# Assessing Orographic Snowfall Characteristics from GV and DPR Observations

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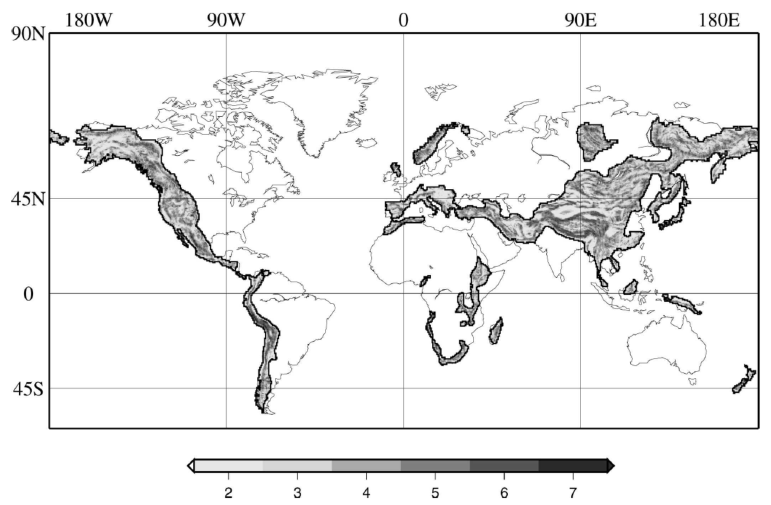
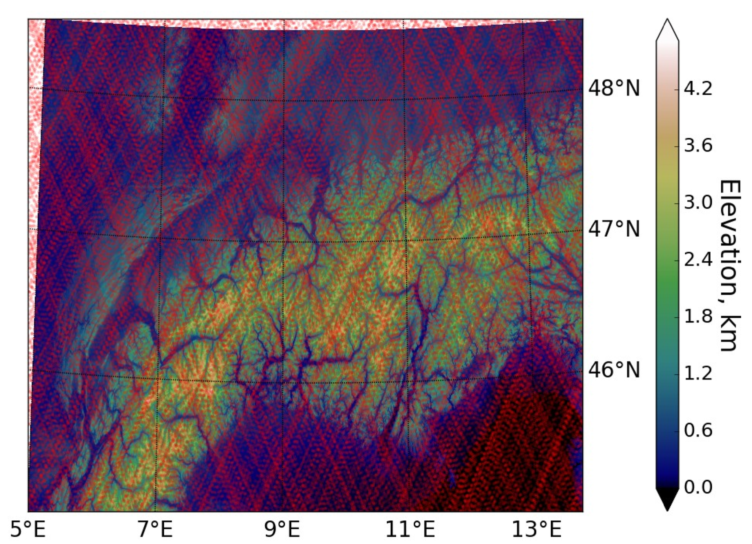
## Overview

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

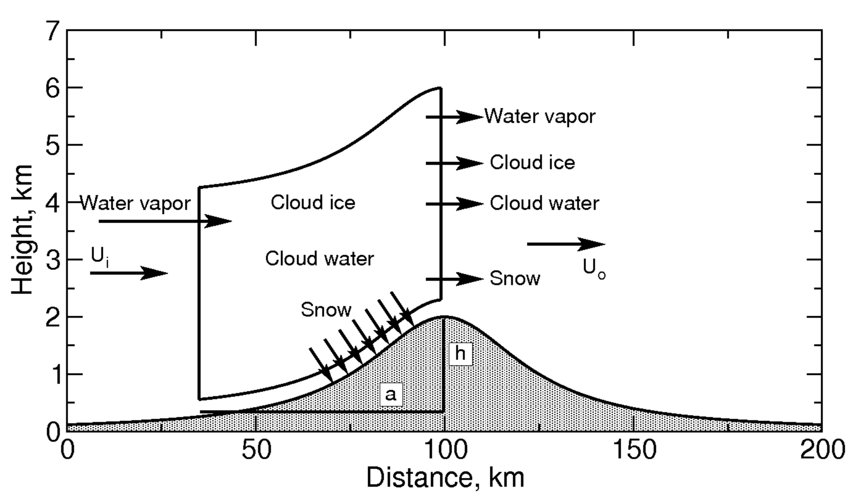
- What are the global occurrence and intensity characteristics of DPR-observed snowfall over areas subject to orographic influence?
- Can relationships between the terrain and the meteorology of the flow incident on a terrain barrier be diagnosed and generalized?
- How do the terrain and flow properties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



