EdiSol

(V 0.39)

User Guide

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1. Introduction

1.1 Requirements

- IBM PC compatible computer 25 MHz 80386 **minimum**
- **Maths** coprocessor
- **At least** 540K of conventional (program) memory.

MSDOS 6.0 or higher is recommended for its disk maintenance tools; alternatively you should use third party tools such as PCTOOLS. There are many different types of laptop PC available and the ones we have tried all work with *EdiSol* provided they meet the minimum specifications. Some of the more modern laptops have features which permit automatic power saving after a certain amount of time or which permit the machine to be switched off without losing the contents of memory (usually when they are running in Windows mode). We find these features can interfere with the operation of the programme and we recommend that the laptop is set up with a minimal DOS configuration and that all power management features are turned OFF.

1.2 Program Installation

Keep backup copies of EDISOL.EXE and the sample calibration file. Make a directory in which all *EdiSol* data will be logged to and copy EDISOL.EXE **and** the calibration file into it (it is easiest if the calibration file is named EDI.CAL). You can then change directory and run *EdiSol* from there.

(You may find that adding a line to your AUTOEXEC.BAT file to change to this directory automatically when starting up the computer also makes life simpler in the field.)

Each user will set up the 'plumbing' for their *EdiSol* system slightly differently but Figure 1 shows the configuration of the system we currently use. Figure 2 is a flow diagram of the essential features of the *EdiSol* program.

2. Operation of *EdiSol*

2.1 Executable and control files

2.1.1 EDISOL.EXE

Type *EDISOL* at the DOS prompt from the directory containing EDISOL.EXE. You **must** also have a valid calibration file on your computer.

2.1.2 Calibration file (EDI.CAL)

These are text files and can be edited with any editor such as *Microsoft Edit* or the *Turbo Pascal* editor. The file gives for each instrument: name, calibration coefficients, units of the calibrated and uncalibrated values and specification of minimum and maximum delay between the sample being taken and the measurement being recorded (e.g. the time taken for an air sample to travel down a sampling tube to a gas analyzer).

The calibration equation is of the form:

$$y = ax^2 + bx + c$$

where y is the calibrated result
x is the uncalibrated data as from the Solent
a,b and c are coefficients.
(c is the offset in calibrated units and for a straight line calibration, a is zero.)
For the fluxes calculated by *EdiSol* to be in reasonable units, your calibrations should be as shown below. (The calibration file format is flexible so that input devices other than the Solent anemometer may be used in the future.)

Format of calibration file for *EdiSol*

Chan#	Name	a	b	c	Raw Units	Calib Units	Min delays	Max delays
1	Solent u	0.0	0.01	0.0	cm s^{-1}	m s^{-1}	0.0	0.0
2	Solent v	0.0	0.01	0.0	cm s^{-1}	m s^{-1}	0.0	0.0
3	Solent w	0.0	0.01	0.00	cm s^{-1}	m s^{-1}	0.0	0.0
4	Solent t	9.9334e-7	0.00	-273.15	0.02m s^{-1}	° C	0.0	0.0
5	Licor CO_2	0.0	0.06	300.00	mV	ppm CO_2	4.0	5.0
6	Licor H_2O	0.0	0.006	5.00	mV	ppth H_2O	4.0	5.0

When setting up at a new site it is recommended that the calibration file be set up to read CO_2 concentrations between 300 and 600 ppm and H_2O concentration between 5 and 35 ppth. As in the example .cal file above, this ensures that measurements will not go out of range and that data will not be lost. After a few days or so, these ranges can be reduced to more closely bracket the local diurnal ranges of concentration.

***NB** when using a LI-COR LI-6262 gas analyser, remember to set the DAC converters to correspond to these calibrations using FCT 05 and 06.*

2.1.3 Dialogue settings file (EDI.CFG)

This file is created automatically to contain the last dialogue box settings and resides in the current directory. It is not vital to the running of the program and, if it is lost, the dialogue boxes values will revert to the defaults in *EdiSol* and the process of filling in the dialogues correctly again, will recreate it.

2.2 Output (data) files

There are three types of output files:

1. **flux data** – containing fluxes, variances, means and rotation angles.
2. **lagged correlation data** – to allow checks to be made on lags when sampling tubes are used.
3. **raw data** – data as output by the Solent serial interface at 20.8 Hz. Saving this data allows the fluxes to be recalculated (for instance if lags have not been properly entered) and or for subsequent spectral analysis.

The file names for all output files are of the same format. DOS allows eight characters for the file name and three characters for an extension. The filename gives day and time when the file was created and when data was first stored in the file. The day is given by the *day of year* number and takes up three characters. Two characters are used for both the hour (00 to 23) and minute (00 to 59). This leaves one character which may be chosen by the user and may be used to signify the site or project.

