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*Supplement of*

## **ORCHIMIC (v1.0), a microbe-mediated model for soil organic matter decomposition**

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

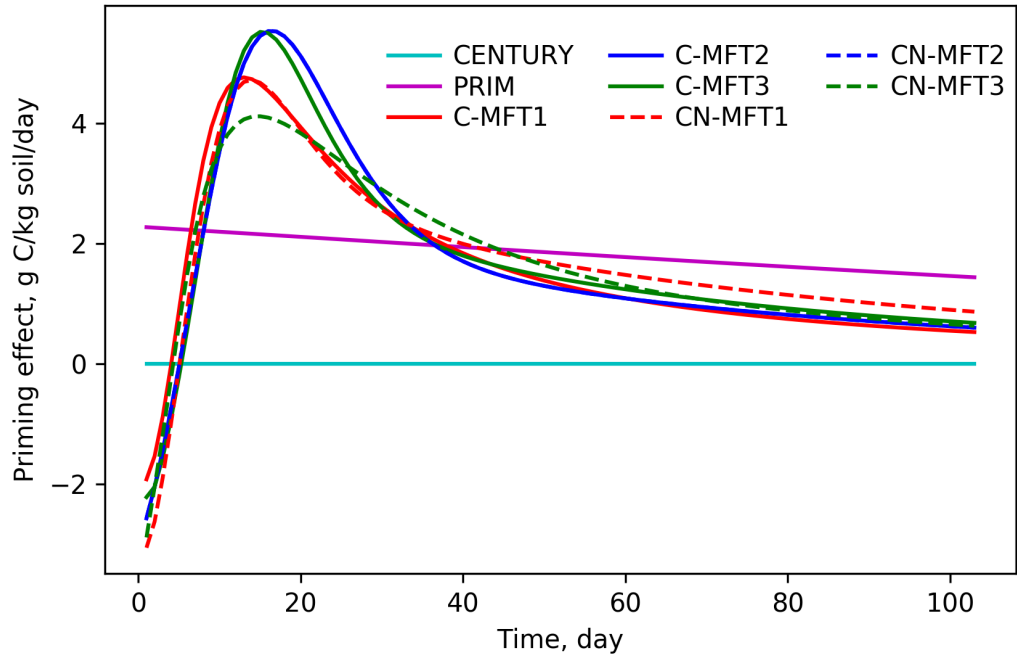
Parameters	Units	Prior values (range)	CENTURY	PRIM	References
$K_{LM}$	d <sup>-1</sup>	0.04 4.0×10 <sup>-4</sup> -0.4	3.99×10 <sup>-3</sup>	5.49×10 <sup>-3</sup>	<i>Parton et al., 1987</i>
$K_{SS}$	d <sup>-1</sup>	0.0011 1.1×10 <sup>-5</sup> -0.11	3.06×10 <sup>-4</sup>	8.32×10 <sup>-4</sup>	<i>Parton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

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

Models	RF only	RS only	RS <sub>Ctrl</sub> 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

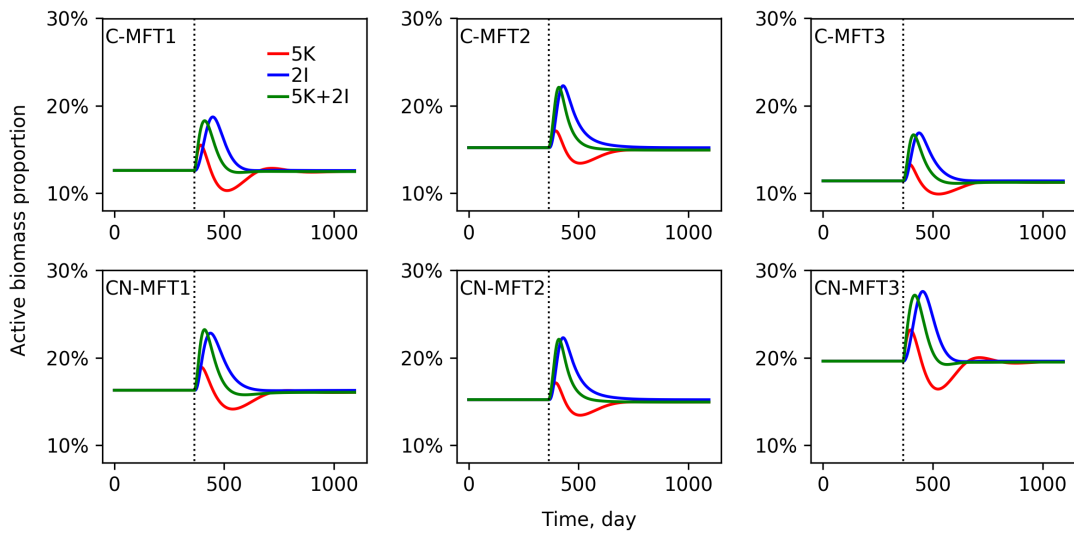
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24 **Figure S1.** Modelled priming effects by CENTURY, PRIM and 6 ORCHIMIC variants (C-  
 25 MFT2 overlapped with CN-MFT2)

