

Atmospheric Sounding Processing ENvironment (ASPE) User Manual

Isabel Suhr & Charles Martin

**NCAR | EARTH OBSERVING
LABORATORY**

Last updated: January 07, 2021

© 2000-2019 University Corporation for Atmospheric Research. All rights reserved.

No part of this manual may be reproduced (electronically or photocopied), translated into another language, or duplicated by any means without prior written consent of the University Corporation for Atmospheric Research (UCAR).

All information contained in this manual is subject to change, without notice.

Table of Contents

Preface

Note on PDF Manual	2
--------------------------	---

User Manual

Introduction	3
Overview of Operation.....	5
Tab Displays.....	8
Menu Commands.....	19
Post-Processing Adjustment.....	21
Quality Control Procedures.....	27
Configuration.....	36
Configuration Parameters	49
Synoptic Map	61
BatchAspen.....	68
Commandline Aspen	70
Input File Formats	73
Output File Formats.....	80

Note on PDF Manual

This PDF is generated from the online Aspen User Manual at [AspenDocs](#) (<https://ncar.github.io/aspendocs/>). The full text of this manual, as well as more detailed information about the QC algorithms and formulas Aspen uses, are available on the AspenDocs site.

Introduction

Want to give Aspen a test drive? It comes with sample data files, located in the Sample Data/ directory (found below the Aspen installation directory).

Aspen (Atmospheric Sounding Processing ENvironment) is used for analysis and quality control (QC) of sounding data. It has the following capabilities:

- Automatically apply quality control procedures to the sounding data
- Present data in tabular and graphical forms
- Automatically determine levels and code them in WMO message formats
- Transmit the WMO messages to other systems
- Save the raw and derived data products in various formats
- View multiple soundings in a synoptic map interface

Since Aspen can process data provided in the AVAPS “D” file, Vaisala MW41, NCAR GLASS, NCAR MCASS, NCAR CLASS, and generic CSV formats, it is able to analyze both dropsonde and upsonde soundings.

Aspen is designed to operate as automatically as possible, while allowing the user to have some control over the QC methods. For instance, as soon as the user selects a sounding file for processing, the data is brought into Aspen and automatically analyzed. In most cases this first pass will be the only one required. If the processing needs to be modified, the user can change the QC parameters and reprocess the data as many times as necessary.

An extensive series of QC algorithms are applied to the data. These algorithms typically have one or two parameters that may be adjusted by the user if the default values are not suitable for a particular sounding. The user can save the modified options, so that when a new sounding is opened, the initial analysis will use the customized QC parameters.

Aspen is designed so that its operation requires minimal user intervention. However, there are a few concepts that are very helpful in understanding the behavior of the program.

The QC process mainly removes suspect data points

Aspen maintains two separate data sets: the raw data and the QC data. At the start of processing, the QC data is an exact copy of the raw data. The algorithms are then successively applied to the QC data. As the processing proceeds, data points that fail each test are removed from QC data set. At the end of this process, a final smoothing is applied to the remaining QC data. It is important to understand that most of the QC steps simply remove unreliable points from the raw data set. The dynamic adjustments and the final smoothing are the only steps where the observed data values are actually modified.

Time is the independent variable

A sounding is simply a time series of observations, and so almost all of the QC operations are based on the time of each data point. The QC parameters are specified in relation to time, and the tabular data listings are ordered by time.

The processing follows a fixed sequence

The complete processing routine is applied as soon as a sounding is selected for analysis, and whenever the user chooses to recompute the analysis. The sequence is as follows:

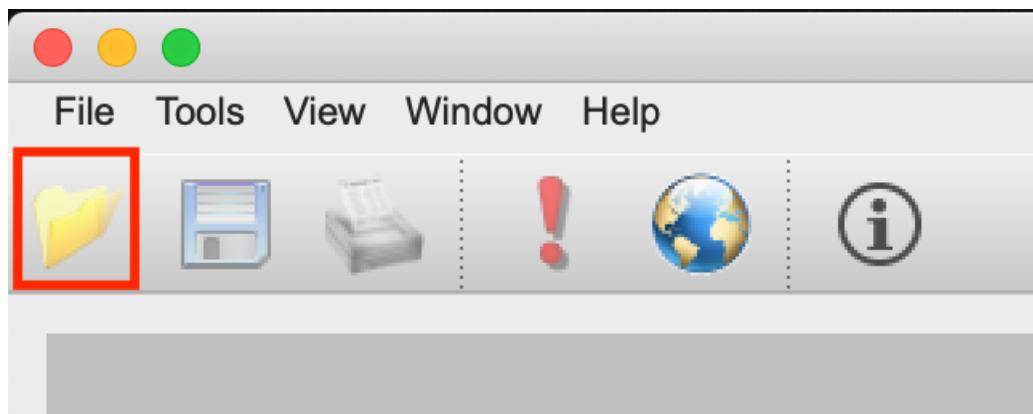
1. Apply the QC algorithms, discarding bad points and applying corrections
2. Compute the levels, by analyzing the QC results.
3. Code the WMO message, using the levels as input.

Throughout this manual, notes in italics provide additional information and suggestions which, while not essential to operation, will help you use Aspen more effectively.

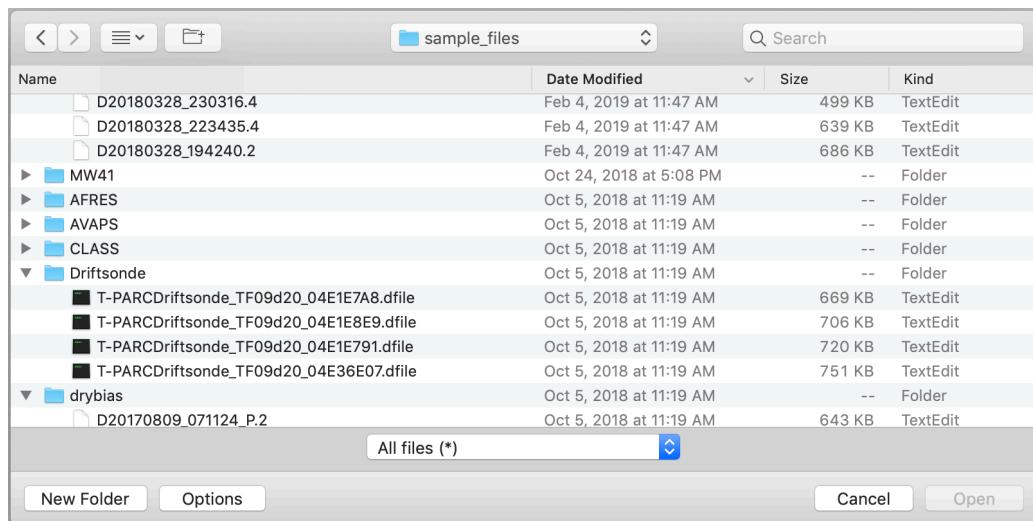
Overview of Operations

Run Aspen

To run Aspen, double click on the Aspen icon , or choose Aspen from the start menu. An initial start screen will appear. If the file selector does not appear immediately, click the open button (or select Open under the File menu):



You will now see the file selector:



The file selector is used to choose the sounding file to be processed. You can move to other directories using the up directory button or the directory chooser. The file filter controls the file types that are displayed in the chooser.

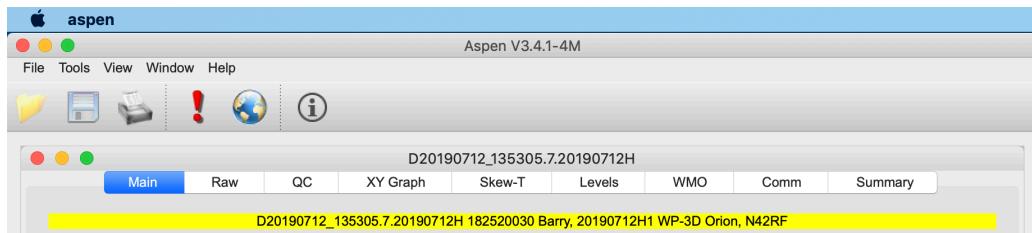
If you do not see your data files in the directory where they are supposed to be, it is probably because the file filter is set incorrectly. Change the file filter to “All files (*)” in order to display all files in the directory.

Open a file

Select the file containing the sounding that you want to analyze. Click once on the file and then press “Open”, or double-click the file name.

Aspen will show a warning message if you select a file that is in a format which it can't process.

Processing of the sounding begins as soon as the file is opened. The progress of the analysis is displayed in the status box in the lower left hand corner of the main screen, but until the processing is complete, the screen will remain blank. When the sounding analysis has completed, the initial screen will be filled with a tab-based display, in which each tab represents a different view of the data. The tabs are arranged from left to right (see figure below) in the general order of the data processing, i.e. from raw data, through the QC and levels computation, to the coded message. Read the Tab Displays section for further description.



Verify data

Verify the sounding by examining all of the tab selections. Refer to the [Post-Processing Adjustment section \(page 21\)](#) for important guidelines on doing this. After examining the sounding, the user may decide that one or more of the processing parameters should be adjusted.

Recompute (if necessary)

The most commonly altered processing parameters can be changed on the Main tab. When they have been set to the desired values, press the Recompute button on the Main Tab to reanalyze the sounding using the new parameters.



The processing status will again be displayed in the lower left status box. When completed, the displays in each tab will be updated with the new results.

Be sure to press the Recompute button after changing the processing parameters; otherwise, the new parameters will not be applied to the sounding.

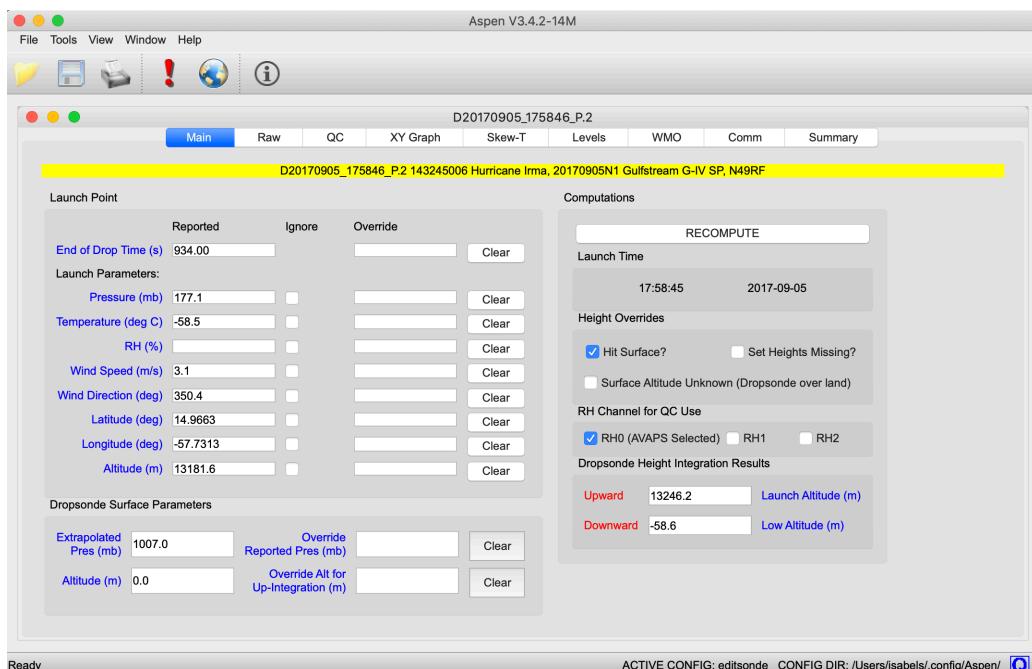
Next sounding

To analyze another sounding, open another data file using the open button. Many soundings can be open at one time. Use the Window menu to choose which sounding is displayed.

Tab Displays

Each tab displays identifying information that describes the sounding. The details are extracted from various fields within the raw data file. For graphical displays, this information is printed as text on the graph. For other tabs, a yellow bar at the top of the tab contains the identification.

Main Tab



The Main tab is used to view and modify certain characteristics of the sounding, including launch observations, height integration results, and end of drop time. See the [Post-Processing Adjustment section \(page 21\)](#) for directions on modifying information in the Main tab.

Be sure to press “RECOMPUTE” after changing items on the Main tab.

Raw Tab

Time (s)	Pres (mb)	Tdry (C)	RH (%)	Spd (m/s)	Dir (deg)	Alt (m)	GPS Alt (m)	DzDt (m/s)	Lat (deg)	Lon (deg)	Sats (n)	Wind err (m/s)	Attributes
-1.00	177.1	-58.5		3.1	350.4	13181.6	13231.1		14.9663	-57.7313	11	0.5	Ae
0.00	174.1	26.5	3.8	230.2	229.4	13175.4		-0.8	14.9663	-57.7312	11	1.6	Ae
0.25				232.1	228.9			-3.3			11		
0.50	180.5	12.2	0.1	230.2	229.3	13173.1		-6.7	14.9670	-57.7304	11	2.3	Ae Bias
0.75				226.8	230.0			-10.1			11	3.3	Ae
1.00	180.6	2.4	0.1	225.4	230.6	13166.2		-13.8	14.9677	-57.7296	11	4.0	Ae Bias
1.25				221.4	229.6			-13.7			11	4.6	Ae
1.50	180.7	-2.4	0.1	218.0	227.8	13160.0		-10.6	14.9663	-57.7289	10	5.0	Ae Bias
1.75				213.0	228.9			-14.3			10	6.0	Ae
2.00	180.9	-5.4	0.1	201.1	228.7	13148.0		-18.1	14.9689	-57.7281	9	7.4	Ae Bias
2.25				156.9	227.7			-17.7			7	10.5	Ae
2.50	181.2	-7.9	0.1	111.8	228.4	13131.6		-24.5	14.9693	-57.7277	7	12.5	Ae Bias
2.75				61.2	230.2			-22.9			5	13.8	Ae
3.00	181.4	-10.3	0.1	36.0	235.5	13131.6		-12.5	14.9695	-57.7275	5	13.6	Ae Bias
3.25				26.7	235.9			-12.4			5	17.6	Ae
3.50	181.7	-12.6	0.1	17.0	241.6	13295.4	13164.7	-16.0	14.9695	-57.7275	5	17.2	Ae Bias
3.75				15.5	244.9			-15.3			7	12.5	Ae
4.00	182.0	-14.8	0.1	13.0	229.8	13282.8	13157.6	-10.9	14.9695	-57.7275	8	8.6	Ae Bias
4.25				11.5	215.4			-9.2			7	7.6	Ae
4.50	182.3	-17.1	0.1	8.1	245.5	13270.5	13147.8	-15.3	14.9684	-57.7276	6	6.7	Ae Bias
4.75				7.8	249.9			-18.7			7	4.7	Ae
5.00	182.6	-19.2	0.1	8.0	254.3	13259.1	13138.8	-20.0	14.9693	-57.7277	7	3.6	Ae Bias
5.25				7.4	255.0			-20.6			7	3.1	Ae

This tab provides the information in the input file in scrollable tabular form. Data values are listed in time order from the beginning of the sounding, with the launch observation shown in the first data line with a time of -1s.

Data from the raw tab can be printed or saved to multiple file formats (see [Output File Formats section \(page 80\)](#)).

Data values that will be removed during Aspen processing are noted with attribute flags in the Raw tab, as shown above. The flags note which quality control procedure will remove the data during processing. The Attributes column, on the right side of the Raw tab, lists the attribute flags that appear in each data line. Mousing over the attribute abbreviations in this column will show the full names of the quality control procedures.

