We are grateful to all reviewers for the valuable comments and constructive suggestions, which helped us to improve the paper. We feel that the reviewer's remarks have been addressed properly in the revised version of the paper. Please find our reply (red color) point by point below.

Reviewer #1

The "fractional sky cover" is a measure of "hemispherical" cloud amount (p. 717, line 8) which is never formally defined.
Done (page 2, second paragraph, lines 2-3 from the top).

…it appears that the technique is relevant to only a very small subset of clouds.
Application of the suggested technique is relevant to different types of clouds. The corresponding statements are added (page 5, first paragraph).

...are you sure you want to call it a "well-established method" in p. 721, line 15?).
This retrieval (Long et al., 2006) has limitations/uncertainties. However, it is applied and cited widely. Thus, we believe that term "well-established" is appropriate.

…calling Nsw a "reference" data set is somewhat misleading. It is a comparison set that helps you check for consistency, not accuracy.
Agree. Word "reference" is deleted from the text (previous section 3, and summary) and clarification is added (page 7, second paragraph, line 9 from the top).

If the ARSCL "cloud fraction" represents a physically different observable than "sky cover" then why compare the two in Fig. 3?
Clarification is added (page 6, lines 3-7 from the top).

And if it is appropriate to compare the two, why not do it all the time?
Such comparison is performed for days when all observations (ARSCL, TSI, broadband radiometer and MFRSR) are available (Fig.6 in the revised version).

The abstract and p.721 line 11 mention that the method can be applied to "different cloud types". Which cloud types beyond shallow cumulus can it be applied to?
Example is added (page 4, lines 2-3 from the bottom)

Fig. 1a and line p. 718, line 12: What "optical depth" is this meant to show? Aerosol only? Aerosol contaminated by cloud? It needs to be clarified.
This is total optical depth (COD + AOD). Term "total" is added (page 6, second paragraph, line 3 from the bottom).

– p. 719, line 12: Would have been nice to give some more info on the radiative transfer model. If this has been documented before please provide the reference.
Done (page 3, second paragraph, line 8 from the top).

– p. 719, line p.15: Is only the total (vertically-integrated) AOD need to be input in the radiative transfer calculations? Are the SSA (acronym should be expanded) and asymmetry factor assumed vertically invariant?
Term "vertically-integrated" is added (page 3, second paragraph, line 4 from the bottom). Acronym SSA is expanded (page 1, second paragraph, line 4 from the top).

– A few small things: p. 716, line 16: Berg et al., 2011; p. 717, line 25-26 delete “the ARSCL”; p. 718, line 19 delete “the” before “transmittance”; p. 719, lines 1-2 “are more than double their morning: : :”; p. 720, line 8 use “total solar irradiance” instead of “solar constant”; p. 721, line 7 delete “The” before “Eq. (3)”; p. 722, line 9 delete “the” before “most”; p. 722, line 14 and Fig. 4 caption “8 other”; p. 722, line 29 and p. 723 line 4 “mid-altitude” instead of “middle-latitude”. Done.

Reviewer #2

p.717 l.10 : Revision of the sentence beginning with "The estimation of N.." is needed.

Done.

It would be interesting to see comparisons to the transmittance ratio method by Min et al. (2008). Are there situations where you prefer one method over the other?

The main objective of this paper is to illustrate the estimation of sky cover using our method for complicated situations when (1) clouds with limited spatial extent (e.g., cumuli) occur, and (2) substantial temporal changes of aerosol optical properties are observed. Since the transmittance ratio method is not designed for such situations (please see Section 2, first paragraph), the comparison is not performed.

I wouldn't consider the comparison to N_sw as validation with totally independent data, since it is based on a similar observation principle.

Agree. Word "reference" is deleted from the text (previous section 3, and summary) and clarification is added (page 7, second paragraph, line 9 from the top).

Reviewer #3

An adequate division into chapters, e.g. method, instruments and data for comparison, results, conclusions) would make it easier for the reader to understand the value and significance of the results.
As recommended, the text is re-organized. The revised version has 5 sections instead of 4 sections in the original version.

The cloud algorithm has been applied to data of 13 days only. Therefore, the results presented may not represent the natural variability of atmospheric conditions at the site.
You are right. We plan to repeat such study for extended time periods and different sites (page 10, second paragraph, lines 1-3 from the bottom).

Moreover, if no data of atmospheric optical depth are available close to the cloud decision time due to lasting overcast conditions, a reasonable estimate of clear sky irradiance difference is needed.
The corresponding statement is added (page 5, lines 9-13 from the top).

Under conditions of high variability of cloud cover and/or fast changes in aerosol optical depths, the cloud algorithm may become problematic. This issue should be addressed to what extent it may affect the results.
To illustrate this issue, we considered day (July 16, 2007) with large changes of sky cover (e.g., from 0.1 to 1.0 and from 1.0 to 0.0 within 4 hours) and AOD (from 0.1 to 0.35 within 9 hours). Even for this day, the suggested retrieval works reasonably well (Fig.5).

Page 717, line 15: The performance of the cloud algorithm is illustrated for days with typical aerosol loading. What will be the result of the cloud algorithms, if the optical characteristics of atmospheric aerosols differ from the climatological means?
Page 719, line 13: If there are longer periods during which no aerosol information can
be derived, what input data are used for the cloud algorithm?
A new section, which discusses potential impact of different factors on the retrieval performance, is added (page 5, first paragraph).

… "Spectral changes of the solar constant " Do you mean changes in extraterrestrial spectral irradiance?
Yes. "solar constant" is replaced by "extraterrestrial spectral irradiance" (page 2, lines 4-5 from the bottom).

Solar zenith angle should provide a large contribution to the changes in the difference of spectral irradiance F(500) – F(415), but it is not mentioned.
Solar zenith angle is added (page 4, second paragraph, line 2 from the bottom).

Page 721, line8: Does the normalization procedure work at all solar zenith angles?
We applied the normalization for all data with different values of solar zenith angle SZA:
$(0.2 < \cos(SZA) < 0.9)$.

Page 723, line 8: It is said that both NVIS and NSW represent a hemispherical measure of cloud amount, which is quite sensitive to a cloud location within the hemispherical field of view (FOV). Is that statement not contradicting to what has been said on page 718, line 5, that the TSI has a hemispherical FOV and provides hemispherical sky images for a large area neighboring the ACRF site?

We do not understand this comment completely. Perhaps, the following statement would address the reviewer's concern. Instruments with hemispherical FOV provide hemispherical sky images and a cloud located in the center of image contributes mostly to the sky cover. Opposite is true for a cloud located near the image edge.

Page 725, line 2, Better specify what 'majority of cases means'. It can be any value greater than 50%.
Done (page 10, second paragraph, line 5 from the bottom)

Page 725, line 2 and 10: It is said that the method can be applied for estimation of fractional sky cover for different cloud types, including cumulus and optically thin clouds with small horizontal size such as shallow cumulus clouds. Are other optically thin clouds such as Cirrus, which is of high importance, also included? It does not become really clear to the reader, for what type of clouds the methods is applicable and how the algorithm will recognize the right cloud type that is detectable by that method.
A new section discusses this issue (page 5, first paragraph).