USING 'FORGE' FOR DATA VIEWING AND EDITING

Version 1.0 DRAFT
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Contents

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

1. About FORGE

FORGE is a web-based 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. Access to a specific station using FORGE is limited to those stations for which you are directly responsible for.

FORGE should work on all normal web browsers (Chrome, Safari, Firefox, Microsoft Explorer?)

Help for FORGE - this document! anything else?

Reporting issues and requesting new features in FORGE can be done at Gitlab:
https://gitlab.com/derek.hageman/forge/-/issues (see section 7 for more details)

FORGE demo
A demo of FORGE is available at:
https://gml.noaa.gov/aero/dataview/station/bos/example-basic.
The demo doe
s not connect to real data and no changes are persistent, so this can be used if you just want to see what the interface looks like, without actually getting access. The demo allows a user to view and edit an example dataset to get a feel for how it works without actually impacting real data. The demo does not require registration to access.
A similar demo with solar radiation plots is also available:
https://gml.noaa.gov/aero/dataview/station/bos/example-solar

Getting registered
To get access to your data for actual editing you will need register. These are the steps to register:
- Go to the page: https://gml.noaa.gov/aero/dataview/
If you have Gmail or a G-suite derived email address:
- Select Log-in with Google (this means you don't need a separate password)
If you do not have a supported sign-in email or don't want to use it
- Select 'create account'
- Provide your name, email and set a password at least 8 characters long

Once you are logged in, you will be redirected to an access request page. Select your station to request access for and it will submit a request. Once that request is approved, you will receive an email with instructions. Those instructions essentially consist of clicking a link in the email to complete the process.

 how do you choose more than one station - do you register separately for each station?

Note: if we don't recognize the name/email requesting data editing access we will contact the PI to be sure the requestor should be approved. Please give us at least 1 working day to do the approval since that is a manual step!

<u>Signing in and starting up</u>

Once your access has been approved, open a web browser and go to this page: https://gml.noaa.gov/aero/dataview/auth/login to login. Alternatively you can bookmark the page for your station. For example, if your station abbreviation is **XXX** the link would be: https://gml.noaa.gov/aero/dataview/station/**xxx**/aerosol-raw

Once you are logged in you will see data plots for your site. The initial time range, data status (raw, editing, clean averaged) and variables shown will be whatever they were last time you accessed FORGE. 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 information in the lower right so you can see where it is in the loading process.

2. FORGE – The Basics

The graphical window
Figure 1 highlights some of the basic screen elements.

Figure 1 Overview of the basic FORGE window
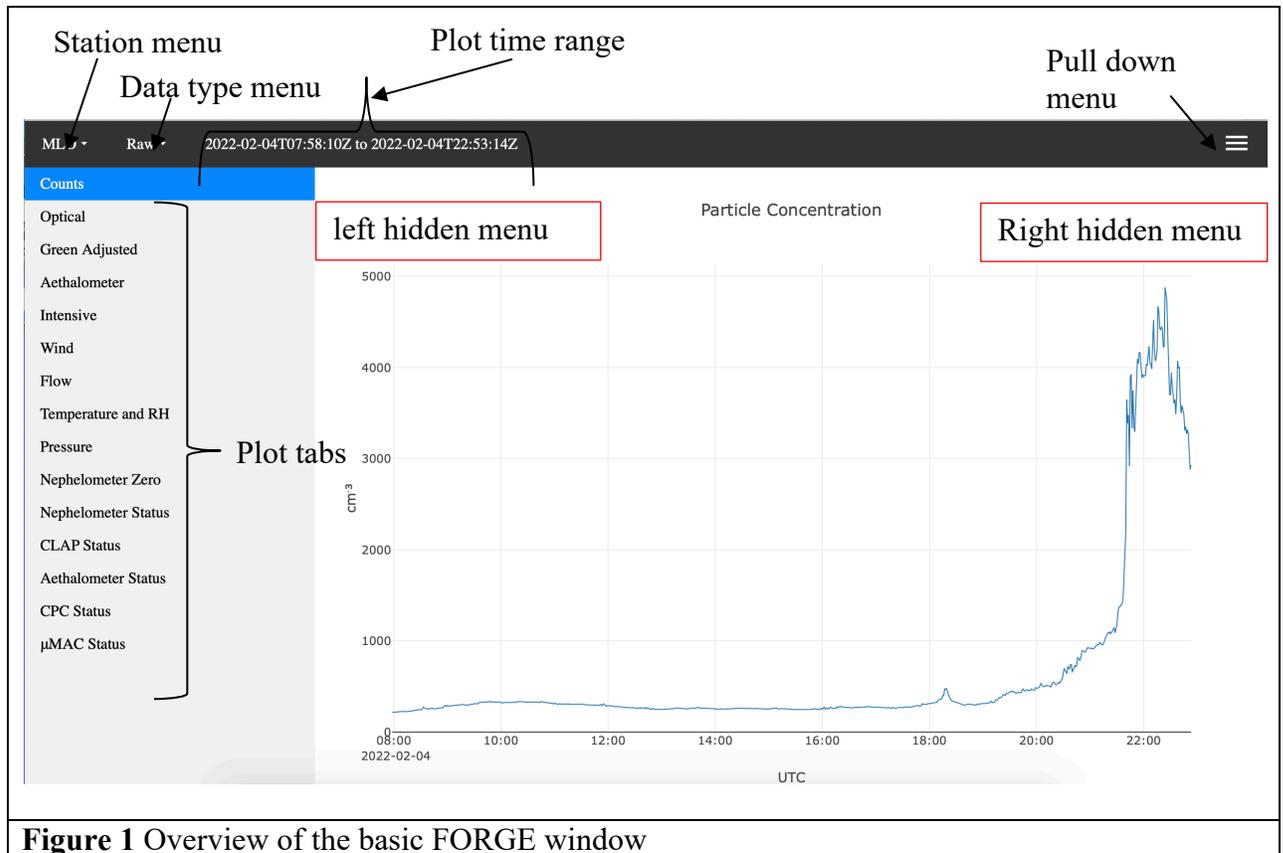
Station menu
To view data from a different station that you have access to (if you have more than 1 station), click on the station menu and choose the station you want to view. Note: you will only be able to view stations you are registered for. If you want to see recent plots from other NFAN sites go to: https://gml.noaa.gov/aero/net/stations.html and choose the 'data plots' option for the station of interest.

Data type menu
There are 4 different types of data available.
- Raw – *displays raw measurement and housekeeping (i.e., flows, pressures, etc) data*
- Editing – *displays multi-paned plots: top plot shows raw data, bottom plot shows edited data (edited data have mentor edits and corrections applied). No housekeeping plots.*
- Clean – *displays data that have been passed with mentor edits and correction applied. If data have not been passed nothing will show in the plots.*
- Averaged – *displays hourly-averaged data clean (i.e., passed) data.*

To change the data type, click on the data type menu and choose a different data type.

Plot time range

This text box shows the time range of data currently being plotted. The time is in UTC. To change the time range, click on the time range and a window will pop up. Edit the time fields and choose apply for the plot to update. Note: we do not recommend plotting more than a few weeks of data unless the data type = average.

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. They also vary with data type. You can move from tab to tab by clicking on a tab with your mouse or by typing the letter 'n' (next) and 'p' (previous) keys. To toggle between two plots use the letter 'b' (back). The tabs just have short names to indicate the variables plotted - you'll need to familiarize yourself with what variables the short names correspond to (e.g., counts = number concentration; optical = spectral scattering from the nephelometer and CLAP; etc).

Pull down menu

The pulldown menu has several options. The options vary with data type. Table 1 shows the pull down menu options for each of the data types and each option is discussed in more detail below.