12.5	Ae
8.6	Ae Bias
7.6	Ae Ae: QC-AmbientEquilibration
6.7	Ae Bias: Dry bias correction
4.7	Ae
0.0	Ae Bias

From the Raw tab it is possible to set processing features on selected data points. Any data cell can be set to either ignore or keep during processing. Ignoring a data point removes it from the QC data, and can be used to remove bad points that don't get removed by Aspen quality control processing. Keeping a data point will ensure it remains in the QC data, and can be used to override Aspen processing when it removes points that should be kept. Keep or ignore data points by selecting the cells you wish to keep/ignore, then right click. In the menu, you can then select to set the keep or ignore attributes or to clear those attributes. You will need to press the recompute button after setting or clearing these attributes.

It is also possible to set end of drop time from the raw tab by selecting the row with the desired end of drop time, then right click to access the menu item to set end of drop time. End of drop time can also be set in the box on the Main tab, and either process will have the same result.

Data lines that come after a user-set end of drop time will appear deselected in the main tab.

310.25					11.1	278.6		
310.50	668.1	-0.3	62.9	11.1	278.7	3519.6	3487.6	
310.75				11.1	278.2			
311.00	668.7	-0.2	61.9	11.2	278.6	3512.7	3481.2	
311.25				11.1	278.2			
311.50	669.2	0.2	59.4	11.1	278.2	3506.7	3474.9	
311.75				11.0	278.1			
312.00	669.8		57.2	10.9	278.0	3498.9	3468.5	
312.25				10.9	277.5			
312.50	670.3		56.8	10.8	277.2	3493.5	3462.1	
312.75				10.7	277.0			
313.00	670.8	-0.1	56.6	10.6	276.2	3487.7	3456.0	
313.25				10.6	276.3			
313.50	671.3	0.0	56.3	10.6	276.4	3480.8	3449.8	

Cells that have been selected as keep or ignore will show the respective attribute flag in the raw tab, and will be highlighted in blue. Launch parameters cannot be assigned keep or ignore attributes, but can instead be modified in the Main tab.

Values in the time column cannot be selected because Aspen indexes data values by time. Additionally, values in the geopotential altitude, satellites, and wind error columns cannot be selected because these values are not processed by Aspen QC.

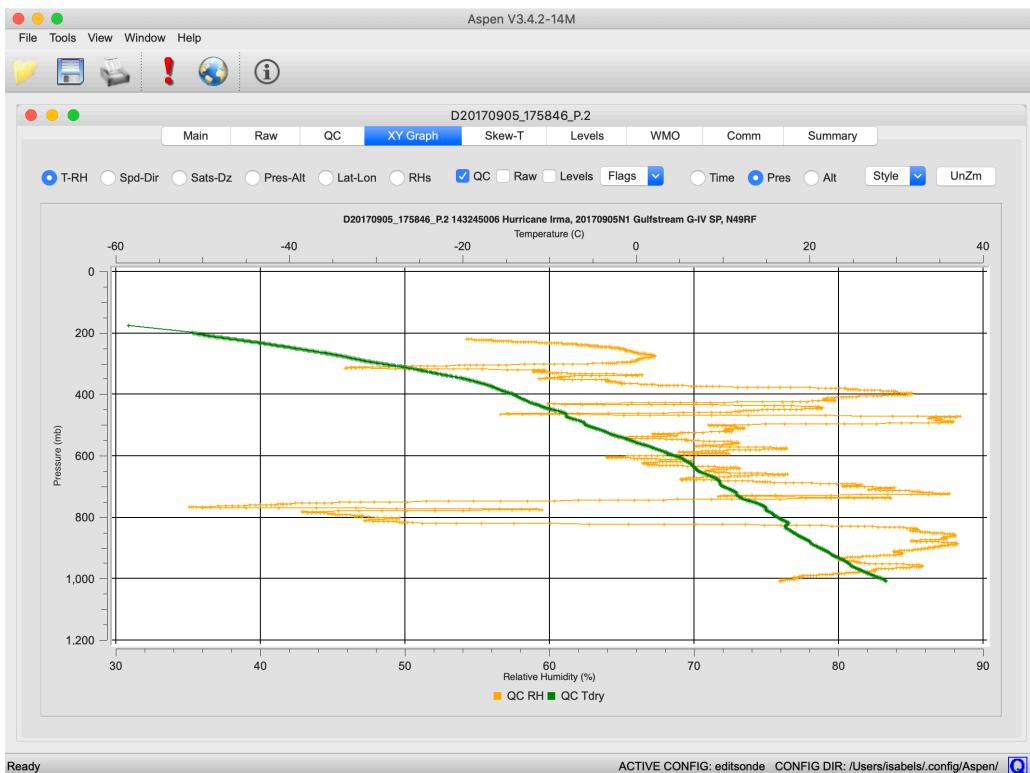
QC Tab

Time (s)	Pres (mb)	Tdry (C)	RH (%)	Spd (m/s)	Dir (deg)	Alt (m)	Dz/dt (m/s)	Lat (deg)	Lon (deg)
84.50	232.5	-43.2	60.2	8.8	250.8	11473.2	-18.6	14.9688	-57.7269
84.75				8.8	250.3				
85.00	232.9	-43.2	60.3	8.8	249.9	11463.9	-18.6	14.9688	-57.7269
85.25				8.8	249.5				
85.50	233.2	-43.1	60.5	8.8	249.1	11454.6	-18.6	14.9688	-57.7268
85.75				8.8	248.7				
86.00	233.5	-43.0	60.6	8.8	248.3	11445.3	-18.6	14.9688	-57.7268
86.25				8.8	247.9				
86.50	233.8	-42.9	60.8	8.8	247.5	11435.9	-18.6	14.9688	-57.7267
86.75				8.8	247.1				
87.00	234.1	-42.9	60.9	8.8	246.8	11426.6	-18.6	14.9688	-57.7267
87.25				8.8	246.4				
87.50	234.5	-42.8	61.0	8.8	246.0	11417.3	-18.6	14.9688	-57.7267
87.75				8.8	245.6				
88.00	234.8	-42.7	61.2	8.8	245.3	11408.0	-18.6	14.9689	-57.7266
88.25				8.8	244.9				
88.50	235.1	-42.7	61.3	8.8	244.6	11398.7	-18.6	14.9689	-57.7266
88.75				8.7	244.2				
89.00	235.4	-42.6	61.4	8.7	243.9	11389.5	-18.6	14.9689	-57.7266
89.25				8.7	243.6				
89.50	235.8	-42.5	61.5	8.6	243.3	11380.2	-18.6	14.9689	-57.7265
89.75				8.6	243.0				
90.00	236.1	-42.4	61.6	8.5	242.7	11370.9	-18.6	14.9689	-57.7265
90.25				8.5	242.5				
90.50	236.4	-42.4	61.7	8.4	242.2	11361.6	-18.6	14.9689	-57.7264

This tab provides the quality-controlled sounding data in scrollable tabular form. Data in this tab is the final Aspen product and is what will be written to output files. Data values are listed in time order, starting with the launch observation with a time of -1s. Empty cells indicate no data at that time.

Data from the QC tab can be printed or saved to multiple file formats (see [Output File Formats section \(page 80\)](#)).

XY Graph Tab



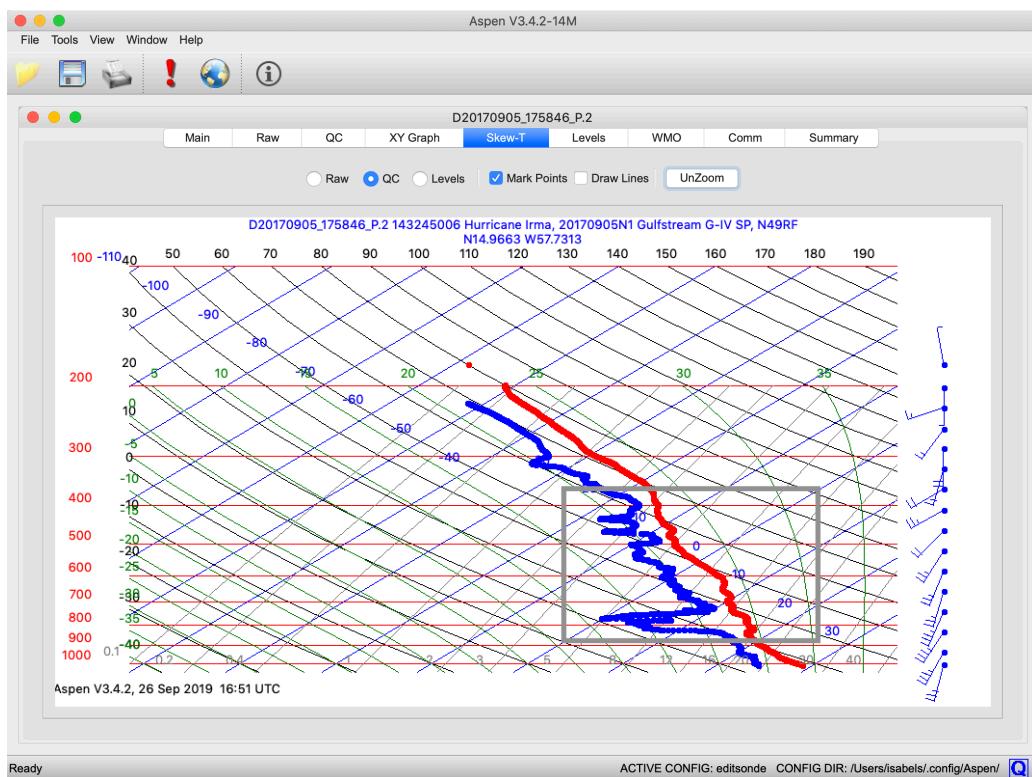
This tab provides numerous options for graphical display of the data. Above the graph are buttons and menus that can select which data to plot and how it is displayed. The options are as follows:

- **Data series selection:** The first 5 radio buttons select which data series to plot on the graph.
 - T-RH: Selects temperature and relative humidity series.
 - Speed-Dir: Selects wind speed and direction series.
 - Sats-Dz: Selects number of satellites and ascent speed series.
 - Pres-Alt: Selects pressure and altitude series.
 - Lat-Lon: Selects latitude and longitude series.
 - RHs: Selects RH1, RH2, and combined RH series (which appear in data from RD94 and older dropsondes).

- **Data processing selection:** The QC, Raw, and Levels checkboxes select the dataset(s) to be displayed in the graph. Multiple datasets may be displayed at the same time. When levels are displayed, standard levels are displayed as triangles and other levels are displayed as circles.
- **Display of attribute flags:** When raw data is displayed, attribute flags can be plotted over the data series. Using the drop-down menu flags can be added, either all flags or flags associated with specific data QC procedures.
- **Y axis selection:** These buttons select the parameter displayed along the vertical axis. Keep in mind that in dropsonde data some lines have data but no pressure or altitude, so to display all the available data using time as the vertical axis is recommended. In addition, when the raw data is displayed using the pressure or altitude vertical axis, the display may be confusing due to noise in the raw pressure reading.
- **Style:** This drop-down menu provides options for customizing the view of the graph: options to add a background grid for either X or Y axis, and whether to plot data points or to include lines between them.
- **Zoom:** To magnify (zoom) an area of the plot, left-click and drag to draw a rectangle around the area of interest. Release the left mouse button to zoom into the defined area. The UnZm button restores the graph to the full area display.

The contents of the XY graph can be saved as either PNG or JPG using the Save button in the Aspen toolbar. PNG provides better compression and much higher quality graphics presentation for the line drawings of Aspen, and is the preferred file format. The pixel dimensions of the saved graphic file can be specified in the configuration options.

Skew-T Tab



A standard skew-T log-P plot is accessed in the Skew-T tab. Selecting data, zooming, changing style, and saving of the plot are available in the same manner as for the XY Graph.

Meteorologists are accustomed to seeing a particular aspect ratio on skew-T plots and thus a consistent shape of the various isopleths. To maintain the correct aspect ratio when zooming, choose a zoom box whose lower left and upper right corners share a common temperature, i.e. they share a common diagonal. An example of a correct zooming rectangle is superimposed on the figure above.

Levels Tab

n	Type	Time (s)	Pres (mb)	Tdry (C)	RH (%)	Dir (deg)	Spd (m/s)	Alt (m)
0	Uppermost Thermodynamic	-1.0	177.1	-58.5				
1	Uppermost Winds	-1.0	177.1			350.4	3.1	
2	62626 REL Location	-1.0	177.1			350.4	3.1	
3	GDL Temperature	31.0	198.7	-51.3				
4	Standard	33.1	200.0	-51.1		175.7	1.8	12469
5	GDL Wind Direction	50.5	211.1			223.1	5.2	
6	GDL Wind Direction	63.3	219.1			250.3	8.9	
7	Uppermost Thermodynamic	66.0	220.8	-48.3	54.3			
8	GDL Wind Direction	81.0	230.3			255.2	8.8	
9	Standard	111.2	250.0	-39.2	64.9	225.2	7.9	10981
10	GDL Wind Direction	166.8	287.2			181.3	10.4	
11	GDL RH	173.5	292.0	-31.0	65.9			
12	Standard	184.7	300.0	-29.3	62.9	184.4	11.2	9706
13	GDL Temperature	204.0	314.0	-26.1	46.0			
14	GDL RH	234.0	335.9	-22.2	66.2			
15	GDL Wind Direction	251.3	348.6			210.8	11.0	
16	GDL Wind Direction	275.5	366.7			245.9	12.7	
17	GDL Temperature	281.0	370.9	-16.9	68.3			

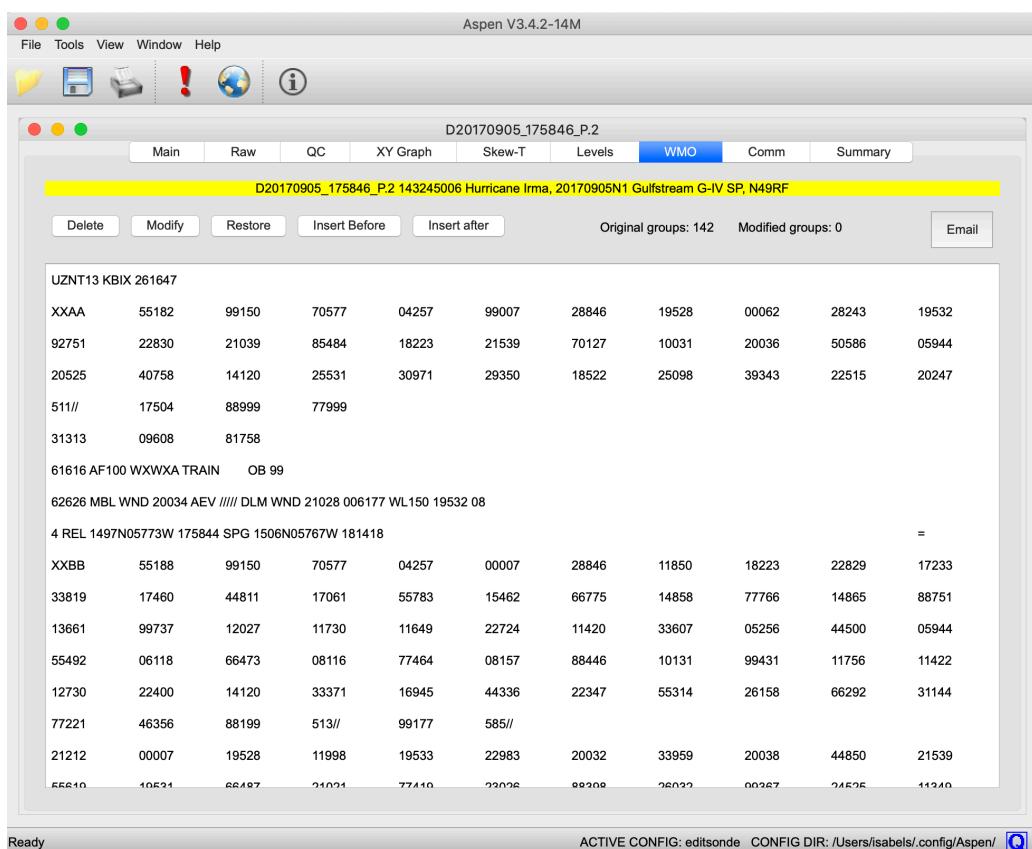
The Levels tab displays the computed levels, which have been derived from the QC data set. The surface and standard levels are highlighted in blue. These are the levels that are coded in parts A and C of the WMO message. The levels data can be printed and saved in CSV format from the Aspen toolbar.

