Supplement S6

October 25, 2021

1 Prescribed vegetation cover and root depths

Rooting depths were fixed to 2m, similar as the model runs of LPJ-GUESS, and vegetation cover was prescribed based on observations of Donohue et al.(2008). Here, a comparison is made between the different runs of the VOM with prescribed and prognostic vegetation properties. The results for Sturt Plains are not included, as the SCE-algorithm did not converge for prescribed roots and prescribed vegetation cover at the same time. We provide here the full analysis for transparency, in addition to the results in the main manuscript.

1.1 Timeseries of modelled fluxes

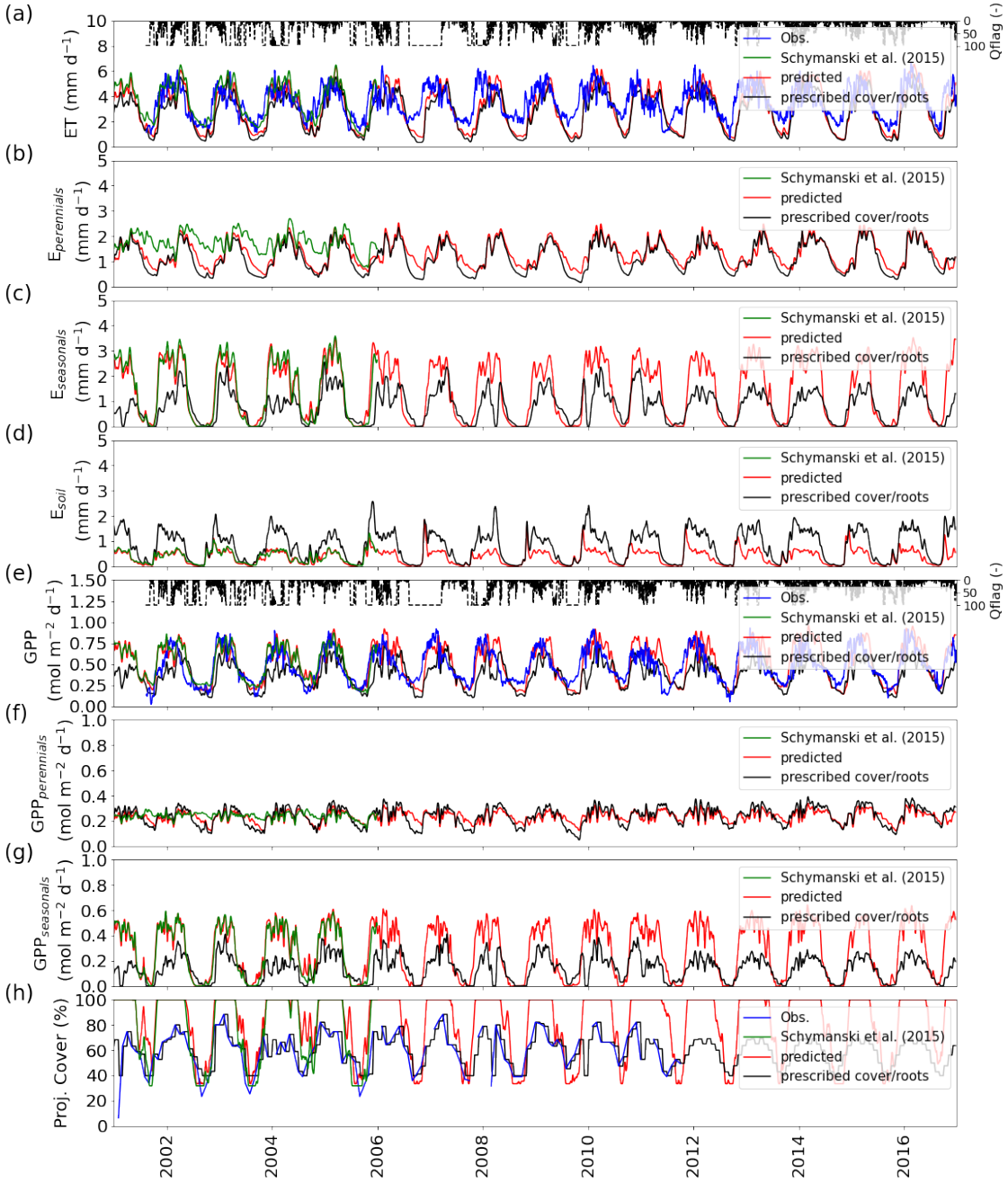

Figure S6.1. *Results for Howard Springs from 2001-2016 (subset from 1980-2016) for a) ET, b) transpiration perennials (trees), c) transpiration seasonals (grasses), d) soil evaporation, e) GPP, f) GPP perennials (trees), g) GPP seasonals (grasses), all smoothed with a moving average of 7 days, for the VOM with predicted (red) and prescribed roots and vegetation cover (black), and fluxtower observations (blue). Results of Schymanski et al. (2015) are shown in green. The daily average quality flags of the fluxtower observations are shown in dashed lines with a value of 100 when a day*

is completely gap-filled and 1 when it is observed.

