

Reply to Reviewer #2

General

The submission “Marine Stratocumulus to Land Fog Transition in the Coastal Mountain-Range of Atacama Desert” is in my opinion a suitable entry for the journal Atmospheric Chemistry and Physics (ACP). The research article describes in detail the setup, instrumentation and measurements during the StraToFog campaign in the Atacama desert in Chile. During the field campaign of around 11 days, fog as a result of inland advection of the 200 to 400 m thick Sc layer was recorded along an transect going from the slightly offshore to 15km inland at 7 locations. This allowed the disentangling of the the MBL evolution, the various micrometeorological processes and their dynamics throughout the fog events. Initially a case study is used to discuss in detail the fogs influence before generalisation for the whole measurement period, giving an interesting insight into the fog characteristics. I do recommend publication but advise to 1) streamline some issues outlined in the below major and minor comments, especially as these would enhance the quality and understandability of the article.

We thank the reviewer for his/her positive assessment of our manuscript and for his/her concern about improving the quality of this work. We have carefully answered and corrected every reviewer comment in blue font below, indicating where in the revised manuscript we have introduced changes. We have paid special attention to carefully replying to reviewers' concerns about instrumentatios setup, the precision scale and the role of wind in fog collection.

Major Comment(s)

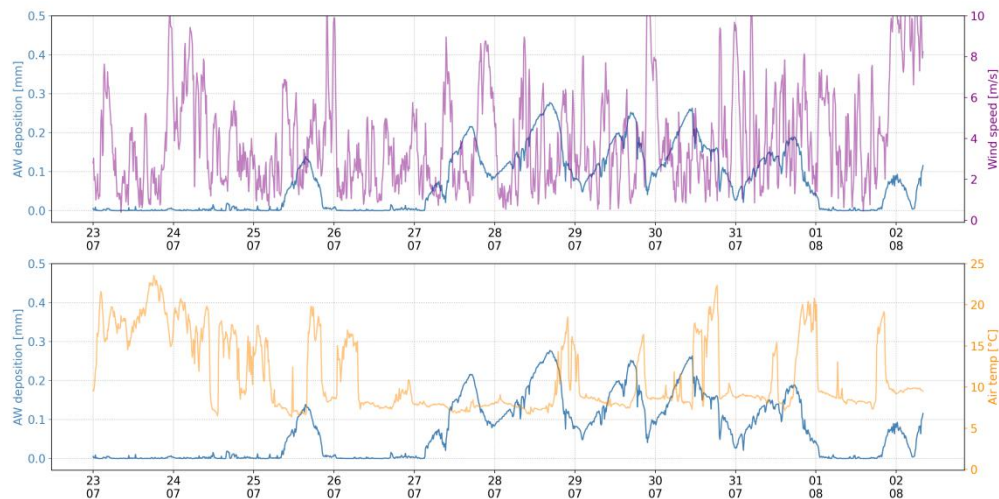
C1: Several of the figure captions are confusing as they list the wrong station/distance/height, e.g. Fig7 states “site C approximately at 860 m ASL (5 km offshore)”, according to Table 1, site C is at 55 m ASL and 2km inland. Please check them carefully and I suggest also to say inland distance as offshore generally implies on the ocean rather than inland. The same holds true for the schematic figures. It would be useful to mark in all schematic figures the station location. Based on Fig 1a/b I find the vertical profile somewhat misleading as Fig1b gives the impression of gradual increase while Fig 1a shows that the slope from the ocean to D is simply less steep – not that there is another step in the terrain. Furthermore, there is some general inconsistency for the format of the stations, namely sometimes in brackets, sometimes without. In the same line I would strongly suggest to split E into two letter due to their altitudinal difference, meaning E_{leeward} becomes F and F becomes G.

