egusphere-2026-605 "Temperature dependence of the contribution of soil moisture to soil respiration and the soil respiration temperature threshold in a temperate deciduous forest"

Dear Associate Editor and Reviewers,

We thank you again for your careful review of our revised manuscript and for your additional constructive comments. We have carefully addressed all of these comments and further revised the manuscript accordingly. Our detailed responses are provided below.

There are still things not to clear to me. The authors show this equation: $Rs = a$exp $(bTs)(cSMC2 + dSMC + e)$; which is actually not applied right? at least there is no statistics provided for the fit of this equation, which is pretty much a standard equation used to predict effects of Ts and SWC.

What authors use instead is an equation with this form: $Rs = $ Trange $* (cSMC2 + dSMC + e)$ (Trange is what you called Tbins, which you actually defined arbitrary...) . Am I right?

IS there differences in the fit of those two equations?

Response: Thank you for this important comment. We agree that this point was not sufficiently clear in the previous version of the manuscript. The equation $R_s = a$exp $(bT_s)(cSMC^2 + dSMC + e)$ was indeed applied in our analysis and was fitted to the full daily dataset. The 5°C temperature binning was not used as an alternative model, but only as a secondary step to examine more clearly how the contribution of SWC changed across temperature conditions. We have revised the Methods section to clarify that Equations (2) and (3) were first fitted to the full daily dataset, whereas the temperature bin analysis was used only for interpretation. We have also added fit statistics for the full dataset models. For the full daily dataset, the Ts-only model yielded an R^2 of 0.782, an RMSE of 274.94, and an AIC of 183,047, whereas the Ts × SWC model yielded an R^2 of 0.846, an RMSE of 230.77, and an AIC of 177,346.

I also propose two other equations:

$Rs = $ Season*$(cSMC2 + dSMC + e)$

$Rs = $ Season* Trange*$(cSMC2 + dSMC + e)$

and see which one gives the best fit

My feeling is that the different shapes of the relation between SWC and Rs will be related to season, which partially covaries with Ts, but not entirely. This may show that part of the variability in Fig 3 might also be related to phenology

Response: We sincerely thank the reviewer for this insightful suggestion. We agree that part of the variability shown in Figure 3 may also be related to phenology. To further examine this possibility, we conducted an additional comparison by separating the

study period into foliage season (FS) and non-foliage season (NFS), which reflect differences in plant activity, while also considering temperature range. This comparison showed that the additional explanatory contribution of SWC was much more pronounced during the foliage season, whereas it was negligible during the non-foliage season. However, this comparison should be interpreted cautiously because the number of observations in the FS group below the estimated breakpoint was limited, which may reduce the stability of the fitted relationship in that subset. These results suggest that the apparent moisture control of soil respiration may shift, at least in part, in association with phenological changes in plant activity. However, a more rigorous assessment of phenological effects would require environmental overlap across phenological stages so that phenological influences can be distinguished more clearly from co-occurring temperature and moisture conditions. In field observations, such overlap is difficult to obtain because periods of high plant and microbial activity generally coincide with warmer conditions, whereas periods of low activity usually occur under cooler conditions. In addition, because this comparison was exploratory and did not directly distinguish autotrophic and heterotrophic components, we did not incorporate these grouped formulations into the main analysis. Instead, we clarified in the revised manuscript that part of the variability in Figure 3 may also reflect phenological influences, and we explicitly acknowledge this point as a limitation of the present study. A more direct evaluation of these phenological influences will require explicit assessment of root activity, together with separate quantification of autotrophic and heterotrophic respiration across phenological stages, in future work.
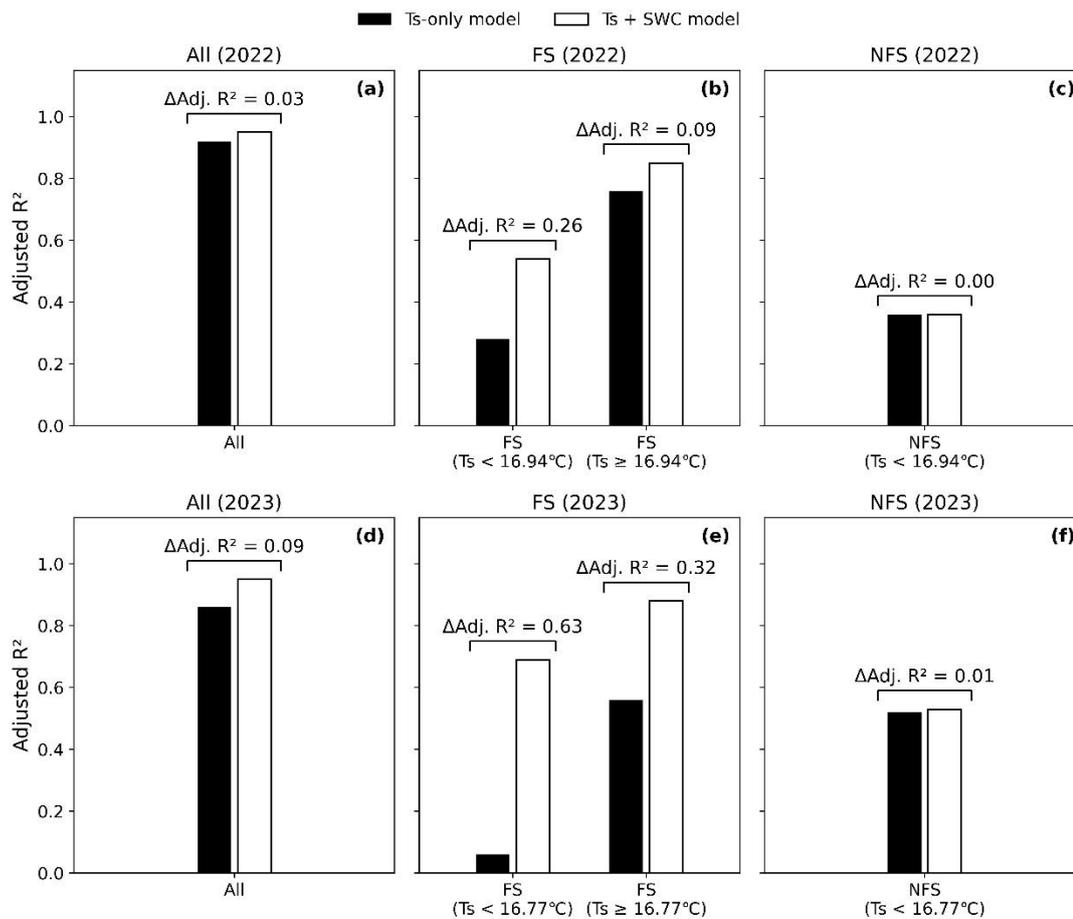
Figure R1. Exploratory comparison of adjusted R² values between the Ts only model and the Ts + SWC model for all observations, foliage season (FS), and non-foliage season (NFS) in 2022 and 2023. For FS and NFS, data were further separated according to the breakpoint-based temperature ranges identified from the Rs versus Ts relationship.