The levels listing may be sorted by any of the variables by clicking on the desired column heading. Clicking a second time in the same heading reverses the order of the sorting. It is typical to sort either by time or pressure, both of which will give similar results. In certain cases the Aspen operator may wish to prevent particular levels from being coded in the WMO message. Clicking on a level in the Levels Tab will mark a level so that it is not coded. Excluded levels are highlighted in red, as shown in the above image. Click again on the level to toggle its status back for normal coding. Clicking on the temperature, RH, speed, direction or altitude fields

will select that individual field and prevent it from being coded in the WMO message. Clicking on any other field (the columns to the left of these) will disable the whole level.

Not all variables are recorded for each level. This is because each level type is used to report only specific variables in the coded message. If a variable is not reported for a given level type, it is not calculated for that level.

WMO Tab



The WMO tab displays the WMO message, which has been coded from the levels information. It can be printed and saved as a .txt file using the Aspen toolbar.

The WMO message can be emailed from within Aspen by pressing the Email button on this tab. The email recipient is specified by the TempEmailAddress configuration parameter. When the Email button is pressed, the default operating system mail client (e.g. Outlook or Apple Mail) is started, and the user is presented with an email editing window. If the message is being mailed to an automatic processing system, such as the NWS email GTS ingest gateway, then the mail

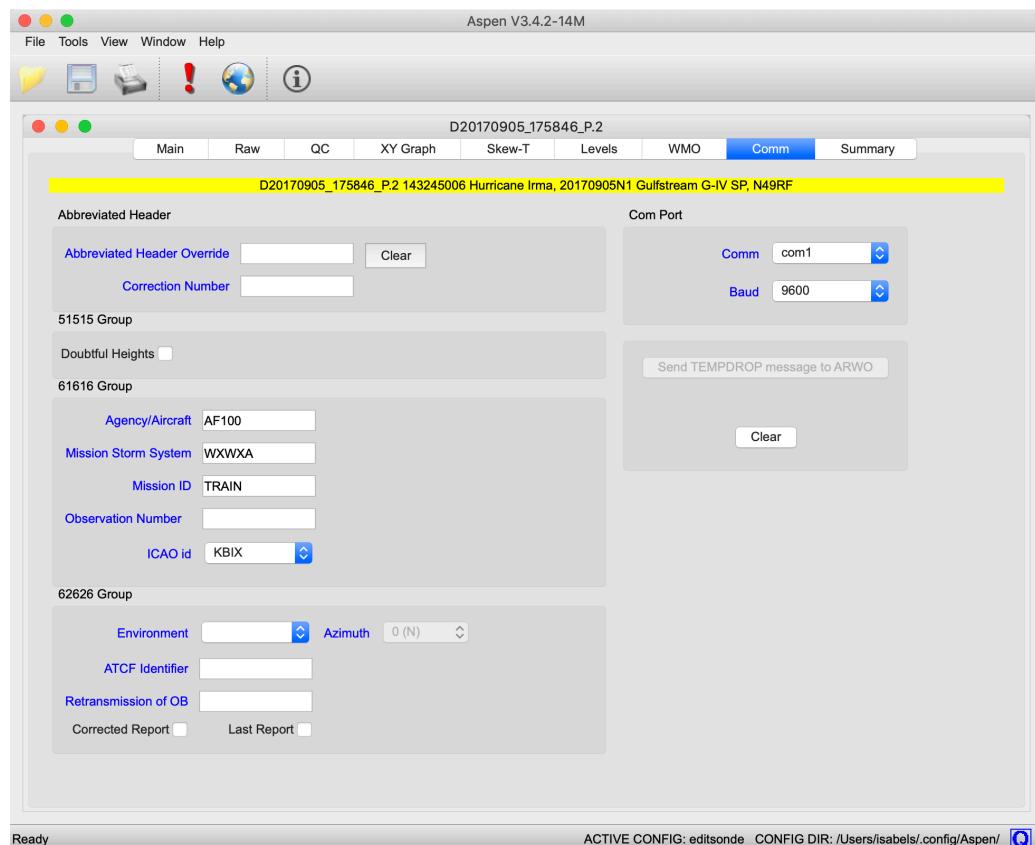
client should be configured to send in plain text format, and to not wrap the text lines. Group or alias entries can also be made in the client address book (e.g. "GTS") to serve as the message recipient address.

The format for the WMO message is very exacting, and there may be times when Aspen does not get the coding quite right. The buttons at the top left of the WMO tab allow the user to modify the WMO message if necessary. Use the mouse to select the code group to be edited, and press the appropriate editing button.

There are a number of administrative entries in the WMO message that are not derived from the levels data. These are items such as the abbreviated header, and information in the 61616 and 62626 groups. This information is managed on the Comm tab. When a field is changed on the Comm tab, the WMO message is adjusted accordingly.

If the sounding analysis is recomputed, a new WMO message will be coded and any edits made previously will be lost.

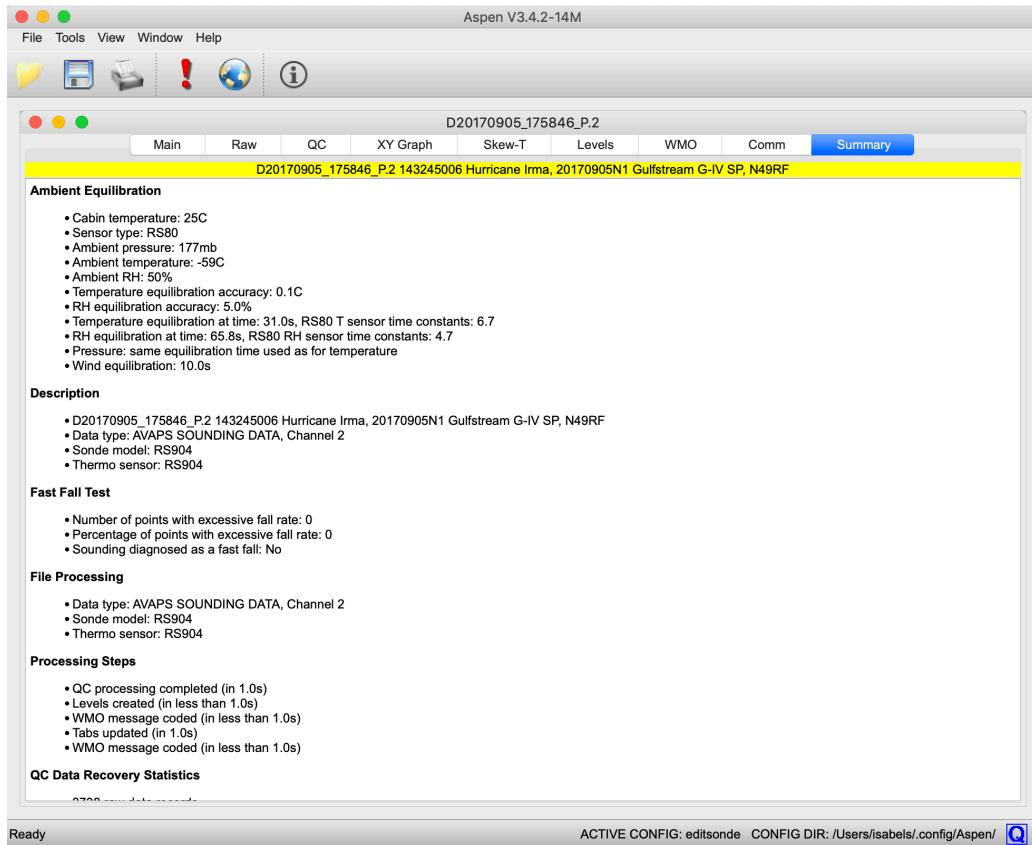
Comm Tab



The Comm tab is used to enter the administrative information that is coded in the WMO message, primarily in dropsonde specific groups. It only appears if a dropsonde file is being analyzed. It also has controls for transmitting the WMO message via an attached interface on the USAFR WC130 aircraft. Press the “Send TEMPDROP message to ARWO” button to transmit the WMO message. A message box will pop up to indicate that the transmission is in progress.

Most of the data entry fields on the Comm tab are saved as soon as they are entered, and used as the defaults for the next sounding that is processed. Be sure to verify that the fields are correct before saving or transmitting the message.

Summary Tab



The Summary tab provides additional diagnostic information about the sounding input file and the processing Aspen has performed on it, including statistics about how many points are filtered out during processing and by which procedure. The information in the Summary tab can be printed or saved in PDF format using the Aspen toolbar.

Menu Commands

File Menu

The File menu contains command choices that are generally applicable to all tabs within Aspen. There are cases when a command cannot be used with a particular tab. For instance, when the Main tab is selected, the File Save command is not enabled, since there is no data product associated with this tab. The following commands are found under the File menu:

Open...	Open a sounding file and begin the processing.
Configuration	Open the configuration editor (available only when no soundings are open).
Save...	Save data products associated with the tab.
Close	Close the sounding.
Close All	Close all currently open soundings.
Print Preview	Preview the print output.
Print...	Print the tab. The output print format will depend on the tab type.

At the bottom of the File menu is a list of the most recently analyzed files. Sometimes it is convenient to go here to reopen a sounding that you have recently examined.

See the [Configuration section \(page 36\)](#) for an explanation of the configuration management procedures.

Tools Menu

The Tools menu provides access to commands associated with the QC parameters, when a sounding is open. See the [Configuration section \(page 36\)](#) for their description.

The Tools menu also provides access to the Synoptic Map view.

View Menu

The display of toolbar and status bar is controlled in the View menu.

Window Menu

The Window menu contains a listing of all of the soundings currently being analyzed by Aspen. Clicking on the file name will bring that sounding to the front of the display. It also provides different options for arranging multiple soundings within the Aspen window.

Help Menu

The Help menu provides access to information about the version of Aspen, as well as to the Aspen manual and configuration log.

Toolbar

The Toolbar contains buttons that provide quick access to common Aspen actions. As with the File menu, the buttons that are enabled depend upon which tab is currently selected.



Toolbar icons shown here include open, save, print, recompute, synoptic map, and information.

Post-Processing Adjustment

Once a sounding has been processed by Aspen, the results must be examined carefully. Frequently some parameters will need to be adjusted to compensate for characteristics of the data.

Remember to press the Recompute button after making post-processing adjustments.

End of data

In a well-behaved sounding, the end of the raw data set will occur at the end of the sounding. For a dropsonde landing in water, this is the usual case. For a dropsonde hitting the earth, or with upsondes, the raw data can contain observations that should not be included in the processed sounding. The user must then manually specify the end of the drop by setting the end of drop time on the Main tab. It is critical that the end of drop be correctly set for dropsonde soundings.

Reported	Ignore	Override
End of Drop Time (s)	575.25	<input type="text"/> <input type="button" value="Clear"/>

The Raw data table and the XY graph are useful for determining the end time. Scroll to the bottom of the raw data to view the values of individual data points. On the XY graph, enable the raw data trace, and use the mouse to zoom in the area of the sounding end. Data point markers and grids can be enabled with buttons above the graph.

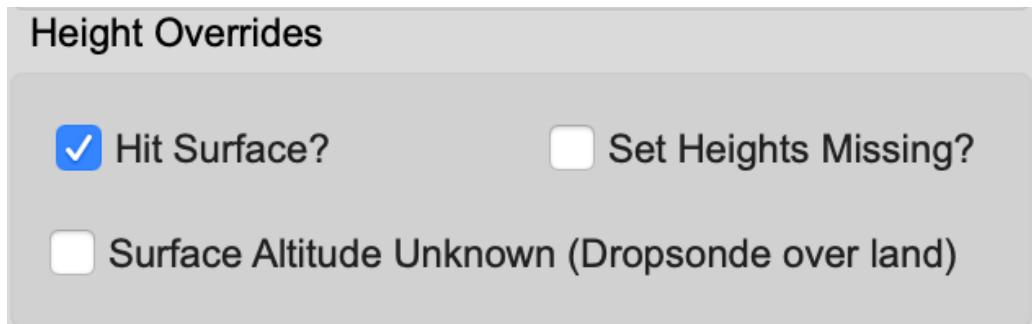
The Raw tab will continue to display all data from the sonde, including data after the selected end-of-drop time. The QC tab will only show data points that are within the end of data time period.

Dropsonde heights and the surface

For dropsonde soundings, the height calculations are the trickiest part of the Aspen analysis. If the drop terminated cleanly at a known altitude, upward integration of the heights is straightforward. Upward integration is impossible, however, if the dropsonde termination altitude is unknown. This can occur if the drop did not make it all of the way to the surface, or if the termination point on land had an unknown altitude.

In the latter situations, the sounding heights can be computed by downward integration from the launch altitude. Note that this is suitable only if the launch altitude is known with accuracy. Usually the launch altitude is provided by the aircraft data system, and it is critical to determine the accuracy of this altitude. If altitude is provided by a radar altimeter over the ocean, it is probably acceptable. If it is provided by a pressure-based altimeter, at some time or distance since the altimeter setting was applied, the aircraft-provided altitude is probably not acceptable.

The Main tab has several items that relate to the height calculations.



In the box labeled "Height Overrides" there are check buttons that have the following effects:

- Hit Surface – The default case. Check this box if the dropsonde hit the surface. The heights will be integrated up from the surface altitude. Uncheck this box if the sonde did not hit surface (i.e. stopped transmitting early) to avoid creating surface levels in WMO outputs.
- Unknown Surface Altitude – Check this box if the surface altitude is unknown, such as when a dropsonde has terminated on land. The heights will be integrated down from the launch altitude, and the surface altitude will be taken from downward integration.
- Set Heights Unknown – Check this box if you feel the heights are not sufficiently accurate, no matter which way they are calculated. The

heights will not be calculated or used in latter processing.

At the lower right of the Main tab is a box displaying the results of the upward and downward height integrations.

Dropsonde Height Integration Results

Upward	6435.2	Launch Altitude (m)
Downward	0.3	Low Altitude (m)

This is shown for diagnostic purposes. If downward integration leads to a launch altitude close to the surface altitude and, likewise, the upward integration is close to the launch altitude, then there is confidence in the launch altitude. If there are significant discrepancies, the launch altitude is probably incorrect. Additionally, differences in the diagnostics can signify a large systematic error in the variables used in the height integration, i.e. pressure, temperature or humidity.

If the surface altitude can be determined for a launch which terminated on land, this value can be entered into the surface altitude override box, so that the upward integration can be computed.

Dropsonde Surface Parameters

Extrapolated Pres (mb)	1030.0	Override Reported Pres (mb)	<input type="text"/>	Clear
Altitude (m)	0.0	Override Alt for Up-Integration (m)	<input type="text"/>	Clear

The final item affecting the height calculation is the Launch Altitude entry in the Launch Parameters box in the upper left of the Main tab. If another source of the launch altitude is available, it may be entered here in order to override the aircraft supplied value. The Clear button can be used to remove the override.

