Supplement of Biogeosciences, 11, 5139–5154, 2014
http://www.biogeosciences.net/11/5139/2014/
doi:10.5194/bg-11-5139-2014-supplement

Biogeosciences
Open Access

Supplement of

The impact of climate variation and disturbances on the carbon balance of forests in Hokkaido, Japan

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Supplementary Material

Table S1. Scenarios for management and climate

Scenario		Temperature	Precipitation	Solar radiation	VPD	CO_2 concentration	Clear-cutting	Forest type	Thinning
S_{full}	Full	Historical	Historical	Historical	Historical	Historical	Yes	Mixed forest to larch forest	Yes
$S_{const\text{-}climate}$	Constant climate	Constant	Constant	Constant	Constant	Historical	Yes	Mixed forest to larch forest	No
$S_{const\text{-}Ta}$	Constant temperature	Constant	Historical	Historical	Historical	Historical	Yes	Mixed forest to larch forest	No
$S_{const\text{-}precipitation}$	Constant precipitation	Historical	Constant	Historical	Historical	Historical	Yes	Mixed forest to larch forest	No
$S_{const\text{-}Sd}$	Constant solar radiation	Historical	Historical	Constant	Historical	Historical	Yes	Mixed forest to larch forest	No
$S_{const\text{-}VPD}$	Constant VPD	Historical	Historical	Historical	Constant	Historical	Yes	Mixed forest to larch forest	No
$S_{const\text{-}CO2}$	Constant CO_2 concentration	Historical	Historical	Historical	Historical	Constant	Yes	Mixed forest to larch forest	No
$S_{non\text{-}conv}$	No conversion	Historical	Historical	Historical	Historical	Historical	Yes	Mixed forest continues to exist	No
$S_{non\text{-}cut}$	No clear-cutting	Historical	Historical	Historical	Historical	Historical	No	Larch forest continues to exist	No
$S_{non\text{-}thin}$	No thinning	Historical	Historical	Historical	Historical	Historical	Yes	Mixed forest to larch forest	No

VPD: vapor-pressure deficit.

To examine the effect of disturbance, VISIT was run for full scenario (S_{full}), in which temperature, precipitation, solar radiation, VPD, and CO_2 concentration are historical with historical disturbances such as clear-cutting, conversion and thinning, climate constant ($S_{const\text{-}climate}$), in which temperature, precipitation, solar radiation, and VPD were constant; temperature constant ($S_{const\text{-}Ta}$); precipitation constant ($S_{const\text{-}precipitation}$); solar radiation constant ($S_{const\text{-}Sd}$); VPD constant ($S_{const\text{-}VPD}$); and CO_2 constant ($S_{const\text{-}CO2}$). These scenarios were run with clear-cutting and conversion of mixed forest to larch forest, and without a thinning event. We also conducted a non-conversion scenario ($S_{non\text{-}conv}$), in which a mixed forest without clear-cutting continued to exist (neither clear-cutting nor plantation occurs); a non-clear-cutting scenario ($S_{non\text{-}cut}$), in which a larch forest without clear-cutting continued to exist; and a non-thinning scenario ($S_{non\text{-}thin}$).

Table S2. Statistics for comparison between carbon fluxes calculated from the VISIT model and those estimated from tower observation (*x*- and *y*-axes are observation-deduced and modeled fluxes)

		Daily scale					Monthly scale					Yearly scale				
Site	Flux	Slope	Intercept	R^2	*P*	*n*	Slope	Intercept	R^2	*p*	*n*	Slope	Intercept	R^2	*p*	*n*
Mature mixed forest	NEP	0.69	0.5	0.47	<0.001	365	0.83	15.7	0.42	<0.05	12	–	–	–	–	1
Mature mixed forest	GPP	0.93	0.2	0.91	<0.001	365	1.00	–2.3	0.99	<0.001	12	–	–	–	–	1
Mature mixed forest	RE	0.68	0.6	0.83	<0.001	365	0.77	8.7	0.94	<0.001	12	–	–	–	–	1
Young larch forest	NEP	0.72	–0.1	0.42	<0.001	3653	1.04	1.1	0.53	<0.001	120	1.51	0.8	0.82	<0.001	10
Young larch forest	GPP	0.98	0.0	0.81	<0.001	3653	1.01	–1.0	0.86	<0.001	120	1.17	–1.7	0.62	<0.01	10
Young larch forest	RE	0.83	0.5	0.87	<0.001	3653	0.89	9.2	0.93	<0.001	120	–	–	–	n.s.	10
Middle-aged larch forest	NEP	0.77	0.2	0.85	<0.001	1095	0.81	5.7	0.93	<0.001	36	–	–	–	n.s.	3
Middle-aged larch forest	GPP	0.93	0.8	0.93	<0.001	1095	0.92	24.5	0.96	<0.001	36	–	–	–	n.s.	3
Middle-aged larch forest	RE	0.97	0.5	0.91	<0.001	1095	0.98	14.8	0.96	<0.001	36	–	–	–	n.s.	3

NEP: net ecosystem production; GPP: gross primary production; RE: ecosystem respiration.