

Supplementary Figures:

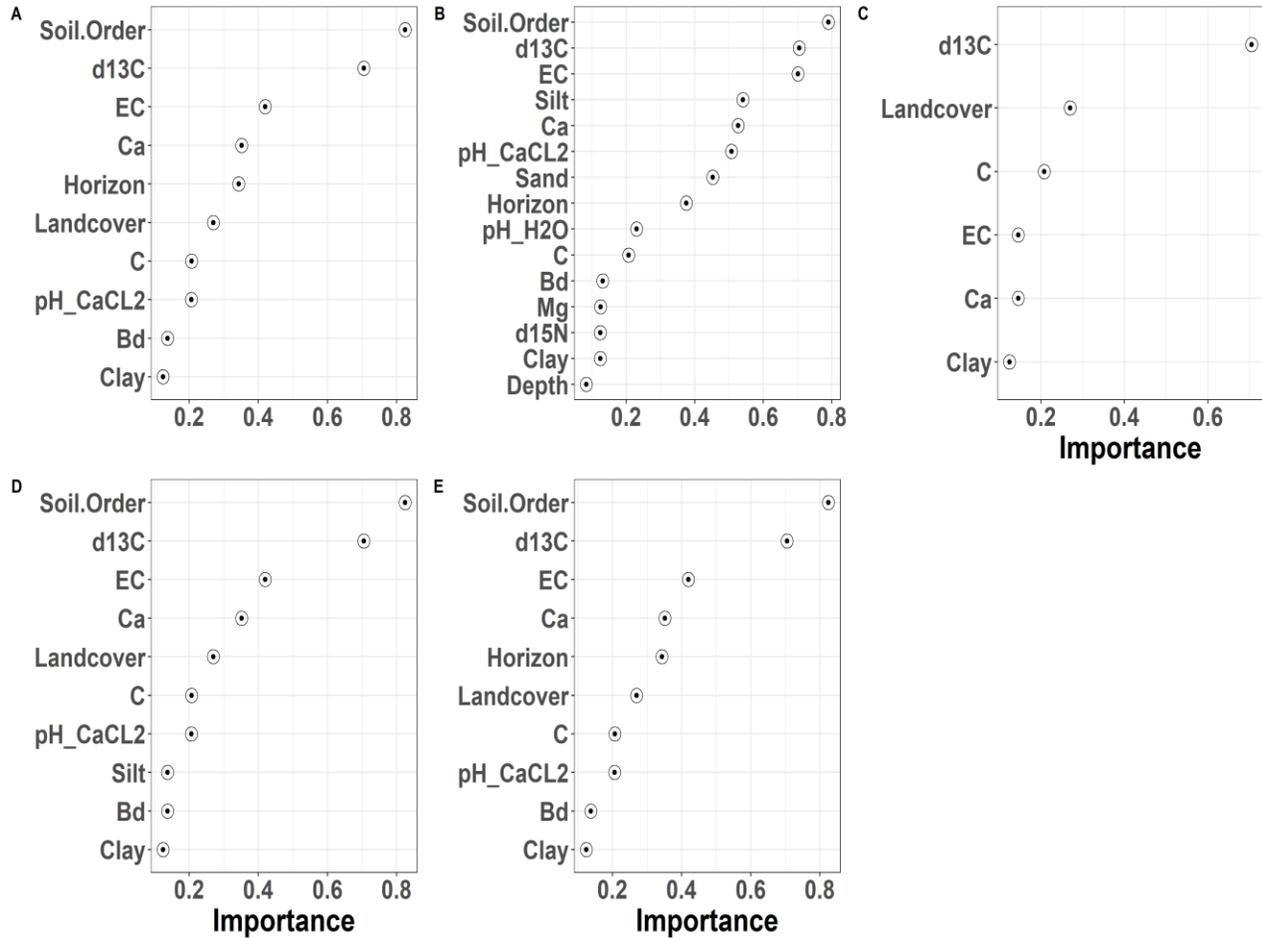


Fig. S1. Variable importance ranking based on the total reduction in mean square error (MSE) for calibrated CART MODIS WUE models. (A) All soil variables used. (B) without land cover (CART_{nLC}). (C) without soil order (CART_{nSO}). (D) without soil horizon (CART_{nSH}). (E) without soil depth (CART_{nSD}). For each model soil order and/or $\delta^{13}\text{C}$ are the most important predictor of WUE, but all other variables contributed to the model error reduction.

