Introduction

Alteddy version 3.90 is a Visual Fortran program developed and used at Alterra for the processing of raw eddy correlation data. Changes with respect to version 3.80 are mainly (for a full overview see Version history) :

- Added angle-of-attack correction following Nakai 2012.
- Replaced temperature crosswind correction Schotanus 1983 with Liu 2001.
- Added three sonic anemometer models, the Young 81000, Gill HS and ATI K-probe.
- Removed sonic path lengths parameters in *location-Par.txt*.
- Added parameter UALIGN in file *location-Raw.txt* defining alignment of sonic anemometer u-axis.
- Added rotation of windspeed u and v to conform to right-handed Cartesian for all sonics.
- Corrected bug in calculation of wind direction for the Gill Windmaster (Pro).
- Moved output of raw data file information from log file to new **Raw.csv* file.
- Air pressure is now always output in the **Fmv.csv* file, also when daily air pressure is used.

Alteddy main task :

- Process raw data (calculate fluxes, means, variances, etc.). See Processing.

Alteddy tools :

- View raw data (to check for spikes, ranges). See Viewing.
- Calculate normalised spectra and cospectra. See Spectra.
- Convert raw binary files to ASCII files (for other data analysis). See Binary to Ascii.
- Calculate planar fit coefficients. See Planar fit.
- Calculate solar elevation and radiation. See Solar radiation.
- Rename raw ASCII files. See Rename files.
- Check site location using Google Maps. See Check site location.

For most of these functions several input parameter files are necessary and the raw data files. A description of the parameter files can be found here and of the raw data files here.

Input raw data

Alteddy can read raw data in ASCII and binary format. The format of the raw data input files is defined in parameter file *location-Raw.txt*. In this parameter file the format of the raw input files is defined in a generic way, so not tailored to the data format of specific data collection software. This enables to read a variety of input formats. Below the setup for ASCII and binary files is explained in more detail. All parameters defining the input format can be found in *location-Raw.txt*.

Generic ASCII files

For ASCII files the parameter FILTYP has to be set to 1. The number of columns has to be set with parameter COLRAW. This should be set to the total number of columns in the file, not the number of columns that is actually used in processing.
The columns in the files can be separated with spaces or tabs (as found in Li-Cor GHG files).
"NAN" or "NaN" encountered in ASCII files will be replaced by error code -9999 when the raw data file is read.
If the files contain header lines that have to be skipped this can be set with parameter HEDRAW.

Generic binary files

For binary files the parameter FILTYP has to be set to 2 (little Endian) or 3 (big Endian). The parameter BNFORM is used to choose how the raw data should be read, as 2-byte signed integers (BNFORM=1), 4-byte signed integers (BNFORM=2), 4-byte reals (BNFORM=3) or as native sonic format.
The number of "columns" has to be set with parameter COLRAW. This should be set to the total number of columns in the file, not the number of columns that is actually used in processing. The term “column” is not appropriate for unformatted binary data but is used here to indicate the position of data in the data stream.
Binary files usually also have a header that has to be skipped. Use parameter HEDRAW to set the number of bytes that have to be skipped.

Specific binary files, Campbell's TOB1 format

These are binary files with an ASCII readable header. Parameter FILTYP has to be set to 2.
The header can be skipped in two ways: by setting parameter HEDRAW to the exact number of bytes in the header or by setting parameter HEDRAW to 8888. When set to 8888 the size of the ASCII header is determined automatically by Alteddy. This can be practical when the size of the header is variable, for instance when the Campbell program is changed several times. Size of the header is in bytes, including the last CR/LF, editors that can show hex codes will show CR/LF as 0D0A.
In TOB1 files the format of each variable can be set individually in the Campbell program.
Alteddy can only process variables in the format "IEEE4". Variables in the format "FP2" and "ULONG" can be skipped but not interpreted.
Variables in the "FP2" format can only be skipped if they occur at the end of a "record" or if they occur in even numbers in between "IEEE4" or "ULONG" numbers.

Skipping bytes at the end of a record (binary files)

The term "record" is not appropriate for unformatted binary data but is used here to indicate one measurement sequence. If binary files contain bytes at the end of a record that should not be interpreted a parameter SKPBYT can be set to skip these. For example if your TOB1 files contain variables in "FP2" format at the end of a record all these values have to be skipped before the next record can be read. You can skip these values by setting parameter SKPBYT to the number of values times 2 (because each value takes up 2 bytes).

Defining the columns (ASCII and binary files)

For Alteddy to know which variable is in which column each column that is defined with parameter COLRAW has to be given a label. This is done in the next section of parameter file *location-Raw.txt* labeled "COLUMN INFO". Here for each column a code has to be given indicating the type of variable in that column. A list of variable codes is given at the bottom of the file.

If a column has to be skipped use code 'skip'. This is implemented for both ASCII and binary files. If a column contains text (a date, time or comment) it can be skipped using code 'text'. This only works for ASCII files. The columns need to be separated by either tabs or spaces.

Other basic rules for the raw data files:

- The raw files should be located in the folder pointed to by parameter DIRRAW in the parameter file *location-Par.txt*.
- The file names should contain day of year (or month and day), hour, minute and year values (year only last 2 digits).
- Files should minimally contain sonic u, v, w and temperature (either sonic or other fast response sensor)
- Maximum number of columns is 20 (including 'text' and 'skip' columns)
- The minimum data file size is 30 minutes of raw data.
- The maximum data file size is currently 14 days of raw data.

Other inputs can be:

- Li-Cor LI-6262/7000 (CO_2 and/or H_2O)
- Li-Cor LI-7500/7200 (CO_2 and/or H_2O)
- Fast response thermocouple
- Campbell Krypton KH_2O hygrometer (H_2O)
- Campbell TGA100A TDL (N_2O and NH_3)
- Los Gatos DLT-100 Fast Methane Analyzer (CH_4)
- Li-Cor LI-7700 open path Methane Analyzer (CH_4)
- Air pressure (or pressure in cell)

Date / time

Alteddy does not read a date/time value from the contents of a raw file. Instead it determines which file (or portion of that file) to use from the date/time codes in the raw file **name**. The number of records to read for an averaging interval is calculated from the interval length (INTAVG) and the raw data logging frequency (NS).

If raw file size > averaging interval : Alteddy will skip through the file until it reaches the part of the file that should be read.
If raw file size = averaging interval : One file is read for each averaging interval.
If raw file size < averaging interval : Multiple files will be opened and read until enough records are read for the interval.

The date and time given in the file name should be of the **beginning** of the logging interval. Output of calculated values has a time code at the **end** of the interval.
If raw file names do not contain the date/time codes there is an option in Alteddy to rename these files using date/time codes found in the file. Files should be ASCII, contents of files are not changed. See here

Binary raw files with names that do not contain date/time codes unfortunately cannot be processed. You will have to find a way to rename them.

Units
Alteddy assumes the values in the raw data files to have the following units:

Sonic windspeed u	m s^{-1}
Sonic windspeed v	m s^{-1}
Sonic windspeed w	m s^{-1}
Sonic speed of sound / temperature	m s^{-1} or Kelvin, defined by parameter TEMUNI
Li-Cor LI-7500/7200 open path H_2O	millimol m^{-3}
Li-Cor LI-7500/7200 open path CO_2	millimol m^{-3}
Li-Cor LI-6262/7000 closed path H_2O	micromol mol^{-1}
Li-Cor LI-6262/7000 closed path CO_2	millimol mol^{-1}
Fast response thermocouple	K
Krypton hygrometer H_2O	g m^{-3}
Air pressure	Pascal
Campbell TGA100A TDL N_2O	nanomol mol^{-1}
Campbell TGA100A TDL NH_3	nanomol mol^{-1}
Los Gatos DLT-100 CH_4	micromol mol^{-1}
Li-Cor LI-7700 open path CH_4	millimol m^{-3}

If the raw data are in other units (for example milliVolts) then offset, gain and multiplier can be used to convert the data from these units to the units given above. See here.

Example configuration files

Example configuration files are provided for some common data logging packages:

- EddylogP (Alterra, binary)
- EddylogW (Alterra, Windows version of EddylogP, binary)

- Eddylog (Alterra, developed from Fastcom (Gill), binary)
- Edisol (Institute of Atmospheric and Environmental Science, University of Edinburgh, binary)
- TOA5 (Campbell datalogger, ASCII)
- TOB1 (Campbell datalogger, binary)
- Carboeurope IP Exchange format for high frequency raw data (ASCII)

See example files here

N.b. Campbell TOB3 binary files cannot be read by Alteddy directly because of their specific structure. Use Loggernet Cardconvert to convert TOB3 to TOB1 files.

Parameter files

Five to six parameter files and the raw files are needed to run the program. The raw files should be located in a folder pointed to by parameter DIREC in the parameter file *location-Par.txt*. All parameter files have to be located in the same folder. The files are:

location-Raw.txt	Describes raw data file format
location-Par.txt	Describes system and instrumental setup
location-Adc.txt	Lists gain, offset and multiplier for all 'channels' in the raw data files
location-Hts.txt	Lists height of system and zero displacement height
location-Pre.txt	Lists average air pressure values for each day
location-Pfc.txt	Contains the planar fit coefficients

Examples of these files can be found here. In the file names change "location" to the name of your site. All parameters files are ASCII.

location-HTS.txt

Lists variable height of system and variable zero desplacement height.

Each time these heights change a new line with year, day and time and the new values has to be added to this file. There is no interpolated between given values, if zero desplacement height changes fast put more lines with heights in the file. These heights are used in the frequency response corrections. A small change in height will only have a very small effect on the final flux. The file is in ASCII format, examples can be found here.

location-PRE.txt

Lists average air pressure values for each day in HPa.

These values can be obtained from the pressure sensor data of an automatic weather station. You should average the (half hourly / hourly) values to daily values. The file is in ASCII format. If air pressure is part of the raw data channels this file is not needed.

