Characteristics of DPR snowfall detections in mountain locations

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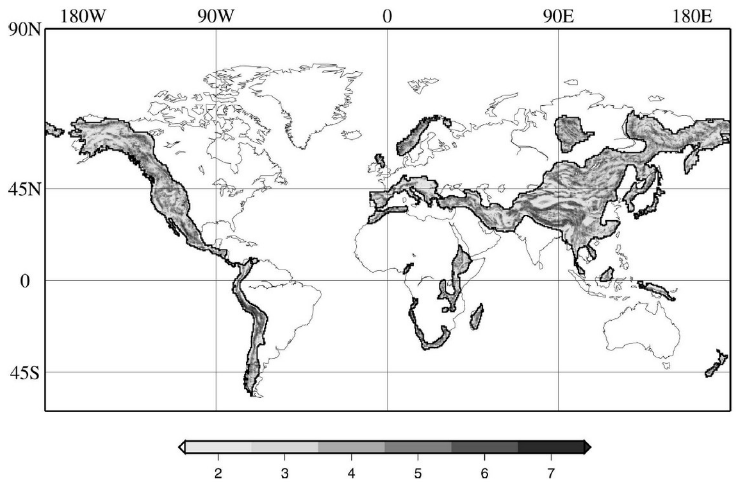
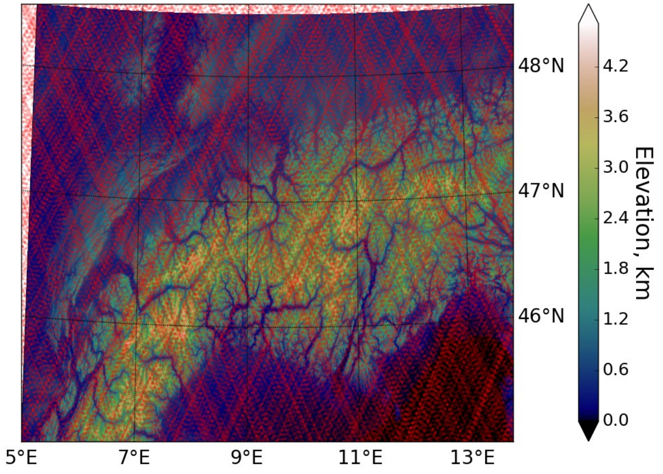
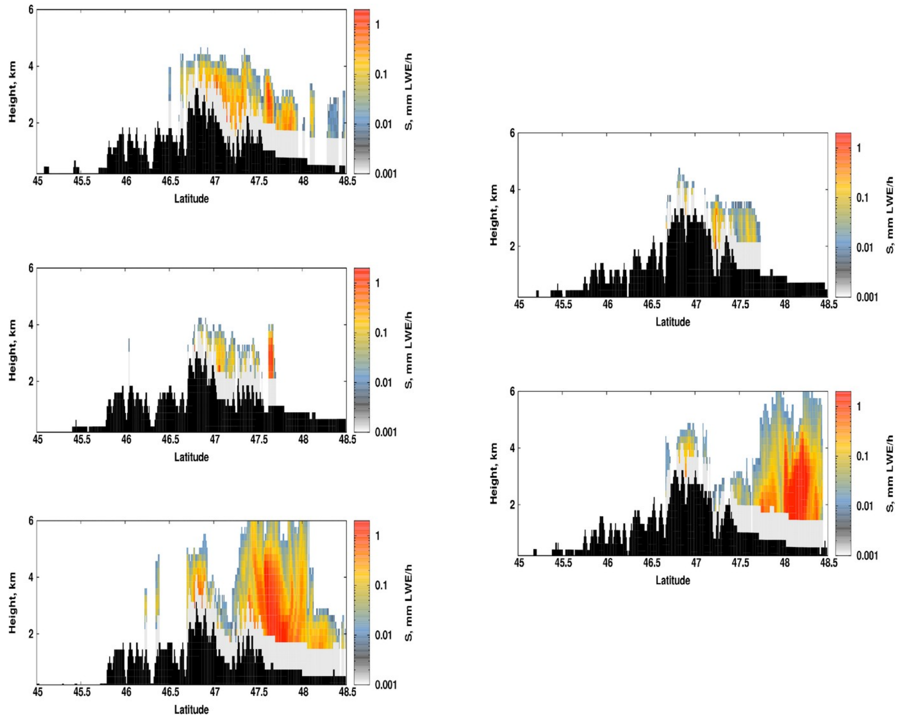
Motivation

