

Dear Referee,

Thank you very much for your careful evaluation of our manuscript and for your constructive comments regarding data overlap, fog classification, isotope interpretation, and the definition of the local meteoric water line. We agree that these issues require clearer conceptual separation and more cautious terminology. We will address them comprehensively in the revised manuscript and dataset.

1. Relationship to previous publications and the purpose of the ESSD data paper

We acknowledge that part of the observational record has been used in our previous process-oriented publications. We have already clarified which observations overlap with previous studies and which records are newly added. Nevertheless, we agree that the distinction between the scientific purpose of the previous papers and that of the present data paper should be made more explicit.

The purpose of the present ESSD manuscript is not to claim that every individual observation is newly generated. Rather, it is to provide a consolidated, quality-controlled, consistently formatted, openly archived, and reusable data product that integrates previously dispersed observations with newly added records. The present dataset includes additional rainfall, groundwater, and fog-isotope observations, together with expanded metadata, sampling-method documentation, quality-control information, uncertainty descriptions, and standardized data structures that were not available as a unified product in the previous process-focused publication.

In the revision, we will further reduce overlap in the interpretive sections, clearly identify previously used observations, and emphasize the added value of comprehensive data curation, documentation, long-term preservation, and reuse.

2. Meteorological fog types versus isotope-based interpretation

We agree that advection fog, radiation fog, and other meteorological fog types are conventionally defined primarily by meteorological conditions, including atmospheric circulation, boundary-layer structure, temperature, humidity, wind profiles, and cloud or visibility observations. We also agree that stable isotopes should not be treated as a substitute for a complete meteorological classification. Our original intention was to use isotope characteristics to infer dominant moisture sources and associated atmospheric processes rather than to claim an unambiguous meteorological classification of every individual fog event.

We recognize that our current terminology does not sufficiently distinguish between these two concepts. We will therefore revise the terminology throughout the manuscript and dataset. The current categories will no longer be presented as independently confirmed meteorological fog types. Instead, they will be described as provisional, isotope-based source or process groups, for example: isotope-inferred advection-type group; isotope-inferred locally recycled group; and

isotope-inferred mixed-source group. We will explicitly state that these groups represent isotope-based interpretations of moisture-source influence and are not equivalent to meteorologically confirmed fog classifications. We will not imply that all events have been independently classified using full meteorological profiles or reanalysis data.

3. Overlap among isotope distributions and interpretation of Figs. 6 and 10

We agree that different water sources and fog-forming processes may exhibit overlapping isotope compositions. Stable isotopes integrate vapor source, atmospheric mixing, condensation, evaporation, and post-collection processes, and therefore cannot be expected to define universally distinct or non-overlapping ranges for individual meteorological fog types.

We also agree that the apparent separation among the groups in Figs. 6 and 10 should not be interpreted as independent proof that the corresponding meteorological fog types are uniquely distinguishable by isotopes. Because the grouping criteria themselves involve isotope parameters, the figures primarily illustrate the isotope-based grouping framework rather than independently validate it.

In the revision, we will:

1. revise the figure titles, captions, and related text to describe the categories as isotope-based source/process groups;
2. remove language implying that the groups occupy unique or unambiguous isotope ranges;
3. explicitly acknowledge overlap and uncertainty among the inferred groups;
4. clarify that isotope patterns provide supporting information about moisture sources and processes, rather than definitive meteorological classification; and
5. reconsider whether the separate regression lines and proportions should remain in the main text or be presented more cautiously as a derived exploratory product.

4. Sensitivity of the isotope-based grouping to the reference line

We agree that the LMWL is not a fixed or universal boundary. Its estimated slope and intercept may vary with sampling duration, event coverage, rainfall amount, seasonality, sub-cloud evaporation, and the samples included in the regression. We therefore agree that the difference between the LMWL reported in the present manuscript and those reported in previous studies should be discussed more carefully.

To evaluate whether the choice of reference line materially affects our interpretation, we have recalculated the LMWL using rainfall samples only and compared it with the previously reported relationship based on rainfall and groundwater samples. The rainfall-only LMWL is:

$$\delta^2\text{H} = 5.7 \delta^{18}\text{O} - 4.3$$

whereas the combined rainfall–groundwater relationship is:

$$\delta^2\text{H} = 5.8 \delta^{18}\text{O} - 5.2$$

The two relationships are very similar, with a slope difference of 0.1 and an intercept difference of 0.9‰.

We also recalculated lc-excess and repeated the isotope-based grouping using the rainfall-only LMWL. Only seven samples changed group assignment: one sample previously assigned to the locally recycled group was reassigned to the mixed-source group, whereas six samples previously assigned to the mixed-source group were reassigned to the locally recycled group. All remaining assignments were unchanged.

These results indicate that the isotope-based grouping is not materially sensitive to whether groundwater is included in the reference-line regression. Nevertheless, in the revised manuscript, we will use the rainfall-only LMWL as the primary precipitation reference. We will also clarify that the LMWL is used as one contextual indicator together with d-excess and lc-excess, rather than as an unambiguous boundary separating meteorological fog types.

5. Scientific role of groundwater and revised treatment of the reference lines

We agree that groundwater cannot provide independent validation of a regression in which the same groundwater samples are included. We will therefore remove the previous circular argument that the proximity of groundwater samples to the fitted relationship independently confirms the validity of the LMWL.

In the revised manuscript, the rainfall-only relationship will be presented as the formal LMWL. The combined rainfall–groundwater relationship, if retained, will be reported separately as a broader precipitation–groundwater meteoric relationship rather than as a precipitation-only LMWL.

Groundwater will instead be discussed as a potential component of the local meteoric moisture pool. In this hyper-arid system, locally recycled atmospheric moisture may be supported not only by recent rainfall and soil-water evaporation, but also by groundwater-supported vegetation and subsurface water recycling. This source-based interpretation is scientifically relevant to the locally recycled isotope group, but it is conceptually distinct from the formal definition of an LMWL.

This revised treatment will therefore separate two related but different roles: rainfall defines the local precipitation reference line, whereas groundwater is considered as a potential local moisture-source endmember. The sensitivity analysis reported above demonstrates that this conceptual separation does not materially alter the isotope-based grouping.

Concluding response

We appreciate the reviewer's distinction between meteorological fog classification and isotope-based moisture-source interpretation. We agree that this distinction was not sufficiently clear in the current manuscript.

In the revision, we will:

1. distinguish meteorologically defined fog types from isotope-based source groups;
2. revise the terminology used in the manuscript, dataset, and figures;
3. avoid presenting isotope distributions as uniquely diagnostic of meteorological fog types;
4. use the rainfall-only LMWL as the primary precipitation reference;
5. report the sensitivity of δC -excess and isotope-based grouping to the reference-line definition; and
6. discuss groundwater separately as a potential local moisture-source endmember.

These revisions will preserve the value of the primary isotope observations while ensuring that the derived source interpretations are presented transparently, cautiously, and consistently with the available evidence.

Thank you again for these constructive comments.