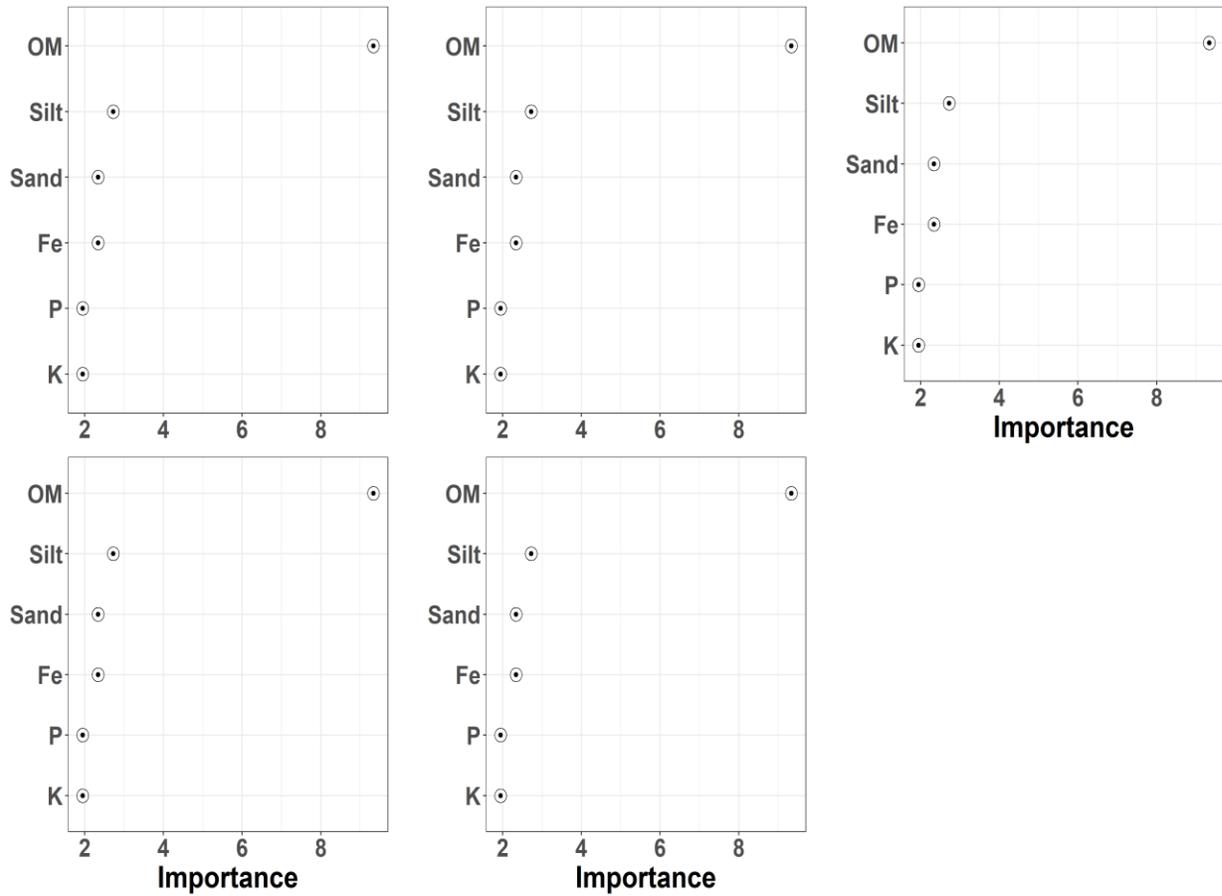


Fig. S2: Variable importance ranking based on the total reduction in mean square error (MSE) for calibrated CART SIF WUE models. (A) All soil variables used. (B) without land cover (CART_{nLC}). (C) without soil order (CART_{nSO}). (D) without soil horizon (CART_{nSH}). (E) without soil depth (CART_{nSD}). For each model, OM is the most important predictor of WUE, but all other variables contributed to the model error reduction.