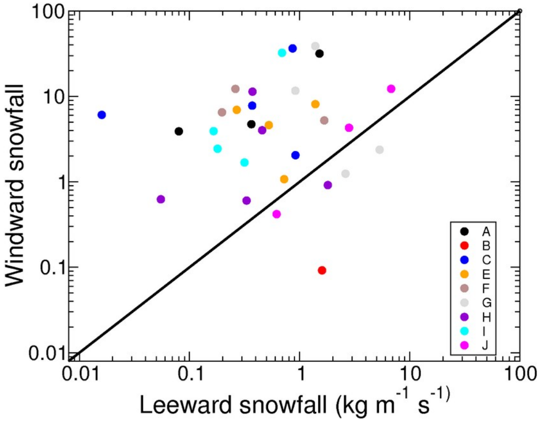


Gauge-constrained precipitation datasets suffer **biases** in regions of complex terrain owing significantly to biases in gauge **siting** and **orographic effects** (Adams et al. 2006, JCLI, their figure 2)



Satellite-based observations provide **improved sampling** of the spatial distribution of precipitation in regions of complex terrain compared to gauge networks.





Questions:

- What are the global occurrence and intensity characteristics of DPR-observed snowfall over areas subject to orographic influence?
- Can relationships between the terrain and the meteorology of the flow incident on a terrain barrier be diagnosed and generalized?
- How do the terrain and flow properties affect snow formation and transport processes?

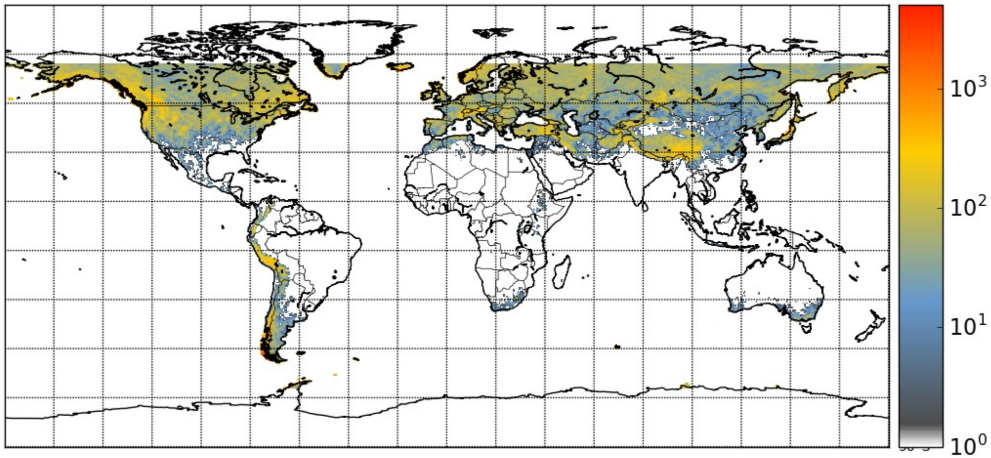
Objective: Apply DPR and GV observations to assess the detection, structure and bulk process parameters of orographic snowfall

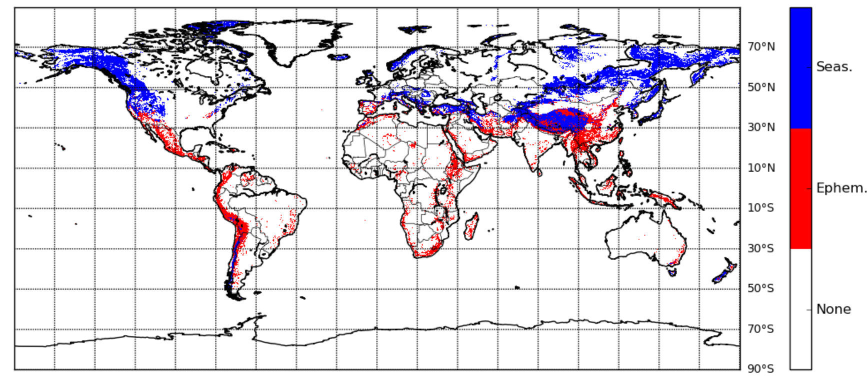
Topics:

- Quantifying DPR orographic snowfall
- Comparisons against CloudSat
- Use of RAMS + QuickBeam for OSSE-like performance testing

Resolving mountain snowfall from the DPR

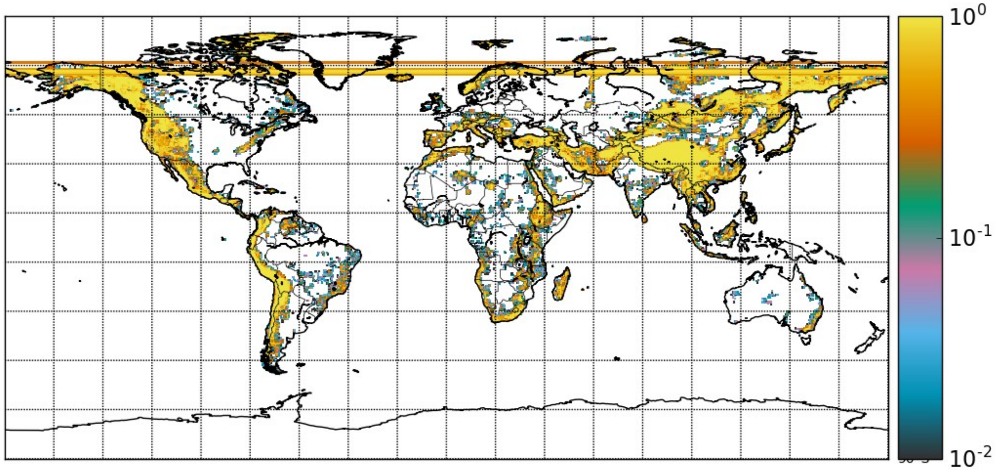
Global annual over-land DPR accumulations



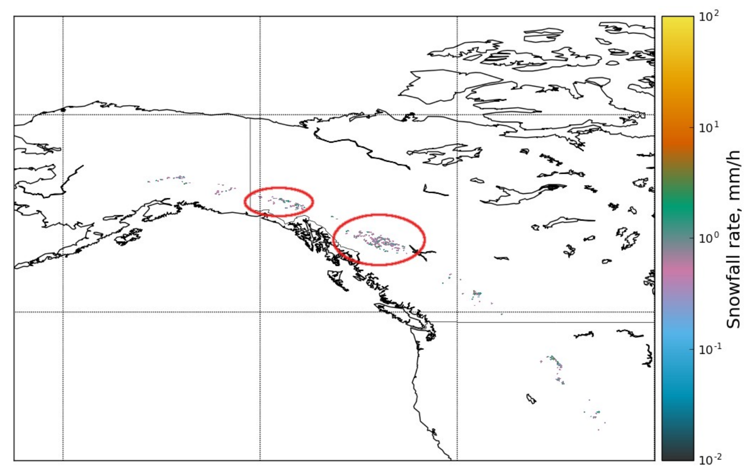


Wrzesien et al. (2019, WRR)

