The paper by Wu et al. (2024) presents the results of a year-long measurement campaign of stable water isotopes and atmospheric conditions in Matara, Sir Lanka. To explain the variability of d^{18}O and d-excess they investigate the contribution from different moisture sources (trajectory analysis), the impact of near-surface relative humidity conditions of different regions, and the influence of convective activity. They conclude that the isotopic composition of water vapor varies seasonally and is influenced by the different moisture sources during the southwest (Arabian Sea) and the northeast monsoon (Bay of Bengal). Near-surface evaporation significantly affects local d-excess while convective activity is significantly correlated to variations in d^{18}O.

The scientific significance of the paper is absolutely given, as continuous measurements of stable water isotopes in water vapor covering at least one year are highly needed. However, the scientific approach and the presentation of the results are sometimes chaotic and confusing and need to be improved. In the following, I will point out the main critical points and make some suggestions.

Scientific Quality/Approach

Classification into Monsoon Periods

The main point is the distinction between the different monsoon periods. You aim to explain the stable water isotopic variability of water vapor in Matara, Sri Lanka. For your subsequent analysis you divided the time series into southwest, northeast, and non-monsoon periods. However, the isotopic signal and the variability of the isotopic composition within these defined seasons vary greatly. In particular, the non-monsoon period starts with a phase of high d^{18}O values with a low d^{18}O variability while the subsequent phase shows highly depleted d^{18}O values with a strong d^{18}O variability. A similar pattern can be observed during the northeast monsoon period with depleted values at the beginning and enriched ones towards the end. Note, the strongest depletion and enrichment are recorded during in one monsoon period, the northeast monsoon. As a result, the subsequent analysis and the respective interpretation are not convincing.

I suggest using a different classification depending on the $d^{18}O$ signal.

Reply: Thank you for your suggestion. We use the southwest monsoon, northeast monsoon, and non-monsoon periods for seasonal classification, mainly based on the literature review and understanding that Matara, as a coastal city, is influenced by both monsoons all year round. Therefore, our focus is on analyzing the changes in water vapor isotopes during different monsoon periods, paying particular attention to changes at different time scales, including daily, monthly, and seasonal. We have also added a separate discussion section on situations where isotopic changes are significant during monsoon or non-monsoon periods.

Definition of Regions

The definition of region a and region b (Line 570ff) is not defined in the text. Moreover, it is not clear, why you chose these regions.

Reply: Thank you for your suggestion. We have added the information of "Regions a and b" in lines 584-587.

Through theoretical models and observational research, it has been shown that d-excess in the oceanic boundary layer or at coastal observation points can effectively indicate the source of ocean evaporation water vapor. "Regions a and b" were chosen based on prevailing wind directions during the southwest and northeast monsoons (Section 3.3). During the southwest monsoon, water vapor mainly comes from the Indian Ocean, while during the northeast monsoon period, water vapor mainly comes from the Bay of Bengal. The region locations were chosen accordingly.

Similarly, it is not clear why you chose a 5°x5° area for the spatiotemporal correlation (Line 625).

Reply: As mentioned in the manuscript (lines 641-644), we chose a 5°×5° square box to minimize the effect of local variations.

Used Variables

The number of considered variables is enormous. However, it is sometimes unclear where they come from (AWS, reanalysis etc.) and why you use all these variables as some are not relevant to your argumentation. For example, BLH and LCL are included in Table 1. Its label states that it contains the data from the station at Matara. In your data section BLH is from ERA5, which should be pointed out in the table and in the text. In contrast, the source for the LCL data is not given at all. Both variables are described in the text, but the results are not discussed in relation to the isotopic variability, neither in this paragraph nor elsewhere. Why do you present them here? Do you really need them?

Reply: Thank you for your suggestion. Following the reviewer's comments, we have added the calculation steps for LCL in Section 2.1 in lines 201-209 as new Equations 1-5. To some extent, LCL can reflect precipitation conditions. Therefore, we chose LCL for the analysis. Sections 3.1 and 3.2 are dedicated to a thorough discussion and analysis of BLH and LCL, allowing us to more comprehensively explore the factors influencing isotopic composition.