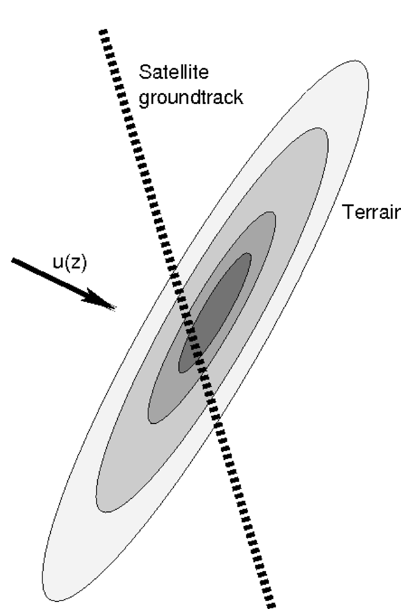

Gauge-constrained precipitation datasets suffer biases in regions of complex terrain owing significantly to biases in gauge siting and orographic effects (Adams et al. 2006, JCLI, their figure 2)




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

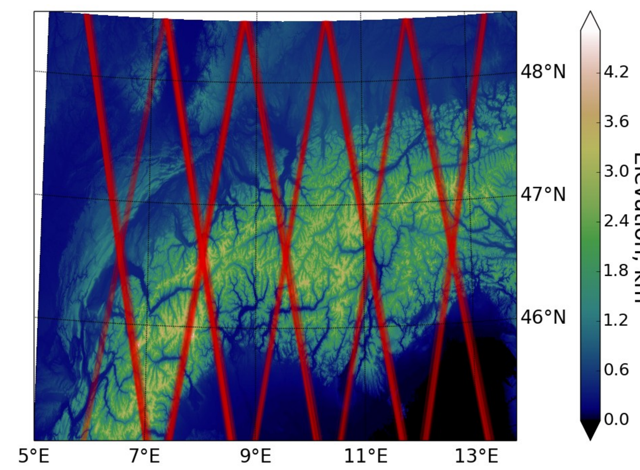



Simple process models provide a framework for examining bulk parameters: e.g. time scales for precipitation formation, transport (from Jiang and Smith, 2003, JAS, as applied to modeled, idealized terrain and flow)



