FLUXNET MARCONI CONFERENCE GAP-FILLED FLUX AND METEOROLOGY DATA, 1992-2000

Summary:

Fluxes of carbon dioxide, water vapor, and energy exchange have been measured at 38 forest, grassland, and crop sites as part of the EUROFLUX and AmeriFlux projects. A total of 97 site-years of data was compiled, primarily between 1996 and 1998 but also for 1992-1995 and 1999-2000. Half-hour flux and meteorology measurements are included plus the gap-filled half-hour estimates and aggregations to day and night, weekly, monthly, and annual periods.

The FLUXNET 2000 Synthesis Workshop was held at the Marconi Conference Center, Marshall, California, June 11-14, 2000. The Marconi Flux Data Collection was compiled to aid in exploring the interactions between the terrestrial biosphere and the overlying atmosphere through carbon, water, and energy exchanges. The workshop resulted in several studies to synthesize and interpret differences and similarities in long-term measurements of carbon dioxide, water vapor, and energy exchanges between vegetation and the atmosphere for a spectrum of ecosystems. A series of synthesis papers based on these data and studies was published in a special issue of the Agriculture and Forest Meteorology, Volume 113, 2002. The papers are listed in the reference section. This data product is being archived as a record of the data used the AFM special issue. Updates and revisions to the data are available at the FLUXNET web site.

The eddy covariance technique is used for long-term continuous measurements of mass and energy fluxes to capture seasonal dynamics and allow for a meaningful scaling with respect to time. The equipment and methodology were standardized among sites by using common software and instrumentation. Comparisons of ecosystem fluxes among sites are usually performed on annual or monthly sums calculated on complete data records; however, the average site data coverage during a year was only 65%. Therefore, development and application of robust and consistent data gap-filling methods was required before fluxes could be calculated. One of the outcomes of the FLUXNET project was computer applications to process the data into complete, consistent, quality assured, and documented data sets (Falge et al. 2001a,b). Gap-filled flux data from four different filling methods are reported. Selected meteorological parameters were also gap filled to support flux estimating methods and are reported. Note that the measured/estimated CO_2 fluxes and storage fluxes were summed into net ecosystem exchange (NEE), and ONLY NEE data are reported. A companion file of related information about this compilation of gap-filled flux products is also provided (ftp://daac.ornl.gov/data/fluxnet/gap_filled_marconi/comp/Marconi_gapzips_website.pdf).

Data reported in this data set have been processed from data kindly provided by flux tower scientists. The data were checked, filled by various methods, and processed and aggregated into a consistent format at five time resolutions. A version of the data has been made available, but the data are still subject to change. For example, some of the data for the EUROFLUX sites were updated and expanded as part of the EUROFLUX collection [Valentini R. (ed.) 2003]. For information on updates for all of the Marconi data, users are urged to check the FLUXNET

Project Web page (http://daac.ornl.gov/FLUXNET/fluxnet.html) and to communicate with the contributing PIs before using the data.

Users may access the convenient subsetting tool provided in the ORNL DAAC Search and Order system to select data files.

Flux measurement site abbreviations, site names, and locations.

Site Abbreviation	Site Abbreviation (Alternate)	Site Name	Country	State	Data Range
BR		Brasschaat (De Inslag Forest)	Belgium		1997-1998
VI	VB	Vielsalm	Belgium		1996-1998
MA	MN	Manaus	Brazil		1996
NB	OBS	BOREAS NSA - Old Black Spruce	Canada		1994-1998
OA		BOREAS SSA - Old Jack Pine, Saskatchewan	Canada		1994
JP		Jack Pine, Saskatchewan	Canada		1994
TH		Tharandt Anchor Station	Germany		1996-1999
WE		Waldstein/WeidenBrunnen	Germany		1996-1998
SO		Soro (LilleBogeskov)	Denmark		1996-1998
HY		Hyytiala	Finland		1996-1998
HE		Hesse	France		1996-1999
GU		Gunnarsholt	Iceland		1996-1998
CP		Castelporziano	Italy		1997-1998
LO		Loobos	Netherlands		1996-1998
FL		Flakaliden	Sweden		1996-1998
NO		Norunda	Sweden		1996-1998
AB		Griffin, Aberfeldy	UK		1997-1998
AT	AQ	Atqasuk	USA	AK	1999
BA	BW	Barrow	USA	AK	1998-1999

