

**Referee comments (questions) are in blue**

**Author comments (replies) are in black**

**Modifications made in the new manuscript by the authors are in red**

**Displacements made in the new manuscript are in green**

## Replies to the referee

We thank the anonymous referee for their very useful comments and suggestions, which help to further improve the paper. Please, find below our replies. Note that the line numbers we use in our replies refer to the track changed manuscript.

### Summary:

This paper uses a dataset (introduced in a previous paper) that has co-located cloud and wind profiles. The lidar retrievals reveal a relationship between the Tropical Easterly Jet, deep convection, and cirrus clouds over the Arabian sea during the South-Asian Summer Monsoon (June-October 2020). Cirrus clouds are twice as likely to occur on mornings following a strong TEJ the evening before. The authors hypothesize a few mechanisms for the strengthening of the TEJ, concluding that deep convection is a major source of divergence from the thermal winds derived from theory. The time lag between events suggests a causal relationship on the frequency of occurrence of cirrus clouds.

### General comments:

The manuscript is much improved from the last version laying out the four hypotheses and using the data to back them up. H4 feels the most significant and supported/interpreted. Section 2.3 Domains of study is a great improvement. However, there are still some major organizational issues that impact clarity and make the paper feel disjointed. This manuscript feels like two separate papers (Sec 4 and 5) being forced into one without much interpretation or connection between the two.

To make the paper feel more unified, you could start with Sec 5 (Deep convection modulates the TEJ on a time scale of half a day). The most significant result of this paper is Fig. 12 showing the schematic of the relationship between deep convection and TEJ; having this main result earlier in the paper could be helpful. Then we look at the impact on cirrus clouds (currently Sec 4) from these changes in both TEJ (winds) and deep convection (and injection or water vapor) after you've already shown that these two (deep convection and TEJ winds) are related. Framing it this way may make it easier to explain the concepts in Sec. 4 since the reader already has developed an understanding of Aeolus, deep convection, and TEJ winds.

We agree on this suggestion. Former Section 5 is now Section 4 and vice versa. To make the paper feel more unified, we added a paragraph at the beginning of the new Section 5 “Drivers of cirrus cloud cover over the Arabian Sea”. This paragraph is a transition between our Section 4 and Section 5:

*“The TEJ variations described above, that we mainly attributed to variations in the meridional temperature contrast, and to a lesser extent to variations in the convective patterns, may in turn have consequences on the cloud cover. In this section we investigate the role of the wind in the cirrus cover, and we attempt to disentangle it from the roles of convective and temperature variations.”* Lines 348-351.

Following this new outline, we accordingly changed the abstract, in which we now first mention the TEJ variations, and then the cirrus cover variations:

*“In this study, we first observe that while the Tropical Easterly Jet (TEJ) is primarily driven by the thermal contrast between warmer land and cooler Indian Ocean, the diverging-rotating outflow around deep convective clouds can strengthen or weaken the TEJ over the Arabian Sea with respect to the wind expected from thermal wind balance, explaining a 3 m/s amplitude variation during the South-Asian Summer Monsoon (SASM). We further focus on disentangling the role of this wind in the formation of cirrus clouds over the Arabian Sea during the SASM, from the roles of temperature and convective intensity variations.”* Lines 3-6.

We also changed the outline of the paper in the last paragraph of the introduction:

*“The paper is structured as follows. We first briefly describe our Aeolus dataset, our domains of study, and the methods used to distinguish deep convective clouds from cirrus clouds and to calculate the thermal wind (Sect. 2). We characterize the annual variation and the diurnal contrast of winds and clouds over the Indian region (Sect. 3). We evaluate how different deep convection patterns above the Indian region weaken or strengthen the zonal wind through divergence and vorticity of the convective outflow on intraseasonal time scale (Sect. 4). We then quantify how the zonal wind affects the thin cloud cover over the Arabian Sea, and we attempt to disentangle this effect from the respective roles of temperature and convective intensity variations (Sect. 5). We finally conclude this paper in Sect. 6.”* Lines 103-107.