N.b. For viewing raw data, calculating (co)spectra and converting binary to ASCII the *location-Pre.txt* (air pressure) file is not needed.

location-ADC.txt

This parameter file lists gain, offset and multiplier for all 'channels' in the raw data files.

Alteddy assumes the values in the raw data files to have the following units:

Sonic windspeed u	m s^{-1}
Sonic windspeed v	m s^{-1}
Sonic windspeed w	m s^{-1}
Sonic speed of sound / temperature	m s^{-1} or Kelvin, defined by parameter TEMUNI
Li-Cor LI-7500/7200 open path H_2O	millimol m^{-3}
Li-Cor LI-7500/7200 open path CO_2	millimol m^{-3}
Li-Cor LI-6262/7000 closed path H_2O	micromol mol^{-1}
Li-Cor LI-6262/7000 closed path CO_2	millimol mol^{-1}
Fast response thermocouple	K
Krypton hygrometer H_2O	g m^{-3}
Air pressure	Pascal
Campbell TGA100A TDL N_2O	nanomol mol^{-1}
Campbell TGA100A TDL NH_3	nanomol mol^{-1}
Los Gatos DLT-100 CH_4	micromol mol^{-1}
Li-Cor LI-7700 CH_4	millimol m^{-3}

If the raw data are in the units given above then gain=1, offset=0 and multiplier=1 can be given. If the raw data are in other units then offset, gain and multiplier can be used to convert the data from these units to the units given above.

The parameter sets (offset, gain and multiplier) given on one line should be in the following order:
- sonic windspeed u
- sonic windspeed v
- sonic windspeed w
- other channel in the order they are given in *location-Raw.txt* (not 'text' or 'skip')

So, for example, if in the *location-Raw.txt* file the channels are given in the order:

'text', 'skip', 'sonv', 'lioc', 'sonu', 'sont', 'sonw', 'lioh', 'skip', 'airp'

Then the order of the channels in *location-Adc.txt* should be:

'sonu', 'sonv', 'sonw', 'lioc', 'sont', 'lioh', 'airp'

Each time the configuration of instruments is changed a new line with year, day and time and the new values has to be added to this file. If a small instrument signal is amplified (using an Instrumentation Amplifier) the multiplier parameter can be used so that the signal will be converted back to the original value before further processing.

The conversion from the value in the raw data file is the following:

Value = Rawvalue / Multiplier(channel) * Gain(channel) + Offset(channel)

For the special case of a Campbell Krypton hygrometer the conversion is:

Value = Log(Rawvalue / Multiplier(channel)) * Gain(channel) + Offset(channel)

For the Campbell Krypton hygrometer use "Coefficient (XKw)" for gain and "Constant (Vo)" for offset (full vapor range).

N.b. A small mistake in the conversion factors in *location-Adc.txt* can have a large effect on calculated fluxes ! Please check by viewing (See Viewing) some raw files that the conversions are correct; the converted signals have on average the magnitude as expected.

location-PAR.txt

Parameter file describing system setup.

INTAVG	Interval for averaging/output in minutes Minimum is 5 minutes, maximum is 360 minutes Set this interval to an exact multiple or exact division of the default raw file size. So if for example raw file size is 30 minutes then valid values of INTAVG are: 5, 6, 10, 15, 30, 60, 90, 120, etc. An averaging interval shorter than 30 minutes is not recommended.
ROTAT	Type of axis rotation : 1 = 2D rotation on each output interval 2 = planar fit method The 2D rotation can be done right away on the raw data (online). Planar fit can only be done after the plane has been fitted to average unrotated windspeed u, v and w obtained with a 2D rotation run. See the planar fit section.
AOACOR	Angle of attack correction method : 0 = no correction 1 = correction following Nakai (2006, wind tunnel calibration) 2 = correction following Nakai (2012, field calibration) These corrections apply to Gill sonic anemometers only.
DCOR	Correction for wind direction (degrees) This correction term depends on the orientation of the Sonic. It is the difference between the direction of the north arrow on the instrument and the real geographic north. Sometimes it is difficult to position the Sonic so that the north stud is pointing exactly to the north. In this case the deviation can be determined by comparing its wind direction output with a wind vane measurement.
PRES	Air pressure (mBar) When air pressure has to be read from file *location-Pre.txt* you should fill in a value of 0. When you want to use a fixed value for all days fill in this value here. If air pressure is read in the "high frequency" raw data you don't need to use the *location-Pre.txt* file.
LATIT	Latitude of the site (degrees) Northern hemisphere gives positive angles. Minutes are given as decimals. LI-7500 : Latitude and longitude and time shift are used to calculate daytime/nighttime. This information is used for the "Apparent-off-season-uptake" correction of CO_2 fluxes. You can check if daytime/nighttime is calculated correctly for your site using the suncalc tool and comparing the output with the flux output.
LONGIT	Longitude of the site (degrees) East of Greenwich gives positive angles. Minutes are given as decimals. If you have a LI-7500 and the "burba-correction" switched on make sure this value is correct, see LATIT.
ALTIT	Altitude of the site (m) Used for calculation of average air pressure at the site

	If the high frequency air pressure has errors then calculated air pressure is used instead
TIMSHFT	Difference between time used in data files and local winter time (in hours). See LATIT and LONGIT.
QFLAGS	Flux quality flag in output : 1 = based on Steady State + Integral Turbulence Characteristics analysis 2 = based on Steady State analysis 3 = based on Integral Turbulence Characteristics 4 = fractional difference of flux SSfr_... , SSfr_... is (Fsub - Ffull)/Ffull where Ffull = flux over full averaging interval and Fsub = average of fluxes over 6 sub-intervals
	separation line
CORLIM	Correlation lower limit, if correlations are lower than CORLIM default lags are used Common values are 0.15 - 0.2. A higher value will result in more frequent use of the default lags. A value of 1.0 will force the use of the default values all the time.
HCOR	Use extra Webb term to correct for Li-Cor LI-7500 heating ("Burba-correction") 0 = no 1 = yes
LAGM(a)	Li-Cor LI-7500 lower boundary for lag search (samples) To optimise the lag search a search window with a lower and upper boundary is defined. When running with a new setup fill in -50 and process a number of days. With the actual lags known a higher boundary can be selected, this will make the program run faster.
LAGX(a)	Li-Cor LI-7500 upper boundary for lag search (samples) To optimise the lag search a search window with a lower and upper boundary is defined. When running with a new setup fill in 50 and process a number of days. With the actual lags known a higher boundary can be selected, this will make the program run faster.
DLAG(a)	Li-Cor LI-7500 default lag (samples) When a lag with sufficient correlation can not be found the program uses a default lag. This value can be determined after processing a number of days and selecting out and averaging the lags with a high correlation coefficient.
LAGM(b)	Li-Cor LI-6262/7000 lower boundary for lag search (samples) To optimise the lag search a search window with a lower and upper boundary is defined. When running with a new setup fill in 0 and process a number of days. With the actual lags known a higher boundary can be selected, this will make the program run faster.
LAGX(b)	Li-Cor LI-6262/7000 upper boundary for lag search (samples) To optimise the lag search a search window with a lower and upper boundary is defined. When running with a new setup fill in 500 and process a number of days. With the actual lags known a higher boundary can be selected, this will make the program run faster.
DLAG(b)	Li-Cor LI-6262/7000 default lag (samples) For explanation see DLAG(a).

TRADL	Li-Cor LI-6262/7000 sampling tube radius (m) Avoid using different radi in one sampling tube. If this is unavoidable give the radius of the longest part.
TLENL	Li-Cor LI-6262/7000 sampling tube length (m) The full length, from the inlet near the Sonic to the sample cell connection.
FLOWL	Li-Cor LI-6262/7000 volume flux of sample air (L/minute).
LAGM(c)	Campbell TGA100A lower boundary for lag search (samples). See LAGM(a).
LAGX(c)	Campbell TGA100A upper boundary for lag search (samples). See LAGX(a).
DLAG(c)	Campbell TGA100A default lag (samples). See DLAG(a).
TRADT	Campbell TGA100A sampling tube radius (m) Avoid using different radi in one sampling tube. If this is unavoidable give the radius of the longest part.
TLENT	Campbell TGA100A sampling tube length (m) The full length, from the inlet near the Sonic to the sample cell connection.
FLOWT	Campbell TGA100A volume flux of sample air (L/minute).
LAGM(d)	Los Gatos DLT-100 lower boundary for lag search (samples). See LAGM(a)
LAGX(d)	Los Gatos DLT-100 upper boundary for lag search (samples). See LAGX(a).
DLAG(d)	Los Gatos DLT-100 default lag (samples). See DLAG(a).
TRADG	Los Gatos DLT-100 sampling tube radius (m) Avoid using different radi in one sampling tube. If this is unavoidable give the radius of the longest part.
TLENG	Los Gatos DLT-100 sampling tube length (m) The full length, from the inlet near the Sonic to the sample cell connection.
FLOWG	Los Gatos DLT-100 volume flux of sample air (L/minute).
LAGM(e)	Li-Cor LI-7700 lower boundary for lag search (samples). See LAGM(a)
LAGX(e)	Li-Cor LI-7700 upper boundary for lag search (samples). See LAGX(a).
DLAG(e)	Li-Cor LI-7700 default lag (samples). See DLAG(a).
LAGM(f)	Li-Cor LI-7200 lower boundary for lag search (samples). See LAGM(a)
LAGX(f)	Li-Cor LI-7200 upper boundary for lag search (samples). See LAGX(a).
DLAG(f)	Li-Cor LI-7200 default lag (samples). See DLAG(a).
TRADL2	Li-Cor LI-7200 sampling tube radius (m) Avoid using different radi in one sampling tube. If this is unavoidable give the radius of the longest part.
TLENL2	Li-Cor LI-7200 sampling tube length (m) The full length, from the inlet near the Sonic to the sample cell connection.
FLOWL2	Li-Cor LI-7200 volume flux of sample air (L/minute).
	separation line

