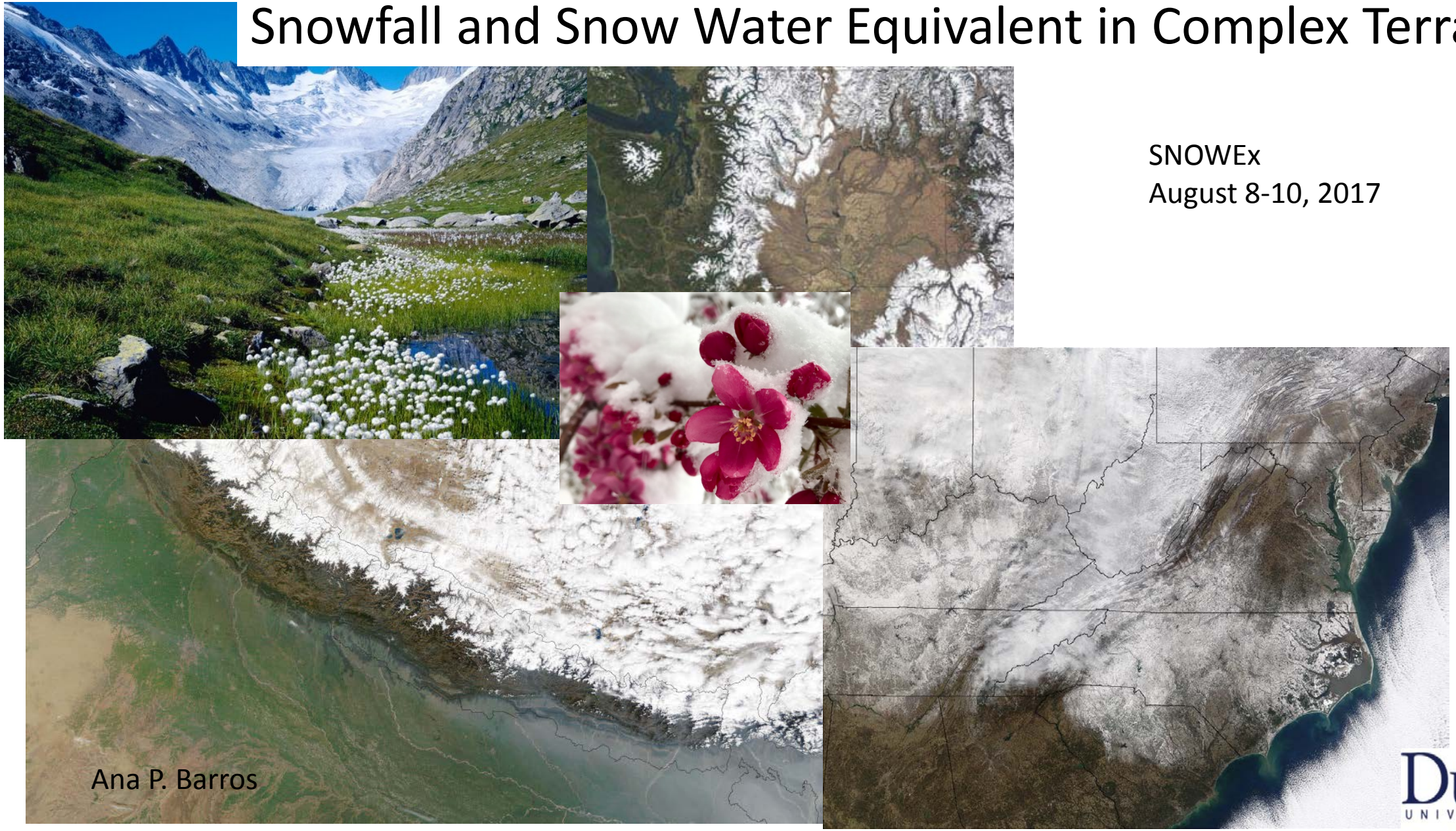
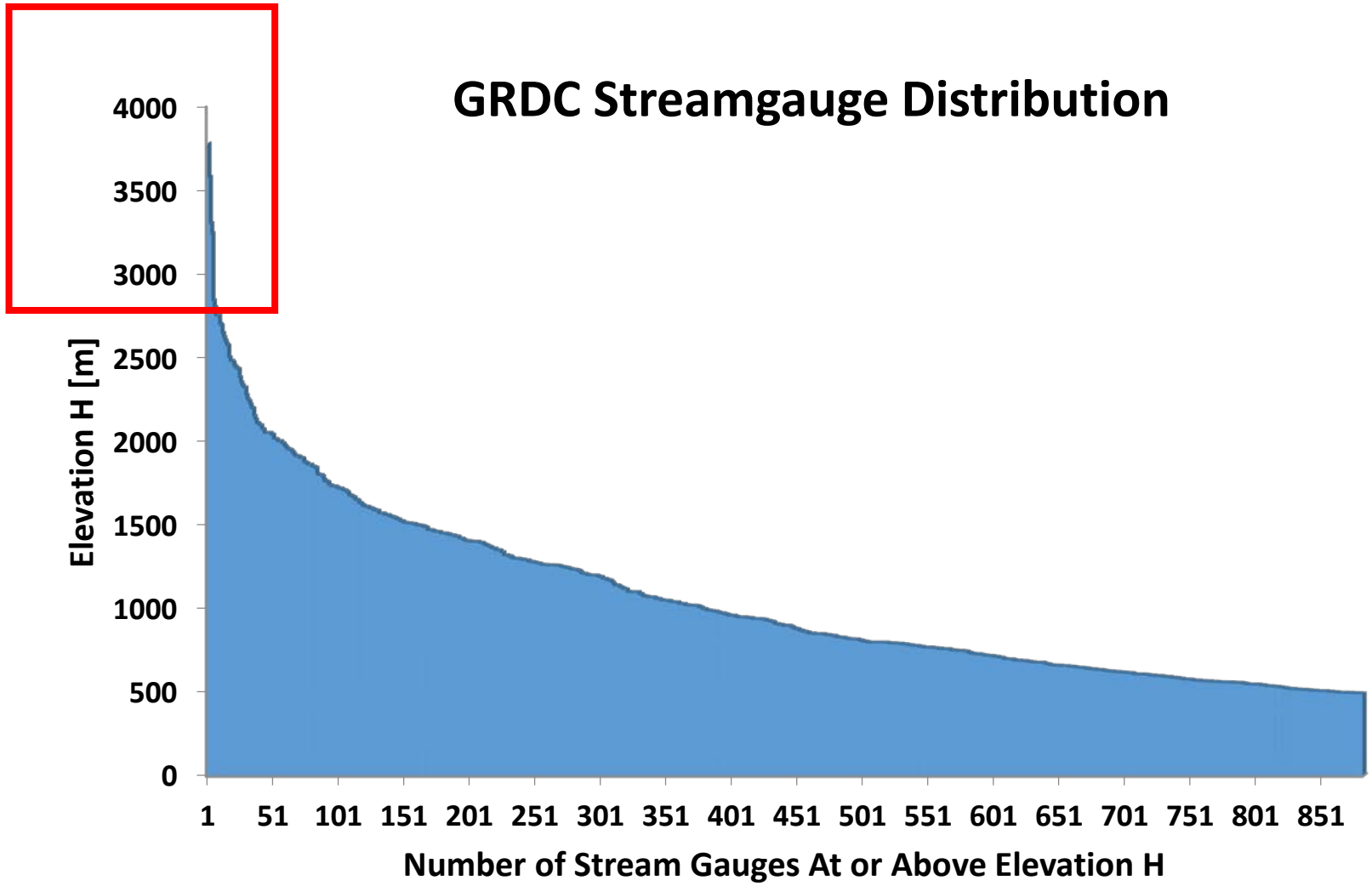
Multiscale Measurements and Modeling of Snowfall and Snow Water Equivalent in Complex Terrain

