OzFlux Variable Names and Definitions

Background

There are three distinct classes of variable names used in the OzFlux quality control and post-processing system. The classes are as follows:

1. The variable name used in the data logger program.
   The names used in the data logger program depend on the origin and version of the program being used. Programs supplied by Campbell Scientific use a different naming convention than the standard logger program supplied by OzFlux. Details of the naming convention used in the OzFlux standard program are given in the program documentation.

2. The variable name used in the netCDF file.
   The naming convention used for variables in the netCDF file follows the naming convention used in the OzFlux standard data logger program. The details of this convention are described later in this section. Note that each variable in the netCDF file also has a "long_name" attribute which gives a text description of the data contained in the variable.

3. The "standard_name" mapped to the netCDF variable name as required by the CF Metadata conventions.
   The netCDF files used by OzFlux implement the CF Metadata conventions. Each variable has an attribute called "standard_name" which comes from the CF controlled vocabulary. Those variables that do not have "standard_name" defined in the CF controlled vocabulary have this attribute set to "not defined".

This document provides information on:

1. General rules for naming variables used by OzFlux.
2. A listing of variables in alphabetical order
3. An alphabetical listing of variables at the L1 and L2 processing levels.
4. An alphabetical listing of variables at the L3 processing level.

General Rules for the OzFlux Variable Naming Scheme

The basic premise for the naming convention adopted by OzFlux is that the ecosystem world can be divided up into stores of quantities and transfers (or fluxes) between these stores. Based on this model, we use either "S" to indicate a store or an "F" to indicate a flux. In practice, many stores of quantities already have symbols which are widely used and for convenience, we use these common names rather than strictly adhere to the stores and fluxes description. For example, the store of heat in the atmosphere should be written "Sha" but we retain the commonly used "Ta" for air temperature.

Letters are appended to the initial "F" or "S" to indicate the quantity being transferred or stored, see the tables below.

The instrument taking the measurement is indicated by appending an abbreviation after the symbol for the quantity, see the table below. Instrument abbreviations are not used for the Kipp and Zonen 4 component radiometer (CNR1 or CNR4), for the soil heat flux plates (HFP3), for the soil temperature (TCAV) and for the soil moisture (CS616).

Symbol	Quantity
Fsd	Down-welling shortwave radiation
Fsu	Up-welling shortwave radiation
Fld	Down-welling longwave radiation
Flu	Up-welling longwave radiation
Fn	Net all-wave radiation
Fa	Available energy
Fh	Sensible heat flux
Fe	Latent heat flux
Fc	CO_2 flux
Fg	Ground heat flux
Fm	Momentum flux

Table 1: Basic symbols for fluxes.

Symbol	Quantity
Sws	Soil moisture, volumetric

Table 2: Basic symbols for stores

Symbol	Quantity
Ta	Air temperature
Tv	Virtual air temperature
Ts	Soil temperature

Table 3: Temperatures

Symbol	Quantity
Ah	Absolute humidity
e	Vapour pressure
q	Specific humidity

Table 4: Humidities

Symbol	Instrument
_CSAT	Campbell Scientific 3D sonic
_7500	Li-7500 open path gas analyser
_HMP	HMP45c T/RH sensor
_KZ	Kipp and Zonen
_NR	NRlite

Table 5: Abbreviations for instruments appended to the variable symbol.

Variable Listing by Alphabetical Order

The following tables give an alphabetical list of the variables in an L3 file from a standard OzFlux tower site. The left-most column is the variable name in the OzFlux netCDF file. The centre column is the CF Metadata Conventions standard name (standard_name) if this is defined for the variable (as at 31/12/2012). This column is blank if the standard name is not defined. The right most column is a description of the variable.

The tables of variable names and definitions are intended as a guide only that applies to a notional “standard” OzFlux site. Most OzFlux sites differ from the “standard” configuration, in which case there may be more, or less, variables than those given in the tables. In the case of more, the naming convention for extra variables can be deduced from the “standard” list given.

