Supplemental figures for "Testing stomatal models at stand level in deciduous angiosperm and evergreen gymnosperm forests using CliMA Land (v0.1)"

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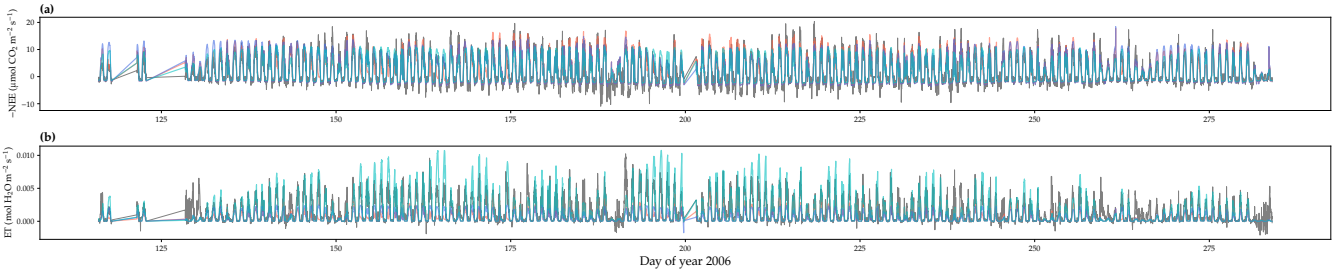

Figure S1. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2006. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

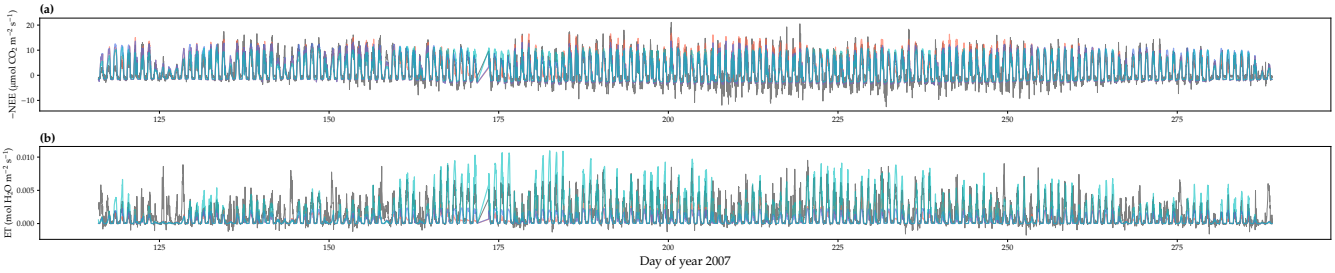

Figure S2. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2007. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

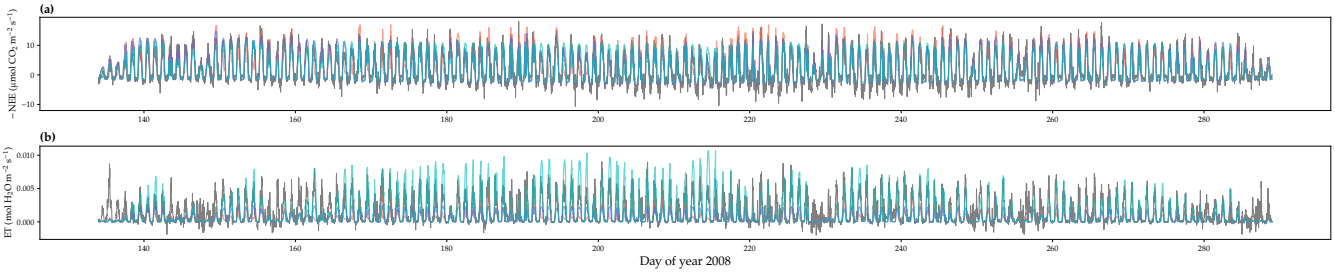

Figure S3. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2008. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