In Subsection 5.4 “Deep convection”, as the TEJ fluctuations are now discussed before the causes of the cirrus fluctuations, we replaced the sentence: *“This change in the location of the maximum of deep convective cloud cover raises the question about the potential role of the location of deep convection on the zonal wind speed over the Arabian Sea, which will be discussed in Sect. 5”*

by the following sentence:

*“These changes in the locations of the maxima of deep convective cloud cover depending on the wind intensity can be compared with the results of Sect. 4. The patterns of differences are correlated but are not identical, as the composites are built here depending on the absolute value of the TEJ, whereas in Sect. 4, they were built depending on the TEJ deviation from the thermal wind balance.”* Lines 451-454.

We finally swapped the order of the two main paragraphs in the conclusion to bring them into line with the new structure adopted throughout the paper.

The hypotheses in Section 4 were a bit confusing and the results unclear as to which hypotheses you end up supporting. I'd frame these more like three equally likely hypotheses: H1; H2; and H3.

We agree on this suggestion and we rephrased subsection 5.1 “Hypotheses”. We first give a general picture of our proposed mechanism, which is not labelled as a hypothesis:

“..., we can thus *propose the following mechanism*: the water injected *over* the Bay of Bengal and the Indian continent at 18 LT and advected by the TEJ during the night *through cold temperatures* is at the origin of the cirrus clouds found at 06 LT over the Arabian Sea (Fig.) *We attempt to establish this mechanism...*” Lines 359-363.

We mention again “this mechanism” in the subsection 5.5 Discussion:

“Overall, these diagnostics *validate the general mechanism proposed in Sec. 5.1, as they show that...*” Line 512.

Then we frame three equally likely hypotheses : the cirrus cover over the Arabian Sea is sensitive to: (H2) the wind; (H3); the temperature; (H4) the deep convective clouds over the Bay of Bengal/continental India;

“*We attempt to establish this mechanism by testing the sensitivity of the cirrus cover over the Arabian Sea at 06LT to: the wind (hypothesis H2, Sect. 5.2), the temperature (hypothesis H3, Sect. 5.3), the deep convective clouds above India and the Bay of Bengal at 18LT (hypothesis H4, Sect. 5.4.). In Sect. 5.5, we draw a conclusion from our results and we study their implication in a warmer climate.*” Lines 361-365.

This is thus the new subsection 5.1 :

“Observational results of Sect. 3 suggest that deep convection *is strongest* over the Bay of Bengal and the Indian continent at 18 LT (Fig. 4a), providing a source of water in the upper troposphere. *This water (vapour or ice crystals) may be* advected westwards during 12 hours by the TEJ, which has a maximum intensity over the Arabian Sea at 06 LT (Fig. 4h). As cirrus clouds found over the Arabian Sea are not always correlated with opaque clouds found at the same place and at the same time (Fig. 4i), we can thus *propose the following mechanism*: the water injected *over* the Bay of Bengal and the Indian continent at 18 LT and advected by the TEJ during the night *through cold temperatures* is at the origin of the cirrus clouds found at 06 LT over the Arabian Sea (Fig. 4e). *We attempt to establish this mechanism by testing the sensitivity of the cirrus cover over the Arabian Sea at 06LT to: the wind (hypothesis H2, Sect. 5.2), the temperature (hypothesis H3, Sect. 5.3), the deep convective clouds above India and the Bay of Bengal at 18LT (hypothesis H4, Sect. 5.4. In Sect. 5.5, we draw a conclusion from our results and we study their implications in a warmer climate.*” Lines 353-365

Then each subsection dives into each of these hypotheses using data and reanalysis attempting to support or reject each hypothesis: (H1) Wind; (H2) Temperature; and (H3) Deep convection.

We changed the titles of the subsections 5.2, 5.3 and 5.4 following your suggestions (5.2 Wind; 5.3 Temperature; 5.4 Deep convection). H2, H3 and H4 are now clearly mentioned in each of these subsections, thus each subsection is associated with one hypothesis.

Furthermore, there should be a short discussion section to tie these two disparate parts together (this is also where you should discuss "implications for future warming Sec 4.6).

In Section 5.5 “Discussion”, based on our results in 5.2 and 5.4, we first show the necessity to disentangle the roles of deep convection and wind:

*“The sensitivity of the cirrus cloud cover to the wind, noted in Sect. 5.2, might be explained by the relationship between the cirrus cover and the deep convective cloud cover (Sect. 5.4), being itself larger when the wind is more intense (Sec. 5.4), in which case the wind would not play a direct role in the cirrus formation. Alternatively, higher occurrences of cirrus clouds over the Arabian Sea may be the result of a combination of both controlling factors : faster winds and larger sources of water injected in the upper troposphere over India and the Bay of Bengal. To disentangle the roles of deep convection and upper tropospheric wind in the occurrence of **cirrus** clouds, we show in Fig. 11d four PDFs of  $u_{allsky}(AS, 06LT)$  for different values of  $\alpha$ , with:”* Lines 473-481.

