

# USING ‘CPX3’ FOR DATA VIEWING AND EDITING

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Note: When this document says to click on something it means use the left mouse button, i.e., normal point and click.

## 1. About CPX3

CPX3 is a graphical user interface for viewing and editing data in the NOAA/ESRL/GMD aerosol database. In addition to aerosol data, the database contains other types of collected or managed by the GMD CPD3 data system, such as ozone and meteorology data. It can be used to look at raw, edited, clean, or averaged data so long as the station and data are set up in the GMD database.

There are two versions of CPX3, one which runs on a Linux or Macintosh computer and has a command line or graphical user interface (GUI). A second, purely GUI, version runs on a Windows computer and is entirely point and click. The CPD3 family of programs, including CPX3, are a work in progress and are currently being tested only at NOAA-operated stations (as of May, 2016).

Help for using any CPD3 program, including CPX3, is available by typing `'programname --help'` at the command line where programname is the name of the program you want help with. Many CPD3 programs are listed on the webpage: <http://esrl.noaa.gov/gmd/aero/software/aerosols/cpd3doc.html>

### **CPX3 demo**

There is a demo available of the Windows version of the data editing software. The demo allows a user to view and edit an example dataset to get a feel for how CPX3 works and how powerful it is. The demo currently only works on Windows PCs running Windows versions 7 and newer. It can be downloaded at:

<ftp://aftp.cmdl.noaa.gov/aerosol/software/cpd3/demo/cpd3-demo-win32.zip>

*To start the demo*, unzip the file and then double click the file "\_demo.bat" in the resulting directory. This will bring up blank plots with the current week. To get the demo data plots you'll need to change the data range in the graphical window to the date range of the demo data (April 25-May 30, 2015). To do this change the start and end date in the plot time range cell at the top of the empty plots. You'll need to hit enter after updating the date for the date change to be applied. . It takes the data about a minute to load so be patient – there is a loading bar in the lower right of the window so you know how much of the data are loaded.

### **Getting Started <not applicable to demo/Windows version>**

To start a CPX3 session you merely need to type `cpx3 stn <enter>` where 'stn' is the 3-letter station identifier. For example to start cpx3 for Cape San Juan, Puerto Rico you would type: `cpx3 cpr <enter>`

This opens and plots the most recent week of raw data from CPR. Note that it takes a few seconds to minutes to load the data in depending on how much data is being loaded – there is a progress bar in the lower right so you can see where it is in the loading process.

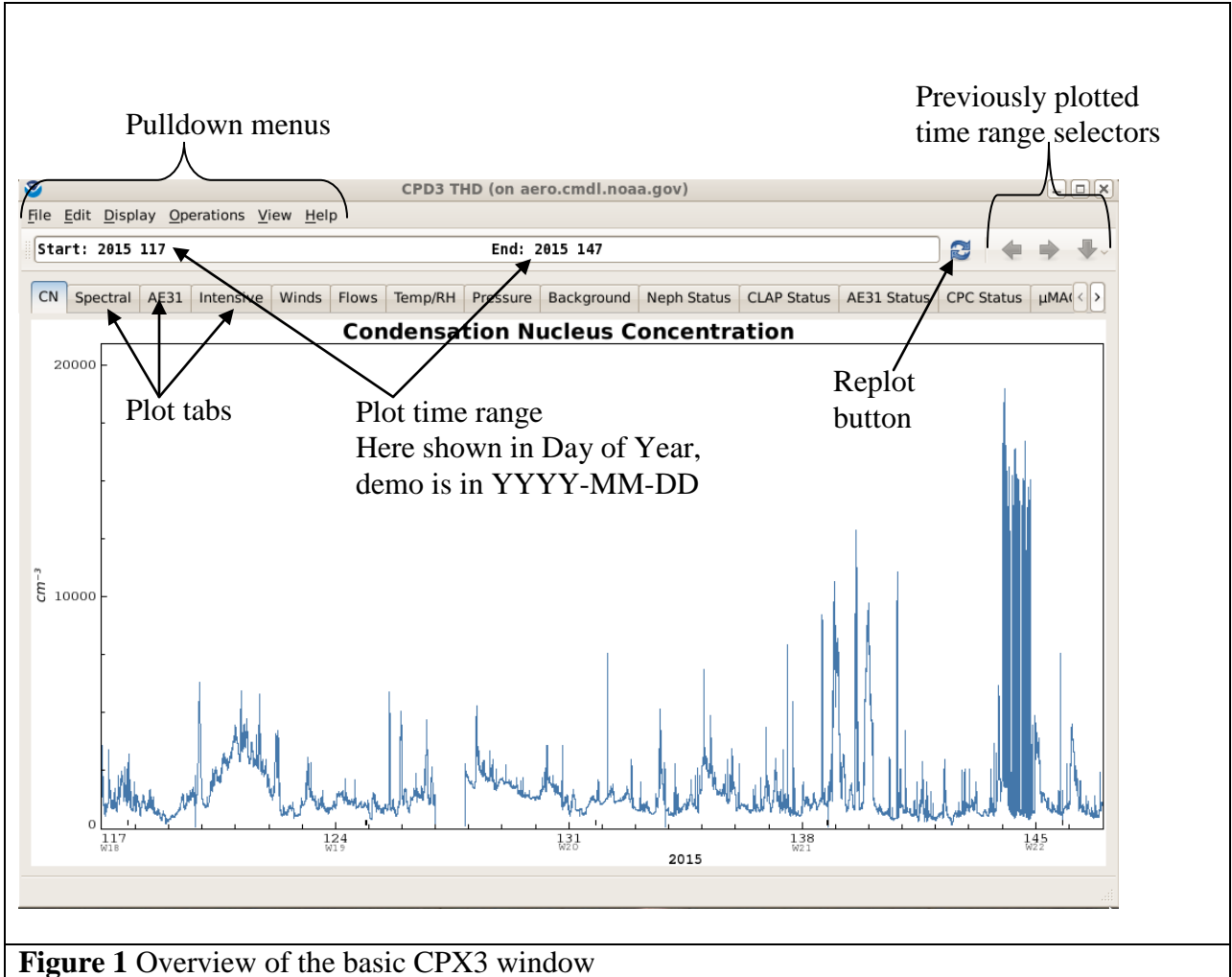
### **Quitting CPX3**

The last item on the CPX3 dropdown 'file' menu is 'quit'. Alternatively you can type `<control><q>` (`<Command>(Q)` on OSX) and CPX3 will quit.

## 2. CPX3 – The Basics

### The graphical window

CPX3 has lots of functionality and it is constantly being updated. Figure 1 highlights some of the basic functions that you will need for data viewing and editing.



**Figure 1** Overview of the basic CPX3 window

### **Dropdown menus**

There are six dropdown menus at the top of the CPX3 plot window with various options. These are described in Table 1.

### **Plot Tabs**

There are plot tabs for different instruments and measured parameters. These vary from system to system depending on what measurements are being made. You can move from tab to tab by clicking on a tab with your mouse or by typing the 'n' (next) and 'p' (previous) keys. To toggle between two plots use the letter 'b' (back). You can also select a tab using the list of tabs under the 'View' dropdown menu (see Table 1).

## Replot Button

Clicking on the replot button will replot the data after a different time range is entered in the plot time range or after a specific region of a plot has been selected. You can also type the letter 'r'.

