Supporting information for "ORCHIMIC (v1.0), a microbe-driven model for soil organic matter decomposition designed for large-scale applications"

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18 **Table S1**. List of parameters with their prior values, range and optimized values for
19 CENTURY and PRIM models

Parameters	Units	Prior values (range)	CENTURY	PRIM	References
K_{LM}	d^{-1}	0.04 4.0×10^{-4}-0.4	3.99×10^{-3}	5.49×10^{-3}	*Parton et al., 1987*
K_{SS}	d^{-1}	0.0011 1.1×10^{-5}-0.11	3.06×10^{-4}	8.32×10^{-4}	*Parton et al., 1987*
Adj_{SA}	unitless	37 (18.5-74)	64.2	61.2	*Parton et al., 1987*
Adj_{SP}	unitless	29 (14.5-58)	31.5	29.1	*Parton et al., 1987*
c_{SA}	kg soil/g C	493.7 (0.0002-1000)	-	0.252	*Guenet et al., 2016*
c_{SS}	kg soil/g C	193.0 (0.0002-1000)	-	514	*Guenet et al., 2016*
c_{SP}	kg soil/g C	136.5 (0.0002-1000)	-	2.00×10^{-4}	*Guenet et al., 2016*

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21 **Table S2**. Akaike information criterion (AIC) values for different models

Models	*RF* only	*RS* only	RS_{Ctrl} only	Priming effect only	All
CENTURY	214.5	36.1	-34.0	1530.8	1723.4
PRIM	85.8	11.0	-20.3	67.7	102.2
C-MFT1	-86.8	-39.3	-52.9	1.2	-309.7
C-MFT2	-93.8	-46.2	-51.8	-26.5	-350.4
C-MFT3	-92.2	-43.4	-50.7	-21.1	-339.4
CN-MFT1	-90.2	-40.0	-53.1	-4.7	-319.9
CN-MFT2	-93.8	-46.2	-51.8	-26.5	-350.4
CN-MFT3	-83.9	-37.2	-52.1	-2.0	-307.3

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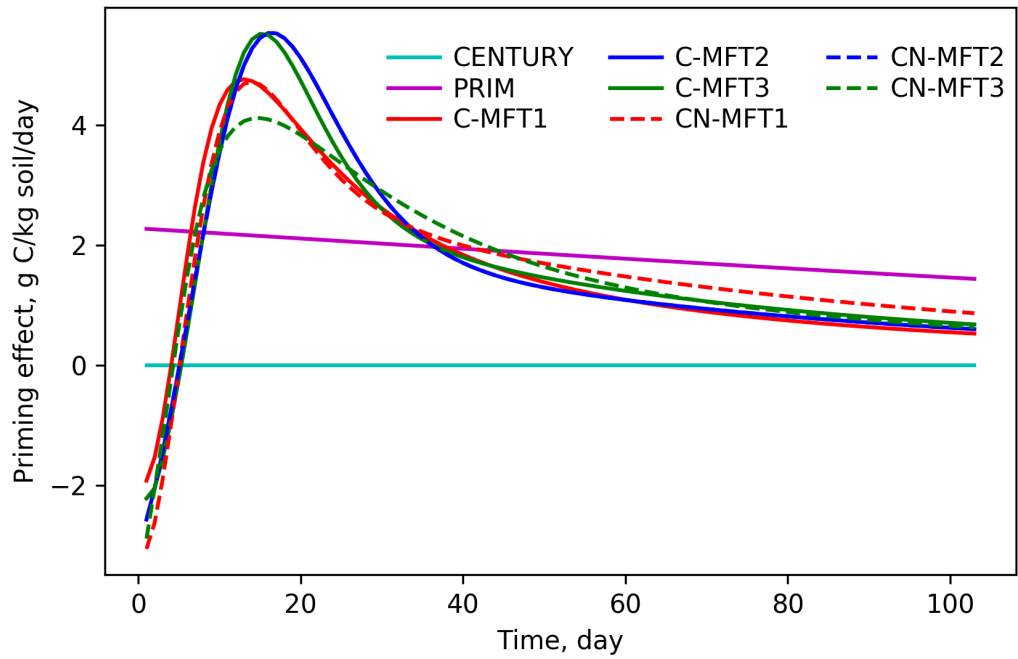
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24 **Figure S1**. Modelled priming effects by CENTURY, PRIM and 6 ORCHIMIC variants (C-
25 MFT2 overlapped with CN-MFT2)

