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Geoscientific Model Development Discussions
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Interactive comment on "Characterising Brazilian biomass burning emissions using WRF-Chem with MOSAIC sectional aerosol" *by* S. Archer-Nicholls et al.

Anonymous Referee #2

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This study coupled a sectional aerosol scheme (MOSAIC) of WRF-chem to the plume rise parameterization, and model results are evaluated against several observations including flight measurements. This work is carried out for studying the 2012 SAMBBA field campaign. Overall, the presentation is well structured and the design of the experiments appears sound, and it is good for the journal of Geoscientific Model Development.

However, the manuscript lacks quite a few references to place readers in the context of mesoscale modeling of biomass burning aerosols, and in some cases, mis-interpret the references. Given this manuscript is submitted to the Model Development, it should include some description of the past model development in this area. I recommend the

authors revise the text to address following concerns before the manuscript can be recommended for publication.

1. P6064, line 20. Regarding the use of coupled mesoscale model to study biomass burning aerosols, I recommend to include the following references. They are among the earliest on this topic and indeed developed a coupled model; in this model, the hourly smoke emission based up GOES fire product is also used. These information should be included in the manuscript as later, the authors did start to talk about diurnal variation of emissions.

Wang, J., and S.A. Christopher, 2006: Mesoscale modeling of central American smoke transport to the United States, 2: Smoke regional radiative impacts on surface energy budget and boundary layer evolution, J. Geophys. Res., 111, D14S92.

Wang, J., et al., 2006. Mesoscale modeling of Central American smoke transport to the United States, 1: "top-down" assessment of emission strength and diurnal variation impacts, J. Geophys. Res., 11, D05S17.

2. P. 6065, :10-25. I recommend to include the following paper in the discussion of large difference in emission estimate. This reference can also provide a support later in the manuscript for increasing the emission by a factor of 5. Indeed, the reference below show the even on monthly and regional scale, the emission differences among current existing operational fire emission databases can be more than a factor of 10. But it does show smaller differences among those top-down estimate. Zhang, F., et al., 2014, Sensitivity of mesoscale modeling of smoke direct radiative effect to the emission inventory: A case study in northern sub-Saharan African region, Environmental Research Letter, 9, 075002.

3. P. 6066 – 6067. It is important to recognize that there are many free parameters in the fire plume rise model that can not constrained by the observations, including heat flux and entrainment rate. While the plume rise model is physically based, several studies have shown that a simple fixed injection height approach may give very

reasonable results in simulating the vertical profile of smoke aerosols. In other words, more sophisticated method may not yield good results in pratice, although this should not prevent us from developing and improving plume rise model. So, some discussion on the “both sides of the coin” is needed here. Wang et al. (2006, reference above), Yang et al. (2013), and Wang et al. (2013) specified injection height at 1.2km, 0.8km, and 0.7km for fires in Central America, Sub-Sahara, and southeast Asia region, respectively, which yield consistent results when compared to either ground-based or CALIOP data. I recommend authors to include these references along with Colarco's paper into the discussion on the importance of inejection height, and how it is now treated in other studies. These references also support the later part of the manuscript in which plume rise model injects too much aerosols into the free troposphere.

Yang, Z., et al., 2013, Mesoscale modeling and satellite observation of transport and mixing of smoke and dust particles over northern sub-Saharan African region, J. Geophys. Res. Atmos. , 118, 12,139-12,157.

Wang, J., et al., 2013, Mesoscale modeling of smoke transport over the Southeast Asian Maritime Continent: interplay of sea breeze, trade wind, typhoon, and topography, Atmospheric Research , 122, 486-503.

Colarco, P. R., et al., 2004, Transport of smoke from Canadian forest fires to the surface near Washington, D.C.: Injection height, entrainment, and optical properties, J. Geophys. Res., 109, D06203.

4. P. 6075. L25. Peterson et al. (2014) has shown that the using FRP divided by the retrieved fire area can better interpret the MISR plume height, at least over the boreal forecast. Please add this in the discussion.

Peterson et al. , 2014. Quantifying the potential for high-altitude smoke injection in North American boreal forest using the standard MODIS fire products and sub-pixel-based methods, J. Geophys. Res. Atmos., 119, 3401-3419.

5. To highlight the novel of this study, some description about the model in section 2, and section 3 could be referred to some other paper in the literature or moved to supplementary material. For example, section 2.3 plume rise parameterization could be pointed to Freitas et al. (2007, 2010). Also Section 3.1 could be shorten and only make some points.

6. Line 18, ‘Between 1 September 2012 and 11 September the model was run with meteorological nudging’, so the nudging doesn't applied for the rest of simulation? Since the first phase of the campaign covers 6-22 September, what is the reason to set 1 September to 11 September as this special?

7. The distribution of AODs in Figure 5 is displaced by the model when compared against satellite data. If we look at the profile in Figure 2, we can see the emission also show the peak area is around 65°W, so beside the wind caused transport, it is better to explain this from the emission part.

8. Figure 5. Are the modeled AOD sampled over the MODIS AOD's time and space when do the comparison? Be clear on this in the figure caption.

9. In Figure 6, the results from 2 scenario simulations could be plotted in one panel, so 8 panels could be replaced with 4 panels. Hence the differences between 2 simulations could be showed.

10. The title like ‘summary and outlook’ might be good for Section 6 instead of ‘conclusion’, and also section 6 could be elaborated more concisely.

11. To make the Table 4 more informative, the resolution information could be included.

Interactive comment on Geosci. Model Dev. Discuss., 7, 6061, 2014.