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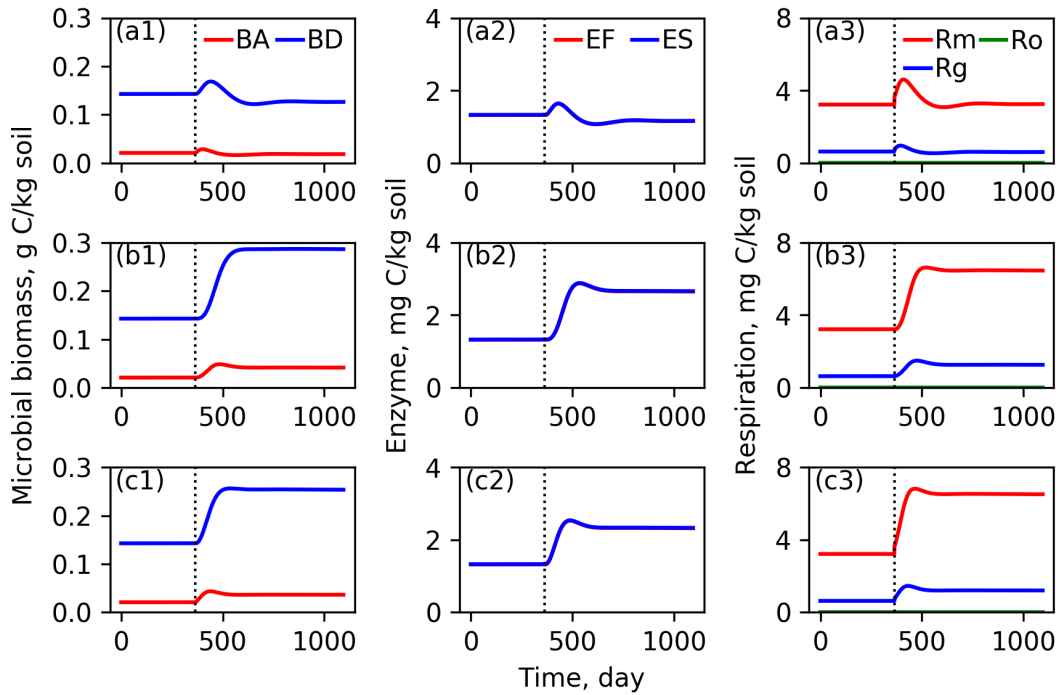


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28 **Figure S2.** Change of active biomass proportion when temperature is stepwise increased by  
 29 5K at  $T=295.15$  K (5K), when FOM input doubles (2I) and both (5K+2I). The vertical black  
 30 dotted line shows the time when the change of temperature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

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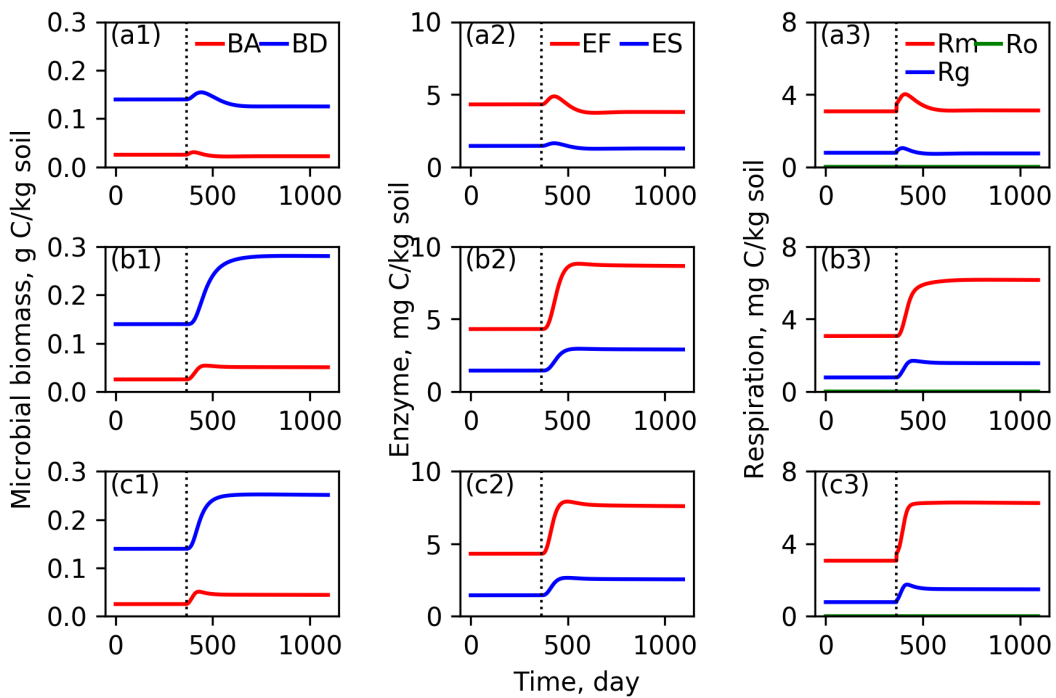
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34 **Figure S3.** Evolutions of active (*BA*) and dormant (*BD*) microbial biomass, FOM-  
 35 decomposing enzymes (*EF*) and SOM-decomposing enzymes (*ES*), maintenance respiration  
 36 (*Rm*), growth respiration (*Rg*) and overflow respiration (*Ro*)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