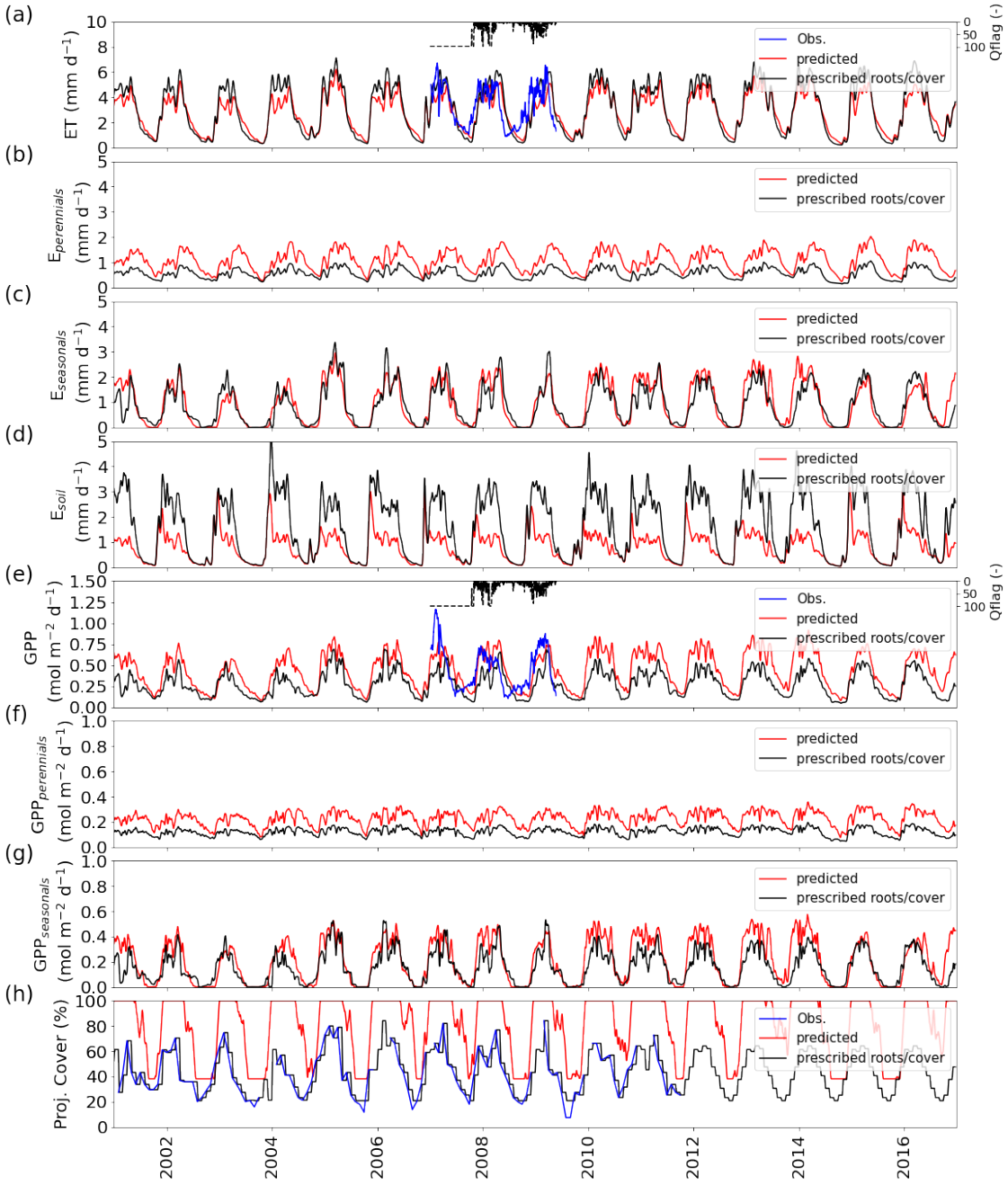

Figure S6.2. *Results for Adelaide River from 2001-2016 (subset from 1980-2016) for a) total ET, b) transpiration perennials (trees), c) transpiration seasonals (grasses), d) soil evaporation, e) total GPP, f) GPP perennials (trees), g) GPP seasonals (grasses), all smoothed with a moving average of 7 days, for the VOM with predicted (red) and prescribed roots and vegetation cover (black), and fluxtower observations (blue). The daily average quality flags of the fluxtower observations are shown in dashed lines with a value of 100 when a day is completely gap-filled and 1 when it is*

observed.