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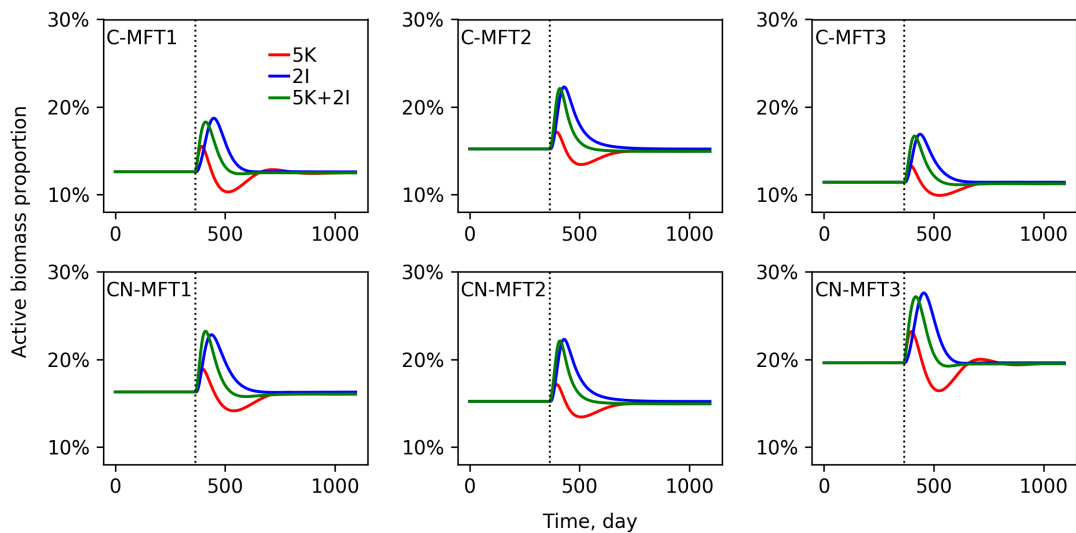
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28 **Figure S2**. Change of active biomass proportion when temperature is stepwise increased by
29 5K at T=295.15 K (5K), when FOM input doubles (2I) and both (5K+2I). The vertical black
30 dotted line shows the time when the change of temperature and/or input was implemented

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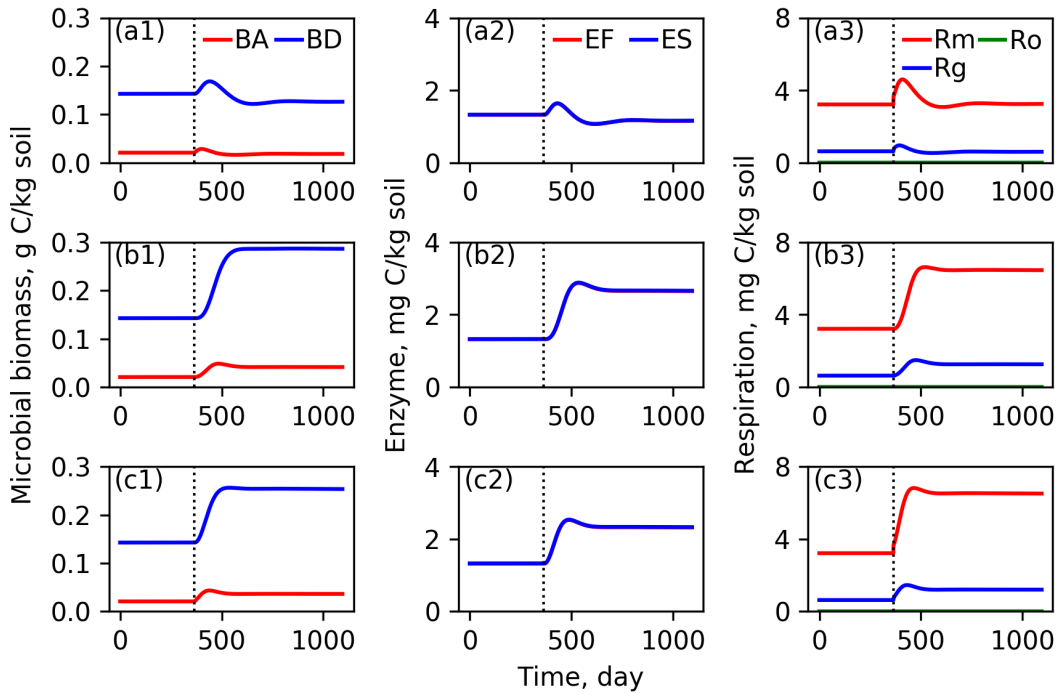