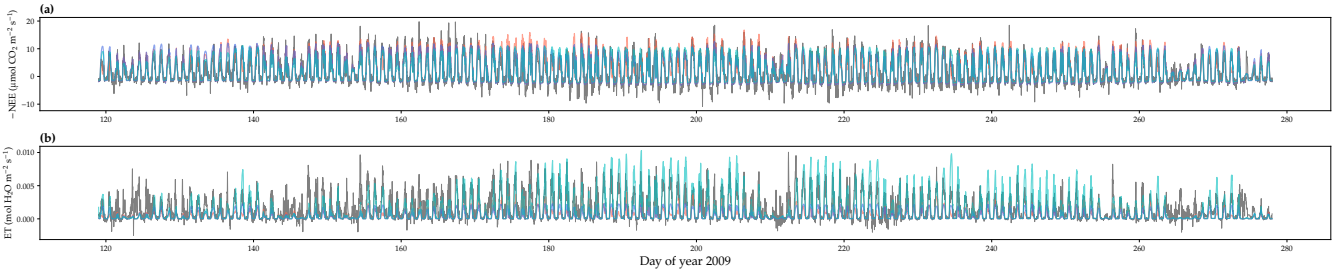

Figure S4. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2009. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

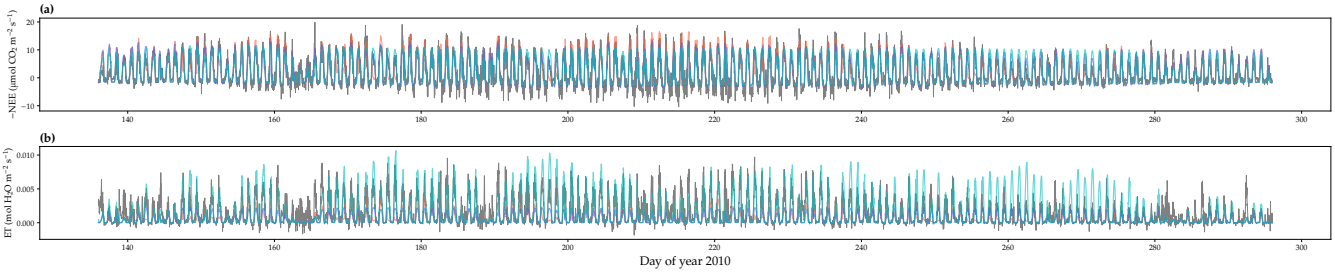

Figure S5. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2010. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

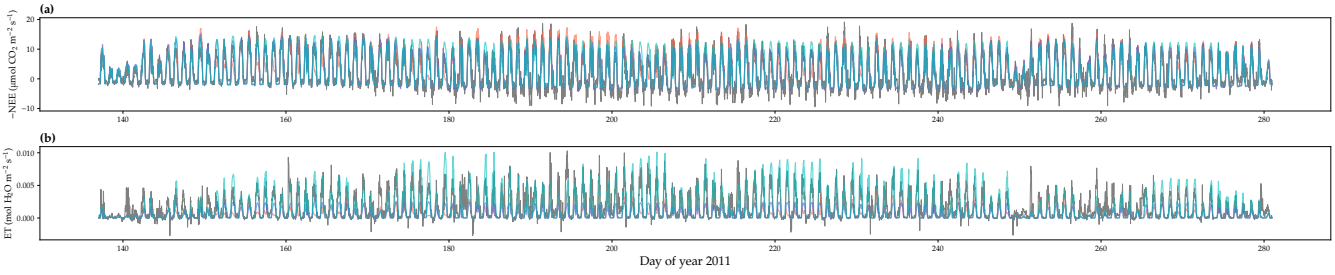

Figure S6. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2011. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

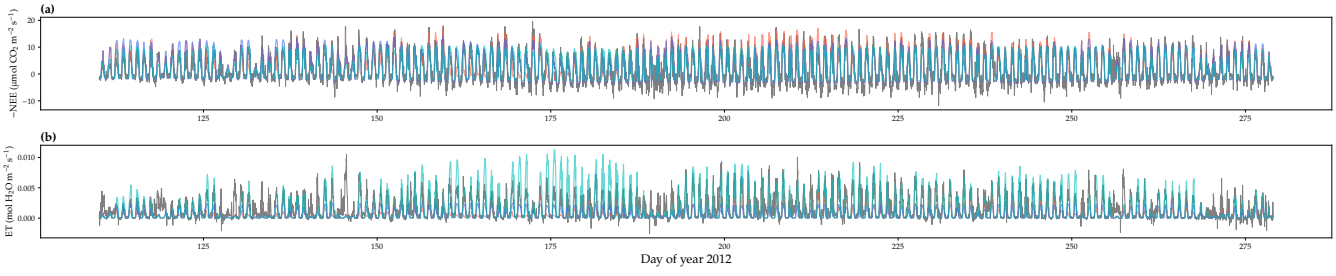

Figure S7. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2012. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