BL		Blodgett Forest	USA	CA	1997-2000
BV	BN	Bondville	USA	IL	1997-1999
DU		Duke Forest - loblolly pine	USA	NC	1998-1999
HA	HP	Happy Valley	USA	AK	1994-1995
HV	HF	Harvard Forest	USA	MA	1992-1999
HL		Howland Forest (main tower)	USA	ME	1996-1997
LW		Little Washita Watershed	USA	OK	1996-1998
ME		Metolius Research Natural Area - old ponderosa pine	USA	OR	1996-1997
NW	NR	Niwot Ridge Forest	USA	CO	1999
WL		Park Falls/WLEF	USA	WI	1997-1999
PO		Ponca City	USA	OK	1997
UP		Upad	USA	AK	1994
SH		Shidler	USA	OK	1997
Sko		Sky Oaks Biological Field Station, Old Stand	USA	CA	1997-2000
Sky		Sky Oaks Biological Field Station, Young Stand	USA	CA	1997-2000
WB		Walker Branch Watershed	USA	TN	1995-1998
WI	WC	Willow Creek	USA	WI	1999
WR		Wind River Crane Site	USA	WA	1998

Data Citation:

Cite this data set as follows:

Falge, E., M. Aubinet, P. Bakwin, D. Baldocchi, P. Berbigier, C. Bernhofer, A. Black, R. Ceulemans, K. Davis, A. Dolman, A. Goldstein, M. Goulden, A. Granier, D. Hollinger, P. Jarvis, N. Jensen, K. Pilegaard, G. Katul, P. Kyaw Tha Paw, B. Law, A. Lindroth, D. Loustau, Y. Mahli, R. Monson, P. Moncrieff, E. Moors, W. Munger, T. Meyers, W. Oechel, E. Schulze, H. Thorgeirsson, J. Tenhunen, R. Valentini, S. Verma, T. Vesala, and S. Wofsy. 2005. FLUXNET Marconi Conference Gap-Filled Flux and Meteorology Data, 1992-2000. Data set. Available on-line [http//www.daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/811.

Please refer to the FLUXNET Data Policy (ftp://daac.ornl.gov/data/fluxnet/gap_filled_marconi/0_DataPolicy.txt) for additional site investigator acknowledgement and participation guidelines.

References:

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Data Format:

Gap-Filled Flux Data:

File Naming Convention:

******_aa_bb_cc.flx** for fluxes (NEE, LE, H, and G)

'**'** serves as site and year identification (e.g., AB97 = Aberfeldy 1997)

- An "e" appended to the site and year (e.g., AB98e_...) indicates that the data came unmodified from the EUROFLUX-CD (Falge et al., 2002)
- An "n" appended to the site and year (e.g., BV98n_...) indicates that the data are "new", having been revised and/or reprocessed for this collection

- Site and year without an appended letter indicates that the data have not been previously released.

'aa' refers to 3 basic gap filling methods: re = nonlinear regression, lu = look up tables, and dc = mean daily courses

'bb' refers to data pretreatment: u0 = u* corrected, and u1 = no correction applied

'cc' refers to time resolution: hh = halfhourly, dd = daily, ww = weekly, mm = monthly, and yy = yearly

Format of daily to yearly calculated flux data files (*.flx):

The data format of daily to yearly files is standardized, and contains 3 blocks of data: total (i.e. day and nighttime), daytime, and nighttime. The data are space-delimited and missing values are set to -9999.

Example data records showing variable column headings, units, and data rows:

```
Period* Int. NEE NEE_e NEE_g NEE_s LE LE_e LE_g LE_s H H_e H_g H_s G G_e G_g G_s
-- -- gCm-2d-1 gCm-2d-1 % gCm-2d-1 MJm-2d-1 MJm-2d-1 % MJm-2d-1 MJm-2d-1 MJm-2d-
1 % MJm-2d-1 MJm-2d-1 MJm-2d-1 % MJm-2d-1
1 tot -9999.0000 8.0000 100.0 1.1772 -9999.0000 4.4714 97.9 9.9099 -9999.0000 5.5000 100.0
0.0000 -9999.0000 0.0000 100.0 0.0000
2 tot -9999.0000 8.0000 100.0 1.1772 -9999.0000 2.9659 58.3 2.7063 -9999.0000 5.5000 100.0
0.0000 -9999.0000 0.0000 100.0 0.0000
```

* where Period can be Day, Week, Month.