The format is then; **IDDDHHMM** where **I** is the identification character, **DDD** is the *day of year* number, **HH** is the hour and **MM** is the minute.

Example*:* the file *S1541430* would contain data starting on day of year *154* at *1430* hours.

The extension is used to identify the type of data in the file as shown below:

1. flux data (extension .FLX)
2. lagged correlation data (extension .COR)
3. raw data (extension .SLT)

The flux and correlation files contain data for the whole of one logging session (from the start of logging until logging is stopped). At the end of the flux averaging period the files are opened to allow the data to be appended, the data are written and then the files are closed again once the data is written. This means if the computer crashes (e.g. because of power failure) any data that have been written to files are not lost.

The raw data is saved to file after every packet of data is received from the Solent anemometer. A new file is used for each flux averaging period and the file is left open until the end of the period for speed. If the computer crashes, raw data in an open file is lost.

Assuming that *u, v, w*, and *T* plus H_2O and CO_2 are being sampled, saving all the raw data uses approximately one megabyte of disk space per hour. Flux files take up about 8 Kb per day and correlation files, about 38 Kb per day. Long time series of flux and correlation data could be stored on a small hard disk (though of course it should be backed up) whereas raw data does present some problem in storage. *EdiSol* automatically checks the amount of hard disk space available; if it less than about 2 Mb, the program stops storing raw data (if this option was selected) but continues to calculate the fluxes over the specified averaging interval. The averaged fluxes continue to be appended to the *.FLX files.

2.2.1 The flux file (.FLX) format

Column	Heading	Description	Units	Notes
1	Yr	1992 etc.		
2	Mon	1,2,,,12		
3	Day	1,2,,,28,[29,30,31] + day of week		
4	h	0,1,2,,,23		
5	m	0,1,2,,,59		
6	Sonic H	Sonic Sensible heat flux	W m^{-2}	see note 2
7	LE	Latent Heat	W m^{-2}	
8	E	Water vapour flux	mmol $m^{-2}s^{-1}$	
9	C	CO_2 flux	µmol $m^{-2}s^{-1}$	
10	MomtmFlux	Momentum flux	m^2 s^{-2}	
11	$U*$	Friction velocity	m s^{-1}	
12	M-O length	Monin - Obukov length	m	
13	var u	variance of u	m^2 s^{-2}	
14	var v	variance of v	m^2 s^{-2}	
15	var w	variance of w	m^2 s^{-2}	
16	var T_s	variance of sonic temperature	$^oC^2$	see note 3
17	var c	variance of CO_2 concentration	μmol^2 mol^{-2}	
18	var h	variance of H_2O concentration	$mmol^2$ mol^{-2}	
19	av u	mean windspeed x_n component	m s^{-1}	x_n is aligned with 330 °
20	av v	mean windspeed v_n component	m s^{-1}	y_n is aligned with 240 °
21	av w	mean windspeed w_n component	m s^{-1}	z_n is aligned with the nominal vertical axis
22	av t	mean sonic temperature	^oC	
23	av c	mean CO_2 concentration	µmol mol^{-1}	
24	av h	mean H_2O concentration	mmol mol^{-1}	
25	windspeed	mean windspeed	m s^{-1}	
26	wind dir	wind direction	degrees	
27	Eta	first rotation angle	degrees	
28	Theta	second rotation angle	degrees	
29	Beta	third rotation angle	degrees	
30	C lag	CO_2 time lag	sample periods	(see note 1)
31	H lag	H_2O time lag	sample periods	(see note 1)

Some Notes about the *.FLX Format

[1] the sample period is equal to (sample rate)$^{-1}$, e.g. if the tabulated time lag is 59 then this is equal to 59/20.8 seconds when the data is logged using a Solent sonic anemometer.

[2]. Sonic sensible heat flux, H_s, is calculated using sonic temperature (see note 3) this is a very close approximation to the virtual heat flux which includes the buoyancy effects of moisture required for calculating stability terms such as Monin-Obukov length. Sensible heat flux, H, is given by $H_s+0.00032c_pTE$ where c_p is the heat capacity of air at constant pressure, T is the absolute temperature and E is the evaporation flux in mmol m^{-2} s^{-1}. (Schotanus, P., Nieuwstadt, F.T.M. and Bruin, H.A.R. 1983 Temperature measurement with a sonic anemometer and its application to heat and moisture fluxes. *Boundary-Layer Meteorology* **26**:81-93.).

[3]. Sonic temperature, T_s, is a very close approximation to virtual temperature, T_v. The relationship of T_s and T_v with temperature, T, is given by, $T_s=T(1+0.32e/p)$ and $T_v=T(1+0.38e/p)$ where e and p are vapour pressure and absolute pressure, respectively.

