

Figure 1: Relationship of weekly-averaged ecosystem fluxes and stomatal conductance with decreasing soil water content during June–September 2010 for the study site. Published in Ruehr et al. (2012).

| Treatment                | Water | E    | T<br>(mm) | W <sub>store</sub> | Drain | SWC <sub>0-40</sub><br>(m <sup>3</sup> m <sup>-3</sup> ) | GPP       | Rh<br>(%) | NEE       |
|--------------------------|-------|------|-----------|--------------------|-------|--|-----------|-----------|-----------|
| 2010                     |       |      |           |                    |       |  |           |           |           |
| w30 <sub>sim</sub>       | +131  | +121 | +3        | +6                 | 0     | 0.13   | +1 (+1)   | +11 (+5)  | -9 (-4)   |
| w40 <sub>sim</sub>       | +175  | +137 | +15       | +20                | 0     | 0.15   | +7 (+5)   | +20 (+9)  | -1 (-1)   |
| w50 <sub>sim</sub>       | +218  | +149 | +25       | +42                | 0     | 0.18   | +11 (+7)  | +22 (+10) | +6 (+3)   |
| w100 <sub>sim</sub>      | +436  | +162 | +39       | +87                | +145  | 0.21   | +16 (+9)  | +23 (+10) | +18 (+10) |
| w100_vpd1 <sub>sim</sub> | +436  | +153 | +45       | +85                | +151  | 0.21   | +32 (+18) | +23 (+11) | +57 (+32) |
| ctrl_vpd1 <sub>sim</sub> | +0    | +0   | +4        | -3                 | +0    | 0.21   | +15 (+8)  | -1 (+0)   | +36 (+21) |
| 2011                     |       |      |           |                    |       |  |           |           |           |
| w30 <sub>sim</sub>       | +174  | +134 | +26       | +31                | 0     | 0.16   | +12 (+7)  | +32 (+17) | +3 (-3)   |
| w40 <sub>sim</sub>       | +233  | +139 | +42       | +49                | 0     | 0.20   | +17 (+11) | +33 (+19) | +15 (+2)  |
| w50 <sub>sim</sub>       | +291  | +145 | +48       | +81                | +14   | 0.20   | +19 (+12) | +34 (+19) | +20 (+4)  |
| w100 <sub>sim</sub>      | +582  | +152 | +51       | +80                | +294  | 0.21   | +20 (+13) | +34 (+20) | +24 (+7)  |
| w100_vpd1 <sub>sim</sub> | +582  | +148 | +66       | +78                | +284  | 0.21   | +40 (+26) | +36 (+22) | +65 (+32) |
| ctrl_vpd1 <sub>sim</sub> | +0    | +0   | +3        | -5                 | +0    | 0.21   | +12 (+8)  | -2 (+0)   | +28 (+18) |

The annual treatment effect is given in brackets.

Figure 2: (Table 4 in the revised manuscript). Effects of decreased drought compared to “normal” summer conditions derived from simulations with the SPA model. Shown are seasonal changes (June–Sep) in soil evaporation (E), transpiration (T), soil water storage (2 m soil depth) and drainage, as well as mean soil water content (0–40 cm soil depth). Seasonal treatment effects for gross primary productivity (–GPP), net ecosystem exchange (–NEE) and heterotrophic respiration (Rh) are given. The annual treatment effects are given in brackets. The water addition treatments are in percent of water supplied to the irrigation experiment (w100<sub>obs</sub>). The effects of reduced VPD are given for non-drought (w100\_vpd1<sub>sim</sub>) and normal summer drought conditions (ctrl\_vpd1<sub>sim</sub>).