Table 1 Pull down menu options

Pull down options for 'Raw', 'Clean' and 'Averaged' data	Pull down options for 'Editing' data
Export data Message Log Settings User Profile Request Access Logout Help	Edit directives Pass data Message Log Settings User Profile Request Access Logout Help

- **Export data - allows user to export data - does this work?**
- **Message Log** - timestamped list of notes from data acquisition computer and instrument reports (very useful for data editing!)
- **Settings** - allows you to change some plot settings (e.g., date stamp format)

- **User Profile** - allows you to input the initials you will use for editing and to change your login password
- **Request Access** - allows you to request access to another station
- **Logout** - duh!
- **Help** - takes you to the Gitlab page where you can report issues and suggest changes (you will need to register to do that so we know where the issue reports/change suggestions are coming from)
- **Edit directives** - this is how you create 'edit directives' during data review. Allows you to identify problematic data either because an instrument wasn't working or the measurements are contaminated (e.g., sampling room air instead of ambient air). More details are provided below in the section on 'Data editing mechanics'
- **Pass data** - this allows you to 'pass' the data for a specific time range. Data are passed once you have reviewed it and either decided they were acceptable and/or applied any necessary edit directives.

The 'Edit directives' and 'Pass data' options are only accessible when the data type is 'Editing'. The 'Export data' option is not available for the 'Editing' data type.

Hidden options
There are a few options which are only visible when hovered over. To see them hover over the upper right or left white space in the corners above the plot, but below the date range.

Table 2 Hidden menu toggle options question for derek - do these toggle options need to be hidden?

Left hidden menu options	Right hidden menu options
From left to right: (1) Toggle between lines and data points (2) Toggle between data label modes (3) Toggle visibility of contaminated data (4) Change plot averaging (min/hour/day/Month)	From left to right: (1) Save png imager of plot (2) Zoom (unclear what this does) (3) Pan data - move up and down the time line (4) Zoom in (5) Zoom out (6) Autoscale (7) Reset axis (can also type letter 'r') (8) Plotly software logo - doesn't do anything

3. FORGE – How to use it

Setting the time range
To look at a specific time range, click on the time range line and that will bring up an editable time range window (Figure 2). 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). The time range window has a handy feature 'Un-passed' which, if clicked on, will automatically set the time range to the last un-passed week of data. The 'Default' option plots the most recent week of data.
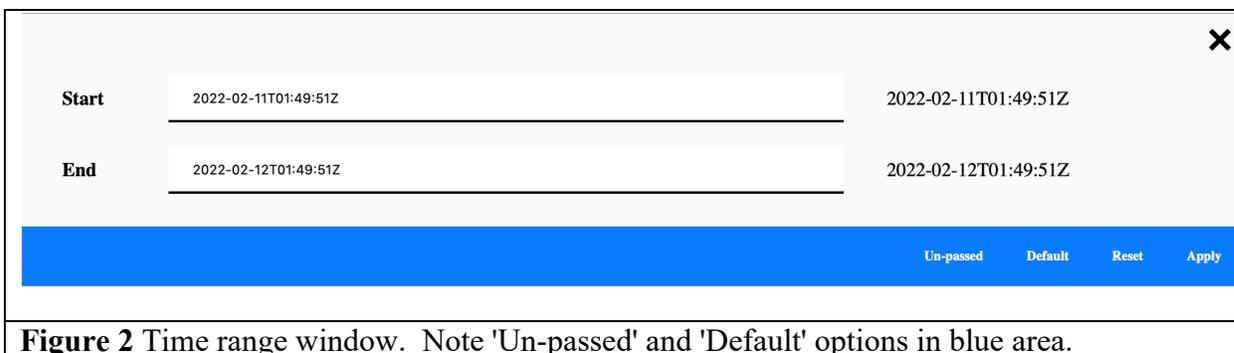
Figure 2 Time range window. Note 'Un-passed' and 'Default' options in blue area.

The start and end times are used to manually set the date range plotted. You can use dates in multiple different formats as described in Table 3. Remember, we don't recommend plotting time ranges of more than a month unless the data type is 'Average'.

Table 3 Example entries to manually choose the data time range[1] to plot

Time stamp window entries		Result
start time	**end time**	
24h	now	Data collected during the past 24 hours
2009w15		Data for week 15, 2009
2009:103	2009:106	Three days of 2009 data: DOY 103, 104 and 105
2009:100	10d	Ten days of data starting on DOY 100
2008–01–15T12:00:00Z	2008–01–16T15:00:00Z	Data between 12pm Jan 15, 2008 and 3pm Jan 16, 2008
2009.5	2009.75	Fractional year – so data between ~July 1 – Sept 30, 2009
2009–01–15	2009–01–30	Data between Jan 15 and Jan 30, 2009

[1]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.

Zooming in on a data feature
Once you have a FORGE 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 several ways to do this.

(1) You can edit the 'Plot time range' values with the appropriate start and end times (e.g., Table 3). That can be an annoying way to do it as it involves typing numbers!
(2) Alternatively, you can use the mouse to select a range. To use the mouse, click on one side of the time range you want to look at, then drag the mouse across the region of interest. When you first click the mouse and start to drag it the entire plot will be shaded gray. As you drag the mouse the selected area will be white. When the white area encompasses the region of interest stop dragging and FORGE will automatically replot to just the white area you have selected. You can zoom horizontally (i.e., in time) or vertically in variable space or both.
(3) Use the pan and zoom icons in the right hidden menu to zoom in (or out).

Returning to a previous data time range
To zoom back out hit the reset (home) icon in the right hidden menu or type the letter 'a'.

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 tab
p	Move to previous tab
r	Replot graphs i.e., use after you select a different time range hmmm
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 don't think this one works?

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.

Going to the last unpassed week of data
As noted above, the time range window has a handy feature 'Un-passed' which will automatically set the time range to the last unedited week of data. We strongly recommend editing the data in chronological order rather than skipping around in time.

General data editing procedure
Once you have a FORGE window open and showing the data to be edited, you are ready to begin editing. We recommend the following procedure.
- Look 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 (pull down menu → 'Message 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 (data type 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 (from CLAP) and scattering all in the same plot window. You can move between the 'Extensive' tab and the individual parameter tabs (e.g., 'CN', 'Scattering', etc.) which show both raw and edited data for each measured variable.
- Open the 'Edit Directives' window (pull down menu → 'Edit Directives')

 Note: you can only edit data when the data type is 'editing'.

How to make a data edit
Open the 'Edit Directives' window (pull down menu → 'Edit Directives'). 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).
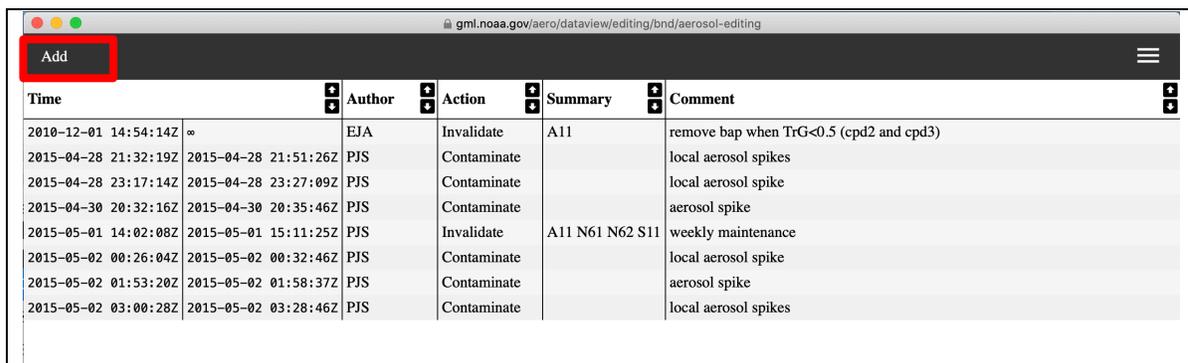
Time		Author	Action	Summary	Comment
2010-12-01 14:54:14Z	∞	EJA	Invalidate	A11	remove bap when TrG<0.5 (cpd2 and cpd3)
2015-04-28 21:32:19Z	2015-04-28 21:51:26Z	PJS	Contaminate		local aerosol spikes
2015-04-28 23:17:14Z	2015-04-28 23:27:09Z	PJS	Contaminate		local aerosol spike
2015-04-30 20:32:16Z	2015-04-30 20:35:46Z	PJS	Contaminate		aerosol spike
2015-05-01 14:02:08Z	2015-05-01 15:11:25Z	PJS	Invalidate	A11 N61 N62 S11	weekly maintenance
2015-05-02 00:26:04Z	2015-05-02 00:32:46Z	PJS	Contaminate		local aerosol spike
2015-05-02 01:53:20Z	2015-05-02 01:58:37Z	PJS	Contaminate		aerosol spike
2015-05-02 03:00:28Z	2015-05-02 03:28:46Z	PJS	Contaminate		local aerosol spikes

