**Q10 meta-analysis**

We have 990 observations from 45 total studies included including 25 from a previous review (Li et al. 2020). We searched for papers using the following search terms: X, X, and X. We reviewed the papers and kept those that met the following criteria: multiple depths below 20 cm were included in the paper and the paper contained deeper depths that were not permafrost. Given that permafrost was the strongest determinant of Q10 in a previous meta-analysis (Li et al. 2020) and that the phase change from solid to liquid water can cause a much stronger exponential response to warming (Koven et al. ?) than a temperature increase that occurs > 0°C, we specifically chose to leave out permafrost soils from our analyses to focus on responses to warming within the range of liquid water.

First, we tested how the Q10 was affected by experimental conditions. Based off the initial data visualization, we tested whether Q10 was affected by study duration and the minimum temperature and its interaction with depth. This model included 953 datapoints. We tested the optimal random effects structure of using the based on the model with the lowest AIC. We tested the site, citation, and site nested within the citation as the random effects. The best model had site nested within citation as the random effect. There was a significant interaction between soil depth and the duration of the study (p=0.0004). In surface soils, there was not much of an effect of study duration on Q10. In the deeper soils, the Q10 decreased as the study duration increased. Because the most available carbon is accessed and respired by the microbial community first, this implies that the more residual carbon was less available in the deeper soils than the surface soils.

Second, we tested how the Q10 was affected by the environmental conditions, specifically the reported mean annual temperature, mean annual precipitation, and land cover and the interaction of each with soil depth. This model included 835 datapoints. We used the same random effect structure as above. Mean annual temperature (p=0.001) and land cover by depth interaction (p<0.0001) were the significant effects in the model. The effect of Q10 on depth was highly dependent on land cover with Q10 increasing with depth in forested sites and Q10 decreasing with depth in cultivated, wetland, and rangeland/grassland sites. Q10 decreased with increasing MAT across all depths.

Lastly, we tested how Q10 was affected by soil variables, specifically the percent carbon, soil C:N, and pH and their interactions with soil depth. This model included 674 datapoints. The main effect of soil C:N (p=0.05) and the interaction of depth with soil pH (p<0.0001) were significant. Q10 increased with increasing soil C:N ratios. Q10 decreased with decreasing pH, an effect that was strongest at depth and Q10 decreased as soil nitrogen increased, an effect that was also strongest at depth.

Missing Data/Data Questions

37 NA’s? for duration

4 NA’s for Q10? Due to double entry

Peatland versus wetland: how do these differ?

92 not possible for percent C, check calculations