SoilFluxPro™

The LI-8100A Data File Viewer (ver 4.0)

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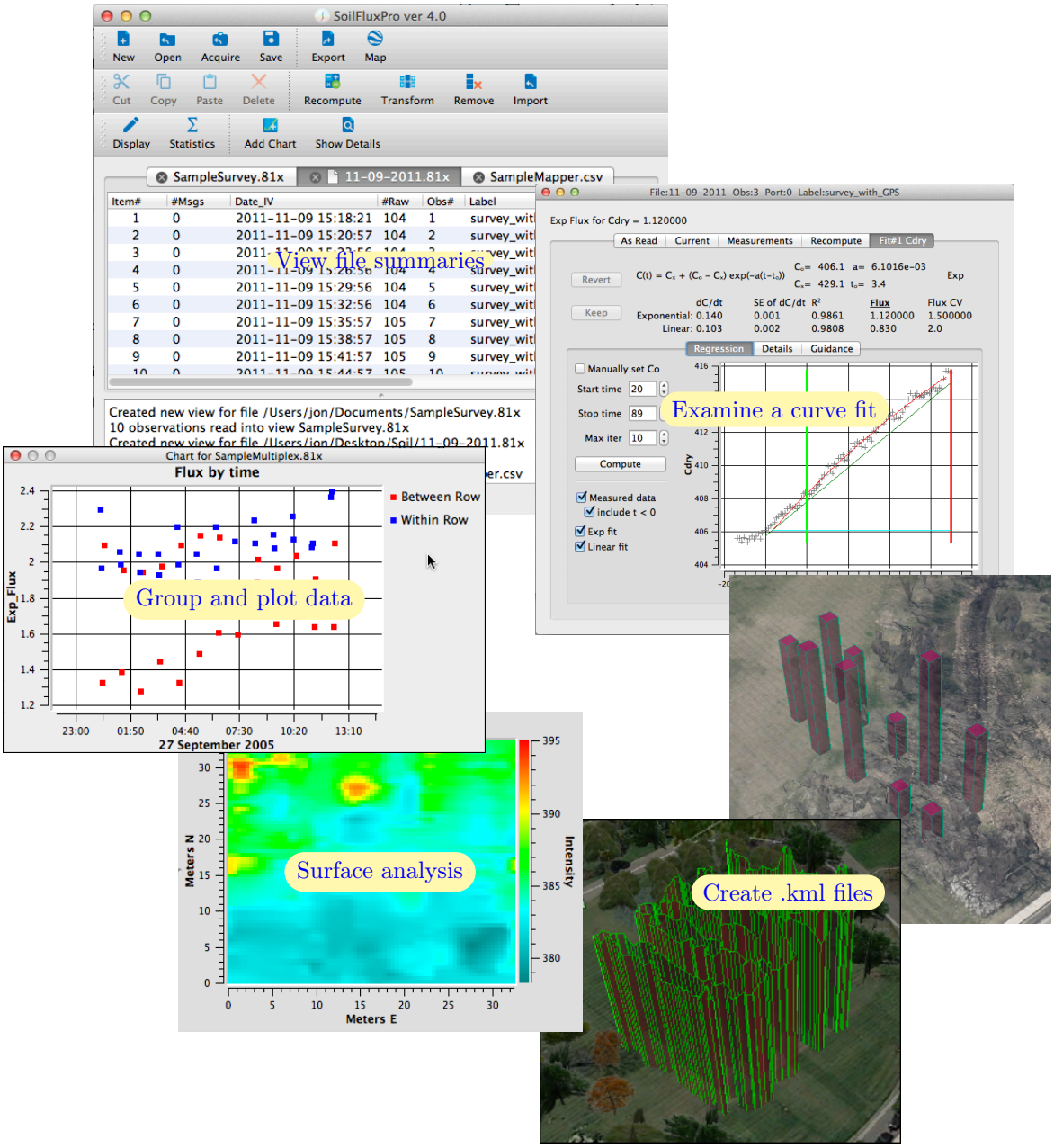
1 Introduction

SoilFluxPro™ (SFP) software is a multi-platform application designed to view and analyze data files for both chamber and continuous measurements generated by the LI-COR LI-8100A Automated Soil CO_2 Flux System.

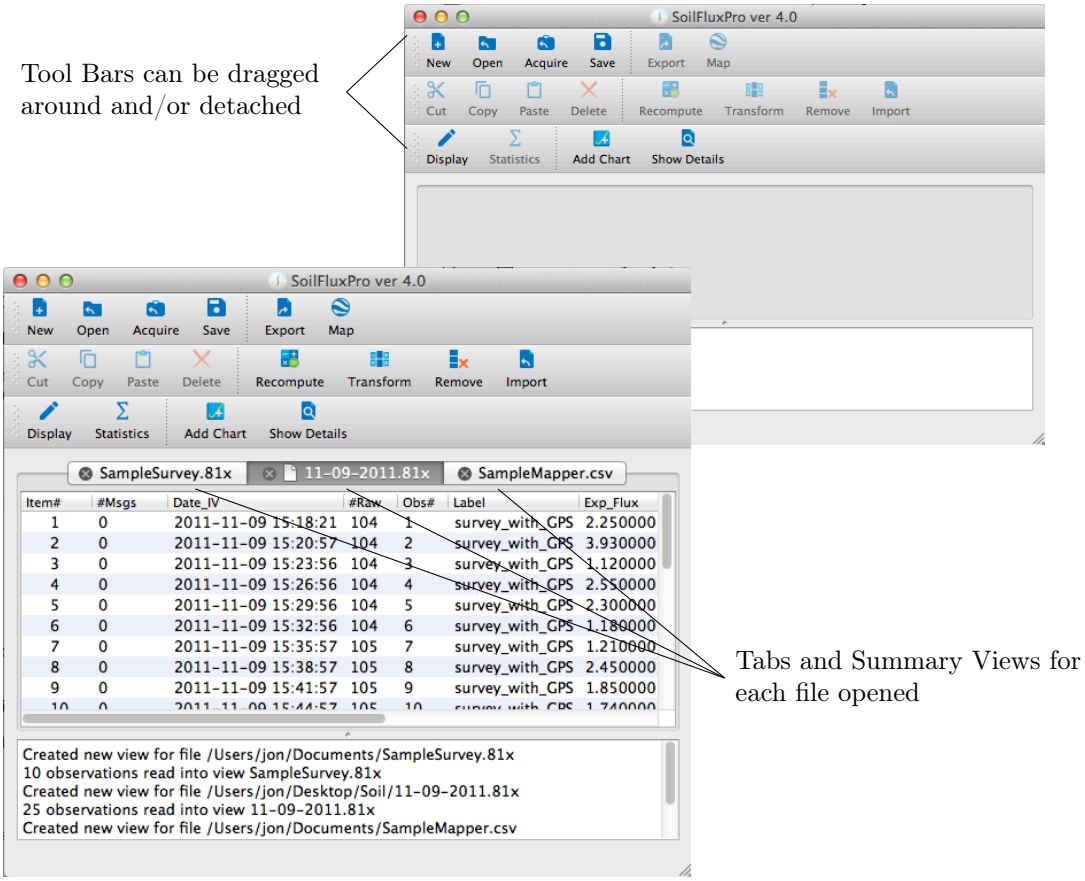
SFP offers a very convenient way to view selected quantities or summaries of these files, as well as quickly plot meaningful analyses that let you evaluate the measurements. Editing and recomputations are easily done.



2 Introductory Tour

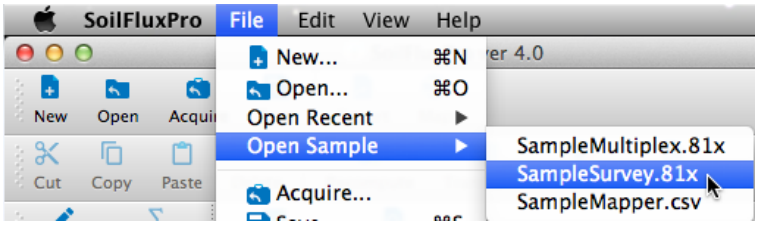
1. Launch SoilFluxPro™

When run, SFP presents you with an empty Main Window and three tool bars. For each LI-8100A data file you open, this view will create a tab sheet for that file, and display a Summary View.



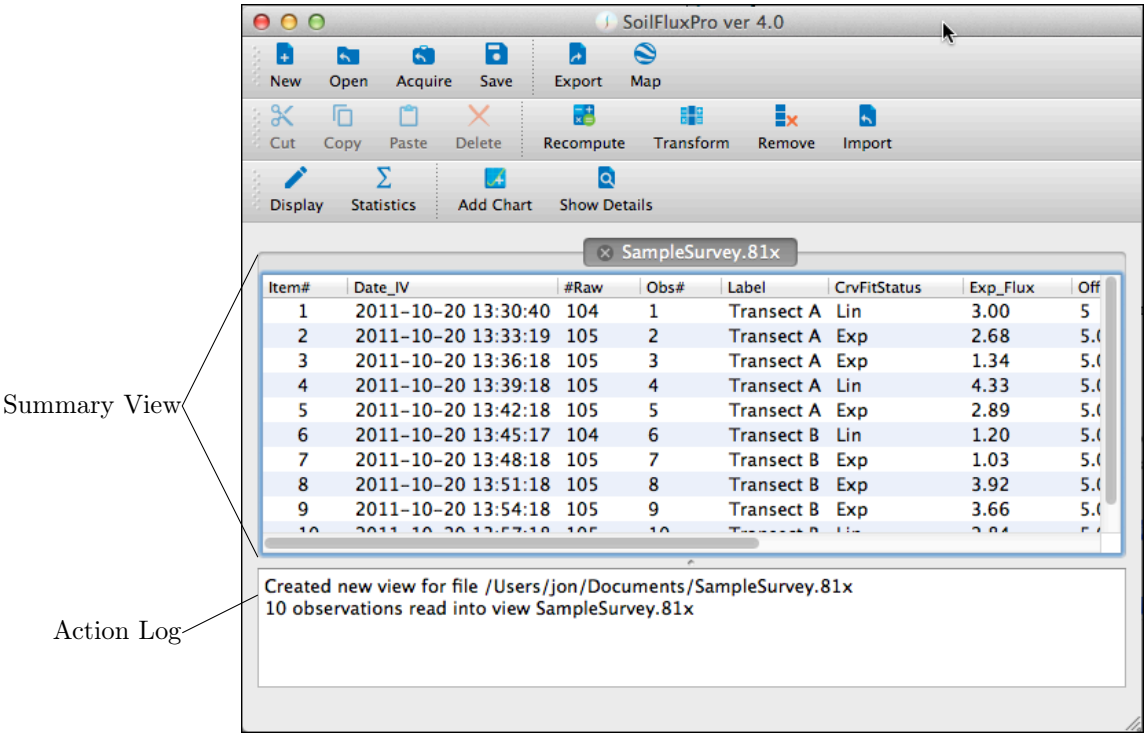
2. Open a Data File

Normally, you would select File ⟩ Open... and pick an LI-8100A data file. Note that there are also several "built-in" sample files located under File ⟩ Open Sample; we'll select the one named SampleSurvey.81x.



3. The Summary View

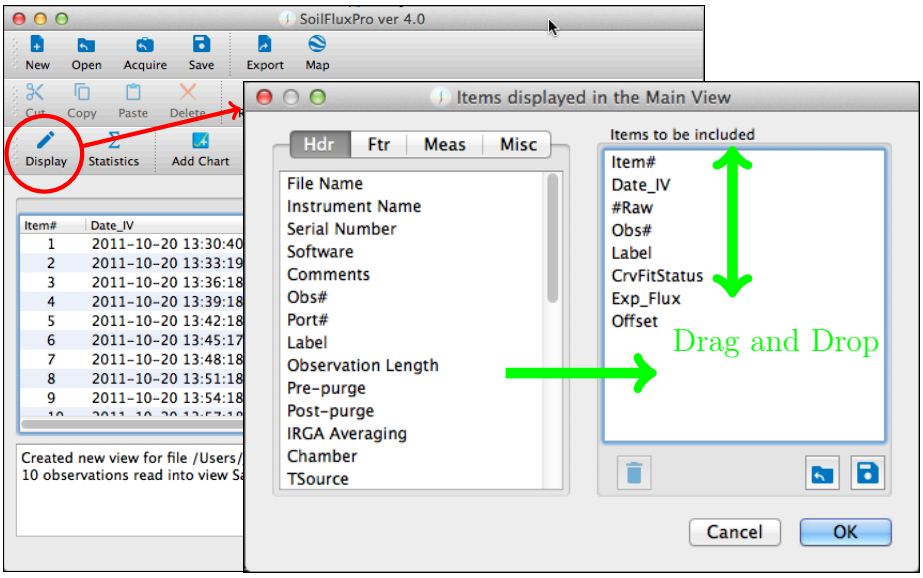
Each observation in the data file is shown on one line in the summary view. In the example here, 10 observations from an LI-8100A with a survey chamber were read. Each observation is represented by one line, showing selected variables (**Label**, **Obs#**, etc.) from that observation.



4. Setting the Displayed Variables

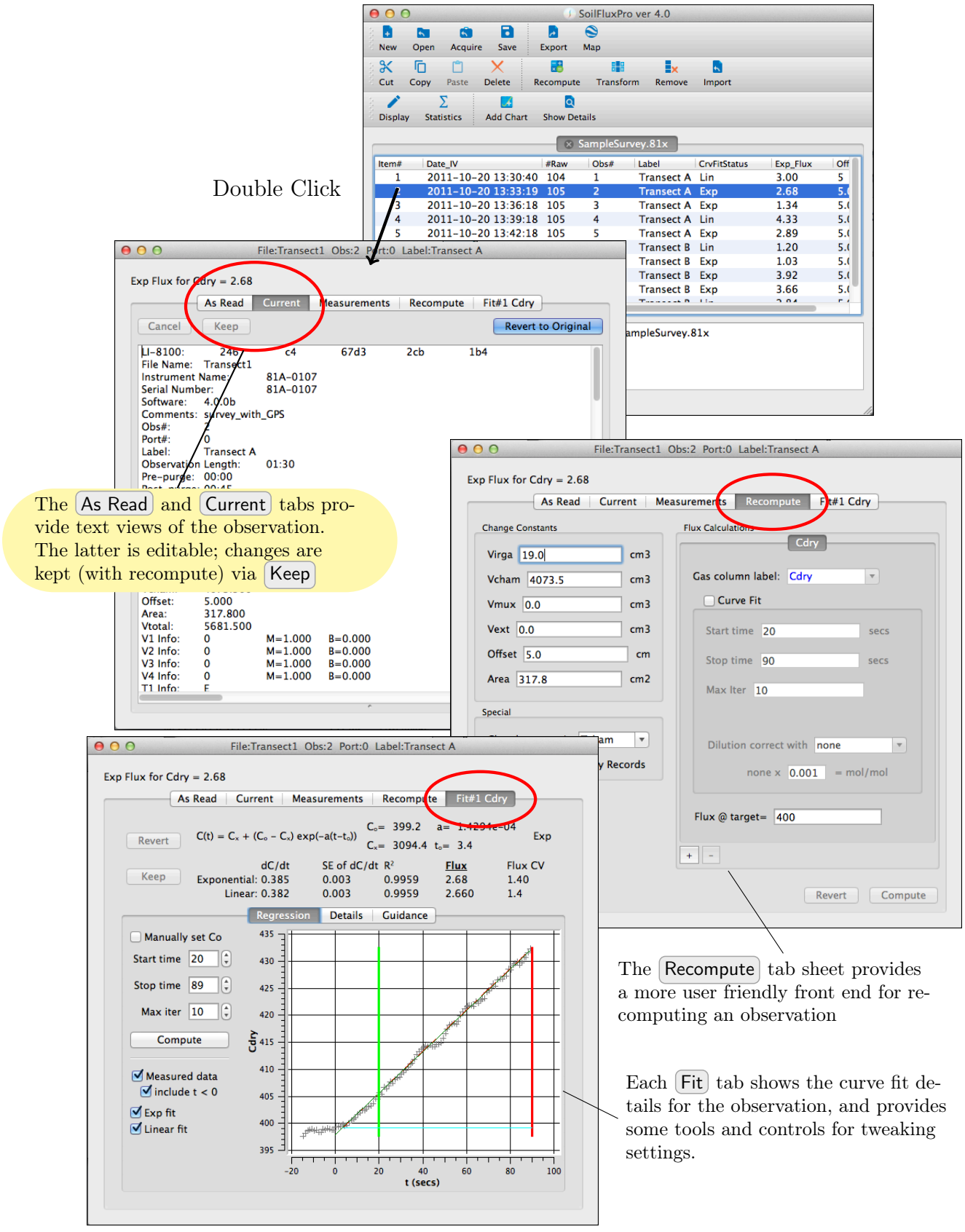
The variables that are displayed for each observation are editable. Select View ⟩ Display (or click on Display), to bring up the dialog for changing them.

Click and drag to add items from the left list to the right list. Also, click and drag items in the right hand list to rearrange them. To delete items from the right hand list, highlight them and click the trash button. This dialog is discussed in more detail in Change Displayed Variables.



5. Zoom in on one Observation (Method 1)

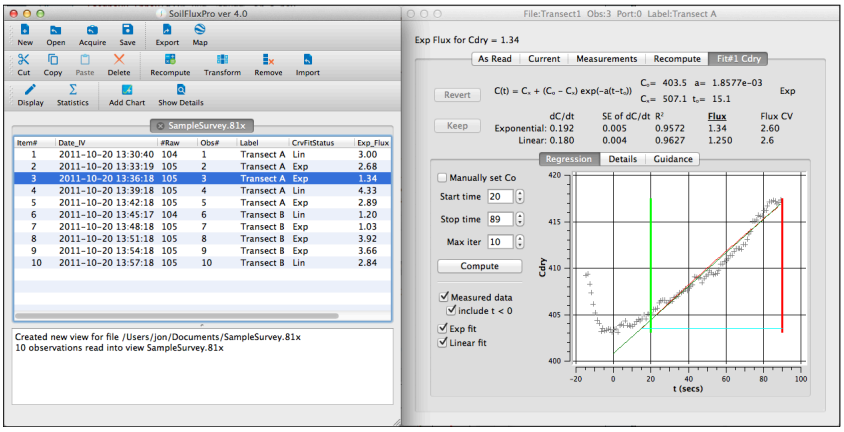
We now illustrate how to view the details of an observation. Double click one of the observations (lines) in the Summary View to open the Observation Details. In this view, we can see all the header, measured, and footer variables. The window opened by double clicking "belongs" to that observation; if you double click another observation, you get another window for that observation.



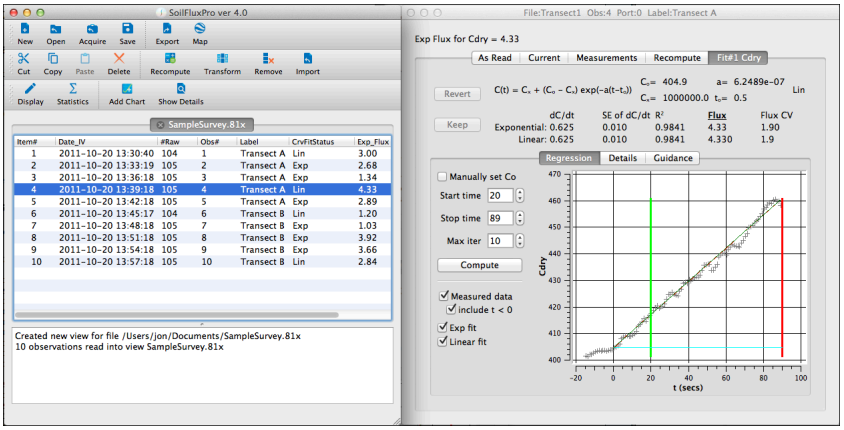
6. Zoom in on an Observation (Method 2)

A second method for seeing details of an observation is to open the Show Details window. This window does not belong to any one observation, but rather shows the first highlighted observation, or (if there are none) the first observation in the active summary view. You can use this to quickly step through a series of observations viewing the curve fit, for example.

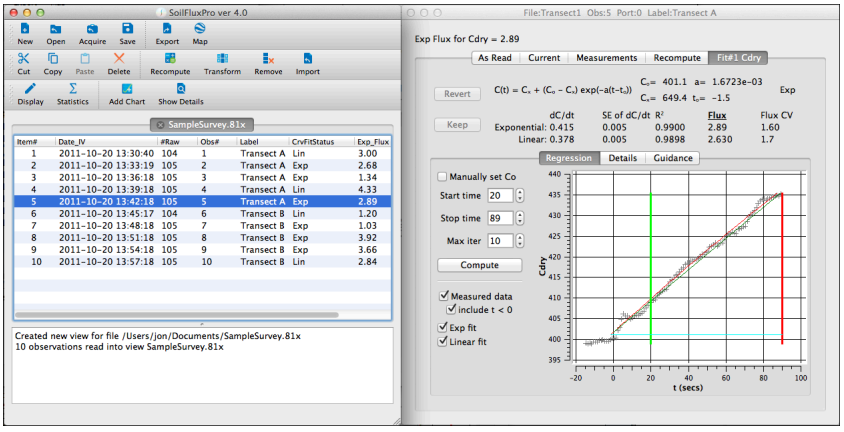
Always shows the first selected observation in the active view



Press ↓

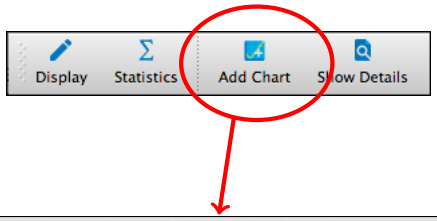


Press ↓

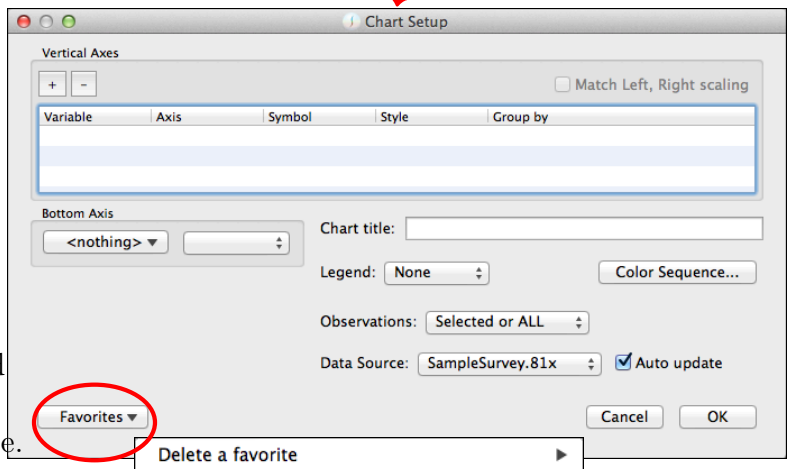


7. Make a Chart

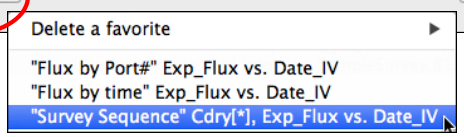
Next, we will demonstrate charts. Click Add Chart.

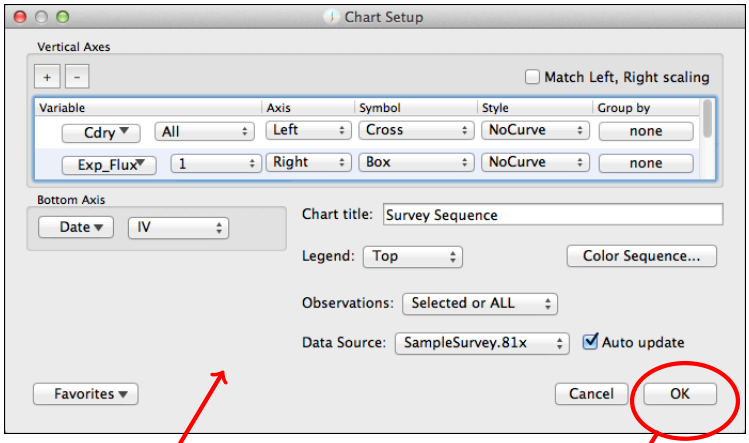


1. You are presented with an empty plot definition.



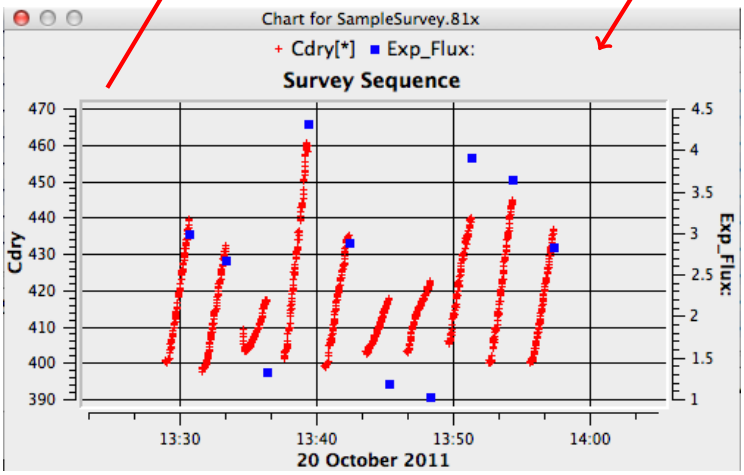
2. Click Favorites and select mykeySurvey Sequence. The dialog should change as shown below.



