Anonymous Referee #1:

This is very interesting and important manuscript reporting on results of global modeling of BrC impact compared with AERONET observations. The manuscript is well written and the presented modeling results are of sufficient novelty for potential publication. In addition to multiple issues already raised by two other reviewers, I would like to note that because the manuscript was likely in preparation for a long time a large volume of recent literature papers escaped authors' sight. Since BrC is a very dynamic research area, my additional requirement for the ACP publication is thorough discussion of 2014-2015 publications relevant to this study, as well as use of the most updated data as is necessary.

We thank the referee for careful reading and valuable comments.

My specific comments are listed below:

1. Text of: P27807 line 23 – P27808 line 17; P27813 lines 1-30; references to include and discuss - - Moise et al, Chemical reviews 2015, 115, (10), 4400-4439; Laskin et al Chem. Rev. 2015, 115, 4335−4382

➔ ***We added the references and related discussions (HULIS, cloud and fog processing, classes of compounds which have been identified as chromophores) as follows:***

Some studies showed that humic-like substances (HULIS) were related to BrC (Hoffer et al., 2006; Kim and Paulson, 2013; Lukács et al., 2007) based on the high absorption Ångström exponent (AAE) of HULIS in the range of 6–7, indicating that the specific absorption increases substantially towards the shorter wavelengths (Hoffer et al., 2006), although the sources and the dominating chromophores of HULIS have not clearly been revealed yet (Moise et al., 2015; Graber and Rudich, 2006).

Furthermore, browning reactions can be accelerated by cloud and fog processing of aerosols (Moise et al., 2015), which are not considered in this study.

On the other hand, several classes of compounds have been identified as potential contributions to BrC - nitroaromatic compounds, such as nitrophenols, imidazole-based and other N-heterocyclic compounds, and quinones (Laskin et al., 2015).

2. Page 27808 lines 4-5: refs to include Lin et al PCCP, 2015, DOI: 10.1039/c5cp02563j, Yu et al Atmos. Chem. Phys. 2014, 14, 13801.

➔ ***We added the references.***

3. Page27808 lines 11-13: ref to include and discuss - Saleh, R. et al Nat. Geosci. 2014, 7, 647.

➔ ***We added the reference and related discussion (the relationship between BC to OC ratio and AAE as follows:***

Saleh et al. (2015) also showed that the BC to OC ratio (proportional to MCE) has negative relationship with AAE.

4. Page27808 lines 15-17: refs to include - Hawkins et al Environ. Sci. Technol. 2014, 48, 2273.; Flores et al. Phys. Chem. Chem. Phys. 2014, 16, 10629.; Liu et al. Geophys.Res. Lett. 2014, 41, 2191.; Laskin et al Environ. Sci. Technol. 2014, 48, 12047.

➔ ***We added the references.***

5. Text of: P27808 line 18 – P27809 line 11 references to include and discuss - Wang et al Atmos. Chem. Phys., 2014, 14, 10989.; Lin et al J. Geophys. Res.: Atmos. 2014, 119, 7453.

➔ ***We added the references and summarized previous study results as follows:***

Despite the ample observational studies, very few modeling studies have been conducted to simulate global and regional distributions of BrC and to further quantify its radiative effect (Feng et al., 2013; Jacobson, 2001; Lin et al., 2014; Park et al., 2010; Wang et al., 2014).

Lin et al. (2014) calculated the DRF of OC by assuming that all of the biomass burning and the biofuel OC is BrC, and all of the SOC (as a high-absorbing case) as BrC. They estimated the global clear-sky DRF of OC as -0.20 W m^{-2}.

6. Page 27809 line 3, and through the text: Use of unpublished work of McMeeking from (2008..!?) is not appropriate by my opinion. Instead, application of recent parameterizations from Liu et al, Geophys. Res. Lett., 41, 742–748, doi:10.1002/2013GL058392 will be more suitable.

➔ ***We could not find the observed relationship between MCE and AAE in the published literature. Liu et al. (2014) also did not provide any relationship between the two, so we maintain our citation of McMeeking (2008) for the equation used in our manuscript.***

7. Page 27809 lines 5-6: ref to include - Lin et al PCCP, 2015, DOI: 10.1039/c5cp02563j

➔ ***We added the reference.***

8. Page 27809 lines 23: ref to include - Chakrabarty et al, Environ. Sci. Technol. Lett. 2014, 1, 44.

➔ ***We added the reference.***

9. Section 7 – Effect on Ozone photochemistry: Ref to include and discuss - Jiang et al. Environ. Sci. Technol. 2012, 46, 11878.

➔ ***Thanks for the constructive comment. We added the reference and the discussion in the***

end of Section 7 as follows:

This maximum O_3 decrease by BrC (-13%) is similar to the O_3 decrease (15%) by fire aerosols in Jiang et al. (2012).