In response to the reviewer's major concern, we agree that some station/distances/heights are incorrect. We have corrected those values in Figures 1 and 7 and Table 1. Likewise, we have changed the word "offshore" throughout the text to "inland", as suggested. We also agree to mark the station location in all schematic figures, like Figure 4. However, in Figure 10, we prefer not to include them to avoid oversaturation, as relevant processes become less understandable when the figure has too many elements. Regarding Figures 1a/b, we are aware of these misalignments observed by the reviewer on sites C/D. Since the transect used in this study is not a straight line from the coast, Figure 1b intends to schematize it as a straight line. For this reason, the profile shown there is a topographic one but is shown diagonally. Taking the reviewer's comment into consideration, we have included a small correction to the schematic profile to avoid confusion. Finally, along with the changes in Figure 1b, we have split site E into E and F and site F into G, as suggested.

C2: I find Table 1 with the instrumentation difficult to read as there are 2 EC systems at E but from my understanding only one precision scale? Based on Fig 1, it seems that this balance is overly exposed to the air (if it is the device in the middle of the image) and thus vibration as well as enhancing cooling. Were steps taken to enhance the representation of this scale accordingly as the exposure especially would lead to jitter in the measurements and higher cooling to added dew as a preferential surface for condensaton.

Yes, there is only one high-precision scale at site E. Now, with the split between E windward and leeward into E and G, Table 1 is much clearer. In addition, we have added some separation lines to avoid confusion. Before the *StraToFog* experiment, we tested the precision scale under different

environmental conditions to evaluate the performance and possible effects of wind or temperature. The scale is located at the centre of a plastic cylinder, which prevents the soil sample from being blown out by wind (losing weight). The scale that supports the soil sample is also isolated from the bottom and plastic wall by a separation of at least 5 cm. To test the effect of temperature on the scale, we took two weeks of measurements, where the first days (as shown in Figure 2e) we were above the MBL under non-cloud conditions. During these days, the scale did not show any weight change, even though temperature varied largely over the diurnal cycle (days 23 and 24 in the plot below). Later on, when we had fog coming in the second week of measurements, we observed changes on the scale. This information is shown below as proof that wind and temperature do not affect the scale measurements.



C3: The fog collection rate is in my opinion strongly dependent on wind speed as higher wind speed transport in the same time interval a higher number of droplets through the sampling interface of the SFC. As such, comparison of different event would be better with a normalisation and also allow for better yield calculation.

We agree with the reviewer's opinion that wind speed is the main physical process controlling fog collection, as shown in Figure 7c and d. This effect has been well-described and modeled before by Lobos-Roco et al., 2025 (<https://doi.org/10.5194/hess-29-109-2025>). For our experiment, we measure fog collection using SFC and wind speed with a meteorological station. Unfortunately, we do not measure the fog microphysics in this experiment (liquid water content, droplet concentration number and droplet radius) to be able to close the fog collection budget. The liquid water content that we measure is estimated from the radiosondes as the adiabatic liquid water content. For this reason, we cannot calculate the yield of fog collection. However, we measure it with an SFC to describe fog diurnal variability at the local scale in relation to thermodynamic variables (Fig. 7 and section 3.2.1). We acknowledge that the reviewer's suggestion is a good idea, but it is not possible or necessary to apply it to this manuscript. Although we took his/her suggestion, including a small phrase in the conclusions at line 397-398 as:

"The (over)saturation of this marine air at the windward mountain slope has a higher liquid water content than in the morning, since the vapor pressure increases to reach saturated vapor pressure. Likewise, wind speed increases compared to the night-morning, transporting more (over)saturated air (fog droplets) into the collector interface, yielding higher collection rates".

Minor Comment(s)

L11: Why does lower air temperature lead to lower liquid water content? Couldn't additional water vapour condense out?

According to Figure 7, during the night, condensation is reached at a lower vapour pressure than in the afternoon; then e_s , controlled by air temperature, drops to reach e (Fig. 7b), and saturation is reached

under lower humidity. In addition, wind speed is low and mainly from the inland desert. These two thermodynamic conditions lead to lower q_l (0.1 g kg^{-1}) compared to the afternoon (Fig. 7d).

L27: Do you mean “due to the growing” .. “ever more attention”/“attention is increasingly being given” ... “in recent years”?

We agree, we changed it according to this suggestion.