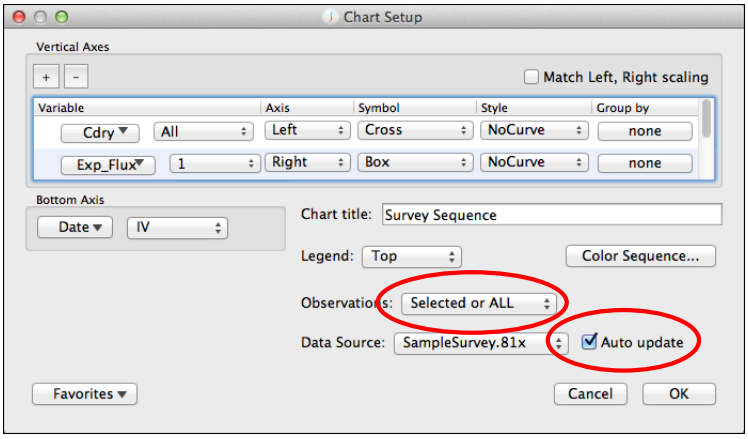


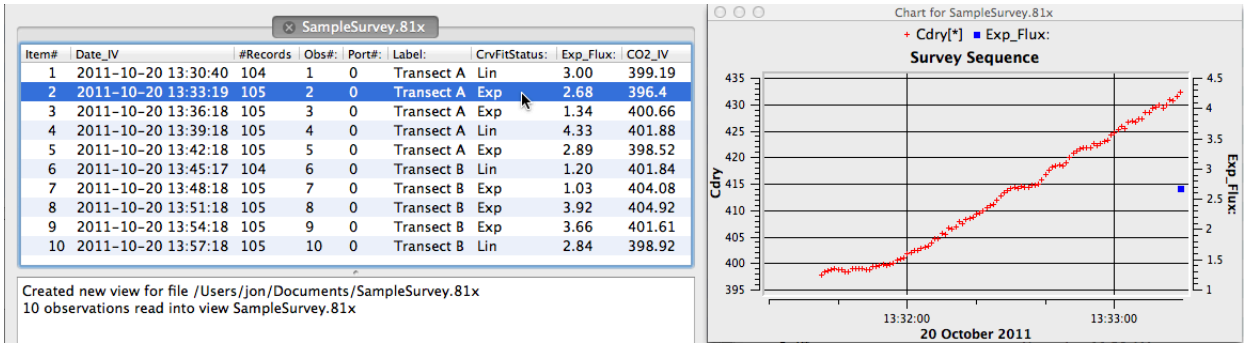
3. Click OK to draw the chart.

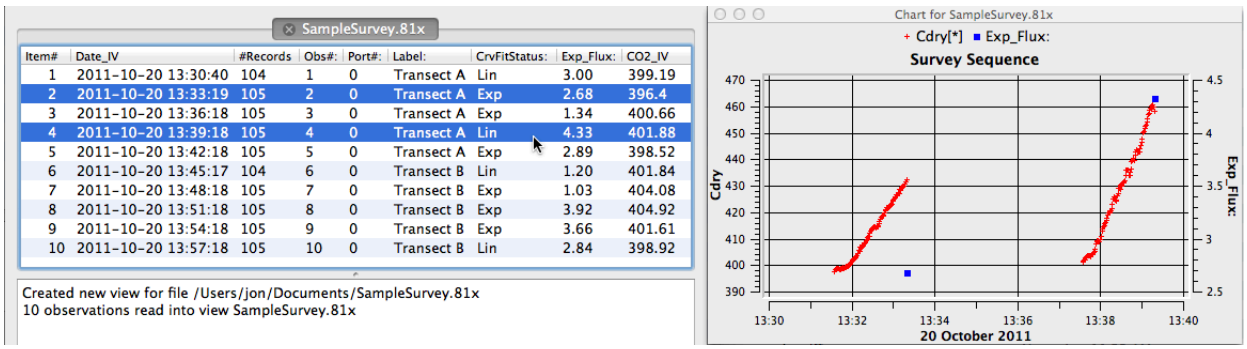
4. You can double click anywhere on the chart to bring back the Setup Dialog.

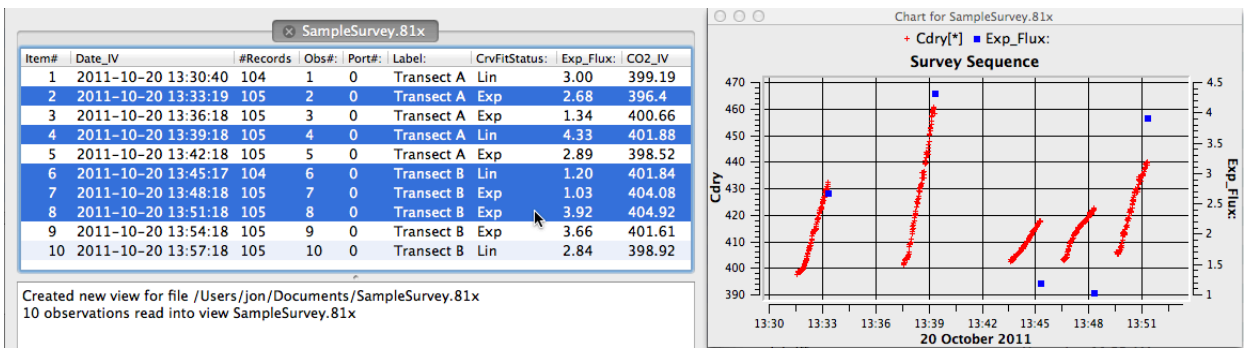


When the Observations setting in the setup dialog is Selected or All, and Auto update is checked, then the chart will update anytime a selection change is made in the summary view, as illustrated below



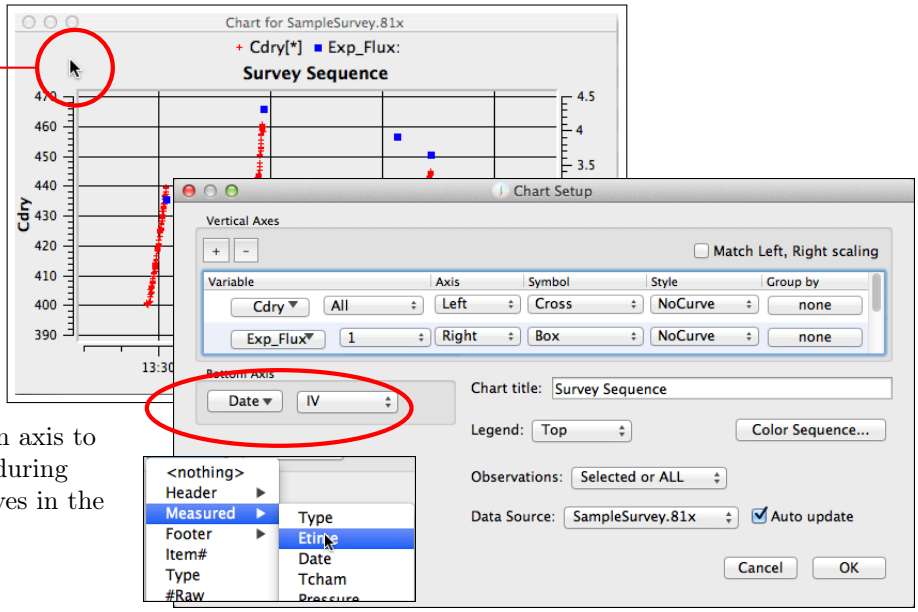




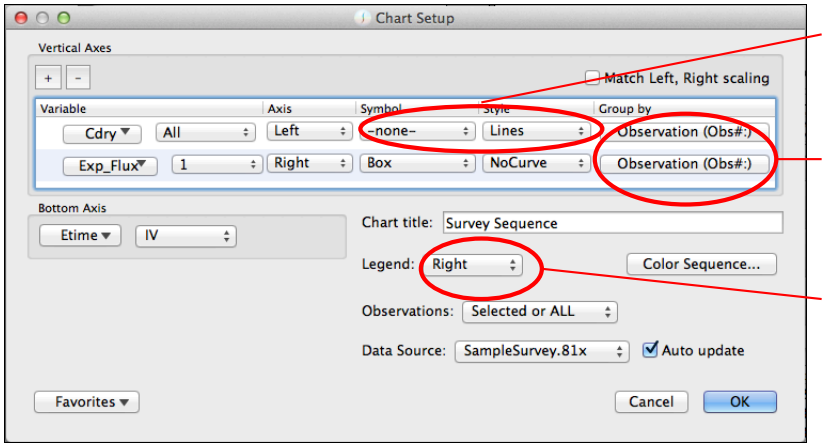


Suppose we want to superimpose the **Cdry** vs. time curves. Double click the chart to bring up the setup dialog for it, and modify it like this:

1. Double click the chart.



2. Change the bottom axis to Etime (elapsed time during the observation - it lives in the Measured submenu).

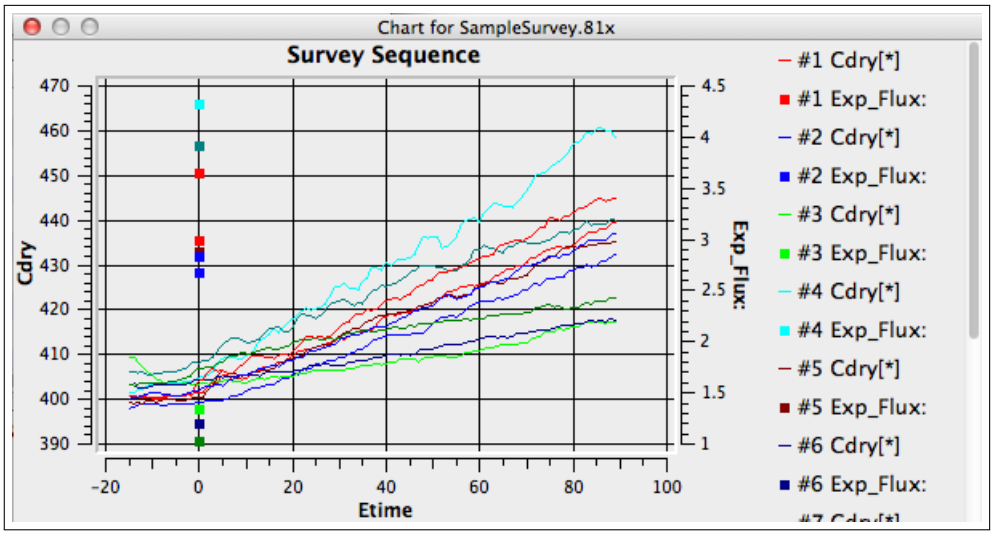


3. Change the **Cdry symbol** to none, and **Style** to Lines.

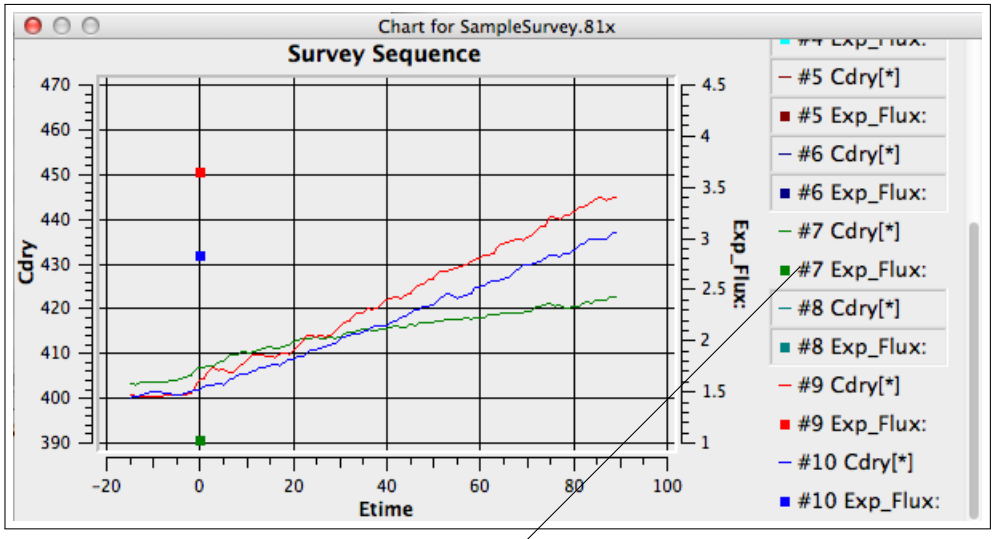
4. Set grouping for both variables to Observation.

5. Move the legend to the right.

6. Click OK.



Note that legend entries are clickable buttons: Click to make that entry disappear from the graph, and click again to make it reappear.



Clickable buttons. Down = hidden, up = visible

3 Summary View

Create an Empty View

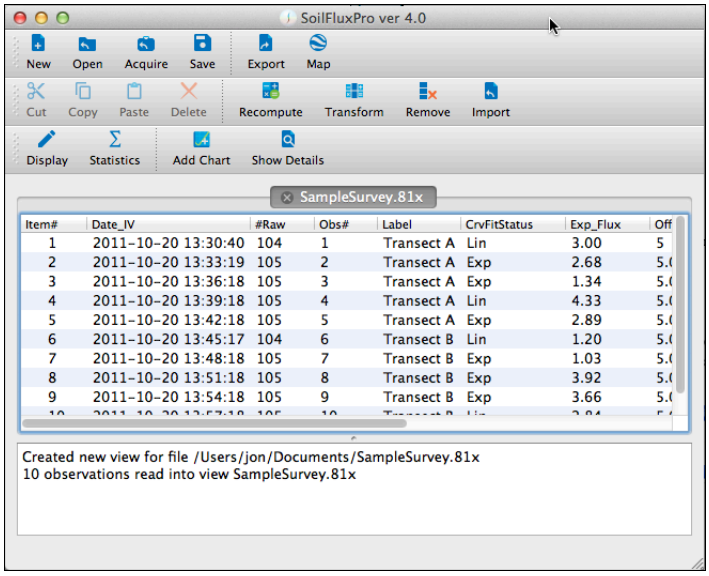
Open a File

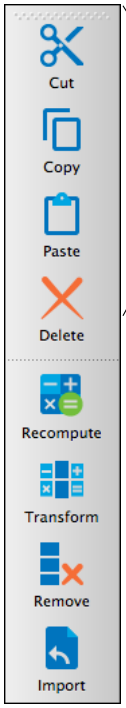
Import from an LI-8100

Save a File

Export Data

Create a .kml file





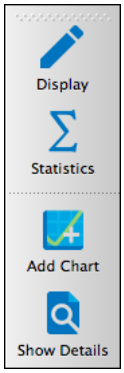
Move Observations Between Views

Recompute Observations

Transform Columns

Remove Columns

Import Columns



Change Displayed Variables

Compute Statistics

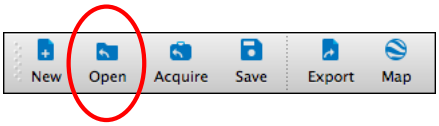
Add a Chart

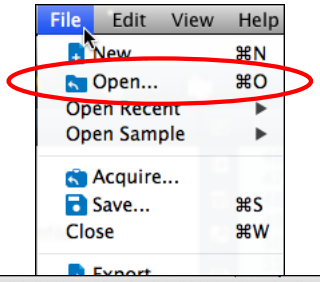
Observation Details

3.1 Open a File

SFP can read both Chamber and Continuous measurement types. Both measurement types can reside within the same file, regardless of the extension type (.81x, .csv).

1. Click Open on the tool bar, or select it in the File Menu.

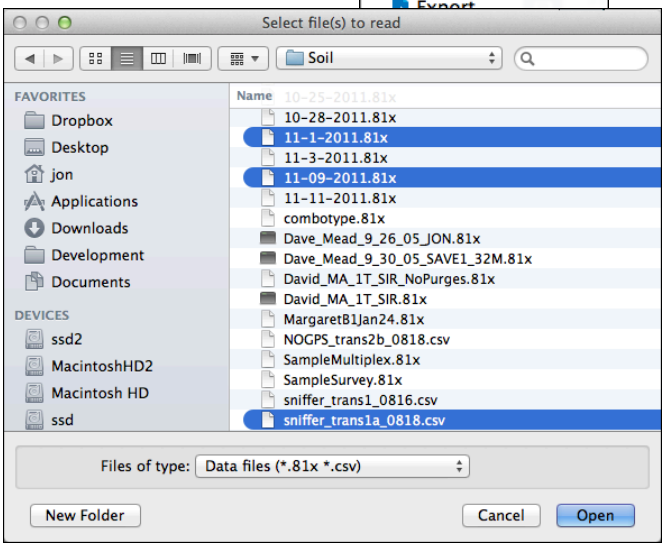




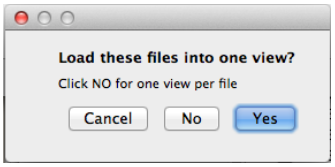
2. Use the Open file dialog box to navigate to the desired directory, and select the file(s) to be opened.

To select multiple files, use ctrl + click (⌘ + click on Mac) to select individual files, or shift + click to select a range.

Note that SFP can read both .csv and .81x file types.



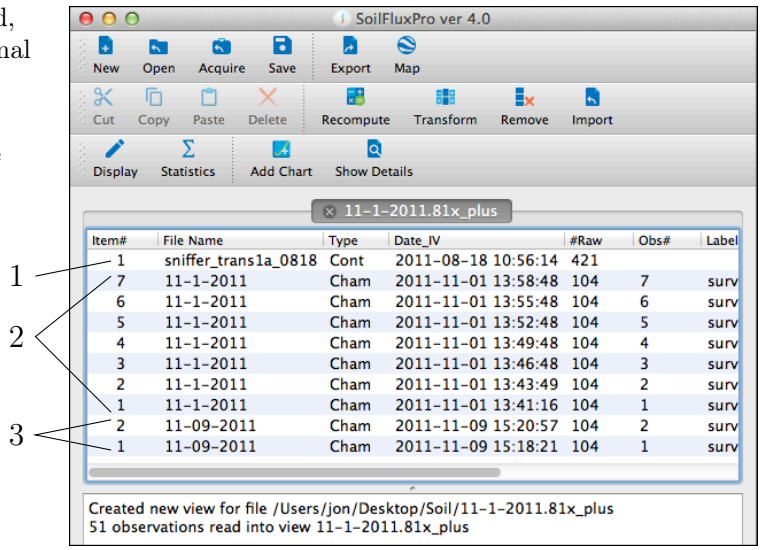
3. If multiple files are selected when you click Open, you are given a choice of combining them all into one view or keeping them separate.



When multiple files are combined, each observation retains its original **File Name**.

Item# indicates the order of the observation as read from the file. **Type** indicates the type of data, Chamber or Continuous.

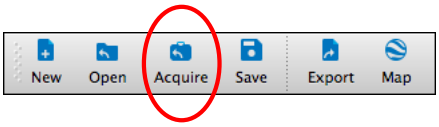
The illustration to the right combines three files into one view.

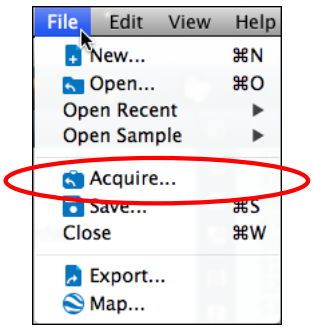


3.2 Import Data From an LI-8100A

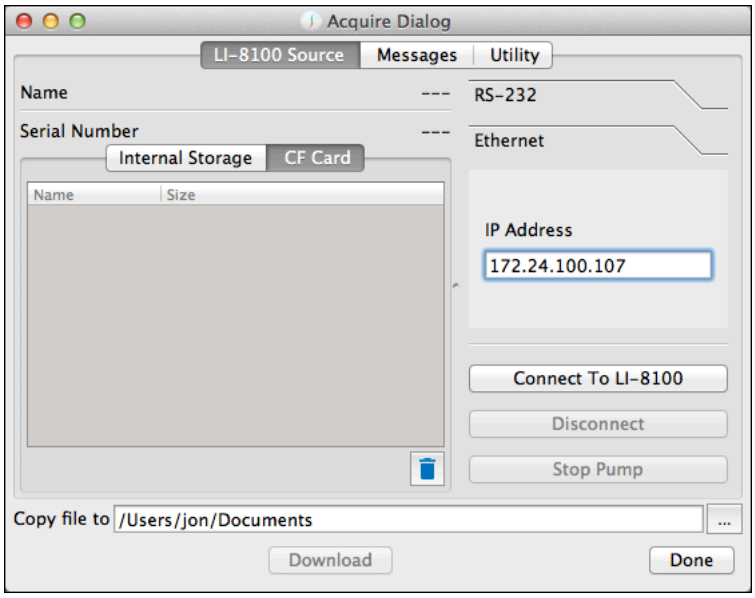
SFP can read data files directly from an LI-8100A.

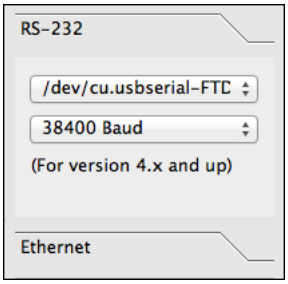
1. Click Acquire on the tool bar, or select it from the File menu.



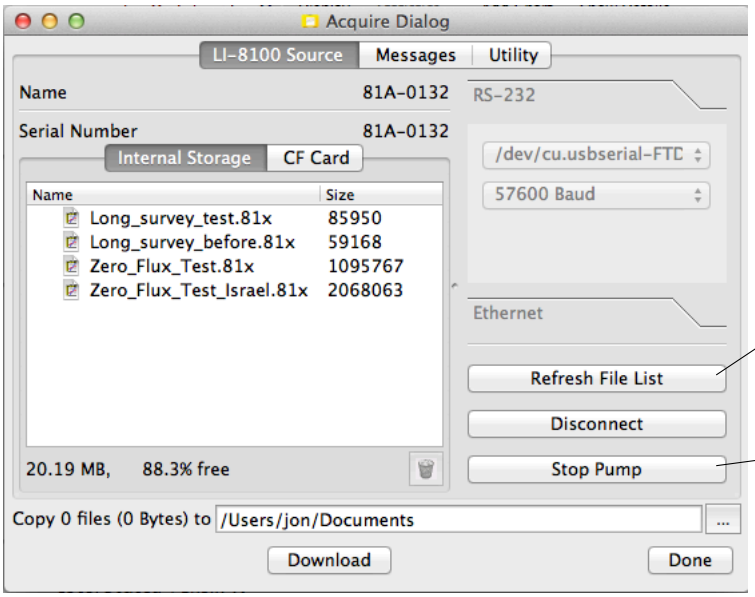


2. Specify IP address if using Ethernet, or select the comm port if using RS-232.





3. Click Connect to LI-8100A. You should get a file list.



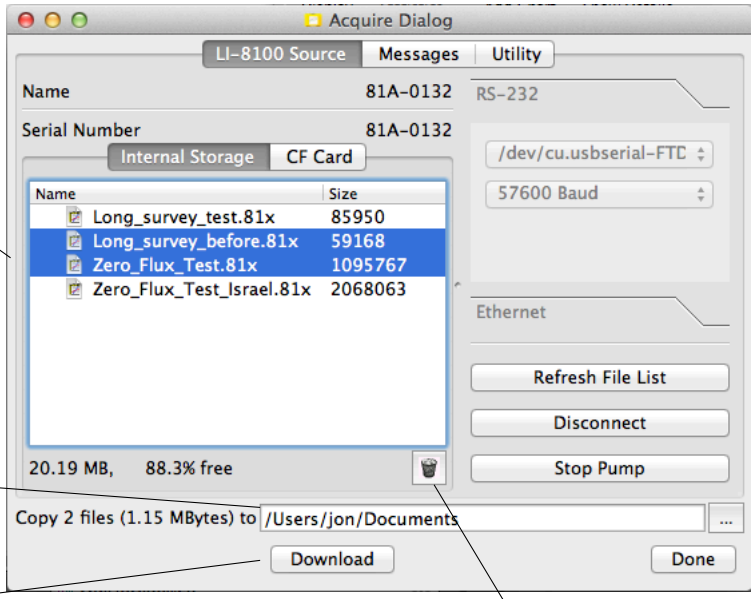
Try this if the list doesn't appear.

If the LI-8100A just powered up, the pump may be running. This will stop it.

4. Select the file(s) to download.

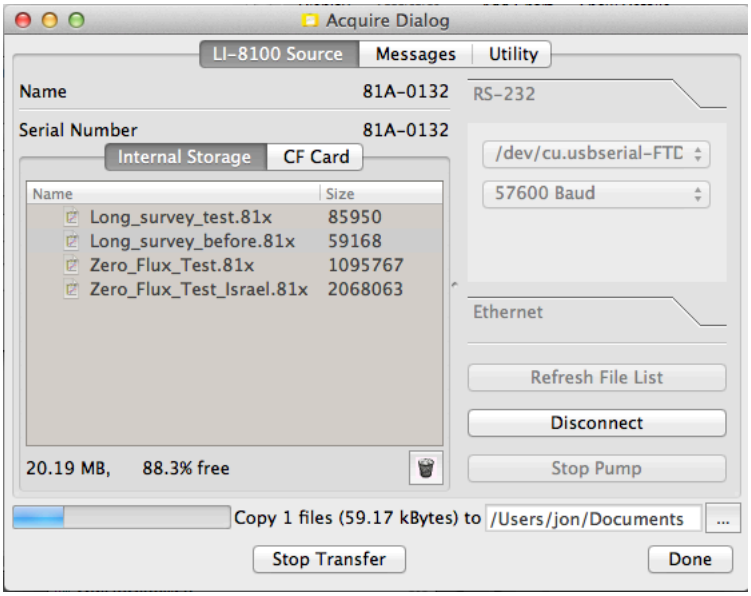
5. Specify the destination directory.