Gridded fractional mountain area

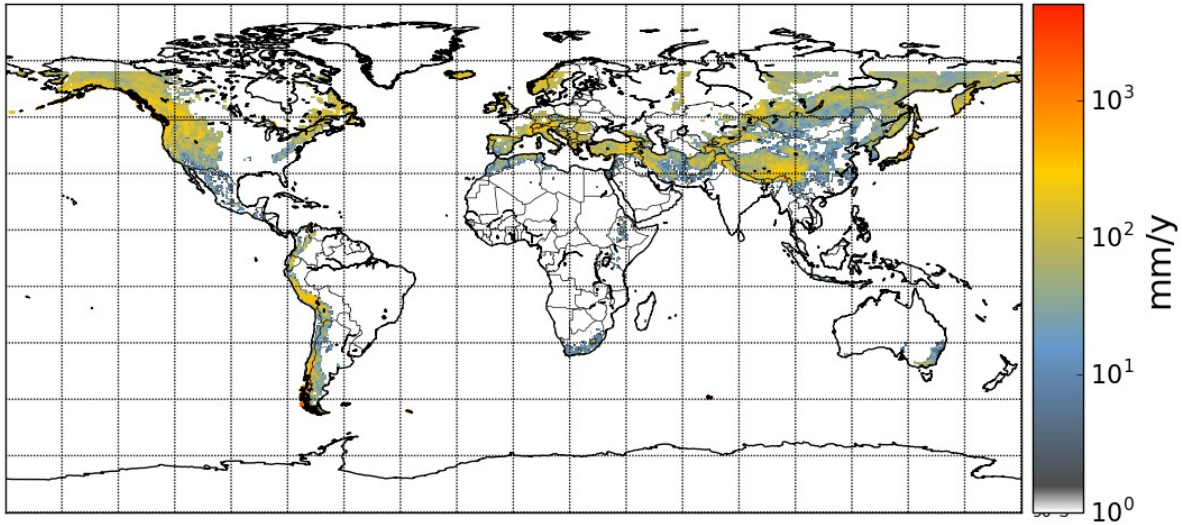


Collocations



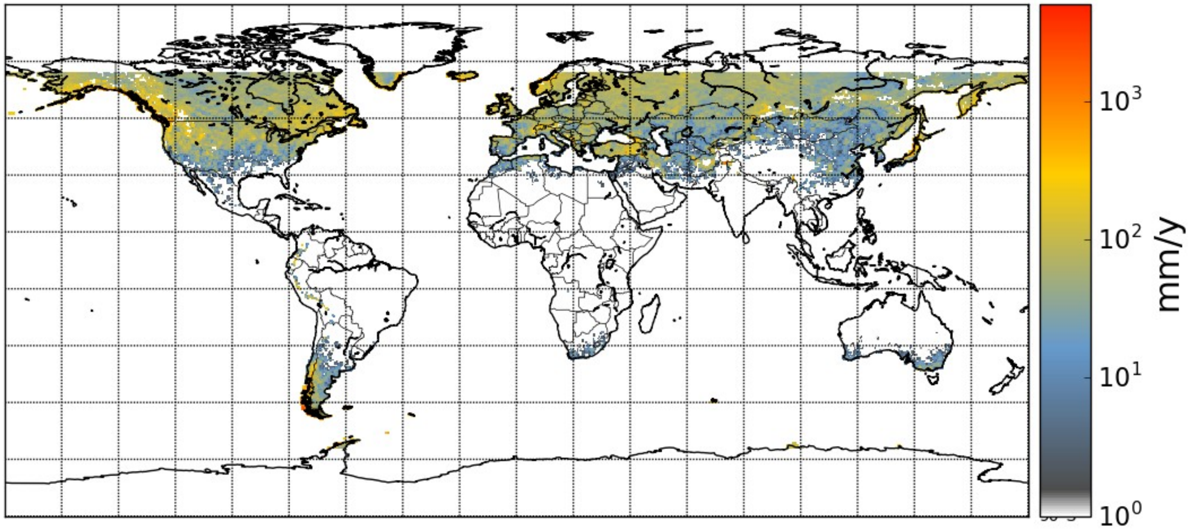
Comparing mountain and non-mountain snowfall