MSPI	Spike detection limit. A sample is flagged as a spike when it deviates from the mean by more than MSPI / 100 * (LIHI() - LILO()). So a low value of MSPI, say 5%, is more strict in removing spikes than a high value. You can play around a bit with this value to find the optimum. In the *location-Log.txt* file you can find how many values were flagged as spike for all the channels (see the explanation of output below).
LILO(a)	Sonic windspeed U lower limit range check (m s^{-1}) The raw data are checked on range before they are used in further processing. Data outside the range are not used. If there are to many data out of range for one averaging period the whole channel is not used. For each channel the lower and upper limit of this check must be given.
LIHI(a)	Sonic windspeed U upper limit range check (m s^{-1}) See LILO(a).
LILO(b)	Sonic windspeed V lower limit range check (m s^{-1}) See LILO(a).
LIHI(b)	Sonic windspeed V upper limit range check (m s^{-1}) See LILO(a).
LILO(c)	Sonic windspeed W lower limit range check (m s^{-1}) See LILO(a).
LIHI(c)	Sonic windspeed W upper limit range check (m s^{-1}) See LILO(a).
LILO(d)	Sonic temperature T Lower limit range check (Kelvin) See LILO(a).
LIHI(d)	Sonic temperature T upper limit range check (Kelvin) See LILO(a).
LILO(e)	Li-Cor LI-7500/7200 H_2O lower limit range check (mmol m^{-3}) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(e)	Li-Cor LI-7500/7200 H_2O upper limit range check (mmol m^{-3}) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(f)	Li-Cor LI-7500/7200 CO_2 lower limit range check (mmol m^{-3}) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(f)	Li-Cor LI-7500/7200 CO_2 upper limit range check (mmol m^{-3}) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(g)	Li-Cor LI-6262/7000 H_2O lower limit range check) (mmol mol^{-1}) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(g)	Li-Cor LI-6262/7000 H_2O upper limit range check (mmol mol^{-1}) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(h)	Li-Cor LI-6262/7000 CO_2 lower limit range check (umol mol^{-1})

	See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(h)	Li-Cor LI-6262/7000 CO_2 upper limit range check) (umol mol^{-1}) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(i)	Fast thermocouple T lower limit range check (Kelvin) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(i)	Fast thermocouple T upper limit range check (Kelvin) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(j)	Campbell Krypton H_2O lower limit range check (g m^{-3}) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(j)	Campbell Krypton H_2O upper limit range check (g m^{-3}) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(k)	Air pressure lower limit range check air pressure (Pa) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(k)	Air pressure upper limit range check air pressure (Pa) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(l)	Campbell TGA100 TDL N_2O lower limit range check (nmol mol^{-1}) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(l)	Campbell TGA100 TDL N_2O upper limit range check) (nmol mol^{-1}) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(m)	Campbell TGA100 TDL NH_3 lower limit range check (nmol mol^{-1}) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(m)	Campbell TGA100 TDL NH_3 upper limit range check) (nmol mol^{-1}) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(n)	Los Gatos DLT-100 CH_4 lower limit range check (umol mol^{-1}) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(n)	Los Gatos DLT-100 CH_4 upper limit range check) (umol mol^{-1}) See LILO(a). If an instrument is not used a dummy value must be given.
LILO(o)	Li-Cor LI-7700 lower limit range check (mmol m^{-3}) See LILO(a). If an instrument is not used a dummy value must be given.
LIHI(o)	Li-Cor LI-7700 upper limit range check) (mmol m^{-3}) See LILO(a). If an instrument is not used a dummy value must be given.
	separation line
TAUCO	Li-Cor LI-7500 time constant (seconds)
PCO	Li-Cor LI-7500 path length (m) Length of the optical path
XCO	Li-Cor LI-7500 separation with sonic W (m)

XCO	Horizontal distance between the middle of the sonic path and the Li-Cor optical path
TAUQ2	Li-Cor LI-6262/7000 H_2O time constant (seconds)
TAUC	Li-Cor LI-6262/7000 CO_2 time constant (seconds)
PC	Li-Cor LI-6262/7000 path length (m) Length of the sample cell
XC	Li-Cor LI-6262/7000 separation with sonic W (m) Horizontal distance between the middle of the sonic path and the air intake point
D1	Fast thermocouple time constant at 0 m s^{-1} windspeed (seconds)
XT	Fast thermocouple separation with sonic W (m) Horizontal distance between the middle of the sonic path and the thermocouple sensor
PQ1	Campbell Krypton H_2O path length (m) Length of the optical path
XQ1	Campbell Krypton H_2O separation with sonic W (m) Horizontal distance between the middle of the sonic path and the Krypton optical path
TAUTL	Campbell TGA100 TDL time constant (seconds)
PTL	Campbell TGA100 TDL path length (m)
XTL	Campbell TGA100 TDL separation with sonic W (m)
TAUG	Los Gatos DLT-100 time constant (seconds)
PG	Los Gatos DLT-100 path length (m)
XG	Los Gatos DLT-100 separation with sonic W (m)
TAUMO	Li-Cor LI-7700 time constant (seconds)
PMO	Li-Cor LI-7700 path length (m)
XMO	Li-Cor LI-7700 separation with sonic W (m)
TAUC2	Li-Cor LI-7200 time constant (seconds)
PC2	Li-Cor LI-7200 path length (m)
XC2	Li-Cor LI-7200 separation with sonic W (m)

location-RAW.txt

Parameter file describing raw data file format.

DIRRAW	Directory with raw data inputfiles, maximum length 60 characters. Gives the directory (folder) where the raw data files are located. This can also be a folder on a CD / DVD. You can choose from three types of paths: - an absolute path (like 'C:\Data\Site') - a path relative to the folder where file *location-Raw.txt* is located (like '\Raw') - the keyword '<current>' which indicates the raw data files are in the same folder as file *location-Raw.txt*
FNFRAW	Raw datafile name format ddd = doy, mo = month, dm = day of month, hh = hour, mm = minute, yy = year either ddd or mo/dm should be there If the codes for date and time are not in the file name but in one of the columns and the file is ASCII, please rename the files using the Rename utility, see here
FILTYP	Type of raw data file : 1 = ASCII file with either integers or reals 2 = binary file with little endian format 3 = binary file with big endian format processor architectures that use the little-endian format include 6502, Z80, x86, VAX, and, largely, PDP-11. Motorola processors such as the 6800 and 68000 have generally used big-endian. PowerPC (which includes Apple's Macintosh line prior to the Intel switch) and System/370 also adopt big-endian.
BNFORM	Binary file format : 1 = 2-byte signed integers 2 = 4-byte signed integers 3 = 4-byte reals 4 = native sonic format Programs that store the raw serial data from a sonic exactely how it is received are Edisol (MS-DOS version, University of Edinburgh), Eddylog (Alterra) and Fastcom (Gill). However this data is stored without the "start/end of transmission" and "status" bytes.
COLRAW	Number of columns in raw datafile Binary files have no columns, or record structure. In case of binary files this number represents the number of instrument signals in each repetition. For the sake of simplicity throughout this helpfile we will refer to this as "columns"
HEDRAW	for ASCII file : Number of header lines for binary file : Number of header bytes Set HEDRAW to 8888 to automatically detect header size in TOB1 files
SKPBYT	Number of bytes to skip at the END of each record (binary files) If you want to skip two 4-byte reals set SKPBYT to 8 If you want to skip three "FP2" values set skip to 6

SONTYP	Type of sonic anemometer used : 1 = Gill R2 2 = Gill Windmaster (Pro) type 1352 3 = Gill Windmaster (Pro) type 1561 and type 1590 4 = Gill HS 5 = Gill R3-50 or R3-100 6 = Campbell CSAT3 7 = Young 81000 8 = Metek USA-1 9 = ATI K-probe For sonic anemometers that have the option to switch on firmware cross wind correction Alteddy assumes that this is done !
UALIGN	North alignment of u-axis of ultrasonic anemometer: 1 = u-axis aligned with North spar 2 = u-axis aligned with axis / transducer 1 Some Gill Instruments ultrasonic anemometers allow you to output wind components in two configurations: AXIS or SPAR. In the AXIS configuration, the *u* horizontal component is aligned with one transducer pair, while in the SPAR configuration it is aligned with the North spar. For ultrasonic anemometers that do not have this option Alteddy will set UALIGN to the appropriate value, ignoring the value given in the *RAW.txt file.
TEMUNI	Sonic temperature units : 1 = Speed of sound : m s^{-1} 2 = Temperature : Kelvin These are the basic units the signal is expected to be stored in. If actually it is stored in, for instance, millivolts then in file *location-Adc.txt* the proper conversion values should be given
NS	Sampling frequency (Hz) The sampling frequency is dependent on the type of sonic used and the software that is used for storage of the raw data. It is essential that this number is correct. Based on this the program knows how many records to read for a given averaging interval.
	separation line
COLC(i)	Instrument code for signal stored in column i Choose one of the following codes: 'sonu' = Sonic windspeed u (m s^{-1}) 'sonv' = Sonic windspeed v (m s^{-1}) 'sonw' = Sonic windspeed w (m s^{-1}) 'sont' = Sonic speed of sound / temperature (m s^{-1} or Kelvin) 'lioh' = Li-Cor LI-7500 open path H_2O (millimol m^{-3}) 'lioc' = Li-Cor LI-7500 open path CO_2 (millimol m^{-3}) 'l6ch' = Li-Cor LI-6262 closed path H_2O (millimol mol^{-1}) 'l6cc' = Li-Cor LI-6262 closed path CO_2 (micromol mol^{-1}) 'l7ch' = Li-Cor LI-7000 closed path H_2O (millimol mol^{-1}) 'l7cc' = Li-Cor LI-7000 closed path CO_2 (micromol mol^{-1})

	'fast' = Fast response thermocouple (K) 'kryp' = Campbell Krypton hygrometer H_2O (g m^{-3}) 'airp' = Air pressure (Pascal) 'tlno' = Campbell TGA100A TDL N_2O (nanomol mol^{-1}) 'tlnh' = Campbell TGA100A TDL NH_3 (nanomol mol^{-1}) 'lgch' = Los Gatos Research DLT-100 CH_4 (micromol mol^{-1}) 'liom' = Li-Cor LI-7700 open path CH_4 (millimol m^{-3}) 'l2ch' = Li-Cor LI-7200 open path H_2O (millimol m^{-3}) 'l2cc' = Li-Cor LI-7200 open path CO_2 (millimol m^{-3}) 'text' = Text, will be skipped 'skip' = Number, will be skipped

Example files

These files can be found in C:\Alteddy3.90\Examples

Example 1

Binary file logged with EddylogP (MS-DOS), 2 byte integers, 6 channels.
Gill Windmaster Pro + Li-Cor LI-7500 CO_2 and H_2O.

