From the Ground to Space: An Analysis of Satellite Solid Precipitation Estimates based on Multi-technique Ground Observations

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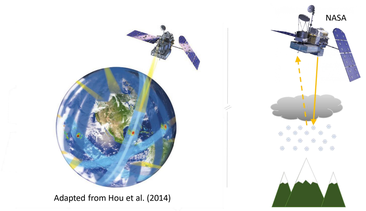
Background

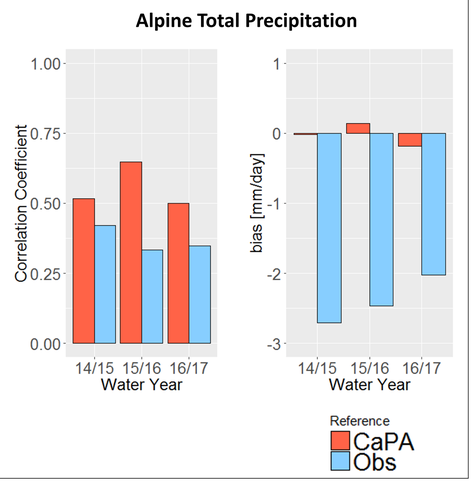
GPM background

- The Global Precipitation Measurement (GPM) is a satellite mission with the goal of measuring precipitation from space.
- GPM has a core satellite with active and passive microwave (PM) sensors, but also relies on the retrieval of PM and infrared sensors onboard other satellites.
- The algorithm that combines all these observations is called Integrated Multi-satellitE Retrievals for GPM (IMERG).
- This algorithm generates a 30 min precipitation estimate that is corrected based on radar retrievals from the GPM core satellite.



Uncertainties on the IMERG Algorithm

- The IMERG algorithm is well developed to estimate liquid precipitation on flat terrain.
- However, there are still improvements that needs to be made for estimates in mountainous terrain, especially for solid precipitation.
- Correlations are low and biases are still high in the mountain terrain of Marmot Creek Research Basin, Canadian Rockies, AB.

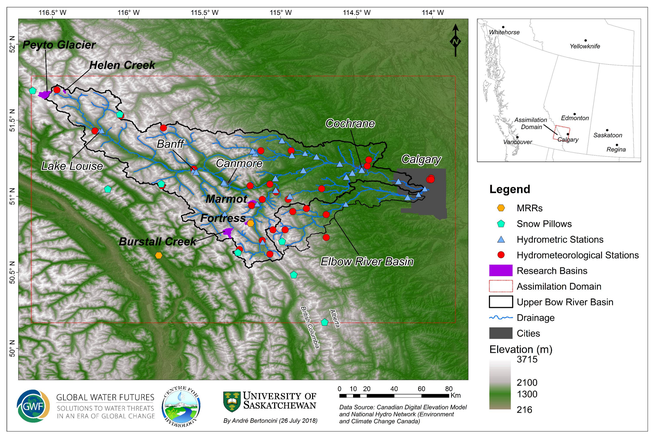


Objective

- This study aims to analyze GPM reflectivity retrievals using Micro Rain Radars (MRR) and a network of ground-based precipitation gauges and disdrometers, located at multiple elevations.

Study Domain and Period

- The study domain includes the Bow River Basin at Calgary.
- The study period is comprised from March 26, 2019, to present (ongoing research).
- The period is coincident with Global Water Future's Storms Across the Continental Divide Experiment (SPADE), whose observations are also used in this research.