Global annual accumulation, mountain

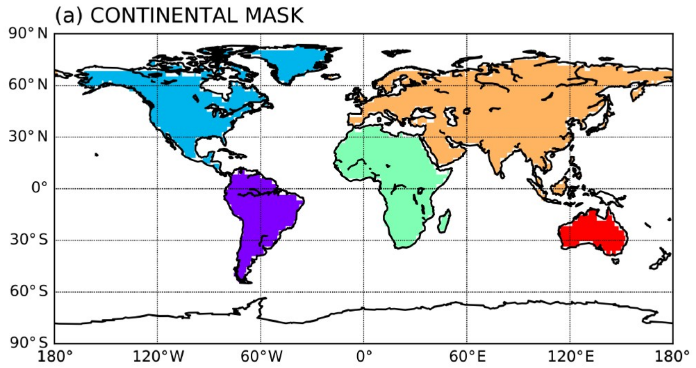


CloudSat mtn: 3.0 mm/y
DPR mtn: 4.2 mm/y

Global annual accumulation, non-mountain



Regional comparisons

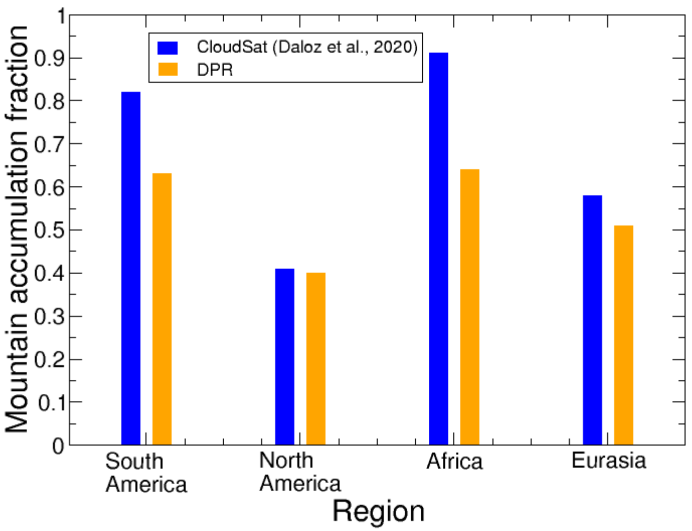


Daloz et al., (2020, TC); L'Ecuyer at al. (2015)

Annual mtn/non-mtn accumulations by region, mm/y

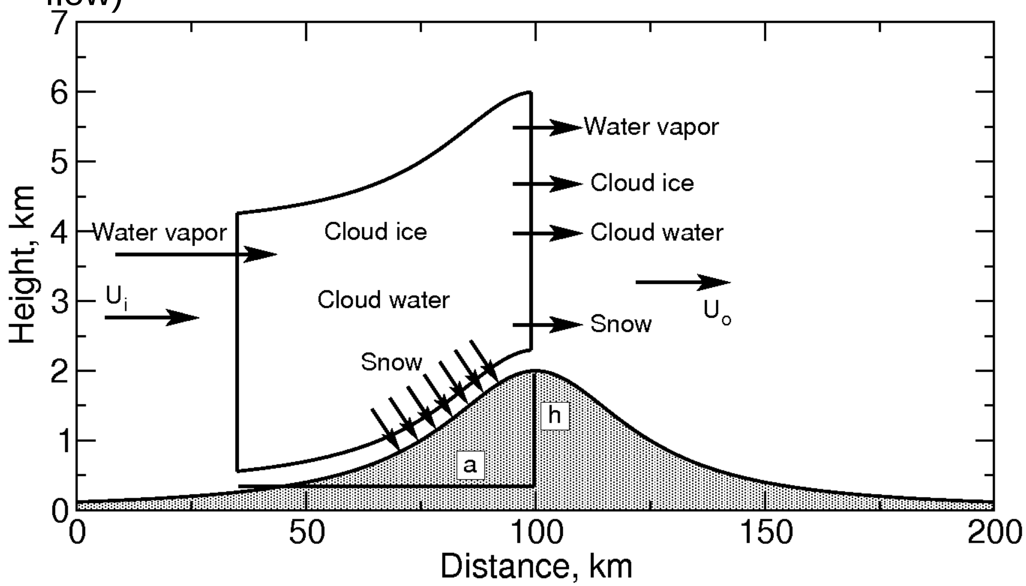
Region	Mountain		Non-mountain	
	CSAT*	DPR	CSAT*	DPR
South America	50.4	26.6	10.8	15.6
North America	192.	36.1	282.	53.6
Africa	0.35	1.35	0.04	0.77
Eurasia	138.	32.6	102.	31.2

*CloudSat values adapted from Daloz et al., (2020, TC)