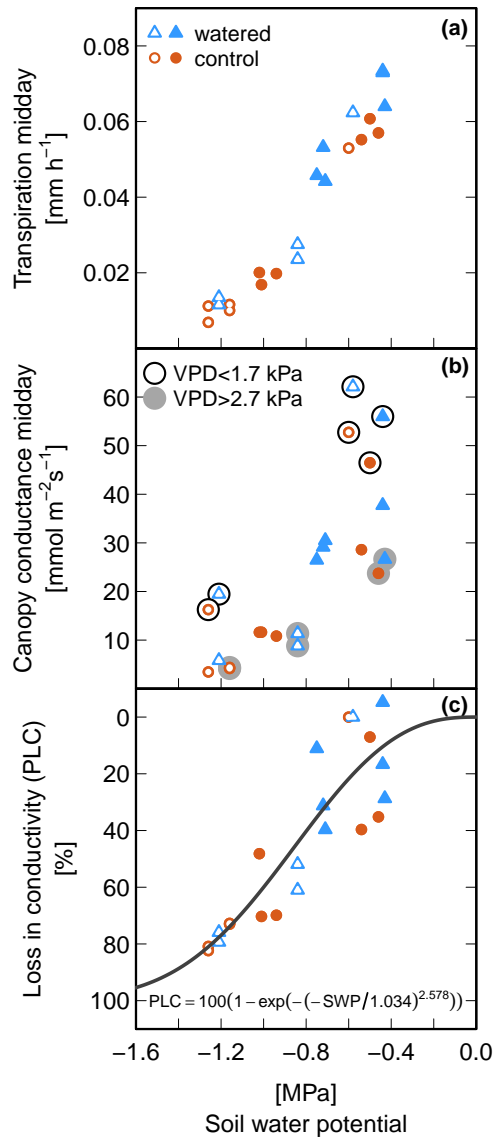


Figure 3: (replaces “old” Figure 3 that was moved to the Supplementary) Changes in tree water relations with declining soil water potential (SWP) for control and watered trees during summer 2011. Shown are changes in (a) midday tree transpiration, (b) midday stomatal conductance ( $G_s$ ) affected by changes in VPD and (c) percent loss in tree conductivity (PLC). Open symbols indicate measurements taken outside the irrigation period in June and September. The relationship of PLC with SWP is represented by a Weibull function that has been integrated in the modified SPA model.