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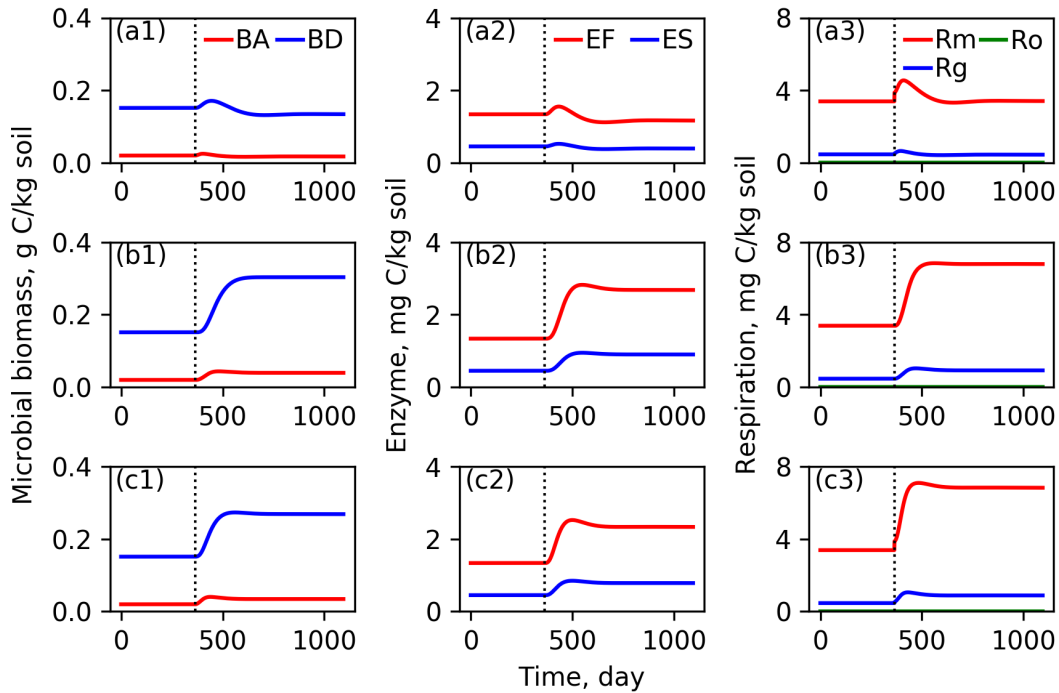


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43 **Figure S4.** Evolutions of active (*BA*) and dormant (*BD*) microbial biomass, FOM-

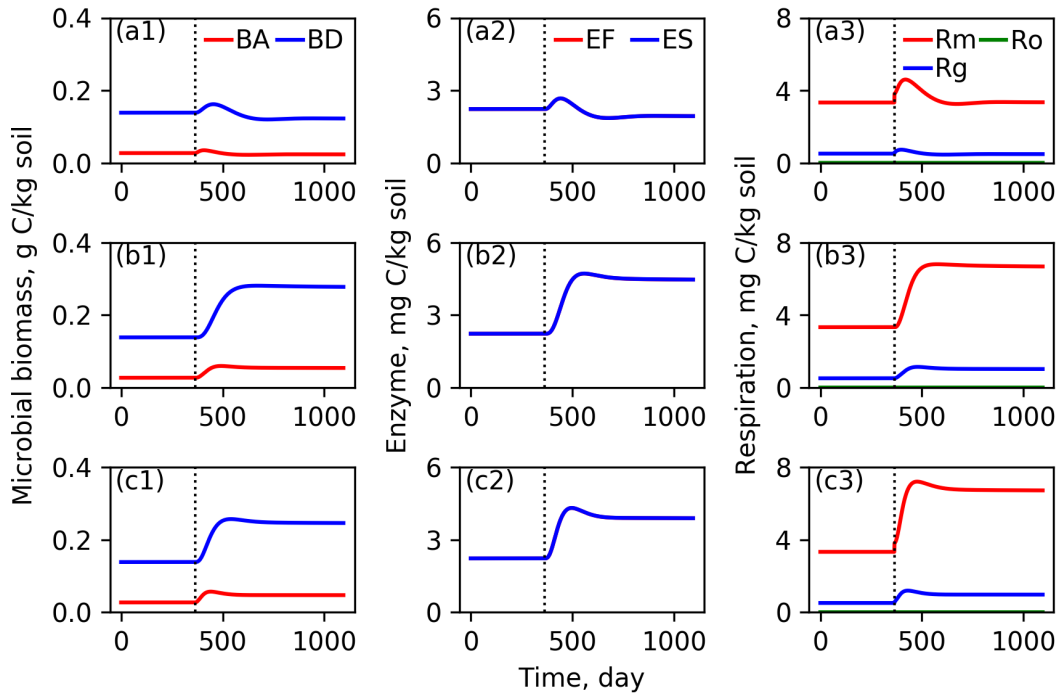
44 decomposing enzymes (*EF*) and SOM-decomposing enzymes (*ES*), maintenance respiration  
 45 (*Rm*), growth respiration (*Rg*) and overflow respiration (*Ro*) for C-MFT2 (a ORCHIMIC  
 46 variant with two MFTs (one FOM specialist and one SOM specialist) and no N dynamics)  
 47 when temperature is stepwise increased by 5K (a1, a2 and a3), when FOM input doubles (b1,  
 48 b2 and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when 5K-  
 49 stepwise increase of temperature and/or doubling input was implemented

