Gap-Filled Flux Products Compilation

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Gap-filled flux products and meteorological data for half-hourly, daily, weekly, monthly, and annual time intervals are presented for each site and year. Selected gap-filling methods were used on both u* corrected data and data that had not been corrected for u*. The data have been processed from data kindly provided by investigators of the AmeriFlux and EUROFLUX projects, and are subject to change. The 97 site-years of data presented here were processed by Eva Falge in December 2000 to support synthesis studies published in the special issue of Agricultural Forest and Meteorology. The papers were discussed at a FLUXNET workshop held at the Marconi Conference Center, June 2000. Hence, we have called these data the Marconi Data Sets and will retain these data sets as an individual unit, although the data have been updated. Users are urged to communicate with the contributing investigators and are reminded that data, when used for publication, are subject to change and also to data policy rules.

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://www.daac.ornl.gov/FLUXNET/fluxnet.html) and to communicate with the contributing PIs before using the data. Users are urged to obtain these updates before they conduct any new anlayses.

Data and data products are provided as collections of files packaged as a Zipped data set for each site-year and as individual ASCII data sets organized on the ORNL DAAC FTP server area. Information is provided describing:

1. Gap-Filling Methods
2. File Names
3. Meteorology Data Files
4. Flux Data Files
5. Fluxnet Site Codes

Individual Site Data

Please kindly inform the site investigators of how you are using the data and of any publication plans. Please acknowledge the data source (either the PI or the FLUXNET Web Site) as a citation or in the acknowledgments if the data are not yet published. In addition, when publishing, please acknowledge the agency that supported the flux tower research. Lastly, we kindly request that those publishing papers using FLUXNET data please provide preprints to the scientists providing the data and to the data archive at the Oak Ridge DAAC.

Site Data

(Contains all flux and meteorological files for the site)

Site Abbreviation	Site	Year
AB	Griffin, Aberfeldy, Scotland	1997
AB	Griffin, Aberfeldy, Scotland	1998
AT	Atqasuk, Alaska	1999
BA, BW	Barrow, Alaska	1998
BA, BW	Barrow, Alaska	1999
HP	Happy Valley, Alaska	1994
HP	Happy Valley, Alaska	1995
BL	Blodgett Forest, California	1997

BL	Blodgett Forest, California	1998
BL	Blodgett Forest, California	1999
BL	Blodgett Forest, California	2000
NW, NR	Niwot Ridge Forest, Colorado	1999
BR	Brasschaat (De Inslag Forest)	1996
BR	Brasschaat (De Inslag Forest)	1997
BR	Brasschaat (De Inslag Forest)	1998
BV, BN	Bondville, Illinois	1997
BV, BN	Bondville, Illinois	1998
BV, BN	Bondville, Illinois	1999
CP	Castelporziano	1997
CP	Castelporziano	1998
DU	Duke Forest - loblolly pine, North Carolina	1998
DU	Duke Forest - loblolly pine, North Carolina	1999
FL	Flakaliden, Sweden	1996
FL	Flakaliden, Sweden	1997
FL	Flakaliden, Sweden	1998
GU	Gunnarsholt	1996
GU	Gunnarsholt	1997
GU	Gunnarsholt	1998
HE	Hesse Forest, Sarrebourg	1996
HE	Hesse Forest, Sarrebourg	1997
HE	Hesse Forest, Sarrebourg	1998
HE	Hesse Forest, Sarrebourg	1999
HL	Howland Forest (main tower), Maine	1996
HL	Howland Forest (main tower), Maine	1997
HV, HF	Harvard Forest, Main, Massachusetts	1992
HV, HF	Harvard Forest, Main, Massachusetts	1993
HV, HF	Harvard Forest, Main, Massachusetts	1994
HV, HF	Harvard Forest, Main, Massachusetts	1995
HV, HF	Harvard Forest, Main, Massachusetts	1996
HV, HF	Harvard Forest, Main, Massachusetts	1997
HV, HF	Harvard Forest, Main, Massachusetts	1998
HV, HF	Harvard Forest, Main, Massachusetts	1999
HY	Hyytiala	1996
HY	Hyytiala	1997
HY	Hyytiala	1998
JP	Sask., 1994 Harv. Jack Pine	1994
LO	Loobos	1996
LO	Loobos	1997
LO	Loobos	1998
LW	Little Washita Watershed, Oklahoma	1996
LW	Little Washita Watershed, Oklahoma	1997
LW	Little Washita Watershed, Oklahoma	1998
MA, MN	Manaus - ZF2 K34	1996
ME	Metolius - mature (old) ponderosa pine, Oregon	1996
ME	Metolius - mature (old) ponderosa pine, Oregon	1997

