We thank the referee for the critical comments.

Referee comment:
Replies to Author comments:
All the precipitation days have been excluded in the revised manuscript for the results shown in Tables 2 and 3 and Figures 2 and 3.
Reply to author comment:
According to table 1, the authors reject minimum 85% of all wet season data. Please justify your results are still representative for an Amazonian wet season.

Reply to referee comment:
We agree with the referee that removing the days with precipitation removes a lot of the available data. The reason why we decided to exclude those days in the previous analysis, was to improve the comparisons of the wet and the dry season. After some internal discussion, we decided to include the precipitation days in the analysis shown in Table 2 and 3 and Figures 2 and 3.

Referee comment:
We removed pristine from the revised manuscript, as our focus for the dataset presented in our manuscript is not on a pristine environment. Nucleation mode particles have been observed in the Amazon region in the vicinity of Sao Paulo (Backman et al., 2012).
Reply to author comment:
This statement raises serious concerns. Sao Paulo is some 3500 km SE of Manaus

Reply to referee comment:
We are very sorry for this mistake, we changed the statement in the updated manuscript as follows:
l.35 To our knowledge this is the first direct observation of NPF events in the Amazon region. Previous observations in Brazil showed the occurrence of nucleation mode particles.

Referee comment
I do not list all typos and grammar mistakes - the manuscript needs a careful revision, especially in 2.4 and 3.

Reply to referee comment:
The main text of the previous version of the manuscript was corrected by a native speaker. Nevertheless, we carefully revised the updated manuscript and corrected the language.

Referee comment:
The authors mix up their notations for the two different sites. Still you can find 'outside' and 'inside rainforest' or 'rainforest canopy' or 'pasture'.

Reply to referee comment:
We thank the referee for pointing out these inconsistencies. The notations for the measurement sites are now consistent as: open pasture/pasture site and inside rainforest site.

Referee comment:
l. 35: 'The occurrence of NPF on ground level in the Amazon region has been observed previously only in the vicinity of large cities.'
The statement needs justification. If it is related to Backman 2012, it is incorrect.

Reply to referee comment:
In Backman et al., 2012 the measurement site was located inside Sao Paulo (see Figure 1 in Backman et al.). Nevertheless, we changed the statement in the updated manuscript, to be more precise, as follows:
l.35: To our knowledge this is the first direct observation of NPF events in the Amazon region. Previous observations in Brazil showed the occurrence of nucleation mode particles.

Referee comment:
paragraph 2.4: In this pragraph multiple statements repeat - it needs to be revisited.

Reply to the referee comment:
This paragraph is updated in the revised manuscript. We think that the information provided in paragraph 2.4 is essential for the results presented in the manuscript, therefore we keep most of the information. Nevertheless, we changed the wording slightly, to make the paragraph more concise, as follows:
l. 300: All the available data from the NAIS were cleaned for a potential instrumental noise. The cleaning process was done visually using the particle and ion size distributions as surface plots. Based on this initial screening, the decision was made whether one or more of the electrometers were reliable or not. The non-reliable data were removed based on the guidelines introduced by Manninen et al. (2010). The NAIS data turned out to be unreliable during the measurements presented here mostly in the size range above 15 nm. Therefore, we decided to show data for the sizes up to 12 nm only in our analysis.
We observed an increase in the concentrations of the cluster ions in the NAIS starting from October 7, 2013 to January 21, 2014. By investigating the raw data files, this drift was observed to be due to too low currents in the sheath air filters. The sheath air filters are electrical filters, using corona needles to neutralize all the remaining ions, which leads to an over-estimation of the ion concentrations. A correction factor of 1.8 was applied to account for this problem in the 4 smallest size channels of the NAIS (0.8-1.25 nm) for the data taken at the T0t site after the drift was observed.

This increased level in the positive polarity of the natural ions continued when the NAIS was re-deployed at the T3 site. The cause was the same (too low a current in the sheath air filters). We consider the positive polarity of the natural charged ions in the NAIS at the T3 site unreliable, therefore the data, regarding the absolute concentrations, using the positive channel for the T3 site is not shown in this study. Additionally, the ion data from September 9-26, 2014 at the T3 site was considered unreliable and also excluded from our analysis.

