

Supplement S4

October 25, 2021

1 Prescribed vegetation cover

Preliminary results showed generally an off-set between observed and modelled vegetation cover. Here, vegetation cover derived from remote sensing (Donohue et al. 2008) is used as input for the VOM, and compared to the VOM-results that optimize the vegetation cover. We provide here the full analysis for transparency, in addition to the results presented in the main manuscript.

1.1 Observed and constructed timeseries of vegetation cover

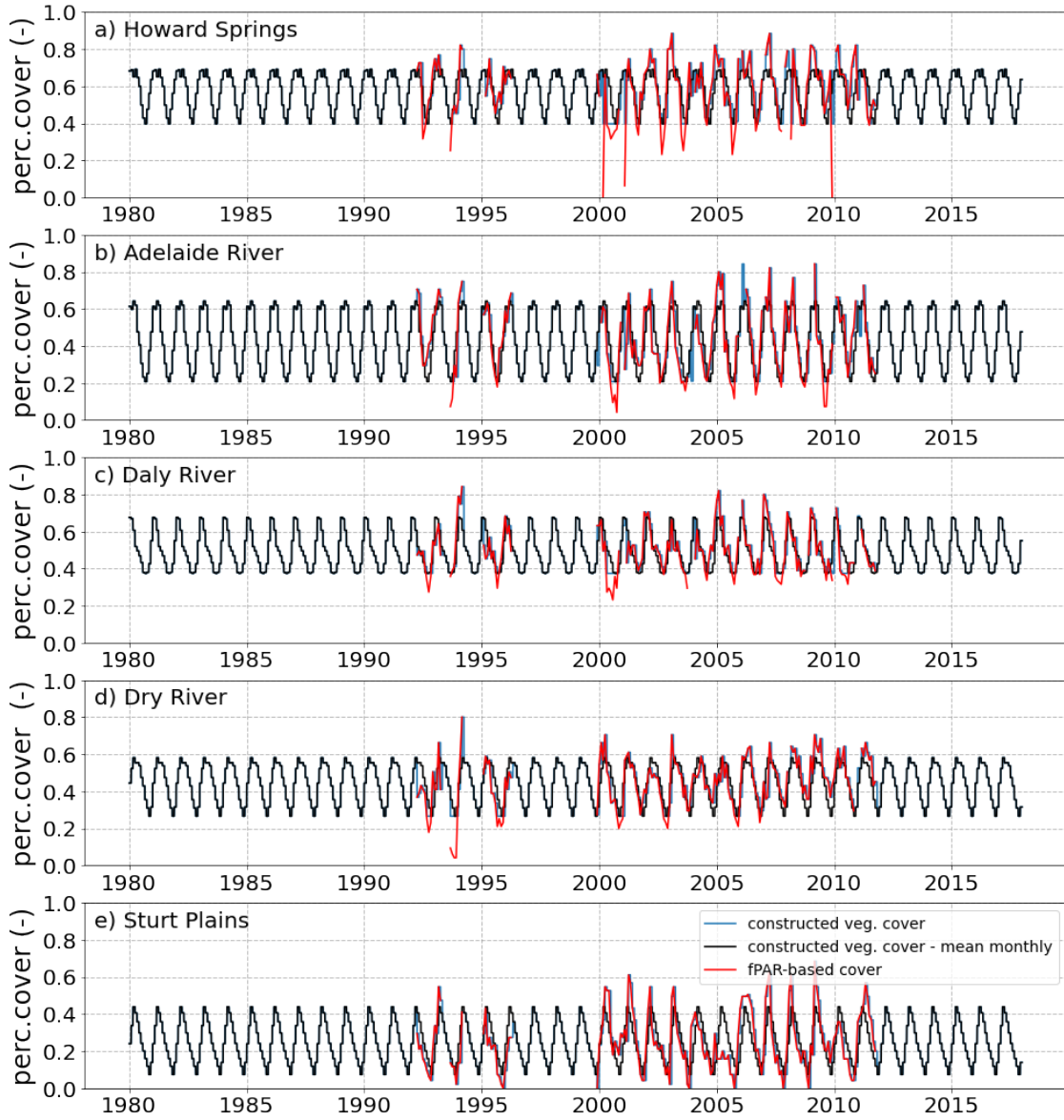


Figure S4.1. *Different abstractions of observation-based vegetation cover with the actual values supplemented by the mean monthly values shown in blue, and just the mean monthly values in black, which are based on the monthly mean values of fPar-based vegetation cover (Donohue et al., 2008) for a) Howard Springs, b) Adelaide River, c) Daly River, d) Dry River and e) Sturt Plains. Observed fPAR-based vegetation cover is shown in red.*