It should be pointed out that the heights are mainly relevant to the coding of the WMO messages, where they are used to report the altitudes of standard pressure surfaces. Even if the heights are unusable, the WMO message will still contain a very accurate report of the sounding based on pressure. The upshot is to set heights to missing when in doubt, rather than report erroneous values.

Dropsonde end of series adjustments

Some environments show extreme vertical gradients near the surface. Soundings taken through the hurricane eyewall are a classic examples of this. Sometimes it is desirable to preserve the high-resolution detail in this part of the sounding, especially for near surface winds, as these data are critical to hurricane evaluation and planning.

The standard smoothing in Aspen is usually specified in order to smooth out some of the variance so that an inappropriate number of levels are not created. But this also removes the desired detail at the bottom of the sounding. In order to alleviate this, Aspen creates an additional filtered copy of the pressure and winds series, and proportionally blends these series back into the main series at the bottom of the sounding. The blending span is specified by the BlendLength configuration parameter. BlendLength is also used as the wavelength of the secondary filter.

Launch parameters

The launch parameters are the surface or aircraft flight level observation made at the time of launch. They become either the bottom or top point in the sounding, depending on the sounding direction. The QC procedures assume that these launch observations are accurate, so they will not be changed. If the launch observations do need to be modified, the Launch Parameters box in the upper left of the Main tab has entries that allow the user to override or ignore them.

Launch Point		Reported	Ignore	Override	
End of Drop Time (s)	575.25	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="button" value="Clear"/>
Launch Parameters:					
Pressure (mb)	465.6	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="button" value="Clear"/>
Temperature (deg C)	-14.0	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="button" value="Clear"/>
RH (%)	34.6	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="button" value="Clear"/>
Wind Speed (m/s)	18.2	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="button" value="Clear"/>
Wind Direction (deg)	249.6	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="button" value="Clear"/>
Latitude (deg)	29.3569	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="button" value="Clear"/>
Longitude (deg)	-92.0210	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="button" value="Clear"/>
Altitude (m)	6427.5	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>	<input type="button" value="Clear"/>

Select ignore to remove existing launch point values or use the override boxes to replace them. Use the Clear button to revert to the original values.

Setting the QC parameters

The QC parameters, which control the operation of the various QC algorithms, can be modified by the user. However, only experienced users who understand the effects of the parameters should do this. See the [Quality Control Procedures section \(page 27\)](#) for a complete description.

The QC parameters are organized in named sets, with one of them designated as the currently active set. The parameters in the active set are the ones used for succeeding analyses by Aspen. The active set name is displayed on the right side of the status bar at the bottom of the Aspen application window. It is visible for every Aspen tab:



The initial installation of Aspen provides a configuration set named “editsonde”, and designates it as active. These parameters are generally useful for dropsonde soundings in a tropical environment. Aspen also supplies other config sets for use with upsondes and different kinds of dropsondes. It is also possible to create a new config set to address specific data considerations.

See the [Configuration section \(page 36\)](#) for directions on setting the active set and maintaining or creating configuration sets.

The user should be in the habit of always checking the status bar to verify that the correct configuration set is designated as active.

To change the choice of active configuration set, close all sounding files within Aspen. The file menu will now have a “Configuration...” entry that allows access to the configuration editor.

Quality Control Procedures

One of the main purposes of Aspen is to apply quality control algorithms to a sounding. These algorithms attempt to systematically detect data points that are likely to be incorrect, and remove them from the QC data set.

The processing begins with a copy of the original (raw) observations. In most cases, all parameters are considered separately. The main exception to this is the handling of the wind observations. In this case, the wind speed and direction are separated into u and v components, and the QC tests are individually applied. However, if one of the two components fails a test, then both components as well as the speed and direction are removed from the QC data.

There are other QC tests that depend upon the relationship between two variables; in some algorithms, the processing of a given parameter requires input from another parameter. For instance, the GPS-measured velocity is used as a discriminator for the horizontal wind observations. In another case, the dynamic adjustment procedure requires the time constant of the sensor making the measurement. This time constant is a function of density and ventilation rate, which are obtained from the pressure and vertical velocity.

The Algorithms

The following table lists the QC processing steps, in the order that Aspen applies them. Also listed are the sounding direction and variables to which each step is applied. Following the table is a more detailed description of each step.

Procedure	Downward	Upward	P	T	RH	Winds	GPS Position
Temperature-dependent dry bias correction*	✓				✓		
Launch parameter overrides	✓	✓	✓	✓	✓	✓	✓
Copy raw data set to QC data set	✓	✓	✓	✓	✓	✓	✓
End of drop override	✓	✓	✓	✓	✓	✓	✓

Ambient equilibration	✓		✓	✓	✓	✓	
Post-splash data check	✓		✓				
Apply fixed offsets	✓	✓	✓	✓	✓		
RH thresholding	✓	✓			✓		
Limit check	✓	✓	✓	✓	✓	✓	✓
Satellite check	✓	✓				✓	✓
Wind error check	✓	✓				✓	
Buddy check	✓	✓	✓	✓	✓	✓	✓
Outlier check	✓	✓	✓	✓	✓	✓	
Filter check	✓	✓	✓	✓	✓	✓	✓
Pressure smoothing	✓	✓	✓				
Monotonic pressure check	✓	✓	✓				
Compute vertical velocity (1)	✓	✓					
Temperature dynamic adjustment	✓	✓		✓			
RH limiting (1)	✓	✓			✓		
Final smoothing	✓	✓		✓	✓	✓	
RH limiting (2)	✓	✓			✓		
Pressure adjustment	✓			✓			
Compute vertical velocity (2)	✓	✓					
Vertical velocity check	✓					✓	
Compute vertical winds	✓						

Create surface observation	✓		✓	✓	✓		
Winds dynamic adjustment	✓	✓				✓	
Fast fall check	✓						
Compute altitude	✓	✓					
Compute position	✓	✓					

* Only applied to specific range of RS94 dropsondes that need the correction.

More details about each processing step follows. Some algorithms are linked to their pages in the QC Algorithms section of AspenDocs. If the step can be adjusted via a configuration parameter, the name of the configuration parameter in the config set and how to access the parameter value in Aspen are listed. See the Configuration section for details on managing Aspen configurations.

Temperature-dependent dry bias correction

A correction is applied to the RH series if a) the sonde is in the specific range of RD94 sondes that need the correction and b) if the correction is not already present in the input data. If the correction is present in the input data, any RH values of 0.1 (signifying very low but nonzero RH) are flagged and removed.

Launch parameter overrides

Settable: Main tab

The user-specified launch parameter overrides, if any, are substituted for the ones given in the data file.

Copy raw data set to QC data set

Parameters: DiscardBadCrcData

Settable: Options > Processing > Discard frames with CRC errors

The QC data set is initialized with a copy of the original observation. If the option is chosen to discard frames with CRC errors, these frames are not copied to the QC data set, except for the very last frame in the original observation (applies only to AVAPS dropsonde soundings).

End of drop override

Settable: Main tab

If the user has specified an end of drop time, all data beyond this time is ignored.

Ambient equilibration

Parameters: WindEquilTime

Settable: Options > QC Parameters > Dropsonde equilibration time override

See [Ambient Point](#).

Post-splash data check

See [Post-splash check](#).

Apply fixed offsets

Parameters: PresOffset , TdryOffset , RHOffset

Settable: Options > QC Parameters > Offset to add

See [Offset Adjustment](#).

RH thresholding

Parameters: RHThreshold

Settable: Options > QC Parameters > Thresholding

Optionally thresholds RH values outside the 0-100% range that still may contain valid data. Thresholding sets RH values between -5% and 0% to 0% and between 100% and 110% to 100%. This thresholds values before quality control takes place, unlike the separate RH limiting that gets applied after processing and is not user-configurable.

Limit check

See [Limit Check](#).

Satellite check

Parameters: WindDisableSatsCheck , WindSats

Settable: Options > QC Parameters > Disable sats check or set minimum number of satellites

See [Satellite Check](#).

Wind error check

Parameters: WindDisableErrorCheck , WindErrorHigh , WindErrorLow

Settable: Options > QC Parameters > Disable wind error check or set limits in upper and lower atmosphere

See [Wind Error Check](#).

Buddy check

Parameters: PresBuddySlope , TdryBuddySlope , RHBuddySlope , WindBuddySlope , GPSPosBuddySlope , GPSAltBuddySlope

Settable: Options > QC Parameters > Buddy check slope

See [Buddy Check](#).

Outlier check

Parameters: PresDisableOutlierCheck , PresOutlier , TdryDisableOutlierCheck , TdryOutlier , RHDisableOutlierCheck , RHOutlier , WindDisableOutlierCheck , WindOutlier

Settable: Options > QC Parameters > Outlier check or disable outlier check

See [Outlier Check](#).

Filter check

Parameters: PresQCWL , PresQCDev , TdryQCWL , TdryQCDev , RHQCWL , RHQCDev , WindQCWL , WindQCDev , WindDisableQCFilter , GPSPosQCWL , GPSPosQCDev , GPSAltQCWL , GPSAltQCDev

Settable: Options > QC Parameters > QC filter wavelength, QC filter deviation limit, disable QC filter

See [Filter Check](#).

Pressure smoothing

Parameters: PresSmoothWL

Settable: Options > QC Parameters > Final smoothing wavelength

The smoothing is applied to the pressure data. The pressure needs to be smoothed before the pressure monotonic check. If the final smoothing wavelength is set to 0, this is not applied. A small amount of final smoothing should almost always be applied to pressure, so that reverse trends in pressure caused by noise will not cause a data point to be discarded. See [Smoothing](#) for more details.

Monotonic pressure check

Parameters: PresMonoCheck

Settable: Options > QC Parameters > Pressure monotonic check

The pressure trace must change monotonically in order for pressure-based searching to be performed. The pressure time series is scanned; when a point is found which follows an incorrect trend (i.e. decreasing for a dropsonde, increasing otherwise), it is removed from the series.

Compute vertical velocity

See [Vertical Velocity](#).

Temperature dynamic adjustment

Parameters: TdryDynCor , TdryDynCorWL

Settable: Options > QC Parameters > Dynamic correction and dynamic correction wavelength

See [Dynamic Adjustment](#).

RH limiting

Incoming RH values can be outside the 0-100% range, but Aspen will not output QC values outside of the range. After other QC processing has been done, make sure RH values are still within what's physically possible. RH values less than 0.1% are set to 0.1% and RH values greater than 100% are set to 100%. This is performed a second time after final smoothing, since that can adjust RH values to outside of the allowable range.

Final Smoothing

Parameters: TdrySmoothWL , RHSmoothWL , WindSmoothWL , BlendLength

Settable: Options > QC Parameters > Final smoothing wavelength

The series are smoothed using the final smoothing wavelength. If the final smoothing wavelength is set to 0, this is not applied. See [Smoothing](#) for more details.

Pressure Adjustment

Settable: Main tab

See [Scalar Adjustment](#).

Vertical velocity check

Parameters: WindVVDelta, WindVVPresWL, BlendLength, ChuteArea, DragCoef, DropSondeMass

Settable: Options > QC Parameters > Vertical velocity difference limit and pressure smoothing wavelength, Options > Processing > Dropsonde parameters

The GPS-measured fall velocity is a good discriminator for the quality of the GPS-derived horizontal wind. If the difference between the GPS-measured vertical velocity and the hydrostatically determined fall velocity is greater than the specified limit, and the same comparison passes for the theoretical fall velocity, the GPS measured horizontal wind value is discarded. The theoretical fall velocity is based on a model of the sonde/parachute aerodynamic properties. Note that a separate pressure series is used for the hydrostatically derived fall velocity, so that it can have a different smoothing wavelength than the standard pressure series. This allows it to be tuned in order to catch the expected variance in the GPS-measured vertical velocity.

Compute vertical winds

Parameters: WindDisableW, ChuteArea, DragCoef, DropSondeMass

Settable: Options > QC Parameters > Disable Vertical Winds Calculation, Options > Processing > Dropsonde Parameters

See [Vertical Wind](#).

Create surface observation

See [Create Surface Observation](#).

Winds dynamic adjustment

Parameters: WindDynCor, WindDynCorWL

Settable: Options > QC Parameters > Dynamic correction and dynamic correction wavelength

See [Dynamic Wind Adjustment](#).

Fast fall check

The hydrostatically computed vertical velocity is compared with the theoretical value. If more than 50% of the values are greater than 1.35 times larger than the theoretical value, the observation is flagged as a “fast fall” sounding. See [Fast Fall Check](#).

Compute altitude

See [Altitude](#) and the [Post-Processing Adjustment section \(page 21\)](#) for a description of height computations.

Compute Position

Parameters: ReportObservedPos , PosInterpSpan

Settable: Options > Processing > Report observed position instead of integrated winds position, position interpolation interval

See [Position](#).

Guidelines for Adjusting QC Parameters

The supplied default values for the Aspen QC parameters in general produce excellent results. However, there may be times when a group of soundings have peculiar error characteristics, and the Q/C parameters need to be modified in order to produce better discrimination against outliers. Some tips for adjusting the configuration parameters are given here. The user should carefully read and understand the descriptions of the QC algorithms given in the preceding section; this will provide the best guidance on modifying the QC parameters to match the error characteristics of the sounding data.

- Toggle the display of raw data off and on in order to see which data points are being rejected by the algorithms. Toggle the “mark points” option, and use the zoom and pan capabilities freely to investigate the effectiveness of the procedures.
- If the sounding system does not report the number of GPS satellites used in the winds calculation, set the GPS satellite threshold to 0, so that winds are not discarded due to a lack of satellites.
- The most frequently adjusted parameters are the the QC filter wavelength and the QC filter deviation, which are used in the filter check and are applied together. In this algorithm, a smoothed curve is calculated from

the data series. If the filter wavelength is small, the curve will closely follow the data; if large the curve will be a very smooth representation of the data. The deviation is the amount that a data point is allowed to deviate from the smoothed curve. If the difference between the curve and the raw data point is larger than the deviation, the data point is discarded. The interplay between the amount of smoothing and the allowed deviation allow for wide latitude in tuning the filter check algorithm.

- The dynamic adjustments for temperature and wind speed can significantly increase the variance of the data series. If the QC results appear noisier than the raw data, it will be due to the dynamic adjustments. Use of the dynamic adjustments is the prerogative of the user, and can be deactivated in the configuration. Note that the tendency of the series, used in the adjustment, is calculated from a smoothed version of the data. The dynamic correction smoothing wavelength is used for the smoothing value during the dynamic adjustment procedure. If a very small smoothing wavelength is specified, the variance increase in the QC data can become significant.

Configuration Parameters

Aspen is very flexible and can produce a large variety of output products. It will analyze data from a number of different sounding systems. In order to tailor it for differing applications, Aspen provides a configuration system. This same system is used to configure Aspen, BatchAspen and Aspen-QC, and the configuration information is shared between each of these programs.

Configuration Items: At the heart of the configuration system is the configuration item, which matches a keyword with a current value, and a default value. The keyword identifies a particular characteristic to be used during the next Aspen analysis; e.g. the smoothing wavelength to be applied the pressure field, or the mass of the dropsonde.

Configuration sets: A collection of all configuration items is collected in a configuration set. Configuration sets are assigned names, and a named set is chosen as the currently active one, to be used the next time that Aspen is run. In this way, users can create configuration sets that are tailored to a particular instrument, environment, or field program, and switch between them as needed.