6. Click Download.



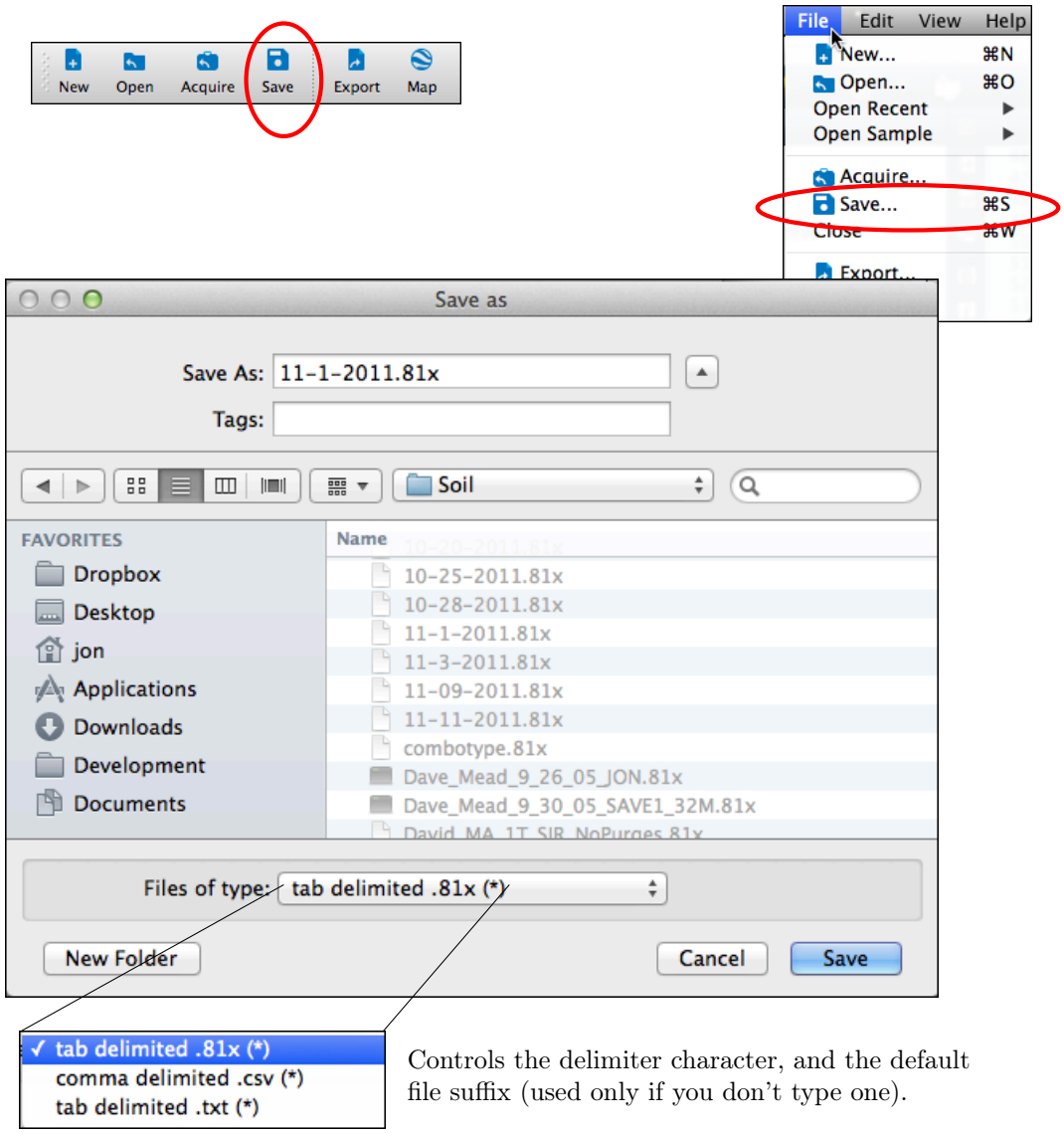
Deletes selected files on the instruement.

The download in progress.



3.3 Save a File

Select File » Save..., or click Save on the tool bar.



Controls the delimiter character, and the default file suffix (used only if you don't type one).

3.3.1 File Suffixes

You can type any suffix (e.g. .81x, .txt, .junk, etc.) that you wish on the file name. If you leave a suffix off, the program will automatically append the one showing in the filter box. However, the *type* of file that is written is determined by the filter box setting.

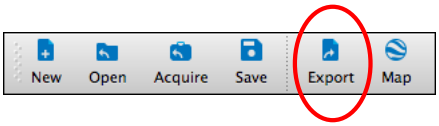
3.3.2 File Delimiters

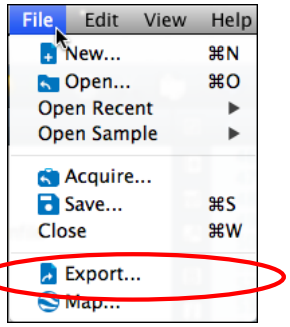
The save dialog filter box also determines what delimiter character is used when the observations are written. Note that SFP can read files with any combination of continuous or chamber measurements with any of these delimiters: tab, comma, or semi-colon. Delimiters must be consistent within an observation, but can be different from one observation to the next within a file. When SFP writes files, however, it will use a consistent delimiter throughout the file.

3.4 Export Data

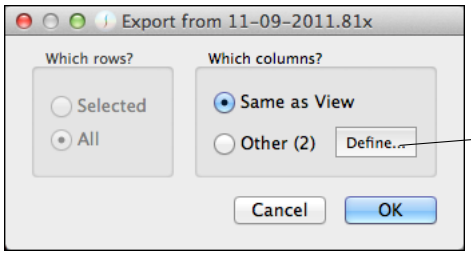
Summary-style data (one observation per row) can be written to a text file, for input to spreadsheet or text editing applications.

1. Click Export, or select it from the File menu.

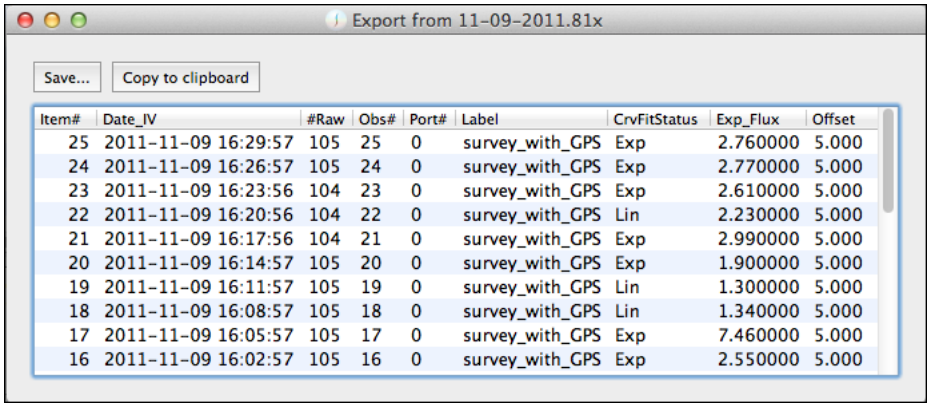




2. Select the fields to export. These can be the same as the Summary View, or you can define a different set.



Export a different set of variables. Click Define... to set (see Selecting Variables Dialog).

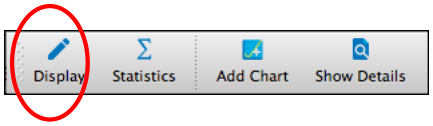


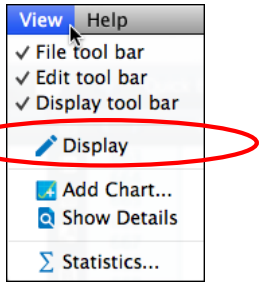
Item#	Date_IV	#Raw	Obs#	Port#	Label	CrvFitStatus	Exp_Flux	Offset
25	2011-11-09 16:29:57	105	25	0	survey_with_GPS	Exp	2.760000	5.000
24	2011-11-09 16:26:57	105	24	0	survey_with_GPS	Exp	2.770000	5.000
23	2011-11-09 16:23:56	104	23	0	survey_with_GPS	Exp	2.610000	5.000
22	2011-11-09 16:20:56	104	22	0	survey_with_GPS	Lin	2.230000	5.000
21	2011-11-09 16:17:56	104	21	0	survey_with_GPS	Exp	2.990000	5.000
20	2011-11-09 16:14:57	105	20	0	survey_with_GPS	Exp	1.900000	5.000
19	2011-11-09 16:11:57	105	19	0	survey_with_GPS	Lin	1.300000	5.000
18	2011-11-09 16:08:57	105	18	0	survey_with_GPS	Lin	1.340000	5.000
17	2011-11-09 16:05:57	105	17	0	survey_with_GPS	Exp	7.460000	5.000
16	2011-11-09 16:02:57	105	16	0	survey_with_GPS	Exp	2.550000	5.000

3. The results can be saved to a file, or copied to the clipboard for pasting into other applications.

3.5 Change Displayed Variables

1. Click Display, or select it from the View menu.

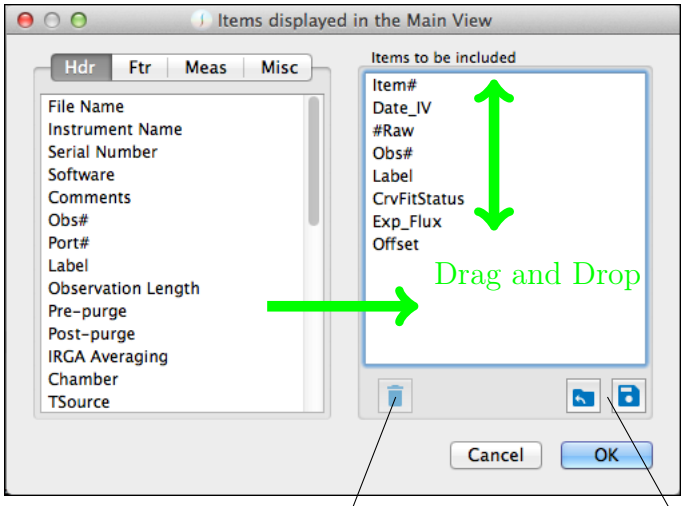




2. The Selecting Variables Dialog (next) is used for this.

3.5.1 Selecting Variables Dialog

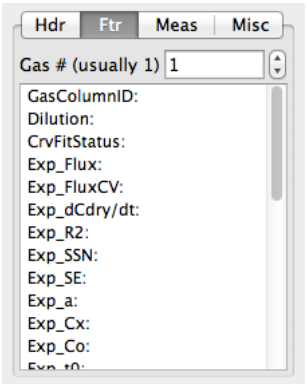
Any time a list of variables needs to be defined, such as when selecting variables to display in the Summary View, or selecting variables to print or export, the following dialog is used:



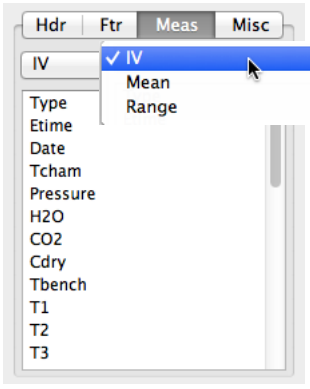
Remove selected items from list.

Read/write right-hand list from/to a file.

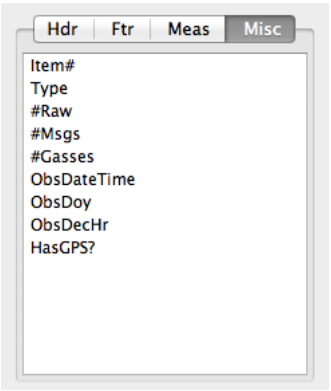
The list of potential variables is divided into 4 lists: Header (above), Footer, Measured, and Miscellaneous (below).



Footer Items. Gas # refers to which flux column to use. Usually this is 1. If you add flux computations, there will be more columns.



Measured Items. You can select IV (initial value), Mean or Range.

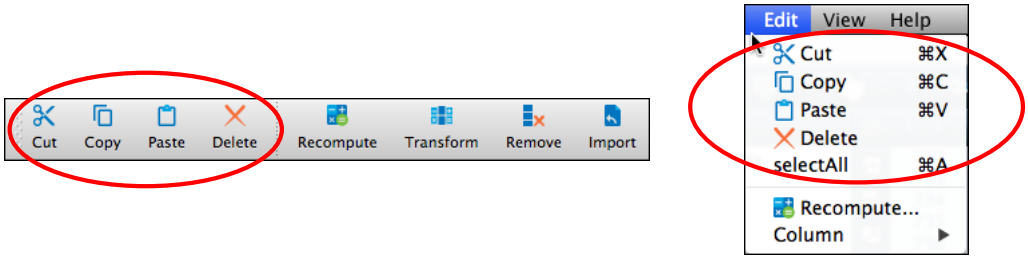


Miscellaneous items.

More information about the structure of LI-8100A files and what these variables are can be found in SFP Definitions.

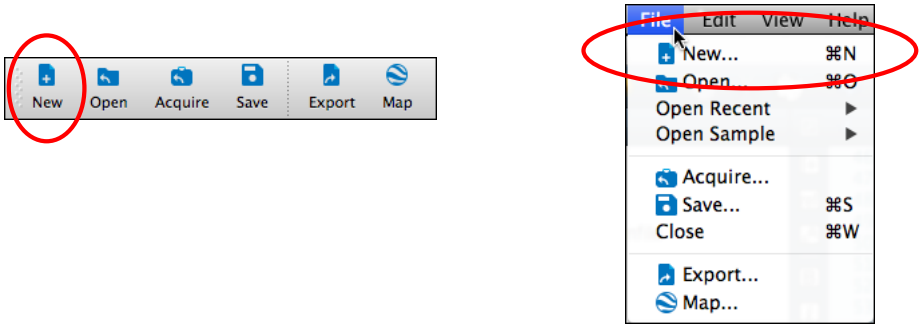
3.6 Move Observations Between Views

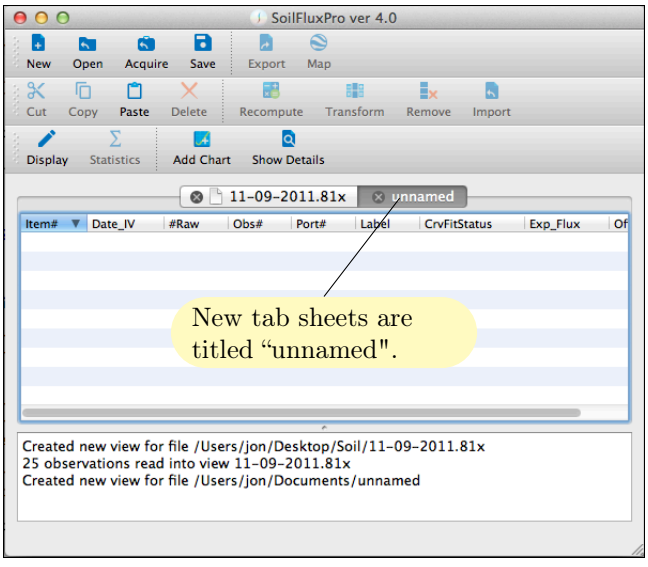
Selected observations in the Summary View can be Copied, Cut, and Pasted. Observations are selected by clicking on them. Note that ctrl + click (or ⌘ + click on Mac) selects multiple observations, and ctrl + click selects a range of observations. See also Create an Empty View.



3.7 Create an Empty View

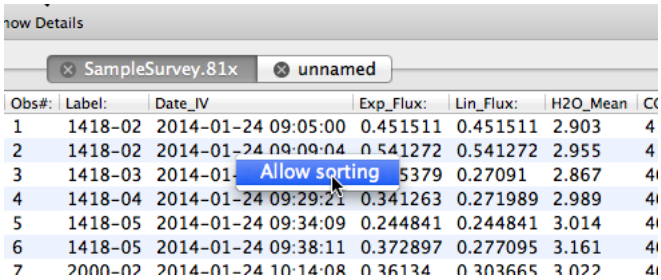
Sometimes it is useful to create an empty view, such as to create a destination for observations that you will paste in from other views (Move Observations Between Views). Creating an empty view is done by selecting New from the File menu or tool bar.



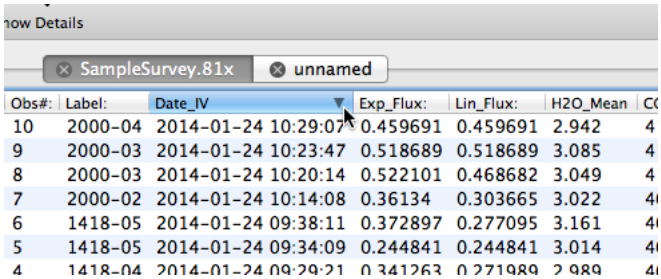


3.8 Sort Observations

Click on the column header you wish to use for sorting. Click again to change sort direction.



1. Enable sorting by right clicking in the content area of a Summary View.

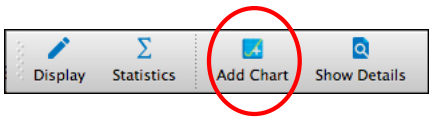


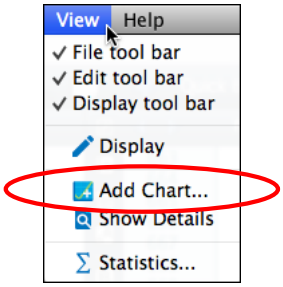
2. When sorting is enabled, you can sort by a column by clicking in that column's header.

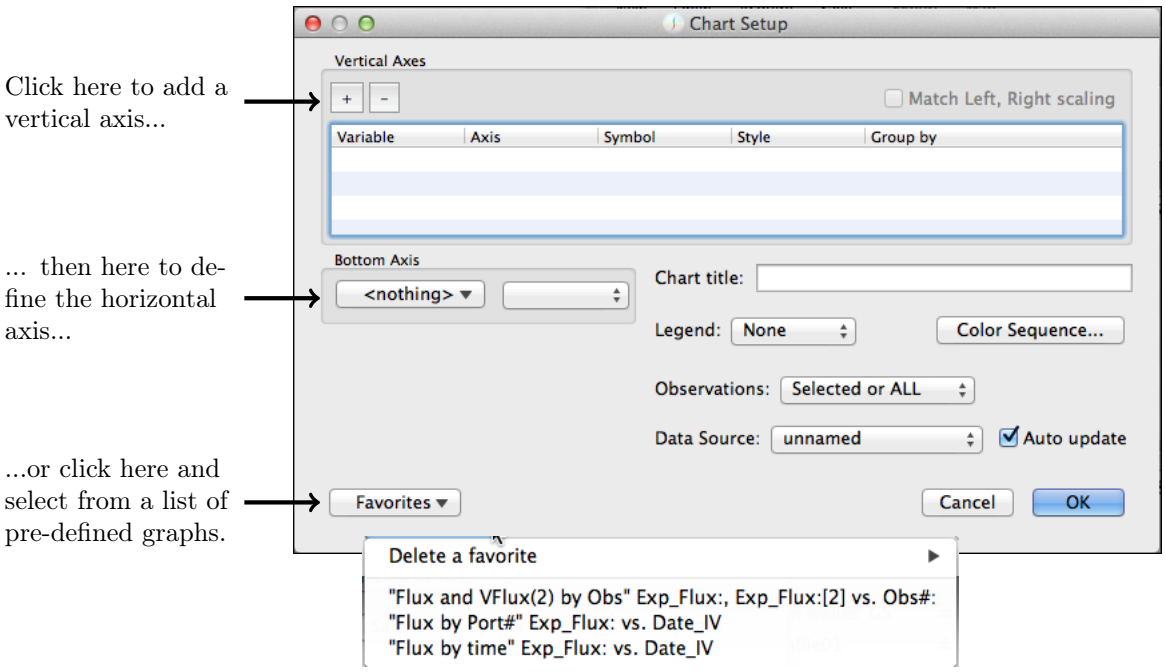
To reverse the direction of sort, click again in the header.

3.9 Add a Chart

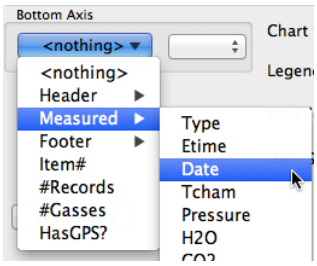
Click Add Chart, or select it from the View menu.



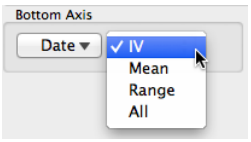




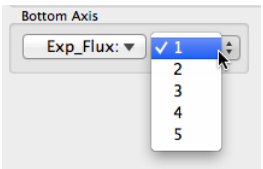
Defining the variable associated with a vertical or bottom axis is done as shown:



1. Use the drop down menu to select the variable. Most are grouped in submenus. Here, we are selecting **Date**.

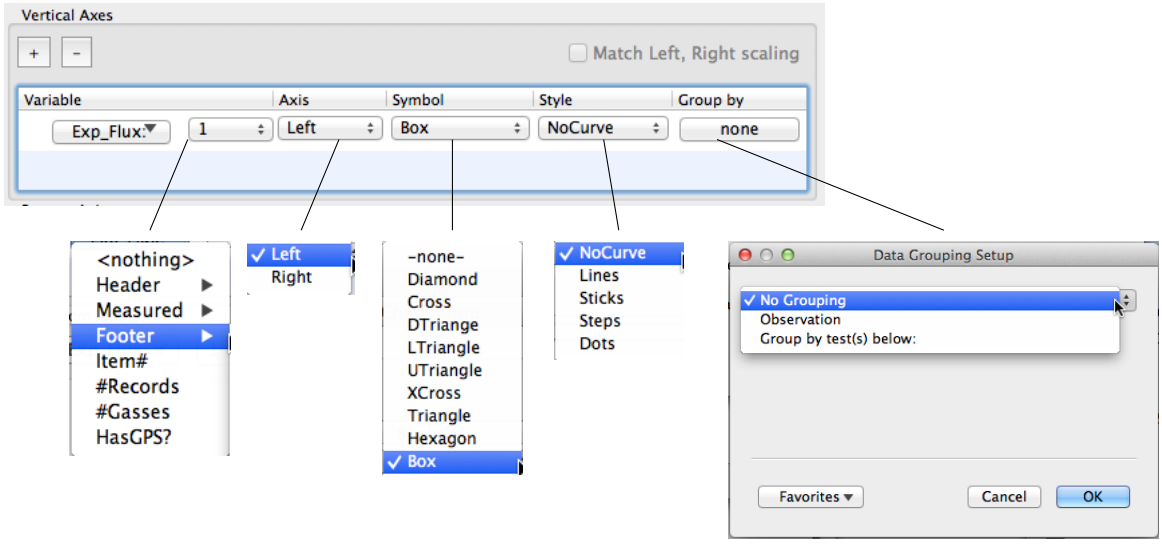


2. Items from the Measured menu have a secondary selection: **IV**, **Mean**, and **Range** have one value per observation, while the **All** selection refers to all of the **Type**=1 values.



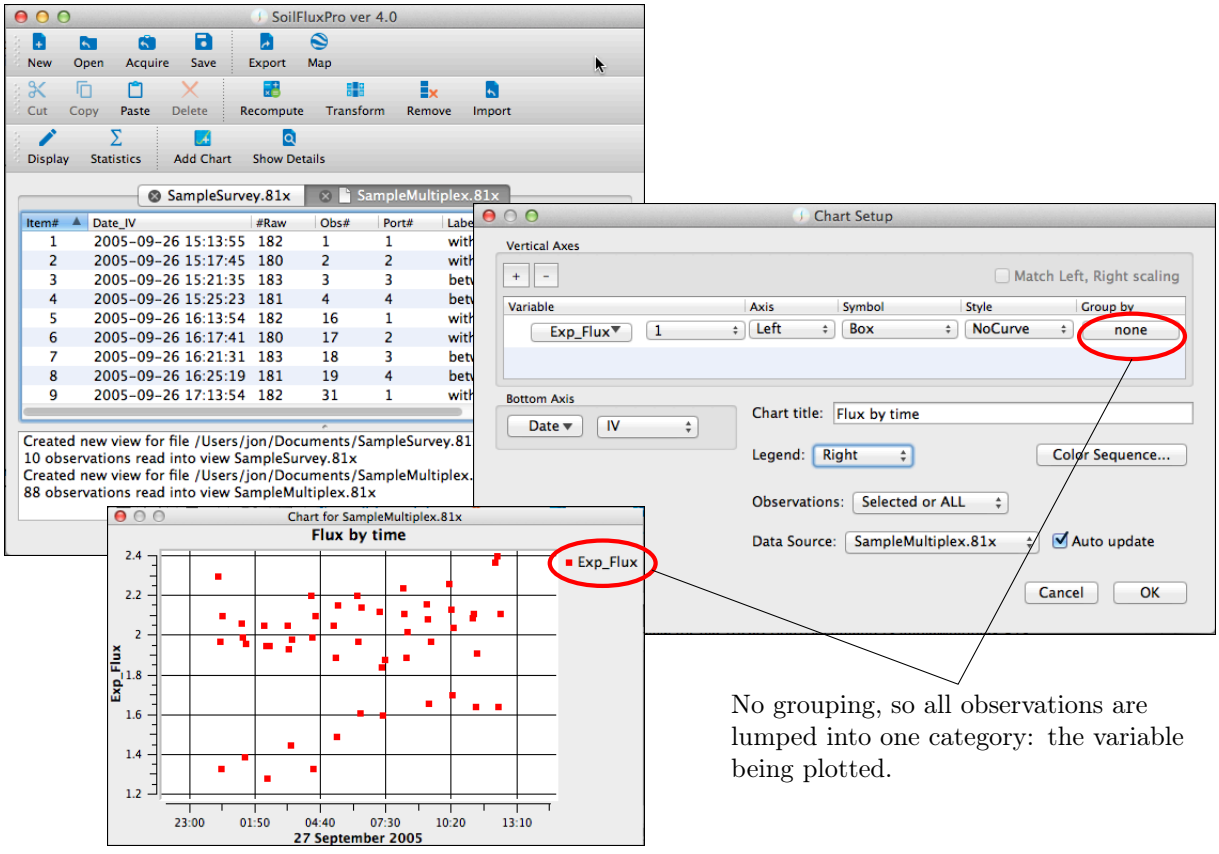
Footer items also have a secondary selection, although it is usually 1. If you have added more flux computations, then this is how you get to them.

