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# Impact of drought hazards on flow regimes in anthropogenically impacted streams: an isotopic perspective on climate stress

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- Table S1 summarizing catchment characteristics and land use information for the rural and urban catchment.
- Table S2 summarizing hydrological parameters used in the analysis
- Figure S1 showing groundwater levels in the rural and urban stream
- Figure S2 and S3 showing hydrologic and isotope responses per water year for the rural agricultural stream and urban stream respectively
- Figure S4 showing lc-excess summarized in a boxplot for the rural and urban stream.
- Table S3 summarizing the applied transit time distribution models.
- Table S4 summarizing the results of the TPLR and gamma model for Mean Transit Time estimations.

**Table S1:** *Catchment characteristics and land use for the entire rural and urban catchment (Marx et al., 2021; Smith et al., 2020).*

| | **Rural (DMC)** | **Urban (Panke)** |
|---|---|---|
| **Catchment Area ($km^2$)** | 66 | 220 |
| **Land Use** | | |
| *Non-irrigated arable* | 50.4 | 34.6 |
| *Urbanized* | 2.5 | 34.1* |
| *Pasture* | 6.9 | <1% |
| *Broadleaf Forest* | 6.0 | 6.5 |
| *Coniferous Forest* | 29.2 | 38.2 |
| *Mixed Forest* | 1.0 | 4.1 |
| *Wetlands* | 4.0 | 1.2 |
| *Heather and Shrub* | - | 5.2 |

* Incl. Housing, industry, roads, squares and railroads

**Table S2:** *Summary of calculated and measured hydrologic parameters*

| **Parameter** | **Data Source** | **Frequency** | **Calculation** |
|---|---|---|---|
| Runoff ($Q_{Ro}$) | Discharge data | 15min – daily | $Q_{RO} = Q_S - Q_B$ |
| Stormflow ($Q_S$) | Discharge data | 15min – daily | Hydrograph Separation after Tang & Carey (2017) |
| Baseflow ($Q_B$) | Discharge data | 15min – daily | Hydrograph Separation after Tang & Carey (2017) |
| Baseflow Index (BFI) | Discharge Data | 15 min – daily | Richard Baker Flashiness Index (RBI) |
| Stable water isotopes | Dataset | Daily – weekly | / |
| Young water fraction | Dataset | WY | - Sine wave method |
| MTT | Dataset | WY | TPLR, Gamma Model |