1.2 Timeseries of modelled fluxes

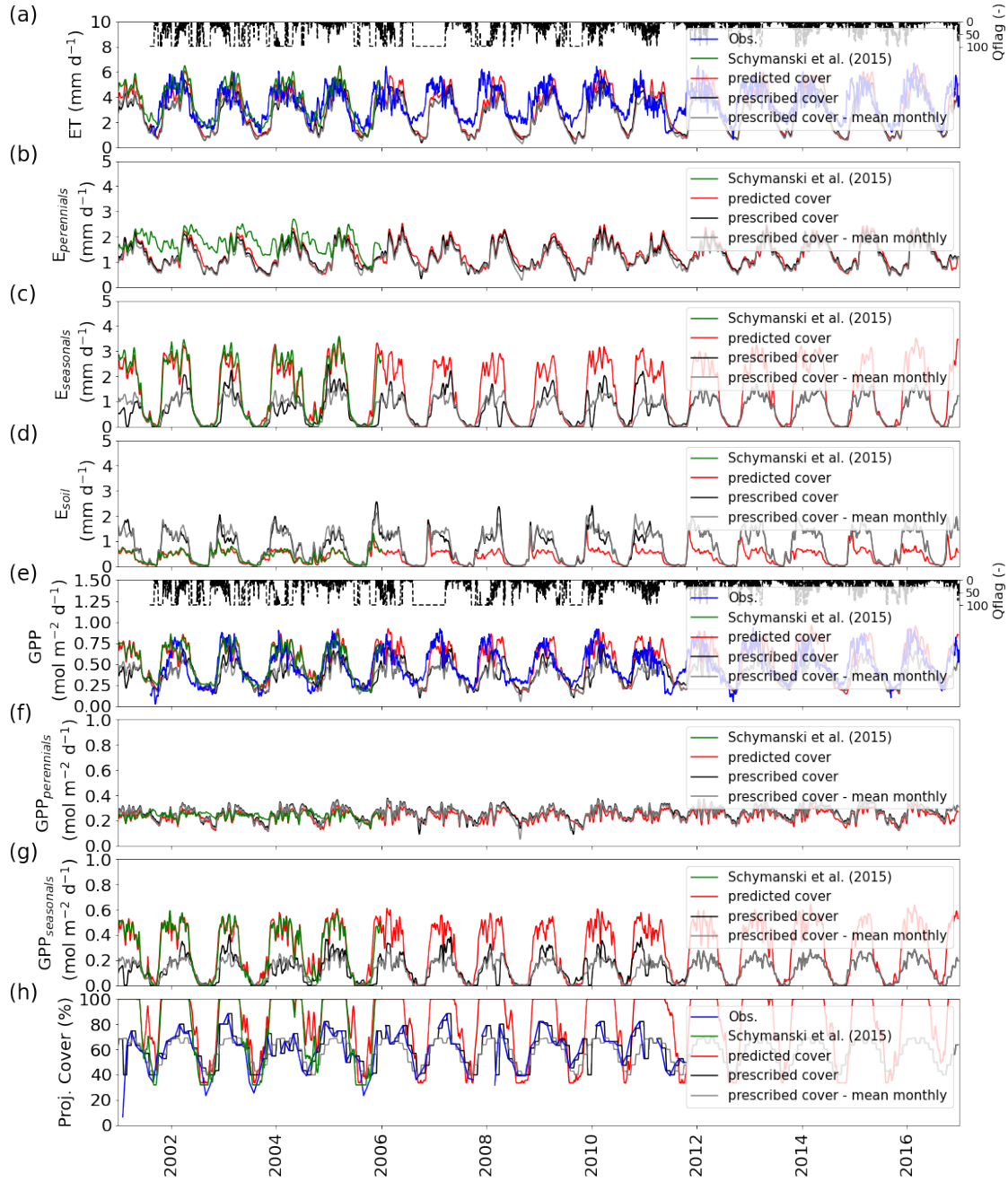


Figure S4.2. Results for Howard Springs from 2001-2016 (subset from 1980-2016) for a) ET, b) transpiration perennials (trees), c) transpiration seasonals (grasses), d) soil evaporation, e) GPP, f) GPP perennials (trees), g) GPP seasonals (grasses), all smoothed with a moving average of 7 days, for the VOM with predicted cover (red), prescribed cover (black), prescribed cover with just mean monthly values (gray) 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.