The vertical axis definition includes which variable to plot, which axis, symbol, curve type, and grouping information.



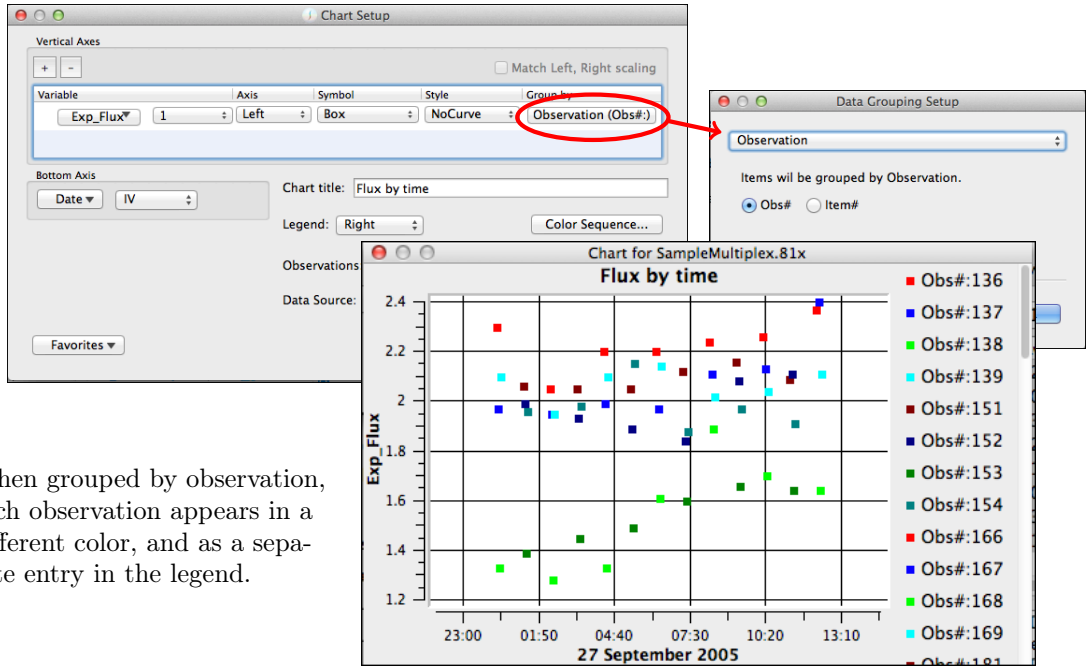
3.9.1 How to Group Plotted Data

To illustrate grouping, we will use a data file with four multiplexed ports. (If you wish to follow along, use File ⟩ Open Sample ⟩ SampleMultiplex.81x. The first graph shows flux as a function of time, with no grouping.



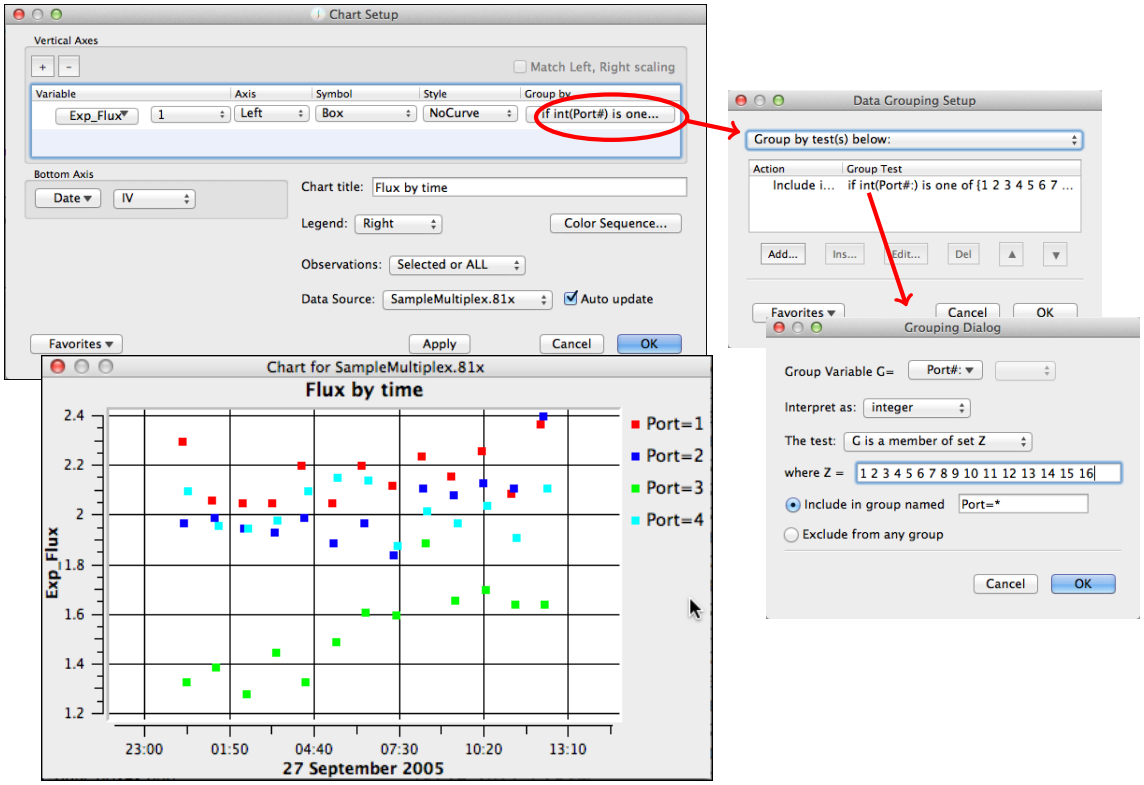
No grouping, so all observations are lumped into one category: the variable being plotted.

Next, we do a simple grouping by observation.

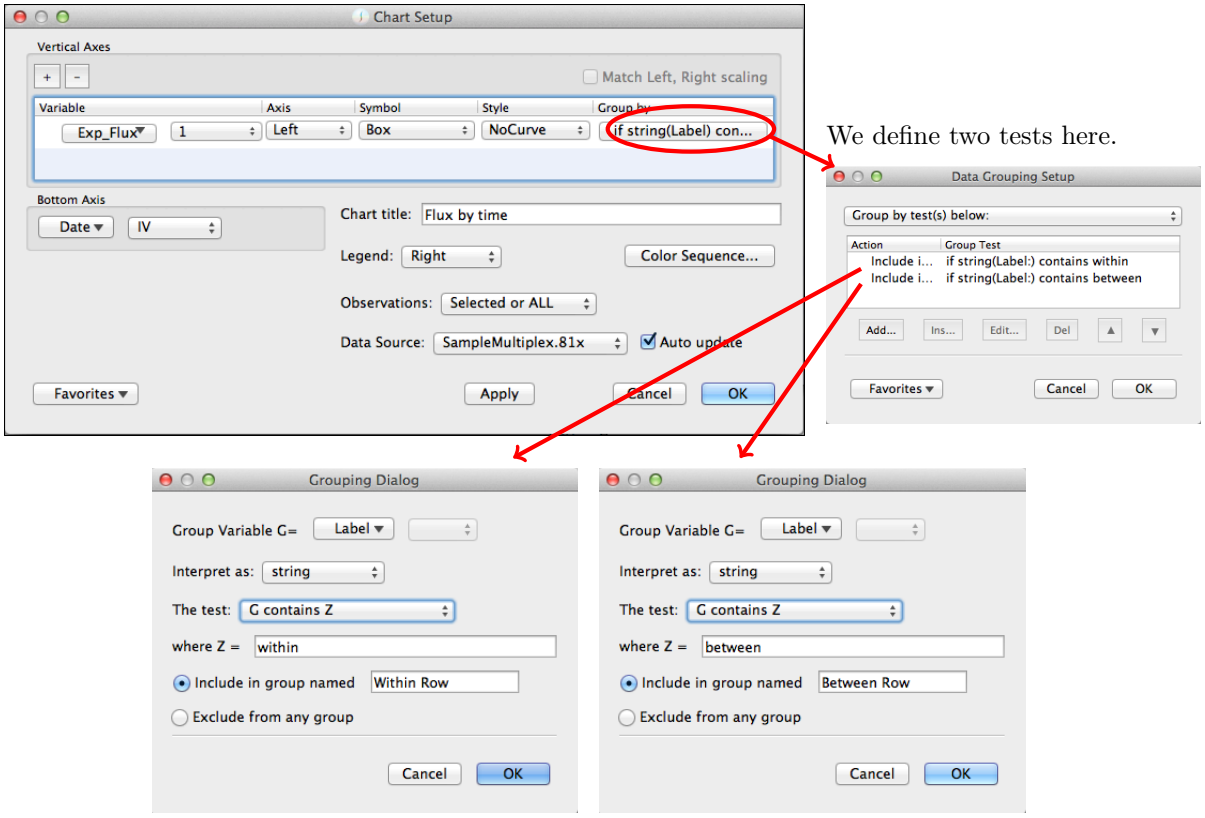


When grouped by observation, each observation appears in a different color, and as a separate entry in the legend.

Grouping can also occur via one or more tests. In this next example, we examine **Port#**, treat them as integers, and combine data sets with like port numbers together, naming them "Port=".

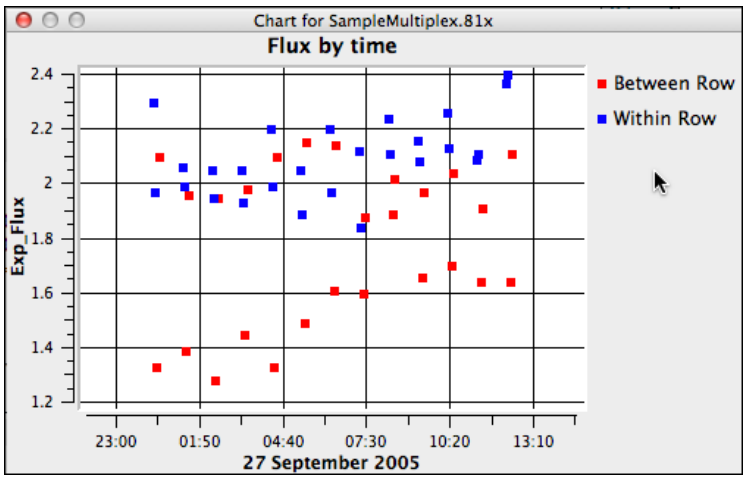


Finally, we combine the data into two groups: between rows and within rows, based on the **Label** in each observation.



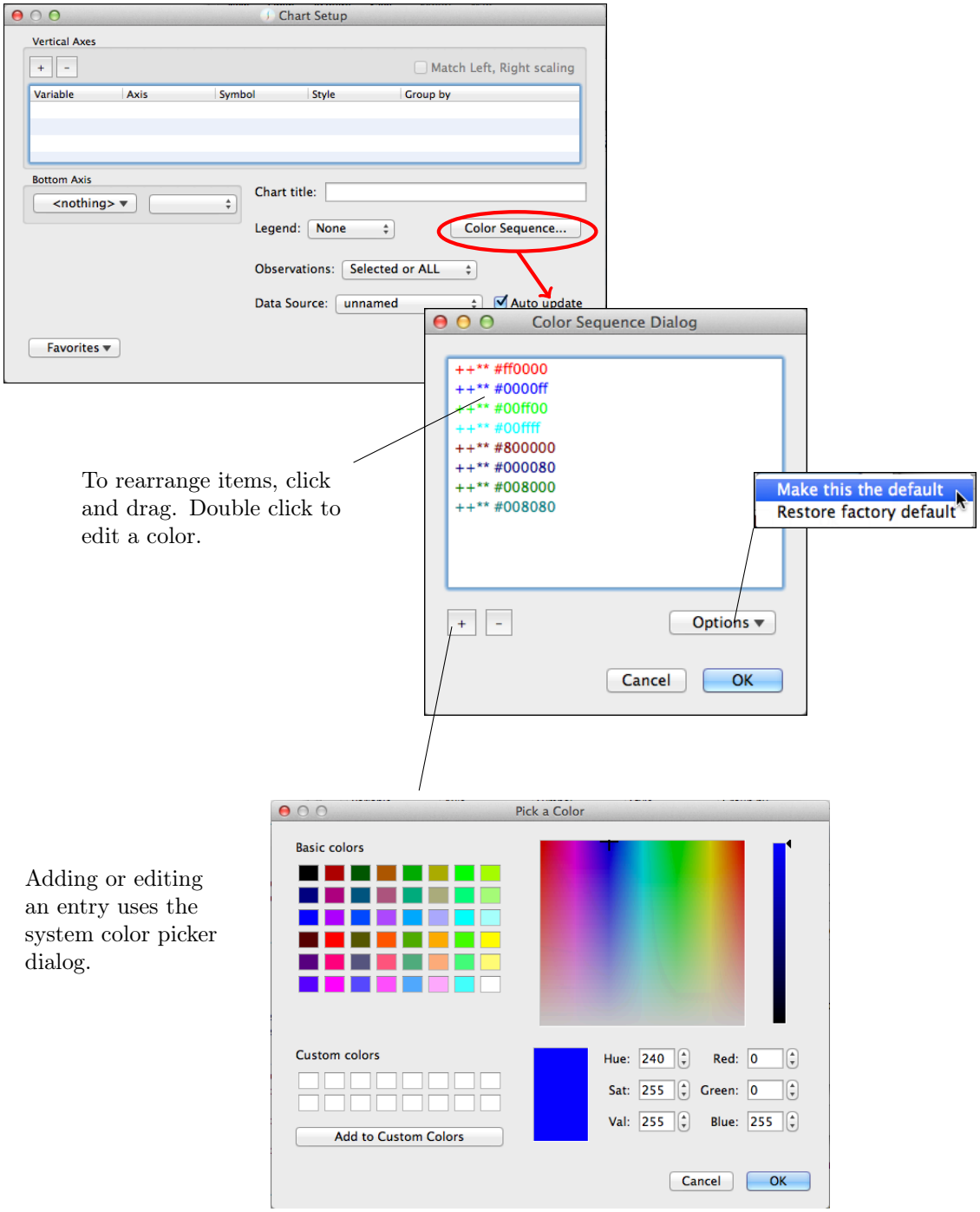
Test 1: If **Label** contains the word *within*, put it in this group.

Test 2: If **Label** contains the word *between*, put it in this group.



3.9.2 Setting the Color Sequence

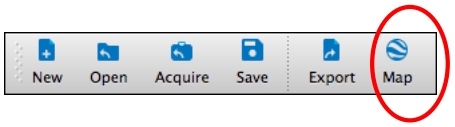
The sequence of colors used in Charts is automatic, but you can modify that sequence with the Color Sequence Dialog.

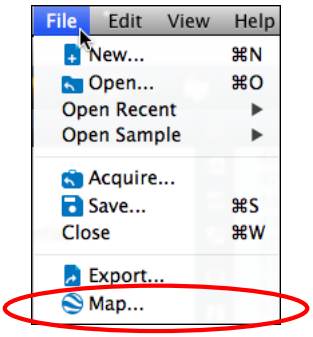


3.10 Create a .kml File for Google Earth

If GPS data is contained in the observation, then a .kml file can be created. The following example uses the file File » Open Sample » SampleMultiplex.81x.

1. Click Map on the tool bar, or select it from the File menu.

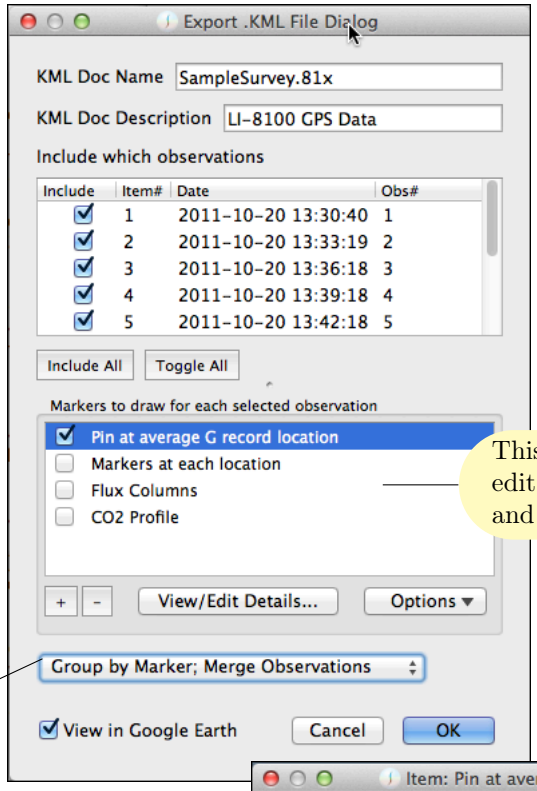




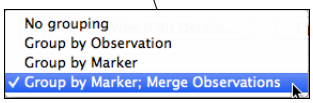
2. Check the observations to be included. This list will only show observations that have Latitude and Longitude data.

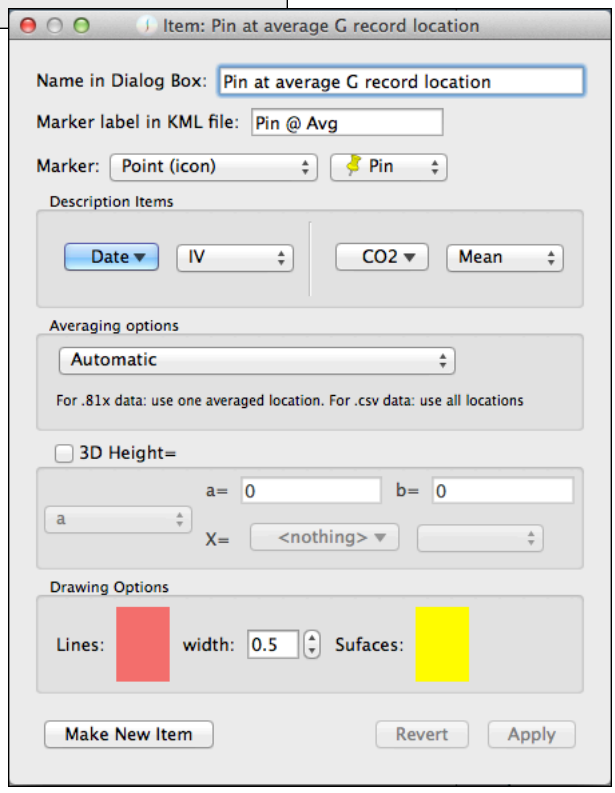
3. Select which sorts of markers you wish to have drawn.

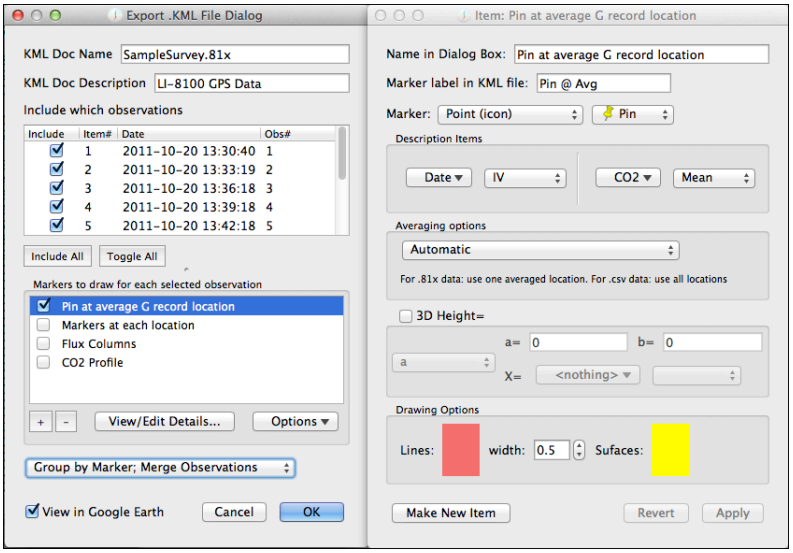
3. Select how the data should be grouped.



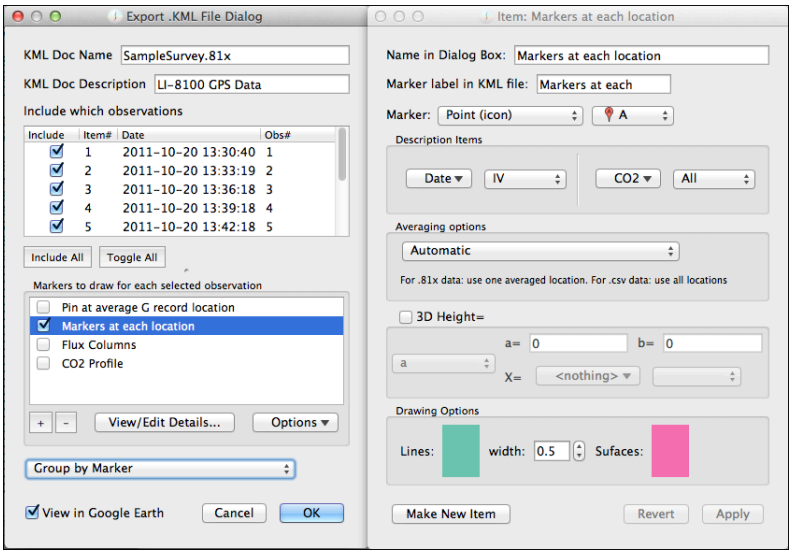
This list is user definable. To edit a definition, highlight it and click View/Edit Details...

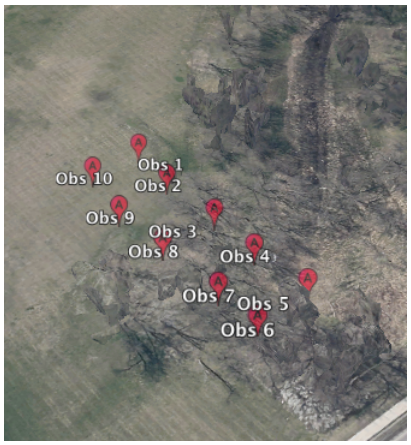




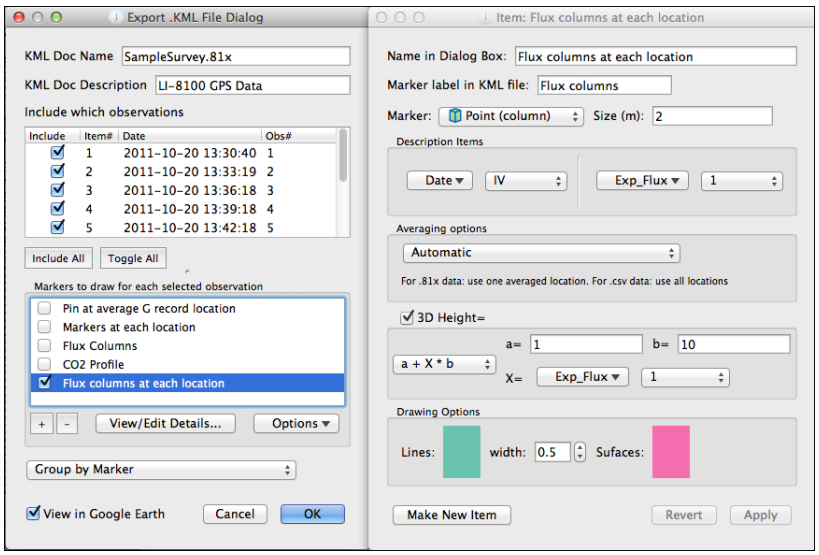


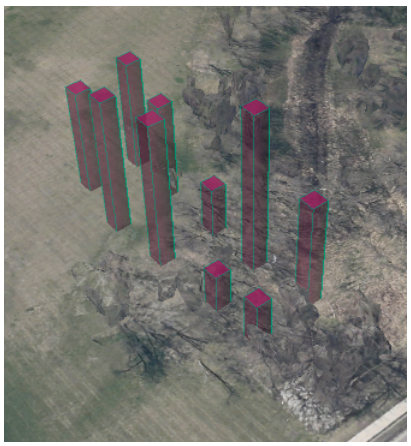
a) Single marker (merged observations) showing average location of all 10 observations.