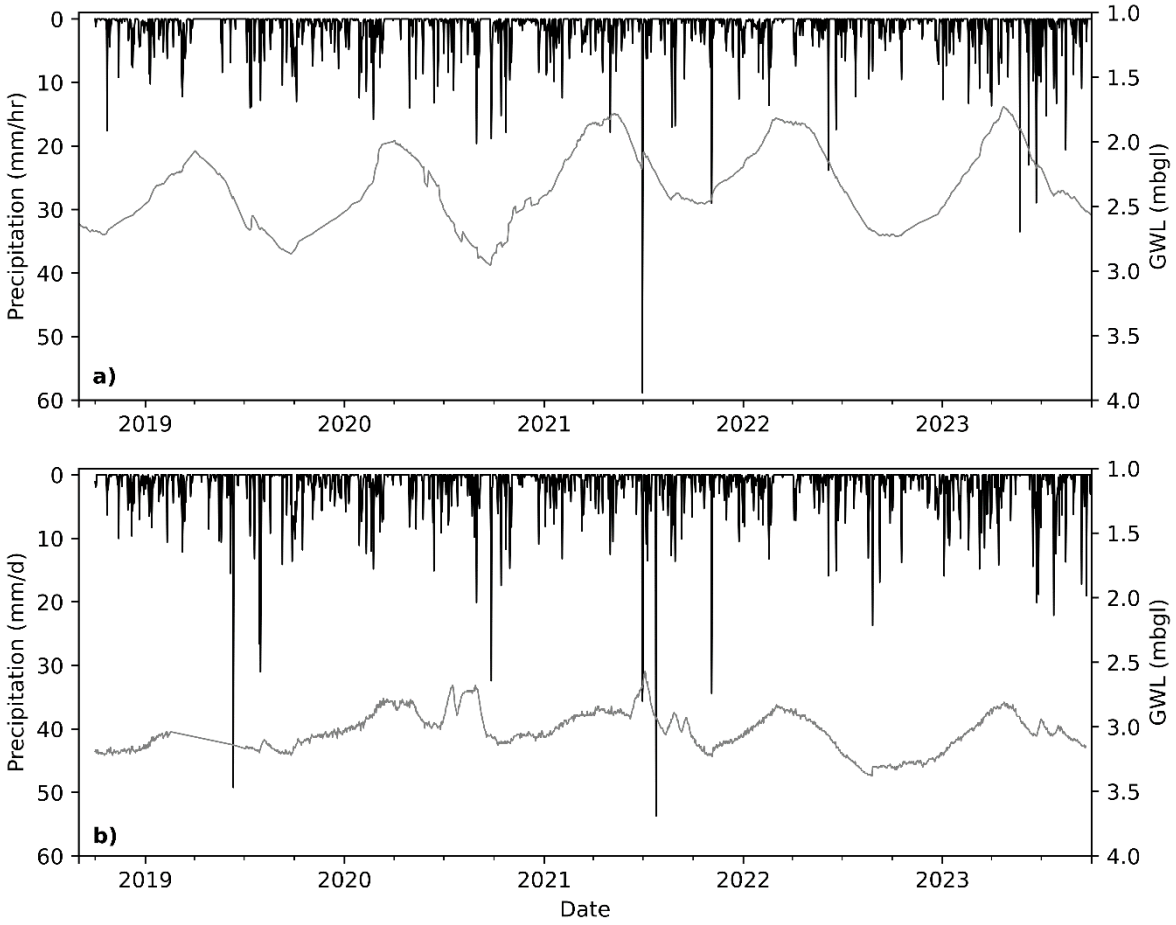


**Figure S1:** Daily precipitation and groundwater levels for the a) rural and b) urban stream.

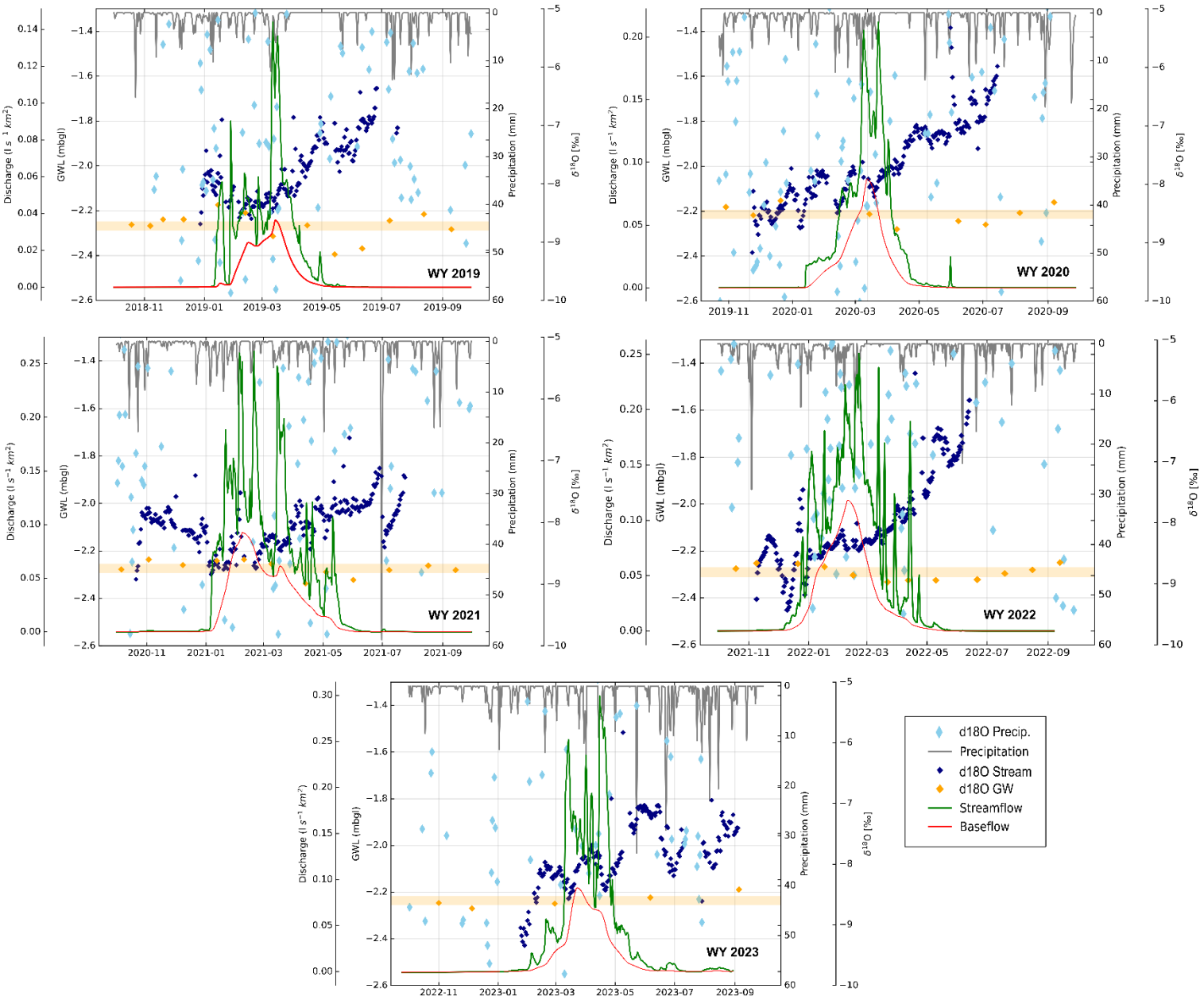


**Figure S2:** Hydrologic and isotope responses per water year for the rural stream

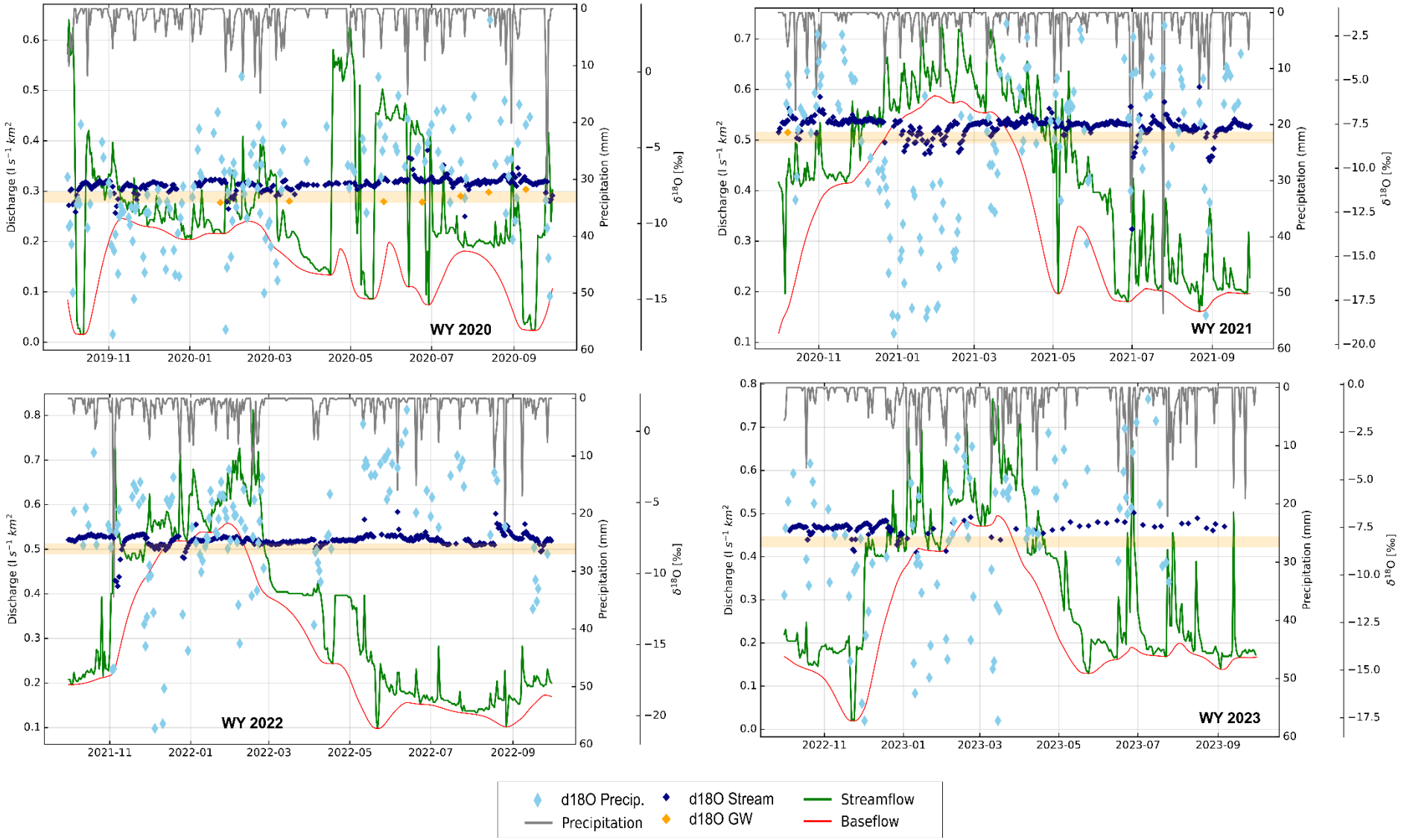


**Figure S3:** *Hydrologic and isotope responses per water year for the urban stream.*

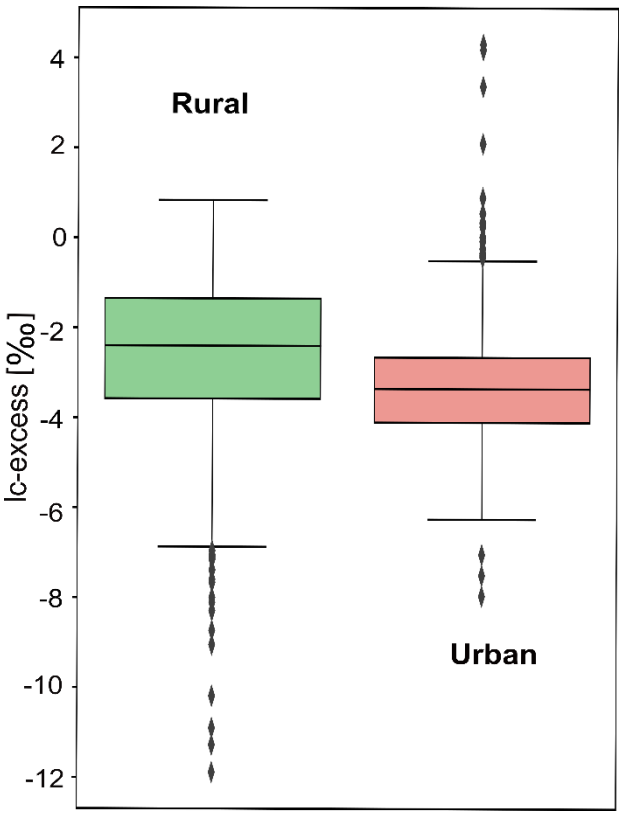


**Figure S4***: Boxplot of lc-excess for the rural (left) and urban (right) stream. Horizontal bars denote means, whiskers show the upper and lower percentiles. Outliers are indicated as points with more negative values indicating greater evaporative enrichment.*

**Table S3:** *Description of applied transit time distributions – gamma and two parallel linear reservoir model (TPLR).*

| Model | Parameters | TTD | MTT |