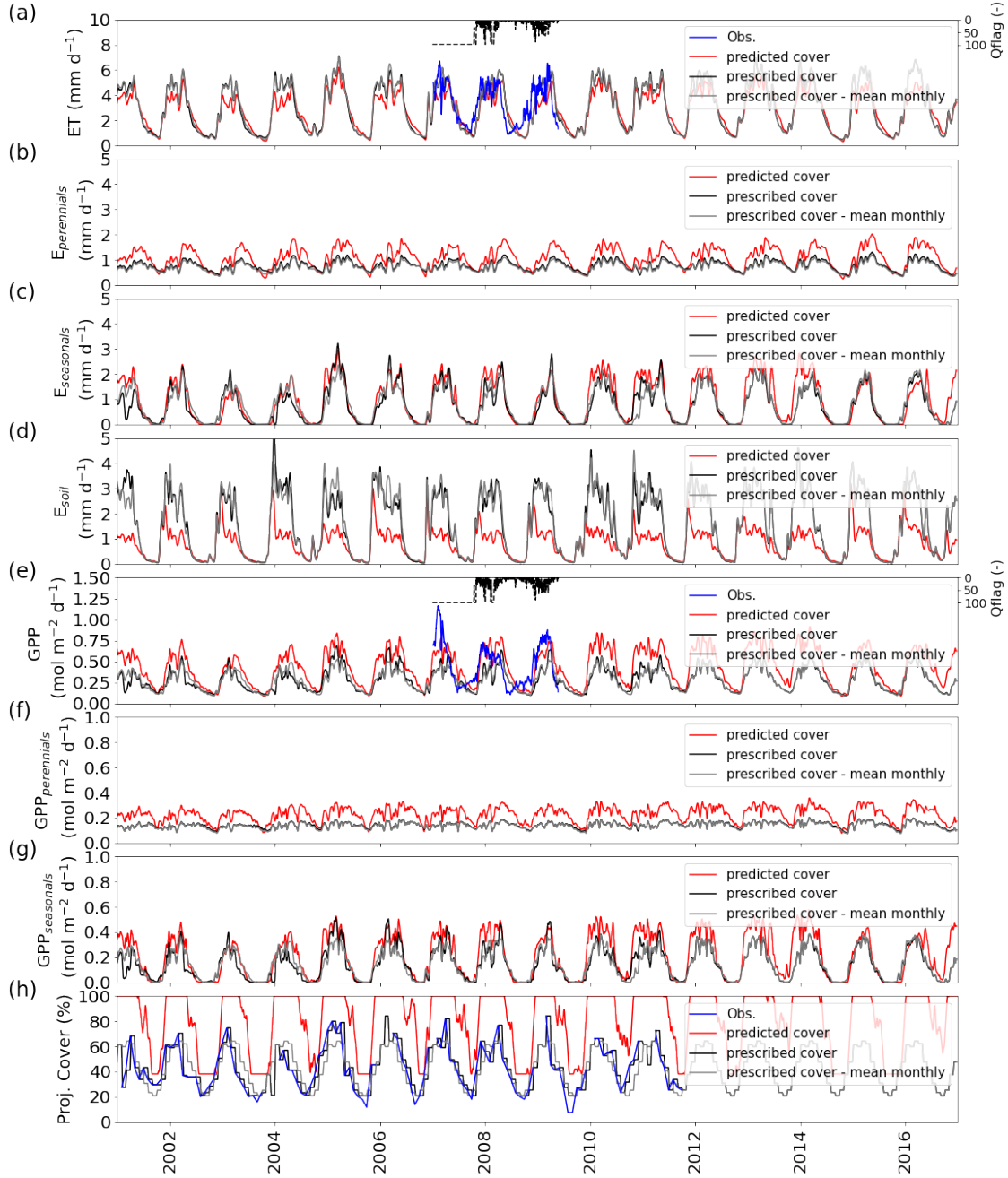


Figure S4.3. Results for Adelaide River from 2001-2016 (subset from 1980-2016) for a) total ET, b) transpiration perennials (trees), c) transpiration seasonals (grasses), d) soil evaporation, e) total GPP, f) GPP perennials (trees), g) GPP seasonals (grasses), all smoothed with a moving average of 7 days, for the VOM with predicted cover (red), prescribed cover (black), prescribed cover with just mean monthly values (gray) 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.

The results with prescribed vegetation cover are rather similar to the results that optimize vegetation cover. Generally, the VOM deviates a bit more from the observations when vegetation is predicted.

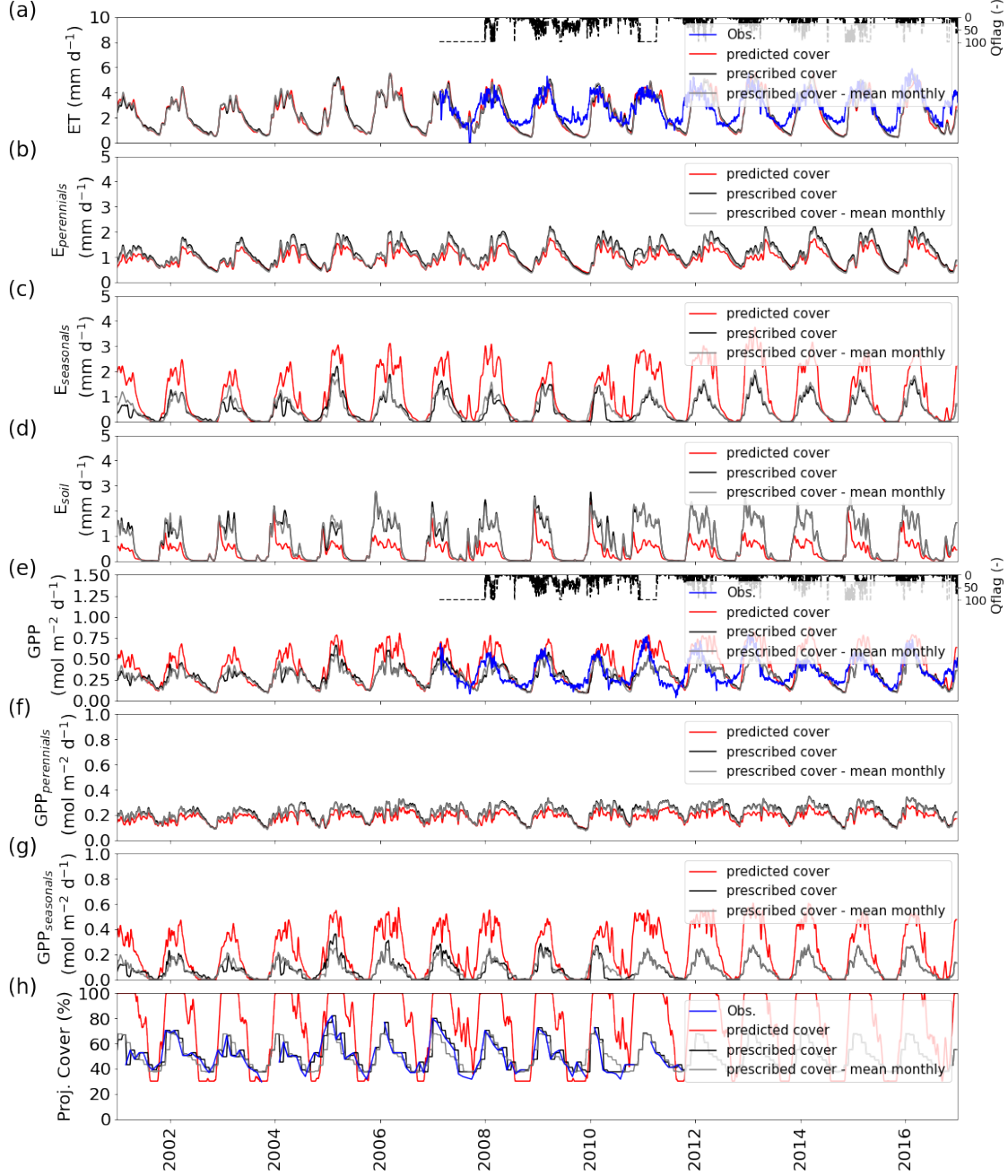


Figure S4.4. Results for Daly River from 2001-2016 (subset from 1980-2016) for a) total ET, b)

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 cover (red), prescribed cover (black), prescribed cover with just mean monthly values (gray) 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.

