Supplementary Information of:

Metabolism overrides photo-oxidation in CO_2 dynamics of Arctic permafrost streams

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Supplementary text 1: Metabolic estimates using the BASE package.

The BASEmetab R package (version 2.3.2) was used to model 5 parameters (GPP, ER, K, temperature sensitivity of ER [θ] and light saturation of GPP [*p*]). To reach convergence the model was run 150,000 iterations, saving the last 50000 as results. The initial value for K was set at 9 d^{-1}, the average of K obtained from *streamMetabolizer*. Metabolic rates estimated using the *streamMetabolizer* package were similar to rates using the BASE metabolism model (Figure S7), which includes parameters for temperature dependence of respiration and non-linear responses of photosynthesis with light. GPP estimates from the two models were highly correlated (R^2 = 0.86) and BASE produced estimates slightly higher than *streamMetabolizer* (paired t-test: t = 3.003, df = 22, p-value = 0.0065 ; mean of the differences and 95% confidence interval = 0.062 [0.019 – 0.105]). For ER estimates between both models were also strongly correlated (R^2=0.84), but without significant differences between estimates (paired t-test: t = 0.55, df = 22, p-value = 0.58 ; mean of the differences and 95% confidence interval = 0.166 [-0.459 – 0.792]). In contrast, K estimated by *streamMetabolizer* was slightly higher than the estimates of K obtained using BASE, with a mean ± s.d of 10.3±4.1 and 7.7±4.3 d^{-1} respectively.

