Response to the Editor

Following the Editor's suggestion, we have incorporated five additional karst springs from Romania into the WoKaS-Iso database. Accordingly, all relevant numbers, tables, figures, metadata, and dataset files have been updated in the revised manuscript and repository. We also thank the editor for approving the extension of the dataset by five Romanian karst springs, which extends the spatial coverage of the dataset and therefore strengthens its representativeness.

Response to Reviewers

Please note that the line numbers referred to in the responses correspond to the tracked-changes version of the revised manuscript.

Reviewer 1

Overall opinions

The manuscript aims to showcase the WoKaS-Iso database. It consists of very useful isotope measurement dataset for various applications in karst hydro(geo)logy and make the data easily accessible to the whole scientific community. The isotope measurements come with precipitation MSWEP, temperature ERA5 and evapotranspiration GLEAM, giving a ready to use dataset with independent estimations of P, T and ET.

The manuscript is well written and pleasant to read. The figures are well designed and clear. The data are well described, and the author give clear recommendation on the use of the data by affecting various flags depending on the data quality. This is useful for the reader and future user of the dataset.

I would recommend this manuscript for publication in ESSD after addressing some minor concerns given as specific comments below. This initiative is of clear interest for the scientific community and will benefit from additional contributions in the future.

We sincerely thank you for your careful reading of our manuscript and for your positive and encouraging evaluation. We greatly appreciate your recognition of the value of the WoKaS-Iso database and your valuable and constructive suggestions for improving the manuscript.

Comment 1:
Line 301: It could be nice to have one figure with some example of time series, maybe showing some different behaviour across North America, Europe and Asia (since these are regions with the more data).

Response: Thank you very much for this helpful suggestion. We agree that including example time series would make the manuscript more informative and would better illustrate the diversity of isotope dynamics represented in the database. In the revised manuscript, we have therefore added Figure 5, which shows overlapping $\delta^{18}O$ time series from three selected spring and three cave drip water records respectively in North America, Europe, and Asia. $\delta^{18}O$ was selected for this comparison due to its more complete availability across the database. The corresponding description and interpretation have been added in Lines 343–352.

Comment 2:
By looking at some time series, I have the impression that Input-FR-S-0016@Lison and Input-FR-S-0017@Loue are the same data. Maybe need to cross checked.

Response: Thank you for this careful observation. We rechecked the dataset and contacted the data contributor to confirm whether there was any mistake.

We can confirm that Lison Spring and Loue Spring share the same precipitation isotope data in our database, whereas their rainfall amount data are different. Our colleague clarified that the isotopic rainfall data for the two springs originate from the same sampling site. The collector for rainfall isotopes was located between two rain gauge stations, one on the Loue spring catchment and the other on the Lison spring catchment. Therefore, the isotope data are identical for both springs.

In contrast, the rainfall amount data are derived from the respective rain gauge stations within each catchment, rather than from the isotope collector itself. To avoid confusion for future users, we have revised the metadata table by adding a more explicit description in the "additional information" column and including the coordinates of the rain gauge stations for reference. Please find the revised **WoKaS_Iso_Spring_Input_Metadata.xlsx** file in the OPARA repository (https://doi.org/10.25532/OPARA-909).

Reviewer 2

This paper introduces the world's first systematically integrated database (WoKaS-Iso) containing time-series data on oxygen-18 and deuterium-1 isotopes from karst springs and cave dripwater, providing detailed descriptions of data sources, standardization procedures, quality control measures, global product evaluations, and data structure. The establishment of this database holds significant value for karst hydrogeology, paleoclimate reconstruction in caves, and hydrological model calibration, particularly for large-scale comparative studies and data-scarce regions. The comprehensive workload and robust data integration align with the data paper positioning of the ESSD journal. However, the paper still exhibits notable shortcomings in several aspects that require reconsideration following substantial revisions.

Comment 1:

The text repeatedly mentions that the database is built upon WoKaS and SISAL_mon_v1, but fails to systematically elaborate on its incremental contributions compared to these two foundational databases (e.g., the number of newly added sites, time series length, data types, etc.). It is recommended to include a "Comparison with Previous Work" section in the introduction or methods section to clearly outline the incremental features.

Response: Thank you for this suggestion. The incremental contributions of WoKaS-Iso relative to WoKaS and SISAL_mon_v1 were mentioned in the original manuscript, where the extension from WoKaS was described (Lines 170–174) and the integration of SISAL_mon_v1 was introduced (Lines 179–185), and the differences between WoKaS-Iso and SISAL_mon_v1 for the cave monitoring component were further described in Sect. 2.1.2 (Lines 280-296). However, we agree that these contributions could be presented in a more systematic and explicit way. We therefore revised Sect. 2 to better summarize the incremental features of WoKaS-Iso. The first paragraph (Lines 170–178) now clarifies the extension of WoKaS-Iso from WoKaS discharge database for karst springs, including stable isotope records for 241 springs and direct linkage with WoKaS discharge records for 29 springs. The second paragraph clarifies the extension from SISAL_mon_v1, including 66 SISAL_mon_v1 caves, 8 additional cave datasets, supplementary drip rate measurements, and GNIP records within a unified database framework (Lines 187–196). The following paragraph further summarizes the complementary hydrological and climatic datasets integrated in WoKaS-Iso (Lines 198–203), and the text now guides readers to the relevant sections for further details.