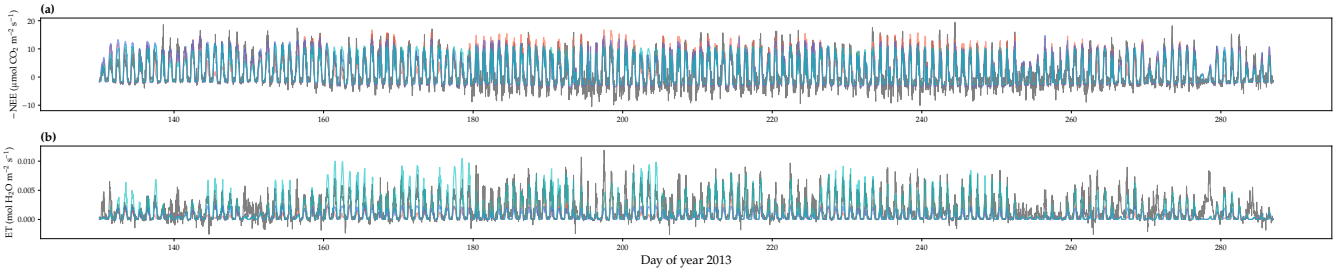

Figure S8. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2013. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

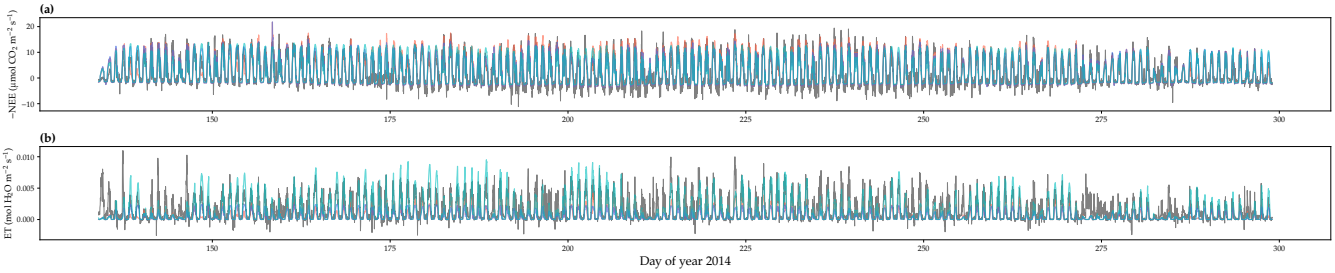

Figure S9. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2014. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

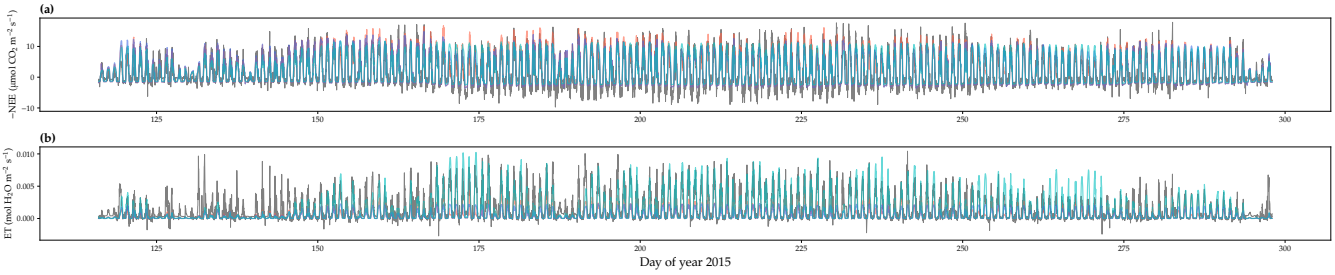

Figure S10. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2015. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