The Active Set: At any time, one of the named configuration sets is designated as the active set. This means that any further processing with Aspen or BatchAspen will use the configuration items from the active set.

It is critical that the user verify that the correct set has been designated as active when processing soundings.

A user interface is provided within Aspen and BatchAspen for manipulating the Aspen configuration. This is divided into two activities. The first is the management of the configuration sets: creating, deleting and activating a set. The second is modification of the configuration items within a selected set.

Note that within Aspen, the management of the configuration sets can only be initiated from the File menu, when no soundings are currently open. Configuration items for any named set may be modified at this time also. However, configuration items for the currently active set may also be modified when soundings are open within Aspen.

aspen.xml: The configuration information is stored in XML format, in a file named `aspen.xml`. A “Document Type Definition file”, `aspen.dtd`, accompanies `aspen.xml`, and must be located in the same directory.

The location of these files depends upon the operating system as well as the `ASPENCONFIG` environment variable. When Aspen first runs, it checks to see if `ASPENCONFIG` is set. If it is, Aspen then checks for the existence of the configuration files in that directory. If the files are not found, Aspen offers to copy default configuration files to that directory.

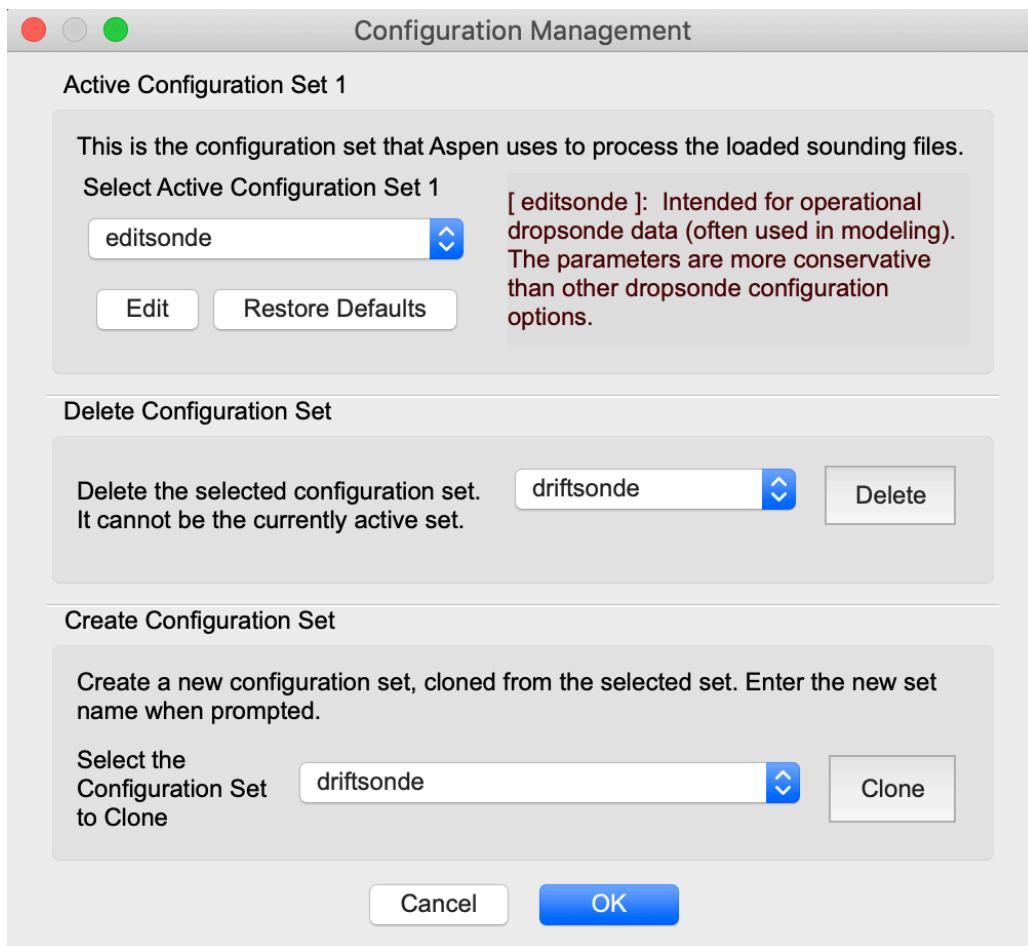
If `ASPENCONFIG` is not set, Aspen will assume directories for the configuration files, according to the following:

- Linux and OSX: `username/.config/aspen`
- Windows: `username\Application Data\Aspen`

This scheme allows individual users to maintain their own versions of configuration files. It also allows users to retain their custom config sets when upgrading to a new version of Aspen.

Configuration Set Management

Management of the configuration sets is available through the `File > Configure...` menu within Aspen and BatchAspen. Choosing this item will cause a configuration set management dialog to open, from which configuration sets may be activated, deleted, created and edited:



The selection drop down box at the top of the dialog is used to select the named configuration set that all other operations will reference. The selected set can be activated, deleted, or edited using other buttons in the dialog. To create a new configuration set, select an existing set to be used a source set, enter a name in the box, and press the Create button. When all configuration editing actions are finished, use the OK button to save them, or the Cancel button to discard the changes.

The individual configuration items for the selected configuration set can be edited by pressing the Edit button. This will bring up a dialog from which the quality control parameters and other options can be modified. See the “Changing the QC Parameters” section (below) for details on modifying the configuration items from this dialog. Pressing the Restore Defaults button will restore the entire set of configuration items for the selected set, restoring them to their default values.

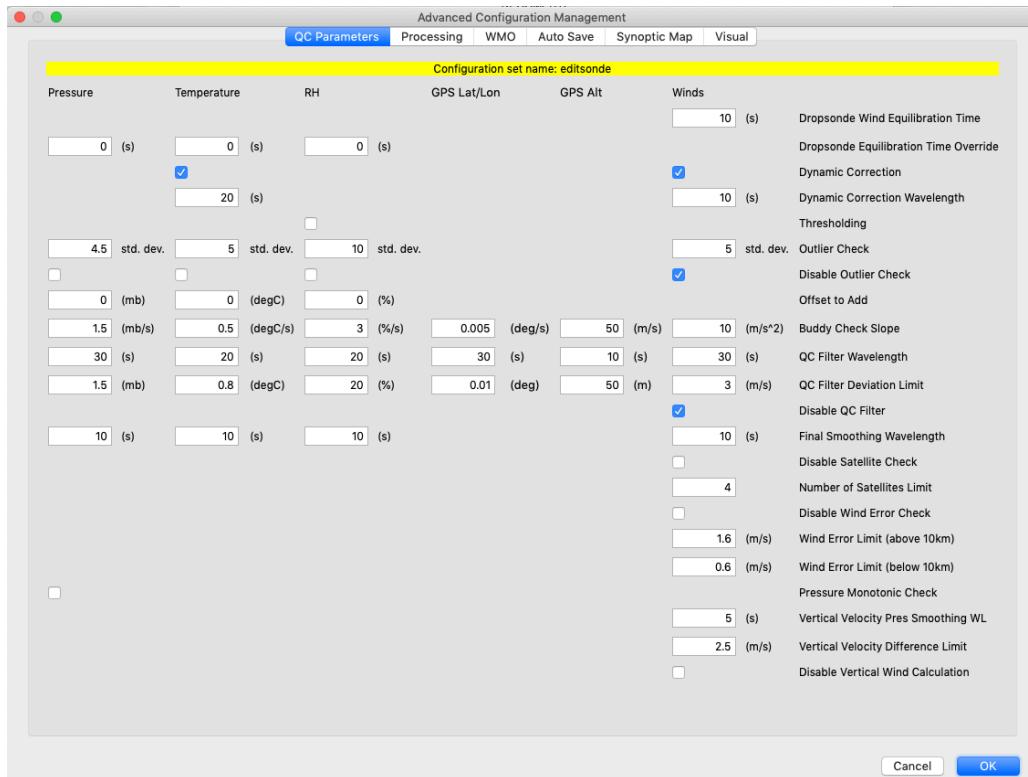
The Sample Configuration Set: There is a special configuration set, named sample, provided with Aspen. This set cannot be activated, deleted or edited. It is available as a default set that can be used as the source when creating a new configuration set.

Remember that within Aspen, the configuration editor is only available (from the File > Configure... menu) when no soundings are open. When soundings are open in Aspen, the options for the currently active configuration set can be edited from the Tools > Options menu.

Changing configuration set values

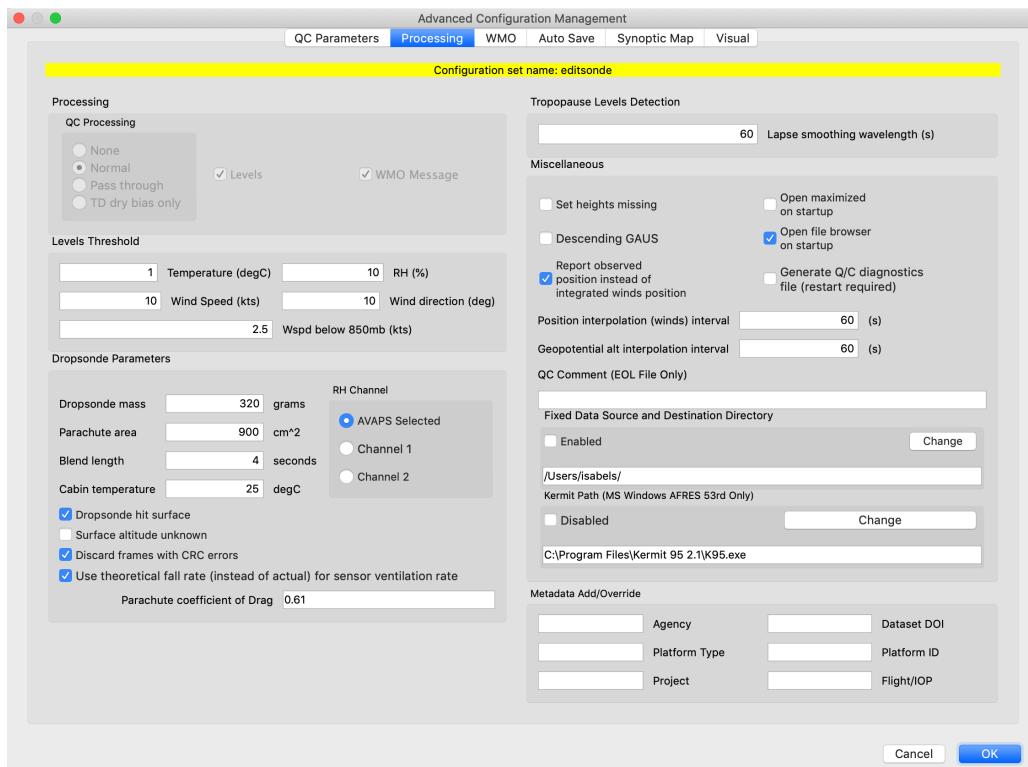
In order to configure Aspen to match your particular requirements, the configuration items (i.e. parameters) within a configuration set must be properly specified. This can be initiated from either the configuration management menu (File > Configure... > Edit Options) when no files are open, or from the options menu (Tools > Options...) when a sounding is open. A tabbed property sheet will open, with six different views.

QC Parameters



The quality control parameters are used to adjust the various quality control algorithms, and are described in the [Quality Control Procedures section \(page 27\)](#).

Processing



QC processing mode: This controls which, if any, quality control Aspen will perform on each sounding that is loaded.

- None: No quality control is done, and no data products are generated. Aspen can be used to view the raw data in XY Graph or Skew-T formats.
- Normal: The default value. Aspen performs all quality control algorithms.
- Pass through: Quality control is not performed, but data products (levels, WMO TEMP and BUFR files) can be created. This mode can be used to treat Aspen as a format conversion tool for sounding data that has already been quality controlled.
- TD dry bias only: Aspen performs no quality control except for applying the temperature-dependent dry bias correction.

Levels and WMO Message: Controls whether Aspen generates levels or WMO data products for each sounding that is loaded. These two features should always be enabled if WMO messages are the ultimate data product (e.g. weather reconnaissance). For other uses, these features may be turned off.

Levels Threshold: These five parameters set the thresholds used in the determination of the GDL levels for the designated measurement. They should be modified with caution, since this would result in a deviation from the specifications of the FMH-3.

Dropsonde mass, parachute area and coefficient of drag: The dropsonde mass, parachute area and coefficient of drag are required in order to estimate the initial fall speed of the dropsonde, after launch from the aircraft. The values differ only from the defaults in special cases where a custom parachute or modified sonde are deployed.

Blend length: This specifies the blend interval and filter wavelength for the blending of higher frequency smoothing of pressure and winds at the bottom of a dropsonde sounding. This applies only to dropsonde soundings.

Cabin temperature: When a sonde is launched from within an aircraft or gondola, the temperature sensor will be close to the temperature within the cabin or gondola. The difference between the cabin and the external ambient temperature is used to calculate the number of temperature sensor time constants required for the sensor to reach ambient conditions. This parameter provides the value used for the cabin temperature.

RH Channel: The AVAPS/Dropsonde RSS80 and RSS94 systems use a sonde that carries dual relative humidity sensors. The firmware in the sonde chooses the humidity value from one of them, and the selected channel is reported in the main RH field of the “D” file. The original values for both sensors are reported in additional columns in the file. The user can elect to use the sonde chosen value (AVAPS selected), or either of the original sensor values (RH1 or RH2).

Dropsonde hit surface: This box is checked if the dropsonde was believed to have hit the surface (the default case). This causes the sounding altitudes to be integrated from the surface altitude upwards; otherwise they will be integrated from the flight level altitude (if available) downward. If checked it also allows the computation of an extrapolated surface data point. Uncheck this box if it is believed the dropsonde did not hit surface (i.e. stopped transmitting early) to use the downward integration for heights and to avoid coding surface levels in WMO messages. This parameter can also be changed from the Main tab.

Surface altitude unknown: Check this box if the dropsonde was believed to have hit the surface, but the surface altitude is unknown, as in a dropsonde landing on the earth. It causes the height integration to be performed from flight level down, but will still calculate surface levels in WMO messages. This parameter can also be changed from the Main tab.

Discard frames with CRC errors: If this box is checked, data frames that are marked as having a CRC error are discarded. This only applies to AVAPS dropsonde soundings.

Use theoretical fall rate for sensor ventilation rate: The sonde fall rate is used in some time constant calculations. Using the observed fall rate of the sonde may include noise or atmospheric abnormalities (e.g. updrafts) that can interfere with these calculations. If this box is checked Aspen will use the calculated theoretical fall rate for these calculations.

Tropopause Levels Detection: The lapse rate smoothing wavelength is the wavelength of the smoother that will be applied to the temperature data before the automatic determination of tropopause levels is made. A tropopause is identified by the derivative of the temperature lapse rate, and so a high variance in temperature can lead to the creation of unrealistic tropopause levels.

Set heights missing: Check this box to cause the height computations to be skipped, in cases where the operator does not trust the data to provide for accurate height integration.

Descending GAUS: Check this box if using descending data collected by a radiosonde using the GAUS system.

Report observed position instead of integrated winds position: By default the winds are integrated from the launch point in order to determine position. Select this option in order to use the GPS observed position (GPS sondes only).

Open maximized on startup: If this box is checked, Aspen will open a window as large as the available display.

Open file browser on startup: If this box is checked, a file browser dialog will open as soon as Aspen is started. Otherwise, the File menu can be accessed in order to select a file to process.

