1. About the data set

Site name (AsiaFlux three letter code)	Sapporo forest meteorology research site (SAP)
Period of registered data	From January 1, 2010 to December 31, 2010
This document file name	SAP_2010_001a.pdf
Corresponding data file name	SAP_2010_001.csv

Revision information

Date	Details of revision	Renewed file name
21 February 2017	First registration	SAP_2010_001a.pdf SAP_2010_001.csv

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2. Site description

Hour line (Time difference from UTC)	Japan Standard Time (JST) (9 hours ahead of UTC)
Location (address)	Sapporo, Hokkaido, Japan
Position	42.9868N, 141.3853E (World Geodetic System 1984, GPS: Garmin eTrex Legend and map)
Elevation	182m above sea level (World Geodetic System 1984, GPS: Garmin eTrex Legend and map)
Terrain type	Gentle slope
Slope	0-7 degrees
Area	130 ha
Fetch	500-1500m
Climate	Cool temperate (Köppen climate classification: Dfb)
Mean annual air temperature	7.3 degree C (Mizoguchi et al., 2014, Tower site, 9 years (2000-2008) average)
Mean annual precipitation	1253 mm (Mizoguchi and Yamanoi, 2015, 4years (2009-2012) average)
Vegetation Type	Deciduous broadleaf forest
Dominant Species (Overstory)	Japanese white birch (*Betula platyphylla*), Mizunara oak (*Quercus crispula*), painted maple (*Acer mono*), aralia (*Kalopanax pictus*), Japanese linden (*Tilia japonica*), Japanese elm (*Ulmus davidiana var. japonica*)
Dominant Species (Understory)	Dwarf Bamboo (*Sasa senanensis, Sasa kurilensis*)
Canopy height	Approx. 20m
Breast high diameter	approx. 25 cm (Japanese White Birch)
Age	100years (in 2012)
LAI	approx. 5.7 in max. of 2000 and 2001 (Sato et al. 2004)
Soil Type	Black soil Bl_D (Andosol: WRB classification)
Other information	

References

Mizoguchi Y., Yamanoi K., Kitamuta K., Nakai Y., Suzuki S. (2014) Meteorological observations at the Sapporo forest meteorology research site from 1999 to 2008, Hokkaido, Japan. Bulletin of FFPRI, 13(4): 193-206. (in Japanese with English abstract)

Mizoguchi Y. and Yamanoi K. (2015) Error in the measurement of precipitation in Hitsujigaoka experimental forest: Influence of the difference in instrument type. Bulletin of FFPRI, 14(3): 145-146.(in Japanese)

Sato M., Utsugi H., Abe S., Iida M., Tanouchi H. (2004) The above ground biomass components of boreal deciduous forest in Northern Japan (II). –The estimation of seasonal changes in LAI-. (in Japanese)

3. Registered data

Observation items	Symbol	Unit	Height(s) Depth(s)	Instruments	Note
Date	DATE	-	-	-	yyyymmdd
Time	TIME	-	-	-	hhmm
Precipitation	PPT	mm	2.0m	B071 (Yokogawa)	See Note [1] (Mizozguchi et al. ,2014; Mizoguchi and Yamanoi, 2015)
Air temperature	Ta	degrees C	29.6m	HMP45D (VAISALA)	(Mizozguchi et al. ,2014)
Relative humidity	Rh	%	29.6m	HMP45D (VAISALA)	See Note [2] (Mizozguchi et al. ,2014)
Wind speed	U	$m \cdot s^{-1}$	29.6m	CYG5103 (YOUNG)	(Mizozguchi et al. ,2014)
Wind direction	WD	degrees	28.5m	DA600-3T (KAIJO)	(Mizozguchi et al. ,2014)
Global solar radiation (incoming / downward)	Sd	$W \cdot m^{-2}$	41.3m	CM-6F (Kipp & Zonen)	See Note [3],[5] (Mizozguchi et al. ,2014)
Reflected solar radiation (upward)	Su	$W \cdot m^{-2}$	39.0m	CM-6B (Kipp & Zonen)	See Note [3]
Photosynthetic active photon flux density (downward)	Pd	micromol$\cdot m^{-2} \cdot s^{-1}$	41.2m	LI190 (LI-COR)	See Note [3], [6]
Reflected PAR (upward)	Pu	micromol$\cdot m^{-2} \cdot s^{-1}$	39.0m	LI190 (LI-COR)	See Note [3], [6]
Net radiation	Rn	$W \cdot m^{-2}$	41.3m / 39.0m	CM-6F and CM-6B (Kipp & Zonen), PIR (Eppley)	See Note [4]
Soil heat flux	G	$W \cdot m^{-2}$	-0.02m	MF-81 (EKO)	
Sensible heat flux	H	$W \cdot m^{-2}$	28.5m		See Section 4
Latent heat flux	lE	NA	NA		
Friction velocity	Ust	$m \cdot s^{-1}$	28.5m-	DA600-3T (KAIJO)	See Section 4
CO_2 flux	Fc	micromol$\cdot m^{-2} \cdot s^{-1}$	28.5m	LI-6262 (LI-COR)	Closed-path system See Section 4 (Yamanoi *et al.*, 2015)
Storage change in canopy air layer	Sc	micromol$\cdot m^{-2} \cdot s^{-1}$	29.6, 20.1, 16.3, 10.5, 3.6 m-	LI-6262 (LI-COR)	See Section 4 (Yamanoi *et al.*, 2015)