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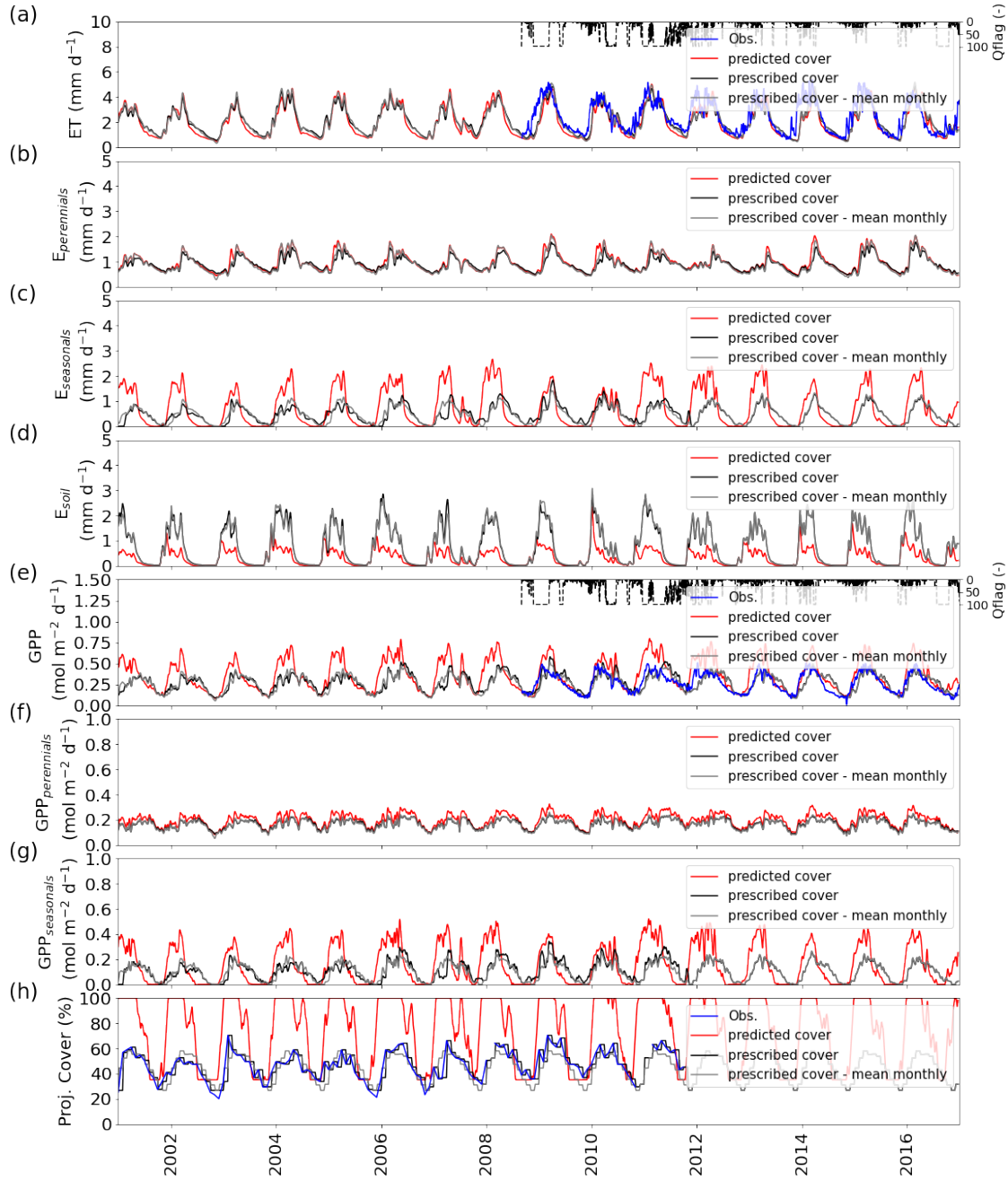


Figure S4.5. Results for Dry River from 2001-2016 (subset from 1980-2016) for a) total ET, b) transpiration perennials (trees), c) transpiration seasonals (grasses), d) soil evaporation, e) total GPP, f) GPP perennials (trees), g) GPP seasonals (grasses), all smoothed with a moving average of 7 days, for the VOM with predicted cover (red), prescribed cover (black), prescribed cover with just mean monthly values (gray) 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.

The results with prescribed vegetation cover are rather similar to the results that optimize vegetation cover. Generally, the VOM deviates a bit more from the observations when vegetation is predicted.

