Comments on, **"The Role of Gravity Waves in the Mesosphere Inversion Layers (MILs) over low latitude (3-15° N) Using SABER Satellite Observations"** by Lingerew and Raju. Using sixteen years of SABER temperature data, the authors investigated the role of gravity waves (GWs) in the mesospheric inversion layers. To understand the role of GWs in the MILs, they estimate the potential energy, and based on the results they argue that the lower and upper MIL distinctions are due to the GWs. The strength of the manuscript is they used a long-term data set however their methodology is not clear. Moreover, this manuscript also lacks the scientific discussion. The present form of the manuscript needs major changes before acceptance for publication. Therefore, I recommend to the editor for a major revision. The detailed major and minor comments are as follows:

Major comments:

1. In section 2, latitudinal information of the data used is given however there is no information about the longitudes! Which reading the whole manuscript, I could see the longitudinal limits of 32 to 48° in Figures 10 and 11 (in section 3.4). Are the temperature profiles averaged over 3-15°N and 32-48°E? If so mention it in section 2. More importantly, the information about how do the MILs are identified is missing. They have only written as a diagnostic technique is used. What kind of diagnostic technique, whether the authors validated the diagnostic method all this information should be provided in the methodology (e.g. Gan et al., 2012; Sivakandan et al. 2014, etc.).

Response: We have mentioned the criteria to separate the inversion phenomenon from the observation data in lines 87-91 from Section 2.

2. One of the major issues in the manuscript lack of a literature survey, though they have cited some of the important papers (Meriwether and Gardner 2000; Gan et al., 2012) but the essential points from those papers are not reflected in their approach. There are various sources proposed as the causative mechanism of the lower and upper MILs. For example, the planetary waves are believed to be the causative mechanism of lower MILs similarly, gravity wave tidal interactions and chemical heating are proposed as a cause of upper MILs. These points are not considered and there is no reason why the authors only focus on the GWs. It is well understood that in most of the cases the GWs breaking in the mesosphere can cause only very few Kelvin temperature changes (>10K). If this is the scenario it cannot explain the higher amplitude MILs. Comment on it.

Response: OK, thank you. We know that all tidal, planetary, and gravity waves, as well as chemical reactions, are causative of an inversion, but here in our study region between 60 and 90 km is the gravity wave, which is generated from the lower atmosphere and propagated to the upper atmosphere till to reach the saturation level for breaking and it impacts the atmospheric variability as causative of an inversion.

3. As mentioned in comment 1, the authors should provide longitudinal information, because this has an important role if they try to understand the role of GWs which are highly localized in nature. It is not clear how the 1hr cutoff frequency applies to the data, if the authors used a particular region then in a day maximum of two to three satellite passes can

be observed based on the area, with this limited data set how effective or logical is the 1hr band pass filter?

Response: we have used only SABER temperature data over the low-latitude in the spatial regions from (3-15) latitude, (32-48) longitude and (60-100 km) altitude. So, as mentioned in the text, we have applied a one-hour interval cut-off frequency of the pass band filter to separate the gravity waves from those other wave activities, such as planetary and tidal atmospheric waves.

4. Why 3rd order polynomial fit? Ramesh and Sridharan (2012) do not elaborate on any method, instead they have cited Leblanc and Hauchecorne (1997). Therefore the article cited here is not relevant. Provide more information about the methodology and its validity (how good it is? if the authors did any test to validate the method etc.)

Response: OK, we can use the reference Leblanc and Hauchecorne (1997) instead of Ramesh and Sridharan (2012) based on their relevance to express the third-order polynomial fit. The 3rd-order polynomial fit is relatively good, as we understand from the scientific community, to provide the background information relative to other orders. Then after having this information we can derive the perturbations by subtracting the background from the observation data.

5. Lines 138-140; in this context, Gan et al., (2012) could be a more suitable paper to cite here than Sivakumar et al. (2001), because they also used SABER data, on the other hand, Sivakumar et al. (2001) only used Rayleigh lidar data over a single location (the data quality above 80 km is questionable). Gan et al. (2012) also found the seasonal variation of MILs in the low latitudes and planetary waves as the cause of lower MILs, whether these authors could find such a relationship? If yes or no provide reasons!

Response: It doesn't need any reason for yes or no to use the reference (Gan et al., 2012) instead of (Sivakumar et al., 2001), because already you have mentioned why Gan is preferable to Sivakumar based on their relevance to supporting the idea about the base of the lower inversion in lines 138–140 so we simply accepted using that one.