We conclude the discussion on  $\alpha$  by referring to the general mechanism proposed in Section 5.1, and we sum up our results by a schematic. In this way we hope to clarify what we end up supporting:

*“Overall, these diagnostics **validate the general mechanism proposed in Sec. 5.1, as they show that both faster westward winds over the Arabian Sea, and larger deep convective cloud fractions over the Bay of Bengal and North-East India contribute hand in hand to an increase of the cirrus cloud fraction over the Arabian Sea in the morning. A schematic is given in Fig. 13 to summarize our results.**”* Lines 512-515.

Then we tie the main results of Sections 4 and 5 together, as we discuss the implications for future climate:

*“The TEJ shows a decreasing trend in the reanalyses during the period 1958–1998 (Rao et al., 2004) and the central TEJ intensity is expected to weaken by 18% over the Indian Ocean by the end of the 21st century (Huang et al., 2020). In addition, (Rao et al., 2004) noticed over 40 years a decrease in the number of tropical cyclones over the Bay of Bengal, and by the end of our century, the CMIP simulations project a suppressed rainfall over the tropical eastern Indian Ocean (Huang et al., 2020). **This simultaneous decrease in the TEJ and deep convection over the East of India is consistent with our findings of Sect. 4, as we find a similar behaviour on an intraseasonal scale. Based on our results of Sect. 5, we predict that the decrease in convective water sources and the reduction in water advection due to a weaker TEJ will lead to a decrease in cirrus cloud cover over the Arabian Sea in the future climate.**”* Lines 520-527.

## Specific comments:

L9: delete comma after “(optically thin)”

Done

L23: always use Oxford commas in scientific writing (add a comma before “or sedimentation”)

Done.

L27: “while cirrus cloud cover remains constant” – I think it is more accurate to say that the deep convective and anvil cloud cover decreases disproportionately compared to cirrus clouds; therefore, the net cloud radiative effect is positive. See Sokol et al., 2024: [doi.org/10.1038/s41561-024-01420-6](https://doi.org/10.1038/s41561-024-01420-6)

Done.

L28: Similar to above, it might be more accurate to say “The change in anvil cloud properties (optical thinning) could have a positive...” instead of “Therefore, the anvil clouds could have a positive...”

Done

L43: “during El Nino/La Nina years, with an intensity” --> “associated with the phase of El Nino Southern Oscillation and the intensity of the TEJ associated with summer monsoon rainfall over India.” (adds parallelism to this sentence structure)

Done

L62: is maximum -> maximizes

Done

L63: This --> This time lag

Done

L65: Layout your hypotheses here. Explicitly state that “we test four hypotheses...”

Done. Our paragraph is now:

*“The aim of this study is thus to investigate the relationships between cirrus clouds, deep convective clouds, and the TEJ over the Indian region during the SASM. We test four hypotheses: (H1) The TEJ is modulated by the circulations associated with the deep convective patterns, (H2) these wind variations affect the cirrus cloud cover over the Arabian Sea; (H3) the cirrus cloud cover in this region depends on the mean temperature of the upper troposphere, (H4) the cirrus cloud cover over the Arabian Sea depends on the intensity of deep convection located over the Indian continent and the Bay of Bengal. Understanding the general framework of these interactions is important, considering the expected weakening of the TEJ in a warming climate (Rao et al., 2004; Huang et al., 2020), as well as the decrease in the convection over the Bay of Bengal (Rao et al., 2004). These changes are likely to impact the cirrus cloud cover over the Indian region in the future.” Lines 78-85.*

L65: add the Oxford comma after “deep convective clouds,”

Done

L81: Clarify: Second, due to the flight track of Aeolus, observations occurring...

Done, but we used “orbit track” instead of “flight track” .

L82: adequate --> suited

Done

L105: Oxford comma

Done

L107: larger than typically --> typically larger than

Done

L123: delete s in “cloud covers” should be “cloud cover”

Done

L191: “The wind still remains...” delete “still” (it redundant with "remains" right after)

Done

L218-220: please clarify: do you mean the longer lifetime of cirrus clouds leads to this weaker diurnal contrast compared to deep convective clouds?