L17-41: I’m missing some information on the Sc deck regarding typical cloud thickness/CB/(CT is given at ~ 1000) as these values are relevant for the transition to fog/intersection with the mountain range. (thickness is in L46 but would be helpful before).

We agree, we have introduced the thickness of the Sc in the ocean at line 38 as: “extensive and continuous Sc cloud of $\sim 250 \text{ m}$ thick (Wood, 2012) within the MBL $\sim 1000 \text{ m ASL}$ (Rahn and Garreaud, 2010)”

L80-L90: I think it is better to keep everything in m ASL as this relates best to the Sc and its relative location. AGL is primarily relevant for the UAV limitations and should be given there in brackets (where not $\sim 1200 \text{ m ASL}$ is given).

We agree. In Table 1, everything is given in ASL. However, we opted to keep the three AGL mentioned between these lines because they refer to the height that the radiosondes and the UAV reach above the surface from which they were launched, which, in the case of the UAV, depends on the height of take off.

Fig 2: I suggest to add 1-3 satellite images of GOES-E here for the selected event discussed in Fig 3.

The former Figure 2 included a satellite image. However, we decided to replace it with the surface pressure anomalies and two pictures because the satellite images did not visually represent the height of the cloud layer during the first and second weeks of the experiment. Below, we show an example of two MODIS images for the two weeks, where no significant differences in cloud height can be seen.

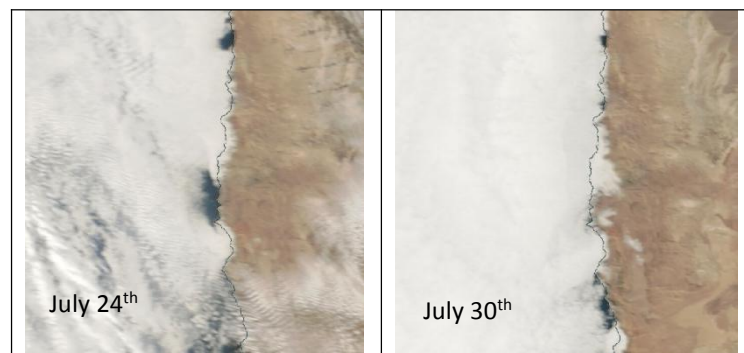


Fig3: It might be interesting to use the ascent speed of the radiosonde as an indicator of vertical wind and thus maybe entrainment? It would be useful to start with d instead of a here, and mark the Sc layer (evident by q) in the remaining three figures with a contour.

The vertical speed of the balloon does not represent the real vertical wind, since it depends on the volume of helium inside the balloon. The rate of ascent recommended by the manufacturer is 5 m s^{-1} , which is equivalent to approximately 0.5 kg of helium. Regarding the order of Figures, we started with potential temperature to first explain the evolution of the MBL, where θ is the main variable. However, we agree to indicate the cloud shape with a dotted line in every subfigure in Figure 3.

L177: Does not the dynamics itself not also influence this, and lead to the strong increase of CT as air flow drives the fog up the mountain, especially in the afternoon as shown also by Fig4?

Yes, we agree with this observation, which is mentioned in the previous phrase in lines 175- 176 as: "This dynamic is produced by the activation of the afternoon sea breeze (Fig. 3c), which promotes moisture advection (Fig. 3b), maintaining the Sc cloud during its inland transition". However, to make it more explicit and take into account the reviewer comment, we have introduced the following change: "This dynamic is produced by the activation of the afternoon sea breeze (Fig. 3c), which promotes moisture advection (Fig. 3b) and pushes the cloud above the mountain, maintaining the Sc cloud during its inland transition".

Fig 6: This figure should be extended to give time series at all stations for this particular event, thus facilitating the understanding of the dynamics of the time period and allow a direct comparison with Fig 7.

We thank the suggestion of the reviewer, however, sites B, E and F are the only ones including a meteorological station registering time series (Table 1 and Figure 1b). This was a strategic decision during the experiment due to limited resources. The met station at site B represent the marine conditions measured by sites A, B and C; the station at site E represent E and D conditions and F (now G) has their own met station.