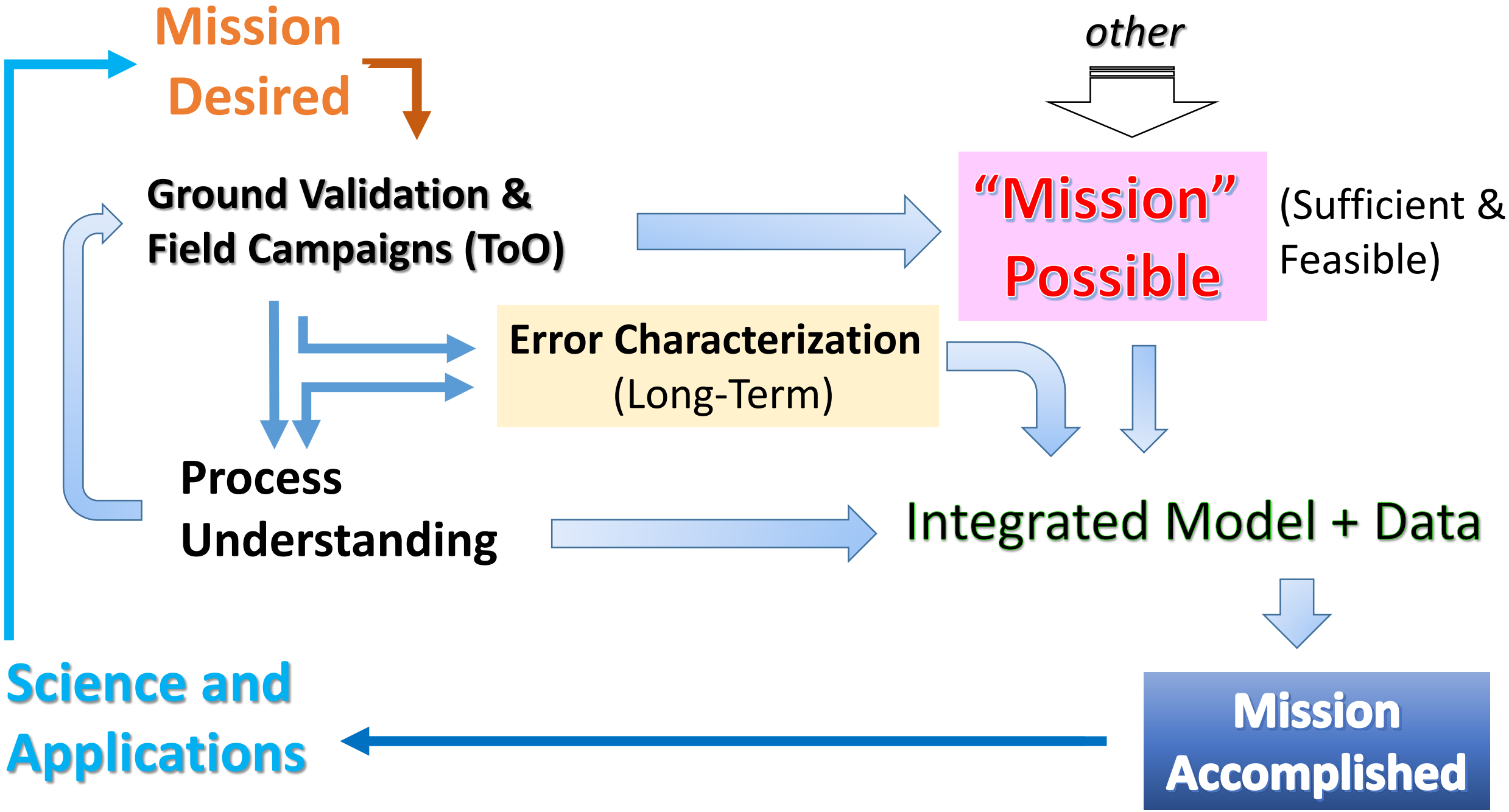


SNOWEx
August 8-10, 2017

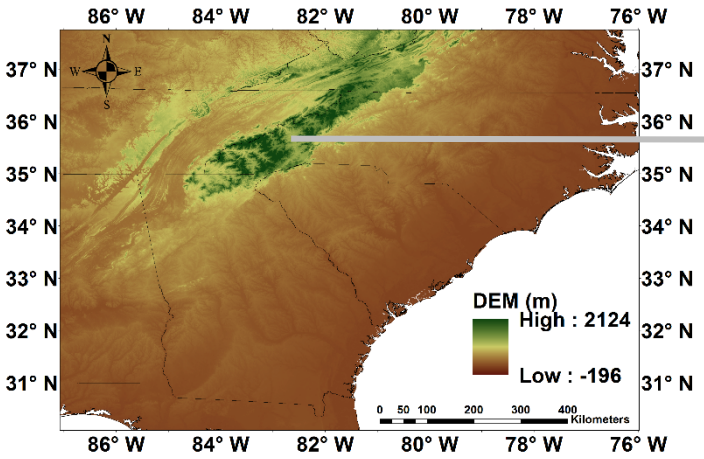
Ana P. Barros

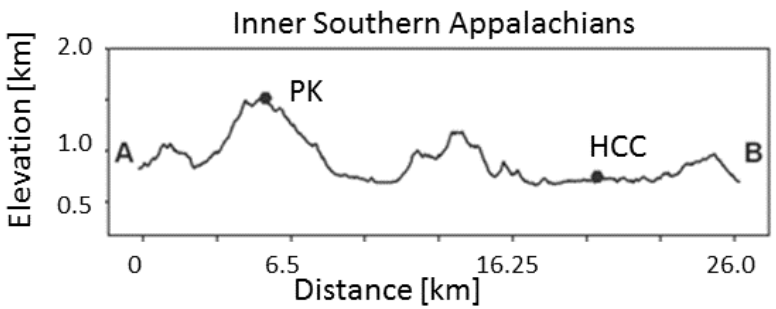
Duke UNIVERSITY

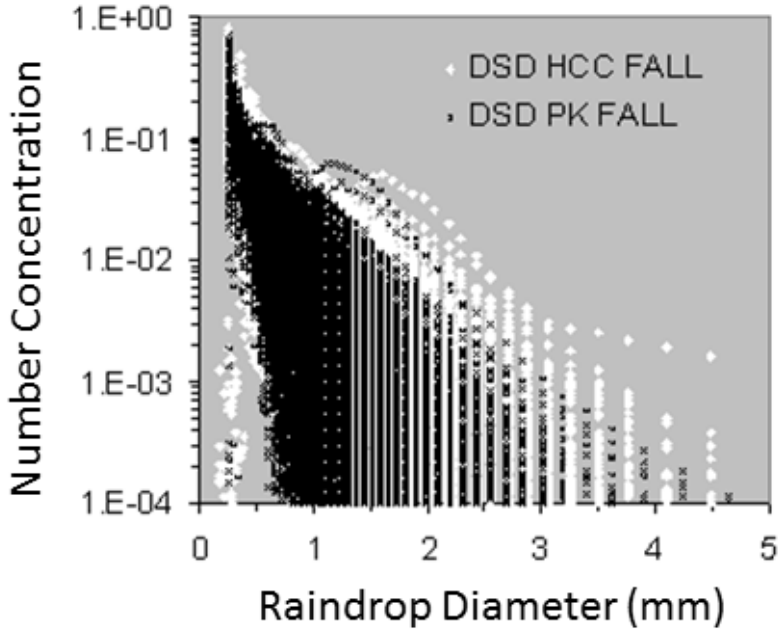

GRDC Streamgauge Distribution
Elevation H [m]
4000
3500
3000
2500
2000
1500
1000
500
0
1
51
101
151
201
251
301
351
401
451
501
