SoilFluxPro™

The LI-8100 Data File Viewer (ver 4.0)

revised 08/22/15

LI-COR

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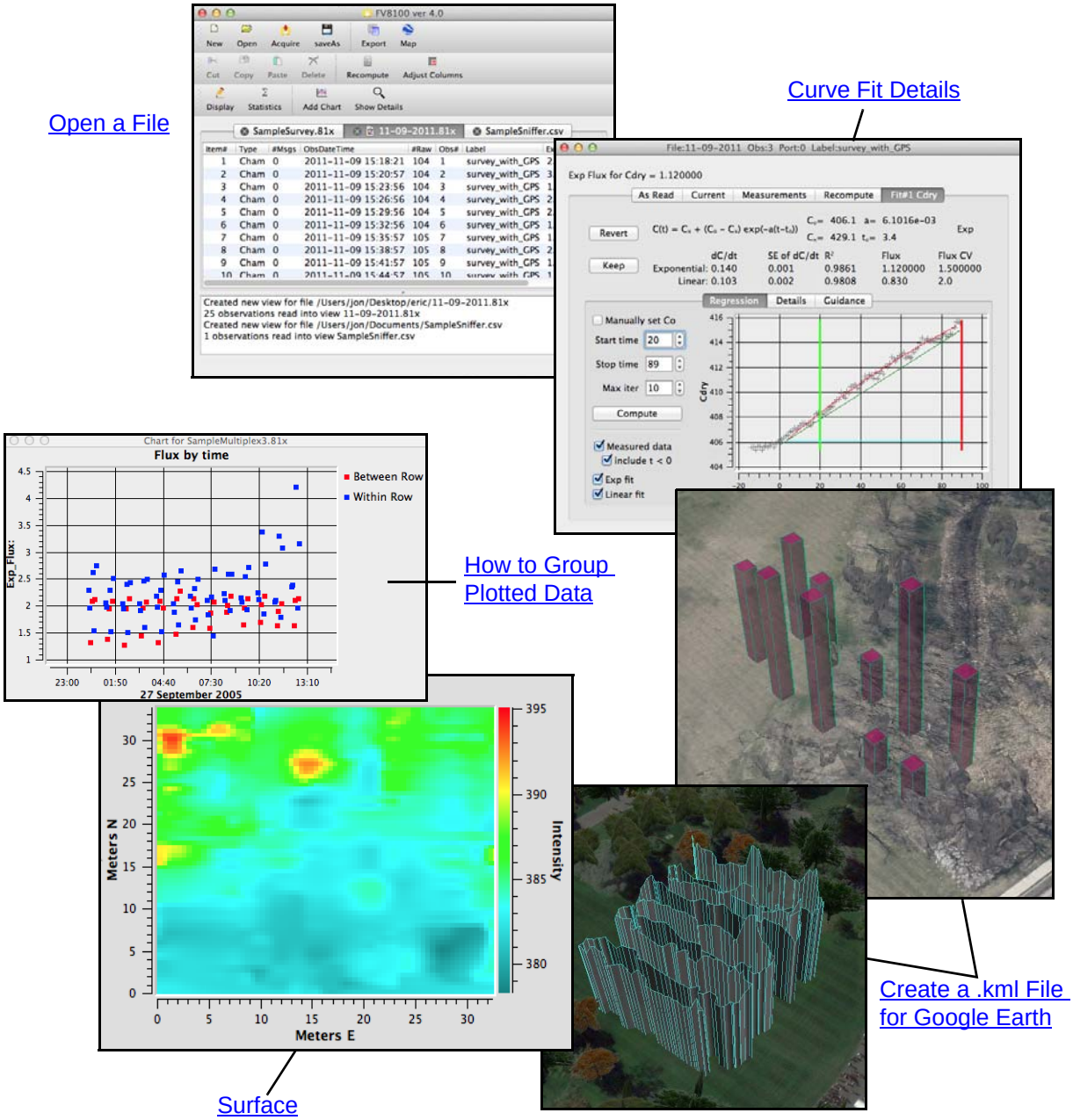
Introduction

SoilFluxPro™ software (formerly FV8100) is a multi-platform application designed to view and analyze data files for both chamber and continuous measurements generated by the LI-COR LI-8100 Automated Soil CO_2 Flux System.

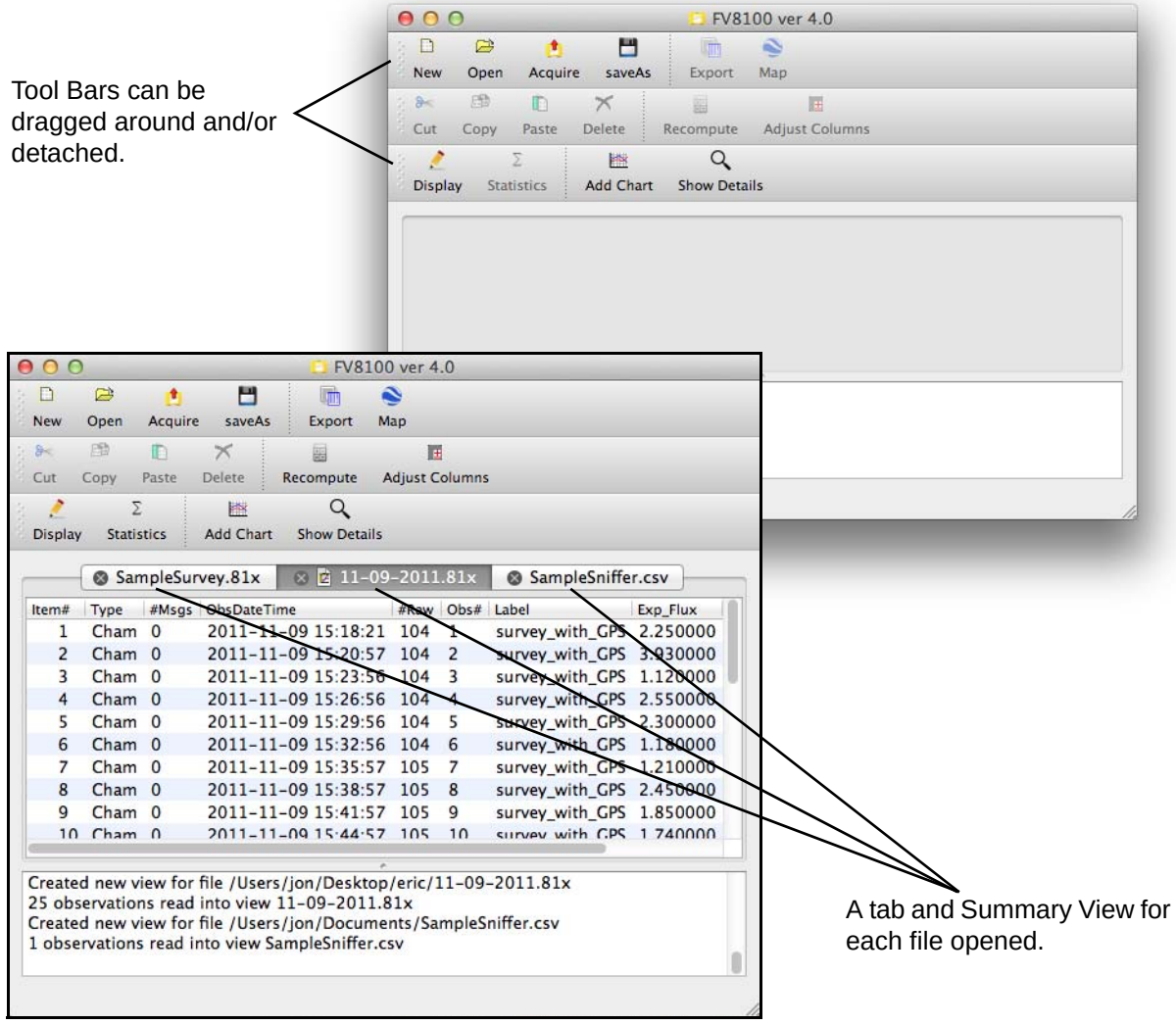
SoilFluxPro offers a very convenient way to view selected quantities or summaries of these files, as well as quickly plot meaningful analyses that let you evaluate the measurements. Editing and recomputations are also easily done.



Introductory Tour

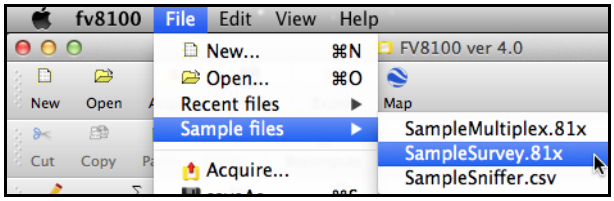
1. Launch SoilFluxPro

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



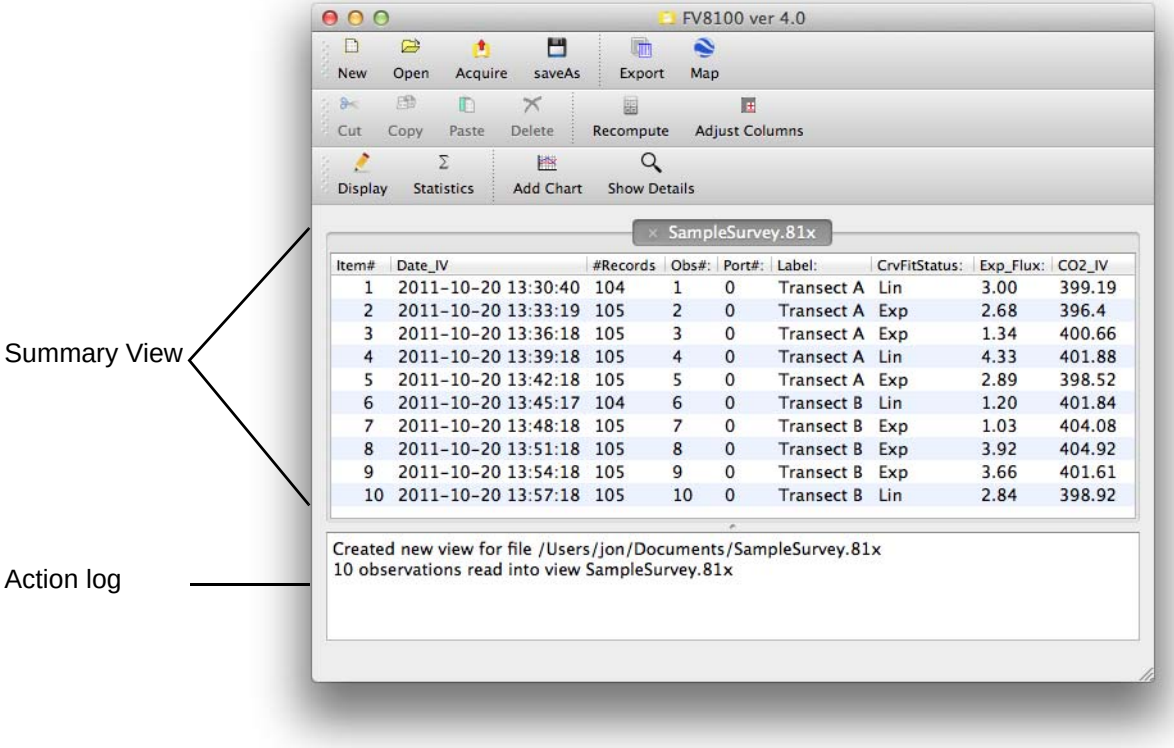
2. Open a Data File

Normally, you would click the Open button, and pick an LI-8100 data file. Note that there are also several sample files located under **Sample files** in the **File** menu; we'll select the survey example.



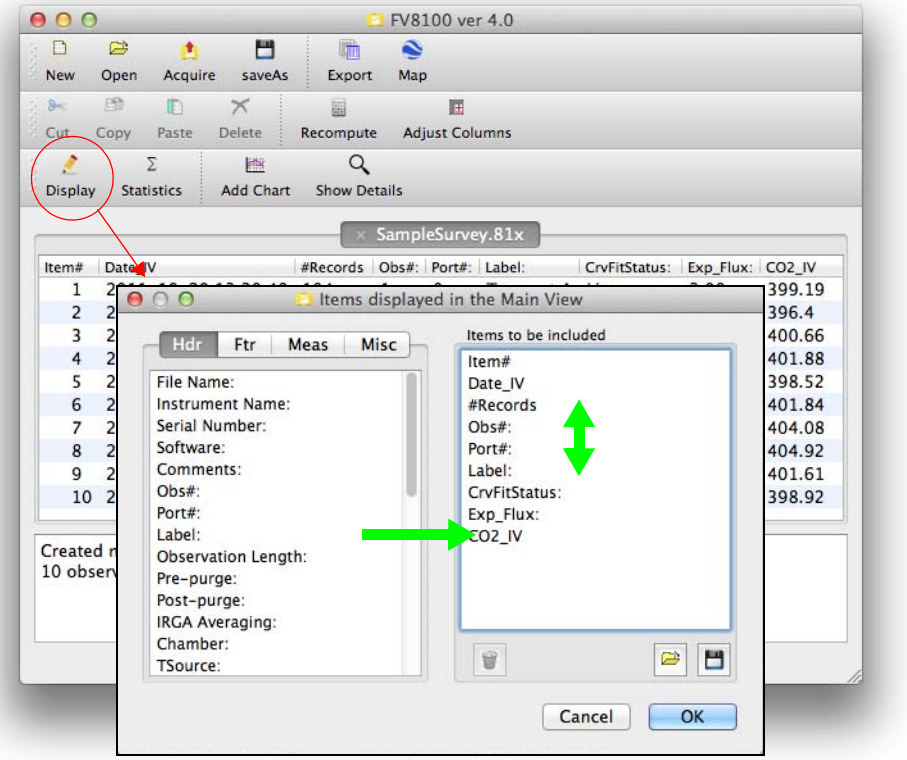
3. The Summary View

Each observation in the data file is shown on one line in the summary view. In the example here, 10 observations from an LI-8100 with a survey chamber were read in. Each observation is represented by 1 line, showing selected variables (Label, Obs#, etc.) from that observation.



4. Setting the Displayed Variables

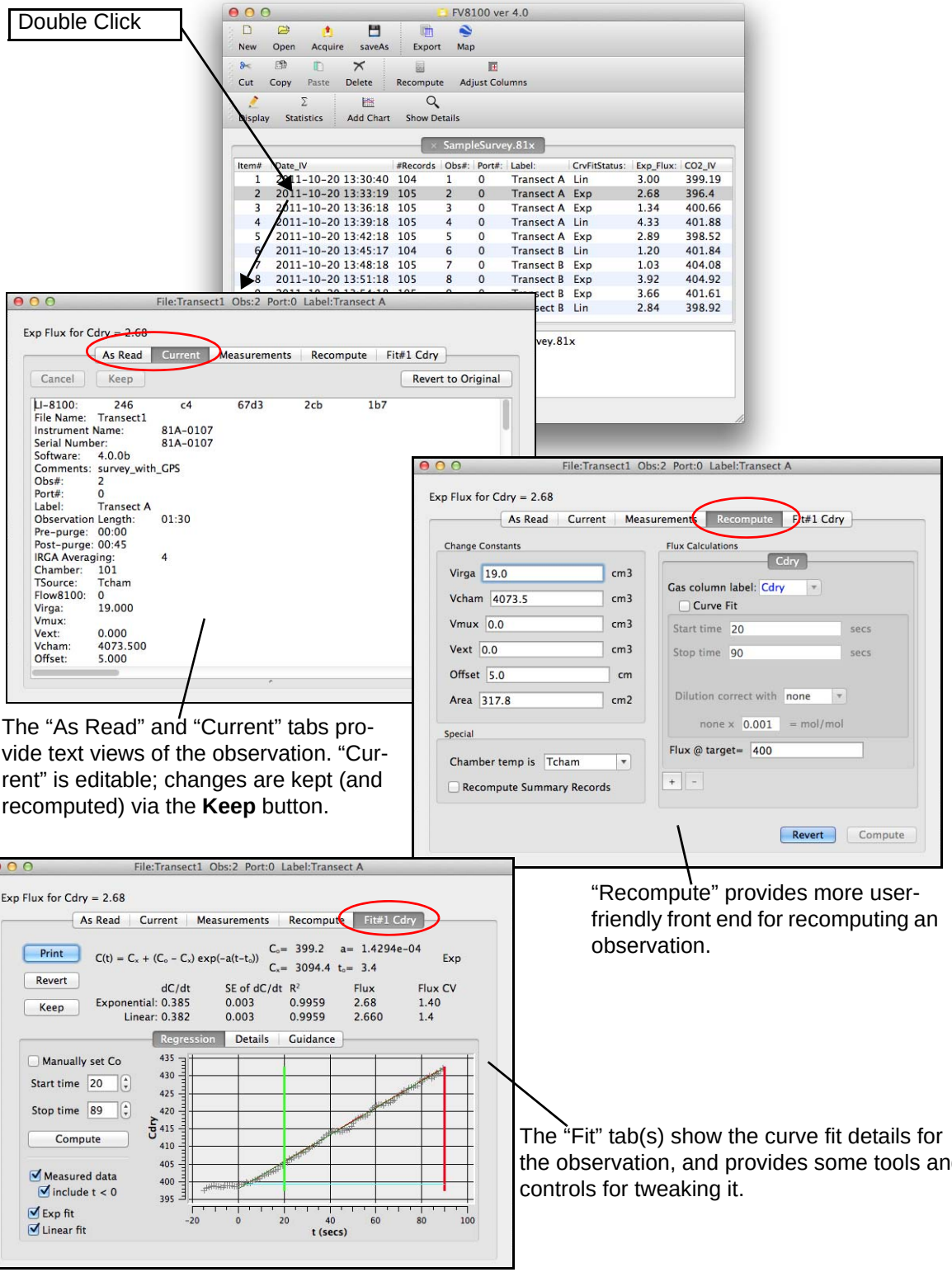
The variables that are displayed for each observation can be selected by you. Click on the Display button, to bring up the dialog for changing them.



Click and drag to add items from left list to 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 “zoom in”, and look at 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.



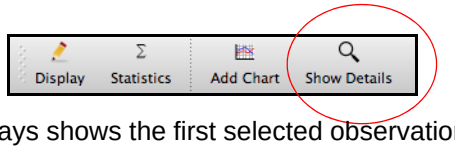
The “As Read” and “Current” tabs provide text views of the observation. “Current” is editable; changes are kept (and recomputed) via the **Keep** button.

“Recompute” provides more user-friendly front end for recomputing an observation.

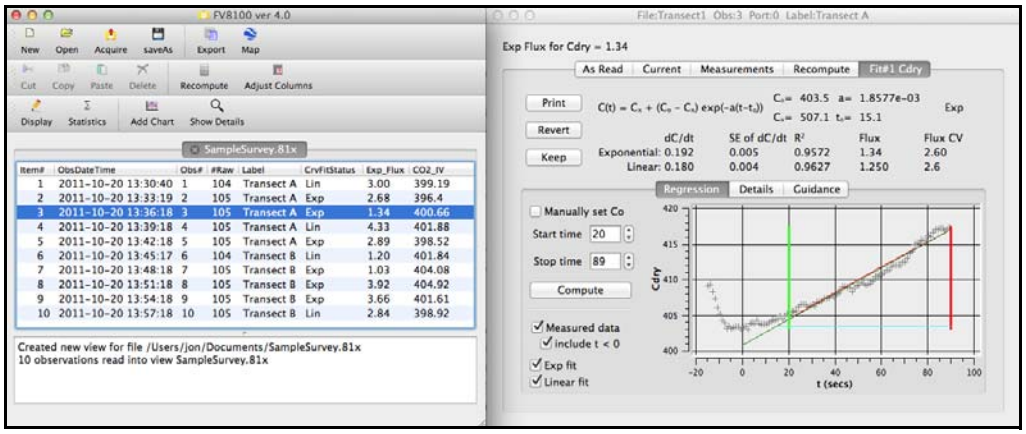
The “Fit” tab(s) show the curve fit details for the observation, and provides some tools and controls for tweaking it.

6. Zoom in on an Observation (Method 2)

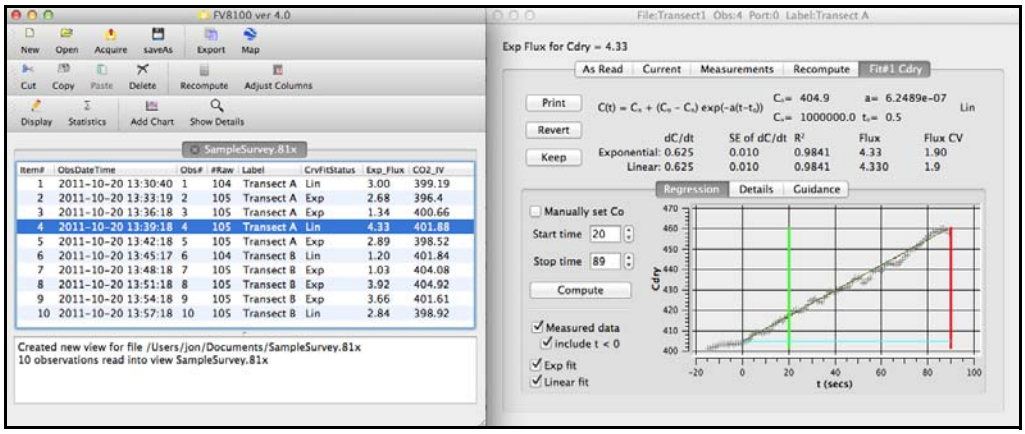
A second method for seeing details of an observation is to open the Details window. This window does not belong to any one observation, but rather shows the first highlighted observation, or (if there are none) the first observation in the active summary view. You can use this to quickly step through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



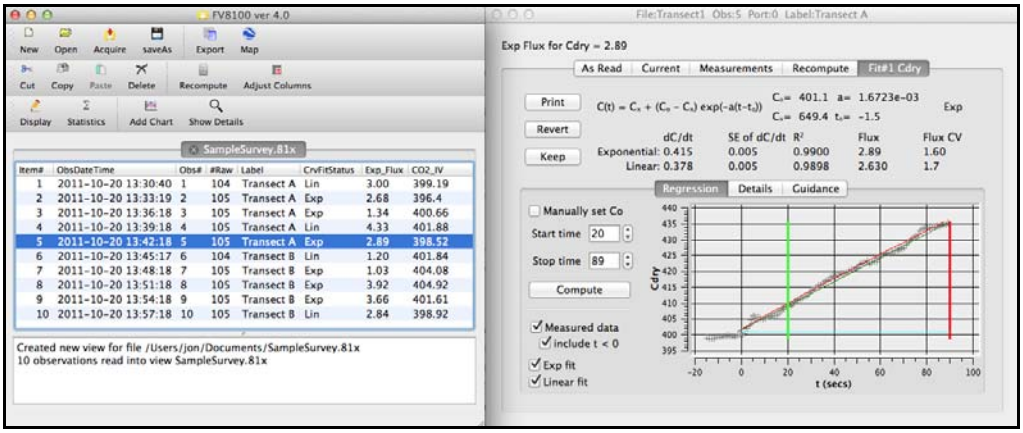
Always shows the first selected observation in the active view.