Eddylogp-Raw.txt
Eddylogp-Adc.txt
Eddylogp-Par.txt
Eddylogp-Hts.txt
Eddylogp-Pre.txt

Example 2

Binary file logged with EddylogW (Windows), 2 byte integers, 6 channels.
Gill Windmaster Pro + Li-Cor LI-7500 CO_2 and H_2O.

Eddylogp-Raw.txt
Eddylogp-Adc.txt
Eddylogp-Par.txt
Eddylogp-Hts.txt
Eddylogp-Pre.txt

Example 3

Binary file logged with Eddylog (MS-DOS, sonic format), 2 byte integers, 9 channels of which 8 are used, 540 byte header (including bad samples).
Gill R2 + Li-Cor LI-6262 CO_2 and H_2O + Krypton hygrometer + fast thermocouple.

Eddylog-Raw.txt
Eddylog-Adc.txt
Eddylog-Par.txt
Eddylog-Hts.txt
Eddylog-Pre.txt

Example 4

Binary file logged with Edisol (Windows), 2 byte integers, 6 channels, 12 byte header.
Gill R3-50 + Li-Cor LI-7500 CO_2 and H_2O.

Edisol-Raw.txt
Edisol-Adc.txt
Edisol-Par.txt
Edisol-Hts.txt
Edisol-Pre.txt

Example 5

ASCII file logged with Campbell datalogger (TOA5), 11 channels of which 7 are used, 4 header lines.
Campbell CSAT + Li-Cor LI-7500 CO_2 and H_2O + air pressure.

Toa5-Raw.txt
Toa5-Adc.txt
Toa5-Par.txt
Toa5-Hts.txt
Toa5-Pre.txt

Example 6

Binary file logged with Campbell datalogger (TOB1), 4 byte reals, 12 channels of which 7 are used, 438 byte header.
Campbell CSAT + Li-Cor LI-7500 CO_2 and H_2O + air pressure.

Tob1-Raw.txt
Tob1-Adc.txt
Tob1-Par.txt
Tob1-Hts.txt
Tob1-Pre.txt

Example 7

Carboeurope exchange format, 10 channels of which 6 are used, 18 line header.
Gill R3-50+ Li-Cor LI-7500 CO_2 and H_2O.

Carbo-Raw.txt
Carbo-Adc.txt
Carbo-Par.txt
Carbo-Hts.txt
Carbo-Pre.txt

Example 8

Li-Cor GHG (LI-7550, TAB separated ASCII) format, 14 channels of which 9 are used, 8 line header.
Campbell CSAT + Li-Cor LI-7500 CO_2 and H_2O + Li-Cor LI-7700 CH_4 + air pressure.

LI7550-Raw.txt
LI7550-Adc.txt
LI7550-Par.txt
LI7550-Hts.txt
LI7550-Pre.txt

Processing

You need to set up several parameter files and the raw data files before processing can start. Please see here for an explanation on how to do this.

When all input files are ready the program can be run (from Start menu or desktop). A window opens where you have to select the *location-RAW.txt* file :

After selecting the parameter file click on PROCESS. A dialog windows opens where you can fill in the year to process and the first and last day to process (only full days can be processed).

Version 3.3 and higher will display the first and last daynumber of available data of the first year as found in folder DIRRAW.

Also some parameters for the graphical display of results can be changed. If you are going to process many days it can be useful to activate the "Shutdown PC when done" option :

Then click on Start to start processing. You should see a screen similar to the one below :

On this screen you will find graphical bars indicating some of the calculated variables and in the top part a scrolling graph of heat fluxes (left y-axis) and fluxes calculated from the other input signals (right y-axis). The statusbar indicates sitecode, year, doy, time and progress of the run.

Latent and sensible heat fluxes are scaled on the **left** y-axis in W m^{-2}, Fluxes of CO_2, N_2O, NH_3 and CH_4 are scaled on the **right** y-axis. CO_2 flux is scaled in umol m^{-2} s^{-1}. N_2O, NH_3 and CH_4 are multiplied by 1000 and are thus scaled in nmol m^{-2} s^{-1}

Version 3.3 and higher also displays bars indicating the percentage of error values in the data. Error values are both out-of-range values and spikes. The bars are located on the left side of the windspeed, temperature and other scalar bars and range from 0 to 100 %. The bar turns red when there are more than 50% error values, in this case the data for the particular interval are not processed.

N.b. If you read the raw data from CD or DVD and an on-access virus scanner is active, disabling the 'on-access scanning' speeds up the execution considerably.

N.b. Minimizing the application stops updating of the graphs. This speeds up the processing run by about 10%.

N.b. The Base Priority of the process can be set to 'low'. This slows down the processing but allows you to continue to work on the PC.

Processing output

Alteddy generates 4 data output files for each run you make, a file with mainly fluxes and means, a file with intermediate results and corrections, a file with variances and uncorrected covariances, a file with statistics of the raw input files and a log file. All except the log file are in ASCII, comma separated and can be edited with an editor like Notepad or imported into a spreadsheet program. On the first line(s) of each outputfile there is a line with column headers and units. The format of the file names is the following:

loc_yy_ddd-ddd_Fmv.csv : fluxes, means and some other stuff
loc_yy_ddd-ddd_Lco.csv : unrotated wind, lags and correlations scalars, axis rotation values, Webb and frequency corrections and some other stuff
loc_yy_ddd-ddd_Cov.csv : variances (final) and covariances (raw)
loc_yy_ddd-ddd_Raw.csv : statistics of the raw input files

where ddd stands for start and end daynumber, loc is the location name and yy is the year.

Sign convention : fluxes from surface to atmosphere are positive, towards the surface negative.

Units for each instrument (......):

Code	Instrument	Flux units	Mea
U-wind	Sonic windspeed u	-	m s^{-1}
V-wind	Sonic windspeed v	-	m s^{-1}
W-wind	Sonic windspeed w	-	m s^{-1}
Windsp	Sonic wind speed	-	m s^{-1}
Tsonic	Sonic temperature	W m^{-2}	°celsiu
Ttherm	Fast thermocouple	W m^{-2}	°celsiu
Op-H_2O	Li-Cor LI-7500 H_2O	W m^{-2}	g m^{-3}
Cp-H_2O	Li-Cor LI-6262/7000/7200 H_2O	W m^{-2}	g m^{-3}
KryH_2O	Krypton KH_2O hygrometer H_2O	W m^{-2}	g m^{-3}
Op-CO_2	Li-Cor LI-7500 CO_2	umol m^{-2} s^{-1}	umol r
Cp-CO_2	Li-Cor LI-6262/7000/7200 CO_2	umol m^{-2} s^{-1}	umol r
Cp-N_2O	Campbell TGA100A TDL N_2O	nmol m^{-2} s^{-1}	nmol r
Cp_NH_3	Campbell TGA100A TDL NH_3	nmol m^{-2} s^{-1}	nmol r
Cp-CH_4	LGR DLT-100 FMA CH_4	nmol m^{-2} s^{-1}	umol r
Op-CH_4	Li-Cor LI-7700 CH_4	nmol m^{-2} s^{-1}	umol r
Apress	pressure sensor	-	pasca

```
n.b. umol = micromol
     nmol = nanomol
```

Below is the output per column given for each file:

loc_yy-ddd-ddd_Fmv.csv

Yr	year (last two digits)
Doy	day of year (jan 1st = 1)
DecTim	time at end of interval, hours with decimal minutes
Flux_......	flux, see instrument codes above. final fully corrected flux values
Qf_F_......	quality flag, see instrument codes above quality flags associated to the fluxes (see Foken 2004) if QFLAGS=1 these flags are from the Steady State (SS) and Integral Turbulence Characterist (ITC) tests if QFLAGS=2 these flags are from the Steady State (SS) tests if QFLAGS=3 these flags are from the Integral Turbulence Characteristics (ITC) tests if QFLAGS=4 these flags are(Fsub - Ffull)/Ffull where Ffull = flux over full averaging interval ar Fsub = average of fluxes over 6 sub-intervals New : If the WPL correction was NOT applied to the flux 100 is added to the quality flag, so for example a flag of 106 means no WPL and quality 6.
Flux_Tau	Momentum flux Tau (Reynolds stress)
Mean_......	mean, see instrument codes above averages of wind and scalars
Mean_APress	mean air pressure
U-star	friction velocity
Z-over-L	z/L
Wind-Direc	wind direction
80PercFlux	distance of 80% integration of flux (footprint) calculated following Schuepp 1990

loc_yy-ddd-ddd_Lco.csv

Yr	year (last two digits)
Doy	day of year (jan 1st = 1)
DecTim	time at end of interval, hours with decimal minutes
Mean_U-unro	mean windspeed u average windspeeds before axis rotation but after conversion to right-handed and alignment with North
Mean_V-unro	mean windspeed v average windspeeds before axis rotation but after conversion to right-handed and