551
601
651
701
751
801
851
Number of Stream Gauges At or Above Elevation H

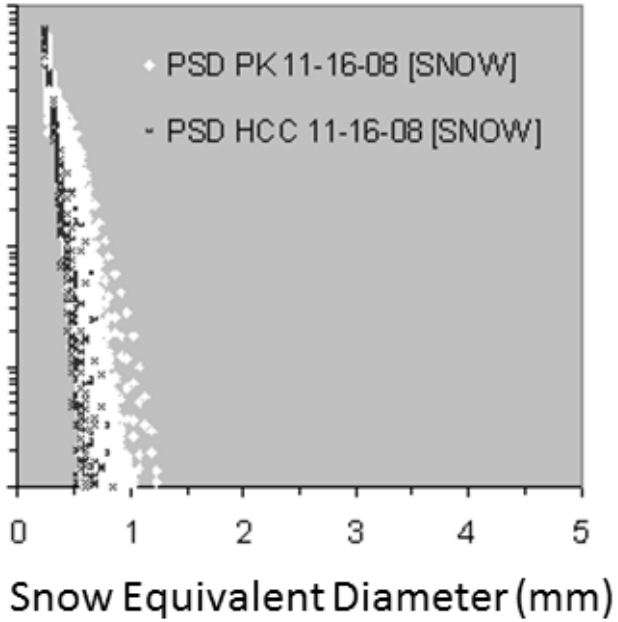

Mission Desired
other
Ground Validation & Field Campaigns (ToO)
"Mission" Possible
(Sufficient & Feasible)
Error Characterization (Long-Term)
Process Understanding
Integrated Model + Data
Science and Applications
Mission Accomplished