Moreover, the analysis is not consistent in its use of variables (see Table below), meaning I cannot discern a clear and coherent line of argumentation. You present BLH and LCL at the beginning, but you did not consider or mention it afterwards. Why is the consideration of wind speed and wind direction necessary and why is it only included in Fig. 4 but not in Fig 2? In Fig 6, you consider dexcess and RHsst although in the rest of the paper you try to understand the $d^{18}O$ variability. You calculated the spatiotemporal correlation between precipitation and $d^{18}O$ of water vapor, but it is not clear to me why you did consider precipitation at this point. At the end, you analyse OLR although it was not considered before. Why you did use the NCEP-NCAR reanalysis for OLR although you used ERA5 for the other variables.

Note: it seems that OLR and therefore convective activity is very important at your study site and agrees with the results of a recently published paper considering the tropical region of Ecuador, South America

- Landshuter, N., Aemisegger, F., & Mölg, T. (2024). Stable water isotope signals and their relation to stratiform and convective precipitation in the tropical Andes. Journal of Geophysical Research: Atmospheres, 129, e2023JD040630. https://doi.org/10. 1029/2023JD040630

I suggest including OLR at the beginning of the results section as time series (maybe at the end of Fig2). Additionally, you could consider generating spatial composites of OLR based on your defined periods.

	Hum (ppmv)	δ18O	δD	Dexcess	T	RH	Q	Press.	Precip	BLH	LCL	Wind spe.
Fig 2	x	x	x	x	x	x	x	x	x			
Tab 1		x	x	x	x	x	x			x	x	
Fig 3		x	x	x			x					
Fig 4		x		x	x	x	x			x	x	x
Fig 5		x					x					
Fig 6				x								
Fig 7		x							x			

Reply: Thank you for your suggestion.

1. See our response to the previous comment regarding BLH and LCL.

2. We considered wind speed and wind direction to better understand the monsoonal effects on Sri Lanka. Fig. S10 also explores the differences during the day- and nighttime periods, highlighting substantial diurnal variations in wind direction that directly impact water vapor stable isotopic composition, creating day-night differences.

3. Previous studies have shown that regional convective activity over a larger area can influence the water vapor stable isotopic composition. Thus, Section 3.4 focuses on how local convective activities, influenced by both the Indian Ocean and the Bay of Bengal, affect the water vapor isotopic composition at Matara station. Daily precipitation and outgoing longwave radiation (OLR) data were used to quantify the intensity of convection. Although the monsoon system is complex, most monsoon rainfall results from convective uplift, making rainfall at Matara a strong indicator for quantifying convection (Lekshmy et al., 2014).

Reference: Lekshmy, P.R., Midhun, M., Ramesh, R., and Jani, R.A.: ^{18}O depletion in monsoon rain relates to large scale organized convection rather than the amount of rainfall, Sci. Rep., 4, 5661, https://doi.org/10.1038/srep05661, 2014.

4. Following the reviewer's comments, we have added the time series diagram of OLR as the new Fig. 2.

Discussion and Interpretation

All the results are only sporadically compared to results of other studies. However, even more important, the results are not discussed and interpreted together to receive an overall conclusion of the results. So, how do all your results fit together? Consider putting a discussion at the end of a paragraph or section or include a section "Discussion", which contains the discussion of your results with other studies and the interpretation.

Reply: Thank you for your suggestion. Following the reviewer's comments, we have added a new "Discussion" Section, which looks at seasonal versus synoptic variabilities and water vapor flux and comparative analysis of the main features and influencing factors. We also added two new figures in the *Supporting Information* (Fig. S11 and S12).

Line 580-583: Here the comparison to another study occurs before presenting your own results. Consider splitting and moving the information of this sentence: The explanation of the relevance of RHsst should be at the beginning of the paragraph or section. A comparison of values from another study should be stated after the presentation of your results.

Reply: Thank you for your suggestion. Following the reviewer's comments, we included an explanation of RH_{SST} at the start of the Section 3.3 (Lines 575-582). In the detailed analysis, we now first present the findings of our own study before making any comparisons with results from neighboring regions.

Presentation Quality

The presentation of the study was often confusing for me. This is attributed to the overall structure of the results section and the use of an imprecise language within the paragraphs.

Figure Selection and Order

The overall structure was not easy to follow, which is linked to the already mentioned mix of analyzed variables, but also to the ordering of the figures and a missing explanation at the beginning of a section claiming why you did the respective analysis. For example:

-Figure 4: Why do you show the daily cycle of the variables? For presenting the new dataset? If so, consider switching Figure 3 and Figure 4 to keep the presentation of the new dataset together before going deeper into finding the explanation for the isotopic signal. Otherwise, I cannot see, why you included Figure 4. It does not contain new information that is already included in Figure 2 and is relevant for the subsequent argumentation/explanation.