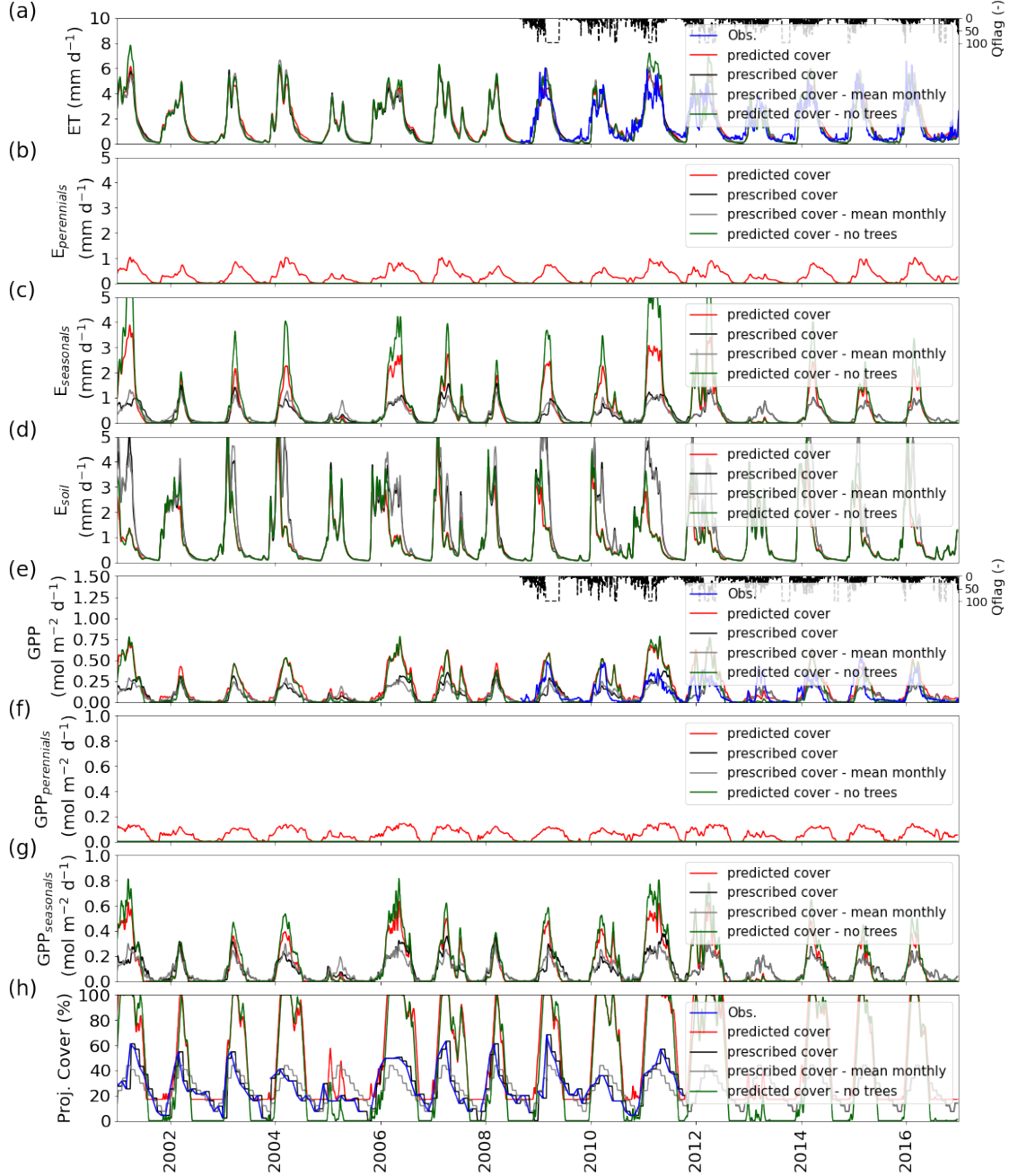


Figure S4.6. Results for Sturt Plains from 2001-2016 (subset from 1980-2016) for a) total ET, b) transpiration perennials (trees), c) transpiration seasonals (grasses), d) soil evaporation, e) total GPP, f) GPP perennials (trees), g) GPP seasonals (grasses), all smoothed with a moving average

of 7 days, for the VOM with predicted cover (red), prescribed cover (black), prescribed cover with just mean monthly values (gray), fluxtower observations (blue) and predicted cover without perennial trees (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.

The results with prescribed vegetation cover are rather similar to the results that optimize vegetation cover. Generally, the VOM deviates a bit more from the observations when vegetation is predicted.