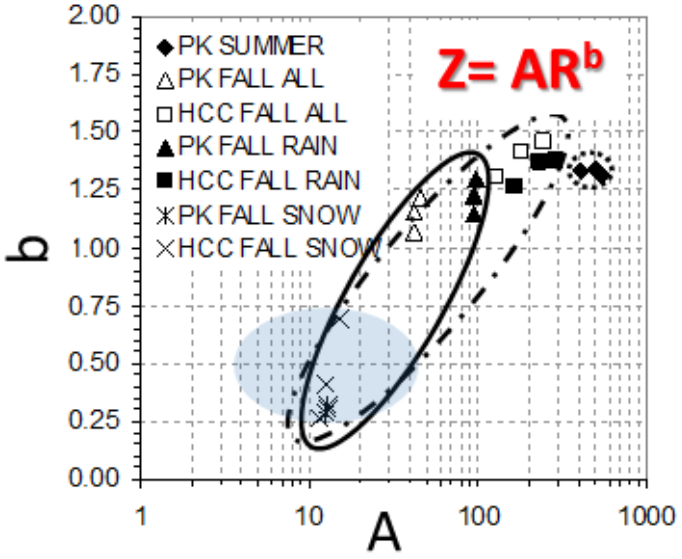
1. Heterogeneity of Microphysics



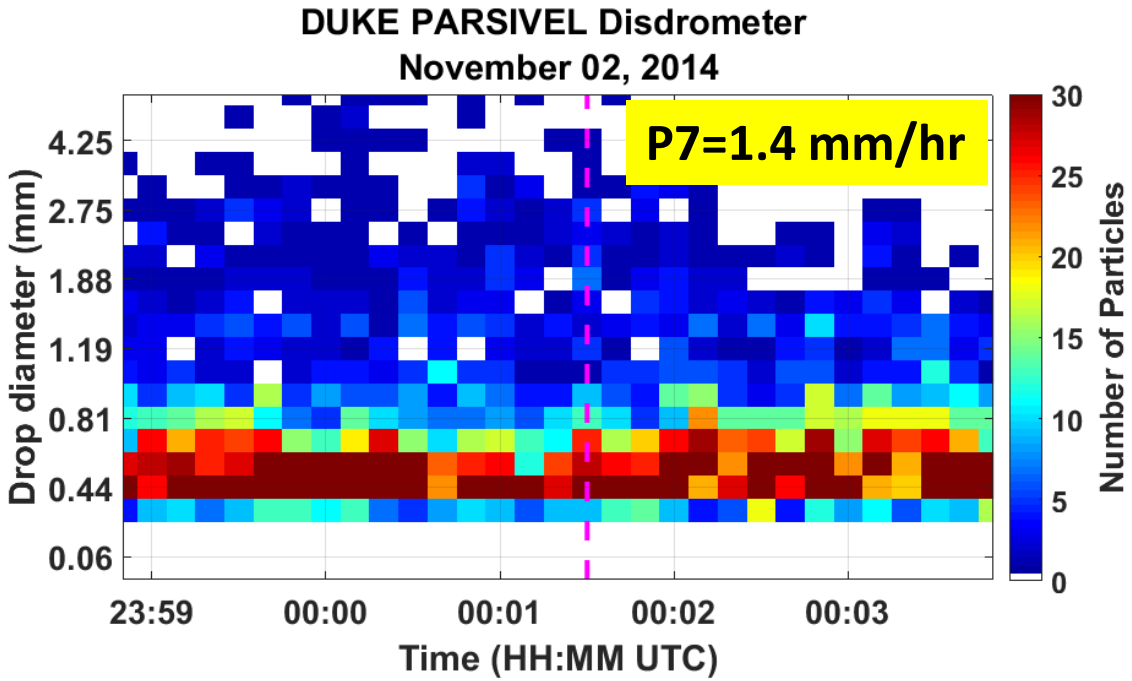


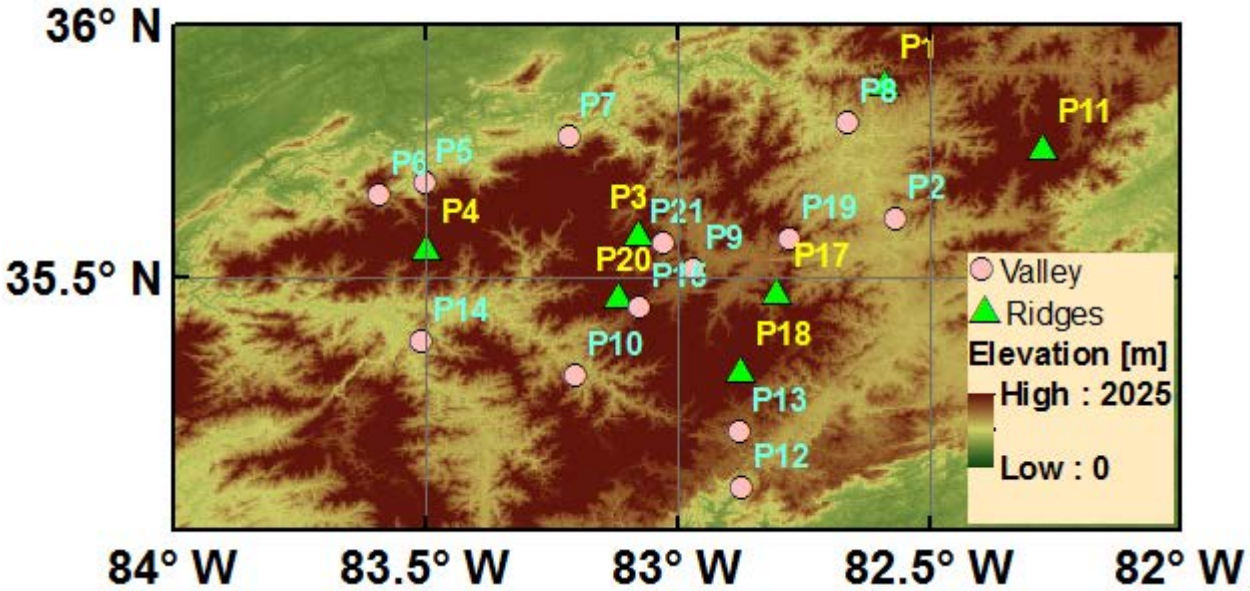


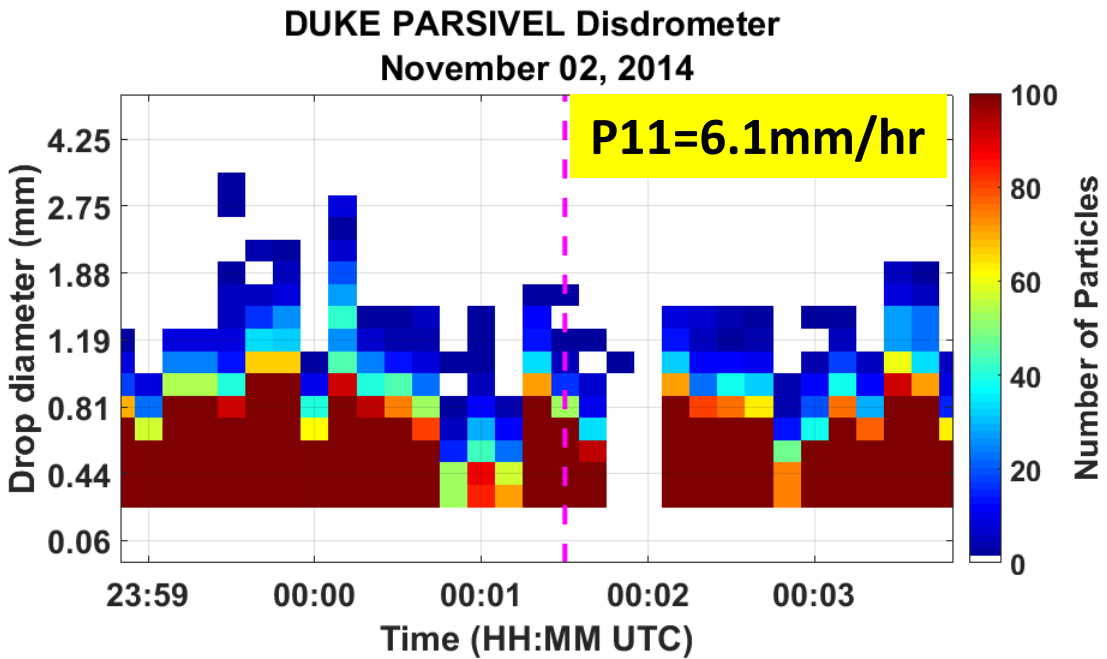