50



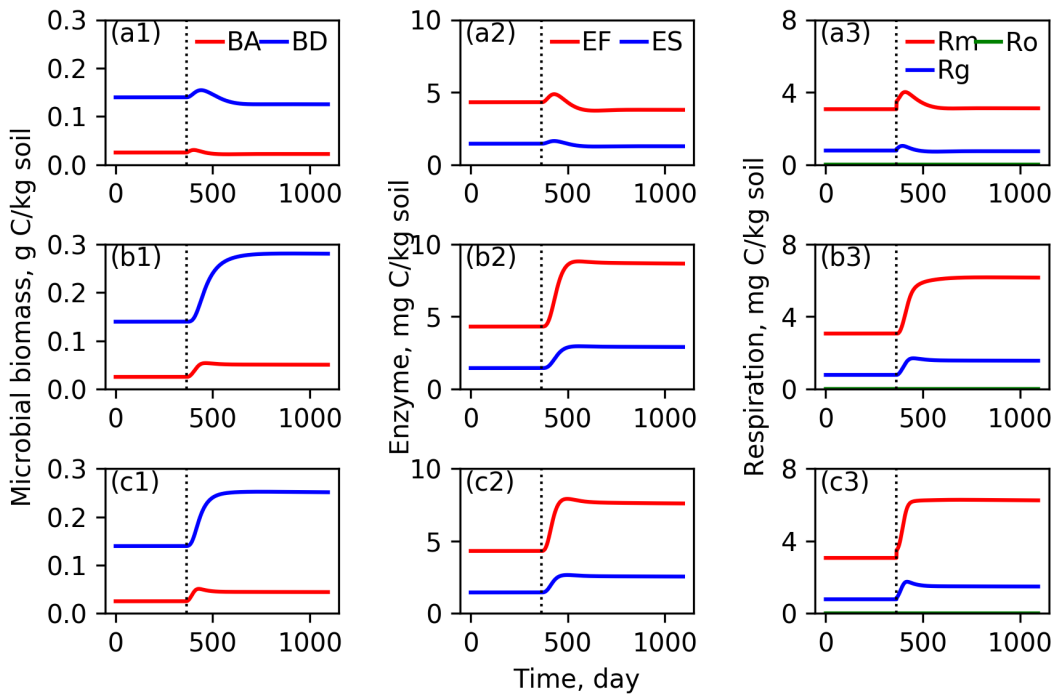
51

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



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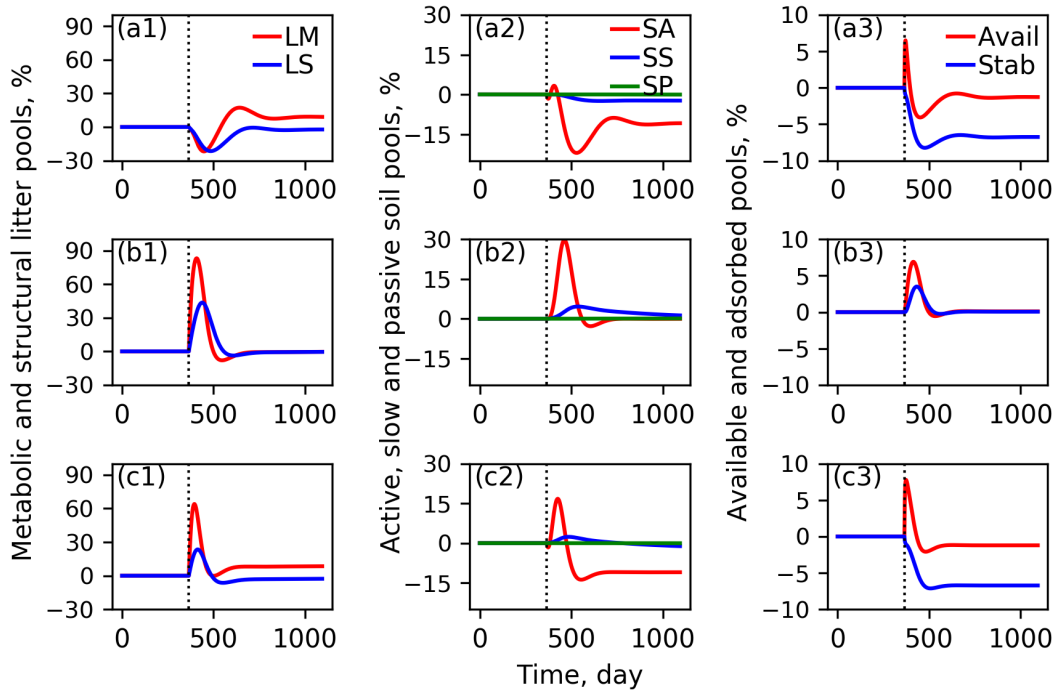
60 **Figure S6.** Evolutions of active (*BA*) and dormant (*BD*) microbial biomass, FOM-  
 61 decomposing enzymes (*EF*) and SOM-decomposing enzymes (*ES*), maintenance respiration  
 62 (*Rm*), growth respiration (*Rg*) and overflow respiration (*Ro*) for CN-MFT1 (a ORCHIMIC  
 63 variant with one 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