Generate Q/C diagnostics file: Select this to cause a file with Q/C diagnostic information to be created. The file name will begin with 'AspenDebug' and have a .txt extension. It will be created either in the directory where the Aspen program is installed, or the directory where the first data file is located. Be sure to disable this option when finished, otherwise diagnostic files will be created every time Aspen is run. After selecting this option, Aspen must be restarted to begin generating diagnostic files.

Position interpolation interval: Set the maximum time interval over which the winds can be interpolated for the position integration calculation. If the gap in winds is greater than this interval, the winds will not be interpolated and the position integration will stop.

Geopotential alt interpolation interval: Set the maximum time interval over which the geopotential altitude can be interpolated. If the gap in pressure data is greater than this interval, the geopotential altitude will stop at the gap.

QC Comment: Text entered here will be appended to the file metadata in EOL format output.

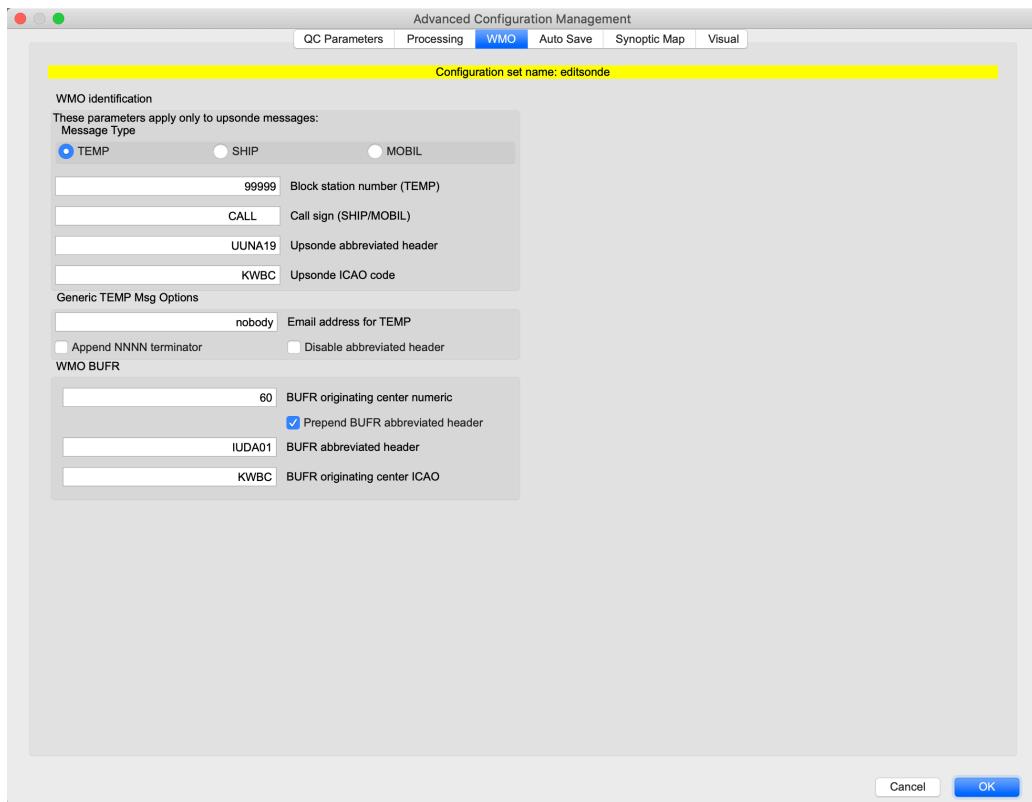
Fixed Data Source and Destination Directory: This will set the save locations for all Aspen outputs to the specified directory, as well as automatically opening the file chooser to that directory.

Kermit Path: Path to Kermit file transfer program. Only used by AFRES 53rd aircraft.

Metadata add or override: Some sounding systems and file formats include metadata that can give additional information about the context of the sounding. If information is not present or not correct in an input file, it can be overridden using these boxes:

- **Agency:** Organization performing the sounding (e.g. NOAA, AF, NCAR)
- **DOI:** The Digital Object Identifier (DOI) that identifies the project or dataset this sounding is part of
- **Platform type:** Type of aircraft or sounding system used (e.g. G-IV, NCAR GAUS)
- **Platform ID:** Identifier of platform (e.g. tail number of aircraft)
- **Project:** Name of project or mission sounding is a part of
- **Flight/IOP:** Name of subset of project or mission

WMO



These parameters contain the information needed to send WMO messages to operational centers for real-time model ingest.

WMO Message Type: Choose the type of TEMP message to be generated for an upsonde sounding.

Block Station Number and Call Sign: These are identifiers that are required either for the TEMP, TEMPSHIP, or TEMPMOBIL messages.

Upsonde Abbreviated Header: The WMO abbreviated header for upsonde WMO messages. (Note that dropsonde abbreviated headers are specified on the Comm tab).

Upsonde ICAO Code: ICAO code for upsonde abbreviated headers. (Note that dropsonde ICAO codes are specified on the Comm tab).

Email address for TEMP: Address to receive an emailed WMO message.

Append NNNN Terminator: If checked, append NNNN to the WMO message when it is saved or emailed. Some communications systems, such as the GTS, require this terminator.

Disable Abbreviated Header: If checked, the abbreviated header will not be generated for the TEMP message. This is useful in the common situation where another system generates the abbreviated header.

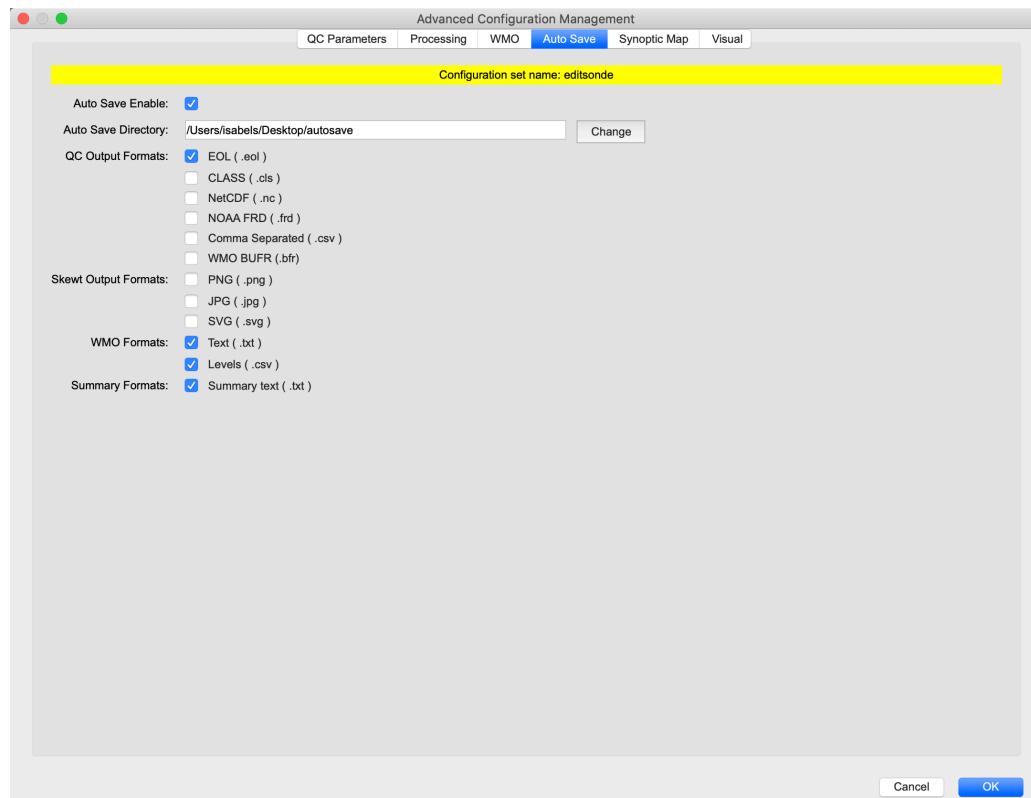
BUFR originating center numeric: WMO identifier of source of BUFR data.

Prepend BUFR abbreviated header: Add abbreviated header to the beginning of the BUFR message.

BUFR abbreviated header: Controls the contents of the header prepended to the BUFR message.

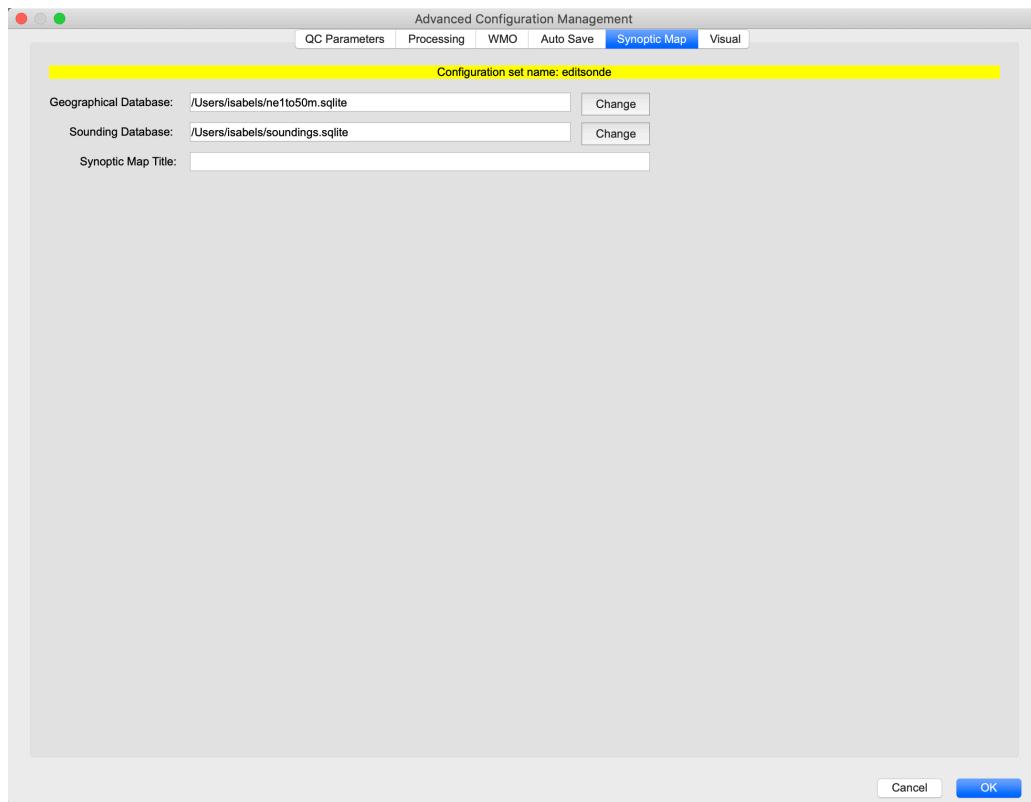
BUFR originating center ICAO: WMO identifier of source of BUFR data.

Auto Save



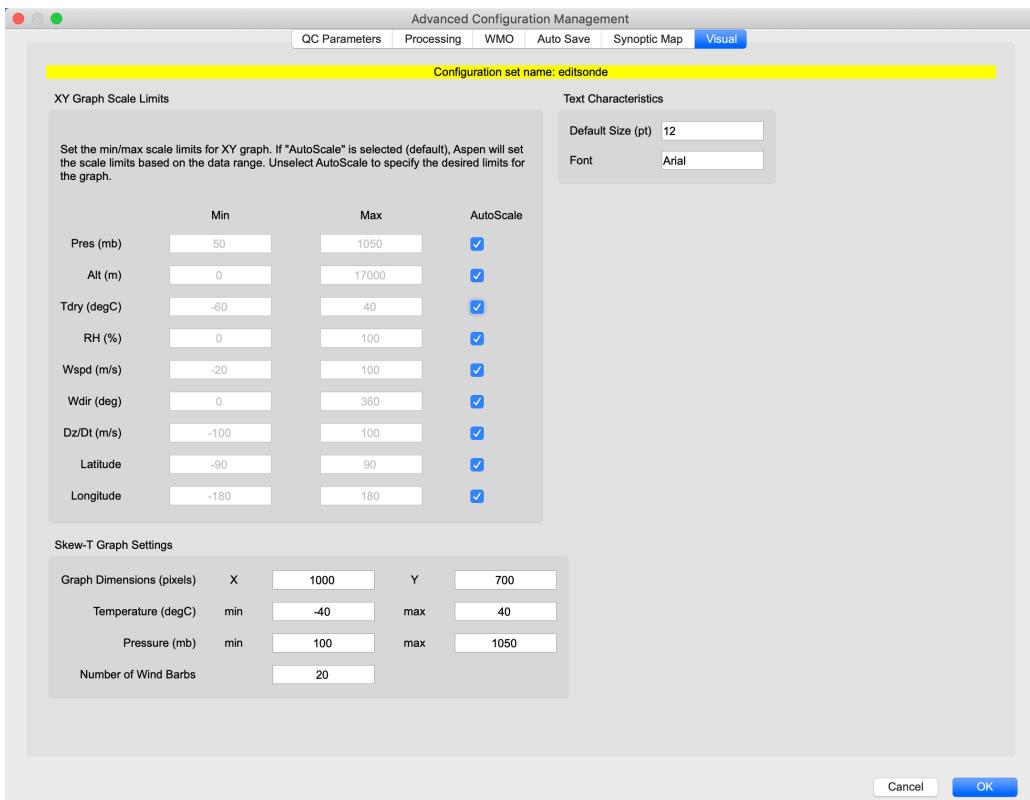
Aspen can be configured to automatically save output products for each file opened. This tab lets users enable auto save, select the directory to save output to, and select which output products should be automatically saved.

Synoptic Map



The paths to the geographic map background database and the soundings database are specified here, as well as the optional title of the synoptic map. See the [Synoptic Map section \(page 61\)](#) for more details.

Visual



XY Graph settings: The minimum and maximum values for each variable that can be displayed in the XY graph can be set here, or can be set to scale automatically based on the minimum and maximum values of the data series that is currently being plotted.

Skew-T Graph settings: The size of the image produced by saving the skew-T graph, as well as limits for temperature and pressure to display on the graph, can be set here.

Text settings: The font and size of the text in Aspen displays can be set here.

Saving Changes and Restoring Defaults

When the user closes a sounding in which the QC parameters have been changed, a dialog box asks if these parameters should be saved as the processing defaults. If the parameters are saved, all soundings opened after this time will be processed using these options. The Tools menu provides a command,

Tools > Restore Defaults, which can be used to restore the options to initial system defaults. Thus the customized parameters will revert to the initial installation defaults.

The user may also revert the QC parameters to the initial installation defaults before opening any soundings. This is done via the File > Configuration... > Restore Defaults button (available only when no soundings have been opened).

When in doubt about the proper values of the QC parameters, restore the defaults.

Corrupted Configurations

As described above, the configuration information is stored in the `aspen.xml` file. If the configuration file becomes corrupted, Aspen will not be able to run, and the file will need to be repaired or restored. The file `AspenOriginal.xml` is provided as a copy of the originally distributed configuration file, and is located in the Aspen installation directory. In the worst case, this file can simply be copied over `aspen.xml` (note that the file name case is significant). This will restore Aspen to the default configuration parameters, but all changes or additions that have been made to the configuration will be lost.

If the `aspen.xml` file is only slightly corrupted, it may be possible to correct the error with a text editor. A simple way to locate a syntax error is to open `aspen.xml` in an internet browser, which provides structured viewing of XML files. The browser will indicate lines that do not parse correctly, and then a standard text editor may be used to fix minor problems.

Configuration Parameters

The Aspen configuration is stored in XML format. There are two files: `aspen.xml` and `aspen.dtd`. `aspen.xml` contains the actual configuration values, while `aspen.dtd` defines the syntax of the `aspen.xml` file.

