Biogeosciences

Supplement of

Quantifying the soil sink of atmospheric hydrogen: a full year of field measurements from grassland and forest soils in the UK

Nicholas Cowan et al.

Correspondence to: Nicholas Cowan (nicwan11@ceh.ac.uk)

Supplement

Table S1. Meteorological equipment used to monitor environmental conditions at the flux measurement fields sites.

Instrument	Manufacturer	Measurement	Height/Depth (m)
Easter Bush (grassland)			
HMP60	Vaisala	Air temperature, relative humidity	1.85
Tipping bucket rain gauge	Casella	Rainfall	0.4
CS655 water content reflectometer	Campbell Scientific	Soil VWC, soil temperature	0.05, 0.10, 0.2
Glencorse (woodland)			
WXT536 weather transmitter	Vaisala	Air temperature, relative humidity, air pressure, wind speed	2.3
ARG100 tipping bucket rain gauge	Environmental Measurements Limited	Rainfall	0.34
CS655 water content reflectometer	Campbell Scientific	Soil VWC, soil temperature	0.05, 0.10, 0.15

Table S2. Summary statistics for net H2 flux (nmol m^{-2} s^{-1}) and deposition velocity (cm s^{-1}) for each date that chamber measurements were carried out at the Easter Bush (grassland) and Glencorse forest (woodland) sites.

Date	Ambient H$_2$ (ppb)	Flux Mean	Flux Median	Flux SD	Flux Min	Flux Max	VD Mean	VD SD
Grassland								
13/09/2023	463.1	-7.5	-7.9	2.7	-13.7	-3.6	0.038	0.014
21/09/2023	484.0	-1.4	-1.3	0.4	-2.3	-0.8	0.007	0.002
12/10/2023	478.3	-1.7	-1.6	0.5	-2.7	-1.1	0.008	0.003
13/10/2023	520.9	-2.1	-2.1	0.8	-3.8	-1.3	0.010	0.004
16/11/2023	453.4	-0.4	-0.3	0.4	-1.3	0.0	0.002	0.002
11/01/2024	552.8	-0.3	-0.1	0.7	-2.2	0.8	0.001	0.003
13/02/2024	511.6	-0.9	-0.7	1.4	-6.4	0.8	0.004	0.006
18/03/2024	534.9	-0.7	-0.7	0.3	-1.3	0.0	0.003	0.001
10/04/2024	524.8	-0.2	-0.1	0.2	-0.7	0.1	0.001	0.001
25/04/2024	542.4	-1.9	-1.6	1.6	-6.8	0.1	0.008	0.007
21/05/2024	494.4	-5.1	-5.4	2.5	-8.5	-1.3	0.024	0.012
22/05/2024	526.9	-5.2	-4.8	3.1	-10.0	-1.0	0.023	0.014
25/06/2024	566.5	-6.8	-5.8	3.4	-15.6	-2.0	0.028	0.014
31/07/2024	459.2	-5.9	-5.3	2.4	-10.9	-3.0	0.030	0.012
28/08/2024	488.2	-0.4	-0.7	1.4	-1.4	5.3	0.002	0.007
25/09/2024	495.9	-0.6	-0.7	0.6	-1.6	1.4	0.003	0.003
All grassland	506.5	-2.6	-1.2	3.1	-15.5	5.3	0.012	0.015
Woodland								
11/09/2023	424.8	-20.5	-23.6	9.4	-34.2	-4.1	0.114	0.052
12/09/2023	447.7	-22.4	-22.3	4.0	-29.3	-16.0	0.118	0.021
01/11/2023	467.9	-16.1	-14.7	5.5	-28.7	-5.6	0.079	0.027
28/11/2023	517.6	-13.6	-16.2	7.4	-27.8	-1.1	0.060	0.033
02/02/2024	516.8	-17.0	-18.7	6.5	-25.2	-4.8	0.075	0.029
21/02/2024	505.3	-14.8	-15.5	8.8	-29.9	-4.2	0.067	0.040
04/04/2024	516.9	-16.7	-15.7	6.2	-27.4	-5.6	0.074	0.027
17/04/2024	518.3	-16.9	-17.2	7.8	-35.8	-4.7	0.075	0.034
16/05/2024	499.6	-23.2	-24.0	8.0	-40.7	-4.1	0.109	0.038
11/06/2024	492.3	-18.3	-19.5	8.0	-39.2	-5.3	0.086	0.038
11/07/2024	456.2	-15.5	-16.5	5.8	-31.0	-3.1	0.079	0.030
07/08/2024	447.4	-23.9	-23.0	4.3	-33.2	-17.6	0.126	0.022
04/09/2024	485.7	-16.2	-17.2	7.7	-33.6	-5.0	0.033	0.016
All woodland	484.6	-18.6	-18.7	7.7	-40.7	-1.1	0.088	0.040