Mean_V-unro	average windspeeds before axis rotation but after conversion to right handed and alignment with North
Mean_W-unro	mean windspeed w average windspeeds before axis rotation
Air-density	air density (including moisture)
Rotat-alpha	axis rotation angle alpha (to make w=0)
Rotat-beta	axis rotation angle beta (to make v'w'=0)
Rotat-gamma	axis rotation angle gamma (to make v=0)
Tlag_......	timelag, see instrument codes above time lags of the scalar signals
Clag_......	correlation, see instrument codes above correlation coefficients calculated for Tlag
WebC_......	Webb correction, see instrument codes above Webb corrections expressed as a correction factor
FreC_......	frequency response correction, see instrument codes above

loc_yy-ddd-ddd_Cov.csv

Yr	year (last two digits)
Doy	day of year (jan 1st = 1)
DecTim	time at end of interval, hours with decimal minutes
Vari_......	variance, see instrument codes above the final fully corrected variances for each variable
.....*.....	covariance, see instrument codes above the raw uncorrected covariances for each variable units are the units of the mean * units of the m except: Tsoni Sonic temperature ºK Tther Fast thermocouple ºK Op-H2O Li-Cor LI-7500 H_2O mmol m^{-3} Op-CO2 Li-Cor LI-7500 CO_2 mmol m^{-3} Op-CO2 Li-Cor LI-7500 CO_2 mmol m^{-3} Cp-H2O Li-Cor LI-6262/7000 H_2O mmol mol^{-1} Cp-CO2 Li-Cor LI-6262/7000 CO_2 umol mol^{-1} Op-CH4 Li-Cor LI-7700 CH_4 mmol m^{-3}

loc_yy-ddd-ddd_Raw.csv

Yr	year (last two digits)
Doy	day of year (jan 1st = 1)
DecTim	time at start of interval, hours with decimal minutes
Pos_record	position in the (first) file from where on the data are read

File(s)	file(s) used for this interval. If more than one file is used the names are separated with a
Num_record	number of records read from the file(s). this number should equal the sampling frequenc interval length in seconds. If it is less not enough records are available.
Out_...	count of the number of out-of-range samples for the interval. The first number is for windspeed u, v and w combined, the second for channel 4 (sonic temperature) the follow columns for the successive instrument channels. The upper and lower limits for each ch are set in location-Par.txt.
Spike_...	These numbers are a count of the number of spiked samples for the given interval. The number is for windspeed u, v and w combined, the second for channel 4 (sonic tempera the following columns for the successive instrument channels. The criterium for spike detection is set in *location-Par.txt*. From the 'ROUT' and 'RSPK' numbers you can check if the limits for checking the data a tight or if there is a real problem with the data (dew formation for example). When you s large numbers for ROUT or RSPK this is an indication that there is either something wro with the instrument OR the lower or higher limits have been set too 'narrow' or the spike detection is too strict.
Messages	Possible messages are: *No WTs corr* No Schotanus correction applied to covariance W'Ts' because the sensible heat flux or latent hea needed for this correction has an erroneous value. *No TsTs/Ts corr* No Schotanus correction applied to variance Ts'Ts' and Ts because the absolute humidity value n for this correction has an erroneous value. *No Webb-7000CO2 corr* Webb correction not applied because the latent heat flux needed for this correction has an errone value. *No Webb-Krypton corr* Webb correction not applied because the sensible heat flux needed for this correction has an erro value. *No Webb-7500H2O corr* Webb correction not applied because the sensible heat flux needed for this correction has an erro value. *No Webb-7200CO2 corr* Webb corrections not applied because the latent heat flux needed for this correction has an erron value. *No Webb-7500H2O corr* Webb correction not applied because the sensible heat flux needed for this correction has an erro value. *No Webb-TGAN2O corr* Webb corrections not applied because the latent heat flux needed for this correction has an erron value. *No Webb-TGANH3 corr* Webb corrections not applied because the latent heat flux needed for this correction has an erron value.

	No Webb-DLTCH4 corr Webb corrections not applied because the latent heat flux needed for this correction has an erron value. *No Webb-7700CH4 corr* Webb corrections not applied because the sensible or latent heat flux needed for this correction h erroneous value. *No O2 corr* No oxygen correction (Krypton hygrometer) applied to covariance W'q' and variance q'q' because sensible heat flux needed for this correction has an erroneous value. *Error: no raw data files found for this interval* There are no raw data files containing data for the interval *Error: not enough records available for this interval* The number of available records is less than 50% of required *Error: too many bad sonic samples for this interval* More than 50% of records required are out of range or spike *Error: no records available in this file* File is empty

loc-Log.txt

During processing and the use of the various tools in Alteddy some information is written to a log file called *location-Log.txt*. Below you can find an example of this output :

ALTEDDY version 3.90 start 04-06-2013 09:32:19

Raw format file = D:\A-USER\LOOBOS\EDDY\EURO-RAW.TXT Dated 2013-06-02 13:42:49
Processing matrix = "U-wind" , "V-wind" , "W-wind" , "Tsonic" , "Op-H2O" , "Op-CO2"
Parameter file = D:\A-user\Loobos\Eddy\Euro-Par.txt Dated 2013-06-02 13:48:29

PROCESSING
Pressure file = D:\A-user\Loobos\Eddy\Euro-Pre.txt Dated 2013-05-06 10:19:50
A to D conversion file = D:\A-user\Loobos\Eddy\Euro-Adc.txt Dated 2013-06-02 13:48:29
System / vegetation heights file = D:\A-user\Loobos\Eddy\Euro-Hts.txt Dated 2013-06-02 13:27:56
Processing files from location Euro year 12 start day 152 end day 213
Output will be stored in files : D:\A-user\Loobos\Eddy\Euro-Log.txt, D:\A-user\Loobos\Eddy\Euro_12-152-213_Fmv.csv, D:\A-user\Loobos\Eddy\Euro_12-152-213_Lco.csv, D:\A-user\Loobos\Eddy\Euro_12-152-213_Cov.csv, D:\A-user\Loobos\Eddy\Euro_12-152-213_Raw.csv
12 152 0.00 A/D conversion date= 11,365,23:59 values= 0.01000 0.00000 1.00000 0.01000 0.00000 1.00000 0.01000 0.00000 1.00000 0.01000 300.00000 1.00000 0.25000 0.00000 5.00000 0.00400 10.00000 5.00000
12 152 0.00 Heights date= 02,150,00:00 values= 27.00 9.90
Ready

N.b.When a next run is made the new information is appended to the same logfile.

Batch processing

The processing task of Alteddy can be started from the command line / batch file. Format of the command is:

programreference rawparameterfile year startday endday

example1

processes data for site CarboE for year 2003 from doy 190 to 190:

C:\Progra~1\Alteddy3.90\alteddy3.90.exe C:\Alteddy3.90\Examples\CarboE\CarboE-Raw.txt 2003 190 190 (Windows XP)

C:\Users\[your login name]\AppData\Local\Alteddy3.90\Alteddy3.90.exe C:\Alteddy3.90\Examples\CarboE\CarboE-Raw.txt 2003 190 190 (Windows Vista / Windows 7)

You can also use the terms "today" (or "TODAY") and "yesterday" (or "YESTERDAY"). In that case the day of year of today or yesterday is used.

example2

Lets say today is 1/5/2009 (doy 121). To process data for site Euro for year 2009 from doy 1 to 30/4/2009 use:

C:\Progra~1\Alteddy3.90\alteddy3.90.exe C:\Data\Euro\Euro-Raw.txt 2009 1 yesterday (Windows XP)

C:\Users\[your login name]\AppData\Local\Alteddy3.90\Alteddy3.90.exe C:\Data\Euro\Euro-Raw.txt 2009 1 yesterday (Windows Vista / Windows 7)

N.b. When running Alteddy from a batch file make sure the path to the raw data files is absolute, do not use the relative path option or keyword <current>. See also here

N.b. The command line in a batch file does not allow spaces in the path. The same holds for a command typed in a DOS-box. That's why instead of "C:\Program Files" the path "C:\Progra~1" is used. In the Start - Run window both versions of the path will work.

Viewing

After selecting the *location-Raw.txt* file click on Tools - View raw data. A dialog window opens where you can choose to convert the data to physical units and 'show only good values'. See table below :

Convert to physical units	Show only good values	Result
no	no	Data are shown as they are read from the raw file
yes	no	Data are converted to physical units and checked on range and spikes, wrong data are not removed
yes	yes	Data are converted to physical units and checked on range and spikes, wrong data are removed
no	yes	not possible

Then a window opens where you can select the raw data file to view :

The data are then displayed in one graph for each 'column' in the raw file :

From top to bottom on the screen you see graphs for windspeed u, v and w, below that the other channels (if there). Units on the Y axis are the same as for the binary to ASCII conversion (see below). Units for the X axis are record number, the number of records shown depends on the setting of the screen resolution. The number of samples on one screen is limited because one pixel is used for each datapoint. This is to assure that all datapoints are visible. With the scrollbuttons you can move to other files (<FILE and FILE>) or move with big steps within a file (<< and >>) or move one screen at a time within a file (< and >) or stop viewing ().

Data that are out of range or a spike will still be shown in the graph but with a grey background. The normal background is white. This way one can check the effect of the lower and upper range settings and the despiking setting in the *location-Par.txt* file. The data with the gray background will not be used for subsequent flux calculations !

Binary to Ascii

This function will only work when the binary file format is properly defined in *location-Raw.txt*. If converted output is wanted also the conversion factors have to be defined in *location-Adc.txt*. After selecting the *location-Raw.txt* file click on Tools - Binary -> ASCII. A window opens where you can select the raw data file(s) to process:

Then a dialog window opens where you can input the sample rate with which you want to read (every nth record), the total number of records to write and whether or not to use the Carboeurope format for output :

The converted file/files is/are placed in the folder where the *location-Par.txt* file is opened and has the same name as the binary file but with *txt* added as extension.