Yes it is what we mean. We slightly changed the sentence:

*“One of the main reasons why the cirrus cloud cover diurnal contrast is much weaker than that of deep convective clouds is the longer persistence of cirrus clouds, as a part of the deep convective clouds at 18 LT are converted to cirrus clouds during the night (Feofilov and Stubenrauch, 2019).”*

Lines 240-243.

L225-226: “This indicates...” This is a strong choice of words. Due to the outflow of anvil from deep convection that can thin into cirrus, is it not also probable that the spatial coverage of cirrus is larger due to spreading whereas the deep convection is more restricted in horizontal extent. See Sassen et al., 2009. They show that cirrus cloud cover correlates with regions of deep convection but has a larger spatial extent (likely due to this spreading of anvil outflow effect).

We removed the sentence: “This indicates that a part of the cirrus clouds over the Arabian Sea may not originate...”

After having noticed that at 18 LT, the zonal gradient of the cirrus cloud cover is not as pronounced as the zonal gradient of the convective cloud cover, we add the reference to Sassen et al. 2009:

*“This result is consistent with those of Sassen et al., (2009), who showed that the cirrus cloud cover has a larger spatial extent than the convective cloud cover, likely due to the spreading of anvil outflow effect.”* Lines 250-251.

L226: “not directly correlated to deep convective clouds” - In fact, I would say that Fig. 4i shows a good correlation between cirrus cloud cover and deep convective cloud cover for 06 LT. And that cirrus clouds spread out from deep convective core at 06LT. But we still do see a shift in both convection and cirrus cloud cover westward from early morning to late afternoon.

We decided to emphasize the westward shift visible from early morning to westward afternoon, without proposing any interpretation. (However we make use of our observations in this section to build up our general mechanism in Section 5.1). At the end of Subsection 3.2 we thus added the following sentence:

*“Finally from 06 LT to 18 LT, we observe a westward shift in both deep convective cloud cover and cirrus cover, which might be due to the TEJ.”* Lines 251-252.

L229: “mainly develops” --> “is strongest”

Done

L229-L231: run on sentence and confusing: “which has a maximum intensity” --> Does the TEJ have a maximum intensity (implied by the grammar here) or do you mean the deep convection has a max intensity at 06 LT? Be precise in your language.

The TEJ has a maximum intensity at 06 LT. To remove ambiguity we replaced “which has a maximum intensity” by “*which shows the strongest winds*” Line 355.

L232: What exactly about Fig. 4i makes you say this?

We clarified our statement about Fig. 4i:

*“(for example, cirrus clouds extend more towards the Western Arabian Sea than deep convective clouds observed at the same local time, see Fig. 4i)...”* Lines 357-358

L241: Clarify the difference b/w H1 and H3. H1 says wind advects moisture from deep convection; H3 says deep convection occurs due to wind and then the moisture is advected. This difference is a bit subtle and maybe irrelevant?? Or is H3 more like testing direct outflow from deep convection forming cirrus later on?

Yes, H3 tests direct outflow from deep convection, forming cirrus later on.

We reformulated our hypotheses (now labelled H2 and H3):

*“We attempt to establish this mechanism by testing the sensitivity of the cirrus cover over the Arabian Sea at 06 LT to: the wind (hypothesis H2, Sect. 5.2), the temperature (hypothesis H3, Sect. 5.3), the deep convective clouds above India and the Bay of Bengal at 18LT (hypothesis H4, Sect. 5.4.)”* Lines 361-363

Section 4.2: Fast wind days could just be thought of as “peak” TEJ in July/Aug...?

Yes, fast wind days mostly coincide with the “peak” season of the TEJ. We added the following sentence at the end of the first paragraph of Subsection 5.2:

*“Fast wind days correspond to the period of the TEJ peak, as they almost all occur between mid-June and the end of August”.* Line 380.

Figure 7: Optionally add a horizontal line for the median speed across all sky conditions (i.e., the fast/slow wind day threshold = -23.6 m/s) for comparison

We added a solid black line for the median speed (or temperature or thin cloud fraction) across all sky conditions for comparison on Fig. 7 and completed the caption *“The dotted lines represent the median values of each PDF and the solid black lines represent the median values across all sky conditions”*.

