1. About the data set

Site name (three letter code)	Teshio CC-LaG experiment site (TSE)
Period of registered data	From August (1st) 2001 to December (31st) 2001
This document file name	FxMt_TSE_2001_30m_01-2.pdf
Corresponding data file name	FxMt_TSE_2001_30m_01-2.csv
Revision information	

Date	Details of revision	Renewed file name
18 April 2008	First registration	FxMt_TSE_2001_30m_01.pdf FxMt_TSE_2001_30m_01.csv SiIn_TSE_2007_03.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_2001_30m_01-2.pdf FxMt_TSE_2001_30m_01-2.csv SiIn_TSE_2007_04.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	Conifer-Hardwood mixed forest
Dominant Species (Overstory)	*Quercus crispula*, *Betula ermanii*, *Betula platyphylla* var. *japonica*, *Abies sachalinensis*, *Picea jezoensis*
Dominant Species (Understory)	*Sasa senanensis, Sasa kurilensis*

Canopy height	18–25 m
LAI	3 and 4–4.5 in a full-growing period for canopy and *Sasa* layer, respectively
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-61C), Sensor span: 20 cm
Type of IRGA	[Closed-path method] NDIR-gas analyzer（LI-COR, LI-7000）, Distance between gas inlet and NDIR: 6m, Height of gas inlet: 32 m, ca. 10 m above canopy surface, Distance between gas inlet and anemometer: 15 cm.
Sampling rate	10Hz
Averaging time	27min 20s
Flux measurement height #1	32m
Flux measurement height #2	
Flux measurement height #3	
Zero-plane displacement	Constant (14 m)
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, net radiation, solar radiation, wind speed are checked once a year, with the certificated instruments.
Other information	Tower: 32 m（Climbable）, 18 m pole (for micrometeorological measurement under the canopy until October 2002). Electrical power: Two power generators Data: All data are recorded using a data logger (TEAC, DRM3b-Mk2), and saved on to MO

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 1.00 and 0.0343, respectively and for H_2O were 1.12 and 0.006, 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	✓ Not applied	
Ablosute thresholds	✓ YES	600 > IE > -300 W m^{-2} 50 > FCO$_2$ >- 50 micro. mol m^{-2} s^{-1}
Others	✓	

3-4. Storage term

		Note/References
Storage term	• **[CO$_2$]**	Storage flux for CO$_2$ (F_s) was estimated by the relationship between the daily F_s calculated from the profile data (F_{sp}) and that calculated from the change in the CO$_2$ concentration only at 32 m (F_{st}) (F_{sp} = 1.69F_{st} + 1.05; r^2 = 0.61), obtained in 2002. Estimated daily F_s was divided equally among each 30 min value in the day. Observation height for the profile in 2002 was 1 (only in snow-free period), 5, 9, 17, 32 m.

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 processing
Year	Year	-	****	****	#### (YYYY)
Date	DOY	-	****	****	1～365(6)
Time	TIME	-	****	****	#### (HHMM)
Wind direction	WD	degrees	32m	Photo-electric wind vane, 020C, MetOne	Vector average
Wind speed	WS_32	$m \cdot s^{-1}$	32m	Photo-electric cup anemometer, 010C, MetOne	
Wind speed	WS_25	$m \cdot s^{-1}$	25m	Photo-electric cup anemometer, 010C, MetOne	
Wind speed	WS_21	$m \cdot s^{-1}$	21m	Photo-electric cup anemometer, 010C, MetOne	
Wind speed	WS_17	$m \cdot s^{-1}$	17m	Photo-electric cup anemometer, 010C, MetOne	
Wind speed	WS_13	$m \cdot s^{-1}$	13m	Photo-electric cup anemometer, 010C, MetOne	
Wind speed	WS_9	$m \cdot s^{-1}$	9m	Photo-electric cup anemometer, 010C, MetOne	
Wind speed	WS_5	$m \cdot s^{-1}$	5m	Photo-electric cup anemometer, 010C, MetOne	
Wind speed	WS_2	$m \cdot s^{-1}$	2m	Photo-electric cup anemometer, 010C, MetOne	
Net Radiation	Rn_32	$W \cdot m^{-2}$	32m	Net radiometer, CNR-1, Kipp&Zonen	
Net Radiation	Rn_3	$W \cdot m^{-2}$	3m	Net radiometer, CNR-1, Kipp&Zonen	sensor at 3 m height is under the canopy
Photosynthetic active photon flux density	PPFD_32	micoromol$\cdot m^{-2} \cdot s^{-1}$	32m	Quantum sensor, LI-190SZ, LI-COR	
Photosynthetic active photon flux density	PPFD1_3	micoromol$\cdot m^{-2} \cdot s^{-1}$	3m	Quantum sensor, LI-190SZ, LI-COR	sensor at 3 m height is under the canopy
Photosynthetic active photon flux density	PPFD2_3	micoromol$\cdot m^{-2} \cdot s^{-1}$	3m	Quantum sensor, LI-190SZ, LI-COR	sensor at 3 m height is under the canopy