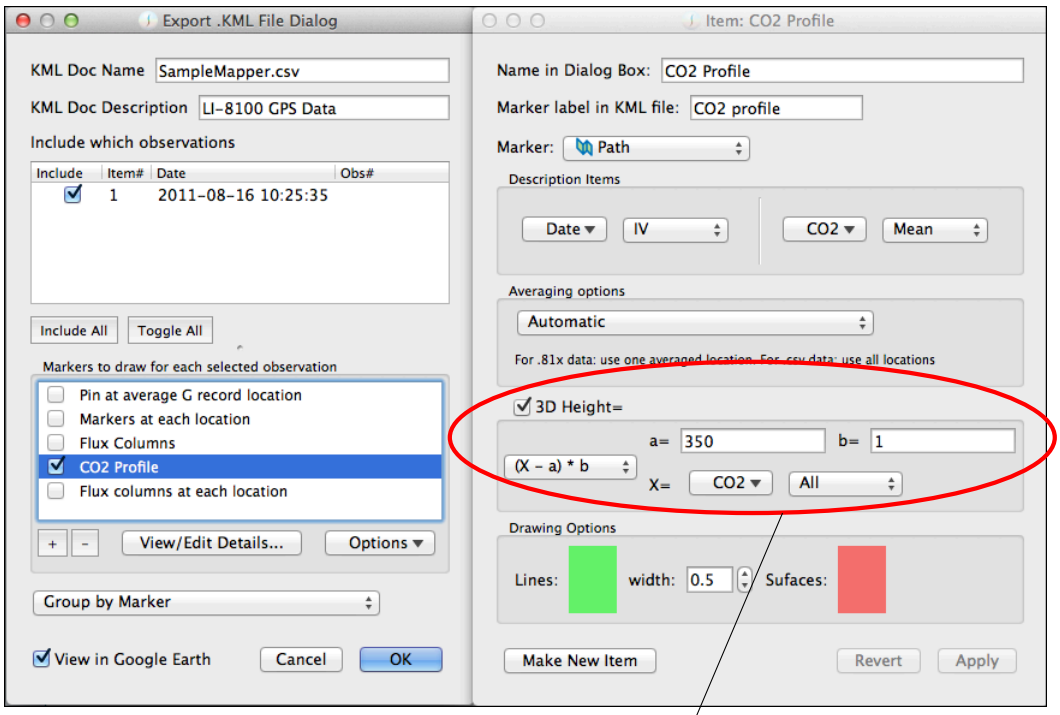
b) To put a marker at each observation, do not merge them.



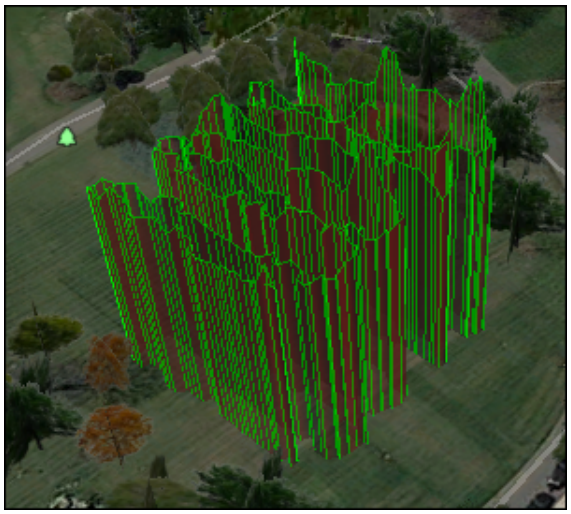


c. Each obs location marked with a 3D column, height proportional to flux.

With continuous measurement (for example, File » Open Sample » SampleMapper.csv), the **Path** marker is probably the most interesting to use.

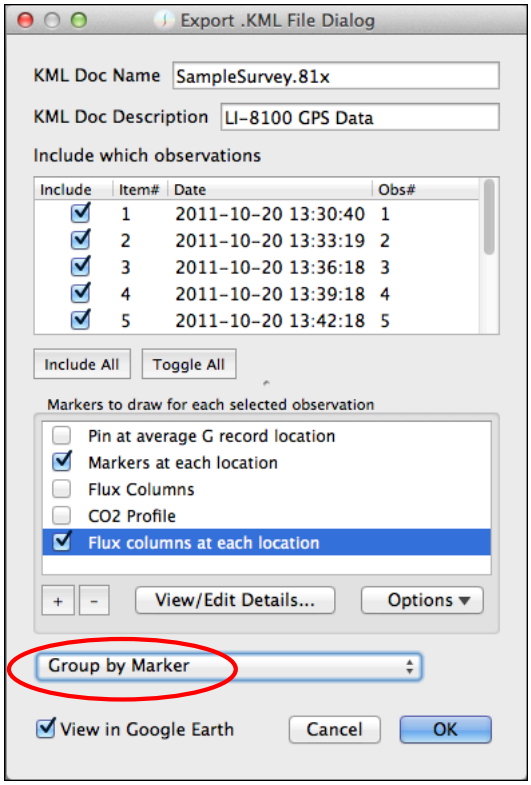


The 3D path has a height (m) that is computed from the CO_2 concentration at each point minus 350.

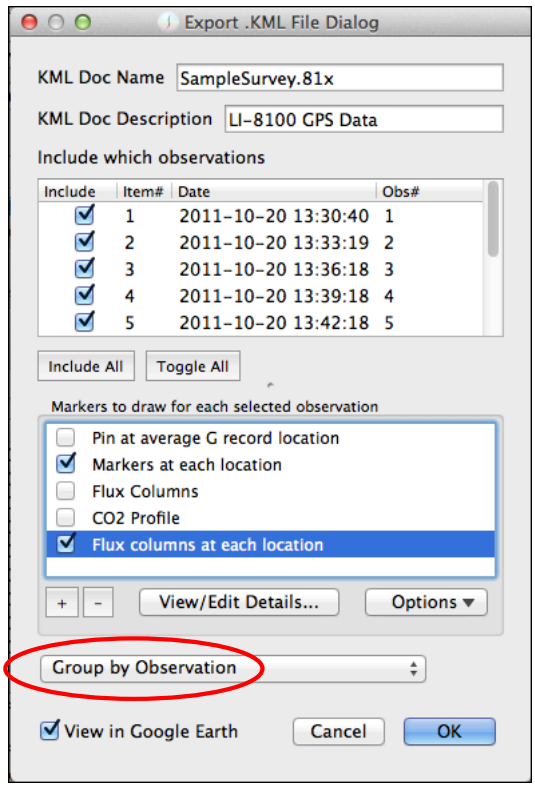


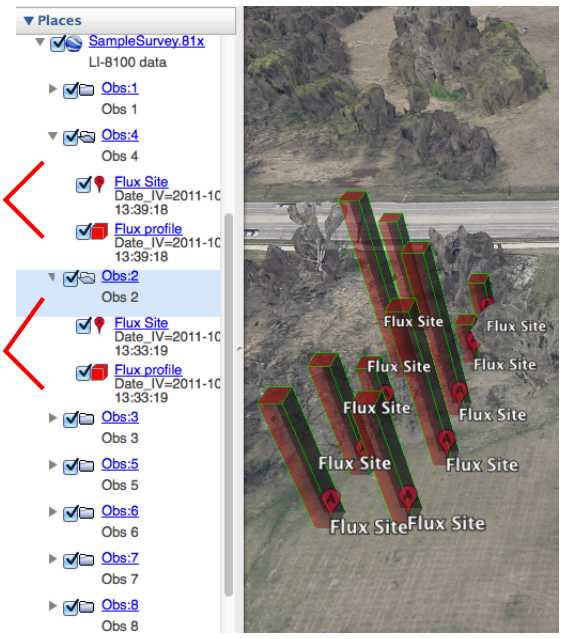
3.10.1 Group by Observation or Marker

The following illustrates the difference between the option to group by observation, and group by marker.



There's a column check box, and a marker check box. Under each are 10 check boxes for each observation location.

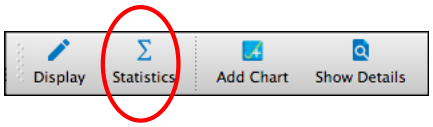


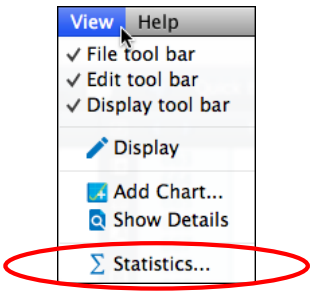


Each of the 10 observations has a check box, and under each is a check box for the column and one for the marker.

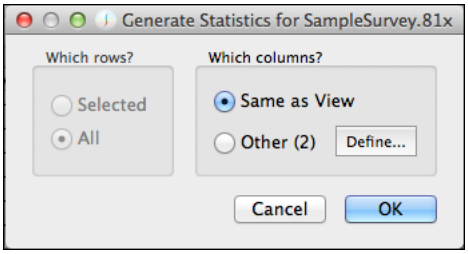
3.11 Compute Statistics

1. Click Statistics, or select it from the View menu.

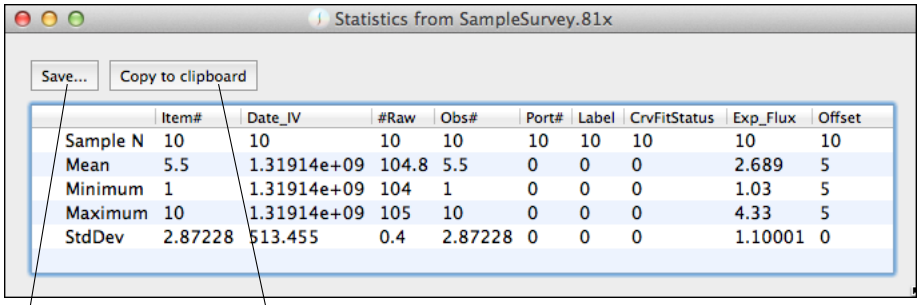




2. Pick the list of variables on which to compute statistics. It can be the same as the Summary View list, or you can pick a different set (SelectingVariables Dialog).



3. Click OK, and the results will be shown in a window. This summary table can be saved as a text file, or printed.



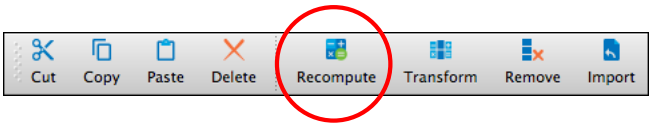
	Item#	Date_IV	#Raw	Obs#	Port#	Label	CrvFitStatus	Exp_Flux	Offset
Sample N	10	10	10	10	10	10	10	10	10
Mean	5.5	1.31914e+09	104.8	5.5	0	0	0	2.689	5
Minimum	1	1.31914e+09	104	1	0	0	0	1.03	5
Maximum	10	1.31914e+09	105	10	0	0	0	4.33	5
StdDev	2.87228	513.455	0.4	2.87228	0	0	0	1.10001	0

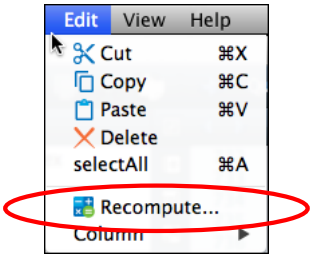
Copy to clipboard puts this content into the system's clipboard, allowing you to paste it into other applications, such as spreadsheets.

Save allows you to write the contents with tab delimiters to a text file.

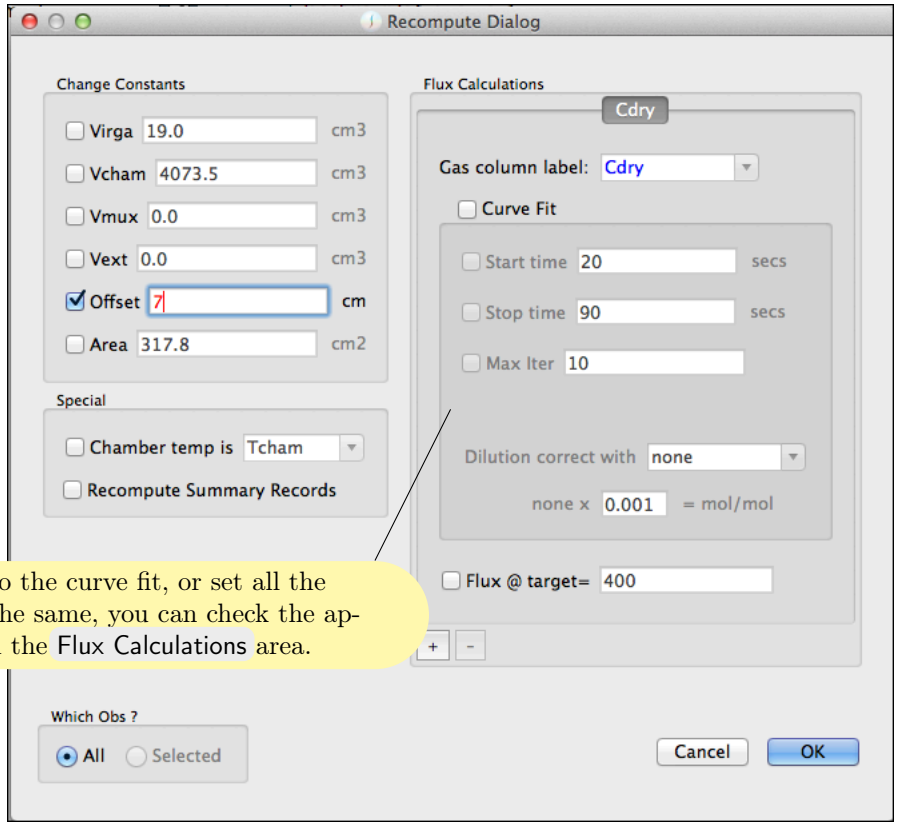
3.12 Recompute Observations

1. Click Recompute, or select it from the Edit menu.



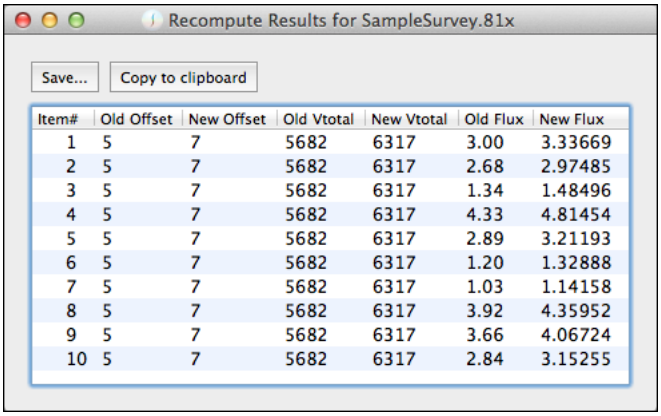


2. In the Recompute Dialog, select the thing(s) you wish to change. In the example below, we are changing the **Offset** (collar height parameter), which will change the total volume, and thus the flux.



If you wish to redo the curve fit, or set all the start/stop times the same, you can check the appropriate boxes in the Flux Calculations area.

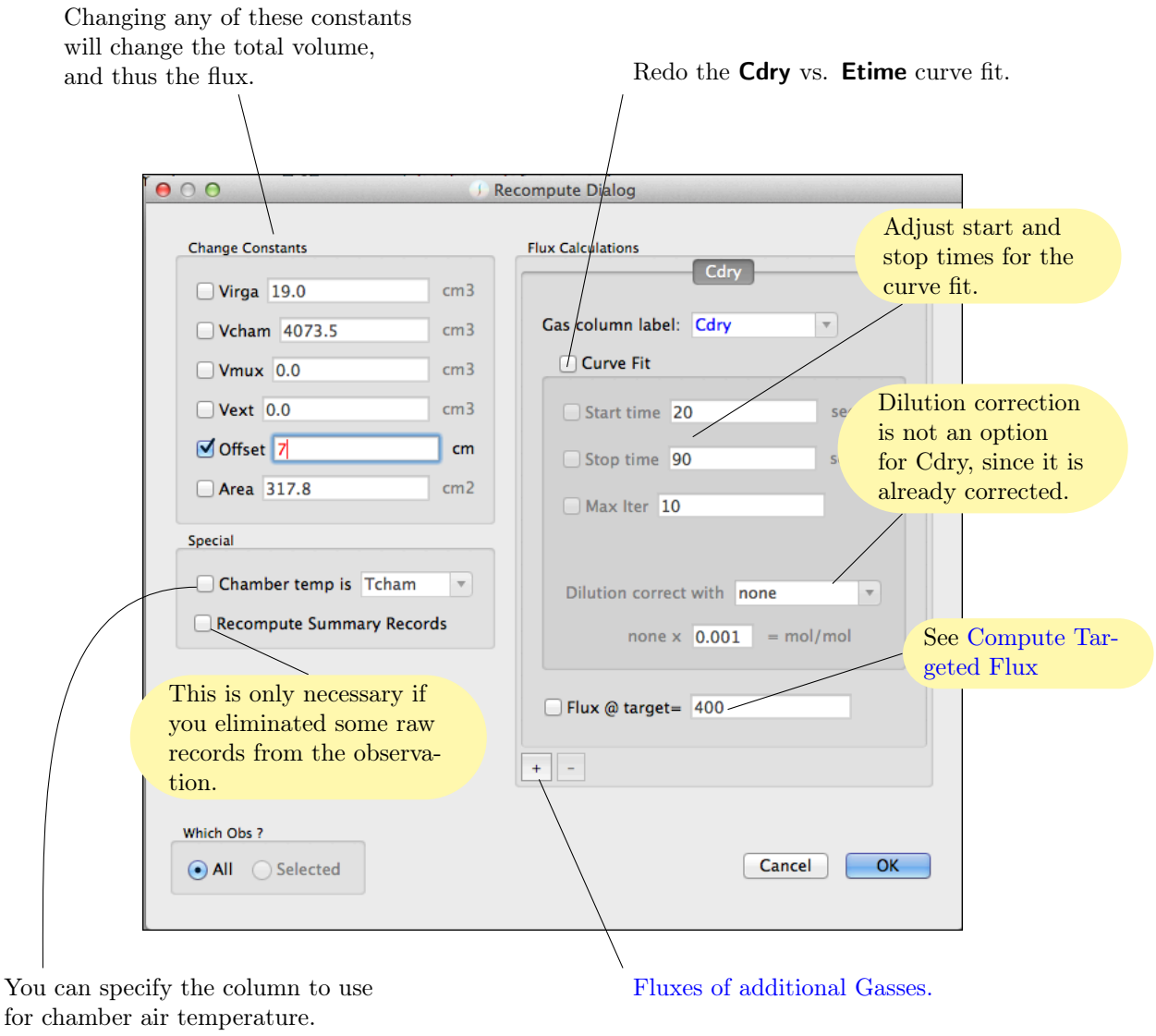
3. Click OK, and the observation(s) will be recomputed, and the results displayed in a summary window.



Item#	Old Offset	New Offset	Old Vtotal	New Vtotal	Old Flux	New Flux
1	5	7	5682	6317	3.00	3.33669
2	5	7	5682	6317	2.68	2.97485
3	5	7	5682	6317	1.34	1.48496
4	5	7	5682	6317	4.33	4.81454
5	5	7	5682	6317	2.89	3.21193
6	5	7	5682	6317	1.20	1.32888
7	5	7	5682	6317	1.03	1.14158
8	5	7	5682	6317	3.92	4.35952
9	5	7	5682	6317	3.66	4.06724
10	5	7	5682	6317	2.84	3.15255

3.12.1 Recompute Options

The figure below indicates the various options available when recomputing.



3.12.2 Compute Targeted Flux

The LI-8100A computes flux at the concentration present when the chamber closed. SFP supports additional flux computations at other targets based on the slope of the exponential fit of **Cdry** vs. **Etime**. To compute the rate of change of **Cdry** at a particular target concentration C_t, we first solve the Exponential Fit expression for time t_t such that $C(t_t) = C_t$. Since

$$C_t = C_\infty + (C_0 - C_\infty)e^{-a(t_t - t_0)} \tag{1}$$

$$t_t = \frac{1}{a} ln \frac{C_0 - C_\infty}{C_t - C_\infty} + t_0 \tag{2}$$

The rate of change of Cdry at time t_t is then

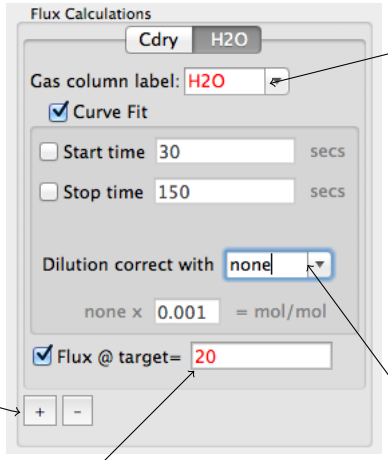
$$\frac{\delta}{\delta t} C(t_t) = a(C_0 - C_\infty) e^{-a(t_t - t_0)} \tag{3}$$

Targeted flux is computed using this slope. The target can be a user entered value (**Target**), and the flux at this value is **Flux@Target**. SFP also computes the minimum Cdry value during chamber closing (**MinCO2**), and the flux at that target value (**Flux@Min**). Target can be specified in the Recompute Observations dialog.

3.12.3 Fluxes of Additional Gasses

The LI-8100A computes flux for **Cdry**, the water corrected CO_2 concentration. You can add additional fluxes for other gasses that are recorded during the measurement (e.g. use **H2O** or use signals from an external gas analyzer that were recorded by the LI-8100A in a spare channel). See Footer for where the results reside.

1. To add a flux computation, click +.



2. Specify the column label for the data to be used for this gas. If you had methane data logged in **V2**, then you would use that. In this figure, we are using the **H2O** column to compute a water flux.

3. If the data needs to be corrected for water vapor, specify the column to use for water vapor (typically **H2O**). Also, specify how to convert the water data in that column to units of mol/mol. (If you used **H2O**, which is in mmol/mol, then the multiplier is 0.001.

4. If you want a targeted flux value, specify the target here.

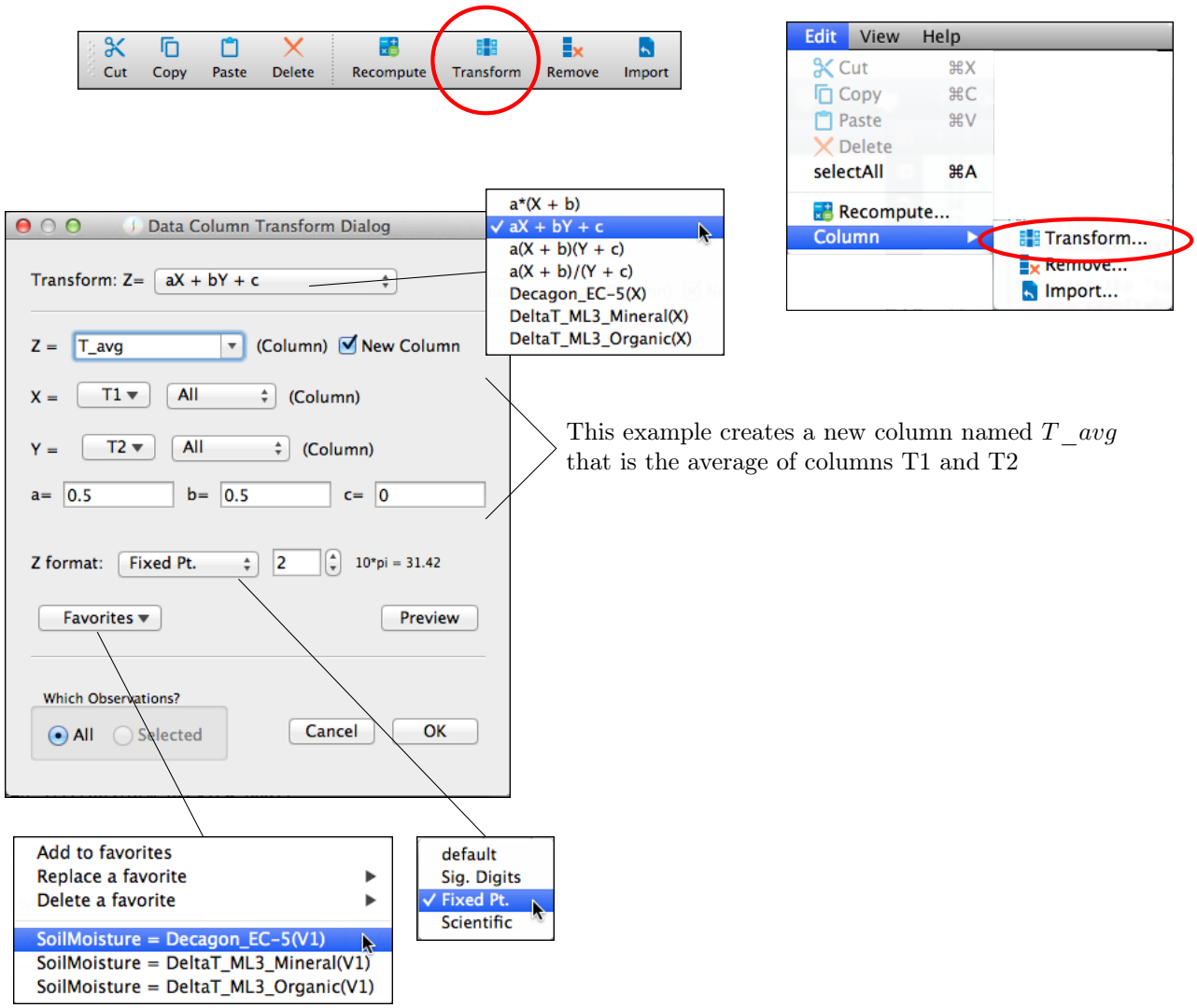
3.13 Transforming Columns

The measured data columns can be can be mathematically transformed, using one of the following:

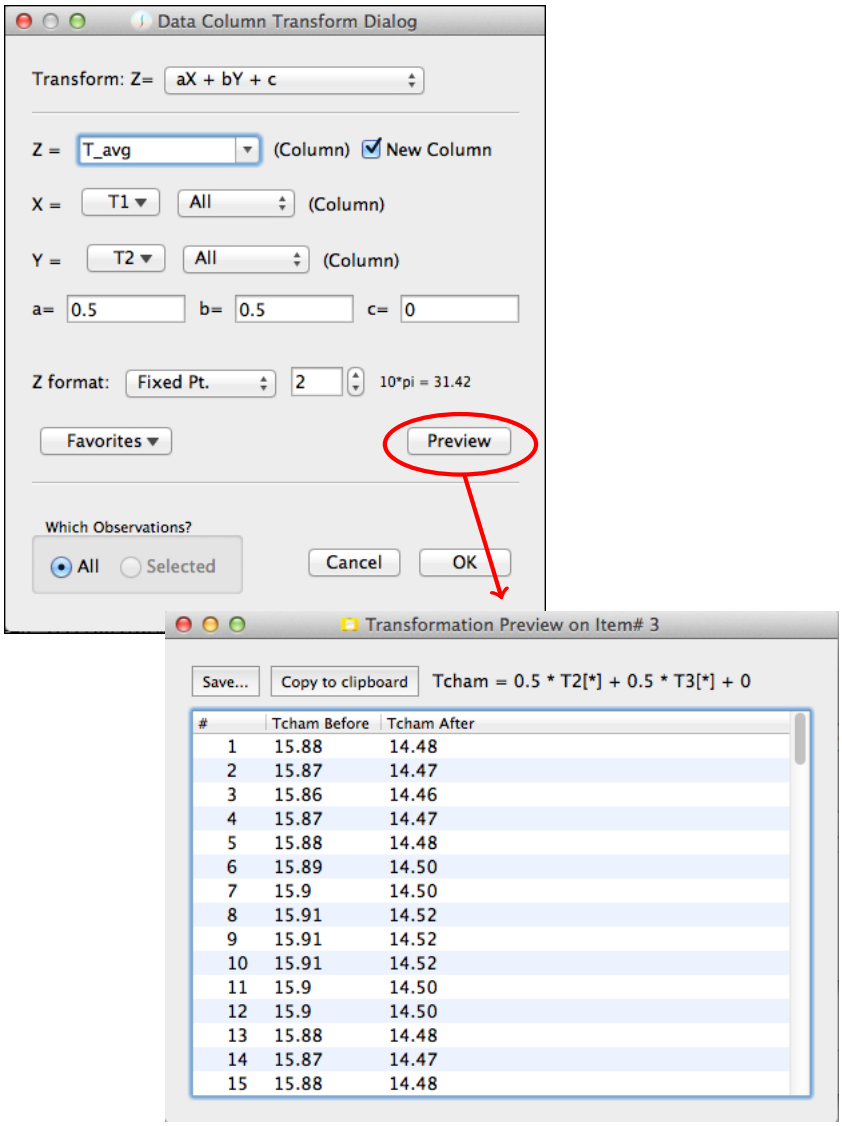
$$
\begin{aligned}
Z &= a(X+b) \\
Z &= aX + bY + c \\
Z &= a(X+b)(Y+c) \\
Z &= a\frac{X+b}{Y+c} \\
Z &= a + bX + cX^2 \\
Z &= a + bX + cX^2 + dX^3 + eX^5 + fX^5 + gX^6
\end{aligned}
\tag{4}
$$

where Z are the values in the column to be transformed, a, $b \ldots g$ are user entered constants, and X and Y are also column values (can be same as Z), but can also be any other value in the observation.