14 **Table S3.** A summary of coefficients of separate multiple regression models between net H_2 flux with

15 soil moisture and soil temperature.

Site	R^2	Intercept	WFPS	$WFPS^2$	Soil T	Soil T^2
Grassland	0.60	-28.05***	0.656***	-0.004***	0.021	-0.002
Woodland	0.14	-15.22*	0.166	-0.001	-1.14	0.03

16 Significance codes: p < 0.001 ***, <0.01 **, <0.1 *

17
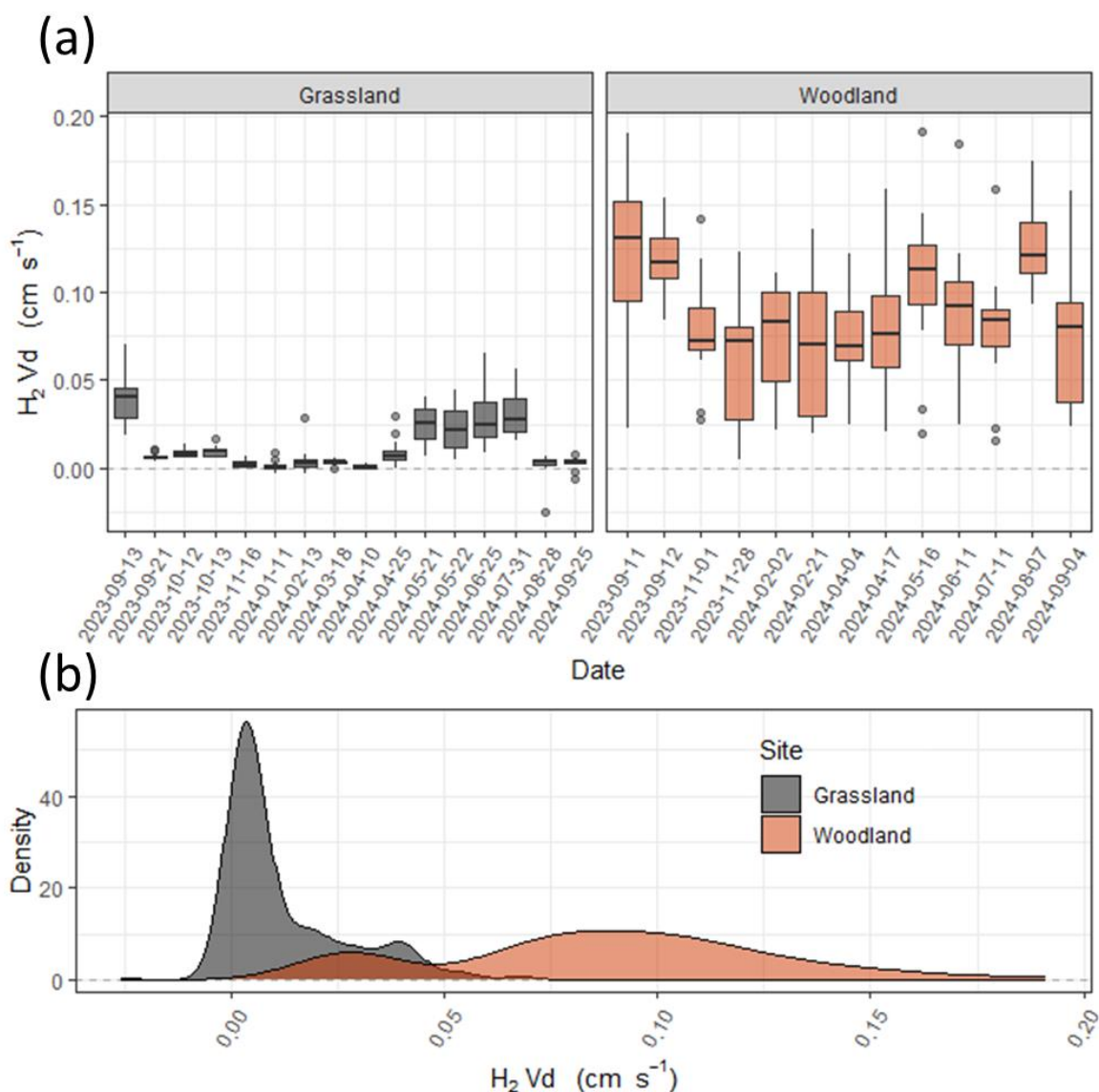