[4].The units given above are only true if the calibrated units are as specified in section 2.1.2

2.2.2 **The lagged correlations file (.COR) format**

These files contain the results of correlations with fluctuations in vertical windspeed and lagged fluctuations of CO_2 or H_2O. *EdiSol* uses these correlations to estimate the lag in measurement of CO_2 and H_2O because of the time taken for the air to travel down the sample tube.

Column	1	2
definition	delay time	correlation coefficient.
Units	in 1/20.8 ths of a second.	

2.2.3 Raw data files (.SLT) format

These are binary files made up a header and data records of 16 bit integers. The number of data fields (integers) varies with the number of analogue inputs to the Solent anemometer: four fields if there are no analogue inputs up to nine fields if there are five analogue inputs. The first record of the file is a header, the first byte of which contains the record size in bytes (=2 x number of fields). The header also contains the seconds and hundredths of the file start time. (Previous versions of *EdiSol* relied on the file end time also to be in the file header but this is no longer required starting from version 0.39).

Header

Byte	1	2	3	4	5	6	7
Content	Record size (bytes)	Start sec	Start sec/100	End hour	End min	End sec	End sec/100

Data record

Column	1	2	3	4	5	6
Variable	u_n	v_n	w_n	C_s	input 1	input 2
Units	m s^{-1}	m s^{-1}	m s^{-1}	1/ 50 m s^{-1}	mV	mV

2.3 Starting *EdiSol*

N.B. Time and date are taken from the PC clock. These may be checked and reset by typing TIME *or* DATE *respectively at the DOS prompt.*

1. Change directory (CHDIR or CD) to the directory that EdiSol.exe is in.

2. Type EdiSol at the DOS prompt.

3. A menu bar should now appear. (*EdiSol* uses the same menu system as Turbo Pascal.)

(*EdiSol* must be able to find a calibration file (default name - EDI.CAL). If a calibration file called EDI.CAL is not in the current directory a File open dialogue box will appear. You should use this dialogue box to locate the calibration file you wish to use. Errors in the calibration file may also cause the program to crash.)

2.4 Real time calculation of fluxes

1. If you wish to override the selection of the calibration file EDI.CAL in the current directory, select LOAD FILE from the CALIBRATION menu and use the resulting dialogue box to select the required file.

2. From the LOG menu select SOLENT (this selects the device from which to log data).

3. Configure the Solent anemometer using the SET UP SOLENT dialogue box.

Check:

- √ The **serial port** selected is the one connected to the Solent (default is COM1).
- √ The **baud rate**; (19200 baud rate is the default, use this unless you have problems communicating with the Solent - slowing down the baud rate to 9600 or 4800 may help but will reduce the time the computer has to process the data and therefore the range of sample lags it can deal with).
- √ The **number of analogue inputs**; (the flux calculations use only 2 inputs, 1 for CO_2 and one for H_2O, but extra inputs may be saved as raw data to file.
- √ The **Solent data mode**; this may be calibrated or uncalibrated wind velocity as *u,v* and *w* components. In the calibrated mode the Solent makes corrections for strut interference (p4 Gill Instruments 3 Axis Research Anemometer Product Specification). **The default is calibrated output**.
- √ The orientation of the sonic. This is the bearing from north of the nominal north pointer on the Solent and allows the calculations of wind direction given in the FLX file to account for the nominal north pointer not being aligned north

When you are satisfied with your selections select Okay or Cancel to escape back to the main menu.

Now, set parameters controlling the logging using the Logging Parameters dialogue box.

Check:

√ the moving average time constant (in seconds). This provides the mean around which the fluctuations are calculated. All channels use the same length of moving average. The moving average also detrends the data and for this a shorter moving average is better than a long one. We use 200s to 500s.

√ the flux averaging period. This is the interval over which the covariances are averaged, however, it is also the interval over which the wind velocity is averaged for use in the co-ordinate rotation. The interval must be long enough to ensure that the mean wind velocity reflects the local stream flow. The default is 30 minutes.

√ The file name prefix. Calculation of covariances results in two files being produced. One contains covariances and turbulence data and is given the extension '.FLX' and the other contains correlations between CO_2 and H_2O fluctuations and vertical wind speed fluctuations and these files are given the extension '.COR'. The fluctuations are used to estimate the time taken by the gas to travel down the sample tube. The name of these files (excluding the extension) are made up of 3 characters for the day of the year, 2 characters for the hour and 2 characters for the minute. DOS allows 8 characters in the file name so the user may select a character to be used as the first character of the file name (the default prefix letter is S).

√ Number of axes to rotate. This may be set from 1 to 3. Above the canopy this would usually be set to 3 to align the wind vectors with the local stream lines (this also makes orientation of the Solent with respect to the vertical non-critical). Inside the canopy only one rotation should be allowed as more than one rotation in conditions of intermittent turbulence (such as inside a canopy or above the canopy in stable conditions) gives spurious results.