**Table 1** – Description of dropdown menus

<p><b>(1) File</b></p> <ul style="list-style-type: none"><li>• Mentor Edits – <i>brings up list of existing edits (if any) and window for adding edits</i></li><li>• Full Screen – <i>toggles GUI to full screen</i></li><li>• View Data – <i>brings up a window so you can select a parameter and view numerical values</i></li><li>• View Event Log – <i>brings up timestamped list of notes from data acquisition computer and instrument reports (very useful for data editing)</i></li><li>• Save Image - <b>&lt;not yet implemented&gt;</b></li><li>• Print - <b>&lt;not yet implemented&gt;</b></li><li>• Export Data – <i>brings up a window so you can select a parameter and export to data file</i></li><li>• Quit – <i>quits CPX3</i></li></ul>
<p><b>(2) Edit</b></p> <ul style="list-style-type: none"><li>• Preferences – <i>allows user to choose timestamp type and EBAS flag prompting</i></li><li>• Display Settings – <b>&lt;not yet implemented&gt;</b> <i>will allow the user to add configuration for tabs, graphs such as changing colors, adding traces</i></li><li>• System Configuration – <b>&lt;not yet implemented&gt;</b> <i>configuration file for 'everything' e.g., where it sends EBAS files (to the scientist and/or to EBAS)</i></li></ul>
<p><b>(3) Display</b></p> <ul style="list-style-type: none"><li>• Raw – <i>displays raw measurement and housekeeping (i.e., flows, pressures, etc) data</i></li><li>• Editing – <i>displays multi-paned plots: top plot is raw data, bottom plot is edited data (mentor edits and corrections applied)</i></li><li>• Clean – <i>displays edited data that have been passed</i></li><li>• Averaged – <i>displays clean (i.e., passed), [hourly]-averaged data</i></li></ul>
<p><b>(4) Operations</b></p> <ul style="list-style-type: none"><li>• Manual – <i>brings up menu with options for manipulating and managing data through a GUI; these tasks can also be accomplished from the command line on a Linux or Macintosh system. Two important options are 'Pass' to pass data and 'Generate EBAS' to generate an EBAS formatted file from the data.</i></li></ul>
<p><b>(5) View</b></p> <ul style="list-style-type: none"><li>• <i>Brings up some options for moving amongst plot tabs (e.g., back, next, previous, etc)</i></li><li>• <i>Has toggle for turning plot legends on and off</i></li><li>• <i>Brings up list of plot tabs so you can go to a specific plot directly</i></li></ul>
<p><b>(6) Help</b></p> <ul style="list-style-type: none"><li>• Help – <b>&lt;not yet implemented&gt;</b></li><li>• Website – <i>takes you to GMD Aerosols software page, which has a section of Frequently Asked Questions for CPX3 (FAQ info is command-line oriented, so may not be useful for cpx3 running on Windows machines)</i></li><li>• Report bug – <b>&lt;not yet implemented&gt;</b></li></ul>

- Show Debug – *shows code error messages*

### Plot Time range

This text box shows the time range of data currently being plotted. A different time range can be typed into the text box and it will be plotted once the ‘replot’ button is clicked.

### Previously plotted time range selectors

These arrows are similar to the back, forward and history arrows on a webpage.

## 3. CPX3 – How to use it

### Extracting data <not applicable to demo/Windows version>

There are two ways to extract specific data for viewing in CPX3.

- (1) One can begin by starting a CPX3 session and then editing the ‘Plot time range’ values at the top of the CPX3 window.
- (2) Alternatively, one can set the desired time range on the command line. There are multiple command line options to set the time range. Some of these are described in Table 2 below.

**Table 2** Telling CPX3 what data time range<sup>1</sup> to plot, examples are all for Bondville (bnd)

Command Line	Result
<code>cpx3 bnd</code>	Most recent week of data
<code>cpx3 bnd 24h now</code>	Data collected during the past 24 hours
<code>cpx3 bnd 2009w15</code>	Data for week 15, 2009
<code>cpx3 bnd 2009:103 2009:106</code>	Three days of 2009 data: DOY 103, 104 and 105
<code>Cpx3 bnd 2009:100 10d</code>	Ten days of data starting on DOY 100
<code>cpx3 bnd 2008-01-15T12:00:00Z 2008-01-16T15:00:00Z</code>	Data between 12pm Jan 15, 2008 and 3pm Jan 16, 2008
<code>cpx3 bnd 2009.5 2009.75</code>	Fractional year – so data between ~July 1 – Sept 30, 2009
<code>cpx3 bnd 2009-01-15 2009-01-30</code>	Data between Jan 15 and Jan 30, 2009

<sup>1</sup>Times are always in UTC. There are additional times stamp permutations, largely following the ISO8601 specification, which are described on the web:  
<http://www.esrl.noaa.gov/gmd/aero/software/aerosols/timeformat.html>.

Station data editing is typically done in weekly increments where the week is defined as Monday through Sunday (thus editing for the previous week can commence on a Monday). Thus, for weekly editing, you will typically use the third example in Table 2.

### Zooming in on a data feature

Once you have a CPX3 session open you may want to look at a specific time period within the period of time displayed, i.e., for editing you may want to look at a spike in the data. Again there are two ways to do this.

- (1) You can edit the ‘Plot time range’ values at the top of the CPX3 window with the appropriate start and end times.
- (2) Alternatively, you can use the mouse to select a range. To use the mouse, click on the left side of the time range you want to look at, then drag the mouse to the right and click again on the right side of the region of interest. CPX3 will put vertical bars at the two edges you have defined, which will turn into a box if the mouse cursor is displaced.

vertically from the starting position. To look at just that time period (or zoomed data), click on the ‘replot’ button.

Table 3 describes various options for using your mouse and the keyboard to select (or de-select) data and to change plot parameters for a better look at the data.

**Table 3** Using your mouse to select data and change plot parameters

<b>Selection action</b>	<b>Result</b>
Click	Selection box, may have vertical and horizontal constraints
Shift+click	Horizontal selection bars only, no x-axis constraint
Control+click	Vertical selection bars only, no y-axis constraint
<esc>	Gets rid of selection constraint
Right-click	Brings up menu of various options including: <ul style="list-style-type: none"> <li>• Manual zoom (so you can force axes to be desired range)</li> <li>• Data smoothing options (e.g., hourly, lowpass filters)</li> <li>• Trace specific options (e.g., add symbols, hide legend)</li> <li>• Show plot in pop-up window (good for comparing with other plots)</li> </ul>

### Returning to a previous data time range

Once you’ve inspected the small feature you were looking at, you may want to expand back to the previous wider time range. In the upper right corner are three arrow buttons. The ‘←’ and ‘→’ are similar in functionality to the forward and backward keys on webpages. The ‘↓’ key pops up a menu with a list of time ranges you’ve looked at recently and you can select the one you want. If you want to go back to the time range you began with when you started cpx3 (for example the whole week of data) you can use a keyboard shortcut and type ‘a’.

### Selecting a data display mode

Use the ‘Display’ dropdown menu to select the display mode.

- ‘Raw’ will show you the unedited, uncorrected data and all the ‘housekeeping’ variables (i.e., flows, temperatures, pressures, etc)
- ‘Editing’ will show you the raw data in the top pane and the edited data in the bottom pane. The edited data plot shows data with the corrections applied. Edited data differs from the ‘clean’ data in that it shows the effect of all edits in the ‘mentor edits’ list, not just the “passed” data edits. (These terms are explained more clearly below.) The housekeeping data are not visible in editing mode.
- ‘Clean’ will show you data with all the “passed” data edits applied

### Shortcut keys

CPX3 can be used entirely as a point-and-click program, however there are some short-cut keys (hotkeys) that may be useful. These are described in Table 4 below.

**Table 4** Shortcut keys (hotkeys)

n	Move to next (right) tab
p	Move to previous (left) tab
r	Replot graphs (same as replot button) i.e., use after you select a different time range
a	Go back to time range that cpx3 was started at (i.e., if you started editing a week of data this will set the x-axis back to the whole week)
b	Allows you to toggle back and forth between the two most recently looked at plot tabs

More shortcuts are described in Appendix A

## 4. Editing data - Mechanics

Specific things to look for when editing data are described in the next section ‘Editing Data – what to look for’. The mechanics of data editing are described here.

**How to determine most recent data passed <not applicable to demo/Windows version>**  
*Not yet implemented for Windows version of CPX3 - it will eventually be an option on a pull-down menu.*

For stations that previously ran cpd2 and are using cpx3 on a Linux machine the following works:

To figure out what the most recently edited week of data is you would type on the command line: `dat a. st at us st n <enter>` (replace stn with the three letter station id, e.g., mlo). The output of `data.status` looks something like:

*Last clean data passed: 2016-04-25T00:00:00Z - Week 16*

Thus week 16 has been passed, so week 17 would be the week that next needs editing and passing.

### General data editing procedure

Once you have a CPX3 window open and showing the data to be edited, you are ready to begin editing. We recommend the following procedure.