Figure S3. Evolutions of active (*BA*) and dormant (*BD*) microbial biomass, FOM-decomposing enzymes (*EF*) and SOM-decomposing enzymes (*ES*), maintenance respiration (*Rm*), growth respiration (*Rg*) and overflow respiration (*Ro*) for C-MFT1 (a ORCHIMIC variant with one generalist and no N dynamics) when temperature is stepwise increased by 5K (a1, a2 and, a3), when FOM input doubles (b1, b2 and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when 5K-stepwise increase of temperature and/or doubling input was implemented

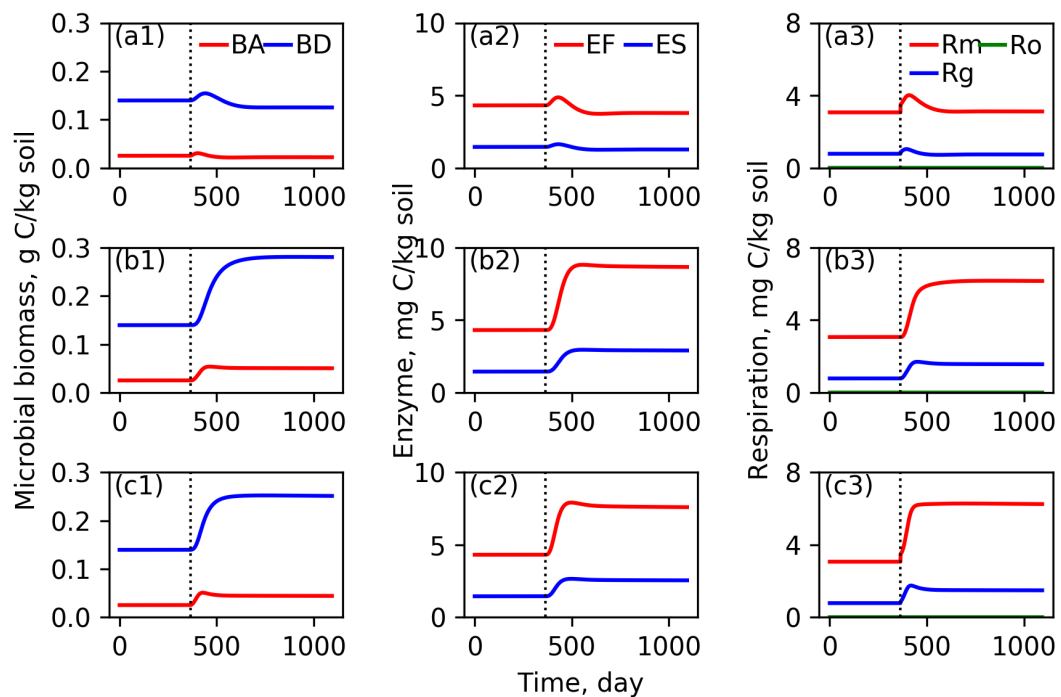
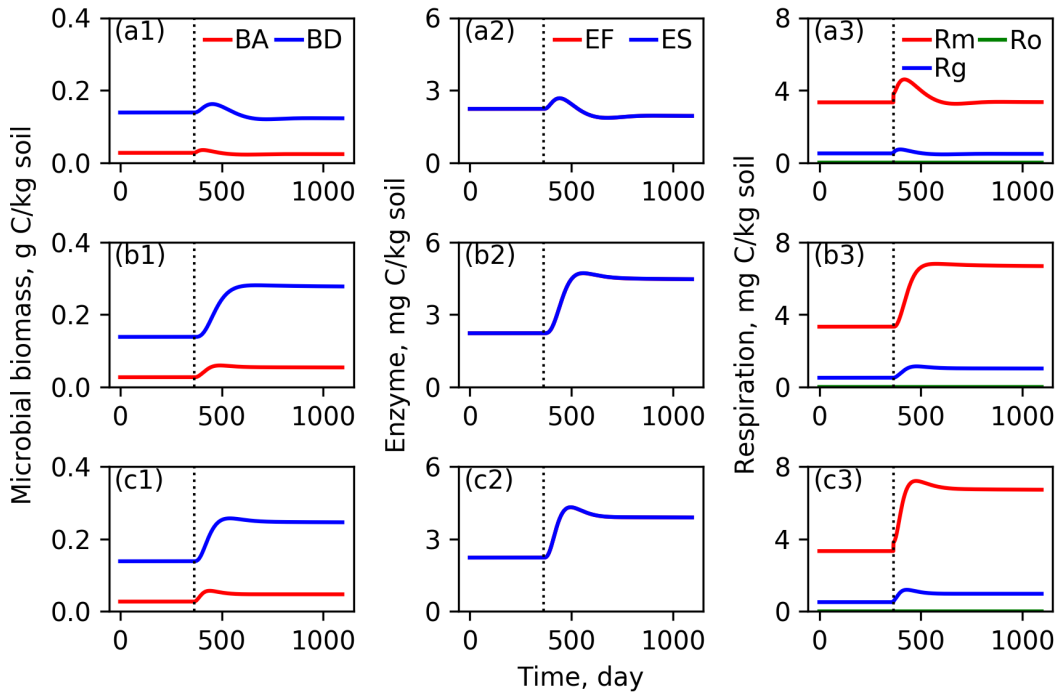