Comment 2:

The evaluation of the three precipitation isotope modelsIsoGSM, Isoscape, and Sine -Curve (Section 2.2.2) was based solely on data from 55 stations, encompassing a mix of cave, spring, and weather station sites, which may introduce bias in the results. The criteria for spatiotemporal matching should be specified more rigorously (e.g., whether matching is performed monthly or whether precipitation amounts are weighted); the assessment findings for δ^2H should also be presen

ted in the main text rather than merely mentioned in the appendix.

Response: Thank you for this important remark. We chose to only use stations from our dataset because we want to identify the best suitable input data product for this WoKaS-Iso dataset. Using the entire set of GNIP stations might have resulted in a different outcome of our comparison but also in poorer estimates of the input to our chosen caves and karst springs as it would have been biased by regions with no WoKaS-Iso locations. The comparison was conducted at the monthly resolution in the original manuscript, as stated "we compared monthly simulated precipitation $\delta^{18}O$ and $\delta^{2}H$ against site-specific observations from both cave drip water and karst spring locations" (Lines 450–451). The procedure for deriving monthly observed values was also described: "For sites with daily precipitation, the monthly amount-weighted precipitation isotopes were calculated, while for sites lacking daily precipitation, the stepwise interpolation of precipitation isotopes was applied to derive monthly means" (Lines 454–457). To make this processing step clearer, we have revised and expanded this description in the revised manuscript (Lines 454–457).

Following the reviewer's suggestion, we have also moved the $\delta^{2}H$ evaluation from the Supplement to the main text. The statistical comparison of $\delta^{2}H$ among the three models is now presented in Fig. 8 and described in Lines 472–477. The $\delta^{2}H$ time-series comparison is presented in Fig. 10, with the corresponding discussion in Lines 494–513.

Comment 3:

In the quality scoring system (Table 6), "Data Collection" receives 3 points, "Digital Data" receives 2 points, and "Global Products" receives 1 point. This scoring criterion does not account for variations in the accuracy of digital data or differences in the reliability of global products across specific regions. It is recommended to introduce more detailed quality metrics (such as data missing rate, temporal continuity, and deviations from adjacent sites) or at least conduct a sensitivity analysis of this scoring system.

Response: Thank you for this valuable suggestion. WoKaS-Iso is a compilation database and the quality scoring system is based on the data source and data availability. The original measurement quality of provided dataset has been done by the original data owners, which is accessible to the reader as we provide each data source. The same is true for the global products: their original sources provide more detailed information about their quality.

We agree that the rate of gaps, temporal continuity, and deviations from adjacent sites can provide valuable information. However, these metrics are not suitable as universal quality criteria for WoKaS-Iso because the isotope time series are highly heterogeneous, irregularly sampled, and have no standard observation frequency. Unlike discharge data where completeness can be calculated based on expected daily values, isotope sampling campaigns do not have a typical temporal resolution, which differs due to the different purposes of sampling set by the original data collectors. To provide complementary information on temporal data coverage, we added a new section 4.3 presenting the empirical cumulative distribution functions (ECDFs) of the time gaps between consecutive $\delta^{18}O$ and $\delta^{2}H$ observations for karst springs and cave drip water (Fig. 12; Lines 785–806). These statistics provide users with additional information on the temporal characteristics of the archived isotope records.

Comment 4:

Figure 3 simultaneously displays data combination types (colors) and sampling resolution (symbol sizes), making them visually difficult to distinguish. It is recommended to split the data or adopt a more intuitive legend design.

Response: Thank you for pointing this out. We have revised Figure 3 by adding a separate symbol size legend to each zoomed panel (Fig. 3a–f).

Comment 5:

Section 2.1.3 contains significant overlap with the content of Figures 4 and 5; it is recommended to consolidate and streamline the content.

Response: Thank you for this suggestion. We have consolidated and streamlined the text in Section 2.1.3.

Comment 6:

Although detailed CSV structures and MATLAB scripts are provided, typical use cases (e.g., how to extract time series from a specific site or perform simple analyses using global product data) are lacking. It is recommended to include a concise example or flowchart in Section 3.4, "Usage Notes."

Response: Thank you for this suggestion. We added an "Example use case" to Section. 3.4, illustrating how users can locate site-specific output data, identify corresponding input data, and access global product datasets for a selected spring or cave site (Lines 672–698).