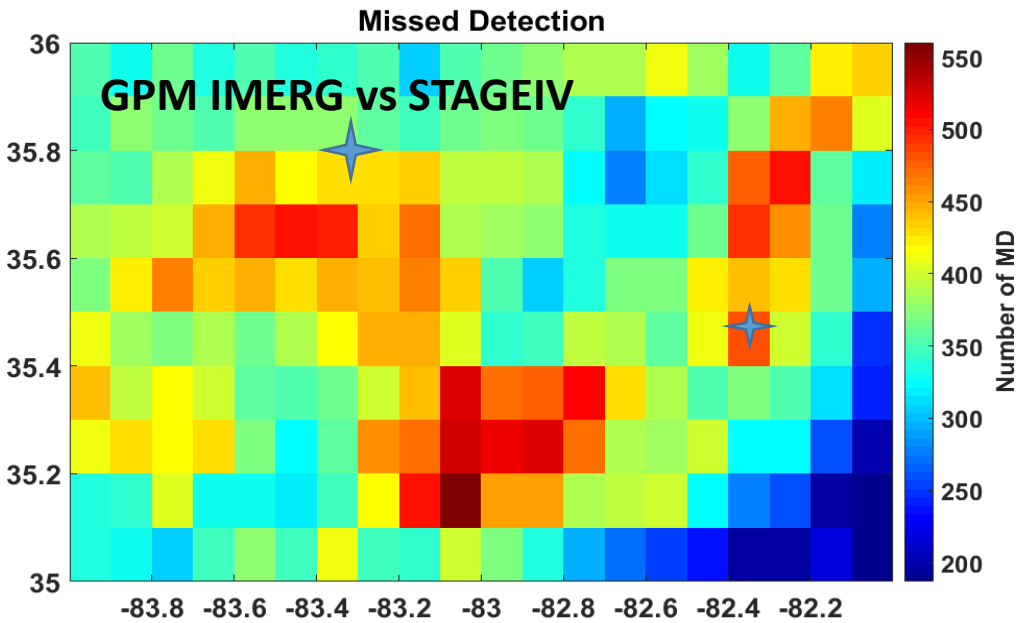


Prat and Barros, JHydrol 2010



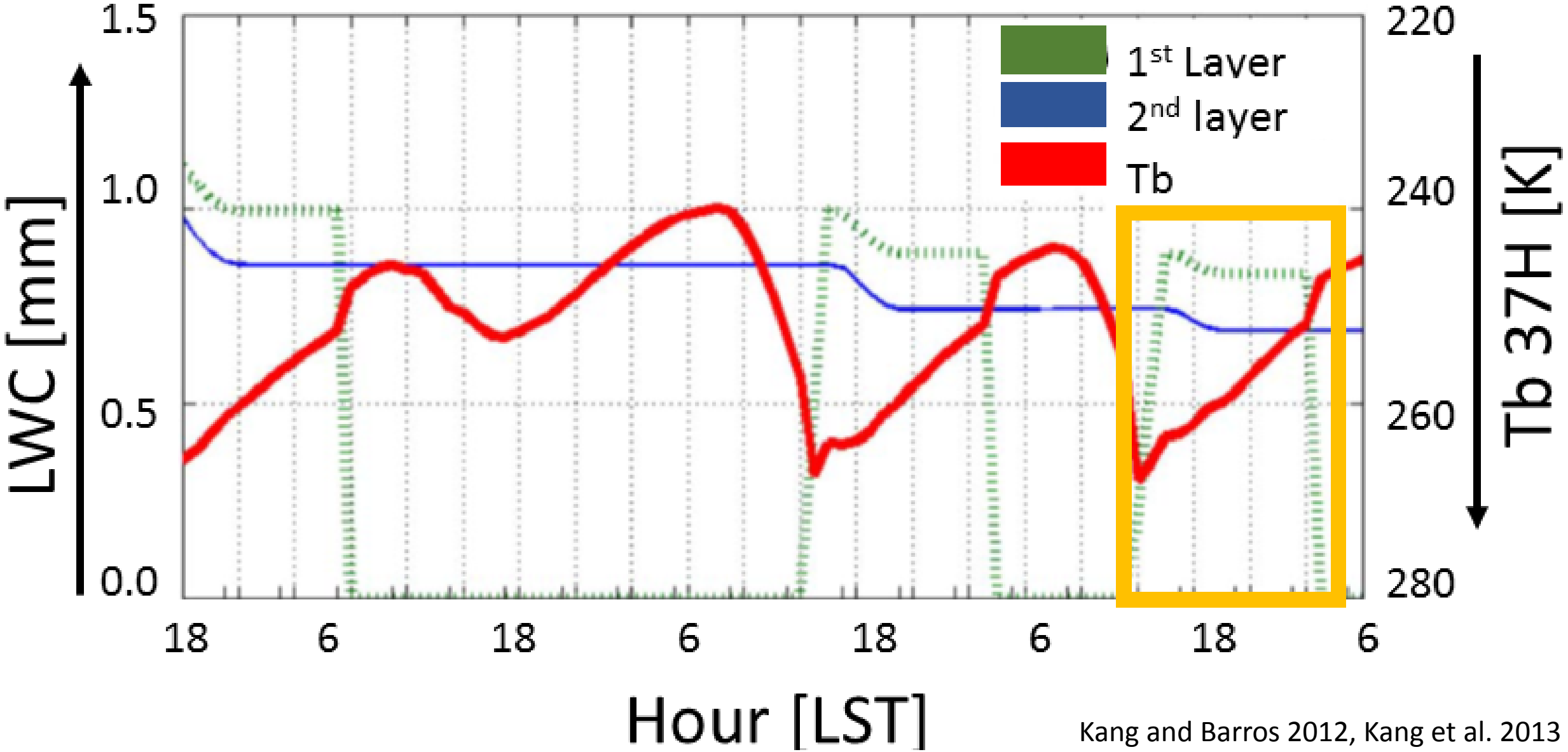




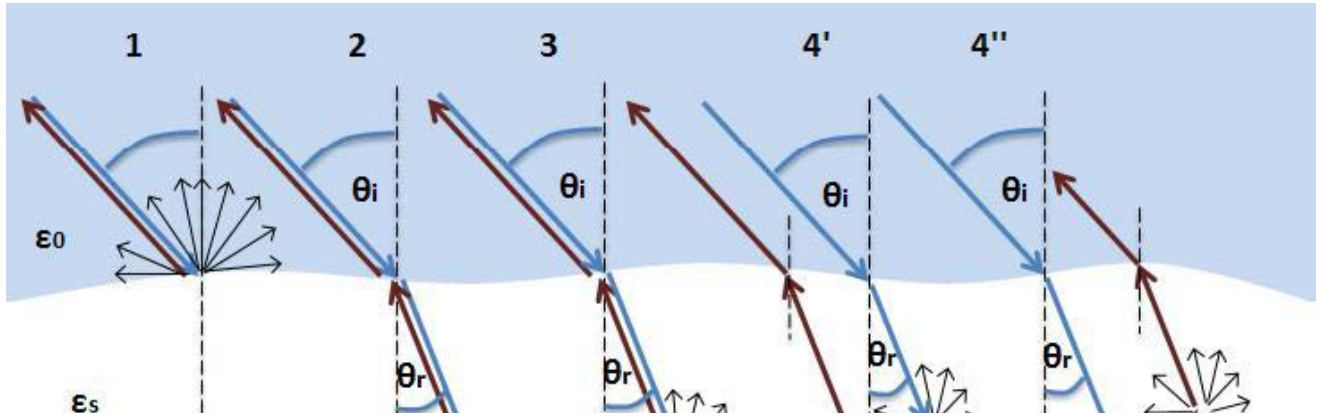


Prat and Barros, 2010b; Duan et al. 2015; Arulraj and Barros, 2017a,b