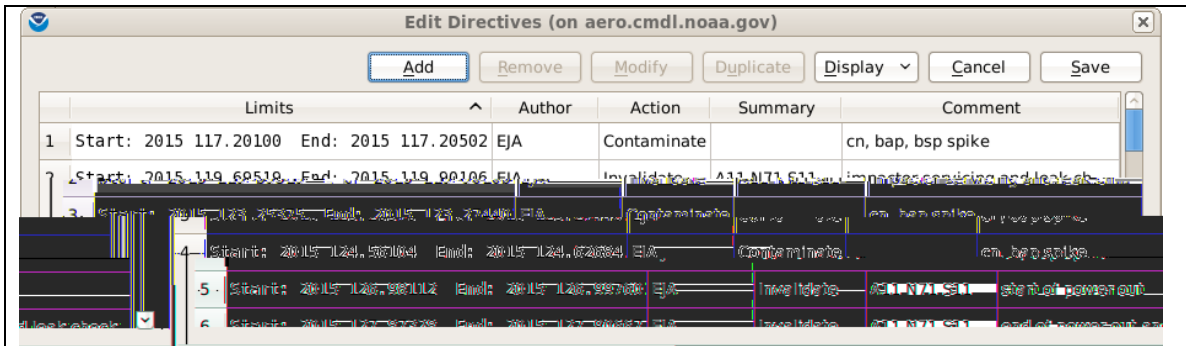
- Scroll through all of the ‘Raw’ data plots. In particular - look at the housekeeping plots to identify issues with flows, pressures or other indicators of system issues
- Open the station log (File dropdown menu → ‘View event log’). See if any issues in the raw data can be associated with normal station maintenance activities or notes of unusual events (e.g., wildfire plumes)
- Switch to editing mode (Display dropdown menu → ‘Editing’). It may be helpful to use the ‘Extensive’ plot tab as the main base for editing. It allows you to see edited particle counts, aerosol absorption and scattering all in the same plot window. You can toggle between the ‘Extensive’ tab and the individual parameter tabs (e.g., ‘CN’, ‘Scattering’, etc.) which show both raw and edited data.
- Open the Mentor Edits window (File dropdown menu → ‘Mentor Edits’)

Note: you can do edits in any display mode (raw, editing, clean), but it’s recommended to use ‘editing’ display mode.

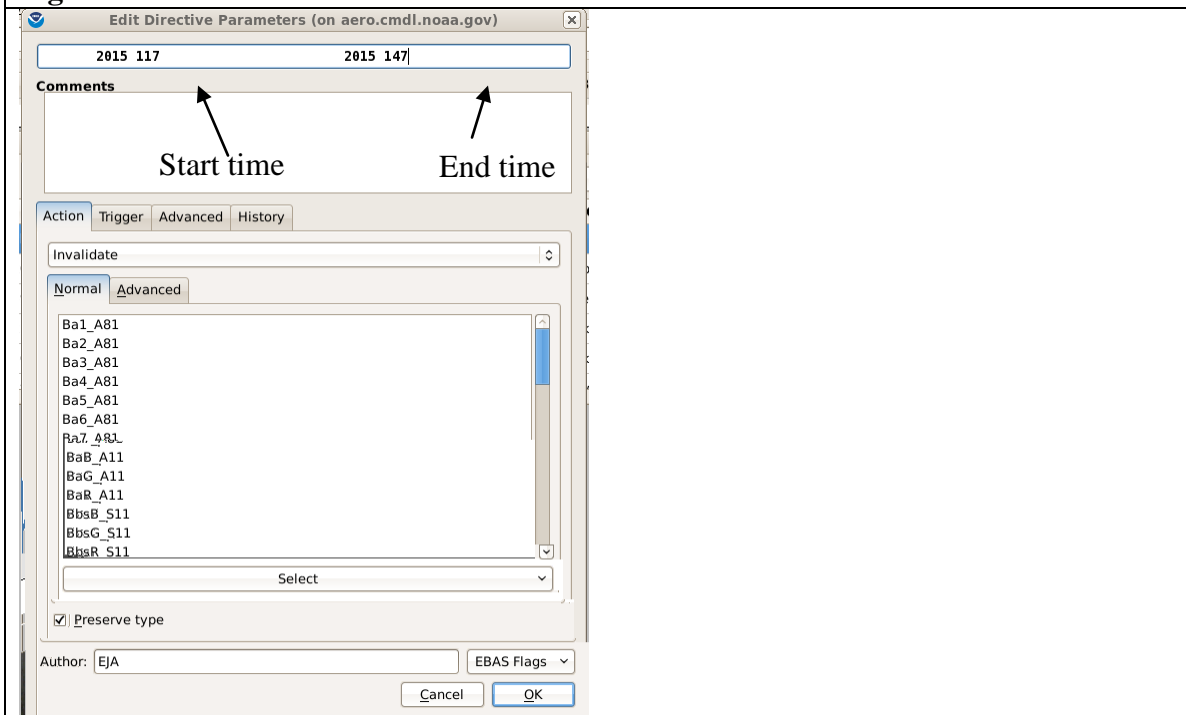
### How to make a data edit

Open the Mentor Edits window (File dropdown menu → ‘Mentor Edits’). This will pop up a window showing any existing edits for the time range currently displayed (Figure 2a). To add an edit, click the ‘Add’ button in the upper left of the ‘Mentor Edits’. This will bring up the ‘Edit Directives’ window (Figure 2b).





**Figure 2a** Mentor edits window



**Figure 2b** Edit directives window

The ‘Edit Directive’ window has several tabs, selection lists, and entry boxes in which to enter information and choose various options.

*Edit start and end times*

‘Start’ and ‘End’ are the start and end time of the edit – i.e., if there is a spike that starts at 2009 103.56 and goes to 2009 103.57 then those are the times that should be used as the start and end times. You can type in the edit times if you know them or you can select the appropriate time period on the plot using your mouse and the start and end times will automatically reflect those times. Not that the time range includes all data starting with the start time and excluding all data from the end time onwards.

*Author*

The data editor’s initials should go here.

*Comments*

Put a brief comment about why the data were edited here. Some examples are ‘absorption spike’, ‘weekly maintenance’, or ‘pump failure’.

### *Action*

There are several types of edits that can be made. The most common include:

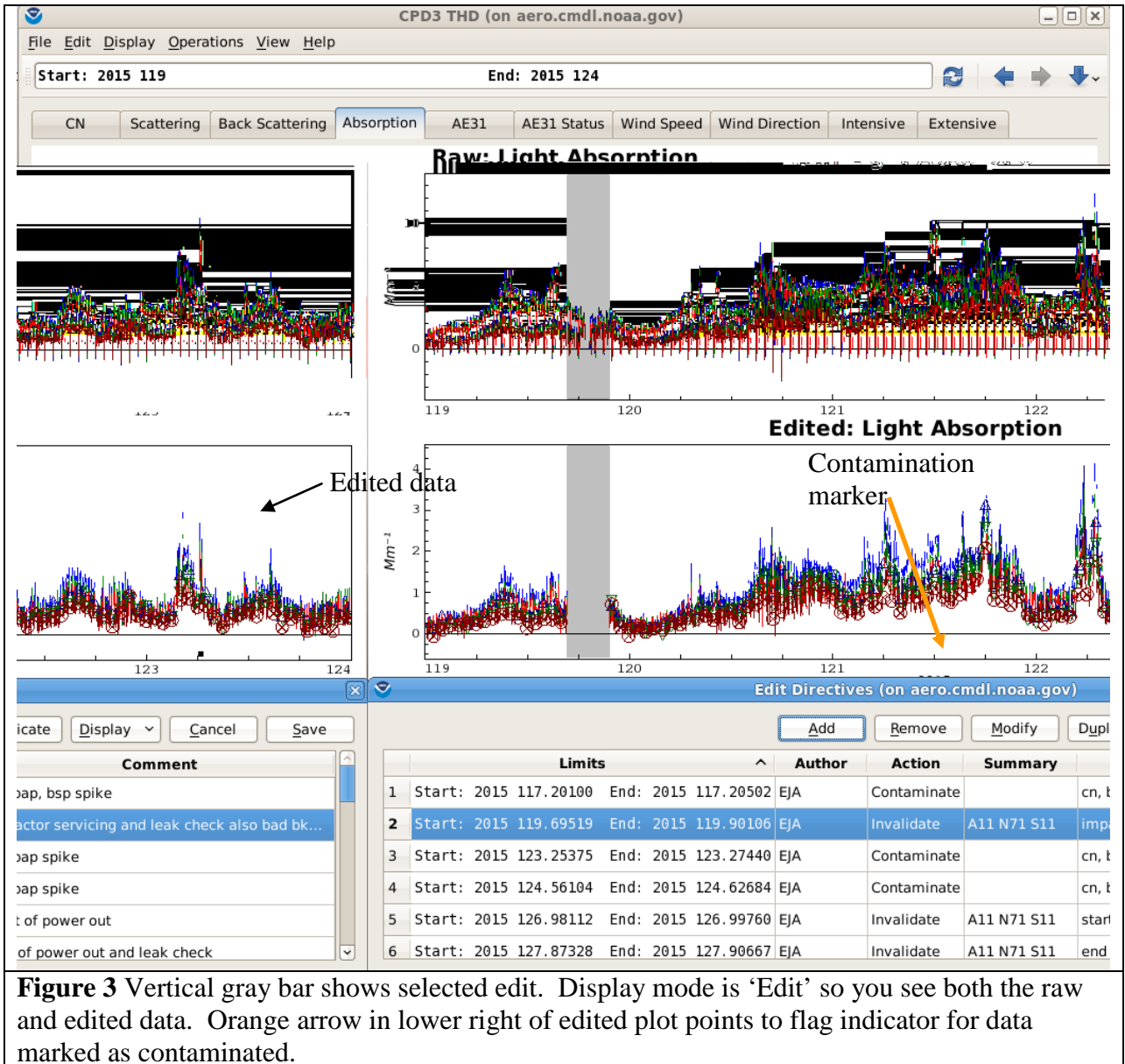
- ‘Invalidate’ – choosing this says the data are bad and should not be included in clean data
- ‘Apply Contamination’ – choosing this causes the data to be flagged as contaminated. Data might be marked as contaminated for many reasons – for example if there is construction occurring near the site affecting the measurements. Contaminated data will be indicated by a small black marker (see Figure 3) on the plot. You can use the right click and use the option under ‘smoothing’ (or ‘all smoothing’) decide whether to show or hide the contaminated data in the plots. By default contaminated data will not be included in the longer term average files (hourly, daily, monthly) (although there is an averaging option which will include contaminated data if desired).
- Change cut size selection – allows you to change size cut (choices: 1, 2.5, 10 um and none)
- ‘Apply Calibration’ – this allows you to apply a polynomial correction to the data

### *Data selection*

You can either choose the individual parameters to which the edit is to be applied from the list of all variables or you can use the ‘selection groups’ dropdown menu and choose the appropriate group(s) (e.g., scattering or absorption). Using the selection groups is typically much easier, especially if all the parameters on an instrument are being invalidated (for example, the scattering and back scattering for all 3 wavelengths on the nephelometer).

Once the ‘Edit Directives’ window is filled out to your satisfaction for a particular edit, click on ‘OK’ and the edit will be added to the list of edits in the ‘Mentor Edits’ window. Save the edit by clicking ‘save’ in the ‘Mentor Edits’ window. When you replot the data the edited pane will reflect the edits. Continue adding edits in this way until you are done with the week. Note: you can make multiple edits before saving. Every time you save your edit directives the data set is reloaded which takes some time so it’s usually quicker to do several edits between saves. However, if you close the edit directives window before you save you will lose all your unsaved edits.

To see the effect of individual edits, open the ‘Mentor directives’ window and click on an edit. A vertical bar will appear to show where that edit occurred. In ‘editing’ display mode this allows you to see where the edit is and the difference between raw and edited plots (see Figure 3). If only absorption data has been edited then the vertical bar will only appear on the absorption pane.



**Figure 3** Vertical gray bar shows selected edit. Display mode is 'Edit' so you see both the raw and edited data. Orange arrow in lower right of edited plot points to flag indicator for data marked as contaminated.

### Modifying an existing edit

There are times when you might want to change an existing edit. When you are doing editing, you may create an edit and then, for some reason, want to change it - for example, to expand or narrow the time range of the edit or change the variables you've chosen. Select the edit in the 'Mentor Edits' window by clicking edit so that the whole row for the edit is highlighted. Click on 'modify' and an edit directive window will pop up that you can change whatever you need to change. When you are done, click on 'OK' and the edit will be updated. You'll need to save the edit to have your change take effect. You can also remove an edit if you determine it should not be applied. Again you will have to save the data to have the change show up in the plots. If data have been passed and then new edits are made and saved, the data will need to be repassed.

### Trigger Edits

CPX3 has the ability to generate some edits based on specific criteria (e.g., data values, instrument flags, etc). For example, trigger edits can be used to invalidate all observations of a variable that are outside of a specified range, which can be useful for instruments that occasionally report invalid, extreme values. Such edits must be used with extreme care to avoid marking valid data as invalid. More details will be forthcoming.

### Passing the edited data

Once you are satisfied with your data edits, you need to save the edit directives and then "pass" the data. This informs the data management system that the data have been QC-checked and approved. There are two ways to pass the data.

- (1) The first way to pass data:<not applicable to demo/Windows version>

Click the "Save" button in the Mentor Edits window to save your edit directives. Then in a terminal window, use the command `da .pass` to pass the data. For example, if you edited data for week 15 of 2009 from Bondville (`cp3 bnd 2009w15 1w`), the syntax for passing the data for this week is

```
da .pass bnd 2009w15
```

More information on `da .pass` is available by typing: `da .pass --help` in a command line window.

- (2) The second way is to use the GUI to pass data (which IS applicable to the demo)

Go to the 'Operations' dropdown menu and select 'manual'. This will (slowly) bring up another dropdown menu with a list of possible operations. To pass the data choose the option 'pass - flag data as having passed mentor QA/QC'.

Any time that changes are made to edit directives the data will need to be repassed for the archived data to reflect the most recent mentor edits.

### Checking the passed data

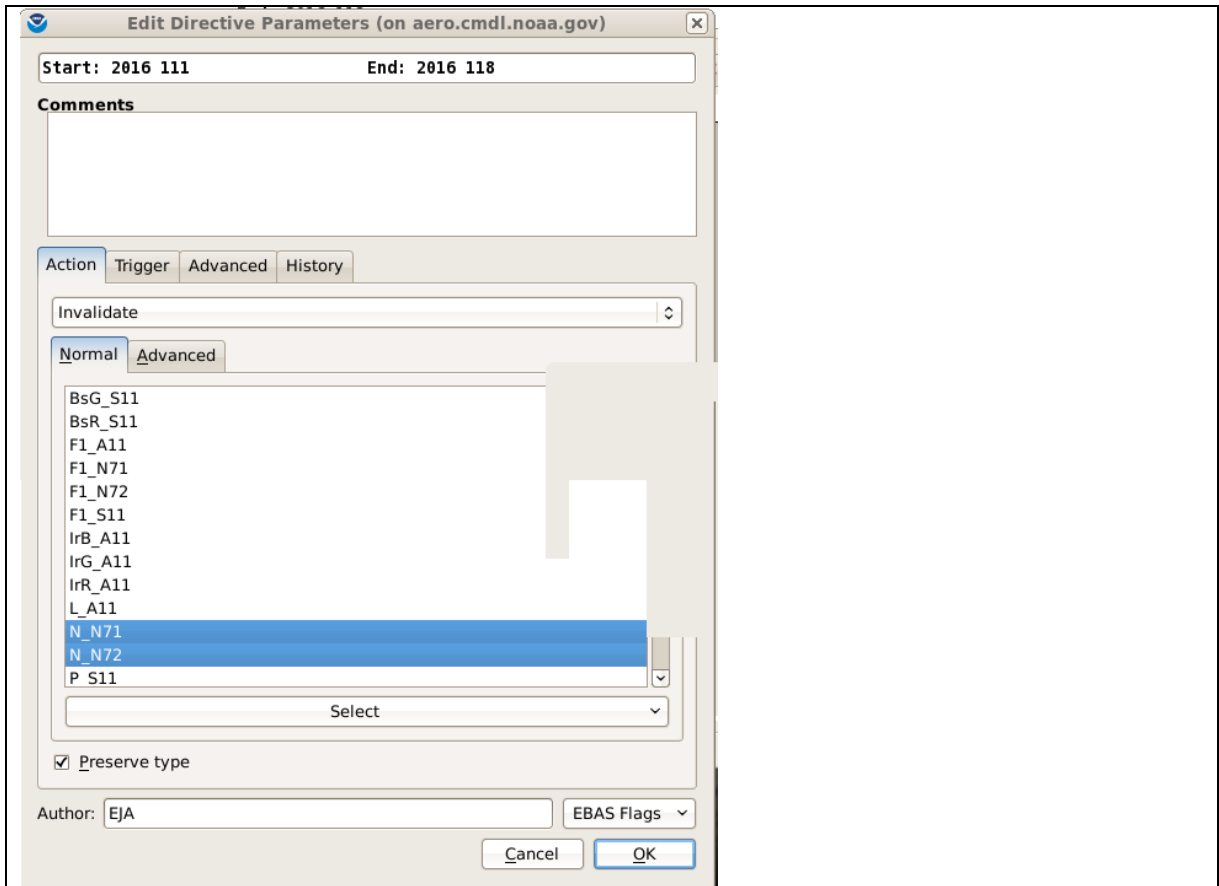
It's good practice to do a final check of the data after you have passed them. Open up a CPX3 session for the time period and choose display mode 'clean'. This allows you to see the final data with all the passed edits applied. If you see problems or additional edits you wish to make then repeat the editing process as described above.