1.3 Partitioning of fluxes

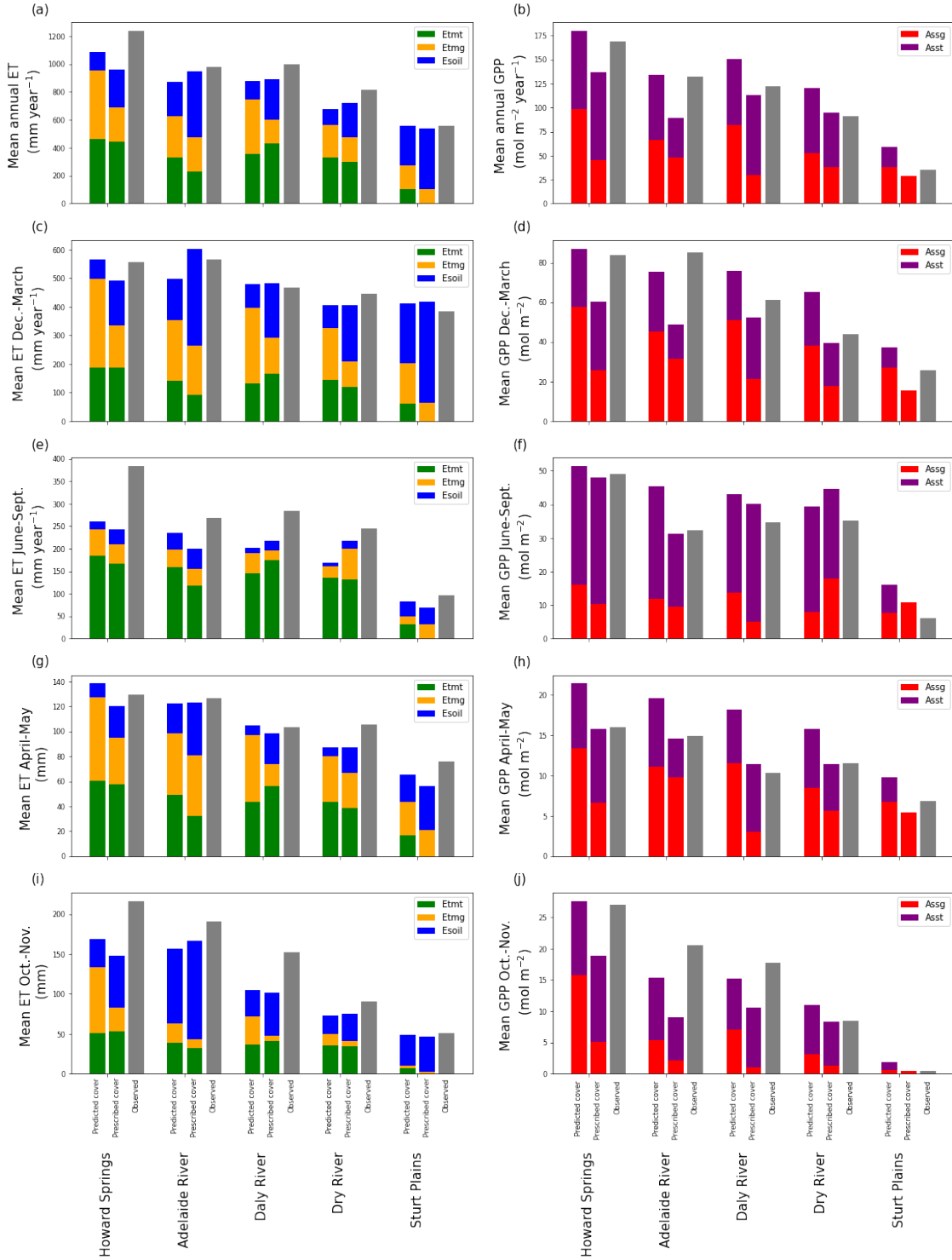


Figure S4.7. Partitioning of the fluxes for a) evapo-transpiration (ET) and b) gross primary productivity (GPP), flux tower observations are shown in gray. The prescribed cover always gives

lower values of grass assimilation grass transpiration for all sites.