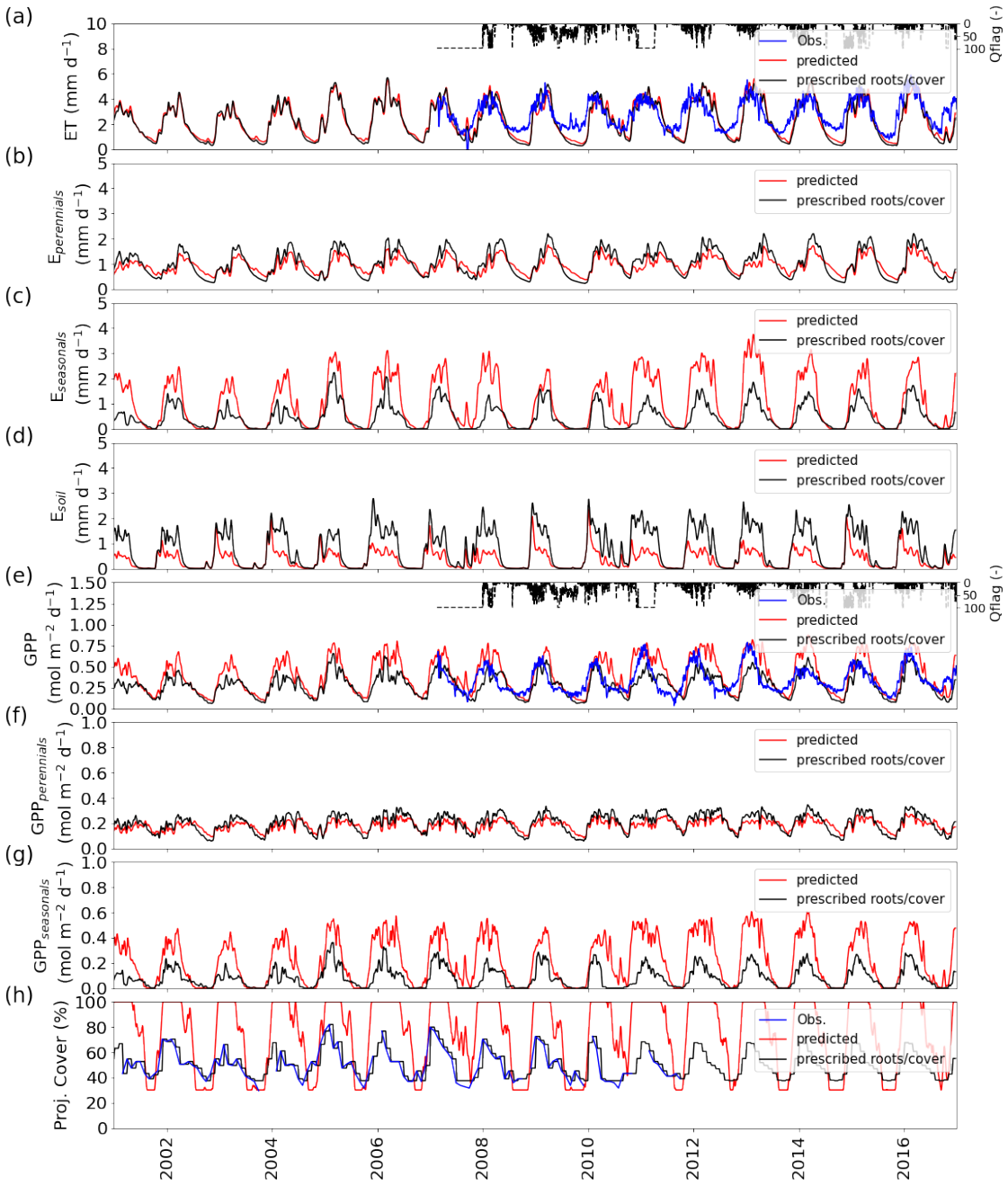

Figure S6.3. *Results for Daly River from 2001-2016 (subset from 1980-2016) for a) total ET, b) transpiration perennials (trees), c) transpiration seasonals (grasses), d) soil evaporation, e) total GPP, f) GPP perennials (trees), g) GPP seasonals (grasses), all smoothed with a moving average of 7 days, for the VOM with predicted (red) and prescribed roots and vegetation cover (black), and fluxtower observations (blue). The daily average quality flags of the fluxtower observations are shown in dashed lines with a value of 100 when a day is completely gap-filled and 1 when it is*

observed.