Units of the data in the ASCII file are:

..txt	units	
wind speed U	m s^{-1}	
wind speed V	m s^{-1}	
wind speed W	m s^{-1}	
temperature from Sonic	°K	
temperature from thermocouple	°K	(if there)
H_2O from Li-Cor LI-7500 / LI-7200	mmol m^{-3}	(if there)
CO_2 from Li-Cor LI-7500 / LI-7200	mmol m^{-3}	(if there)
H_2O from Li-Cor LI-6262/7000	mmol mol^{-1}	(if there)
CO_2 from Li-Cor LI-6262/7000	umol mol^{-1}	(if there)
H_2O from Campbell Krypton hygrometer	g m^{-3}	(if there)
N_2O from Campbell TGA100A TDL	nmol mol^{-1}	(if there)
NH_3 from Campbell TGA100A TDL	nmol mol^{-1}	(if there)
CH_4 from LGR DLT-100 Fast Methane Analyzer	umol mol^{-1}	(if there)
CH_4 from Li-Cor LI-7700 open path Methane Analyzer	mmol m^{-3}	(if there)
air pressure	pascal	(if there)

n.b. umol = micromol

N.b. this function can be used not only to convert binary files to ASCII but also to convert ASCII to ASCII. If you have raw ASCII files that contain columns that are not used or if you want to reduce file size use this function.

Spectra

After selecting the *location-Raw.txt* file click on Tools - Calculate spectra. A dialog window opens where you can select if you want output of natural (n) or dimensionless (f = n * (Z-d) / U) frequencies, if the PC should be shut down when finished and if you want a delay between the output of subsequent spectra :

The Spectra routine calculates spectra and cospectra from the files listed in the file *spectra.fil*. You can either create this file yourself (see example batch file *filelist.bat* in the help folder) or let Alteddy create a list for you. This allows you to select files for a specific period. Spectra and cospectra will be calculated for the data in the files listed in *spectra.fil* only. You can for instance select only the files around noon, during rainy periods, etcetera.
If *spectra.fil* is not found the following dialog screen opens :

If you choose Yes Alteddy will create the filelist and then give you the opportunity to edit the list by opening it in Notepad :

After closing Notepad spectra and cospectra are calculated for each raw data file, divided over three stability classes (unstable, near neutral and stable) and binned and averaged. The averaged (co)spectra are shown on screen :

It shows spectra and cospectra for stability class unstable (z/L<-0.02), near neutral (-0.02<z/L<0.02) and stable (z/L>0.02) for all series present in the raw data file. The (co)spectra shown are averaged while the program reads the files so in the beginning they will look less smooth than after reading and processing more files. The (co)spectra in the output files are the average of all individual (co)spectra of each raw data files listed in the *spectra.fil* file. If the raw files are large enough several (co)spectra will be calculated from the same file (the largest possible dataset for one spectrum calculation is 36864 records).

Spectra and cospectra are calculated using Numerical Recipies routines for Fast Fourier Transformations. Size and number of spectral data subsets depend on the number of available records in one file:
< 12288 : number of subsets = 1, subset = 2048 records
< 20480 : number of subsets = 1, subset = 4096 records
< 36864 : number of subsets = 2, subset = 4096 records
> 36864 : number of subsets = 4, subset = 4096 records
Total number of records used is = (2 * number of subsets + 1) * size subset

The calculated spectra are logarithmically binned to provide smooth estimates. Bins range from 0.001 to 1000, 10 per decade for n (dimensionless frequencies) and 0.0001 to 100 for f (natural frequencies).

When all files are processed the screen shows the number of files which were used for each individual averaged (co)spectrum :

Spectra output

Two files are created, one with spectra (*location-SPEC.DAT*) and one with cospectra (*location-COSPEC.DAT*). Below is the output per column given for each file for an example setup with a Gill R3-50 sonic with a Li-Cor LI-7500 connected to analog input 1 (H_2O) and analog input 2 (CO_2). A different setup will give a slightly different output.

Instrument codes (......):

Code	Instrument
U-wind	Sonic windspeed u
V-wind	Sonic windspeed v
W-wind	Sonic windspeed w
Windsp	Sonic wind speed
Tsonic	Sonic temperature
Ttherm	Fast thermocouple
Op-H_2O	Li-Cor LI-7500 H_2O
Cp-H_2O	Li-Cor LI-6262/7000/7200 H_2O
KryH_2O	Krypton KH_2O hygrometer H_2O
Op-CO_2	Li-Cor LI-7500 CO_2
Cp-CO_2	Li-Cor LI-6262/7000/7200 CO_2
Cp-N_2O	Campbell TGA100A TDL N_2O
Cp_NH_3	Campbell TGA100A TDL NH_3
Cp-CH_4	LGR DLT-100 FMA CH_4
Op-CH_4	Li-Cor LI-7700 CH_4
Apress	pressure sensor

Below is the output per column given for each file:

location-SPEC.dat		units
Frequency	natural or dimensionless frequency	Hz
Uns_......	unstable spectral powers, see instrument codes above	-
Neu_......	near neutral spectral powers for windspeed U'	-
Sta_......	stable spectral powers for windspeed U'	-
Neu_Kaim_u	near neutral Kaimal spectral powers for windspeed U'	-
Neu_Kaim_w	near neutral Kaimal spectral powers for windspeed W'	-
Neu_Kaim_t	near neutral Kaimal spectral powers for temperature Sonic T'	-

location-COSPEC.dat		units
Frequency	natural or dimensionless frequency	Hz
Uns_W_....	unstable cospectral power for W' and ...' (see above)	-
Neu_W_....	near neutral cospectral power for W' and ...' (see above)	-
Sta_W_....	stable cospectral power for W' and ...' (see above)	-
Neu_Kaim_u	near neutral Kaimal cospectral power for W'U'	-
Uns_Kaim_u	unstable Kaimal cospectral power for W'U'	-
Uns_Kaim_t	unstable Kaimal cospectral power for W'T'	-

Planar fit

To use the planar fit rotation option for processing, a plane has to be fitted first to the unrotated windspeeds. To obtain unrotated windspeeds a run has to be made with the 2D rotation option. So the steps should be:

1 Do a run with the 2D rotation option for the period for which you want to get the plane.
2 Run the planar fit routine that calculates the plane.
3 Check the planar fit angles in *location-Pft.txt*.
4 Change the ROTAT option in *location-Par.txt* to planar fit.
5 Run again.

Alteddy versions 3.3 (or higher) outputs and expects to find the unrotated windspeeds in different columns than previous versions did. To do a planar fit with versions 3.3 (or higher) the windspeeds will have to be calculated with version 3.3 or higher

If conditions don't change one planar fit can be used for the whole measurement period. Conditions for which a new planar fit may have to be made are:

- substantial change in vegetation height
- foliated versus non-foliated vegetation
- change in sonic height or orientation

To do the planar fit click on Tools - Planar Fit. A window opens where you can select the *loc_yy_ddd-ddd_Lco.csv* file that contains the unrotated averaged windspeeds u, v and w :

A window opens where you select the number of wind direction sectors and the maximum windspeed to use for the calculation :

After clicking OK the calculation is performed and the resulting angles alpha and beta are shown in a polar plot :

You should experiment with the number of sectors needed to adequately represent the local streamline conditions. If a calculation with many sectors results in many very similar angles and you are measuring above a uniform crop the number of sectors can be reduced.

Planar fit output

An ASCII file is produced called *location-Pft.txt*. This file contains the B-coefficients from multiple linear regression and rotation angles *alpha* and *beta* for each sector.

Below an example :

```
sector  sector           b0           b1           b2        alpha         beta  val
 start     end                                                                     co
000000, 000030,   -0.02344,    0.00259,   -0.04268,   -0.14814,   -2.44396,
000030, 000060,   -0.00760,   -0.03033,   -0.05239,    1.73502,   -2.99917,
000060, 000090,   -0.01017,    0.06830,   -0.06887,   -3.89826,   -3.93993,
000090, 000120,    0.03365,   -0.00668,   -0.00891,    0.38243,   -0.51022,
000120, 000150,    0.04199,    0.00391,   -0.02246,   -0.22375,   -1.28670,
000150, 000180,    0.02807,   -0.00128,   -0.07580,    0.07328,   -4.33466,
000180, 000210,   -0.07438,   -0.00978,   -0.03092,    0.56035,   -1.77092,
000210, 000240,   -0.04524,   -0.09658,   -0.06548,    5.50460,   -3.74625,
000240, 000270,    0.11855,    0.00223,   -0.11107,   -0.12680,   -6.33797,
000270, 000300,    0.09565,    0.01149,   -0.09616,   -0.65536,   -5.49285,
000300, 000330,    0.01624,    0.00576,   -0.05799,   -0.32928,   -3.31875,
000330, 000360,   -0.00189,    0.00604,   -0.04550,   -0.34584,   -2.60498,

For period from doy 186 time 14.00 till doy 190 time 24.00
Number of sectors   12
Wind speed maximum  10
```

It also lists per sector during how many intervals wind direction was in that sector. The period that was used for the calculations, number of sectors and wind speed limit is also given.

N.b. for subsequent processing using the planar fit option only coefficients *b0* to *b2* are used, the angles *alpha* and *beta* (in degrees) are derived from *b1* and *b2* and are listed only to make checking the results easier. User changes to *alpha* and *beta* do not have any effect on the results.
alpha = pitch = rotation about y-axis = w -> 0.
beta = roll = rotation about x-axis = w'v'-> 0

Solar radiation

This utility can calculate solar elevation and radiation for a given period. The solar elevation calculation is based on Astronomical Algorithms by Jean Meeus. The radation calculation is based on FAO (radiation at top atmosphere). Radiation is corrected for absorption by the atmosphere (12% absorption).
After selecting the *location-Raw.txt* file click on Tools - Solar calculations. A dialog window opens where you can enter the period of the year for which to calculate :

Longitude is defined as; west of Greenwich negative, east of Greenwich positive.

Latitude is defined as; Northern hemisphere positive, Southern hemisphere negative.

Timeshift is defined as the difference between time used in the data files and local winter time.

The output file is placed in the folder where the *location-Par.txt* file is opened and has the name *location-Sun.txt*. It contains:

location-Sun.txt			units
1	Yr	year	-
2	Doy	day of year (jan 1st = 1)	-
3	DecTim	time, hours with decimal minutes	-
4	Elevation	Solar elevation	degrees
5	Radiation	Shortwave radiation at the surface	$W\ m^{-2}$

Check site location

Click on Tools - Check location. This opens the Google Maps website, using either Microsoft Internet Explorer or Mozilla Firefox, and displays a map centered on the tower location given in *location-Par.txt*.