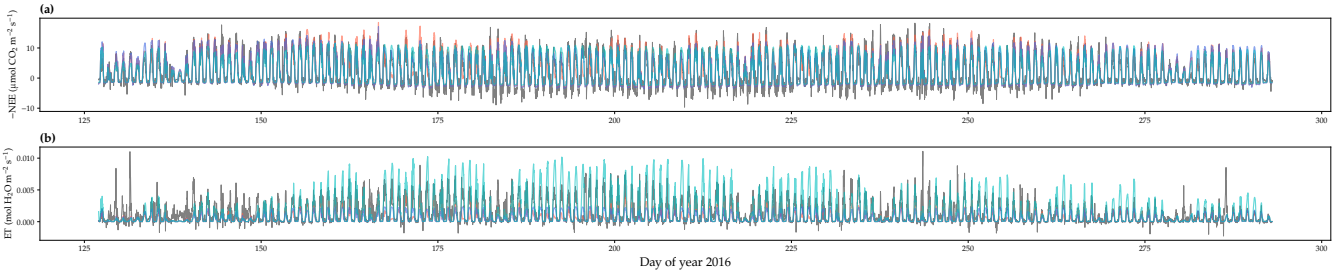

Figure S11. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2016. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

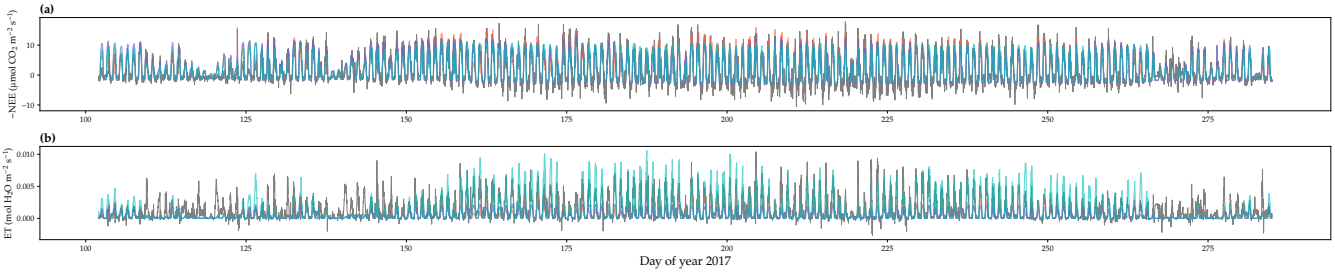

Figure S12. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2017. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

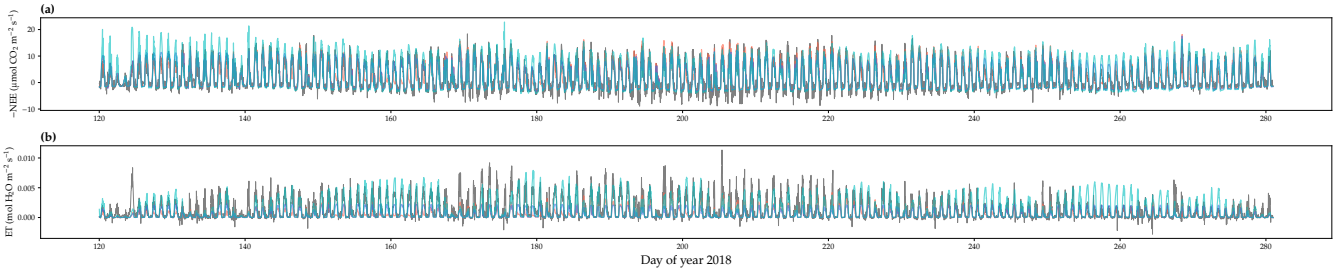

Figure S13. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2018. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