NB, OBS	BOREAS NSA - Old Black Spruce	1994
NB, OBS	BOREAS NSA - Old Black Spruce	1995
NB, OBS	BOREAS NSA - Old Black Spruce	1996
NB, OBS	BOREAS NSA - Old Black Spruce	1997
NB, OBS	BOREAS NSA - Old Black Spruce	1998
NO	Norunda, Sweden	1996
NO	Norunda, Sweden	1997
NO	Norunda, Sweden	1998
PO	Ponca City, Oklahoma	1997
PO	Shidler, Oklahoma	1997
Sko	Sky Oaks, Old Stand, California	1997
Sko	Sky Oaks, Old Stand, California	1998
Sko	Sky Oaks, Old Stand, California	1999
Sko	Sky Oaks, Old Stand, California	2000
Sky	Sky Oaks, Young Stand, California	1997
Sky	Sky Oaks, Young Stand, California	1998
Sky	Sky Oaks, Young Stand, California	1999
Sky	Sky Oaks, Young Stand, California	2000
SO	Soroe, LilleBogeskov	1996
SO	Soroe, LilleBogeskov	1997
SO	Soroe, LilleBogeskov	1998
SO	Soroe, LilleBogeskov	1999
TH	Tharandt, Anchor Station	1996
TH	Tharandt, Anchor Station	1997
TH	Tharandt, Anchor Station	1998
TH	Tharandt, Anchor Station	1999
UP	Upad, Alaska	1994
VI	Vielsalm	1996
VB	Vielsalm	1997
VI	Vielsalm	1998
WB	Walker Branch Watershed, Tennessee	1995
WB	Walker Branch Watershed, Tennessee	1996
WB	Walker Branch Watershed, Tennessee	1997
WB	Walker Branch Watershed, Tennessee	1998
WE	Bayreuth, Waldstein/WeidenBrunnen	1996
WE	Bayreuth, Waldstein/WeidenBrunnen	1997
WE	Bayreuth, Waldstein/WeidenBrunnen	1998
WL	Park Falls/WLEF, Wisconsin	1997
WL	Park Falls/WLEF, Wisconsin	1998
WL	Park Falls/WLEF, Wisconsin	1999
WC	Willow Creek, Wisconsin	1999
WR	Wind River Crane Site, Washington	1998

Gap-Filling Methods

These data were processed using the four methods (Table 1) developed by Eva Falge et al. (2001a and 2001b). In general, the "Look-up table" method, with U* corrected NEE, algorithm appears to be the most robust method for most sites.

Table 1. Gap-filling methods.

Method	Gap Filling Method Description	File name component
MDC_corr	Filling by mean daily courses of NEE, LE, H; data u* corrected	_dc
Lookup_corr	Filling by look up tables for PAR-Ta (NEE), PAR-VPD (LE, H); NEE u* corrected	_lu_u0
Regr_corr	Filling by nonlinear regression (NEE only!) with Ts (nighttime), Ta sorted PAR (daytime); NEE u* corrected	_re_u0
Regr_notcorr	Filling as Regr_corrected, but NEE not u* corrected	_re_u1
Meteo	Meteorological forcing parameters	

File Names

For each site-year of data, we have compiled 20 files for flux data and 5 for meteorology data. A Zipped data set containing 25 files is provided for each site-year of data. File names that are used for each site-year use the following form:

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

xxyy_cc.met for meteorological data.

'xxyy' serves as site identification (see Siteinfo.doc, Table 1),

xx:= 2-3 character site code

yy:= 2-digit year code, e.g., "99"=1999

'aa' refers to 3 basic filling methods:

re:= nonlinear regression,

lu:= look up tables,

dc:= mean daily courses

'bb' refers to data pre treating:

u0:= u* corrected,

u1:= no correction applied

'cc' refers to time resolution:

hh = half hour

dd = daily

ww = weekly

mm:= monthy,

yy:= yearly

For instance WB98_re_u0_mm.flx is u* corrected flux data filled by regression methods, and summed/averaged into monthly data for 1998 for Walker Branch site. A set of the file names for all 25 files is presented below.

Table 2. Examples of 25 file names contained in the Zipped data set for a site-year of flux data.