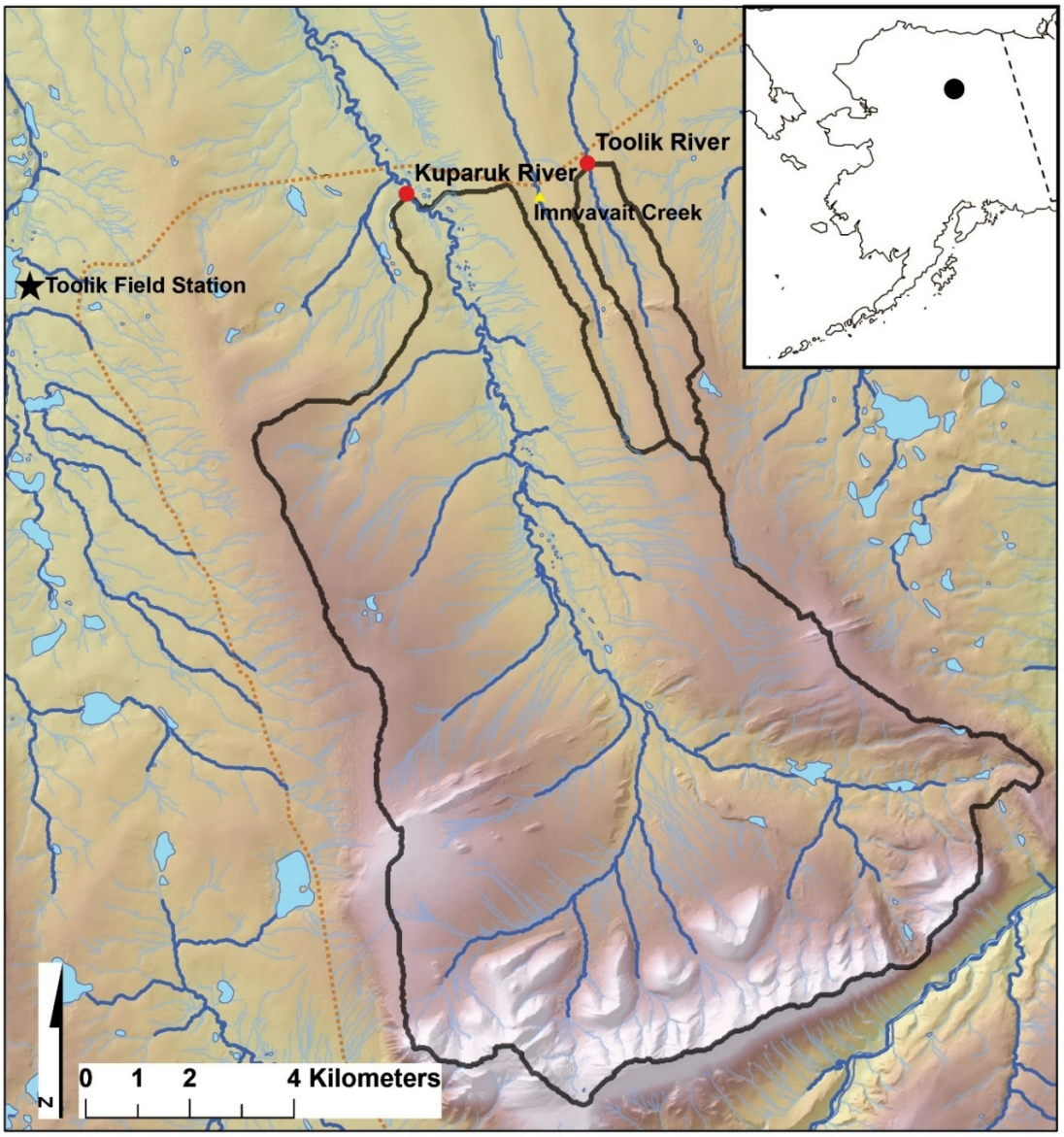

Figure S1: Map of the two catchments studied. The red dots denote the sampling locations for the three streams, with their watersheds delineated (black lines). The yellow triangle shows the location of Imnavait Creek, an adjacent stream where photo-oxidation data is available (Cory et al. 2014). The coloration denotes the elevation, the dashed brown line the Haul road, and the black star the location of the Toolik Field Station.