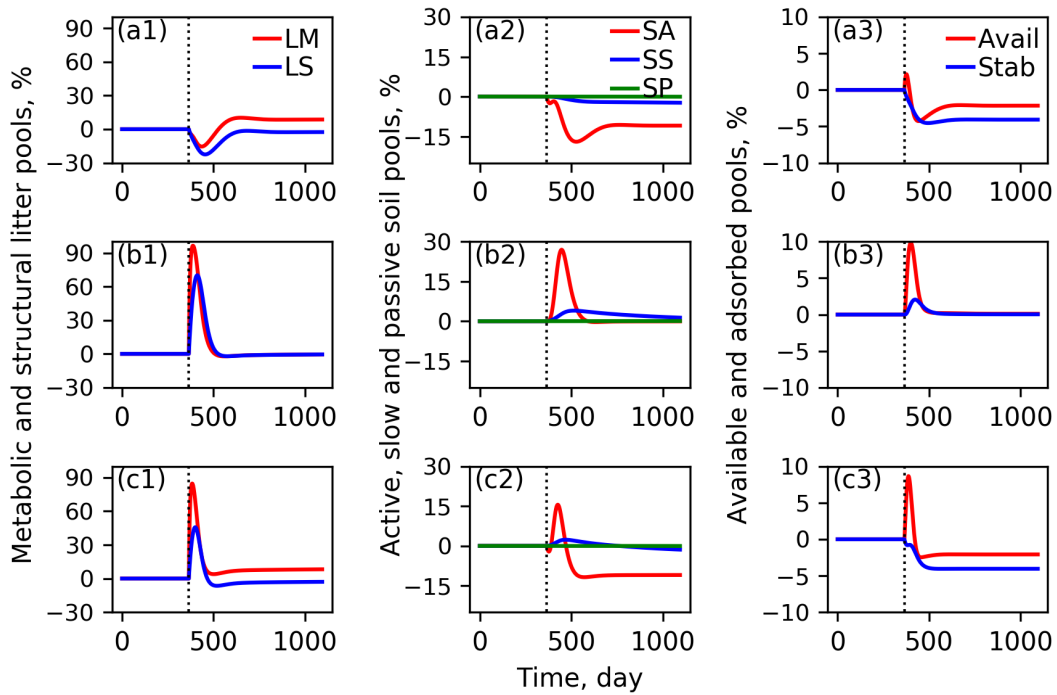
67

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

70 ( $R_m$ ), growth respiration ( $R_g$ ) and overflow respiration ( $R_o$ ) for C-MFT3 (a ORCHIMIC  
 71 variant with two MFTs (one FOM specialist and one SOM specialist) and N dynamics) when  
 72 temperature is stepwise increased by 5K (a1, a2 and, a3), when FOM input doubles (b1, b2  
 73 and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when 5K-  
 74 stepwise increase of temperature and/or doubling input was implemented

