

### **Response to Editor's Comments**

We would like to sincerely thank the Editor for sending the manuscript for third review. Now we have addressed the comment raised in the last review by Reviewer-3. For this, we have carried out an analysis to show that our analysis is not biased, if we used Pressure height instead of Geometric height in the reanalysis data. More details are provided in the reply to the Reviewer-3's comment. However, following the reviewer's suggestion, we have mentioned in the revised manuscript that we are using Pressure height for all the reanalyses, which do not biases our results. More details are provided in the reply to the Reviewer-3's comment.

Now we are herewith submitting the following for the consideration of publication:

- Replies to the reviewer's comments
- Track change manuscript along with figures and tables (in .pdf)
- Revised manuscript with figures and tables (in LaTeX)

We request Editor to kindly process further in order to make the manuscript publishable in your esteemed journal "Atmospheric Chemistry and Physics (ACP)".

All the authors listed on the manuscript concur with submission of the above mentioned manuscript.

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### **Response to Reviewer-3's comments**

**Q.** *I have reviewed the revised manuscript and author responses. My question about altitude registration has not been satisfactorily addressed. The radar retrieves vertical velocity as a function of geometric altitude. The formula provided in the response, and in the revised manuscript, for calculating altitude is "pressure altitude" that assumes a constant scale height value  $H$  (it is not stated anywhere what value of  $H$  is used). The "pressure height" is not the same as geometric height. The differences may be small, but I think it matters in something like Fig 4 and 5 where they are plotting altitude profiles. Since reanalyses routinely output geopotential height (GH), it should be trivial to use GH to put the  $w$  profiles from reanalyses on the same geometric altitude grid as the radar  $w$  profiles. Again this may not change the results dramatically, but also speaks to maintaining a certain level of scientific rigor in the process. So I think the authors should either compute geometric height for the reanalysis results, or at the very least describe that they are using "pressure height", provide the value of  $H$  they use, and demonstrate somehow that this does not introduce biases or errors in their comparisons.*

**R.** We would like to sincerely thank the referee-3 for the third evaluation and for his suggestions to check the biases (if any), if we used Pressure height (used for reanalyses) instead of Geometric height (used for Radar). For this, we have done the following exercise:

We have taken a typical Radiosonde ascent (i-met radiosonde which is GPS based with pressure sensor) over Gadanki. GPS based radiosonde gives geometric height ( $h_g$ ) from which we estimated geopotential height ( $h$ ) using the following equation(1) :

$$h = \left( \frac{r}{r+h_g} \right) h_g \quad (1)$$

where,  $r$  is the radius of the earth.

Further, we estimate pressure height from radiosonde measured pressure using the Hypsometric equation (2):

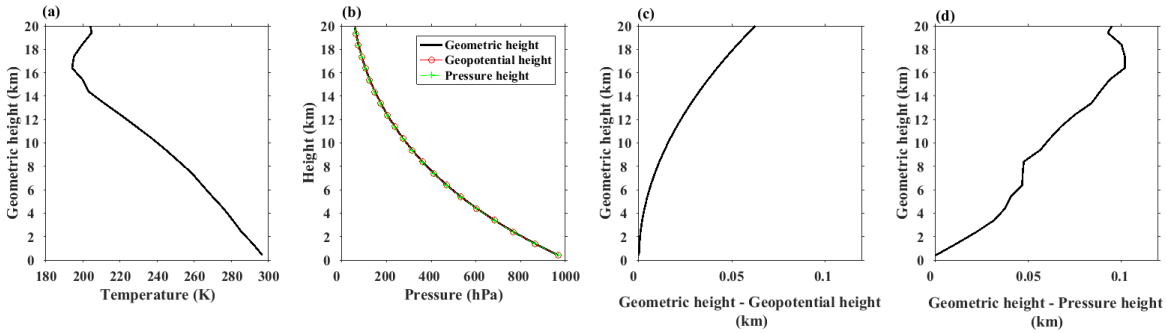
$$(h_{p2} - h_{p1}) = \frac{R_d T}{g_0} \ln \left( \frac{P_1}{P_2} \right) \quad (2)$$

Where,  $h_{p1}$  (base) and  $h_{p2}$  (top) (i.e., Pressure height) are the height at pressure  $P_1$  and  $P_2$  respectively,  $R_d$  is gas constant,  $g_0$  is acceleration due to gravity and  $T$  is the absolute temperature. The scale height is varying with altitude in the equation (2).

Pressure versus geometric, geopotential and pressure heights do not show any significant differences (Fig1 a).

The difference between geometric and geopotential height is found to be <50 m below tropopause (Fig.1 c) , and the difference between geometric and pressure height is found to be <50 m below 10 km and above it is < 100 m (Fig.1 d), which is insignificant for the present analysis and does not bias the result as the radar

resolution itself is 150 m. Thus, we conclude that there will be no significant difference if we used Pressure height instead of Geometric height and do not bias the results.



**Figure 1.** Typical height profile of (a) temperature, (b) variation of pressure w.r.t. geometric, geopotential and pressure height, (c) difference between geometric and geopotential height, and (d) difference between geometric and pressure height over Gadanki.