√ Atmospheric pressure. To calculate fluxes of gases from measurements of molar ratios, atmospheric pressure is needed. An error of 1% in the pressure used results in an error of 1% in the flux. Use standard pressure for the altitude at which you measure. Day-to-day variation may cause errors of up to ±3%

√ Whether you wish raw data to be saved. Raw data is saved to disk in the same format as it is transmitted from the Solent but without the packet numbers or packet start and finish markers. (N.B. Gill instruments in the Solent Product Specification reverses the conventional meaning of the terms packet and record. We use them in the more usual way with the record as a single set of observations and a packet as a collection of records.) The file names are made up as for .FLX or .COR files but with the extension .SLT. It is possible to switch between storing and not storing raw data whilst *EdiSol* is running - simply use the toggle key combination, CTRL-R and an indicator on the logging screen will update the status of this option.

When you are satisfied with this dialogue box select OKAY to continue to the Define Instrument Channel dialogue box or select Cancel to escape back to the main menu.

√ Identify the data channels using the Define Instrument Channels dialogue box. The channel numbers used are the field numbers of the records from the Solent. Therefore, channel 1, 2, and 3 are *u*, *v* and *w* respectively, channel 4 is speed of sound (ultimately, the sonic temperature) and channels 5 to 9 are the Solent analogue inputs 1 to 5.

Check:

- the channel number for the *u* component of the wind velocity. *u*,*v* and *w* channels must always be in successive channels. (For data collected by the Solent via the serial interface *u*,*v* and *w* are channels 1,2 and 3.
- the channel number for temperature (the default is 4)
- the CO_2 concentration channel (the default is 5)
- the H_2O concentration channel (the default is 6)

Select OKAY to start logging or CANCEL to escape back to the main menu.

Text at the bottom left of the screen will appear as the program tries to establish contact with the anemometer. If a message box appears announcing failure to establish contact with the Solent, check the serial connection and try to log from the Solent again.

Warning.
- The **default** start up mode is that **no** raw data is to be saved.

2.4.2 Quit Logging

To stop logging press Control and *q* keys at the same time.

2.5 The Logging Screen

The top line shows the status of the serial link with the Solent, e.g. baud rate, the second to last and last numbers (at the right) of this line show the number of the last packet received and the number of records in the packet. *These two numbers are very useful for checking that the computer is keeping up with the data collection*. The packet number should increment by one (at just under once every second) and the number of records should be constant at 20 (indicating the Solent sonic anemometer is being used in the prompted mode). If the numbers deviate from these values, data is being missed and probably corrupted. See the trouble shooting section for remedies.

Underneath the status line information on each channel is shown. Each line represents one channel and shows: identification number, description, raw data from the Solent, data after calibration, running mean and fluctuation from the mean. Instantaneous fluxes of sensible heat, CO_2 flux and evaporation (usually W m^{-2}, μmol m^{-2} s^{-1} and mmol m^{-2} s^{-1} respectively) are displayed (see the section on the calibration file).

The status of the moving average is shown below the channel information. Information displayed is: whether or not the moving average has been initialised, the time constant and current time according to the computer's clock. An indicator also shows whether the option to store raw data has been selected.

At the end of the flux averaging period the average CO_2 flux, evaporation and sensible heat flux are shown at the bottom of the screen. The flux file (*.FLX) and delay correlations file (*.COR) are also written to at this time.

2.6 Viewing data files

Flux and lag correlation files are text files and so may viewed using the DOS editor *EDIT* (MS-DOS version 5 and above) or the Windows editor *NOTEPAD*.

Raw data files are binary files and so may not be viewed using text editors. *EdiSol* provides the means with which to view them and convert them to text. This facility is available under the File menu. Make sure the file type is correct by choosing the File type option under the file menu and selecting *Solentuvw*. (Solentuvw files are the format in which *EdiSol* saves raw data and Rivox90 and FIFE89 files are file formats that have been used previously in the IERM micrometeorology lab.). Next, select the Open option and use the dialog box to choose the file you wish to view.

2.7 Trouble shooting

Problem: Nonsense numbers are shown in the raw data or the packet number and record count
Reason: The PC is being asked to do too much.
Solution: Reduce the number of analog inputs or reduce the delay range.

Problem: The program cannot establish communications with the Solent anemometer.
Reason: Communications synchronisation problems.
Solution: Reinitialise the Solent anemometer by unplugging power from the interface box and reconnecting it.

3. Post-Processing *.SLT files

This is much the same as calculating fluxes in real time with the same dialogue boxes to be filled in with the exception that the SET UP SOLENT dialogue box is replaced with the DEFINE DATA SET DIALOGUE box. The sequence of dialogue boxes is as follows.

1. If you wish to override the selection of the calibration file EDI.CAL in the current directory, select LOAD FILE from the CALIBRATION menu and use the resulting dialogue box to select the required file.