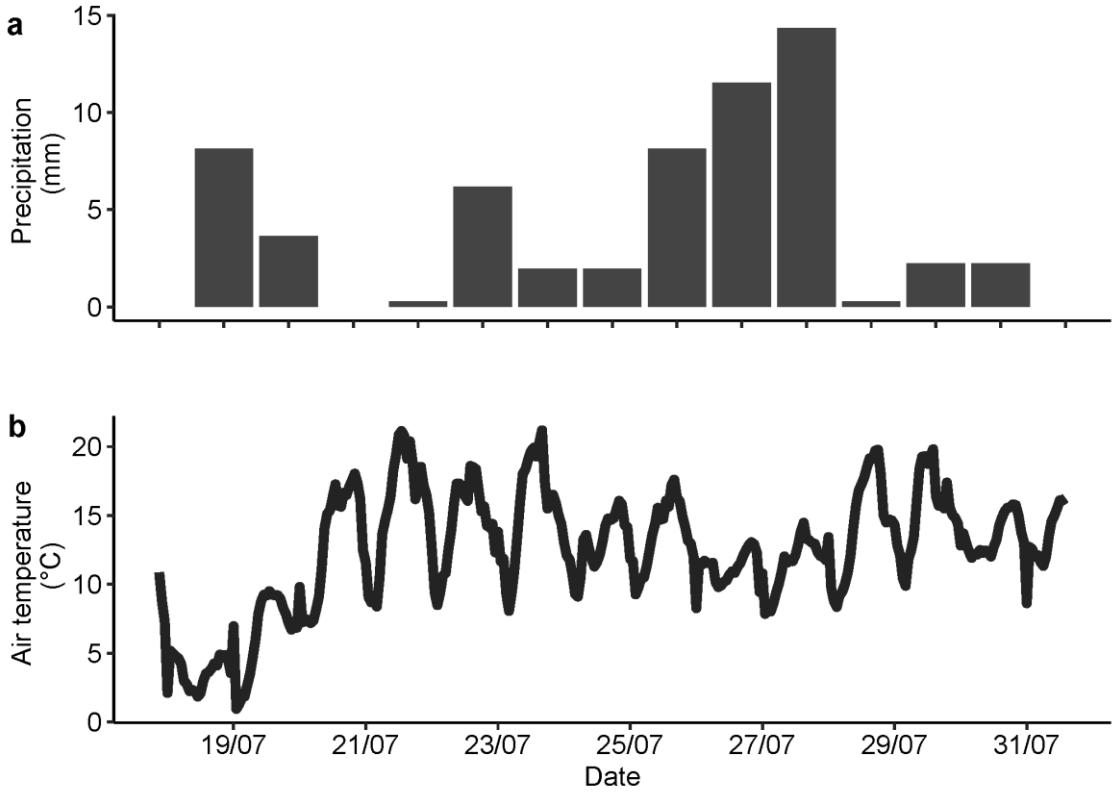

Figure S2. Weather data at the Toolik Field station during the sampling period. (a) shows the daily total precipitation, and (b) is the air temperature measured at 5 m. above the soil.

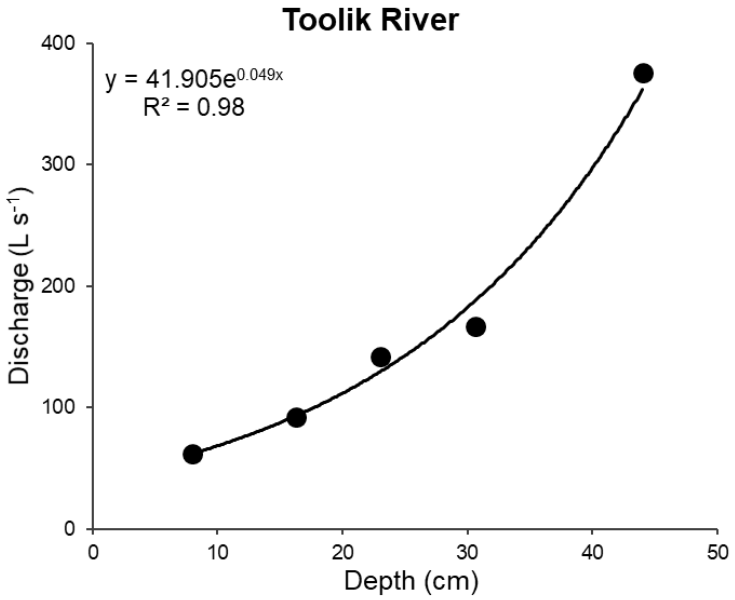

Figure S3. Depth ~ discharge relationship for Toolik River. Each point represents a discharge measurement.

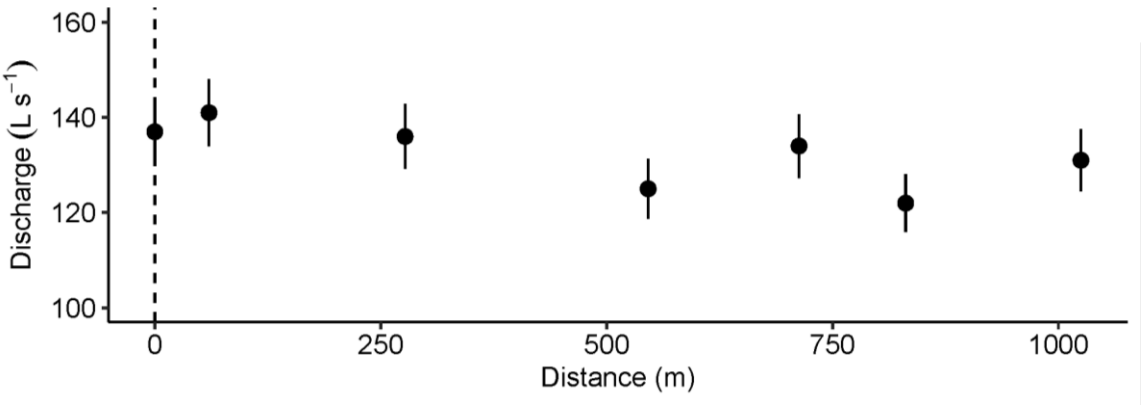

Figure S4. Spatial measurements of discharge performed in Toolik River. These spatial measures were performed to assess potential lateral inputs of water. The error bars indicate the +/-5% accuracy of the method to measure discharge.