Rain-induced ion events were selected as days, when an ion burst coincided with the onset of precipitation. The median and the maximum (99th percentile) ion concentrations were calculated during periods when the rain intensity was >0 mm h^{-1}. In case of more than one rain-event per day, two separate rain-events were classified as such, if the start of the second one occurred more than an hour after the end of the first one. Any fluctuations in the rain intensity for a time period shorter than 1 hour were considered to be part of a single rain-event. At T0t, we classified 962 rain-events and at T3, 221 rain-events.

The new particle formation event analysis from the ion spectrometer data, including the event classification and formation and growth rate calculations, followed the already well-defined guidelines (Kulmala et al., 2012). In the data analysis, the first step was to classify all available days into NPF event and non-event days according to methods introduced earlier by Hirsikko et al. (2007) and Manninen et al. (2010). The days which do not fulfill the criteria of an event or non-event day, are categorized as undefined days, however, there were no days classified as undefined in this study. The classification was performed manually through a visual inspection of daily contour plots of particle number size distributions. The second step in the analysis was to define the characteristics related to each NPF event, such as the particle growth rate (GR) and formation rate (J). The GRs were calculated for two different size bins (2-3 nm and 3-7 nm in particle diameter) using both ion and neutral particle data from the NAIS. The particle growth rate was determined by finding the times at which the maximum concentrations of ions/particles in each of these size ranges occurred. A fit between the points was then applied to determine the growth rates. The particle formation rate was determined for the lower end of each size bin (2 and 3 nm) by considering the growth rates, the condensation sink, and the coagulation sink.

Referee comment:
l. 345: 'The intermediate (2-4) positive ion concentrations are about a factor of 2 higher (16 (-) wet, 29(+) wet; 18 (-) wet, 32 (+) dry).' - wet, wet, wet, dry - there is something wrong.

Reply to the referee comment:
This mistake happened in the process of correcting the language in the previous manuscript. We are sorry for that mistake. It has been corrected in the revised manuscript as follows:
l. 334: The ion concentrations in the intermediate size range (2-4 nm) are a factor of 2 higher (17 (-) wet, 34(+) wet; 17 (-) dry, 34 (+) dry).

Referee comment:
l. 358: The presented numbers don't match those in the respective table.
l. 362: The presented numbers don't match those in the respective table.

Reply to the referee:
We thank the referee for pointing out theses mistakes, we carefully compared the numbers in the text to those in all the Tables and Figures in the updated manuscript and now there should not be any such mistakes anymore.

Referee comment:
l. 415: The Wang 2016 statement is repetitive.

Reply to the referee:
We agree that the Wang statement is repetitive. We changed the paragraph in the updated manuscript as follows:
l. 416: The appearance of 6-10 nm size particles and their peak concentration could present a similar scenario as observed in Wang et al (2016) of small particles brought down from the free troposphere. Wang et al. (2016) reported the production of small aerosol particles as a result of new particle formation at cloud outflow region, with further transport within the boundary layer via strong convection during precipitation events in the Amazon. Wang et al. (2016) noted that the <20 nm

particle concentrations decreased very rapidly. We suggest the process that we observe to be a local one, as the production of ions was observed to only last for the duration of the precipitation.

Referee comment:
l. 473: 'The results of the back-trajectory calculations are shown in Figure 10. On non-NPF days, the 50 th percentile of air masses originate from about 2.6°S, 56.6°W and 537.4 m.a.s.l., a location on the Amazon river upstream. On NPF days, the back-trajectory calculations show an origin at 1.6°S, 56.5°W and 738.9 mm a. s. l.; further north, which is an area with dense rainforest.'
The quoted air mass origins do not fit to the coordinates in the figure. Also, one should not interpret one single point of a trajectory as the specific origin. Also, 738.9 mm seems wrong.

Reply to the referee:
We agree with the referee that the numbers here are wrong. We corrected the numbers in the updated manuscript
l. 468 On non-NPF days, the 50th percentile of air masses originate from about 2. 9°S, 58.6°W and 545 m.a.s.l., a location upstream of the Amazon river. On NPF days, the back-trajectory calculations show an origin at 2.5°S, 58.5°W and 602.5 m a. s. l.; further north, which is an area with dense rainforest. The results of the back-trajectory calculations are shown in Figure 10.

