Supplementary Information

Gaseous elemental mercury (GEM) fluxes over canopy of two typical subtropical forests in south China

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1 Calculation steps of turbulent transfer coefficient (*K*):

Turbulent transfer coefficient *K* was calculated according to the similarity theory after the measurement of the wind speed and temperature profile (Yu and Sun, 2006)

(1) Calculation of Richard Sunds (R_i):

$$R_i = \frac{g(\frac{T_2-T_1}{z_2-z_1}+\gamma_d)}{T_0(\frac{u_2-u_1}{z_2-z_1})^2} \quad , \tag{S1}$$

where g is the acceleration of gravity (9.8 m s^{-2}), γ_d is the dry adiabatic lapse rate (0.00976 K m^{-1}), z_1 and z_2 are the heights (m), T_1, T_2 and T_0 are the temperatures at two heights and the mean value (K), u_1 and u_2 are wind speeds at two heights (m s^{-1}).

(2) Determination of the initial atmospheric stability (ζ_0):

$$\zeta_0 = \begin{cases} R_i, \ R_i < 0 \\ \frac{R_i}{1-5R_i}, \ 0 \le R_i \le 0.1, \\ 0.2, \ R_i > 0.1 \end{cases} \tag{S2}$$

(3) Determination of universal dimensionless gradient function($\Phi(\zeta)$):

$$\Phi_m(\zeta_0) = \begin{cases} (1-15\zeta_0)^{-1/4}, & \zeta_0 \le 0 \\ 1+5\zeta_0, & \zeta_0 > 0 \end{cases} \quad , \tag{S3}$$

$$\Phi_h = \Phi_c = \begin{cases} {\Phi_m}^2, & \zeta_0 \le 0 \\ \Phi_m, & \zeta_0 > 0 \end{cases} \quad , \tag{S4}$$

where Φ_h, Φ_c and Φ_m are the universal functions of sensible heat, mercury, and momentum.

(4) Calculation of scales of speed (u_*) and temperature (θ_*):

$$u_* = \frac{\kappa(u_2-u_1)}{\Phi_m(\zeta_0)\ln[(z_2-d)/(z_1-d)]} \quad , \tag{S5}$$

$$\theta_* = \frac{\kappa(T_2-T_1)}{\Phi_h(\zeta_0)\ln[(z_2-d)/(z_1-d)]} \quad , \tag{S6}$$

where d is the displacement of zero plane (m), equal to 0.7 times of the vegetation height, κ is the Karman constant (0.4).

(5) Calculation of Monin-Obukhov length (L) and atmospheric stability (ζ):

$$L = \frac{{u_*}^2}{\kappa^2 \frac{g}{\theta_0}\theta_*} \quad , \tag{S7}$$

$$\zeta = z \ / \ L \quad , \tag{S8}$$

where $\theta_0 = T_0$, and z indicates the height related to the flux (m).

(6) If there is a large difference between ζ and ζ_0, set $\zeta_0 = \zeta$ and repeat steps (3)-(5) until ζ converging to one value.

(7) Calculation of turbulent transfer coefficient (K) using the parameters

$$K = \frac{u_* \kappa z}{\Phi_c(\zeta)}, \quad \text{(S9)}$$

References

Yu, G., and Sun, X.: The principle and method of terrestrial ecosystems flux observations. Higher Education Press, Beijing, 2006. (In Chinese)

Table S1. Sensors used for measuring meteorological parameters

Sensor type	Version	Detection range	Accuracy
Air temperature (two heights)	43347-L (R. M. Young Inc., USA)	-50 ~50°C	± 0.1°C
Wind speed and direction (two heights)	WindSonic (Gill Inc., UK)	Wind speed: 0 ~ 60 m/s Wind direction: 0–359º	± 2% speed ± 3º direction
Air temperature and humidity	HMP 155A (Vaisala Inc., Finland)	Temperature: -80–60°C Humidity: 0.8–100%	± 0.2°C
Solar radiation	CS300 (Campbell Scientific Inc., USA)	300–1120 nm	± 5%
Soil temperature and moisture	CS 616 (Campbell Scientific Inc., USA)	Temperature: -30–70°C Moisture: 0.05–0.5	Temperature: ± 0.5°C Moisture: ± 5%
Precipitation	52202/52203 (R. M. Young Inc., USA)	≥ 0.1 mm	2% (≤ 25 mm/h) 3% (≤ 50 mm/h)

Table S2. Seasonal atmospheric GEM flux and meteorological parameters at QYZ and HT sites. Data format: mean value (variance), min value ~ max value.