Variable	CF standard name	Definition
AGC_7500		Li-7500 automatic gain control
Ah		Absolute humidity from HMP, merged with Li-7500 if required
Ah_7500_Av		Absolute humidity from Li-7500, average
Ah_7500_Sd		Absolute humidity from Li-7500, standard deviation
Ah_HMP_XXm		Absolute humidity from HMP at XXm, average
AhAh		Absolute humidity from Li-7500, variance
albedo	solar_albedo	Solar albedo
Cc		CO_2 concentration from Li-7500, merged with slow sensor if available
Cc_7500_Av		CO_2 concentration from Li-7500, average
Cc_7500_Sd		CO_2 concentration from Li-7500, standard deviation
CcCc		CO_2 concentration from Li-7500, variance
Cpm		Specific heat of moist air
C_ppm		CO_2 concentration in parts per million (ppm, umol/mol)
Cs		Specific heat capacity
Day		Day of the month
Ddd		Decimal day of the year (eg 1.5 is 12:00 1/1/2013)
Diag_7500		Li-7500 diagnostic value
Diag_CSAT		CSAT diagnostic value
e	water_vapor_partial_pressure_in_air	Vapour pressure
esat		Saturation vapour pressure

Variable	CF standard name	Definition
eta		Horizontal rotation angle from 2D coordinate rotation of CSAT data
Fa		Available energy using Fn,Fg
Fc		CO_2 flux, rotated to natural wind coordinates, WPL corrected Fc
Fe	surface_upward_latent_heat_flux	Latent heat flux, rotated to natural wind coordinates, WPL corrected Fe
Fg_XXcm		Soil heat flux, raw values from individual sensors (suffix a, b, c etc) at depth below surface of XXcm
Fg		Soil heat flux corrected for storage
Fh	surface_upward_sensible_heat_flux	Sensible heat flux, rotated to natural wind coordinates, Fh rotated and converted from virtual heat flux
Fld	surface_downwelling_longwave_flux_in_air	Down-welling long wave radiation
Flu	surface_upwelling_longwave_flux_in_air	Up-welling long wave radiation
Fm		Momentum flux, rotated to natural wind coordinates
Fn	surface_net_allwave_radiation	Net all-wave radiation, merged from available sources eg CNR1 or CNR4 with NRlite
Fn_KZ		Net all-wave radiation from the Kipp and Zonen CNR1 or CNR4
Fn_NR		Net all-wave radiation from the Kipp and Zonen NRlite
Fsd	surface_downwelling_shortwave_flux_in_air	Down-welling short wave radiation
Fsu	surface_upwelling_shortwave_flux_in_air	Up-welling short wave radiation
H_ppt		H_2O concentration in parts per thousand (ppt, mmol/mol)
Hdh		Decimal hour of the day eg 12.5 is 12:30 pm
Hour		Hour of the day

Variable	CF standard name	Definition
L		Monin-Obukhov length, corrected for frequency response using Massman
Lv		Latent heat of vapourisation
Minute		Minute of the hour
Month		Month of the year
ps	surface_air_pressure	Air pressure (Li-7500)
q	specific_humidity	Specific humidity
Precip		Precipitation, 30 minute total
rhod		Density of dry air
rhom	air_density	Density of moist air
S		Soil heat flux storage in the layer above the heat flux plates
Second		Seconds into the current minute
SHD		Specific humidity deficit
Sws		Spatial average of shallowest volumetric soil moisture measurements
Sws_XXcm		Volumetric soil moisture, raw values from individual sensors (suffix a, b, c etc) at depth below surface of XXcm
Ta	air_temperature	Air temperature from the HMP at the same height as the sonic and IRGA, merged with air temperature from the sonic if required
Ta_CSAT		Air temperature calculated from virtual temperature measured by the sonic anemometer
Ta_HMP_XXm		Air temperature from the HMP at XXm
theta		Vertical rotation angle from 2D coordinate rotation of CSAT data

Variable	CF standard name	Definition
Tpanel		Panel temperature at logger
Ts		Spatial average of soil temperature measurements
Ts_XXcm		Soil temperature, raw values from individual sensors (suffix a, b, c etc) at depth below surface of XXcm
Tv_CSAT		Virtual air temperature from sonic anemometer
u		Longitudinal component of wind-speed in natural wind coordinates
ustar		Friction velocity, rotated to natural wind coordinates
uw		Momentum flux X component, corrected to natural wind coordinates
Ux		Wind speed from sonic anemometer, longitudinal component
UxA		Covariance of Ux (CSAT) and H_2O (Li-7500)
UxC		Covariance of Ux (CSAT) and CO_2 (Li-7500)
UxT		Covariance of Ux (CSAT) and T (CSAT)
UxUx		Longitudinal wind speed (CSAT coordinates), variance
UxUy		Covariance of Ux and Uy (CSAT coordinates)
UxUz		Covariance of Ux and Uz (CSAT coordinates)
Uy		Wind speed from sonic anemometer, lateral component
UyA		Covariance of Uy (CSAT) and H_2O (Li-7500)
UyC		Covariance of Uy (CSAT) and CO_2 (Li-7500)
UyT		Covariance of Uy (CSAT) and T (CSAT)
UyUy		Lateral wind speed component (CSAT coordinates), variance

