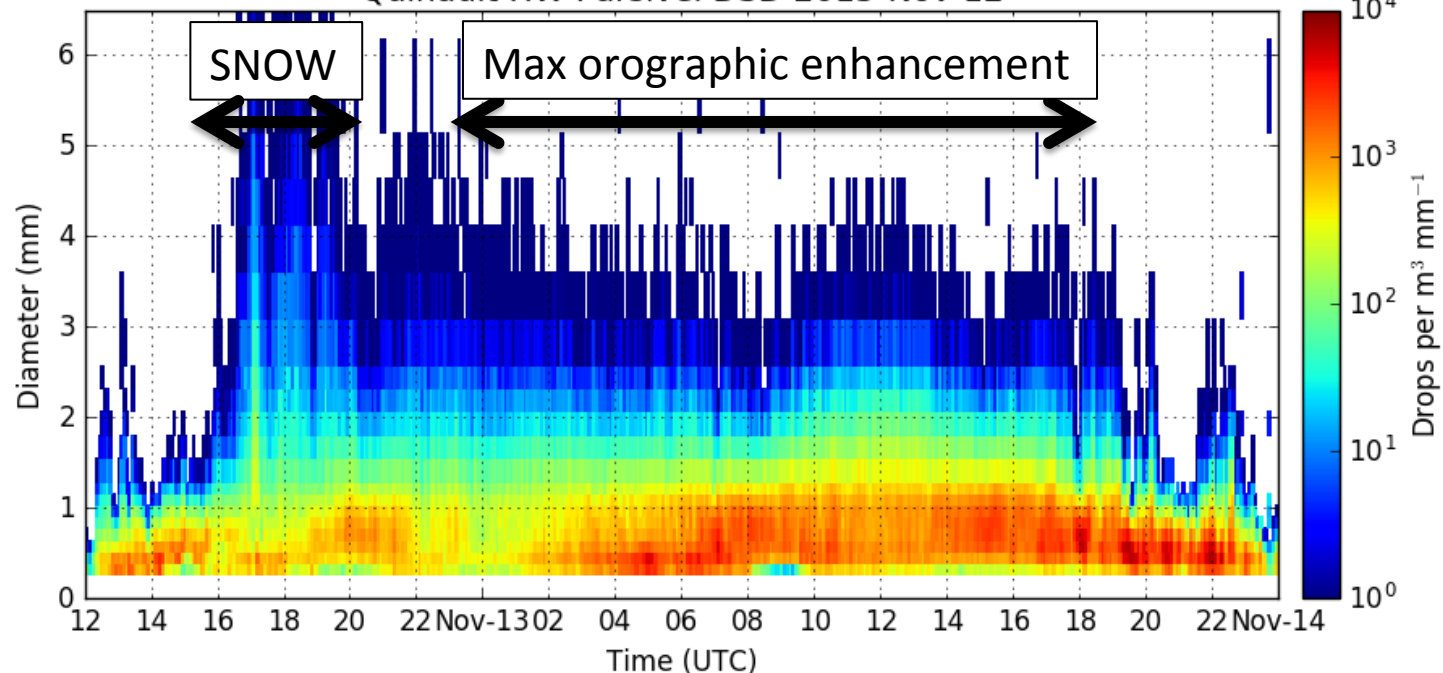
Low-level jet is within 1 km of the surface near NPOL and starts lifting around 20 km from radar (white arrow).

Drop formation + growth occurs below melting level ahead of high terrain.

Jet lifting decreases 50-60 km from radar.

