1. About the data set

Site name (three letter code)	Teshio CC-LaG experiment site (TSE)	
Period of registered data	From January 1 2006 to December 31 2012	
This document file name	FxMt_TSE_2006-2012_30m_01-2.pdf	
Corresponding data file name	FxMt_TSE_2006_30m_01-2.csv, FxMt_TSE_2007_30m_01-2.csv, FxMt_TSE_2008_30m_01-2.csv, FxMt_TSE_2009_30m_01-2.csv, FxMt_TSE_2010_30m_01-2.csv, FxMt_TSE_2011_30m_01-2.csv, FxMt_TSE_2012_30m_01-2.csv	
Revision information		
Date	Details of revision	Renewed file name
17 July 2014	First registration	FxMt_TSE_2006-2012_30m_01.pdf FxMt_TSE_2006_30m_01.csv FxMt_TSE_2007_30m_01.csv FxMt_TSE_2008_30m_01.csv FxMt_TSE_2009_30m_01.csv FxMt_TSE_2010_30m_01.csv FxMt_TSE_2011_30m_01.csv FxMt_TSE_2012_30m_01.csv SiIn_TSE_2014_07.pdf
6 October 2022	DOI (Digital Object Identifier) was assigned. The contact person#2 was updated. The citation format was described in the other information.	FxMt_TSE_2006-2012_30m_01-2.pdf FxMt_TSE_2006_30m_01-2.csv, FxMt_TSE_2007_30m_01-2.csv FxMt_TSE_2008_30m_01-2csv FxMt_TSE_2009_30m_01-2.csv FxMt_TSE_2010_30m_01-2.csv FxMt_TSE_2011_30m_01-2.csv FxMt_TSE_2012_30m_01-2.csv SiIn_TSE_2014_08.pdf
Contact person#1	Kentaro Takagi (kentt@fsc.hokudai.ac.jp)	
Contact person#2	Yoshiyuki Takahashi (yoshiyu@nies.go.jp)	
Contact person#3		
Other Information	When this data set is referred to in publications, it should be cited in the following format. Takagi and Takahashi (2022), Micrometeorological CO_2 Flux Data at Teshio CC-LaG Experiment site (TSE), Ver.x.x *1, National Institute for Environmental Studies, DOI:10.17595/20221006.001. (Reference date *2: YYYY/MM/DD) *1 The version number is indicated in the name of each data file. *2 As the reference date, please indicate the date you downloaded the files.	

2. Site description

☺to Data provider·························Please explain the site condition during the period of this dataset.
☻to DB user ································See also the general information file.

Hour line (Time difference from UTC)	Japan standard time (JST) (9 hours ahead of UTC)
Vegetation Type	Young larch plantation

Dominant Species (Overstory)	hybrid (*Larix gmelinii*×*L. kaempferi*) larch
Dominant Species (Understory)	*Sasa senanensis* and *Sasa kurilensis*
Canopy height	1.5 (av. in 2006)—3.5(av. in 2011) m (larch plantation), 1.5 m (Sasa)
LAI	The plant area index (PAI) values for the canopy trees and the understory Sasa bamboos, measured using an LAI-2000 leaf-area meter (Li-Cor, Lincoln, NE, USA), were 3.2 and 4.1 m2 m^{-2}, respectively, at this parameter's seasonal maximum in 2002 (Figure). From January to March 2003, trees covering an area of 13.7 ha were clear-cut. The total biomass volume of trees at the site was 2193 m3 (Koike et al. 2001), of which 1203 m3 (ca. 25 Mg C ha^{-1}) were removed as logs by clear-cutting. Sasa was left intact under the snowpack, but 7 months later, just before the planting of hybrid larch seedlings (in late October 2003), they were strip-cut into alternating 4-m-wide cut and uncut rows in the clear-cut area to give space for the planting of ca 30 000 2-year-old hybrid larch (Larix gmelinii (Rupr.) Kuzen. ver japonica (Maxim. Ex Regel) Pilg. × L. kaempferi (Lamb.) Carrière) at a density of 2500 ha^{-1} (0.04 Mg C ha^{-1}). In the rows where Sasa remained, Sasa PAI increased steeply from 1 year after clear-cutting until 2007, reaching a peak at 8.0 m^2 m^{-2} in 2010, which is about double the value in 2002 before clear-cutting. In the rows where Sasa was strip-cut, Sasa weeding in the strip cut rows was conducted from once (2005 and 2006) to three times (2004) per year between late May and late July until 2006. Weeding eliminated all Sasa growing between the larch trees. The Sasa was no longer weeded starting in 2007 because the larch were higher than the surrounding Sasa, and were able to receive enough solar radiation to grow without interference. Sasa soon recovered in the strip-cut rows, and in 2008, 2 years after the last weeding, the PAI was almost the same as that in the surrounding uncut rows, blanketing all gaps between the trees. On the other hand, the PAI of the larch remained low (1.7 m^2 m^{-2} in 2010) at its seasonal maximum and was minor compared with that of Sasa.
Other information	