Figure S1. Deposition velocities of H_2 measured using the flux chamber method at grassland (Easter Bush, grassland; grey) and forest (Glencorse Forest, woodland; red) sites in Midlothian, Scotland. Boxplots (a) represent the median, and 25th and 75th percentiles of flux data of 20 chambers, respectively (whiskers represent the 95th percentiles). (b) Frequency distributions of the flux data for both sites (Flux presented in Figure 2).
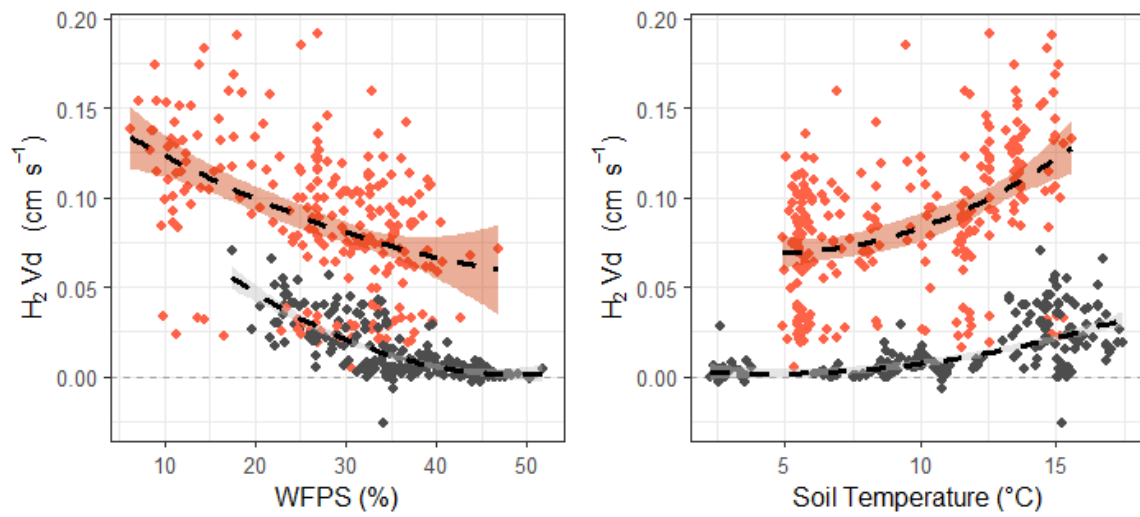
25