Photosynthetic active photon flux density	PPFD3_3	micoromol·m^{-2}·s^{-1}	3m	Quantum sensor, PAR-01L, PREDE	sensors are under the canopy
Photosynthetic active photon flux density	PPFD4_3	micoromol·m^{-2}·s^{-1}	3m	Quantum sensor, PAR-01L, PREDE	sensors are under the canopy
Photosynthetic active photon flux density	PPFD5_3	micoromol·m^{-2}·s^{-1}	3m	Quantum sensor, PAR-01L, PREDE	sensors are under the canopy
Photosynthetic active photon flux density	PPFD6_3	micoromol·m^{-2}·s^{-1}	3m	Quantum sensor, PAR-01L, PREDE	sensors are under the canopy
Photosynthetic active photon flux density	PPFD7_3	micoromol·m^{-2}·s^{-1}	3m	Quantum sensor, PAR-01L, PREDE	sensors are under the canopy
Global solar radiation (incoming)	Rg1_32	W·m^{-2}	32m	Thermopile type pyranometer, M-21F, Kipp&Zonen	
Global solar radiation (incoming)	Rg2_32	W·m^{-2}	32m	Net radiometer, CNR-1, Kipp&Zonen	
Global solar radiation (incoming)	Rg_3	W·m^{-2}	3m	Net radiometer, CNR-1, Kipp&Zonen	sensor at 3 m height is under the canopy
Lomg-wave radiation (incoming)	Rgl1_32	W·m^{-2}	32m	Thermopile type infrared radiometer, PIR, EPPLEY	
Lomg-wave radiation (incoming)	Rgl2_32	W·m^{-2}	32m	Net radiometer, CNR-1, Kipp&Zonen	
Lomg-wave radiation (incoming)	Rgl_3	W·m^{-2}	3m	Net radiometer, CNR-1, Kipp&Zonen	sensor at 3 m height is under the canopy
Global solar radiation (outgoing)	Rg_out_32	W·m^{-2}	32m	Net radiometer, CNR-1, Kipp&Zonen	
Global solar radiation (outgoing)	Rg_out_3	W·m^{-2}	3m	Net radiometer, CNR-1, Kipp&Zonen	sensor at 3 m height is under the canopy
Long-wave radiation (outgoing)	Rgl_out_32	W·m^{-2}	32m	Net radiometer, CNR-1, Kipp&Zonen	
Long-wave radiation (outgoing)	Rgl_out_3	W·m^{-2}	3m	Net radiometer, CNR-1, Kipp&Zonen	sensor at 3 m height is under the canopy
Air temperature	Ta_32	degrees C	32m	Ventilated platinum resistance thermometer, HMP45A, VAISALA	
Air temperature	Ta_25	degrees C	25m	Ventilated platinum resistance thermometer, HMP45D, VAISALA	

Air temperature	Ta_21	degrees C	21m	Ventilated platinum resistance thermometer, HMP45D, VAISALA	
Air temperature	Ta_17	degrees C	17m	Ventilated platinum resistance thermometer, HMP45D, VAISALA	
Air temperature	Ta_13	degrees C	13m	Ventilated platinum resistance thermometer, HMP45D, VAISALA	
Air temperature	Ta_9	degrees C	9m	Ventilated platinum resistance thermometer, HMP45D, VAISALA	
Air temperature	Ta_5	degrees C	5m	Ventilated platinum resistance thermometer, HMP45D, VAISALA	
Air temperature	Ta_2	degrees C	2m	Ventilated platinum resistance thermometer, HMP45D, VAISALA	
H_2O concentration	Ho_32	$g \cdot m^{-3}$	32m	Ventilated HUMICAP hygrometer, HMP45A, VAISALA	
H_2O concentration	Ho_25	$g \cdot m^{-3}$	25m	Ventilated HUMICAP hygrometer, HMP45D, VAISALA	
H_2O concentration	Ho_21	$g \cdot m^{-3}$	21m	Ventilated HUMICAP hygrometer, HMP45D, VAISALA	
H_2O concentration	Ho_17	$g \cdot m^{-3}$	17m	Ventilated HUMICAP hygrometer, HMP45D, VAISALA	
H_2O concentration	Ho_13	$g \cdot m^{-3}$	13m	Ventilated HUMICAP hygrometer, HMP45D, VAISALA	
H_2O concentration	Ho_9	$g \cdot m^{-3}$	9m	Ventilated HUMICAP hygrometer, HMP45D, VAISALA	
H_2O concentration	Ho_5	$g \cdot m^{-3}$	5m	Ventilated HUMICAP hygrometer, HMP45D, VAISALA	
H_2O concentration	Ho_2	$g \cdot m^{-3}$	2m	Ventilated HUMICAP hygrometer, HMP45D, VAISALA	
Precipitation	PPT	mm	32m	0.1 mm-pulse tipping-bucket rain gauge with heater, CYG-52202, RM Young	30 min sum
Barometric pressure	Pa	hPa	2m	BAROCAP barometer,	