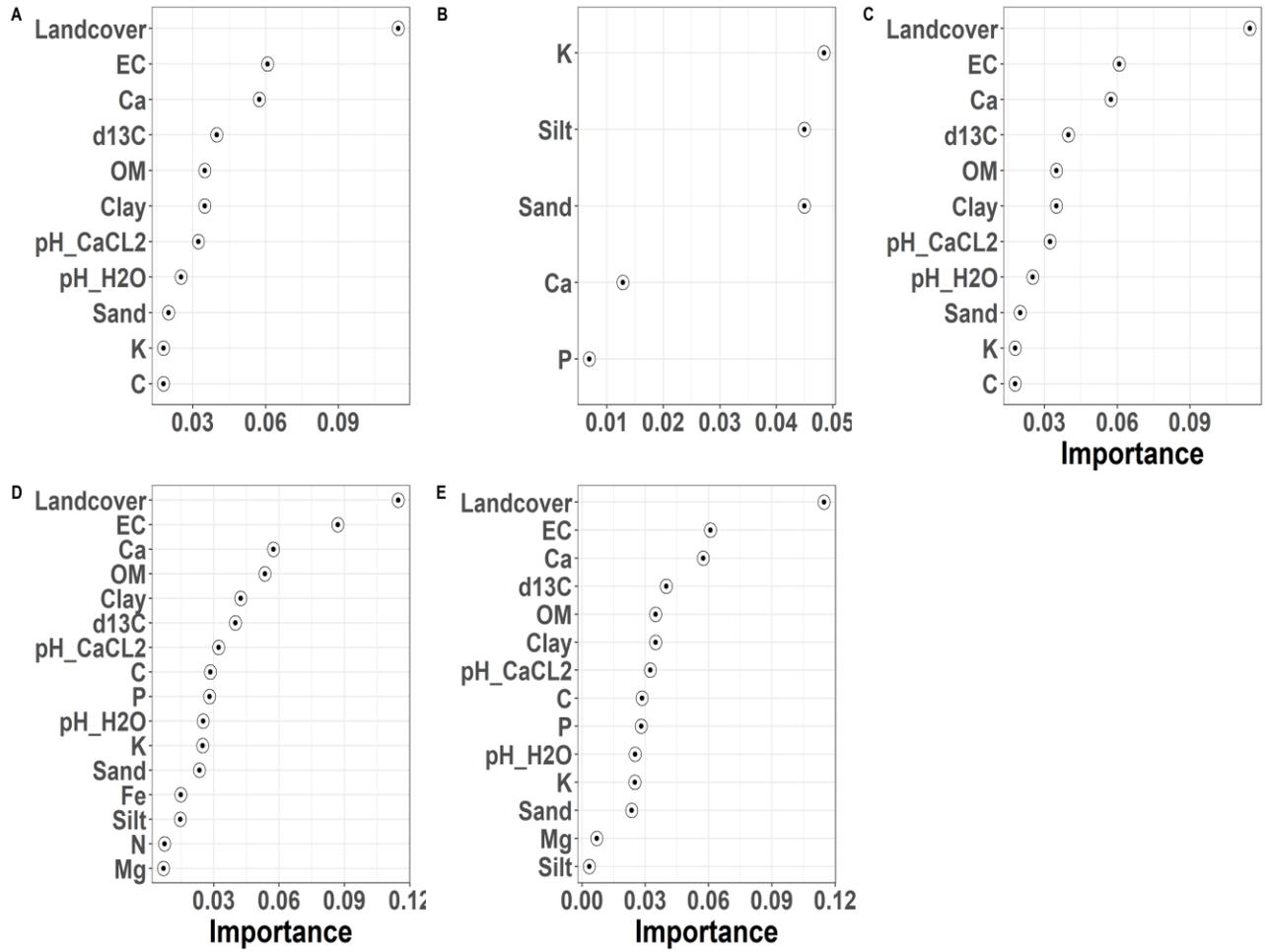


Fig. S3. Variable importance ranking based on the total reduction in mean square error (MSE) for calibrated CART Landsat CUE models. (A) All soil variables used. (B) without land cover (CART_{nLC}). (C) without soil order (CART_{nSO}). (D) without soil horizon (CART_{nSH}). (E) without soil depth (CART_{nSD}). For each model land cover (except B) is the most important predictor of CUE, but all other variables contributed to the model error reduction.