		Atmospheric GEM concentration (ng m^{-3})	Air temperature (°C)	Air humidity (%)	Soil temperature (°C)	Soil moisture (%)	Solar radiation (W m^{-2})
Winter	**QYZ**	4.05 (1.53)	7.64 (5.67)	72.5 (21.7)	8.52 (2.37)	0.30 (0.02)	221 (221)
		1.64 ~ 11.7	-4.51 ~ 25.9	16.4 ~ 98.7	3.90 ~ 15.2	0.27 ~ 0.36	0 ~ 846
	HT	5.94 (3.20)	6.42 (5.12)	77.9 (20.2)	7.33 (2.40)	0.28 (0.01)	169 (188)
		1.32 ~ 22.9	-5.15 ~ 24.0	15.8 ~ 100	1.78 ~ 14.3	0.26 ~ 0.32	0 ~ 857
Spring	**QYZ**	3.47 (1.81)	19.0 (6.08)	82.2 (15.9)	18.0 (4.35)	0.37 (0.02)	224 (246)
		0.97~17.4	4.60 ~ 33.6	31.3 ~ 98.4	8.00 ~ 26.2	0.31 ~ 0.47	0 ~ 987
	HT	5.50 (2.91)	16.7 (5.56)	86.4 (14.2)	16.1 (3.99)	0.28 (0.02)	201 (232)
		1.45 ~ 22.9	4.93 ~ 32.1	25.4 ~ 99.5	7.42 ~ 25.1	0.24 ~ 0.34	0 ~ 971
Summer	**QYZ**	3.30 (1.23)	27.3 (3.77)	80.0 (15.8)	26.1 (1.52)	0.37 (0.04)	325 (291)
		1.60 ~ 8.83	20.1 ~ 36.8	35.9 ~ 98.3	22.8 ~ 29.5	0.28 ~ 0.52	0 ~1000
	HT	5.51 (3.09)	25.2 (3.73)	87.4 (14.0)	26.6 (1.93)	0.25 (0.02)	207 (261)
		1.43 ~ 21.4	18.0 ~ 36.0	41.4 ~ 99.7	22.4 ~ 30.1	0.21 ~ 0.31	0 ~ 988
Fall	**QYZ**	3.75 (1.18)	20.7 (6.16)	80.3 (17.0)	20.5 (3.93)	0.26 (0.03)	252 (235)
		1.42 ~ 8.76	5.66 ~ 36.3	32.4 ~ 100	12.1 ~ 28.3	0.22 ~ 0.35	0 ~ 943
	HT	6.64 (3.26)	19.3 (6.04)	83.9 (16.3)	20.5 (4.83)	0.26 (0.02)	217 (245)
		1.56 ~ 22.9	1.45 ~ 34.4	34.6 ~ 100	8.61 ~ 28.5	0.23 ~ 0.31	0 ~ 965