2. Diurnal Cycles and Climatology of Environmental Conditions



Kang and Barros 2012, Kang et al. 2013



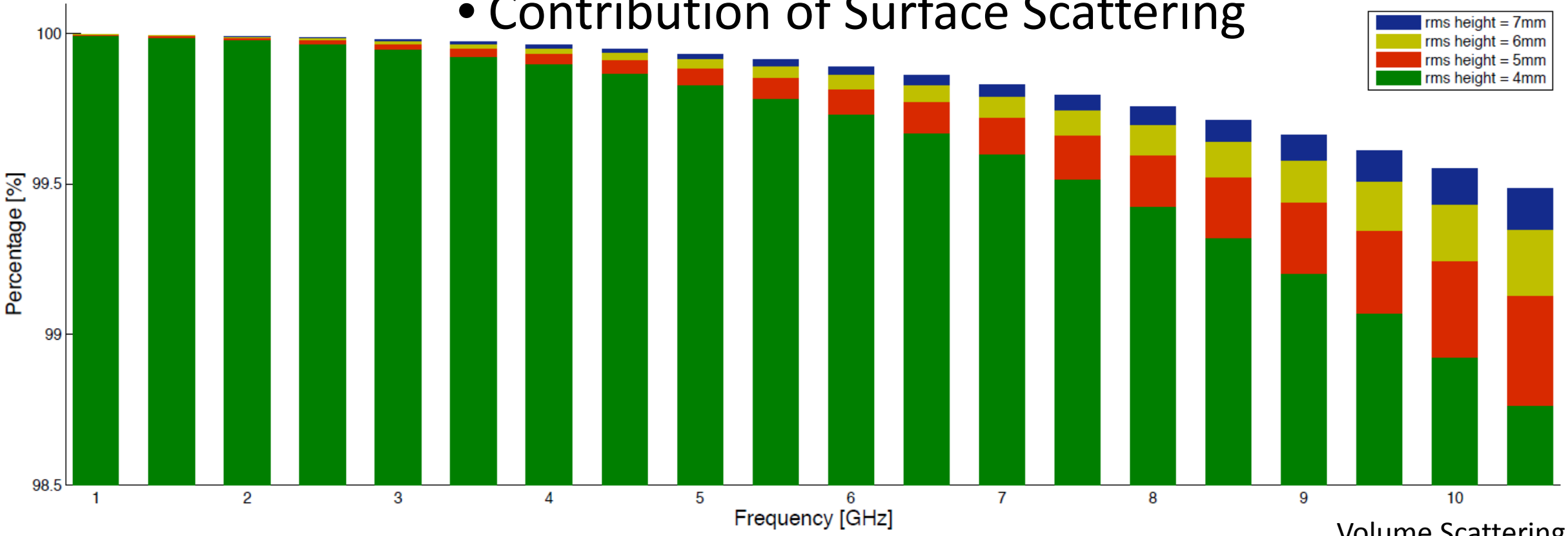
1- Surface scattering (wet snow)