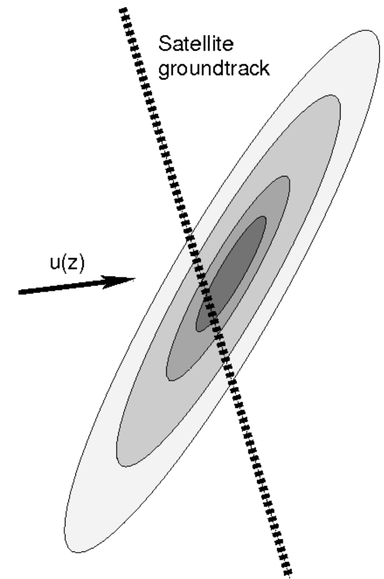


B. Process analyses

Simple process models (from Jiang and Smith, 2003, JAS, as applied to modeled, idealized terrain and flow)

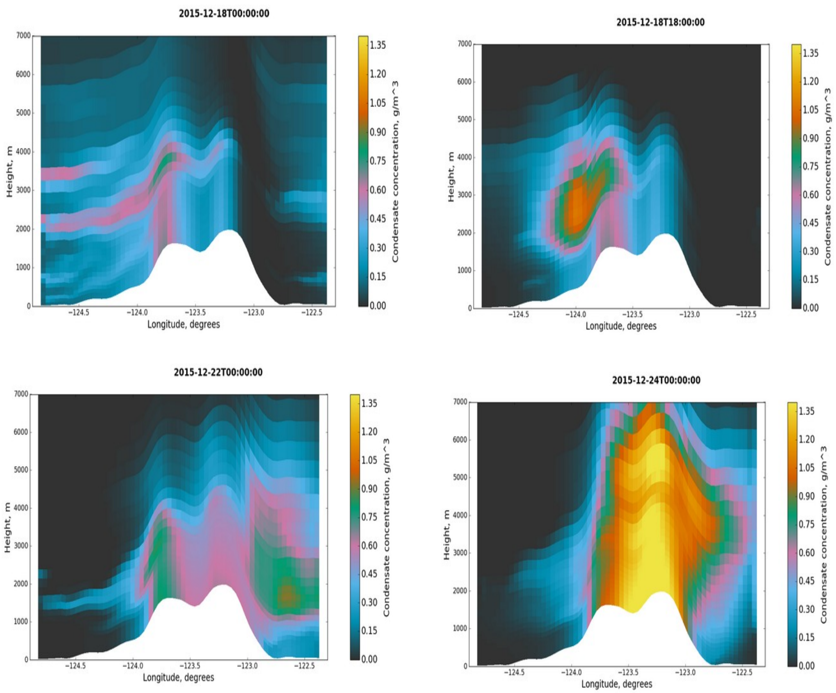


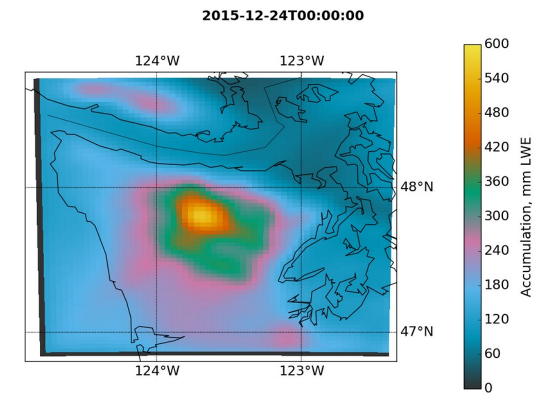
Real observations introduce irregularities: spatial variations in terrain and flow, not steady-state conditions, possibly poor orientation of ground track over terrain.