Press ↓

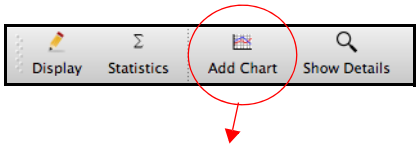


Press ↓

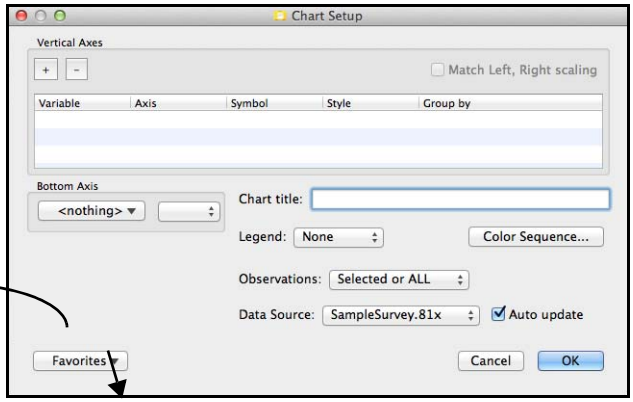


7. Make a Chart

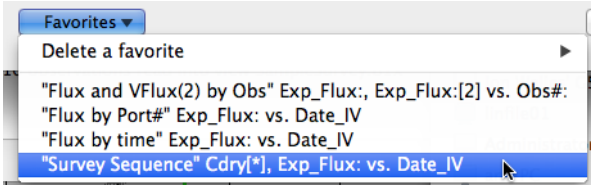
Next, we will demonstrate charts. Click the **Add Chart** button.



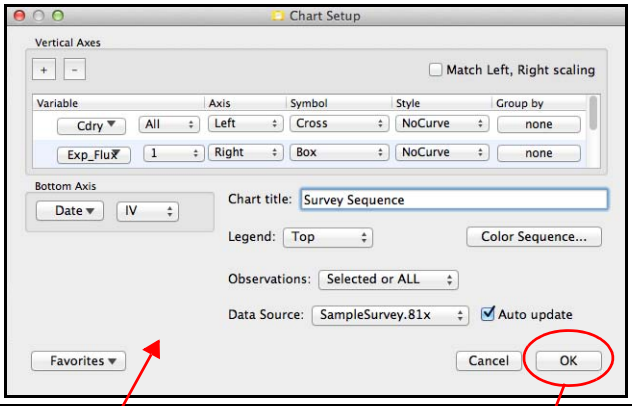
1. You are presented with an empty plot definition.



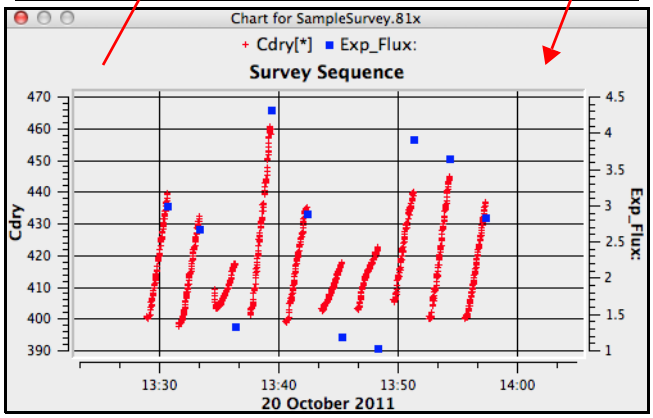
2. Click on Favorites and select “Survey Sequence” from the Favorites menu. The dialog should change as shown below.



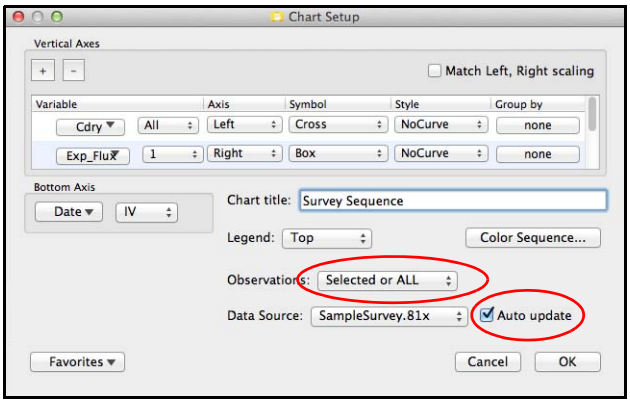
3. Click **OK** to draw the chart.

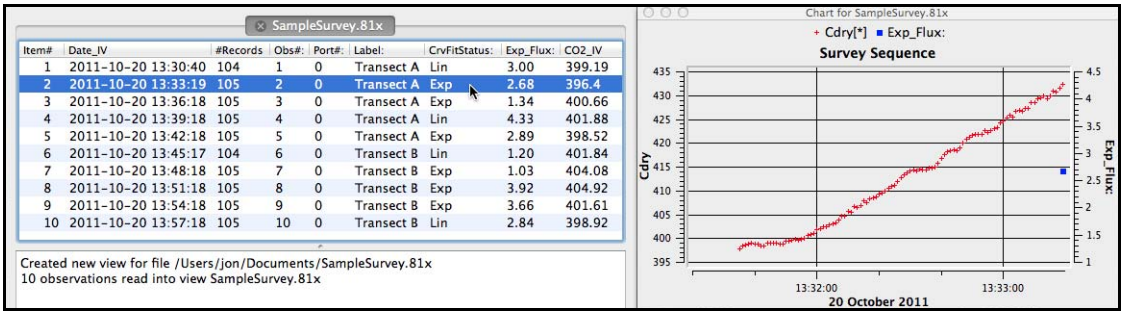


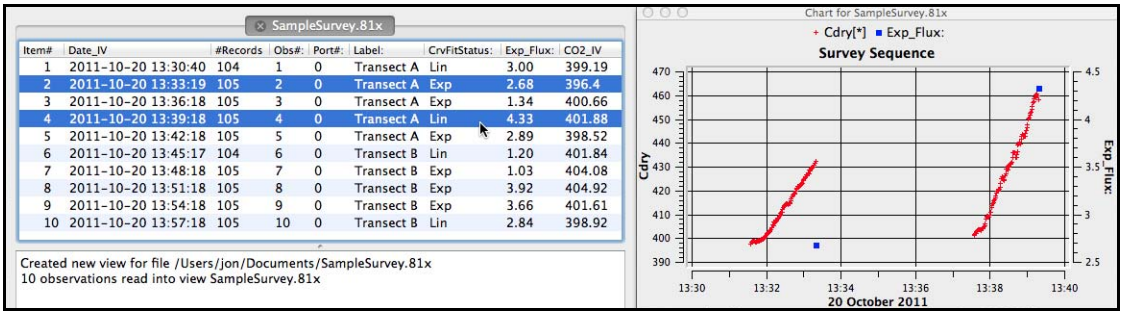
4. You can **double click** on the chart to bring back the Setup Dialog.

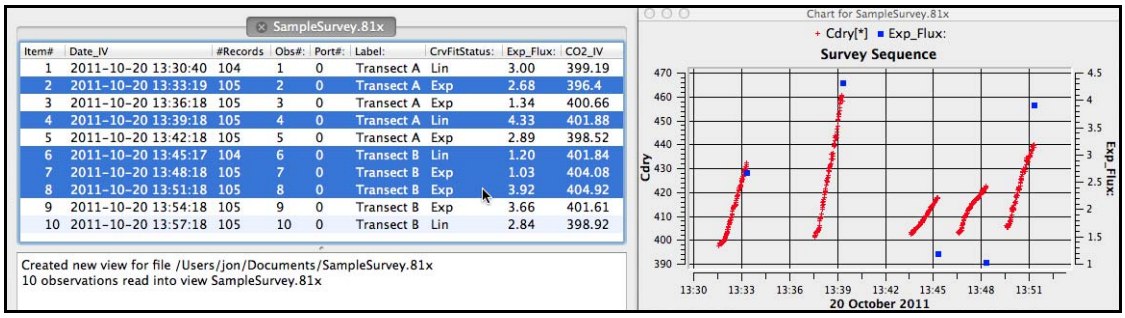


When the “Observations:” setting in the setup dialog is “Selected or All”, and “Auto update” is checked, then the chart will update anytime a selection change is made in the summary view, as illustrated below:



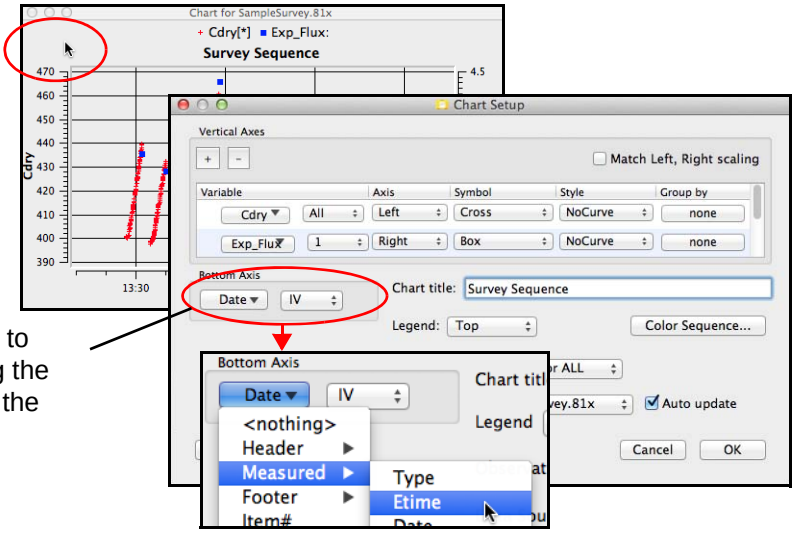




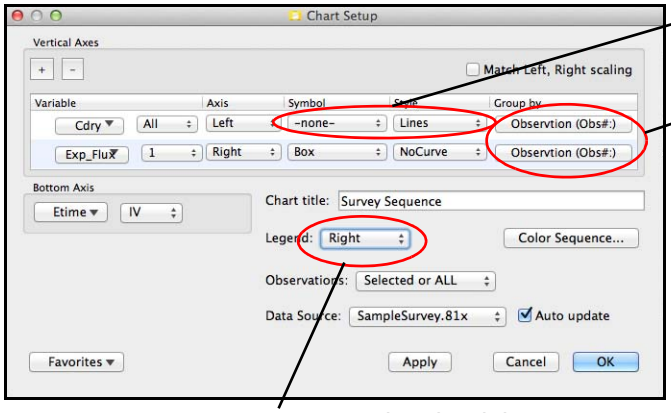


Suppose we want to superimpose the Cdry vs. time curves. Double click the chart to bring up the setup dialog for it, and modify it like this:

1. Double click the chart



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

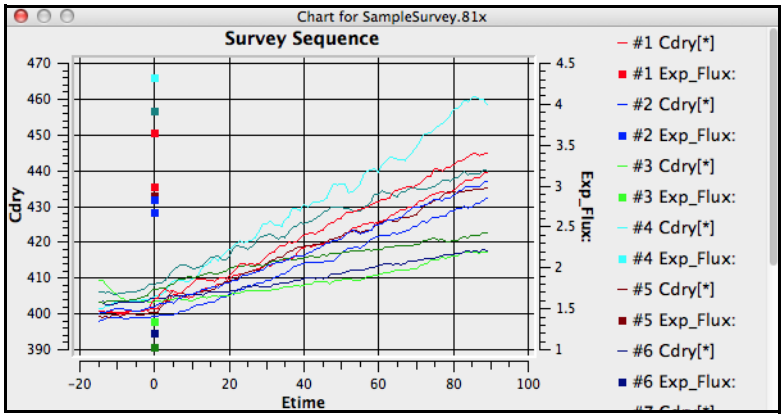


3. Change the Cdry symbol to '-none-', and Style to 'Lines'.

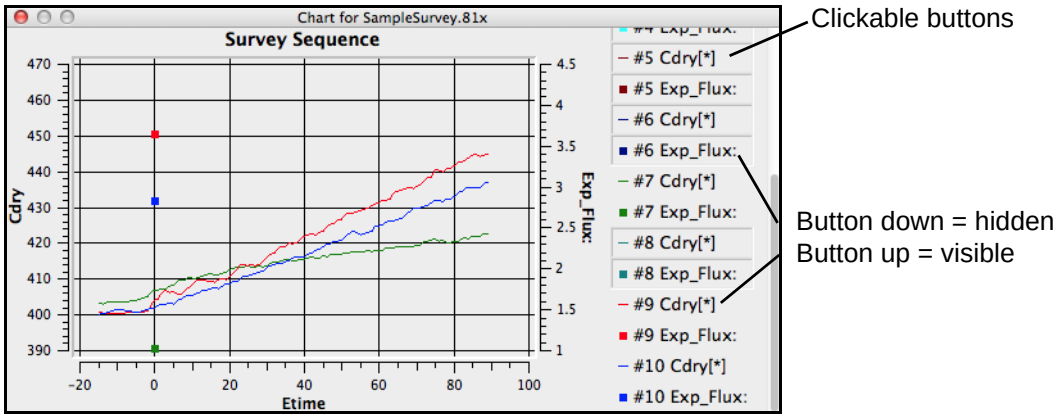
4. Set grouping for both variables to "Observation"

5. Move Legend to the right.

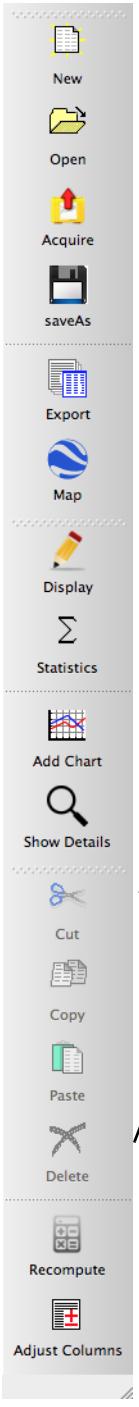
6. Click **OK**



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



Summary View



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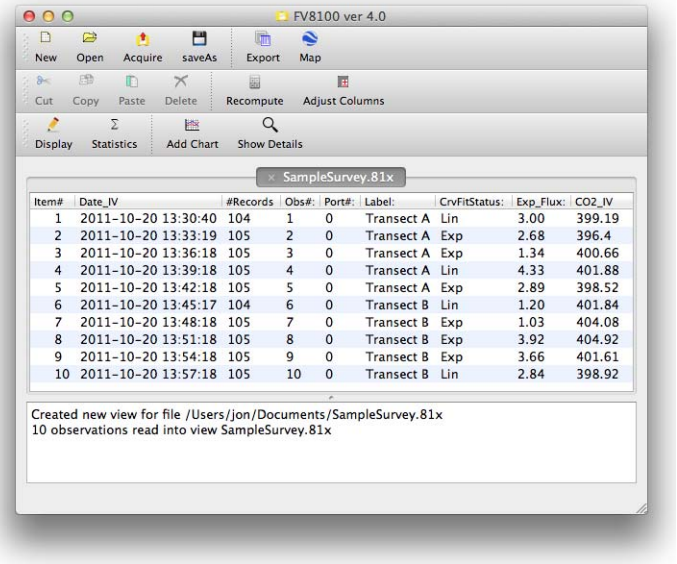
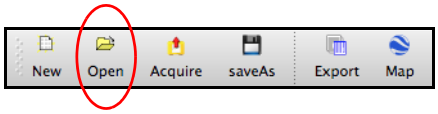


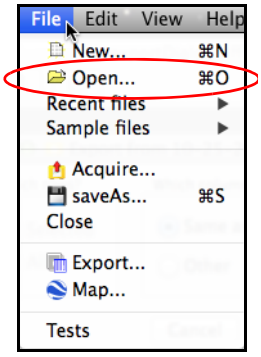
Open a File

Summary View

SoilFluxPro can read both Chamber and Continuous measurement types. Both measurement types can reside within the same file. Also, it really doesn't matter what the extension type (.81x, .csv) is for a file.

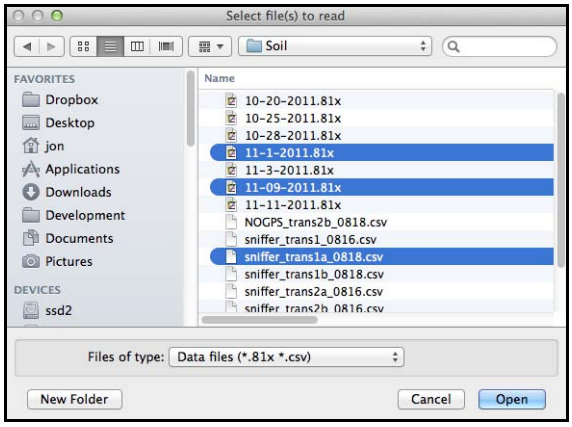
1. Click Open on the tool bar, or select Open in the File menu



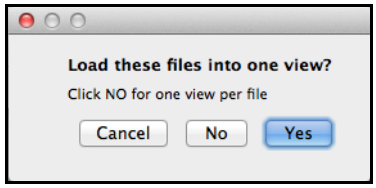


2. Use the Open file dialog box to navigate to the desired directory, and select the file(s) to be opened.

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



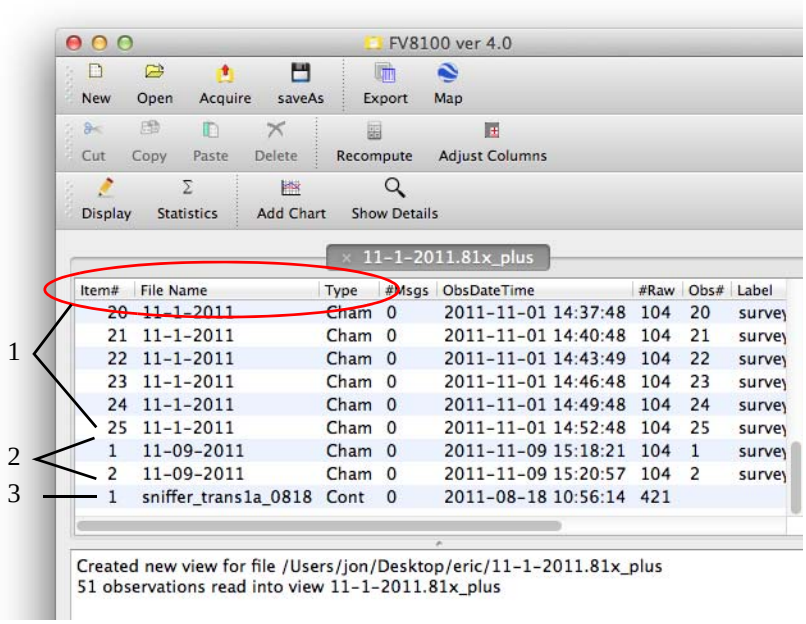
Note: You can select multiple files. Use <ctrl> + click to select individual files, or <shift> + click to select a range. If multiple files are selected when you click Open, you are given a choice of combining them all into one view, or keeping them separate



When multiple files are combined, each observations 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.

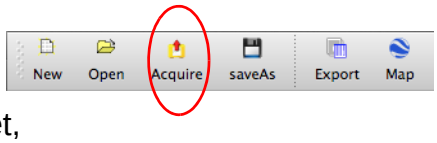


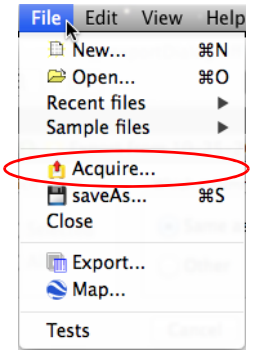
Import Data From an LI-8100

Summary View

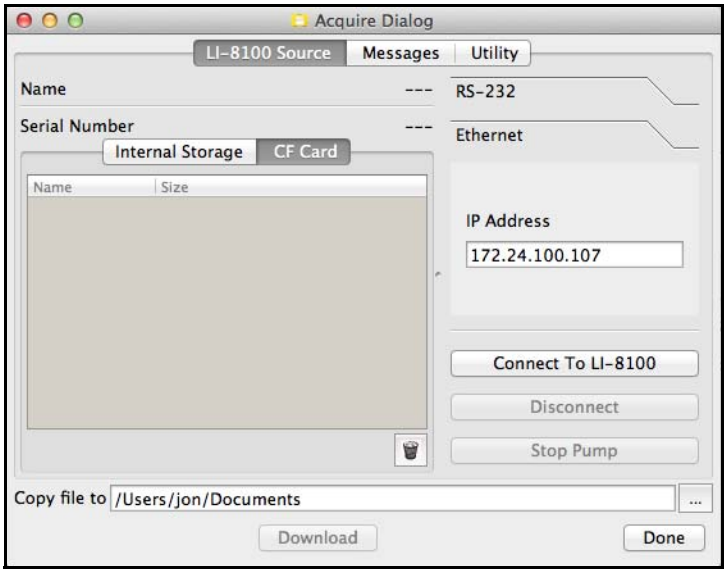
SoilFluxPro can read data files directly from an LI-8100.

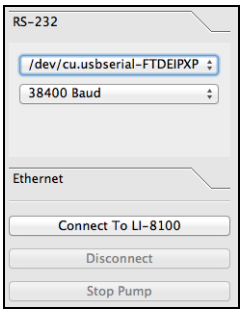
1. Click the Acquire button on the tool bar, or select it from the File menu.



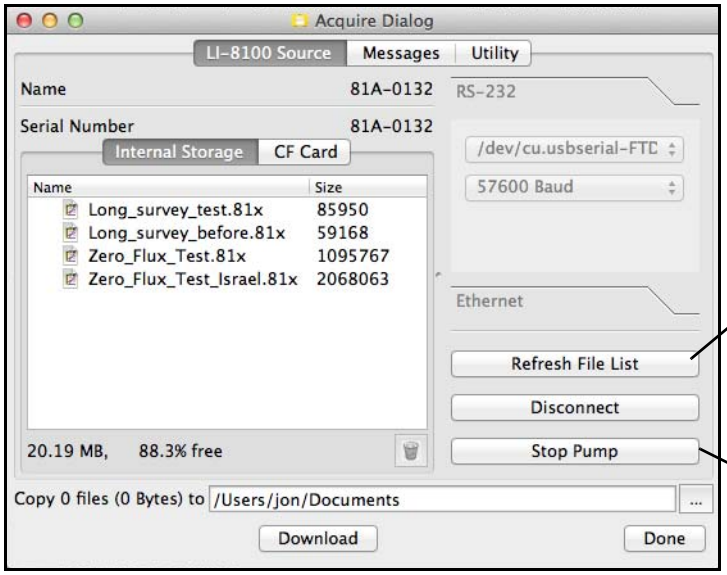


2. Specify IP address if using Ethernet, or select the comm port if using RS-232.





3. Click the **Connect** to LI-8100 button. You should get a file list.



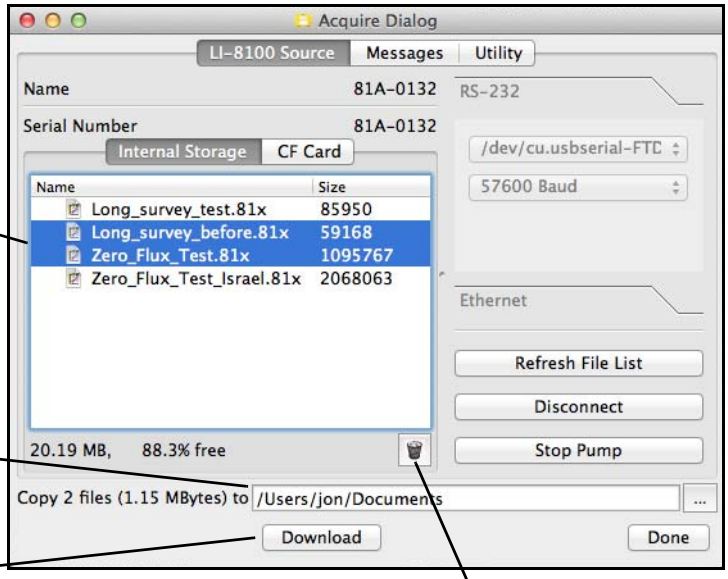
Try this if the file list doesn't appear.

