

Interactive comment on “Investigation of the wet removal rate of black carbon in East Asia: validation of a below- and in-cloud wet removal scheme in FLEXPART v10.4” by Yongjoo Choi et al.

Anonymous Referee #1

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General comments:

This paper introduces a method to access the wet removal rate of BC in East Asia based on long-term measurements, in the aspect of the air mass back trajectories. The authorship made effort to obtain the overall wet removal rates of BC as a function of accumulated precipitation along trajectories, the half-life and e-folding lifetime. Depending on the measurement sites, the wet removal rates of BC showed large regional differences, and various reasons are explored. Further, they diagnosed the scavenging coefficients of the below- and in-cloud scavenging scheme implemented in the FLEXi-

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ble PARTicle (FLEXPART) Lagrangian transport model with the obtained wet removal rates of BC, and suggested that underestimation of wet scavenging coefficients in the model simulation. Finally, they evaluated the relative importance of various factors in the in-cloud scavenging process, and indicated that the convective available potential energy should be considered to better represent the regional difference of BC wet scavenging over East Asia.

The topic of the manuscript is well suited for publication in ACP. The long-term dataset are generally applicable, whereas some discussions are lack of persuasion. I suggest more effort should be put into the presentation of the results before publication. My major concern is about the preset for the calculation and the reasons for the regional difference of wet removal efficiency.

(1) The authors used 500 m as a starting altitude and 72h back trajectories were calculated. Is it an arbitrary selection? How does this affect the final assessment of wet removal?

(2) The authors attributed the regional difference in wet removal efficiency to the difference in the coating thickness of BC particles. In the discussion section, they consider that depending on the emission sectors, the coating thickness of BC particles could be a major factor causing the difference in the wet removal efficiency. I think such explanation is hard to believe. The freshly emitted BC particles has transported for a long distant before scavenged. How could the freshly emitted BC particles affect their coating thickness before scavenged? Actually, there are many published paper showing factors that drive the ageing of BC, which should be included in the discussion.

Specific comments:

1. Introduction: “Specifically, the in-cloud process is more efficient and complicated than the below-cloud process because the nucleation removal of aerosol particles within clouds is thought to account for more than 50% of the aerosol particle mass removal from the atmosphere globally” I wonder if there are any scavenging efficiency

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data for BC alone, since this paper mainly focus on the wet removal of BC.

2. Introduction: “Wet deposition is still challenging to predict BC concentration in the atmosphere due to the difficulties of accurate evaluation of wet removal.” It would be better to include more explanation on why it is challenging to represent wet deposition, which tightly links to the discussion section of this paper.

3. Introduction: It would be better to simply explain “emission rates and deposition terms”.

4. Experimental section: “when the airmass altitude was lower than 2.5 km. . .”. Is there any explanation for this?

5. Line 199-: Is there any correlation between wet removal of BC and meteorological parameters?

Minor:

Line 65: “stat”?

Line 73: “significant”?

Line 136: “good spatial coverage”?

Line 149: “thus the TE was an effective indicator”.

Line 193: “However”?

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-402>, 2020.