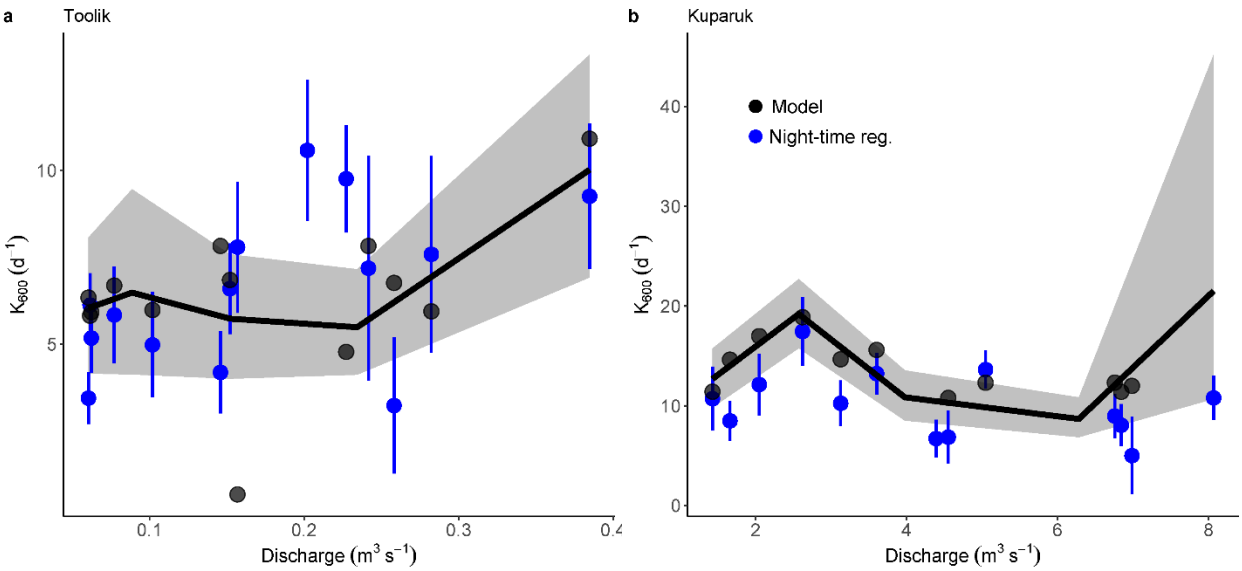

Figure S5. Comparison of the K_{600} modelled (black) using the metabolism model and the K_{600} obtained from the night-time regression (blue), which were used as priors for the final K. The model pools K for different bins of discharge to make a flexible Q~K relationship (line). Error bars represent 2 standard deviations.