3. Observation and calculation
☺to Data provider·································A list of references is shown in the last page. **Please fill-in the blanks as much as possible, or select the suitable option.**

3-1. Flux observation system and data acquisition

Type of sonic anemometer	Sonic anemometer-thermometer (KAIJO, DA600-3TV, TR-61A), Sensor span: 10 cm
Type of IRGA	[Closed-path method] NDIR-gas analyzer（LI-COR, LI-7000）, Distance between gas inlet and NDIR: 15 m, Height of gas inlet: 4.6 m (until May 2007) and 5.7 m (from May 2007), Distance between gas inlet and anemometer: 5 cm.
Sampling rate	10 Hz
Averaging time	30 min
Flux measurement height #1	4.6 m (until May 2007) and 5.7 m (from May 2007).
Flux measurement height #2	
Flux measurement height #3	
Zero-plane displacement	Constant (0.6m)
Roughness length	Not evaluated
Calibration information	CO_2 fluctuations were calibrated every day by using two standard CO_2 gases (320 and 420 μmol mol^{-1}). Sensors for air temperature, relative humidity, PAR are checked once a year, with the certificated instruments.
Other information	Tower: 32 m （Climbable） Flux tower:8m Electrical power: Commercial power supply (From 10 Feb. 2005) Data: All data are recorded using a data logger (CSI, CR-5000), and saved on to HD card

3-2. Flux calculation

		Note/References
Flow attenuation	✓ Not applied	
Coordinate rotation	✓ Planar fit *1	The sonic rotation angle for planar fit rotation was determined every day using 30-min averages of wind speed in a 15-day moving window
Lag removal	✓ Constant value for each month	Sonic-tube lag time for CO_2 & H_2O was determined monthly by averaging the lag times determined every 30 min under turbulent conditions

3-3. Flux corrections

		Note/References
For sensible heat flux	✓ Cross wind correction *2 ✓ Water vapor correction *3	
High frequency loss	• **Which fluxes? [u*, H]** ✓ Moor (1986) *4 (Correction for path length and sensor separation) • **Which fluxes? [LE]** ✓ Moor (1986) *4 (Correction for path length for SAT) ✓ Experimental approach *5-7 (see Note) • **Which fluxes? [Fc]** ✓ Moor (1986) *4 (Correction for path length for SAT) ✓ Experimental approach *5-7 (see Note)	Co-spectra between vertical winds and scalars (temperature and CO_2 & H_2O concentrations) were normalized according to the covariance integrated over the band-pass range and averaged over periods with similar wind speed under turbulent conditions. The correction factor (ε) was determined from the ratio of integrated, normalized co-spectra, using temperature as a reference. ε depends on the mean wind speed (u): $\varepsilon = a + b\ u$, where a and b are coefficients that were determined every year or upon a change in the system; a and b for CO_2 were 0.94 to 1.18 and 0.01 to 0.266, respectively, from 2006 to 2012and for H_2O were 1.02 to 1.35 and 0.09 to 0.52, respectively
Low frequency loss (Detrending)	✓ Block average	
WPL Correction*8	✓ For latent heat (LE) flux ✓ For CO_2 flux	
Others	✓ Temperature dependency for latent heat: L ✓ Humidity dependency for specific heat: Cp ✓ Temperature dependency for air density ✓ Pressure dependency for air density	