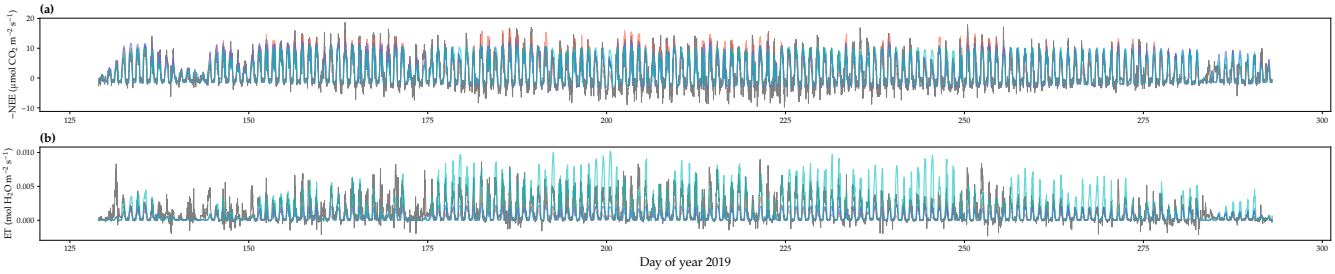

Figure S14. Comparison of model predicted carbon/water fluxes to US-NR1 (Niwot Ridge, evergreen gymnosperm forest) flux tower observations for year 2019. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

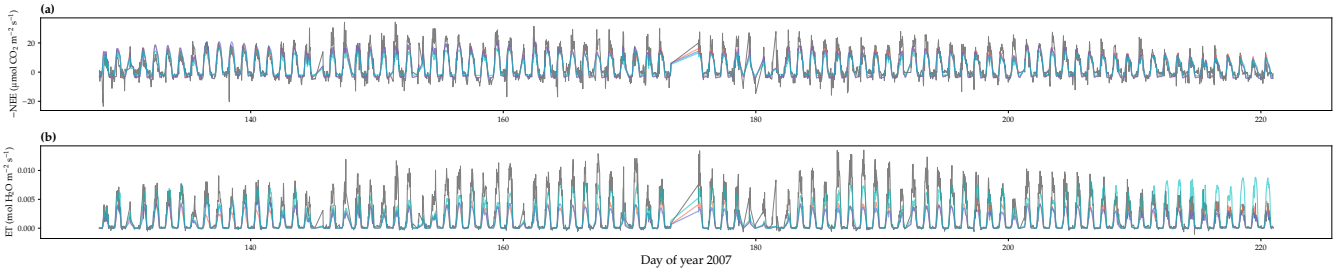

Figure S15. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2007. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

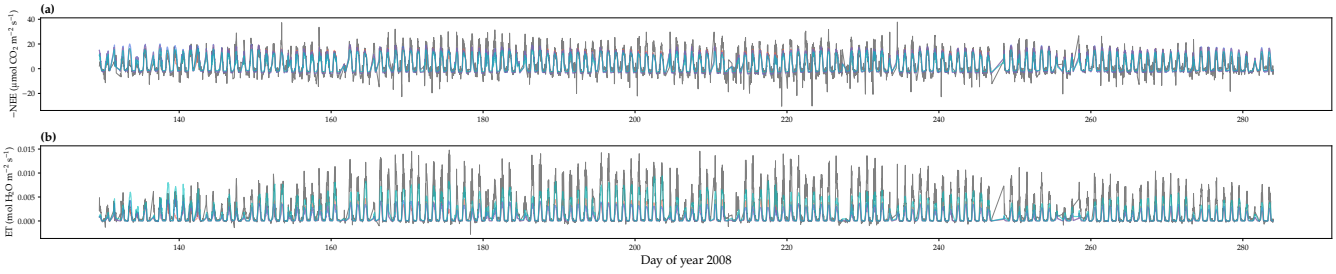

Figure S16. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2008. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

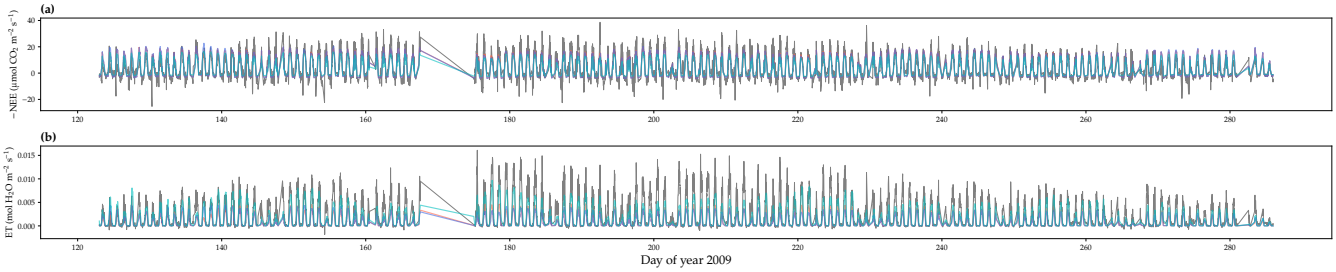

Figure S17. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2009. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