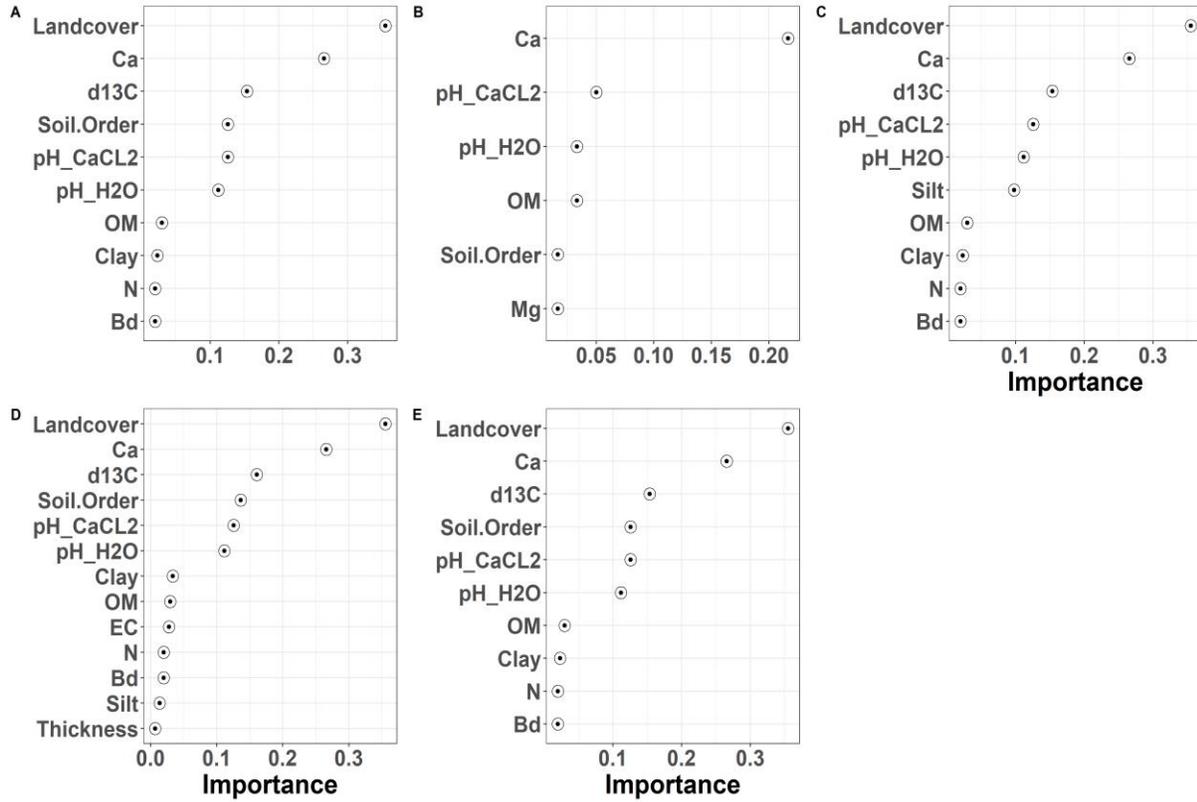


Figure S4. Variable importance ranking based on the total reduction in mean square error (MSE) for calibrated CART MODIS CUE models. (A) All soil variables used. (B) without land cover (CART_{nLC}). (C) without soil order (CART_{nSO}). (D) without soil horizon (CART_{nSH}). (E) without soil depth (CART_{nSD}). For each model land cover (except B) is the most important predictor of CUE, but all other variables contributed to the model error reduction.