Figure S4. Evolutions of active (*BA*) and dormant (*BD*) microbial biomass, FOM-

Figure S5. Evolutions of active (*BA*) and dormant (*BD*) microbial biomass, FOM-decomposing enzymes (*EF*) and SOM-decomposing enzymes (*ES*), maintenance respiration (*Rm*), growth respiration (*Rg*) and overflow respiration (*Ro*) for C-MFT3 (a ORCHIMIC variant with three MFTs (one generalist, one FOM specialist and one SOM specialist) and no N dynamics) when temperature is stepwise increased by 5K (a1, a2 and a3), when FOM input doubles (b1, b2 and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when 5K-stepwise increase of temperature and/or doubling input was implemented

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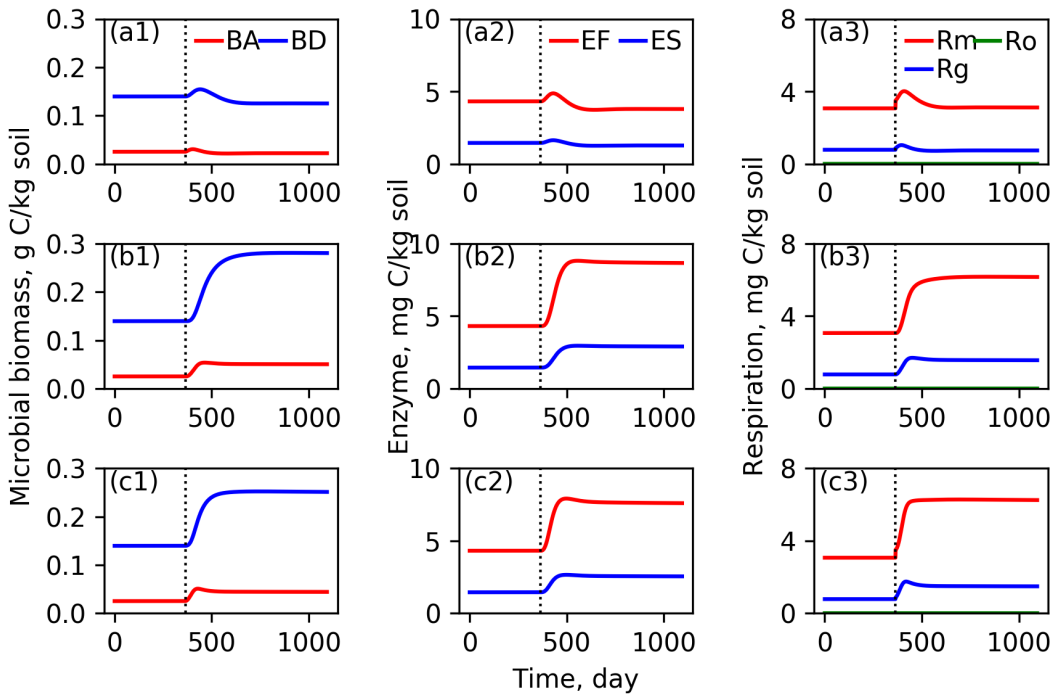
60 **Figure S6**. Evolutions of active (*BA*) and dormant (*BD*) microbial biomass, FOM-
61 decomposing enzymes (*EF*) and SOM-decomposing enzymes (*ES*), maintenance respiration
62 (*Rm*), growth respiration (*Rg*) and overflow respiration (*Ro*) for CN-MFT1 (a ORCHIMIC
63 variant with one generalist and N dynamics) when temperature is stepwise increased by 5K
64 (a1, a2 and, a3), when FOM input doubles (b1, b2 and b3), and both (c1, c2 and c3). The
65 vertical black dotted line shows the time when 5K-stepwise increase of temperature and/or
66 doubling input was implemented

