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# Modelling evapotranspiration during precipitation deficits: identifying critical processes in a land surface model

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**Table S1.** Study flux tower sites. PFT stands for plant functional type.

| Site name | Country | Lat. | Long. | CABLE PFT | Record length |
|---|---|---|---|---|---|
| Amplero* | Italy | 41.90 | 13.61 | $C_3$ grass | 2003-2006 |
| Blodgett* | USA | 38.90 | -120.63 | Evergreen needleleaf | 2000-2006 |
| Bugac | Hungary | 46.69 | 19.60 | $C_3$ grass | 2002-2006 |
| El Saler | Spain | 39.35 | -0.32 | Evergreen needleleaf | 2003-2005 |
| El Saler 2 | Spain | 39.28 | -0.32 | $C_3$ crop | 2005-2006 |
| Espirra | Portugal | 38.64 | -8.60 | Evergreen broadleaf | 2001-2006 |
| Fort Peck | USA | 48.31 | -105.10 | $C_3$ grass | 2000-2006 |
| Harvard | USA | 42.54 | -72.17 | Deciduous broadleaf | 1994-2001 |
| Hesse | France | 48.67 | 7.06 | Deciduous broadleaf | 1999-2006 |
| Howard Springs* | Australia | -12.49 | 131.15 | $C_4$ grass | 2002-2005 |
| Howland main | USA | 45.20 | -68.74 | Evergreen needleleaf | 1996-2004 |
| Hyytiälä | Finland | 61.85 | 24.29 | Evergreen needleleaf | 2001-2004 |
| Kruger | South Africa | -25.02 | 31.50 | $C_4$ grass | 2002-2003 |
| Loobos | Netherlands | 52.17 | 5.74 | Evergreen needleleaf | 1997-2006 |
| Merbleue | Canada | 45.41 | -75.52 | Wetland | 1999-2005 |
| Mopane | Botswana | -19.92 | 23.56 | $C_4$ grass | 1999-2001 |
| Palang* | Indonesia | 2.35 | 111.04 | Evergreen broadleaf | 2002-2003 |
| Sylvania | USA | 46.24 | -89.35 | Deciduous broadleaf | 2002-2005 |
| Tumbarumba* | Australia | -35.66 | 148.15 | Evergreen broadleaf | 2002-2005 |
| University of Michigan* | USA | 45.56 | -84.71 | Deciduous broadleaf | 1999-2003 |

* Selected site

**Table S2.** Parameter values for the three soil classes used to run CABLE. “Default” and “new” refer to the two hydrological schemes employed in the study. Where only one value is given, both schemes use an identical value for the parameter.

| **Parameter** | **Sand** | | **Medium** | | **Clay** | |
|---|---|---|---|---|---|---|
| Silt content (fraction) | 0.08 | | 0.34 | | 0.17 | |
| Clay content (fraction) | 0.09 | | 0.33 | | 0.67 | |
| Sand content (fraction) | 0.83 | | 0.33 | | 0.16 | |
| Soil dry bulk density ($kg/m^3$) | 1600 | | 1490 | | 1381 | |
| Dry soil heat capacity (J/kg/C) | 850 | | 850 | | 850 | |
| | *Default* | *New* | *Default* | *New* | *Default* | *New* |
| Volumetric water content at wilting ($m^3/m^3$) | 0.072 | 0.034 | 0.179 | 0.149 | 0.286 | 0.251 |
| Volumetric water content at field capacity ($m^3/m^3$) | 0.142 | 0.168 | 0.255 | 0.298 | 0.367 | 0.369 |
| Volumetric water content at saturation ($m^3/m^3$) | 0.398 | 0.384 | 0.440 | 0.447 | 0.482 | 0.469 |
| Parameter *B* (Clapp and Hornberger, 1978) | 4.20 | 4.34 | 7.80 | 8.12 | 11.4 | 13.6 |
| Hydraulic conductivity at saturation (m/s) | $166 \times 10^{-6}$ | $17 \times 10^{-6}$ | $83 \times 10^{-6}$ | $2.9 \times 10^{-6}$ | $1 \times 10^{-6}$ | $2 \times 10^{-6}$ |
| Matric potential at saturation (m) | 0.106 | 0.062 | 0.255 | 0.280 | 0.405 | 0.468 |