We also agree with the referee that one should not interpret one single point of a trajectory as the specific origin. The back-trajectories were calculated as ensembles and the median values of those were used for presenting the results in Figure 10. We included this in the updated manuscript as follows:
l. 464: The back trajectories were calculated as ensembles for 24 hours to arrive at 13:00 UTC (09:00 local time) on NPF days at 500m a. s. l.

Referee comment
l. 487: There is no table 4.

Reply to the referee:
We are sorry for this mistake, the reference to the table is corrected in the updated manuscript:
l. 480: Table 3 shows a comparison of the median particle and ion concentrations (25th – 75th percentiles in brackets),

Referee comment:
l. 532: According to table 1 there were 517 rainy days instead of 646 - which is wrong as well. The yearly sums add up to 643 rainy days.

Reply to the referee:
The numbers are corrected in the table and text in the updated manuscript. There were 643 total rainy days. The year 2014 in Table 1 is divided into T0t and T3 site.
Table 1 is revised in the updated manuscript, as follows:

		# of days with rain data	# of days with rain event	NAIS particle data	NAIS ion data	NPF
2011	August	5	2	0	0	0
	September	6	1	4	4	0
	October	28	14	31	31	0
	November	30	18	30	30	0
	December	31	23	16	16	0
total 2011		**100**	**58**	**81**	**81**	**0**
2012	January	31	31	31	31	0
	February	29	18	29	29	0
	March	31	0	9	9	0
	April	30	29	29	29	0
	May	31	25	16	16	0
	June	30	23	4	4	0
	July	31	24	0	0	0
	August	31	12	0	0	0
	September	30	4	0	0	0
	October	31	0	0	0	0
	November	30	5	0	0	0
	December	31	24	16	16	0
total 2012		**366**	**195**	**134**	**134**	**0**
2013	January	31	26	31	31	0
	February	28	28	28	28	0
	March	31	24	31	31	0
	April	30	29	30	30	0
	May	31	27	31	31	0
	June	30	23	30	30	0
	July	31	9	31	31	0
	August	31	15	26	26	0
	September	30	13	30	30	0
	October	30	16	31	31	0
	November	30	24	30	30	0
	December	31	17	31	31	0
total 2013		**364**	**251**	**360**	**360**	**0**
2014	January T0t (rain data only from T0t)	20	13	25	25	0
	January T3	0	0	5	5	2
	February	28	23	28	28	2
	March	31	28	31	31	4
	April	30	27	23	23	0
	May	0	0	0	0	0
	June	0	0	0	0	0
	July	0	0	0	0	0

		# of days with rain data	# of days with rain event	NAIS particle data	NAIS ion data	NPF
	August	31	13	6	6	0
	September	30	16	30	12	0
	October	31	19	13	13	0
total 2014		**201**	**139**	**161**	**143**	**8**
total		**1031**	**643**	**736**	**718**	**8**

Referee comment:
Table 1: Some numbers are incorrectly summed up.
Also, it seems unlikely that there was no rain in March 2012 in the middle of the wet season.

Reply to the referee:
The numbers are now all corrected in the updated Table 1. Our data shows that there was no precipitation in March in 2012, which we agree seems strange, as it is during the wet season.

Referee comment:
There are typos in almost all figure captions and/or labels.

Reply to the referee:
The Figure captions and labels have been carefully revised in the updated manuscript.

Figure 2: There is a lot of variation during February. This is not discussed.
Additionally, the units are missing. Furthermore, the label states you refer to T0t, the caption states it is the outside forest station.

Reply to the referee:
The Figure was updated in the revised manuscript, as we now decided to keep the rainy days in the data analysis. The label and the captions are corrected in the updated manuscript. It seems that the variation in February, is a result of excluding the rainy days. As shown in Table 1, we only have data from February from 2012 and 2013. In February 2012, rain occurred on 18 out of 29 days and in February 2013 on 28 out of 28 days, that leaves not many data points in February, when the rainy days are excluded from the analysis. The referee pointed this out correctly, hence we included the rainy days in the analysis in the updated manuscript again.