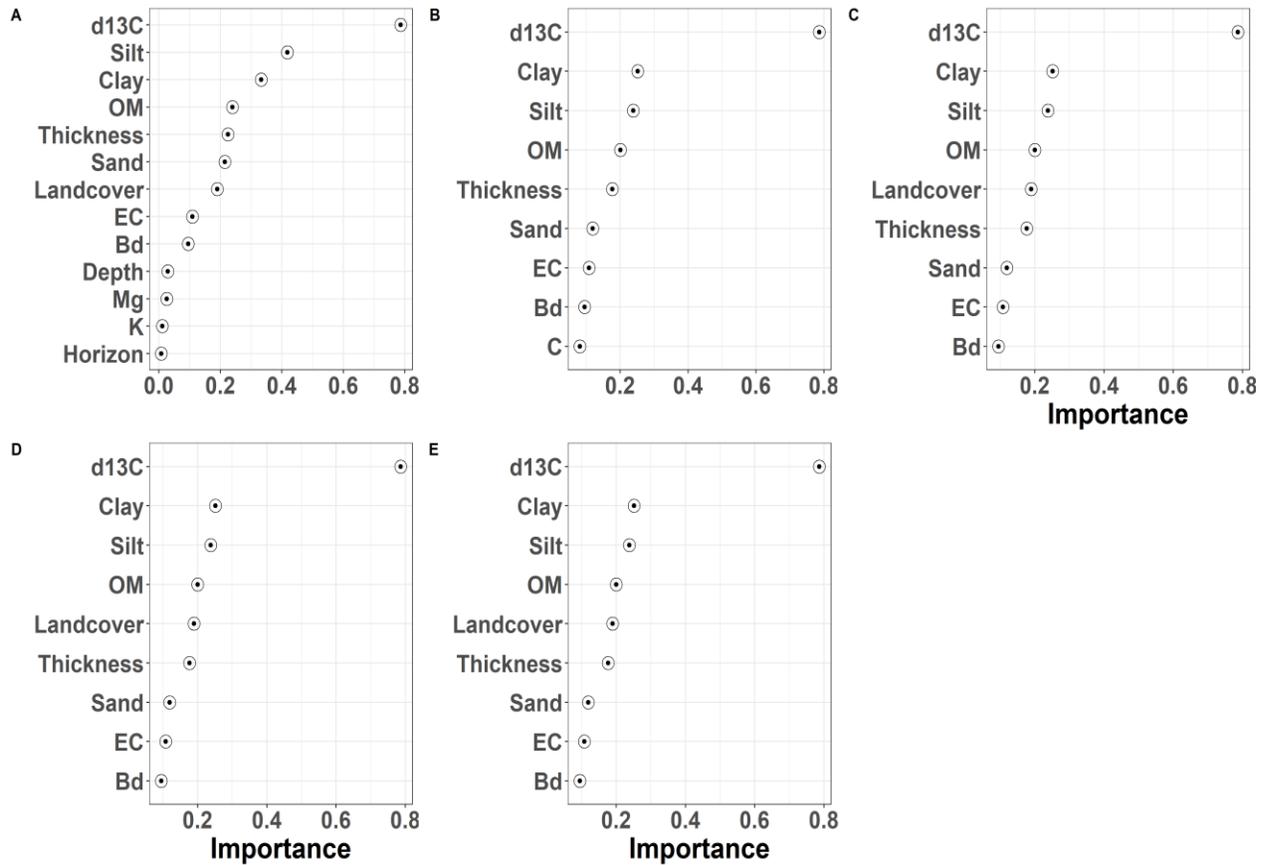
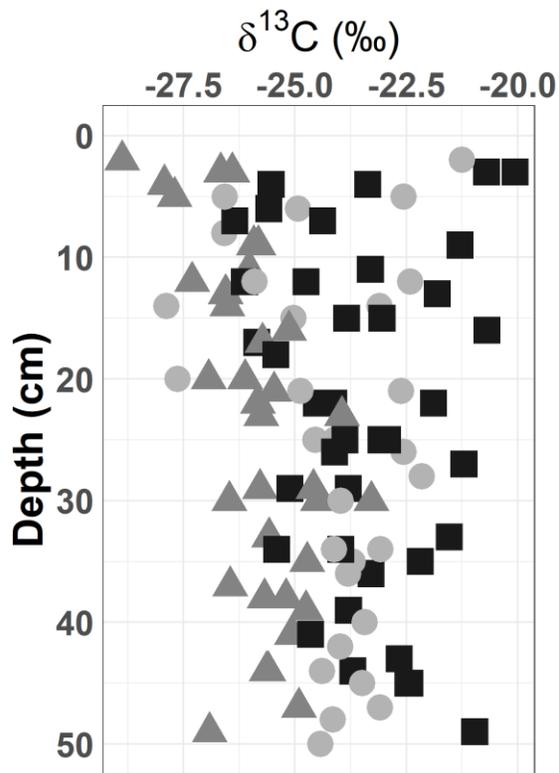
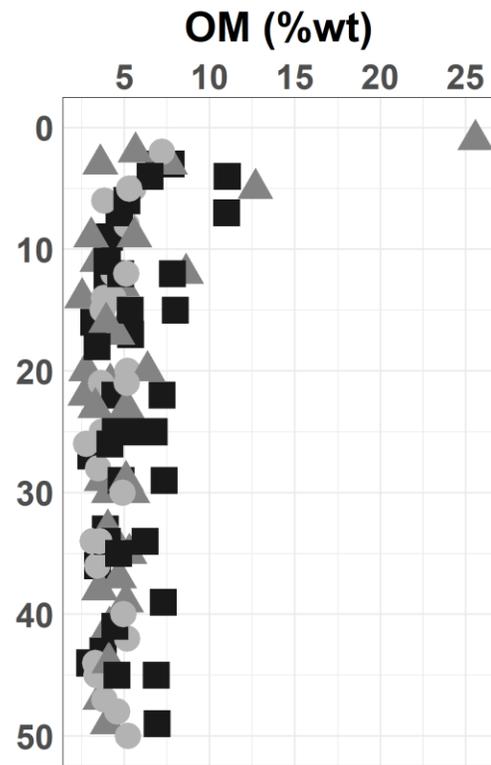