To do a column transform, click Transform on the tool bar or Edit > Column > Transform...



The Preview button applies the transform to the first file in the potential list and shows the results in a view; it does not change the observational data.



3.13.1 Soil Moisture

There are three “built-in" soil moisture transformations. Decagon_EC-5 uses a 3rd order polynomial, and the two DeltaT_ML3 transforms use a 6th order polynomial. Coefficients shown below.

Name	a	b	c	d	e	f	g
Decagon EC-5	-0.612	1.16	-0.314	-	-	-	-
DeltaT ML3 (Mineral)	-0.071	0.735	0.75	-8.759	21.838	21.998	8.097
DeltaT ML3 (Organic)	-0.039	0.802	0.819	-9.556	23.823	23.997	8.833

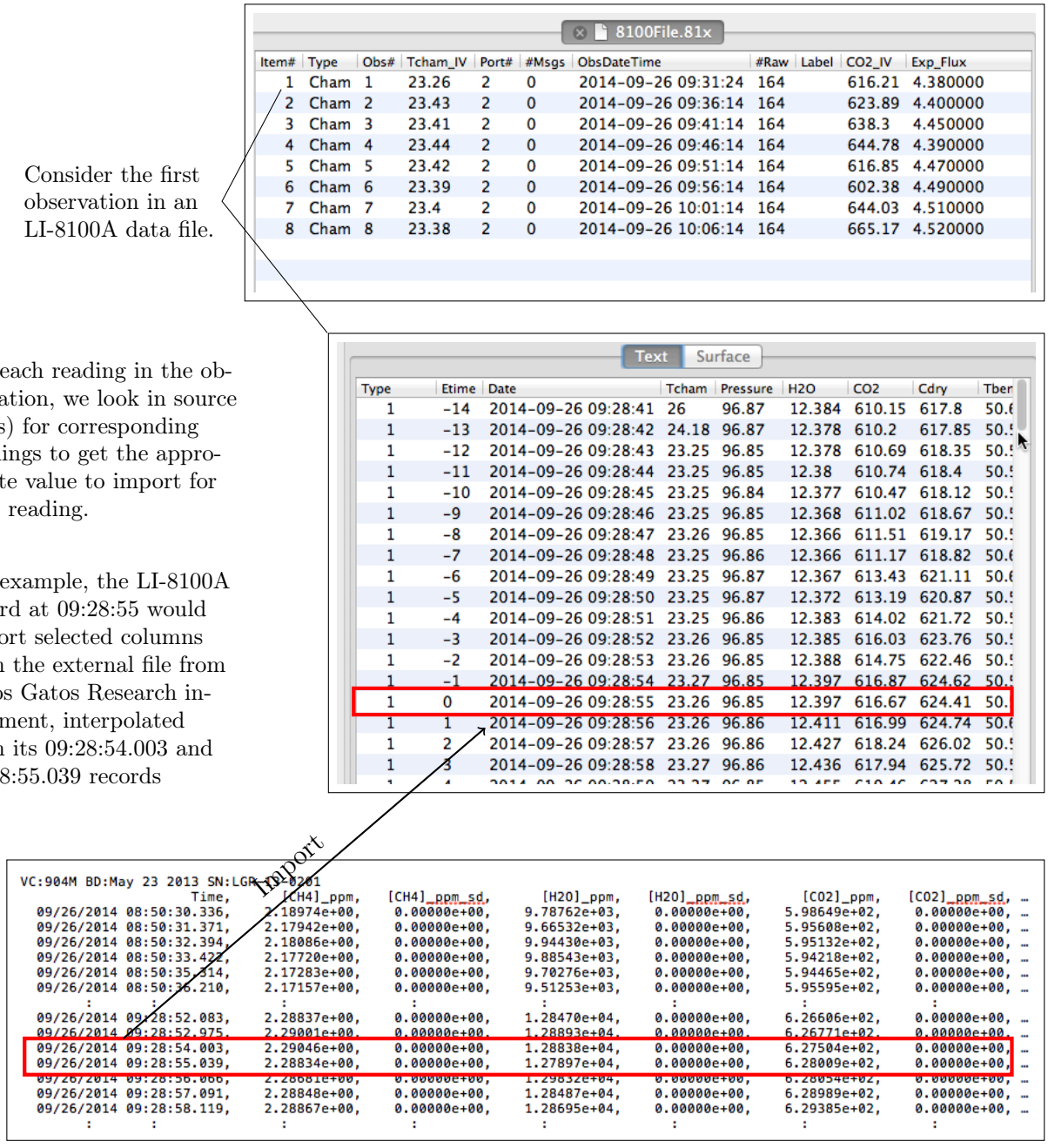
3.14 Importing Columns

Data collected and stored in a separate file by another gas analyzer running in parallel with the LI-8100A can be imported into the LI-8100A data file, and fluxes computed from it. The methodology is to scan the external file(s) for the observations needed based on the time stamps in the LI-8100A file. The figure below illustrates the process.

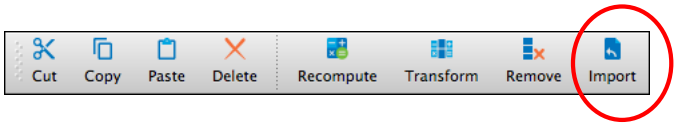
Consider the first observation in an LI-8100A data file.

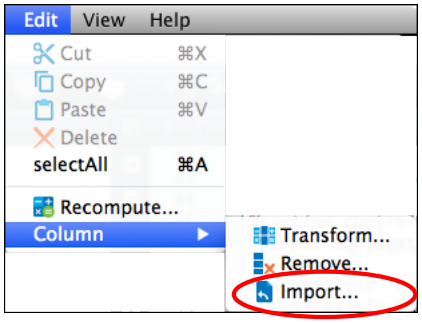
For each reading in the observation, we look in source file(s) for corresponding readings to get the appropriate value to import for that reading.

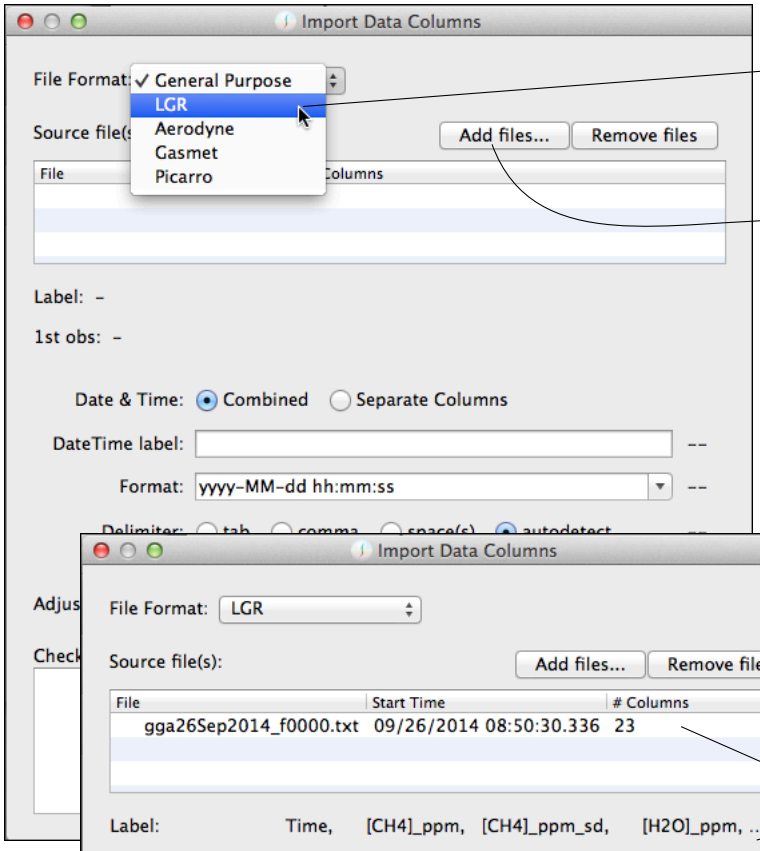
For example, the LI-8100A record at 09:28:55 would import selected columns from the external file from a Los Gatos Research instrument, interpolated from its 09:28:54.003 and 09:28:55.039 records



To import columns of externally collected data, click the Column Import tool bar button.

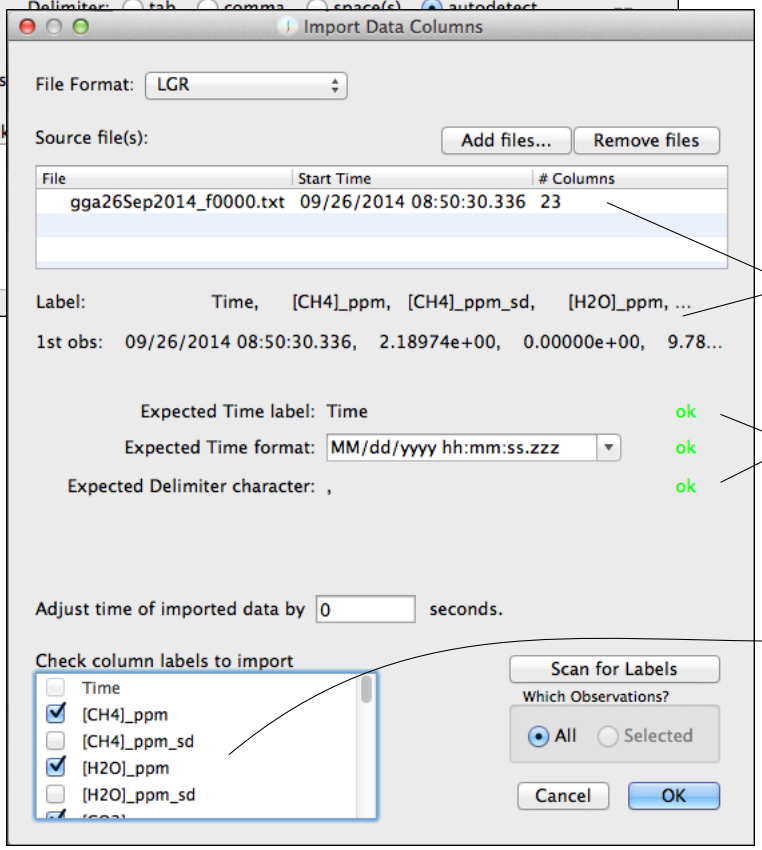






Step 1. Select the file format of the source file(s).

Step 2. Add the source file(s) to the list.



The label line and first observation from the first file in the source list.

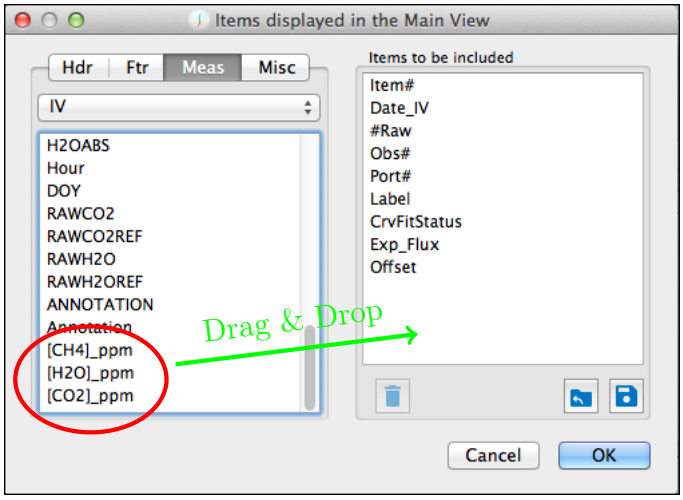
The expected format for an LGR file. ok means that format was successful, while Error means that format was not successful.

The list of data columns found in the first source file, when parsed according to the above expected formats.

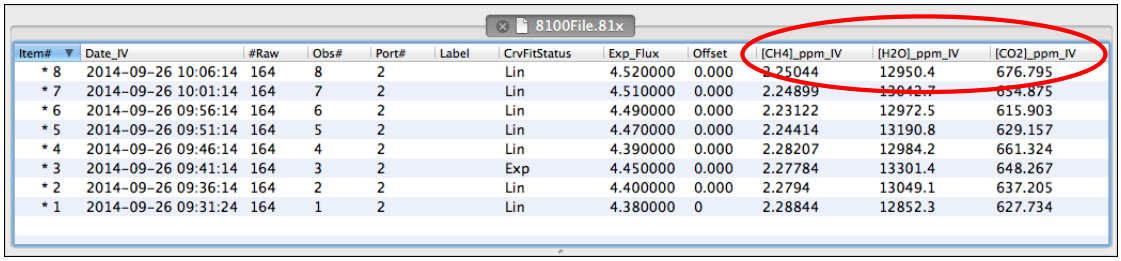
Step 3. Check the columns you wish to import. Note that column(s) used for time and date are shown here, but are not checkable.

Once the columns are imported, you can view them in the summary view, plot them, or use them to compute fluxes.

Imported columns in the Display Editor. Drag to add them...

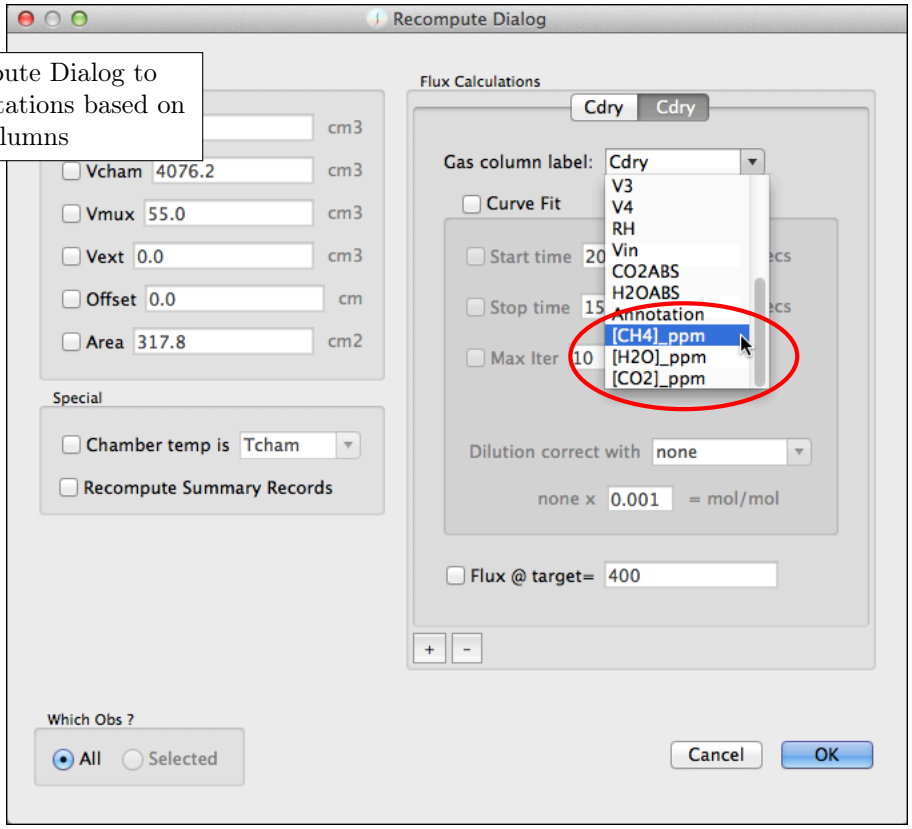


...to the Summary View.



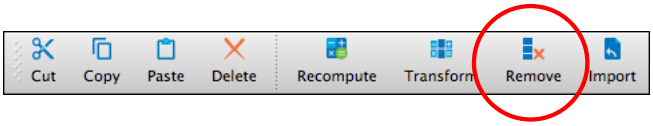
Item#	Date_IV	#Raw	Obs#	Port#	Label	CrvFitStatus	Exp_Flux	Offset	[CH4]_ppm_IV	[H2O]_ppm_IV	[CO2]_ppm_IV
* 8	2014-09-26 10:06:14	164	8	2		Lin	4.520000	0.000	2.25044	12950.4	676.795
* 7	2014-09-26 10:01:14	164	7	2		Lin	4.510000	0.000	2.24899	13042.7	654.875
* 6	2014-09-26 09:56:14	164	6	2		Lin	4.490000	0.000	2.23122	12972.5	615.903
* 5	2014-09-26 09:51:14	164	5	2		Lin	4.470000	0.000	2.24414	13190.8	629.157
* 4	2014-09-26 09:46:14	164	4	2		Lin	4.390000	0.000	2.28207	12984.2	661.324
* 3	2014-09-26 09:41:14	164	3	2		Exp	4.450000	0.000	2.27784	13301.4	648.267
* 2	2014-09-26 09:36:14	164	2	2		Lin	4.400000	0.000	2.2794	13049.1	637.205
* 1	2014-09-26 09:31:24	164	1	2		Lin	4.380000	0	2.28844	12852.3	627.734

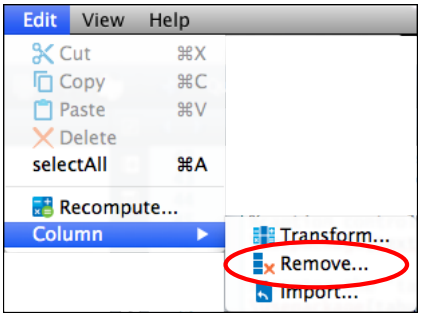
Use the Recompute Dialog to add flux computations based on the imported columns



3.15 Removing Columns

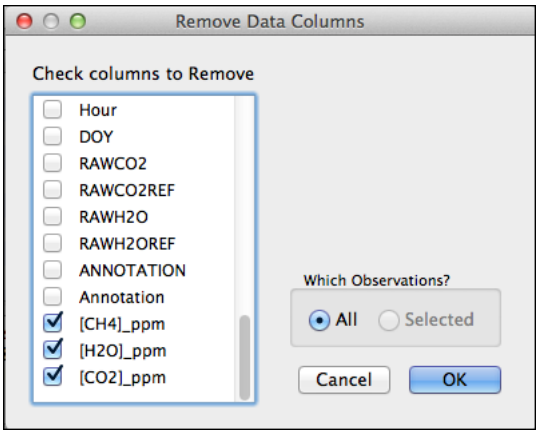
To remove columns from observations, click on Remove, or else select it from Edit > Column > Remove...





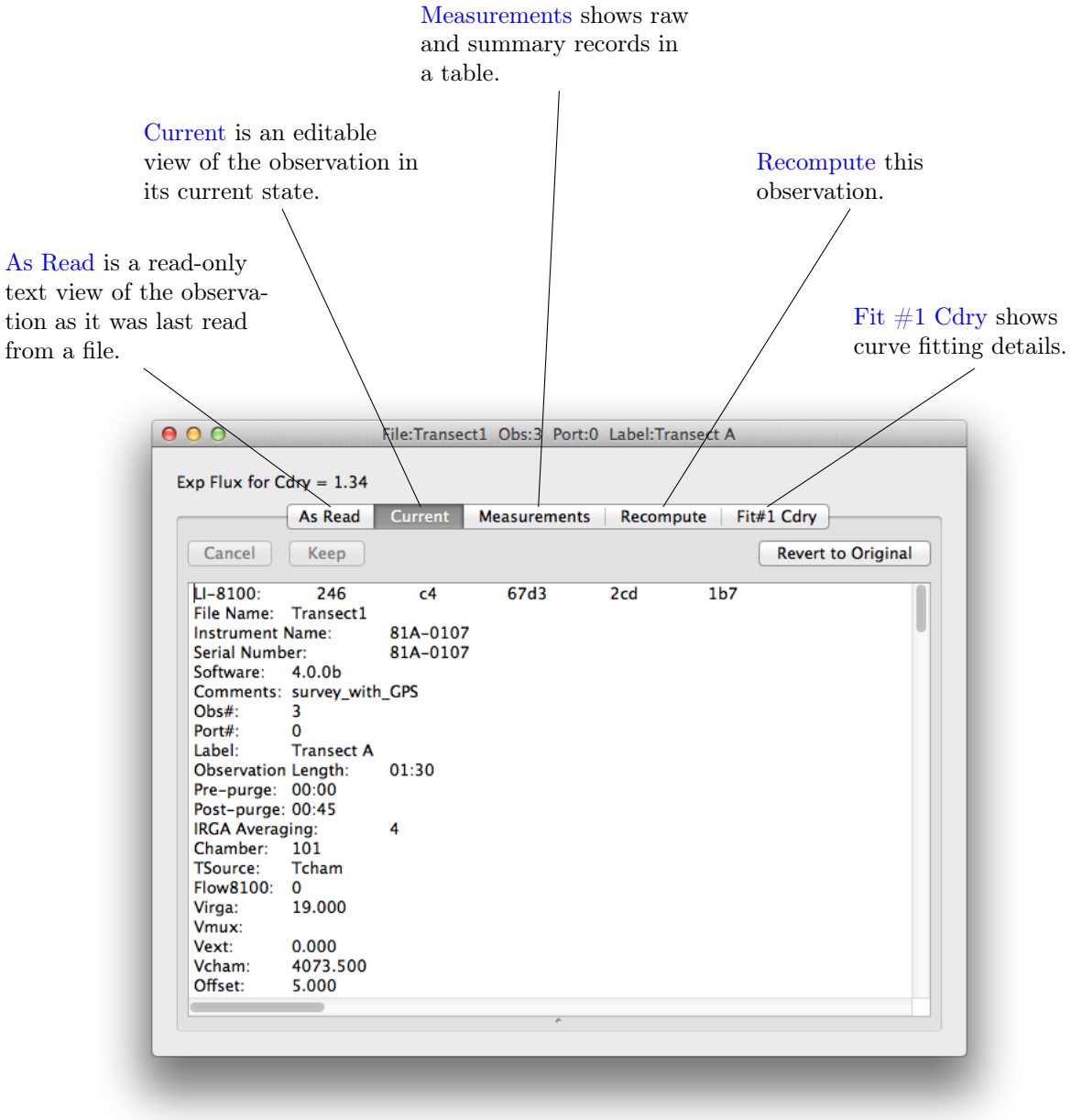
Check the names of the columns you wish to remove from the observations, and click OK.

Note: There is no “undo" for this.



