MICROMETEOROLOGY

Hourly estimates of evaporation, heat flux and conductances supported by climate data and calibrated estimates of the hourly momentum flux and atmospheric stability. The data were recorded during the intensive study periods at 5 of the 6 ABRACOS sites and range in duration from 3 weeks to 3 months.

The micrometeorology data files are as follows:

PASTURE

File NAME	Mission NUMBER	Site Code	Year	Local Time/Date	
				Initial	Final
PASTM1	1	FD	1990	01hr, 18 Sep.	24hr, 2 Nov.
PASTM2	2	FD	1991	01hr, 29 June	12hr, 11 Sep.
PASTM3	3	NS	1992	01hr, 06 Aug.	12hr, 7 Oct.
PASTM45	4/5	NS	1993	01hr, 31 Mar.	12hr, 28 Jul.
PASTM6.	6	BS	1993	18hr, 05 Oct.	09hr, 26 Oct.
PASTM7.	7	NS	1994	12hr, 11 Aug.	15hr, 24 Aug.

FOREST

File NAME	Mission NUMBER	Site Code	Year	Local Time/Date	
				Initial	Final
FORSTM3	3	RJ	1992	16hr, 08 Aug.	10hr, 05 Oct.
FORSTM45	4/5	RJ	1993	01hr, 04 Apr.	24hr, 26 July
FORSTM6	6	RV	1993	11hr, 18 Oct.	10hr, 27 Oct.
FORSTM7	7	RJ	1994	17hr, 13 Aug.	15hr, 25 Aug.

where the site codes are as follows,

FD	Fazenda Dimona, near Manaus, Amazonas

NS	Fazenda Nossa Senhora, near Ji-Parana, Rondonia
BS	Fazenda Boa Sorte, near Maraba, Para
RJ	Reserva Jaru, near Ji-Parana, Rondonia
RV	Reserva Vale, near Maraba, Para

Site details are given in the climate text file AB-AWS.TXT

Within each file each datum is in free format, in seven character columns and space delineated. Missing data are indicated by a value of -99. In summary the columns are follows:

Col.	Description	
1	Julian day number	
2	Hour(local)	
3	Total incoming short-wave.	W/m^2
4	Reflected short-wave.	W/m^2
5	Net radiation.	W/m^2
6	Soil heat flux.	W/m^2
7	Air temperature	oC
8	Specific humidity	g/kg
9	Wind speed	m/s
10	Wind direction (degrees arc, clock-wise from North)	
11	Friction velocity	m/s
12	Stability parameter, z/L, where L is Monin-Obukhov length	
13	Integrated stability correction parameter for sensible heat flux	
14	Integrated stability correction parameter for momentum flux	
15	Aerodynamic conductance for heat fluxes	mm/s
16	Bulk surface conductance.	mm/s
17	Latent Heat Flux.	W/m^2

18	Sensible Heat Flux.	W/m^2
19	EITHER Pasture: soil moisture in the root zone	m3/m^3
19	OR Forest: change in biomass heat storage	W/m^2
20	Rainfall.	mm
21	Soil temperature at 10cm (some pasture sites only)	oC
22	Soil temperature at 20cm (some pasture sites only)	oC
23	Soil temperature at 40cm (some pasture sites only)	oC

DATA FILE DETAILS AND NOTES

The following is a more detailed description of each column giving:

Instrument type details (AWS refers to the collocated Automatic Weather Station)
Instrument location details
Derivation of analyzed figures
Quality control information
Cautionary notes where problems arise

General information concerning groups of missions is given first, followed by notes specific to individual missions indicated by the site code and mission number (e.g. FD-2)

1. JULIAN DAY NUMBER

All data files contain a continuous time series of hourly information, although some files have gaps in individual channels.

2. HOUR

Time is local and gives the end time of the hourly period for which the total or average is given.