Fig 7: Suggest do add the difference $e_s - e$ on the left axis in Fig 7c.

Ok, we agree.

L257: by $T_s \rightarrow$ by T_s in this and similar environment

Ok, we agree.

L291-293: This is rather an effect of the advection as described in the lines just before, not that fog forms or do you mean when no advection occurs here? If so, this is not clear. These lines should be part of the previous paragraph, i.e. each state of the three should be a separate paragraph to facilitate the reading. I would actually suggest to start with the morning setting in both the text and the schematic in Fig 10.

We agree with the reviewer's suggestion to split the paragraph into separate paragraphs explaining subfigures 10a, 10 b, and 10c. In addition, to be more precise, we have introduced the following change on line 292: "These conditions maintain fog with low liquid water content, which, combined with weak winds, yields low fog collection rates".

L308: But its already advected fog (or the advected Sc layer) beforehand? The change is mainly that air is still saturated now also on the leeward side?

Yes, during the afternoon, the Sc layer is advected into the windward slope of the mountain, forming fog, but on the leeward slope only the MBL moisture (unsaturated air) reaches the surface, producing water vapour adsorption. Later in the evening, the advected Sc layer dominates over two slopes, producing surface fog deposition. For avoiding confusion, we have modified the sentence like: "Later in the evening, advective Sc-fog layer dominates the windward and the leeward slopes, producing surface fog deposition (Fig. 8)".

L317: There are more sources for the Namib and similar processes, namely many by Andersen et al. and a similar field campaign is outlined in Spirig et al.

We appreciate the reference suggestion, we carefully check the literature and we have decided to add the one of Spirig et al. (2019) because it similarities in the reserach strategy and results.

L326-L333: Give some context how far away the sampling occurred to give easy context for comparability

Agreed, we added the time range of the studies to give a better context for comparison.

L336: I'm missing the reference of Feigenwinter et al. since they used microlysimeters in the Namib desert too.

Agreed, although the original work of the microlysimeter on which Feigenwinter based the study is the one we cited from Heusinkveld et al. 2006. The reference has been added.

L376-379: Is this also relevant for AW prediction for the use of fog water as additional water source?

Yes, absolutely, we mentioned this idea in the introduction. To take the reviewer's comment into account, we have added a final sentence: "Likewise, this more accurate processes representation will set the basis upon which AW resources can be quantified and forecasted."

Typos/Editorial suggestions

L4: "this relevant system" → "this crucial process" (since it's about advection/transition)

Agree, we changed the sentence

L5: at the coastal → in the coastal (or at the coast of the Atacama)

Agree, we changed the sentence

L8: Ensure "15" and "km" are on the same line with a non-breakable space or \: if written in latex

Thanks it has been corrected.

L11: "due to lower wind speed and liquid water content" → "due to both lower wind speed and lower liquid water content".

Agree, we changed the sentence

L17: results in fog at the "results in fog due to the intersection of the Sc with the"

Agree, we have changed the sentence.

L19: on Earth: the Atacama Desert → "on Earth that is the the Atacama Desert" or "on Earth, the Atacama Desert"

Agree, we have changed the sentence.

L27: to ecological → to the ecological

Agree, we have changed the sentence.

L48: fog can be intercepted by rocks → water from the fog collects on

Corrected.

L58: this research aims to → we aim to/our research aims

Agree, we have changed the sentence.

L59: StraToFog, designed through a topographic with → StraToFog with a topographics transect experimental design/setup to ...

Agree, we have changed the sentence.

L67: relic fog oasis?

Yes, as described in the literature.

L 68 crust(Lehnert → crust (Lehnert

Corrected.

L70: elevates → rises

Corrected.

L71: landscape → the landscape / on the surface, due to → on the surface due to
Corrected.

L72: the experiment was deployed → measurement were conducted
Agree, we have changed the sentence.

L74: from a ~2km → from ~2km
Corrected.

L77: to the vertical → by the vertical variability?
Corrected.

Fig1: Source for a? Google Earth? Self-made? (looks nice)
Google Eaterth
Google Earth, the reference has been added

L96: which included → which influenced
We say that the site includes measurements of net radiation...