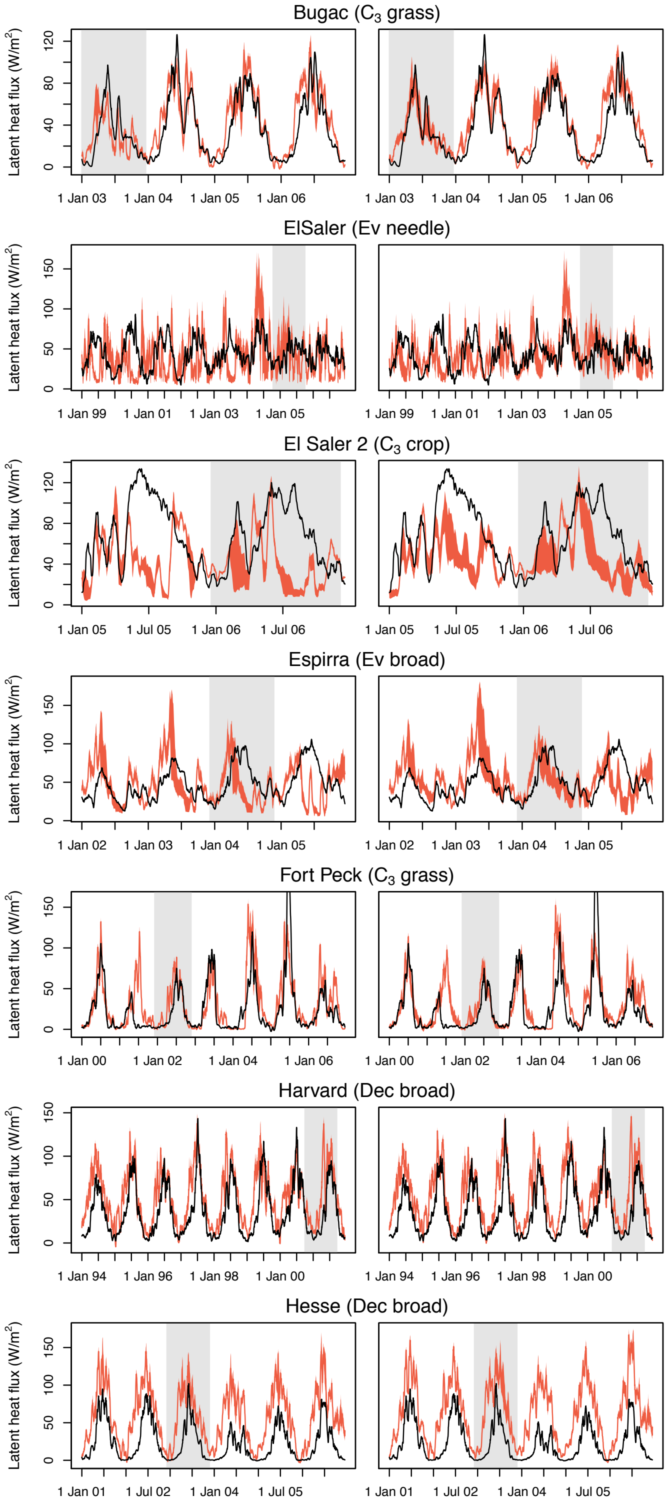


**Fig. S1.** The range in simulated latent heat (red) during the whole observational data period using the default (left panel) and new (right panel) hydrological schemes with alternative LAI, $g_s$ and soil parameterisations. Observed latent heat is shown in black. The grey shading denotes the year of lowest precipitation.

