Aircraft Flux - Raw: U of Wy. (FIFE)

Summary:

The University of Wyoming (UW) King Air atmospheric boundary layer measurement missions were flown in 1987 during IFCs 3 and 4. This Raw Boundary Layer Fluxes data set contains parameters that describe the environment in which the flux data were collected and the flux data itself. The fluctuations in all variables were calculated with three different methods (the arithmetic means removed, the linear trends removed, or filtered with a high-pass recursive filter) prior to the eddy correlation calculations. This data set contains the data with the arithmetic means removed (i.e., RAW). All the flux measurements were obtained with the eddy-correlation method, wherein the aircraft is equipped with an inertial platform, accelerometers, and a gust probe for measurement of earth-relative gusts in the x, y, and z directions. Gusts in these dimensions are then correlated with each other for momentum fluxes and with fluctuations in other variables to obtain the various scalar fluxes, such as temperature (for sensible heat flux) and water vapor mixing ratio (for latent heat flux). The summary of data calculated from each aircraft pass includes various statistics, correlations, and fluxes calculated after the time series for each variable with the arithmetic means removed.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

Aircraft Flux - Raw: U of Wy. (FIFE)
(Raw Boundary Layer Fluxes from the UW King Air).

Data Set Introduction:

This Raw Boundary Layer Fluxes data set contains parameters that describe the environment in which the flux data were collected (e.g., aircraft position, atmospheric temperature, pressure, wind) and the flux data itself (e.g., gust statistics, temperature statistics, momentum flux statistics, and latent and sensible heat fluxes). This data set contains the flux data with the arithmetic means removed.

Objective/Purpose:

The objectives of this investigation were:

1. To study the boundary-layer, sensible and latent heat fluxes over the FIFE site,
2. To use airborne flux profiles to predict surface flux values and to compare these predicted fluxes to those measured at the surface,
3. To use various flight patterns to study sensible and latent heat budgets in the boundary layer in the FIFE study area.

Summary of Parameters:

Two types of parameters are available in this data set. The first type are those which describe the environment in which the flux data were collected. These parameters include aircraft position, atmospheric temperature, pressure, wind, and downwelling and upwelling radiation. The second type of parameters are the flux data themselves, these include the gust statistics, temperature statistics, momentum flux statistics, and latent and sensible heat fluxes. These data have had the arithmetic means removed (i.e., RAW data).

Discussion:

The University of Wyoming (UW) King Air atmospheric boundary layer measurement missions were flown in 1987 during IFCs 3 and 4. Most of the flux-measurement missions during IFC-3 and IFC-4 were flown using coordinated patterns involving the Wyoming King Air and the Twin Otter. The Wyoming King Air usually flew a series of identical horizontal flight lines each at a lower altitude than the last.

This series of horizontal passes at different altitudes is referred to as a "stack". Three basic patterns of stacks were used:

1. Repeated stacks along one line,
2. Repeated stacks along one line flown in a time-centered pattern to allow removal of first order, time trends, and

3. Double stacks, with one stack at each end of the FIFE site (north and south ends), also flown in a time-centered pattern to allow removal of first-order time trends. These are described in Betts et al. (1990) and Kelly et al. (1992) (see the *References Section*).

Related Data Sets:

- Detrended Atmospheric Turbulence Data from the NCAR King Air.
- Filtered Atmospheric Turbulence Data from the NCAR King Air.
- Raw Atmospheric Turbulence Data from the NCAR King Air.
- Detrended Boundary Layer Fluxes from the Twin Otter.
- Filtered Boundary Layer Fluxes from the Twin Otter.
- Raw Boundary Layer Fluxes from the Twin Otter.
- Detrended Boundary Layer Fluxes from the UW King Air.
- Filtered Boundary Layer Fluxes from the UW King Air.
- Eddy Correlation Surface Flux Observations (USGS).
- Eddy Correlation Surface Flux Observations (UNL).
- Eddy Correlation Surface Flux Observations (GSFC).
- Eddy Correlation Surface Flux Observations (UK).
- Eddy Correlation Surface Flux Observations (Argonne).
- Bowen Ratio Surface Flux Observations (GSFC).
- Bowen Ratio Surface Flux Observations (KSU).
- Bowen Ratio Surface Flux Observations (Fritschen).
- Bowen Ratio Surface Flux Observations (UNL).
- Bowen Ratio Surface Flux Observations (USGS).
- Bowen Ratio Surface Flux Observations (Smith).
- FIFE Radiosonde Data.
- FIFE Standard Pressure Level Radiosonde Data.
- FIFE Radiosonde Wind Profiles.
- FIFE Temperature and Humidity Profiles.
- Quick Look Boundary Layer Height.
- Boundary Layer Heights Using SODAR.
- NOAA Radiosonde Observations.

FIS Data Base Table Name:

AIRCRAFT_FLUX_DATA_raw.

2. Investigator(s):

Investigator(s) Name and Title:

Dr. Robert D. Kelly
Dept. of Atmospheric Science

Title of Investigation:

Flux profiles and flux budgets in FIFE boundary layer.

Contact Information:

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Requested Form of Acknowledgment.