Figure 2:

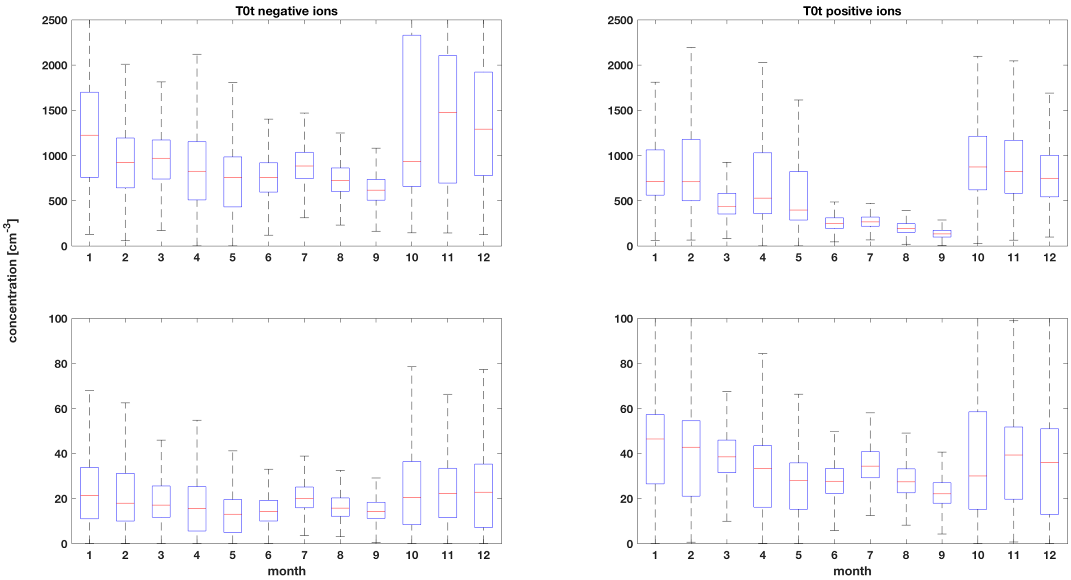

Figure 2: The median annual variations for positive and negative cluster (0.8 – 2nm) and intermediate (2 - 4 nm) ions, from the inside the rainforest site are shown. The boxes show the 25th-75th percentile and the whiskers are 1.5 x IQR (interquartile range), data points beyond the whiskers are considered outliers.

Referee comment:
Figure 3: The units are missing.

Reply to the referee:
Figure 3 is corrected in the updated manuscript.

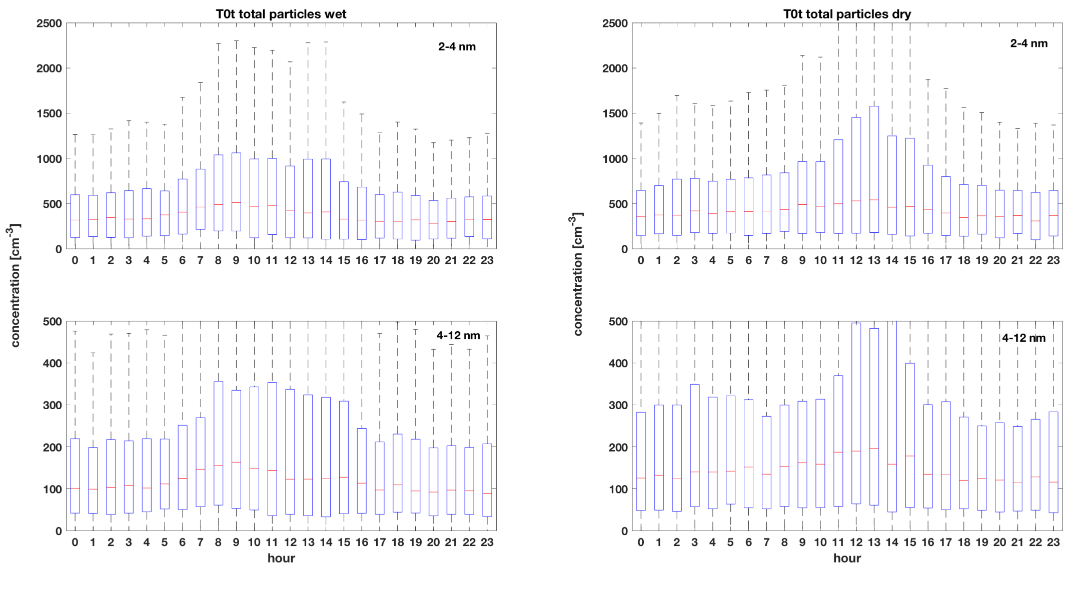

Figure 3. The median diel patterns of the intermediate (2-4 nm) and the large (4-12 nm) particles from the NAIS measurements at the T0t measurement site are shown. On the left -hand side are the values for the wet and on the right-hand side the values for the dry season. The boxes represent 25th – 75th percentiles and the whiskers are 1.5 x IQR (interquartile range), data points beyond the whiskers are considered outliers.

