Review of "*Changes in water quality and ecosystem processes at extreme summer low flow of 2018 detected with high-frequency sensors*" Huang et al. at HESS (ref: egusphere-2025-656)

The study demonstrates that the extreme low-flow conditions of summer 2018 in the Lower Bode stream led to marked alterations in some water quality and ecosystem functioning parameters. Elevated water temperature and chlorophyll-a concentrations coincided with reduced dissolved oxygen and nitrate levels. Stronger diurnal oxygen fluctuations and a significant increase in gross primary productivity, dominated by benthic algae, were observed alongside higher ecosystem respiration, resulting in near-zero net ecosystem productivity. Although less clear, net nitrate uptake rates did not change, the proportion of nitrate removed increased significantly due to benthic algae assimilation, indicating a more efficient internal nutrient cycle during extreme drought conditions.

The manuscript provides novel insights by employing high-frequency, reach-scale measurements to assess ecosystem responses under extreme low flow, a methodological approach still rare in the literature compared with studies based on traditional grb sampling schemes. This study adds to a growing body of recent research of drought effects on aquatic hydrology, ecology and biogeochemistry by providing novel insights into water quality and instream ecosystem processes under extreme low-flow conditions. It is both original and significant, as it enhances our understanding and predictive capacity regarding the consequences of more frequent and severe droughts in Central Europe under climate change, with clear implications for freshwater ecosystem management.

Overall the ms. is very clearly presented, well-structured and relies on highly valuable, high quality data.

Major comments

- The relative simplicity of the comparative analysis between drought and extreme summer drought conditions makes the results easy to follow and convincing. However, I believe that a Q-C and/or hysteresis-type analysis could help to better understand the sensitivity of each site, water quality parameter or ecosystem process to changing flow conditions, as well as the trajectory of these responses during flow reduction (in a drought) and flow recovery (after the drought).
- One of the paper's most innovative goals is to exploit cutting-edge sensor technologies to more effectively capture the rapid and novel mechanisms underlying water quality and ecosystem functioning responses under low-flow conditions. However, one of the major challenges is to properly calibrate these sensors. While this issue has already been resolved for some parameters included in the study, for others it remains quite complex and requires a solid set of 'classical measurements' taken in the field and covering environmental gradient comparable to those of the study. Although the paper does mention this aspect, it lacks a detailed description of the protocols followed to calibrate the *Chl-a* and NO_3^- sensors. For these variables, I also find the absence of a 1:1 plot comparing sensor-based measurements with classical sampling and laboratory analyses.
- The manuscript provides a description of in-stream aerobic metabolism modeling, but the presentation lacks sufficient detail on key aspects of the model and the

results obtained. Uncertainties in the estimates are mentioned, yet the sources of variability and how they influence the results are not fully explored. While the potential integration of lateral oxygen inflows is briefly discussed, the evaluation remains superficial and does not convincingly demonstrate their impact. Alongside the previous, some examples of observed versus modeled dissolved oxygen concentrations should be included in the supplementary information.

Minor comments

Lines 96-101*: This level of detail, including the description of the statistical tests used, is not meant to be included in the introduction.

Line 243: Panel letters of Figure 3 are missing in the Figure but referenced in the text.

Line 293: Correct: “at GGL by 0.45 mg L-1 at GGL ($p < 0.01$) and non-significantly at STF 0.28 mg L-1”:

Line 295: add by between “and” and “0.73”.

Line 370: remove mobile

Line 377: expand the how in-stream processes can affect/are affecting NO3- removal. What about other dissolved inorganic N forms.

The following key references on this topic are missing (Gómez-Gener et al. 2020; Dupas et al. 2025; Harjung):

Dupas, R., A. Lintern, A. Musolff, C. Winter, O. Fovet, and P. Durand. 2025. Water quality responses to hydrological droughts can be predicted from long-term concentration–discharge relationships. Environ. Res.: Water **1**: 015001. doi:10.1088/3033-4942/adb906

Gómez-Gener, L., A. Lupon, H. Laudon, and R. A. Sponseller. 2020. Drought alters the biogeochemistry of boreal stream networks. Nat Commun **11**: 1795. doi:10.1038/s41467-020-15496-2

Harjung, A. Impact of drought periods on carbon processing across surface-hyporheic interfaces in fluvial systems. 232.

* *Line numbers corresponds to author track changed document.*