The boundary layer flux data were collected during 1987 by Robert D. Kelly using the University of Wyoming King Air aircraft. His contribution of these data is particularly appreciated.

3. Theory of Measurements:

All the flux measurements were obtained with the eddy-correlation method, wherein the aircraft is equipped with an inertial platform, accelerometers, and a gust probe for measurement of earth-relative gusts in the x, y, and z directions. Gusts in these dimensions are then correlated with each other for momentum fluxes and with fluctuations in other variables to obtain the various scalar fluxes, such as temperature (for sensible heat flux) and water vapor mixing ratio (for latent heat flux). The fluctuations in all variables were calculated with three different methods prior to the eddy correlation calculations (see the *Data Manipulations Section*).

4. Equipment:

Sensor/Instrument Description:

Collection Environment:

Airborne.

Source/Platform:

King Air Aircraft.

Source/Platform Mission Objectives:

See the *Objective/Purpose Section*.

Key Variables:

The important parameters in this data set are as follows:

1. Means of air temperature, potential air temperature, mixing ratio, north/south and east/west wind components, and atmospheric pressure.
2. Root mean square and linear trend of the means listed above.
3. Root mean square and skewness of the vertical gust wind velocity, north/south and east/west wind gust velocity, along-wind and cross-wind component of the wind gust velocity, potential temperature and water mixing ratio.
4. Momentum flux and the correlation coefficient for north/south and east/west wind gusts and vertical velocity, and along-wind and across-wind component of the wind gust velocity and vertical velocity.
5. Sensible and latent heat flux and the correlation coefficients for these fluxes.
6. Moist air density times specific heat capacity.
7. Latent heat of vaporization.
8. Moist air density.

Principles of Operation:

See the *Theory of Measurements Section*.

Sensor/Instrument Measurement Geometry:

- The gust probe was mounted at the end of the aircraft nose boom.
- Inertial platform and accelerometers were mounted close to the main wing spar near the center of gravity for the aircraft.
- The temperature probe was mounted in an instrument cluster on the wing tip.
- The lyman-alpha and the dew-point hygrometer were mounted inside the cabin, drawing air from a vacuum-pump driven sample tube.

Manufacturer of Sensor/Instrument:

University of Wyoming King Air equipment.

Variable	Instrument
Air temp.	Rosemount
Dewpoint temp.	Cambridge Model 1373C
Vapor density	In-house Lyman-alpha
Mag. heading	King KPI553/Sperry C14-43
Static press.	Rosemount 1201FA1B1A
Geom. Alt.	Stewart Warner APN159
Geom. Alt.	King KPA 405
Rate of climb	Rosemount 1241A4BCDE
Total press.	Rosemount 831CPX
Azimuth VOR	King KNR615 VOR
Distance DME	King KNR705A DME
Lat/lon	Texas Inst 91 LORAN-C
Lat/lon	Litton LTN-51 INS
Ground veloc.	Litton LTN-51 INS

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Vert. veloc.        Litton LTN-51 INS
Pitch/roll          Litton LTN-51 INS
Platform hdg.       Litton LTN-51 INS
Pitch/roll          Humphrey SA0905021 gyro.
Flow angle          Rosemount 858AJ/831CPX
Vert. accel.        Humphrey SA0905021 accel.
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Calibration:

Instruments subject to calibration as follows: Air temperature Manufacturer's one-time calibration was used. Lyman-alpha Calibrated by correlation with dew-point hygrometer data from slow-rate ascent sounding at start of each flight. Resulting regression was applied to all data from that flight. Pressure sensors for static pressure and gust differential pressures were calibrated at the beginning of each IFC against a Mercury column standard.

5. Data Acquisition Methods:

Most of the flux-measurement missions during IFC-3 and IFC-4 involved coordinated patterns with the Wyoming King Air and the Twin Otter. One such flight included a horizontal grid pattern for the Twin Otter and a vertical "stack" of horizontal passes for the King Air. The "stack" in this case included W-to-E then E-to-W passes at each of four different altitudes (1010, 730, 580, and 520 meters above Mean Sea Level), followed by a repeat of the same pattern. The data for each flight were subdivided into the horizontal passes (each about 2-3 minutes) for processing, and are presented in this archive on a pass-by-pass basis. The information for each pass includes time, aircraft heading, and pass end-points, which allow reconstruction of the overall pattern used for that particular experiment.

6. Observations:

Data Notes:

Not available.

Field Notes:

Not available at this revision.

7. Data Description:

Spatial Characteristics:

The FIFE study area, with areal extent of 15 km by 15 km, is located south of the Tuttle Reservoir and Kansas River, and about 10 km from Manhattan, Kansas, USA. The northwest corner of the area has UTM coordinates of 4,334,000 Northing and 705,000 Easting in UTM Zone 14.

Spatial Coverage:

Each horizontal flight pass covered either the E-W or the N-S horizontal extent of the FIFE study area (15x15 km). Vertically, all the passes were within the mixed-layer portion of the planetary boundary layer, i.e., within the layer of nearly constant potential temperature and mixing ratio.

Spatial Coverage Map:

Not available.

