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Interactive comment on "Measuring the specific surface area of wet snow using 1310 nm reflectance" *by* J.-C. Gallet et al.

Anonymous Referee #2

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The authors reported on the measured results of the specific surface area (SSA) of wet snow using the technique for SSA measurement of dry snow (DUFISSS). They compared the SSA of snow under wet condition and that under the frozen condition and concluded that liquid water has little effect on the measured SSA. They also indicated the limitations of the present optical models in predicting wet snow reflection. Their topic is challenging, but has scientific significance; that is, the establishment of a method to measure the SSA of wet snow will contribute greatly to advancing our understanding of wet snow. Therefore, I think it is worthy of publication in The Cryosphere. However, the current version leaves room for improvement to clarify ambiguous explanations before publication. Below I give my specific editorial comments and suggestions for improvements that enable better understanding of the arguments in the manuscript.

Specific editorial comments

1. Add to the discussion the possibility of structural change due to freezing.

How long does it take to freeze wet snow completely under the experimental condition (-2.2 °C)? There was no information in the present text. I would guess several hours are needed to freeze the sample completely under the experimental conditions, and if this is the case, some metamorphism, such as grain growth, should occur. Have you estimated how much change in grain size occurs because of water in the snow under the experimental conditions? These discussions will support the authors' assumption that any detectable change in structure can be attributed to.

2. Evidence that the estimation formula in DUFISSS can be applied to estimate the SSA of wet snow structure.

Wet snow usually has a clustered structure with aggreegation of several grains, and its structure should be quite different from that of dry snow. On the other hand, the formula for estimating the SSA from the reflectance in DUFISSS is based on dry snow. I would guess that the SSA estimation formula based on the reflectance should depend on the grain structure characterristics. Thus, I wonder whether the formula in DUFISSS can be applied to the wet snow structure. If the authors have any evidence, such as comparison results of the SSA of frozen snow (it should have the same structure as wet snow) calculated using DUFISSS and that using another method (e.g. the BET method, or x-ray method), I recommened that they add a discussion of the validity of applying the estimation formula in DUFISSS to a wet snow structure; these discussions will support the authors' arguments.

3. Explanation of introduction of Eq. (8)

Eq. (8) is a key equation, but I could not understand how it was derived from Eqs. (4) and (5). Please add a more detailed explanation to ensure that Eq. (8) can be derived by the readers themselves.

4. How the SSA changes with water in snow

The initial information on the SSA value that was measured before wetting will help readers to understand the effect of water in snow on the change in the SSA value. Thus, if the authors measured these data, I recommend adding them in a table and discussing them.

Suggestions for improvements:

P5257 L16: Here, “per mass” should be “per volume”. Please check the definition of the liquid water content in Nolin and Dozier (2000).

P5257 L18: Is the value of 26% small enough to neglect?

P5264 L17: I think the assumption that grains are independent of each other could be problematic, in particular when the liquid water content is high. Please discuss the validation of this assumption more detail.

Table 1: Does “density “ refer to “dry density” or “wet density”? Please clarify the definition of density.

Interactive comment on The Cryosphere Discuss., 7, 5255, 2013.