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68 **Figure S7**. Evolutions of active (*BA*) and dormant (*BD*) microbial biomass, FOM-
69 decomposing enzymes (*EF*) and SOM-decomposing enzymes (*ES*), maintenance respiration

(*Rm*), growth respiration (*Rg*) and overflow respiration (*Ro*) for C-MFT3 (a ORCHIMIC variant with two MFTs (one FOM specialist and one SOM specialist) and N dynamics) when temperature is stepwise increased by 5K (a1, a2 and, a3), when FOM input doubles (b1, b2 and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when 5K-stepwise increase of temperature and/or doubling input was implemented
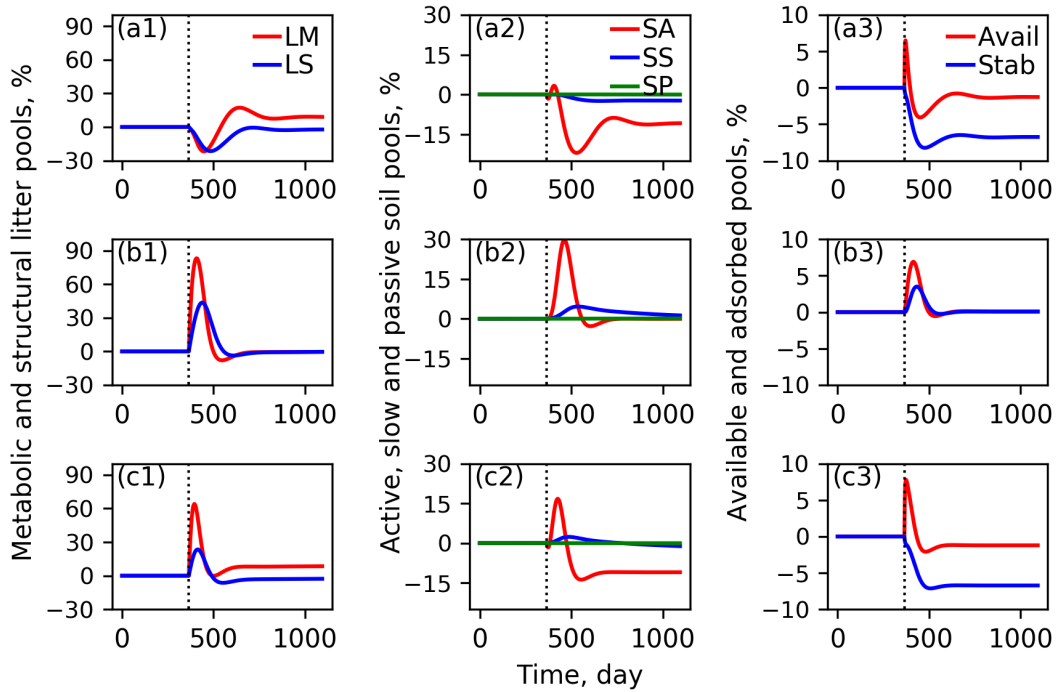
Figure S8. Relative change of C in metabolic (*LM*) and structural (*LS*) litter pools (a1, b1 and c1), active (*SA*), slow (*SS*) and passive (*SP*) soil pools (a2, b2 and c2), available (*Avail*) and absorbed (*Absorb*) pools (a3, b3 and c3) for C-MFT1 model when temperature is stepwise-increased by 5K at T = 295.15 K (a1, a2 and a3), when FOM input doubles (b1, b2 and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when the change of temperature and/or input was implemented