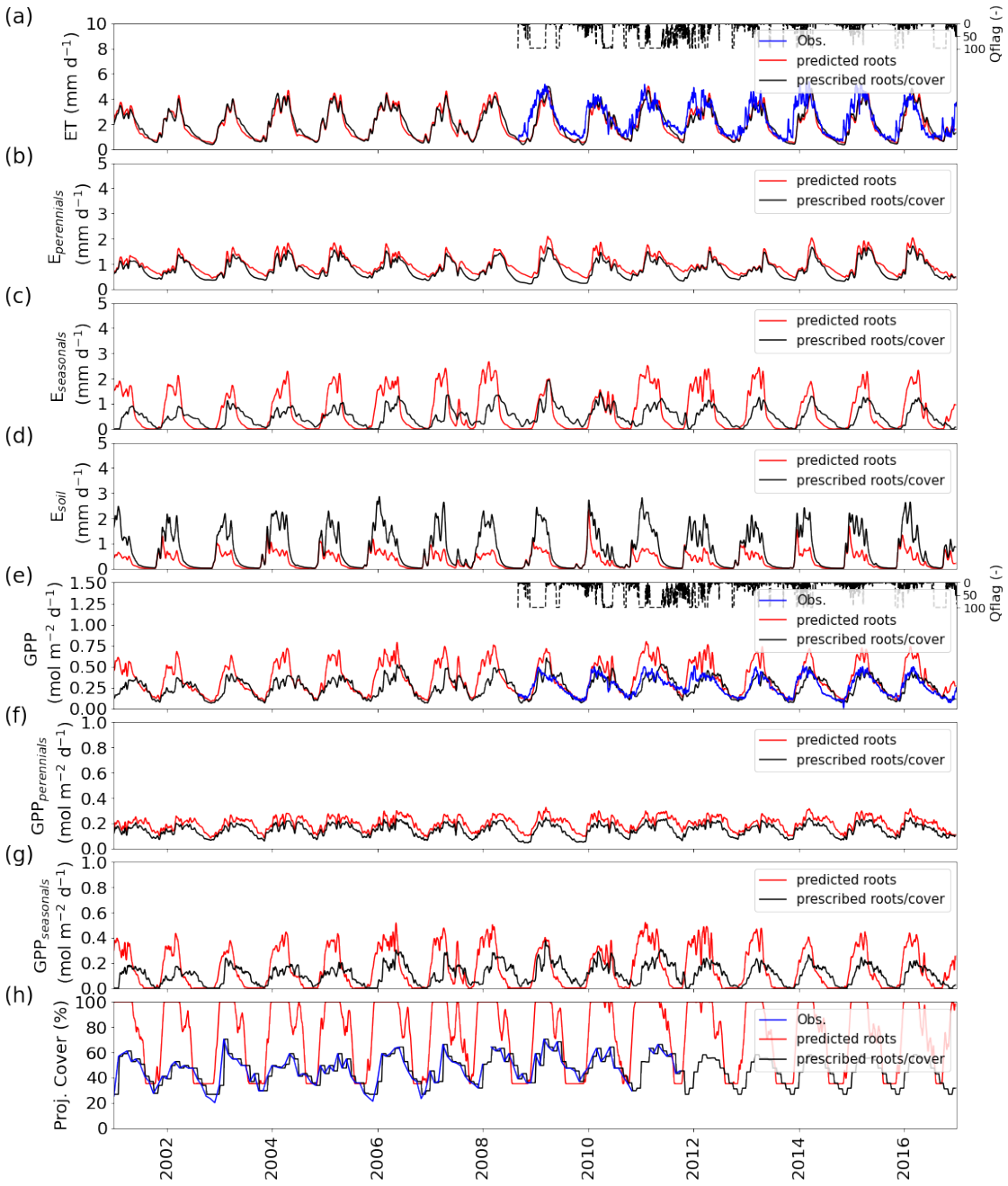

Figure S6.4. *Results for Dry River from 2001-2016 (subset from 1980-2016) for a) total ET, b) transpiration perennials (trees), c) transpiration seasonals (grasses), d) soil evaporation, e) total GPP, f) GPP perennials (trees), g) GPP seasonals (grasses), all smoothed with a moving average of 7 days, for the VOM with predicted (red) and prescribed roots and vegetation cover (black), and fluxtower observations (blue). The daily average quality flags of the fluxtower observations are shown in dashed lines with a value of 100 when a day is completely gap-filled and 1 when it is*

observed.