Spatial Resolution:

The King Air eddy correlation data were collected at 10 Hz and an average true airspeed of about 85 m/s, giving an average spatial resolution of about 9 m. However, each data point in this archive represents an entire horizontal pass and therefore has a resolution no smaller than the FIFE study area itself (15 km).

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Temporal Coverage:

The King Air data cover IFCs 3 and 4 of 1987 (Aug. and Oct. 1987).

The duration of individual flights ranged from 2 to 4 hours.

Temporal Coverage Map:

Not available.

Temporal Resolution:

Each aircraft pass took approximately 2 to 3 minutes, which then represents the minimum resolution of the data in this archive. The times required to complete the single and double stacks of horizontal passes ranged from ½ to 2 hours, which then represents the minimum resolution of the flux profiles and budgets.

Data Characteristics:

The SQL definition for this table is found in the AF_raw.TDF file located on the FIFE CD-ROM Volume 1.

Parameter/Variable Name			
Parameter/Variable Description	**Range**	**Units**	**Source**
OBS_DATE The date the observation was made on, in the format (DD-MMM-YY).			
START_TIME The starting time for the observation run in GMT, in the format (HHMM). The seconds for this time is stored in START_SECONDS.		[GMT]	
START_SECONDS The seconds component of the START_TIME (format SS).		[GMT]	
DURATION The duration of the flight in the format (MMSS).			
AIRCRAFT_ID The ID name for the aircraft which made the observation run.			
START_LAT The starting latitude for the observation run.			
START_LON The starting longitude for the observation run.			
START_NORTHING The starting northing position of the aircraft in UTM coordinates.		[meters]	

START_EASTING The starting easting position of the aircraft in UTM coordinates.	[meters]
END_LAT The ending latitude for the observation run.	
END_LON The ending longitude for the observation run.	
END_NORTHING The ending northing position of the aircraft in UTM coordinates.	[meters]
END_EASTING The ending easting position of the aircraft in UTM coordinates.	[meters]
HEADING The heading of the aircraft. from North]	[degrees
HEIGHT_ABOVE_MEAN_SEA_LVL The altitude of the aircraft above mean sea level, as determined by air pressure.	[meters]
HEIGHT_ABOVE_GRND_LVL The altitude of the aircraft above the ground, as determined by radar.	[meters]
AIR_TEMP_MEAN The mean air temperature. Celsius]	[degrees
POTNTL_TEMP_MEAN The potential mean air temperature. Kelvin]	[degrees
MIX_RATIO_MEAN The mixing ratio taken from a dew-point hygrometer.	[grams] [kg^-1]

NS_WIND_VELOC_MEAN The mean north/south wind component (V), with north being positive.	[meters] [sec ^-1]
EW_WIND_VELOC_MEAN The mean east/west wind component (U), with east being positive.	[meters] [sec ^-1]
PRESS_MEAN The mean air pressure.	[millibars]
SURF_TEMP_MEAN The mean surface temperature. Celsius]	[degrees
DOWNWELL_RADTN_MEAN The mean downwelling radiation count.	[Watts] [meter^-2]
UPWELL_RADTN_MEAN The mean upwelling radiation count. [meter^-2]	[Watts]
VEG_INDEX_MEAN The mean vegetation (greenness) index.	
AIR_TEMP_RMS The root mean square of the temperature recorded in column AIR_TEMP_MEAN.	[degrees Celsius]
POTNTL_TEMP_RMS The root mean square of the potential temperature recorded in the column POTNTL_TEMP_MEAN.	[degrees Kelvin]
MIX_RATIO_RMS The root mean square of the mixing ratio recorded in the column MIX_RATIO_MEAN, taken from a dew-point hygrometer.	[grams] [kg^-1]
NS_WIND_VELOC_RMS The root mean square of the	[meters]

north/south wind component recorded in column NS_WIND_VELOC_MEAN.	[sec ^-1]
EW_WIND_VELOC_RMS The root mean square of the east/west wind component recorded in column EW_WIND_VELOC_MEAN.	[meters] [sec ^-1]
PRESS_RMS The root mean square of the pressure recorded in column PRESS_MEAN.	[millibars]
SURF_TEMP_RMS The root mean square of the surface temperature recorded in column SURF_TEMP_MEAN.	[degrees Celsius]
DOWNWELL_RADTN_RMS The root mean square of the downwelling radiation count recorded in column DOWNWELL_RADTN_MEAN.	[Watts] [meter^-2]
UPWELL_RADTN_RMS The root mean square of the upwelling radiation recorded in column UPWELL_RADTN_MEAN.	[Watts] [meter^-2]
VEG_INDEX_RMS The root mean square of the vegetation (greenness) index recorded in column VEG_INDEX_MEAN.	
AIR_TEMP_LINEAR The linear trend of the temperature recorded in the column AIR_TEMP_MEAN.	[degrees Celsius] [meter^-1]
POTNTL_TEMP_LINEAR The linear trend of the potential temperature recorded in column POTNTL_TEMP_MEAN.	[degrees Kelvin] [meter^-1]
MIX_RATIO_LINEAR The linear trend of the mixing ratio recorded in column	[grams] [kg^-1]