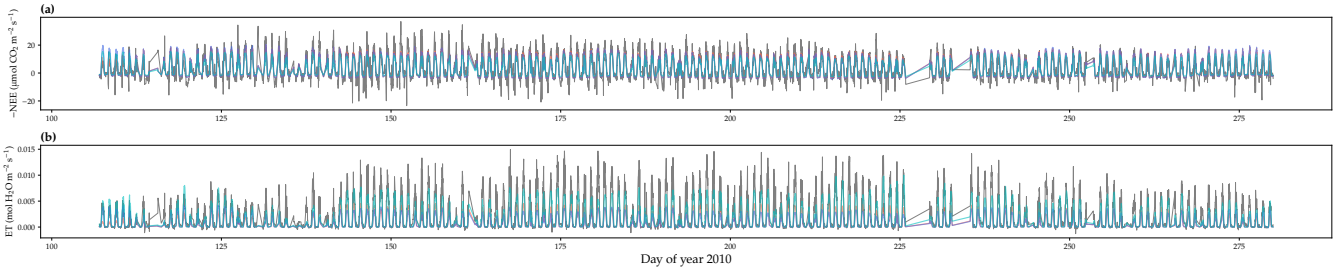

Figure S18. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2010. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

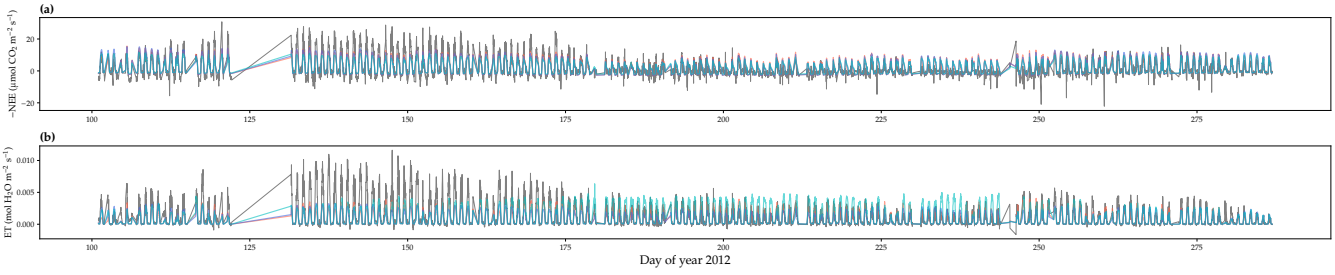

Figure S19. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2012. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

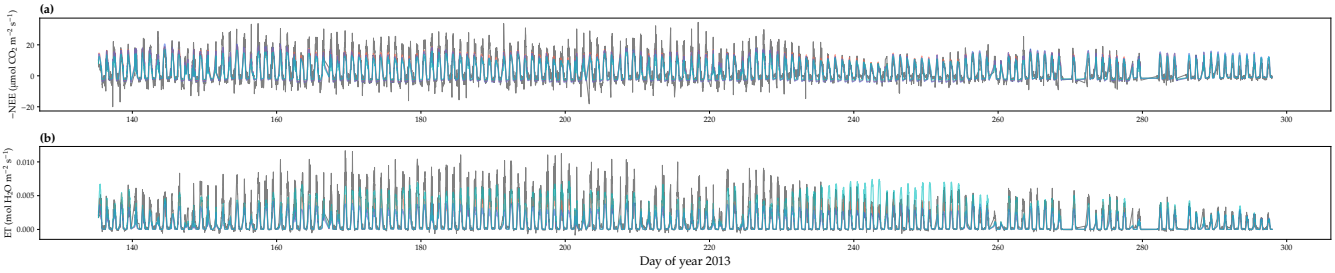

Figure S20. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2013. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

