

## ***Interactive comment on “Mega fire emissions in Siberia: potential supply of soluble iron from forests to the ocean” by A. Ito***

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Received and published: 13 May 2011

The author is grateful to all reviewers for their constructive comments. Below is a detailed answer to the comments.

Comment 1: Line 16 (p. 1488) Briefly summarise any validation results that might be relevant to the evaluation between the modelled and MOPITT CO.

Response: Overall, validation results based on in situ profiles between 2002 and 2007 exhibit biases of less than 1% at the surface, 700 hPa, and 100 hPa, and a bias of –5.8% at 400 hPa (Deeter et al., 2010). With respect to the retrieved total column, the observed overall bias drift is  $0.018 \pm 0.005 \times 10^{18}$  (molecules  $\text{cm}^{-2} \text{ yr}^{-1}$ ).

Comment 2: Line 17-20 (p 1490): My interpretation here is that the distinction between  
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ground layer and aboveground forest fires is based on the duration of the active fire detections. Do aboveground fires burn for just 1 day and ground layer fires burn for 2-8 days or do ground layer fires burn for >8 days and aboveground 1-8 days? What is the basis for these temporal durations?

Response: Surface fires of aboveground fuels usually last for several days, but MODIS may not capture all smoldering fires in part because of their low temperature. Thus the aboveground (ground-layer) fuels are assumed to burn for 1 day (1–8 days) from the initial date of the fire which is determined by the daily fire count data.

Comment 3: Line 4 (p 1492): How is smoldering and flaming combustion defined / identified in relation to the emission factors?

Response: Aboveground and ground-layer fuel components are considered separately by the model. Because of the differences in combustion between aboveground and ground-layer biomass observed for boreal forests, we assumed: (1) 80% of the aboveground biomass was consumed by flaming combustion, and 20% by smoldering combustion; and (2) 20% of the soil organic layer was consumed by flaming combustion, and 80% by smoldering combustion (Kasischke and Bruhwiler, 2002).

Comment 4: Line 1-4 (p 1493) : If the method for identifying stand replacing fires for temperate forests is consistent with the approach used by Potapov et al. for boreal forest fires this could be mentioned earlier in the manuscript (e.g. 1st paragraph p. 1490). If methods to identify stand replacing boreal forest and temperate forest fires are different it would be beneficial to briefly outline how stand replacing boreal forest fires are identified (around page 1490). This is particularly relevant given the high fuel consumption estimates from these fires.

Response: The method for identifying stand replacing fires for temperate forests is based on our emission model (Ito and Penner, 2005). The description of Potapov et al. is added to introduction as follows: Their analysis of forest cover loss was based on a decision tree classification. The burned areas were identified on reference imagery by

fire events or by distinct spectral signatures of ash on the ground. The ancillary image sources were used to assign pixels as burned areas or other factors such as logging, tree mortality due to insect outbreaks and windfalls.

Comment 5: Line 3 (p 1501) : The differences in the spatial variation between the modelled CO and MOPITT observations at different altitudes is believed to result from the use of MODIS fire pixel counts to characterise the temporal variation of fire emissions. Line 13 (p. 1490) indicates that only pixel counts from Terra are used which may not fully account for the diurnal variation of biomass burning. Work by Vermote et al. (2009) indicates that a diurnal fire cycle exists in central Russia with greater fire activity during the Aqua overpass. Would including the Aqua observations to characterise the daily variation in fire activity improve the temporal consistency of the simulated CO? There also appears to be a slight temporal offset between the model and observations in Figure 3. Vermote, E., E. Ellicott, O. Dubovik, T. Lapyonok, M. Chin, L. Giglio, and G. J. Roberts (2009), An approach to estimate global biomass burning emissions of organic and black carbon from MODIS fire radiative power, *J. Geophys. Res.*, 114, D18205, doi:10.1029/2008JD011188

Response: Both the Terra and Aqua MODIS active fire products are used to maximize the probability of fire detection against various omission errors such as cloud obscuration or temporal mismatch between peak fire intensity and satellite overpass time. In fact, a diurnal fire cycle exists in boreal Russia with greater fire activity during the Aqua's afternoon overpass, which could be driven by local weather or fuel conditions (Vermote et al., 2009). Fire detections with low confidence were not used to reduce the probability of false alarms. The systematic differences between model results and the MOPITT observations are not seen from the anomalies of CO from the 5-year averages. The anomalies due to the fire emissions are calculated from the differences in CO between the monthly averages for each year and the monthly averages calculated from the 5-year data. The linear correlation coefficient for the anomaly ( $r = 0.71$ ) is larger than that for the monthly mean ( $r = 0.61$ ). These results suggest that the intense

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fires may not cause the systematic time lag.

Comment 6: Technical comments Comment 6.1: Line 28 (p. 1491): replace "that consume more" with "larger"

Response: This is done.

Comment 6.2: Line 24 (p. 1493): replace "Amounts of monthly burned areas" with "Monthly burned area estimates"

Response: This is done.

Comment 6.3: Line 22 (p. 1495): Replace "rest" with "remaining"

Response: This is done.

Comment 6.4: Figure 5: To improve interpretation of the lower plots ("Effect of intense fires") the x-axis scale could be reduced to 100 and 200 ppb.

This figure is removed, but the comment is reflected in other figures.

#### References

Deeter, M. N., Edwards, D. P., Gille, J. C., Emmons, L. K., Francis, G., Ho, S.-P., Mao, D., Masters, D., Worden, H., Drummond, J. R., and Novelli, P. C.: The MOPITT version 4 CO product: Algorithm enhancements, validation, and long-term stability, *J. Geophys. Res.*, 115, D07306, doi:10.1029/2009JD013005, 2010.

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ing MODIS and Landsat imagery to estimate and map boreal forest cover loss, *Rem. Sens. Environ.*, 112(9), 3708–3719, 2008.

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Interactive comment on *Biogeosciences Discuss.*, 8, 1483, 2011.