1.2 Partitioning fluxes

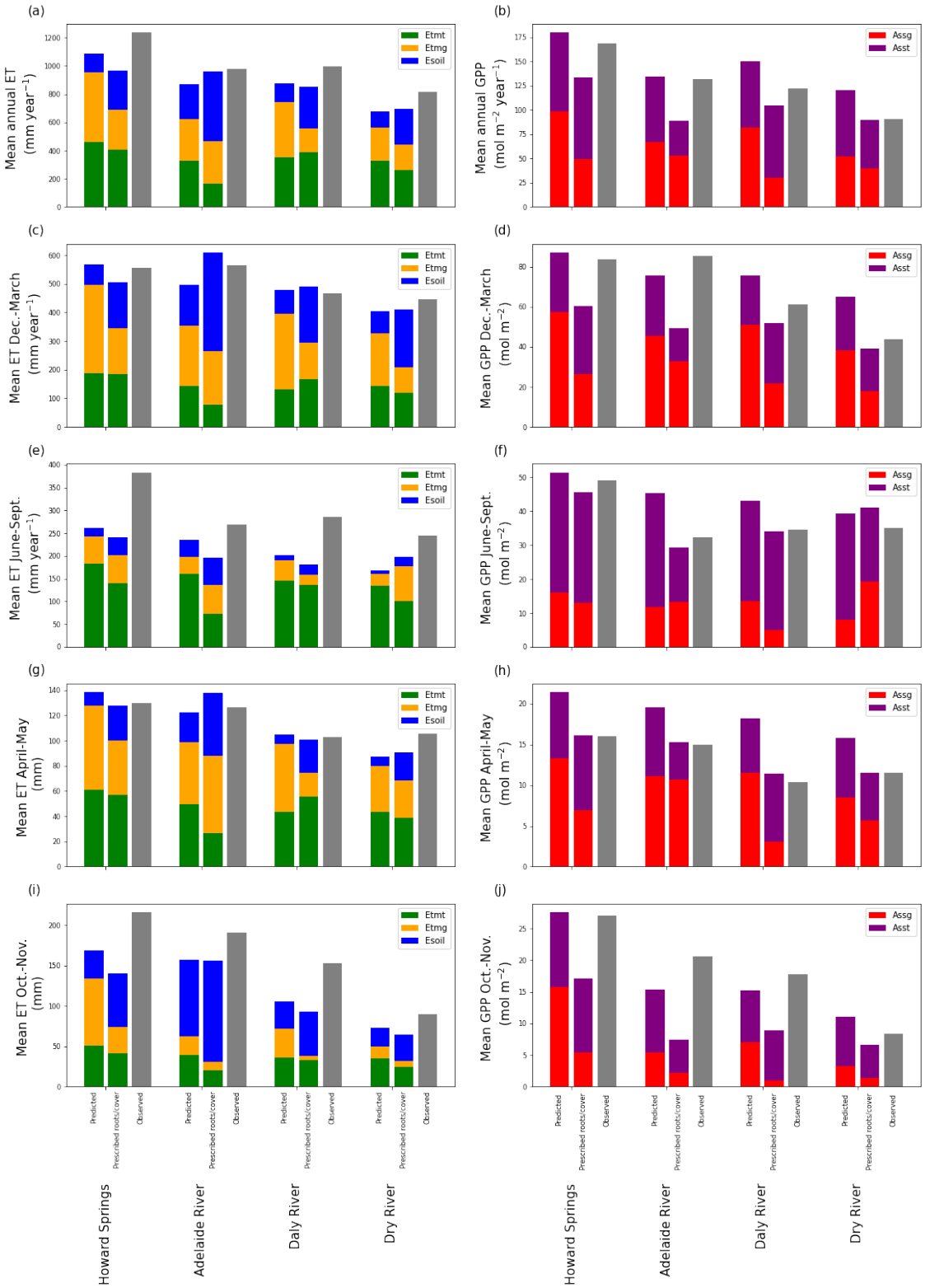

Figure S6.5. *Partitioning of the fluxes for the VOM in fully prognostic mode, and the VOM with prescribed roots and vegetation cover, with a) evapo-transpiration (ET) and