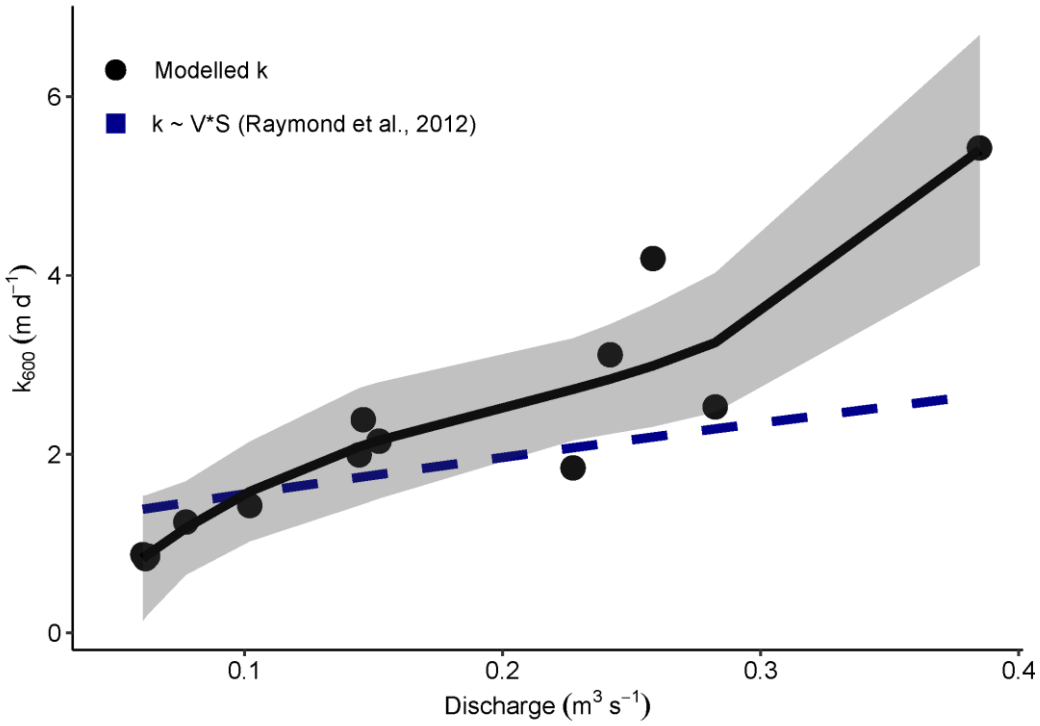

Figure S6. Comparison of the k_{600} modelled with the estimated using velocity and discharge as predictors of k_{600}, for Toolik River.

