Model M2-dif steady state equations

The equilibrium solutions to the C pools of model M2-dif are given by:

$$C_P = K_D r_{ed} z(-2gI_{ml}f_{ge}f_{ug}r_{md} + 2gI_m f_{ug}r_{md} - 2gI_{sl}f_{ge}r_{mr}f_{ug} - 2gI_{sl}f_{ge}f_{ug}r_{md} + 2gI_{sl}r_{mr} + 2gI_{sl}r_{md} - I_{ml}f_{ge}f_{ug}r_{ed}r_{md} + I_{ml}f_{ug}r_{ed}r_{md} - I_{sl}f_{ge}r_{mr}f_{ug}r_{ed} - I_{sl}f_{ge}f_{ug}r_{ed}r_{md} + I_{sl}r_{mr}r_{ed} + I_{sl}r_{ed}r_{md})/(gI_{ml}V_D f_{ge}r_{mr}f_{ug} + gI_{ml}V_D f_{ge}f_{ug}r_{md} + 2gI_{ml}f_{ge}f_{ug}r_{ed}r_{md} - 2gI_{ml}f_{ug}r_{ed}r_{md} + gI_{sl}V_D f_{ge}r_{mr}f_{ug} + gI_{sl}V_D f_{ge}f_{ug}r_{md} + 2gI_{sl}f_{ge}r_{mr}f_{ug}r_{ed} + 2gI_{sl}f_{ge}f_{ug}r_{ed}r_{md} - 2gI_{sl}r_{mr}r_{ed} - 2gI_{sl}r_{ed}r_{md} + I_{ml}f_{ge}f_{ug}r_{ed}^2 r_{md} - I_{ml}f_{ug}r_{ed}^2 r_{md} + I_{sl}f_{ge}r_{mr}f_{ug}r_{ed}^2 + I_{sl}f_{ge}f_{ug}r_{ed}^2 r_{md} - I_{sl}r_{mr}r_{ed}^2 - I_{sl}r_{ed}^2 r_{md}) \quad \text{(A1)}$$

$$C_D = -z(r_{mr} + r_{md})/(gV_U f_{ug}(f_{ge} - 1)) \quad \text{(A2)}$$

$$C_M = f_{ug}(I_{ml}f_{ge} - I_{ml} + I_{sl}f_{ge} - I_{sl})/(f_{ge}r_{mr}f_{ug} - r_{mr} + f_{ug}r_{md} - r_{md}) \quad \text{(A3)}$$

$$C_{ED} = -gf_{ge}f_{ug}(I_{ml}r_{mr} + I_{ml}r_{md} + I_{sl}r_{mr} + I_{sl}r_{md})/(r_{ed}(2gf_{ge}r_{mr}f_{ug} - 2gr_{mr} + 2gf_{ug}r_{md} - 2gr_{md} + f_{ge}r_{mr}f_{ug}r_{ed} - r_{mr}r_{ed} + f_{ug}r_{ed}r_{md} - r_{ed}r_{md})) \quad \text{(A4)}$$

$$C_{EM} = -f_{ge}f_{ug}(gI_{ml}r_{mr} + gI_{ml}r_{md} + gI_{sl}r_{mr} + gI_{sl}r_{md} + I_{ml}r_{mr}r_{ed} + I_{ml}r_{ed}r_{md} + I_{sl}r_{mr}r_{ed} + I_{sl}r_{ed}r_{md})/(r_{ed}(2gf_{ge}r_{mr}f_{ug} - 2gr_{mr} + 2gf_{ug}r_{md} - 2gr_{md} + f_{ge}r_{mr}f_{ug}r_{ed} - r_{mr}r_{ed} + f_{ug}r_{ed}r_{md} - r_{ed}r_{md})) \quad \text{(A5)}$$

In these equations, I_{ml} and I_{sl} are metabolic and structural litter input, which represent litter additions to the C_D and C_P pools, respectively.