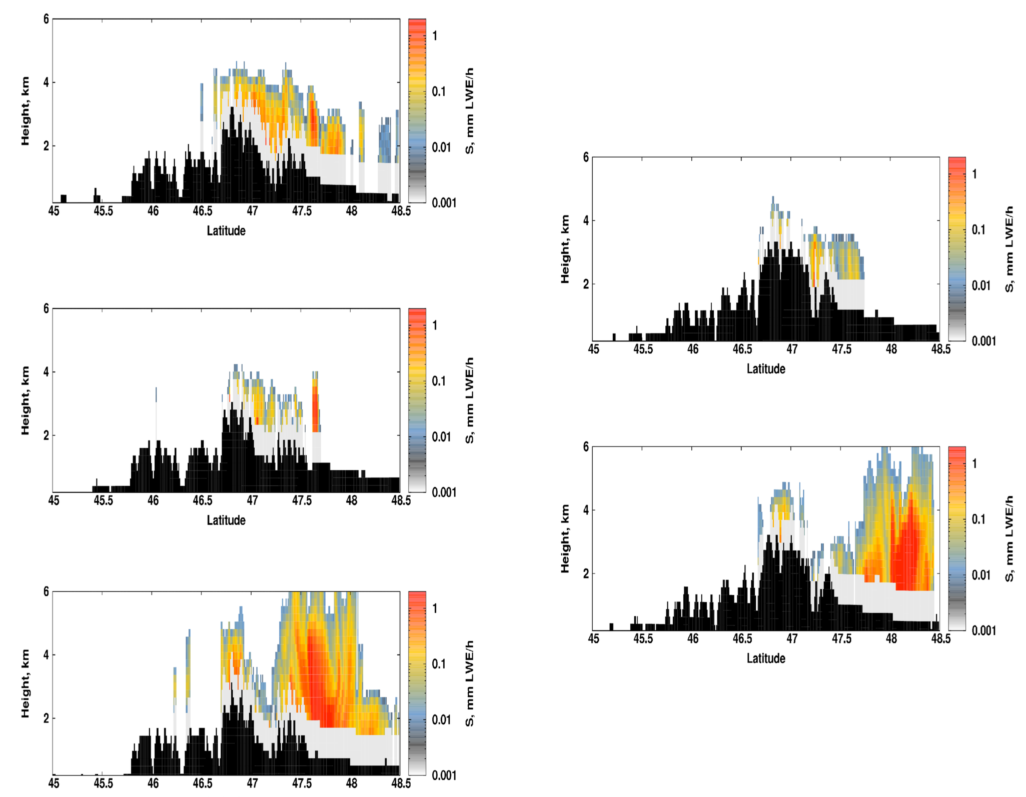

Real observations introduce irregularities: spatial variations in terrain and flow, not steady-state conditions, possibly poor orientation of ground track over terrain.

## Prior CloudSat-based analyses

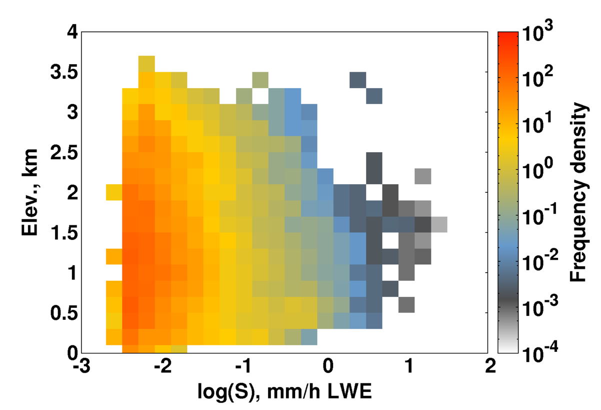



CloudSat overpasses for the Alps.
Sun synchronous orbit provides highly coincident ground tracks.

### Varied snowfall response for near-identical terrain under distinct meteorological conditions:

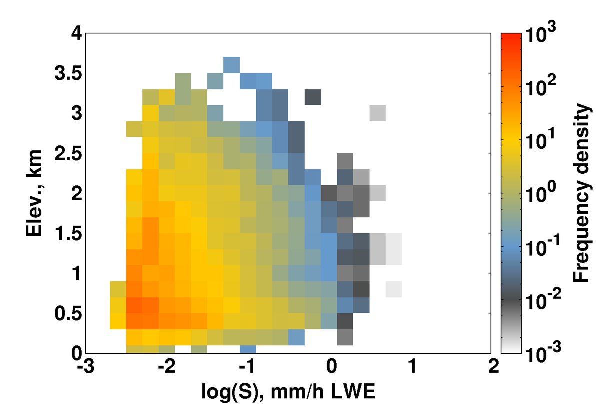


### Distinct spatial structures of snowfall for along-boundary versus cross-boundary flow:

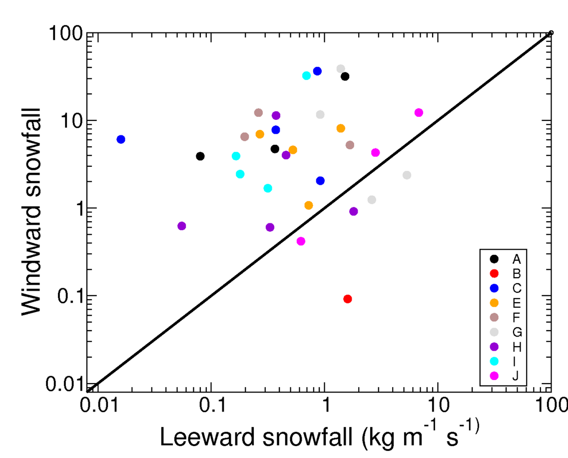



Along-boundary flow (less orographic influence)

Cross-boundary flow (more orographic influence)

