Thanks a lot to the editor for your suggestions and decision on our manuscript, which have greatly helped improve it. We have revised the manuscript accordingly and provided detailed responses to all comments following your recommendations. Below are our responses to the comments, and all changes are clearly marked in red in the version of “Revised manuscript”.

-About the comment (1): *Knowledge gap and novelty. The revised introduction is better, but the knowledge gap and novelty are still not stated clearly. The contrast with prior work remains somewhat general. It would help to engage the literature more explicitly and clarify what specific inference becomes possible only because of the sampling design used here.*

-Response: Thanks for your good suggestion. Yes, as you pointed out, we agree that the original manuscript had shortcomings in clearly identifying specific knowledge gaps and highlighting the novelty of the sampling design. In the revised manuscript, we have strengthened the Introduction in the following aspects:

(1) We now point out that most previous studies on LGD lack continuous or sufficiently high-frequency observations, making it difficult to capture monthly-scale variability. We further emphasize that this limitation hinders the identification of linkages within the process chain of “precipitation/evaporation → hydraulic gradient → groundwater discharge.”

(2) We have added a more targeted discussion of representative studies, specifying their monitoring frequencies and their limitations in resolving dynamics over a complete hydrological year. We now explicitly state that the monthly high-resolution sampling design adopted in this study, combined with synchronous monitoring of lake water levels and groundwater levels, enables: (i) quantification of monthly-scale variations in LGD and (ii) identification of the response relationships between meteorological forcing and groundwater discharge.

The revised text is as follows:

“The LGD rate exhibits pronounced temporal variability over the hydrological year, primarily influenced by the combined effects of hydrological and meteorological factors (Burnett et al., 2017; Shi et al., 2022; Sun et al., 2024). In relatively closed lake systems (lacking perennial surface river inflows or where inflowing runoff has minimal impact on hydrodynamics, water balance, or residence time), meteorological factors are generally the dominant drivers of LGD. However, the magnitude and direction of these influences vary considerably across regions. For example, studies in Lake Taihu indicate that evaporation can enhance LGD by regulating lake water levels (Shi et al., 2022) (four sampling campaigns); research in Huixian Lake in karst regions shows that precipitation can promote LGD by elevating groundwater levels (two sampling campaigns) (Zhang et al., 2024); whereas studies of subsidence lakes in coal mining areas have found that both precipitation and evaporation are negatively correlated with LGD, suggesting a complex influence mechanism of meteorological factors (four sampling campaigns) (Jiang et al., 2024). Although these studies have provided valuable insights, most observations are limited to extreme hydrological periods (e.g., wet and dry seasons) or are conducted at seasonal resolution (four sampling campaigns), generally lacking continuous monitoring with high-frequency. As a result, understanding of LGD dynamics at the monthly scale remains limited. However, the responses of lake water levels and groundwater levels to precipitation and evaporation typically occur on a monthly timescale, making it difficult for low-frequency or seasonal observations to effectively capture how water level fluctuations regulate LGD. In particular, along the process pathway of "precipitation/evaporation → lake/groundwater levels → LGD," the mechanistic linkages remain insufficiently understood. Therefore, compared to the low-frequency monitoring commonly adopted in existing studies, high-frequency observations at the monthly scale can provide new insights and evidence for elucidating intra-seasonal LGD processes—an important scientific issue that has not yet received adequate attention in previous research." (**Line 38-60**)

-About the comment (2): *Mechanistic interpretation. The conceptual diagram is a useful addition, but the interpretation still reads as more correlation-based than mechanistic. The discussion would be stronger if it more clearly distinguished among the observations, the inferred mechanisms, and the broader interpretation.*

-Response: Thanks for your good suggestion. We have reorganized this section related to the conceptual diagram according to the three levels of "observations—mechanistic interpretation—generalized implications." The revised content is as follows:

"Observations show that PME is closely associated with lake water level variations. During periods of higher PME, the decline in lake water level slows or even reverses, whereas under lower PME conditions, the rate of lake level decline accelerates. Meanwhile, groundwater levels exhibit a response pattern consistent with lake water level variations. From a mechanistic perspective, this relationship can be explained as follows: PME directly influences lake water level dynamics by regulating the lake water balance, and further alters the water level difference between the lake and groundwater. When the decline in lake water level is relatively small, groundwater discharge to the lake weakens, thereby suppressing the decline in groundwater levels. Conversely, when lake level decline intensifies, groundwater discharge is enhanced, leading to a further decrease in groundwater levels. Ultimately, this process regulates the seasonal variability of LGD rates by modifying the hydraulic gradient. On this basis, this process can be conceptualized as a coupled framework of "meteorological forcing–water level response–hydraulic gradient regulation–LGD variation" (Figure. 5)." (**Line 404-415**)

-About the comment (3): *Implications of high-frequency observations. The discussion of the value of high-frequency observations remains somewhat broad. Please state more explicitly what new conceptual or management insight emerged from this study that could not have been resolved with lower-frequency sampling.*

-Response: -Response: Thanks for your good suggestion. We have further improved the explanation of the significance of high-frequency observations and revised Section 3.4.1 of the manuscript accordingly.

The specific revisions are as follows:

"Traditional low-frequency sampling (e.g., single measurements or quarterly observations) is insufficient to capture short-term variability in LGD and its coupling with transient meteorological conditions and water level fluctuations. In contrast, high-frequency observations enable the resolution of rapid LGD responses to environmental drivers—such as meteorological forcing and water level changes—over shorter timescales. They also provide high-resolution hydrological time series, thereby offering robust data support for more accurate estimation of LGD fluxes.