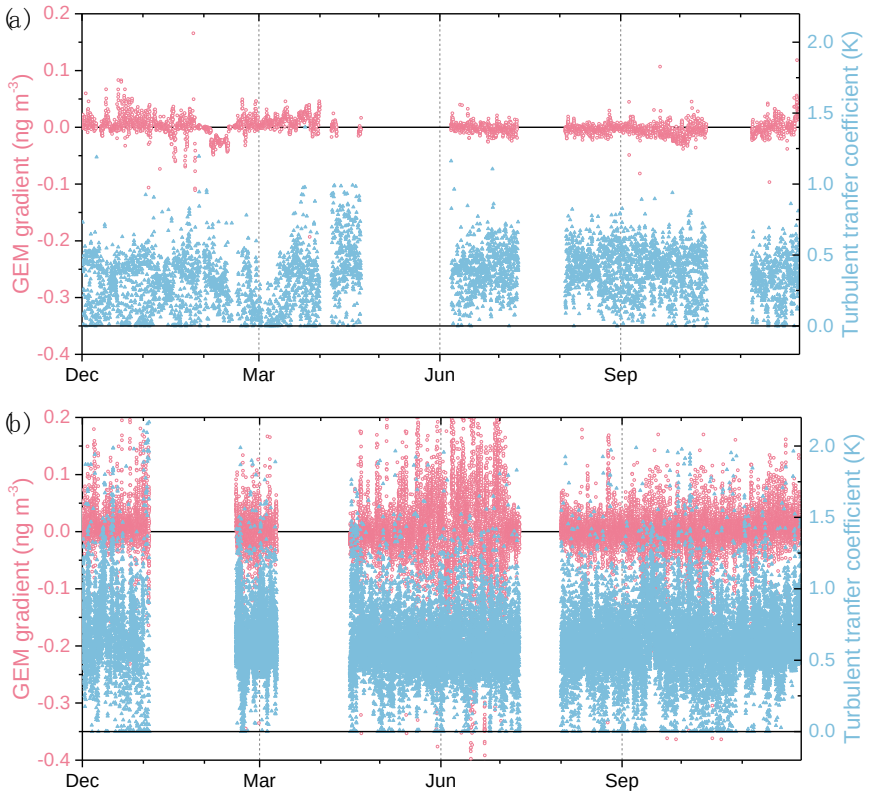
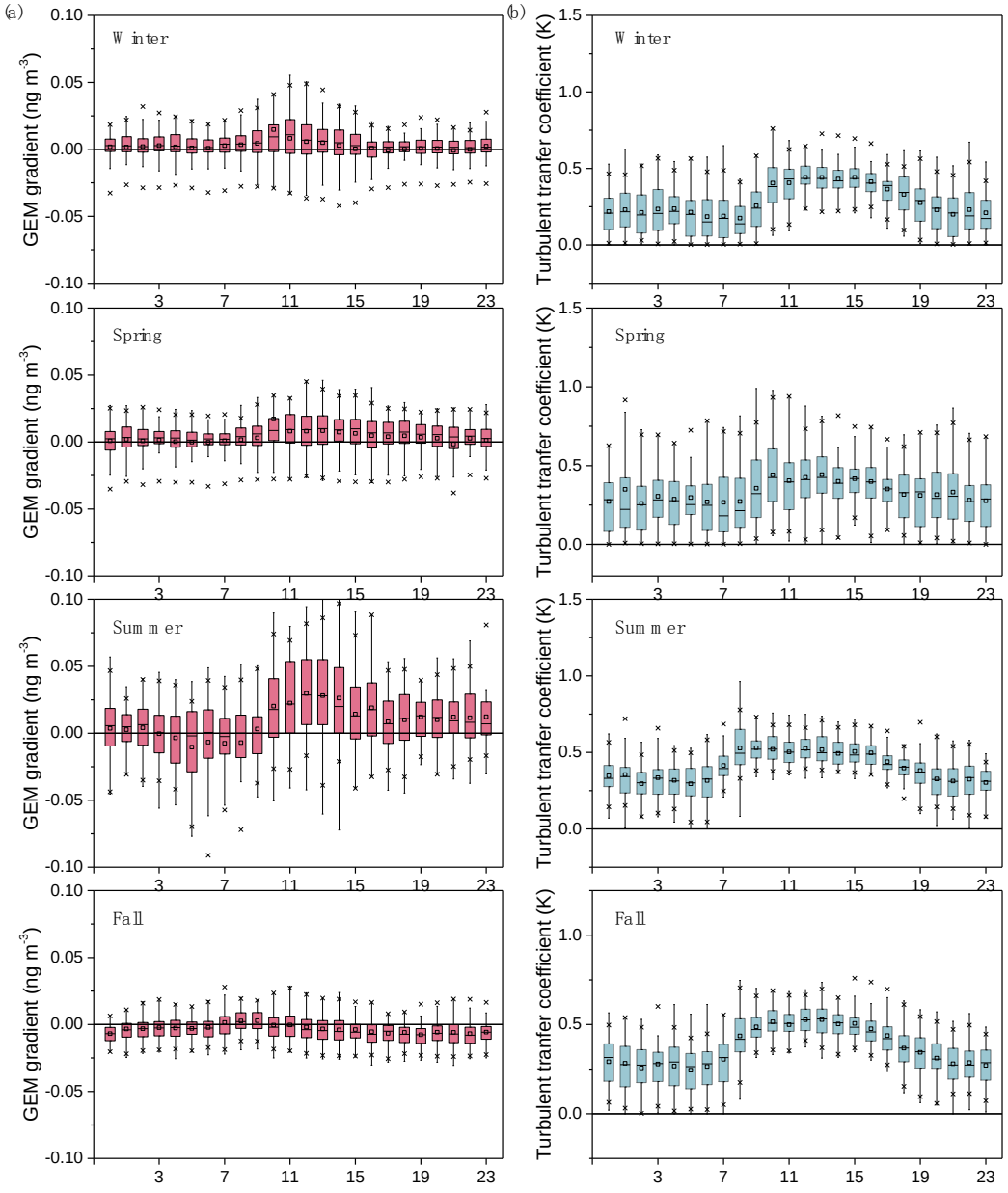