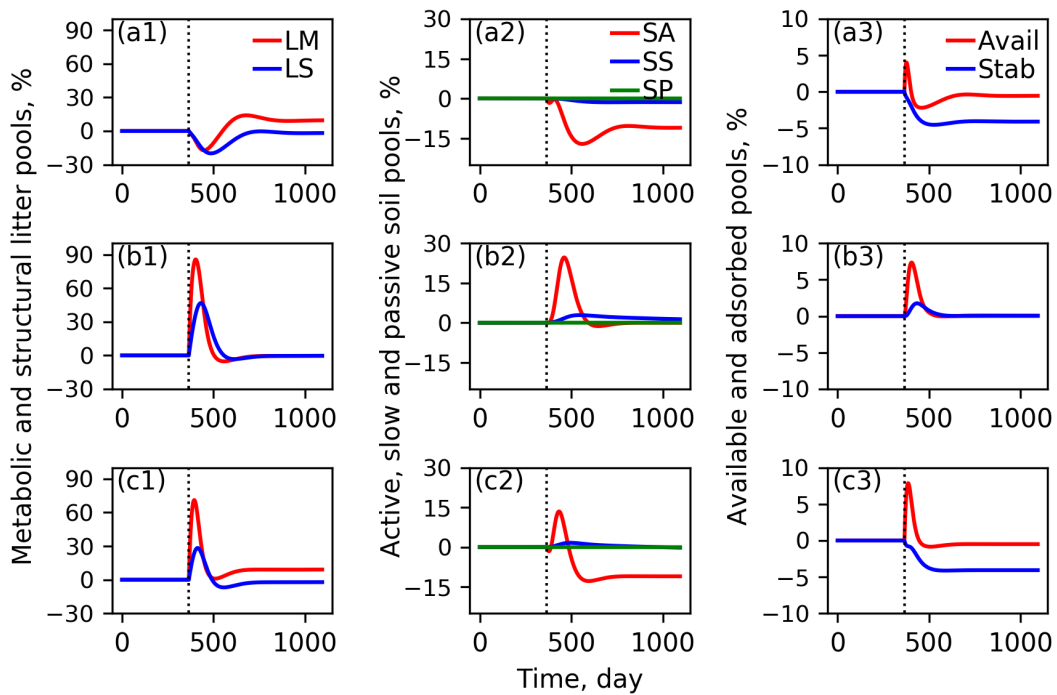


75  
 76 **Figure S8.** Relative change of C in metabolic ( $LM$ ) and structural ( $LS$ ) litter pools (a1, b1 and  
 77 c1), active ( $SA$ ), slow ( $SS$ ) and passive ( $SP$ ) soil pools (a2, b2 and c2), available ( $Avail$ ) and  
 78 absorbed ( $Absorb$ ) pools (a3, b3 and c3) for C-MFT1 model when temperature is stepwise-  
 79 increased by 5K at  $T = 295.15$  K (a1, a2 and a3), when FOM input doubles (b1, b2 and b3),  
 80 and both (c1, c2 and c3). The vertical black dotted line shows the time when the change of  
 81 temperature and/or input was implemented



