To the editor and reviewer 3:
We have revised the paper to address the main issues raised by the reviewers, as well as to include minor modifications of the authors. In the following list, we first address the major issues that are of importance in general, then we refer to the issues raised by reviewer 2. The major revisions of this paper including 4 parts:

(1) We reorganized Section 1 "Introduction". We emphasized the significance of retrieving the sea ice thickness distribution from CP SAR both in the ice services and sea ice forecasting. And an overview of the differences between dual-, quad- and compact-polarimetric modes was provided.
(2) In section 3 "Simulation", we carefully discuss the effect of snow layer, and we used real scenario roughness parameters to evaluate the rough surface scattering contribution now.
(3) For data process in Section 4.2, the processing chains were described detailed. The procedure of ice drift correction was provided. The method of segmentation level and deformed ice was modified, the new processing chain can exclude deformed ice, and the ice thickness values > 2.2 m has been passed.
(4) The limitations (including snow layer and environment conditions) and outlook of our method was descried and discussed.
Detailed response to the reviewers' comments is below. Reviewers' comments are in italic immediately followed by our response.

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.
In this version, we present a discussion about the influence of the snow layer both in the section describing our simulations and in the section concerning the experimental results.

Detailed comments
P5446, L9: Change "Sea of Labrador" to "Labrador Sea".
Done.

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.

Is now included.

P5452, L2: Is "CC" missing in Eq.9.
No, it is used for shorten the expressions for cc and c2

P5454, L20: In Figure 3, the snow cover is missing, or ignored. Please see comment for P5459, L9, below.
The issue of a snow cover is now considered in the text (see our answers below).

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

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.
We did not include this reference, since it reports on two measurements of the co-polarization correlation coefficients observed at ice thicknesses < 6cm and > 8 cm which unfortunately does not fit into the context of our analysis provided here.

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.
We discussed the effects of the snow cover mentioned by the reviewer at the end of Section 3.2 and included the references. In Section 4.2 we list the measured air temperatures, which are low. Considering that heavy snow falls took place shortly before the radar measurements, and that temperatures were below -7℃ between snow fall and image acquisition, we assume that we can ignore any brine wicking effects. However, we do not have any information about elder snow layers.

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.

Because of the new processing chain and the careful separation of level and deformed ice, we did not obtain ice thickness values > 2.2 m for the profile data that passed the thresholds in the processing chain. Hence we can exclude the presence of MY ice along our profiles.