Net ecosystem exchange	NEE	micromol·m^{-2}·s^{-1}			Ust screening (Ust >= 0.31), Gap filled (Yamanoi *et al.*, 2015)
Ecosystem respiration	Re	micromol·m^{-2}·s^{-1}			Gap filled (Yamanoi *et al.*, 2015)
Gross primary production	GPP	micromol·m^{-2}·s^{-1}			GPP=-NEE+Re

Note

[1] Observed at Hitsujigaoka meteorological observation field (42.9950N, 141.3906E, 146.5m a.s.l.).
[2] Data of >100% is replaced by 100%.
[3] Night time data is replaced by 0.0.
[4] Summation of 4 elements (Sd, Su, Longwave radiation_downward and Longwave radiation_upward).
[5] Instrumental error is corrected using the FFPRI standard sensor
[6] Ageing deterioration is corrected

References

Mizoguchi Y., Yamanoi K., Kitamuta K., Nakai Y., Suzuki S. (2014) Meteorological observations at the Sapporo forest meteorology research site from 1999 to 2008, Hokkaido, Japan. Bulletin of FFPRI, 13(4): 193-206.(in Japanese with English abstract)

Mizoguchi Y. and Yamanoi K. (2015) Error in the measurement of precipitation in Hitsujigaoka experimental forest: Influence of the difference in instrument type. Bulletin of FFPRI, 14(3): 145-146.(in Japanese)

Yamanoi K., Mizoguchi Y., Utsugi H. (2015) Effects of a windthrow disturbance on the carbon balance of a broadleaf deciduous forest in Hokkaido, Japan. Biogeosciences. 12: 6837-6851.

Data format

Data consists of fixed length (8 digits) comma separated format. Missing data is labeled as ”-9999.0” or "-9999.00"

Line 1: Symbol (Date, Time, PPT, Ta, …..)

Line 2: Unit (yyyymmdd, hhmm, mm, degC, ….)

"hhmm" shows intermediate time of averaging period.

i.e. "1215" labels half-hourly average (or sum) of data from 12:00 to 12:30

Line 3: Comment

Line 4: Data

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Data example

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    Date, Time,      PPT,       Ta,       Rh,        U,       WD,       Sd,       Su,       Pd,       Pu, ...........
yyyymmdd, hhmm,       mm,    degC,        %,     ms-1,      deg,     Wm-2,     Wm-2,    (*1),     (*1), ...........
File= KWG_2000_001.CSV; Created: 20100326; Gap= -9999.0; (*1): micro-mol m-2 s-1                        ...........
20000101, 0015,      0.0,     3.34,    87.19,     1.58, -9999.0,      0.1, -9999.0,      0.1,      0.0, ...........
20000101, 0045,      0.0,     3.12,    88.14,     1.44, -9999.0,      0.0, -9999.0,      0.1,      0.0, ...........
20000101, 0115,      0.0,     2.36,    90.51,     1.15, -9999.0,     -0.3, -9999.0,      0.1,      0.0, ...........
20000101, 0145,      0.0,     2.14,    91.32,     0.83, -9999.0,      0.0, -9999.0,      0.1,      0.0, ...........
20000101, 0215,      0.0,     2.28,    88.96,     0.49, -9999.0,     -0.3, -9999.0,      0.1,      0.0, ...........
20000101, 0245,      0.0,     2.24,    89.82,     0.35, -9999.0,     -0.2, -9999.0,      0.2,      0.0, ...........
20000101, 0315,      0.0,     2.05,    89.49,     1.50, -9999.0,      0.1, -9999.0,      0.2,     -0.1, ...........
20000101, 0345,      0.0,     2.41,    87.25,     1.27, -9999.0,      0.0, -9999.0,      0.2,      0.0, ...........
20000101, 0415,      0.0,     2.31,    86.83,     1.12, -9999.0,     -0.2, -9999.0,      0.1,      0.0, ...........
20000101, 0445,      0.0,     2.84,    83.36,     0.54, -9999.0,     -0.6, -9999.0,      0.0,      0.0, ...........
20000101, 0515,      0.0,     2.53,    83.32,     1.23, -9999.0,      0.2, -9999.0,      0.2,      0.0, ...........
20000101, 0545,      0.0,     1.59,    87.54,     1.29, -9999.0,     -0.6, -9999.0,      0.0,      0.0, ...........
20000101, 0615,      0.0,     1.89,    85.13,     0.94, -9999.0,      0.4, -9999.0,      0.3,      0.0, ...........
20000101, 0645,      0.0,     1.77,    82.40,     0.83, -9999.0,      3.5, -9999.0,      8.5,      0.4, ...........
20000101, 0715,      0.0,     2.67,    76.83,     1.38, -9999.0,     45.8, -9999.0,     71.9,     11.6, ...........
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4. Observation and calculation