3-4. Quality control

		Note/References
Raw data test*9	✓ Spike test (see Note) ✓ Absolute limits ✓ Absolute variance ✓ Higher-moment statistics ✓ Resolution test ✓ Discontinuities	Threshold for the spike was more than 5× s.d. in a series of 3000 overlapping datapoints
Non steady state test	✓ YES	The measured flux signals of 30 min duration was divided into 6 sub records (5 min), and if the difference between the mean covariance of the 6 sub records and the covariance for the full period is more than 60% under turbulent condition, the flux data were removed (Instationarity ratio test)*10

Integral turbulence characteristics[*10]	✓ YES	The observed integral characteristic of the vertical wind (σ_w/u_*) was compared to the ideal values estimated from the Monin-Obukhov similarity, where σ_w and u_* are the standard deviation of the vertical wind velocity and friction velocity, respectively. The flux values were removed when the difference between the observed and ideal values was more than 70%
Correlation coefficient	✓ Not applied	
Wind direction	✓ Not applied	
Footprint test	✓ YES	Fetch for the flux observation decreased after the clearcutting. The distances between the flux observation point and boundaries of the cut area ranged from 140 to 340 m in the eight cardinal and intercardinal directions. To remove the effect of flux from outside the clearcut, we evaluated the footprint of the observed CO_2 flux using the model developed by Kormann & Meixner (2001) [*11], which accounts for thermal stability. We evaluated the cumulative footprint every 30 min up to 2 km and up to the boundaries of the cut area (distance according to wind direction) from the observation point in 1-m steps. The flux data were removed if the ratio of the two cumulative values was <0.7 (i.e., contribution from the cutover was less than about 70%).
Ablosute thresholds	✓ YES	600 > lE > -300 W m^{-2} 50 > FCO_2 > -50 micromol m^{-2} s^{-1}
Others	✓	

3-4. Storage term

		Note/References
Storage term	• **Not evaluated**	

3-5. Other information

☺to Data provider·································If your flux data were evaluated by gradient method, please explain the observation method here.

		Note/References

4. Registered Data

Observation items	Symbol	Unit	Height (s) Depth(s)	Instruments	Level of data processi ng
Year	Year	-	****	****	#### (YYYY)
Date	DOY	-	****	****	1 ～ 365(6)
Time	TIME	-	****	****	#### (HHMM)
CO_2 flux	Fc	micromol・m^{-2}・s^{-1}	4.6 or 5.7 m	[Closed-path method] NDIR-gas analyzer（LI-COR, LI-7000）, Distance between gas inlet and NDIR: 15 m, Height of gas inlet: 4.6 m (until May 2007) and 5.7 m (from May 2007), Distance between gas inlet and anemometer: 5 cm	
CO_2 concentration	Co	ppm	4.6 or 5.7 m	Same as above	
Friction velocity	Ust_1	m・s^{-1}	4.6 or 5.7 m	Same as above	Not filled
Friction velocity	Ust_2	m・s^{-1}	4.6 or 5.7 m	Same as above	Gap filled
Global solar	Rg_32	W・m^{-2}	32m	Thermopile type pyranometer, CM-21F, Kipp&Zonen	