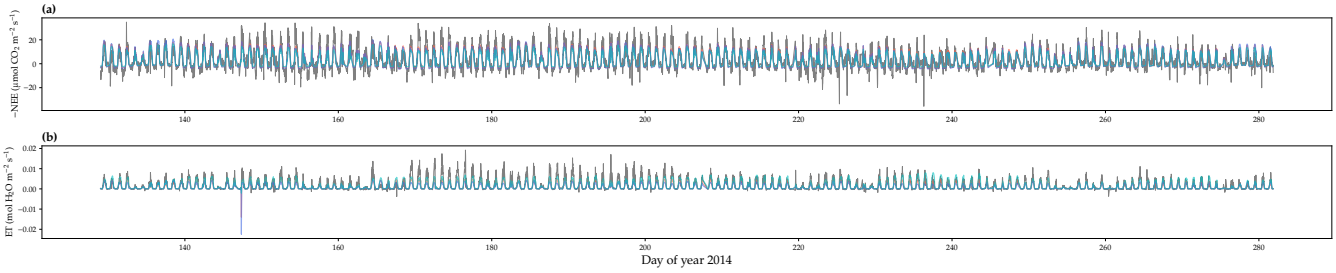

Figure S21. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2014. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

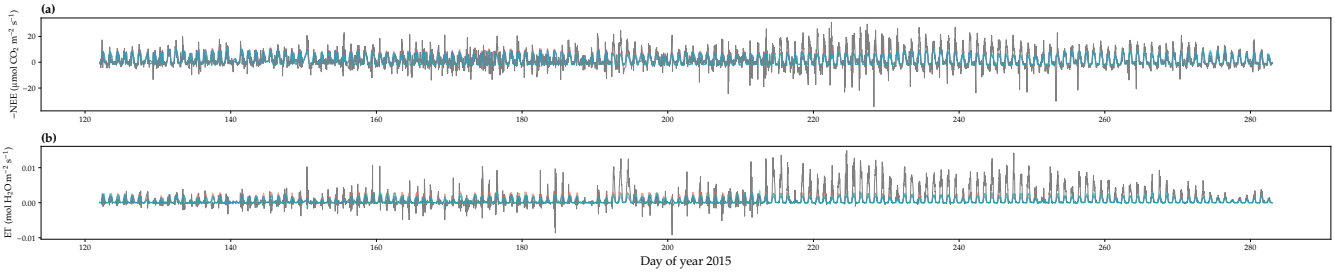

Figure S22. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2015. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

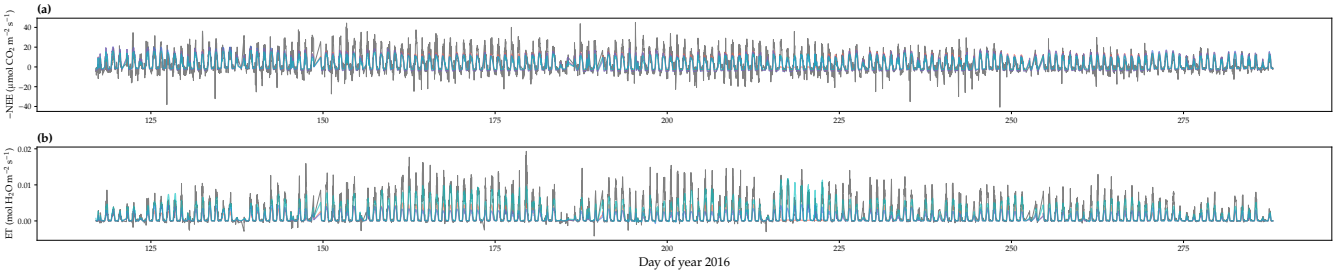

Figure S23. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2016. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

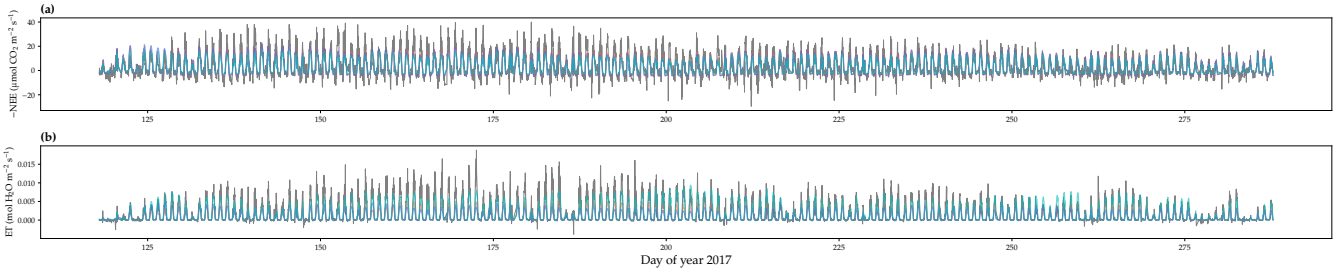

Figure S24. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2017. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

