Figure S1. Spatial domain defined by the Northern Circumpolar Soil Carbon Database version 2 (NCSCDv2) region. The tundra-taiga regions were separated based on the presence-absence of forested areas using the GlobCover map (http://due.esrin.esa.int/page_globcover.php). Forested areas included: closed to open broadleaved evergreen or semi-deciduous forest (>5m), closed (>40%) broadleaved deciduous forest (>5m), open (15-40%) broadleaved deciduous forest/woodland (>5m), closed (>40%) needleleaved evergreen forest (>5m), open (15-40%) needleleaved deciduous or evergreen forest (>5m) and closed to open (>15%) mixed broadleaved and needleleaved forest (>5m).

Table S1. DALEC2 model parameter description, and prior ranges based on ecologically viable limits.

Process	Parameter	Prior range	Units
Plant phenology	Leaf onset day	1-365	day
	Leaf fall leaf	1-365	day
	Leaf fall period	20-150	day
	Labile C release period	10-100	day
	Canopy efficency	5.0-50	
	Leaf mass per area	5-200	g C m^{-2}
Allocation of NPP	Fraction of GPP respired	0.3-0.7	
	Fraction of NPP to foliage C pool	0.01-1	
	Fraction of NPP to labile C pool	0.01-1	
	Fraction of NPP to roots C pool	0.01-1	
C pools	Foliar C pool	20-2000	g C m^{-2} yr
	Labile C pool	20-2000	g C m^{-2} yr
	Woody C pool	100-100000	g C m^{-2} yr
	Fine root C pool	20-2000	g C m^{-2} yr
	Litter C pool	20-2000	g C m^{-2} yr
	Soil organic matter C pool	100-200000	g C m^{-2} yr
Turnover rates	Lifespan	1.001-8	
	Wood turnover	0.000025-0.001	/day
	Root turnover	0.0001-0.01	/day
	Litter mineralization	0.0001-0.01	/day
	Soil organic matter mineralization	0.0000001-0.001	/day
	Decomposition rate	0.00001-0.01	/day
	Temperature dependence exponent factor	0.018-0.08	

35 **Table S2. Data set description of the 8 selected sites derived from the FLUXNET2015 database. MAT stands for Mean Annual Temperature while MAP for Mean Annual Precipitation.**

Site ID	DK-NuF	DK-ZaH	RU-Ha1	US-Prr	CA-Man	CA-NS7	RU-Sam	RU-Tks
Site Name	Nuuk Fen	Zackenberg Heath	Hakasia steppe	Poker Flat	Manitoba	UCI-1998 burn site	Samoylov	Tiksi
Latitude	64.1	74.5	54.7	65.1	55.9	56.6	72.4	71.6
Longitude	-51.4	-20.6	90.0	-147.5	-98.5	-99.9	126.5	128.9
MAT (°C)	-1.4	-9.0	-	-2.0	-3.2	-3.5	-	-12.7
MAP (mm)	750.0	211.0	-	275.0	520.0	483.0	-	323.0
Eco-type (IGBP)	Wetland	Heathland	Grasslands	Evergreen Needleleaf	Evergreen Needleleaf	Open shrubland	Grassland	Grasslands
Tundra-Taiga	Tundra	Tundra	Tundra	Taiga	Taiga	Taiga	Tundra	Tundra
Data availability	2008-2015	2000-2014	2002-2004	2010-2014	1994-2008	2002-2005	2002-2014	2010-2014

Table S3. General properties of the global vegetation models used in this study (derived from Nishima et al. 2014 and 2015).

GVM	Vegetation	Number of PFT	Nitrogen	Fire	Permafrost	Soil depth	Soil temperature function	Soil moisture function	Reference
HYBRID4	DGVM	6	Yes	No	No	-	Exponential with optimum	Optimum curve	Friend and White (2000)
JeDi	DGVM	15	No	No	No	> 5 m	Exponential (Q10: 1.4)	-	Pavlick et al. (2013)
JULES	DGVM	5	No	No	Yes	-	Exponential (Q10: 2.0)	Linear with plateau	Clark et al. (2011)
LPJml	DGVM	10	No	Yes	Yes	3 m	Lloyd & Taylor	Linear with plateau	Sitch et al. (2003)
SDGVM	Fixed PFT	7	Yes	Yes	No	1 m	Optimum curve	Optimum curve	Woodward et al. (1995)
VISIT	Fixed PFT	16	No	Yes	No	1 m	Lloyd & Taylor	Optimum curve	Ito and Inatomi (2012)

40

Table S4. Information about the 4 different scenarios used in the sensitivity analysis, using HWSD soil database with and without biomass, and NCSCD with and without biomass. We report C fluxes [NBE, Net Biome Exchange; NPP, Net Primary Production; R_h, heterorophic Respiration], C pools [C_{photo}, C_{veg}, C_{dom}, C_{tot}] and transit times [TT_{photo}, TT_{veg}, TT_{dom}, TT_{tot}]. The averages 45 **contain the estimations between the 5th and 95th percentiles, and the median in bold (50th percentile).**

		HWSD						NCSCD					
		With biomass			Without biomass			With biomass			Without biomass		
		P05	P50	P95	P05	P50	P95	P05	P50	P95	P05	P50	P95
C fluxes	NBE	-261	**-62**	894.6	-267.5	**-98.2**	924.9	-258.2	**-52.2**	1158.6	-266.5	**-89.9**	1165.7
	NPP	176.8	**262.3**	376.1	158.6	**242.3**	355.5	177.5	**263.5**	377.6	159.8	**244**	357.2
	R_h	26.6	**193.9**	1162.9	19.3	**131.6**	1164.4	29	**206**	1428.4	20.6	**141.6**	1407.1
C pools	C_{photo}	63.1	**118.9**	223.1	150.3	**562.5**	1653	63.4	**119.6**	224.8	151.2	**565.4**	1650.5
	C_{veg}	486.6	**1353**	5296	1031.7	**3573.8**	43899.1	489.2	**1398.3**	6006.5	1037.8	**3588.3**	43949.5
	C_{dom}	7843.5	**18749.7**	36056.9	9082	**20946.8**	50601.3	10329.3	**24489.4**	47506.6	11906	**27079.1**	60657.6
	C_{tot}	9183.9	**20377.7**	39553.4	11877.9	**26398.7**	86233.1	11737.3	**26276.1**	51209.8	14966.5	**33140.4**	93666.2
Transit times	TT_{photo}	0.9	**1.4**	2.4	2.9	**10.9**	61	0.9	**1.4**	2.4	2.9	**10.7**	58.5
	TT_{veg}	1.6	**4.2**	16.5	3.1	**10.3**	46	1.6	**4.2**	16.2	3.1	**10.2**	45.9
	TT_{dom}	10	**106.7**	724	12.2	**126.4**	625.2	10.2	**133.9**	897.6	12.4	**154.8**	792.6
	TT_{tot}	12	**120**	933.5	19.4	**212**	1692.2	12.1	**150.8**	1139.7	18.9	**243**	1878.7