L276: ON a given day FOR each 480 m...

Done

L277: Not only is the peak important but the other local maxima. What does the spreading out of the pdf signify? Why is the peak at higher temperatures stronger for higher cirrus quartiles? Also, why is the second highest quartile (light blue line in Fig. 7b) so different (not following the trend) from the other quartiles? Are the second local maxima related to cirrus detrained from convection?

Right,

What does the spreading out of the pdf signify? -> larger pdf spread means that such cirrus cloud fractions can be found in more diverse temperature conditions.

Why is the peak at higher temperatures stronger for higher cirrus quartiles? -> Higher cirrus quartiles seem associated with higher temperatures because they are found below the cold point tropopause, while lower cirrus quartiles are found at the cold point tropopause and above, where temperatures are very cold (below 195 K). Therefore, it appears that the altitude where the higher cirrus quartiles is responsible for the second local maxima.

Also, why is the second highest quartile (light blue line in Fig. 7b) so different (not following the trend) from the other quartiles? -> The second highest quartile is associated with cirrus clouds at lower altitudes (typically 15.2 km or less) and therefore, overall higher temperatures. Oppositely, the highest quartile (in red) is observed at altitudes between 14 and 16.5 km of altitude, so it is associated with a wider range of temperatures including the coldest (at the cold point tropopause), and the warmest (around 14-15 km of altitude).

Are the second local maxima related to cirrus detrained from convection? -> Please, see the end of the response to the second point, they do not seem to be related to detrainment from deep convection but rather from the altitude

We added the following sentences in the manuscript:

*“...cirrus cloud fraction. These temperature maxima are related to the altitude of the cirrus. The two lower quartiles (black and dark blue lines), are observed at the cold point tropopause (around 16 km) and above, where temperatures are very cold (below 195 K), which explains the large peaks of their PDFs centred on low temperatures. In contrast, the highest quartile (red line), with above 8% cirrus cloud fraction, is observed between 14 km and the cold point tropopause, which explains that it is associated with both warm and cold temperatures. The second highest quartile (light blue), is typically observed below the cold point (15.2 km or less) and is thus in general associated with warmer temperatures than the three other quartiles. The PDFs of temperatures associated with the largest quartile of cirrus cloud fractions (> 8.0%) has a median value of 202.1 K, which is right between the median value of the third quartile of 204.2 K and the median values of the first and second quartiles (respectively 200.6 and 200.9 K).”* Lines 409-415.