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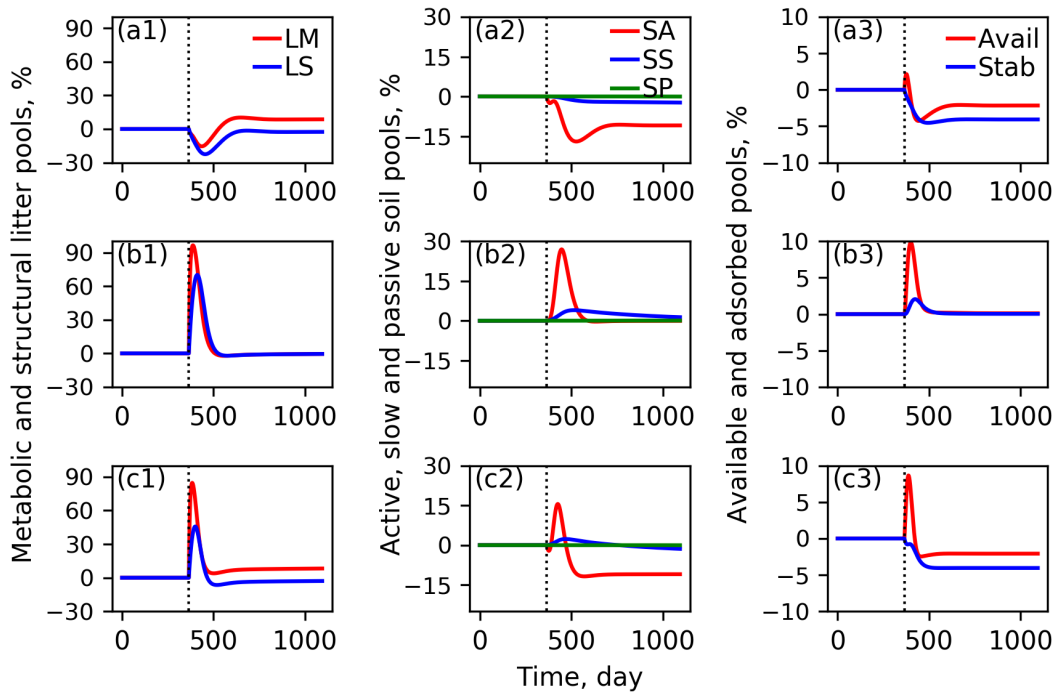