Filename	Gap filling method	U* treatment	Time step
WB98_dc_u0_hh.flx	"Gap filling by mean daily courses of NEE, LE, H"	data u* corrected	half-hour
WB98_dc_u0_dd.flx	Gap filling by mean daily courses of NEE, LE, H	data u* corrected	daily
WB98_dc_u0_ww.flx	Gap filling by mean daily courses of NEE, LE, H	data u* corrected	weekly
WB98_dc_u0_mm.flx	Gap filling by mean daily courses of NEE, LE, H	data u* corrected	monthly
WB98_dc_u0_yy.flx	Gap filling by mean daily courses of NEE, LE, H	data u* corrected	yearly
WB98_lu_u0_hh.flx	Gap filling by look up tables for PAR-Ta (NEE), PAR-VPD (LE, H)	NEE u* corrected	half-hour
WB98_lu_u0_dd.flx	Gap filling by look up tables for PAR-Ta (NEE), PAR-VPD (LE, H)	NEE u* corrected	daily
WB98_lu_u0_ww.flx	Gap filling by look up tables for PAR-Ta (NEE), PAR-VPD (LE, H)	NEE u* corrected	weekly
WB98_lu_u0_mm.flx	Gap filling by look up tables for PAR-Ta (NEE), PAR-VPD (LE, H)	NEE u* corrected	monthly
WB98_lu_u0_yy.flx	Gap filling by look up tables for PAR-Ta (NEE), PAR-VPD (LE, H)	NEE u* corrected	yearly
WB98_re_u0_hh.flx	Gap filling by nonlinear regression (NEE only!) with Ts (nighttime), Ta sorted PAR (daytime)	NEE u* corrected	half-hour
WB98_re_u0_dd.flx	Gap filling by nonlinear regression (NEE only!) with Ts (nighttime), Ta sorted PAR (daytime)	NEE u* corrected	daily
WB98_re_u0_ww.flx	Gap filling by nonlinear regression (NEE only!) with Ts (nighttime), Ta sorted PAR (daytime)	NEE u* corrected	weekly
WB98_re_u0_mm.flx	Gap filling by nonlinear regression (NEE only!) with Ts (nighttime), Ta sorted PAR (daytime)	NEE u* corrected	monthly
WB98_re_u0_yy.flx	Gap filling by nonlinear regression (NEE only!) with Ts (nighttime), Ta sorted PAR (daytime)	NEE u* corrected	yearly
WB98_re_u1_hh.flx	Gap filling by regression corrected	NEE not u* corrected	half-hour

WB98_re_u1_dd.flx	Gap filling by regression corrected	NEE not u* corrected	daily
WB98_re_u1_ww.flx	Gap filling by regression corrected	NEE not u* corrected	weekly
WB98_re_u1_mm.flx	Gap filling by regression corrected	NEE not u* corrected	monthly
WB98_re_u1_yy.flx	Gap filling by regression corrected	NEE not u* corrected	yearly
WB98_hh.met	Meteorological forcing parameters		half-hour
WB98_dd.met	Meteorological forcing parameters		daily
WB98_ww.met	Meteorological forcing parameters		weekly
WB98_mm.met	Meteorological forcing parameters		monthly
WB98_yy.met	Meteorological forcing parameters		yearly

Meteorology data files (named as *.met)

The meteorology files are monthly and yearly aggregations and contain 3 data types: total (i.e. "tot" - day and nighttime), daytime ("day"), and nighttime ("night"). For each variable (Table 3) either sum or average/minimum/maximum, percent of gaps filled and standard deviation (S.D.) are provided. The S.D. is the standard deviation calculated from the respective daily sum or daily mean. The data are comma-delimited, missing values are set to -9999. These files (along with the 0.5 hr data) are stored as a collection of files zipped together for a site-year.

Table 3. Variables in Meteorology data files.

Variable*	Description	Units**
Siteid	2-4 letter code	
Year	"Year"= 4-digit number	
Time	"Month"=1-12 or 0 for "yy" annual values	
GapMethod	Gap-filling method; "lookup" using U* corrected NEE	
Int.	"tot","day", "night" refer to total day, daytime only, nighttime only	
Rg	Sum of Global radiation for time period	MJ m-2 month-1 (or year-1 or day-1)
Rg_g	Percent gaps filled for period	%
Rg_s	S.D.	MJ m-2 day-1
PAR	Sum of Photosynthetic active radiation for time period	mol m-2 month-1 (or year-1)
PAR_g	Percent gaps filled for period	%
PAR_s	S.D.	mol m-2 day-1) (for monthly, yearly)