2. From the LOG menu select FILE .

3. Define the files to be used using the DEFINE DATA SET dialogue box. The concept is of a data set comprised of a number of contiguous files though the dataset may start and finish part way through a file. The files must be in the same directory and be of the same type (filename extension) and same filename prefix. The file names must be in the same form as created by *EdiSol.*

Enter:

- the start of the dataset with day (as day of year), hour and minute.
- the end of the dataset with day (as day of year), hour and minute.
- the file type. For data logged with *EdiSol* the files will be of Solentuvw (.SLT)
- the file name prefix character
- the file name extension
- the directory the files are in
- the sample rate (this is 20.8 Hz for files produced by *EdiSol*).

Then fill in the Logging Parameters and Define Instrument Channels dialogue boxes as described in section 2.4

4 Operating the system

4.1 Calculating and setting the CO_2 and H_20 delay times

In eddy covariance, fluctuations between vertical air velocity measured with a three component sonic anemometer are correlated with fluctuations in CO_2 concentration measured with an IRGA. Since the air is pumped down a tube from the anemometer to the IRGA there can be a delay of several seconds between measuring changes in air velocity and recording the simultaneous change in scalar concentration at the IRGA. For the fluxes to be calculated correctly. the delay time must be measured and entered in the *EdiSol* calibration file. There are four ways to find the time lag down the tube.

1. Calculate the lag from the flow rate and sample tube size.

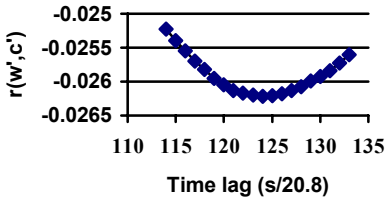
2. Blow down the tube and use a stop watch to estimate the time lag.

3. Collect fifteen minutes data and use the *EdiLag* program (found on the distribution disk) to calculate time lag and correlations. This data should be treated in the same way as the time lag correlation data saved in the .COR files described below.

4. Plot correlation coefficient against time lag using the data from an *EdiSol* .COR file. The maximum and minimum time lags to be used in the *EdiSol* calibration file are set at the time lag corresponding to the maximum correlation coefficient ± up to 0.5 second.

Example:

For the CO_2 time lag data (from HAPEX Sahel '92) which is shown in the Figure on the right, the maximum correlation coefficient is at 124/20.8 = 6.2 seconds. So the time lags in the EDI.CAL file would be set to between 5.8 and 6.6 seconds.



If the time lags in the EDI.Cal file are set incorrectly when the system is first run it is possible that the correlation data in the .COR file will fall to one side of the turning point in the graph. If this happens there are two possible solutions:

Run *EdiSol* logging data from the .SLT file generated from the run with the error in the time lags. Set the delays in the calibration file from say 0-10 seconds so you are guaranteed to find the correct time delay (when *EdiSol* is run with data from a file rather then with real time data from the sonic anemometer, processing speed is no longer critical and it is possible to deal with a wider range of time delays). To do this select the Log from file option in the main menu of *EdiSol*.

Run *EdiSol* again with a new estimate for the time lags.

4. Look at the time lags tabulated in the *EdiSol* .FLX files and use these to calculate the mean time lag.

Notes.

- The H_20 delay will be slightly longer then the CO_2 delay.
- If there is an error in the delay times set in the EDI.Cal file there will also be errors in the calculated fluxes saved in the .FLX files. Provided the raw data (.SLT files) have been saved the errors can be corrected by post processing the raw data and corrected fluxes calculated.
- When fluxes are zero there is almost no correlation of gas concentration with vertical wind speed so this method of lag calculation fails. HOWEVER, the flux calculated with lags changing by about one second is also very small under these conditions and error in the fluxes will be insignificant.
- Provided you are sure the data saved in the .FLX files is correct there is no need to save raw data (.SLT files) and correlation data (.COR files). Before making this decision be sure that the time lags are correctly set.

4.2. Hard disk maintenance

Run scandisk and defrag each time files are deleted from the hard disk onto which output files are saved. MSDOS saves data in files to the next free block on the hard disk. When files are deleted they leave gaps on the hard disk which MSDOS fills with subsequent files. Therefore, the blocks in which a file is written are often not contiguous and in this case MSDOS takes some time finding the next available block. This delay is often enough to cause data to be lost and more frequently for flux averaging times to be missed.

