Thank you for your helpful comments and for taking the time to point out options to improve our manuscript.

We have revised the manuscript following both reviewers' suggestions. In the following, we reply (in standard font) to your comments (cited in italics).

This manuscript is acceptable after some revision. I would strongly recommend stating the goals of the work more explicitly up front. A paragraph at the end introduction would go a long way to addressing this. Tying these observations and retrievals together at the beginning of the paper will help the reader through the rest of the work. That comment and other more minor comments are below.

The first reviewer had comments to the same effect, and the introduction has been modified accordingly.

Page 2 : Line 4 Remove the second "and"

Fixed.

Page 2 : Line 4 Can I assume that both instruments are pointing in the nadir? If so, reword this sentence to reflect that fact.

Yes, the sentence has been adjusted:

> The cloud optical thickness and the droplet effective radius are retrieved from spectral radiance data in nadir and from hyperspectral radiances in a 40° field of view around nadir.

Page 2 : Line 10 Time delays aren't the only problem. The in-situ observations won't get the profile at the instant that the remote sensing observation is being made.

That is true, and discussed later on (also see similar comments by the first reviewer). The one in situ profile we have from this flight indicates a more or less constant effective radius at least in the upper half of the cloud, so for this case this problem seems to be minor, although one profile cannot be generalised to the entire cloud. The lack of profiles is added to the abstract as suggested:

> The comparison to in-situ data cannot give a definite answer as to which method is better because of unavoidable time delays between the in-situ

> measurements and the remote-sensing observations, and due to the scarcity of in situ profiles within the cloud.

Page 2 : Line 14 I don't think "However" is quite the right word here.

Deleted.

Page 3 : Line 1 I'd swap the order of "and climate change is particularly strong" and the first point the boundary layer clouds. It will flow a little better with the clause "as shown by..." hanging off the end.

Fixed:

> This is of particular interest in the Arctic where climate change is particularly strong and boundary-layer clouds greatly influence the surface radiation budget, as shown by Shupe and Intrieri (2004) from ground-based remote-sensing observations.

Page 4 : Line 2-3 I would add a paragraph at this point discussing the specific goals of the work and this paper. The transition feels a bit abrupt to me. I don't believe the manuscript addressed why you were applying both the 2-wl and 5-wl methods. I would use the introduction to do this. You can also tie in the use of these results to the hyperspectral image retrievals.

The introduction has been expanded to better specify the goals of the paper in the context of the general process that is currently being made in the scientific community in this field, and to better outline the procedure taken in this manuscript.

Page 4 : Line 7 Was this really meant to be a new paragraph? I don't think it should be. This happens again on Page 5:Line 3.

Fixed in both cases.

Page 5 : Line 5 Delete "own"

Fixed.

Page 8 : Line 16 ...in the form...

Fixed.

1Page 8 : Line 21 When you say "a significantly lower retrieval", I think you mean a lower frequency of these low tau values (or something to that effect, yes?).

Yes, correct. The sentence has been re-worded:

> One choice, r_eff^{4}, leads to a significantly lower frequency of such low values of optical thicknesses, ...

Page 11 : Line 5-6 Similar to my comment before in the abstract, the time delay is only part of the problem. With two aircraft you're still only going to get the size information at 1 level in the cloud.

During straight legs, that is true. The in situ aircraft would, however, insert profile flights at regular intervals to observe the vertical structure of the cloud and the vertical dependence of the cloud particle microphysics. The closure procedure would of course focus on locations at which the aircraft actually was near cloud top. During our previous Arctic campaigns we usually had good cases with extensive cloud covers sufficiently often, so we are optimistic that the logistics of flying on such a mission are no obstacle to the scientific objective. The corresponding section in the Conclusions has been re-worded to reflect this more specifically:

> Fundamental limitations are the time delay between remote sensing and in-situ observations and the vertical variability of the microphysics within the cloud. Only with simultaneous collocated measurements above and inside the cloud (with two aircraft) can this limitation be overcome and can closure between the different methods be attempted. The aircraft within the cloud would alternate between profiling (to capture the general vertical structure of the cloud) and flight legs near cloud top for closure purposes. A measurement campaign to this purpose is currently being prepared.

Page 12 : Line 22 I would again recommend adding the goals of the work to the introduction and then incorporating that theme here at the beginning of the conclusions to tie them together. It will help the overall flow.