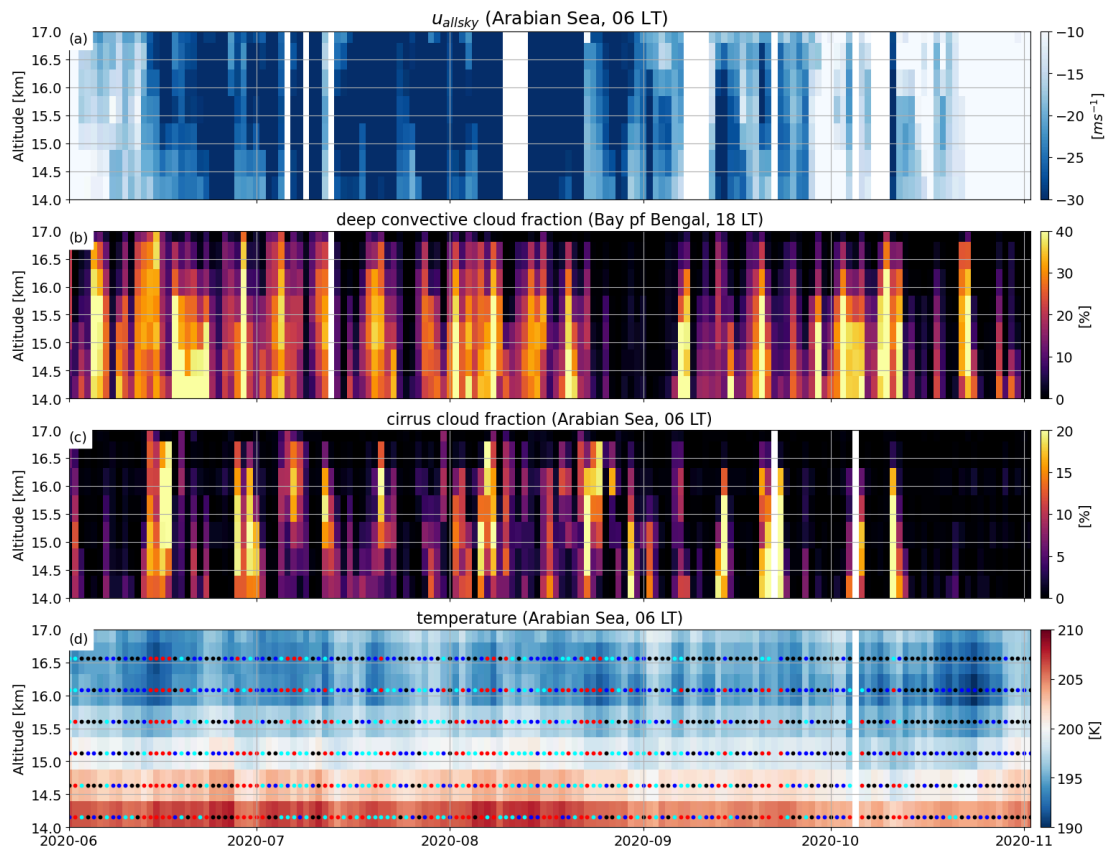


Figure R1: Times series of the regionally averaged profile of a)  $u_{allsky}$  over the Arabic Sea (06 LT), b) deep convective cloud fraction over the Bay of Bengal (18 LT), c) cirrus cloud fraction over the Arabic Sea (06 LT), and d) temperature over the Arabic Sea (06 LT). On d), the colour of the dots (black, dark blue, light blue, and red) represent the corresponding quartile of the cirrus cloud fraction and can be compared with Fig. 11.

L284: “we can discard our hypothesis H2” - With all of your caveats after this statement, I don't think you should say "discard" here. maybe more like "while we cannot thoroughly disprove H2 based on these results, we can conclude that the temperature is not the main or sole driver of cirrus clouds in this region"

Yes, thank you for this suggestion. We removed “we can discard our hypothesis H2” and we added at the end of subsection 5.3:

*“Thus, while we cannot thoroughly disprove H2 based on these results, we can conclude that the temperature is not the main or sole driver of cirrus clouds in this region.”* Lines 425-427.

L290: “second” --> “third hypothesis H3”

We removed “second” from this sentence.

L307-310: Move to before line 290. Start the section with this analysis - it is the strongest evidence. Then move to fast vs slow wind days.

Done. Subsection “Deep convection” now starts with:

*“In order to test our hypothesis H4, we show on Fig. 11c that for the four quartiles of deep convective cloud fractions observed over the Bay of Bengal at 18 LT (delimited by 6.9%, 16.7%, 26.2%), the median values of cirrus cloud fractions observed over the Arabic Sea 12 hours later at 06 LT are*

3%, 4.5%, 5.5% and 7% respectively. Thus larger cirrus cloud fractions are associated with larger deep convective cloud fractions observed 12 hours before at the same altitude.” Lines 429-432.

Add "this shows that deep convection is important for cirrus formation and persistence; deep convection provides a direct source of ice crystals in the upper troposphere and acts as a source for water vapor which is then advected by the TEJ to over the Arabian sea. We explore the relationship of wind by categorizing each day into fast or slow wind days as described in Fig. 5.”

We added this sentence. However we preferred to write :

*“We explore the relationship between deep convection and wind by categorizing... Fig. 9”* Lines 439-440.

L312-313: You could move this up to L293 to set up the analysis discussion rather than note it at the end.

The sentence has been moved just at the end of the first paragraph of the subsection “Deep convection”:

*“In order to test our hypothesis H4, we show on Fig. 11c that for the four quartiles of deep convective cloud fractions observed over the Bay of Bengal at 18 LT (delimited by 6.9%, 16.7%, 26.2%), the median values of cirrus cloud fractions observed over the Arabian Sea 12 hours later at 06 LT are 3%, 4.5%, 5.5% and 7% respectively. Thus larger cirrus cloud fractions are associated with larger deep convective cloud fractions observed 12 hours before at the same altitude. This shows that deep convection is important for cirrus formation and persistence; deep convection provides a direct source of ice crystals in the upper troposphere and acts as a source for water vapor which is then advected by the TEJ to over the Arabian sea. Note however that comparing the Arabian Sea at 06 LT and the Bay of Bengal 12 hours before, at 18 LT makes sense if the wind speed is sufficient to advect air parcels from the Bay of Bengal to the Arabian Sea.”* Lines 429-437.