Figure 2a Mentor edits summary window
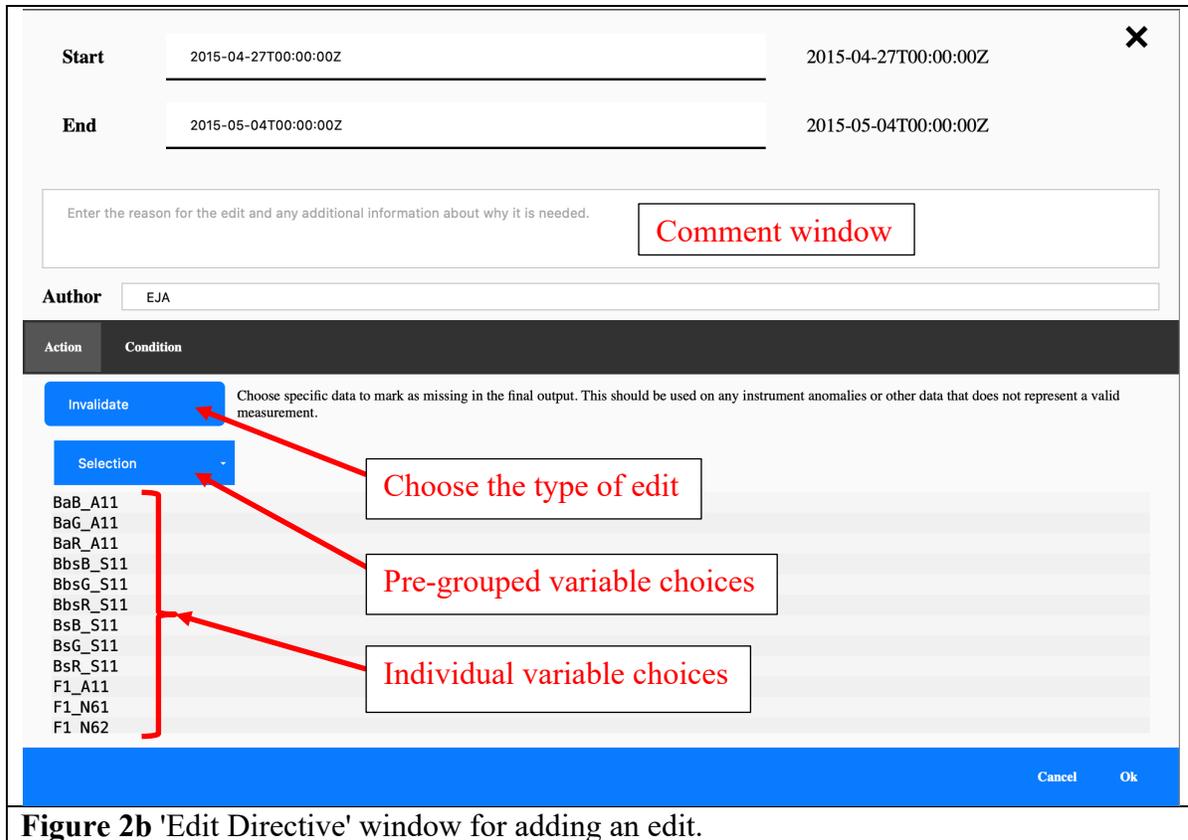
Figure 2b 'Edit Directive' window for adding an edit.

The 'Edit Directive' window has several places 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. Note 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'.

Edit type
There are several types of edits that can be made (Table 4). The most common include:

- *'Invalidate'* – choosing this says the data are bad and should not be included in clean data
- *'Contaminate'* – 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 or due to wind sector screening. Contaminated data will be indicated by a small black marker on the plot (see Figure 3).

You can use the left hidden menu option that looks like a funnel (Table 2) to show or hide the contaminated data in the plots. Note that, by default, the 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).

- *'Size cut fix'* – allows you to change size cut (choices: 1, 2.5, 10 μm and none)
- *'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 one or more of the 'Pre-grouped' data choices (Table 4). Using the selection groups is typically much quicker because you don't need to select individual variables, especially if all the variables on an instrument are being invalidated (for example, the scattering and back scattering for all 3 wavelengths on the nephelometer). Note that both the pre-grouped data options and the instrument specific options only selects the relevant aerosol measurement; neither option will select housekeeping parameters such as T and RH. Housekeeping parameters need to be selected manually by clicking ono the individual variables.

Table 4 Edit type options and Pre-grouped data selection options

Edit type options	Pre-grouped data selections	Instrument selection (station specific)
✓ Invalidate Contaminate Calibration Recalibrate Flow Correction Size Cut Fix BaG A11	Instrument ▸ Scattering Absorption Counts Scattering, Absorption, and Counts Nephelometer P, T, and RH Wind speed and direction System flags	N61 ▸ S11 ▸ A11 ▸ N62 ▸ (Useful if there is more than one of the same type of instrument - e.g., here there are two CPCs (N61 & N62).
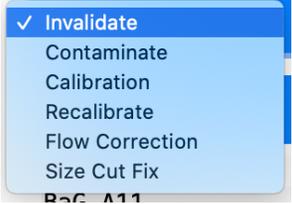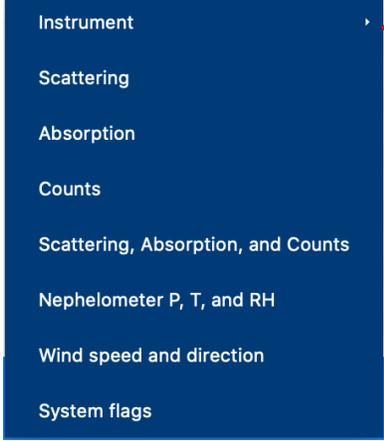
Once the 'Edit Directives' window is filled out to your satisfaction for a particular edit, click on 'OK' in the lower right and the edit will be added to the list of edits in the 'Edit Directives' window. When you replot the data, the edited pane will reflect the edits. Continue adding edits in this way until you are done with the week.