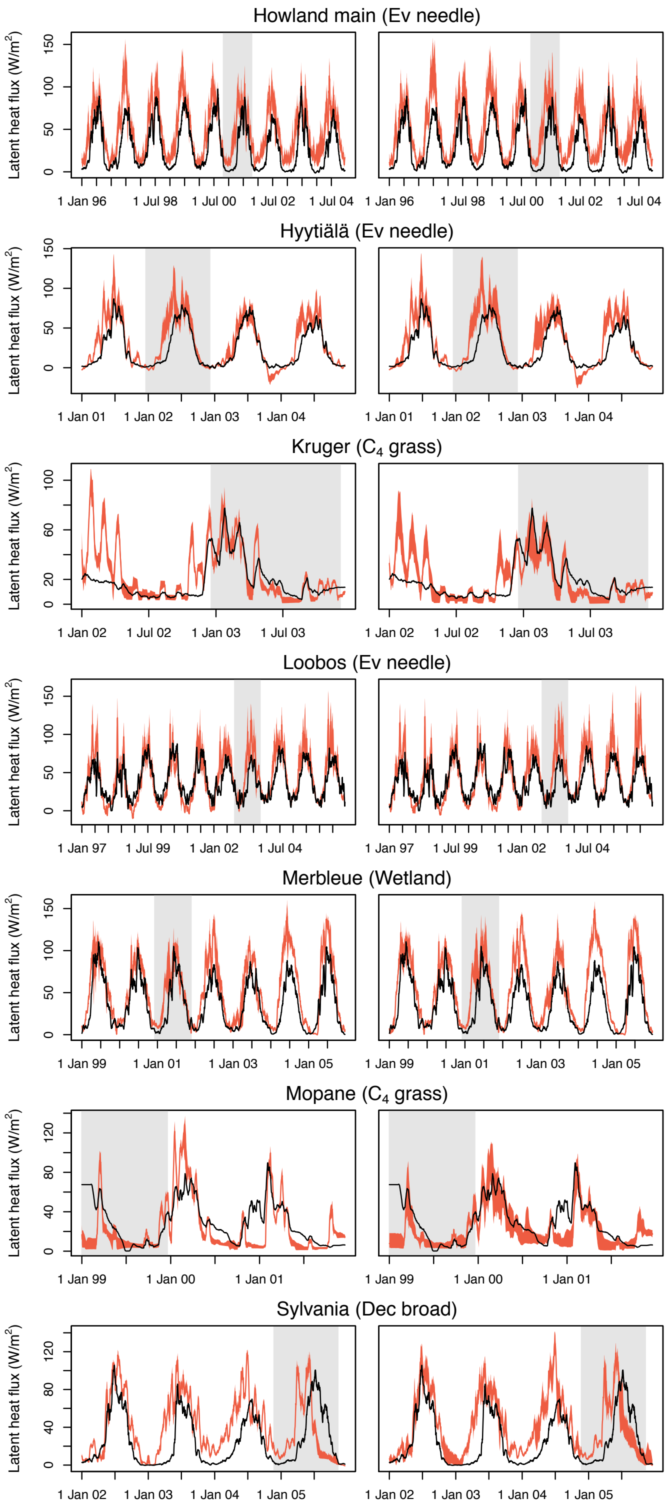


**Fig. S1 continued.**

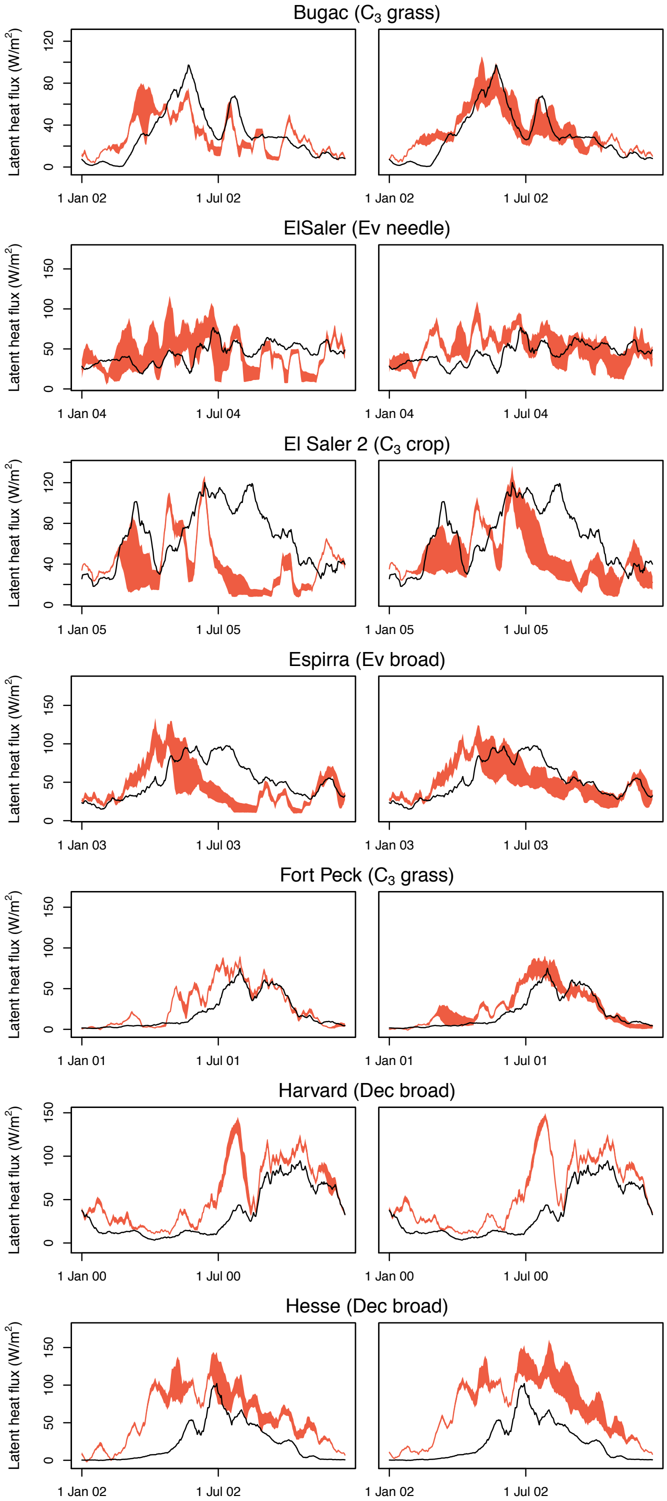


**Fig. S2.** The range in simulated latent heat (red) during the year of lowest precipitation using the default (left panel) and new (right panel) hydrological schemes with alternative LAI, $g_s$ and soil parameterisations. Observed latent heat is shown in black.