### Editing data when there are multiple similar instruments

Sometime stations have multiple instances of identical instruments or more than one instrument that measures the same parameter even if the instruments aren't identical. There may be times when the data from one of these instruments needs to be edited but not the other. An example could be where a station has two different CPCs. Both of these instruments measure aerosol number concentration, so they are in the 'counts group'. Choosing 'counts' from the 'selection groups' menu in the 'edit directive' window will result in data from both CPCs being edited. (see Figure 4). If you only want to edit the data from one of the counts group instruments you have two options.

- Option 1 is to select counts from the 'selection groups' menu and then change the highlighted parameters so that it just contains the parameters for the instrument you went to edit (see Figure 4).
- Option 2 is you can scroll through the initial list of all system parameters (there are a lot so this can be annoying) and just pick the ones you wish to edit.

Once you've selected the parameters you want to edit then you would fill out the edit directives box as described above.



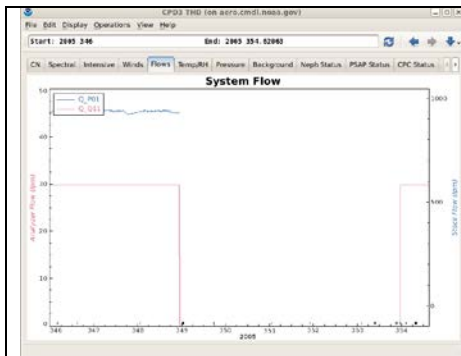
**Figure 4.** In this example, the first CPC is instrument N\_N71 and the second CPC is instrument N\_N72. When you select counts from the 'selection groups' menu both instruments are highlighted as shown. If you click on N\_N71 it will no longer be highlighted and only N\_N72 will have the edit applied to it. (note: **not applicable to demo**)

## 5. Editing Data – Things to look for

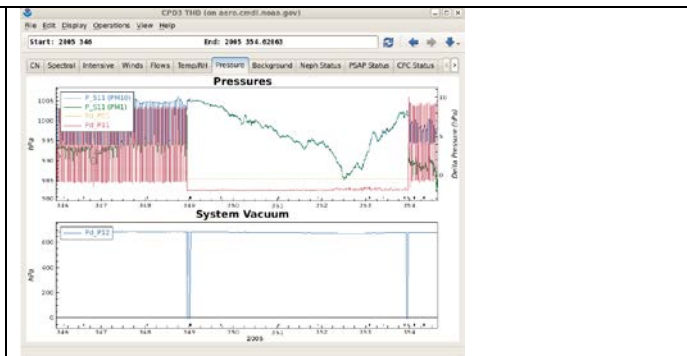
Even the GMD-style aerosol rack is not perfect (!) and occasionally there are instrument maintenance activities or system glitches that result in data that need to be edited out. Below are shown some plots of some of the more common scenarios that require editing. It can be really helpful to look at the ‘event log’ under the file dropdown menu. This includes any messages that the station technicians enter into the station computer as well as instrument flags.

### Pump failure

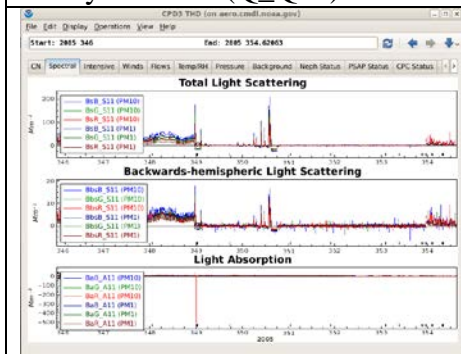
Pumps occasionally fail. Carbon vane pump vanes may break, diaphragm(s) in a diaphragm pump may crack, and the blowers can corrode and stop working. Depending on how your system is configured, pump failures will require different data editing commands to invalidate data that are affected by the failure. Figure 5 presents some examples of data plots when there were issues with a carbon vane pump.



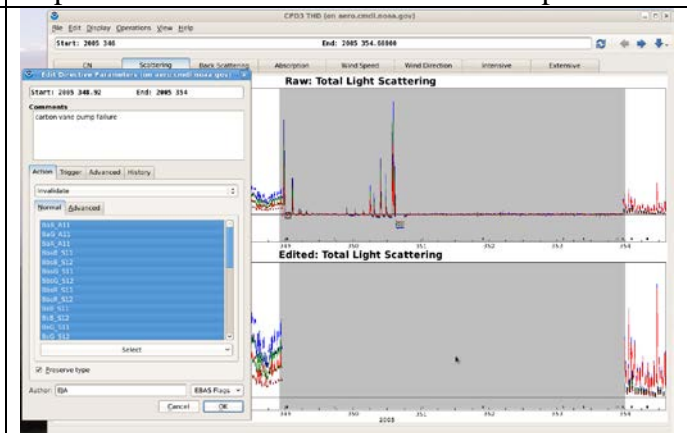
**Figure 5a** Here the carbon vane pump has failed. This is the pump that pulls sample air through the nephelometer. This flow is called the ‘analyzer flow’ (Q\_Q11). <not in demo>



**Figure 5b** This pump failure means there is no flow going through the impactors and thus the pressure difference (Pd\_P11, red line) for the 1um impactor is the same as for the 10 um impactor



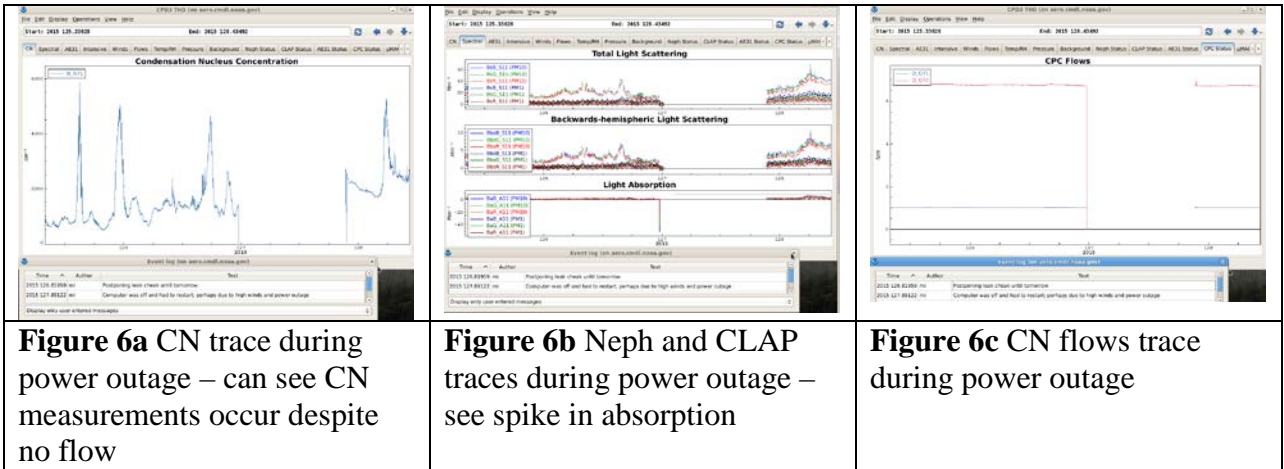
**Figure 5c** Without analyzer flow sample air doesn’t flow through the neph, so the scattering will be low (~zero) unless aerosol is pushed through the system somehow (high winds?).



