Response to RC1

General comments

This manuscript presents a valuable global dynamic precipitation isotope dataset with a long temporal coverage, multiple temporal products, and a generally well-structured validation framework. Overall, the manuscript is of high quality, and the dataset has clear scientific value and broad potential applications, especially for isotope-related studies in data-sparse regions. In my view, the paper is already close to publishable in its current form. I only suggest a few minor revisions:

Response:

We sincerely thank the reviewer for carefully evaluating our manuscript and for providing constructive comments and suggestions.

Comment 1:

Please clarify more explicitly the nature of the climatological and monthly evaluation framework. The leave-one-out jackknife approach is appropriate and rigorous, but it is better described as a cross-validation framework rather than a fully independent external validation.

Response 1:

Thank you for this helpful comment. We have revised the beginning of section 2.3 to clarify that the climatological and monthly evaluation were conducted using a cross-validation framework.

Changes in the revised manuscript and/or dataset:

The beginning of section 2.3 was revised as follows:

"We evaluated the climatological and monthly datasets against GNIP observations using leave-one-out jackknife cross-validation. Observations were compared with the collocated model grid-cell values using the same station set as in the bias correction. To prevent information leakage that would inflate skill estimates, for each target station, we recomputed the annual-mean correction without that station before evaluating errors at its location."

Comment 2:

Please provide a few more details on the ArcGIS-based global IDW interpolation, such as the main parameter

settings or coordinate handling, to improve reproducibility.

Response 2:

We have added information on the ArcGIS version, coordinate system, interpolation domain, output resolution, and IDW parameter settings used to generate the global correction maps.

Changes in the revised manuscript and/or dataset:

The following text was added to section 2.2.

"Because GNIP stations are spatially sparse, we generated a global correction map via inverse-distance-weighting (IDW) interpolation using ArcGIS Pro 3.6.2. The interpolation was performed in the WGS 84 geographic coordinate system over the domain 180°W–180°E and 80°S–80°N, with an output cell size of 1.25°. A power parameter of 2 and the ArcGIS default variable search neighborhood comprising the 12 nearest stations were used."

Comment 3:

Please state a little more clearly the intended scope of the annual-mean bias correction. The results suggest that it is mainly effective for improving long-term mean and monthly consistency, whereas improvements at the daily scale are more limited. This clarification would help users better understand the appropriate use of the dataset at different timescales.

Response 3:

We agree that the intended scope of the annual-mean bias correction should be stated more clearly. The correction was introduced primarily to reduce systematic regional biases in the long-term mean modeled isotope fields. These biases become more evident at monthly to annual timescales, over which the spatiotemporal variability of precipitation isotopes exhibits more systematic patterns. In contrast, daily isotope variability is strongly influenced by transient meteorological and event-scale processes that cannot be corrected by a constant annual offset. We have therefore clarified in section 2.2 that the annual-mean correction is intended mainly to improve the spatial consistency of long-term mean and monthly isotope fields, while its effect on daily variability is limited.

Changes in the revised manuscript and/or dataset:

The beginning of section 2.2 was revised as follows:

"The annual-mean correction was mainly intended to reduce persistent spatial biases in the long-term mean and monthly isotope fields. Broad isotope patterns are more evident at these timescales, whereas daily isotope

variations are more strongly influenced by short-term meteorological conditions and individual precipitation events.”

Response to RC2

General comments

The authors present a global product of isotopes in precipitation using an isotopic model driven by reanalysis data. Consistent fields of isotopes in precipitation can be very valuable for a large variety of users from climatology, hydrology, ecology, to plant physiology. With this in mind, I would suggest a variety of amendments to the dataset.

Response:

We sincerely thank the reviewer for carefully evaluating our manuscript and for providing constructive comments and suggestions.

Comment 1:

Isotopes in precipitation alone are not so useful without other information such as other environmental variables. They come from the reanalysis product JRA-3Q. I do not know how to access this data and I could not find out easily. It looks like it is only available to collaborative institutions. A solution would be to include a subset of variables in this data product. One could follow the subset that ECMWF chose for the timeseries downloads (https://cds.climate.copernicus.eu/datasets/reanalysis-era5-single-levels-timeseries?tab=overview).

Response 1:

JRA-3Q is publicly available to registered users through several data providers, including Japan Meteorological Agency and the NCAR Research Data Archive. To clearly distinguish the isotope dataset produced in this study from the original reanalysis dataset, we have not included JRA-3Q meteorological variables in our archive. Instead, users can obtain the required variables directly from the original data providers. We have added access information for JRA-3Q to section 5.

Changes in the revised manuscript and/or dataset:

The following sentence was added to section 5.

