

The Cryosphere Discuss., referee comment RC1  
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## Comment on tc-2021-295

Anonymous Referee #1

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Referee comment on "Review article: Global monitoring of snow water equivalent using high-frequency radar remote sensing" by Leung Tsang et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-295-RC1>, 2021

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The paper is a very thorough review of the remote sensing methodology for assessing water equivalent in the seasonal snow pack. The primary focus is on technique which utilize X to Ku band radars. There is a detailed discussion of theory concerning scattering from the evolving snow grains, scattering from rough interfaces, the effects of vegetation and complications from snow wetness. In situ and airborne data are used to illustrate generally good agreement between theory and observations.

The paper includes discussion of different retrieval algorithms and their limitations. Suggestions for improving retrievals by augmenting with other data sets (such as passive microwave) as well as incorporation of other radar techniques (such as tomography and InSAR) are included.

The paper concludes with a discussion of two recently proposed satellite missions. Of the two, the Canadian TSSM-Explorer is an early stage of development.

I think this is a useful, stand alone review of current progress in using radar to measure snow water equivalent. The scientific justification and the rationale for high resolution radar (as opposed to solely passive microwave techniques from space) are well justified. One quibble I have is the short statement at the end of section 3.1.1. There, the authors briefly mention the role of layering in the snow pack on backscatter. Given the efforts by several of the authors on the impact of layering, I am surprised that there was not more discussion of a point that could present a problem for thick snow packs and well into the winter season when layering might be expected to develop.

More generally, papers of this sort often set up the scientific and engineering arguments for a satellite mission. Because TSSM seems to be moving along, it is not clear to me whether the paper is designed to influence development beyond the completed Phase 0

study. If so, then the point might be emphasized with a discussion of recommended mission and instrument requirements. If not, then the paper loses some of its justification in my opinion.