Variable	CF standard name	Definition
UyUz		Covariance of Uy (CSAT) and Uz (CSAT)
Uz		Wind speed from sonic anemometer, vertical component
UzA		Covariance of Uz (CSAT) and H_2O (Li-7500)
UzC		Covariance of Uz (CSAT) and CO_2 (Li-7500)
UzT		Covariance of Uz (CSAT) and T (CSAT)
UzUz		Vertical wind speed (CSAT coordinates), variance
v		Lateral component of wind-speed in natural wind coordinates
Vbat		Battery voltage at logger
VPD	water_vapor_saturation_deficit_in_air	Vapour pressure deficit
vw		Momentum flux Y component, corrected to natural wind coordinates
w		Vertical component of wind-speed in natural wind coordinates
wA		Kinematic vapour flux, rotated to natural wind coordinates, frequency response corrected, and density flux corrected (wpl)
wC		Kinematic CO2 flux, rotated to natural wind coordinates
Wd	wind_from_direction	Wind direction, merged from CSAT and any other available wind direction measurements, corrected to bearing from true north
Wd_CSAT		Wind direction from CSAT, bearing from longitudinal axis
Ws	wind_speed	Wind speed, merged from CSAT and any other available wind speed measurements
Ws_CSAT		Wind speed from CSAT
wT		Kinematic heat flux, rotated to natural wind coordinates
xlDateTime		Date/time in Excel format
Year		Year

Variable Listing by Processing Level

L1 and L2

The following tables list the variables used in the OzFlux netCDF files at the L1 and L2 processing levels, in alphabetical order.

Variable	CF standard name	Definition
AGC_7500		Li-7500 automatic gain control
Ah_7500_Av		Absolute humidity from Li-7500, average
Ah_7500_Sd		Absolute humidity from Li-7500, standard deviation
Ah_HMP_XXm		Absolute humidity from HMP at XXm, average
AhAh		Absolute humidity from Li-7500, variance
Cc_7500_Av		CO_2 concentration from Li-7500, average
Cc_7500_Sd		CO_2 concentration from Li-7500, standard deviation
CcCc		CO_2 concentration from Li-7500, variance
Day		Day of the month
Ddd		Decimal day of the year (eg 1.5 is 12:00 1/1/2013)
Diag_7500		Li-7500 diagnostic value
Diag_CSAT		CSAT diagnostic value
Fg_XXcm		Soil heat flux, raw values from individual sensors (suffix a, b, c etc) at depth below surface of XXcm
Fld	surface_downwelling_longwave_flux_in_air	Down-welling long wave radiation
Flu	surface_upwelling_longwave_flux_in_air	Up-welling long wave radiation
Fn_KZ		Net all-wave radiation from the Kipp and Zonen CNR1 or CNR4
Fn_NR		Net all-wave radiation from the Kipp and Zonen NRlite
Fsd	surface_downwelling_shortwave_flux_in_air	Down-welling short wave radiation
Fsu	surface_upwelling_shortwave_flux_in_air	Up-welling short wave radiation
Hdh		Decimal hour of the day eg 12.5 is 12:30 pm
Hour		Hour of the day

Variable	CF standard name	Definition
Minute		Minute of the hour
Month		Month of the year
ps	surface_air_pressure	Air pressure (Li-7500)
Precip		Precipitation, 30 minute total
Second		Seconds into the current minute
Sws_XXcm		Volumetric soil moisture, raw values from individual sensors (suffix a, b, c etc) at depth below surface of XXcm
Ta_HMP_XXm		Air temperature from the HMP at XXm
Tpanel		Panel temperature at logger
Ts_XXcm		Soil temperature, raw values from individual sensors (suffix a, b, c etc) at depth below surface of XXcm
Tv_CSAT		Virtual air temperature from sonic anemometer
Ux		Wind speed from sonic anemometer, longitudinal component
UxA		Covariance of Ux (CSAT) and H_2O (Li-7500)
UxC		Covariance of Ux (CSAT) and CO_2 (Li-7500)
UxT		Covariance of Ux (CSAT) and T (CSAT)
UxUx		Longitudinal wind speed (CSAT coordinates), variance
UxUy		Covariance of Ux and Uy (CSAT coordinates)
UxUz		Covariance of Ux and Uz (CSAT coordinates)
Uy		Wind speed from sonic anemometer, lateral component
UyA		Covariance of Uy (CSAT) and H_2O (Li-7500)
UyC		Covariance of Uy (CSAT) and CO_2 (Li-7500)
UyT		Covariance of Uy (CSAT) and T (CSAT)

