

## Answer to Referee #1

General comments: This paper described a laboratory study of the collection of aerosol particles (AP) by water drops due to the influence of environmental humidity condition a specifically sub saturation. The two forces this paper focuses on are the thermophoretic and diffusio-phoretic forces. It has been shown previously that the humidity effect can play an important role in bridging the Greenfield gap of AP wet removal from the atmosphere, but accurate lab measurements of this effect were not available. Hence this work is a welcome follow-up of previous works. I have read the manuscript and found that their approach is reasonable and the experiments were carried out with suitable equipment and careful steps. I believe the paper can be accepted for publication by ACP with the following minor revision suggestions.

### Thank you for your general comment

Specific comments: Line 38-40: “anthropogenic APs have also been reported causing cardiovascular disorders on humans. In fact, the Great Smog of London in 1952, one of the best known related events, caused up to 12,000 deaths (Bell et al., 2004)” – did Bell et al. say that the deaths in London Smog were due to cardiovascular disorder? If so, you should say so. The way you have it now doesn’t make a direct connection.

**You are right it is not reported as « cardiovascular disorder ». We change the sentence by : « Moreover, anthropogenic APs have also been reported impacting human health (Dockery et al., 1992). In fact, the Great Smog of London in 1952, one of the best-known related events, caused up to 12,000 deaths (Bell et al., 2004). »**

### With the new reference:

**Dockery, D. W., Schwartz, J., & Spengler, J. D. (1992). Air pollution and daily mortality: associations with particulates and acid aerosols. Environmental research, 59(2), 362-373.**

Line 41: “another AP pollution event” change to “another AP pollution hazard”

**The suggestion is taken into account**

Line 45: “respectively in 1986 and 2011” –change to “in 1986 and 2011, respectively”

**The suggestion is taken into account**

Line 45: “this caesium-137” delete “this”

**The suggestion is taken into account**

Line 48-49: “Far away from the source, the main mechanism involved in the AP scavenging originates from the interactions between APs and clouds or their precipitations” – before you mention scavenging, you should have a short paragraph discussing the general removal of AP including the dry removal and wet removal. Then you can start talking about scavenging.

**The suggestion is taken into account, we change the beginning of the paragraph by :**

**«Thus, it is essential to understand the two mechanisms which scavenge atmospheric APs back to the ground. First APs can settle through many effects like gravity, wind, surface forces, turbulence, etc. This is referred as dry AP deposition. There is also the wet AP deposition due to the interactions between APs and clouds or their precipitations. The present paper deals with the wet removal since, far away from the source, it is the main mechanism involved in the AP scavenging (Jaenicke, 1993). Note that Flossmann (1998) numerically showed [...] »**

Line 54: “AP activation into cloud hydrometeors” AP activation to form cloud hydrometeors

**The suggestion is taken into account**

Line 61: "AP has to leave the streamline that surrounds" AP has to deviate from the streamline around"

**The suggestion is taken into account**

Line 65: "strong enough to leave the streamline" – "strong enough to deviate significantly from the streamline"

**The suggestion is taken into account**

Line 90-94: this sentence needs to be rewritten

**We edited these sentences as followed :**

« Diffusiophoresis is the sum of the drag force produced by Stefan flow and the momentum transferred to APs (located in a diffusion boundary layer), due to the dissymmetry of molecular weight. Note that the Stefan flow (repulsive around an evaporating cloud droplet) is on average five times larger than the addition to the diffusion flows (attractive around an evaporating cloud droplet) as mentioned by Santachiara et al. (2012). So, diffusiophoresis repulses APs from the evaporating droplet (see Figure 1, D) which in turn decreases the CE. Finally, since the amplitude of the thermophoresis is on average twice larger than the diffusiophoresis (Tinsley et al., 2006), APs are ultimately attracted toward droplets in subsaturated air due to these phoretic effects (see Figure 1, E). Thus, the coupling of the thermophoresis and diffusiophoresis increases the CE when the relative humidity decreases. »

Line 100: "it is mandatory" – It is desirable

**The suggestion is taken into account**

Line 107: "no equivalent" – no similar

**The suggestion is taken into account**

Line 110: "to fill up the lack of data" to fill up the deficiency of data in this area

**The suggestion is taken into account**

Line 115: delete "finally"

**The suggestion is taken into account**

Line 119: "specially" especially

**The suggestion is taken into account**

Line 120: change to: Depee et al. (2019) focused on electrostatic forces but did not consider thermos- and diffusiophoresis.

**The suggestion is taken into account**

Line 154: "detailed" described

**The suggestion is taken into account**

Line 169: "is three times larger" becomes three times

**The suggestion is taken into account**

Line 170: "is used between" is installed between

**We might be wrong but « install » is mainly used for program/software... I changed « is used » by « is set ». Is that OK for you ?**

Line 173: can you include a chart of your Boltzmann charge distribution?

Unfortunate, we were not able to measure the APs' charge distribution. We considered the charge distribution established by Wiedensohler (1988); which is very close but a little more reliable than Boltzmann distribution for the bipolar source of ions we used.

Line 199: "highlighted" do you mean "emphasized"?

**We replaced « highlighted » with « emphasised »**

Line 218: "thanks" strange usage

**We replaced « thanks to » with « through »**

Line 251: "evaluated" estimated

**The suggestion is taken into account**

Line 269: "inserted" Tintroduced

**Inserted is replaced with Injected**

Line 277: "inserted" introduced. "a kind of flat torus" ~ flat torus inlet

**We replaced with: "The APs are injected from the sides of the entire circumference through a flat torus inlet"**

Line 325: "growth factor" is this the linear growth factor, i.e., that of the diameter or radius?

**We are not sure to completely understand your question.**

**The growth factor is the ratio between wet and dry size of a particle, as a function of the air relative humidity. No matter you consider the radius or the diameter, the growth factor is equal.**

Line 392-393: "after an experiment results effectively from scavenging event in the In-CASE collision chamber"

after the experiment results effectively from scavenging by drops in the In-CASE collision chamber and not from contamination from other sources. **OK**

**This sentence is replace with:**

**"after the experiment results effectively from collection by drops in the In-CASE collision chamber and not from contamination from other sources"**

Line 419: "both" two

**The suggestion is taken into account**

Line 532: "shown" showed~ **OK**

**The suggestion is taken into account**

Line 563: "On figure 9" In figure 9

**The suggestion is taken into account**

Line 578" "weak"â~ small

**The suggestion is taken into account**

Line 579: "dominating" dominating over

**The suggestion is taken into account**

Line 600:~ Table 2: your T is not the true temperature but temperature difference, right?

**No it is the true air temperature in the collision chamber. To avoid confusion  $T$  is replaced with  $T_{air}$  in the table (expressed in Celsius degrees).**

Line 621: "to check the CE" to investigate the CE~

**The suggestion is taken into account**