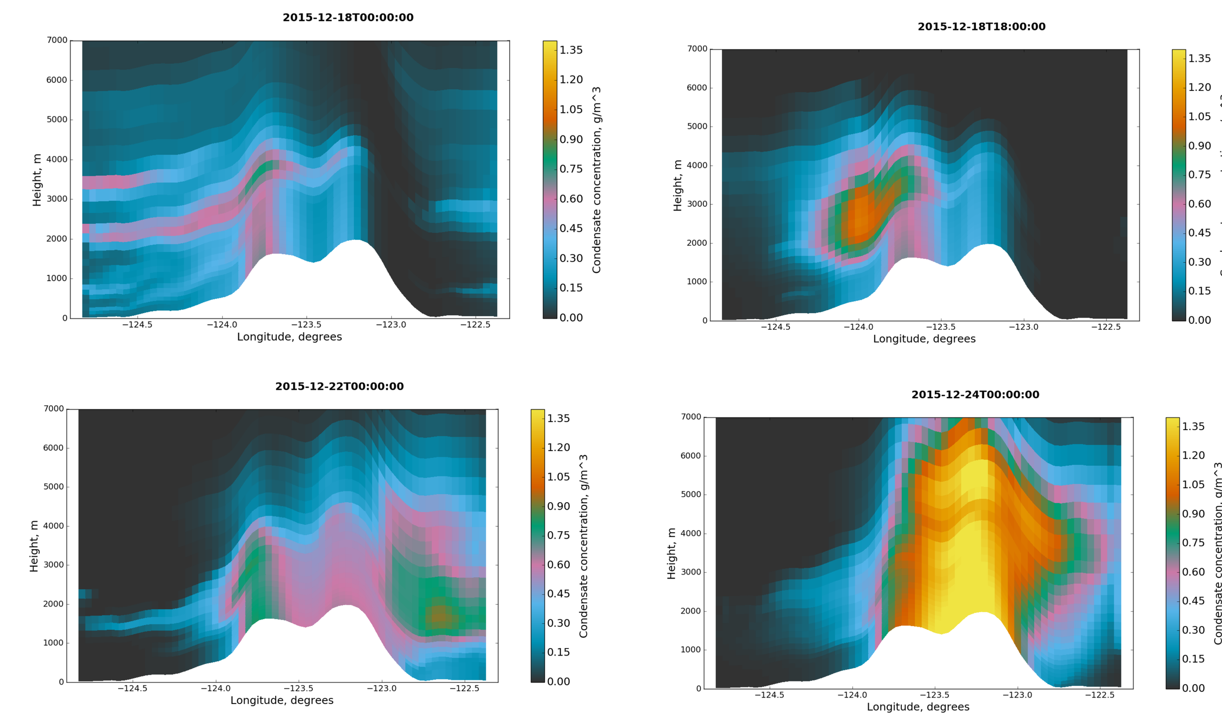



### Windward enhancement of snowfall:

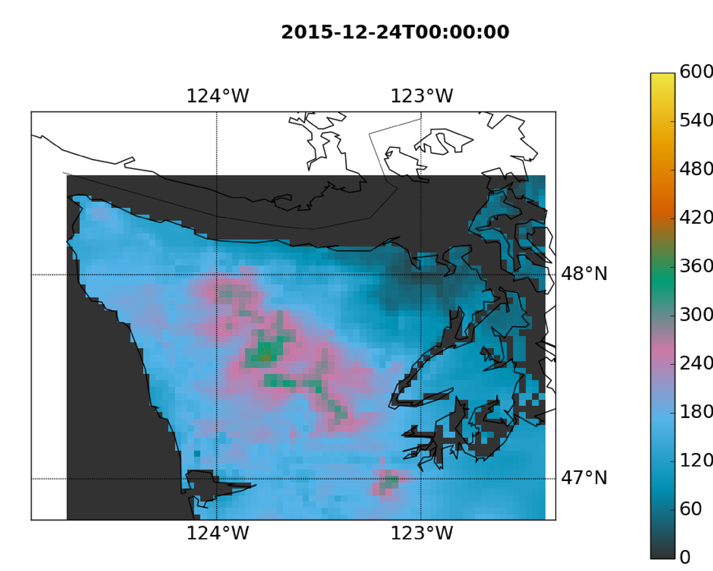



## An OLYMPEx-based test environment

**CSU RAMS simulation for 17-24 December, 2015 focused over the Olympic Peninsula.**

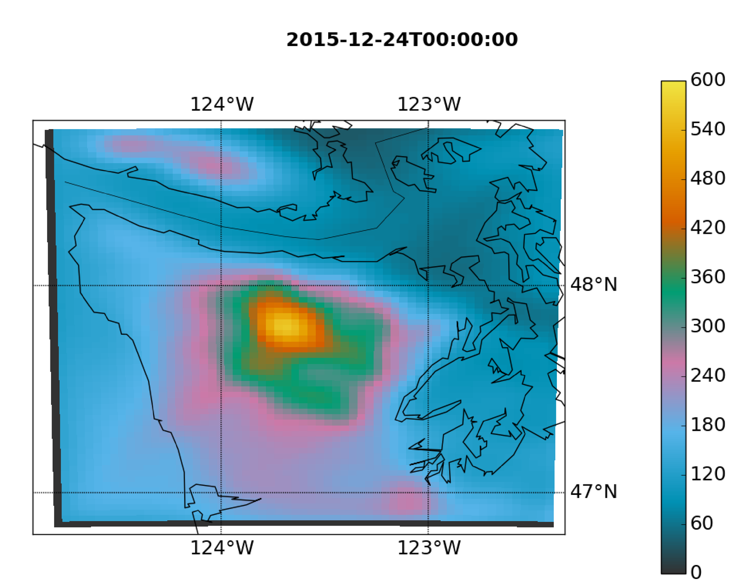