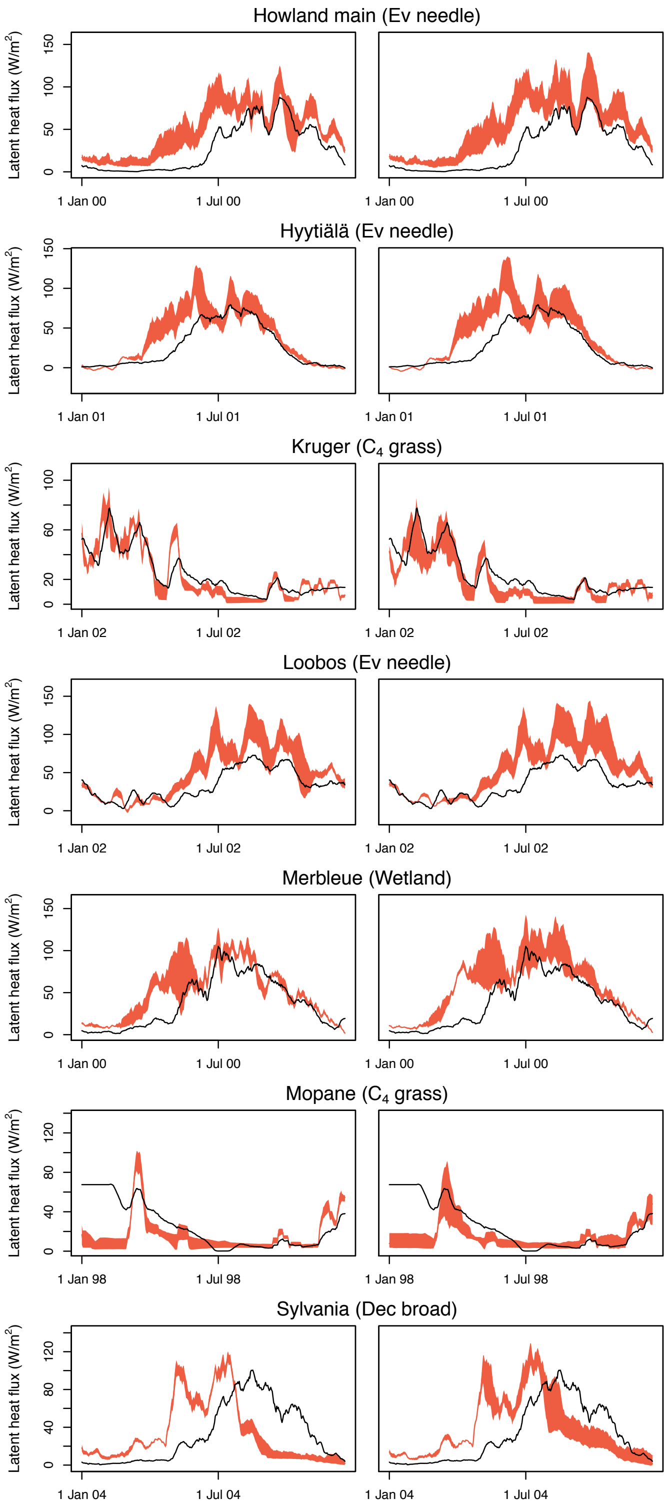


**Fig. S2 continued.**

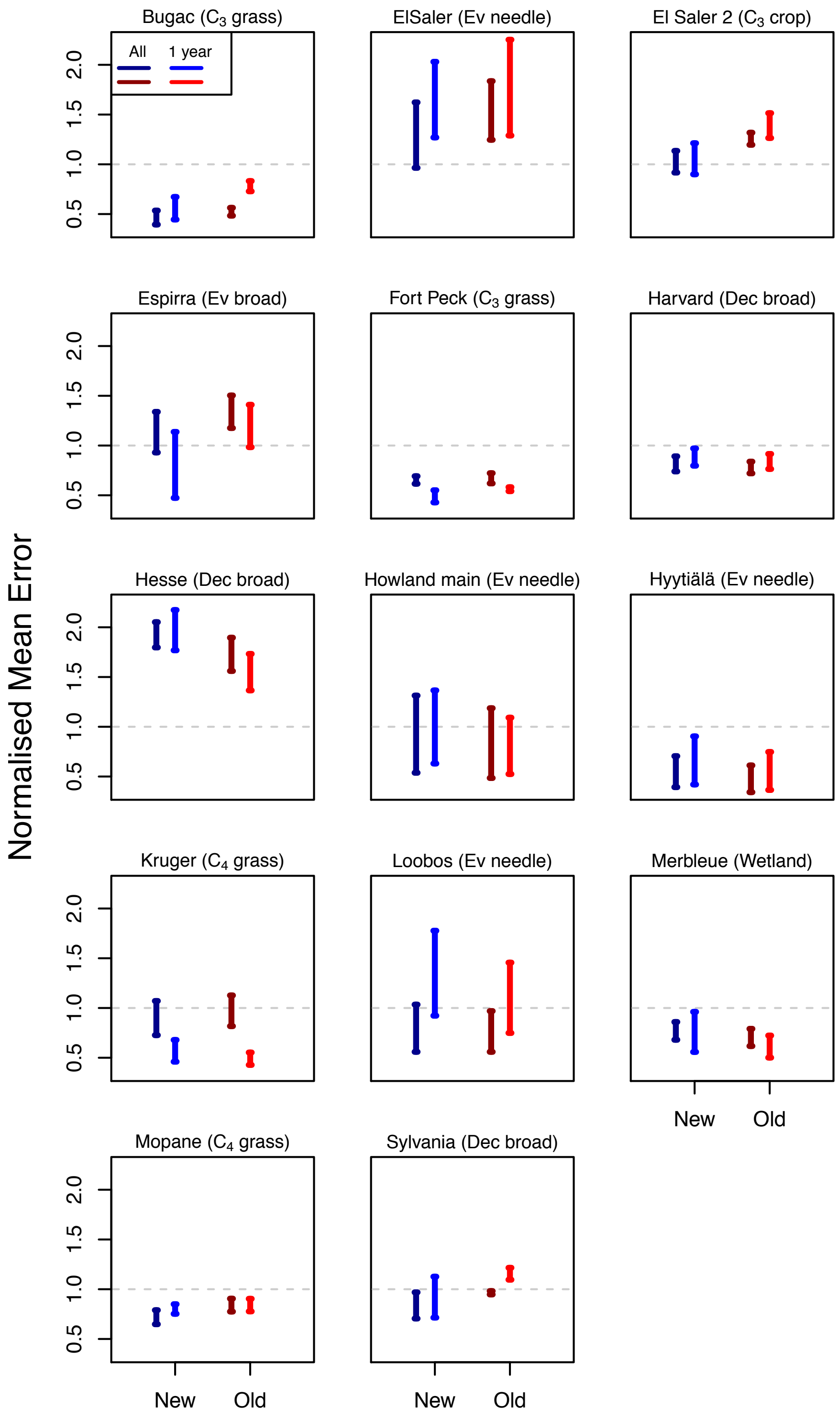


**Fig. S3.** The range in normalised mean error metrics of latent heat simulations using the default (red) and new (blue) hydrological schemes with alternative LAI, $g_s$ and soil parameterisations during the whole data period and the year of lowest precipitation. The new scheme was run with 0° slope.

