

Interactive comment on “Retrieval of snow albedo and grain size using reflectance measurements in Himalayan basin” by H. S. Negi and A. Kokhanovsky

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Reply to Referee 1:

General comments:

1. Grammar and turn of phrase need improvement to ease readability - clearly this is a technical paper but it needs to be edited further to improve its presentation, especially in the sections that bookend the technical mathematical description of the model.

Reply: The English grammar will be taken care in the final revised paper. The option of editing will be used with final submission. So that English grammar will also be checked

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by a professional copy editor.

Specific comments:

1. P2339 (section 1 - introduction) The authors imply that snowfall during the winter melts during the summer. While this is undoubtedly true for much of the snow, not all the winter snowfall melts since much of it remains as perennial especially at high altitude.

Reply: Yes, the sentence will be modified in final revised paper.

2. P2339. The authors describe the three different zones for the Himalayan mountains. On what data/study are these zones based? It would be useful to include a map demonstrating the spatial extend of these regions.

Reply: The three different zones for the Himalayan mountains are described based on the study carried out by Sharma and Ganju, Cold Regions Sci. Tech., 31, 95-102, 2000, using snow-meteorological data of 25 years from different field observatories over western Himalaya and terrain conditions. The map of these regions will be included in final revised paper.

3. P2339: The authors discuss the need to estimate grain size, and, indeed, the paper explores substantively grain size estimates. But, they also need to state that they seek to estimate surface grain size only (this work does not seek to estimate vertical variations of snow grain size in the pack).

Reply: Yes, we have estimated the surface snow grain size only. At the same time two wavelength channels $1.05\mu\text{m}$ and $1.24\mu\text{m}$ were used to retrieve snow grains, these retrieved grain size depends on radiation penetration depth, which is wavelength dependent (Bourdelle and Fily, Ann. Glaciol., 17, 86-92, 1993; Li et al., Geophys. Res. Lett., 28, 1699-1702, 2001). Ideally for homogenous snow pack the retrieved snow grains should be same using both the wavelength and if we get the variations in snow grains this we can call as vertical homogeneity in the snow pack. However, the re-

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trieval of vertical variations of snow grain size in the pack is influenced by the unknown deposition of soot and dust layers inside the snow and also by buried crust layers. Therefore, the task is not an easy one. Currently, we are developing the technique for the determination of snow vertical grain size variation from nadir observations with the aim to apply the algorithm to satellite data. On the ground, the pit work and near infrared photography of snow walls is more important because deeper snow layers can be accessed and analyzed.

4. P2340. The authors need to explain fully why the locations for sampling were chosen - what significance did these sites have? And why were the locations different?

Reply: All the experiments were carried out at three different locations of Beas basin in Lower Himalaya. This provides ample opportunity to see the variations in snow grain size and albedo in a short span of time due to its temperate climatic conditions, which changes snow cover very fast. In addition, in these locations Snow and Avalanche Study Establishment (SASE) has its snow-meteorological observatories at location-1 (lat.32°16'21"N , long.77°10'58"E, 2039m), location-2 (lat.32°19'03"N, long.77°09'20"E, 2480m) and location-3 (lat.32°21'18"N, long.77°07'35"E, 3050m). The snow-meteorological parameters collected at these locations are helpful in the investigations. The experiments were conducted in different time and different places (i.e. locations 1 and 2) to study the different types of seasonal snow. The broadband albedo could not be collected on these dates and locations as shown in Table 1, due to instrument unavailability. Therefore broadband albedo measurements were carried out with spectroradiometer experiments at location-3 and comparison shown separately by Fig.6.

5. P2340 On line 12-13, the authors state that "the experiments were carried out within 5-10 minutes to minimize the atmospheric effect on snowpack". within 5-10 minutes of what? This does not make sense.

Reply: One set of observations of reflectance followed by spectral albedo measure-

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ment using spectroradiometer was carried out in 5-10minutes. This shows that the time difference between the ART retrieved albedo using the measured reflectance and directly observed spectral albedo was very small, such that the illumination conditions and atmospheric conditions can be assumed unaltered.

6. P2340 The grain size measurement protocol needs to be fully explained. How many grains? What about surface crust features (wind blown etc)?

Reply: For grain size measurement, grain samples were selected from 3-4 places nearby the experimental area and average maximum grain diameter were measured using crystal gauge with magnifying hand lens. In the present study experiments were not conducted on surface crust snow. Wind activity is also not extreme in study areas, as max recorded wind speed was found between 2-3m/s. Therefore no experiments performed on wind blown and sastrugi type snow cover.

7. P2341 At end of the introduction, a map should be included of the study location.

Reply: The map of Western Himalaya comprising different snow climatic zones will be included with marked study locations in the revised paper.

Interactive comment on The Cryosphere Discuss., 4, 2337, 2010.

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