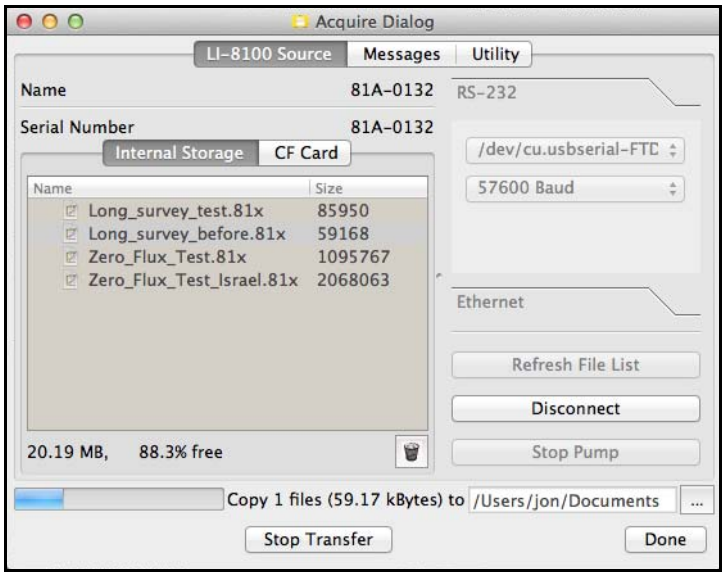
If the LI-8100 just powered up, the pump may be running. This will stop it.

4. Select the file(s) to download.

5. Specify the destination directory.

6. Click **Download**.

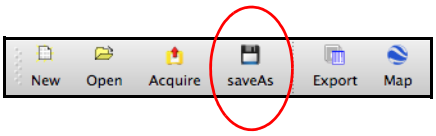


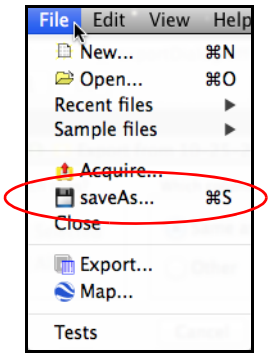


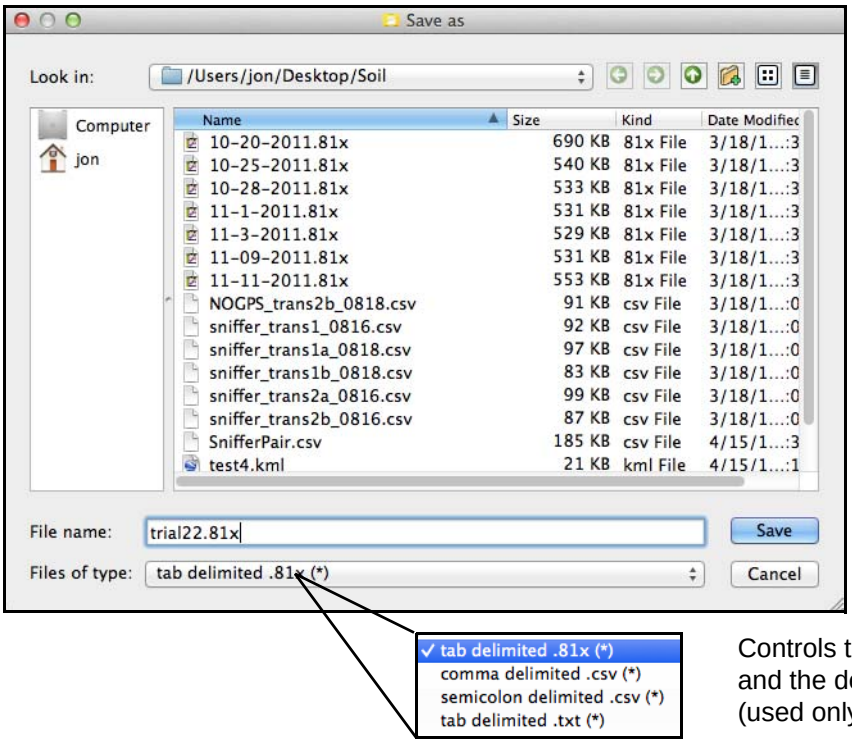
Save a File

Summary View

Click on the SaveAs button, or select Save As... from the File Menu.







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

File Suffixes

Save a File

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.

File Delimiters

Save a File

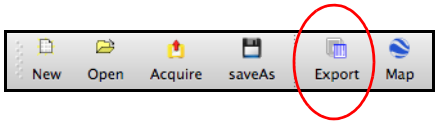
The save dialog filter box also determines what delimiter character is used when the observations are written. Note that SoilFluxPro can read files with any combination of continuous or chamber measurements with any of these delimiters: tab, comma, or semi-colon. Delimiters must be consistent within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

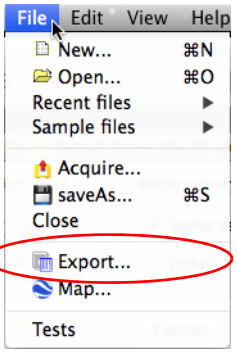
Export Data

Summary View

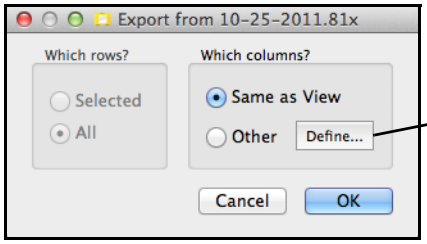
Summary-style data (one observation per row) can be written to a text file, for input to spreadsheet or text editing applications.

1. Click on the Export button, or select Export from the File Menu.

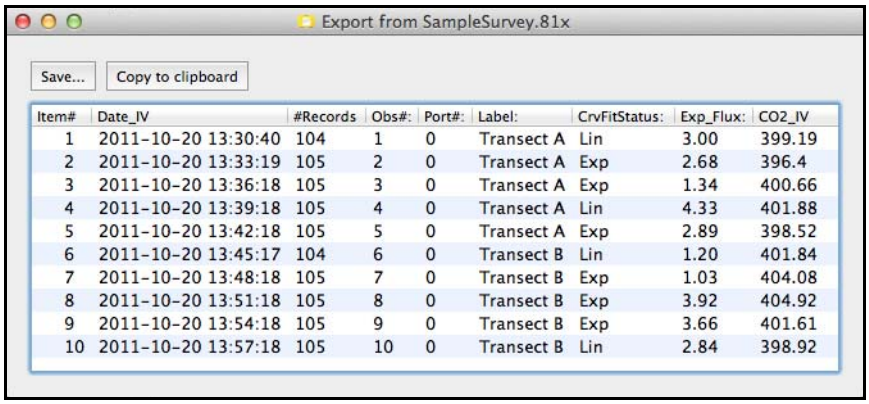




2. Select the fields to export. These can be the same as the Summary View, or you can define a different set.



Export a different set of variables. Click Define... to set (Selecting Variables Dialog). The default "other" list is in the Default Export File List (See Preferences).



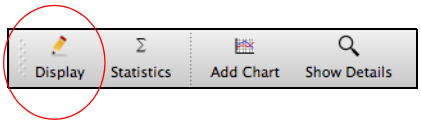
Item#	Date_IV	#Records	Obs#:	Port#:	Label:	CrvFitStatus:	Exp_Flux:	CO2_IV
1	2011-10-20 13:30:40	104	1	0	Transect A	Lin	3.00	399.19
2	2011-10-20 13:33:19	105	2	0	Transect A	Exp	2.68	396.4
3	2011-10-20 13:36:18	105	3	0	Transect A	Exp	1.34	400.66
4	2011-10-20 13:39:18	105	4	0	Transect A	Lin	4.33	401.88
5	2011-10-20 13:42:18	105	5	0	Transect A	Exp	2.89	398.52
6	2011-10-20 13:45:17	104	6	0	Transect B	Lin	1.20	401.84
7	2011-10-20 13:48:18	105	7	0	Transect B	Exp	1.03	404.08
8	2011-10-20 13:51:18	105	8	0	Transect B	Exp	3.92	404.92
9	2011-10-20 13:54:18	105	9	0	Transect B	Exp	3.66	401.61
10	2011-10-20 13:57:18	105	10	0	Transect B	Lin	2.84	398.92

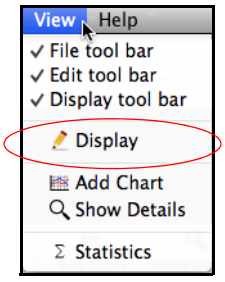
3. The results can be saved to a file, or copied to the clipboard for pasting into other applications.

Change Displayed Variables

Summary View

1. Click on the Display button, or select Display from the View menu.



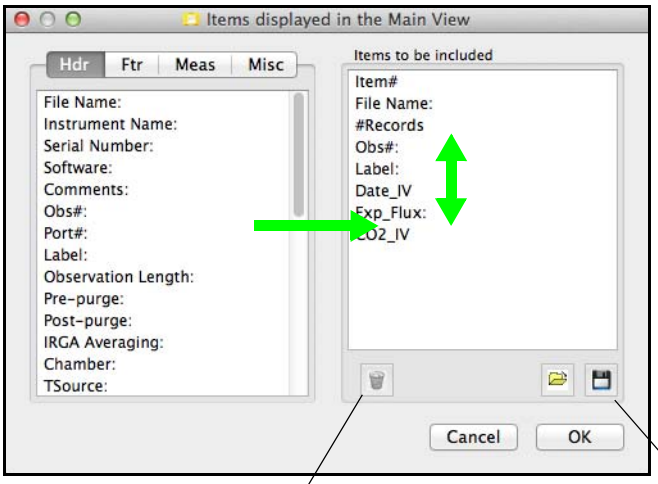


2. The Selecting Variables Dialog (next) is used for this.

Selecting Variables Dialog

Change Displayed Variables

Anytime a list of SoilFluxPro 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:



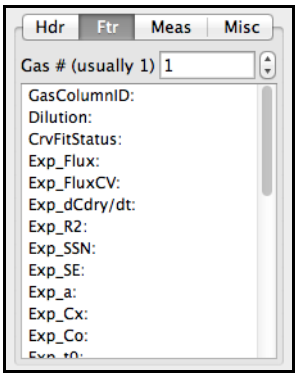
Drag items from the left list to the right list to include them.

Drag item in the right list up and down to arrange them

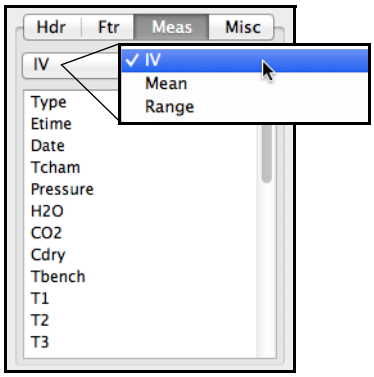
Remove selected items from list.

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

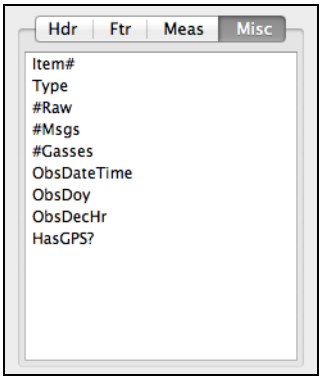
The list of potential variables is divided into 4 lists: Header, Footer, Measured, and Miscellaneous.



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.



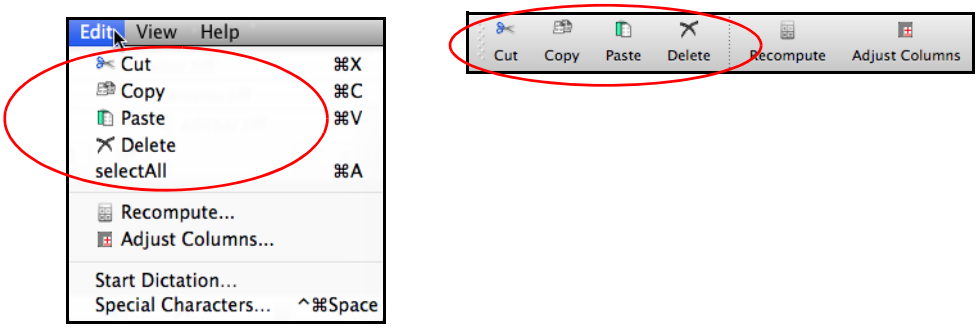
Miscellaneous items.

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

Move Observations Between Views

Summary View

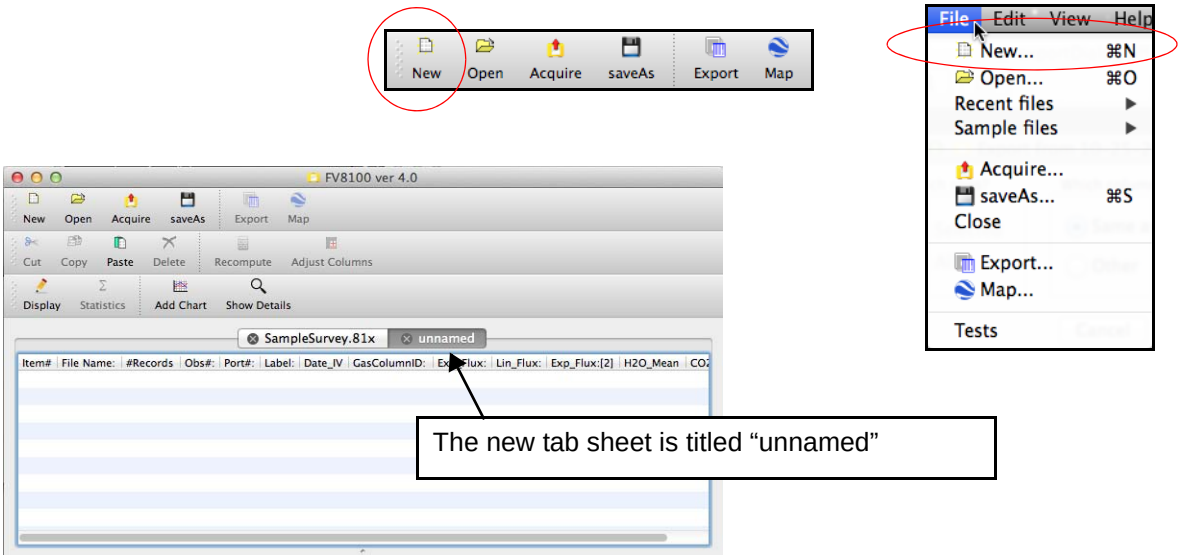
Selected observations in the Summary View can be Copied, Cut, and Pasted. Observations are selected by clicking on them. Note that <ctrl> click selects multiple observations, and <shift> click selects a range of observations. See also Create an Empty View.



Create an Empty View

Summary View

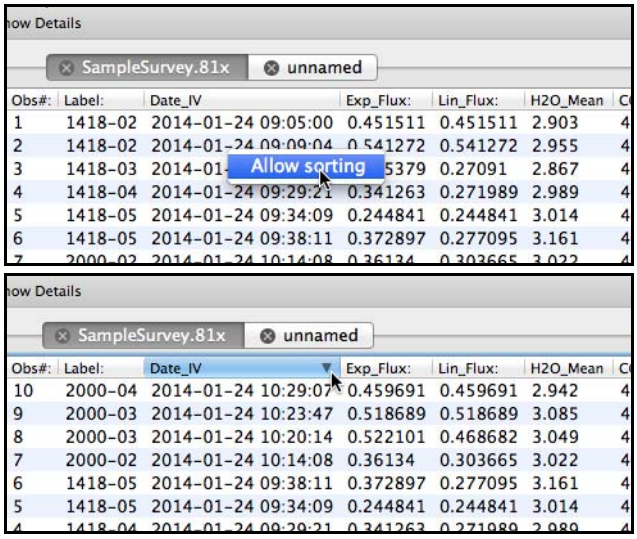
Sometimes it is useful to create an empty view, such as to create a destination for observations that you will paste in from other views (Move Observations Between Views). Creating an empty view is done by selecting New from the file menu or tool bar.



Sort Observations

Summary View

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.

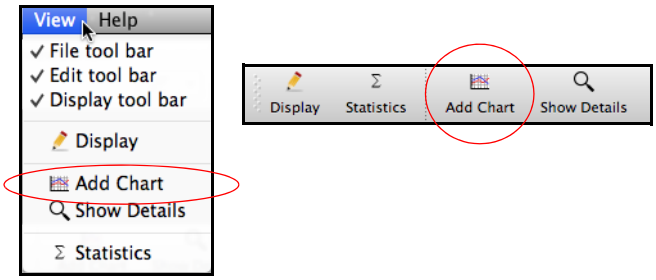
2. When sorting is enabled, you can sort by a column by clicking in the column header.

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

Add a Chart

Summary View

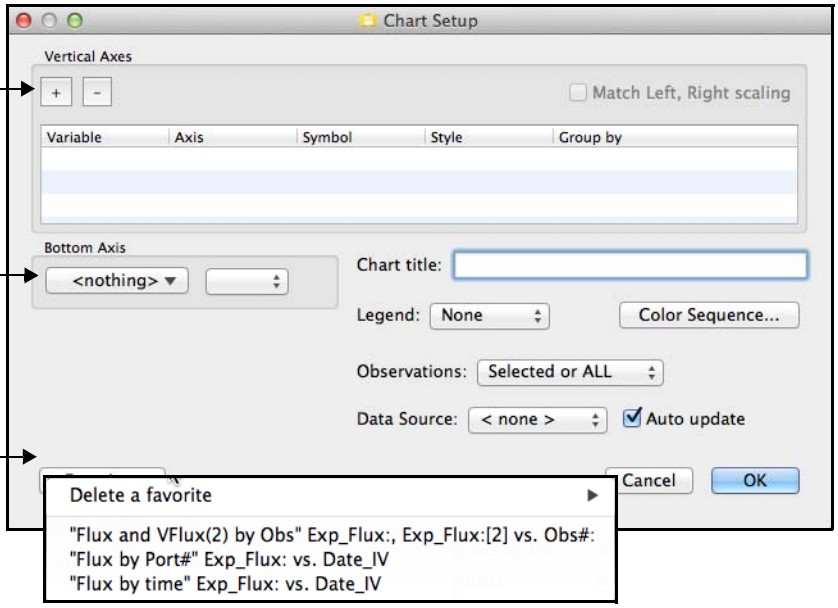
Click on the Add Chart button, or select Add Chart from the View Menu.



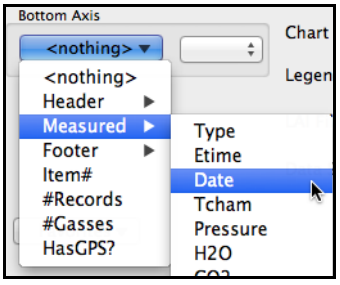
Click here to add a vertical axis...

...then click here to define a horizontal axis.

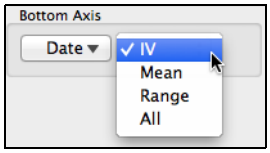
Or click here and select from a list of pre-defined graphs.



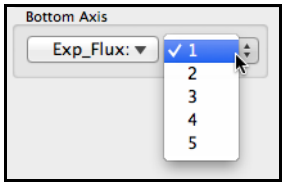
Defining the variable associated with a vertical or bottom axis is done as shown:



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

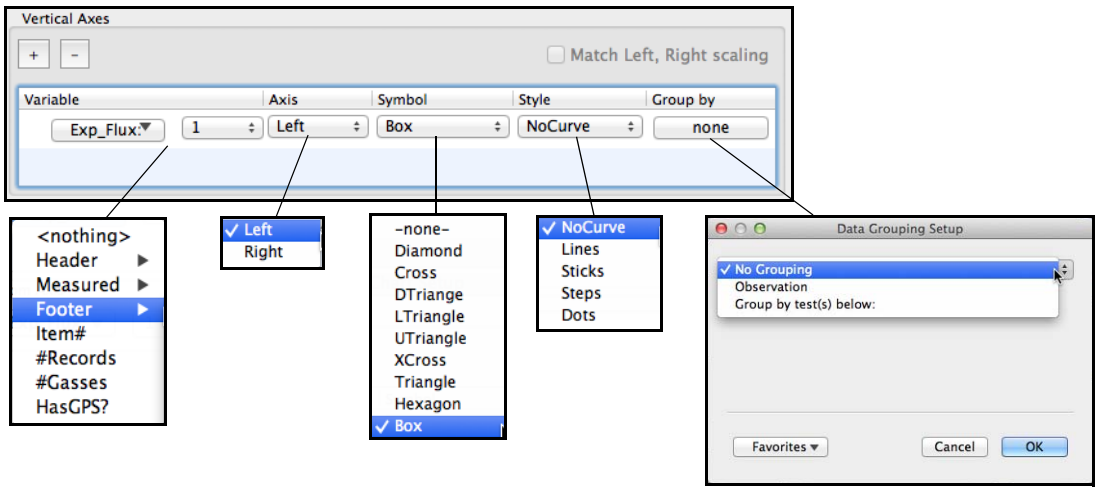


2. Items from the Measured menu have a secondary selection: IV, Mean, and Range have one value per observation, while the "All" selection refers to all of the Type=1 values.



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.

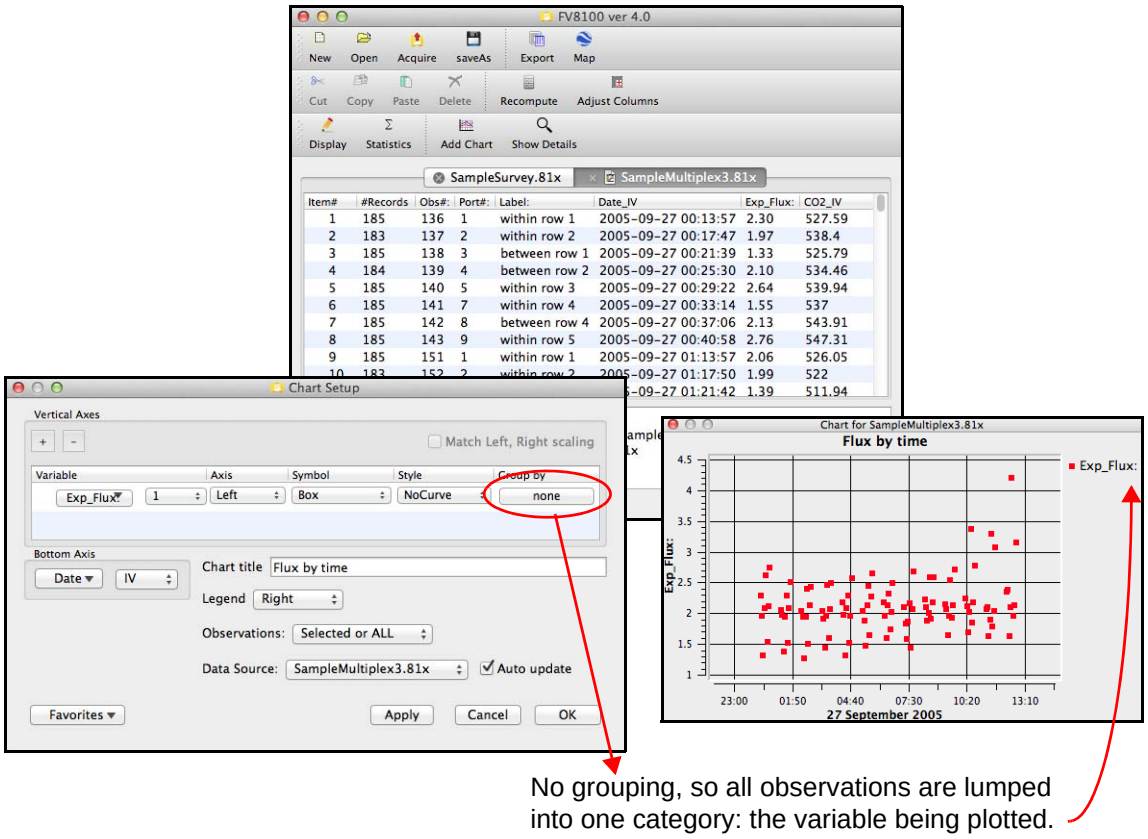
The vertical axis definition includes which variable to plot, which axis, symbol, curve type, and grouping information.