Variable	CF standard name	Definition
UyUy		Lateral wind speed component (CSAT coordinates), variance
UyUz		Covariance of Uy (CSAT) and Uz (CSAT)
Uz		Wind speed from sonic anemometer, vertical component
UzA		Covariance of Uz (CSAT) and H_2O (Li-7500)
UzC		Covariance of Uz (CSAT) and CO_2 (Li-7500)
UzT		Covariance of Uz (CSAT) and T (CSAT)
UzUz		Vertical wind speed (CSAT coordinates), variance
Vbat		Battery voltage at logger
Wd_CSAT		Wind direction from CSAT, bearing from longitudinal axis
Ws_CSAT		Wind speed from CSAT
xlDateTime		Date/time in Excel format
Year		Year

L3

The following tables list the variables used in the OzFlux netCDF files at the L3 processing level, in alphabetical order.

Variable	CF standard name	Definition
Ah		Absolute humidity from HMP, merged with Li-7500 if required
albedo	solar_albedo	Solar albedo
Cc		CO_2 concentration from Li-7500, merged with slow sensor if available
Cpm		Specific heat of moist air
C_ppm		CO_2 concentration in parts per million (ppm, umol/mol)
Cs		Specific heat capacity
e	water_vapor_partial_pressure_in_air	Vapour pressure
esat		Saturation vapour pressure
eta		Horizontal rotation angle from 2D coordinate rotation of CSAT data
Fa		Available energy using Fn,Fg
Fc		CO_2 flux, rotated to natural wind coordinates, WPL corrected Fc
Fe	surface_upward_latent_heat_flux	Latent heat flux, rotated to natural wind coordinates, WPL corrected Fe
Fg		Soil heat flux corrected for storage
Fh	surface_upward_sensible_heat_flux	Sensible heat flux, rotated to natural wind coordinates, Fh rotated and converted from virtual heat flux
Fld	surface_downwelling_longwave_flux_in_air	Down-welling long wave radiation
Flu	surface_upwelling_longwave_flux_in_air	Up-welling long wave radiation
Fm		Momentum flux, rotated to natural wind coordinates
Fn	surface_net_allwave_radiation	Net all-wave radiation, merged from available sources eg CNR1 or CNR4 with NRlite
Fsd	surface_downwelling_shortwave_flux_in_air	Down-welling short wave radiation
Fsu	surface_upwelling_shortwave_flux_in_air	Up-welling short wave radiation

Variable	CF standard name	Definition
H_ppt		H_2O concentration in parts per thousand (ppt, mmol/mol)
L		Monin-Obukhov length, corrected for frequency response using Massman
Lv		Latent heat of vapourisation
ps	surface_air_pressure	Air pressure (Li-7500)
q	specific_humidity	Specific humidity
Precip		Precipitation, 30 minute total
rhod		Density of dry air
rhom	air_density	Density of moist air
S		Soil heat flux storage in the layer above the heat flux plates
SHD		Specific humidity deficit
Sws		Spatial average of shallowest volumetric soil moisture measurements
Ta	air_temperature	Air temperature from the HMP at the same height as the sonic and IRGA, merged with air temperature from the sonic if required
theta		Vertical rotation angle from 2D coordinate rotation of CSAT data
Ts		Spatial average of soil temperature measurements
u		Longitudinal component of wind-speed in natural wind coordinates
ustar		Friction velocity, rotated to natural wind coordinates
uw		Momentum flux X component, corrected to natural wind coordinates

Variable	CF standard name	Definition
v		Lateral component of wind-speed in natural wind coordinates
VPD	water_vapor_saturation_deficit_in_air	Vapour pressure deficit
vw		Momentum flux Y component, corrected to natural wind coordinates
w		Vertical component of wind-speed in natural wind coordinates
wA		Kinematic vapour flux, rotated to natural wind coordinates, frequency response corrected, and density flux corrected (wpl)
wC		Kinematic CO2 flux, rotated to natural wind coordinates
Wd	wind_from_direction	Wind direction, merged from CSAT and any other available wind direction measurements, corrected to bearing from true north
Ws	wind_speed	Wind speed, merged from CSAT and any other available wind speed measurements
wT		Kinematic heat flux, rotated to natural wind coordinates