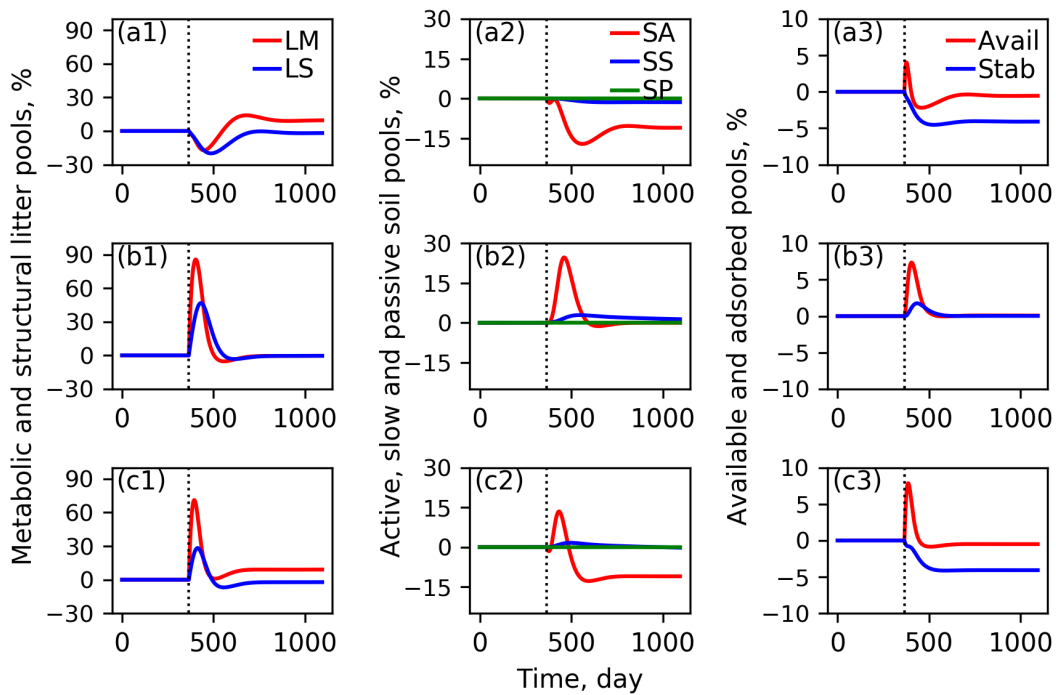
Figure S9. Relative change of C in metabolic (*LM*) and structural (*LS*) litter pools (a1, b1 and c1), active (*SA*), slow (*SS*) and passive (*SP*) soil pools (a2, b2 and c2), available (*Avail*) and absorbed (*Absorb*) pools (a3, b3 and c3) for C-MFT2 model when temperature is stepwise-increased by 5K at T = 295.15 K (a1, a2 and a3), when FOM input doubles (b1, b2 and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when the change of temperature and/or input was implemented

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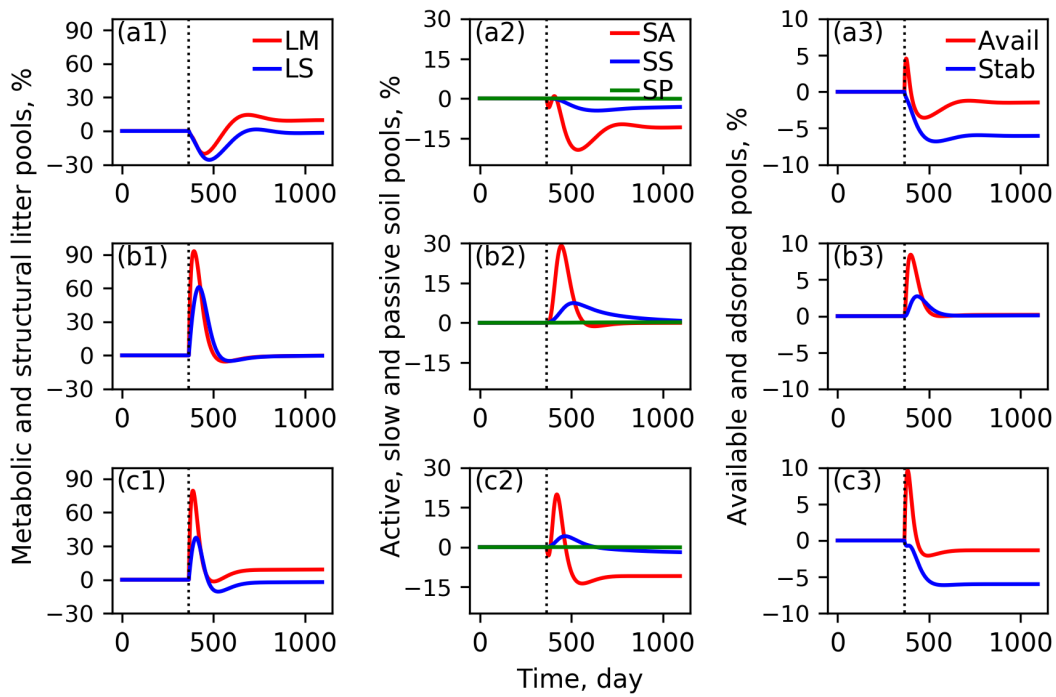
Figure S10. Relative change of C in metabolic (*LM*) and structural (*LS*) litter pools (a1, b1 and c1), active (*SA*), slow (*SS*) and passive (*SP*) soil pools (a2, b2 and c2), available (*Avail*) and absorbed (*Absorb*) pools (a3, b3 and c3) for C-MFT3 model when temperature is

