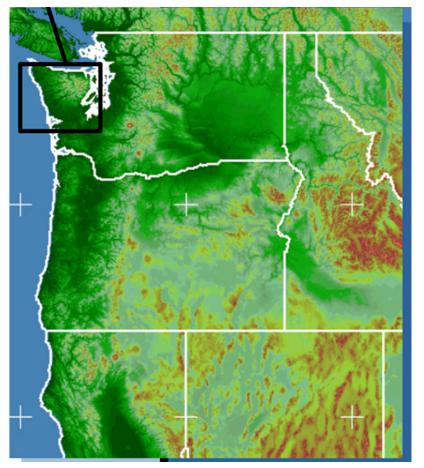


(co-authors: Joe Zagrodnik, Stacy Brodzik, **Angela Rowe, Robert Houze)**

Measuring Precipitation from Space

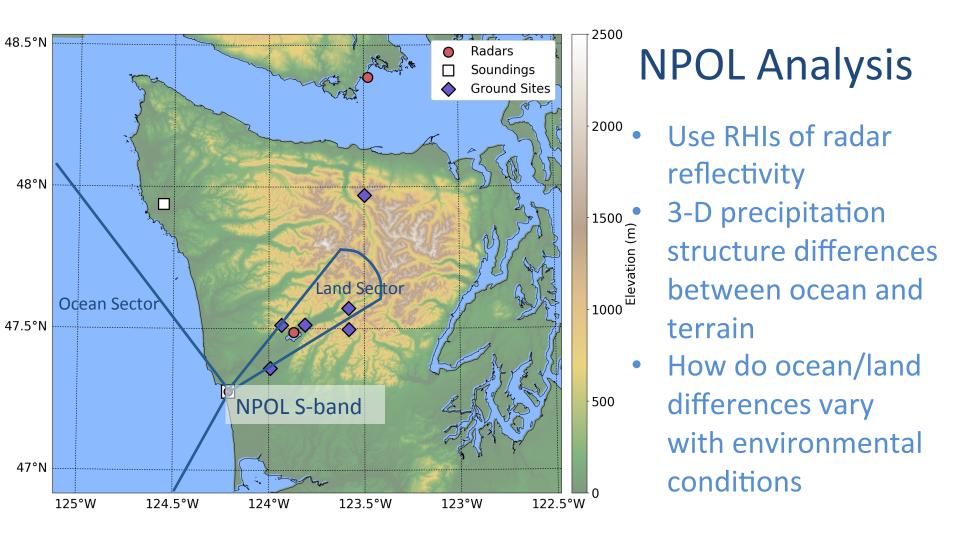
- Dual Polarization Radar (DPR) on GPM provides 3-D precipitation measurements
- What is the unique precipitation structure in complex terrain?
- Need for Ground validation



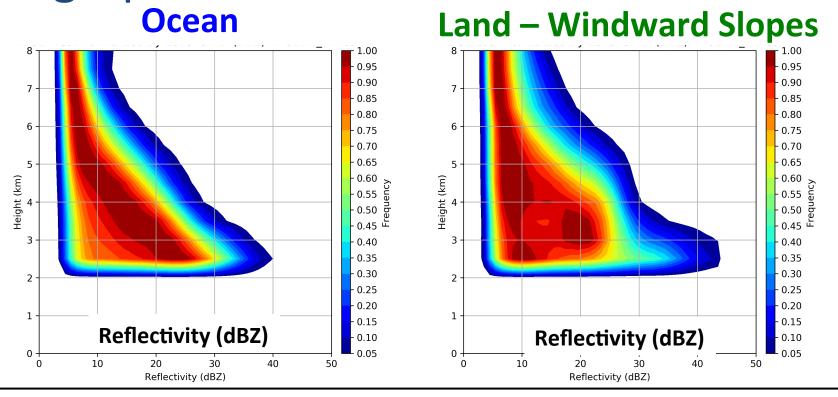


OLYMPEX – GV Nov 2015- Jan 2016

- Took place on Olympic Peninsula
- Full compliment of radars, aircraft, ground network
- Physical validation of precipitation algorithms for the GPM satellites
- Document precipitation processes in winter midlatitude cyclones over complex terrain



Orographic Enhancement Aloft from NPOL

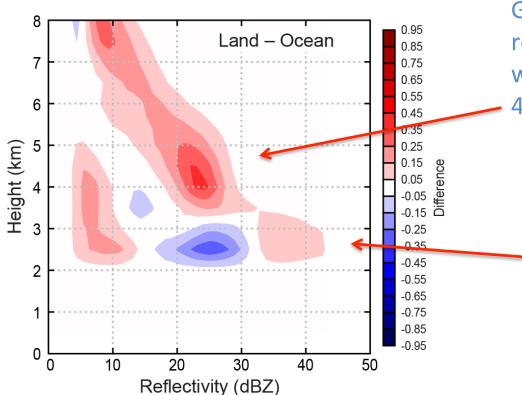


Contoured Frequency by Altitude Diagrams (CFADs)