To see the effect of individual edits, open the 'Edit directives' window and click on an edit so it is highlighted (in blue). A vertical gray bar will appear on the plots 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).
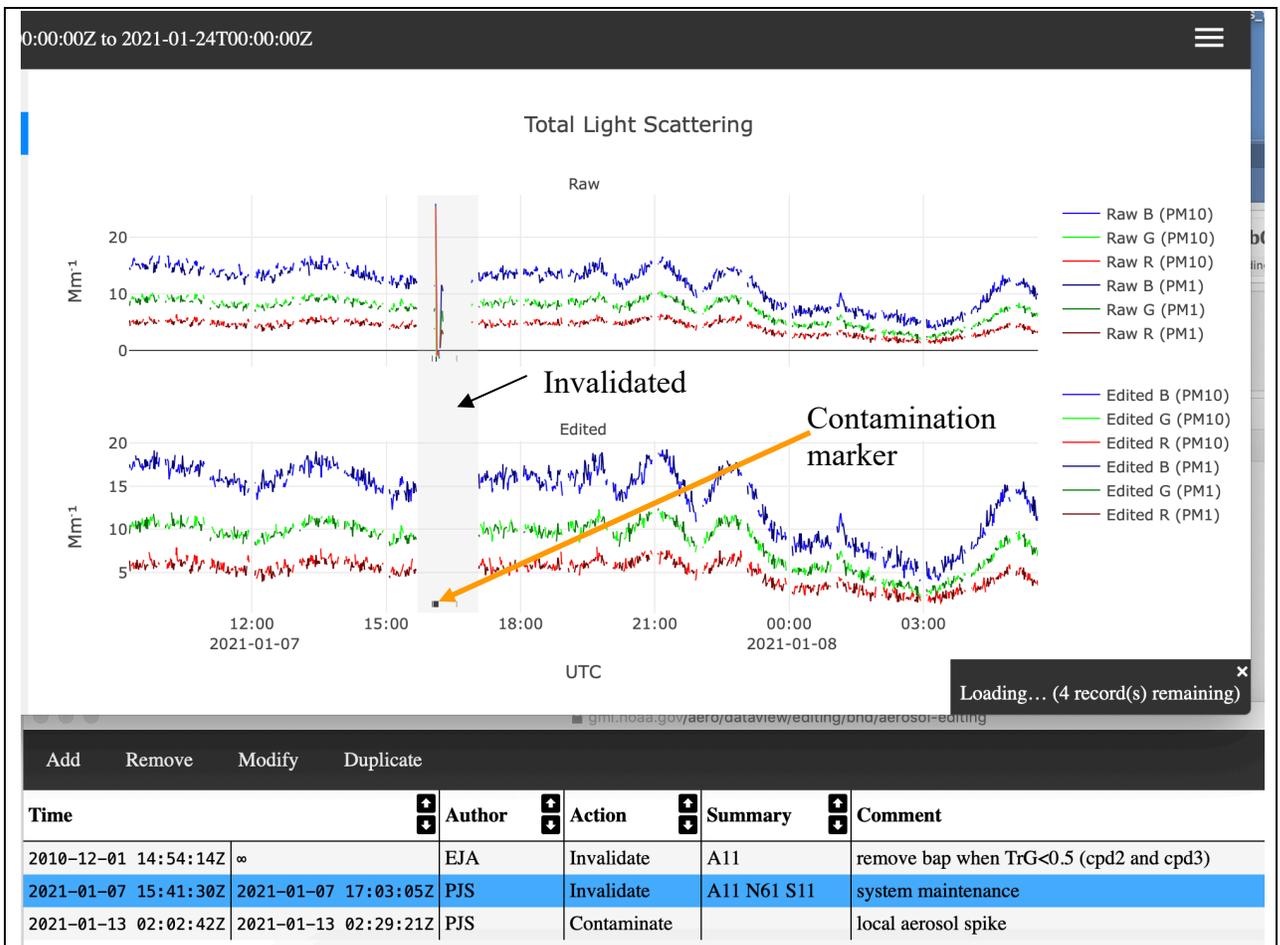
Figure 3 Vertical gray shading in plot shows time range of selected edit (line highlighted in blue in Edit Directives window, seen below plots. Display mode is 'Edit' so you see both the raw and edited data. Orange arrow points to flag indicator for data marked as contaminated.

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 'Edit Directives' 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 can also remove an edit if you determine it should not be applied. If data have already been passed and then new edits are made or edits are modified, 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. The edit that removes CLAP data when the green transmittance is less than 0.5 is an example of a trigger edit.

Passing the edited data

Once you are satisfied with your data edits, you will need to "pass" the data to ensure that edits are part of the final data record. This informs the data management system that the data have been QC-checked and approved. To pass the data go to the pulldown menu in the upper right (see Figure 1). The second option is 'Pass data'. Clicking on this will bring up a window with a start and end time (which should match the period you've just reviewed). You can make a comment about the week in the text box if you wish. What sort of comments would be good here? Then click 'ok'. It can take 5-10 min for the data to pass, i.e., it will take 5-10 min before you can view 'clean' data.

Whenever 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. You can do this by choosing data 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. As noted - it can take 5-10 min after passing data before the clean data for that pass to be viewable.

Editing data when there are multiple similar instruments

As noted above stations sometimes have multiple instances of identical instruments (e.g., two MAGIC CPCs) or more than one instrument that measures the same parameter even if the instruments aren't identical (e.g., absorption from both the CLAP and Aethalometer). 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 CPCs. Both of these instruments measure aerosol number concentration, so data from both are included 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. If you only want to edit the data from one of the counts group instruments you have two options.

- Option 1 is to select the specific instrument from the 'Pre-grouped data' → 'instrument' options (see Table 4, third column).
- 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 CPC you wish to edit (both are selected in Figure 4).

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 counts from the first CPC are variable N_N71 and the counts from the second CPC are variable N_N72. When you select counts from the 'selection groups' menu both variables 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.

5. Editing Data – Things to look for

Even the GML-style aerosol system 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 'message log' under the pulldown 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. Figure 5 presents some examples of data plots when there were issues with a carbon vane pump.
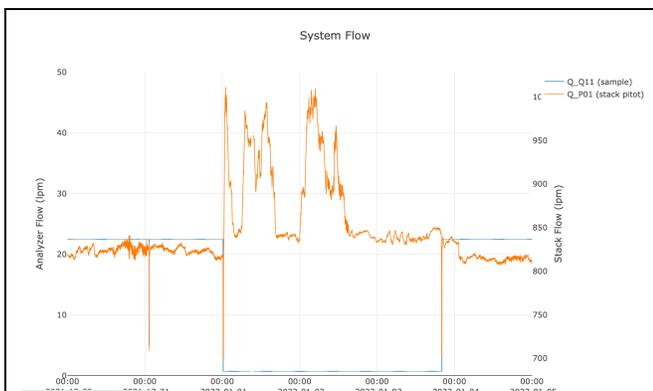
Figure 5a Here the carbon vane pump has failed. This is the pump that pulls sample air through the nephelometer. This flow is called the 'analyzer flow' (Q_Q11). The stack flow values also are a bit strange - in this case the pump was running backwards and affected those as well.
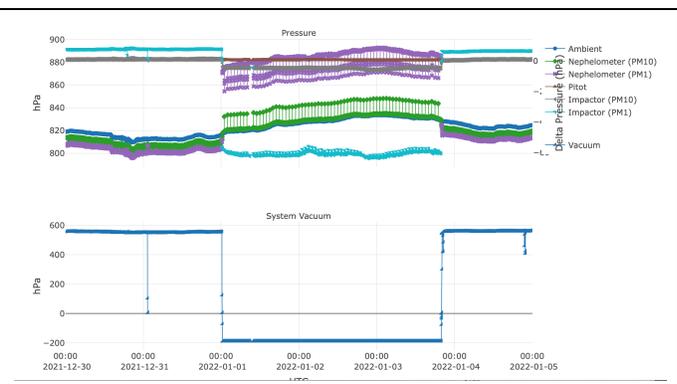
Figure 5b This pump failure will also affect the impactor dP values. Usually when a pump fails the dP values for PM1 and PM10 become the same. In this particular case, the pump was running backwards so that did not happen.
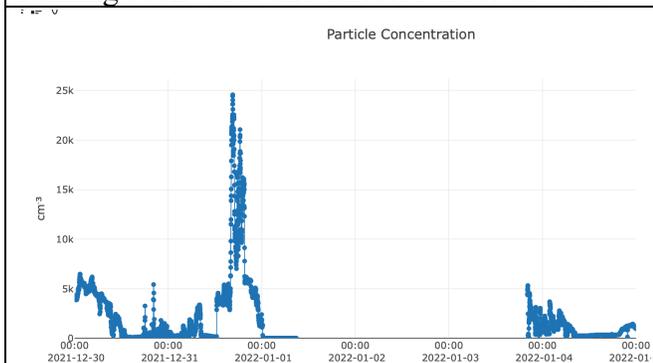
Figure 5c Without analyzer flow sample air doesn't flow through the instruments (for example, this plot shows the TSI CPC counts go to zero). Scattering and absorption may also go to zero. Neph background values may be variable as there is no flow to pull particles out

Figure 5d Example of edit for pump failure.