6. There is no clear information about how the occurrence frequency is estimated. Provide it?

Response: We can calculate the occurrence rate (percentages) for lower and upper inversions by counting the number of inversion days every month from 2005 to 2020.

7. How the mesopause altitudes are taken care or eliminated from the statistics? Which could be a false indication of inversion. And could the authors note any solar activity dependency of MILs occurrence (for example, Sivakandan et al. (2014))?
Response: We did our work about inversions and their causative gravity waves in MLT dynamic regions over low latitudes, but we didn't consider the pous (mesopous).

8. Lines 151-155, In the literature there are different causative mechanisms are proposed for the multiple MILs, (I suggest the authors go through Meriwether and Gardner (2004); Gan et al. (2012)).

Response: OK, we will check again on their scientific investigations.

9. Section 3.2, is a good point to investigate but before doing that the data need to be binned properly with local time. I am a bit concerned about how good to investigating the latitudinal and longitudinal variations in a small region using satellite data, each temperature profile could be nearly 500 km spatial averaged.

Response: It is not local time; instead, we have used the period during 2005–2020 over the latitudinal regions (3–15) and longitudinal regions (32-48).

10. The scientific discussion is very spare and weak. They should compare the present results with earlier studies based on the similarities and differences the scientific reasoning also should be included in the manuscript.

Response: OK, we will try to elaborate the discussion based on your comment.

11. How the GWs potential energy is connected to the MILs? First establish the connection by showing a single case in which a physical connection should be clear and then go for the statistics.

Response: Relay, we have background information on how gravity waves impact the inversions of the upper atmosphere. The connection is that a gravity wave is generated from the lower atmosphere, and the wave propagates to the upper region until it reaches the saturation level over the upper region. The wave is then broken to dissipate the energy, and its energy impacts the region by increasing its temperature. In this region, the temperature increment with elevation is known as an inversion. This is the reason we connected the gravity waves with an inversion.

Minor comments:

12. Lines 8-9, The mesosphere…This is a transitional region not only in the low latitudes! So modify the statement.

Response: The Mesosphere transitional region over low latitudes is a distinct and highly turbulent zone of the atmosphere relative to mid- and high latitudes.

13. Lines 39-40, define the MILs.

Response: The Mesospheric Inversion Layer (MIL) is a feature that increases the temperature profiles in the mesosphere region.

14. Line 41, a typo, ‘mesosphere’

Response: OK, we corrected

15. Line 73, these references are irrelevant here. Provides references about the data validation and limitation as well as instrumental specifications.

Response:

16. Line 75, longitudinal information is missing!

Response: OK, we will correct it.

17. Figure 4: Sivakandan et al. (2014) also did such a statistical analysis using the SABER data over Indian low latitudes, could you compare the present results with their results and provide some scientific reasoning for the observed differences or similarities?

Response: OK, thank you. We will try to check and compare with his scientific results.

18. Line 218 …that the inversion temperature is in the range of…It is not an inversion temperature range only a temperature range.

Response: Yes, it is the inversion-day observed temperature.

19. Line 242 onwards, the longitudinal information is suddenly introduced here, it should be introduced in section 2.

Response: Ok

20. Lines 245-247, these lines are not clear. Please see the major comment 3.

Response: OK, we will elaborate

21. Figure 5b, a typo 'thickness' References suggested to read and compare with the present results and include in the discussion part (some of the articles are cited here but those results are not utilized to improve the discussion part):

Response: It is corrected and includes the references based on their relevance.

1. Gan, Q., S. D. Zhang, and F. Yi (2012), TIMED/SABER observations of lower mesospheric inversion layers at low and middle latitudes, *J. Geophys. Res.*, 117, D07109, doi:10.1029/2012JD017455.
2. Meriwether, J. W., and C. S. Gardner (2000), A review of the mesosphere inversion layer phenomenon, *J. Geophys. Res.*, 105(D10), 12405–12416, doi:10.1029/2000JD900163.
3. Sivakandan, M., Kapasi, D., and Taori, A.: The occurrence altitudes of middle atmospheric temperature inversions and mesopause over low-latitude Indian sector, Ann. Geophys., 32, 967–974, https://doi.org/10.5194/angeo-32-967-2014, 2014.
4. Ramesh, K., S. Sridharan, and S. Vijaya Bhaskara Rao (2014), Causative mechanisms for the occurrence of a triple layered mesospheric inversion event over low latitudes, *J. Geophys. Res. Space Physics*, 119, 3930–3943, doi:10.1002/2013JA019750.