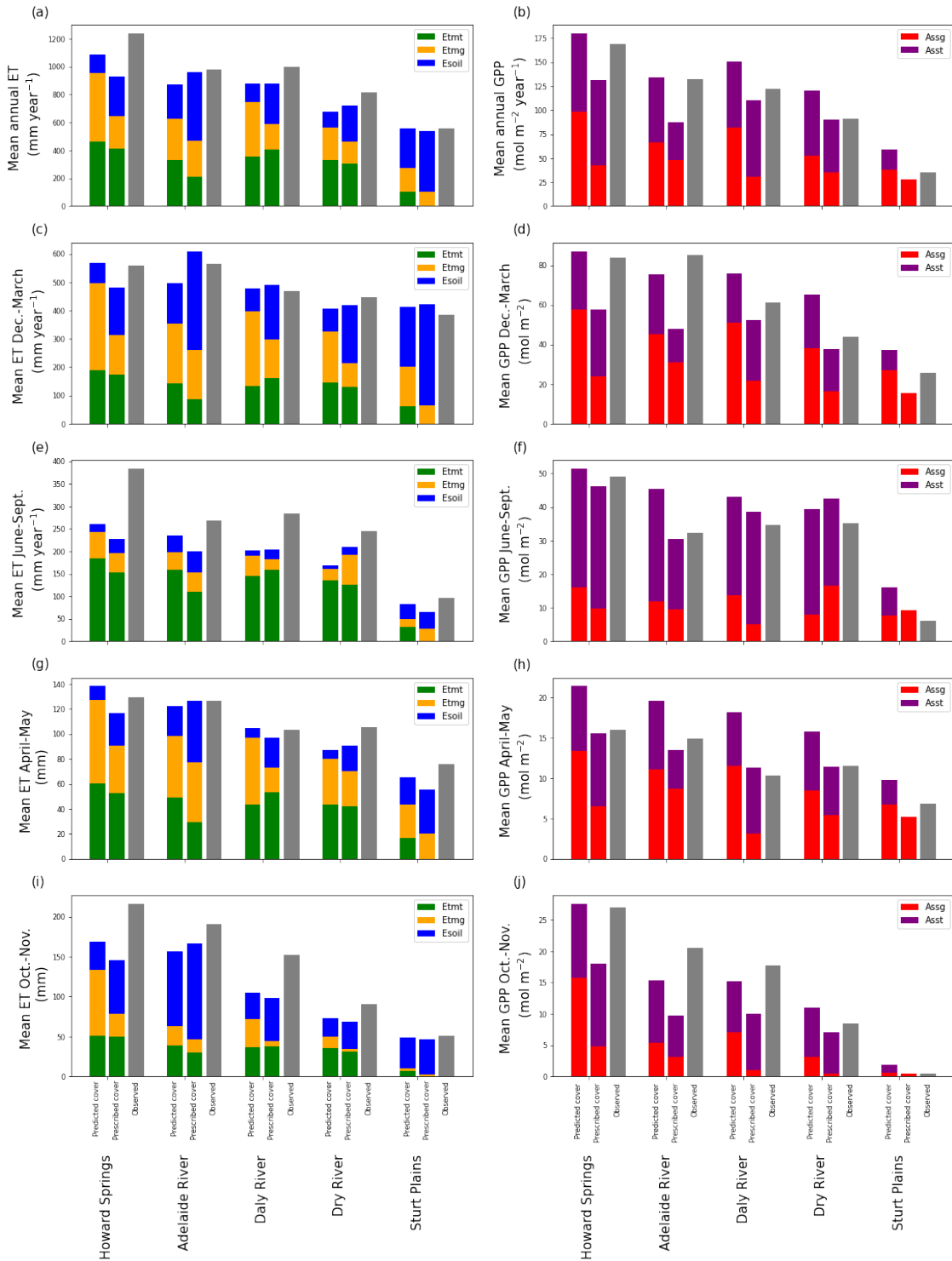


Figure S4.8. Partitioning of the fluxes for a) evaporation and b) assimilation, flux tower observations are shown in gray. The prescribed cover is here based solely on mean monthly values.

1.4 Parameters

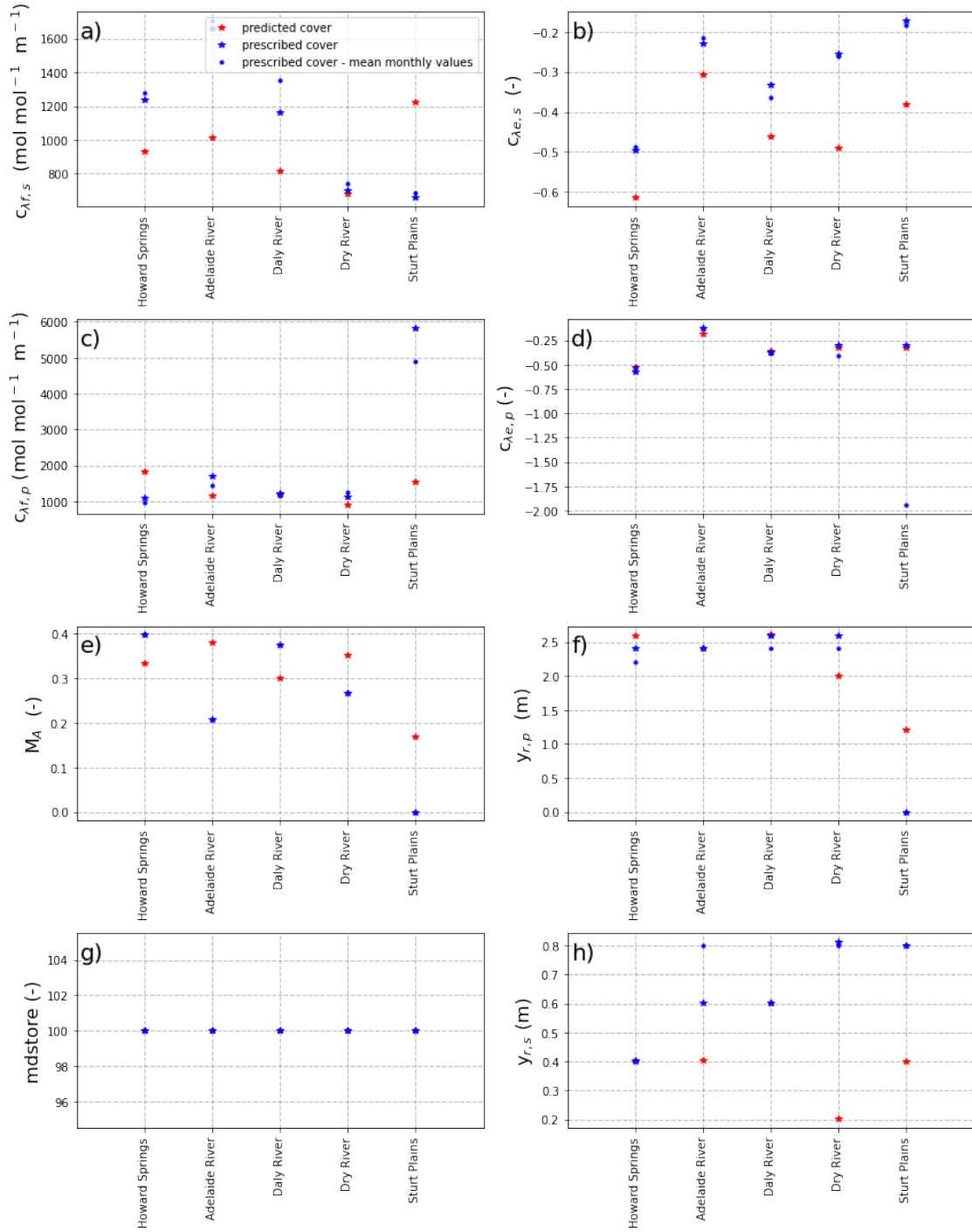


Figure S4.9. Optimal vegetation parameters for prescribed cover (blue) and predicted cover (red), for a) and b) the two parameters $c_{\lambda f, s}$ and $c_{\lambda e, s}$ effecting the water use for perennial vegetation, c) and d) the two parameters $c_{\lambda f, p}$ and $c_{\lambda e, p}$ effecting 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 $y_{r,s}$. A clear pattern seems absent, except for grass rooting depths that seem to increase for the prescribed cover at drier sites.