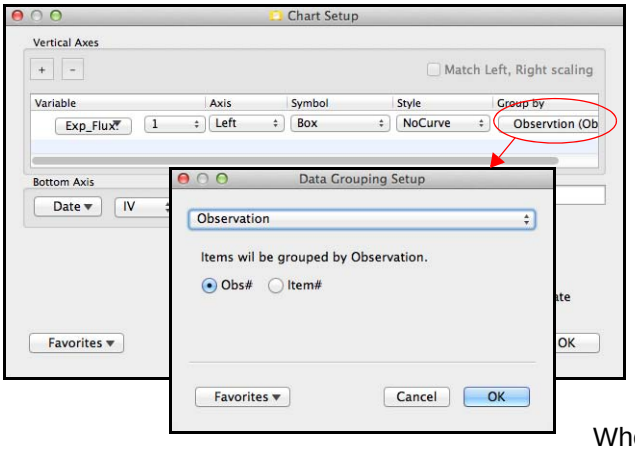
How to Group Plotted Data

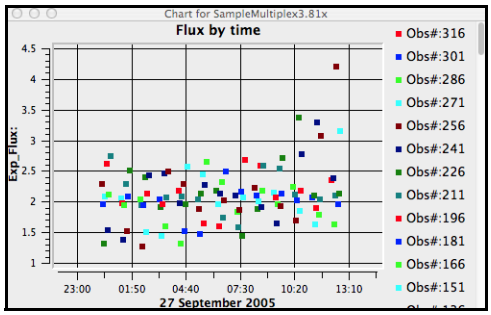
[Add a Chart]

To illustrate grouping, we will use a data file with 9 multiplexed ports. (If you wish to follow along, the **SampleMultiplex** file under **File** -> **Samples** can work, although it is trimmed down to 4 ports.) The first graph shows flux as a function of time, with no grouping.



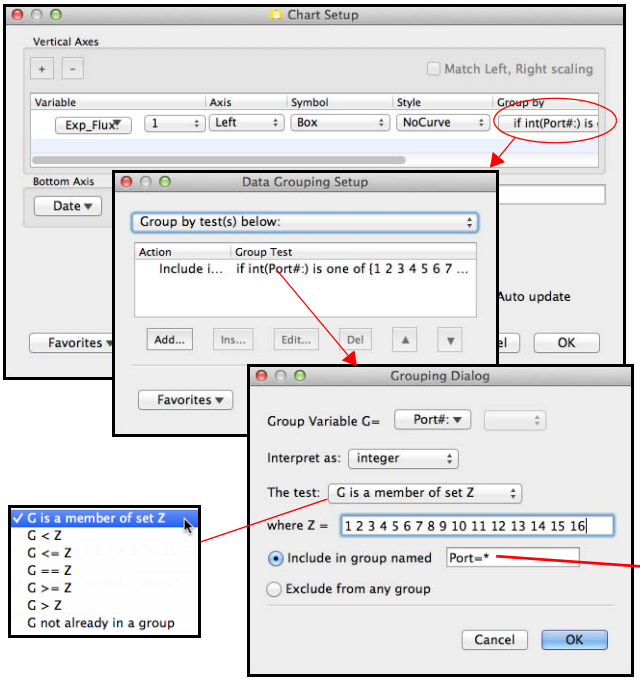
Next, we do a simple grouping by observation.

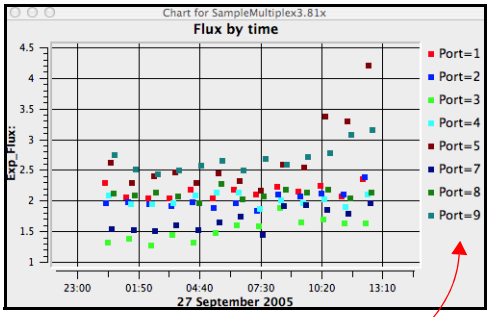




When grouped by observation, each observation appears in a different color, and as a separate entry in the legend.

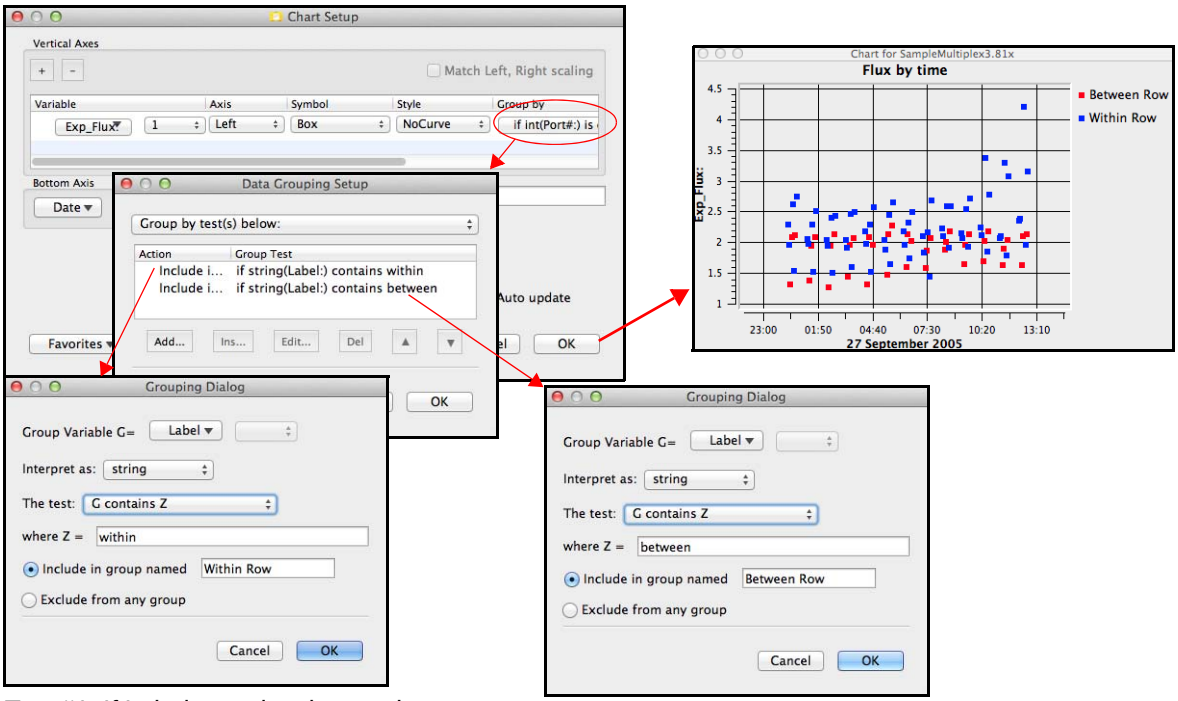
Grouping can also occur via one or more tests. In this next example, we examine Port#, treat it as an integer, and combine data sets with like port numbers together, naming then Port=.





Use an asterisk (*) to include the Z value in the group label.

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



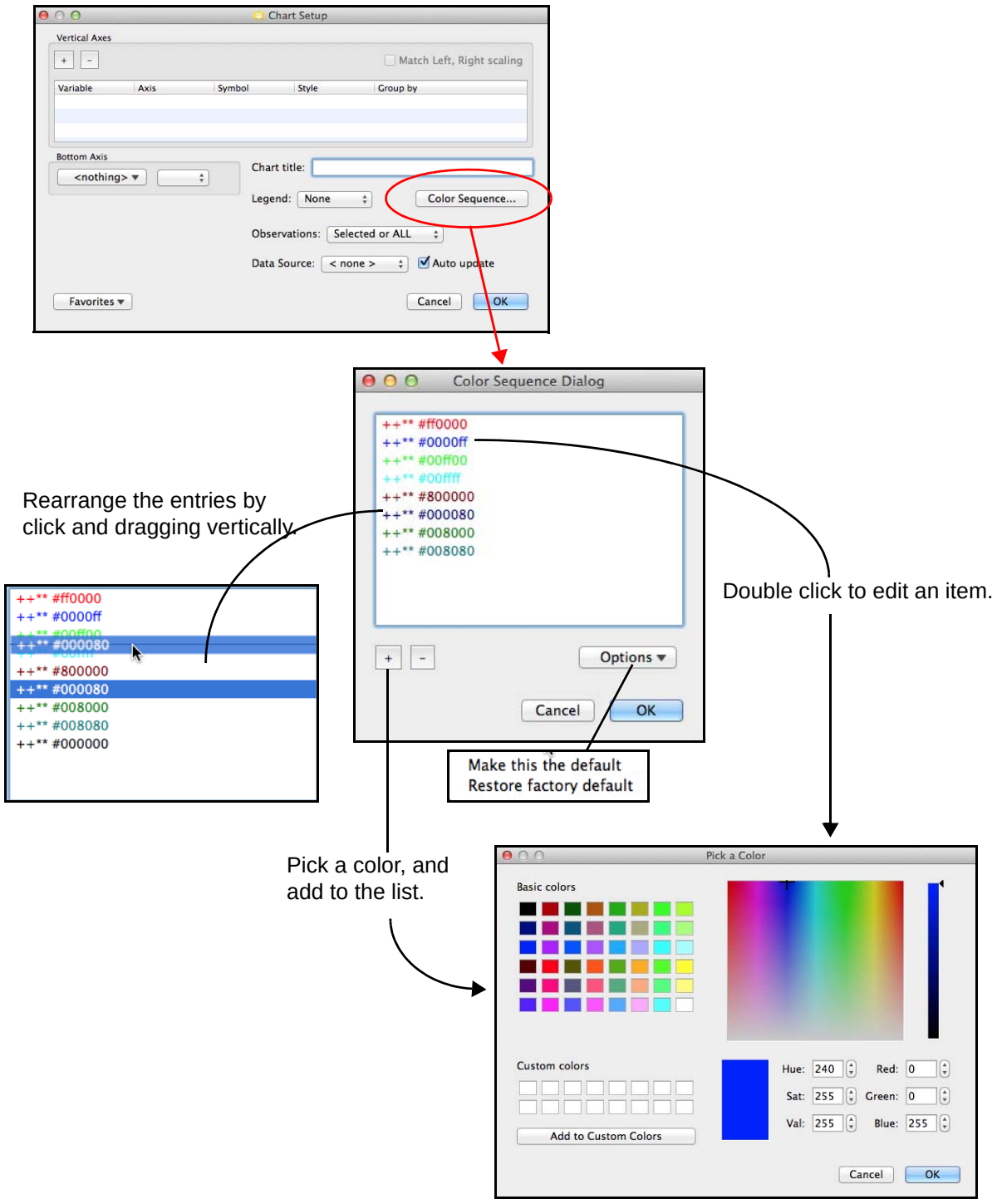
Test #1: If Label contains the word ‘within’, put it in this group.

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

Setting the Color Sequence

Add a Chart

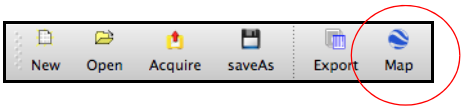
The sequence of colors used in Charts is automatic, but you can modify that sequence with the Color Sequence Dialog.

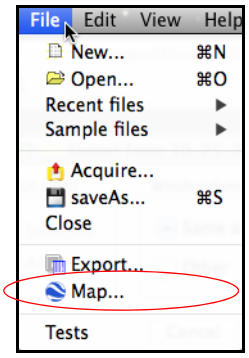


Create a .kml File for Google Earth

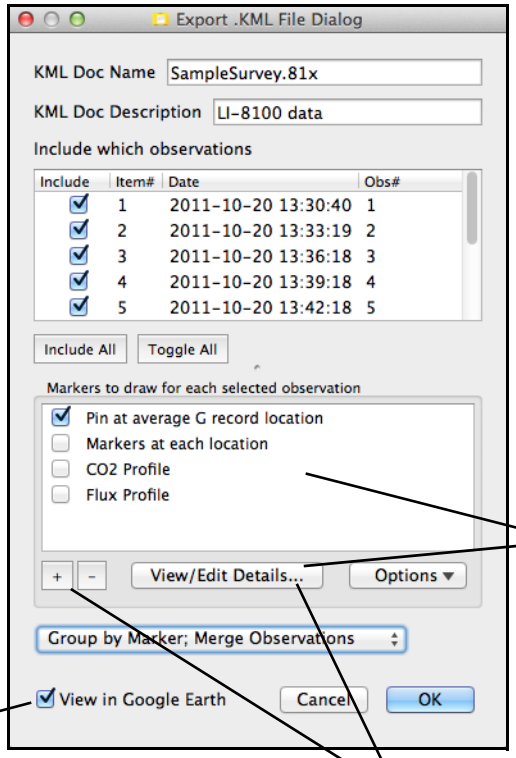
Summary View

If GPS data is contained in the observation, then a .kml file can be created.





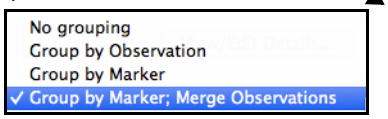
1. Check the observations to be included. This list will only show observations that have Latitude and Longitude data.

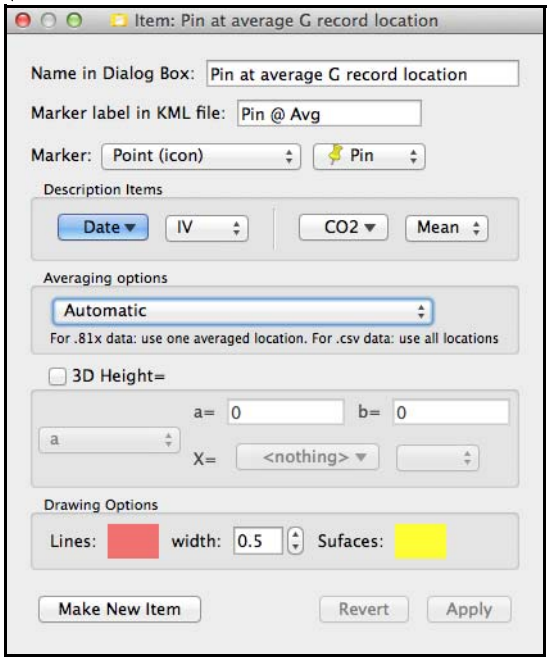


2. Select which sorts of markers you wish to have drawn

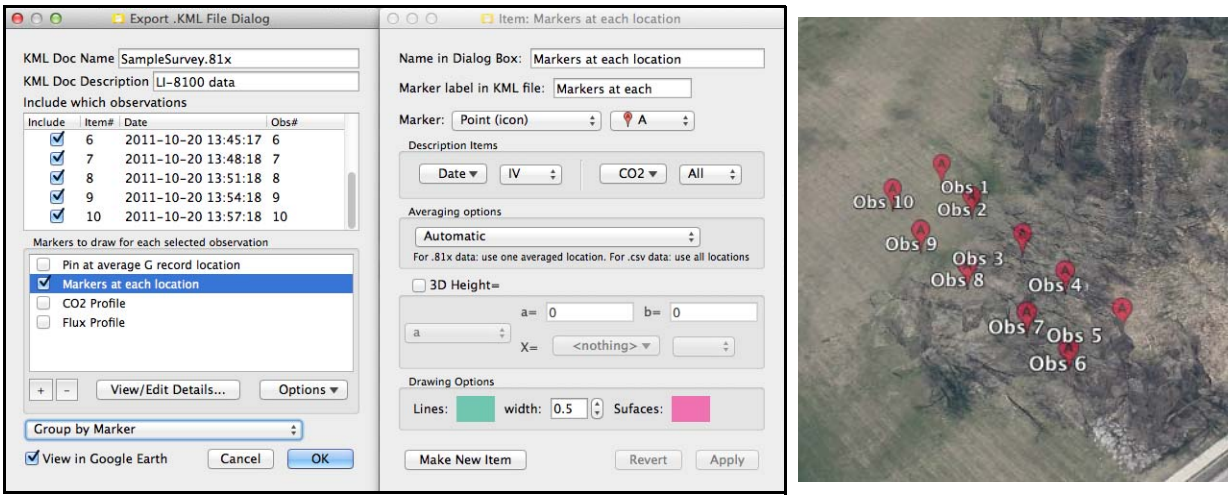
This list is user definable. To edit a definition, highlight it and click the **View/ Edit** button.

3. Select how the data should be grouped.

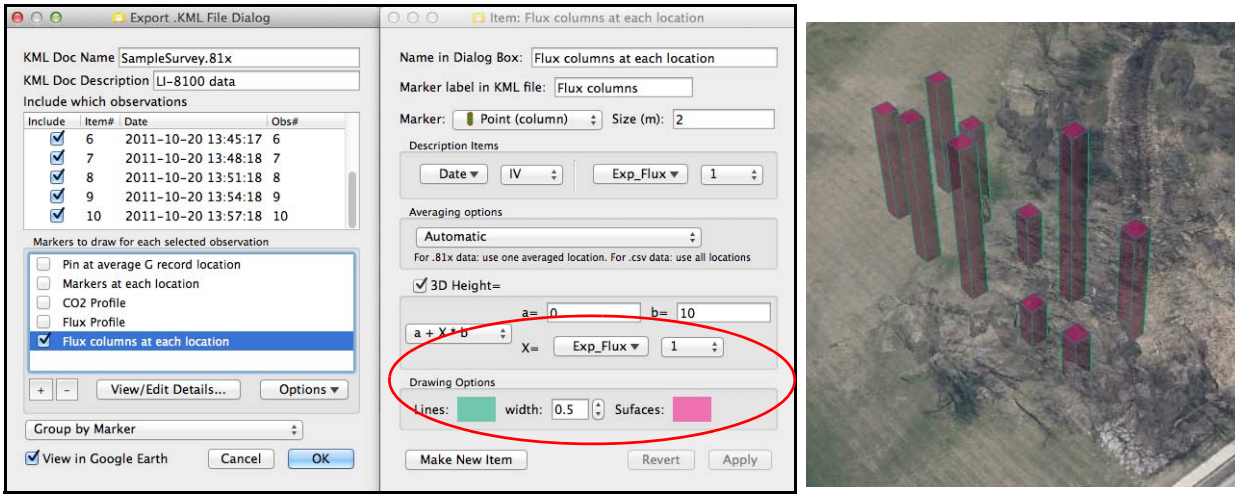




a) Single marker (merged observations) showing average location of all 10 observations.

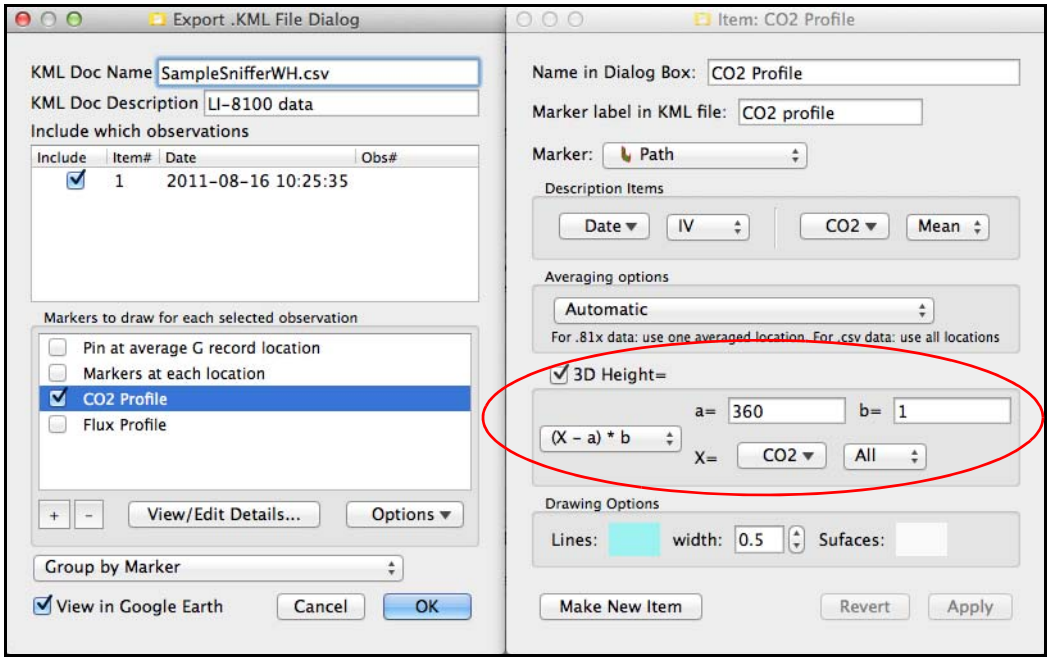


b) To put a marker at each observation, do not merge them.

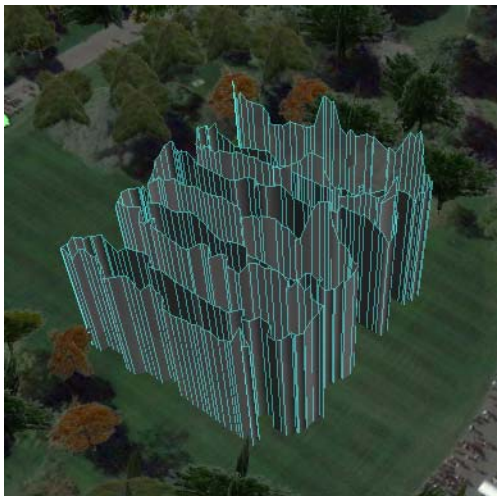


c. Each obs location marked with a 3D column, height proportional to flux.

With continuous measurement (for example, the SampleSniffer.csv file in the File -> Samples menu), the Path marker is probably the most interesting to use.



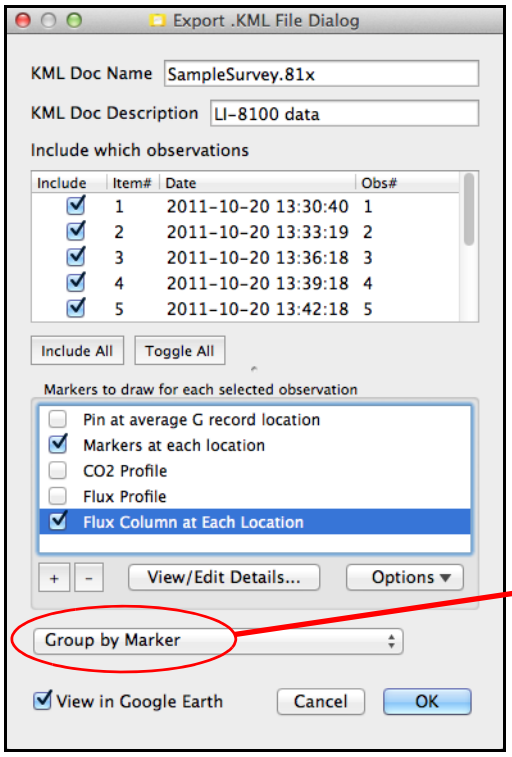
The 3D path has a height (m) that is computed from the CO_2 at each point - 360.