b) gross primary productivity (GPP), flux tower observations are shown in gray.*

1.3 Parameters

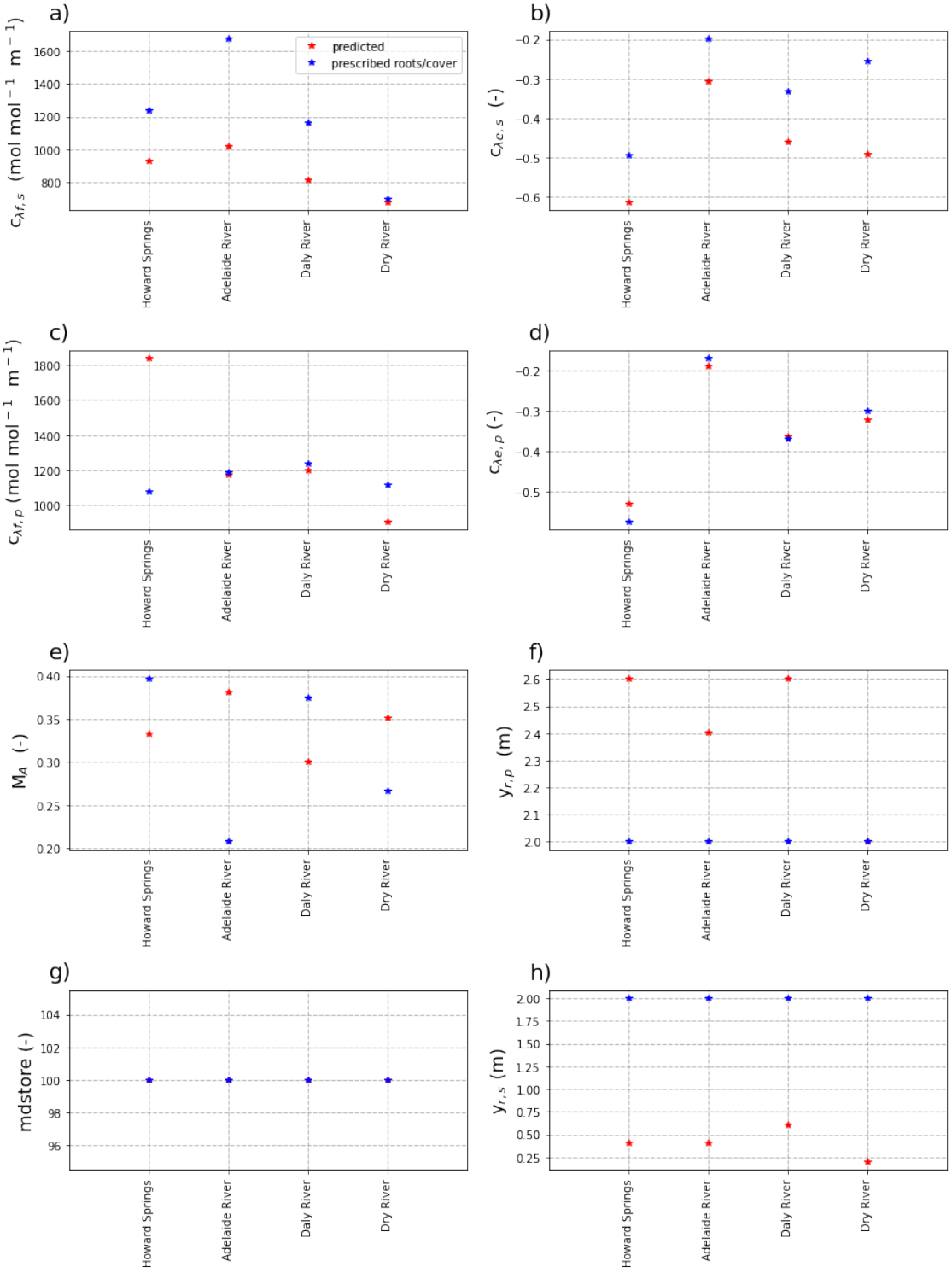

Figure S6.6. *Optimal vegetation parameters for prescribed roots and vegetation cover (blue) and*

