This article presents in-cloud scavenging coefficients that are function of rain rate for different types of clouds (cumulonimbus and stratus). Their suggested formulas can be a good reference for simplified models. I have several questions that need to be answered or clarified before publication.

1. They said that their approach is a theoretical approach, but I think there are many parameterizations and assumptions used to build their in-cloud scavenging coefficients. Also, their formulas are based on only one set of specific representation of cloud microphysics.

Our approach is described as a theoretical one because we rely on a microphysical description of all the interactions between the three phases water aerosol particles. Moreover, the description of these microphysical mechanisms is based on a physical description and not on a set of experimental data.

Note that this work aims in validating the approach. The sensitivity to more specific parameters will be presented in a following work. We will for example derive a spectral scavenging coefficient ($\Lambda_{cloud}(d_{ap})$). Indeed, both activation and collection processes are spectrally dependant. Moreover, we will investigate the influence of background aerosol size distribution and nature on the scavenging coefficient.

For example, in equation (14), they adopted some collection efficiencies that were previously developed or parameterized by someone else. What if different collection efficiencies are used? Will the in-cloud scavenging coefficients be significantly different? I wonder how general the formulas they proposed in this study are.

The two main mechanisms involved in the incorporation of aerosol particles into hydrometeors are the activation of aerosol into droplets and their collection by droplets.

Indeed, the modelling of activation that we consider is the κ-Köhler theory introduced by (Petters, M. D., & Kreidenweis, S. M.,2007). This model is still a reference to account for activation process.

Concerning collection of aerosols by droplets, this process in modelled by a theoretical model built by Depee et al (2019). This model relies on Lagrangian tracking of aerosol particles around droplets falling at terminal velocity. This model from Dépée et al. 2019 has been further validated on laboratory experiments (Dépée et al., 2021, Part I ; Dépée et al., 2020, Part II). Note that Dépée, Lemaitre, Monier and Flossmann are author of both articles. In certain extent, the model development by Dépée et al. was a prerequisite performed in prevision of present article.

2. Are solid hydrometeors taken into account in-cloud scavenging? For the cumulonimbus case, I believe there are some ice or snow in the upper levels, and they certainly contribute aerosol removal. At the cloud base, there are no solid hydrometeors? all melted? In this warm temperature case, there might no snow. However, let's assume temperature is low enough, and only snow is the precipitating hydrometeors (no rain). In this case, one cannot use their formulas that only consider rain. Do you have plan to include snow?

First, we focus on the in-cloud scavenging, so the below-cloud scavenging - made by snow, rain or any other hydrometeor is not the purpose. Second, we consider the main mechanisms occurring between the cloud base and the cloud top, including ice nucleation (line 156 -157 : "To model heterogeneous ice nucleation, we consider all the mechanisms described by Vali et al., (2015). The Biggs formula (1953) is used to describe immersion freezing and the model of Meyers et al., (1992) for condensation and contact freezing, as well as deposition nucleation. All these mechanisms have recently been incorporated into the DESCAM model by Hiron and Flossmann, (2015).").
However, in DESCAM, there is no modelling of aerosol collection by ice crystals, because it depends on the crystal morphology which would require a description of the crystal type (Magono and Lee, 1965). Nevertheless, for the cumulonimbus modelled in the present article, we believe that the contribution of collection by ice crystals to the global cloud scavenging is a second order mechanism compared to both activation and collection by droplets. This is because the concentration of interstitial aerosol particles when ice water content calculated by DESCAM is already low due a previous incorporation into the droplet according to warm processes that have acted previously (fig. 6a).
For the cumulonimbus model, depending on the cloud criteria considered to determine the cloud boundaries, the hydrometeor are either in ice state (figure 7a&b) or in liquid state (figure 7c). No main influence of the nature of the precipitation at the cloud base is observed from these three cases. This is because the scavenging coefficient is calculated on the basis of $\phi_{ap,\,precip}(dap)$ (eq. 15) that is determined by the summation of the flux of particle in both ice and liquid (eq.8).

3. They explained why status clouds are more efficient in removing aerosols even though the rain rates are the same for status and cumulonimbus. Besides the explanation using equations, can you provide more physically based interpretation?

The scavenging by stratus clouds is not more efficient than by cumulonimbus. However, if you parametrize the cloud scavenging by the rainfall rate, which is generally performed in the literature, it is observed that for a same rainfall rate the scavenging coefficient of status is higher than the one of cumulonimbus. Indeed, as the relative humidity is higher in cumulonimbus, there is more condensation and the same mass of aerosol collected (or activated) in diluted in a larger mass of water. However, this is balanced by the cumulonimbus rainfall rate which is on average 25 times higher than the stratus one.

4. I wonder if aerosol removal by falling hydrometeors within clouds can be called in-cloud scavenging. In-cloud scavenging usually indicates the removal by activation or collection. Based on their approach that examines the mass change of aerosols at the cloud base, I wonder if it is okay to include the effect of wash out in the in-cloud scavenging process.

The definition of what is an in-cloud scavenging could be discussed. The definition used here is for application to the atmospheric transport modelling. In these models, it is challenging to have access to the microphysical values like the share of activated aerosol, or the droplet/ice crystal size distribution. Whereas these models can have access to the rainfall intensity (whether the precipitation is rain or snow) and good guess to the cloud base and top altitude by the observation or processing of the NWP. That is the reason why this pragmatic definition of the in-cloud scavenging is used: all processes involved between the base and the top of the cloud.

5. Can scavenging coefficients be the same for mass concentration and number concentration of aerosols in equation (1)?

Both definitions are equal as far as they are written spectrally (as we do) and with a uniform density of all the aerosol particles. In our study, we assume the aerosol particles consisted of ammonium sulphate, so this equality is true. If the aerosol particles density in not uniform, which is the case in the atmosphere mathematical we should indicate if it is a mass scavenging coefficient or a number one. To avoid confusion, we added the exponent m to the scavenging coefficient $\Lambda_{cloud}^{m}(d_{ap})$ in case of application of our model to a population of aerosol with various density. Indeed, the scavenging coefficient we derived is based on mass fluxes (eq. 3).

6. I recommend improving their English writing through the manuscript.

The manuscript has been proofread by a scientist native English speaker. Thanks to his helpful contribution, we choose to associate him (Daniel Hardy) as a co-worker of this article.