Response to reviewer #2

We sincerely thank the reviewer for their constructive assessment of our work and detailed, well-thought-through comments and suggestions, which will surely improve the quality of the analysis and the written manuscript.

In particular, we will include CV_C/CV_Q as a complementary metric to characterize and discuss chemostasis in line with Thompson et al. (2011). This way, high variability in concentrations, despite a low correlation to Q, will not be classified as chemostasis but as "high reactivity" in line with Musolff et al. (2015). Furthermore, we will add a visualization of precipitation, together with discharge, groundwater table heads, and the drought threshold to Figure 1 in form of a new panel. We will address all further comments as suggested, which was not a difficult choice, as the suggestions made were very concrete and right on point. Please see our line-by-line response for details.

Lines 94–96: The authors list the investigated solutes as elemental species (e.g., Ca, Mg, Fe, Mn). Since the study focuses on dissolved constituents in stream water, it would be scientifically more precise and chemically consistent to use ionic notation where appropriate (e.g., Ca^{2+}, Mg^{2+}, K^{+}, $Fe^{2+/3+}$, Mn^{2+}, Sr^{2+}, Cl^{-}, NO_3^{-}, SO_4^{2-}). This would improve clarity regarding the actual dissolved species analyzed and align the terminology with standard hydrochemical conventions.

Good point. We will consistently add the ionic notation throughout the manuscript.

Lines 119–121: The definition of the recovery period and the criterion used to determine the end of the drought should be clarified further. In particular, the term "normal" discharge levels is currently too vague and should be quantitatively defined. Please specify which hydrological threshold, reference period, or statistical criterion was used to determine when discharge conditions had returned to "normal" levels. This clarification is important for the reproducibility and interpretation of the drought and recovery period delineation.

We will add a panel to Figure 1 that depicts the time series of discharge, precipitation and groundwater table heads, as well as the thresholds (i.e., 0.01 mm h^{-1}) for the drought identification and its start and endpoint. The recovery period starts when discharge rises above this threshold for more than individual event peaks and ends in September, when monthly discharge levels are back to normal (+ 2.6 mm $month^{-1}$ in September, as compared to average September precipitation since 2012; in contrast, July 2018 was 110.0 mm $month^{-1}$ drier than average and August was 19.4 mm $month^{-1}$ drier).

Line 123 (Figure 1b): The readability and interpretability of the figure could be improved by revising the legend to explicitly indicate which years correspond to the respective displayed data points. In addition, it may be helpful to label or number the five identified precipitation events directly within the figure. This would facilitate a clearer comparison of the different discharge and groundwater table responses to specific precipitation events during drought conditions.

We will add the specific years to the legend and add small labels to the within-drought events.

Lines 130–131: Figure 1a does not appear to show discharge on a logarithmic scale; this likely refers instead to Figure 1b. Please check and correct the figure reference accordingly.

Correct, discharge is on a log-transformed scale on panel 1b only. We will correct this on in the text below the figure caption.

Lines 142–143: The manuscript refers to Table S1 for the overview of discarded events. However, this table could not be found in the Supplementary Material. Please include the missing table for completeness and transparency of the data selection procedure. In addition, the sentence could be reformulated for clarity as follows: “Overall, we identified 63 events, out of which, depending on the respective solute species, 6–27 events had no or incomplete concentration measurements and were therefore discarded (Table S1).”

This is right, we apologize. It did not fit into the supplement, due to its size. However, it should have been uploaded separately and we will, of course, do that.

Lines 145–149: A brief clarification that precipitation rates were normalized within the ERRA framework would improve the methodological description and further highlight that this approach enables a consistent comparison between precipitation events and the corresponding rainfall–runoff responses across the different hydrological periods.

We will add this clarification to the suggested lines.

Lines 155–157: For clarity, please specify explicitly that the analysis refers to changes in the slope of the Q–gw relationship. This would make it easier to follow which relationship is being referred to, particularly since the manuscript frequently discusses C–Q relationships. In this context, simply writing “slope of Q–gw” or “Q-gw slope” would already be sufficient.

We will add that the breakpoint was calculated for both the C-Q as well as the gw-Q relationship.

Lines 162–164: The interpretation of $b \approx 0$ as a constant concentration pattern should be phrased more carefully, as a near-zero C–Q slope does not necessarily indicate a truly chemostatic response. Changes in concentration variability decoupled from discharge may still occur despite $b \approx 0$, which can reflect chemodynamic behavior. It may therefore be helpful to mention that constant or chemostatic patterns can be further substantiated using variability-based metrics such as CV_C/CV_Q (e.g. Thompson, S. E., Basu, N. B., Lascurain, J., Aubeneau, A., andRao, P. S. C.: Relative dominance of hydrologic versus biogeochemical factors on solute export across impact gradients, Water Resour. Res., 47, 10, https://doi.org/10.1029/2010wr009605,2011.)

We will add the CV_C/CV_Q, as explained above.

Lines 166–186: As breakpoint determination plays a central role in this study, please clarify whether breakpoint detection was performed systematically and, if so, describe the specific method, statistical criterion, or threshold used to identify the breakpoints.