2- Ground scattering (dry snow)

3- Volume scattering

4- (1+3) interactions

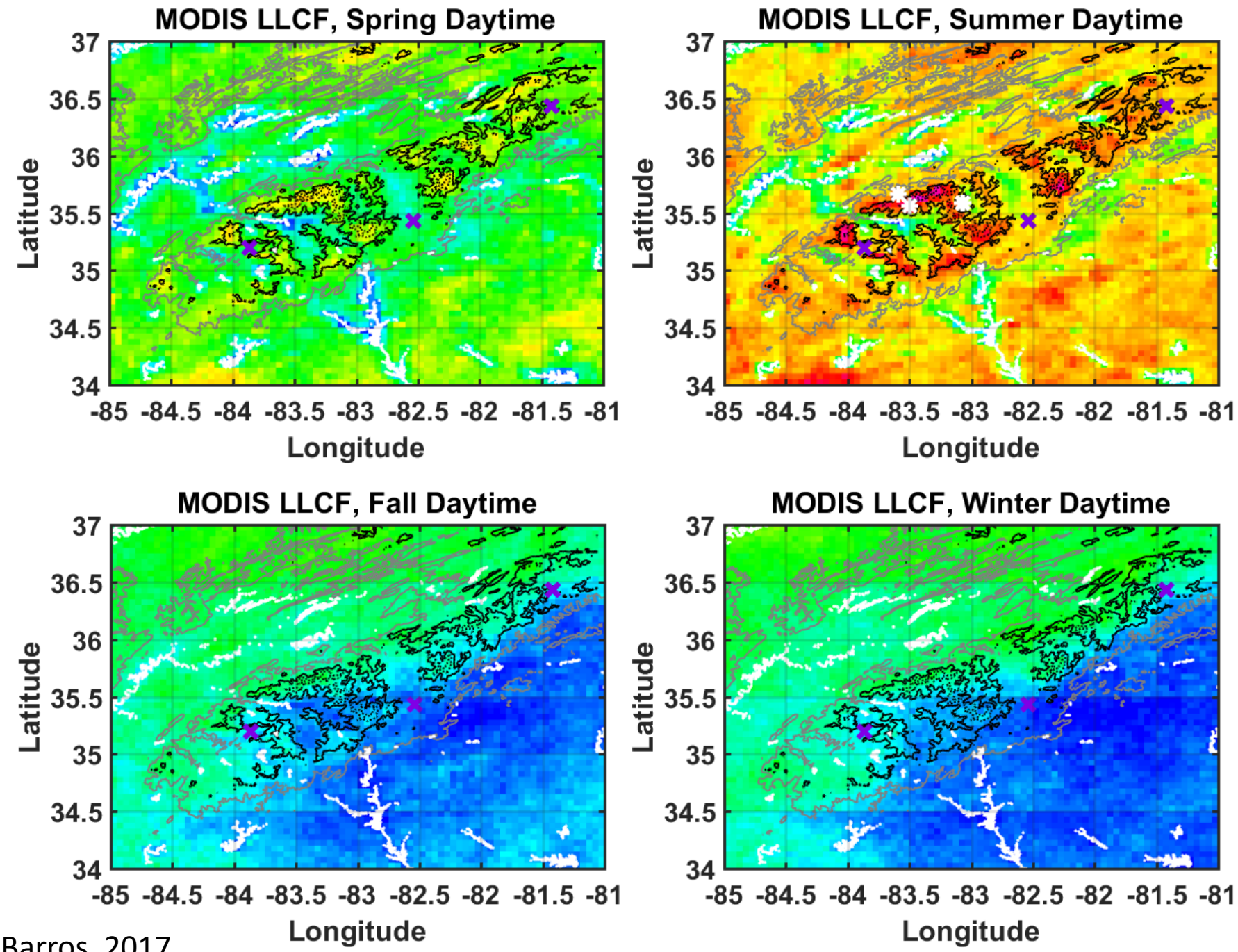
- Contribution of Surface Scattering



Volume Scattering

Besic et al. 2013

Mid-day LLCF



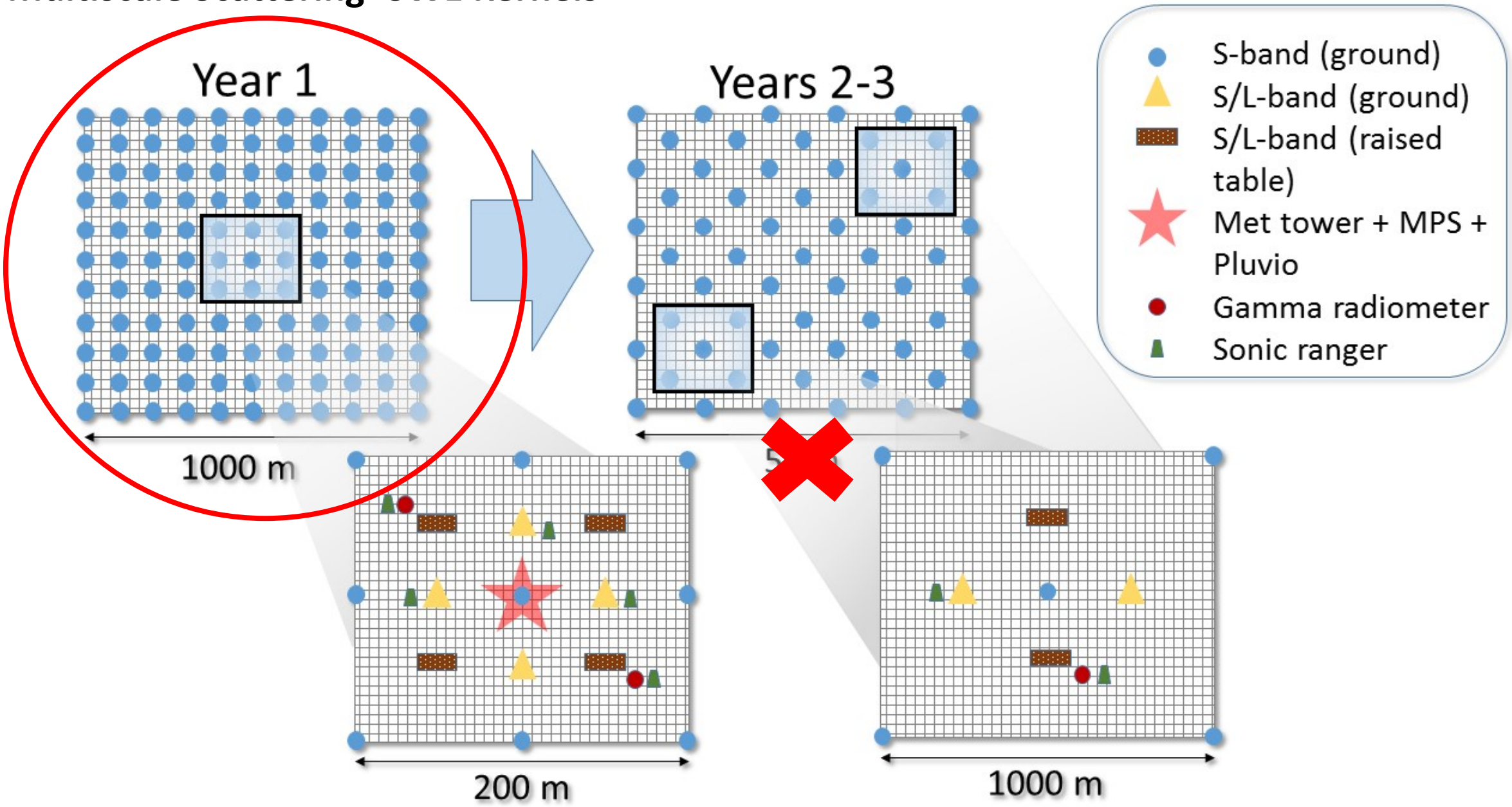
ΔSW> 100 W/m2

Duan and Barros, 2017

Work Plan

- ❑ *Wet Snow Transients and Deep Freeze-Melt Cycles*
- ❑ *Vertical Microphysics Structure including Depth Hoar*
- ❑ ***Dynamic,Thermodynamic and Material Boundaries***
- ❑ *Warming at Air-Snow and Ground-Snow Interface*
  - ✓ *Mixed Phase Precipitation*