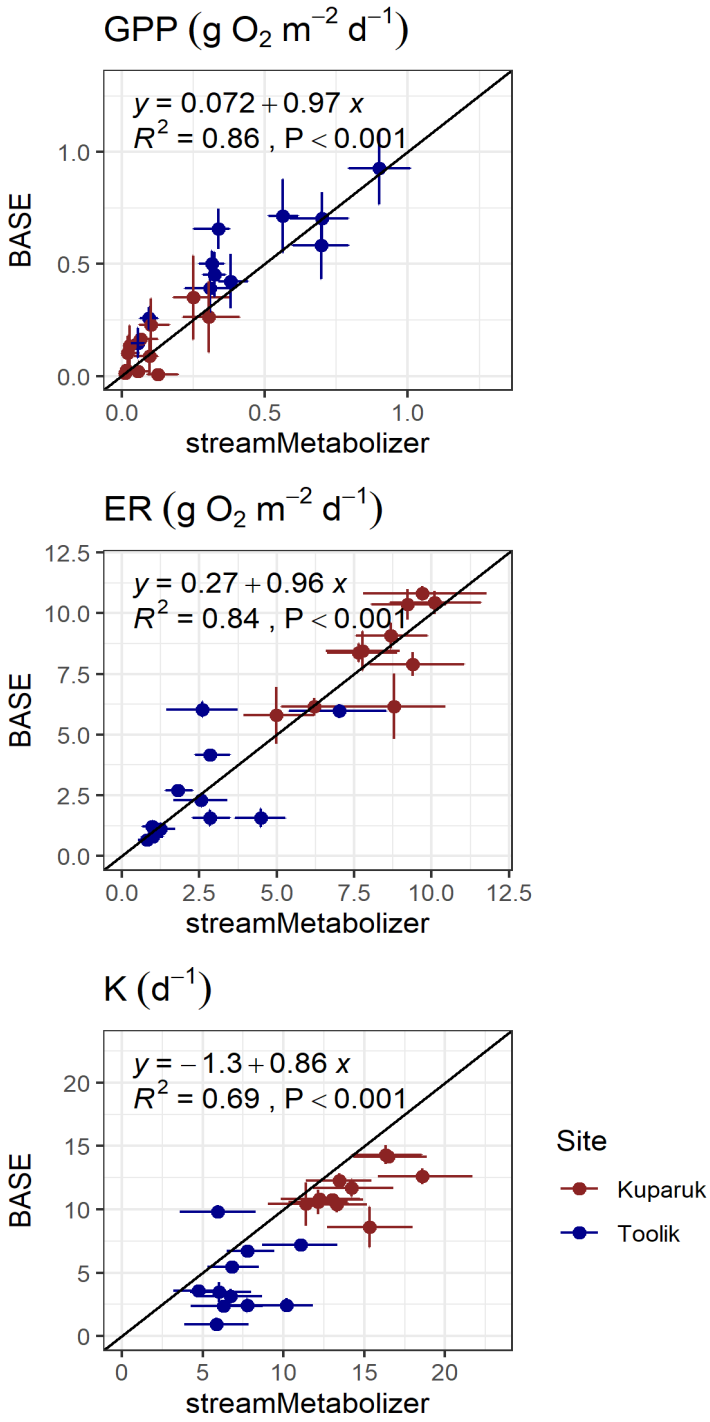

Figure S7. Comparison of GPP, ER and K obtained both with *streamMetabolizer* and BASE models. Error bars represent ±2 standard deviations

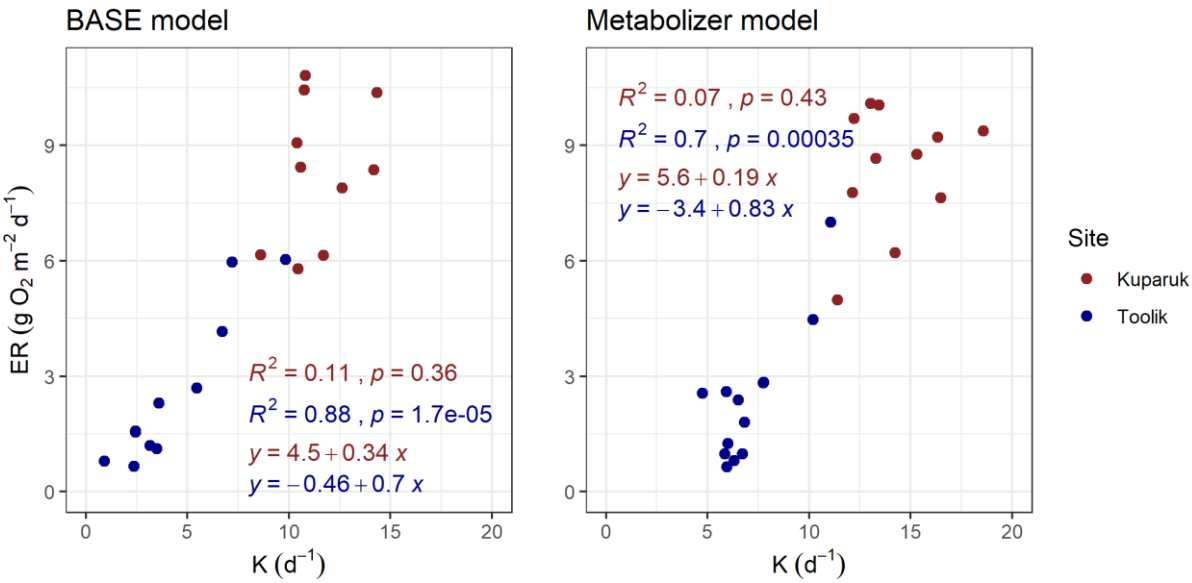

Figure S8. Comparison of the K~ER relationship obtained both with *streamMetabolizer* and BASE models.