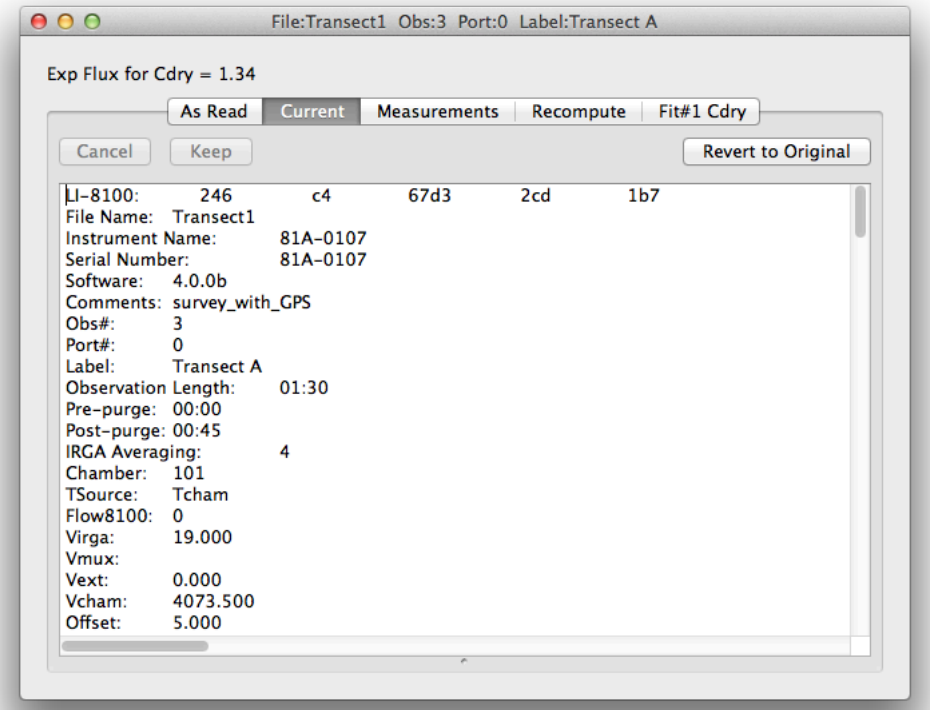
4 Observation Details

To see Details for an observation, double click on that observation in Summary View. This opens a view that "belongs" to that observation, updating automatically whenever something changes in that observation (e.g. recompute). Alternatively, click Detail View, and see the detail view of whatever observation happens to be highlighted in the active Summary View. Confused? See Zoom in on one Observation (Method 1) and Zoom in on an Observation (Method 2).



4.1 Current

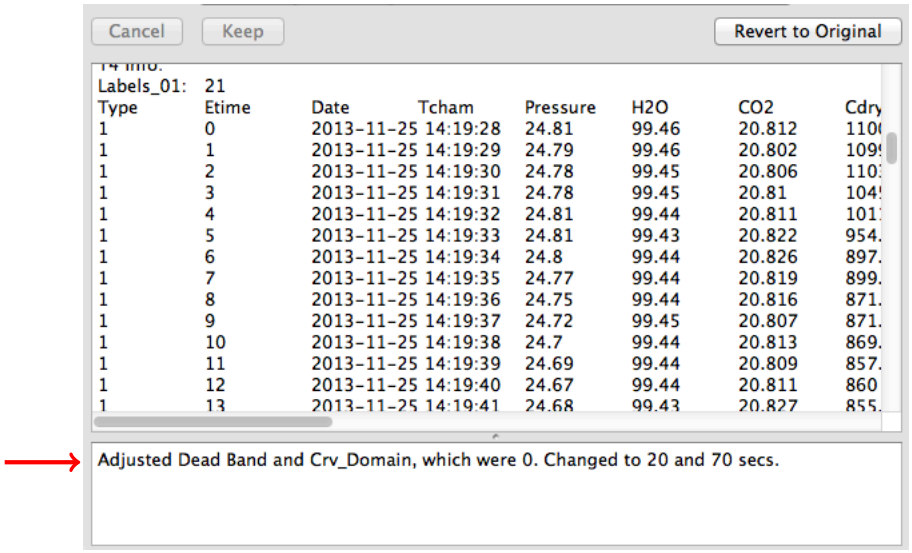
The Current tab shows the observation in text form in its present form, including any changes due to recomputations, column transformations, etc. This view is editable, so any sort of editing is possible. Keep will rescan the text, just as if it were reading from a file. This does not change the original view, so any changes you make (as well as any recomputations, etc.) can always be undone by clicking Revert to Original.



To change Area, Volume, and/or Label for multiple observations all at once, see Recompute Observations.

4.1.1 Warnings and Messages

Warnings can be generated by the LI-8100A during the measurement; these are stored in records whose **Type** is -1. They were put into the file at the time measurements were taken, and typically say something about a measurement condition, such as high humidity, or the measurement was restarted, etc. In addition, SFP itself can generate messages at the time an observation is read, and the list of SFP's messages are shown below.

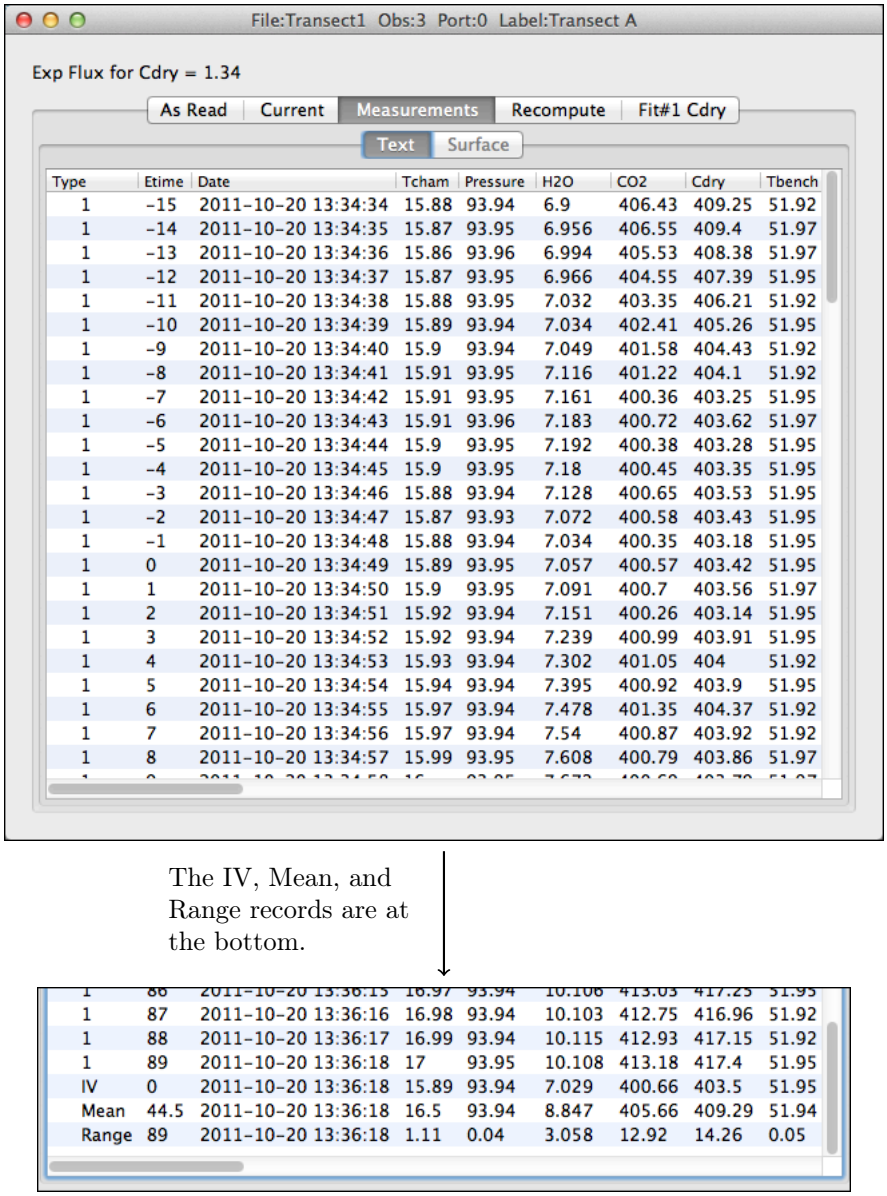


SFP Message	Explanation
`File Name: missing from header`	The label **File Name** was not found, but subsequent records were.
`ERROR: Failed to find measured data labels`	The line that identifies measured columns Type Etime Date... was missing.
`Old version. Updating format`	The original file is an older version format.
`Adjusting dead band and Crv_Domain...`	This would typically be caused by all or part of the observations footer missing.
`Warning: Chamber never closed?`	Elapsed times never reached values >0.
`Summary Records and Footer not found`	The file ended without any summary records or footer.
`Footer not found`	No footer was found in the file.

4.2 Measurements

4.2.1 Text

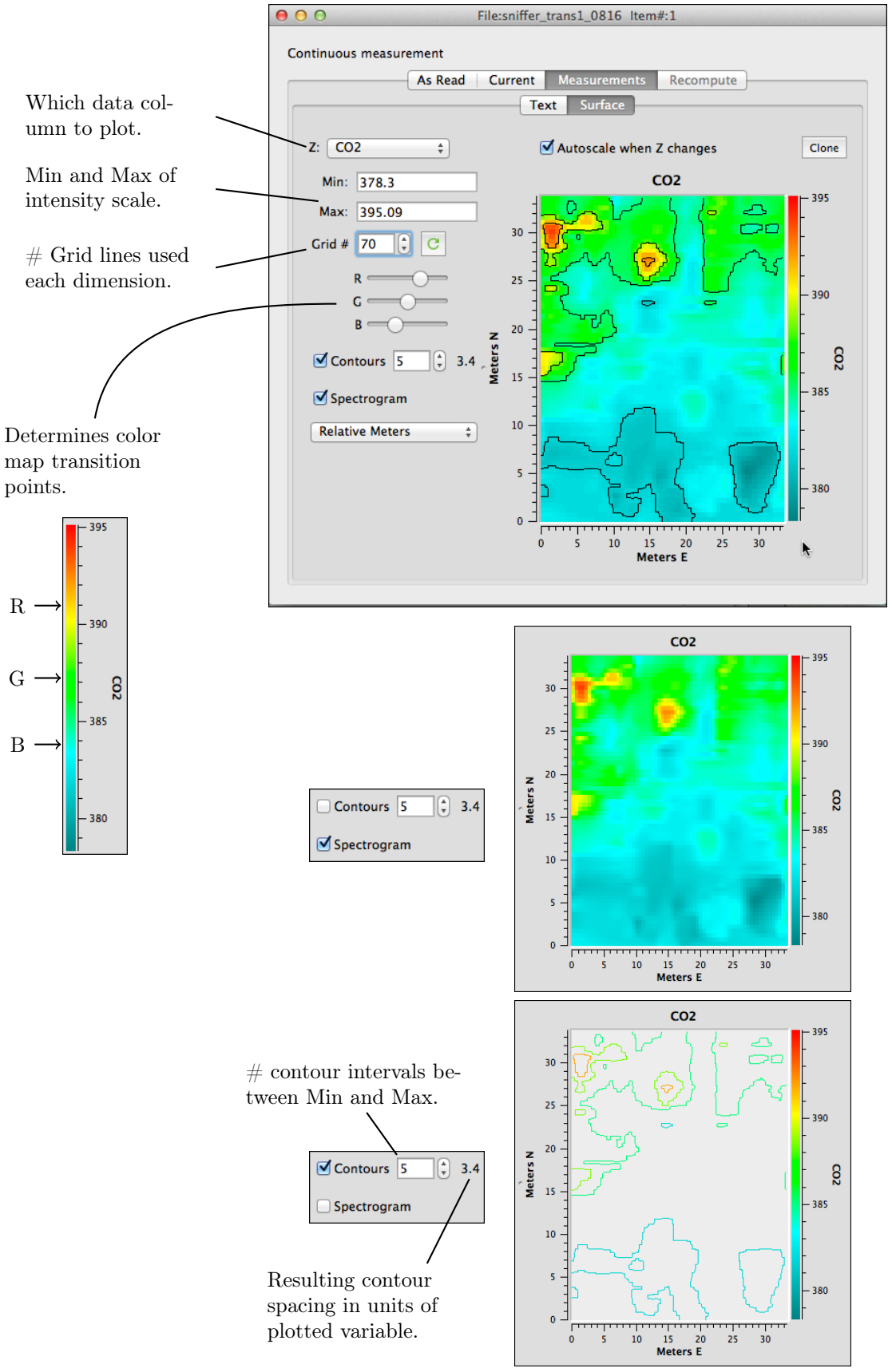
The Measurement tab sheet shows all of the raw records for this observation under the Text tab.



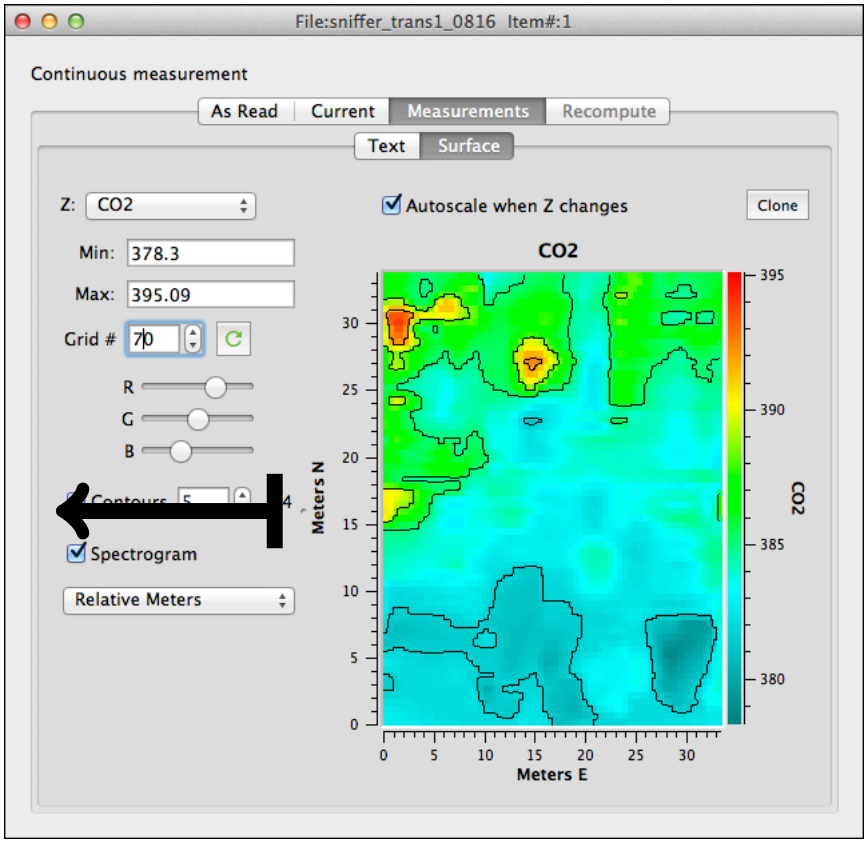
The IV, Mean, and Range records are at the bottom.

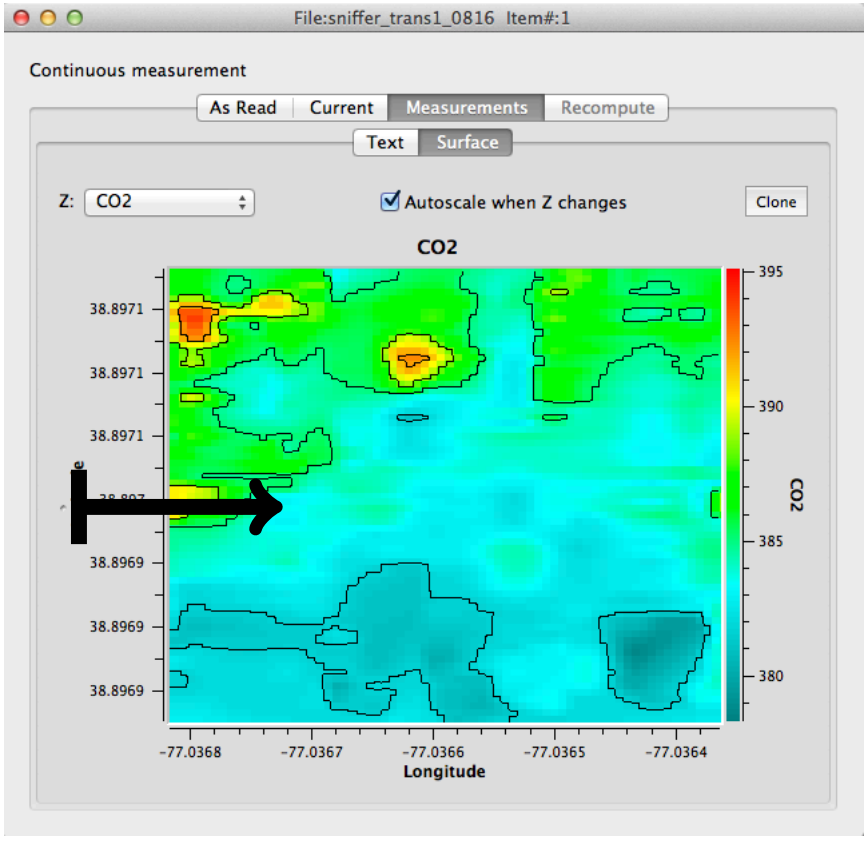
4.2.2 Surface

For Continuous measurements that have GPS data, the Surface tab allows spectrographs and contours to be plotted on the surface of your choice.

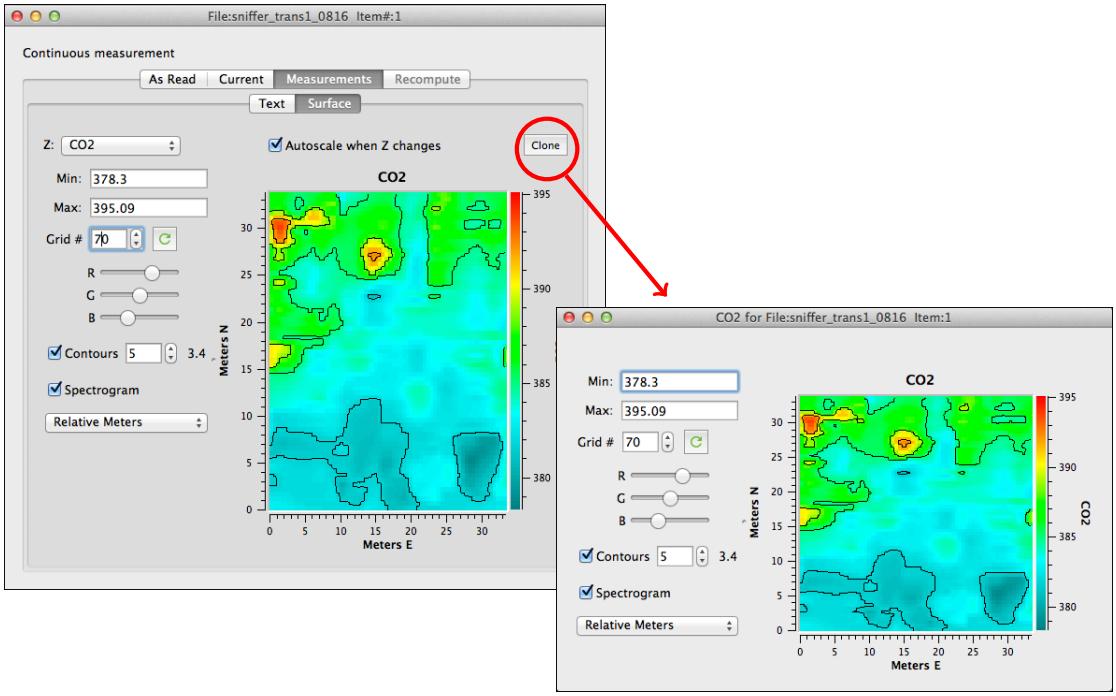


Note the partition control below: sliding it to the left will cover the setup controls.

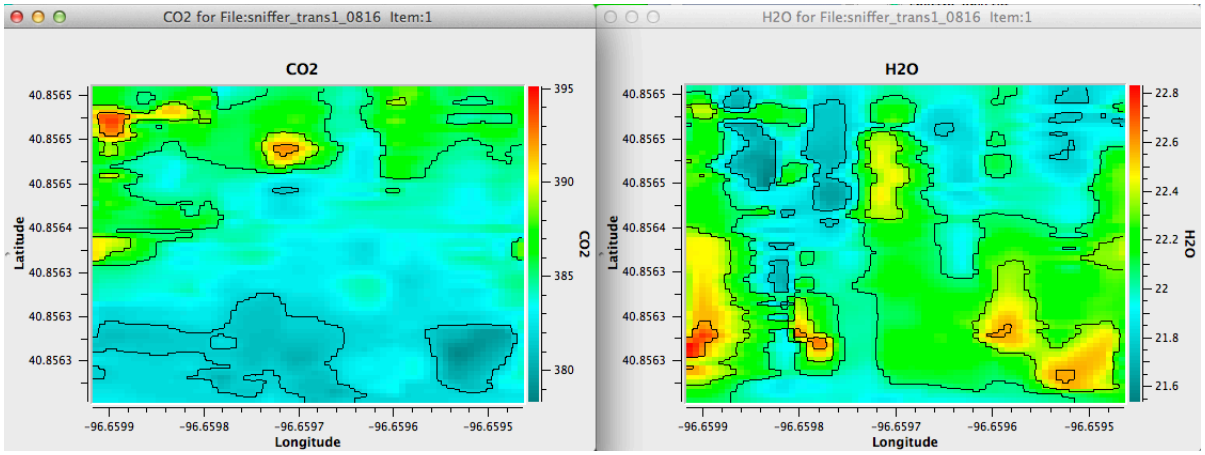




The Clone button will make a standalone window out of the surface graph and controls. The cloned window retains all the controls except being able to change the variable that is plotted. The window is also autonomous from the observation or its detail window that created it. If you delete the source observation from a view, the detail window also goes away, but not this cloned view.

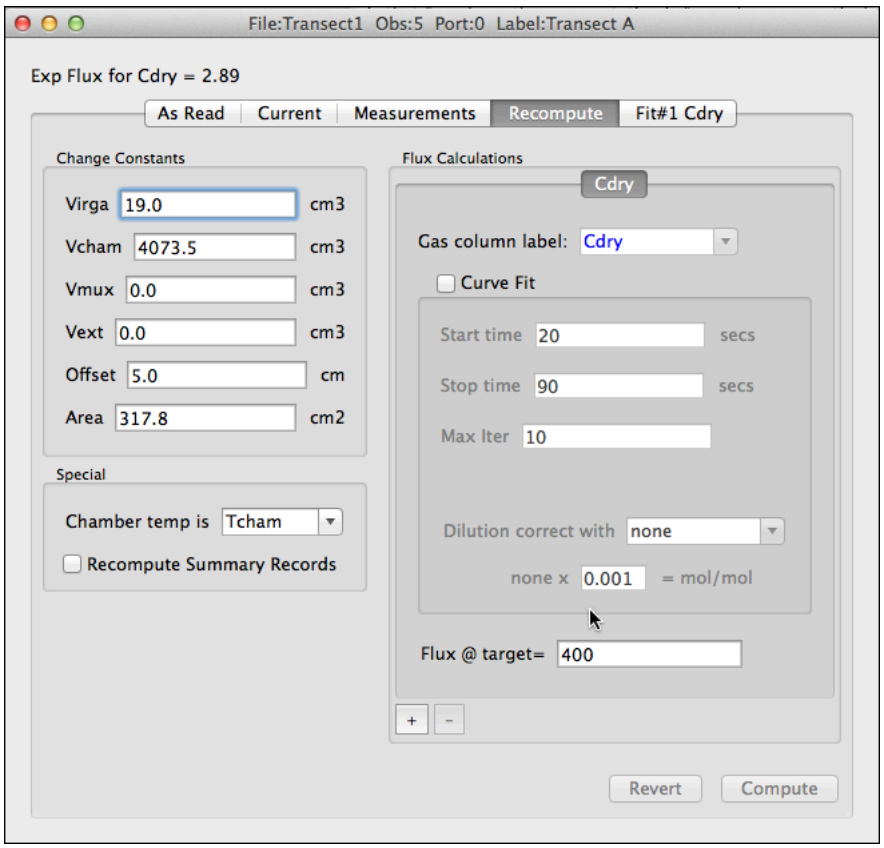


Using clones can let you compare multiple variables from the same observation.



4.3 Recompute

The Recompute tab in the Detailed View provides a mechanism to recompute just the target observation. The interface is very similar to that provided in Recompute Observations; the only difference is that from here, the recomputation is focused on one particular observation.

