The Cryosphere Discuss.,
doi:10.5194/tc-2016-266-RC1, 2016

The Cryosphere Discussions
Open Access
EGU

Interactive comment on "*In situ* continuous visible and near-infrared spectroscopy of an alpine snowpack" *by* Marie Dumont et al.

Anonymous Referee #1

Received and published: 22 December 2016

Review of

Marie Dumont, Laurent Arnaud, Ghislain Picard, Quentin Libois, Yves Lejeune, Pierre Nabat, Didier Voisin, and Samuel Morin. In situ continuous visible and near-infrared spectroscopy of an alpine snowpack; submitted to The Cryosphere Discuss., doi:10.5194/tc-2016-266, 2016

General comments:

This paper provides a very sound study on the determinations of several snow surface proprieties such as snow specific surface area (SSA), effective light-absorbing impurities content and presence of liquid water, based on spectral albedo measurements. The authors well describe the Methods and theoretical framework for analyzing the aforementioned effects depending on snow albedo. The paper also builds up on re-

cent studies in this field (e.g. Picard et al.). The methodological framework of handling the albedo data is quite elaborated including atmospheric model outputs and using several assumptions. I assume that these methodological framework is constructed to investigate the relationship between snow albedo and the snow cover proprieties.

To my opinion, the authors should analyze and present a bit more of the raw albedo data in order to explain the methods used. For me it is unclear why the authors are estimating the ratio of the diffuse and direct irradiance. To my knowledge, the albedo is defined as the ratio of the incoming and reflected global radiation. Both are affected by either direct sunlight or anisotropic reflectance depending on solar zenith angle (and cosine error of the entrance optics etc.). I assume that the authors take into account theses effects by using atmospheric model outputs and the methods describes in the paper.

However, it would be very useful and maybe simpler, to analyze the diurnal course of the snow albedo depending on solar zenith angle (SZA), when a minor change of the snow surface proprieties can be assumed. Most likely the spectral albedo shows a dependence on SZA – also depending on the wavelength selected, however, this dependency should be similar for all days of the season. If such a relationship can be found, all data of the days can be normalized to a reference SZA and then used for the comparison with the specific snow surface proprieties such as snow specific surface area (SSA), effective light-absorbing impurities content and presence of liquid water. This is in particular important for days with partly direct sun impact and partly cloudy in order to select either only direct sun albedo or cloud covered albedo. In this respect, it would be very useful the show the diurnal course of fully cloud albedo and to compare these effects with direct sun albedo. Due to this method, all SZA depending effects (e.g. cosine error of the entrance optics, slope of the surface) may be removed, which may allow to find a clearer signal between snow cover proprieties and spectral albedo.

In summary: I suggest to analyze and present some data of daily albedo depending on SZA and different cloud conditions and to discuss shortly these effects in regard

of SSA, LWC and impurities just based on the measurements before presenting the analysis including model calculations.

The submitted paper is well written and organized and the methods and data are fully described. The paper can be published with minor revision requested.

Specific comments:

Section 2.1: Some more details about the spectral albedo measurements are needed: - What is the height above snow surface of the two entrance optics, was the height constant over the season? Or was the height changing with growing snow cover? What would be the effect of the different hights. - What is the effect when the entrance optics where changes (from up to down and vice versa)? Was that tested? This would give a hint of the expected uncertainty of the albedo measurement, including all effects such a cosine error. - Spectral resolution of 3 nm: Do you mean the spectral bandwidth or the spectral sampling rate? - Are the domes heated?

Page 4, line 4: (iv) correction of the angular response: How did this correction applied. Was the correction applied for both entrance optics? Are the entrance optics similar in respect of the cosine error?

Page 6, line 18; Can the reflected radiation on snow be assumed as isotropic. Is there any reference for this assumption? Most likely the reflected radiation also shows a dependency on SZA.

Page 7: line 6. Maybe there is a strong dependence of the scaling factor depending on SZA. Was this analyzed? Maybe this explains the distribution of the scaling factor A in Figure 3.

Smaller issues:

The abstract basically describes the intention and results of the study – no changes.

The text is well written and no major typos have been detected so far..

Interactive comment on The Cryosphere Discuss., doi:10.5194/tc-2016-266, 2016.