MIX_RATIO_MEAN (derived from dew point).	[meter^-1]
NS_WIND_VELOC_LINEAR The linear trend of the north/south wind component recorded in column NS_WIND_VELOC_MEAN.	[meters] [sec ^-1] [meter^-1]
EW_WIND_VELOC_LINEAR The linear trend of the east/west wind component recorded in column EW_WIND_VELOC_MEAN.	[meters] [sec ^-1] [meter^-1]
PRESS_LINEAR The linear trend of the pressure recorded in column PRESS_MEAN.	[millibars] [meter^-1]
SURF_TEMP_LINEAR The linear trend of the surface temperature recorded in column SURF_TEMP_MEAN.	[degrees Celsius] [meter^-1]
DOWNWELL_RADTN_LINEAR The linear trend of the downwelling radiation count recorded in DOWNWELL_RADTN_MEAN.	[Watts] [meter^-2] [meter^-1]
UPWELL_RADTN_LINEAR The linear trend of the upwelling radiation count recorded in column UPWELL_RADTN_MEAN.	[Watts] [meter^-2] [meter^-1]
VEG_INDEX_LINEAR The linear trend of the vegetation (greenness) index recorded in column VEG_INDEX_MEAN.	
MOIST_AIR_DENSITY_X_CP The moist air density times specific heat capacity (CP). Kelvin^-1]	[Watts][sec] [degrees
LATENT_HEAT_OF_VAPOR The latent heat of vaporization at 20 degrees Celsius. [gram^-1]	[Watts] [sec]

MOIST_AIR_DENSITY The moist air density. [meter^-3]	[kg]
VERT_GUST_VELOC_RMS_raw The root mean square of the vertical wind gust velocity.	[meters] [sec ^-1]
NS_GUST_VELOC_RMS_raw The root mean square of the north/south wind (U) gust velocity.	[meters] [sec ^-1]
EW_GUST_VELOC_RMS_raw The root mean square of the east/west wind (V) gust velocity.	[meters] [sec ^-1]
ALONG_WIND_VELOC_RMS_raw The root mean square of the along-wind component of the wind gust velocity.	[meters] [sec ^-1]
ACROSS_WIND_VELOC_RMS_raw The root mean square of the across-wind component of the wind gust velocity.	[meters] [sec ^-1]
POTNTL_TEMP_RMS_raw The root mean square of the potential temperature.	[degrees Kelvin]
WATER_MIX_RATIO_RMS_raw The root mean square of the water mixing ratio (lyman alpha).	[grams] [kg^-1]
CO2_MIX_RATIO_RMS_raw The root mean square of the carbon dioxide content.	[milligrams] [kg^-1]
VERT_GUST_VELOC_SKEW_raw The skewness of the vertical gust wind velocity.	
NS_GUST_VELOC_SKEW_raw The skewness of the north/south wind gust velocity.	

EW_GUST_VELOC_SKEW_raw The skewness of the east/west wind gust velocity.	
ALONG_WIND_VELOC_SKEW_raw The skewness of the along-wind component of the wind gust velocity.	
ACROSS_WIND_VELOC_SKEW_raw The skewness of the across-wind component of the wind gust velocity.	
POTNTL_TEMP_SKEW_raw The skewness of the potential temperature.	
WATER_MIX_RATIO_SKEW_raw The skewness of the water mixing ratio.	
CO2_MIX_RATIO_SKEW_raw The skewness of the carbon dioxide content.	
NS_MOMNTM_FLUX_raw The north/south momentum flux, calculated from W*V (wind components).	[Newtons] [meter^-2]
EW_MOMNTM_FLUX_raw The east/west momentum flux, calculated from W*U (wind components).	[Newtons] [meter^-2]
ALONG_MOMNTM_FLUX_raw The along-wind momentum flux, calculated from W*along-wind gust (wind components).	[Newtons] [meter^-2]
ACROSS_MOMNTM_FLUX_raw The across-wind momentum flux, calculated from W*across-wind gust (wind components).	[Newtons] [meter^-2]

SENSIBLE_HEAT_FLUX_raw The sensible heat flux. [meter^-2]	[Watts]
LATENT_HEAT_FLUX_raw The latent heat flux. [meter^-2]	[Watts]
CO2_FLUX_raw The carbon dioxide flux. [hectare^-1] [hour^-1]	[kg]
NS_MOMNTM_CC_raw The correlation coefficient for vertical wind velocity and north/south wind gusts.	
EW_MOMNTM_CC_raw The correlation coefficient for vertical wind velocity and east/west wind gusts.	
ALONG_MOMNTM_CC_raw The correlation coefficient for vertical wind velocity and along-wind component of the wind gust velocity.	
ACROSS_MOMNTM_CC_raw The correlation coefficient for vertical wind velocity and across-wind component of the wind gust velocity.	
SENSIBLE_HEAT_CC_raw The correlation coefficient for the sensible heat flux.	
LATENT_HEAT_CC_raw The correlation coefficient for the latent heat flux.	
CO2_FLUX_CC_raw The correlation coefficient for the CO2 flux.	

MIX_RATIO_CC_raw
The correlation coefficient for
the mixing ratio * potential
temperature.

COMMENTS
Any comments pertaining to this
record.

