Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-123-RC1, 2016

Atmospheric Measurement Techniques Discussions
Open Access
EGU

Interactive comment on "Ground-based imaging remote sensing of ice clouds: uncertainties caused by sensor, method and atmosphere" *by* Tobias Zinner et al.

Anonymous Referee #2

Received and published: 13 May 2016

Review of: "Ground-based imaging remote sensing of ice clouds: uncertainties caused by sensor, method and atmosphere" by Zinner et al.

1 General remarks

The manuscript provides an in-depth description and sensitivity study of ground based cirrus retrieval using transmitted solar radiance. Extensive radiative transfer simulations are used to present the retrieval approach and quantify retrieval uncertainties of

Printer-friendly version

Discussion paper

different sources. A transmittance ratio in the visible part of the solar spectrum is used to overcome the ambiguity between transmissivity and cloud optical thickness. The method is applied to measurements of the hyperspectral line imager specMACS for two case studies. The results are compared with satellite retrieval of cloud properties.

The application of cloud transmissivity retrieval to spectral solar imager observations is a potential tool for future investigation of clouds with high spatial resolution. Especially high resolution fields of cloud particle size may help to understand microphysical processes in cirrus. In this regard, the manuscript provides an important contribution to current and future research and is worth to be published.

However, in my opinion the manuscript lacks of three major issues which have to be reassessed in detail before publishing the manuscript. First, existing similar methods have not been discussed appropriately in the manuscript. Second the authors did not apply the latest improvements of transmittance retrieval but rather stick to a classical approach. Additionally, the second case study was an unfortunate choice as the comparison with satellite observations is not meaningful due to contamination by low level clouds.

Below, I compiled a list of comments which have to be considered in a revised version of the paper. There might be some contradictory statements resulting from my misinterpretation of the text when first reading. I am sure the authors will know how to weight in such cases and how to improve the text to avoid misinterpretations by other readers.

2 Major comments

Existing methods have not been considered

In the manuscript some available studies have not been discussed properly. E.g., the problem discriminating the ambiguity of thin and thick cirrus clouds was already solved

by Brückner et al. (2014) who applied a similar retrieval for transmissivity measurements and also used a ratio in visible wavelength for a third coordinate in the retrieval grid separating thin and thick cirrus.

Similarly, in the sensitivity study and in the conclusions shape effects for transmissivity are discussed. Results of the sensitivity study should by compared to Schäfer et al. (2013) who did similar sensitivity studies for the retrieval of optical thickness by transmissivity in case of tropical cirrus. Additionally, Schäfer et al. (2013) present an approach to estimate ice crystal shape. This could be applied to some extend for the measurements of specMACS as well reducing the retrieval uncertainty due to the assumption of ice crystal shape.

State of art transmissivity retrievals

I wounder, why the authors do not build their retrieval algorithm on the existing improvements introduced by Brückner et al. (2014), McBRide et al. (2011), LeBlanc et al. (2015) for transmissivity retrievals? These retrieval are based on radiance ratios instead of absolute radiance/transmittance and do improve the retrieval uncertainty. This was even discussed by the authors in the conclusions. Therefore, I wounder why the authors did not apply these new methods despite knowing that they provide more precise results than the "classical" Nakajima-King approach. As all look-up tables seem to be calculated for the full spectral range given by specMACS, switching to ratios should be an easy task.

Case study 2. October

The choice of the second case study presented in the manuscript was rather unfortunate. As discussed in detail by the authors, the comparison between satellite and ground-based measurements suffers due to low level clouds contaminating the cloud retrieval of the satellite instruments. Therefore, the data sets are in general not compa-

rable in my point of view. Presenting this comparison is not meaningful and does not add any value to the manuscript. At least not for the main subject, cirrus transmittance retrieval using imaging spectrometers. So I would suggest to choose another case or at least remove the satellite comparison. Instead it might be worth to compare and discuss the differences in cloud properties and retrieval uncertainties between both cases.

3 Minor comments

P1, 7: Typo: "noise,."

P1, 12: "verification": In what way was this accomplished? Comparison with satellite data?

P1, 15: "variability": variability of what? clouds?

P2, 10: Greenhouse effect of cirrus also depends on temperature/altitude of the cirrus!

P2, 32: Airborne remote sensing might be suited better for improving satellite observations as these have at least a similar geometry. For motivation, ground-based techniques can also be considered for long term monitoring operations, e.g., ARM sites, CloudNet.

P4, 9: How many spatial pixel does one line have?

P5, 31: Typo or double negation? "does not show an unambiguous relationship" change to "does show an ambiguous relationship"

P6, 8: Emphasize that this method is well known. Not only for existing transmittance retrieval as discussed above, but also any cloud mask/cloud fraction algorithms in all sky imaging uses such ratios.

P6, Section 3.2: Section 3.2. somehow does not fit in the outline of the manuscript. It should be placed at 2.2 where already model, surface albedo and ice crystal scattering properties are introduced.

P7, 31: What about particle size? This should also affect the thresholds.

P8, 11: wording: "...unsing with respect..." please change.

P9, Section 3.5: The section is quite long and needs to be split into single paragraphs to improve the readability.

P12, 25: Give numbers for the mean values.

Figure 3: Indicate the wavelengths selected for the retrieval.

Fig 7 and 8: I would suggest to merge Fig. 7 and 8 to reduce the number of figures.

Fig 8,9,12: Increase font size of axes and labels.

Bibliography

Brückner, M., Pospichal, B., Macke, A., and Wendisch, M.: A new multispectral cloud retrieval method for ship-based solar transmissivity measurements, J. Geophys. Res. Atmos., 119, 11.338–11.354, doi:10.1002/2014JD021775, 2014.

LeBlanc, S. E., Pilewskie, P., Schmidt, K. S., and Coddington, O.: A spectral method for discriminating thermodynamic phase and retrieving cloud optical thickness and effective radius using transmitted solar radiance spectra, Atmos. Meas. Tech., 8, 1361–1383, doi:10.5194/amt-8-1361-2015, 2015.

McBride, P. J., Schmidt, K. S., Pilewskie, P., Kittelman, A. S., and Wolfe, D. E.:

A spectral method for retrieving cloud optical thickness and effective radius from surface-based transmittance measurements, Atmos. Chem. Phys., 11, 7235–7252, doi:10.5194/acp-11-7235-2011, 2011.

Schäfer, M., Bierwirth, E., Ehrlich, A., Heyner, F., and Wendisch, M.: Retrieval of cirrus optical thickness and assessment of ice crystal shape from ground-based imaging spectrometry, Atmos. Meas. Tech., 6, 1855–1868, doi:10.5194/amt-6-1855-2013, 2013.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-123, 2016.

Printer-friendly version

Discussion paper