Figure S1. Annual variations of GEM gradient and turbulent transfer coefficient (K) at QYZ (a) and HT (b) stations. The observations lasted for one year at both sites (January to December in 2014).


(a)
(b)
Winter
Spring
Summer
Fall
GEM gradient (ng m-3)
Turbulent tranfer coefficient (K)
0.10
0.05
0.00
-0.05
-0.10
1.5
1.0
0.5
0.0
3
7
11
15
19
23

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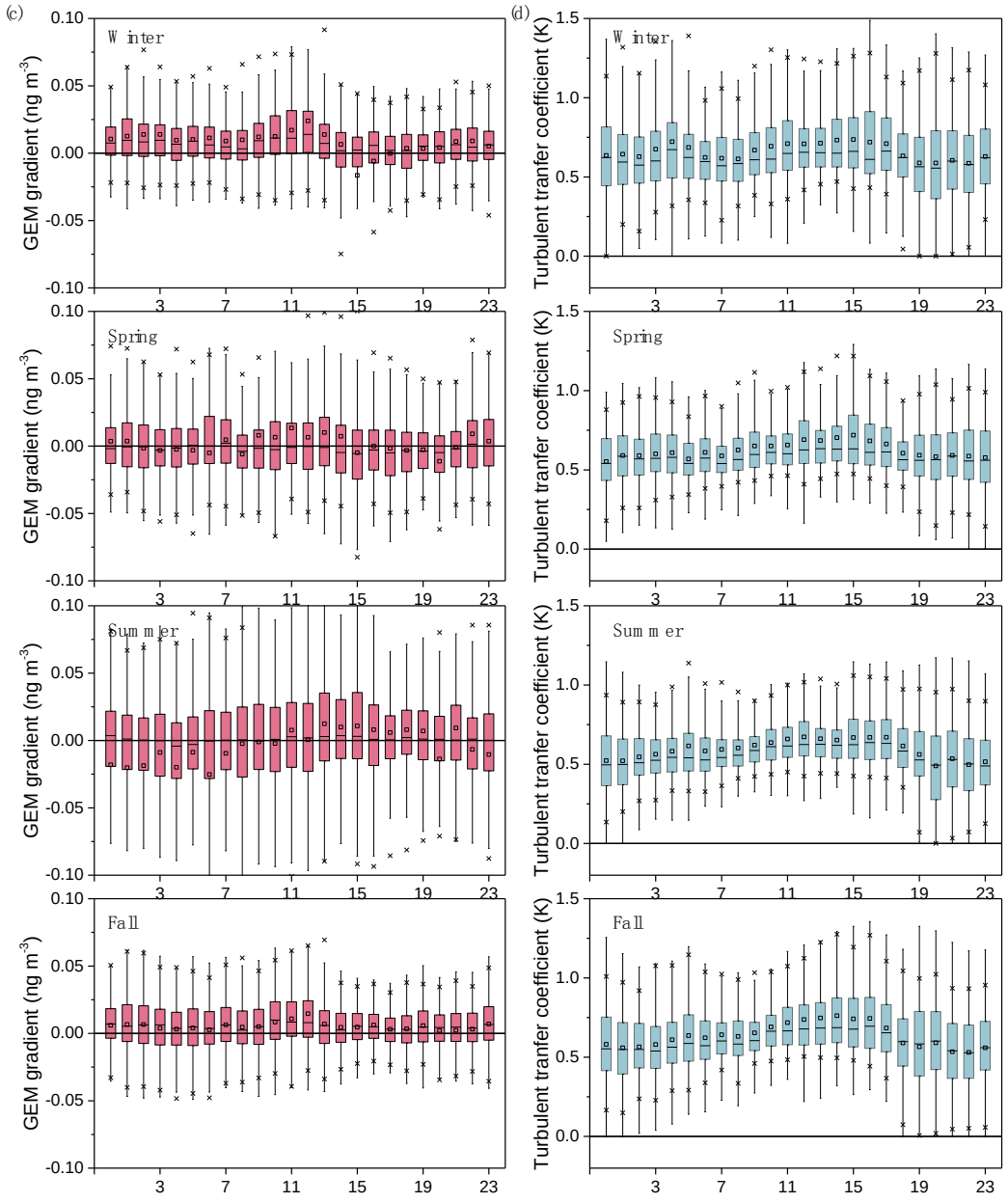


Figure S2. Diurnal variations of GEM gradient and turbulent transfer coefficient (K) in each season. (a) GEM gradient at