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| of the sampling volume during the zero air check.	

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 they 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.

| **Figure 6a** CN trace during power outage – can see CN measurements occur despite no flow.	**Figure 6b** CLAP absorption traces (raw and edited) during power outage – see spike in absorption	**Figure 6c** CN flow traces during power outage
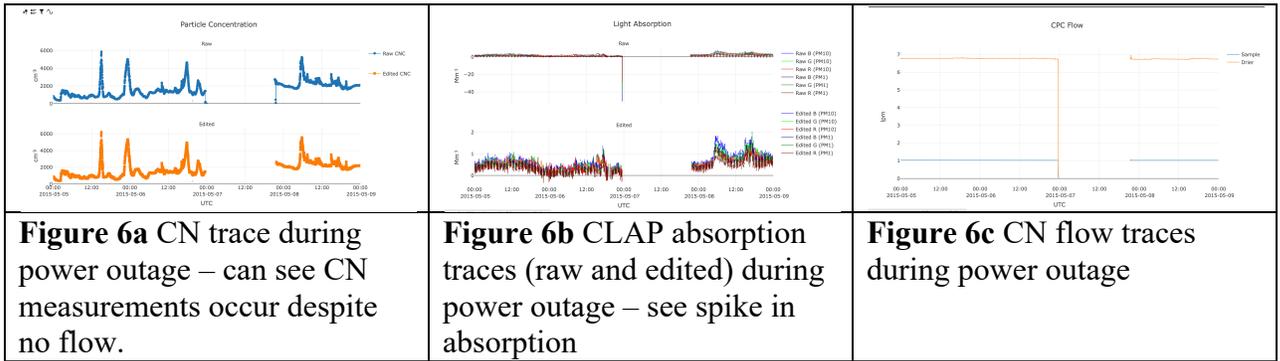
Span Check

The standard operating procedure for nephelometers recommends regular measurements of the calibration gases (air and CO_2) 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).

Figure 7 The nephelometer scattering data is automatically removed during a span check but you still see the absorption data in the raw data plots (left plot). The RH/dewpoint traces show when the very dry CO_2 is entering the nephelometer

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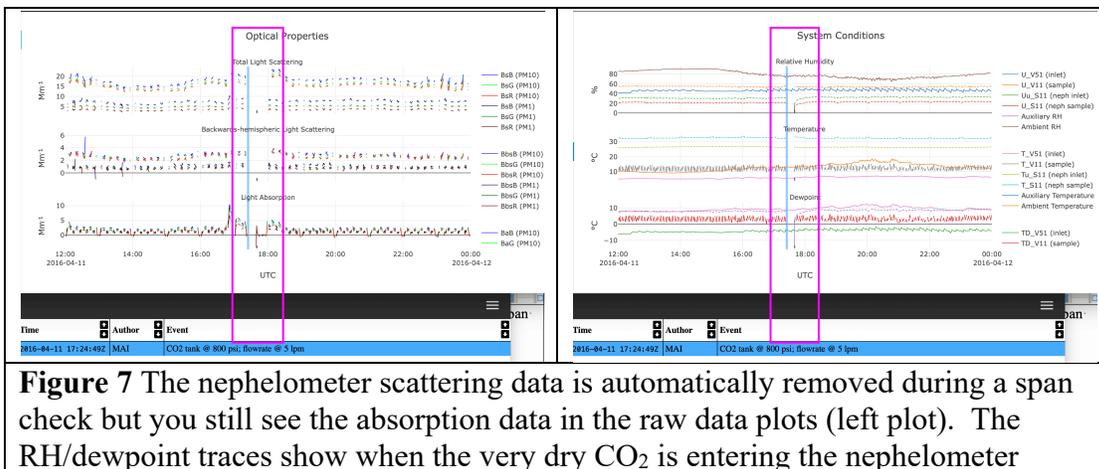
(right plot). Blue vertical shading indicates when message log for span check was entered, pink box highlights span check period plus a little time on each end.

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.
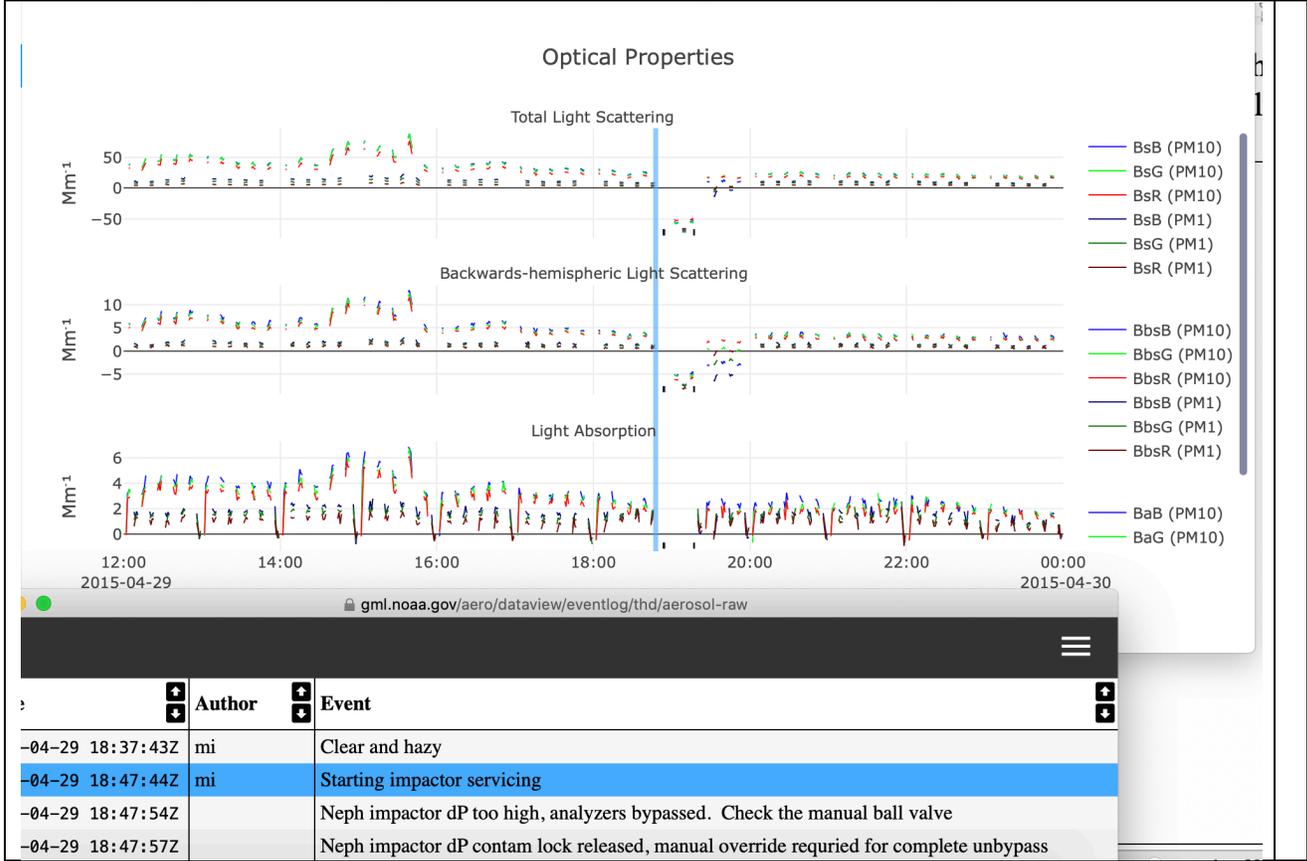

Figure 8 The vertical blue shading highlights when the impactor servicing started. The neph data has gone negative because the impactor servicing occurred during a neph zero and a bad background resulted. (This is more likely to occur for a TSI neph which zeroes every hour than for an Ecotech neph which zeros every 24 h.)