Referee comment:
Figure 4: The precipitation unit is wrong.

Reply to the referee:
Figure 4 is updated in the revised manuscript

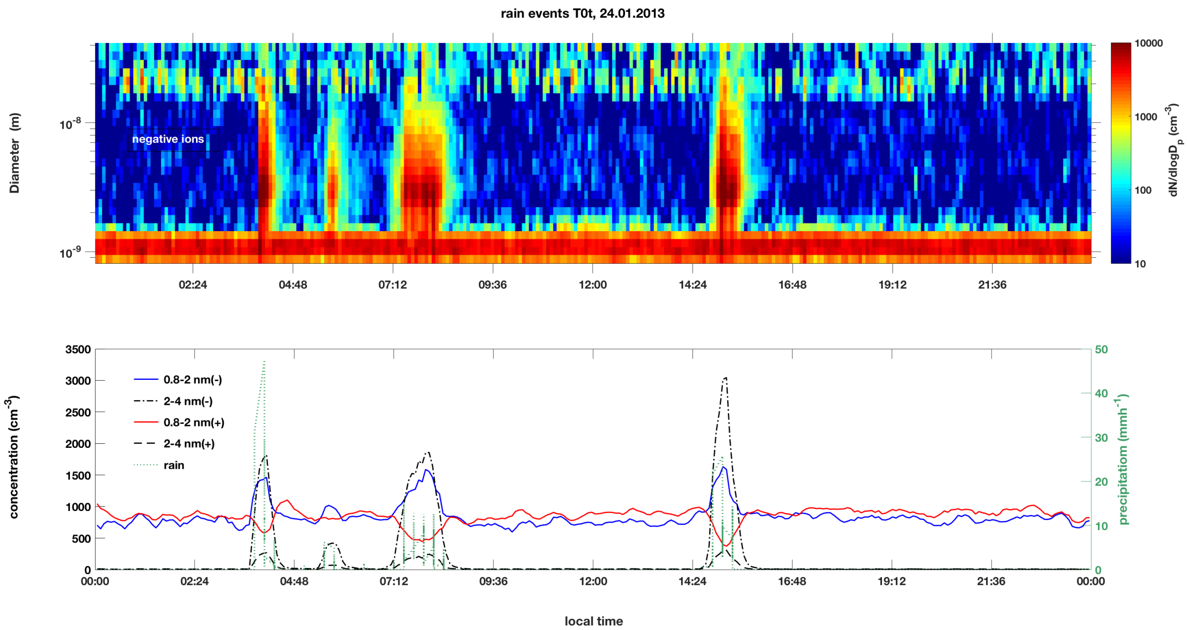

Figure 4. An example for a rain event at the T0t, inside the rainforest measurement site is shown. The upper panel shows the surface Figure of the NAIS negative ion channel. The lower panel shows (i) the concentrations of positive (red line), (ii) negative (blue line) cluster ions (0.8 – 2 nm), (iv) positive (dashed black line), and (v) negative (dot-dashed line) intermediate (2 -4 nm) ions on the left - hand axis. The precipitation rate in mmh^{-1} is shown in green on the right - hand axis.

Referee comment:
Figure 5: The figure raises a lot of questions. Why is the number of days with and without rain zero for March, why is it even possible that both is zero?
One other example: according to table 1, it was raining on 23 days each in June 2012 and June 2013 but in this figure the number of rain days is between 10 and 15. Figure 5 is totally inconsistent with table 1.
Additionally the unit for precipitation is missing.

Reply to the referee:
We agree with the referee that the way the data was presented in Figure 5 in the previous version of the manuscript was not appropriate. In the previous version of the manuscript, we presented the median values for rain and no rain days in the bar plot. This seems to have resulted in the zero values in March. The updated Figure shows the mean number of rain and no-rain days in the bar plot. The data shown in Figure 5 are exactly the same as in Table 1.