				PTB210-C6C5A, VAISALA	
Ground heat flux	G1_2	$W \cdot m^{-2}$	-2cm	Heat flux plate, HFT-1.1, REBS	
Ground heat flux	G2_2	$W \cdot m^{-2}$	-2cm	Heat flux plate, HFT-1.1, REBS	
Ground heat flux	G3_2	$W \cdot m^{-2}$	-2cm	Heat flux plate, HFT-1.1, REBS	
Ground heat flux	G4_2	$W \cdot m^{-2}$	-2cm	Heat flux plate, HFT-1.1, REBS	
Ground heat flux	G5_2	$W \cdot m^{-2}$	-2cm	Heat flux plate, HFT-1.1, REBS	
Soil water content	SWC1_5	$m^3 m^{-3}$	-5cm	TDR sensor, CS615, CSI	
Soil water content	SWC1_10	$m^3 m^{-3}$	-10 cm	TDR sensor, CS615, CSI	
Soil water content	SWC1_30	$m^3 m^{-3}$	-30 cm	TDR sensor, CS615, CSI	
Soil water content	SWC1_60	$m^3 m^{-3}$	-60 cm	TDR sensor, CS615, CSI	
Soil water content	SWC2_5	$m^3 m^{-3}$	-5 cm	TDR sensor, CS615, CSI	
Soil water content	SWC2_10	$m^3 m^{-3}$	-10 cm	TDR sensor, CS615, CSI	
Soil water content	SWC3_5	$m^3 m^{-3}$	-5 cm	TDR sensor, CS615, CSI	
Soil water content	SWC3_10	$m^3 m^{-3}$	-10 cm	TDR sensor, CS615, CSI	
Soil water content	SWC4_5	$m^3 m^{-3}$	-5 cm	TDR sensor, CS615, CSI	
Soil water content	SWC4_10	$m^3 m^{-3}$	-10 cm	TDR sensor, CS615, CSI	
Soil water content	SWC5_5	$m^3 m^{-3}$	-5 cm	TDR sensor, CS615, CSI	
Soil water content	SWC5_10	$m^3 m^{-3}$	-10 cm	TDR sensor, CS615, CSI	
Soil temperature	Ts1_1	degrees C	-1 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts1_5	degrees C	-5 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts1_10	degrees C	-10 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts1_20	degrees C	-20 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts1_40	degrees C	-40 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts1_80	degrees C	-80 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts1_120	degrees C	-120 cm	Platinum resistance	

				thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts2_1	degrees C	-1 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts2_5	degrees C	-5 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts2_10	degrees C	-10 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts3_1	degrees C	-1 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts3_5	degrees C	-5 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts3_10	degrees C	-10 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts4_1	degrees C	-1 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts4_5	degrees C	-5 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts4_10	degrees C	-10 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts5_1	degrees C	-1 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts5_5	degrees C	-5 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Soil temperature	Ts5_10	degrees C	-10 cm	Platinum resistance thermometer, C-PTWP, CLIMATEC	
Snow depth	SNOWD	m	Ca. 4m	Sonic ranging sensor , SR50, CSI	
Sensible heat flux	H	W・m^{-2}	32m	DA-600-3TV, TR61C, Kaijo	
Latent heat flux	LE	W・m^{-2}	32m	DA-600-3TV, TR61C, Kaijo & LI-7000, LICOR	
Net ecosystem CO$_2$ exchange	NEE1	micoromol・m^{-2}・s^{-1}	32m	DA-600-3TV, TR61C, Kaijo & LI-7000, LICOR	
Net ecosystem CO$_2$	NEE2	micoromol・m^{-2}・s^{-1}	32m	DA-600-3TV, TR61C,	With friction

exchange				Kaijo & LI-7000, LICOR	velocity correction (u*>0.3 m/s)
Friction velocity	USt	m・s^{-1}	32m	DA-600-3TV, TR61C, Kaijo	

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.