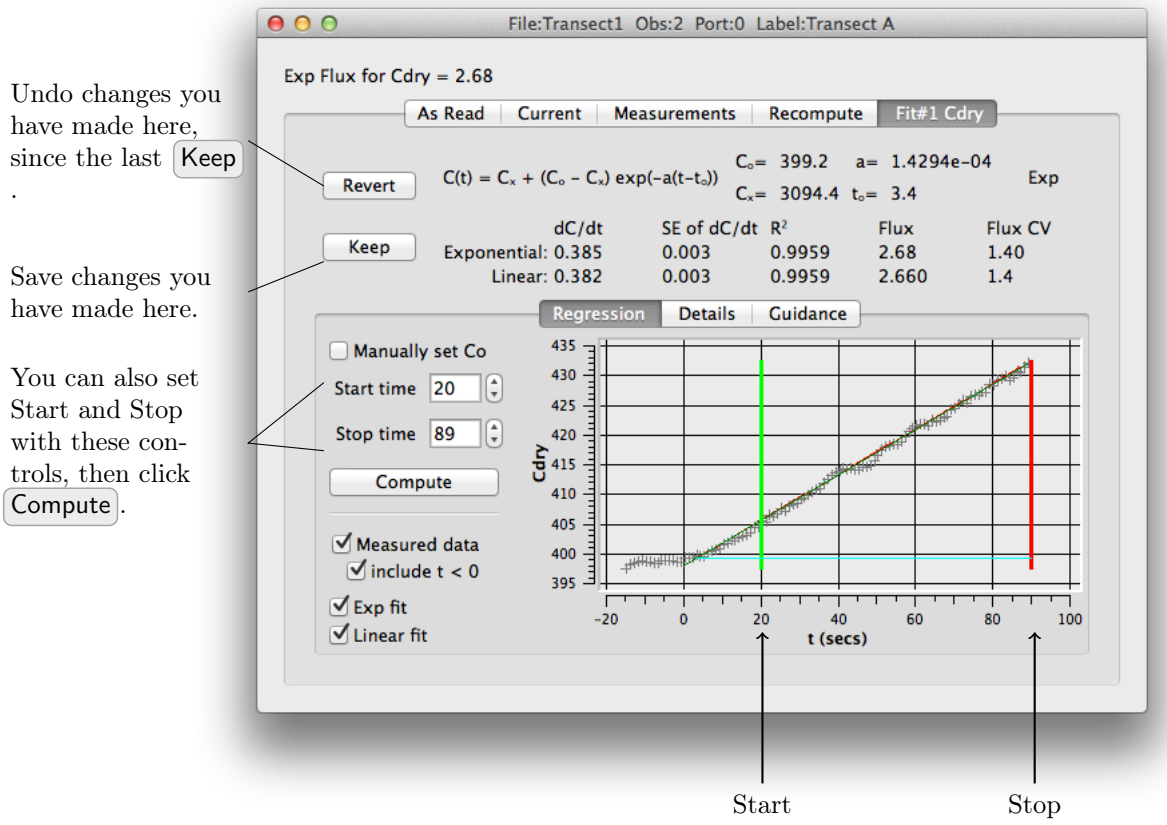


4.4 Curve Fit Details

The Fit tab in the Observation Details view provides a close look at the exponential and linear fits for an observation.

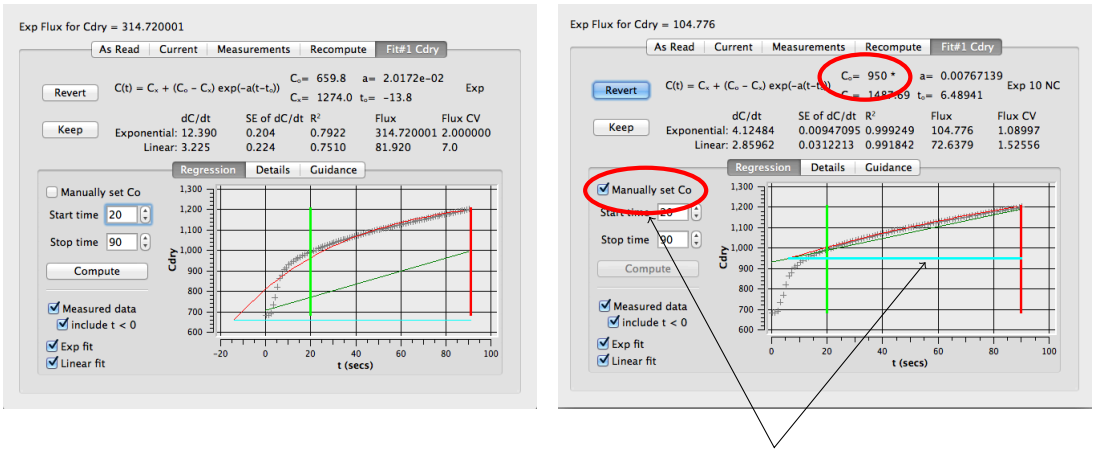
4.4.1 Changing Start/Stop Times

Click and drag the green Start (left vertical) line, or the red Stop (right vertical) line. When you release the mouse button, the data between the lines are linearly and exponentially fit, and the results shown in the grid above the chart. This doesn't actually change the observation, unless you click Keep.



4.4.2 Manually Set C_0

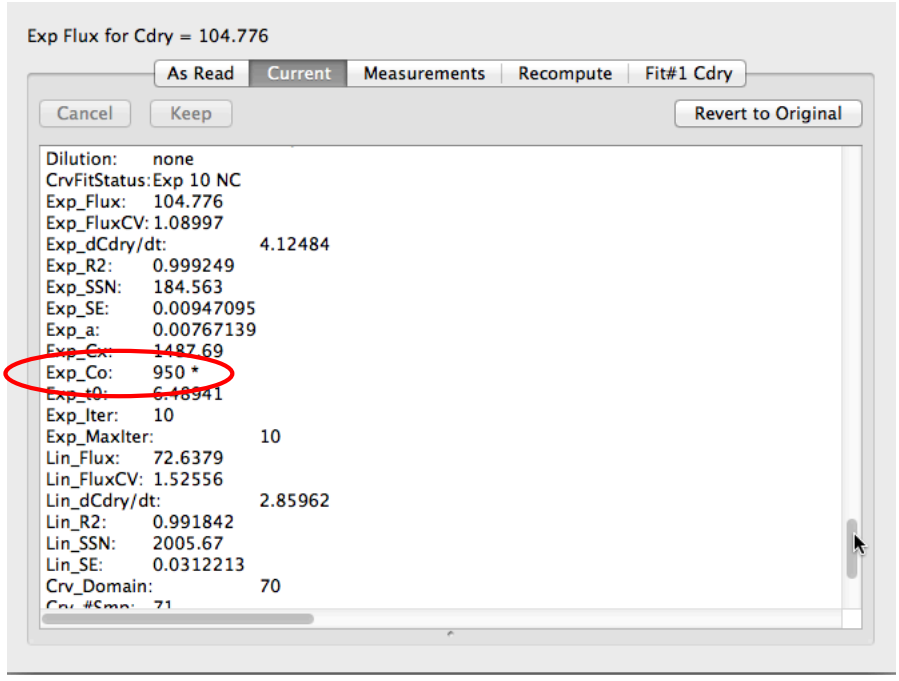
Co, the starting value of **Cdry**, is usually determined from the **IV** value of **Cdry**. You can manually override this by checking the Manually Set Co check box, and clicking and dragging the blue horizontal line to the desired value. This normally is not necessary, but is available for strange data sets such as is shown below.



Check the box, then click and drag the blue line.

The figure is typical of non-standard chambers that do not close, so sampling begins immediately, resulting in a “catch up" period. The software picked a value for **Co** of 659.8 (the blue line, left figure). The right hand figure has the Manually Set Co box checked, and the blue line has been dragged up to a more reasonable-looking value of 950.

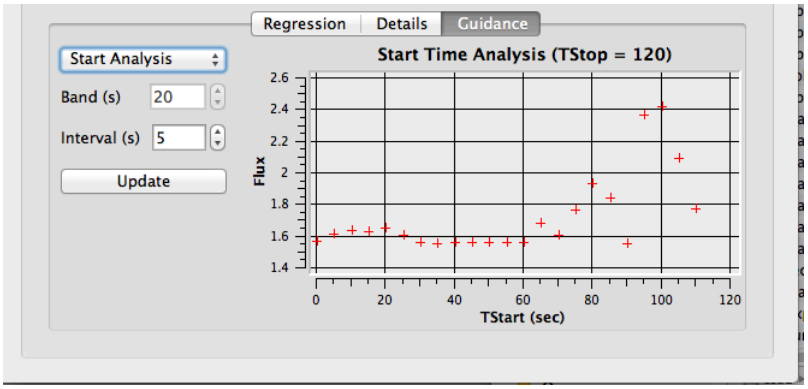
Manually set **Co** values are marked with an asterisk, as seen above and in the Footer.



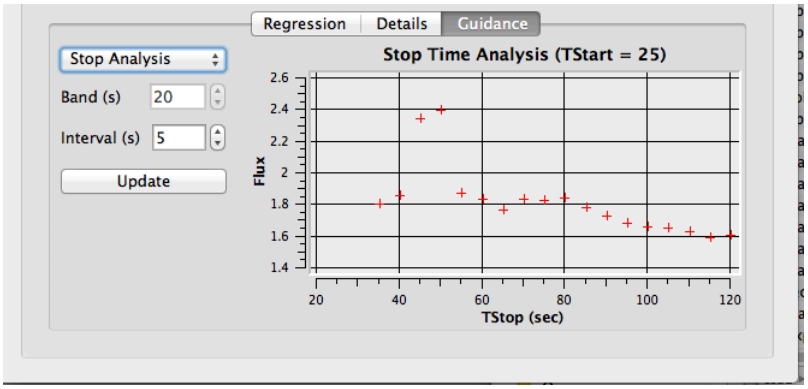
4.4.3 Start/Stop Guidance

The Guidance tab provides some automated tools for assessing start and stop times.

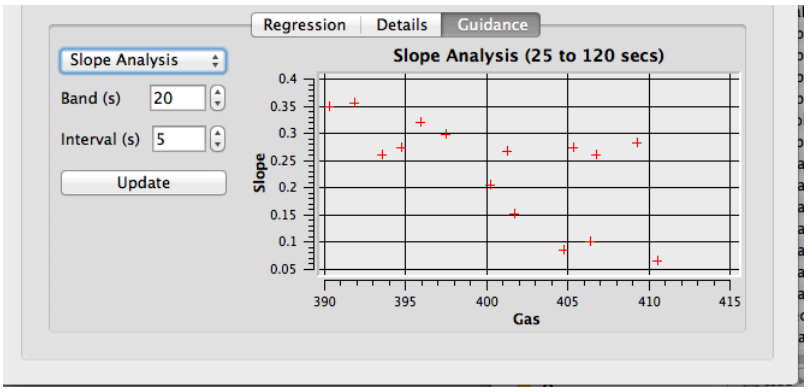
The Start Analysis plot shows Flux as a function of Start time (given the current Stop time).



The Stop Analysis plot shows Flux as a function of Stop time, given the current Start time.



The Slope Analysis shows the slope of an exponential fit of data in a moving band between the current Start and Stop times. In general, you try to work in the region where this changes linearly with CO_2.

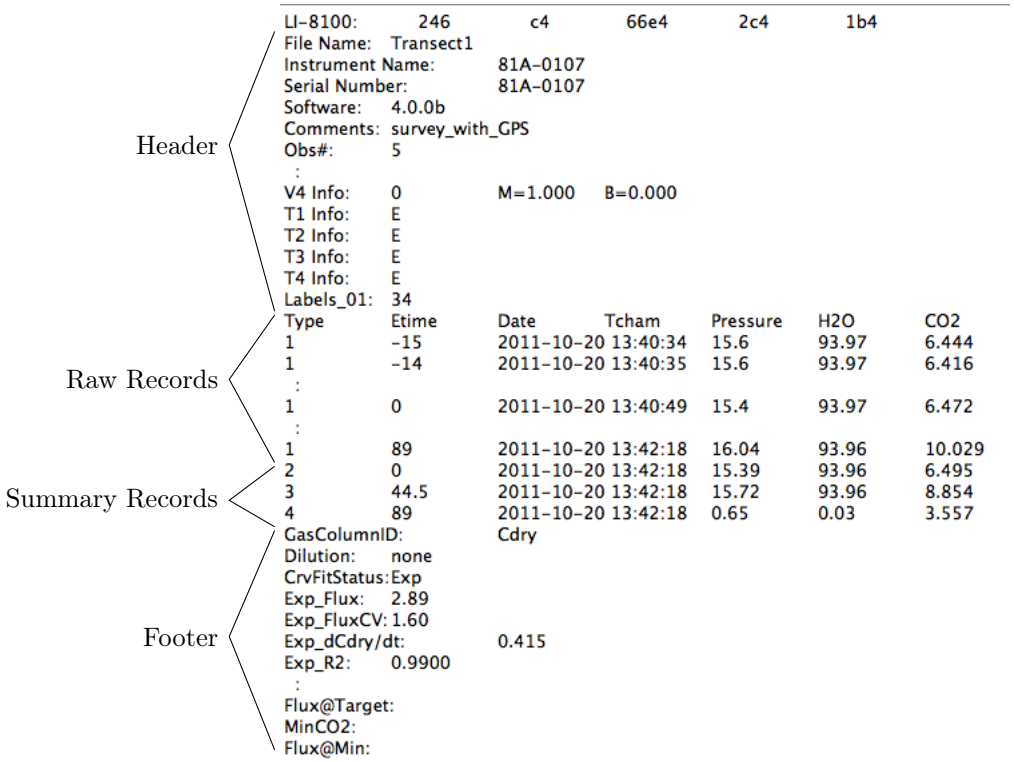


5 Miscellaneous Topics

5.1 LI-8100A Data File Format

5.1.1 Chamber Measurements

LI-8100A chamber measurement files consist of lines of tab-delimited text that constitute one or more Observations. One observation is illustrated below:



Header. The lines from LI-8100A: through Labels_01:.

Raw Records. A record of **Type** = 1. These represent measured data from the time the chamber starts to close, to the when it starts to open.

Type	Description
-1	Warning Record
1	Raw Record
2	Initial Value (Regressed from first 10 seconds of ETime>=0 data))
3	Mean Value (of ETime >= 0 data)
4	Range Value (of ETime >= 0 data)

Summary Records. A record of Type 2, 3, or 4. An Observation has one of each.

Footer. The results of the analysis, including flux values. The footer won't be present for files logged with the **Compute Flux** option off, or for Version 1 files (below). However, SFP will regenerate the footer.

5.1.2 Footer

The footer contains the calculations for an observation. SFP adds multiple flux capability, and these computations add some items to the columns found in the footer. In the example below, there is one extra column **[CH4]_ppm** and two extra rows (**GasColumnID** and **Dilution**). This indicates that an extra flux computation was done, using an imported column, and it used the LI-8100A's water measurement **H2O** for the dilution correction.

GasColumnID:	Cdry	[CH4]_ppm
Dilution:	none	H2O 0.001
CrvFitStatus:	Exp 2	Lin
Exp_Flux:	4.45074	6.54166e-05
Exp_FluxCV:	1.09471	30.5448
Exp_dCdry/dt:	0.878935	1.29185e-05
Exp_R2:	0.999895	0.0773575
Exp_SSN:	14.8426	0.0003644
Exp_SE:	0.0007953	3.94342e-06
Exp_a:	2.6594e-05	1.29185e-11
Exp_Cx:	33,696	1e+06
Exp_Co:	646.609	2.3074
Exp_t0:	1.115	-351.287
Exp_Iter:	2	10
Exp_MaxIter:	10	10
Lin_Flux:	4.44089	6.54166e-05
Lin_FluxCV:	1.09473	30.5448
Lin_dCdry/dt:	0.87699	1.29185e-05
Lin_R2:	0.999894	0.0773575
Lin_SSN:	14.8707	0.0003644
Lin_SE:	0.0007967	3.94342e-06
Crv_Domain:	130	130
Crv_#Smp:	130	130
Dead Band:	00:20	00:20
TimeClosing:	14	14
Target:	400	400
Flux@Target:	4.48395	6.53906e-05
MinCO2:	638.27	2.30123
Flux@Min:	4.45187	6.54166e-05

5.1.3 Continuous Measurements

LI-8100A Continuous Measurement data files consist of lines of comma-delimited text, as is illustrated below:

```
File Name:,sniffer_trans1_0816
Instrument Name:,Sniffer
Serial Number:,81A-0107
Software:,4.0.0b
Comments:,
DATAH,Date,Pressure,H2O,CO2,Cdry,Tbench,T1,T2,T3,T4,V1,V2,V3,V4,LATITUDE,LONGITUDE,STATUS,SPEED,COURSE,RH,Tbo ...
DATA,2011-08-16 10:18:53,93.34,22.1,382.91,391.56,51.95,183.23,183.2,183.2,183.16,0.534,21.59,0.015,2.14748e+06 ...
DATA,2011-08-16 10:18:54,93.33,22.099,383.27,391.93,51.92,183.22,183.18,183.22,183.2,0.534,21.586,0.015,2.14748 ...
DATA,2011-08-16 10:18:55,93.34,22.1,383.5,392.17,51.95,183.25,183.2,183.2,183.2,0.534,21.59,0.015,2.14748e+06,38 ...
DATA,2011-08-16 10:18:56,93.35,22.113,383.42,392.09,51.97,183.23,183.2,183.23,183.18,0.534,21.59,0.015,2.14748e ...
DATA,2011-08-16 10:18:57,93.35,22.117,383.58,392.26,51.97,183.27,183.2,183.2,183.2,0.534,21.59,0.015,2.14748e+0 ...
DATA,2011-08-16 10:18:58,93.36,22.115,383.81,392.49,51.97,183.24,183.22,183.2,183.2,0.534,21.586,0.015,2.14748e ...
DATA,2011-08-16 10:18:59,93.34,22.1,384.01,392.69,51.97,183.24,183.2,183.2,183.22,0.534,21.599,0.015,2.14748e+0 ...
```

5.2 SFP Definitions

SFP classifies the variables in LI-8100A files into three types: Header, Measured, and Footer, and adds a fourth type, Miscellaneous.

5.2.1 Miscellaneous Variables

Miscellaneous variables are not produced by the LI-8100A, but are added by SFP.

Label	Description
Item#	When a file is read, observations are assigned values starting with 1. They retain this number throughout their life loaded in SFP, even if observations are sorted, copy-pasted, etc. This value is not retained when a view is written to a file; when that file is read, Item# values are again assigned based on the order observations are read.
Type	Cham if a chamber measurement, or Cont if a continuous measurement.
#Msgs	The number of Warnings and Messages. Warnings are -1 TYPE records found in the data. Messages may be generated when SFP reads the file.
#Raw	Number of Type 1 records in the observation.
#Gasses	Number of gasses for which flux computations have been done. That is, the number of data columns in the footer. See Version 3.2 Footer.
ObsDateTime	Equivalent to the Date value of the record having ETime = 0.
ObsDateTime	Day of the Year (fractional) of ObsDateTime.
ObsDecHr	Decimal hour of the day of ObsDateTime.
HasGPS?	Yes if there are GPS columns (at least Latitude and Longitude) in the raw and summary data.

5.2.2 Header Variables

Header variables are in the header of files produced by the LI-8100A.

Label	Description
LI-8100	5 hexidecimal values giving the size of the header, label, raw data, summary data, and footer. This is not used by SFP.
File Name	The original file name (as stored on the LI-8100A) is preserved by SFP, regardless of how you may rename the Windows files that contain this data, or cut and paste observations.
Instrument Name	
Serial Number	
Software	Version of the embedded code in the instrument. If the file has been stored by SFP, this field will also contain the SFP version.
Comment	User entered at time of data collection.
Obs#	Observation number.
Port#	Multiplexer port number. (0 if not using a multiplexer.)
Label	User entered at time of data collection.
Observation Length	The original observation length.
Observation Delay	Wait time between observations. (Renamed in version 3 to Prepurge.
Pre-purge	Wait time before observations (named Observation Delay in v.2).
Post-purge	Wait time after observations (new in version 3).
IRGA Averaging	Averaging time for the gas analyzer.
Chamber	Model identifier for the chamber used.
TSource	Which channel to use for temperature for flux computations.
Flow8100	Pump setting in the LI-8100A box.
FlowMux	Pump setting in the multiplexer box.
Tmux	Multiplexer temperature at start of observation
Virga	Volume of the IRGA (cm3)
Vmux	Volume of the multiplexer (if used) (cm3)
Vext	Volume of extension tubing (cm3)

Continued on next page

Header Variables, Cont'd

Label	Description
Vcham	Volume of the chamber (cm3)
Offset	Offset (cm) used in volume calculation
Area	Exposed soil area (cm2)
Vtotal	Total volume (cm3)
V1..V4 Info	Information on how the voltage channel is configured: Multiplexer channel, slope, offset, etc.
T1...T4 Info	Thermocouple type information.
Labels_01	Number of columns in the raw data section

5.2.3 Measured Variables

Summary statistics of measured variables are identified by the column label, and a prefix of **IV**, **Mean**, or **Range**. Thus, for example **IV Cdry** means the Type 2 value of the **Cdry** column, and **Range Etime** means the Type 4 value of the **Etime** column.

5.2.4 Footer Variables

The table below describes the Footer variables.

Label	Description
CrvFitStatus	Curve fit solution. **Exp** means the exponential fit was better than the linear fit (Exp_SSN < Lin_SSN). **Lin** means the linear fit was still better after the maximum number of iterations, and the nonlinear coefficients have therefore been derived from linear fit.
Exp_Flux	Flux computed from Exponential Fit.
Exp_FluxCV	Coefficient of variance (%) of Exp Flux.
Exp_dCdry/dt	Slope of the Exponential Fit at time t_0.
Exp_R2	Correlation coefficient for Exponential Fit.
Exp_SSN	Normalized sum of squares of residuals for Exponential Fit.
Exp_SE	Standard error (%) of the Exponential Fit.
Exp_a	The a term in the Exponential Fit.
Exp_Cx	The C_∞ term in the Exponential Fit.

Continued on next page

Header Variables, Cont'd

Label	Description
Exp_Co	The C_0 term in the Exponential Fit. Usually the IV value of Cdry, but if followed by $*$, indicates it has been manually set. See Manually Set Co.
Exp_t0	The t_0 term in the Exponential Fit.
Exp_Iter	Number of iterations used in the Exponential Fit.
Exp_MaxIter	Maximum number of iterations allowed for the Exponential Fit. This is fixed to 10 in the LI-8100A, but can be adjusted in SFP.
Lin Flux	Flux computed from Linear Fit.
Lin_FluxCV	Coefficient of variable (%) of Lin Flux
Lin dCdry/dt	Slope of the Linear Fit.
Lin_R2	Correlation coefficient for the Linear Fit.
Lin_SSN	Normalized sum of squares of residuals for Linear Fit.
Lin_SE	Standard error (%) of the Linear Fit.
Crv_Domain	Time span (s) used in the curve fit.
Crv_#Smp	Number of data points used for curve fitting.
Dead Band	Time (s) after the chamber closes that are skipped by the analysis, in the latest (re-)computation
TimeClosing	Time (s) it took the chamber to close.

The values below are not part of an LI-8100A data file as output by the instrument. They are, however, added to the footer of files saved by SFP.

GasColumnID	The column label for which flux is computed. The first one will always be Cdry.
Dilution	The column label used for the H2O measurements if a dilution correction is applied to the GasColumnID flux computation. When computing flux for Cdry, this is none, since dilution is already accounted for in Cdry. If a column label is specified, it will be followed by a decimal value, that represents what was used to convert the value in the water column to units of mol/mol.
Target	See Compute Targeted Flux.
Flux@Target	Flux at Target (Compute Targeted Flux).
MinCO2	Minimum CO_2 during chamber closing.
Flux@Min	Flux computed at the Minimum CO_2 value.

5.3 Curve Fitting Details

The LI-8100A (and SFP) fit measured variables **Cdry** vs. **Etime** in two ways: the traditional linear fit, and the theoretically more correct exponential fit.

Linear Fit. Dilution corrected CO_2 (C) is plotted against time in seconds (t) and fit by linear regression.

$$C(t) = mt + b \tag{5}$$

where slope m is reported as **Lin dCdry/dt**. Offset b is not reported. The correlation coefficient of this fit is reported as **Lin_R2**. The CO_2 flux based on this rate is reported as **Lin Flux**.

Exponential Fit. Dilution corrected CO_2 (C) is plotted against time in seconds (t) and fit by a nonlinear regression.

$$C(t) = C_\infty + (C_0 - C_\infty)e^{-a(t-t_0)} \tag{6}$$

C_0 is the starting concentration, and is known (**Type** 2 value of **Cdry**). It is also the theoretical concentration when $t = t_0$. The nonlinear regression solves for C_∞ , t_0, and a, which are reported as **Exp_Cx**, **Exp_a**, and **Exp_t0** respectively. The correlation coefficient of the fit is **Exp_R2**, the slope at $t = t_0$ is **Exp_dCdry/dt**, the standard error of this slope is **Exp_SE**, the CO_2 flux based on this slope is **Exp_Flux**, and the coefficient of variation of this flux (in %) is **Exp_FluxCV**.

The data sets are the same for both fits, and is some subset of the Raw Records. There is a dead band (**Dead Band**) of user-defined length to allow for complete mixing in the just closed chamber (SFP labels this value to as Start time). The LI-8100A uses all of the raw records after the start time slash deadband, but SFP allows you to shorten this by specifying a Stop time. How much data was fit (number of seconds) is available as **Crv_Domain**, and **Crv_# Smp** is the number of data points.

Exp_Iter reports the number of iterations that the nonlinear regression took, which typically is less than 5. If the regression takes the maximum number of iterations (**Exp_MaxIter** - set via Recompute) and still hasn't converged, then the normalized sums of the squares of the residuals are compared (**Lin_SSN** and **Exp_SSN**) to see which gave the better fit. **CrvFitStatus** reports the result as **Lin** or **Exp**. **Exp** means the nonlinear fit had lower residuals than the linear fit, and **Lin** means the linear fit was better. Whenever **Lin** is reported, note that the nonlinear coefficients are set as follows, based on the linear fit:

$$\begin{aligned} C_\infty &= 1 \times 10^6 \\ t_0 &= \frac{C_0 - b}{m} \\ a &= \frac{m}{C_\infty - C_0} \end{aligned} \tag{7}$$

Lin usually indicates something strange with the data, caused by gusty conditions, a poor chamber seal with surface, excessive **DeadBand**, etc..

5.4 Preferences

The Preferences Dialog allows you to modify the tool bar appearance.