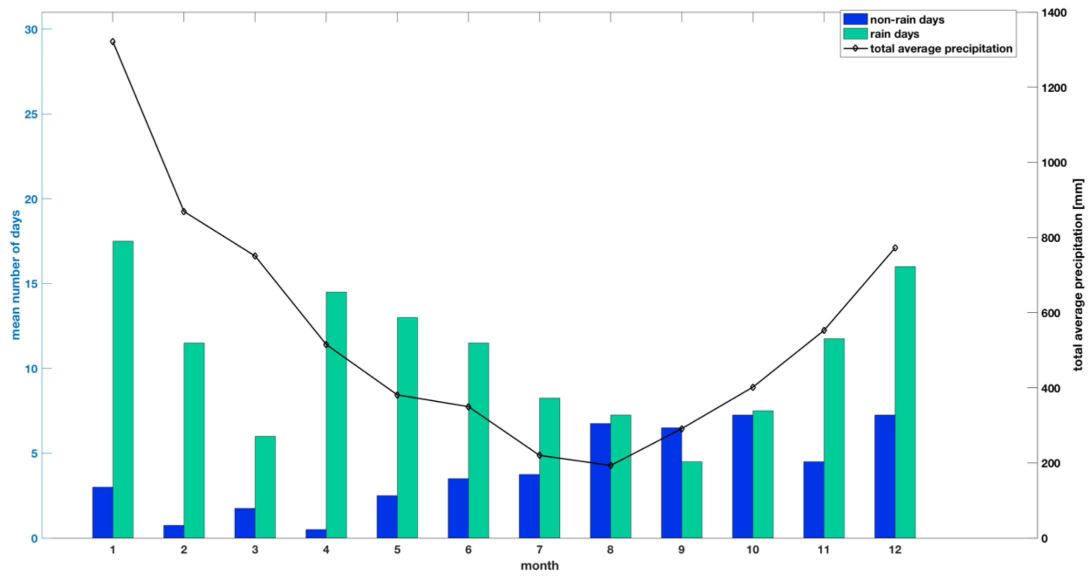

Figure 5. The statistics of the precipitation days at the T0t site are shown. The blue bars show the mean number of days per month with no precipitation and the green bars the mean number of days per month with precipitation rates above zero. The black line shows the average total precipitation per month in mm on the right-hand axis.

Referee comment:
Figure 6: In an earlier version, the rain rates at the two stations were comparable. In this version they are different by a few orders of magnitude. It is concerning that the authors do not recognize or discuss this.

Reply to the referee:
We agree with the referee that this should be discussed in the manuscript. In the previous version of the manuscript, the rain data at the pasture site was taken from an optical rain gauge. The rain data in the current manuscript for the T3 site is using also a Vaisala weather station. We thought that the data of the two measurement sites would be more comparable if for the analysis at both sites, Vaisala weather stations are used for the meteorological data. The Vaisala station and the optical rain gauge differ in the precipitation values, the days and times are the same for both data sets. The data from the optical rain gauge and the Vaisala station at T3 are available at the ARM data browser.
A few sentences have been added in the updated manuscript.
l. 224: In addition to the ion spectrometer measurements, the measurement hut hosted a Vaisala system (WXT-520) for acquiring meteorological parameters.
The auxiliary data from the T3 site, presented in this manuscript includes measurements from an ultrafine CPC, with a 50% activation diameter of 10 nm and an SMPS with a lower cut-off of 20 nm. The meteorological data was retrieved from a Vaisala system (WXT-520). Those datasets are available at the ARM data browser.

Referee comment
Figure 10: Units are missing.

Reply to the referee:
Figure 10 updated with units in the revised manuscript

Figure 10: median back trajectories for NPF (blue) and non-event (red) days are shown. The trajectories were calculated 24hours backwards arriving at 09:00 local time at 500 m a.s.l. at the open pasture measurement site.

Referee comment:
Figure 11: Why is the lower cut off of the SMPS at 20 nm?

Reply to the referee comment:
When looking at the size distributions measured by the SMPS and comparing them to the ones measured by the NAIS, the SMPS starts to be unreliable below 20 nm. The NAIS is a more reliable instrument for the smaller sizes than the SMPS. In the SMPS, the aerosol needs to be charged first, which is problematic, due to the low charging probabilities at smaller sizes. Additionally, SMPS inlet systems usually suffer from high diffusion losses.