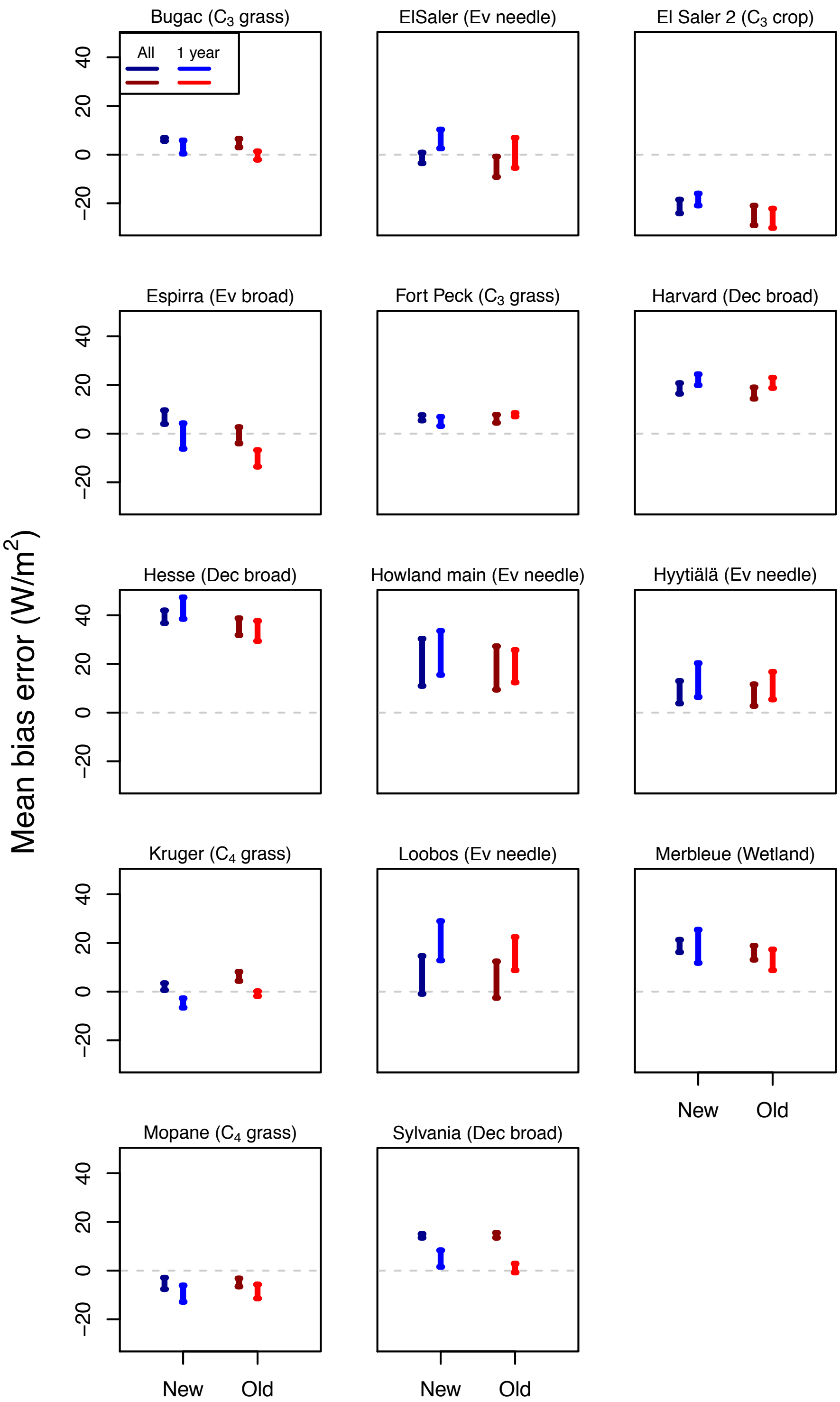


**Fig. S4.** The range in mean bias error metrics of latent heat simulations using the default (red) and new (blue) hydrological schemes with alternative LAI, $g_s$ and soil parameterisations during the whole, annual and dry-down periods. The new scheme was run with 0° slope.