82

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

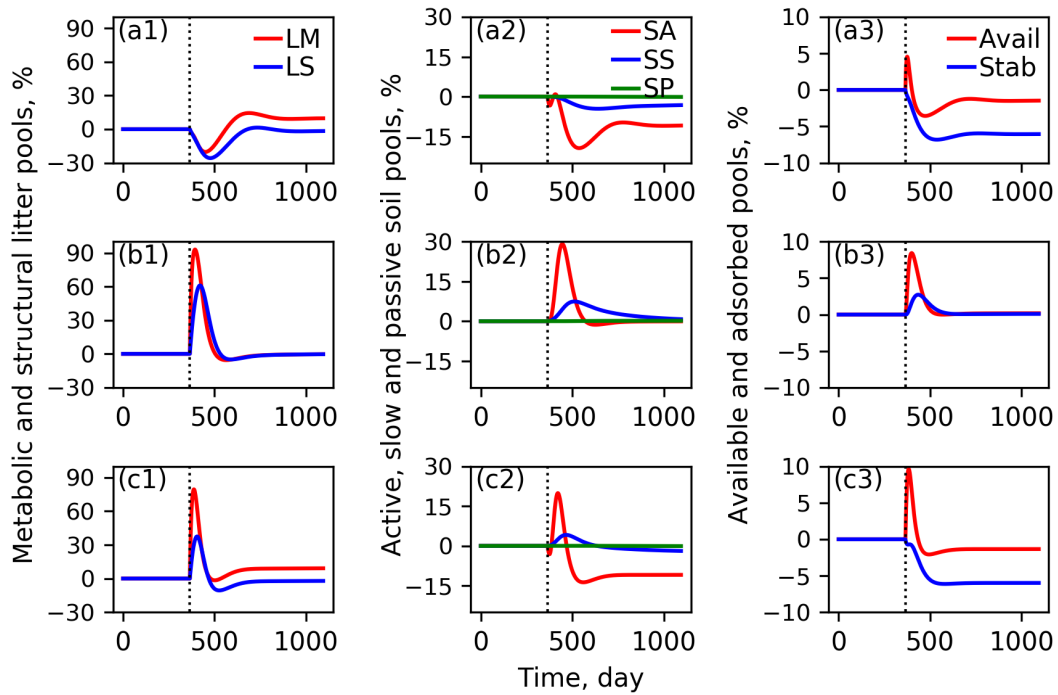


89

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



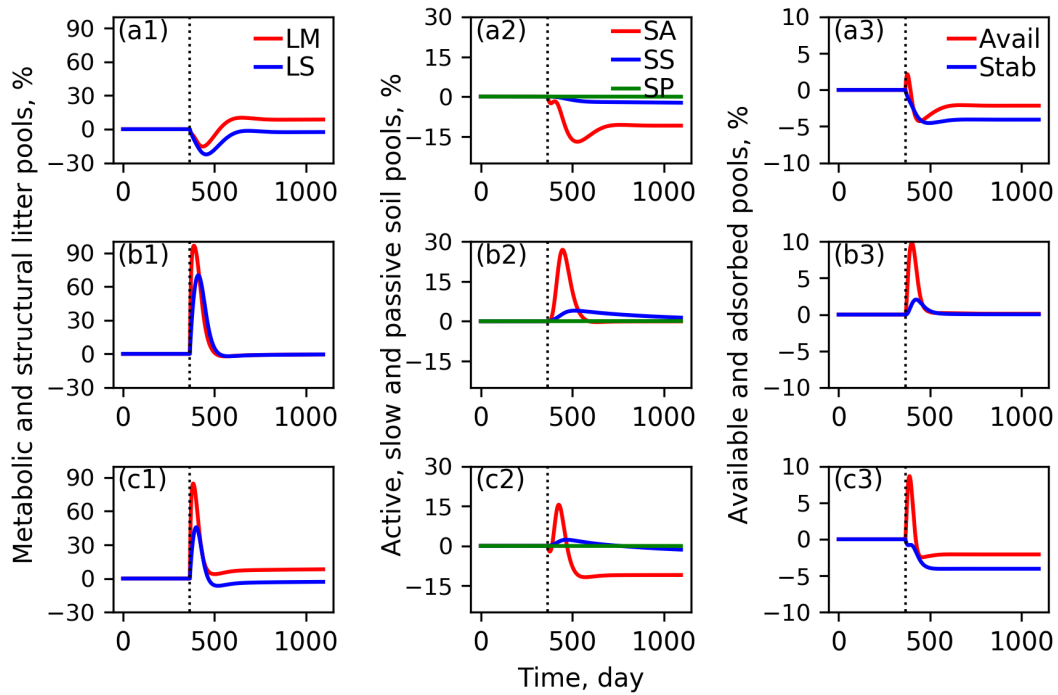
93 stepwise-increased by 5K at  $T = 295.15$  K (a, a2 and a3), when FOM input doubles (b1, b2  
 94 and b3), and both (c1, c2 and c3). The vertical black dotted line shows the time when the  
 95 change of temperature and/or input was implemented



96

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 adsorbed (*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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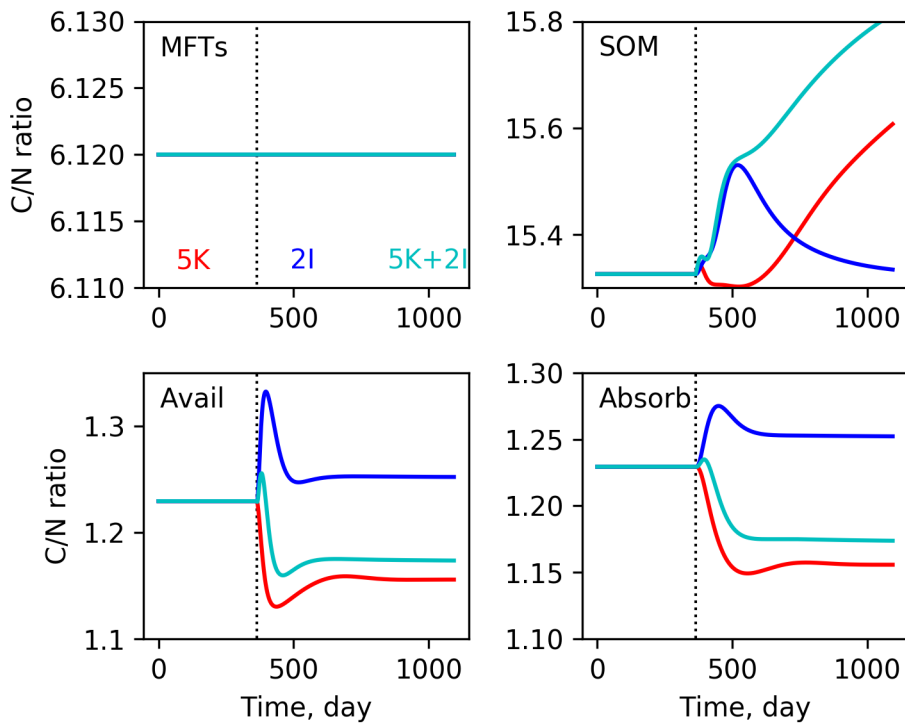


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105 **Figure S12.** Relative change of C in metabolic (*LM*) and structural (*LS*) litter pools (a1, b1  
 106 and c1), active (*SA*), slow (*SS*) and passive (*SP*) soil pools (a2, b2 and c2), available (*Avail*)  
 107 and adsorbed (*Absorb*) pools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