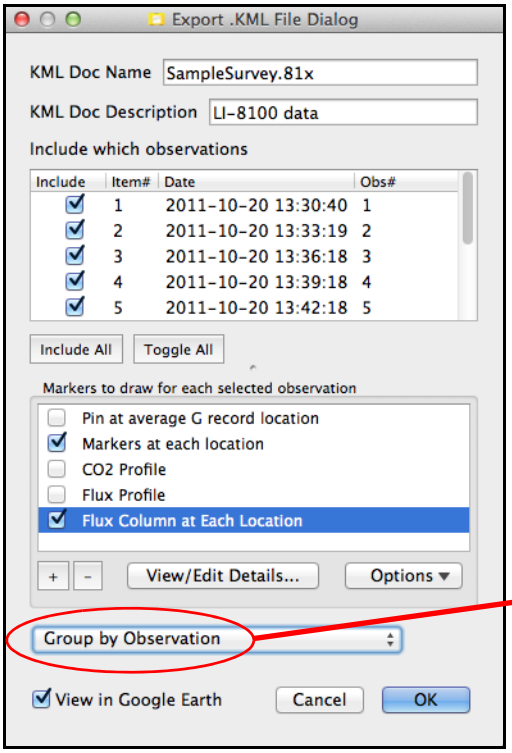
Group by Observation or Marker

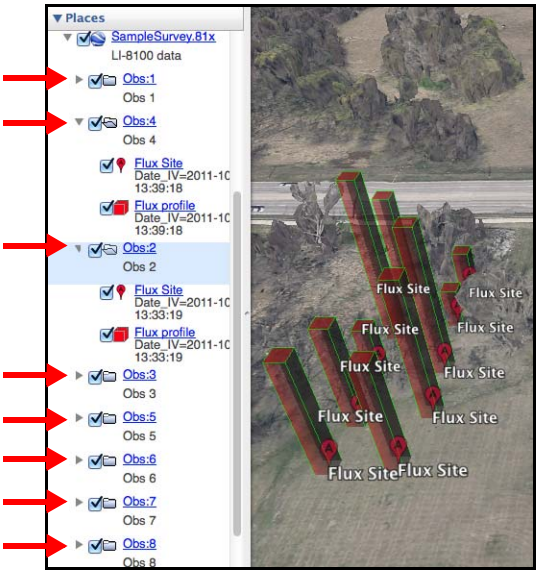
[Create a .kml File for Google Earth]

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.



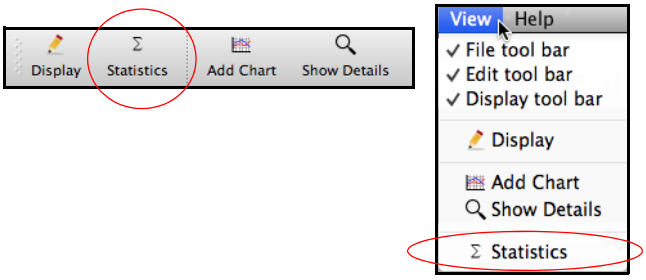


Each of the 10 observations has a check box, and under each is a check box for the column and one for the marker.

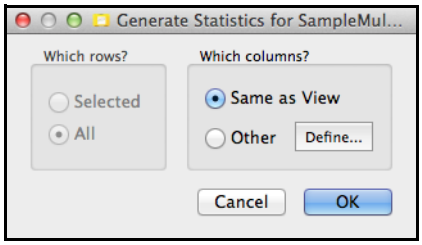
Compute Statistics

Summary View

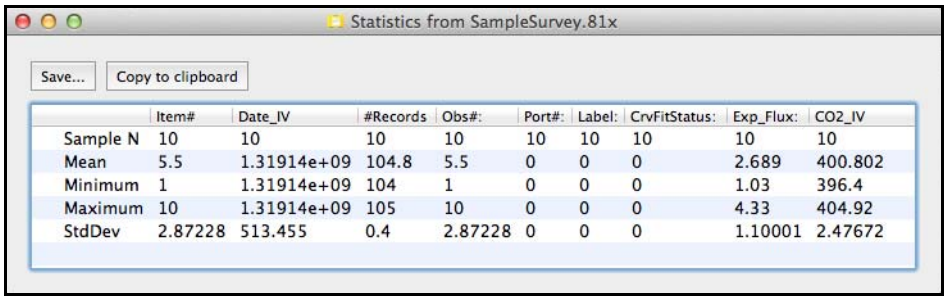
1. Click on the Statistics button, or select the Statistics item from the View menu.



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 (Selecting Variables Dialog).



Once you click Compute, the results will be shown in a window. This summary table can be saved as a text file, or printed



	Item#	Date_IV	#Records	Obs#:	Port#:	Label:	CrvFitStatus:	Exp_Flux:	CO2_IV
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	400.802
Minimum	1	1.31914e+09	104	1	0	0	0	1.03	396.4
Maximum	10	1.31914e+09	105	10	0	0	0	4.33	404.92
StdDev	2.87228	513.455	0.4	2.87228	0	0	0	1.10001	2.47672

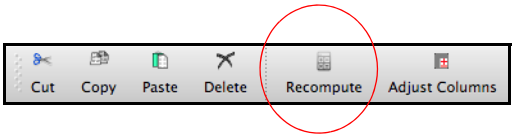
Save allows you to write the contents with tab delimiters to a text file.

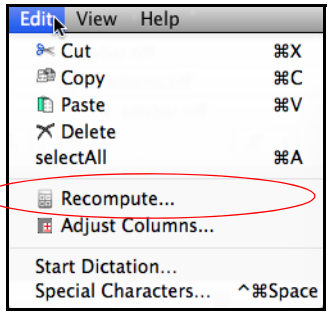
Copy to clipboard puts that same content into the PC's system clipboard, allowing you to paste it into other applications, such as spreadsheets.

Recompute Observations

Summary View

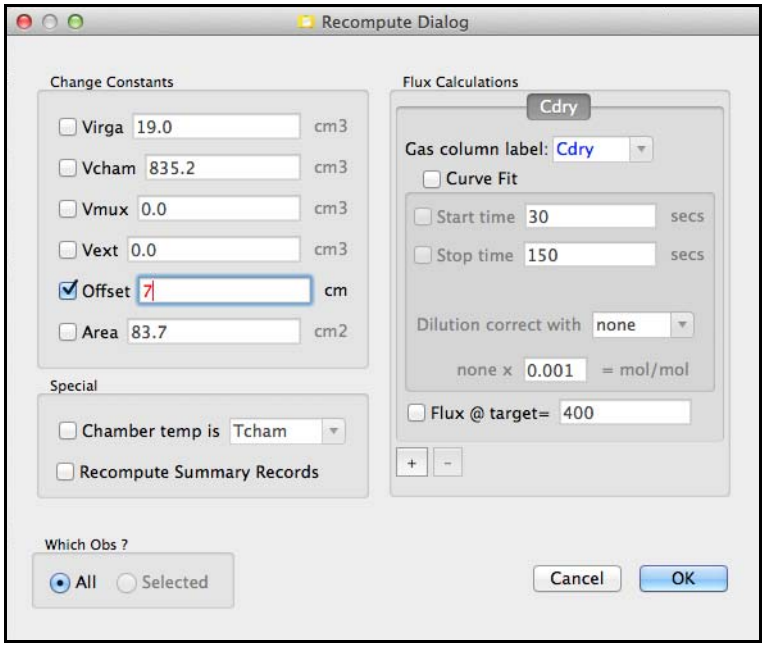
1. Click on the Recompute button, or else select Recompute from the Edit menu.



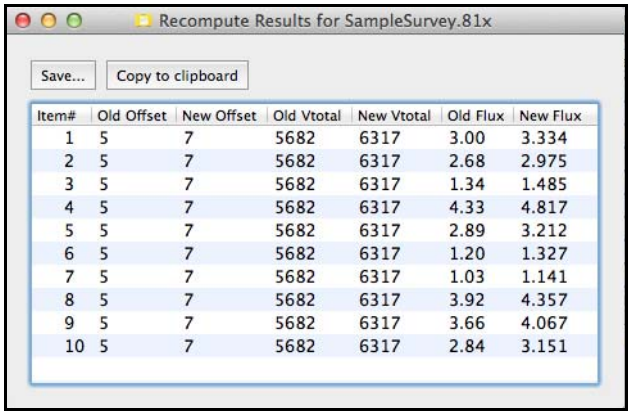


2. In the Recompute Dialog, select the thing(s) you wish to change. In the example below, we are changing the Offset (collar height parameter), which will change the total volume, and thus the flux.

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.

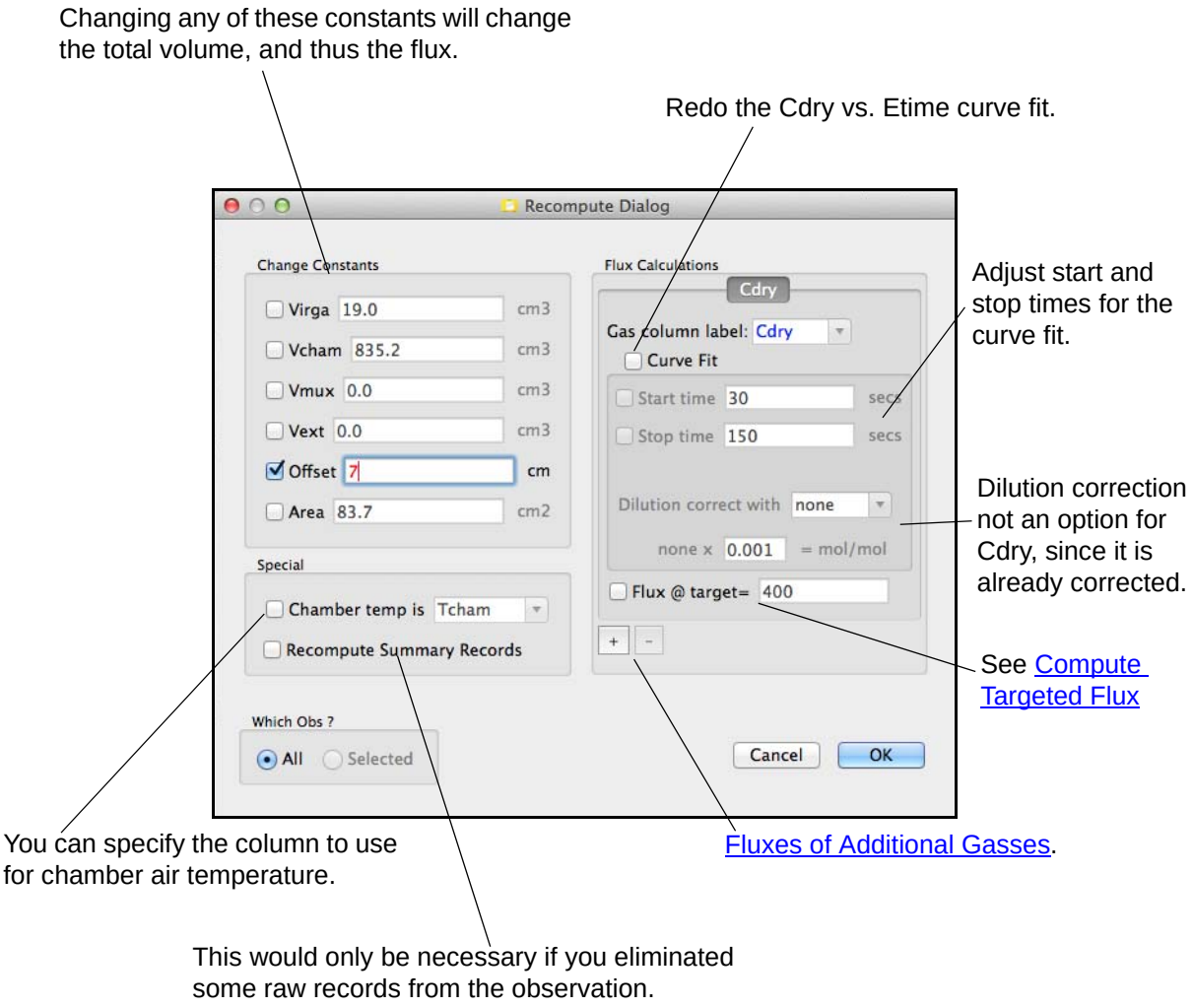


Item#	Old Offset	New Offset	Old Vtotal	New Vtotal	Old Flux	New Flux
1	5	7	5682	6317	3.00	3.334
2	5	7	5682	6317	2.68	2.975
3	5	7	5682	6317	1.34	1.485
4	5	7	5682	6317	4.33	4.817
5	5	7	5682	6317	2.89	3.212
6	5	7	5682	6317	1.20	1.327
7	5	7	5682	6317	1.03	1.141
8	5	7	5682	6317	3.92	4.357
9	5	7	5682	6317	3.66	4.067
10	5	7	5682	6317	2.84	3.151

Recompute Options

Recompute Observations

The figure below indicates the various options available when recomputing.



Compute Targeted Flux

Recompute Observations

The LI-8100 computes flux at the concentration present when the chamber closed. SoilFluxPro 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

$$C_t = C_\infty + (C_o - C_\infty)e^{-a(t_t - t_o)} \quad (1)$$

$$t_t = \frac{1}{a}\ln\left(\frac{C_o - C_\infty}{C_t - C_\infty}\right) + t_o \quad (2)$$

The rate of change of Cdry at time t_t is then

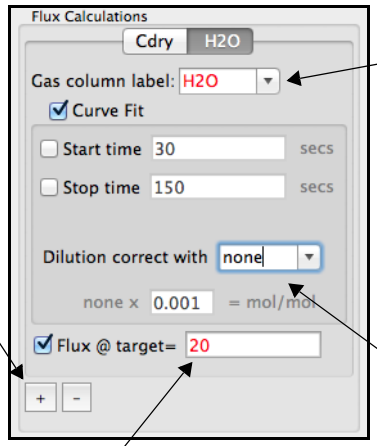
$$\frac{\partial}{\partial t}C(t_t) = a(C_\infty - C_o)e^{-a(t_t - t_o)} \quad (3)$$

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. SoilFluxPro 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.

Fluxes of Additional Gasses

Recompute Observations

The LI-8100 computes flux for Cdry, the water corrected CO2 concentration. You can add additional fluxes for other gasses that are recorded during the measurement (e.g. use the H2O values, or use signals from an external gas analyzer that were recorded by the LI-8100 in a spare channel). See Version 3.2 Footer for where the results reside.



1. To add a flux computation, click the add button.

2. Then 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're 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.

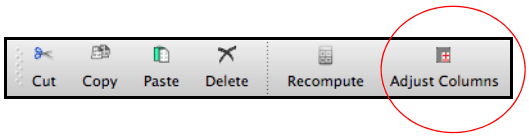
Transforming Columns

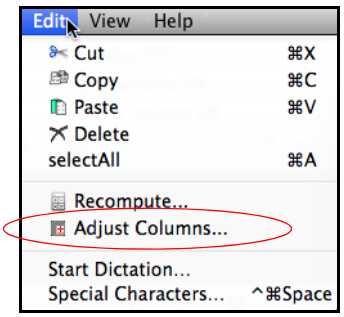
Summary View

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

$$
\begin{aligned}
Z &= a(X+b) \\
Z &= aX + bY + c \\
Z &= a(X+b)(Y+c) \\
Z &= a\frac{(X+b)}{(Y+c)}
\end{aligned}
\qquad (4)
$$

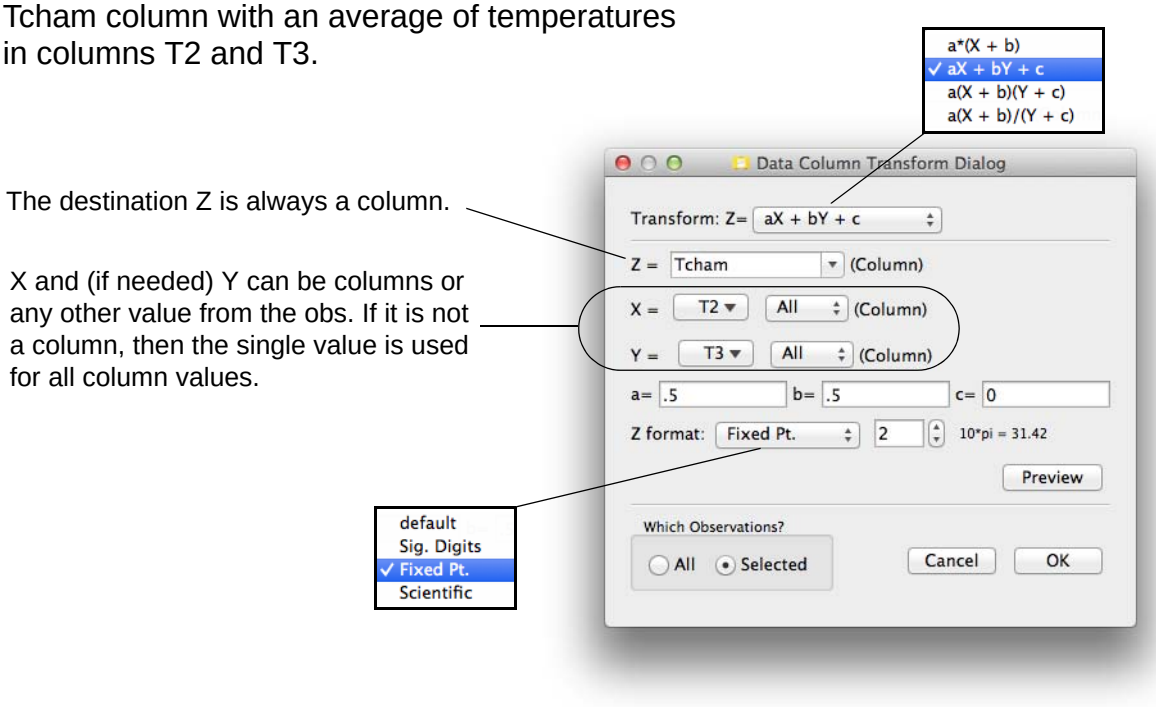
where *Z* are the values in the column to be transformed, *a*, *b*, and *c* are user entered constants, and *X* and *Y* are also column values (can be same as Z), but can also be any other value in the observation.



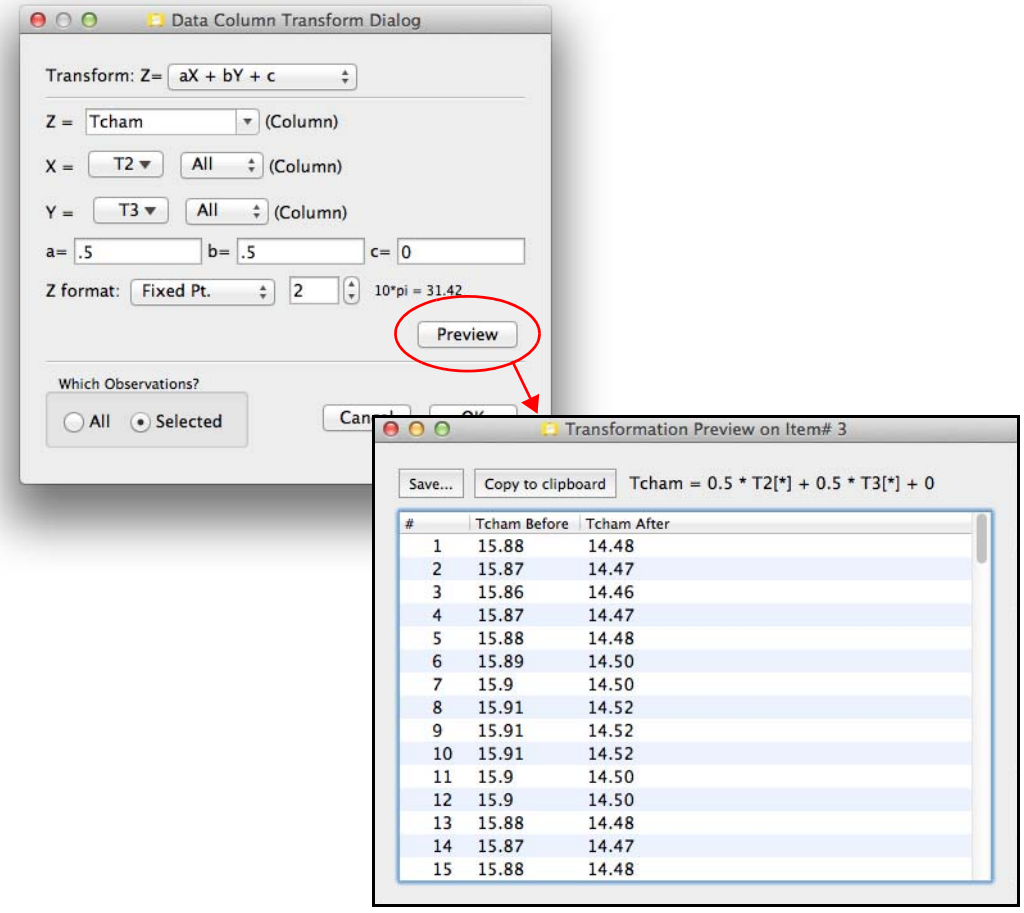


Use the transform dialog to select the transformation and column, the source column(s) or values, the constants, and the format for writing the results.

The example here shows how to replace the Tcham column with an average of temperatures in columns T2 and T3.



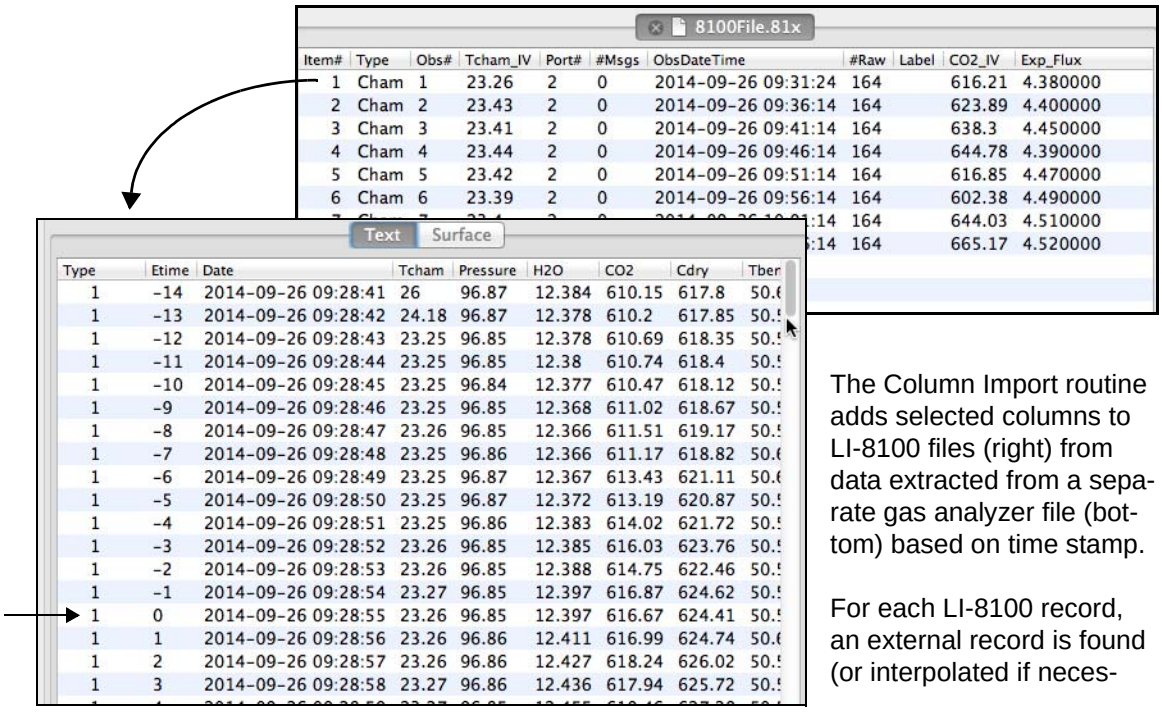
The preview button applies the transform to the first file in the potential list and shows the results in a view; it does not change the observational data.