Leak check and filtered air checks

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 CPC filtered air check.

Figure 9 This plot shows the dip in CN during a bi-weekly filtered air check. This plot is a good example of the usefulness of the event log in terms of identifying issues in the data.
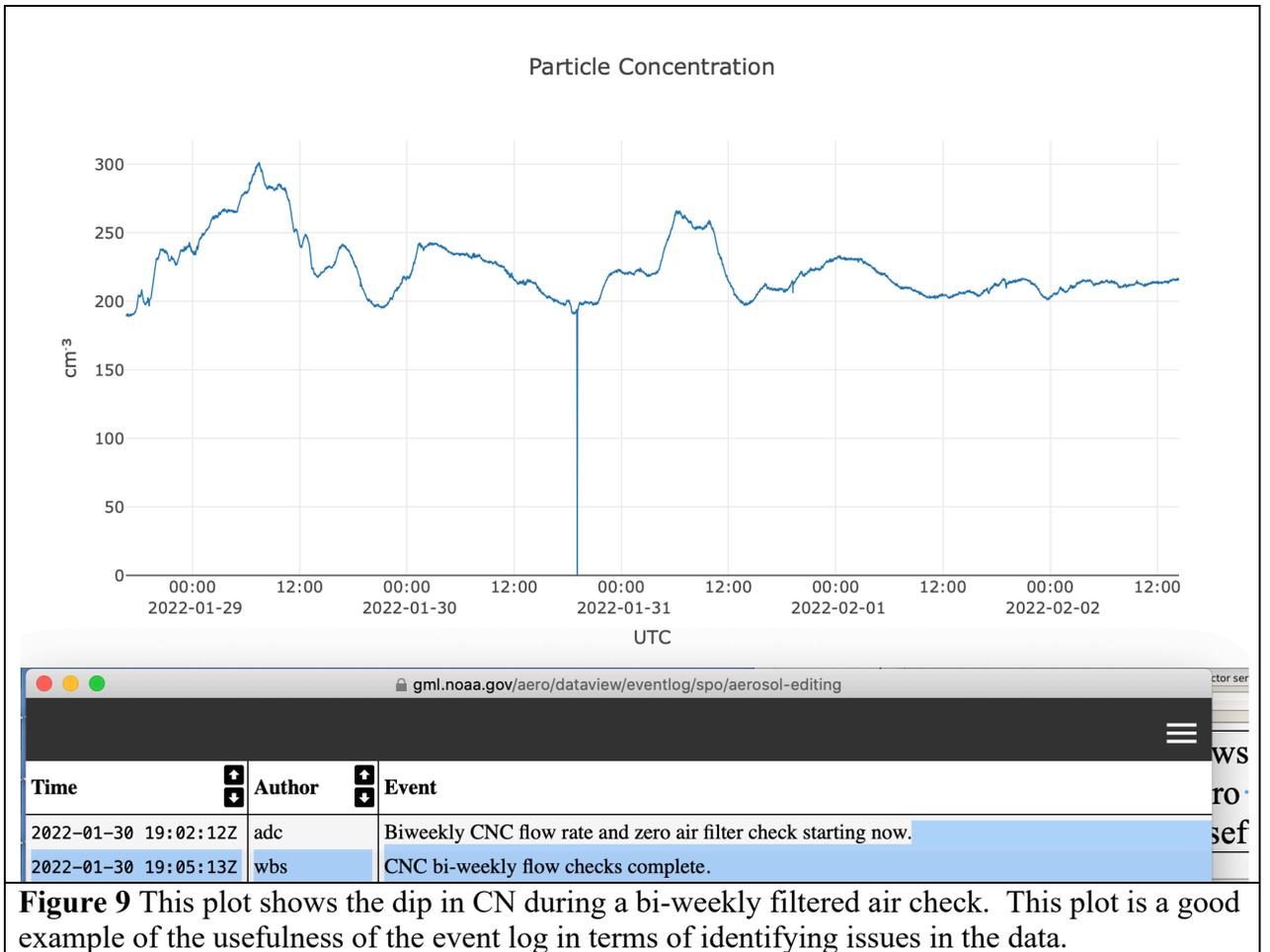
PSAP or CLAP filter change

There are often very large spikes that occur when a PSAP or CLAP 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.
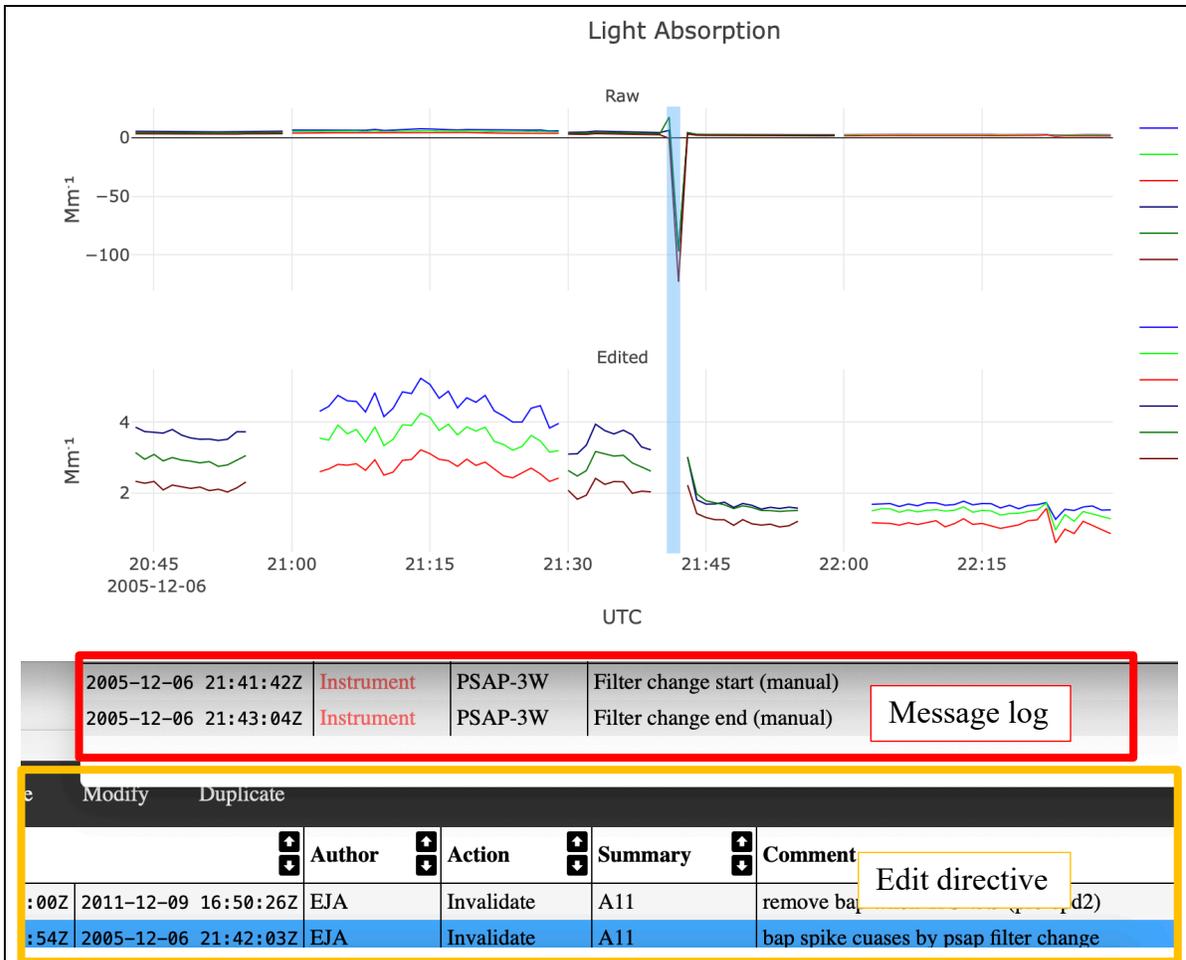
Figure 10 The top plot shows a big spike in the raw data that occurred when a PSAP filter was changed. The bottom plot shows the data after the spike was removed as indicated by the highlighted edit in the edit directive window (orange box). The red box shows the instrument message log indicating a filter change. Similar spikes can occasionally be observed when the CLAP filter is changed.