QYZ; (b) K at QYZ; (c) GEM gradient at HT; (d) K at HT. Box horizontal border lines represent the 25th, 50th and 75th percentiles from bottom to top, the whiskers represent outliers, and the 5th and 95th percentiles are marked as cross. The open square in the box represents the mean value.

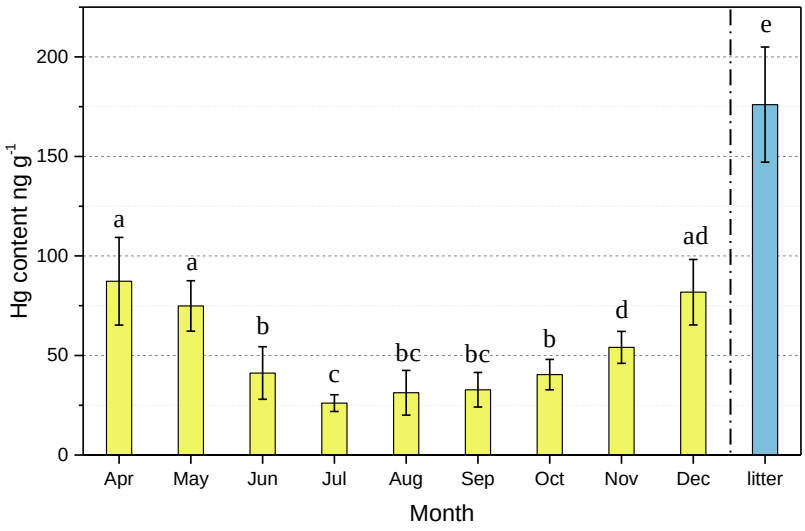


Figure ~~S1~~S3. The monthly variation of Hg content of current-year foliage of *cunninghamia lanceolata* and the Hg content of litter at HT site. Different letters in a column mean significant difference ($n = 18$, $p < 0.05$).