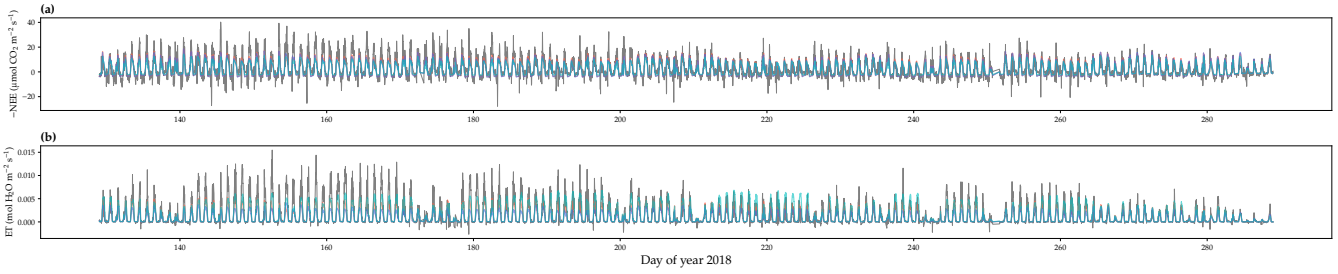

Figure S25. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2018. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

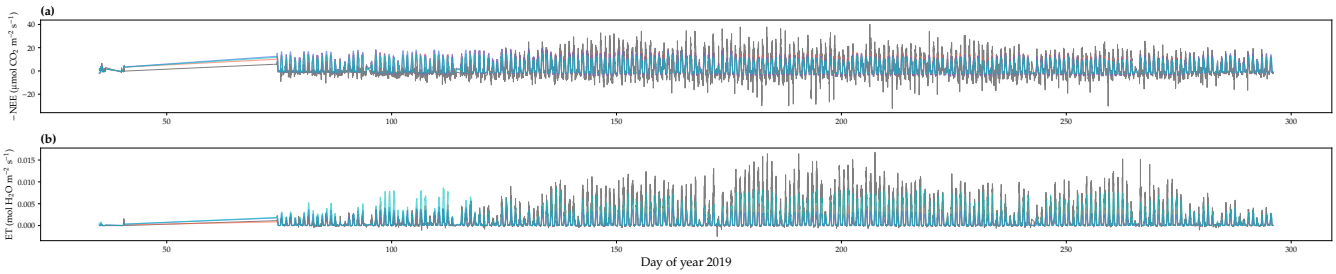

Figure S26. Comparison of model predicted carbon/water fluxes to US-MOz (Ozark, deciduous angiosperm forest) flux tower observations for year 2019. **(a)** Gray curve plots the half-hourly net ecosystem exchange (CO_2 flux; NEE) in the growing season. Shaded red, blue, and cyan curve each plots the Ball et al. (1987), Medlyn et al. (2011), and Wang et al. (2020) stomatal model predictions (BBM, MED, and OSM), respectively. **(b)** Comparison of modeled and observed half-hourly total transpiration flux (water flux; ET).

References

Ball, J. T., Woodrow, I. E., and Berry, J. A.: A model predicting stomatal conductance and its contribution to the control of photosynthesis under different environmental conditions, in: Progress in photosynthesis research, pp. 221–224, Springer, 1987.

Medlyn, B. E., Duursma, R. A., Eamus, D., Ellsworth, D. S., Prentice, I. C., Barton, C. V. M., Crous, K. Y., de Angelis, P., Freeman, M., and Wingate, L.: Reconciling the optimal and empirical approaches to modelling stomatal conductance, Global Change Biology, 17, 2134–2144, 2011.

Wang, Y., Sperry, J. S., Anderegg, W. R. L., Venturas, M. D., and Trugman, A. T.: A theoretical and empirical assessment of stomatal optimization modeling, New Phytologist, 227, 311–325, 2020.