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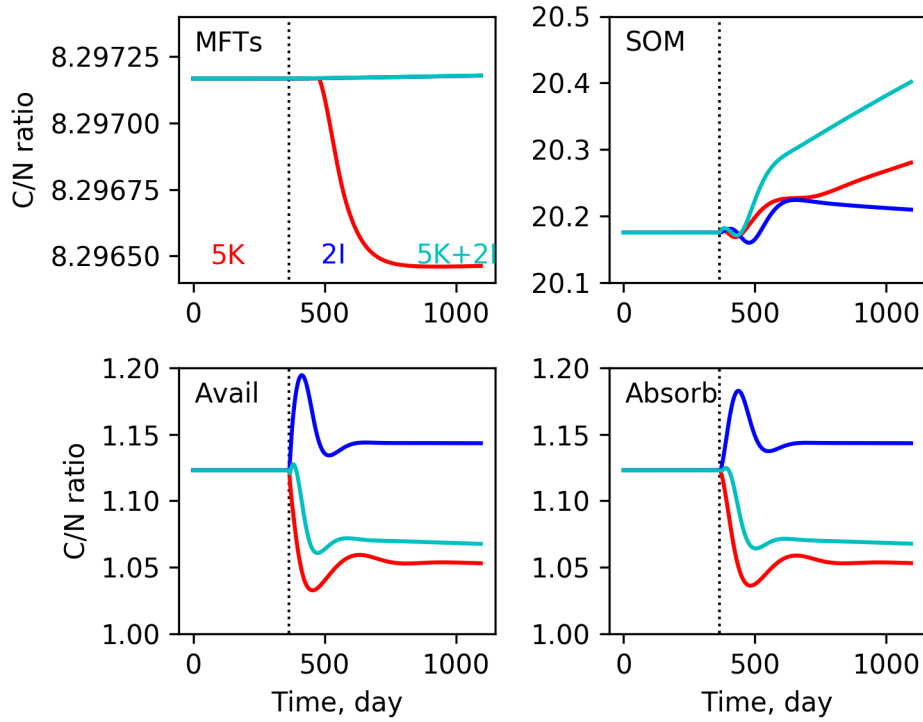


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114 **Figure S13.** Change of C/N ratios for microbial (MFTs), soil organic matter (SOM), available

115 (*Avail*) and absorbed (*Absorb*) pools for CN-MFT1 model when temperature is stepwise-  
 116 increased by 5K at T = 295.15 K (5K), when FOM input doubles (2I), and both (5K+2I). The  
 117 vertical black dotted line shows the time when the change of temperature and/or input was  
 118 implemented

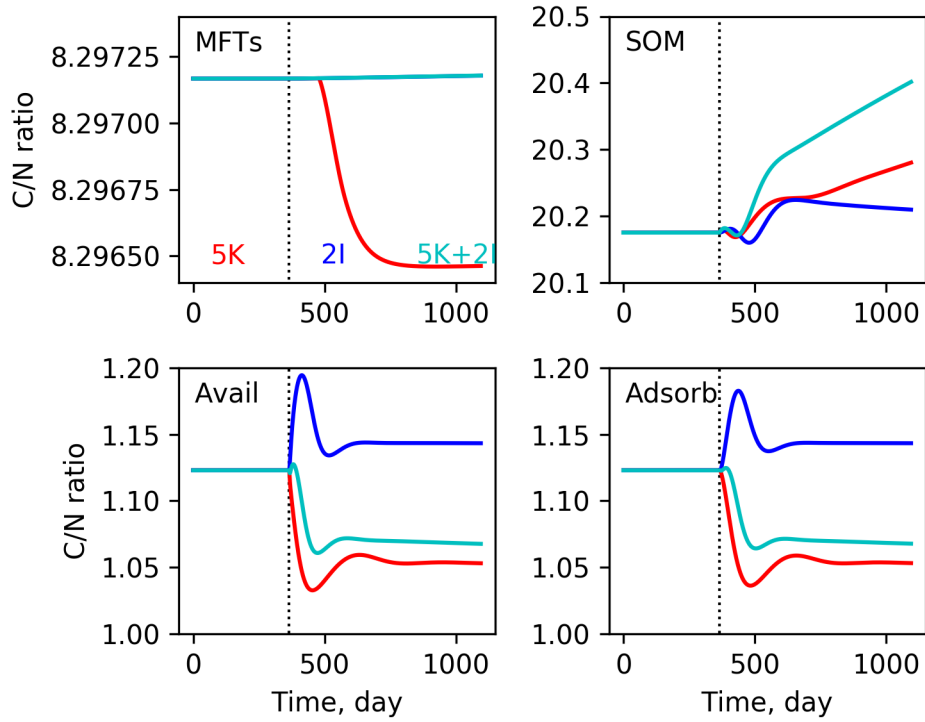
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123 **Figure S14.** Change of C/N ratios for microbial (MFTs), soil organic matter (SOM), available  
 124 (*Avail*) and absorbed (*Absorb*) pools for CN-MFT2 model when temperature is stepwise-  
 125 increased by 5K at T = 295.15 K (5K), when FOM input doubles (2I), and both (5K+2I). The  
 126 vertical black dotted line shows the time when the change of temperature and/or input was  
 127 implemented

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**Figure S15.** Change of C/N ratios for microbial (MFTs), soil organic matter (SOM), available (*Avail*) and absorbed (*Absorb*) pools for CN-MFT3 model when temperature is stepwise-increased by 5K at T = 295.15 K (5K), when FOM input doubles (2I), and both (5K+2I). The vertical black dotted line shows the time when the change of temperature and/or input was implemented