XML elements are delineated by start and end tags, and are nested to create a hierarchical data structure. `aspen.xml` observes the following structure:

```
<aspenConfig>
<active>dropsonde</active>
<set name="sample">
    <option name="ReportObservedPos" type="bool">
        <current>false</current>
        <default>false</default>
    </option>
    .
    .
    .
    <option immediate="true" name="CallSign" type="string">
        <current>CALL</current>
        <default>CALL</default>
    </option>
    <option immediate="true" name="IcaoIndex" type="numeric">
        <current>1.00000</current>
        <default>1</default>
    </option>
</set>
<set name="dropsonde">
    .
    .
    .
</set>
</aspenConfig>
```

Thus, the Aspen configuration contains one entry (`<active>`), designating which named configuration set is active, followed by one or more named configuration sets (`<set>`). Each configuration set contains a list of configuration options (`<option>`), with the current and default values for each option. Each option has a designated type:

- `bool` – boolean, with a value of either true or false.
- `numeric` – A floating point numeric value.
- `string` – A text string.

An option may also be marked with `immediate=true` to effect an immediate save of the option when it is changed. It is useful for some options to be saved immediately after they are changed, before closing the sounding in Aspen, so that when the next sounding is analyzed, it will immediately use the new version of the option. For instance, if the dropsonde operator on the Hurricane Hunter aircraft opens a sounding, and then changes the ICAO value for the TEMP message, it is likely that all soundings opened during the same run of Aspen should use this value for the ICAO string. An immediate save allows the configuration to be updated, without having to close that sounding.

The case of the configuration item name is critical. It must be matched exactly as shown.

QC algorithm parameters

<code>WindSmoothWL</code>	<code>int</code>
<code>WindQCWL</code>	<code>int</code>
<code>WindDynCor</code>	<code>bool</code>
<code>WindDynCorWL</code>	<code>int</code>
<code>WindBuddySlope</code>	<code>double</code>
<code>WindQCDev</code>	<code>double</code>
<code>WindDisableQCFilter</code>	<code>bool</code>
<code>WindOutlier</code>	<code>double</code>
<code>WindDisableOutlierCheck</code>	<code>bool</code>
<code>WindSats</code>	<code>int</code>
<code>WindDisableSatsCheck</code>	<code>bool</code>
<code>WindErrorHigh</code>	<code>double</code>

WindErrorLow	double
WindDisableErrorCheck	bool
WindVVdelta	double
WindVVPresWL	int
BlendLength	int
WindEquilTime	double
WindDisableW	bool
PressSmoothWL	int
PresQCWL	int
PresBuddySlope	double
PresQCDev	double
PresOutlier	double
PresDisableOutlierCheck	bool
PresOffset	double
PresMonoCheck	bool
TdryQCWL	int
TdryDynCor	bool
TdryDynCorWL	int
TdryQCDev	double
TdryOutlier	double
TdryDisableOutlierCheck	bool
TdryOffset	double
TdryBuddySlope	double

TdrySmoothWL	int
RHSmoothWL	int
RHQCWL	int
RHBuddySlope	double
RHQCDev	double
RHOutlier	double
RHDisableOutlierCheck	bool
RHOffset	double
RHThreshold	bool
GPSPosBuddySlope	double
GPSPosQCWL	int
GPSPosQCDev	double
GPSAltBuddySlope	double
GPSAltQCWL	int
GPSAltQCDev	double

Processing parameters

DiscardBadCrcData	bool
ReportObservedPos	bool
DoQC	int
descendingGAUS	bool
ChuteArea	double
UseTheoryVentRate	bool

DragCoef	double
DropSondeMass	double
CabinTemp	double
PosInterpSpan	double
AltInterpSpan	double
RHchoice	int
QCDisclaimer	string

Sonde metadata parameters

Agency	string
AircraftType	string
AircraftId	string
Project	string
Flight	string
DatasetDOI	string

Levels generation parameters

DoLevels	bool
TdryLevelDelta	double
RHLevelDelta	double
WspdLevelDelta	double
Wspd850LevelDelta	double
WdirLevelDelta	double

TropSmoothWL	double
--------------	--------

WMO message generation parameters

DoWMO	bool
CallSign	string
BSN	string
TempMsgType	int
TempAppendNNNN	bool
ExcludeAbrHdr	bool
UpsondeAbrHdr	string
UpsondeICAO	string
TempEmailAddress	string
BufrOrigCenter	int
BufrAddAbrHdr	bool
BufrAbrHdr	string
BufrOrigCenterICAO	string
ACagency	string
MissionStorm	string
MissionId	string
IcaoIndex	int
AbrHdrOvr	string
AtcfId	string
OptIcao	string

ResampleBufr	bool
--------------	------

WMO message sending parameters

DisableKermit	bool
KermitPath	string
BaudRateIndex	int
CommPortIndex	int

User setup parameters

DataDir	string
WmoSaveDir	string
QCSaveDir	string
RawSaveDir	string
XYPlotSaveDir	string
SkewTPlotSaveDir	string
FixedSrcEnabled	bool
FixedSrcDir	string
QcDiagFile	bool
GeoDBPath	string
SoundingDBPath	string
SynopticMapTitle	string
OpenFileSelFilter	string
AutoFile	bool

OpenMaximized	bool
---------------	------

Visual parameters

PlotPixelsX	int
PlotPixelsY	int
NumberSkewTWinds	int
SkewTtmin	double
SkewTtmax	double
SkewTpmin	double
SkewTpmax	double
TextSizePt	int
FontFamily	string
xyGraphPresAuto	bool
xyGraphPresMin	double
xyGraphPresMax	double
xyGraphAltAuto	bool
xyGraphAltMin	double
xyGraphAltMax	double
xyGraphTdryAuto	bool
xyGraphTdryMin	double
xyGraphTdryMax	double
xyGraphRHAuto	bool
xyGraphRHMin	double

xyGraphRHMax	double
xyGraphWspdAuto	bool
xyGraphWspdMin	double
xyGraphWspdMax	double
xyGraphWdirAuto	bool
xyGraphWdirMin	double
xyGraphWdirMax	double
xyGraphDzDtAuto	bool
xyGraphDzDtMin	double
xyGraphDzDtMax	double
xyGraphLatAuto	bool
xyGraphLatMin	double
xyGraphLatMax	double
xyGraphLonAuto	bool
xyGraphLonMin	double
xyGraphLonMax	double

Autosave parameters

QCAutoSaveEnable	bool
QCAutoSaveDir	string
QCAutoSaveFmtEol	bool
QCAutoSaveFmtFrd	bool
QCAutoSaveFmtCls	bool

QCAutoSaveFmtNc	bool
QCAutoSaveFmtCsv	bool
QCAutoSaveFmtBufr	bool
SkewtAutoSaveFmtPng	bool
SkewtAutoSaveFmtJpg	bool
SkewtAutoSaveFmtSvg	bool
WmoAutoSaveFmtTxt	bool
WmoAutoSaveFmtCsv	bool
SumAutoSaveFmtTxt	bool

BatchAspen parameters

BatchSaveDir	string
BatchSaveRawCLS	bool
BatchSaveQCCLS	bool
BatchSaveRawEOL	bool
BatchSaveQCEOL	bool
BatchSaveQCFRD	bool
BatchSaveQCBUFR	bool
BatchSaveRawCDF	bool
BatchSaveQCCDF	bool
BatchSaveRawCSV	bool
BatchSaveQCCSV	bool
BatchSaveWMO	bool

BatchSaveSkewTSvg	bool
BatchSaveSkewTPng	bool
BatchSaveLevels	bool

Per-sounding parameters

Some processing adjustments make sense to apply to a single sonde, but not to set as the default for processing all sondes. Examples of this include overriding end-of-drop time or indicating that the sonde did not hit surface. These items are by default not saved in the `aspen.xml` configuration file, but are part of the configuration set while Aspen is running. These parameters can be changed in Aspen via the Main tab or the Tools menu, and can be modified as command line arguments to `Aspen-QC`.

SetHtsMissing	bool
DropsondeHitSfc	bool
SfcAltUnknown	bool
SfcAltOverride	double
SfcPresOverride	double
LastDataTimeOverride	double
PresEquilTimeOverride	double
RHEquilTimeOverride	double
TdryEquilTimeOverride	double
IgnoreLaunchAlt	bool
IgnoreLaunchLat	bool
IgnoreLaunchLon	bool
IgnoreLaunchPres	bool
IgnoreLaunchRH	bool

IgnoreLaunchTdry	bool
IgnoreLaunchWdir	bool
IgnoreLaunchWspd	bool
LaunchAltOverride	double
LaunchPresOverride	double
LaunchTdryOverride	double
LaunchRHOverride	double
LaunchWdirOverride	double
LaunchWspdOverride	double
LaunchLatOverride	double
LaunchLonOverride	double
ObsNum	int

Synoptic Map

The Synoptic Map provides a plan view of station models for soundings, at selected levels. These are overlaid on a geographic basemap.

If Aspen has been reinstalled you may be prompted to configure the geographic database location. See [Configuration. \(page 61\)](#)

Databases and Configuration

Sounding Database

Every time Aspen processes a sounding, Q/C data are written to the *sounding* database. The Synoptic Map uses this as a data source for plotting the map, and the individual soundings are identified in the database by the source data file name. The database is created the first time that you run Aspen.

This is a simple SQLite3 database, which is a single file. You can maintain separate databases as needed, simply by selecting a different file name and/or location. You can even use the SQLite3 database for your own applications, if desired.

Soundings may be removed from the database using the Synoptic Map sounding browser. If a sounding is processed multiple times in Aspen, the most recent data replaces existing values in the database.

Geographical Database

The shape data for the geographical base map is also stored in an SQLite3 database. This *geographical* database is distributed with Aspen. Because it is difficult for a program to easily determine its install location on multiple operating systems, you must configure Aspen to locate this database.

Configuration

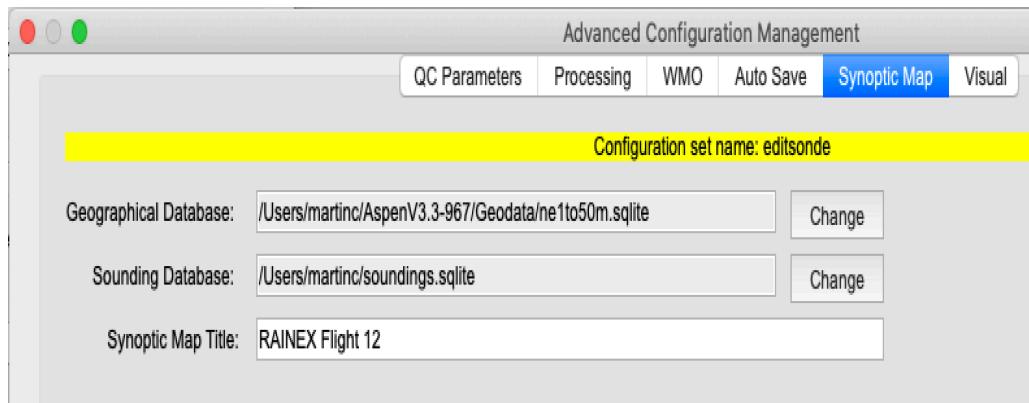
You will be prompted to enter the database locations when the Synoptic Map is opened for the first time. The default location can be used for the *sounding* database.

The explicit location of the *geographical* database must be provided. This will be a .sqlite file in the Geodata directory below where Aspen is installed, e.g.:

username/AspenV3.4.1/Geodata/ne1to50m.sqlite

The Aspen installation location may vary, but it is typically in the user's home directory.

The database file locations can also be changed from the Synoptic Map tab of the standard Aspen configuration screen:

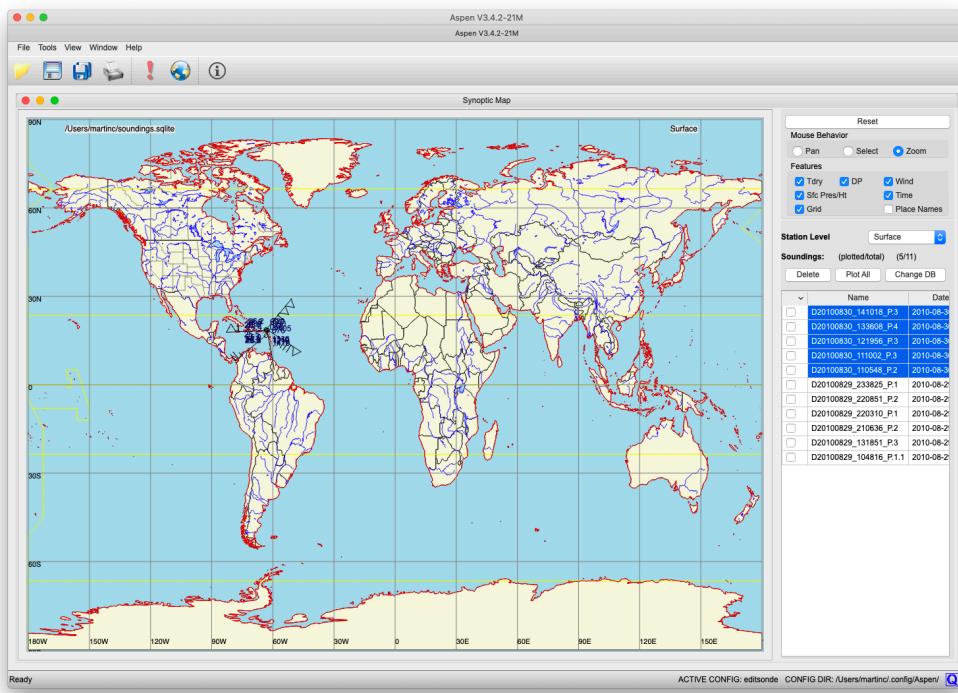


Usage

Open the Synoptic Map from the *Tools* menu, or by clicking the World button:

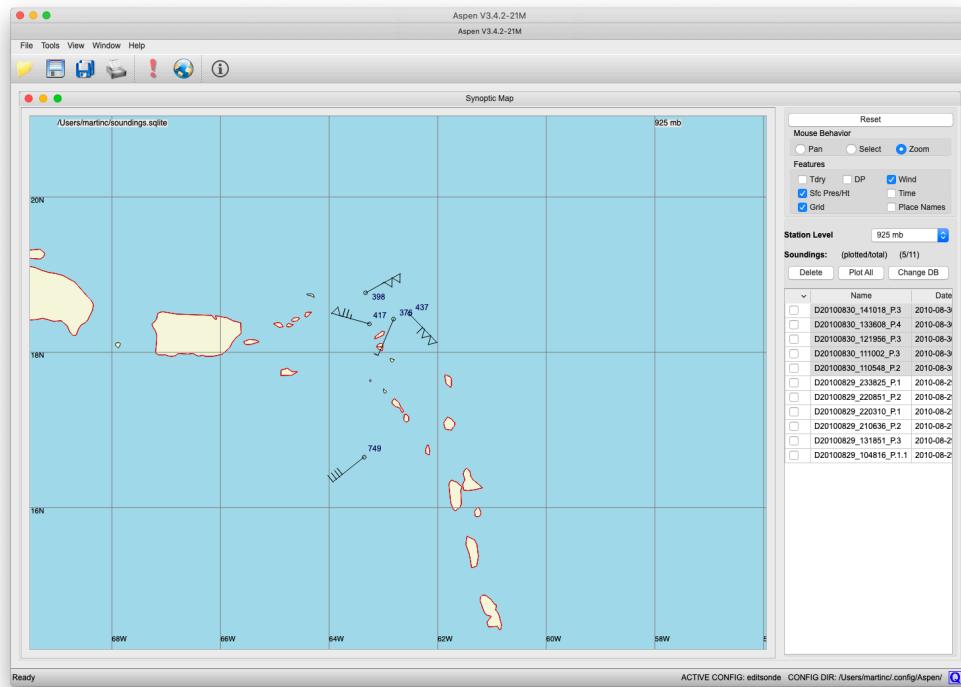


A new window will open, displaying a world map. A control panel and database browser are shown on the right side. Select soundings in the database browser to display them on the map.