Ta	Average Air temperature (tower top) of time period	deg. C
Ta_g	Percent gaps filled for period	%
Tami	Minimum Air temperature of time period	deg. C
Tamx	Maximum Air temperature of time period	deg. C
Ta_s	S.D.	deg. C
Ts	Average Soil temperature (5 cm depth) of time period	deg. C
Ts_g	Percent gaps filled for period	%
Tsmi	Minimum Soil temperature of time period	deg. C
Tsmx	Maximum Soil temperature of time period	deg. C
Ts_s	S.D.	deg. C
RH	Average relative humidity (tower top) of time period	%
RH_g	Percent gaps filled for period	%
RHmi	Minimum relative humidity of time period	%
RHmx	Maximum relative humidity of time period	%
RH_s	S.D.	%
VPD	Average vapor pressure deficit (tower top) of time period	kPa
VPD_g	Percent gaps filled for period	%
VPDmi	Minimum vapor pressure deficit of time period	kPa
VPDmx	Maximum vapor pressure deficit of time period	kPa
VPD_s	S.D.	kPa
Ca	Average CO2 concentration in air (tower top) of time period	ppm
Ca_g	Percent gaps filled for period	%
Cami	Minimum CO2 concentration in air of time period	ppm
Camx	Maximum CO2 concentration in air of time period	ppm
Ca_s	S.D.	ppm
Rn	Sum of Net radiation for time period	MJ m-2 month-1 (or year-1 or day-1)
Rn_g	Percent gaps filled for period	%
Rn_s	S.D.	MJ m-2 day-1 (for monthly or yearly)
PPT	Sum of precipitation	mm month-1 (or year-1)
PPT_g	Percent gaps filled for period	%

PPT_s	S.D.	mm day-1 (for monthly, yearly)
SWC	Average Soil water content	cm3 H2O cm-3 soil
SWC_g	Percent gaps filled for period	%
SWC_s	S.D.	cm3 H2O cm-3 soil
WS	Average wind speed	m s-1
WS_g	Percent gaps filled for period	%
WS_s	S.D.	m s-1
Pa	Average air pressure	kPa
Pa_g	Percent gaps filled for period	%
Pa_s	S.D.	kPa
U*	Average Friction velocity	m s-1
U*_g	Percent gaps filled for period	%
U*_s	S.D.	m s-1

*This column defines order of variables (i.e., the header row) for the met data files.

**Units for the "tot" (daytime plus nighttime) are as given. Units for daytime and nighttime separately are per "time period", i.e. the values added together give the "total").

Flux data files (named as *.flx)

The data format of flux variables (Table 4) in monthly and yearly files is standardized, and contains 3 data types: total (i.e. "tot" - day and nighttime), daytime("day"), and nighttime ("night"). For each variable either sum or average/minimum/maximum, percent of gaps filled and standard deviation (S.D.) are provided. The S.D. is the standard deviation calculated from the respective daily sum or daily mean. The data are comma-delimited, missing values are set to -9999. These files (along with the 0.5 hourly data) are stored as a collection of files zipped together for a site-year. They are available on the FLUXNET Synthesis FTP Server (see below).

Table 4. Variables in flux data files.

Variable*	Description	Units**
Siteid	2-4 letter code	
Year	"Year"= 4-digit number	
Month	"Month"=1-12 or 0 for "yy" annual values	
GapMethod	Gap-filling method; "lookup" using U* corrected NEE	
Interval	"tot","day", "night" refer to total day, daytime only, nighttime only	
NEE	Sum of net ecosystem exchange (FC + storage + correction if applied) for time period	gC m-2 month-1 (or year-1)
NEE_e	Error (+/-) introduced by filling for NEE	+/- gC m-2 month-1 (or year-1)

NEE_g	Percent gaps filled for period	%
NEE_s	S.D.	gC m-2 day-1 (for month or year)
LE	Sum of latent heat for time period	MJ m-2 month-1 (or year-1)
LE_e	Error (+/-) introduced by filling for LE	+/- MJ m-2 month-1 (or year-1)
LE_g	Percent gaps filled for period	%
LE_s	S.D.	MJ m-2 day-1 (for monthly or yearly:)
H	Sum of sensible heat for time period	MJ m-2 month-1 (or year-1)
H_e	Error (+/-) introduced by filling for H	+/- MJ m-2 month-1 (or year-1)
H_g	Percent gaps filled for period	%
H_s	S.D.	MJ m-2 day-1 (for monthly or yearly)
G	Sum of soil heat flux for time period	MJ m-2 month-1 (or year-1)
G_e	Error (+/-) introduced by filling for G ("zero" in this version)	+/- MJ m-2 month-1 (or year-1)
G_g	Percent gaps filled for period	%
G_s	S.D.	MJ m-2 day-1 (for monthly or yearly)

*This column defines order of variables (i.e., the header row) for the flux data files.

**Units for the "tot" (daytime plus nighttime) are as given. Units for daytime and nighttime separately are per "time period", i.e. the values added together give the "total").

References

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