Importing Columns

Summary View

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



8100File.81x

Item#	Type	Obs#	Tcham_IV	Port#	#Msgs	ObsDateTime	#Raw	Label	CO2_IV	Exp_Flux
1	Cham	1	23.26	2	0	2014-09-26 09:31:24	164		616.21	4.380000
2	Cham	2	23.43	2	0	2014-09-26 09:36:14	164		623.89	4.400000
3	Cham	3	23.41	2	0	2014-09-26 09:41:14	164		638.3	4.450000
4	Cham	4	23.44	2	0	2014-09-26 09:46:14	164		644.78	4.390000
5	Cham	5	23.42	2	0	2014-09-26 09:51:14	164		616.85	4.470000
6	Cham	6	23.39	2	0	2014-09-26 09:56:14	164		602.38	4.490000
						:14	164		644.03	4.510000
						:14	164		665.17	4.520000

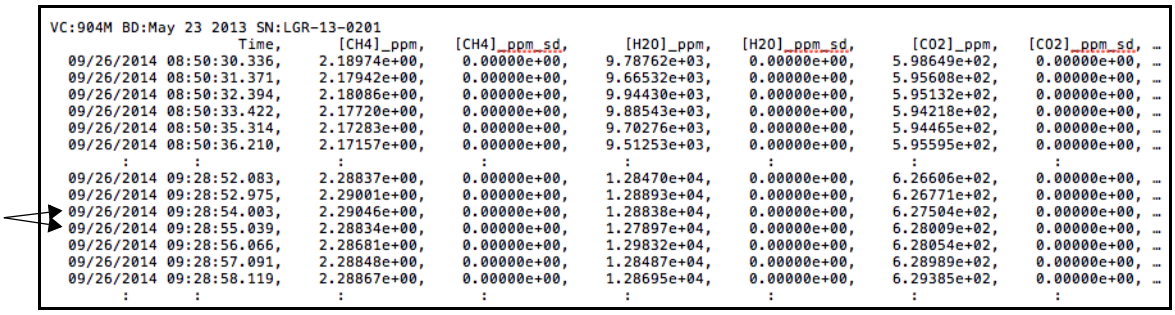
Text | Surface

Type	Etime	Date	Tcham	Pressure	H2O	CO2	Cdry	Tber
1	-14	2014-09-26 09:28:41	26	96.87	12.384	610.15	617.8	50.(
1	-13	2014-09-26 09:28:42	24.18	96.87	12.378	610.2	617.85	50.5
1	-12	2014-09-26 09:28:43	23.25	96.85	12.378	610.69	618.35	50.5
1	-11	2014-09-26 09:28:44	23.25	96.85	12.38	610.74	618.4	50.5
1	-10	2014-09-26 09:28:45	23.25	96.84	12.377	610.47	618.12	50.5
1	-9	2014-09-26 09:28:46	23.25	96.85	12.368	611.02	618.67	50.5
1	-8	2014-09-26 09:28:47	23.26	96.85	12.366	611.51	619.17	50.5
1	-7	2014-09-26 09:28:48	23.25	96.86	12.366	611.17	618.82	50.(
1	-6	2014-09-26 09:28:49	23.25	96.87	12.367	613.43	621.11	50.(
1	-5	2014-09-26 09:28:50	23.25	96.87	12.372	613.19	620.87	50.5
1	-4	2014-09-26 09:28:51	23.25	96.86	12.383	614.02	621.72	50.5
1	-3	2014-09-26 09:28:52	23.26	96.85	12.385	616.03	623.76	50.5
1	-2	2014-09-26 09:28:53	23.26	96.85	12.388	614.75	622.46	50.5
1	-1	2014-09-26 09:28:54	23.27	96.85	12.397	616.87	624.62	50.5
1	0	2014-09-26 09:28:55	23.26	96.85	12.397	616.67	624.41	50.5
1	1	2014-09-26 09:28:56	23.26	96.86	12.411	616.99	624.74	50.(
1	2	2014-09-26 09:28:57	23.26	96.86	12.427	618.24	626.02	50.5
1	3	2014-09-26 09:28:58	23.27	96.86	12.436	617.94	625.72	50.5

The Column Import routine adds selected columns to LI-8100 files (right) from data extracted from a separate gas analyzer file (bottom) based on time stamp.

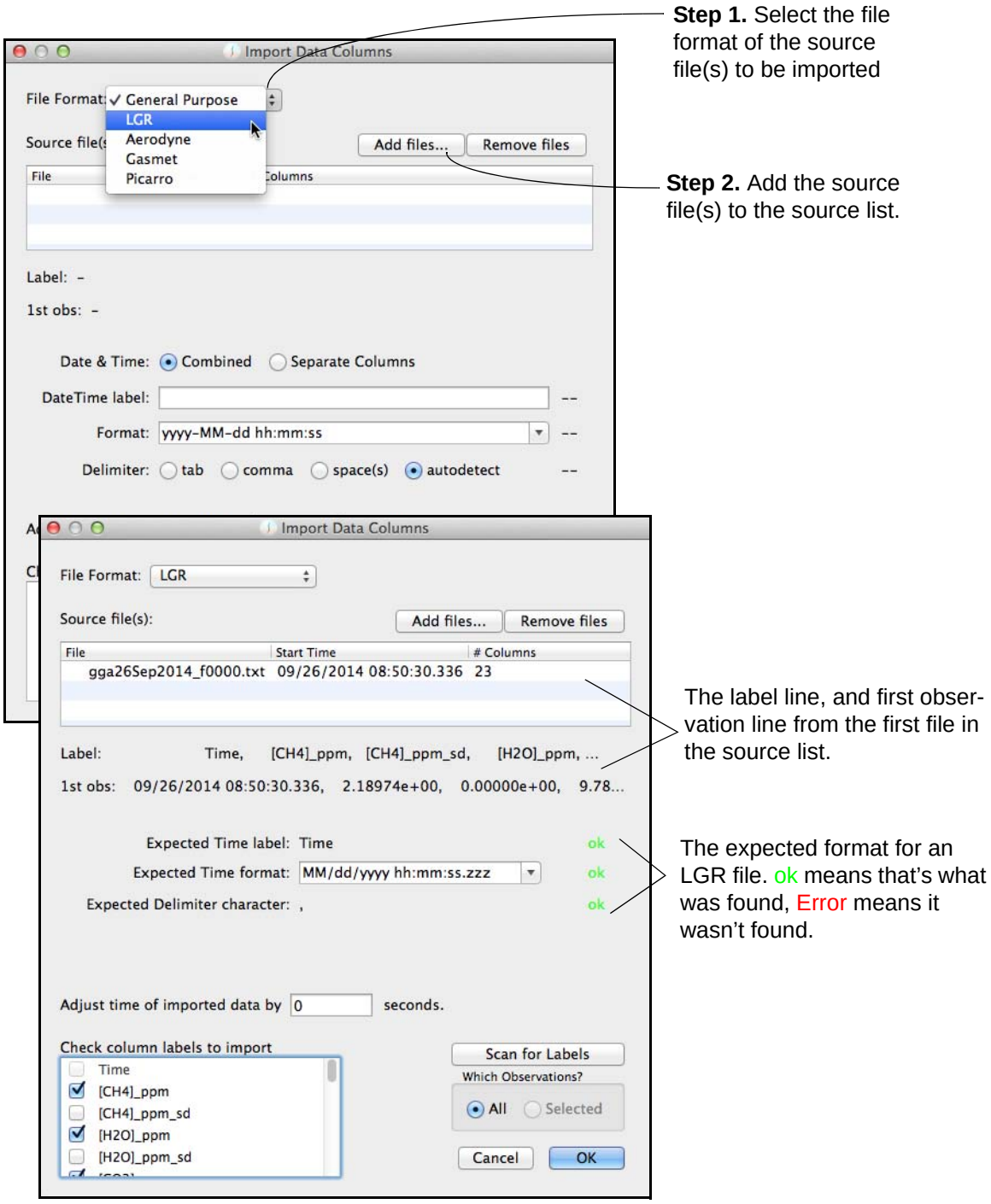
For each LI-8100 record, an external record is found (or interpolated if neces-

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



```
VC:904M BD:May 23 2013 SN:LGR-13-0201
                  Time,     [CH4]_ppm,   [CH4]_ppm_sd,      [H2O]_ppm,   [H2O]_ppm_sd,      [CO2]_ppm,   [CO2]_ppm_sd, …
  09/26/2014 08:50:30.336,    2.18974e+00,    0.00000e+00,    9.78762e+03,    0.00000e+00,    5.98649e+02,    0.00000e+00, …
  09/26/2014 08:50:31.371,    2.17942e+00,    0.00000e+00,    9.66532e+03,    0.00000e+00,    5.95608e+02,    0.00000e+00, …
  09/26/2014 08:50:32.394,    2.18086e+00,    0.00000e+00,    9.94430e+03,    0.00000e+00,    5.95132e+02,    0.00000e+00, …
  09/26/2014 08:50:33.422,    2.17720e+00,    0.00000e+00,    9.88543e+03,    0.00000e+00,    5.94218e+02,    0.00000e+00, …
  09/26/2014 08:50:35.314,    2.17283e+00,    0.00000e+00,    9.70276e+03,    0.00000e+00,    5.94465e+02,    0.00000e+00, …
  09/26/2014 08:50:36.210,    2.17157e+00,    0.00000e+00,    9.51253e+03,    0.00000e+00,    5.95595e+02,    0.00000e+00, …
        :           :             :               :               :               :               :
  09/26/2014 09:28:52.083,    2.28837e+00,    0.00000e+00,    1.28470e+04,    0.00000e+00,    6.26606e+02,    0.00000e+00, …
  09/26/2014 09:28:52.975,    2.29001e+00,    0.00000e+00,    1.28893e+04,    0.00000e+00,    6.26771e+02,    0.00000e+00, …
  09/26/2014 09:28:54.003,    2.29046e+00,    0.00000e+00,    1.28838e+04,    0.00000e+00,    6.27504e+02,    0.00000e+00, …
  09/26/2014 09:28:55.039,    2.28834e+00,    0.00000e+00,    1.27897e+04,    0.00000e+00,    6.28009e+02,    0.00000e+00, …
  09/26/2014 09:28:56.066,    2.28681e+00,    0.00000e+00,    1.29832e+04,    0.00000e+00,    6.28054e+02,    0.00000e+00, …
  09/26/2014 09:28:57.091,    2.28848e+00,    0.00000e+00,    1.28487e+04,    0.00000e+00,    6.28989e+02,    0.00000e+00, …
  09/26/2014 09:28:58.119,    2.28867e+00,    0.00000e+00,    1.28695e+04,    0.00000e+00,    6.29385e+02,    0.00000e+00, …
        :           :             :               :               :               :               :
```

To perform a Column Import, click the Column Import tool bar button, and the following dialog will appear.



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

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

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

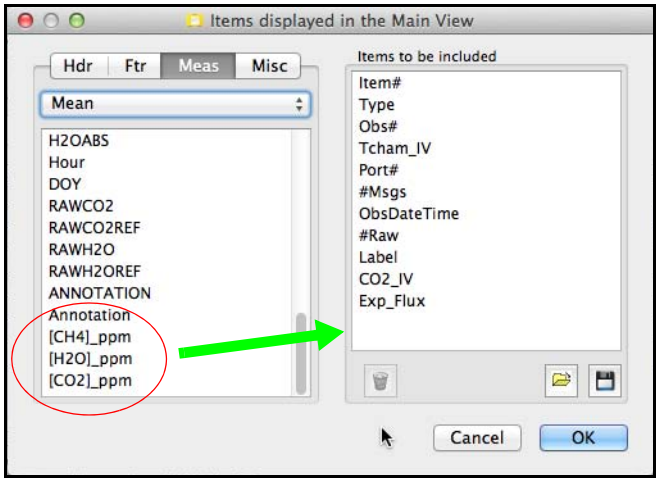
The expected format for an LGR file. ok means that's what was found, Error means it wasn't found.

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

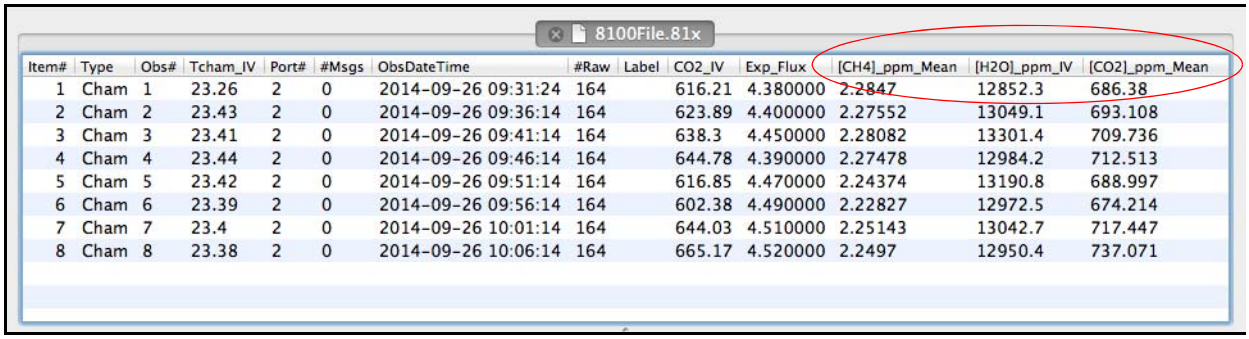
Step 3. Check the columns you wish to import. Note that column(s) used for time and date are shown here, but are not checkable.

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

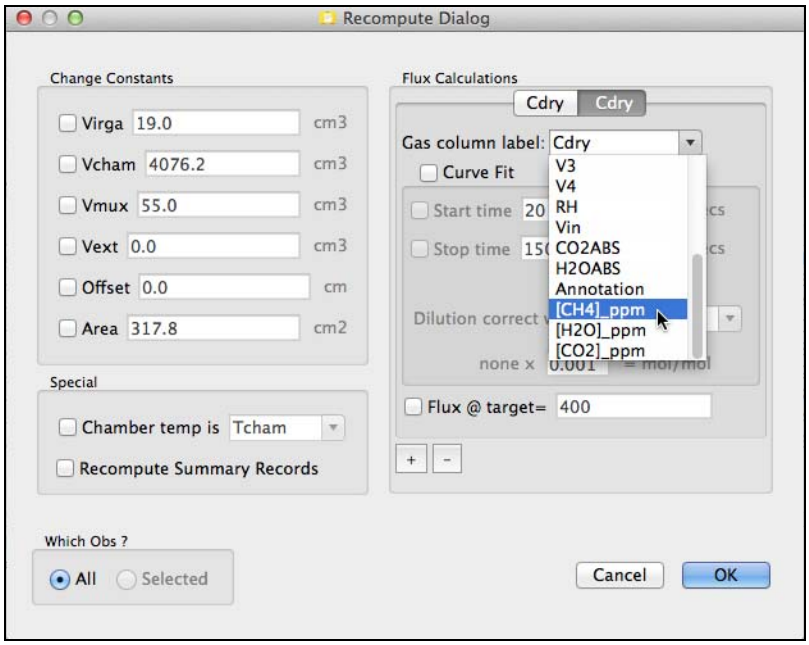
Imported columns in the Display Editor. Drag to add them...



...to the Summary View.



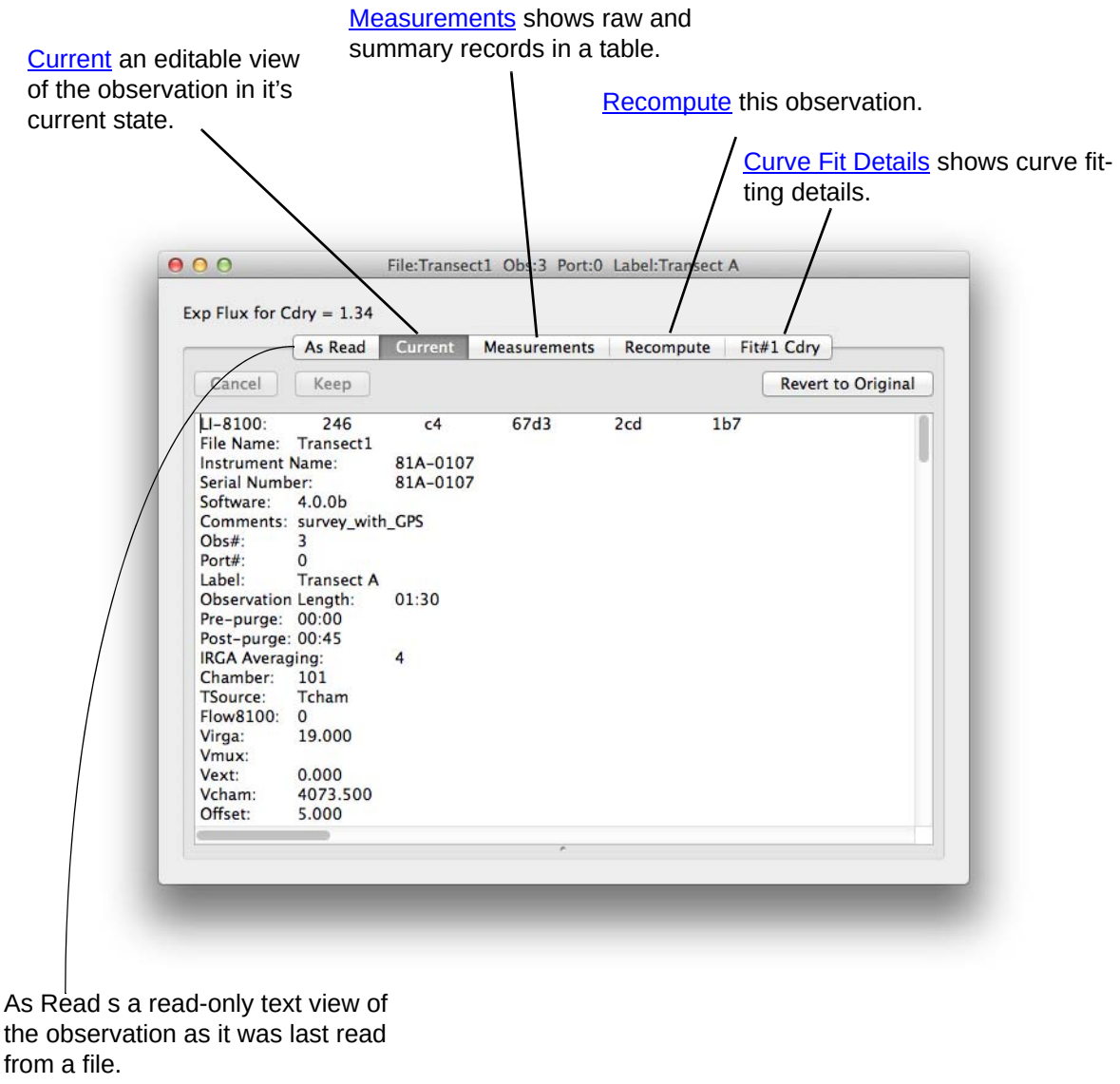
Item#	Type	Obs#	Tcham_IV	Port#	#Msgs	ObsDateTime	#Raw	Label	CO2_IV	Exp_Flux	[CH4]_ppm_Mean	[H2O]_ppm_IV	[CO2]_ppm_Mean
1	Cham	1	23.26	2	0	2014-09-26 09:31:24	164		616.21	4.380000	2.2847	12852.3	686.38
2	Cham	2	23.43	2	0	2014-09-26 09:36:14	164		623.89	4.400000	2.27552	13049.1	693.108
3	Cham	3	23.41	2	0	2014-09-26 09:41:14	164		638.3	4.450000	2.28082	13301.4	709.736
4	Cham	4	23.44	2	0	2014-09-26 09:46:14	164		644.78	4.390000	2.27478	12984.2	712.513
5	Cham	5	23.42	2	0	2014-09-26 09:51:14	164		616.85	4.470000	2.24374	13190.8	688.997
6	Cham	6	23.39	2	0	2014-09-26 09:56:14	164		602.38	4.490000	2.22827	12972.5	674.214
7	Cham	7	23.4	2	0	2014-09-26 10:01:14	164		644.03	4.510000	2.25143	13042.7	717.447
8	Cham	8	23.38	2	0	2014-09-26 10:06:14	164		665.17	4.520000	2.2497	12950.4	737.071



Setting up a flux computation with an imported column.

Observation Details

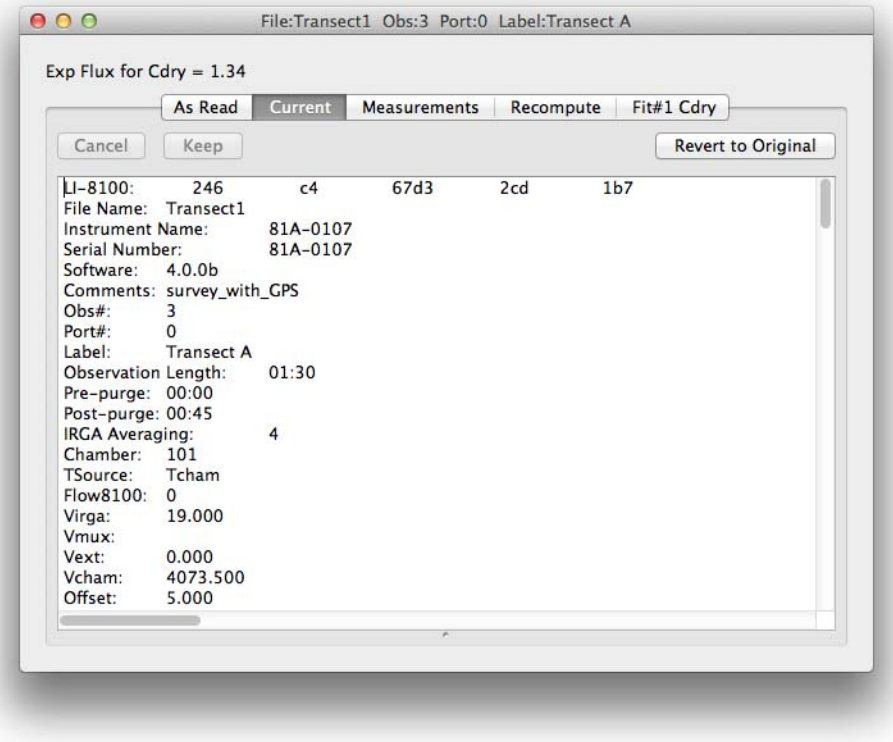
To see Details for an observation, double click on that observation in Summary View. This open's a view that "belongs" to that observation, updating automatically whenever something changes in that observation (e.g. recompute). Alternatively, click the Detail View tool button, and see the detail view 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).