Supplementary figures

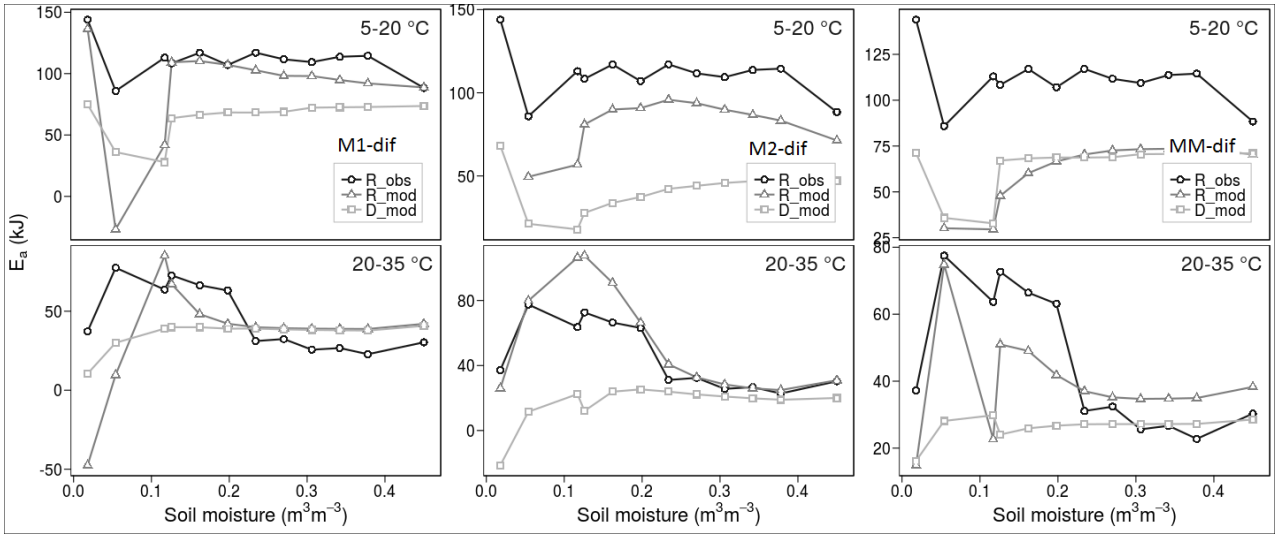

Figure S1: Relationships of apparent activation energies against soil volumetric moisture content. Values are given for measured and modelled respiration and for modelled decomposition. Each plot compares observed values against a different calibrated model (M1-dif, M2-dif and MM-dif). Apparent activation energies are shown for the temperature ranges 5-20 (top panel) and 20-35 °C (bottom panel).

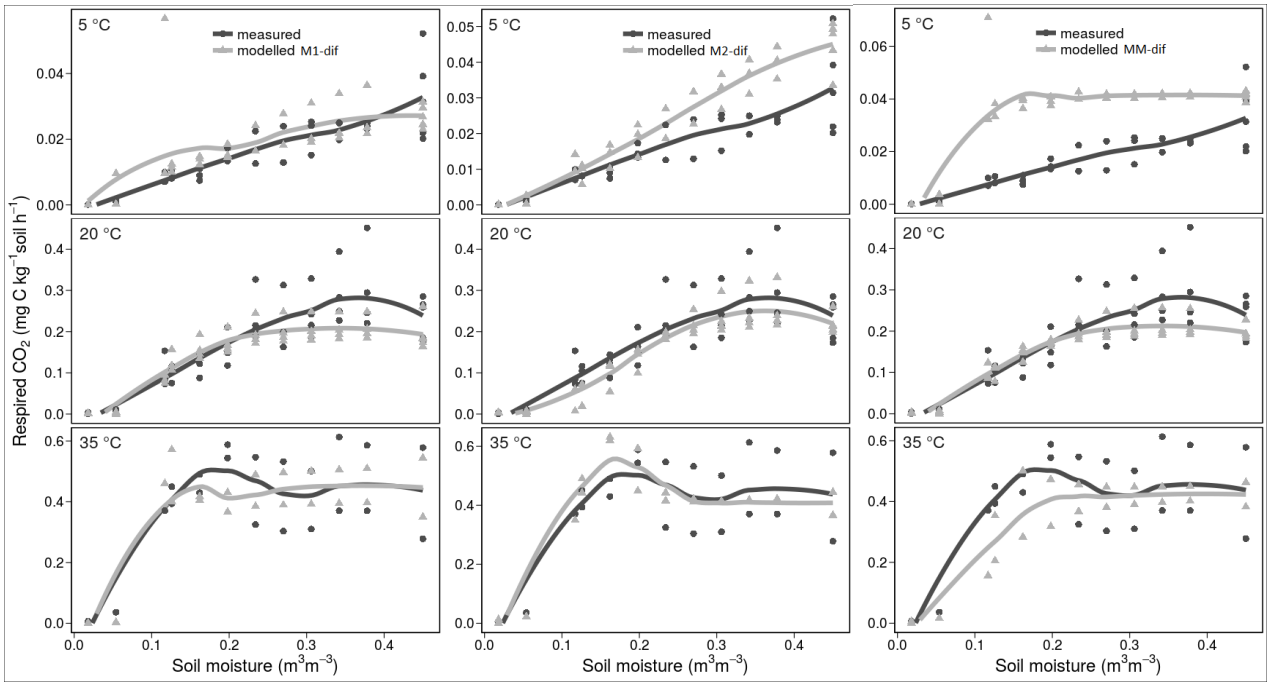

Figure S2: The relationship between respiration rates and soil moisture content shown for measured and modelled values. Each plot compares the measurements a different model (M1-dif, M2-dif, MM-dif). Lines are a smooth loess fit to show the average relationship.