Reply: Thank you for your suggestion. The intraday variations of isotopes and meteorological observation data shown in Fig. 4 are different from the time series presented in Fig. 2. Section 3.2 links the water vapor stable isotopes with local near surface water vapor, temperature, relative humidity, and precipitation. It serves for the analysis of how local meteorological elements affect the changes in stable isotopes of water vapor on a daily time scale, and allows us to focus on exploring the meteorological factors and influencing processes that occur in the local atmospheric boundary layer during the day and their potential impact on changes in $\delta^{18}O$ and d-excess. In addition, we can explore how the diurnal variation in near surface atmospheric water vapor stable isotopes is influenced the differences in local diurnal water vapor condensation processes, which allows us to distinguish between the different impacts of local processes that affect the variation of near surface atmospheric water vapor stable isotopes in different seasons.

-Figure 6: Why do you consider d-excess here? It is hard to follow your argumentation at this point. Do you use d-excess to support the $d^{18}O$ results? Or is it an analysis of a different isotopic variable? In the first case, you should be more specific and explain the link and how the d-excess results support your results of the moisture source analysis. In the second case, consider putting Figure 6 at the end of your analysis.

Reply: Thank you for your suggestion. Ocean evaporation initiates the sequence of phase transformations that occur during the global water cycle and is a determining factor for isotopic variations. Understanding the controlling factors of oceanic evaporation is essential to elucidate isotopic shifts in the marine boundary layer. Observational data from numerous marine boundary layer studies have demonstrated a significant (typically negative) relationship between d-excess in near-surface water vapor and the relative humidity of the sea-surface air (RH_{SST}). In cases where dynamic fractionation during air mass transport is either absent or minimal, d-excess can serve as an indicator of the moisture source region (Bonne et al., 2014). Our study utilized this method to examine sea surface evaporation conditions and found that the results are consistent with trajectory tracking, confirming that water vapor at Matara station is largely replenished via an influx from surrounding oceanic sources.

Reference: Bonne, J-L., Masson-Delmotte, V., Cattani, O., Delmotte, M., Risi, C., Sodemann, H., and Steen-Larsen, H.C.: The isotopic composition of water vapour and precipitation in Ivittuut, Southern Greenland, Atmos. Chem. Phys., 14, 4419-2014, https://doi.org/10.5194/acp-14-4419-2014, 2014.

-Note Figure 2 shows humidity (ppmv) and pressure, which are not considered in the text. Remove those variables from the plot or include them if they are relevant for your argumentation.

Reply: Thank you for your suggestion. Humidity (obtained from the LGR instrument) in shown in Fig. 2, and was utilized in the humidity correction process as detailed in Text S1.1 of the *Supporting Information*. Air pressure is employed to compute specific humidity and lifting condensation level (LCL). This is why we included time series plots for both variables.

Imprecise Language and Structure within Paragraphs

The language is often imprecise and does not only influence the readability of the manuscript but also the scientific quality. This mainly applies to the "Results" section. In the following, you find the most important cases.

Introduction

The introduction needs to be reconsidered. The first two paragraphs explain the influence of the monsoon on the Tibetan Plateau although the Tibetan Plateau is not considered in this study.

Reply: Thank you for your comments. Sri Lanka serves as an important hub for moisture transport from the Indian Ocean to the Indian subcontinent and the Tibetan Plateau. Therefore, understanding the atmospheric water vapor stable isotope composition and moisture sources in Sri Lanka's southernmost region of Matara, can provide insights into the variations in precipitation and water vapor influenced by the Indian summer monsoon over the Tibetan Plateau.

Line 105-112: This paragraph explains basic knowledge about stable isotopes and should be included before describing the results of recent studies (Line 81).

Reply: Following the reviewer's comments, we have adjusted the order of the third paragraph in the introduction (lines 82-94).

Data and methods

Line 201: Why did you use data from 2000-2020? Did you mean for the average annual precipitation and air-temperature? Is all the rest of the analysis restricted to the field campaign period?

