

## ***Interactive comment on “Long-term observations of black carbon mass concentrations at Fukue Island, western Japan, during 2009–2015: Constraining wet removal rates and emission strengths from East Asia” by Yugo Kanaya et al.***

**Anonymous Referee #2**

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This manuscript presents the analysis of black carbon observations during 2009-2015 at a surface site in Japan. The focus is on seasonal variability of BC and the interpretation of such variability through the use of  $\Delta_{BC}/\Delta_{CO}$  ratios to infer the role of wet removal rates and BC emissions from upwind regions (China, Korea, and Japan). The manuscript presents valuable new observations and thus is suitable for potential publication in ACP. My main concerns are (1) neglect of in-cloud scavenging of BC during the course of the long-range transport which may not associate with precipitation; (2) inadequate justification of the source regions inferred from the back trajectory; and (3) incorrect use of precipitation-affected BC observations to infer emissions. These

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issues are explained in depth below.

Major Comments:

1) Wet deposition of BC includes both in-cloud and below-cloud scavenging. In-cloud scavenging is where BC gets into cloud droplets and below-cloud scavenging is the washout of BC by falling rain droplets. While the occurrence of the latter is always associated with precipitation, the former may not because not all clouds precipitate. Both scavenging processes are expected to happen during the relative long course of transport BC from its source regions to the Fukue Island sampling site. The authors use precipitation data as a proxy of BC wet deposition, thus neglecting the role of in-cloud scavenging which may be potentially important. This bias needs to be corrected.

2) Fig 1 and 3 (source regions of BC sampled at Fukue): It is not clear to me how the different regions are determined. I doubt that observations from a single site are able to offer unambiguous information of such refined source regions. The back trajectories (Fig 3) appear to overlap between different clusters. The authors need to demonstrate BC data at Fukue can distinguish those source regions; if not some of the regions should be lumped together. In addition, the authors seem to claim that the BC observations at Fukue can even distinguish emissions between coasts and in-land of the continent (pg 10, line 14-15), which is not plausible given the distance of this site from the continent and large spatial extension of the back trajectories.

3) Section 3.3 and Figure 12, trend of BC masses by source region: BC data with non-zero APT should not be used to constrain emissions. Wet scavenging is efficient to remove all BC during transport and thus non-zero APT air masses sampled at Fukue have lost all the source signatures of BC and contain only background. Although the authors apply an empirical correction to infer the BC loss due to precipitation, that correction is obviously subject to high uncertainty which is difficult to constrain. The authors should use only a subset of observations which are determined to have minimal influence of wet deposition when constraining emissions.

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