4-1. Flux observation system and data acquisition

Type of sonic anemometer	DA600-3T (Probe TR-61A) (KAIJO)
Type of IRGA	LI-6262, LI-COR
Sampling rate	5Hz
Averaging time	30min
Flux measurement height #1	28.5m
Zero-plane displacement	
Roughness length	
Calibration information	CO_2/H_2O gas analyzer was calibrated once a day by flowing standard gases that were automatically controlled.
Other information	

4-2. Flux calculation

Calculation methods		Note
Flow attenuation [*4-6]	Not applied	
Coordinate rotation [*1-3]	Applied	double rotation
Lag removal [*2, 7, 8]	Applied	automatic

4-3. Flux corrections

Correction methods		Target flux	Note
Cross wind correction[*9, 10]		sensible heat flux (H)	
Vapor correction		sensible heat flux (H)	
High frequency loss	Band-pass covariance method [*12]	CO_2 flux (Fc)	
	Experimental approach [*2]		
Low frequency loss (Detrending)	Linear detrend [*16]	sensible heat flux (H), friction velocity (Ust), CO_2 flux (Fc),	
WPL Correction[*17-21]		CO_2 flux (Fc)	
Others [*22-24]	Temperature dependency for latent heat Humidity dependency for specific heat Temperature dependency for air density Pressure dependency for air density		

4-4. Quality control [*25-26]

QC methods				Note
Raw data test [*25,26]	Spike test [*27]		Applied	
	Absolute limits		Applied	
	Absolute variance		Applied	
	Higher-moment statistics	skewness	Applied	
		kurtosis	Applied	
	Discontinuities	Harr mean test	Applied	
		Harr variance test	Applied	
	Visual inspection		Applied	
Non steady state test[*25]			Not applied	
Absolute thresholds			Applied	
Others				

4-5. Storage term

Target storage		Note
CO_2	From CO_2 profile data (29.6, 20.1, 16.3, 10.5, 3.6 m) Sampling interval: 5 minutes at each height -	

References

Yamanoi K., Mizoguchi Y., Utsugi H. (2015) Effects of a windthrow disturbance on the carbon balance of a broadleaf deciduous forest in Hokkaido, Japan. Biogeosciences. 12: 6837-6851.

Kitamura K., Nakai Y., Suzuki S., Ohtani Y., Yamanoi K., Sakamoto T. (2012) Interannual variability of net ecosystem production for a broadleaf deciduous forest in Sapporo, northern Japan. Journal of Forest Research, 17(3):323-332

MIZOGUCHI Yasuko, OHTANI Yoshikazu, YASUDA Yukio, TAKANASHI Satoru, NAKAI Yuichiro, IWATA Hiroki (2012) Seasonal and interannual variation in net ecosystem production of an evergreen needleleaf forest, Japan. Journal of Forest Research, 17(3):283-295

5. Important events

Date	Events
26 October 2010	Snow damage to tree crown
17 November 2010	Electric power outage due to facility maintenance

6. Publications relating to this site

WATANABE Tsutomu, NAKAI Yuichiro, KITAMURA Kenzo, UTSUGI Hajime, TOBITA Hiroyuki, ISHIZUKA Shigehiro (2005) Scaling energy and CO_2 fluxes from leaf to canopy using a Multilayered Implementation for Natural Canopy-Environment Relations (MINCER). Phyton, 45:353-360

NAKAI Yuichiro, KITAMURA Kenzo, SUZUKI Satoru, ABE Shin (2003) Year-long carbon dioxide exchange above a broadleaf deciduous forest in Sapporo, Northern Japan. Tellus B, 55(3):305-312

SUZUKI Satoru, ISHIZUKA Shigehiro, KITAMURA Kenzo, YAMANOI Katsumi, NAKAI Yuichiro (2006) Continuous estimation of winter carbon dioxide efflux from the snow surface in a deciduous broadleaf forest. Journal of Geophysical Research, 111:D17101 KITAMURA Kenzo, NAKAI Yuichiro, SUZUKI Satoru, OHTANI Yoshikazu, YAMANOI Katsumi, SAKAMOTO Tomoki (2012) Interannual variability of net ecosystem production for a broadleaf deciduous forest in Sapporo, northern Japan, Journal of Forest Research, 17(3): 323-332..

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Publication list: http://www2.ffpri.affrc.go.jp/labs/flux/paper_e.html[SAP]

References cited

Flux calculation

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

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Flux correction

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