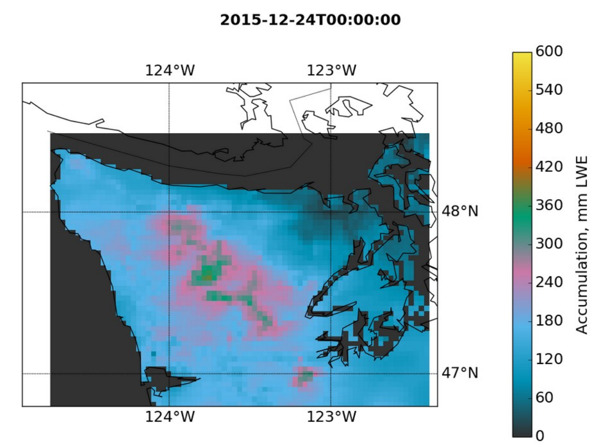


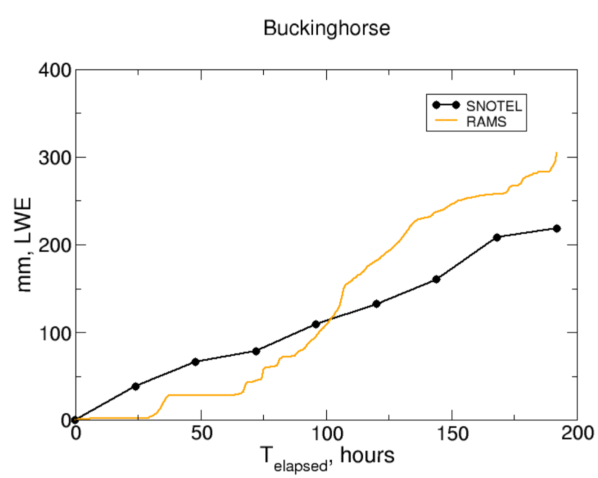
Uncertainty analyses

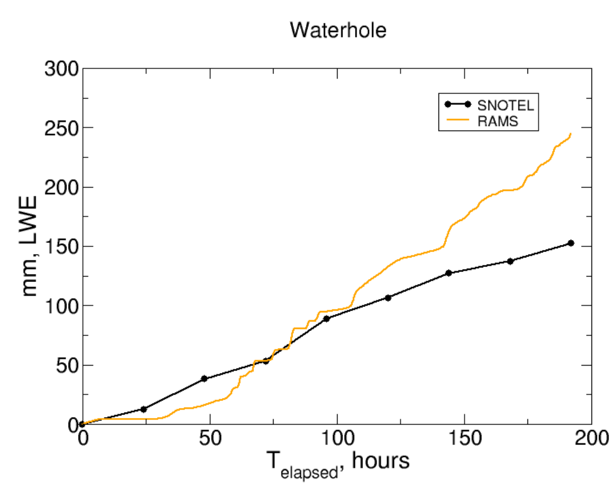
CSU RAMS simulation for 17-24 Dec 2015 for the Olympic Peninsula