Figure S2. Correlations between H_2 Vd and water filled pore space (WFPS) and Soil Temperature. WFPS and soil temperature measured at 10 cm depth via sampling probe. A 2nd order polynomial fit (black dashed line) is included as a visual aid (y = $a_1x^2 + a_2x + c$). Figure presented as Flux in Figure 3.
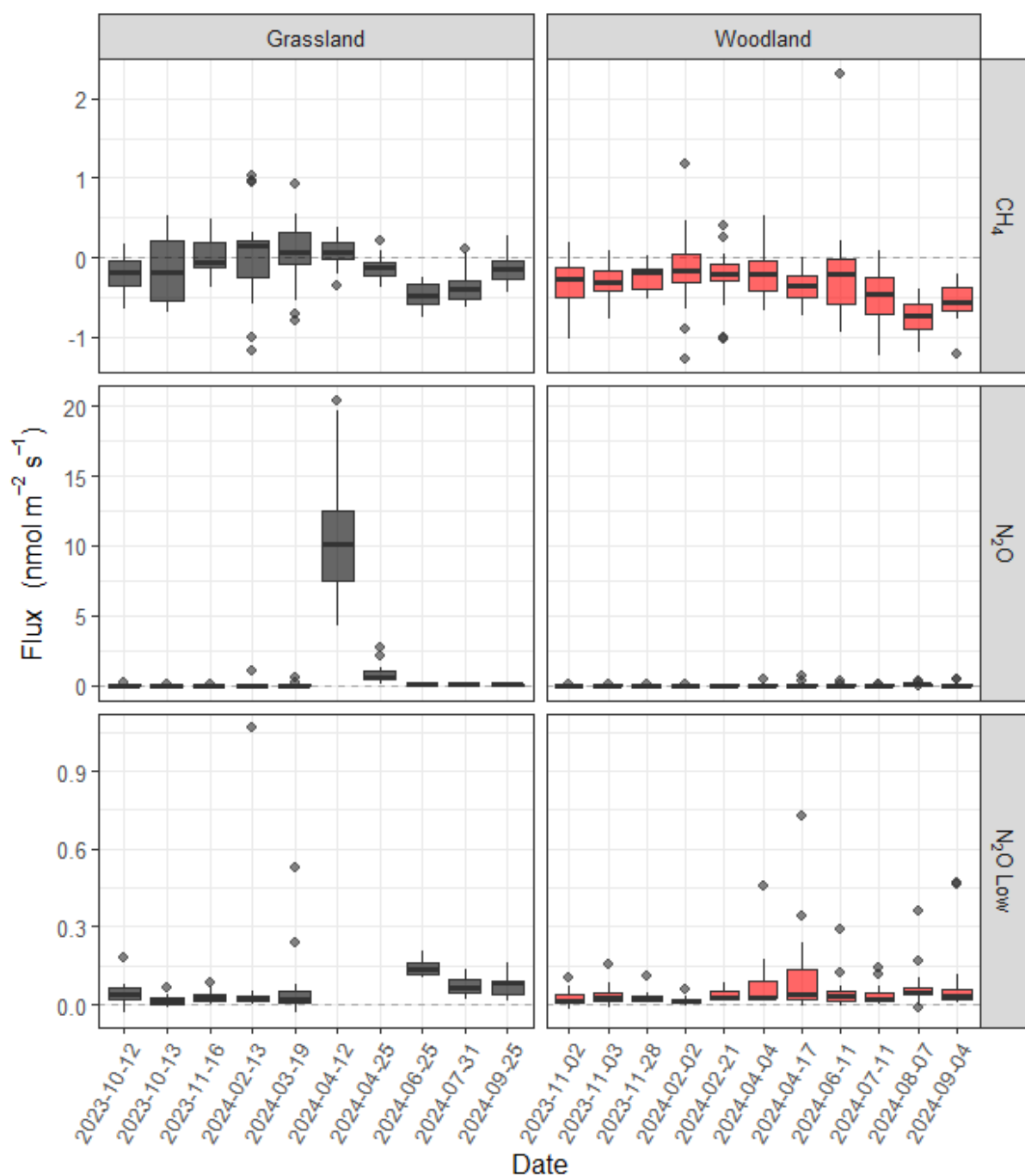
29