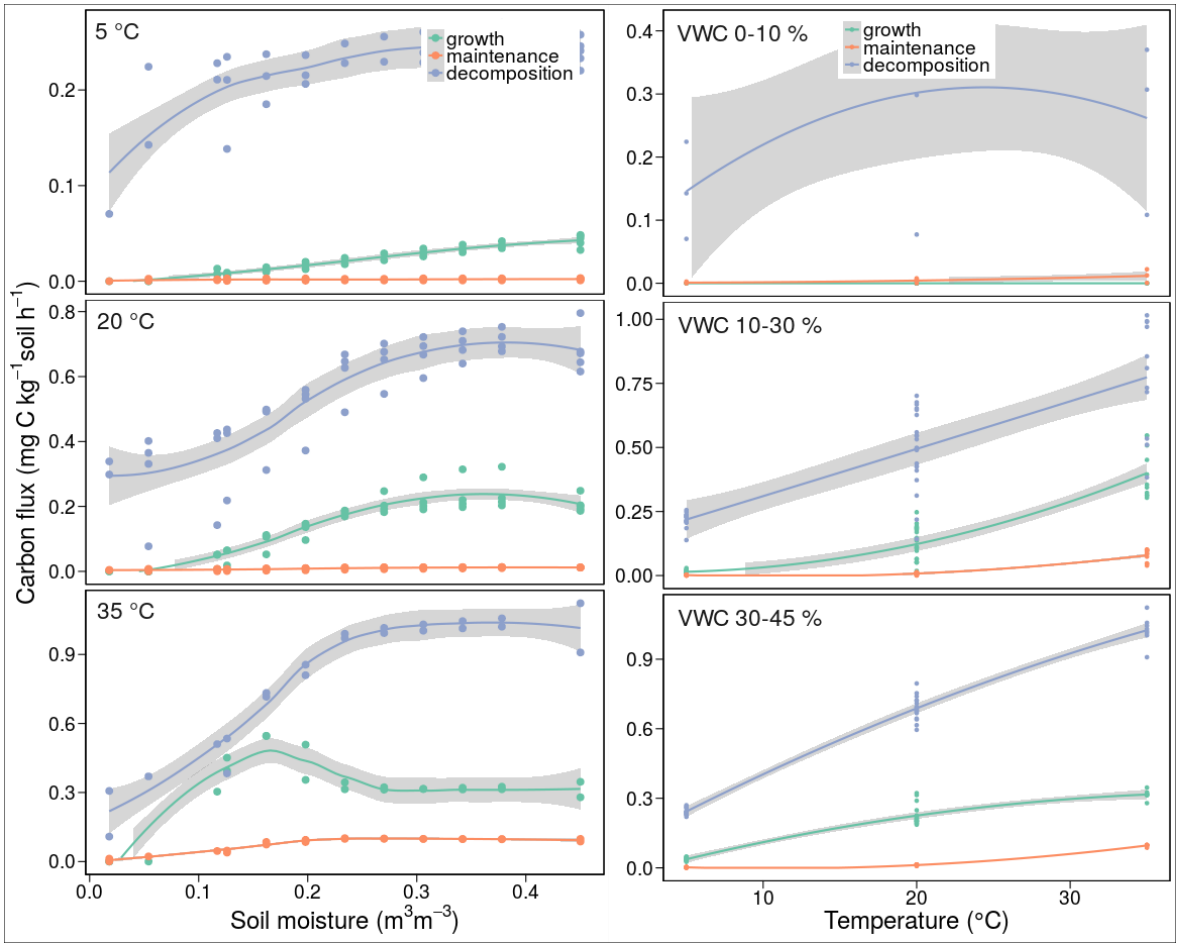

Figure S3: Respiration (growth and maintenance) and decomposition fluxes modelled using M2-dif against soil moisture (left plot) and soil temperature (right plot). Shaded areas denote the 95% confidence intervals from a loess fit.