FIFE_DATA_CRTFCN_CODE
The FIFE Certification Code for *
the data, in the following format:
CPI (Certified by PI), CPI-???
(CPI - questionable data).

LAST_REVISION_DATE
data, in the format (DD-mmm-YY).

Footnote:

* Valid levels

The primary certification codes are: EXM Example or Test data (not for release) PRE Preliminary (unchecked, use at your own risk) CPI Checked by Principal Investigator (reviewed for quality) CGR Checked by a group and reconciled (data comparisons and cross checks)

The certification code modifiers are: PRE-NFP Preliminary - Not for publication, at the request of investigator. CPI-MRG PAMS data that is "merged" from two separate receiving stations to eliminate transmission errors. CPI-??? Investigator thinks data item may be questionable.

Sample Data Record:

OBS_DATE	START_TIME	START_SECONDS	DURATION	AIRCRAFT_ID	START_LAT
11-OCT-87	1725	25	255	WYO	3903.5
11-OCT-87	1731	43	319	WYO	3903.5
11-OCT-87	1738	49	315	WYO	3903.5
11-OCT-87	1752	11	326	WYO	3903.7

START_LON	START_NORTHING	START_EASTING	END_LAT	END_LON	END_NORTHING
-9636.7			3903.2	-9626.3	
-9626.3			3903.8	-9637.2	
-9637.2			3903.5	-9626.8	
-9626.9			3903.5	-9637.6	

END_EASTING	HEADING	HEIGHT_ABOVE_MEAN_SEA_LVL	HEIGHT_ABOVE_GRND_LVL
92	925	684	
271	926	692	
90	585	334	
270	588	344	

AIR_TEMP_MEAN	POTNTL_TEMP_MEAN	MIX_RATIO_MEAN	NS_WIND_VELOC_MEAN

.61	281.89	2.11	.83
.72	281.96	2.12	.91
4.07	282.09	2.15	.88
4.32	282.36	2.14	.43

EW_WIND_VELOC_MEAN	**PRESS_MEAN**	**SURF_TEMP_MEAN**	**DOWNWELL_RADTN_MEAN**
.24	907	99.9	9999
.08	906.8	99.9	9999
.8	944.9	99.9	9999
1.48	944.6	99.9	9999

UPWELL_RADTN_MEAN	**VEG_INDEX_MEAN**	**AIR_TEMP_RMS**	**POTNTL_TEMP_RMS**
999	9.99	.13	.15
999	9.99	.12	.13
999	9.99	.11	.14
999	9.99	.09	.13

MIX_RATIO_RMS	**NS_WIND_VELOC_RMS**	**EW_WIND_VELOC_RMS**	**PRESS_RMS**
.11	1.22	.94	.8
.11	1.21	.94	.8
.09	.93	.83	.8
.08	.87	.86	.7

SURF_TEMP_RMS	**DOWNWELL_RADTN_RMS**	**UPWELL_RADTN_RMS**	**VEG_INDEX_RMS**
99.9	999	999	9.99
99.9	999	999	9.99
99.9	999	999	9.99
99.9	999	999	9.99

AIR_TEMP_LINEAR	**POTNTL_TEMP_LINEAR**	**MIX_RATIO_LINEAR**
.00000606	-.00000199	-.00000544
.0000106	.0000101	.000000979
.0000121	.00000565	-.0000101
-2.500E-08	-.00000206	.00000915

NS_WIND_VELOC_LINEAR	**EW_WIND_VELOC_LINEAR**	**PRESS_LINEAR**
.0000505	-.0000911	.00000841
-.00000794	.00000549	.00000831
.0000147	.0000178	.0000361
.0000396	-.0000056	-.0000207

SURF_TEMP_LINEAR	**DOWNWELL_RADTN_LINEAR**	**UPWELL_RADTN_LINEAR**
.999	.999	.999
.999	.999	.999
.999	.999	.999
.999	.999	.999

VEG_INDEX_LINEAR	**MOIST_AIR_DENSITY_X_CP**	**LATENT_HEAT_OF_VAPOR**
.999	1158.3	2453.53
.999	1157.6	2453.53
.999	1191.7	2453.53
.999	1190.2	2453.53

MOIST_AIR_DENSITY	**VERT_GUST_VELOC_RMS_raw**	**NS_GUST_VELOC_RMS_raw**
1.153	1.26	1.22
1.152	1.28	1.21
1.186	1.22	.93
1.184	1.25	.87

EW_GUST_VELOC_RMS_raw	**ALONG_WIND_VELOC_RMS_raw**	**ACROSS_WIND_VELOC_RMS_raw**
.94	1.19	.97
.94	1.22	.93
.83	.98	.77
.86	.86	.88

POTNTL_TEMP_RMS_raw	**WATER_MIX_RATIO_RMS_raw**	**CO2_MIX_RATIO_RMS_raw**
.15	.17	9.99
.13	.16	9.99
.14	.12	9.99
.13	.11	9.99