A more general introduction has been added to the 'Conclusions':

> We have shown that airborne measurements of the spectral nadir radiance can be successfully combined with imaging spectrometry to retrieve the

cloud optical thickness as a two-dimensional field as wide as the field of view (40°). Besides the geometric expansion of the available data, we also work towards a better exploitation of the spectral information contained in our measurements. The classic retrieval approach makes use of merely two wavelengths. In this paper we have compared that to a five-wavelength algorithm, while parallel works by Coddington et al. (2012) and King and Vaughan (2012) point out that the full spectral information can ultimately be exploited in optimized retrievals. This present paper takes two steps: (1) applying retrievals that use two and five wavelengths to nadir measurements of spectral radiance to retrieve cloud optical thickness and effective radius; and (2) extending the geometric coverage for optical thickness to a 40° field of view by incorporating imaging spectroscopy (hyperspectral imaging) into the algorithm. Step (2) lacks a retrieval of effective radius due to limited spectral coverage of the imaging spectrometer.

Figure 2 I would list in the caption the wavelengths where the red crosses are marked rather saying "exemplary wavelengths".

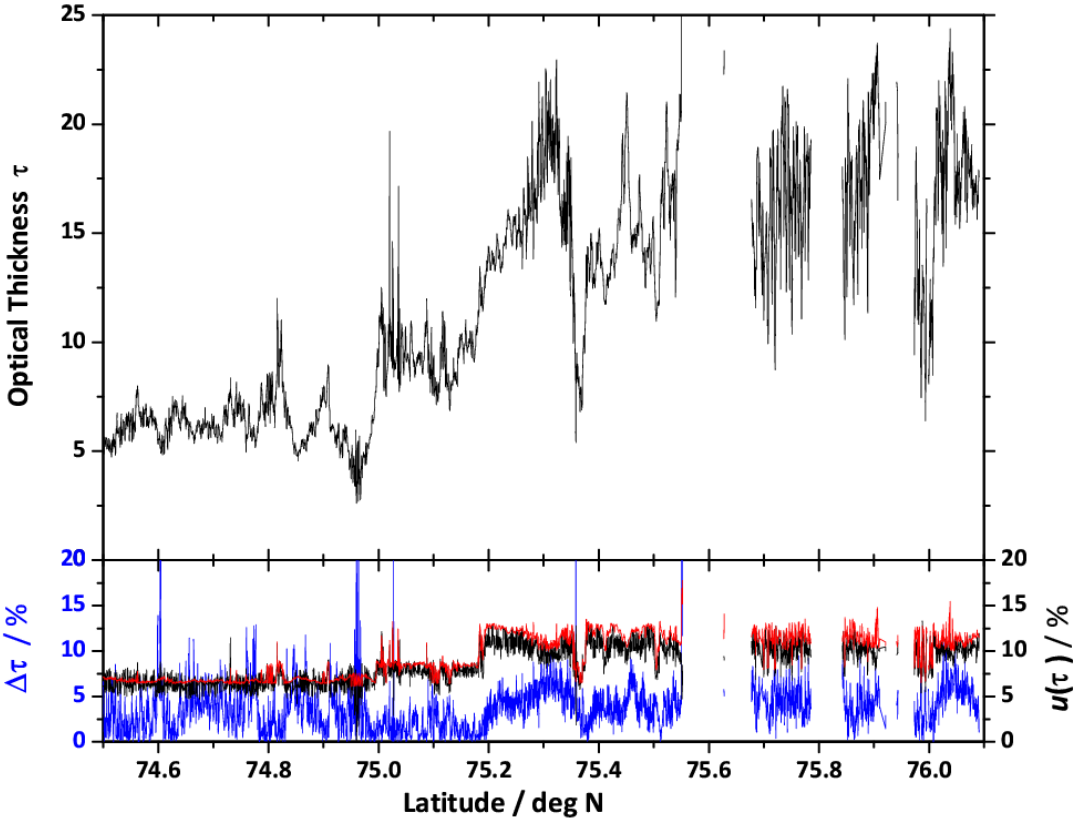
"Exemplary wavelengths" has been replaced by "exemplary data points", as all data in this figure are in fact at the same wavelength.

Figure 4 It may be helpful to state explicitly that the aircraft was heading South (assuming that I've interpreted it correctly).

During the remote-sensing leg at 3000 m altitude, the aircraft was heading south. The in situ leg was flown on the way back, heading north. The track is explained better now.

Figure 5 With the optical thickness changing a factor of 4 or 5, it would be better to show the change in optical thickness as a percentage.

Fixed:


Optical Thickness τ
25
20
15
10
5
Δτ / %
20
15
10
5
0
u(τ) / %
20
15
10
5
0
74.6
74.8
75.0
75.2
75.4
75.6
75.8
76.0
Latitude / deg N