93   stepwise-increased by 5K at T = 295.15 K (a, a2 and a3), when FOM input doubles (b1, b2
94   and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when the
95   change of temperature and/or input was implemented

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97   **Figure S11**. Relative change of C in metabolic (*LM*) and structural (*LS*) litter pools (a1, b1
98   and c1), active (*SA*), slow (*SS*) and passive (*SP*) soil pools (a2, b2 and c2), available (*Avail*)
99   and absorbed (*Absorb*) pools (a3, b3 and c3) for CN-MFT1 model when temperature is
100   stepwise-increased by 5K at T = 295.15 K (a1, a2 and a3), when FOM input doubles (b1, b2
101   and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when the
102   change of temperature and/or input was implemented

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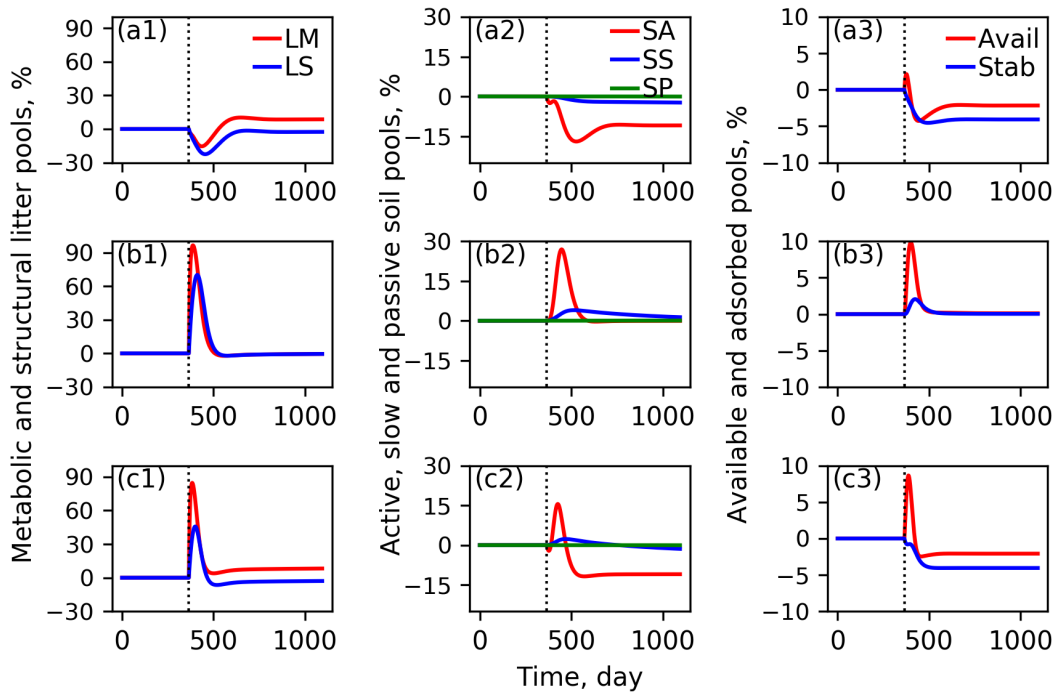
Figure S12. Relative change of C in metabolic (*LM*) and structural (*LS*) litter pools (a1, b1 and c1), active (*SA*), slow (*SS*) and passive (*SP*) soil pools (a2, b2 and c2), available (*Avail*) and absorbed (*Absorb*) pools (a3, b3 and c3) for CN-MFT2 model when temperature is stepwise-increased by 5K at T = 295.15 K (a1, a2 and a3), when FOM input doubles (b1, b2 and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when the change of temperature and/or input was implemented

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