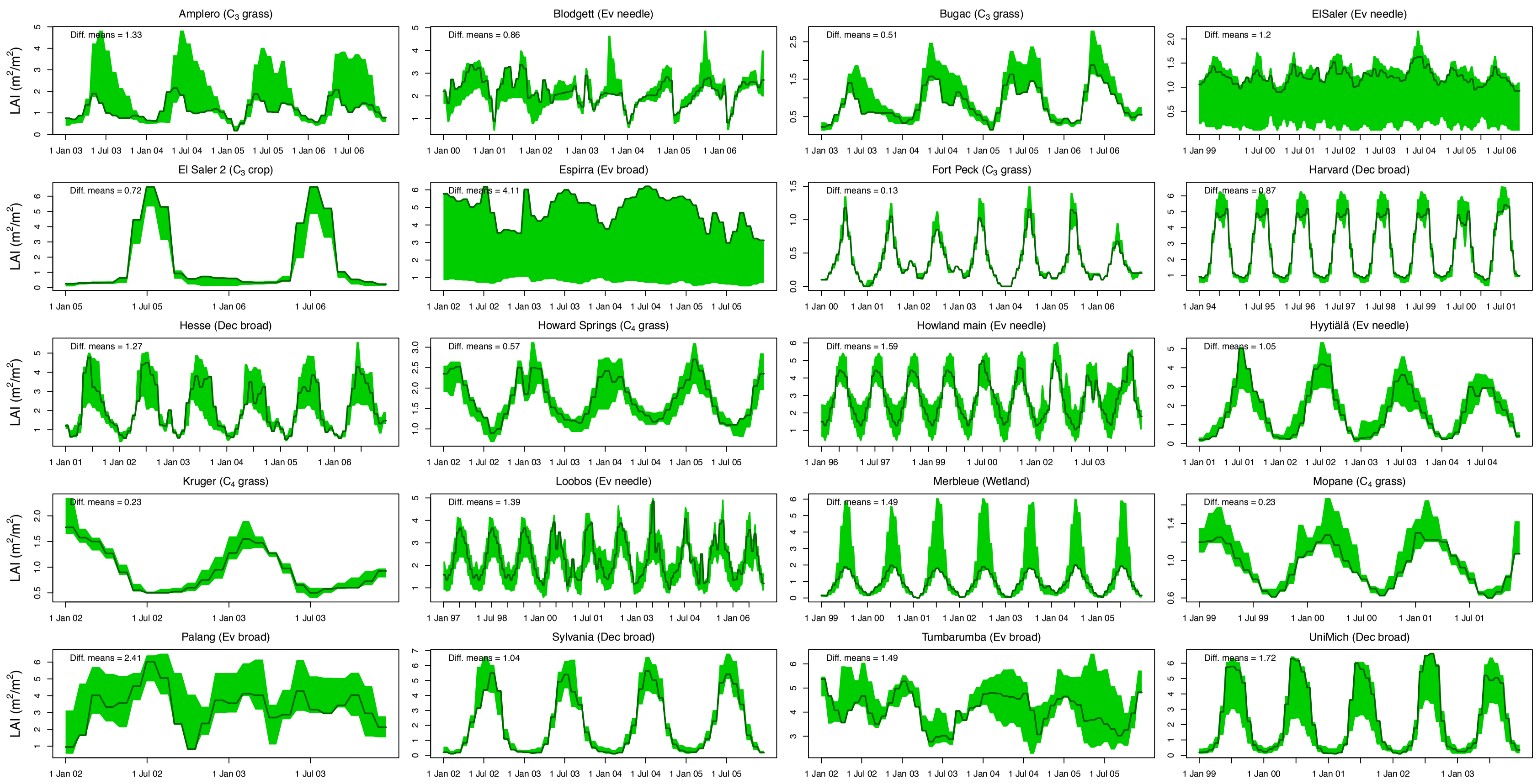


**Fig. S5.** LAI time series used to run CABLE. The solid line shows "the centre" time series, the upper bound of the green range shows the "maximum" and the lower bound the "minimum" time series. The mean absolute difference between the "maximum" and "minimum" LAI time series is shown.

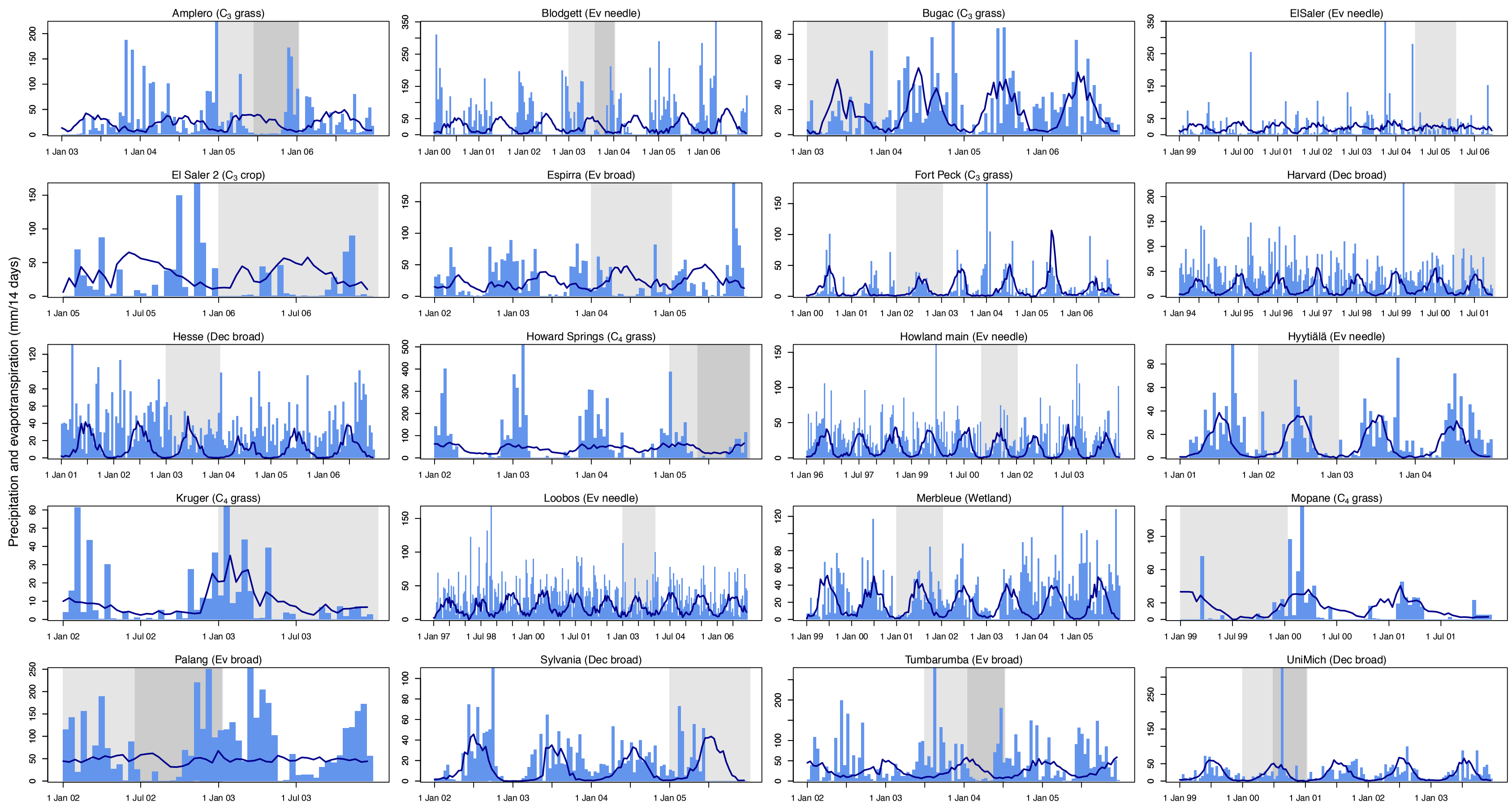


**Fig. S6.** Observed 14-day precipitation (bars) and evapotranspiration (lines; converted from $Q_E$) totals. The grey shading denotes the one-year period and the dark grey shading denotes the dry-down period for the selected sites.

