



*Supplement of*

## **Calibrating the soil organic carbon model Yasso20 with multiple datasets**

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Supplemental Table 1: Fractioning of litter input into different Yasso pools based on a rough determination if the ecosystem is a non-forest, semi-forest or forest. In this study the NPP was multiplied by these factors.

	Non-Forest	Semi-Forest	Forest
Non-woody fraction	1	0.7	0.4
Small woody fraction	0	0.2	0.3
Large woody fraction	0	0.1	0.3
A_Non-woody	0.5	0.5	0.5
W_Non-woody	0.2	0.2	0.2
E_Non-woody	0.1	0.1	0.1
N_Non-woody	0.2	0.2	0.2
A_Small woody	-	0.7	0.7
W_Small woody	-	0	0
E_Small woody	-	0	0
N_Small woody	-	0.3	0.3
A_Large woody	-	0.7	0.7
W_Large woody	-	0	0
E_Large woody	-	0	0
N_Large woody	-	0.3	0.3
Size_Non-woody	0	0	0
Size_Small woody	2	2	2
Size_Large woody	10	10	10

Supplemental Table 2: The litterfall amount ( $\text{kgC y}^{-1}$ ) and fractions for the SOC measurement sites in Hyytiälä, Finland.

	CT_SP	VT_SP	VT_NS	MT_SP	MT_NS	OMT_NS
Non-woody litter	0.171	0.211	0.251	0.234	0.249	0.262
Non-woody size	0	0	0	0	0	0
A_Non_woody	0.573	0.569	0.539	0.565	0.539	0.538
W_Non_woody	0.156	0.153	0.134	0.151	0.135	0.135
E_Non_woody	0.075	0.07	0.06	0.075	0.059	0.059
N_Non_woody	0.196	0.203	0.267	0.209	0.267	0.268
Small woody litter	0.066	0.093	0.124	0.122	0.14	0.164
Small woody size	2	2	2	2	2	2
A_Small_woody	0.475	0.475	0.475	0.475	0.475	0.475
W_Small_woody	0.019	0.019	0.019	0.019	0.019	0.019
E_Small_woody	0.078	0.078	0.078	0.078	0.078	0.078
N_Small_woody	0.428	0.428	0.428	0.428	0.428	0.428
Large woody litter	0.025					
Large woody size	10	10	10	10	10	10
A_Large_woody	0.67	0.67	0.473	0.67	0.473	0.473
W_Large_woody	0.023	0.023	0.114	0.023	0.114	0.114
E_Large_woody	0.008	0.008	0.041	0.041	0.008	0.041
N_Large_woody	0.299	0.299	0.372	0.299	0.372	0.372

Supplemental Table 3: Climate drivers used for Hyytiälä, Finland. Values averaged for 2010-2020 from the local measurement information

Annual precipitation (mm y <sup>-1</sup> )	684.675
January mean temperature (C)	-6.64
February mean temperature (C)	-6.38
March mean temperature (C)	-2.99
April mean temperature (C)	3.05
May mean temperature (C)	9.52
June mean temperature (C)	13.69
July mean temperature (C)	16.62
August mean temperature (C)	14.84
September mean temperature (C)	10.1
October mean temperature (C)	4.05
November mean temperature (C)	0.1
December mean temperature (C)	-3.64

Supplemental Table 4 The estimated parameter value MAPs and Gelman-Rubin coefficients for DEzs, DREAMzs and AM for global calibration against all data streams. Parameter that did not pass the G-R test are bolded.

	DEzs MAP	DEzs G-R	DREAMzs MAP	DREAMzs G-R	AM MAP	AM G-R
$\alpha_A$	0.51	1.01	0.46	1.06	<b>0.53</b>	<b>1.15</b>
$\alpha_W$	5.19	1.01	4.7	1.06	<b>5.37</b>	<b>1.17</b>
$\alpha_E$	0.13	1.01	0.11	1.04	<b>0.13</b>	<b>1.23</b>
$\alpha_N$	0.10	1.01	0.1	1.05	<b>0.1</b>	<b>1.31</b>
$\alpha_H$	0.001	1.02	0.002	1.02	0.002	1.07
pWA	0.5	1.00	0.5	1.03	0.50	1.04
pWN	0.16	1.01	0.17	1.08	0.16	1.06
pEW	0.99	1.02	0.97	1.09	0.98	1.09
pH	0.004	1.01	0.004	1.04	0.005	1.00
wED	-0.19	1.01	-0.18	1.03	-0.19	1.03
wCIDET	-0.03	1.01	-0.02	1.04	-0.02	1.04
wLIDET	0.	1.01	0.	1.01	0.	1.04
$\beta_1$	0.16	1.00	0.17	1.08	<b>0.16</b>	<b>1.30</b>
$\beta_2$	-0.002	1.00	-0.002	1.07	<b>-0.002</b>	<b>1.48</b>
$\beta_{1N}$	0.17	1.00	<b>0.18</b>	<b>1.12</b>	<b>0.19</b>	<b>1.28</b>
$\beta_{2N}$	-0.005	1.00	<b>-0.005</b>	<b>1.13</b>	<b>-0.006</b>	<b>1.38</b>
$\beta_{1H}$	0.07	1.02	<b>0.07</b>	<b>1.15</b>	<b>0.07</b>	<b>1.55</b>
$\beta_{2H}$	0.	1.02	<b>0.</b>	<b>1.18</b>	<b>0.</b>	<b>1.28</b>
$\gamma$	-1.44	1.01	-1.66	1.09	<b>-1.58</b>	<b>1.30</b>
$\gamma_N$	-2.0	1.04	-2.0	1.07	<b>-1.99</b>	<b>1.19</b>
$\gamma_H$	-6.9	1.01	-5.78	1.09	<b>-8.56</b>	<b>1.30</b>
$\phi_1$	-2.55	1.01	-2.32	1.03	<b>-2.64</b>	<b>2.88</b>
$\phi_2$	1.24	1.01	1.18	1.05	<b>1.32</b>	<b>2.69</b>
R	0.25	1.01	0.25	1.05	<b>0.25</b>	<b>2.08</b>

Supplemental Table 5 Estimated parameter MAP values with DEzs approach using all the datasets opposed to the individual litter decomposition experiments in the calibration

Parameter	Global	CIDET	LIDET	ED
$\alpha_A$	0.51	1.33	0.60	0.58
$\alpha_W$	5.19	9.95	9.40	5.74
$\alpha_E$	0.13	0.14	0.00	0.17
$\alpha_N$	0.10	0.02	0.08	0.10
$\alpha_H$	0.0015	-	-	-
pWA	0.50	0.59	0.59	0.41
pWN	0.16	0.08	0.06	0.16
pEW	0.99	0.26	0.42	0.97
pH	0.0042	-	-	-
wED	-0.19	-	-	0.
wCIDET	-0.03	0.	-	-
wLIDET	0.	-	0.	-
$\beta_1$	0.16	0.19	0.13	0.19
$\beta_2$	-0.002	-0.003	-0.001	0.
$\beta_{1N}$	0.17	0.19	0.19	0.20
$\beta_{2N}$	-0.005	0.	-0.003	0.
$\beta_{1H}$	0.07	-	-	-
$\beta_{2H}$	0.	-	-	-
$\gamma$	-1.44	-0.46	-1.74	-0.88
$\gamma_N$	-2.0	-1.2	-0.06	-1.57
$\gamma_H$	-6.9	-	-	-
$\phi_1$	-2.55	-	-	-
$\phi_2$	1.24	-	-	-
r	0.25	-	-	-