Precipitation in the mountains of Central Asia: isotopic composition and source regions

Response to the Referees' Comments

Dear Editor,

The authors are grateful to the anonymous referees for their additional comments.

All comments have been addressed and implemented in the revised manuscript.

We have submitted a revised copy of the manuscript with tracked changes.

On behalf of all authors,

Dr. Saidaliyeva and Prof. Shahgedanova

Anonymous Referee #1

General comment: Thank you for revising your paper. This new version is a substantial improvement on the original manuscript in my opinion. I have only a few minor comments.

L75: longer, not shorter

Corrected

L107-110: Please move to "Data and Methods" section

This sentence was added at the end of the Introduction on recommendation of Reviewer 2. No change.

L148: a citation for Tretyakov rain gauge could be useful

References have been included to describe the Tretyakov rain gauge (Yang et al., 1995). We have also added a justification for using this type of rain gauge based on the detailed comparison of various anti-evaporative systems which demonstrated that promptly collected samples were not influenced by evaporation Michelsen et al., 2018.

(Line): "The event-based precipitation samples were collected using the standard Tretyakov precipitation gauges (Yang et al., 1995) immediately after the precipitation events by the trained meteorological observers who were ever present at the sites for the duration of the study period. A comparison of the ability of different types of precipitation collectors to prevent evaporation and associated fractionation showed that the use of this type of gauge is acceptable in isotope hydrology especially when used in regions with temperate to semi-arid climates and when the time between the precipitation occurrence and sample collection is short (i.e. days) (Michelsen et al., 2018)."

L184-192 and L199-205: In my opinion these parts could be omitted to shorten the manuscript, just cite the reference works.

In the original comments, Reviewer 1 asked us to add this information. We agreed then that this information helps readers to understand the text and we prefer to keep both sections.

L207-208: Please remove this sentence.

The sentence has been deleted.

L212: Hysplit does not have a horizontal resolution! Hysplit is a model using a meteorological dataset with a horizontal resolution. In this case, you used the GDAS1 meteorological dataset with a horizontal resolution of 1°x1°.

This correction has been made.

L215: I still have some doubts about running the model at elevations of the studied sites. But ok, these authors provided a possible explanation.

Thank you for your comment. No change made as none was requested.

L265-267: Is really important this statement? I suggest removing it.

Sentence has been re-phrased.

L287-288: Please include R^2 and p-values for these equations. Theoretically, the geographical effects should be stable across the year because they depend on physical and geographical factors which are stable for a specific site (e.g., altitude). I think these authors should better explain this part. A seasonal effect of geographical factors is quite unexpected, but it could be indirectly due to different moisture source regions and atmospheric disturbances.

P-values have been provided (Lines 290-293) and added to the Supplement Table S2. R^2 is not an informative statistic for stepwise regression (Rose & McGuire, 2019) and it why it hasn't been included.

The following explanation, as Reviewer 1 suggested, has been added to Discussion (Lines 498-499): "Seasonal variations in the importance of geographical predictors were observed due to the indirect effects of different moisture source regions, atmospheric disturbances, and changes in evaporation between summer and other seasons" (Lines 506-507)

L307-208: Please include p-values for these equations.

P-values have been added to Equations 8-9

L312-313: Two values for three seasons, it is unclear which values is referred to which season. Please report the standard deviation for each season.

We have re-phrased the sentence and provided values and standard deviation for each season.

L339-341: I don't understand how it is possible that the relationship is not significant for the entire dataset but always significant for each of the 4 seasons. I would have preferred to calculate the regression model between the mean values (or volume-weighted mean values) of d-excess for each site in the investigated period.

The lack of statistical significance in the overall dataset is due to strong changes in atmospheric circulations between seasons (domination of westerlies flow in spring and autumn but not in summer and winter). We explain this results in Discussion (Lines 498-499) and highlighted similar results were obtained for the Chinese Tien Shan.

L347: Which precipitation samples are these? In the Method section, you mentioned 7 monthly samples from Dushanbe, but here you present data from 149 samples.

These samples include averaged monthly event-based samples for each sampling point separately plus 7 monthly samples from Dushanbe. This has been clarified in the text.

L494-496: This is an interesting outcome because it highlights the importance of local investigations. Global models may be useful but also largely imprecise.

We agree with this comment and hope that our results contribute to improving the relevant global models.

L530: Theoretically, snow should have a more negative isotope composition.

This sentence does not comment on isotopic composition. This sentence is about d-excess value for snow and rain in the CKS. Isotopic ratio for snow was -15.0‰ and -110.6‰ for $\delta^{18}O$ and δD, respectively, in CKS.

L643: Please, pay attention to the isotopic terminology. Precipitation ratios is wrong. I suggest "… an extensive isotopic database for the mountains of CA".

Thank you for your suggestion. We agree that it is more clear presentation. Sentence has been corrected.

L663: isotope, not isotopologue

Corrected

References

Rose, S., & McGuire, T. G. (2019). Limitations of *P*-Values and *R*-squared for Stepwise Regression Building: A Fairness Demonstration in Health Policy Risk Adjustment. *The American Statistician*, *73*(sup1), 152–156. https://doi.org/10.1080/00031305.2018.1518269