1 Reply to Reviewer 2

Review of the article titled Life Cycle of Stratocumulus Clouds over one Year at the Coast of the Atacama Desert by Schween and coauthors for publication in the Atmos. Chem. Phys.

The authors have used 1-year of data collected at the airport site in Northern Chile to document the seasonal, and diurnal cycle of clouds, water vapor, LWP and turbulence. Focus is on marine boundary layer clouds. The article is overall well-written and will be of interest to the general meteorological community. Data in that part of the world is very rare, so the work is novel. Please find below my comments that can further improve the paper.

We are grateful to reviewer 2 for his comments and suggestions to improve the paper. We will adress the points with italic text like this and provide changes in the text in red .

1.1 Major Comments:

The paper is very long at this moment with 16 figures and 2 tables. I suggest you combine some of the figures and maybe put some in the supplemental material to reduce the paper. Figure 5 is redundant due to figure 6, so maybe put figure 5 in the supplemental material. Same thing can be done for Figures 12 and 13. You can also combine the Figure 6 and figure 7, by putting the cloud boundaries on top of the cloud fraction. Currently the paper is too long, and it will be good if you can bring it down to 10 figures. Thanks.

We believe that Figure 5 (cloud FOC per hour) by itself provides valuable information which cannot directly be found in Figure 6 (cloud FOC per hour and height interval). An incorperation of Figure 7 (mean cloud base and top heights per hour) into Figure 6 (cloud FOC per hour and height) including the scatter would make Figure 6 very difficult to read. Figure 12 (BL class FOC per hour) and Figure 13 (BL class profiles) show different things and we see no way to combine their content. We therefore stay with the current selection of plots.

Figure 14, 15 and 16 and the associated text, you have tried to probe largescale fields that might control the boundary layer dynamics and cloudiness. I suggest you plot the lower tropospheric stability (Klein and Hartmann, 1993) or Estimated Inversion Strength (Wood and Bretherton 2006). You can further plot all the reanalysis reported surface sensible heat flux and latent heat flux. These quantities over the ocean and over the land site will tell you if there are any local factors that differ from the ocean and the site. This might also illuminate why the marine clouds evaporate over land at your site. Your explanation of stability and winds etc. ignores advection, and it can simply be the case that the clouds form over the ocean and dissipate over land due to lack of moisture supply from the surface, rather then shortwave heating.

We think that an investigation of surface fluxes would be a good starting point for a further analysis. Nevertheless you have to consider that the topography at the coast is rather extreme with a steep cliff of 400 m height at just 4 km distance from the coastline. Further inland topography rises within a few kilometers to more than 1 km height asl, i.e. above the ocean inversion. The IFS has at the location of IQQ already an elevation of around 200 m above sea level, i.e. 150 m higher than in reality. Such an analysis would therefore require a careful validation of model or reanalyis data. We believe that this becomes too far out of the scope of this paper.

Figure 15 is not in a suitable form. The standard deviation lines are not visible for any season except JJA.

we apologize for that. Reviewer 1 had a similar comment. We adapted the scaling of the figure.

I think it will be good if you plot the phase diagrams of surface winds to understand any local circulations. There are many papers on such a phenomenon, so not going to mention here. Please look at papers that probe the land-sea breezes. Probing this will make your article much stronger. Thanks.

Focus of the paper are the clouds. The wind profile is more a supporting argument to explain the diurnal development of the clouds. We searched the literature but we found no representation or analysis which we thought would increase the understanding of the phenomenon. Given the fact that the paper is already too long and we were asked to reduce the number of figures we decided to leave it as is.

Last major thing I will mention is the lack of information on profiles of turbulence. The Doppler Lidar was pointing vertically, so you can derive estimates of variance and skewness of vertical velocity. These are also used for PBL classification. I suggest you show the diurnal cycle of these quantities same as you have done for cloud properties.

As described in section 2.3.2 the boundary layer classification scheme incorporates turbulent dissipation rate ϵ and vertical velocity skewness S_w. Turbulent dissipation rate is derived at every height from the spatial power spectrum of vertical velocity as described in Manninen et al. (2010). Figures 12 and 13 accordingly represent these properties with the distinction non turbulent versus turbulent based on $\epsilon \lesseqgtr 10^{-4} m^2 s^{-3}$ and the distinction cloud driven / convective based on $S \lesseqgtr 0$. We understand the interest of the reviewer to view profiles of turbulent properties and their development over the day. But again: the paper is already long and we were asked to reduce its length.

1.2 Minor Comments:

It will be good if you show the diurnal cycle plots as a function of local time rather than UTC. This will make things easier to understand.

We intentionally used UTC as time axis because for this location night appears at the left side and daytime on the right side. We incorporated in all plots the average time of sunrise and sunset to clarify this. We believe that this is the better method of representation as neither night nor day are split. Nevertheless we added a sentence to figure 3 to clarify:

Night appears on the left side, and day on the right side of each plot.

Line 23-24: Mention precipitation loss of water too. Also, not sure what you mean by fresh. Thanks.

"Fresh Water " at this point is indeed somewhat misleading. We included precipitation as mechanism. the sentence reads now:

Evaporation from the ocean and mixing through the boundary layer provides a continuous flow of water vapor balancing the water loss at cloud-top (Schubert et al. 1979I, Stevens et al. 2003) and precipitation back into the ocean (Wood 2012).

Line 39-41: These are very bold statements. So can you please add reference to support them? Thanks.

The reference is the same as in the sentence before. We nevertheless added it at the end of the sentence.

Figure 1: Not sure what is the point of showing cloud boundaries on this map. They are also difficult to identify and not discussed in the text.

We added a sentence:

The stratuscloud thus interferes with the topography whithin a few kilometers, provides as fog water to the surface and is limited in its extension to the east (blue and red lines in Fig.1).

Line 111: you mean eastern Pacific?
Yes we do - we corrected that.

Line 220: situation seems like a strange word to use here.
That sounds indeed a bit weird - We dropped the word stratocumulus in front of the word 'situation'

Line 231: do you mean evaporate the clouds? Dissolve has a solid into liquid connotation.
Yes we do. We used the term consequently seven times, too many languages interfering with each other in my brain. Replaced them all by evaporate.

Line 248-253: Seems that the text contradicts the figure. Can you please double check? The numbers dont seem to add up.
We checked the numbers: they are correct.