Current

Observation Details

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. The **Keep** button will rescan the text, just as if it were reading from a file. This does *not* change the original (Current), so any changes you make (as well as any recomputations, etc.) can always be undone by pressing the Revert to Original button.

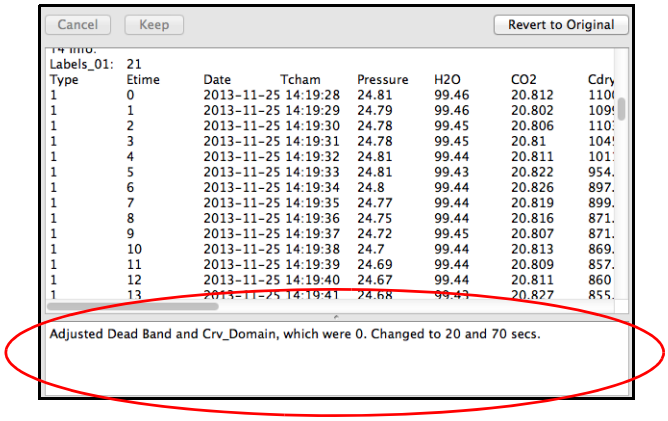


To change Area, Volume, and/or Label for multiple observations all at once, see Recompute Observations

Warnings and Messages

Observation Details

Warnings can be generated by the LI-8100 during the measurement; these are stored in records whose Type value is -1. There 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, SoilFluxPro itself can generate messages at the time an observation is read. The list of possible messages are shown below.



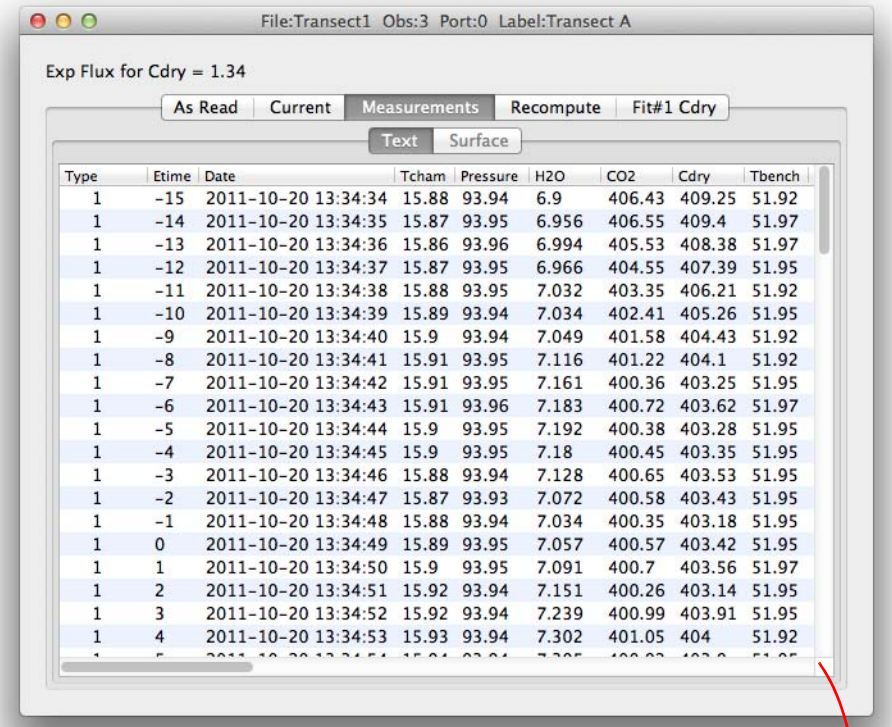
SoilFluxPro Message	Explanation
File Name: missing from header	The label ‘File Name:’ was not found, but subsequent records were.
ERROR: Failed to find measured data labels	The line that identifies measured columns “Type Etime Date...” was missing.
Old version. Updating format.	The original file is an older version format.
Adjusting dead band and Crv_Domain...	This would typically be caused by all or part of the observation’s 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.

Measurements

Observation Details

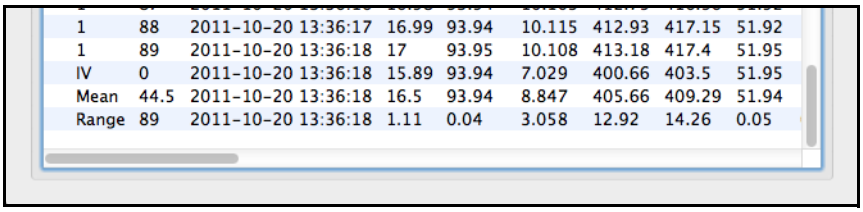
Text

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



Type	Etime	Date	Tcham	Pressure	H2O	CO2	Cdry	Tbench
1	-15	2011-10-20 13:34:34	15.88	93.94	6.9	406.43	409.25	51.92
1	-14	2011-10-20 13:34:35	15.87	93.95	6.956	406.55	409.4	51.97
1	-13	2011-10-20 13:34:36	15.86	93.96	6.994	405.53	408.38	51.97
1	-12	2011-10-20 13:34:37	15.87	93.95	6.966	404.55	407.39	51.95
1	-11	2011-10-20 13:34:38	15.88	93.95	7.032	403.35	406.21	51.92
1	-10	2011-10-20 13:34:39	15.89	93.94	7.034	402.41	405.26	51.95
1	-9	2011-10-20 13:34:40	15.9	93.94	7.049	401.58	404.43	51.92
1	-8	2011-10-20 13:34:41	15.91	93.95	7.116	401.22	404.1	51.92
1	-7	2011-10-20 13:34:42	15.91	93.95	7.161	400.36	403.25	51.95
1	-6	2011-10-20 13:34:43	15.91	93.96	7.183	400.72	403.62	51.97
1	-5	2011-10-20 13:34:44	15.9	93.95	7.192	400.38	403.28	51.95
1	-4	2011-10-20 13:34:45	15.9	93.95	7.18	400.45	403.35	51.95
1	-3	2011-10-20 13:34:46	15.88	93.94	7.128	400.65	403.53	51.95
1	-2	2011-10-20 13:34:47	15.87	93.93	7.072	400.58	403.43	51.95
1	-1	2011-10-20 13:34:48	15.88	93.94	7.034	400.35	403.18	51.95
1	0	2011-10-20 13:34:49	15.89	93.95	7.057	400.57	403.42	51.95
1	1	2011-10-20 13:34:50	15.9	93.95	7.091	400.7	403.56	51.97
1	2	2011-10-20 13:34:51	15.92	93.94	7.151	400.26	403.14	51.95
1	3	2011-10-20 13:34:52	15.92	93.94	7.239	400.99	403.91	51.95
1	4	2011-10-20 13:34:53	15.93	93.94	7.302	401.05	404	51.92

The IV, mean, and range are found by scrolling to the bottom.

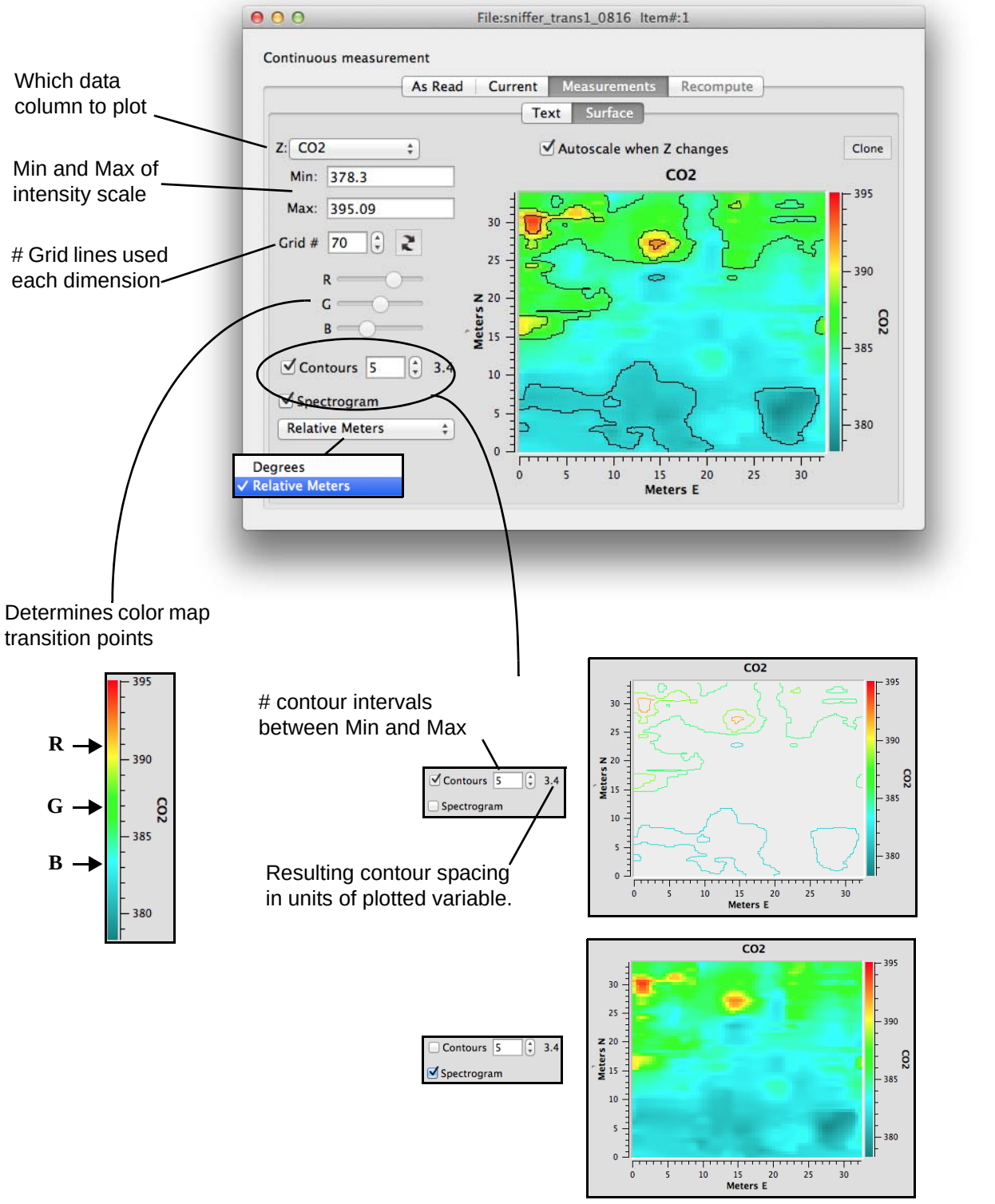


1	88	2011-10-20 13:36:17	16.99	93.94	10.115	412.93	417.15	51.92
1	89	2011-10-20 13:36:18	17	93.95	10.108	413.18	417.4	51.95
IV	0	2011-10-20 13:36:18	15.89	93.94	7.029	400.66	403.5	51.95
Mean	44.5	2011-10-20 13:36:18	16.5	93.94	8.847	405.66	409.29	51.94
Range	89	2011-10-20 13:36:18	1.11	0.04	3.058	12.92	14.26	0.05

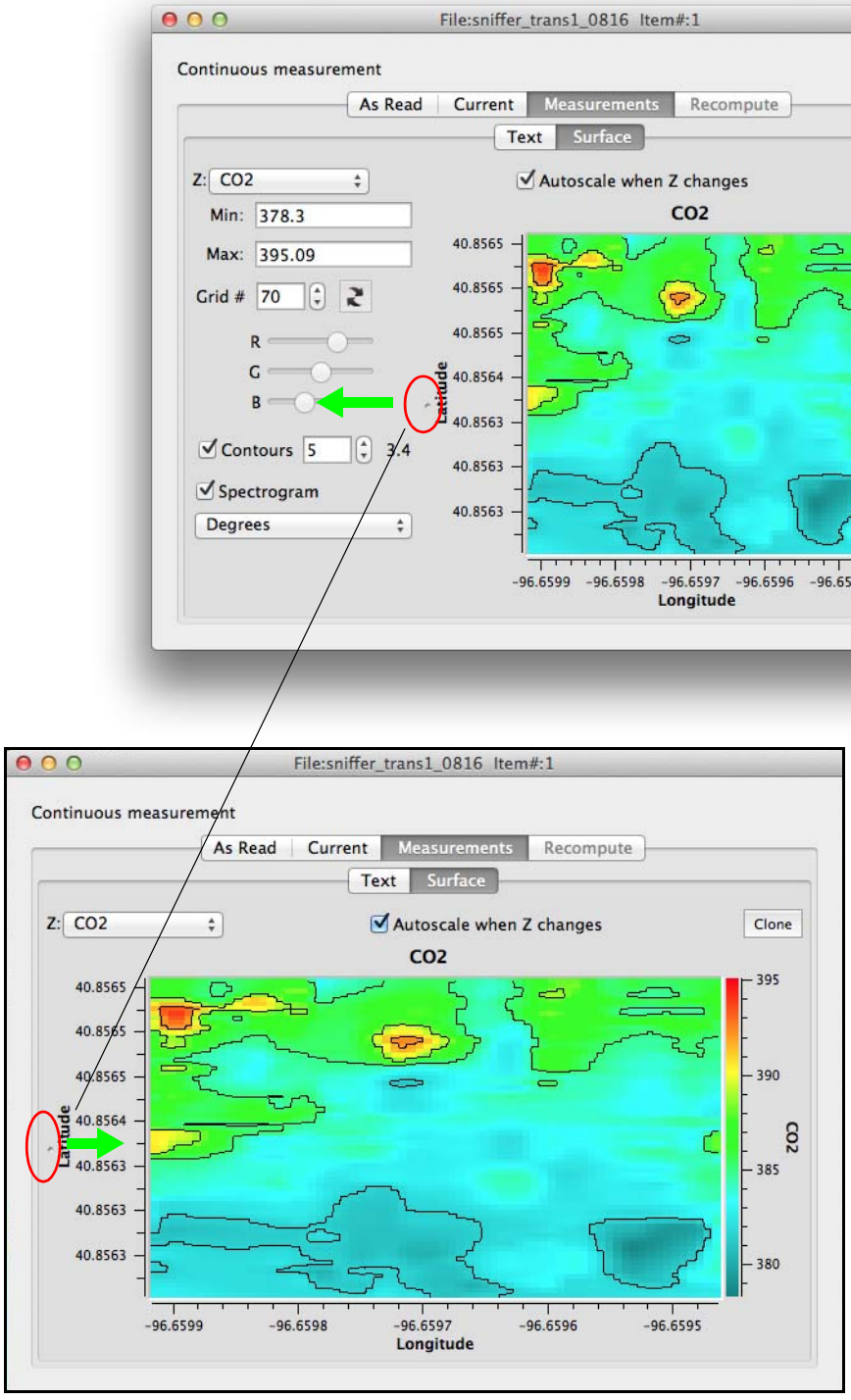
Surface

Observation Details

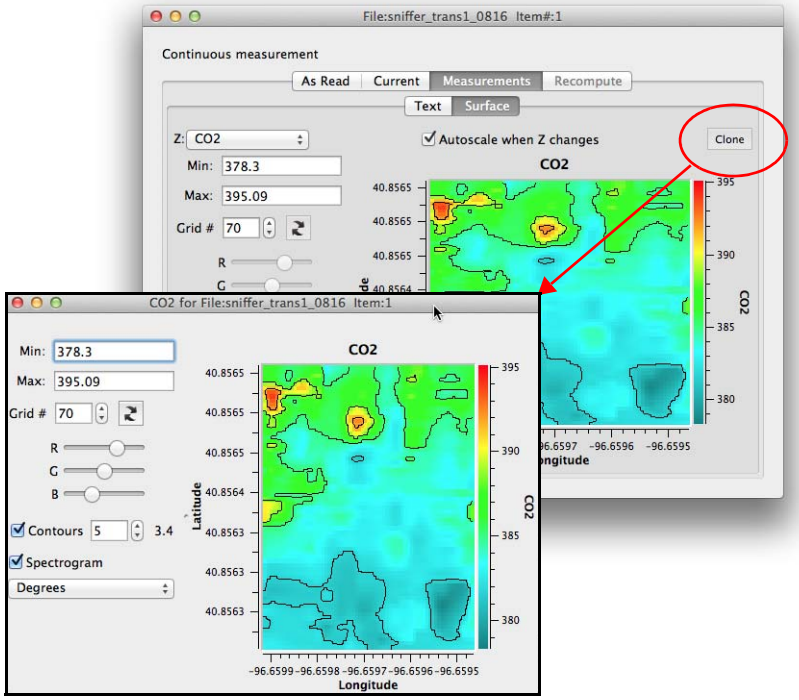
For Continuous measurements that have GPS data, the Surface tab allows spectrographs and contours to be plotted on the surface of your choice.



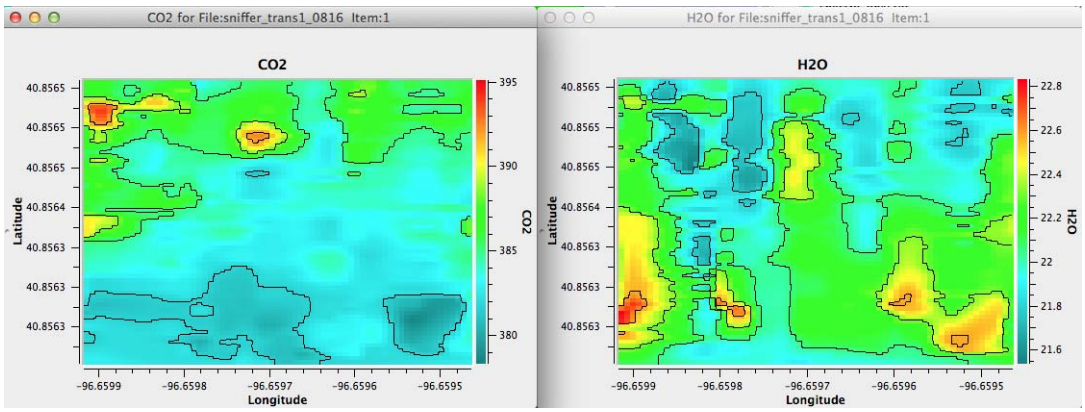
Note the partition control below: sliding it to the left will cover the setup controls.



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 SoilFluxPro observation or it's 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.



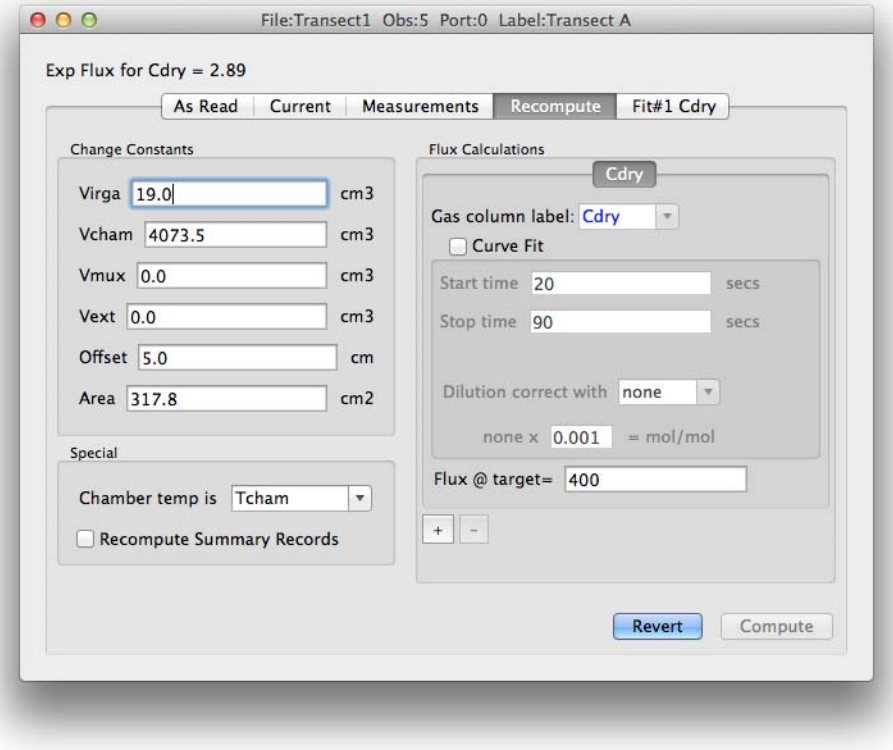
Using clones can let you compare multiple variables from the same observation.



Recompute

Observation Details

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.

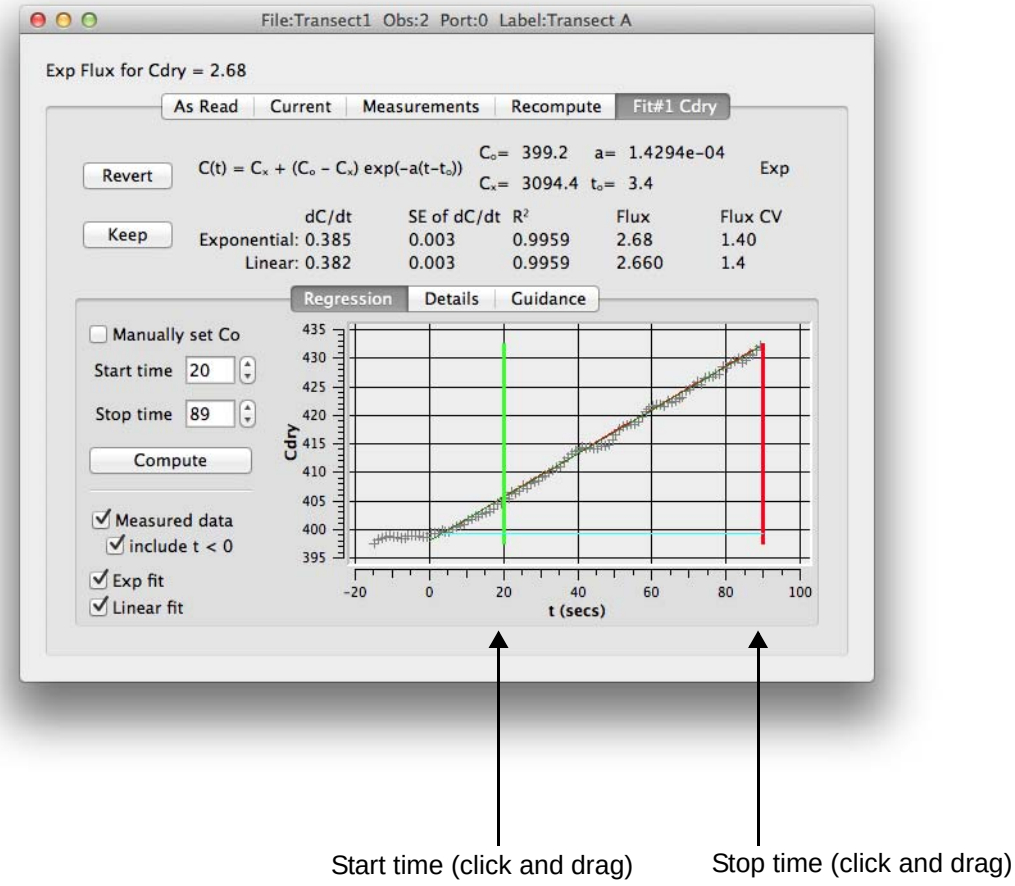


For details on using this interface, see Recompute Observations

Curve Fit Details

Observation Details

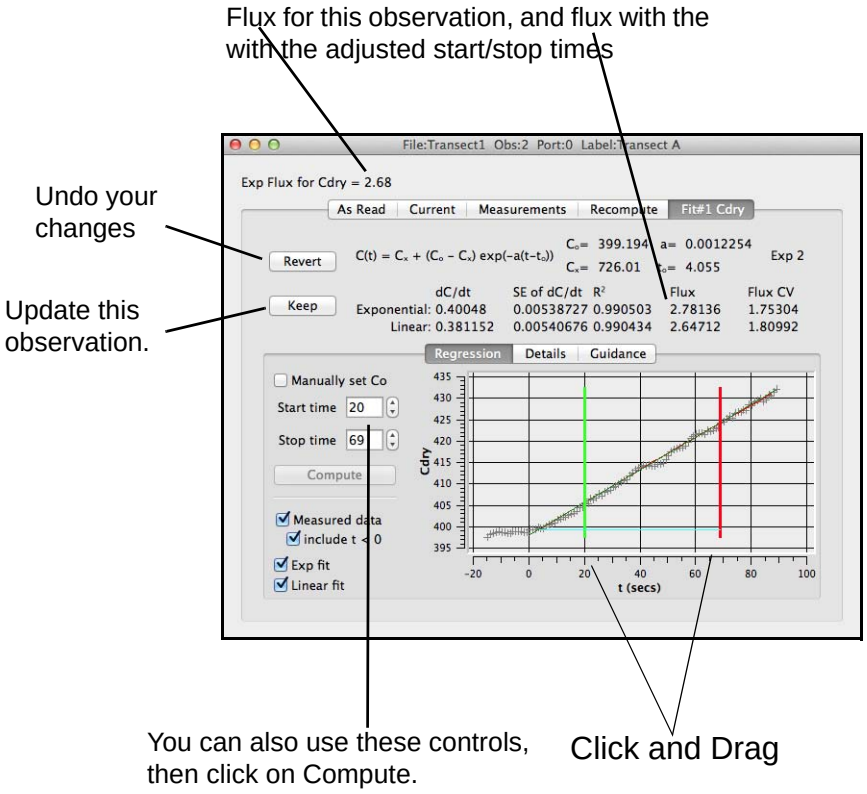
The Fit tab in the Observation Details view provides a close look at the exponential and linear fits for an observation.



