Response to comments from referee 3

> **[R3-1]** *This paper proposes an innovative way for the mechanistic interpretation of Eh measurements under mixed-potential conditions in aquatic environments. Using time-series data from field experiments over a period of almost two years from a shallow artificial pond the authors identified changes in the ln[O2]–Eh relationship and interpreted these as evidence for redox-network reconfiguration. This is a valuable manuscript, with thoughtful considerations on modelling interactions among the factors that affect system dynamics, and it is potentially valuable for researchers using Eh measurements in aquatic systems. The conceptual novelty, addressing the interpretation of field-measured Eh values under mixed-potential conditions, and the combination of theory and field observations are clear strengths of this work. I strongly recommend its publication, but would recommend the authors to consider some considerations for improvement:*

[Response to R3-1]

We sincerely thank the referee for the positive and encouraging assessment of our manuscript. We are grateful that the referee found the mixed-potential interpretation, conceptual novelty, and combination of theoretical development with field observations valuable. In response to the comments, we have clarified the pond configuration, the field conditions, the treatment and possible influence of leaf litter, and the role of seasonal temperature variation in the interpretation of the ln[O_2]–Eh relationship.

> **[R3-2]** *Figure 2: Could this figure show with more clarity the design of the pond and the conditions of the experiment? E.g., flow direction, segments of the channel that were modified, relationships in the spatial location and photo directions.*

[Response to R3-2]

We thank the referee for this helpful suggestion. We agree that the original Fig. 2 did not sufficiently clarify the pond configuration, the modified channel, flow direction, and photograph viewpoints. In the revised manuscript, we have revised Fig. 2a to show the monitoring sites, open peripheral side channel, pumping location, flow direction, and approximate viewing directions of the photographs. We have also revised the caption to clarify that the channel was an open peripheral side channel and that the arrows indicate the direction of water flow driven by intermittent pumping.

> [R3-3] *The authors mention a leaf litter system. Can the authors elaborate on how it affected the measurements? Are any assumptions made regarding the changes in the chemistry of the pond due to the presence of leaves?*

[Response to R3-3]

We thank the referee for this important comment. The pond is surrounded by trees and receives substantial inputs of leaf litter, especially in autumn. In the revised

manuscript, we have clarified that leaf litter was not actively removed during the monitoring period and was left to decompose within and around the pond. We agree that leaf-litter decomposition can influence microbial activity, oxygen production and consumption, organic-matter inputs, and potentially the measured Eh and EC.
At the same time, we did not make a quantitative chemical assumption about the changes in pond chemistry caused specifically by leaf litter, because redox-sensitive solutes and dissolved/particulate organic matter were not measured in this study. We therefore treat leaf litter as a plausible background source of organic matter and microbial activity, rather than as a separately quantified driver. The EC anomaly used to define the disturbance regimes was interpreted operationally as a response to the May–June 2023 excavation-related physical disturbance, not as a direct or exclusive measure of redox-network reconfiguration.

[Changes in manuscript]

We revised Sect. 2.1 to state that leaf litter was not actively removed and was left to decompose within and around the pond. The revised text now states:

> Leaf litter was not actively removed during the monitoring period and was left to decompose within and around the pond.

We also revised Sect. 3.2 to acknowledge that biological oxygen production and consumption, including processes associated with organic matter and biofilms, may have contributed to the observed DO and Eh dynamics:

> Dissolved oxygen (DO) tended to increase during the latter part of the post-disturbance regime relative to the same season in the previous year (Fig. 3c). This pattern may reflect multiple processes, including enhanced air--water gas exchange and vertical exchange associated with inflow/pumping events, as well as biological oxygen production and consumption. Over the same period, Eh exhibited an overall upward shift following the disturbance (Fig. 3d).

> **[R3-4]** *Consider including supplementary analyses showing seasonal variations or temperature normalization.*

[Response to R3-4]

We thank the referee for this helpful suggestion. Seasonal variation is shown in Supplementary Fig. A1, which presents the pH and water-temperature time series over the monitoring period. In the revised manuscript, we also explicitly state that temperature can influence oxygen solubility and biological activity and that it showed typical seasonal cycles and vertical structure during the observation period.

We considered adding an additional temperature-normalized analysis. However, we decided not to apply a single empirical temperature normalization to the ln[O_2]–Eh relationship because temperature can affect several processes simultaneously, including oxygen solubility, microbial activity, transport, and interfacial reaction kinetics. Under mixed-potential conditions, these effects need not act through a single correction factor and a simple normalization could therefore obscure rather than clarify the interpretation. In addition, the reported Eh values were already converted to SHE-referenced values using the manufacturer-recommended temperature correction for the Ag/AgCl reference electrode. We therefore used the temperature record as seasonal context rather than as an independent normalization variable.

[Changes in manuscript]

We retained Supplementary Fig. A1 as the seasonal-context figure and revised Sect. 3.2 to explicitly acknowledge the relevance of temperature. The revised text states:

> Temperature, which can influence oxygen solubility and biological activity, showed typical seasonal cycles and vertical structure over the observation period, while pH ranged from 5.79 to 7.35 (mean 6.60) (Supplementary Fig. A1).