1.5 Relative errors

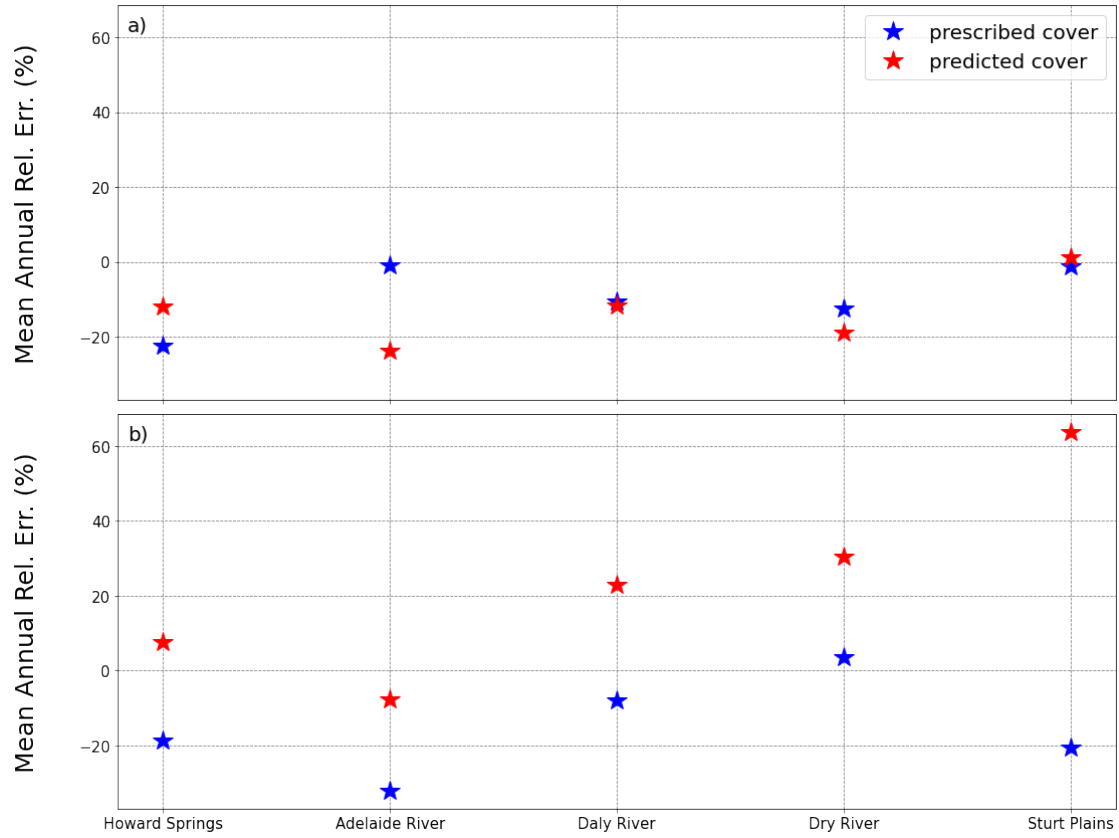


Figure S4.10. The relative errors between the mean annual fluxes for a) ET and b) GPP, with prescribed cover in blue and predicted cover in red. Similar results as the timeseries in Figures S4.2 - S4.6, it can be noted that there are hardly any difference for evapo-transpiration, but for GPP the relative error moves towards more negative values (i.e. GPP is always lower).

1.6 NCP-values

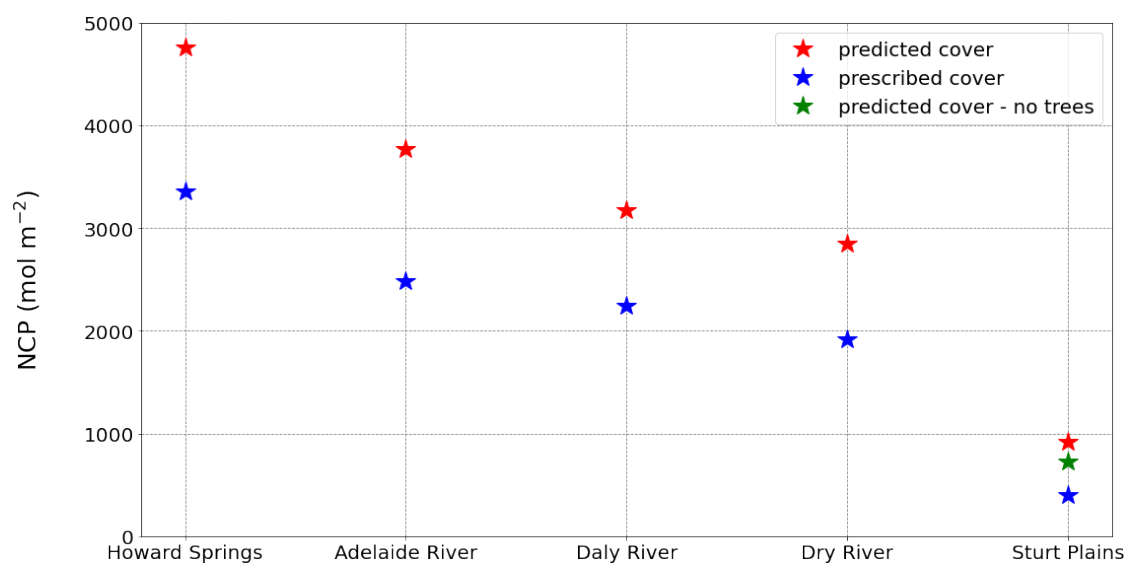


Figure S4.11. *The total NCP for the VOM with predicted cover (red), prescribed cover (blue), and predicted cover without trees (only for Sturt Plains) in green.*