5. Setting up a LI-COR LI-6262 for *EdiSol*

(Note: The LI-COR should be set up as shown in Figure 2)

1. Check CO_2 configuration using Function 1. Check calibration coefficients from the calibration sheet for the analyser you are using. Reference concentration is zero. Water vapour corrections should be set **to Band Broadening + Dilution**
2. Check H_20 configuration using Function 2. Check calibration coefficients from the calibration sheet for the analyser you are using.
3. Check miscellaneous (in effect, the pressure transducer) with Function 3
   - Set Avg(s)=0 (fast as possible).
   - Set Auxiliary offset and multiplier for the pressure transducer you are using (calibration sheet).
   - Auxiliary Destination is 43
   - Barometric pressure, code 43.
4. Set Digital to Analogue converter 1 (DAC1) using function 5; Set code to 22 (CO_2 µmol mol^{-1}); Set the output range to suit and ensure *EdiSol* calibration coefficients match your setting of the LI-COR, e.g. 0v represents 300 µmol mol^{-1} and 5V represents 400 µmol mol^{-1}.
5. Set Digital to analogue converter 2 (DAC2) using function 6 Set code to 32 (H_2O mmol mol^{-1}) Set the output range to suit and ensure *EdiSol* calibration coefficients match your setting of the LI-COR, e.g. 0v represents 0 mmol mol^{-1} and 5V represents 20 mmol mol^{-1}.

It is advisable to write down the Calibration Coefficients for the IRGA you are using. Below is the *typical* information we record for one of our analysers and which we can re-program into the IRGA should the calibration data be lost (e.g. after a power failure of some sort).

LI-COR LI-6262 calibration coefficients
IRG3-806 13 Feb. 1997

CO_2 Calibration (enter using FCT01)

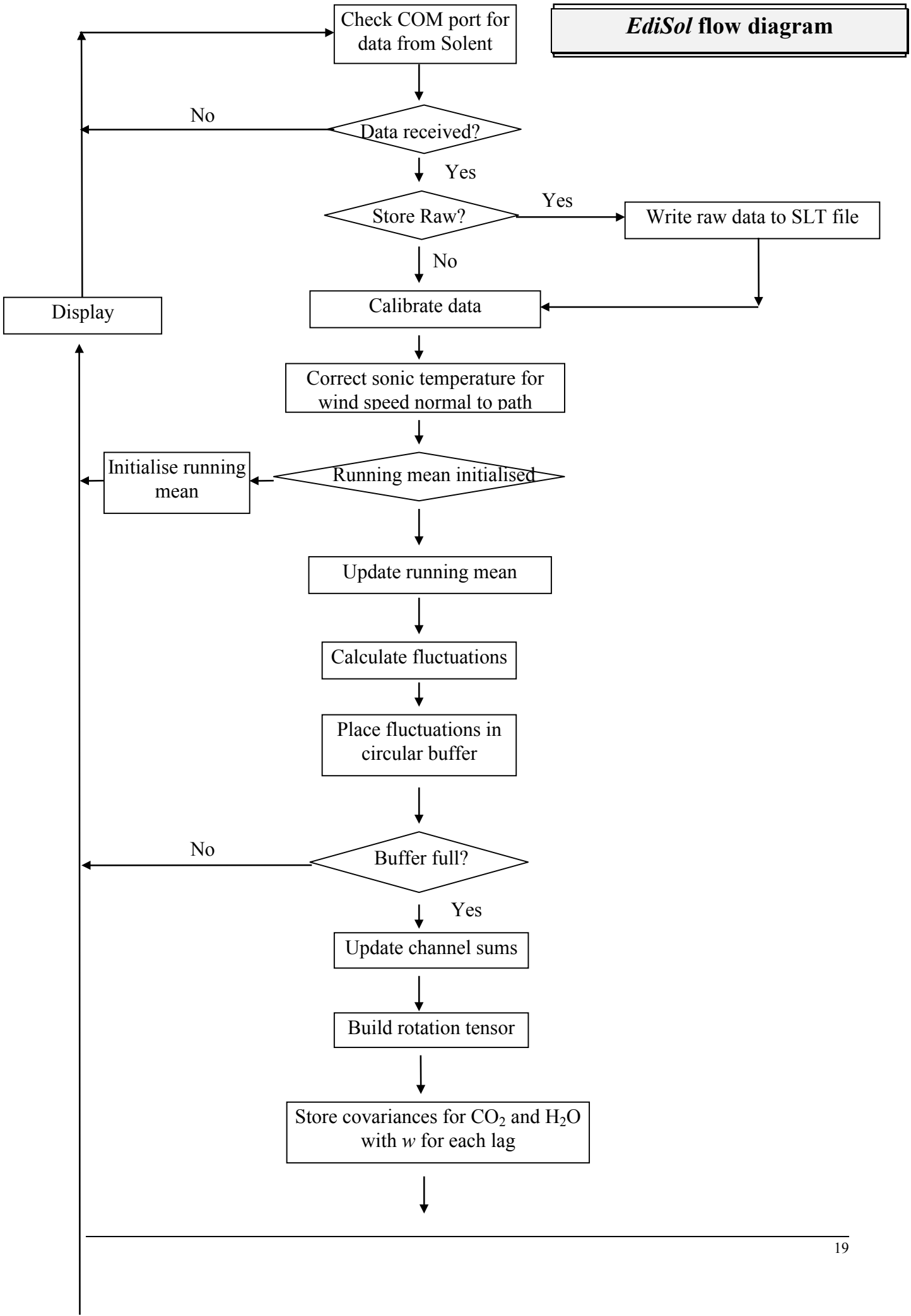
```
C2    T    36.5
      K    17673
      A    0.13980
      B    1.3199e-5
      C    6.2007e-9
      D    -8.3321e-13
      E    5.9018e-17
```

