

## Author's Response to Referee #2

We would like to thank referee #2 for the positive and thorough review of our manuscript. We have answered all comments below (for easier comparison the referee comments are included in *italic*).

Scientific points :

*#1: P5467, L25-26: Do the authors have any idea why the seasonal variation is more pronounced in the Northern Hemisphere?*

#1: As expected, the seasonal variation is more pronounced in the Northern Hemisphere, where the distinct seasonal temperature cycle typically causes a strong seasonal humidity cycle as well. Following the discussion in Scherllin-Pirscher et al. (2011) we can see that the magnitude of  $T_{diff}$  depends primarily on specific humidity, and hence it is directly related to the seasonal cycle.

We will change the text on P5467, L25 according to the above given answer.

*#2: P5469, L5ff: Might a meridional mean show this information more clearly than a table?*

#2: The goal of Table 2 and Table 3 was to provide a guideline of the transition region between dry and moist air. Since this transition region shows a clear latitudinal and seasonal dependence we wanted to list these reference values. Furthermore the tables list in which geographical sectors and years highest transition values are typically found.

*#3: P5469, L14: Suggest replacing "No temporal pattern" with "No strong temporal pattern".*

#3: We will follow your suggestions.

*#4: P5469, L18: How do Figs 4 and 5 show "longitudinal variations of water vapor were small"? Don't Figs 3-5 show that the Indian monsoon, which is localised in longitude as well as latitude, has a rather large effect?*

#4: We thank the referee for his or her comment. We will rewrite the statement in the following way:

“We discuss trends in absolute humidity, by analyzing differences between dry and physical temperature for all CMIP5 models, using 10° zonal-mean climatological fields. We keep in mind that longitudinal variations are on average about 1 km (cf. Fig. 4 and Fig.5), resulting in an about 0.5 km difference for zonal mean fields.”

*#5: P5471, L12ff: Is it worth stressing the strong statement that "at low altitudes the trends in dry temperature become negative, since the increase in water vapor overcompensates the moderate increase in physical temperature"?*

#5: We would like to keep these sentences since we regard this as an important result. Anywhere else a positive trend in physical temperatures corresponds to a positive trend in dry temperature – here it is different, and it is not self-evident that this has to be the case.

However, we will change the text in the following way:

P5471, L12: “Dry temperature trends at high altitudes are virtually the same, but at low altitudes the trends in dry temperature become negative, in contrast to the physical temperature trends, since the modeled increase in water vapor overcompensates the moderate increase in physical temperature. “

*#6: P5471, L21: Perhaps amend line to read "... of about 14% if Tdry were used as a proxy for T"?*

#6: We will follow your suggestions.

Typographical/syntactical points :

*#1: P5460, L18: "comparably large". Do the authors mean "noise as large as the signal", or "relatively large"? Perhaps just omit the word.*

#1: We will write: “the signal-to-noise ratio gets comparably large”

*#2: P5462, L25: "gains of importance" → "gains in importance".*

#2: Thank you very much. We will correct it.

#3: P5463, L24: *Maybe spell out  $N = 1e6(n-1)$ ?*

#3: We will include  $N=10^6(n-1)$ , with  $n$  being the refractive index.

#4: P5465, L5: *"allowed" → "allowed us" or "allows us".*

#4: We will write: "allowed us"

#5: P5465, L20: *"shows to be" → "can be shown to be" (or simply "is").*

#5: We write: ... is ...

#6: P5467, L10: *"smaller than -6K". Maybe "larger in magnitude than 6K"? The casual reader might not realise that "smaller than -6" actually means a bigger effect. (If the authors had defined  $T_{diff}$  to be the positive quantity  $T-T_{dry}$  these sorts of ambiguities of language would not have arisen.)*

#6: Thank you for this comment. We will follow your suggestions and write: ... "larger in magnitude than 6 K". Despite potential language ambiguities we found it important to use the "true" physical temperature as reference and to display the correct sign of  $T_{diff}$ .

#7: P5467, L14: *"contourlines" → "contour lines" or "contours".*

#7: We will write "contour lines".

#8: P5468, L7 (and elsewhere): *"dependance" → "dependence".*

#8: Thank you very much. We will take care of this.

#9: P5472, L3: *Suggest replacing "a safe estimate down to which altitude" by "a safe estimate of the altitude down to which".*

#9: We will follow your suggestion.

#10: *P5485, Fig 6: Very nice - tells a complicated story clearly.*

#10: Thank you very much!

#11: *P5488, Fig 9 caption: "dry an physical" → "dry and physical".*

#11: Thank you.