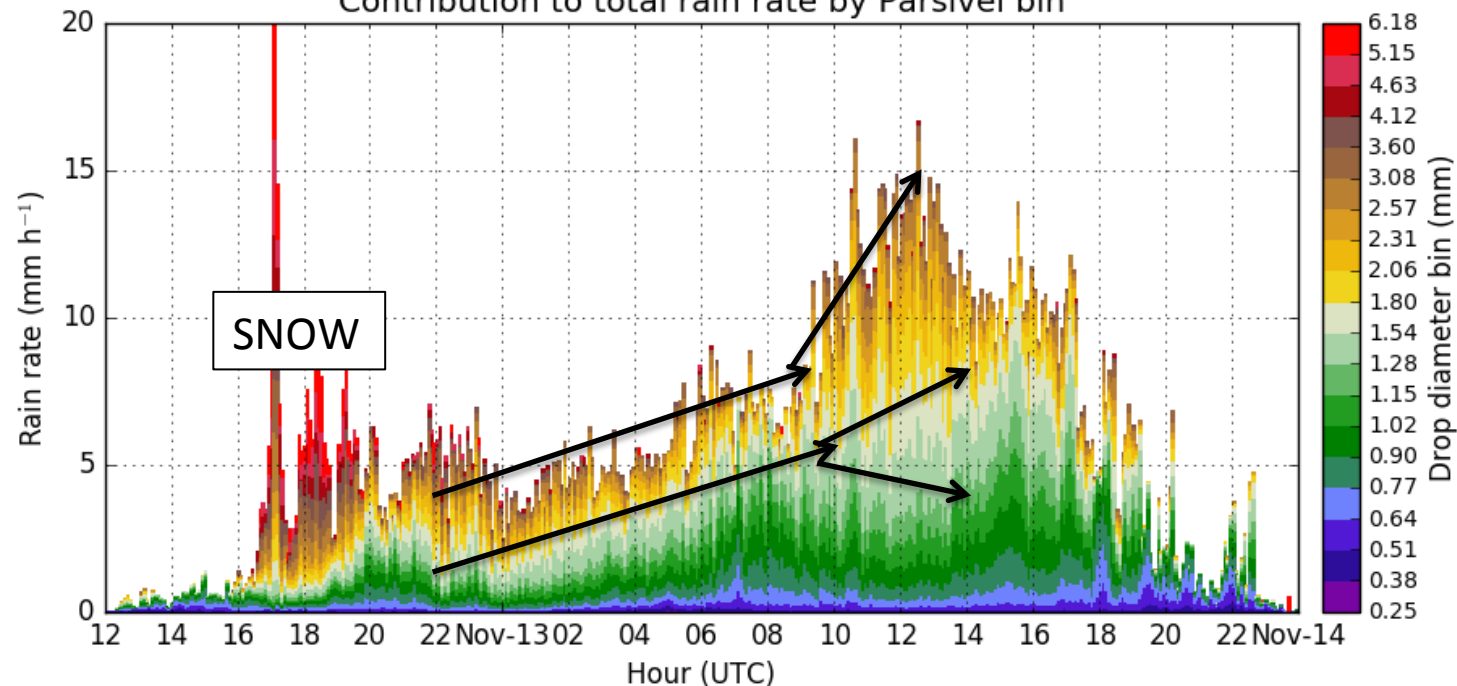


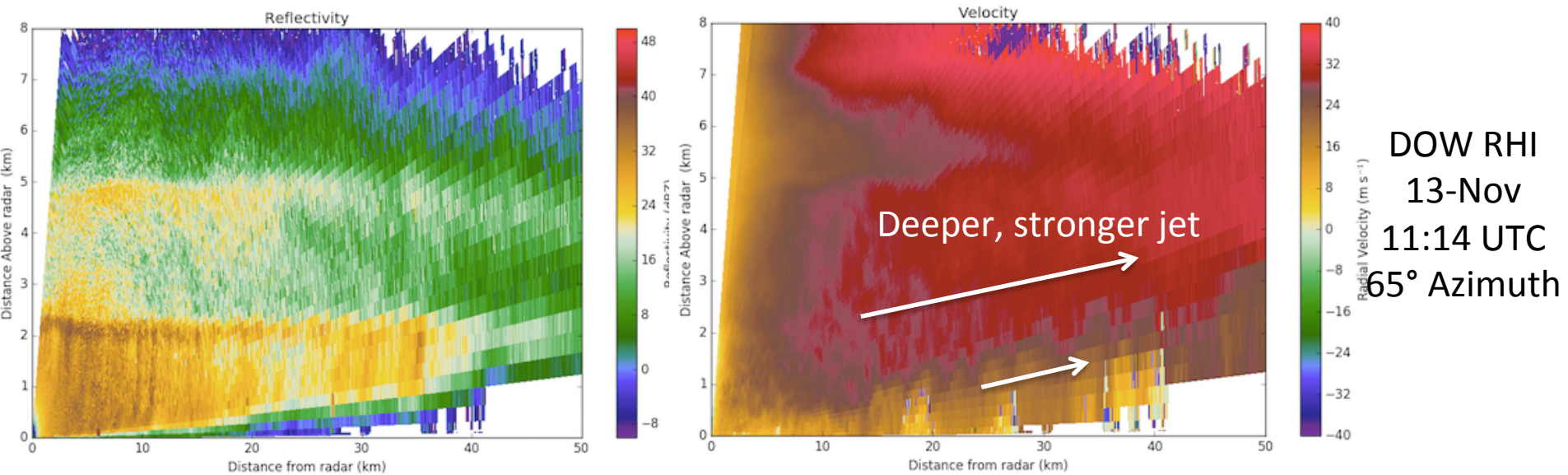
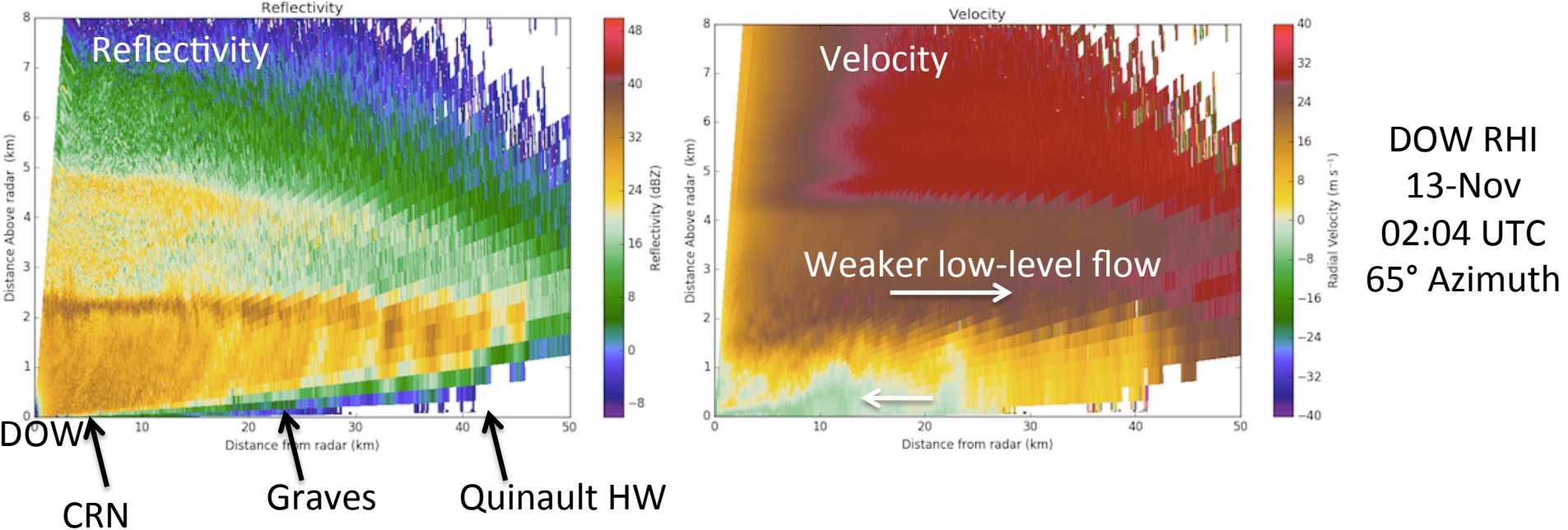
Quinault HW Parsivel DSD 2015-Nov-12



10-13 UTC,
medium-to-large
sized drops
account for the
increase in rain
rate!

Contribution to total rain rate by Parsivel bin





Enhancement later in event at Quinault HW possibly related to evolution of low to mid level jet. Appreciable shear is observed between upper and lower layers.

Summary of Nov 12-13 Case:

- Impressive rainfall totals came from predominately warm orographic enhancement (rapid growth and fallout of small rain drops).
- **Warm** enhancement processes dominated:
 - Within the warm sector of this AR event
 - During the period of highest rain rates (at CRN)
 - At relatively low elevations
 - When the low-level jet lifts below the melting level
- **Cold** precipitation was also present throughout the event (evidenced by a bright band). One period of likely cold enhancement (at Quinault HW) when LLJ was the strongest and near/above the bright band.