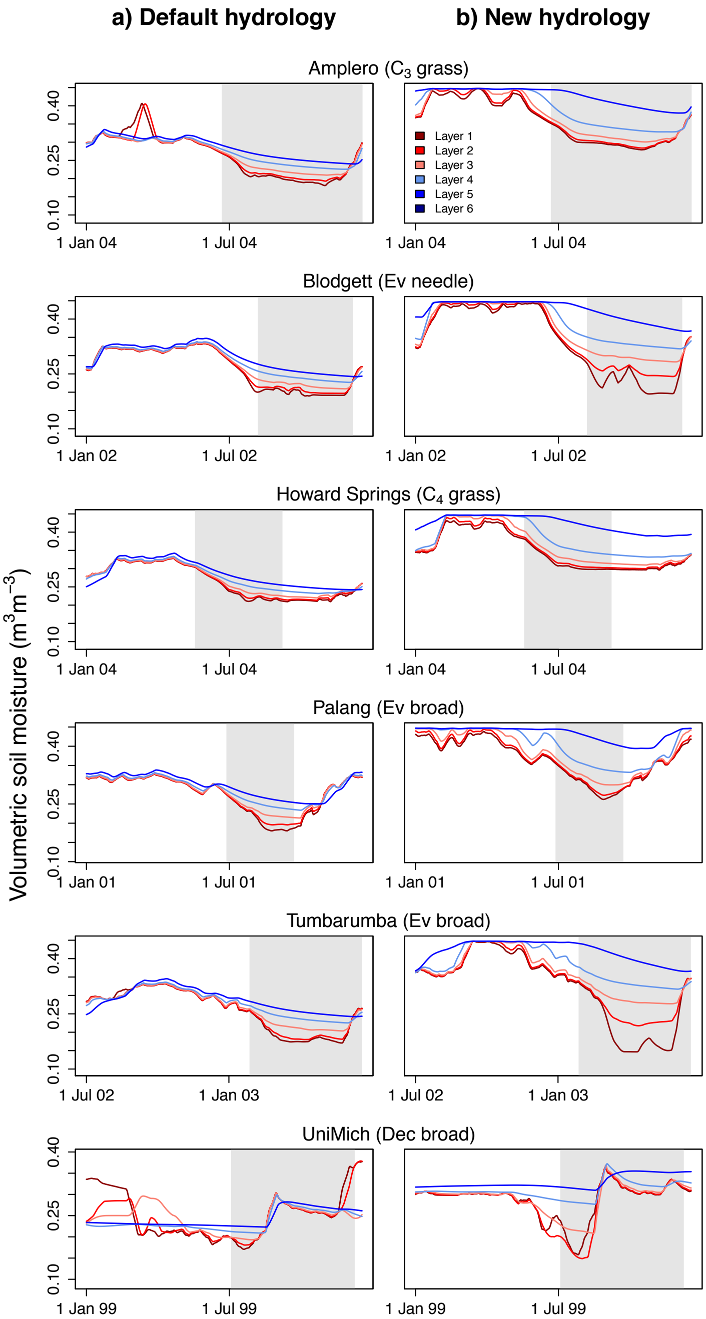


**Fig. S7.** Simulated volumetric soil moisture in each of CABLE's six soil layers during the one-year period using the default (left panel) and new (right panel) hydrological schemes. Other parameterisations were set to their default values (medium soil, Medlyn $g_s$ and centre LAI). Soil layer depths from the top layer 1 to bottom layer 6 are 0.022, 0.058, 0.154, 0.409, 1.085 and 2.872 metres, respectively. The grey shading denotes the selected dry-down period. All time series run from January to December, except Tumbarumba which run from July to the following June.