    - ❖ Passive-Active Multifrequency
    - ❖ Spatial Heterogeneity and Scaling Behavior

Multiscale Scattering- SWE Kernels



Continuous Observations

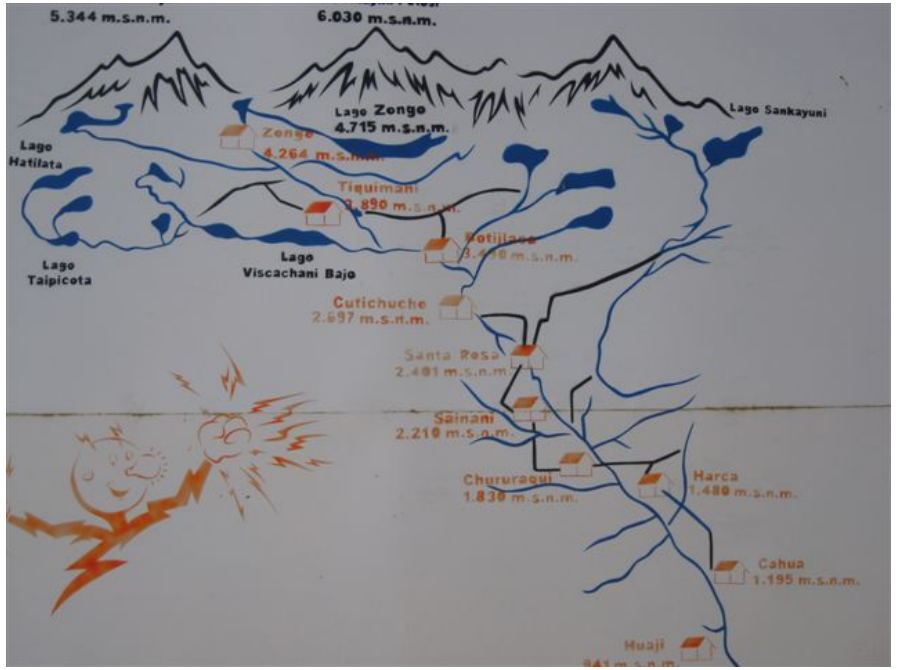
Barros and Lang, 2003;Lang and Barros, 2004

SNOWEx-2

Measurements and “Big” Science Questions

Other Opportunities

- *Science*

Mountain Hydrology and Hydroecology
Active versus frozen ground hydrology , groundwater hydrology
Snowfall and Mixed Phase Precipitation
Land-Atmosphere Interactions
Vegetation / bofedales/ steppes

- *Applications*