|---|---|---|---|
| **Gamma** | α = shape parameter<br>β = scale parameter | $\frac{\tau^{\alpha-1}}{\beta^{\alpha}\Gamma(\alpha)}\exp(-\frac{\tau}{\beta})$ | αβ |
| **Two parallel linear reservoir (TPLR)** | $\tau_f$ = transit time of fast reservoir<br>$\tau_s$= transit time of slow reservoir<br>φ =ratio of fast/slow reservoir | $\frac{\varphi}{\tau_f}\exp\left(-\frac{\tau}{\tau_f}\right)+\frac{1-\varphi}{\tau_s}\exp(-\frac{\tau}{\tau_s})$ | $\varphi\tau_f+(1-\varphi)\tau_s$ |

**Table S4:** *Mean transit times estimated with TPLR and Gamma Models. TPLR TTD Parameters ($\tau_f$ and $\tau_s$) and Gamma Model fitting parameters ($\alpha$ and $\beta$), fitting efficiency (NSE), minimized root-mean-square error (RMSE), mean square error ($R^2$) and estimated mean transit time (MTT). Below: TPLR Model results for a wet and a dry year in the rural and urban stream.*

| **TPLR** | **$\tau_f$** *(1-50)* | **$\tau_s$** *(1-1825)* | **$\varphi$** | **NSE** | **RMSE** | **$R^2$** | **MTT (d)** |
|---|---|---|---|---|---|---|---|
| ***Rural*** | 21.7 | 1262 | 0.6 | 0.54 | 0.63 | 0.54 | 1014 |
| ***Urban*** | 5.3 | 1311 | 0.4 | 0.57 | 0.64 | 0.59 | 1180 |
| **Gamma** | **$\alpha$** *(0.1-2.5)* | **$\beta$** *(1-1825)* | **-** | **NSE** | **RMSE** | **$R^2$** | **MTT (d)** |
| ***Rural*** | 0.44 | 1704 | - | 0.49 | 0.67 | 0.48 | 759 |
| ***Urban*** | 0.42 | 1698 | - | 0.46 | 0.65 | 0.46 | 707 |