**Figure 5d** Example of edit for pump failure

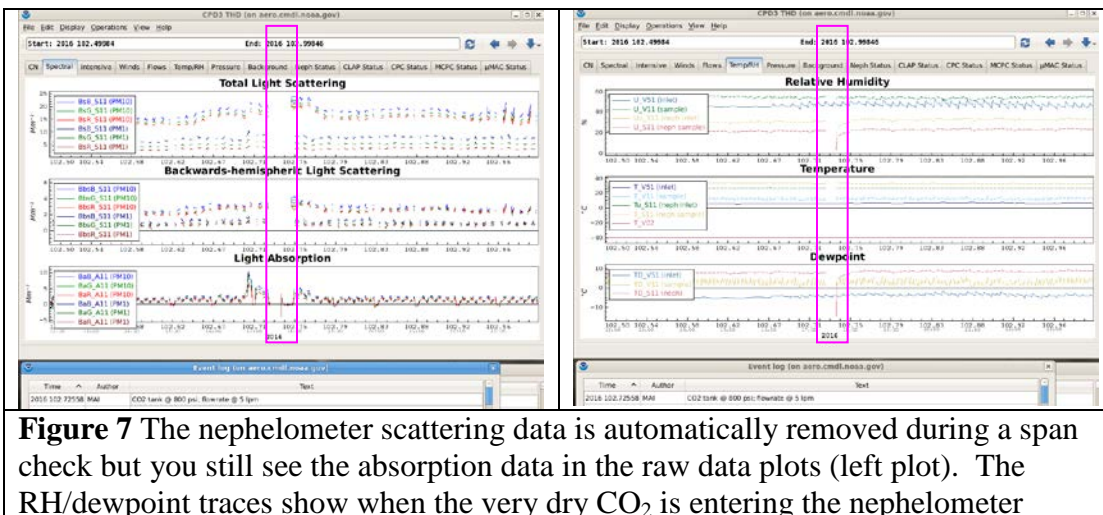
### Power outage

When there's a power failure, a UPS generally protects the instruments and the computer and the system will run after the power has failed for as long as the UPS battery supports it. However, the pumps are very rarely powered by a UPS, and so stop running during a power failure. This often results in plots looking like the pump failure plots (see Figure 6). There may also be some spikes when the pumps go off line or come back online. Cases like these demonstrate the value of examining the housekeeping parameters and station event log files routinely as part of the data QC review process.



### Span Check

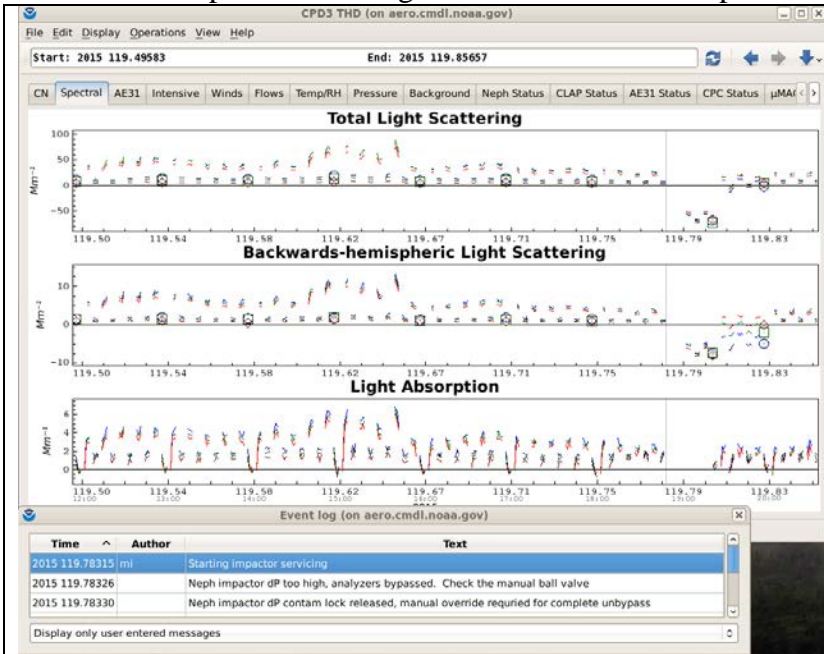
The standard operating procedure for nephelometers recommends regular measurements of the calibration gases (air and CO<sub>2</sub>) to verify proper instrument operation (“span checks”). The CPD software at the station automatically marks as invalid the nephelometer data acquired during a span check. Because the PSAP and CLAP instruments require a nephelometer scattering measurement for their scattering correction, the absorption measurements will also be automatically invalidated in the edited file (but they will show up in the raw file). So while you don't necessarily have to invalidate either of these data streams, it's a good idea to look closely at the measurements around the span check to make sure there aren't any related spikes or other strange looking data (see Figure 7).



(right plot). <not in demo>

### Impactor Servicing

Measurements taken during the impactor servicing should be marked as invalid because the instruments are bypassed (no flow). Figure 8 shows an example of negative scattering values because the impactor servicing occurred over the time period of the hourly zero.

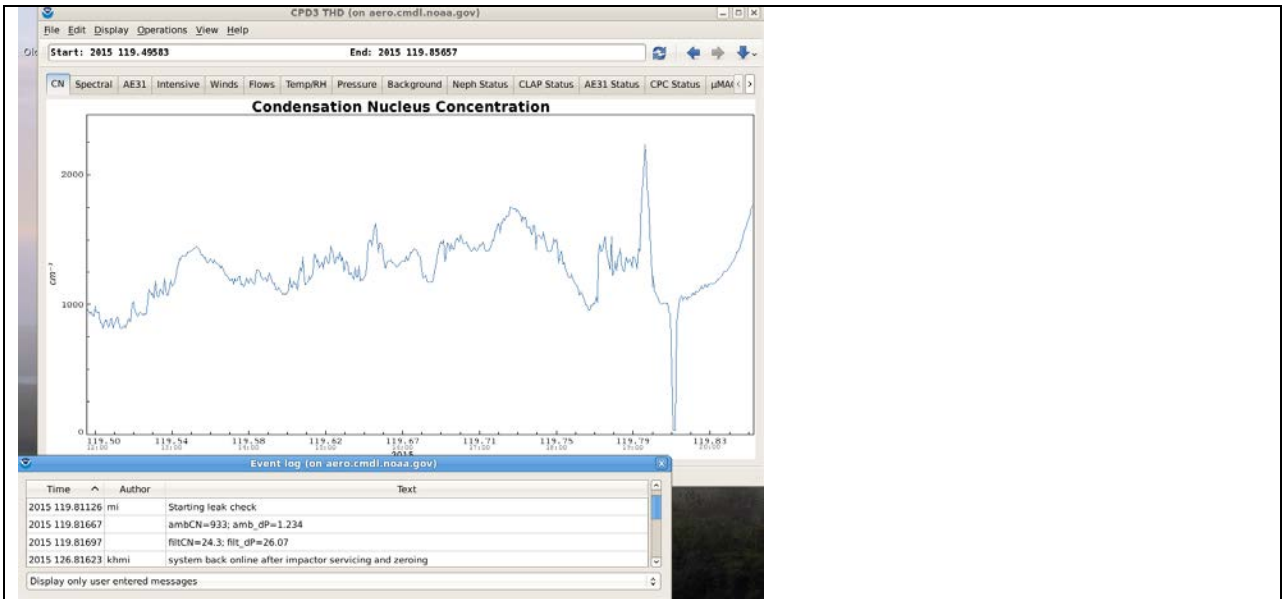


**Figure 8** The vertical gray line highlights when the impactor servicing started. The neph data has gone negative because the impactor servicing occurred during a neph zero and a bad background resulted.

