Atmos. Chem. Phys. Discuss., 8, S9990–S9992, 2008
www.atmos-chem-phys-discuss.net/8/S9990/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Physical interpretation of the spectral radiative signature in the transition zone between cloud-free and cloudy regions" *by* J. C. Chiu et al.

J. C. Chiu et al.

Received and published: 18 December 2008

Response for general comments:

Thank you very much for your comments. We agree that radiative transfer calculations for various aerosol and cloud parameters are important, which is the main focus of our future work.

Response to minor comments:

1) Added aerosol single scattering albedo information on Captions of Fig. 5.

2) Changed the last sentence of the 2nd paragraph in Section 4.1 to: "The SUM increases because aerosol scattering increases at both wavelengths. The DIF increases because the change in AOD is larger at 870 nm than at 1640 nm."

3) For this journal, all comments in open discussion and final response will be archived with this paper and accessible for all readers. Therefore, we leave derivations of Eq. (9) in this reply.

The slope of the linear relationship between SUM and DIF for a general case of $\tau_\lambda^a > 0$ is derived as follows. From Eqs. (4b) and (7), we get

$I_{870} + I_{1640} = (a_+ + c_+\tau^c) \cdot k$;

$I_{870} - I_{1640} = (a_- + c_-\tau^c) \cdot k$,

where k is a proportionality constant,

$c_+ = P_{870}^c + \varpi_{1640}^c P_{1640}^c$, and

$c_- = P_{870}^c - \varpi_{1640}^c P_{1640}^c$.

Let us define

$I_{870} + I_{1640} = x$, $I_{870} - I_{1640} = y$, and $\tau^c = t$.

Then, for $t_1 = t + \Delta t$, we have

$x_1 = [a_+ + (c_+(t + \Delta t)] \cdot k = x + \Delta x$, and

$y_1 = [a_- + (c_-(t + \Delta t)] \cdot k = y + \Delta y$,

where

$\Delta x = c_+\Delta t \cdot k$ and $\Delta y = c_-\Delta t \cdot k$. It follows from here that

slope = $\frac{\Delta y}{\Delta x} = \frac{c_-}{c_+} = \frac{P_{870}^c - \varpi_{1640}^c P_{1640}^c}{P_{870}^c + \varpi_{1640}^c P_{1640}^c}$.

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4) Revised.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 17549, 2008.

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