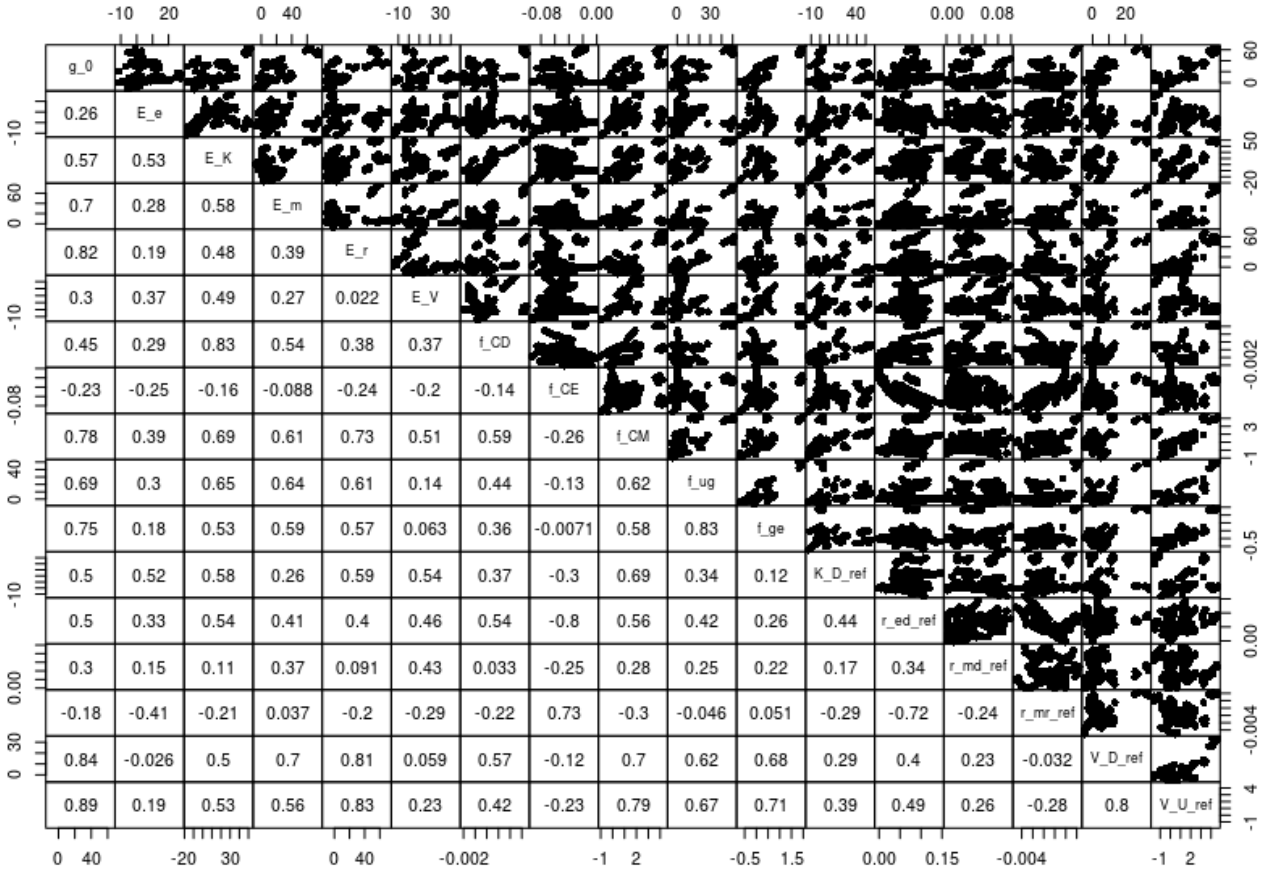

Figure S4: Correlations between sensitivity functions of model parameters (obtained by using R function sensFun from package FME). All R^2 values are below 0.9 but several are above 0.8, e.g. between V_U_ref and g_0 (0.89), V_U_ref and E_r (0.83), V_D_ref and g_0 (0.84), f_CD and E_K (0.83) and V_D_ref and V_U_ref (0.8), f_ug and f_ge (0.83).

Table S1: Calibrated model parameters with initial values and lower and upper bounds.

Name	Units	Initial value	Lower bound	Upper bound	Calibrated value
g_0	h^{-1}	1.4	0.1	10	2.2
E_{a_K}	kJ	90	10	130	89
E_{a_r}	kJ	90	10	130	95
E_{a_V}	kJ	90	10	130	87
f_D	-	8.8E-05	1E-05	0.001	9.2e-5
f_E	-	0.00058	1E-05	0.001	6.1e-4
f_M	-	0.043	0.001	0.1	0.071
f_{ug}	-	0.6	0.3	0.8	0.7
f_{ge}	-	0.025	0.01	0.1	0.025
K_{D_ref}	kg C m^{-3}	60	30	300	50
n	-	2.7	1	3	2.3
m	-	1.2	1	3	1.2
r_{ed_ref}	h^{-1}	0.0002	1E-05	0.001	5e-4
r_{md_ref}	h^{-1}	0.002	0.001	0.01	1.5e-3
r_{mr_ref}	h^{-1}	4E-05	1E-06	0.001	4.2e-5
V_{D_ref}	h^{-1}	0.3	0.1	1	0.35
V_{U_ref}	h^{-1}	0.09	0.01	0.1	0.092