Frequencies normalized by level for all NPOL RHI data over ocean and land above 2 km height

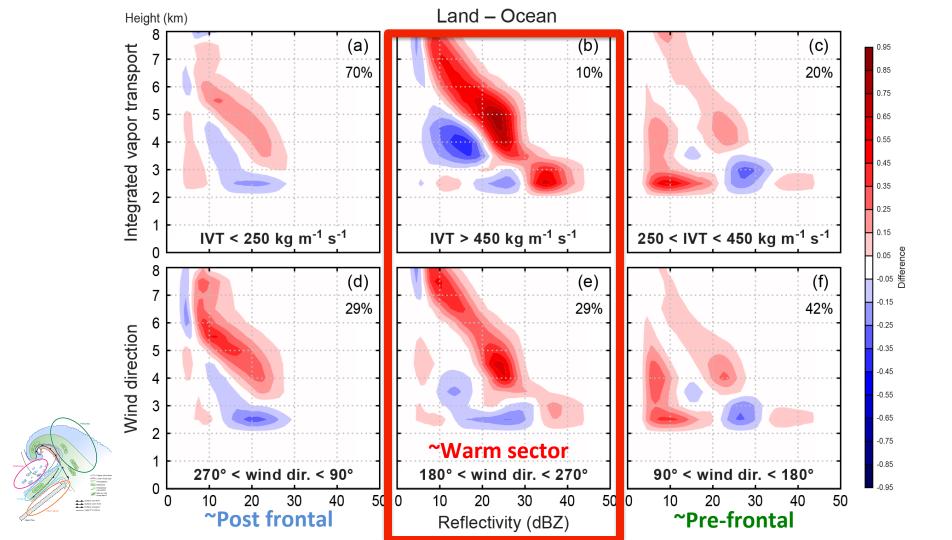
Orographic Enhancement Aloft from Radar

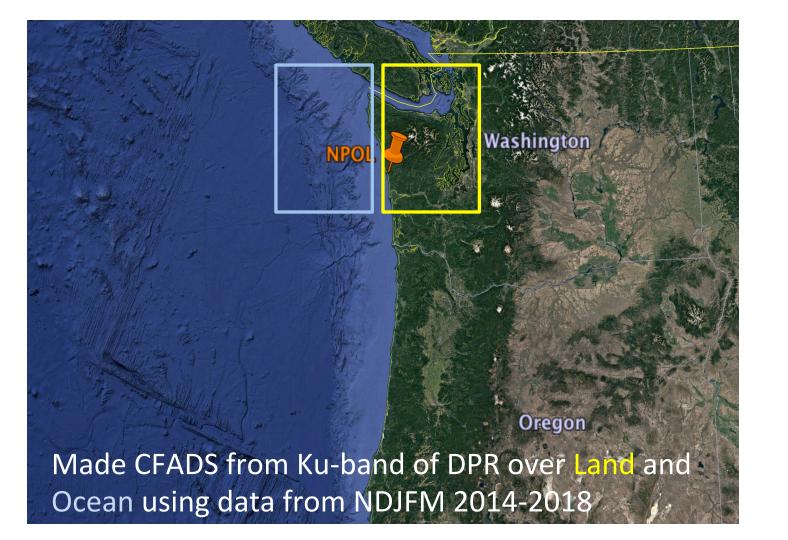




Greater frequency of higher reflectivities at all levels over windward slopes. Maximum at 4-5 km range for all conditions

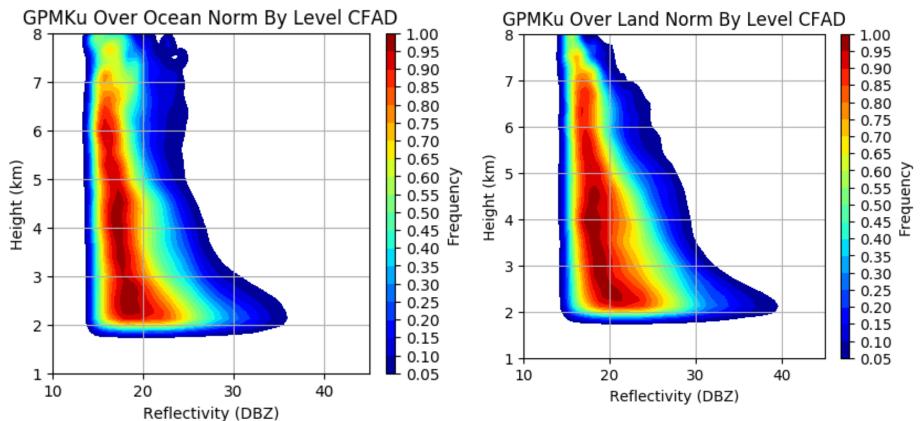
Shift to higher reflectivity near melting level (2-3 km during warm events)