"The JRA-3Q reanalysis data used as meteorological forcing are publicly available to registered users through the Japan Meteorological Agency (https://www.data.jma.go.jp/jra/html/JRA-3Q/index_en.html#USAGE) and the NCAR Research Data Archive (https://gdex.ucar.edu/datasets/d640000/)."

Comment 2:

It is also important that I can do my own averages as a user. For example, I want to have averages per season. With the current product, this is only possible with the netcdf product because the csv product does not include precipitation. But I also do not know what is precipitation in the product: mean, sum, …?

Response 2:

We agree that users may wish to calculate customized temporal averages, such as seasonal precipitation-weighted isotope values. The dataset provides daily, monthly, and climatological products, while other temporal aggregations can be calculated by combining the isotope data with precipitation data obtained directly from JRA-3Q, as noted in our response to Comment 1. We also removed the precipitation variable from the revised NetCDF files because it was insufficiently described and is not part of the isotope product.

Changes in the revised manuscript and/or dataset:

The precipitation variable was removed from the revised NetCDF files to maintain a clear distinction between the isotope product and the original JRA-3Q meteorological data. JRA-3Q precipitation data can be obtained from the URLs added to section 5.

Comment 3:

In plant physiology, for example, isotopes in precipitation is not enough. I would need also isotopes in atmospheric vapour. This should be available from the isotope model as well so one could include it in the product.

Response 3:

We agree that atmospheric vapor isotope data may be useful for some applications. We have therefore added daily isotopic compositions of vertically integrated atmospheric water vapor to the NetCDF files as supplementary variables. Because these vapor isotope fields were not independently evaluated in the present study, they are provided primarily for exploratory use and should be interpreted with caution.

Changes in the revised manuscript and/or dataset:

The following sentence was added to section 3.

“Daily isotopic compositions of vertically integrated atmospheric water vapor are also provided in the daily NetCDF files as supplementary variables. These variables were not evaluated against observations in the present study and are therefore intended primarily for exploratory use.”

Comment 4:

For quite a few applications, sub-daily information is important. Leaf water isotopes are, for example, very different in midday and at night. Other people started using the isotopic composition of single events such as storms, which a reanalysis-driven product could probably provide. The hourly product would hence be very valuable. I would rather have the hourly than the daily product.

Response 4:

We agree that sub-daily isotope information would be valuable for studies of individual precipitation events and processes with strong diurnal variability. The ICM is operated at an hourly time step and can technically provide hourly precipitation-isotope outputs. However, suitable observational datasets for evaluating hourly isotope variability are currently very limited, particularly at the global scale. We therefore consider that distributing an hourly global product without adequate evaluation could give users an unjustified impression of its reliability. In the present study, we focus on the monthly and daily products, for which observational evaluation is available. Compared with previous dynamic precipitation-isotope products, which have generally emphasized climatological means and monthly variability, the present study places greater emphasis on daily and monthly variability. The development and evaluation of an hourly product are left for future work.

Changes in the revised manuscript and/or dataset:

No hourly product was added because sufficient observational data are not available to evaluate its reliability.

Comment 5:

An important point of the current dataset is for me the physical consistency, which is more difficult with pure data-driven approaches. But in this way, the current bias correction poses problems. Especially once vapour isotopes are included, one cannot simply do a bias correction of the precipitation isotopes. A solution would be that corrected and uncorrected data is provided.

Response 5:

We agree with the reviewer. In addition to the bias-corrected data, we have added uncorrected precipitation-isotope data as an additional product. The uncorrected data are provided in NetCDF format at daily, monthly, and climatological-mean products.

Changes in the revised manuscript and/or dataset:

Uncorrected daily, monthly, and climatological-mean precipitation-isotope data were added to the NetCDF products.

The following sentence was added to Sect. 3:

“For reference, uncorrected precipitation-isotope data are also provided in the NetCDF products at daily, monthly, and climatological-mean timescales.”

Comment 6:

I do not think that the current bias-correction is appropriate. By doing an inverse distance-weighted correction, there is a correction if a GNIP station is nearby but no correction if there is no GNIP station nearby. But the latter has probably the same bias than the former. The current bias correction does also not take into account known dependencies of water isotopes such as the altitude effect and continental effects. I would imagine rather a bias correction with an external drift such as kriging.

Response 6:

We agree that the IDW-based correction has limitations, particularly in regions with sparse GNIP coverage and complex topography. Values far from observation stations are less constrained, and the method does not explicitly account for known spatial controls on precipitation isotopes. Further improvements in isoscape accuracy, including the correction method, remain necessary, and we are currently investigating alternative approaches.