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

Neph bulb degradation (TSI neph only)
As the TSI 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 (orange) and neph voltage (green). The current increasing and the voltage decreasing are an indication that the lamp is close to failure.
This only applies to the TSI neph (the Ecotech neph doesn't use the same type of light source).
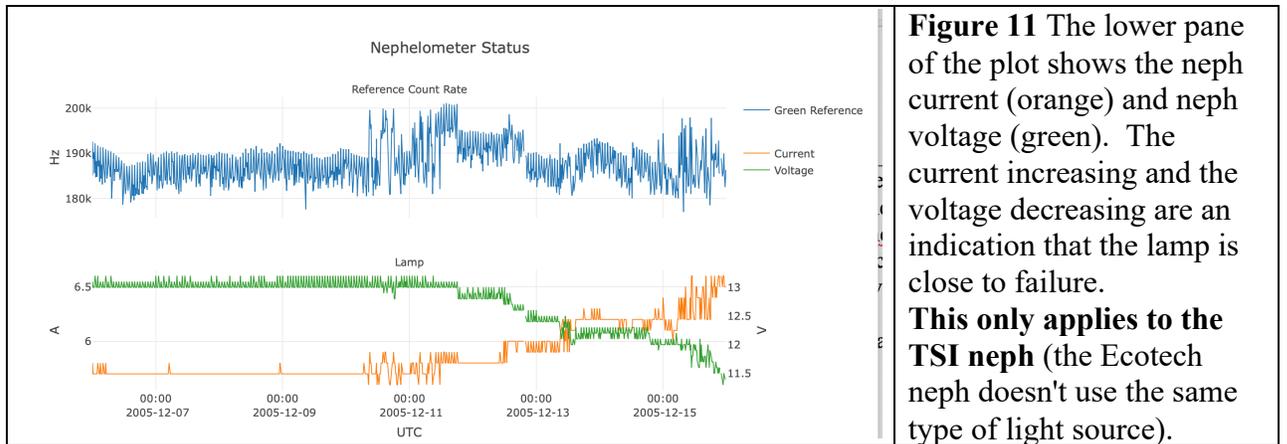
Size cut switching issues

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 February 7 and 8 the impactor pressure is erratic (e.g., gray 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. A FORGE edit can be used to change the size cut flag to reflect the actual size cut using the 'Cut Size Fix' edit type option.
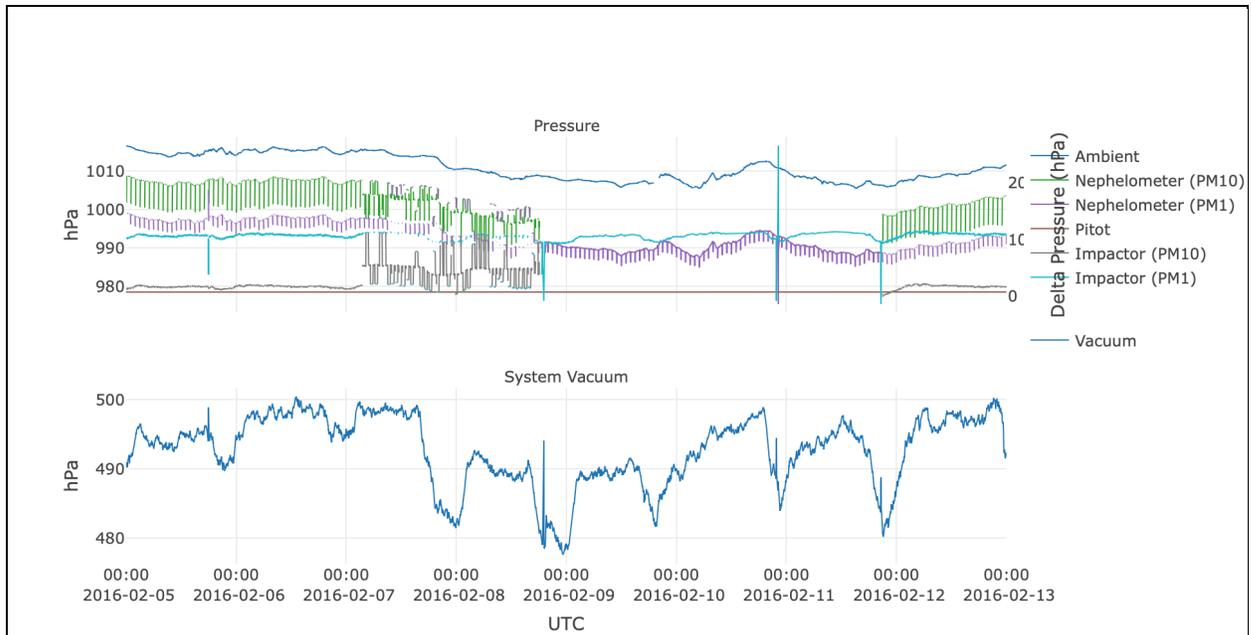
Figure 12 Here you can see that the impactor dP values for both size cuts are relatively smooth for 2016-02-05 to 2016-02-07 (gray and turquoise lines). Around DOY 38.2 the impactor dP values start going crazy indicating an issue with the electronic ball valve which switches between size cuts. A few hours into 2016-02-07 the station technician disabled size cut switching so only PM1 aerosol was sampled. Late on 2016-02-11 the ball valve was replaced and switching was turned on again. Another thing to note from this plot is that the neph pressures for the two size cuts are different. The neph PM1 pressure (purple) is lower than for PM10 (green) because of pressure drop across the PM1 impactor. Similarly, when things are operating properly, the impactor PM1 dP (turquoise) is higher than the dP for PM10 (gray) because there is a greater pressure drop when the air is going through the PM1 impactor.

Nephelometer background problems

In NOAA/ESRL/GMD aerosol systems the TSI neph is set to do a zero (measure filtered air) once an hour and the Ecotech neph is typically set to do a zero every 24 h. 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}). For the TSI neph, 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). Need to figure out values for Ecotech backgrounds...at WPB they are 30-45 Mm-1 for scattering and 20-25 Mm-1 for backscattering. Are those normal values? Variable background values can be indicative of a problem with the nephelometer. Figure 13 shows two examples of background values problems to look for.
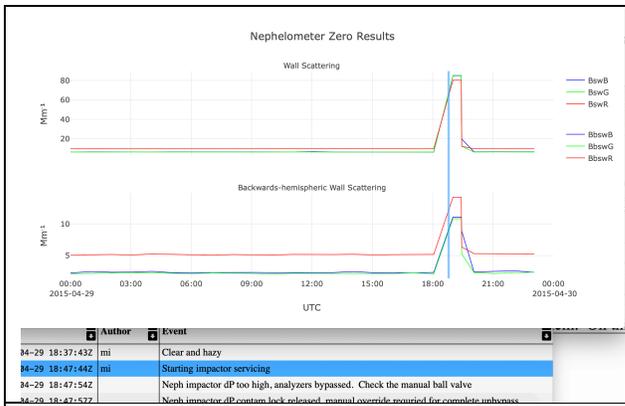
| **Figure 13a** Occasionally the neph background values will show a slight blip. Usually this is nothing to worry about – in this particular case the there was no flow through the neph because the system impactors were being cleaned. The data for the time period of the bad background should either be invalidated or a zero-order polynomial correction can be done for each wavelength. This is more likely to occur for the TSI neph because the TSI neph zeroes every hour while the Ecotech neph which zeroes every 24h | **Figure 13b** If the neph background values look like this – it is a problem. On this occasion the automatic zero valve on the TSI 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 indicate the scattering should usually be invalidated. Also - the problem causing this should be figured out and resolved. |
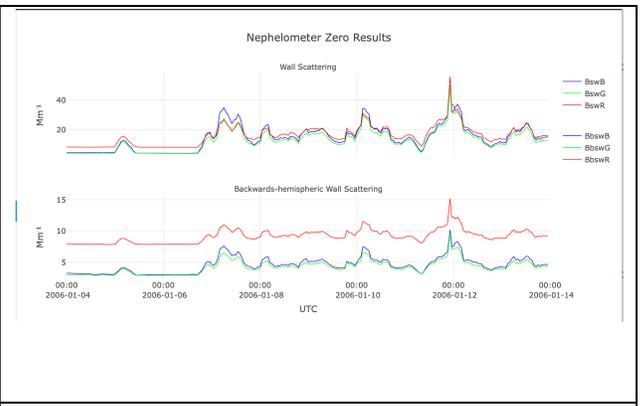
7. Reporting an issue or suggestion to Gitlab

