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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud droplet activation properties and scavenged fraction of black carbon in liquid-phase clouds at the high-alpine research station Jungfraujoch (3580 m a.s.l.)" *by* Ghislain Motos et al.

Anonymous Referee #1

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The present manuscript describes the use of a sophisticated aerosol sampling system at a mountain site to investigate cloud droplet activation of both BC-free and BC-containing particles. The authors present unique data set of the in-situ CCN properties and scavenged fractions of these aerosols on a number and mass basis, which are useful for elucidating the parameters (water vapor supersaturation and aerosol microphysical properties) that control activation. Through the data analysis, they demonstrate that the simple k-Köhler theory under the assumptions of spherical core-shell structure of BC-containing particles can reasonably predict their cloud droplet activa-

tion, despite their complex morphology and non-ideal properties of coating materials in the real world. This is an important observational evidence that justifies the simple treatment of BC activation in regional and global models. Although I think some points in the manuscript need clarification, but overall I recommend this manuscript for publication in ACP after minor modification.

Specific comments:

P12, Line 30–31 and P13, Line 6–8: In these parts, the authors state that "Such variations in SS_peak are driven by variations in atmospheric dynamics (i.e., updraft)..." and "variations in D_half were mainly driven by variations in updraft velocities and resulting supersaturations,...", respectively. However, in addition to the updraft velocity, the SS_peak can also depend on total aerosol number concentrations (i.e., higher number concentrations of aerosols can lead to lower SS_peak). Therefore, the relationship between the absolute number concentrations of aerosols (total inlet) and SS_peak should be mentioned somewhere in the paper and the aerosol concentration data can be included in Table 1. Furthermore, to characterize cloud properties discussed in this paper, please consider including the LWC data in Table 1. The difference of the SMPS data between total and interstitial inlets may indicate the cloud droplet number concentrations, which might be also useful for characterizing cloud properties.

P14, Line 18–22: If the deviations of several data points in Figure 8a from 1:1 line are greater than measurement uncertainty, some data would indicate that BC particles were scavenged more efficiently than total aerosols. I do not understand the reason for that.

P15, Line 10–14: What refractive index values are assumed for BC core and BC-free aerosols for the SP2 data analysis?

Figure 9b and 9c: Which inlet for these SP2 data? Total inlet?

Figure 9c: Is the y-axis number fraction of thickly coated BC? The caption is not clear.

P16, Line 6–8: As the authors mentioned in P16, Line 1–4, the SS_peak values may be underestimated due to increased interstitial aerosol number concentrations due to WBF process in mixed phase clouds. Therefore, comparing the activated fraction for T < -5°C case and warm cloud case with "comparable SS_peak" looks logically inconsistent.

Figure 11: In this figure, coating thickness is indicated by color scale for rBC with mass equivalent diameter of about 50–300 nm. However, if the small BC (D_rBC ~50 nm) has thin coatings (i.e., total optical diameter < 180 nm), the SP2 cannot quantify the coating thickness?

P19, Line 28, "lower" should be "higher"?

Minor corrections:

P3, Line 35: "(2016))" should be "(2016)".

P5, Line 20: "(Very. . .(2000)" should be "(Very. . .(2000))".

P17, Line 22: "DrBC" should be "D_rBC"

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