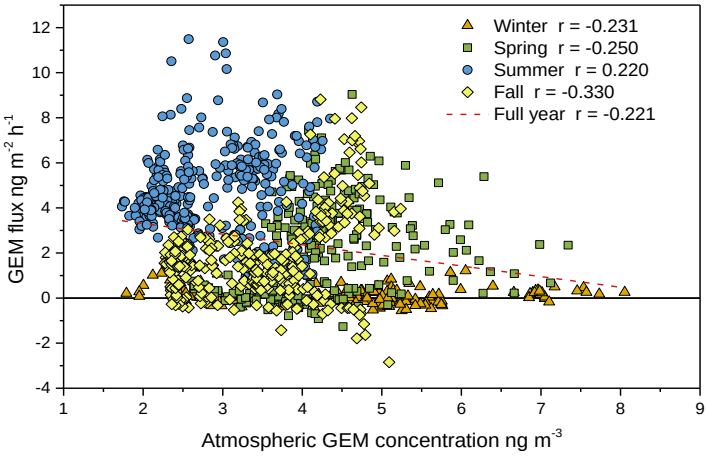


Figure ~~S2~~S4. The correlation of GEM flux and atmospheric GEM concentration of soil at QYZ site (unpublished data).

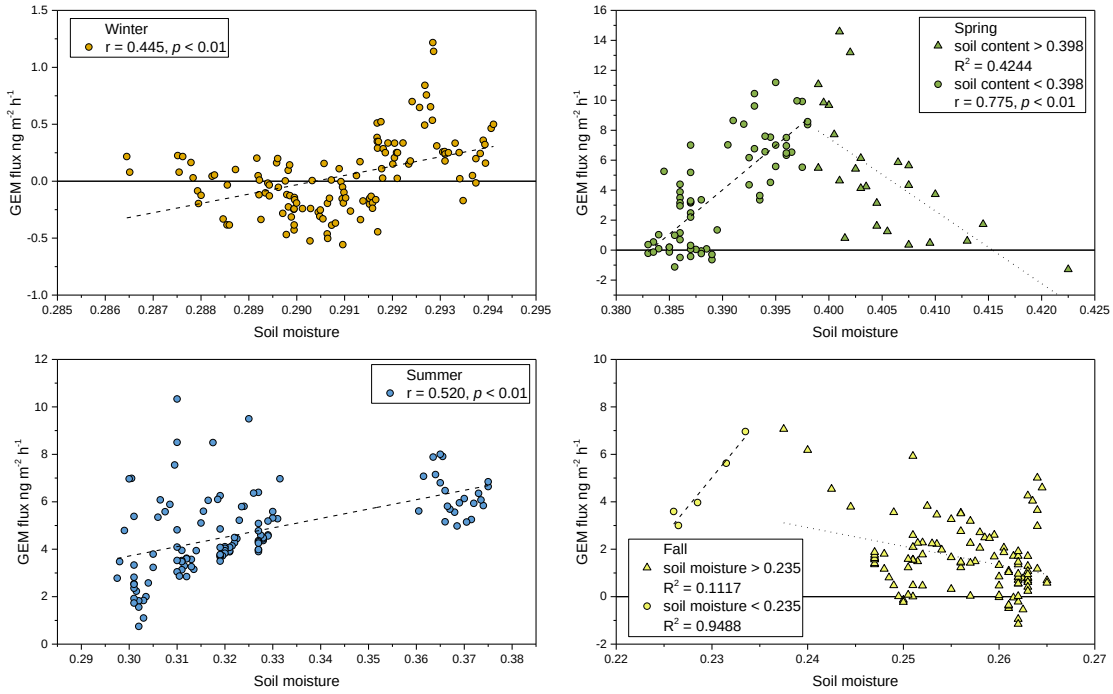
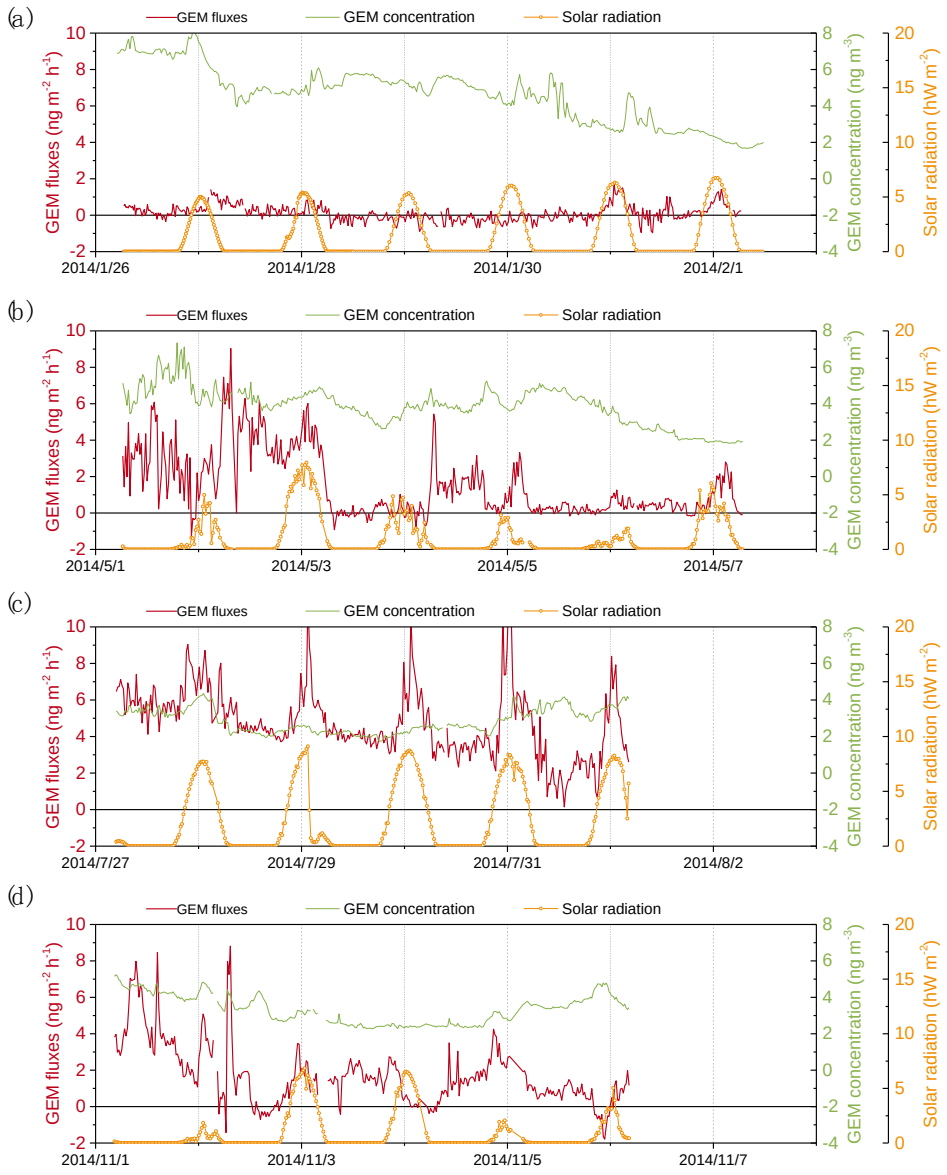


Figure ~~S3~~S5. The soil GEM flux varied with the change of soil moisture in winter (a), spring (b), summer (c) and fall (d) at QYZ site (unpublished data).



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86 **Figure S6.** The diurnal variation of soil GEM emission fluxes, GEM concentrations and solar radiations in winter (a), spring (b), summer
87 (c) and fall (d) (unpublished data).

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