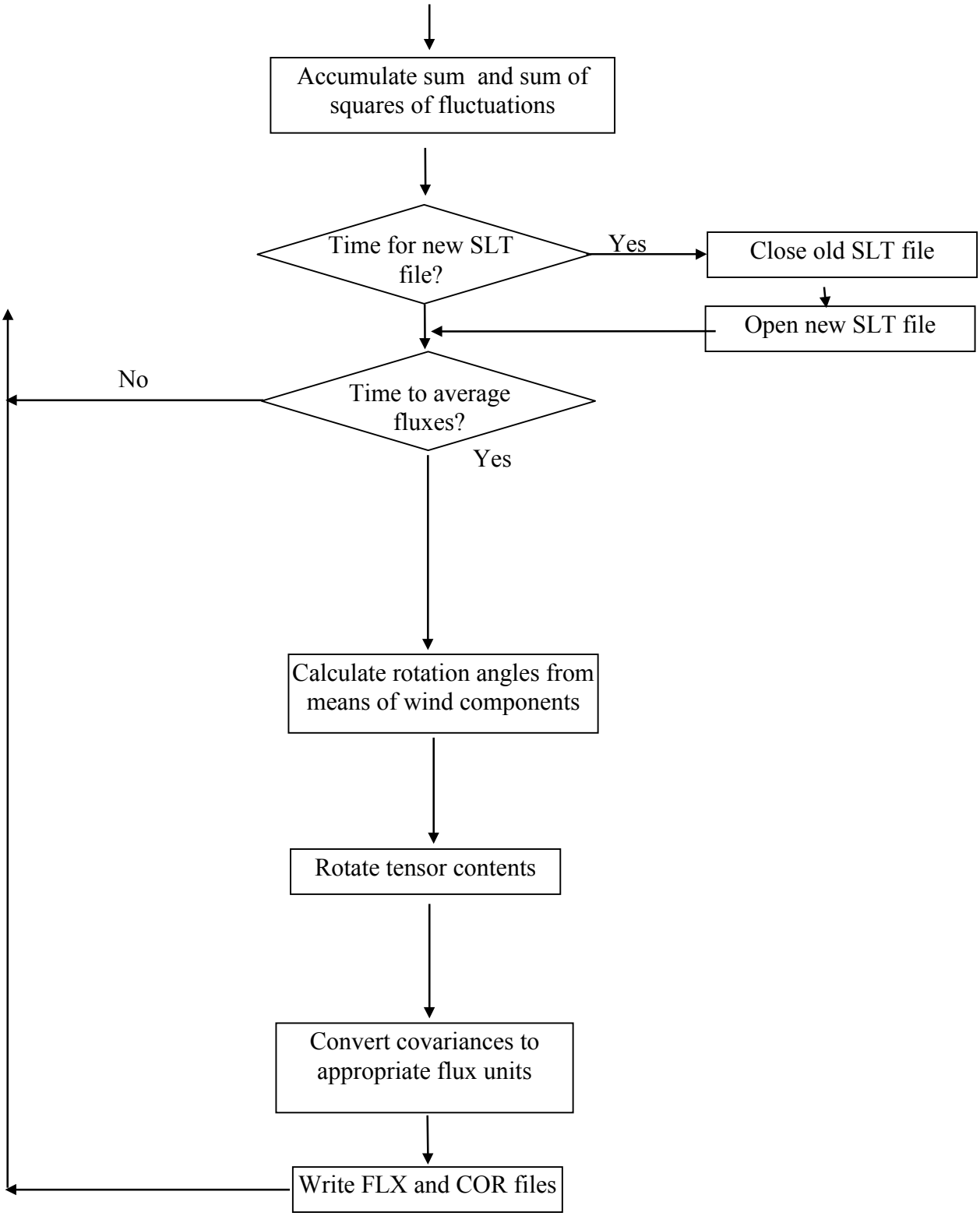
H_2O Calibration (enter using FCT02)

```
H2    T    41.3
      K    15100
      A    6.5150e-3
      B    2.8743e-6
      C    2.8900e-11
```