Reply: We selected the period from 2000 to 2020 to better understand the multi-year average meteorological conditions of the study area (Fig. 1c). Here, 2m temperature, precipitation, and calculated specific humidity are used to reflect the long-term averages of temperature, precipitation, and specific humidity at Matara, i.e., to understand the region's average weather conditions. If we had used the same short period from 2020 to 2021 (for which we have observations), this would not necessarily have been representative of the local climatic conditions.

Line 201ff: The structure is here not consistent, you present ERA5 data, then NCEP-NCAR and then you go back to ERA5 data. You say here that ERA5 is good for missing observational data. Did you use it for this purpose?

Reply: The meteorological reanalysis data used in the article (except for outgoing longwave radiation (OLR)) were obtained from ERA5 reanalysis dataset, and OLR dataset comes from NCEP reanalysis dataset. Through comparison and validation, ERA5 can be beneficial in supplementing missing meteorological data obtained *in-situ* observation. Therefore, ERA5 is used to supplement the missing data observed.

Line 332: It is unclear how you derived the specific humidity of the trajectories

Reply: Following the reviewer's suggestion, we have added the information of how specific humidity was derived (lines 337-341).

Results

Line 348: Starting a paragraph by describing what a figure shows is not very helpful for the reader. Instead, I would shortly explain the structure of the section.

Line 348-350: Figure 2 does also show SST, precipitation, and humidity, which is not stated. Are all variables from the weather station? If not, please make it clear and include the source of the dataset in the text (and in the Data section).

Reply: Following the reviewer's suggestions, we added the information on SST and local meteorological parameters in line 425. SST data come from the ERA5 reanalysis dataset (line 228). The remaining data shown in the original Fig. 2 are from AWS measurements.

Line 351: What kind of "average" values? Hourly, daily, monthly, annual? The consideration of different time scales is interesting, however, as in the given line, it is not clear which time scale you are considering. This is often not clear in the following paragraphs. It was confusing for me. To increase the readability of the text, I suggest being more precise regarding the time scale. Moreover, it would help to present all results of one timescale together or always in the same order.

Reply: In Fig. S3, the data are presented as hourly averages. Monthly averages are subsequently calculated from these hourly values, with error bars included to show the amount of variability. Following the reviewer's comments, we added some additional information regarding the averaging time scales in lines 124-125 of the *Supporting Information*.

Line 352: Lifting condensation level, where does the data come from? Be more specific and take care of the structure. First, consider AWS data and if necessary, consider variables from other datasets. However, in your case, LCL is not important for your argumentation as you do not mention it in the rest of your manuscript.

Reply: Lifting condensation level (LCL) is calculated from air temperature, relative humidity, and air pressure measured by the AWS. We have added the formulas used by the AWS internal algorithm to Section 2.1 (lines 201-210, and equations 1-5). LCL is included in this study due to its role in illustrating the water vapor condensation process.

Line 356: No definition exists of the non-monsoon period: how is it defined? In Section 2.1 you introduce four monsoon periods but in your analysis you only have three.

Reply: This was indeed ambiguous in the manuscript. The non-monsoon months are defined as March-April and October-November. In Section 2.1, we had referred to the non-monsoon periods as the first and second inter-monsoon period instead, which may have created confusion. Furthermore, for the analysis we combined both non-monsoon periods into a single period. We have tried to remove this ambiguity and make this clearer (lines 186-187).

Line 351-end of paragraph: You describe temperature, specific humidity, and relative humidity in an inconsistent way. Try to structure your paragraph either by presenting each variable or by going through the different months/seasons and compare the variables with each other, but always keep the same order.

Reply: Following the reviewer's comments, we adjusted the order of the variables in lines 374-397.

Line 383-385: True, however, this does not fit to the time series and is related to the classification issue I mentioned before.

Reply: Following the reviewer's comments, we adjusted the time series of the variables in lines 405-407.

Line 358: In your text is no reference to Fig. S2. Overall, you should check that every figure is referred to in the text and that the reference has the correct number.

Reply: Following the reviewer's comments, upon careful review of the figure reference, we confirm that Fig. S3 is the correct reference, which was noted in line 388.

Line 363: You introduced the seasons in your text as monsoon seasons. For more clarity, try to avoid using other seasonal conventions such as winter, spring etc. throughout your text.

Reply: Following the reviewer's comments, we have adjusted the seasonal description in lines 384-388 to enhance clarity and ensure a more accurate representation of the data.