**Comparisons against accumulations from reconstructed precipitation (Cao and Lettenmaier, 2018)**

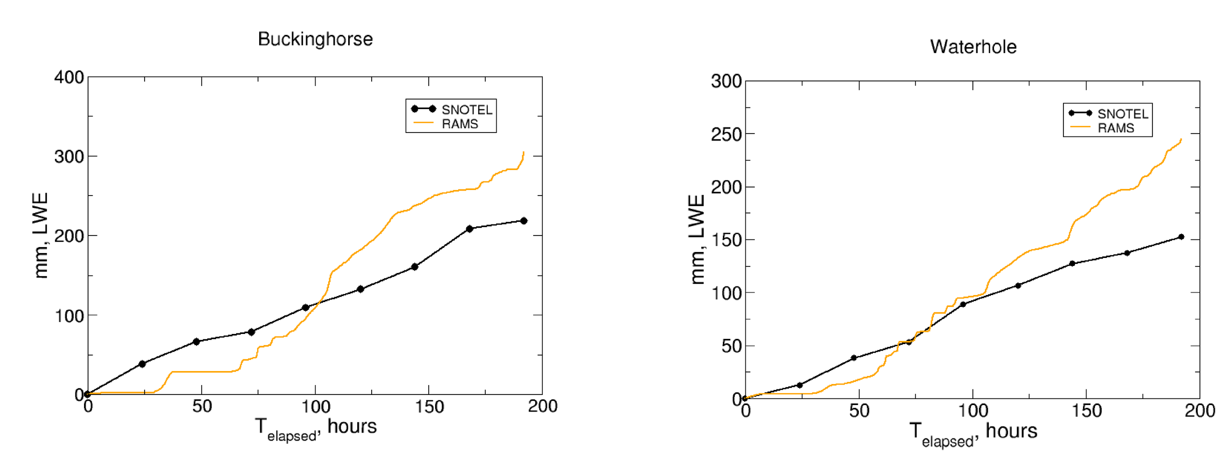



Accumulations at end of period from reconstructed precipitation

*RAMS results.* Overestimates of accumulations at end of period. Broader "bullseye" of enhanced accumulation versus above.