PX-240 Pressure Transducer

```
FCT71 = 58.870
FCT72 = 0.01526
FCT73 = 43
FCT75 = 0
```


EdiSol flow diagram
Check COM port for data from Solent
Data received?
No
Yes
Store Raw?
Yes
Write raw data to SLT file
No
Calibrate data
Display
Correct sonic temperature for wind speed normal to path
Running mean initialised
Initialise running mean
Update running mean
Calculate fluctuations
Place fluctuations in circular buffer
Buffer full?
No
Yes
Update channel sums
Build rotation tensor
Store covariances for CO_2 and H_2O with w for each lag


Accumulate sum and sum of squares of fluctuations
Time for new SLT file?
Yes
Close old SLT file
Open new SLT file
No
Time to average fluxes?
Yes
Calculate rotation angles from means of wind components
Rotate tensor contents
Convert covariances to appropriate flux units
Write FLX and COR files

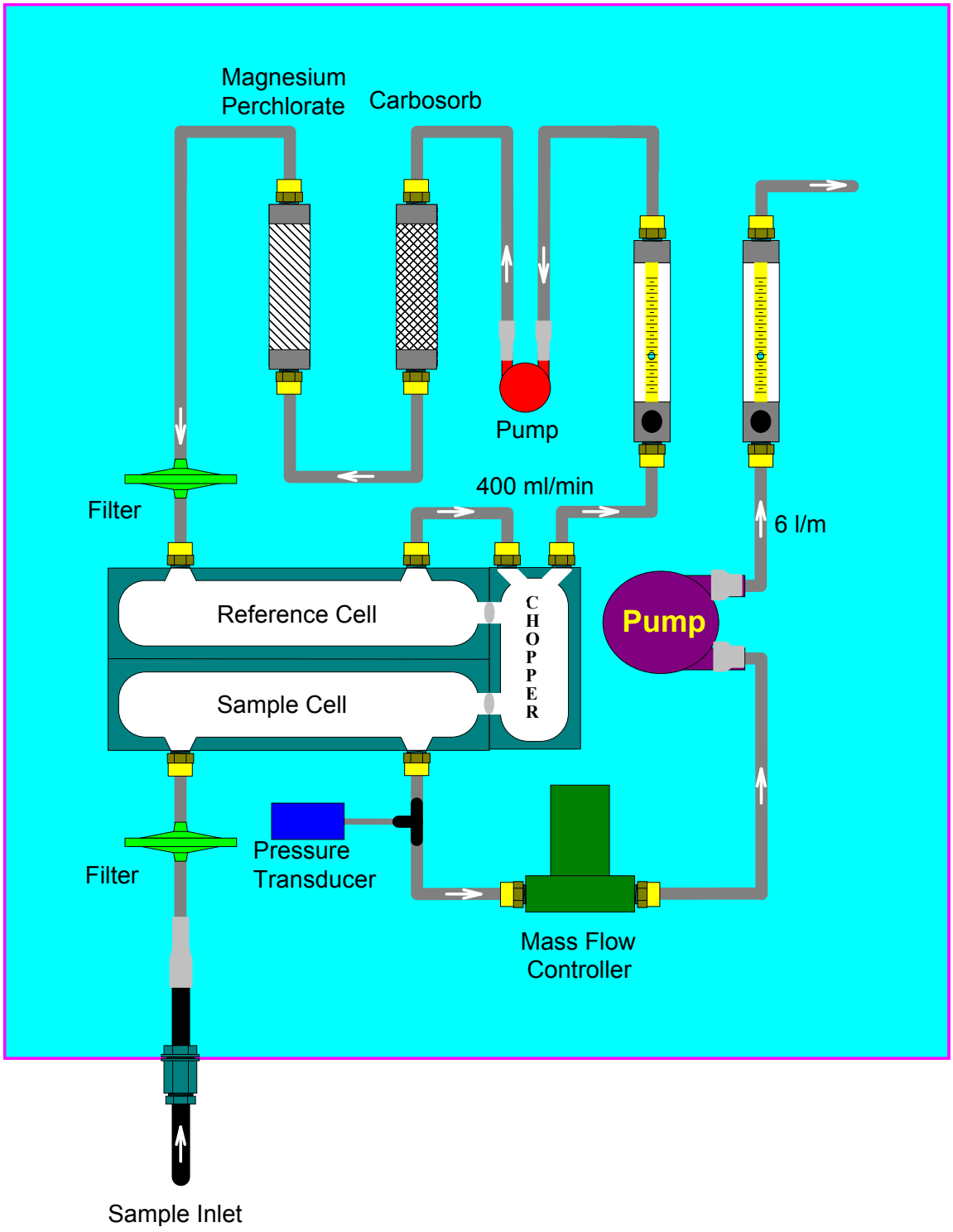


Figure 2 - Sample and reference gas pathways in an *EdiSol* system.