the VOM with predicted vegetation parameters (red) , for a) and b) the two parameters $c_{\lambda f,s}$ and $c_{\lambda e,s}$ effecting the water use for perennial vegetation, c) and d) the two parameters $c_{\lambda f,p}$ and $c_{\lambda e,p}$ effecting the water use for seasonal vegetation, e) vegetation cover of the perennial vegetation $M_{A,p}$, f) the rooting depth for the perennial vegetation $y_{r,p}$ and g) the plant water storage (fixed) and h) the rooting depth for the seasonal vegetation $y_{r,s}$.

1.4 Relative errors

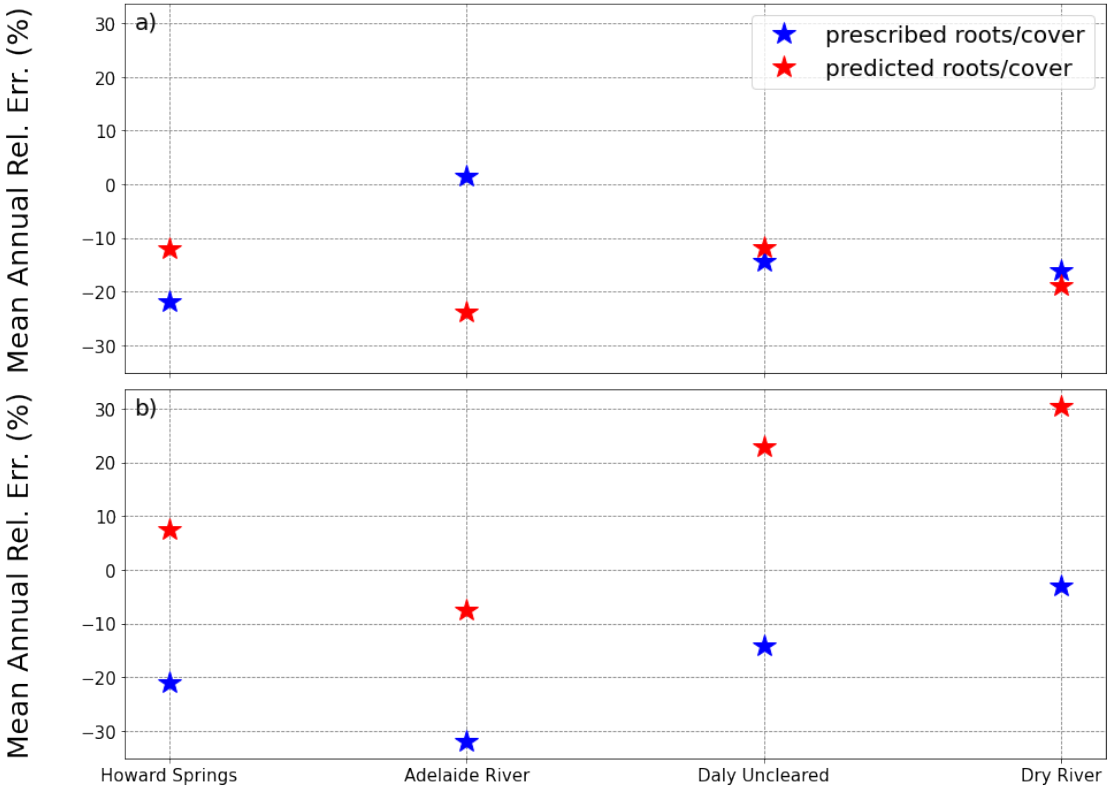

Figure S6.7. *The relative errors between the mean annual fluxes for a) evapo-transpiration (ET) and b) gross primary productivity (GPP), with prescribed roots and vegetation cover in blue and the VOM with predicted roots and vegetation cover in red.*