We will add that breakpoints are identified using the segmented package in R (Fasola et al., 2018), which relies on the iterative fitting of piecewise linear regression models. Breakpoints are identified where a change in slope provides a significantly better fit to the observed data than a single straight line.

Line 173: Please add the index i to C in Equation 2 (i.e., C_i) for consistency with Equation 1 and to clearly indicate that concentrations are evaluated separately for each solute species.

We will add index i to equation 2, where appropriate.

Lines 186–188: The wording “groundwater table gradually declines while discharge levels do not drop much further” may imply that discharge no longer decreases after the breakpoint. However, discharge still appears to decline, although at a substantially lower recession rate once discharge fall below the breakpoint. Consider revising the wording to reflect this more clearly. Furthermore, the statement that “discharge continues to respond to precipitation events, while the groundwater table lacks such short-term responses and appears to be largely decoupled from the discharge dynamics” could be supported more convincingly by adding a time series of precipitation, discharge, and groundwater table depth in Figure 2. Such a visualization would help illustrate the differing temporal responses and the inferred decoupling during drought conditions. Alternatively, a direct reference to Figure 1b at this point in the text would help support and contextualize this interpretation.

We will rephrase our wording in lines 186-188 to “groundwater tables continue to decline at a constant rate, while the decline in discharge slows down considerably”. Moreover, we will add precipitation to Figure 1.

Lines 265–267: It would be helpful to add a direct reference to Figure 1b in this section, as the figure supports the interpretation that precipitation events triggered short-term discharge responses while groundwater table depth remained largely unresponsive during drought conditions.

We will add a reference to Figure 1b.

Lines 299–301: The discussion of chemodynamic patterns is scientifically relevant. However, this behavior is currently not explicitly demonstrated in the Results section. Since the interpretation of $b \approx 0$ as a constant concentration pattern plays an important role in the manuscript, it would strengthen the analysis to include additional metrics that better distinguish chemostatic from chemodynamic behavior. In particular, the inclusion of the CV_C/CV_Q ratio (e.g., in a table similar to Table 1) would provide a more robust basis for supporting the assumption that low-flow conditions with $b \approx 0$ indeed reflect chemostatic behavior. The CV_C/CV_Q metric would more clearly separate periods of low concentration variability (chemostatic behavior) from chemodynamic responses, as discussed here. Furthermore, the inclusion of the CV_C/CV_Q metric could help to sharpen the definition and interpretation of the term “chemodynamic” within the context of this study while also providing stronger quantitative support for the interpretations presented in the discussion.

We will add the CVC/CVQ to our analysis as explained above.

Line 348 (Figure 5): The caption should describe the bottom row of Figure 5 in more detail to improve the interpretation of the graph. In particular, please clarify how the bottom panels differ from the upper panels and explicitly explain the meaning of the varying symbol sizes. A more detailed description of the symbol scaling and panel structure would make the figure easier to understand for the reader.

We agree that the figure caption is a little too short and would benefit from additional details. We will therefore add: “Left panels depict exemplary solutes of geogenic origin, which are calcium and magnesium (underlain in yellow), panels in the center depict exemplary solutes of mixed origin (atmospheric and geogenic), which are nitrate and chloride (underlain in green), and panels on the right depict exemplary solutes that enter stream water dominantly

from the catchments soils, which are iron and chromium (underlain in purple). Upper panels depict all data points measured, whereas lower panels show minimum or maximum concentrations during the runoff events identified, depending on whether concentrations decrease (min) or increase (max), with the point width representing peak discharge."

Lines 399–401: While the statement explains the observed enrichment behavior during rewetting, the chemodynamic component of the transport response could be described in more detail. In addition to the general reconnection of soil zones during rewetting, a chemodynamic enrichment behavior may result from the reconnection of heterogeneously distributed source zones within the catchment, leading to temporally variable enrichment patterns in solute mobilization. However, the term "chemodynamic" remains somewhat insufficiently defined throughout the manuscript and may therefore be interpreted differently in this context. In my view, chemodynamic behavior describe high concentration variability relative to discharge variability and thus indicate processes that are at least partly decoupled from discharge dynamics. If, in this section, the intention is primarily to describe an increase in solute concentrations coupled to increasing discharge during rewetting, the term "enrichment pattern" may already be more appropriate and precise. Lines 417–421: Since this section specifically discusses changes in redox conditions and associated mobilization processes, it may be more appropriate to replace the term "biochemical processes" with a more specific description related to redox-driven processes. For example, terms such as "redox-related processes" or "redox-controlled processes" may better reflect the mechanisms discussed here and provide a more precise description of the processes influencing metal mobility under reducing conditions.

We will add the CVC/CVQ to our analysis ad discuss the results accordingly.

Technical corrections:

Lines 94–96: The chemical notation throughout the manuscript should be checked carefully for consistency and formatting. In particular, the indices in chemical formulas such as NO_3^- and SO_4^{2-} should be consistently formatted.

We will do as suggested.

Line 115: Please adjust the font formatting of "Hisdal et al., 2024" to match the formatting style and font used consistently throughout the manuscript and reference list.

We will adjust the font.

Line 542–543: The corresponding DOI could be added to this reference to improve completeness and accessibility of the cited source.

Good point. We will add the DOI to the reference.