Line: 379: You present the results of $d^{18}O$, dD, and d-excess. Nice. However, at some point you should state that you will only consider $d^{18}O$ in the following.

Reply: Following the reviewer's comments, we added "Consequently, the subsequent analysis will concentrate on the variations in $\delta^{18}O$." as a transitional sentence to provide explanation and clarification in lines 404-406.

Line 394: State or explain (maybe already in the introduction) that high values of d-excess are related to moisture recycling.

Reply: Following the reviewer's comments, we added "The high values of d-excess are related to moisture recycling." in line 416.

Line 395-396: I cannot see it in the figure. Is it a result or an explanation/interpretation? In the latter case, please make it clear and use a reference e.g.,

Reply: The analysis in this part is based on the inferred relationships between $\delta^{18}O$, specific humidity, and d-excess presented in Fig. 2. The sentence is intended as a concluding remark.

- Graf, P., Wernli, H., Pfahl, S., and Sodemann, H.: A new interpretative framework for below-cloud effects on stable water isotopes in vapour and rain, Atmos. Chem. Phys., 19, 747-765, https://doi.org/10.5194/acp-19-747-2019, 2019.
- Aemisegger, F., Pfahl, S., Sodemann, H., Lehner, I., Seneviratne, S. I., & Wernli, H. (2014). Deuterium excess as a proxy for continental moisture recycling and plant transpiration. *Atmospheric Chemistry and Physics*, *14*(8), 4029–4054. https://doi.org/10.5194/acp-14-4029-2014
- Aemisegger, F., Spiegel, J. K., Pfahl, S., Sodemann, H., Eugster, W., & Wernli, H. (2015). Isotope meteorology of cold front passages: A case study combining observations and modeling. *Geophysical Research Letters*, *42*(13), 5652–5660. https://doi.org/10.1002/2015gl063988

Similarly, Line 536-541, it is not clear, whether the stated information belongs to results of the study (please add a reference to the respective figure) or interpretation/background information from another study (please add reference).

Reply: Following the reviewer's comments, we added the reference to Fig. 5a (line 580).

Line 529: please order the factors in the way they appear in the following text.

Line 542: Did you really calculate water vapor sources as for example done by Sodemann, H., C. Schwierz, and H. Wernli (2008), Interannual variability of Greenland winter precipitation sources: Lagrangian moisture diagnostic and North Atlantic Oscillation influence, J. Geophys. Res., 113, D03107, doi:10.1029/2007JD008503.

or did you calculate the mean water vapor content of the clustered trajectories, or did you calculate the mean water vapor change along the clustered trajectories?

Reply: In this study, we employed the HYSPLIT backward trajectory model to compute the water vapor trajectories that reach Matara station. The analysis focused on changes in water vapor along its path to the Matara, and the moisture sources. Although trajectory frequency and clustering were calculated, the contributions of individual moisture sources were not analyzed.

Line 549: It is unclear, what the $d^{18}O$ of the trajectories (Figure 5) means. It is probably not the mean traced $d^{18}O$ along a trajectory, but it is the calculated concentration-weighted $d^{18}O$. How should this measure be interpreted?

Reply: Identifying the moisture source is an important topic in hydrological research, and different studies employ different app roaches to identify the moisture source, e.g., through a separate analysis of meteorological and isotopic data. Here, we employed the Concentration Weighted Trajectory (CWT) method and combine it with water vapor d-excess to infer the moisture source. The advantage is that d-excess is minimally affected by environmental factors, making it a good indicator for moisture tracing. Additionally, the analysis results can be visualized to intuitively identify the potential moisture sources. Previous studies (Salamalikis et al., 2015) have shown the suitability of the CWT model for this purpose.

Reference: Salamalikis, V., Argiriou, A.A., and Dotsika, E.: Stable isotopic composition of atmospheric water vapor in Patras, Greece: A concentration weighted trajectory approach, Atmos. Res., 152, 93-104, https://doi.org/10.1016/j.atmosres.2014.02.021, 2015.

Line 550: Results do not agree with the results of section 3.4

Reply: Following the reviewer's comments, we modified the sentence as follows (lines 558-560).

Moisture from all sources shows seasonal variations, with $\delta^{18}O$ values lower during the southwest monsoon than during the northeast monsoon.

I hope my comments help to improve your manuscript.