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Atmospheric Measurement Techniques Discussions

Interactive comment on "Satellite retrieval of the liquid water fraction in tropical clouds between -20 and $-38\,^{\circ}$C" *by* D. L. Mitchell and R. P. d'Entremont

Anonymous Referee #1

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Review of "Satellite retrieval of the liquid water fraction in tropical clouds between -20 and -38°C" by D.L. Mitchell and R.P. d'Entremont Paper # AMTD 4-7657-2011

General comments:

This paper focuses on the derivation of liquid water fraction in tropical cirrus clouds from remote sensing methodology using thermal infrared channels mainly. More precisely the authors have developed a method using both measurements in the CO_2-absorption band and measurements in two split-window channels for deriving cloud top temperature and cloud emissivities independently. This remote sensing method is original in

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itself and allows revealing how cloud microphysical characteristics, which are related to the emissivities, depend on cloud temperature. The additional originality of the paper is that the author exploit this retrieved microphysics-cloud top temperature relationship to estimate cloud liquid fraction for T > -40°C. The method is applied to two cloud scenes observed by MODIS during the TC4 field campaign in 2007. The subject of this paper is appropriate to AMT journal and the principal results are clearly presented in the abstract that can be understood without reading the paper first. However some parts of the paper are not clear enough and should be better argued.

Therefore, I recommend that this paper be accepted for publication after revisions along the lines outlined below.

Specific comments:

The method for deriving cloud liquid fraction is based on the fact that βeff is constant for T<-40°C (i.e. for all-ice clouds) while βeff increases for T>-40°C. The author state that the increasing of βeff is due to the presence of liquid particles. It seems to the reviewer that this statement is mainly based on the Giraud et al. (2001) study in which only one day of coïncident POLDER-ATSR2 data is considered. The Giraud et al. results should be used with caution because (i) the POLDER instrument is not well-adapted for very thin cirrus clouds and (ii) the warm clouds analyzed in their study are probably altostratus clouds.

The authors dedicate subsection 5.1 to the question “liquid water or ice ?” They note that it is conceivable that the increase in βeff is due to small ice crystals but they show that it is very unlikely for the 5 August 2007 case study. What gives the “small ice crystals” hypothesis for the other case study ? Is it unconceivable that a small fraction of IWC is associated to very small near-spherical ice particles ? I think the authors should moderate their conlusions.

The retrieval algorithm presented in this study assumes that MODIS pixels are clear or overcast. What’s happened if pixels are partially cloudy ? The authors should briefly

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discuss that in section 5.

Section 4 relative to the algorithm description is not very clear, in particular bottom of p. 7669 and top of p. 7670. At first reading it is difficult to understand if there is one or two βt values. Maybe an additional figure showing the different threshold values should be informative.

Minor comments and technical corrections :

p.7661, l.14 : "The second term is the upwelling surface and atmospheric energy that. . .."?

p.7664, l.19-22: Please describe the dataset more deeply (year, where) here and not on page 7666.

p.7671, l.10-15 : why the authros do not evaluate their retrieval using mean diameter less than 9 microns ?

p. 7674, l.19-21 : it seems to the reviewer that the sentence beginning "Yang et al. optical. . .." is redundant with the previous one.

p. 7677, l.7-8: Not clear. Is it a result from the present study ? If not a reference would be useful.

p.7679, l.24 :Add Hu et al (2010) paper is the reference list

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/4/C2828/2012/amtd-4-C2828-2012-supplement.pdf

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