Figure S5. Variable importance ranking based on the total reduction in mean square error (MSE) for calibrated CART SIF CUE models. (A) All soil variables used. (B) without land cover (CART_{nLC}). (C) without soil order (CART_{nSO}). (D) without soil horizon (CART_{nSH}). (E) without soil depth (CART_{nSD}). For each model, $\delta^{13}\text{C}$ is the most important predictor of CUE, but all other variables contributed to the model error reduction.

A



B



● AG ▲ Forest ■ Grass

Figure S6. Variability of (A) Soil $\delta^{13}\text{C}$ and (B) soil OM with soil depth for the study sites.

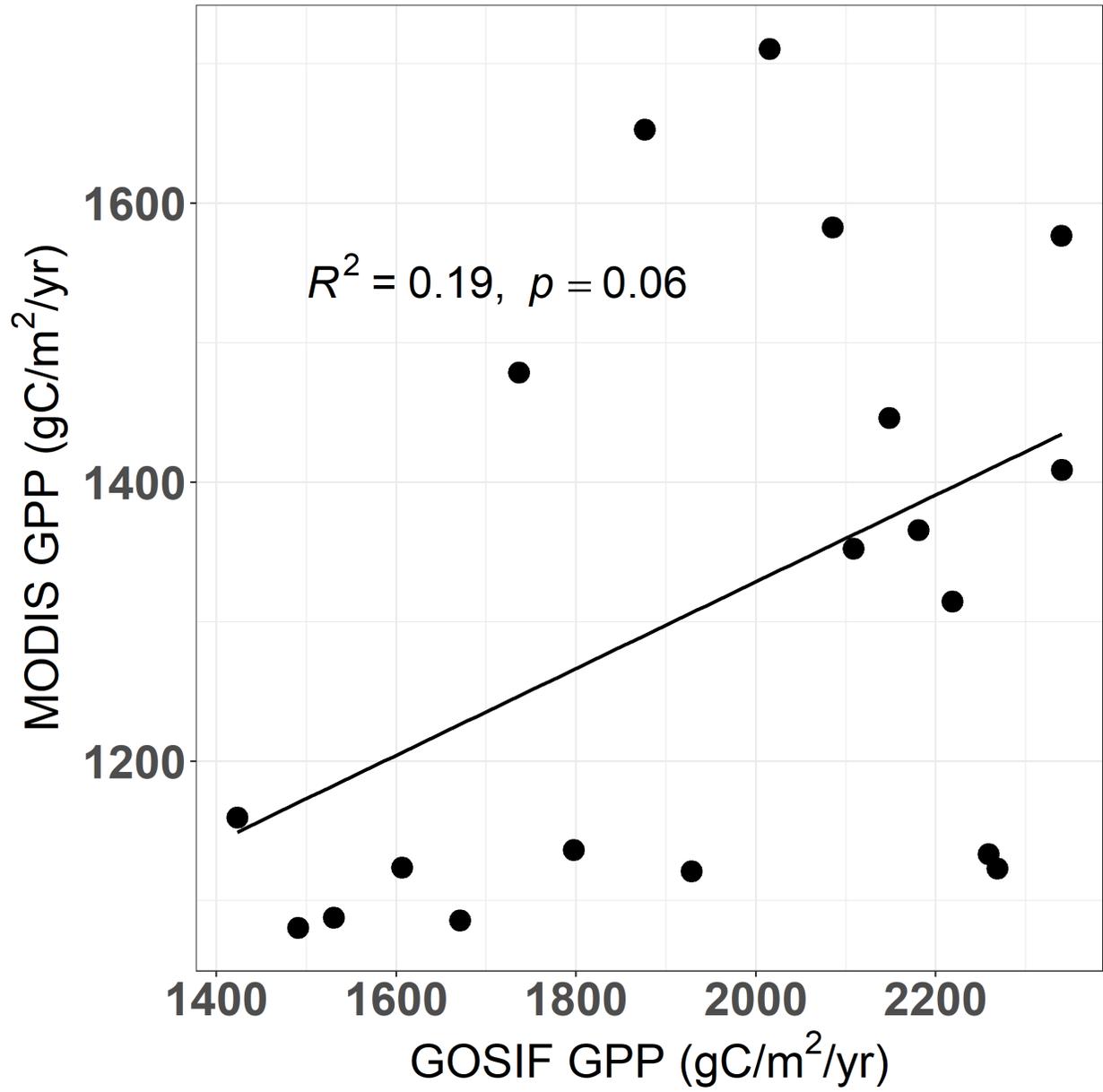


Figure S7. Plot showing the relationship between GEOSIF GPP and MODIS GPP for all the study sites.

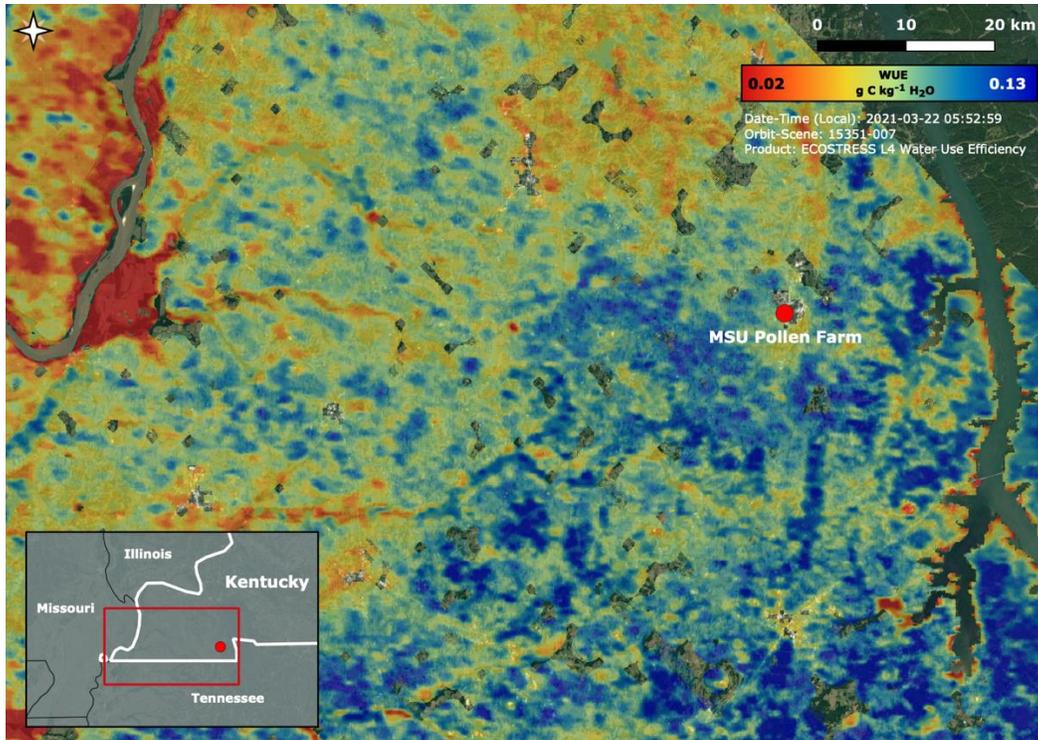


Figure S8. Water Use Efficiency (WUE) from the ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) reveals spatial variability in WUE throughout the landscape at high spatial resolution (70 m x 70 m).