Latitude and longitude is used for daytime/nighttime determination in the "Apparent-off-season-uptake" Webb correction of CO_2 fluxes (Burba 2008). If you have a Li-Cor LI-7500 and this correction switched on (HCOR=1 in *location-Par.txt*) make sure these values are correct !

You can use the Solar radiation tool as an extra check to see if daytime/nighttime is calculated correctly for your site. compare the radiation output with the flux output or with meteo data (if these have the same timing as the flux data).

As a reminder:

Longitude is defined as; west of Greenwich negative, east of Greenwich positive.

Latitude is defined as; Northern hemisphere positive, Southern hemisphere negative.

Timeshift is defined as the difference between time used in the data files and local winter time.

Rename raw files

Alteddy can only process raw data files that have a code in the filename for year, DOY (or month and day) and time. If you have ASCII files with different names but with a date/time code in the records of the file you can use this utility to rename them.

The contents of the files will NOT be changed.

The procedure is as follows:
1 Set up a *location-Raw.txt* file describing the ASCII files to be renamed (also for later use).
2 For the moment define a dummy name for parameter FNFRAW in *location-Raw.txt*.
3 Run the rename function.
4 Change parameter FNFRAW to the format chosen for renaming.

Click on Tools - Rename files. A window opens where you can select the raw files to rename :

Afer pressing OK a next dialog opens where you can define at which positions in the file records the date values can be found :

The file you want to rename has to contain values for either day of year or month/day of month (choose with radio-button). You also have to define a format for the name of the output files. The format has to contain the codes yy, hh and mm and either ddd or mo/dm.
If the file you want to rename does not contain a value for the year you can set the slider for "Year position" to zero and fill in a value manually in the field behind "Result". This fixed value (last 2 digits of the year) will then be used for all files selected.

After clicking Start the next dialog opens :

Here you can check if the renaming works well and then choose to either confirm for each file or confirm for all selected files.

N.b. Date/time information is taken from record 30 of each file. If files have headers of more than 29 lines the rename function will not work..

Units

Alteddy assumes the values in the raw data files to have the following units:

Sonic windspeed u	m s^{-1}
Sonic windspeed v	m s^{-1}
Sonic windspeed w	m s^{-1}
Sonic speed of sound / temperature	m s^{-1} or Kelvin, defined by parameter TEMUNI
Li-Cor LI-7500/7200 open path H_2O	millimol m^{-3}
Li-Cor LI-7500/7200 open path CO_2	millimol m^{-3}
Li-Cor LI-6262/7000 closed path H_2O	millimol mol^{-1}
Li-Cor LI-6262/7000 closed path CO_2	micromol mol^{-1}
Fast response thermocouple	K
Krypton hygrometer H_2O	g m^{-3}
Air pressure	Pascal
Campbell TGA100A TDL N_2O	nanomol mol^{-1}
Campbell TGA100A TDL NH_3	nanomol mol^{-1}
Los Gatos DLT-100 CH_4	micromol mol^{-1}
Li-Cor LI-7700 CH_4	millimol m^{-3}

If these measurements have been stored in different units (mV, counts, Celsius, g m^{-3}, etc.) you can specify conversion factors in file *location-Adc.txt*.

Processing program flow

```
Declarations of constants
Define output filenames and open

FOR EACH DAY

   Get air pressure (if not in raw data)

      FOR EACH TIME INTERVAL

         Initialise variables

         Get A/D conversion values for this time

         Get system / vegetation heights for this time

         Find raw data file / position in raw data file for this interval

         Read samples from raw data file(s)

         Check number of records

         Convert samples to physical units

         Check samples on range and spikes

         Correct samples of t for crosswind contamination (Liu, 2001)

         Rotate u and v to right-hand Cartesian coordinates

         Apply cosine calibration to samples (optional, Gill sonics only)

         Calculate averages

         Calculate wind direction

         Calculate angles and rotate samples, 2D or planar fit (Wilczak, 2001).

         Calculate averages again

         Determine time lags of signals with respect to Sonic T

         Calculate (co)variances with block average for whole interval

         Calculate (co)variances with block average for 6 sub-intervals

         Determine Steady State quality flag (Foken, 2004)

         Determine Integral Turbulence Characteristics quality flag (Foken, 200

         Frequency response corrections on (co)variances (Moore, 1986)

         Recalculate u* and z/L

         Calculate distance of 80% integrated flux contribution (Schuepp, 1990)

         Correct covariance w'Ts' for humidity fluctuations (Schotanus, 1983)

         Correct variance t't' for humidity fluctuations (Schotanus, 1983)

         Correct t for humidity (Schotanus, 1983)

         Correct covariance w'q' Krypton for density fluctuations O2 (Tanner, 1
```

```
         Calculate Webb speed and add Webb term to fluxes (Leuning and King, 19

         Final unit conversions

         Assign overall flux quality flag (Foken, 2004)

         Output to the 3 output files and to the logfile

   NEXT TIME INTERVAL

NEXT DAY

Close output files
End
```

DOY list

Instruments

Configuration settings of the instruments :

Gill sonic anemometer R3-50 / R3-100

WINDREP=UVWCAL (calibrated uvw)
SOSREP=SPEED (report speed of sound)
ABSTEMP=OFF (no PRT temperature reporting)
CTONE=OFF (no confidence tone)
INST=ON (instantaneous mode on)
ALIGNUVW = SPAR (align u-axis with North spar)
Eddylogp sets these parameters automatically, and also:
ANAIP 1 E - ANAIP x E (number of analog inputs (x))
AVERAGE=10 (10 Hz output)
STRFMT=BINARY (binary output)
MSGMODE=CONT (continuous reporting)
BAUD=9600 (baudrate 9600)

Gill sonic anemometer Windmaster (Pro) type 1352

M7 (uvw continuous binary)
U1 (wind units m s^{-1})
G1 (averaging off)
E1 (full duplex communication)
X2 (align u-axis to spar)
Eddylogp sets these parameters automatically, and also:
Jx (number of analog inputs (x))
P6 (10 Hz output)
B3 (9600 baud)
F1 (8 data, no parity)

Gill sonic anemometer Windmaster (Pro) type 1561 / 1590

A2 (SOS output)
B3 (9600 baud)
F1 1 (retries on)
F2 1 (instantaneous sampling on)
F3 1 (calibration on)
G0 (averaging disabled)
H2 (power on message disabled)
I2 (analogue input data on)
J1 (select normal resolution)
M8 (message format binary, UVW, short)
P6 (output rate is 10 Hz)
X1 (align U axis to unit North spar)

Gill sonic anemometer R2

1 (calibrated uvw)
Eddylogp sets these parameters automatically, and also:
4+x (number of analog inputs, 5=1, 6=2, etc.)
M (9600 baud)

Li-Cor gas analyzer LI-6262

Set averaging time (FCT 74) to 0 seconds
Set the CO_2 resolution (FCT 75) to 'High'
Set the vapour flag (FCT 76) to 'Band broadening & dilution'
Set the DAC outputs

Li-Cor gas analyzer LI-7500

set bandwidth to 20 Hz
set delay time to 240 + (9*6.5) = 299 ms
set the DAC outputs to output millimol m^{-3} for both CO_2 and H_2O
n.b. You should update the LI-7500 embedded software to version 3.0, previous versions have a bug in the delay time.

Li-Cor gas analyzer LI-7200

set bandwidth to 20 Hz
set delay time to 240 + (9*6.5) = 299 ms
set the DAC outputs to output millimol m^{-3} for both CO_2 and H_2O

Li-Cor gas analyzer LI-7700

Set mirror heater control to the disired settings
Set spin motor control to the disired settings
When logging using a Campbell datalogger: set IP to a fixed address and set output rate to zero
Use the uncorrected methane number density channel (CH4D, millimol m^{-3})

Instrument specific settings for Alteddy (in *location-Par.txt*) :

Li-Cor gas analyzer LI-7500

TAUCO = 0.10 time constant (10 Hz)
PCO = 0.120 sensor path length (m)

Li-Cor gas analyzer LI-7200

TAUC2 = 0.10 time constant (10 Hz)
PC2 = 0.120 sensor path length (m)

Li-Cor gas analyzer LI-6262

TAUQ2 = 0.3340 LI6262 H_2O time constant (3 Hz)

TAUC = 0.20 LI6262 CO_2 time constant (5 Hz)

PC = 0.1520 LI6262 sensor path length (m)

Li-Cor gas analyzer LI-7000

TAUQ2 = 0.10 LI7000 H_2O time constant (10 Hz)

TAUC = 0.10 LI7000 CO_2 time constant (10 Hz)

PC = 0.1520 LI7000 sensor path length (m)

Fast response thermocouple

D1 = 0.710 time constant at 0 m s^{-1} windspeed (1.4 Hz)

Campbell KH_2O Krypton hygrometer

PQ1 = 0.01250 H_2O sensor path length (m)

Campbell TGA100

TAUTL = 0.3340 TDL sensor time constant (3 Hz)
PTL = 1.50 TDL sensor path length (m)

Los Gatos DLT-100 Fast Methane Analyzer

TAUG = 0.10 DLT-100 time constant (seconds)
PG = 0.20 DLT-100 path length (m)

Li-Cor LI-7700 open path Methane Analyzer

TAUMO = 0.05 DLT-100 time constant (seconds)
PMO = 0.50 DLT-100 path length (m)

Version history

Changes from Alteddy version 3.80 to version 3.90 :
Added angle-of-attack correction following Nakai 2012.
Replaced temperature crosswind correction Schotanus 1983 with Liu 2001.
Added three sonic anemometer models, the Young 81000, Gill HS and ATI K-probe.
Removed sonic path lengths parameters in *location-Par.txt*.
Added parameter UALIGN in file *location-Raw.txt* defining alignment of sonic anemometer u-axis.
Added rotation of windspeed u and v to conform to right-handed Cartesian for all sonics.
Corrected bug in calculation of wind direction for the Gill Windmaster (Pro).
Moved output of raw data file information from log file to new **Raw.csv* file.
Air pressure is now always output in the **Fmv.csv* file, also when daily air pressure is used