Figure S3. Fluxes of CH$_4$ and N$_2$O measured using the flux chamber method at grassland (Easter Bush, grassland) and forest (Glencorse Forest, woodland) sites in Midlothian, Scotland. Boxplots represent the median, and 25th and 75th percentiles of flux data and whiskers represent the 95th percentiles. N$_2$O Low used to show scale of fluxes on dates excluding fertiliser induced peaks on 12/04/24 and 25/04/24.

37
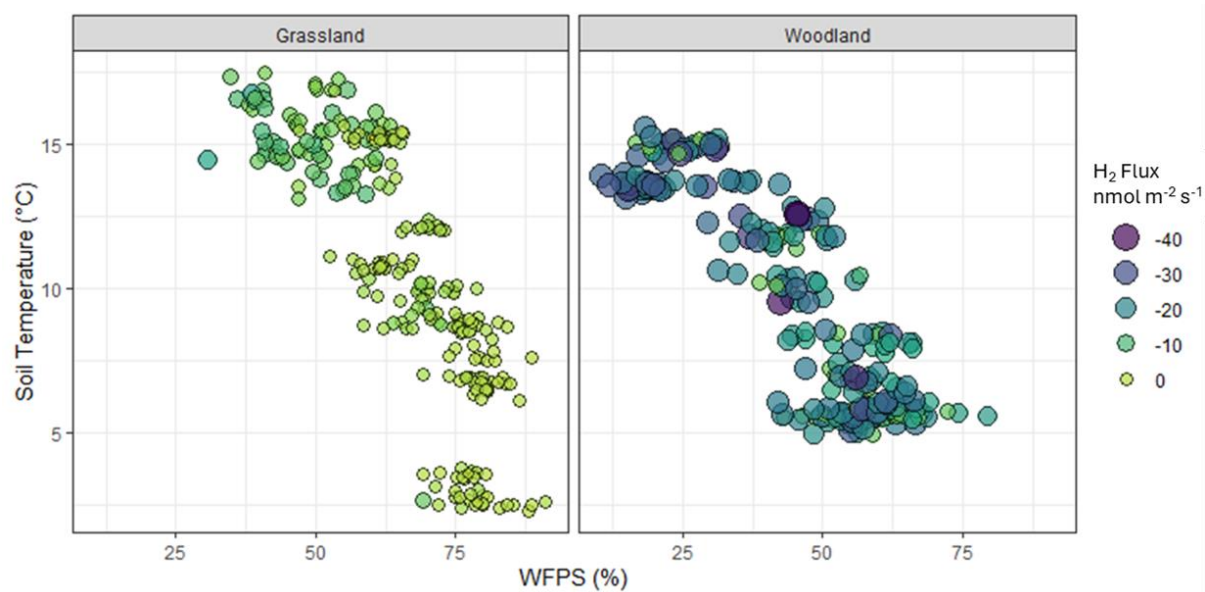
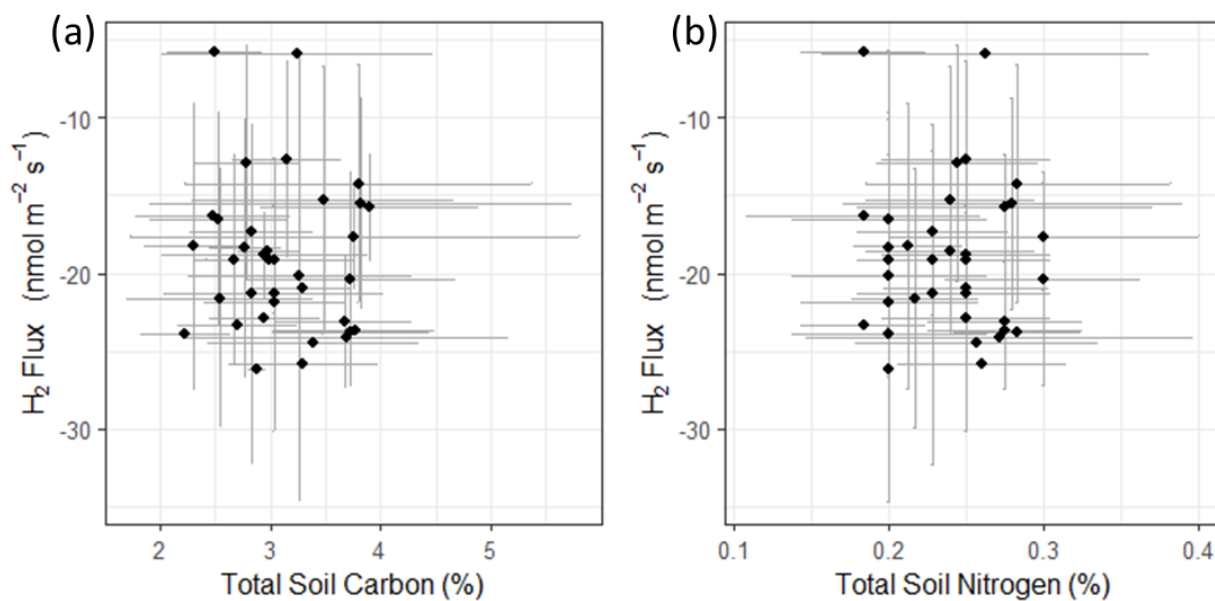**Figure S4.** Scatterplots of WFPS and soil temperature at the Grassland and Woodland site.

Figure S5. (a) Mean H_2 flux vs mean soil carbon measured from each chamber at the woodland site.
(b) Mean H_2 flux vs mean soil nitrogen measured from each chamber at the woodland site (95% C.Is.
included in all figures).