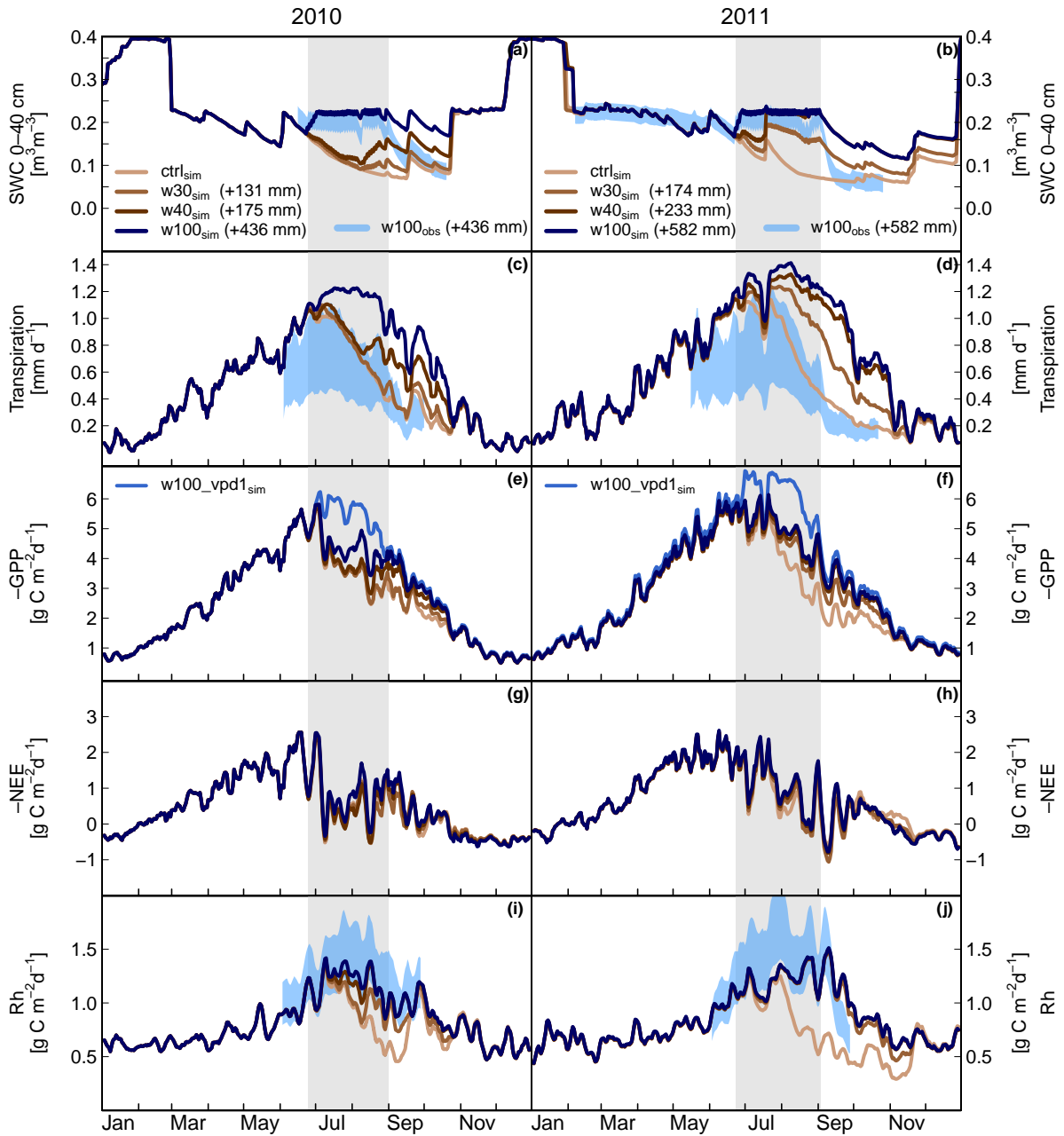


Figure 4: (Figure 4 of the revised manuscript) Effects of experimentally decreased summer drought on soil water content (SWC; **a–b**), transpiration ( $T$ ; **c–d**) and carbon fluxes (**f–j**). The model simulation  $w100_{sim}$  mimicked the field watering treatment (+436 mm in 2010 and +582 mm in 2011) and  $w30_{sim}$  and  $w40_{sim}$  are 30 and 40% of irrigation water added, the  $ctrl_{sim}$  is the “normal” summer drought. The limiting effect of VPD on GPP is indicated by running the  $w100_{sim}$  scenario at low VPD conditions of 1 kPa (**e–f**). Note that simulated winter-time SWC above field capacity ( $> 0.23 \text{ m}^3 \text{ m}^{-3}$ ) results from surface layer freezing. Observations of SWC,  $T$  and heterotrophic respiration (Rh) in the watered treatment ( $w100_{obs}$ ) are depicted by the light colored area (mean  $\pm$  error estimate). The duration of the water additions is highlighted in gray.

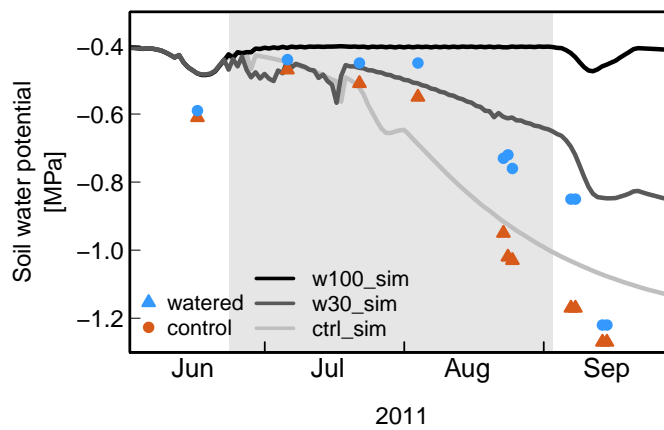


Figure 5: (Fig S4 in the revised supplementary of the manuscript). The dynamics of observed and simulated soil water potential (SWP) for control and watered treatment during the summer 2011. The simulation run w100<sub>sim</sub> equals the irrigation treatment and the w30<sub>sim</sub> simulates 30% of the water added. The duration of the watering treatment is highlighted by the gray area. Note the relative good accordance of the field watered treatment with the w30<sub>sim</sub> during the irrigation period, and fast declines of observed SWP thereafter. Observed SWP for the control matched the simulation (ctrl<sub>sim</sub>) relatively well, but were overestimated by the model in September.