3. TOTAL INCOMING SHORT-WAVE (W/m^2)

AWS - Recorded by Kipp and Zonen solarimeter

FD-1	## GAP ##	>	217 14:00 (first 10 days)
FD-2	## GAP ##	190 10:00	93 19:00 (small gap 10th - 13th day)

4. REFLECTED SHORT-WAVE (W/m^2)

AWS - Recorded by Kipp and Zonen solarimeter

FD-1	## GAP ##	>	217 14:00 (first 10 days)
NS-45	## GAPS ##	> 129 21:00 144 19:00 146 21:00	101 06:00 130 20:00 145 20:00 157 20:00

5. NET RADIATION (W/m^2)

AWS - REBS net all-wave radiometer

6. SOIL HEAT FLUX (W/m^2)

This is a larger and more important component of the energy balance at pasture sites than forest. Each AWS has two sensors placed at 5mm in the soil which is an adequate sample for forests but less so for pasture. During most pasture missions 9 sensors were used at 5mm depth. Some gaps have been filled using regressions against either net radiation in the pasture or air temperature in the forests.

NS-3 During the dry start to this mission evaporation could be occurring below the sensors creating a small underestimation in the heat or vapour flux. Compensation for this could be derived from the following years analysis. (see below)

NS-45 During the driest part of this mission evaporation below the shallow sensors was identified. The evaporation front passed below the 5mm sensors on about day 271. After this SHF in the data base is derived from the deeper sensors (15cm) to give the overall heat energy leaving the system, and diurnally adjusted for soil heat storage above the sensors using the soil temperature measurement.

BS-6 Record based upon only two sensors.

BS-6 10% patched using regression with net radiation

RJ-3 ## GAP ## 8 days (266-234) filled by regression with air temperature

7. AIR TEMPERATURE (oC)

AWS - Platinum resistance thermometer except FD-M1, FD-M2 and other instances where it was necessary to the micromet. channel.

FD-1	## GAPS ##	269 03:00 - 269 10:00
		270 01:00 - 270 10:00
		270 20:00 - 271 11:00
		(small gaps 8th to 10th day)

8. SPECIFIC HUMIDITY (g/kg)

AWS - Platinum resistance wet-bulb thermometer except FD-M1, FD-M2 and other instances where it was necessary to the micromet. channel.

FD-1	## GAPS ##	269 03:00 - 269 10:00
		270 01:00 - 270 10:00
		270 20:00 - 271 11:00
		(small gaps 8th to 10th day)
RV-6	## GAPS ##	283 22:00 - 285 13:00
		286 01:00 - 291 11:00

9. WIND SPEED (m/s)

AWS - Didcot Instruments, UK

10. WIND DIRECTION (degrees arc, clock-wise from North)

AWS - Didcot Instruments, UK

FD-1	## GAP ##	>	271 14:00 (first 10 days)
FD-2	## GAP ##		190 10:00 - 193 19:00

11-15. MOMENTUM FLUX VARIABLES

Friction velocity (m/s)
Stability parameter, z/L
Integrated stability correction for sensible heat flux
Integrated stability correction for momentum flux
Aerodynamic conductance for heat fluxes (mm/s)

All momentum flux and stability variables are calculated using the best possible roughness calibration for each site (see Wright et al 1992, Wright et al 1996b) as follows:

Mission	z	d	z0
FD-1	3.5	0.17	0.026
FD-2	3.5	0.19	0.026
NS-3	5.5	0.38	0.064
NS-45	5.5	0.40	0.064
NS-7	3.8	0.20	0.030
BS-6	4.0	0.46	0.076
RJ-3 & 45	53.5	5.8	2.60

RV-6	53.5	30.1	2.35

Data base columns 11-14 where then calculated by iteration of the wind profile and stability correction formulae based on the Monin-Obukhov length, L, and similarity theory (Arya 1988). The aerodynamic conductance given in column 15 is then calculated from the friction velocity and stability corrections, and is the conductance applicable for heat and water vapour. This application includes a correction for the different source/sink heights for heat and momentum and gives ln(z0m/ z0h) the value 2.0 for pasture and 1.5 for forest (Brutsaert, 1984). When heat flux data is missing the variables are given for neutral conditions