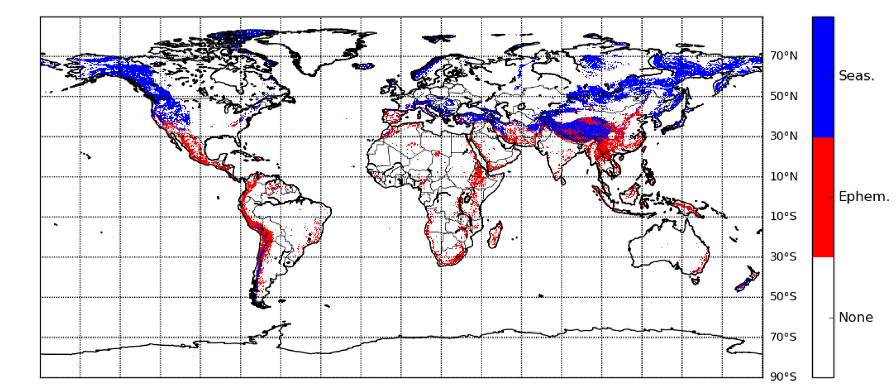



**Comparisons against SNOTEL sites near Hurricane Ridge**

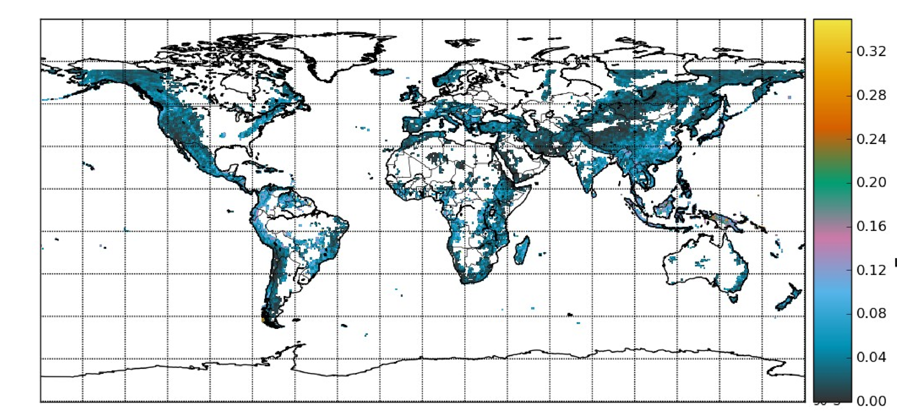



## Mapping DPR precipitation and snow occurrence to mountain locations

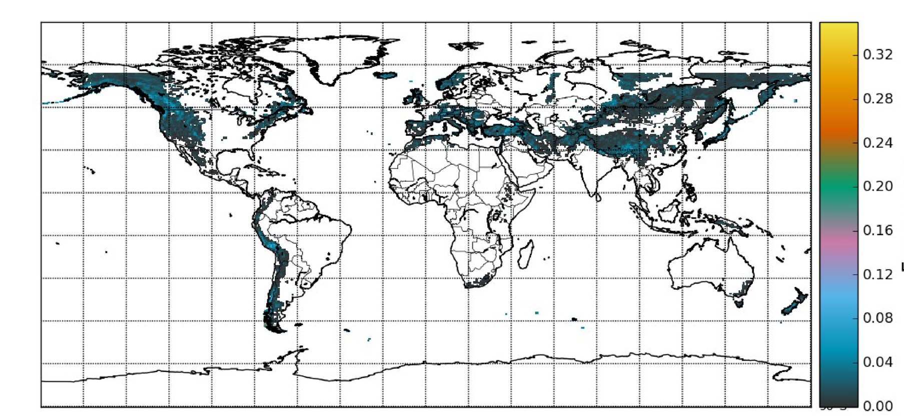
**"Mountain" locations from Wrzesien et al. (2019, WRR)**




**DPR (MS) mountain precipitation frequency**




**DPR (MS) mountain snow frequency**




## Next steps

- **The collocation of DPR detections to the "mountain" locations is the first step toward quantifying DPR's mountain snowfall, identifying distinct snowfall events, and compositing events based on terrain and incident flow properties. Objective techniques developed for evaluating characteristics of snow events observed by vertically-pointing ground-based radar will be adapted for application to the DPR observations and retrieved snowfall rates.**
- **The RAMS simulation of OLYMPEx precipitation events provides a test bed for examining the impact of "real" flow and terrain on analyses using simple 1D process models. This simulation and others (e.g., ICE-POP) will be used to assess uncertainties in the bulk process parameters derived from the process model.**

## Acknowledgments

This work was supported by the National Aeronautics and Space Administration by research grants #NNX16AE87G and #80NSSC19K0732. CloudSat-based work was performed at University of Wisconsin - Madison for the Jet Propulsion Laboratory, California Institute of Technology.

Thanks to Dr. Melissa Wrzesien, University of North Carolina - Chapel Hill, for sharing the mountain snow mask dataset.

## Contact

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