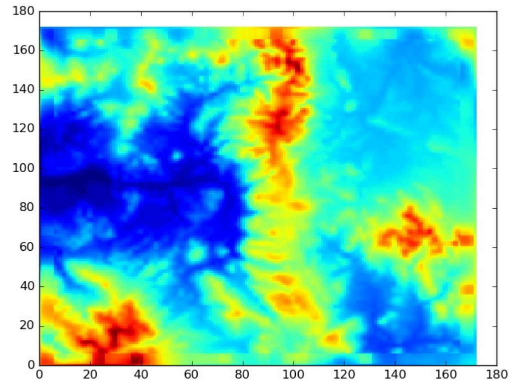


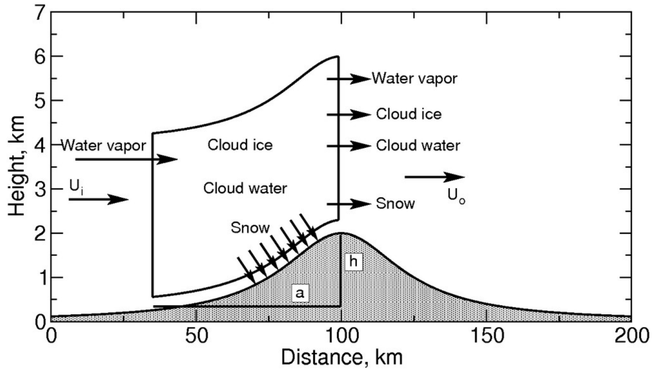




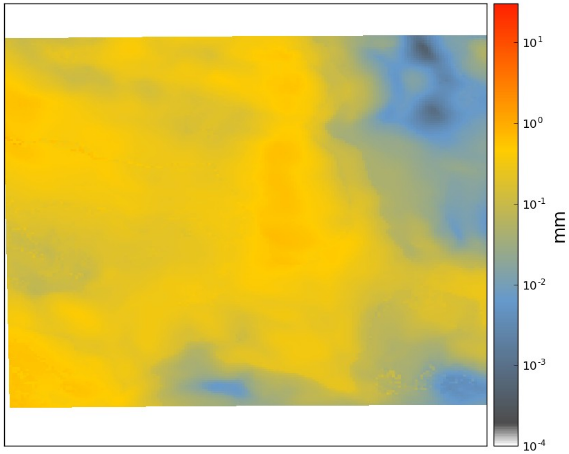
Uncertainty analyses

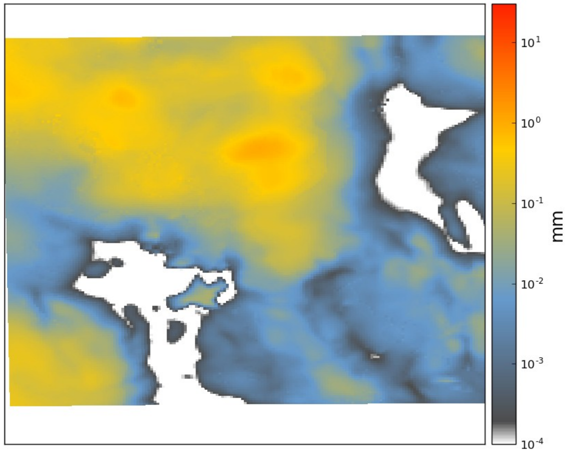
RAMS simulation for Feb 2007 Front Range snowstorm with QuickBeam



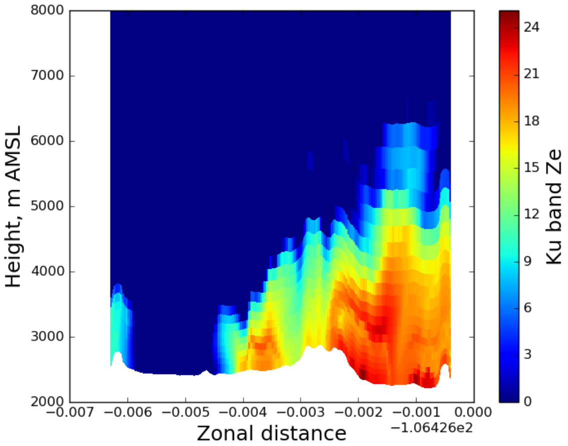


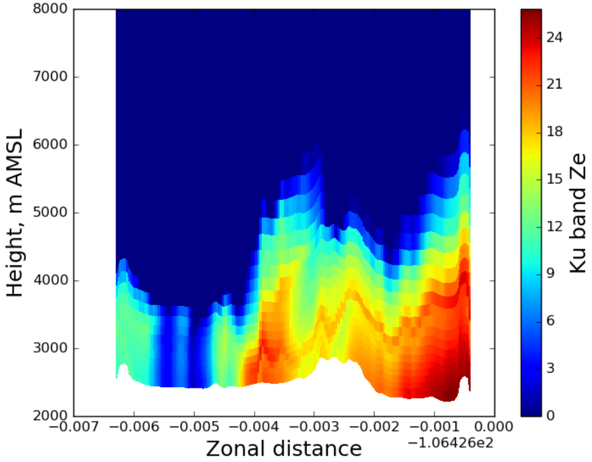
Timestep surface accumulations





QuickBeam Ku-band simulations





Summary and Plans

Summary:

- A DPR-terrain collocations dataset supports quantifying DPR mountain snowfall, identifying and compositing distinct events.
- Substantial accumulation differences versus CloudSat, but maybe complementary?
- RAMS plus Quickbeam provides a basic OSSE-like environment for examining the spaceborne radar capabilities for quantifying orographic precipitation and process properties.

Plans:

- How are event properties distributed (e. g. intensities versus terrain gradient and along-flow position)?   How are the distributions impacted by meteorology?
- How may DPR characteristics impact process assessments?