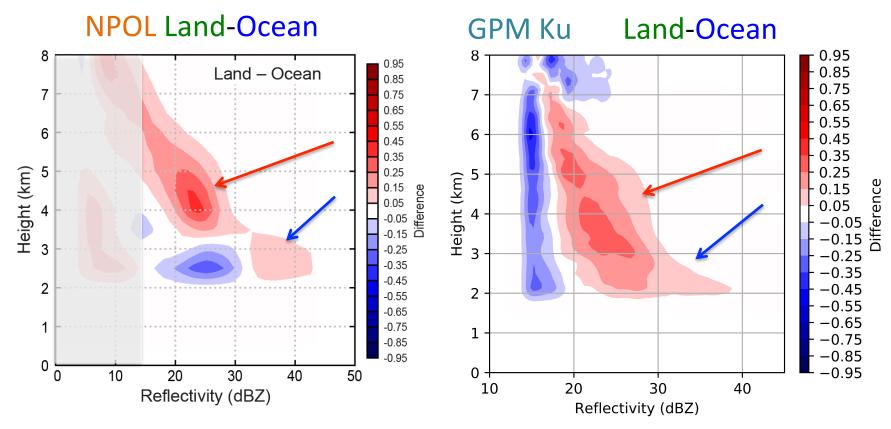




Ocean

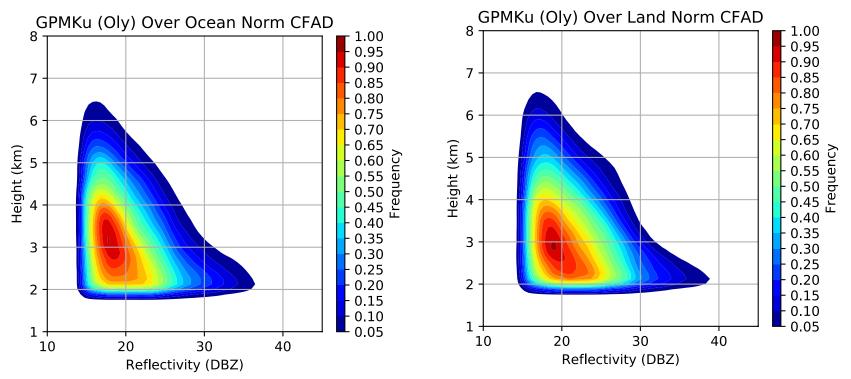
Land



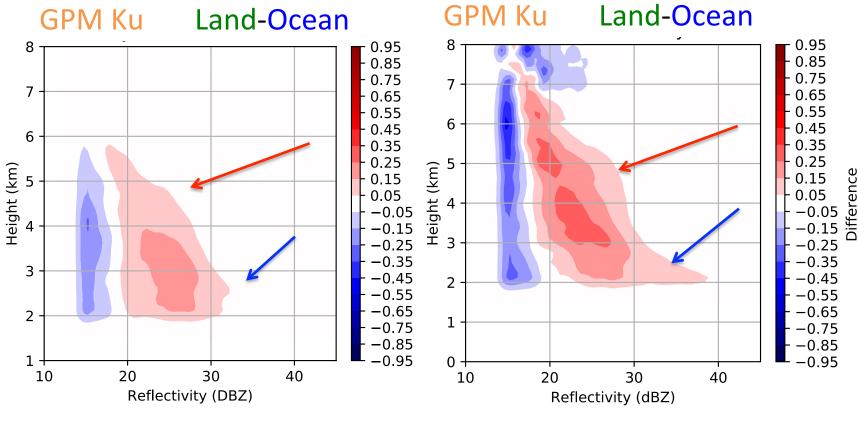


Normalized by level

Ocean Land

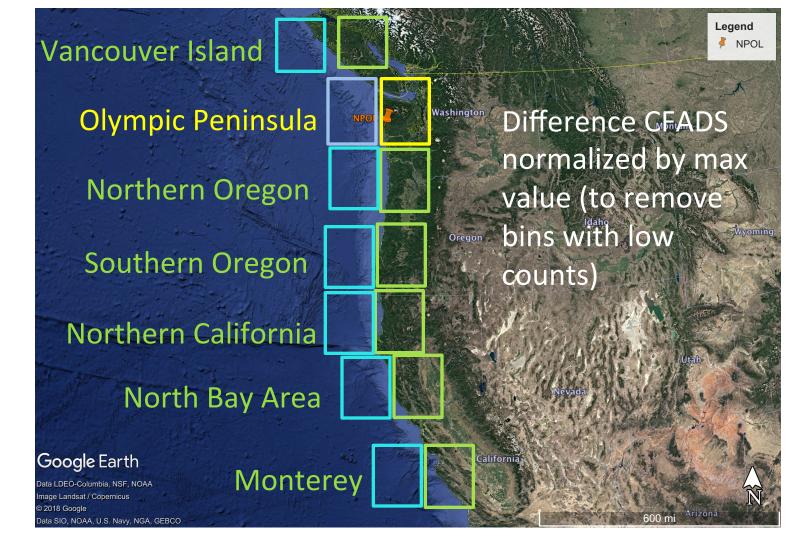


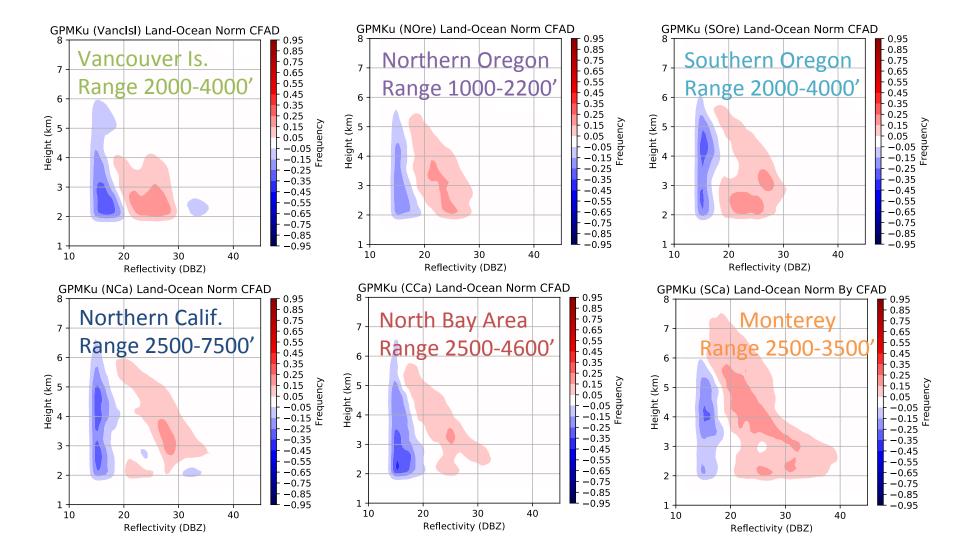
Normalized by Maximum Bin



Normalized by Maximum Bin

Normalized by level

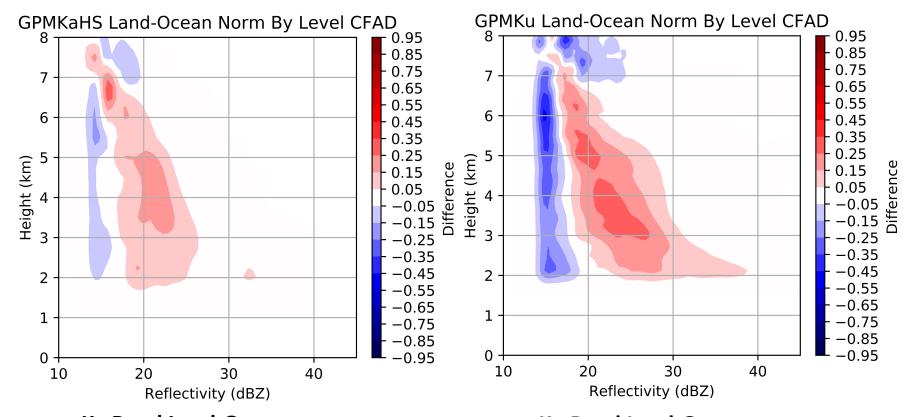




Terrain-Enhanced Precipitation Processes above the Melting Layer

- Enhancement of the precipitating cloud system occurs aloft over complex terrain seen by NPOL
- Enhancement on windward slopes greatest during warm, strongly forced events
- DPR documents same enhancement pattern as NPOL over coastal mountain ranges
 - Shift to higher reflectivity at all levels over terrain
 - Hint of secondary enhancement seen over all locations, esp. Monterey region where terrain rise is closer to the coast compared to other locations





Ka Band Land-Ocean Difference

Ku Band Land-Ocean Difference