Changes from Alteddy version 3.73 to version 3.80 :
Corrected bug that prevented the WPL correction to be applied to the LI-7200 CO2 flux (under some conditions)
Corrected bug in frequency response corrections routine
Added spectral correction for high-pass filtering (Moncrieff, 2004, table 2.2)
Added application of surface heating correction (Burba 2008) to LI-7500 latent heat fluxes
Added option to skip specific number of bytes at the END of binary records in raw input files (set with parameter SKPBYT in file *location-Raw.txt*)
Added automatic detection of header size in TOB1 files (set variable HEDRAW to 8888 in file *location-Raw.txt*)
Changed extension spectral output files to csv
Added momentum flux tau to output file **Flx.csv*
Variables for file names extended to 260 characters to allow longer paths
Added variable for site altitude to *location-Par.txt* (used for air pressure checking)
Added check on pressure in raw data files, if out of range replaced by pressure calculated from altitude
Some minor changes to the GUI
Changed scale bar graph temperature to -10 - 40 (processing)
Changed scale bar graph air pressure to 70000 - 110000 (processing)
Corrected bug in link to help file

Changes from Alteddy version 3.72 to version 3.73 :
Corrected bug in yaw rotation angle calculation (v=0) for planar fit

Changes from Alteddy version 3.71 to version 3.72 :
Modified quality flags to include information on failed WPL correction (adding 100 to flag)
Some improvements to progress/error messaging
Small changes to the user interface (colors, dialogs)

Changes from Alteddy version 3.7 to version 3.71 :
Corrected bug in WPL correction for LI-7000 CO_2 (introduced in version 3.6)
Raw input file formats now include TAB-separated ASCII files (Li-Cor GHG files)

Folder names in path to raw data files can now contain spaces

Changes from Alteddy version 3.6 to version 3.7 :

Included calculations for the Li-Cor LI-7200 closed-path CO_2 / H_2O analyzer

"NAN" or "NaN" encountered in ASCII files will be replaced by -9999 when file is read

Path to raw data files can now be absolute, relative or current folder (set in *location-Raw.txt)*

Spectroscopic corrections LI-7700 replaced with those from the Li-Cor LI-7700 manual 984-10751.

Changes from Alteddy version 3.5 to version 3.6 :

Included calculations for Li-Cor LI-7700 open-path Methane analyzer

Added 3 flux quality flag output options (1=SS+ITC, 2=SS, 3=ITC, 4=flux fractional difference)

Removed output of steady state test fractional differences in fluxes to file loc_yy_ddd-ddd_Lco.csv

Added full check of file with daily air pressure at start of run

Added check on yyyy code in raw file name template

Changes from Alteddy version 3.4 to version 3.5 :

Added latent heat Webb correction for Li-cor LI-7000 CO_2 (if latent heat available)

Added option to check the site coordinates in Google Maps

Changes from Alteddy version 3.3 to version 3.4 :

Updated LI-7500 surface heating correction to latest approach (Burba 2008)

Replaced steady state test with Foken 2004 quality flag system

Added extra sorting of raw file name list for processing, will now run with UNIX networkdisk

Added latent heat Webb correction for Campbell TGA100 N_2O and NH_3 (if latent heat available)

Included calculations for Los Gatos DLT-100 Fast Methane Analyzer

Parameter file (*.PAR) revised (again!)

Modified raw file searching, now faster execution when encountering raw data gaps

Corrected bug in output of rotation angle Gamma (classic rotation)

Added output of steady state test fractional differences in fluxes to file loc_yy_ddd-ddd_Lco.csv

Changes from Alteddy version 3.2 to version 3.3 :

Limits for NS and INTAVG broadened, added check on product NS*INTAVG*60 (<300000)

Corrected bug in Rename raw files utility

Extended binary raw file options with choice of little or big Endian numbers

Extended binary raw file format with native sonic formats

Added bars indicating number of out of range s^{-1}pike values to processing screen

Various changes to GUI and start parameter dialog (now checks for available raw files)

Changes from Alteddy version 3.1 to version 3.2 :

Re-programmed reading raw data, will read most common formats now

Input only external temperature signal (without sonic temperature) is now possible

Introduced separate raw data configuration file ?-Raw.txt

Output of un-rotated mean windspeeds to loc_yy_ddd-ddd_Lco.csv file moved to first columns in file

Output of rotation angles also for planar fit and moved to first columns in file loc_yy_ddd-ddd_Lco.csv
Output of air density in kg/m³ (humid) added to file loc_yy_ddd-ddd_Lco.csv
Added utility for renaming raw ASCII data files
Added utility for calculating solar elevation and radiation
Created Microsoft Compiled HTML Help file
Installation through Nullsoft installer

Changes from Alteddy version 3.0 to version 3.1 :
Calculations for Campbell TGA100A Tunable Diode Laser N_2O / NH_3 included
Binary to ASCII converter can now handle multiple files and Carboeurope exchange output
Output of corrected variances moved from loc_yy_ddd-ddd_Lco.csv file to loc_yy_ddd-ddd_Cov.csv file
Added output of un-rotated mean windspeed u and v to loc_yy_ddd-ddd_Lco.csv file (for planar fit)
Added option to fit a plane through previously calculated u, v and w data
Modified axis rotation routine to include planar fit method (Wilczak, 2001)
Replaced vd Molen angle-of-attack routine by more accurate Nakai routine
Added additional Webb-term to correct for surface heating of the Li-Cor LI-7500
Split inlet tubing characteristics in those for LI-6262/7000 and those for TGA100A
Removed frequency response spatial averaging transfer function for closed path sensors
Added output option without conversion to physical units for the binary to ASCII converter

Changes from Alteddy version 2.1 to version 3.0:
Re-programmed finding and reading of raw data files, files size now from 30 min to 14 days
Added dialogs for spectra, viewing and binary to ASCII converter
Added option to view raw data after checking on range and despiking
Added option to view raw data without conversion to physical units
Added option to automatically create file list (spectra.fil) for spectra calculations
Extended checks on parameters in .par file
Number of channels extended to 10
Added binary input option for reading TOB1 files (Campbell Table Oriented Binary)
Added raw data air pressure sensor input option
Kaimal spectral functions added to (co)spectra output
Various minor changes to the GUI
Option added to set the Base Prioriy of the process to 'low'
Added output of un-rotated mean vertical windspeed w to loc_yy_ddd-ddd_Lco.csv file
Lag of LI-7500 now calculated (was fixed at 300 ms) in same way as for LI6262/7000
Added parameter file with variable height of system and zero displacement height
Changed file name format for parameter files, now with .txt extension
Changed file name format for output files, now with .csv extension
Windspeed u and v changed from vectors to scalars by taking absolute value

Changes from Alteddy version 2.0 to version 2.1 :
Added 4th (CSAT) and 5th (USA-1) sonic type, The CSAT has internal cross wind correction
Added ASCII input option for reading the Carbeurope exchange format for high frequency data
Added second header line for loc_yy_ddd-ddd_Fmv.csv files with output units

Added binary input option for reading EClog (Free University Amsterdam) data (only R2)

Changes from Alteddy version 1.2 to version 2.0:
Crosswind correction of sonic temperature now done on raw samples
Corrected small bug in humidity correction of sonic temperature
Re-programmed O_2 correction Krypton hygrometer following van Dijk (2003)
Re-programmed calculation of Webb speed / Webb correction term
Axis rotation now done on raw samples
Output of variances moved from loc_yy_ddd-ddd_Fmv.csv file to loc_yy_ddd-ddd_Lco.csv output file
Output variances Li-Cor CO_2 units changed from umol m^{-3} to umol mol^{-1}
Added option to shut down PC when finished processing
Output variances Li-Cor CO_2 units changed from umol m^{-3} to umol mol^{-1}
Removed linear detrend option
Corrected bug in calculation of wind direction
Added output of indicators for 'detrending uncertainty' of fluxes
Output Krypton hygrometer for viewing and binary->asci changed from kg m^{-3} to g m^{-3}
Corrected bug in calculating mean horizontal windspeed

Changes from Alteddy version 1.0 to version 1.2:
Added subroutine calculating (co)sine corrections to u,v and w signals
Averaging period extended to maximum of 240 minutes
Common variables now in VFortran module Modeddy
Added a menu bar
Removed routines for Ready, Error and Wait, now done with standard VFortran dialog
Various changes to the GUI
Improved error messaging
Added raw data file viewer (originally separate program Eddyplot)
Added binary to ASCII raw data file converter (originally separate program Bintoasc)
Added spectral analysis routine (originally separate program Spectrawsc)
Parameters read from *.PAR file now in module Modeddy

Changes from Eddywsc to Alteddy version 1.0:
Output reduced to 3 files per run instead of 3 files per day
Output files are contiguous, no more gaps in data series
Added block average detrending option
Can read raw data files from Gill R3 sonic
Calculation of distance of 80% of flux contribution in *Fmv.csv output file
Headers in output files
Graphical interface with flux graph of processed data
File with list of files (*.FIL) no longer needed
Parameter file (*.PAR) revised, now includes frequency response correction parameters
No longer dummy line needed in calibration file (and name changed to *.ADC)
Values in output files are comma separated
Output of lags and correlations moved from logfile to *Lco.csv output file
Checking of parameters when reading parameter file (*.PAR)

File with average air pressure per day now optional, alternative is fixed pressure
Averaging period for output less dependent on length raw data files (maximum 120 minutes)
Calculations for open path Li-Cor LI-7500 included
Despiking of raw data
Added several options for the 3rd coordinate rotation (v'w' = 0, lateral rotation)
Crosswind correction not for Gill R3 (calibrated output is already corrected)

Literature

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