L98: to weigh → weighing (or simply measuring the weight of a ...)
Corrected.

Tab1: localization → location
Corrected.

Fig2: I suggest to show c/d closer on the region as the pressure systems are large enough to be clearly seen even when zoomed in a bit more. Also “The saded time period correpsond” “The → shaded time period corresponds”
Corrected.

L121: StraToFog is italic in other places, but normal here. Change here to be consistent
Corrected.

L134: around 15 K. → around 15 K over 300 m height difference – so 5 K/100m?
No, the inversion layer is the theta jump measured as the difference between the MBL mixed potential temperature (vertical line) and the begining of the free troposphere vertical gradient.

Fig3: It would be helpful to add a vertical line at 16 LT in the vertical time profiles so that its evident without the caption when the ascent happened
Added.

L155: in (Schween ..) → (Schween ...)
Corrected.

L166 between 2 and 3 km → between 2 and 3 km inland
Corrected.

L167: The CT between 2 and 3 km inland → The CT remains nearly constant over the same distance, ...
Corrected.

L173: This lifting of the CB → This lifting of the CB and CT?
Corrected.

Fig7: correspond to → corresponds to
Corrected.

L221: conductive →conducive
Corrected.

L223: e and e_s near → make italic or use math symbol as introduced on the line just before.
Corrected.

L244-L245: indicating that the weight measured by the high precision balance is decreasing, which means surface evaporation → as evaporation occurs, reducing the weight measured by the high precision balance.
Corrected.

L257: predicted by T_s →predicted by T_s in this ecosystem
Corrected.

Fig8e: Add vapor adsorption with marker similar to dew/fog
We cannot add a marker for vapor adsorption in Fig. 8e because, in terms of RH over T_s , vapour adsorption and evaporation do not differ. Instead, we added the vapour adsorption marker in Fig. 8d, where it is clearly grouped.

L247/Fig8: In L247 it's vapor absorption and in the Fig8 is vapor adsorption, I would think its mainly adsorption as surface process/top most mm of pore volume maybe? If intentional disregard
Yes adsorption, corrected.

L264: respectively (Fig. 1b) → respectively (Fig. 1b) during the time from the 25th of July onward, i.e. the time period with nightly fog events.
This correction would make the sentence excessively longer. We added "during the *StraToFog* experiment foggy days".

L267: low radiation→ low net radiation? Clarify if net or you refer to a component
Low net radiation, corrected.

L269: where Sc cloud → where the Sc cloud
Corrected.

L289: weakens as it is → weakens over the course of the night?
Corrected.

L291-292: oversaturated air is induced by atmospheric cooling; then e_s decreases to reach e → air oversaturates due to atmospheric cooling as e_s decreases down until e .
Corrected.

L293: yield low→ yields low
Corrected.

L293: remains trapped → remains capped by the subsidence
Corrected.

L293: although unsaturated ($RH < 100\%$) → although humidity decreases below 100% due to the descent of air on the leeward side.
Corrected.

L298: as a consequence of fog dissipation, air temperature → as a consequence of fog dissipation, the surface is receiving solar irradiation, in turn increasing available energy and thus initiating stronger turbulent fluxes as well as an increase air temperature.
Corrected.

L302: the topographic barrie → the topographic barrier and continous advection of the Sc layer, ..

We mentioned the Sc advection just in the previous sentence.

L304: ocean moisture advection → ocean moisture advection under the Sc layer
Corrected.

L305: (Fig. 7b) (Montecinos et al., 2018) → (Fig. 7b and Montecinos et al., 2018)
Corrected.

L307: while the → despite the ... due to the strong RH gradient ...
Corrected.

L320: CT → Cts
Corrected.

L360: flux and dew formation → flux and also dew formation due to ongoing radiative cooling
Corrected.

L360: sunrise onwards, surface temperature triggers → sunrise onwards, surface temperature increases as the Sc/fog only partially blocks solar irradiance, which triggers the turbulent fluxes.
Corrected.

L378: StraToFog → *StraToFog*
Corrected.