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How daily groundwater table drawdown affects the diel rhythm of hyporheic exchange

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Calculating Groundwater Table Drawdown

Boano et al. (2008) performed a number of simulations for different stream aspect ratios (the ratio between river half-width and river stage) and average slopes of the groundwater table, and found out that the upwelling velocity has a linear correlation with the slope of the groundwater table:

$$\frac{q_b}{K} = 0.57 \frac{dh}{L_w} \tag{S1}$$

where q_b is the groundwater upwelling velocity, K is the hydraulic conductivity which is 10^{-3} m/s in this study, dh is the head difference between river stage and groundwater table elevation, L_w is the half-width of the river channel which is 2.5 m.

In the present study, we made use of this linear relationship to evaluate how much the head difference dh would change due to the daily groundwater level fluctuations. To achieve this objective, we made additional assumptions that the distance between the river bank and the hypothetical groundwater level observation point is equal to the river half-width, L_w; and the slope of the groundwater table is less than 0.1. The average river aspect ratio in the model setting is around 25, which falls within the range of the explored aspect ratios in Boano et al. (2008).

With the highest groundwater level fluctuation amplitude, q_b varies daily from 1×10^{-3}m/s to 9×10^{-3} m/s, resulting in a change in the head difference dh of 3.5 cm. With the medium groundwater level fluctuation amplitude, the change in the head difference dh is 1.8 cm. With the lowest groundwater level fluctuation amplitude, the change in the head difference dh is 0.9 cm.

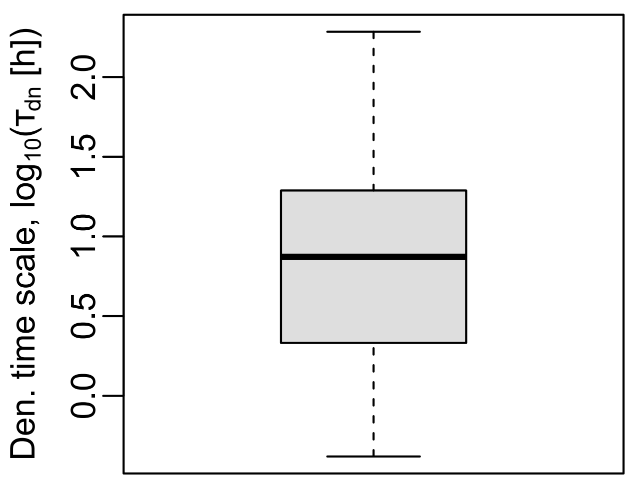

Figure S1. Box plot of the characteristic time scale for denitrification ($log_{10}[h]$). The 25^{th} quantile is 0.38, the 50^{th} quantile is 0.87, and the 75^{th} quantile is 1.28. Values taken from Gomez-Velez and Harvey (2014); Gomez-Velez et al. (2015)

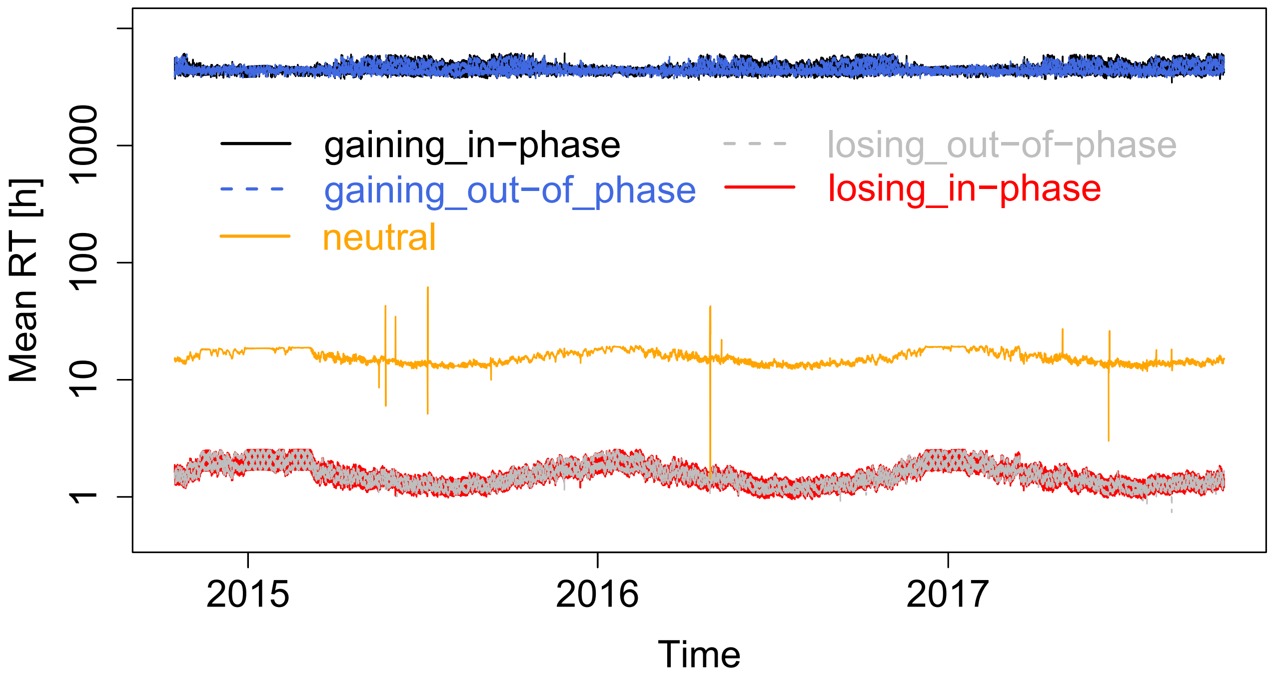

Figure S2. Mean residence time ($log_{10}[h]$) of in-phase and out-of-phase scenarios under gaining, losing and neutral conditions.

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