VERT_GUST_VELOC_SKEW_raw **NS_GUST_VELOC_SKEW_raw** **EW_GUST_VELOC_SKEW_raw**

.63	-.795	-.189
.585	-.302	.134
1.123	-.358	-.106
.907	.134	.104

ALONG_WIND_VELOC_SKEW_raw	ACROSS_WIND_VELOC_SKEW_raw
-.577	.077
-.35	-.127
0	-.155
.034	.016

POTNTL_TEMP_SKEW_raw	WATER_MIX_RATIO_SKEW_raw	CO2_MIX_RATIO_SKEW_raw
1.248	-.438	9.999
1.043	-.641	9.999
.517	.057	9.999
.952	-.691	9.999

NS_MOMNTM_FLUX_raw	EW_MOMNTM_FLUX_raw	ALONG_MOMNTM_FLUX_raw
.05	-.28	-.03
-.22	-.09	-.22
-.04	.09	.03
-.25	-.08	-.15

ACROSS_MOMNTM_FLUX_raw	SENSIBLE_HEAT_FLUX_raw	LATENT_HEAT_FLUX_raw
.28	32	149
.07	-26	179
-.09	102	80
-.22	104	37

CO2_FLUX_raw	NS_MOMNTM_CC_raw	EW_MOMNTM_CC_raw	ALONG_MOMNTM_CC_raw
999.9	.03	-.2	-.02
999.9	-.12	-.06	-.12
999.9	-.03	.08	.02
999.9	-.2	-.07	-.12

ACROSS_MOMNTM_CC_raw	SENSIBLE_HEAT_CC_raw	LATENT_HEAT_CC_raw
.2	.15	.28
.05	-.13	.35
-.08	.5	.23
-.17	.55	.1

CO2_FLUX_CC_raw	MIX_RATIO_CC_raw	COMMENTS
99.99	99.99	
99.99	99.99	
99.99	99.99	
99.99	99.99	

FIFE_DATA_CRTFCN_CODE	LAST_REVISION_DATE	
CPI	25-AUG-92	WYO
CPI	25-AUG-92	WYO
CPI	25-AUG-92	WYO
CPI	25-AUG-92	WYO

8. Data Organization:

Data Granularity:

The King Air eddy correlation data has an average spatial resolution of about 9 m. However, each data point in this archive represents an entire horizontal pass and therefore has a resolution no smaller than the FIFE study area itself (15 km). Each aircraft pass took about 2 - 3 minutes, which then represents the minimum resolution of the data in this archive. The times required to complete the single and double stacks of horizontal passes ranged from ½ to 2 hours, which then represents the minimum resolution of the flux profiles and budgets.

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

Data Format:

The CD-ROM file format consists of numerical and character fields of varying length separated by commas. The character fields are enclosed with a single apostrophe. There are no spaces between the fields. Each file begin with five header records. Header records contain the following information: Record 1 Name of this file, its table name, number of records in this file, and principal investigator name. Record 2 Path and filename of the previous data set, and path and filename of the next data set. (Path and filenames for files that contain another set of data taken at the same site on the same day.) Record 3 Path and filename of the previous site, and path and filename of the next site. (Path and filenames for files of the same data set taken on the same day for the previous and next sites, sequentially numbered by SITEGRID.) Record 4 Path and filename of the previous date, and path and filename of the next date. (Path and filenames for files of the same data set taken at the same site for the previous and next date.) Record 5 Column names for the data within the file, delimited by commas. Record 6 Data records begin.

Each field represents one of the attributes listed in the chart in the *Data Characteristics Section* and described in detail in the TDF file. These fields are in the same order as in the chart.

9. Data Manipulations:

Based on re-examination of the Wyoming King Air data and on comparisons with data from the Twin Otter, several corrections have been applied to the Lyman-alpha water vapor density and mixing ratio data. These corrections include

1. Correction of the vapor fluxes for the effects of heat flux (Webb et al. 1980) and
2. Correction of all the correlations and fluxes involving the Lyman-alpha to account for a 0.3 second time lag between that instrument and the others on the aircraft. In addition, it appears that both the instrument offset and gain tended to drift somewhat during flights. The change in offset does not present a problem in the flux calculations, since all simple offsets are removed by de-meaning, detrending, or filtering for each aircraft pass. Such processing does not, however, correct for changes in instrument gain. The correlations and fluxes involving the Lyman-alpha data have been included here for completeness, but should be used with caution.

The summary of data calculated from each aircraft pass includes various statistics, correlations, and fluxes calculated after the time series for each variable, the arithmetic means have been removed.

10. Errors:

Sources of Error:

Errors have been introduced into the water vapor and mixing ratio parameters because of errors associated with the Lyman-alpha instrument. As described in the *Usage Guidance Section* below, it appears that both the instrument offset and gain tended to drift somewhat during flights. The change in offset does not present a problem in the flux calculations, since all simple offsets are removed by demeaning the data for each aircraft pass.

Such processing does not, however, correct for changes in instrument gain. The correlations and fluxes involving the Lyman-alpha data have been included here for completeness, BUT SHOULD BE USED WITH CAUTION.

Quality Assessment:

Data Validation by Source:

The major effort at data validation was by inter-comparison of data from the various flux aircraft used in FIFE, based on wing-to-wing horizontal flights over the FIFE study area, at the same altitudes as those used in the various experiments. An excellent summary of these comparisons is contained in MacPherson et al. 1992.