Variable	Units (see notes below)	Description
Day		Day=digit 1-365 or 366, Week=1-52, Month=1-12 (In yy this column is omitted.)
Int.		tot, day, night refer to total day, daytime only, nighttime only
NEE	gC m-2 day-1 (or week-1 or month-1 or year-1)	Sum of net ecosystem exchange (FC+storage+correction if applied) for time period
NEE_e	+/- gC m-2 day-1 (or week-1 or month-1 or year-1)	Error (+/-) introduced by filling for NEE
NEE_g	%	Percent gaps filled for period
NEE_s	umol m-2 s-1 (for weekly, monthly, yearly; gC m-2 day-1)	S.D.
LE	MJ m-2 day-1 (or week-1 or month-1 or year-1)	Sum of latent heat for time period
LE_e	+/- MJ m-2 day-1 (or week-1 or month-1 or year-1)	Error (+/-) introduced by filling for LE
LE_g	%	Percent gaps filled for period

LE_s	W m-2 (for weekly, monthly, yearly; MJ m-2 day-1)	S.D.
H	MJ m-2 day-1 (or week-1 or month-1 or year-1)	Sum of sensible heat for time period
H_e	+/- MJ m-2 day-1 (or week-1 or month-1 or year-1)	Error (+/-) introduced by filling for H
H_g	%	Percent gaps filled for period
H_s	W m-2 (for weekly, monthly, yearly; MJ m-2 day-1)	S.D.
G	MJ m-2 day-1 (or week-1 or month-1 or year-1)	Sum of soil heat flux for time period
G_e	+/- MJ m-2 day-1 (or week-1 or month-1 or year-1)	Error (+/-) introduced by filling for G (zero in this version)
G_g	%	Percent gaps filled for period
G_s	W m-2 (for weekly, monthly, yearly; MJ m-2 day-1)	S.D.

Note 1: Units for the first 365 rows are for total (i.e., day plus nighttime) data.

Note 2: Units for daytime only data (rows 366-730) and nighttime only data (rows 731-1095) are per time period. The corresponding daytime and nighttime values are added to give the total.

Format of half-hourly calculated flux data files (*.flx):

The data format of half-hourly files is space-delimited and missing values are set to -9999.

Example data records showing variable column headings, units, and data rows:

```
Day Hour NEE NEEx LE LEx H Hx Gs Gsx
-- -- umolm-2s-1 -- Wm-2 -- Wm-2 -- Wm-2 --
1 0.50 3.190 1 68.49 0 -9999.00 1 9999.00 1
1 1.00 2.755 1 0.47 1 -9999.00 1 9999.00 1
```

Variable	Units	Description
Day		Julian day (1-365 or 366)
Hour		Decimal time of day (end of interval)
NEE	umolm-2s-1	Net ecosystem exchange (FC+storage+correction if applied) in micro mole CO2 m-2 s-1
NEEx		Index
LE	Wm-2	Latent heat
LEx		Index
H	Wm-2	Sensible heat
Hx		Index
Gs	Wm-2	Soil heat flux

Gsx		Index

Footnote: Index value for a respective variable indicates the status of the reported half-hourly value.

Index Value	Status	Reported Value
0	Original value	Measured value
1	Missing in original	-9999
2	Rejected from original	-9999
3	Filled by redundant value	Measured value from second instrument
4	Data removed by data provider	-9999

Gap-Filled Meteorological Data:

File-Naming Convention:

****cc.met for meteorological data

'****' serves as site and year identification (e.g. AB97 = Aberfeldy 1997)

'cc' refers to time resolution: hh = halfhourly, dd = daily, ww = weekly, mm = monthly, and yy = yearly

Format for Daily to Yearly Summarized Meteorological Data Files:

The data format of daily to yearly files contains 3 blocs of data: total (i.e., day and nighttime), daytime, and nighttime. The data are space-delimited, and missing values are set to -9999. For selected gap-filled variables, either sum or average / minimum / maximum, percent of gaps filled, and standard deviation (S.D.) are provided. In daily files, S.D. is calculated from 48 half-hourly values. In weekly, monthly, annual files, it is calculated from the respective daily sum or daily mean.