Comment 7:

L80: "The database incorporates data sourced from 236 springs and 74 caves, totaling 997 time series..." It does not specify how many of these time series contain both $\delta^{18}O$ and δ^2H, or how many contain only one of them.

Response: Thank you for this suggestion. We have added specific information to the Abstract, stating how many spring and cave sites contain both $\delta^{18}O$ and δ^2H records and how many contain only one isotope tracer (Lines 85–86). Further details are provided in Table 1 and Section 2.1.1.

Comment 8:

The statement L91 ("serving 10%–25% of the global population (Ford and Williams, 2007; Stevanovic, 2019)" cites literature from nearly two decades ago, making its data somewhat outdated; more recent global assessments could be incorporated.

Response: Thank you for this suggestion. We have revised the statement by incorporating more recent global assessments. The revised text now distinguishes between the proportion of the global population living in karst areas and the proportion depending on karst freshwater resources, with updated citations to Goldscheider et al. (2020) and Stevanović (2019) (Lines 95–97).

Comment 9:

L145 "they largely omit $\delta^{18}O$ and δ^2H data from karst springs and cave drip waters"GNIP/GNIR. The design itself was not intended for karst water; the criticism seems somewhat excessive.

Response: Thank you for this suggestion. We agree that the previous wording could be interpreted as overly critical of GNIP/GNIR. We have therefore reworded the sentence (Lines 152–154).

Comment 10:

Table 1 contains only figure captions; the main text does not explain the steps illustrated in Figure 1.

Response: Thank you for this suggestion. The workflow shown in Fig. 1 was described in the opening paragraphs of Section 2 and further detailed in Section 2.1.2 "Karst Springs" and "Cave Monitoring" (Lines 264–296) for output data, and Section 2.2.1 for input data. We agree that the connection between Fig. 1 and the main text was not sufficiently explicit. We have therefore expanded the Fig. 1 caption to summarize the database construction workflow and refer readers to the relevant detailed sections (Lines 210–217). In addition, Fig. 1 is now explicitly cited in the corresponding methodological descriptions for karst springs, cave monitoring, and input data (Lines 264, 280, and 396).

Comment 11:

In Figure 3, colors represent data combinations (flow rate + $\delta^{18}O$ + δ^2H, etc.), while symbol sizes indicate resolution; however, the legend does not explain the meaning of these sizes.

Response: Response: Thank you for this suggestion. We have added a symbol-size legend to each zoomed panel of Fig. 3 (Fig. 3a–f) to clarify that symbol size represents sampling resolution.

Comment 12:

“only GNIP stations within 25 km were retained”The reason for choosing 25 km was not explained, nor were altitude differences considered.

Response: We thank the reviewer for this comment. The 25 km threshold goes indeed along with uncertainty due to topographic effects. But this is also true for our coarsely resolved large-scale products. To account for that a 25 km threshold was chosen to align with the spatial resolution of the Isoscape and Sin Curve Model datasets used. Their resolution (both 5 arcmin, ≈10 km) implies a maximum representative distance of roughly twice the grid-cell diagonal (~28 km). Thus, the 25 km buffer is a conservative and resolution-consistent choice, also compatible with coarser meteorological datasets that we used such as ERA5 (~31 km). This elaboration is added at Lines 404-408.

Comment 13:

The stated IsoGSM spatial resolution of "200 km" in Table 2 is inaccurate. IsoGSM typically has a T42 spectral resolution (approximately 2.8 × 2.8, or about 300 km); please verify this.

Response: Thank you for raising this concern. We used the IsoGSM-NCEP-R2 product with T62 resolution. We confirmed this with our coauthor Prof. Kei Yoshimura who has been involved in the development of IsoGSM for many years and confirmed that there has been no version of T42 before. To avoid confusion, we changed the model’s name in Table 2 from “IsoGSM” to “IsoGSM-NCEP-R2” and added two additional references, Kanamitsu et al. (2002b) and Bong et al. (2024), in the main text (Line 433).

Comment 14:

Section 3.3 mentions that extraction scripts for three products are provided, but IsoGSM and Isoscape are not included. Explain the reason or provide a simple NetCDF reading example.

Response: Thank you for this suggestion. For IsoGSM, we previously did not have permission to share the complete global dataset during manuscript preparation. We have now obtained permission to include the global IsoGSM-NCEP-R2 datasets in DAT format in the OPARA repository and added a corresponding extraction script for users. We also added an extraction script for the Sine Curve model and revised the README.md file to describe data access, input CSV preparation, script execution, and output file structure. The new folders and scripts are described in Section 3.3 (Lines 611–625), and the usage notes for the scripts are provided in Section 3.4 (Lines 656–661).

For Isoscape, no MATLAB extraction script is provided because the product is distributed as gridded raster datasets in GeoTIFF format, and the values used in WoKaS-Iso were extracted in ArcGIS Pro. We have added instructions on where to download the raster maps and how to extract values for new sites using GIS-based raster extraction in Sect. 3.4 (Lines 662–671).