Confidence Level/Accuracy Judgment:

The detrended data are recommended for future analysis. The raw and filtered flux data are not recommended for future use.

Measurement Error for Parameters:

Variable	Accuracy	Resolution
Air temp.	0.5 C	.006 C
Dewpoint temp.	0.5 C, >0 C	.006 C
Vapor density	n/a	.0006 g/m**3
Mag. heading	1 deg	.02 deg
Static press.	1 mb	.06 mb
Geom. Alt.	1% reading	.24 ft
Geom. Alt.	3%, <500 ft	1 m
5%, >500 ft		
Rate of climb	1%, <15000 ft	.004 m/s
2%, >25000 ft		
Total press.	1 mb	.005 mb
Azimuth VOR	1 deg	.02 deg
Distance DME	.2 n mi	.1 n mi
Lat/lon	<.01 deg	.0017 deg
Lat/lon	<1 nm/hr drift	.0017 deg
Ground veloc.	<1 nm/hr drift	.04 m/s
Vert. veloc.	1 m/s	.02 m/s
Pitch/roll	.01 deg	.005 deg
Platform hdg.	.05 deg	.005 deg
Pitch/roll	.2 deg	.0006 deg
Flow angle	.2 deg	.00075 deg
Vert. accel.	.002 g	.0001 g

Additional Quality Assessments:

FIS staff applied a general QA procedure to the data to identify inconsistencies and problems for potential users. As a general procedure, the FIS QA consisted of examining the maximum, minimum, average, and standard deviation for each numerical field in the data table. Inconsistencies and problems found in the QA check are described in the *Known Problems with the Data Section*.

Data Verification by Data Center:

The data verification performed by the ORNL DAAC deals with the quality of the data format, media, and readability. The ORNL DAAC does not make an assessment of the quality of the data itself except during the course of performing other QA procedures as described below.

The FIFE data were transferred to the ORNL DAAC via CD-ROM. These CD-ROMs are distributed by the ORNL DAAC unmodified as a set or in individual volumes, as requested. In addition, the DAAC has incorporated each of the 98 FIFE tabular data sets from the CD-ROMs into its online data holdings. Incorporation of these data involved the following steps:

- Copying the entire FIFE Volume 1, maintaining the directory structure on the CD-ROM.
- Using data files, documentation, and SQL code provided on the CD-ROM to create a database in Statistical Analysis System (SAS).
- Creating transfer files to transfer the SAS metadata database to Sybase tables.

Each distinct type of data (i.e. "data set" on the CD-ROM), is accompanied by a documentation file (i.e., .doc file) and a data format/structure definition file (i.e., .tdf file). The data format files on the CD-ROM are Oracle SQL commands (e.g., "create table") that can be used to set up a relational database table structure. This file provides column/variable names, character/numeric type, length, and format, and labels/comments. These SQL commands were converted to SAS code and were used to create SAS data sets and subsequently to input data files directly from the CD-ROM into a SAS data set. During this process, file names and directory paths were captured and metadata was extracted to the extent possible electronically. No files were found to be corrupted or unreadable during the conversion process.

Additional Quality Assurance procedures were performed as follows:

- Statistical operations were performed to calculate minimum and maximum values for all numeric fields and to create a listing of all values of the character fields. During this process, it was determined that various conventions were used to represent missing values. (Note: no modifications were made to any data by the DAAC). In most cases, missing value identification conventions were discussed in the accompanying .doc file. Based on a visual check of the minimum and maximum values, no glaring errors or holes were identified that might indicate errors introduced during CD-ROM mastering by the FIFE project or data ingest by the DAAC.

- Some minor inconsistencies and typographical errors were identified in some of the character fields and column labels, however, no modifications were made to the data by the DAAC.
- Some conversions of ASCII data were necessary to move the data from a DOS platform to a UNIX platform. Standard operating system conversion utilities were used (e.g., dos2unix).
- Much of the metadata required for archival is imbedded in the narrative documentation accompanying the data sets and extracted manually by DAAC staff who have read the .doc files provided on the CD-ROM and have hand entered this information into the metadata database maintained by the DAAC. QA procedures have been performed on these metadata to identify and eliminate typographical errors and inconsistencies in naming conventions, to ensure that all required metadata is present, and to ensure the accuracy of file names and paths for retrieval.
- Data requested for distribution to users are checked to verify that files copied from disk to other media remain uncorrupted.

As errors are discovered in the online tabular data by investigators, users, or DAAC staff, corrections are made in cooperation with the principal investigators. These corrections are then distributed to users. CD-ROM data are corrected when re-mastering occurs for replenishment of CD-ROM stock.

11. Notes:

Limitations of the Data:

Not available.

Known Problems with the Data:

On August 11 and 17, and October 11, 1987, there are 140 LATENT_HEAT_FLUX_raw readings over 400 [W][m^-2].