Section 4.5: the alpha parameter is confusing. In the previous section you just showed that deep convective cloud cover is not fixed, so why should we assume that it is fixed here. You can see that cirrus cloud fraction changes from the other analyses.

However, the other points here about the wind speed influencing whether or not the pass of Aeolus at 6LT "sees" the detrained cirrus is SUPER important.

To avoid confusion, we replaced “fixed value of deep convective cloud fraction” by “given value of deep convective cloud fraction”.

*“The parameter alpha is between 0 and 1, and for any given value of deep convective cloud fraction observed at 18 LT over the Bay of Bengal, alpha increases when the cirrus cloud fraction over the Arabian Sea increases 12 hours later at 06 LT.”* Lines 481-482

L320-327: This should be in the domain section (2.3) so you can just refer back to that here instead of explaining it a few times throughout the paper

These lines have been moved at the end of subsection 2.3 “Domains of study”.

L338-340: I'm not sure its necessarily the cirrus clouds leaving a "trail" of ice crystals (which would themselves constitute a cloud), maybe: At speeds faster than 25 m/s, the cirrus clouds may have traveled beyond the Aeolus passover at 06 LT; however, we still see higher ice crystal concentrations likely due to the large spatial coverage/long lifetime of cirrus clouds

Done. The sentence is now:

*"In contrast, for westward  $u_{allsky}(AS, 06 LT)$  faster than 25 ms<sup>-1</sup>, the cirrus clouds may have traveled beyond the Aeolus passover at 06 LT; however, we still see higher ice crystal concentrations likely due to the large spatial coverage/long lifetime of cirrus clouds. This could explain why values of  $\alpha > 0.03$  are more often observed than values of  $\alpha < 0.03$  for westward  $u_{allsky}(AS, 06 LT)$  faster than 25 m/s."* Lines 503-507.

Section 4.6 Implications in a warming climate should be moved to the discussion section since none of this is a result from anything you are showing.

The implications in a warming climate are now moved to the subsection "Discussion".

L355: "convective patterns AND locations"

Done

L426: It might be useful to show this derivation in an appendix. Or provide a citation. Can you reasonably ignore the  $d/dx$  component of vorticity?

Indeed, this is a good point and although  $v \ll u$ , we do not find a solid argument to neglect  $dv/dx$  in front of  $du/dy$  at the considered length scales. We thus decide not to speak about vorticity, but instead of the variable  $\Delta u_y$ , the difference of the derivative  $du/dy$  between strengthened and weakened wind days. We also mention that we cannot directly estimate the vorticity from our data, as we do not have any information on the meridional wind component.

We changed the first sentence of Subsection 4.4:

*"We consider the variable  $\Delta_y u$  which quantifies the difference of the derivative  $d(u_{allsky})/dy$  between strengthened and weakened wind days:*

*Eq. 8*

*We estimate  $\Delta_y u$  between the points  $A_N$  and  $A_S$ ...*

Then after having given the values of  $\Delta_y u$ , we add the sentence:

*"Although  $\Delta_y u$  does not measure a vorticity difference between strengthened and weakened wind days (that would be impossible to estimate from Aeolus data as they do not contain any information on the meridional wind), these values are consistent with the existence of an anticyclonic circulation around deep convective patterns."* Lines 235-338.

Figure 13: panel c has contour lines without a colorbar associated. At least say the increment between contour lines and if orange or purple is positive or negative.

We directly added on the new Fig. 8 (previously Fig. 13) the values of the contours associated with deep convective cloud covers.

L470: (on the order of days) your analysis seems to be only looking at 12-hour increments, so why not be specific here. Or did you look at 12 hr, 24 hr, 36 hr, 48 hr, etc.?

We indeed look at 12 hour increments, however, when looking at the time series on Fig. 5, we can see that we can have several consecutive days with strengthened or weakened TEJ. Even though the wind perturbation is observed with a lag of 12 hours after deep convection, it can subsist for several days, hence our sentence “*Our results indicate that the same dipole also modulates the TEJ on much shorter time scales (on the order of days).*” Line 628.