16. BULK SURFACE CONDUCTANCE (mm/s)

Calculated from a rearrangement of the Penman-Monteith equation. The value is set to -99 either at night or when the calculated values is very high or negative. (Wright et al. 1995,1996a)

17. LATENT HEAT FLUX (W/m^2)

Pasture and forest fluxes were frequently verified against other independent Bowen ratio and eddy-correlation devices

Pasture - evaporation calculated from estimates of Bowen ratio (9m profile tower), directly from an eddy-correlation device or as a residual of the energy balance when the two former sources are unavailable. A few gaps of not more than 2 daylight hours were filled using a detailed time-series model of Bowen ratio.

Forest - the same as for pasture but without the use of psychrometer profiles. Changes in biomass heat storage were include in the residual energy balance method (Moore and Fisch,1986)

FD-1	## GAPS ##	269 03:00 - 269 10:00
		270 01:00 - 270 10:00
		270 20:00 - 271 11:00
		(small gaps 8th to 10th day)
FD-2	## GAP ##	180 00:00 - 180 17:00
		(first day)
RV-6	## GAPS ##	283 22:00 - 285 13:00
		286 01:00 - 291 11:00
		293 10:00 - 294 10:00

18. SENSIBLE HEAT FLUX (W/m^2)

Pasture and forest fluxes were frequently verified against other independent Bowen ration and eddy-correlation devices

Pasture - heat flux calculated from estimates of Bowen ratio (9m profile tower), directly from an

eddy-correlation device. A few gaps of not more than 2 daylight hours were filled using a detailed time-series model of Bowen ratio.

Forest - the same as for pasture but without the use of psychrometer profiles.

FD-1	## GAPS ##	269 03:00 - 269 10:00
		270 01:00 - 270 10:00
		270 20:00 - 271 11:00
		(small gaps 8th to 10th day)
FD-2	## GAP ##	180 00:00 - 180 17:00
		(first day)
RV-6	## GAPS ##	283 22:00 - 285 13:00
		286 01:00 - 291 11:00
		293 10:00 - 294 10:00

19. EITHER PASTURE: SOIL MOISTURE IN THE ROOT ZONE (m3/m^3)

Mean moisture storage in the top 1.5 m (FD) or 2.0 m (NS & BS) of soil, derived from between 5 and 8 neutron access tubes with 10-20 cm measurement depth increments. (Wright 1995, 1996a)
Or FOREST: CHANGE IN BIOMASS HEAT STORAGE (W/m^2)
Calculated using the AWS air temperature and humidity in the equations of Moore and Fisch (1986) and best estimates of forest structure parameters from Reserva Jaru.

FD-2	## GAP ##	180 00:00 - 180 23:00 (first day)

20. RAINFALL (mm)

AWS - Didcot Instruments, UK. 0.1-0.2mm tipping bucket device.

FD-1	## GAPS ##	>	- 277 19:00 278 21:00 - 281 19:00

A Manual raingauge showed little significant rain fall up to day 277, except for 27mm during the afternoon of day 270.

21-23. SOIL TEMPERATURE AT 10cm (pasture only) (oC)
SOIL TEMPERATURE AT 20cm (pasture only)(oC)
SOIL TEMPERATURE AT 40cm (pasture only)(oC)

Mean of three thermistors at 10 cm and a single thermistor at the other two depths.

FD-1	## GAPS ##	>	267 13:00 (10cm and 20cm)
		>	271 16:00 (40cm)
		279 17:00 -	281 16:00 (all)
		283 12:00 -	287 06:00 (all)
		289 16:00 -	302 10:00 (40cm)
		306 11:00 >	271 16:00 (40cm)
FD-2	## GAP ##	180 00:00	180 17:00
		(first day)	
FD-2	No data for 40 cm		
NS-3	## GAP ##	>	225 11:00 (all)
		270 10:00 -	>
NS-45	## GAPS ##	>	111 24:00
		114 10:00 -	114 16:00
		185 00:00 -	186 14:00

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