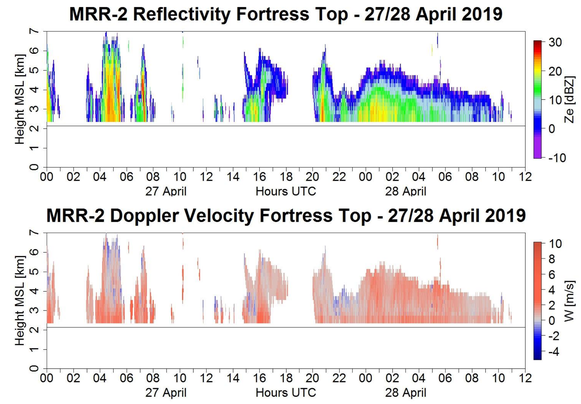
Methods

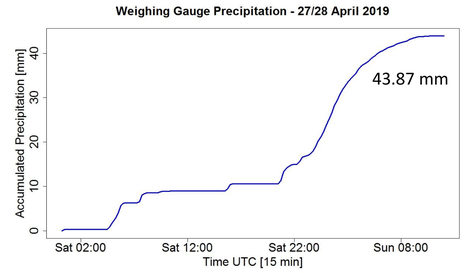
- Collocated GPM and MRR reflectivity profiles were searched during the study period. There are four MRRs available for analysis at different sites. MRR data were processed following Maahn and Kolias (2012).
- Three Parsivel optical disdrometers measured particle sizes near the surface in order to retrieve precipitation phase, particle size distribution, terminal fall velocity and snowfall or rainfall rate.
- Five Geonor and five OTT Pluvio weighing precipitation gauges measured precipitation accumulation along a transect from the western to eastern slopes of the Canadian Rockies. Snowfall was corrected for undercatch following Smith (2007).
- As part of the SPADE project, falling snow crystals were observed every 10 minutes during the storms.

Preliminary Results

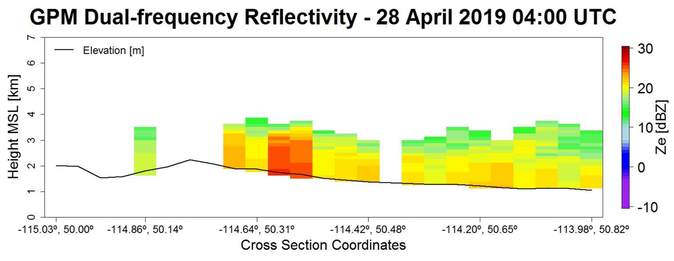
Anatomy of a Spring Snowstorm in the Canadian Rockies (April 27-28)

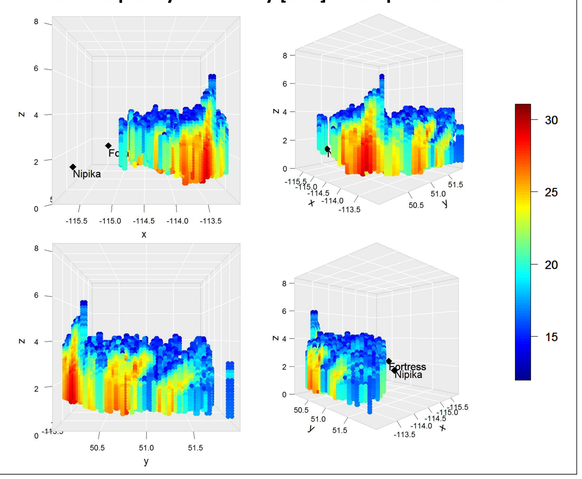
-From the Ground





-From Space





Conclusions and Outlook

- To this date, no GPM and MRR collocated profiles were found at a representative GPM pixel.
- However, a preliminary assessment (April 27-28 snowstorm) within the study domain shows that GPM radar retrievals are capable of providing useful information on the structure of snowstorms.
- This analysis sheds light on the biases of satellite solid precipitation estimates and suggests solutions for correcting these observations.

Acknowledgments

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References

Maahn, M., & Kollias, P. (2012). Improved Micro Rain Radar snow measurements using Doppler spectra post-processing. *Atmospheric Measurement Techniques*, 5(11), 2661–2673. https://doi.org/10.5194/amt-5-2661-2012

Smith, C. D. (2007). Correcting the wind bias in snowfall measurements made with a Geonor T-200B precipitation gauge and Alter wind shield. In *Proceedings of the 14th SMOI, San Antonio, 2007* (p. 6).