### Leak check

All measurements taken during a leak check should be marked as invalid because there is a filter on the aerosol inlet. Figure 9 shows an example of the CN trace during a system leak check.

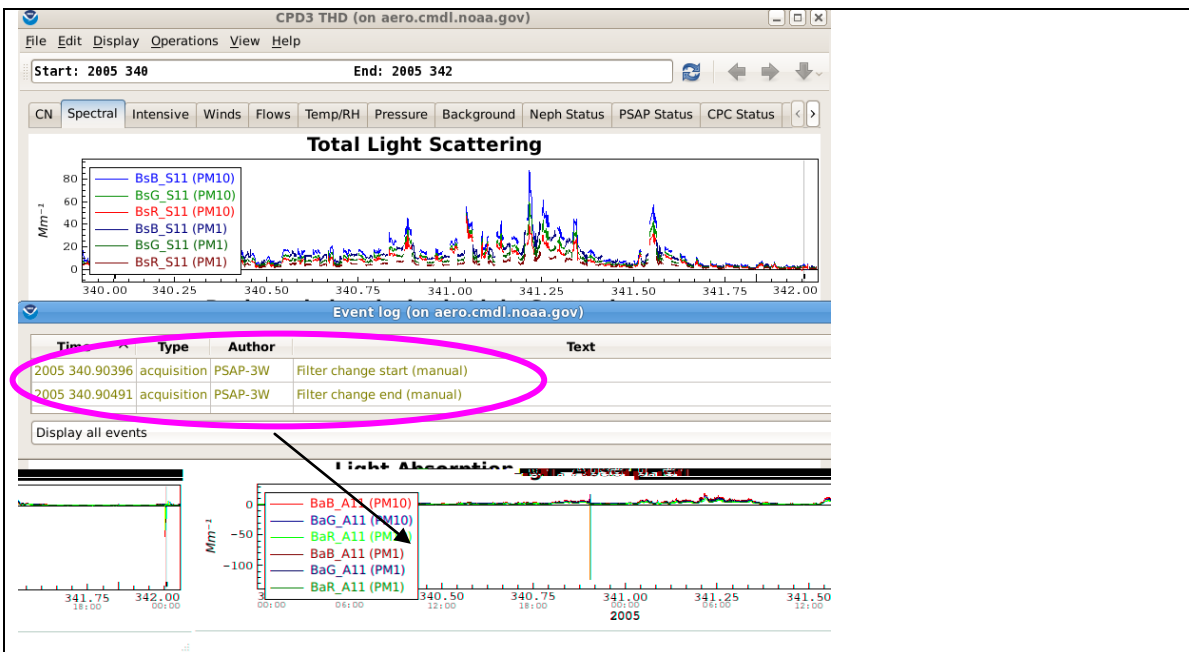




**Figure 9** This plot shows the dip in CN during a leak check – similarly the other measurements will also be close to zero during the leak check. If not – there’s a leak somewhere! This plot is a good example of the usefulness of the event log in terms of identifying issues in the data.

### PSAP filter change

There are often very large spikes that occur when a PSAP filter is changed (Figure 10). Whether these are due to light getting into the instrument or the new filter settling into place or the flow adjusting back to its sampling value is unclear. Regardless of the cause these spikes should be invalidated.

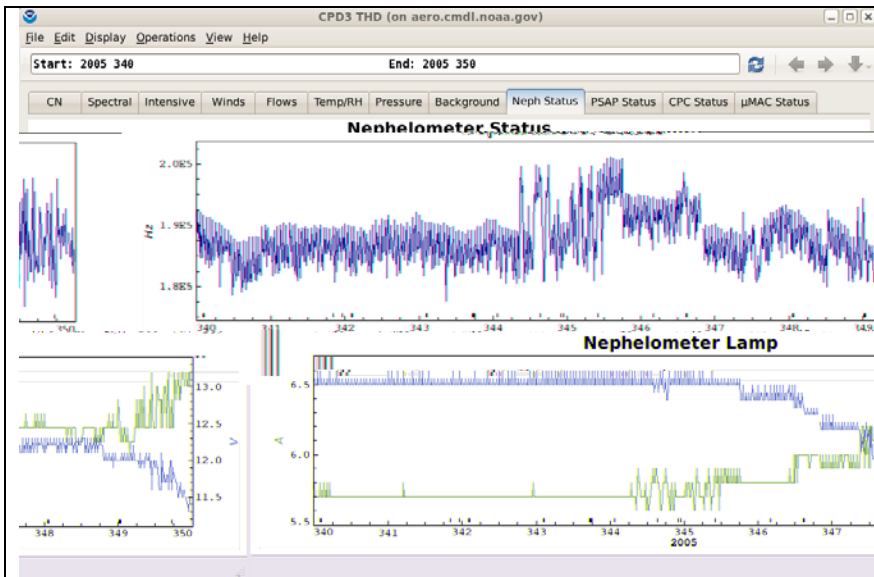


**Figure 10** You can see the big spike that occurs when the PSAP filter is changed <not in demo>

## 6. Things to check to be sure the system is running properly

### Neph bulb degradation

As the neph lamp degrades its resistance decreases, and in order to maintain a constant lamp power setting the current increases and the voltage decreases (Figure 11). When you see this, it's time to change the lamp. If such a situation goes on for too long, damage to the nephelometer can occur.



**Figure 11** The lower pane of the plot shows the neph current (blue) and neph voltage (red). The current increasing and the voltage decreasing are an indication that the lamp is close to failure.

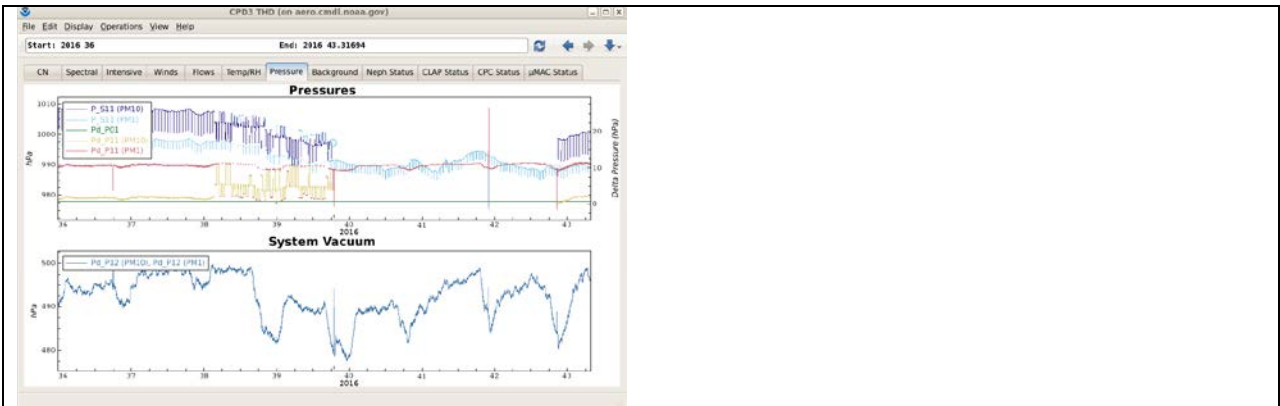
<not in demo>

### Size cut switching issues

Sometimes, the size cut switching can be disabled accidentally. At other times, the station operator may choose to turn off size cut switching on purpose (for example, if the impactor switching valve failed). Either occurrence is not necessarily a reason for removing data, but since it is easily seen in the plots that show up on the web each day – it's something to keep an eye on to make sure it hasn't happened by mistake.