Changing Start/Stop Times

Curve Fit Details

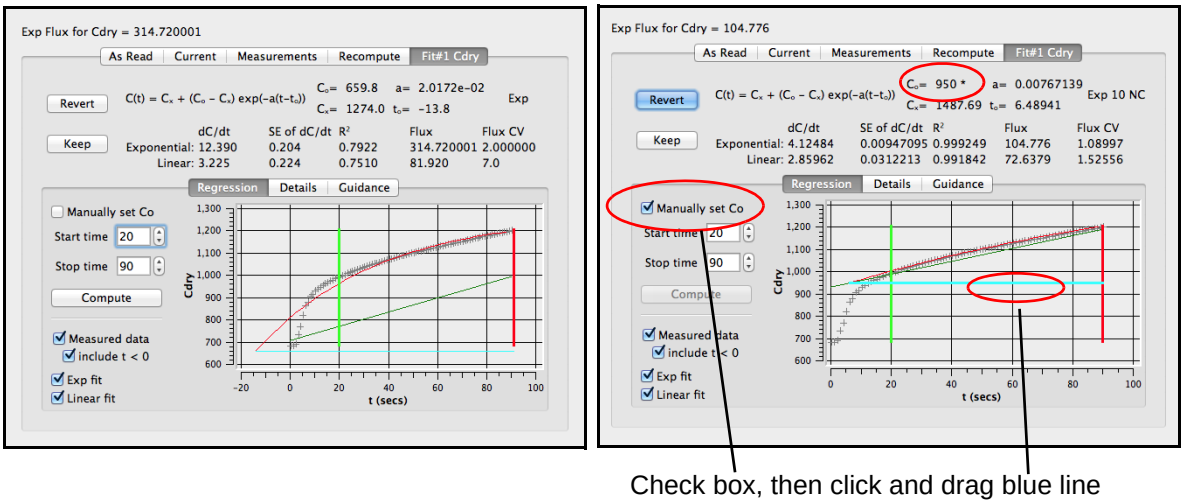
Click and drag the green Start (left vertical) line, or the red Stop (right vertical) line. When you release the mouse button, the data between the lines are linearly and exponentially fit, and the results shown in the grid above the chart. This doesn't actually change the observation, unless you click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



Manually Set C_o

Curve Fit Details

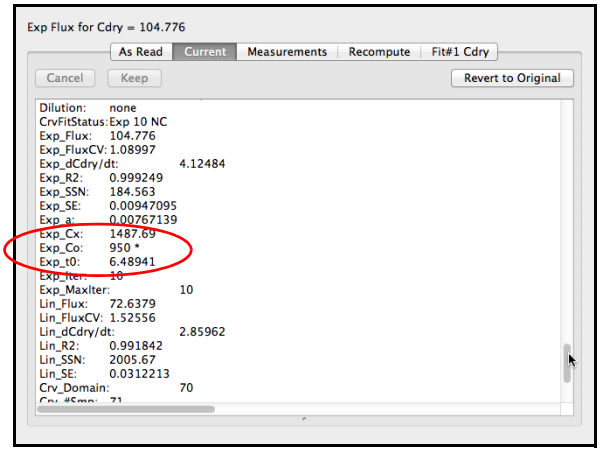
Usually, C_o, the starting value of C_{dry}, is determined from the IV value of Cdry. You can manually override this by unchecking the "The Manually Set C_o" check box, and clicking and dragging the blue horizontal line to the desired value. This normally is not necessary, but is available for strange data sets such as is shown below.



In the figure is typical of non-standard chambers that do not close, but rather just starts sampling, 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 value are marked with an asterisk, as seen above and in the Footer.

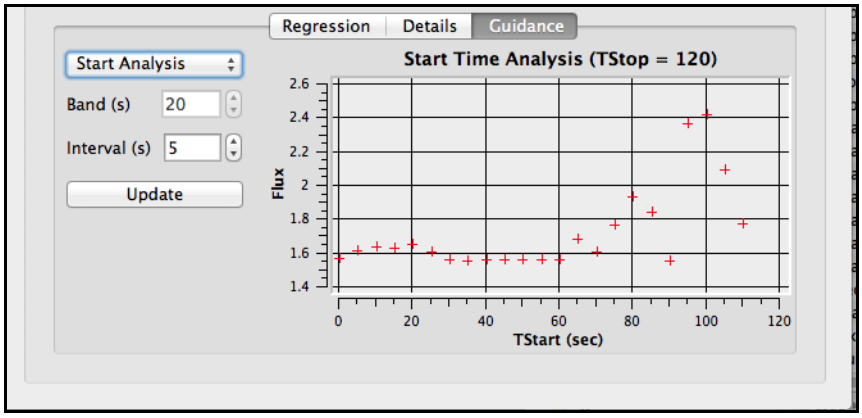


Start/Stop Guidance

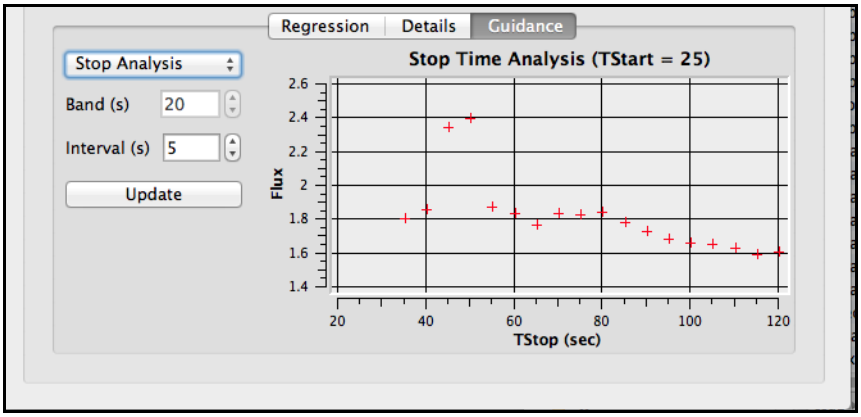
Curve Fit Details

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

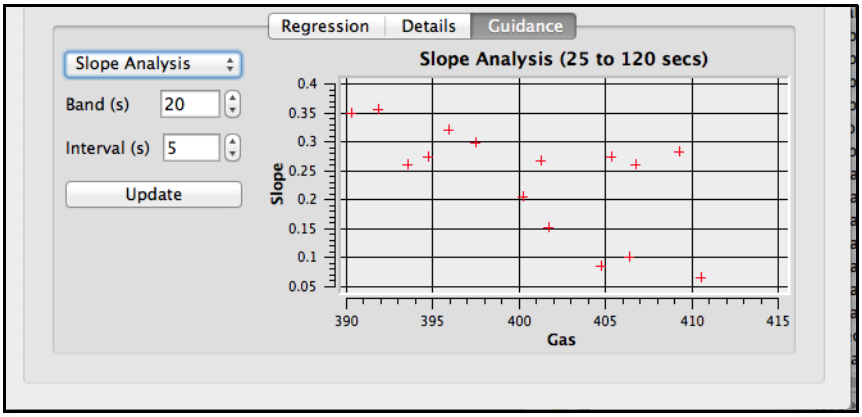
The **Start Times** plot shows Flux as a function of Start time (given the current Stop time).



The **Stop Times** 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.



Miscellaneous Topics

LI-8100 Data File Format

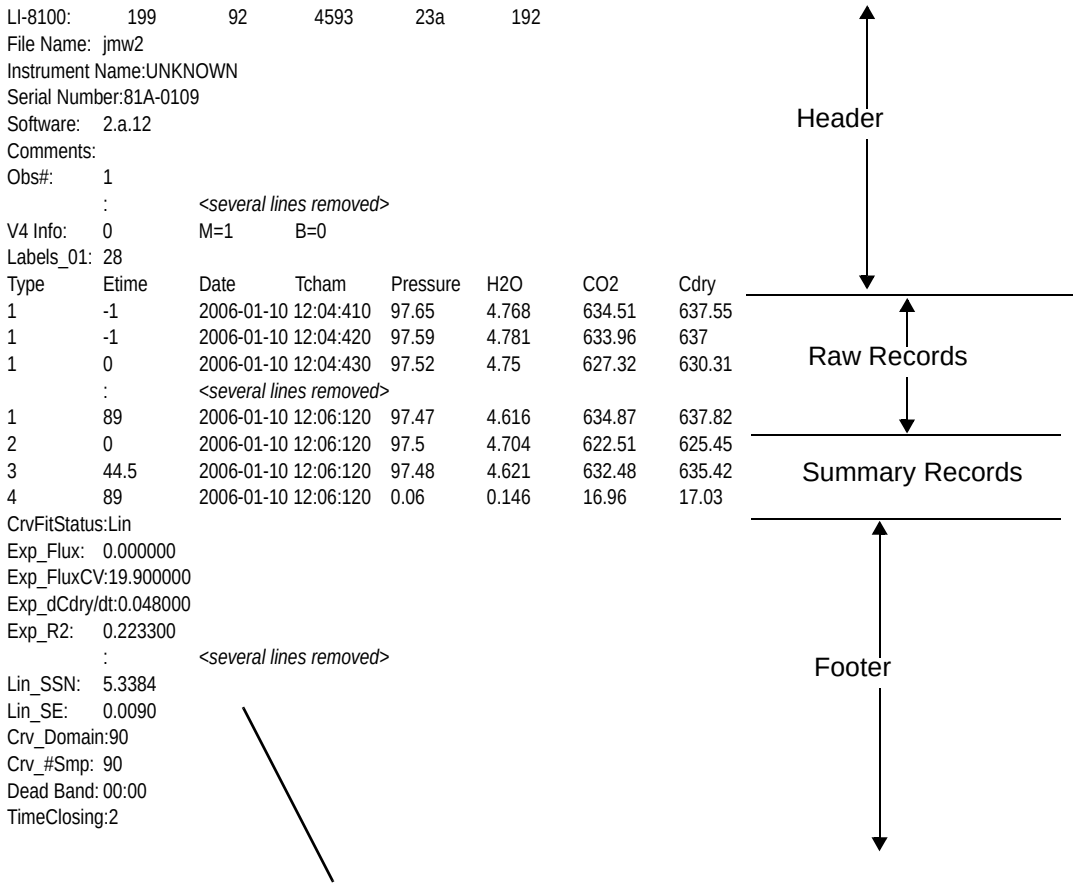
Miscellaneous Topics

Chamber Measurements

LI-8100 Data File Format

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

Chamber Measurement, Version 2+ Format



SoilFluxPro version 3.2 and above has a slightly modified Footer format. See Version 3.2 Footer.

Header. The lines from “LI-8100:” through “Labels_01:”.

Type. The first item in each measurement record is the Type:

Type	Description
-1	Warning record

Type	Description
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)

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.

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

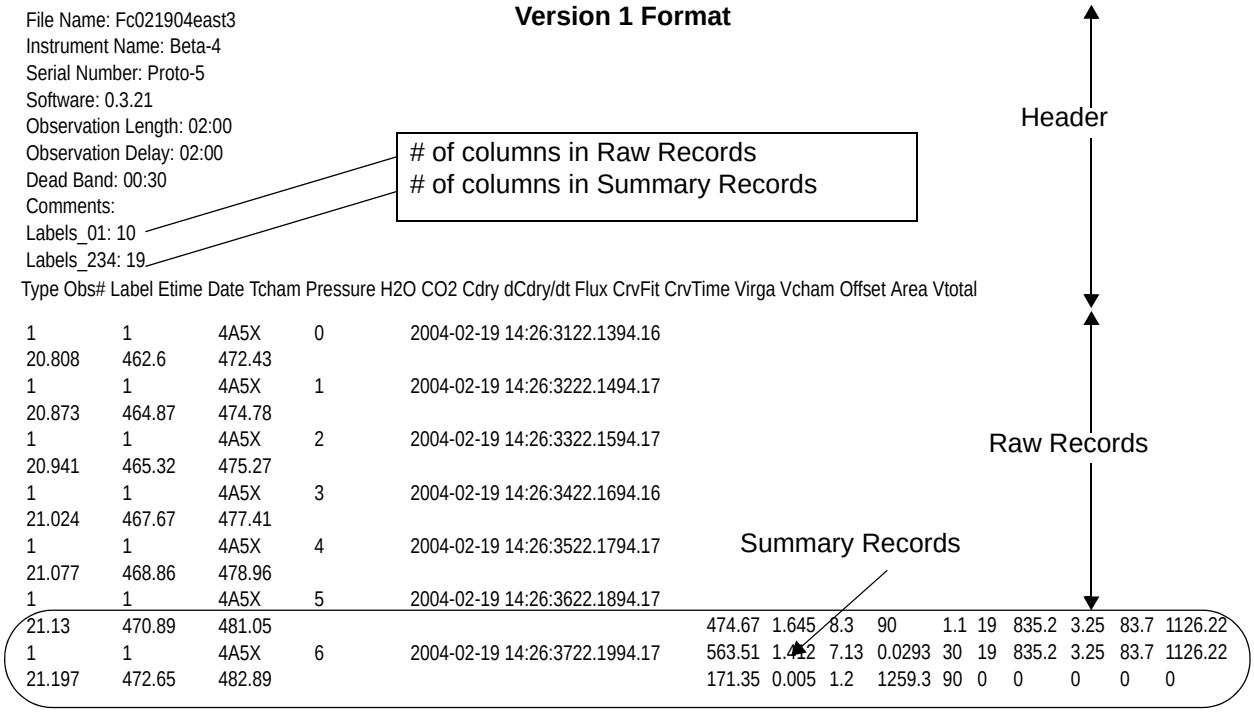
Footer. The results of the analysis, including flux values. The footer won't be present for files logged with the "Compute Flux" option off, or for Version 1 files (below). However, SoilFluxPro will regenerate the footer.

Observation. The Header + n Raw Records + 3 Summary Records + the Footer.

Version 1 Formats

LI-8100 Data File Format

The Version 1 format (pre-multiplexer) is illustrated below.



The big difference is lack of a Footer; all of the results are buried in the summary records, in extended columns. There are also Header differences, and version 1 files may have “missing” headers in subsequent Observations within a file.

When SoilFluxPro reads Version 1 formatted files, they are automatically converted to Version 2 format.

Version 3.2 Footer

LI-8100 Data File Format

Version 3.2 of the SoilFluxPro adds multiple flux capability, and this shows up in some changes to the footer. In the example below, there are two extra columns (with labels V1 and CO2), and two extra rows (labels GasColumnID and Dilution). This indicates that two extra flux computations were done, using V1 and CO2, in addition to the standard flux computation, which is based on CDry.

Potentially more columns

Two new row labels

GasColumnID:	Cdry	V1	CO2
Dilution:	none	H2O 0.001	none
CrvFitStatus:	Exp 2	Exp 2	Exp 2
Exp_Flux:	3.25	3.16	2.78
Exp_FluxCV:	1.12	1.11	1.13
Exp_dCdry/dt:	1.0722	1.0421	0.9163
Exp_R2:	0.9992	0.9994	0.9991
Exp_SSN:	0.3962	0.2621	0.3636
Exp_SE:	0.0031	0.0025	0.0030
Exp_a:	2.54E-03	2.22E-03	1.17E-03
Exp_Cx:	1248.8	1273.1	1595.7
Exp_Co:	826.8	804.2	815.0
Exp_t0:	-1.2	-2.4	0.4
Exp_Iter:	2	2	2
Exp_MaxIter:	10	10	10
Lin_Flux:	2.86	2.81	2.62
Lin_FluxCV:	1.18	1.16	1.15
Lin_dCdry/dt:	0.9435	0.9293	0.8651
Lin_R2:	0.9983	0.9988	0.9989
Lin_SSN:	0.8061	0.5605	0.4283
Lin_SE:	0.0044	0.0037	0.0032
Crv_Domain:	80	80	80
Crv_#Smp:	80	80	80
Dead Band:	00:10	00:10	00:10
TimeClosing:	18	0	0
Target:	370.0	0.0	0.0
Flux@Target:	6.76	8.57	5.67
MinCO2:	764.3	766.5	754.5
Flux@Min:	3.73	3.41	2.99

Computing a flux for V1 would be done if a second gas analyzer is connected to the LI-8100A, with a linearized analog output being fed into channel V1.

The flux for CO_2, without a dilution correction in this case, lets you see the impact of evaporation when you neglect it; the flux was reduced to 2.78 from 3.25 in this example.

When a dilution correction is done (the V1 example), you can pick the quantity used for the water measurement, and the multiplier to use to convert that reading into mol/mol. In this case, we used the data in the H2O column (units are mmol/mol), along with a multiplier of 0.001.

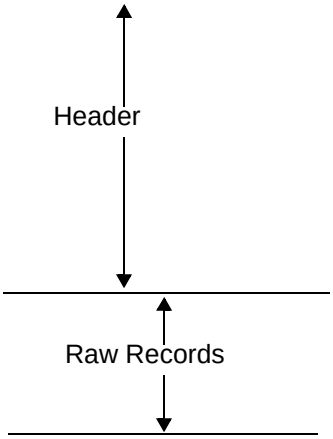
Continuous Measurements

LI-8100 Data File Format

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

File Name: jmw2
Instrument Name:UNKNOWN
Serial Number:81A-0109
Software: 2.a.12
Comments:

Type	Etime	Date	Tcham	Pressure	H2O	CO2	Cdry
1	-1	2006-01-10	12:04:410	97.65	4.768	634.51	637.55
1	-1	2006-01-10	12:04:420	97.59	4.781	633.96	637
1	0	2006-01-10	12:04:430	97.52	4.75	627.32	630.31
	:	*<several lines removed>*					



SoilFluxPro Definitions

Miscellaneous Topics

SoilFluxPro classifies the variables in LI-8100 files into three types: Header, Measured, and Footer. SoilFluxPro adds a few of its own in a fourth type, Miscellaneous.

Miscellaneous Variables

SoilFluxPro Definitions

The table below describes the Header variables.

Label	Description
Item#	When a file is read, observations are assigned values starting with 1. They retain this number throughout their life loaded in SoilFlux-Pro, 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 SoilFluxPro 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.
ObsDOY	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.

Header Variables

SoilFluxPro Definitions

The table below describes the Header variables.

Label	Description
LI-8100	5 hexidecimal values giving the size of the header, label, raw data, summary data, and footer. (This is no longer used by SoilFluxPro, as of version 4.0)

Label	Description
File Name	The original file name (as stored on the LI-8100) is preserved by SoilFluxPro, 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 SoilFluxPro, this field will also contain the SoilFlux-Pro 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 Pre-purge.
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-8100 box.
FlowMux	Pump setting in the multiplexer box.
Tmux	Multiplexer temperature at start of observation
Virga	Volume of the IRGA (cm^3)
Vmux	Volume of the multiplexer (if used) (cm^3)

Label	Description
Vext	Volume of extension tubing (cm^3)
Vcham	Volume of the chamber (cm^3)
Offset	Offset (cm) used in volume calculation
Area	Exposed soil area (cm^2)
Vtotal	Total volume (cm^3)
V1 Info	Information on how the voltage channel is configured: Multiplexer channel, slope, offset, etc.
V2 Info	
V3 Info	
V4 Info	
T1 Info	Thermocouple type information.
T2 Info	
T3 Info	
T4 Info	
Labels_01	Number of columns in the raw data section

Measured Variables

SoilFluxPro Definitions

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.

Footer Variables

SoilFluxPro Definitions

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.

Label	Description
Exp_FluxCV	Coefficient of variance (%) of Exp Flux
Exp_dCdry/dt	Slope of the Exponential Fit at time t_o.
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.
Exp_Co	The C_o 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_o 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-8100, but can be adjusted in SoilFlux-Pro.
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.

Label	Description
(The values below are not part of an LI-8100 data file as output by the instrument. They are, however, added to the footer of files saved by SoilFluxPro.	
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 at MnCO2 (Compute Targeted Flux).

Curve Fitting Details

Miscellaneous Topics

The LI-8100 (and SoilFluxPro) 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 available as Lin dCdry/dt. Offset b is not available. The correlation coefficient of this fit is available as Lin_R2. The CO_2 flux based on this rate is available as Lin Flux.

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

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

C_o is the starting concentration, and is known (Type 2 value of Cdry). It is also the theoretical concentration when $t = t_o$. The nonlinear regression solves for C_∞, t_o, and a,

which are available as Exp_Cx, Exp_a, and Exp_t0 respectively. The correlation coefficient of the fit is Exp_R2, the slope at $t = t_o$ 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 (SoilFluxPro also refers to this as a Start time). The LI-8100 uses all of the raw records after the start time / deadband, but SoilFluxPro allows you to shorten this by specifying a stop time. How much data you fit is available as Crv_Domain of the number of seconds, and Crv_#Smp for 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:

$$\begin{aligned} C_\infty &= 1\times10^6 \\ t_0 &= \frac{C_0 - b}{m} \\ a &= \frac{m}{C_\infty - C_0} \end{aligned} \qquad (7)$$

"Lin" usually indicates something strange with the data, such as a kink in the time series of Cdry - not uncommon in gusty conditions with a less than perfect chamber vent design.

Preferences

Miscellaneous Topics

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