Using Gitlab

If you experience problems with FORGE or want to make a suggestion for improvement the best way to do so is through the Gitlab interface. The 'help' option in the pulldown menu links to the Gitlab interface.

Clicking on help will get you to the login interface (Figure Xa). In the upper right corner click the sign in button and log in with your Google account, other supported account or set up an independent account. Once you are logged in you can click on the 'New issue' button in the upper right, which will bring up a form (Figure Xb) for reporting your issue or request. (Note: both issues and requests are considered 'issues').

Give the title something relevant, for example: '*make the edit indicator shading darker?*' and then a longer description of the request/issue: "*when i click on an edit to highlight an edit so i can see the line or shading on the plot showing me where the edit took place, it's really hard to see the line. it's also the same color as the grid lines. could you make it a darker gray? or even a different color?*"

There is an option to attach a file - for example a screenshot of the problem. When you are done filling out form and attaching files if you are doing that, then hit 'Create issue' button. This will send a notification to our programmer who will look into how to address the issue.

Using Gitlab allows our programmer to readily keep track of issues/solutions and schedule time appropriately. It is much more efficient than emailing - if you email directly then the first the programmer will take is to create an issue in Gitlab so it is great if you do that instead!

If there are questions about what is being requested you will get an email from our programmer asking for clarification. The email is sent from the Gitlab interface and links back to the issue, so that all the communication is in one place. When the issue is closed you will get an email saying the issue has been resolved.
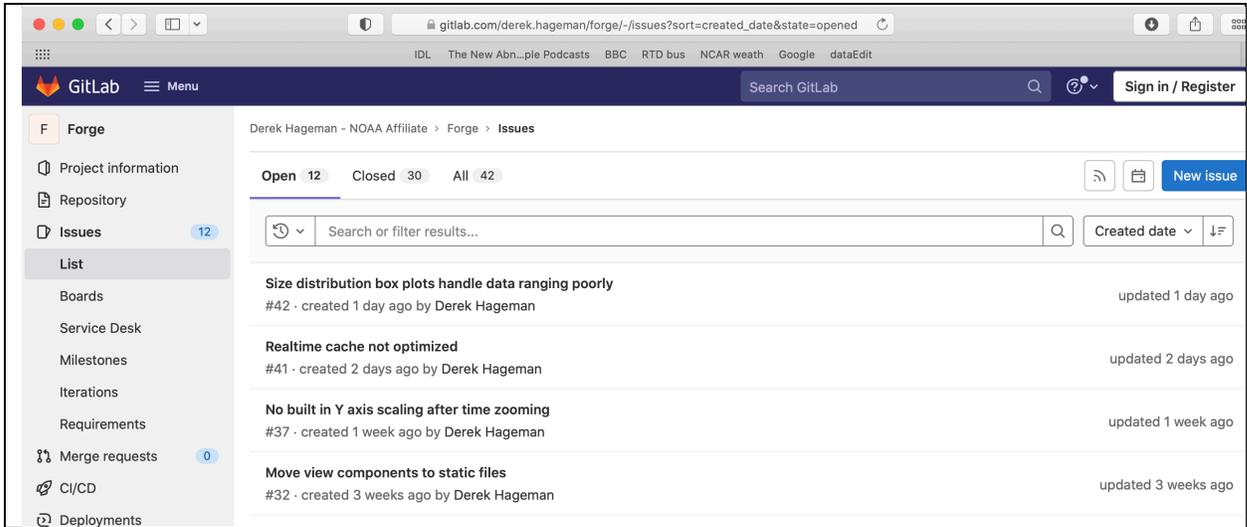
Figure 14a Login interface for Gitlab
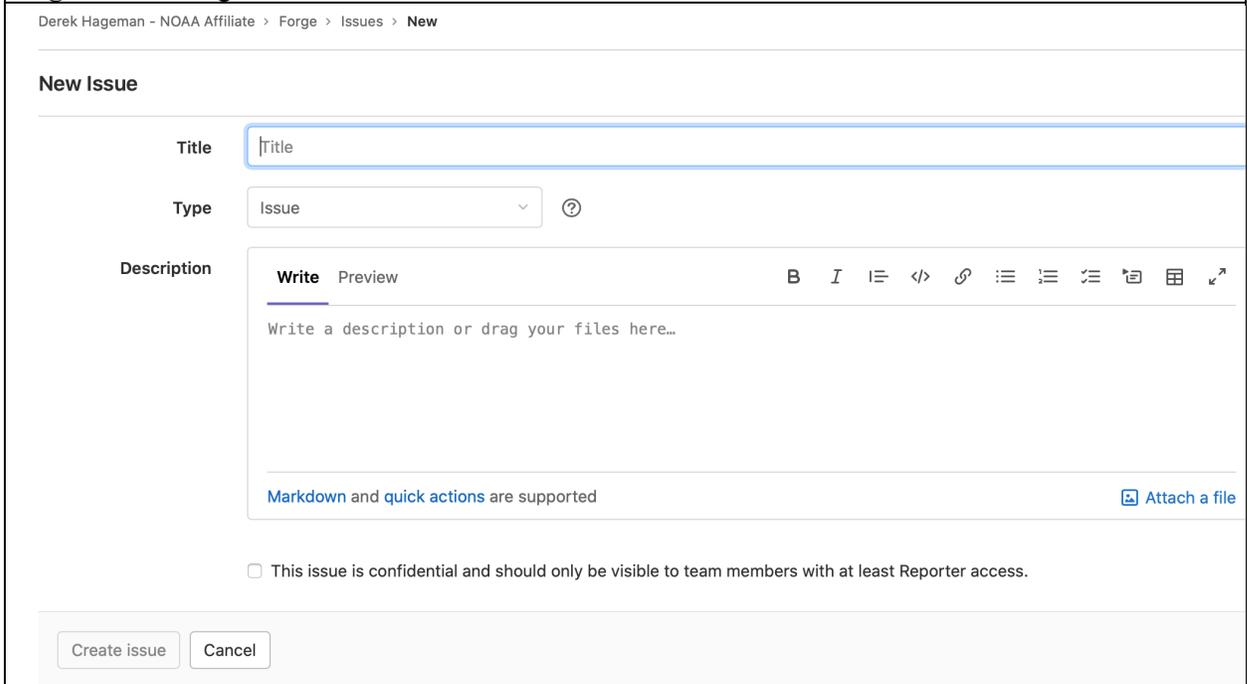
Figure 14b Issue form in Gitlab

Email alternative to Gitlab

If for whatever reason you cannot use Gitlab please use this (very long) email:
contact-project+derek-hageman-forge-26743528-issue-@incoming.gitlab.com

Doing so will also set up an issue for tracking in Gitlab without you needing to log in to Gitlab. Both of these options are highly preferable to just directly emailing someone at NOAA about issues, since it helps track the status of them.

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

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>