radiation(incoming)					
Photosynthetic active photon flux density (downward)	PPFD_32	micromol・ m^{-2}・s^{-1}	32m	Quantum sensor (LI-COR, LI-190SZ until May 2007), (EKO Instruments, ML-020P from May 2007)	
Air temperature	Ta_32	degrees C	32m	Ventilated platinum resistance thermometer, HMP45A, VAISALA	
Relative humidity	Rh_32	%	32m	Ventilated platinum resistance thermometer, HMP45A, VAISALA	
Sensible heat flux	H_1	W・m^{-2}	4.6m	DA-600-3TV, TR61A, Kaijo	Not filled
Sensible heat flux	H_2	W・m^{-2}	4.6m	DA-600-3TV, TR61A, Kaijo	Gap filled
Latent heat flux	LE_1	W・m^{-2}	4.6m	DA-600-3TV, TR61A, Kaijo & LI-7000, LICOR	Not filled
Latent heat flux	LE_2	W・m^{-2}	4.6m	DA-600-3TV, TR61A, Kaijo & LI-7000, LICOR	Gap filled
Ground heat flux	G	W・m^{-2}	-2cm	Heat flux plate, HFT-1.1, REBS	
Precipitation	PPT	mm	3m	0.1 mm-pulse tipping-bucket rain gauge with heater, CYG-52202, RM Young	30 min sum
Soil water content	SWC_5	m^3 m^{-3}	-5cm	TDR sensor, CS615, CSI	
Soil water content	SWC_10	m^3 m^{-3}	-10 cm	TDR sensor, CS615, CSI	
Soil water content	SWC_30	m^3 m^{-3}	-30 cm	TDR sensor, CS615, CSI	
Soil water content	SWC_60	m^3 m^{-3}	-60 cm	TDR sensor, CS615, CSI	
Soil temperature	Ts_1	degrees C	-1 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts_5	degrees C	-5 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts_10	degrees C	-10 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts_20	degrees C	-20 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts_40	degrees C	-40 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts_80	degrees C	-80 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts_120	degrees C	-120 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Reflected solar radiation	RR	W・m^{-2}	32m	Net radiometer, CNR-1, Kipp&Zonen	
Net Radiation	Rn	W・m^{-2}	32m	Net radiometer, CNR-1, Kipp&Zonen	
Wind direction	WD	degrees	32m	Photo-electric wind vane (MetOne, 020C)	Vector average
Wind speed	WS	m・s^{-1}	32m	Photo-electric cup anemometer (MetOne, 010C)	
Barometric pressure	Pa	hPa	2m	BAROCAP barometer, PTB210-C6C5A, VAISALA	
Atmospheric stability parameter	ZL	-			

5. Note for data users

☺to Data provider································If you use some tags (flags/identifiers) to identify the levels of data processing, please explain the meanings of the tags.

The figure of "-99999" denote missing or rejected data.

6. Important events

☺to Data provider································Please list noteworthy events during the observation period. For example, relocation of the instruments, reasons for missing observation, dates of sowing and harvesting at agricultural site should be listed in the table by date.

Date	Events

References

Flux calculation

*1 Wilczak. J.M., Oncley, S.P. and Stage, S.A., 2001. Boundary-Layer Meteorology, 99: 127-150.

Flux correction

*2 Kaimal J.C. and Gaynor, J.E., 1991. Boundary-Layer Meteorology, 56: 401-410.

*3 Hignett, P., 1992. Boundary-Layer Meteorology, 61: 175-187.

*4 Moore, C.J., 1986. Boundary-Layer Meteorology, 37: 17-35.

*5 Aubinet, M. et al.,2000. Advances in Ecological Research, 30: 113-175.

*6 Aubinet, M. et al. 2001. Agricultural and Forest Meteorology, 108: 293-315.

*7 Kowalski, AS. et al. 2003. Global Change Biology, 9: 1051-1065.

*8 Webb, E. K., Pearman, G.I. and Leuning, R., 1980. Quarterly Journal of the Royal Meteorological Society, 106: 85-100.

Quality control

*9 Vickers, D. and Mahrt, L., 1997. Journal of Atmospheric and Oceanic Technology, 14: 512-526.

*10 Foken, T. and Wichura, B., 1996. Agricultural and Forest Meteorology, 78: 83-105.

*11 Kormann R. and Meixner F.X., 2001 Boundary-Layer Meteorology, 99, 207-224.