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The Cryosphere Discussions

Interactive comment on "Retrieval of the thickness of undeformed sea ice from C-band compact polarimetric SAR images" *by* X. Zhang et al.

Anonymous Referee #3

Received and published: 22 November 2015

General comments:

The authors present a theoretical and experimental analysis of a new CP-ratio derived from compact polarimetry data, based on simulated data using RADARSAT-2 polarimetric data. The paper is well-reasoned and the experimental evidence supports the theoretical examination. This is a significant contribution well-suited to The Cryosphere.

A general concern is that the influence of the snow cover is not taken into account for the thermodynamic and scattering models, and it is ignored in the experimental data. There are additional items that need to be addressed prior to publication; these are outlined below.

Detailed comments:

P5446, L9: Change "Sea of Labrador" to "Labrador Sea".

P5448, L11: The following paper (recently accepted) should be included:

Geldsetzer, T., M. Arkett, T. Zagon, F. Charbonneau, J.J. Yackel and R. Scharien, (2015). All season compact-polarimetry SAR observations of sea ice. Canadian Journal of Remote Sensing.

P5452, L2: Is "CC" missing in Eq.9.

P5454, L20: In Figure 3, the snow cover is missing, or ignored. Please see comment for P5459, L9, below.

P5456, L14: Why is 5.3 Ghz used instead of the 5.405 Ghz of RADARSAT-2?

P5456, L28: Perhaps include the following paper to support the change near 4 cm thickness:

Isleifson, D., Hwang, B., Barber, D. G., Scharien, R. K., & Shafai, L. (2010). C-band polarimetric backscattering signatures of newly formed sea ice during fall freeze-up. Geoscience and Remote Sensing, IEEE Transactions on, 48(8), 3256-3267.

P5459, L9: On first-year sea ice the snow cover (even < 20 cm) can have significant salinity (due to brine wicking), resulting in brine volumes large enough to influence backscatter (Barber and Nghiem, 1999; Galley et al., 2009). Therefore, the snow cover cannot be ignored. The snow salinity is usually greatest in the bottom 2 to 8 cm, likely creating a dielectric interface within the snow. This should be discussed as a possible source of error with respect to GPR measurements, in that the snow thickness may be underestimated; and thus ice thickness may be overestimated. The dielectric properties of the snow will also affect refraction, which will impact the incidence angle with regards to SPM modeled values for the sea ice surface. Please comment on how the above factors may, or may not, affect the overall results.

Barber, D. G., & Nghiem, S. V. (1999). The role of snow on the thermal dependence of microwave backscatter over sea ice. Journal of Geophysical Research: Oceans (1978–2012), 104(C11), 25789-25803.

Galley, R. J., Trachtenberg, M., Langlois, A., Barber, D. G., & Shafai, L. (2009). Observations of geophysical and dielectric properties and ground penetrating radar signatures for discrimination of snow, sea ice and freshwater ice thickness. Cold Regions Science and Technology, 57(1), 29-38.

P5460, L8: In the CIS ice charts for March 19 and 20, 2011, there is no multi-year ice in the areas covered by the RADARSAT-2 scenes. Therefore, the thicker ice measurements require additional and/or different explanations.

Interactive comment on The Cryosphere Discuss., 9, 5445, 2015.