

Airborne SnowSAR data at X- and Ku- bands over boreal forest, alpine and tundra snow cover

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Overall Recommendation: Major revision.

General Statement

This paper well describes historical deployments of SnowSAR at X- and Ku- band for airborne active microwave observations for SWE retrieval from remote sensing.

1. While worthwhile to archive the past applications of the airborne SnowSAR deployments, it would be desirable to point out lessons learned from expensive airborne campaign along with in-situ snow and weather observations on the ground. Please refer to point-by-point conclusions in the past literature similar to:

Mätzler, Christian, and Erwin Schanda. "Snow mapping with active microwave sensors." *Remote Sensing* 5.2 (1984): 409-422.

Matzler, Christian, Erwin Schanda, and Walter Good. "Towards the definition of optimum sensor specifications for microwave remote sensing of snow." *IEEE Transactions on Geoscience and Remote Sensing* 1 (1982): 57-66.

Foster, J. L., et al. "Derivation of snow water equivalent in boreal forests using microwave radiometry." *Arctic* (1991): 147-152.

2. Another limitation is in a lack of contributions from snow hydrology models such as SNOWPACK and CROCUS. Please include how applications of the snow hydrology model can support SWE retrieval algorithm of using SnowSAR, i.e. microwave volume scattering approach.
3. Another note could be made with in-situ observations not limited to snowpit measurements but including ground-based remote sensing measurements. Recently, state-of-art ground technologies have been proposed including Specific Surface Area, Tomography Scanning of snow microstructure, and ground-based remote sensing measurements. I think an inclusion of the recent development of field and laboratory technologies would make synergy with airborne SnowSAR observations toward SWE retrieval algorithms.
4. While this paper is aimed at summarizing SnowSAR airborne observations, it would be useful to indicate a brief future planning how to use SnowSAR to retrieve SWE at the end. For example, 'background scattering' is quite well known, and the paper also summarizes the lower boundary scattering. A paragraph or a diagram would benefit the audience to understand how the SnowSAR observations and ancillary dataset will be utilized for SWE retrieval.

Minor issue

1. *In abstract and line 55*: ‘dual polarized (VV/VH) → dual polarized (VV, VH, HV, and HH). Is there any physical reason only using VV, VH, and HV, not HH? If so, please provide this in the beginning.
2. ‘operable from a small aircraft’ → ‘operated by various sizes of aircrafts’. It was deployed by P3 back in 2017 at NASA SnowEx
3. Any reference for ‘In Canada, the TVCEX campaign took place in March and April 2013, with two flight campaigns over sites in the Trail Valley Creek (TVC) watershed, Northwest Territories, representative of the tundra snow regime.’? I found Di Leo, D., et al. "Radiometric calibration of the SnowSAR images of sub-arctic open tundra watershed in Canada." (2015): 7-7.
4. Figure 1 Caption: ‘Location of weather station’ → ‘Location of weather station, ground-based remote sensing, and in-situ snowpit observations’ to be complete
5. Figure 1 north and south: the left panel may be 90 degree counter clockwise rotation to satisfy the right panel. Try to be physically correct the aerial photo along with vegetation map. It will help the retrieval algorithm to account for vegetation effect on microwave volume scattering.
6. Figure 4: It is excellent to see flight occurrences such as M00 to M10. It may be helpful to move y-axis of air temperature up not to avoid to see SWE evolution.
7. Line 235: ‘17 March 2011 (M00)’ → It is helpful to have local time to interpret a diurnal status of snowpack during a daytime.
8. ‘SnowSAR mission T1, T2’ also needs local time, not the UTC.
9. Specify which frequency and polarization in Figure 3 and 10.
10. Figure 1, 2, etc: Please consider ‘google map™’ embedded format.
11. Spatial distribution of snowpit observations: For a microwave forward modeling perspective, locations of snowpits are essential to be compared with SnowSAR. I think a map of spatial distribution of snowpits is prerequisite at least for one or two campaigns.