More importantly, the continuous datasets obtained from high-frequency observations allow this study to reveal several key conceptual insights that cannot be captured by low-frequency sampling. First, LGD responses to meteorological forcing are not simply synchronous, but may exhibit significant lag effects and stage-dependent regulation. Second, the synchronous fluctuations between lake water levels and groundwater levels may follow different dominant control pathways under varying hydrological conditions, thereby highlighting the nonlinear characteristics of the "meteorological forcing → water level response → LGD variation" chain. In addition, the short-term contributions of LGD to lake nutrient inputs and ecological responses (e.g., variations in Chl-a or algal bloom events) can be detected in a timely manner, whereas such signals are often averaged out and obscured in low-frequency observations.

From a management perspective, high-frequency observations allow for a more refined characterization of the instantaneous contribution of LGD to lake nutrient loading and its relationship with eutrophication processes, thereby providing a scientific basis for early warning and refined regulation of lake water quality risks. Meanwhile, LGD predictive models developed based on high-frequency data can significantly improve the ability to capture groundwater input responses under extreme meteorological conditions, offering more timely decision support for lake water resource and ecosystem management.

Therefore, in LGD research, high-frequency observations not only improve the accuracy of flux estimation, but more importantly overcome the temporal limitations of low-frequency sampling, enabling the identification of dynamic mechanisms and ecological effects of LGD processes. As such, they should be prioritized in future research and applications." (**Line 498-524**)

We sincerely thank the Anonymous Referee #2 for the positive evaluation and recommendation for publication.

Thanks a lot to Anonymous Referee #3 for your suggestions for our manuscript, which are all important in improving our manuscript. Below are our responses to the comments, and all changes are clearly marked in red in the version of "Revised manuscript with tracked changes".

-About the comment (1): *In the Introduction, the literature review on observational frequency is still somewhat general. It would help to cite a few representative studies together with their actual sampling frequency to make the contrast clearer.*

-Response: Thanks for your good suggestion. According to your and the editor's comments, we have revised this section of the Introduction accordingly, with particular emphasis on clearly indicating the sampling frequency.

The specific revisions are as follows:

"The LGD rate exhibits pronounced temporal variability over the hydrological year, primarily influenced by the combined effects of hydrological and meteorological factors (Burnett et al., 2017; Shi et al., 2022; Sun et al., 2024). In relatively closed lake systems (lacking perennial surface river inflows or where inflowing runoff has minimal impact on hydrodynamics, water balance, or residence time), meteorological factors are generally the dominant drivers of LGD. However, the magnitude and direction of these influences vary considerably across regions. For example, studies in Lake Taihu indicate that evaporation can enhance LGD by regulating lake water levels (Shi et al., 2022) (four sampling campaigns); research in Huixian Lake in karst regions shows that precipitation can promote LGD by elevating groundwater levels (two sampling campaigns) (Zhang et al., 2024); whereas studies of subsidence lakes in coal mining areas have found that both precipitation and evaporation are negatively correlated with LGD, suggesting a complex influence mechanism of meteorological factors (four sampling campaigns) (Jiang et al., 2024). Although these studies have provided valuable insights, most observations are limited to extreme hydrological periods (e.g., wet and dry seasons) or are conducted at seasonal resolution (four sampling campaigns), generally lacking continuous monitoring with high-frequency. As a result, understanding of LGD dynamics at the monthly scale remains limited. However, the responses of lake water levels and groundwater levels to precipitation and evaporation typically occur on a monthly timescale, making it difficult for low-frequency or seasonal observations to effectively capture how water level fluctuations regulate LGD. In particular, along the process pathway of “precipitation/evaporation → lake/groundwater levels → LGD,” the mechanistic linkages remain insufficiently understood. Therefore, compared to the low-frequency monitoring commonly adopted in existing studies, high-frequency observations at the monthly scale can provide new insights and evidence for elucidating intra-seasonal LGD processes—an important scientific issue that has not yet received adequate attention in previous research.” (**Line 38-60**)

-About the comment (2): *Please check for wording such as “higher temporal resolution,” “high-frequency,” and similar phrases, and use them consistently throughout the manuscript.*

-Response: Thanks for your good suggestion. This wording has now been consistently standardized as “high-frequency.” (**Line 52, 58, 344, 521**)

-About the comment (3): *Some figure interpretations would benefit from slightly more explicit take-home statements in the main text before the detailed description is given.*

-Response: Thanks for your good suggestion. In the section on the regulatory effects of the precipitation–evaporation balance on LGD, we have added a clear core conclusion at the beginning of each paragraph to enhance the logical structure and readability of the text.

The specific revisions are as follows:

“The hydraulic gradient determines the variation in the LGD rate.” (**Line 378**)

“Net precipitation (PME) indirectly controls seasonal variations in LGD by regulating the hydraulic gradient.” (**Line 403-404**)

-About the comment (4): *A final careful language edit would still be helpful. There are places where the intended meaning is understandable but the phrasing remains slightly awkward or overly absolute.*

-Response: Thanks for your good suggestion. We have carefully reread and thoroughly checked the entire manuscript, and revised expressions that were semantically inadequate.

The specific revisions are as follows:

“is mainly influenced” (**Line 527**)

“are a major control on” (**Line 530-531**)

“are strongly influenced by” (**Line 535**)

“can be interpreted as” (**Line 539**)

“play a significant role” (**Line 547**)

“can influence” (**Line 548**)

“play a key role in shaping” (**Line 550**)

“conditions that can amplify the influence of groundwater” (**Line 553**)

“thereby influencing the seasonal magnitude of LGD” (**Line 557-558**)

“acts as an important conduit” (**Line 558**)

“is likely applicable to” (**Line 578**)

“to better constrain the dominant nutrient sources” (**Line 584-585**)

“which may lead to increased” (**Line 592**)

“highlight the important role” (**Line 593**)