Usage Guidance:

Following are STATEMENTS OF GUIDANCE FROM THE PI as to the use of these data:

- Based on extensive inter-comparisons of the aircraft data with other aircraft and, especially, with the surface measurements, it is strongly recommended that only the variables derived from linearly detrended time series (Aircraft Flux Data Detrend) be used for analysis. (A thorough discussion of the effects of the filtering, and why the filtering was used in the first rounds of aircraft data analysis are discussed in Kelly et al. 1992.)
- In addition, it is recommended that the King Air Lyman-alpha data be used with caution. It appears that both the instrument offset and gain tended to drift during flights. The change in offset does not present a problem in the flux calculations, since all simple

offsets are removed by demeaning the data for each aircraft pass. Such processing does not, however, correct for changes in instrument gain. The correlations and fluxes involving the Lyman-alpha data have been included here for completeness, but should be used with caution.

Any Other Relevant Information about the Study:

Not available at this revision.

12. Application of the Data Set:

The Raw Boundary Layer Fluxes data set can be utilized to predict surface flux values and to compare these predicted fluxes to those measured at the surface. In addition, sensible and latent heat budgets in the boundary layer in the FIFE study area can be analyzed.

13. Future Modifications and Plans:

The FIFE field campaigns were held in 1987 and 1989 and there are no plans for new data collection. Field work continues near the FIFE site at the Long-Term Ecological Research (LTER) Network Konza research site (i.e., LTER continues to monitor the site). The FIFE investigators are continuing to analyze and model the data from the field campaigns to produce new data products.

14. Software:

Software to access the data set is available on the all volumes of the FIFE CD-ROM set. For a detailed description of the available software see the *Software Description Document*.

15. Data Access:

Contact Information:

ORNL DAAC User Services
Oak Ridge National Laboratory

Telephone: (865) 241-3952
FAX: (865) 574-4665
Email: ornldaac@ornl.gov

Data Center Identification:

ORNL Distributed Active Archive Center
Oak Ridge National Laboratory
USA

Telephone: (865) 241-3952
FAX: (865) 574-4665
Email: ornldaac@ornl.gov

Procedures for Obtaining Data:

Users may place requests by telephone, electronic mail, or FAX. Data is also available via the World Wide Web at http://daac.ornl.gov.

Data Center Status/Plans:

FIFE data will be available from the ORNL DAAC. Please contact the ORNL DAAC User Services Office for the most current information about these data.

16. Output Products and Availability:

Raw Boundary Layer Fluxes from the UW King Air are available on FIFE CD-ROM Volume 1. The CD-ROM filename is as follows:

\DATA\AIR_FLUX\AF_raw\ydddMULT.WYR for the RAW data.

Note: capital letters indicate fixed values that appear on the CD-ROM exactly as shown here, lower case indicates characters (values) that change for each path and file.

The format used for the filenames is: *ydddMULT.sfx*, where *y* is the last digit of the year (e.g., 7 = 1987, and 9 = 1989), and *ddd* is the day of the year (e.g., 061 = sixty-first day in the year). The filename extension (.*sfx*), identifies the data set content for the file (see the *Data Characteristics Section*) and is equal to .WYR for this data set.

17. References:

Satellite/Instrument/Data Processing Documentation.

Not available at this revision.

Journal Articles and Study Reports.

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Kelly, R.D. 1992. Atmospheric boundary layer studies in FIFE: challenges and advances. J. Geophys. Rsch. 97(D17):18,373-18,376.

Kelly, R.D., E.A. Smith, and J.I. MacPherson. 1992. A comparison of surface sensible and latent heat fluxes from aircraft and surface measurements in FIFE 1987. J. Geophys. Rsch. 97(D17):18,445-18,453.

MacPherson, J.I., R.L. Grossman, and R.D. Kelly. 1992. Inter-comparison results for FIFE flux aircraft. J. Geophys. Rsch. 97(D17):18,499-18,514.

Webb, E.K., G.I. Pearman, and R. Leuning 1980. Correction of flux measurements for density effects due to heat and water vapor transfer. Quart. J. Roy. Meteor. Soc. 106:85-100.

Archive/DBMS Usage Documentation.

Contact the EOS Distributed Active Archive Center (DAAC) at Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee (see the *Data Center Identification Section*). Documentation about using the archive and/or online access to the data at the ORNL DAAC is not available at this revision.

18. Glossary of Terms:

A general glossary for the DAAC is located at Glossary.

19. List of Acronyms:

BL Boundary Layer CD-ROM Compact Disk, Read-Only Memory DAAC Distributive Active Archive Center EOS Earth Observing System EOSDIS EOS Data and Information System FIS FIFE Information System FIFE First ISLSCP Field Experiment IFC Intensive Field Campaign INS Inertial navigation system ISLSCP International Satellite Land Surface Climatology Project LTER Long-Term Ecological Research ORNL Oak Ridge National Laboratory PBL planetary boundary layer SQL Structured Query Language TDF Table Definition File URL Uniform Resource Locator UTM Universal Transverse Mercator

A general list of acronyms for the DAAC is available at Acronyms.

20. Document Information:

April 28, 1994 (citation revised on October 14, 2002).

This document has been reviewed by the FIFE Information Scientist to eliminate technical and editorial inaccuracies. Previous versions of this document have been reviewed by the Principal Investigator, the person who transmitted the data to FIS, a FIS staff member, or a FIFE scientist generally familiar with the data. It is believed that the document accurately describes the data as collected and archived on the FIFE CD-ROM series.

Document Review Date:

March 15, 1996.

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