1. About the data set

Site name (AsiaFlux three letter code)	Sapporo forest meteorology research site (SAP)
Period of registered data	From January 1, 2000 to December 31, 2000
This document file name	SAP_2000_001f.pdf
Corresponding data file name	SAP_2000_001.csv SAP_2000P_001.csv (Hourly precipitation data)

Revision information

Date	Details of revision	Renewed file name
13 April 2010	First registration	SAP_2000_001.pdf SAP_2000_001.csv SAP_2000P_001.csv
8 June 2010	Document file is updated: p.9, line12: Publication list URL	SAP_2000_002.pdf
21 July 2010	Document file is updated: p.9, line10-12: Publication information (title) is corrected.	SAP_2000_003.pdf
28 July 2010	Document file is renamed (no change in document contents): Version management is changed: 003 → 001c (corresponding data version + alphabetical sequence)	SAP_2000_001c.pdf
17 August 2011	Document file is updated: p.2, 13th row on right: Name of a dominant species is corrected.	SAP_2000_001d.pdf
15 May 2012	Document file is updated: p.9, line10: Publication information is updated.	SAP_2000_001e.pdf
31 July 2012	Document file is updated: New format is applied. p.1: Details in each revision are added. p.2: Dominant Species (Understory): Sasa Bamboo is corrected to Dwarf bamboo.	SAP_2000_001f.pdf

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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	7.0 degree C (Tower site, 4years (2000-2003) average)
Mean annual precipitation	980 mm (Meteorological station(*1 *2), 4years (2000-2003) 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	90years (in 2002)
LAI	approx. 4 in max.
Soil Type	Black soil Bl_D (Andosol: WRB classification)
Other information	

Reference

*1 Hokkaido Research Center, Forestry and Forest Products Research Institute
FFPRI-Hokkaido (1998) Hitsujigaoka experimental forest operation plan. FFPRI-Hokkaido, Sapporo, Japan. pp1-44
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3. Registered Data

Observation items	Symbol	Unit	Height(s) Depth(s)	Instruments	Note
Date	DATE	-	-	-	yyyymmdd
Time	TIME	-	-	-	hhmm
Precipitation	PPT	mm	1.8m		
Air temperature	Ta	degrees C	41.1m	HMP45D (VAISALA)	
Relative humidity	Rh	%	41.1m	HMP45D (VAISALA)	
Wind speed	U	$m \cdot s^{-1}$	41.4m	WM-30P (IKEDA)	
Wind direction	WD	degrees	28.5m	DA600-3T (KAIJO)	
Global solar radiation (incoming / downward)	Sd	$W \cdot m^{-2}$	41.3m	CM-6F (Kipp & Zonen)	
Reflected solar radiation (upward)	Su	$W \cdot m^{-2}$	39.0m	CM-6B (Kipp & Zonen)	
Photosynthetic active photon flux density (downward)	Pd	$micromol \cdot m^{-2} \cdot s^{-1}$	41.2m	LI190 (LI-COR)	
Reflected PAR (upward)	Pu	$micromol \cdot m^{-2} \cdot s^{-1}$	39.0m	LI190 (LI-COR)	
Net radiation	Rn	$W \cdot m^{-2}$	41.3m / 39.0m	CM-6F and CM-6B (Kipp & Zonen), PIR (Eppley)	4 elements (Sd, Su, Longwave radiation_downward and Longwave radiation_upward)
Soil heat flux	G	$W \cdot m^{-2}$	-0.02m	MF-81 (EKO)	
Sensible heat flux	H	$W \cdot m^{-2}$	28.5m	DA600-3T (KAIJO)	
Latent heat flux	lE	NA	NA	NA	
Friction velocity	Ust	$m \cdot s^{-1}$	28.5m	DA600-3T (KAIJO)	
CO_2 flux	Fc	$micromol \cdot m^{-2} \cdot s^{-1}$	28.5m	DA600-3T (KAIJO) LI-6262 (LI-COR)	Closed-path system, QC
Storage change in canopy air layer	Sc	$micromol \cdot m^{-2} \cdot s^{-1}$	2.7, 11.0, 16.7, 20.5, 30.0 m	LI-6262 (LI-COR)	
Net ecosystem exchange	NEE	$micromol \cdot m^{-2} \cdot s^{-1}$	-	-	NEE=Fc+Sc Ust selection (Ust >= 0.38), another screenings *1 Gap filled *2

Ecosystem respiration	Re	micromol·m^{-2}·s^{-1}	-	-	Missed Re at night and daytime Re were estimated using an empirical model (Re =*f*(Ts)) *2
Gross primary production	GPP	micromol·m^{-2}·s^{-1}	-	-	GPP=-NEE+Re Gap filled *2

Note

*1 |φ| >10° ,|ψ|>10° (in 3D rotation: first(θ), second(φ), third(ψ))→ eliminated

*2 –NEE = GPP + RE (daytime), –NEE = RE (nighttime)

GPP = Agmax* alpha*PAR/ (Agmax+alpha*PAR) : Parameters were derived everyday. (from April to November)

GPP = 0 (from December to next March)

Re = -NEE(nighttime) = a* exp(b*Ts) : Parameters (a & b) were derived yearly.

Reference

Data format

Data consists of fixed length (8 digits) comma separated format. Missing data is labeled as "-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-61C) (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	
Other information	

4-2. Flux calculation

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

4-3. Flux corrections

Correction methods		Target flux	Note
Cross wind correction[*9, 10]		For sensible heat flux (H)	
Vapor correction		For sensible heat flux (H)	
High frequency loss	Band-pass covariance method [*12]	For latent heat flux (lE) 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]		For latent heat flux (lE) CO_2 flux (Fc)	
Others [*22-24]	Temperature dependency for latent heat: L Humidity dependency for specific heat: Cp 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			
	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				
Others				

4-5. Storage term

Target storage		Note
CO_2	From CO_2 profile data (2.7, 11.0, 16.7, 20.5, 30.0 m) Sampling interval: 120 seconds at each height	

References

5. Important events

Date	Events

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.

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

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