We retained the IDW method because it is simple and transparent and improved performance in leave-one-out cross-validation. As noted in our response to Comment 5, both corrected and uncorrected precipitation-isotope data are now provided, allowing users to select the appropriate product or apply their own corrections.

Changes in the revised manuscript and/or dataset:

The following sentence was added to section 2.2:

“Because the correction is based on IDW interpolation of GNIP observations, it is less constrained in regions with sparse station coverage.”

Comment 7:

I was also a bit surprised that IsoGSM was not mentioned, which provides a similar data product. It would be interesting to know the differences, the strength and weaknesses of both products so that I can choose the appropriate product for my needs.

Response 7:

IsoGSM is included as one of the isotope-enabled GCMs in our SWING2-based comparison in section 4.2 and in the Supplement. Rather than focusing on a single model, we describe the broader difference between the present offline, reanalysis-driven ICM product and nudged isotope-enabled GCM products.

Changes in the revised manuscript and/or dataset:

In response to Comments 7 and 8, the following sentence was added to the Introduction:

"Previous isotope-model intercomparison efforts include SWING2 (Risi et al., 2012), while the more recent WisoMIP framework provides an updated assessment of isotope-enabled atmospheric models (Bong et al., 2026)."

Comment 8:

The author compared to SWING2 results but the latest results of this intercomparison are called WisoMIP now (Bong et al., Journal of Geophysical Research: Atmospheres 2026, https://doi.org/10.1029/2025JD044985)

Response 8:

Thank you for bringing this recent study to our attention. The WisoMIP results were not yet available when the model comparison in this study was prepared, and we therefore used the SWING2 outputs available to us. We agree that WisoMIP provides a more recent assessment of isotope-enabled atmospheric models. We have added a reference to Bong et al. (2026) in the Introduction and clarified its relationship to the earlier SWING2 intercomparison.

Changes in the revised manuscript and/or dataset:

In response to Comments 7 and 8, the following sentence was added to the Introduction:

"Previous isotope-model intercomparison efforts include SWING2 (Risi et al., 2012), while the more recent WisoMIP framework provides an updated assessment of isotope-enabled atmospheric models (Bong et al., 2026)."

Comment 9:

Units are missing in all products.

Response 9:

We have added unit information to the precipitation-isotope variables in the NetCDF and CSV products. For

the GeoTIFF products, the units of all variables are now clearly stated in the accompanying README file.

Changes in the revised manuscript and/or dataset:

Unit information was added to the variable attributes in the NetCDF files. For the CSV products, units were added to the column headers and described in the accompanying README files. For the GeoTIFF products, the units of $\delta^{18}O$, $\delta^{2}H$, and d-excess were specified in the README file.

Comment 10:

I find the csv product not very useful. It would of course be fantastic if I only have to download the grid cell I am interested in but currently I have to download a zip file for a large area from which I then have to extract the grid cell.

Response 10:

We agree that the previous CSV archive structure made it difficult for users to efficiently locate and extract a time series for a specific grid cell. We nevertheless retained the CSV format because it provides accessible point-based time series for users who do not routinely work with NetCDF. We recognize, however, that the regional ZIP archives may contain many grid cells outside a user's area of interest and that users must identify and extract the required file. Distributing each grid-cell CSV as a separate downloadable record would result in an impractically large number of files. We have therefore retained the regional ZIP structure but improved its usability by adding an index of the enclosed grid cells, a global tile-index map, and coordinate ranges to the ZIP filenames. The same data are also provided in NetCDF format, allowing users to select the format most suitable for their analysis.

Changes in the revised manuscript and/or dataset:

Each CSV ZIP archive now includes an index listing the enclosed grid-cell files. A global tile-index map was also added, and the ZIP filenames were revised to indicate the geographic extent of each archive.

Comment 11:

The description of the data files is insufficient in the manuscript and also on the Zenodo sites. For example, I had to find out by trial and error which zip file I have to download for my specific station.

Response 11:

We recognize that the previous filenames and documentation did not allow users to easily identify the ZIP archive containing a specific location. We have therefore expanded the dataset descriptions on Zenodo,

revised the ZIP filenames to indicate their geographic coverage, and added both a global tile-index map and a file index within each archive. These changes allow users to identify the appropriate ZIP archive from the latitude and longitude of their target location and then locate the corresponding grid-cell CSV file.

Changes in the revised manuscript and/or dataset:

A global tile-index map was added to the dataset and linked to the corresponding ZIP filenames. The ZIP filenames were revised to include the coordinates of the upper-left and lower-right corners of their geographic extent. Each ZIP archive also includes an index of the enclosed grid-cell CSV files.