In the first case, when the size cut switching has been accidentally disabled (i.e., by choosing the wrong options on the data acquisition laptop), the software is smart enough to know what the proper size cut is and no data editing action is needed (other than resuming size cut switching if desired). However, if the size cut switching is disabled due to a hardware failure (i.e., the electronic ball valve fails) then data editing action will likely be needed. Figure 12 shows a time series of pressures measured when the impactor switching valve failed and a few days later the station technician disabled size cut switching so that the state of the size cut would be known. In this example, for most of DOY 38 and DOY 39 the impactor pressure is erratic (e.g., yellow trace in Figure 12). The erratic impactor pressure means it is unclear which size cut is being measured (PM1 or PM10), so for this situation it makes sense to invalidate the data for instruments downstream of the impactors until the technician disabled size cut switching. The electronic ball valve can also fail in such a way that it is stuck on one size cut. When this occurs

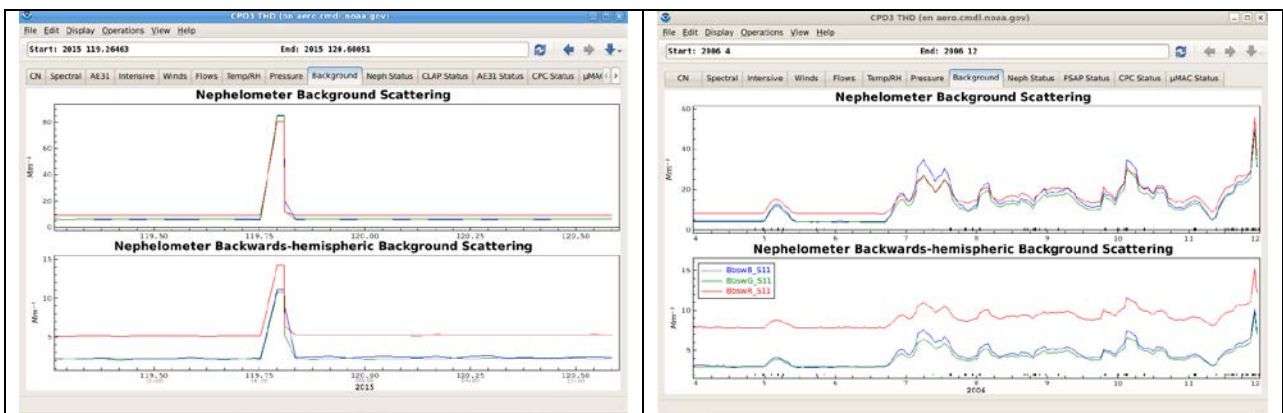
the data acquisition software will continue to flag the data as alternating in size cut. CPX3 edits can be used to change the size cut flag to reflect the actual size cut using the ‘Change Cut Size Selection’ edit type option.



**Figure 12** Here you can see that the impactor dP (Pd\_P11) values for both size cuts are relatively smooth for DOY 36-38.2 (red and yellow lines). Around DOY 38.2 the impactor dP values start going crazy indicating an issue with the electronic ball valve which switches between size cuts. On DOY 39.75 the station technician disabled size cut switching so only PM1 aerosol was sampled. On DOY 42.87 the ball valve was replaced and switching was turned on again. Another thing to note from this plot is that the neph pressures (P\_S11) for the two size cuts are different. P\_S11 for PM1 (light blue) is lower than P\_S11 for PM10 (dark blue) because of pressure drop across the PM1 impactor. Similarly, when things are operating properly, Pd\_P11 for PM1 (red line) is higher than Pd\_P11 for PM10 (yellow line) because there is a greater pressure drop when the air is going through the PM1 impactor. <not in demo>

### Nephelometer background problems

In NOAA/ESRL/GMD aerosol systems the TSI neph is set to do a zero (measure filtered air) once an hour. The scattering measured during the filtered air zero is called the neph background. The background values should be relatively constant (i.e., shouldn't change more than a few tenths of a  $Mm^{-1}$ ). Typically all the background values should be less than 10 and the back-scattering background values should be less than 5 (red wavelength values tend to be a little higher). Variable background values can be indicative of a problem with the nephelometer. Figure 13 shows two examples of background values problems to look for.



**Figure 13a** Occasionally the neph background values will show a slight blip. Usually this is nothing to worry about – in this particular case there was no flow through the neph because the system impactors were being cleaned. The data for the time period of the bad background should either be invalidated or a zero-order polynomial correction can be done for each wavelength.

**Figure 13b** But if the neph background values look like this – this is a problem. On this occasion the automatic zero valve on the neph failed and instead of measuring filtered air the neph was measuring a mixture of ambient and filtered air. Periods of bad backgrounds like this should usually be invalidated.

## Appendix A – CPX3 short cuts

There are additional short cuts in CPX beyond those described in Table 4.

There are a few shortcuts which work regardless of where you are in the GUI.

<Control><q> quits CPX3  
 <Control><s> save image <not yet implemented>  
 <Control><p> print image <not yet implemented>

There are also short cuts based on using <alt><letter> to allow you to move through the different dropdown menus. *On Mac OSX systems you may have to use the command key rather than <alt>.*

Top level 1 – <alt> short cuts

<alt><f> - opens File dropdown menu  
 <alt><e> - opens Edit dropdown menu  
 <alt><d> - opens Display dropdown menu  
 <alt><o> - opens Operations dropdown menu  
 <alt><v> - opens View dropdown menu  
 <alt><h> - opens help dropdown menu

Once you are in a menu using the <letter> shortcut you can continue to choose using <alt> <letter>

*Shortcuts for <alt><f> File dropdown menu*

<e> - open mentor edits window  
 <f> - changes CPX3 to full screen  
 <d> - view and select variables to show numerical values  
 <l> - view event log (i.e., station message log)  
 <s> - save image <not yet implemented>  
 <p> - print image <not yet implemented>  
 <x> - export data  
 <q> - quits CPX3

So for example if you wanted to use shortcuts to see the station message log:  
 <Alt><x> then <l>

*Shortcuts for <alt><d> Display dropdown menu*

Use the up/down arrow keys and space bar to chose a display mode

*Shortcuts for <alt><e>Edit dropdown menu*

<p> - allows you to chose the time format (e.g. Year DOY, or yy-mm-dd)

**Table A** Shortcut keys (hotkeys) (same as Table 4 in main text)

n	Move to next (right) tab
p	Move to previous (left) tab
r	Replot graphs (same as replot button) i.e., use after you select a different time range
a	Go back to time range that cpx3 was started at (i.e., if you started editing a week of data this will set the x-axis back to the whole week)
b	Allows you to toggle back and forth between the two most recently looked at plot tabs

## Appendix B – Getting help

There are three ways to get help with cpx3

1. From a command line prompt. At the command line type:

```
cpx3 --help <enter>
```

This will list out some cpx3 options as shown in box below

```
Usage: cpx3 [ switches ] [ station ] [ times ] [ mode ]

This is the main graphical display for CPD3. This shows various
plots of available data. By default it will display the last week of
raw data
starting at the previous midnight UTC. The display mode can be
switched to display data that has been passed by the station mentor
or to a
view that allows for comparison of data so that the mentor can make
appropriate edits.

Switches can be given at any point in the command line, however a
simple "--" terminates switch processing and all further arguments
are
treated as bare words.

Arguments:
  station The station to show
           Default: Inferred from the current directory
  times   The time range of data to display
  mode    The display mode
           Default: "raw" mode
--ignore-state Ignore saved window state
--profile Display profile
           Default: aerosol

Examples:
General usage:

    cpx3 brw 2010: 1 2010: 2

This displays data for the station "brw" from 2010-01-01 to 2010-01-02.

Default one week of data:

    cpx3 sgp

This displays the last seven days of data for the station "sgp"
starting at the previous midnight UTC.

Explicit mode:

    cpx3 thd 2012w3 clean

This displays the third week of 2012 (2012-01-16 to 2012-01-23) using
the "clean" display mode. That is, this will show only data that has
been passed by the station mentor.
```

2. On the web. Help for the command line interface to CPX3 is here:  
<http://esrl.noaa.gov/gmd/aero/software/aerosols/cpd3faq.html> but there is not really

online CPX3 help for the graphical interface other than a link to a pdf of this document at [ftp://aftp.cmdl.noaa.gov/aerosol/doc/software/Using\\_CPX3.pdf](ftp://aftp.cmdl.noaa.gov/aerosol/doc/software/Using_CPX3.pdf).

3. Within CPX3. You can get help from within CPX3 (this document) by clicking on the Help dropdown menu <not yet available>.

## **Appendix C – Configuring CPX3 plots**

The CPX3 program is very flexible and allows you to change how the plots look both temporarily and more permanently. <not yet available>