Example data records showing variable column headings, units, and data rows:

```
Period* Int. Rg Rg_g Rg_s PAR PAR_g PAR_s Ta Ta_g Tami Tamx Ta_s Ts Ts_g Tsmi Tsmx
Ts_s RH RH_g RHmi RHmx RH_s VPD VPD_g VPDmi VPDmx VPD_s Ca Ca_g Cami Camx
Ca_s Rn Rn_g Rn_s PPT PPT_g PPT_s SWC SWC_g SWC_s WS WS_g WS_s Pa Pa_g Pa_s
U* U*_g U*_s
-- -- MJm-2d-1 % MJm-2d-1 molm-2d-1 % molm-2d-1 degC % degC degC degC degC % degC
degC degC % % % % % kPa % kPa kPa kPa ppm % ppm ppm ppm MJm-2d-1 % MJm-2d-1
mmd-1 % mmd-1 cm3cm-3 % cm3cm-3 ms-1 % ms-1 kPa % kPa ms-1 % ms-1
1 tot 1.00 100.0 22.41 1.60 100.0 35.39 0.75 100.0 0.40 1.50 0.31 2.90 100.0 2.87 2.94 0.02
98.45 41.7 95.38 100.00 1.66 0.019 100.0 0.004 0.046 0.008 369.4 100.0 367.6 370.4 0.7 -0.61
100.0 13.58 8.0 100.0 0.1 -9999.000 100.0 0.000 0.82 100.0 0.16 95.98 100.0 0.11 0.730 100.0
0.129
2 tot 1.00 100.0 22.41 1.60 100.0 35.39 1.49 56.3 0.40 3.48 1.08 2.90 100.0 2.87 2.94 0.02 95.20
```

18.8 90.41 100.00 3.66 0.037 100.0 0.004 0.074 0.025 368.7 56.3 363.7 370.4 1.5 -0.61 100.0 13.58 8.0 100.0 0.1 -9999.000 100.0 0.000 0.93 56.3 0.40 95.98 100.0 0.11 0.730 100.0 0.129

* where Period can be Day, Week, or Month

Variable	Units (see notes below)	Description
Period		Day=digit 1-365 or 366, Week=1-52, Month=1-12 (In yy this column is omitted.)
Int.		tot, day, night refer to total day, daytime only, nighttime only
Rg	MJ m-2 day-1 (or week-1 or month-1 or year-1)	Sum of global radiation for time period
Rg_g	%	Percent gaps filled for period
Rg_s	MJ m-2 day-1 (or week-1 or month-1 or year-1)	S.D. of Rg
PAR	mol m-2 day-1 (or week-1 or month-1 or year-1)	Sum of photosynthetic active radiation for time period
PAR_g	%	Percent gaps filled for period
PAR_s	umol m-2 s-1 (for weekly, monthly, yearly; mol m-2 day-1)	S.D.
Ta	deg. C	Average air temperature (tower top) of time period T
a_g	%	Percent gaps filled for period
Tami	deg. C	Minimum air temperature of time period
Tamx	deg. C	Maximum Air temperature of time period
Ta_s	deg. C	S.D.
Ts	deg. C	Average soil temperature (5 cm depth) of time period
Ts_g	%	Percent gaps filled for period
Tsmi	deg. C	Minimum soil temperature of time period
Tsmx	deg. C	Maximum soil temperature of time period
Ts_s	deg. C	S.D.
RH	%	Average rel. humidity (tower top) of time period
RH_g	%	Percent gaps filled for period
RHmi	%	Minimum rel. humidity of time period
RHmx	%	Maximum rel. humidity of time period
RH_s	%	S.D.
VPD	kPa	Average vapor pressure deficit (tower top) of time period
VPD_g	%	Percent gaps filled for period
VPDmi	kPa	Minimum vapor pressure deficit of time period
VPDmx	kPa	Maximum vapor pressure deficit of time period
VPD_s	kPa	S.D.
Ca	ppm	Average CO2 concentration in air (tower top) of time period

