

This study extends the TCKF1D-Var framework to integrate nitrogen and water vapor Raman channel observations from the CMA Mie–Raman lidar (MRL) network for retrieving high-resolution water vapor profiles in the nocturnal boundary layer before heavy precipitation. The topic is scientifically meaningful and practically valuable for severe weather monitoring. However, the manuscript currently has critical issues in **physical interpretability, result explanation, and writing standardization**. Major revisions are required to improve logical coherence, technical transparency, and scientific contribution before consideration for publication. Here are some of my comments:

1. Title is misleading. This study mainly retrieves water vapor profile prior to nocturnal heavy precipitation, not nocturnal water vapor profiles.
2. Line 20, please also note the number of events evaluated.
3. Line 23, ERA5 prior profiles or ERA5 profiles?
4. Line 28, “large hourly rainfall totals” needs to be rephrased.
5. Line 35, again, ‘during nighttime’, or ‘before sunset’?
6. Line 36, please add introduction to current observing systems used for fine scale moisture profiles and their detailed limitations. And in line 39, what limitation?
7. Some references are way too old.
8. Line 46, “a priori assumption” or “a priori requirement”?
9. Line 58, “Despite these advances”?
10. Line 102, did you mean measurement sensitivity by saying resolution?
11. Line 2.2.2, “The Fifth...”. Also, it is suggested to change the title to: Atmospheric Priori.
12. Eq. 1 is unnecessary since it is a well known equation.
13. Since microwave instrument is also introduced in Fig. 2, it is necessary to give a brief introduction to this dataset and the purpose of this dataset in this study.
14. Please rephrase the title of section 3.1&3.2
15. Line 322, the definition of heavy rainfall here is not proper. Extreme rainfall events were identified using the 99th percentile, this method accounted the local climatological features. So, why the identification of heavy rainfall uses another approach? To expand your sample set, you can define heavy rainfall using the 95th or 90th percentile.
16. Line 325-328, what is the purpose of analyzing these differences?
17. Line 349, these three groups were not defined before.
18. Fig. 5&6 can be merged.
19. Line 372, where is Fig. 4a?
20. Physical interpretation is required for Fig. 6. For example, the moisture rich layer – rainfall intensity relations could be helpful.
21. It seems the assimilation approach only improves the accuracy by less than ~5%. Am I understanding correctly?
22. Section 3.3 provides two cases for case analysis. Firstly, these two cases are two extremes. Can you also provide one case from the middle category? Secondly, please add lines in these figures to show the precipitation time. Thirdly, the writing is somewhat redundant, please rephrase this section carefully. Line 425, actually, it is not that clear in Fig. 9a&b. It seems the approach developed in this study is less impactful for heavy rainfall compared to numerical products with good quality. Maybe an experiment using forecasts rather than

reanalysis could lead to better results. Lastly, the analysis of these two cases lacks a physical perspective, especially for moisture evolution. Simply analyze the incremental pattern is insufficient, a physical based analysis, such as the linkage between moisture evolution and boundary layer processes, is necessary. BTW, radiosonde observations could also be used as priors. Comparisons using different priors will strongly benefit the paper.

23. Since Raman lidar has a blind area generally below 100 m, please add the bottom layer height in all the figures.
24. Some grammar issues: “repetation” to “repetition”, “mircophysics” to “microphysics”
25. A table summarizing key retrieval settings (vertical resolution, time window, etc.) could benefit readers.