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Interactive comment on "Effect of smoke on the transmissivity of photosynthetically active radiation inside the canopy" *by* M. Yamasoe et al.

Anonymous Referee #2

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General comments

This paper investigates how biomass aerosols affect radiative transfer inside plant canopies as well as aerosol effects on net ecosystem exchanges of water vapor, sensible heat and CO_2. The authors have apparently obtained a very useful dataset at a unique location that could be used to answer some important questions regarding aerosol-carbon-water interactions. However the paper suffers from the following deficiencies:

1. Temporal trends in aerosol optical depth (AOD) and vegetation activities are ignored. As shown in Figure 2 of the paper, AOD decreased from the beginning to the end of

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the period used in the analysis (15 September to 15 November 2002). The authors explained that this trend in AOD was due to suppression of biomass fires caused by increased rainfall. If so, increased rainfall could have increased vegetation activities during this period. This could complicate the relationship between AOD and NEE of CO_2. More generally, if low AOD is associated with wet conditions and if wet conditions reduce vegetation water stress and enhance carbon uptake, then the diffuse radiation effect of aerosols could be underestimated.

2. Their analysis on effects of aerosols on water vapor, sensible heat and CO_2 fluxes lacks statistical power. The authors based their analyses on daily means. Because of the high frequency of cloudy conditions, there are only 9 to 10 data points for them to show any relationship between AOD and these fluxes. They also admitted that there was not even a single cloudless day. The cloud effect could not be possibly avoided by their approach. Furthermore, by using daily means, compounding effects caused by changes in solar elevation angles are neglected by the authors. I suggest that the authors should conduct their analyses on an hourly basis to avoid these problems. An example can be found in the following paper:

Gu, L., J. D. Fuentes, H. H. Shugart, R. M. Staebler, and T. A. Black, 1999. Responses of net ecosystem exchanges of carbon dioxide to changes in cloudiness: results from two North American deciduous forests, J. Geophys. Res., 104, 31421–31434.

3. It is known that diffuse radiation penetrates plant canopies better. To my knowledge, the first study that demonstrated this phenomenon is the one by Young and Smith (1983):

Young, D. R. and W. K. Smith, 1983. Effect of cloud cover on photosynthesis and transpiration in the subalpine understory species Arnica Latifolia, Ecology, 64, 681–687.

4. The authors seem to have the commonly held misconception that better penetration inside plant canopies by diffuse radiation is the reason why plant canopies use diffuse

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radiation more efficiently. In fact, the direct reason is that light is much more uniformly distributed among different leaves under diffuse radiative transfer regimes than under direct beam radiative transfer regimes. Detailed explanation is given in the Supporting Online Matter of Gu et al. (2003), which is cited by the authors.

5. The nonlinear relationship between diffuse radiation, cloud cover and NEE of CO_2 has been shown and discussed in detail in Gu et al. (1999), which is missed by this paper.

6. When atmospheric aerosol loading levels change, environmental factors (e.g. temperature, soil water etc.) that influence ecosystem respiration will likely change accordingly. This will complicate the relationship between AOD and NEE of CO_2. This factor needs to be addressed.

Minor comments:

1. Page 5916, line 18. Justify the use of the 10% criterion for classifying cloud – contaminated days.

2. Page 1917, line 26. Change 'eventually' to 'even'.

3. Page 5918, line 6. Stabilization of the atmosphere is unlikely the reason why water vapor and sensible heat fluxes decrease with increasing AOD. A more likely explanation is the decrease in available energy associated with AOD. Turbulence stabilization is only an issue during nighttime.

4. The discussion on the relationship between AOD and CO_2, water vapor and sensible heat fluxes is too strenuous, considering there are only 10 data points.

5. Figure 8 is not needed.

6. Figure 9. There is no need to show the turbulent flux not corrected for CO_2 storage.

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