Ca_g	%	Percent gaps filled for period
Cami	ppm	Minimum CO2 concentration in air of time period
Camx	ppm	Maximum CO2 concentration in air of time period
Ca_s	ppm	S.D.
Rn	MJ m-2 day-1 (or week-1 or month-1 or year-1)	Sum of net radiation for time period
Rn_g	%	Percent gaps filled for period
Rn_s	MJ m-2 day-1 (or week-1 or month-1 or year-1)	S.D. of Rn
PPT	mm day-1 (or week-1 or month-1 or year-1)	Sum of precipitation
PPT_g	%	Percent gaps filled for period
PPT_s	mm 30min-1 (for weekly, monthly, yearly; mm day-1)	S.D.
SWC	cm3 H2O cm-3 soil	Average soil water content
SWC_g	%	Percent gaps filled for period
SWC_s	cm3 H2O cm-3 soil	S.D.
WS	m s-1	Average wind speed
WS_g	%	Percent gaps filled for period
WS_s	m s-1	S.D.
Pa	kPa	Average air pressure
Pa_g	%	Percent gaps filled for period
Pa_s	kPa	S.D.
U*	m s-1	Average friction velocity
U*_g	%	Percent gaps filled for period
U*_s	m s-1	S.D.

Note 1: Units for the first 365 rows are for total (i.e., day plus nighttime) data.

Note 2: Units for daytime only data (rows 366-730) and nighttime only data (rows 731-1095) are per time period. The corresponding daytime and nighttime values are added to give the total.

Format of half-hourly gap-filled meteorological data files:

The data format of half-hourly files is space-delimited, and missing values are set to -9999.

Example data records showing variable column headings, units, and data rows:

```
Day Hour Rg Rgx PAR PARx Ta Tax Ts Tsx RH RHx VPD VPDx Ca Cax Rn
Rnx PPT PPTx SWC SWCx WS WSx Pa Pax Ustar Ustarx
-- -- Wm-2 -- umolm-2s-1 -- degC -- degC -- % -- kPa -- ppm -- Wm-2 -- mm --
cm3cm-3 -- ms-1 -- kPa -- ms-1 --
```

1 0.50 0.00 1 0.00 1 0.4 1 2.91 1 96.57 2 0.02 1 370.400 1 -12.1 1 0.173 1 -9999.000 1 0.691 1 96.00 1 0.90 1 1 1.00 0.00 1 0.00 1 0.5 1 2.91 1 97.84 2 0.00 1 370.188 1 -10.3 1 0.280 1 -9999.000 1 0.679 1 96.01 1 0.74 1

Variable	Units	Description
Day		Julian day (1-365 or 366)
Hour		Decimal time of day (end of interval)
Rg	W m-2	Global radiation
Rgx		Index (see table footnote)
PAR	umolm-2s-1	Photosynthetic active radiation in micro mole quantum m-2 s-1
PARx		Index
Ta	deg.C	Air temperature (tower top)
Tax		Index
Ts	deg.C	Soil temperature (5 cm depth)
Tsx		Index
RH	%	Rel. humidity (tower top)
RHx		Index
VPD	kPa	Vapor pressure deficit (tower top)
VPDx		Index
Ca	ppm	CO2 concentration in air (tower top)
Cax		Index
Rn	W m-2	Net radiation
Rnx		Index
PPT	mm	Precipitation
PPTx		Index
SWC	cm3 H2O cm-3 soil	Soil water content
SWCx		Index
WS	m s-1	Wind speed
WSx		Index
Pa	kPa	Air pressure
Pax		Index
U*	m s-1	Friction velocity
U*x		Index

Footnote: Index value for a respective variable indicates the status of the reported half-hourly value.

Index value	Status	Reported value
0	Original value	Measured value
1	Missing in original	-9999
2	Rejected from original	-9999

3	Filled by redundant value	Measured value from second instrument
4	Data removed by data provider	-9999

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