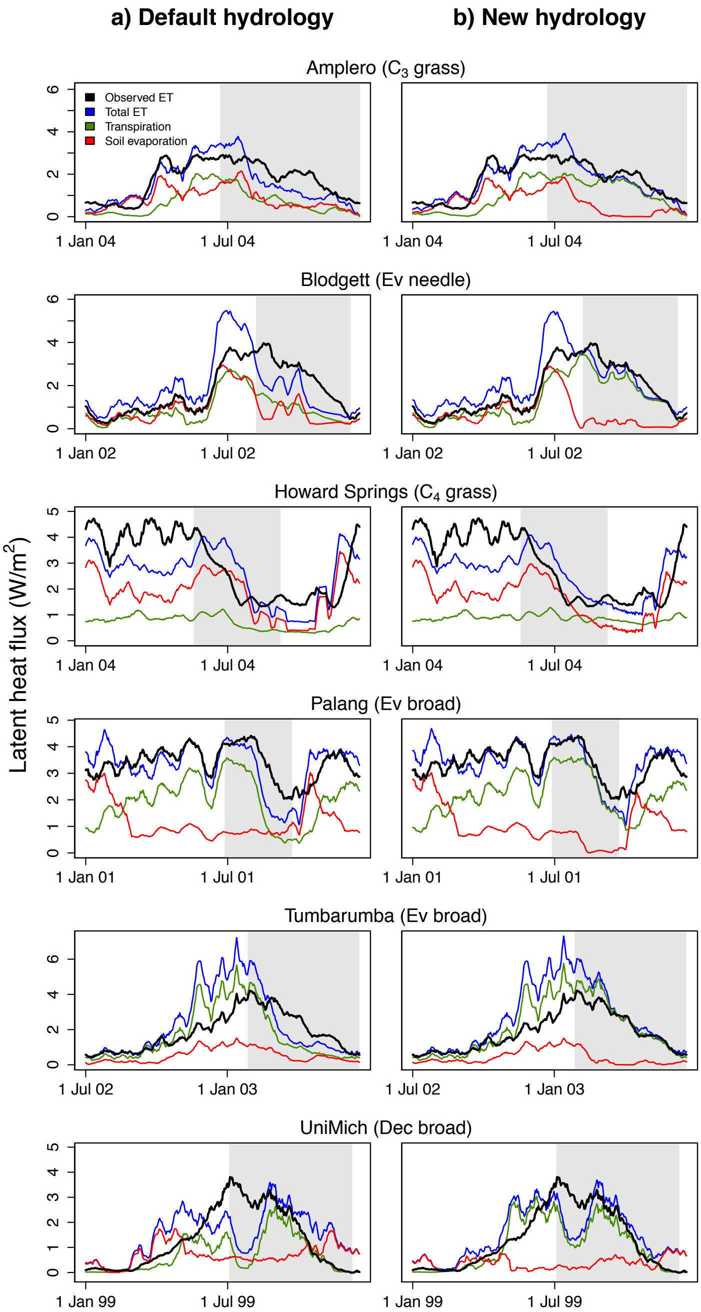


**Fig. S8.** Simulated total evapotranspiration, soil evaporation and transpiration during the one-year period using the default (left panel) and new (right panel) hydrological schemes. Other parameterisations were set to their default values (medium soil, Medlyn $g_s$ and centre LAI). Observed evapotranspiration (converted from latent heat) is shown in black. The grey shading denotes the selected dry-down period. All time series run from January to December, except Tumbarumba which run from July to the following June.

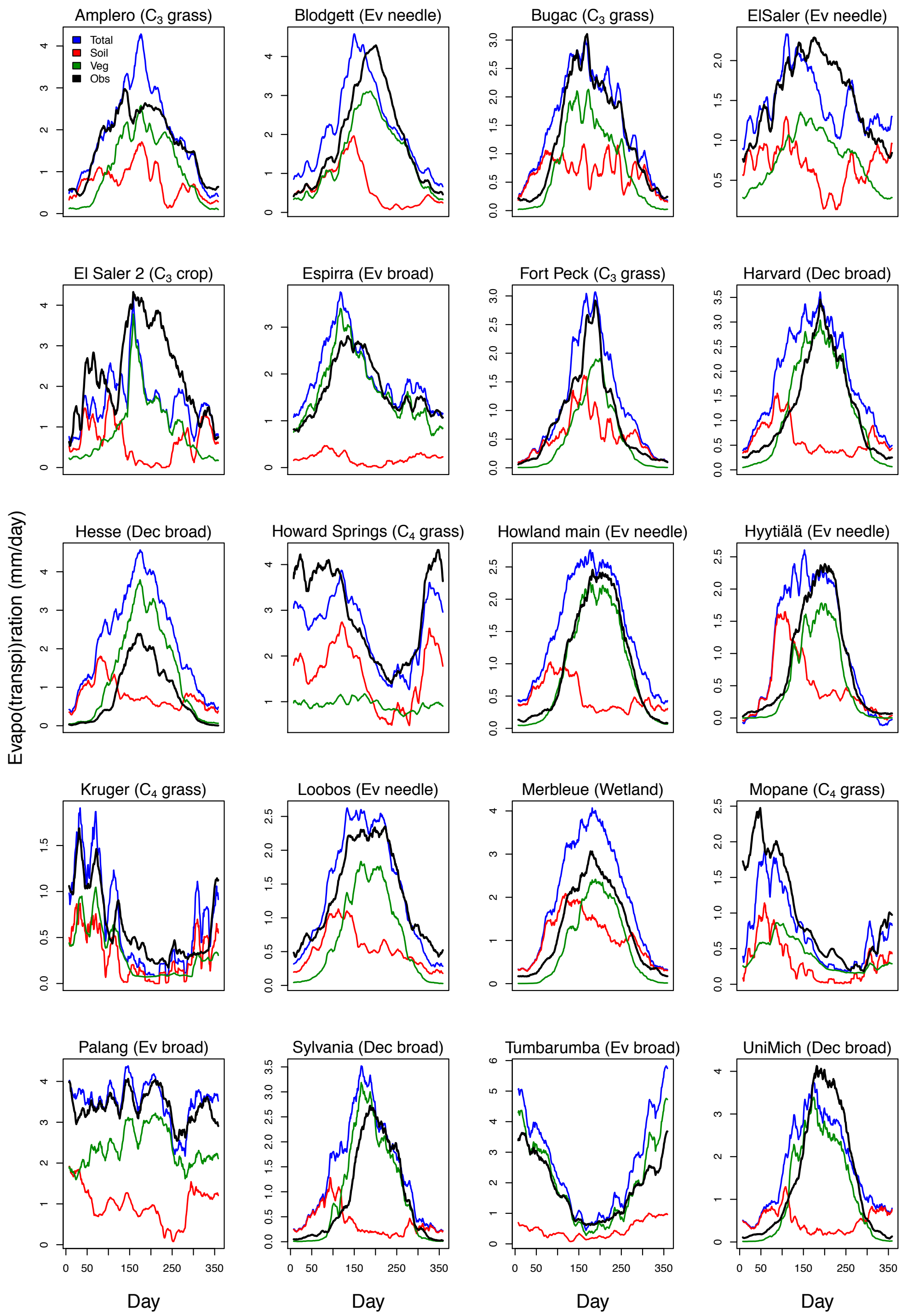


**Fig. S9.** 14-day running mean climatology of simulated total evapotranspiration (blue), soil evaporation (red) and transpiration (green). Observed total evapotranspiration (converted from $Q_E$) is shown in black. CABLE simulation using the new hydrology with Medlyn $g_s$, medium soil, centre LAI and 0° slope was used for plotting.

## References

Clapp, R. B. and Hornberger, G. M.: Empirical equations for some soil hydraulic properties, Water Resour. Res., 14, 601–604, 1978.