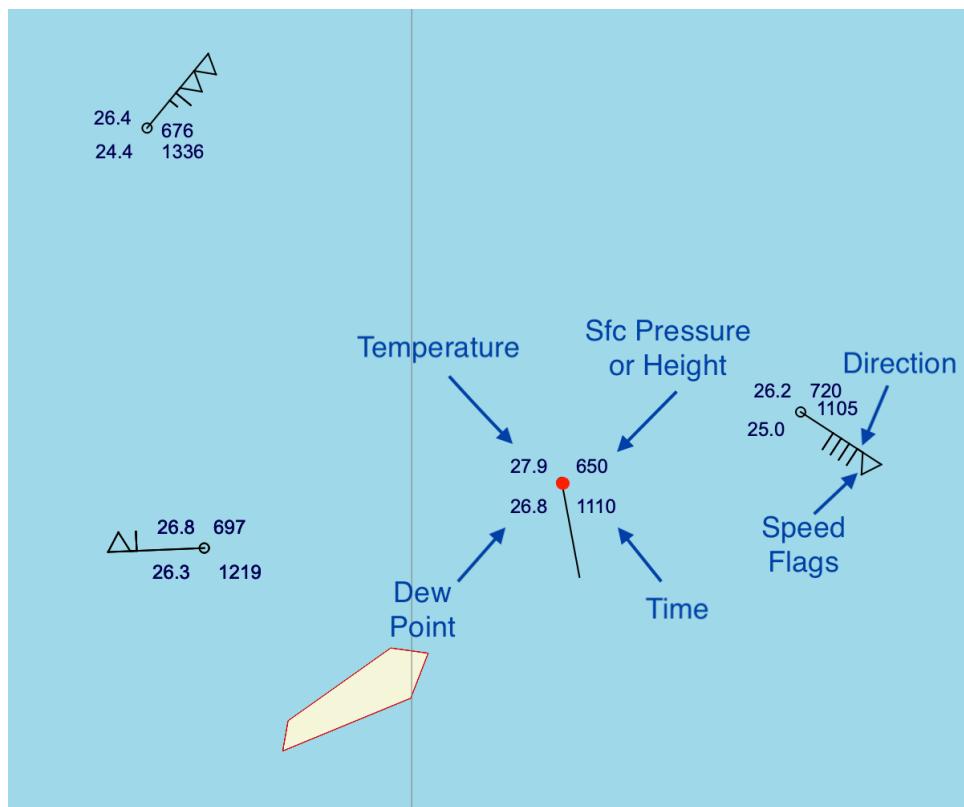


Map Navigation

- Left-click and drag to zoom into a region.
- Right-click to revert one zoom step.
- Use the radio-buttons at the top of the control panel to select the map mouse behavior. You can also just double click on the map to cycle through these options.
- Use the Station Level drop-down to select which sounding level to display. Standard pressure levels and a few diagnosed levels are available.



Station Model



Each observation for the selected level is depicted by a standard meteorological *station model*. If there is no data for the sounding at that particular level, a single small circle is displayed.

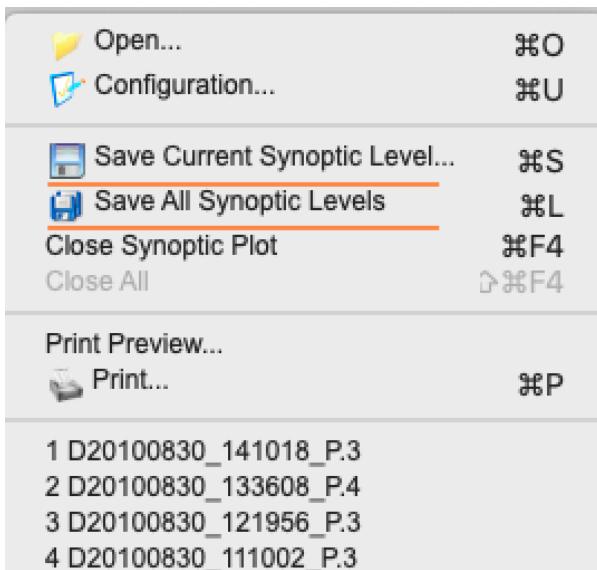
The station model elements are selected on the control panel. They are:

- Temperature (degrees C).
- Dew point temperature (degrees C).
- Pressure if at the surface (10^{\star}mb); altitude if above the surface (msl).
- Time of the sounding (UTC).
- Wind direction (the barb points into the wind).
- Wind speed, determined by summing the flags:
 - half line segment: 5 kts.
 - full line segment: 10 kts.
 - triangle: 50 kts.

When you hover over the center of the station model, the circle will turn red and identifying information will pop up. Click right to select reprocessing of the sounding, or to remove it from the map.

Saving Images

Map images may be saved when the Synoptic Map window is open. Select the desired save option from the main Aspen File menu:



Saving the current synoptic level will generate one image. Saving all synoptic levels will generate a set of images, one for each station level available.

Control Panel

The control panel has display options at the top, and a sounding browser on the bottom. Note that different sounding information may be displayed by scrolling the browser window left/right. Mouse behavior, station model features, and displayed levels are selected from the options.

The station model is generally too busy when all parameters are selected for display. De-clutter the display unchecking the ones that you don't really need.

- Displaying a sounding: Click on the sounding name to (de)select it.
- Deleting a sounding: Use the check boxes and the Delete button to permanently remove a sounding from the database. It can be added back to the database by reprocessing the sounding file with Aspen.
- Changing the database: Use the Change DB button.

Reset

Mouse Behavior

Pan Select Zoom

Features

Tdry DP Wind
 Sfc Pres/Ht Time
 Grid Place Names

Station Level Surface

Soundings: (plotted/total) (0/11)

	Name	Date
<input type="checkbox"/>	D20100830_141018_P.3	2010-08-30
<input type="checkbox"/>	D20100830_133608_P.4	2010-08-30
<input type="checkbox"/>	D20100830_121956_P.3	2010-08-30
<input type="checkbox"/>	D20100830_111002_P.3	2010-08-30
<input type="checkbox"/>	D20100830_110548_P.2	2010-08-30
<input type="checkbox"/>	D20100829_233825_P.1	2010-08-29
<input type="checkbox"/>	D20100829_220851_P.2	2010-08-29
<input type="checkbox"/>	D20100829_220310_P.1	2010-08-29
<input type="checkbox"/>	D20100829_210636_P.2	2010-08-29
<input type="checkbox"/>	D20100829_131851_P.3	2010-08-29
<input type="checkbox"/>	D20100829_104816_P.1.1	2010-08-29

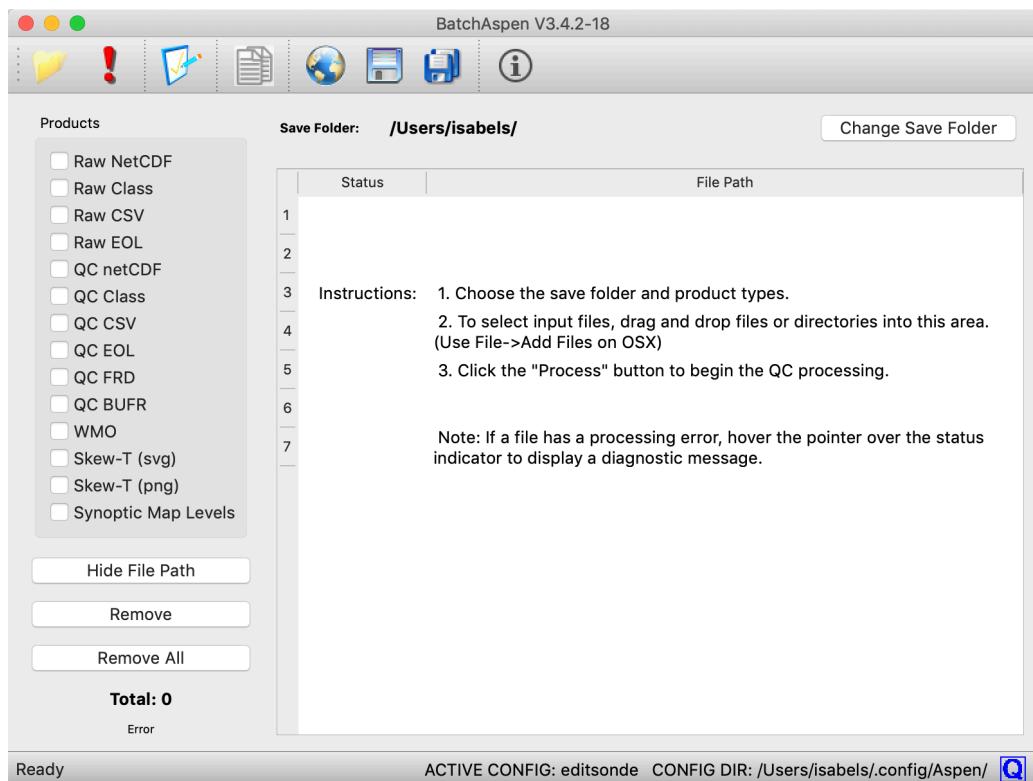
BatchAspen

BatchAspen is a separate application that is used to apply the Aspen Q/C procedures to a collection of multiple sounding files. The user selects the data products to be created. The program then iterates over the list of files, placing the results in a specified destination directory.

BatchAspen shares an exact copy of the QC processing algorithms that are used by Aspen, so that identical results for both programs can be guaranteed. The exception to this is when modifications are made by the user during standard Aspen processing.

Starting BatchAspen and Selecting Files

Start the application by clicking on the BatchAspen icon or selecting BatchAspen from the start menu. A single screen will be presented.



To add files for processing, drag and drop the files into the processing list on the right side of the window, or use the Open button in the toolbar or File > Open to select one or more files for processing. Files may be removed from the processing list by selecting them in the processing list, and pressing the “Remove” button, or press “Remove All” in order to empty the list completely.

Files from multiple directories can be collected in a single processing list. However, all output files will be created in a single directory.

To select the output directory, press the “Change Save Folder” button at the top right, then choose the desired output directory from the directory chooser.

Q/C Processing

The desired output products are chosen using the checkboxes in the bar on the left side of the BatchAspen window. An output file of each selected type will be created for each input file.

To begin the processing, press the “Process” (!) button or select File > Process. BatchAspen will begin processing each file, starting at the beginning of the list. A status indicator appears next to each file. The status indicator is gray before a file is processed, yellow while a file is being processed, green if a file has been processed successfully, and orange if it had processing errors.

When processing is underway, the “Process” button changes to a “Stop” button, which can stop processing before the end of the list has been reached.

Q/C Parameters

BatchAspen uses the same configuration scheme as Aspen, which is documented fully in the [Configuration section \(page 36\)](#). As with Aspen, activating the File->Configure... menu item will display the configuration management interface.

The configuration set that is designated as active is used by both Aspen and BatchAspen.

Commandline Aspen

Aspen-QC is a version of Aspen that performs the Q/C and message coding functions, but does not provide a graphical user interface. Therefore, it can be run from shell scripts or the command line, to process a sounding data file in a standalone mode. The same Q/C and coding algorithms used in Aspen are incorporated into Aspen-QC .

The Aspen-QC executable is provided in the Aspen distribution for all operating systems.

On Mac OSX, an additional script, `run_aspenqc`, is provided. This script sets up the appropriate library paths, then runs Aspen-QC . Supply command line arguments to this script the same way as you would to Aspen-QC directly.

Aspen-QC uses the same XML configuration file as Aspen (`aspen.xml` and `aspen.dtd`), located in the user's config directory. If the configuration directory is not set up, then it will search the current working directory for these files. If the files are not found, then a built-in configuration will be used. It is not recommended to use the built-in configuration.

Be sure to examine `aspen.xml` to verify that the desired configuration set is specified as the current set. Alternatively, a good practice is to always specify the desired configuration set via the command line switch.

Switches

Command line switches control the processing and output products from AspenQC:

Options:

-i [--input] [=arg(=stdin)]	sounding data file
-l [--eol] [=arg(=stdout)]	create eol output
-f [--frd] [=arg(=stdout)]	create frd output
-e [--csv] [=arg(=stdout)]	create csv output
-c [--class] [=arg(=stdout)]	create class output
-w [--wmo] [=arg(=stdout)]	create wmo output
-n [--netcdf] [=arg(=stdout)]	create netcdf output
-g [--svg] [=arg(=stdout)]	create skewt svg output
-b [--bufr] [=arg(=stdout)]	create BUFR output
-d [--dims] arg	skewt dimensions pmin:pmax:tmax
in:tmax	
-q [--qc] [=arg(=none)]	Override QC mode: normal, pas
s, tddrybias	
-v [--verbose]	verbose enabled
-s [--config] arg	override active config set
-o [--options] arg	override config options opt
1=val:opt2=val:...	
-h [--help]	help

- **i** – the name of the input data file. The file type will be automatically determined, and can be any of the file types that Aspen can read. If this parameter is missing, the data are read from standard input.
- **l, f, e, c, w, n, g, b** – Generate an output file of the specified file type. The output specifiers can take an optional file name, to which the data will be written. If not provided, the output products will be written to standard output.
- **d** – Specify limits for the Skew-T SVG image, in the format pmin:pmax:tmin:tmax. The fields are pmin: minimum pressure (mb), pmax: maximum pressure(mb), tmin: minimum temperature (C), tmax: maximum temperature (C). Skew-T diagrams can produce odd results for arbitrary plotting limits, and some experimentation will be necessary to determine appropriate values for the limits.
- **q** - Override the QC mode. QC modes that can be specified are normal (all Aspen processing applied), tddrybias (only the temperature-dependent dry bias correction applied), or pass (passthrough mode, output products are generated but no quality control is applied to the data)
- **v** – Print (verbose) status messages as the processing proceeds.
- **s** – Specify a config set name to override the config set designated as active in the Aspen XML.

- o - Set the value for one or more config attributes. See the [Configuration Parameters \(page 49\)](#) section for a list of all configuration set attributes. (Boolean config item values must be given as 0 or 1, not ‘true’ or ‘false’.)
- h – Print out the usage statement.

An example of an AspenQC usage would be:

```
AspenQC -i classData.dat -e classData.csv -s editsonde -g skewt.svg
```

This ingests a CLASS file and creates skew-T and CSV output using the editsonde config set.

Input File Formats

Aspen can ingest sounding data that is provided in the following file formats.

Note that the file formats are not complete; i.e one format will contain information that another format does not support. Metadata in particular is not consistent between file formats.

Warning: Aspen automatically detects the format of the file that it opens, and assumes that the sounding contained is from the associated instrument. This can lead to ambiguities, if Aspen is used to process a file that it has written. For instance, if dropsonde data are saved by Aspen in “CLASS” format, and then this file is used as input to Aspen, the program will assume that the data are from an upsonde sounding, rather than a dropsonde. This can lead to erroneous results within Aspen, since the characteristics of the sounding system affect the processing procedures. In addition, care should be taken not to process data twice when using formats Aspen can both read and write.

NCAR AVAPS GPS Dropsonde “D” files

The AVAPS D file includes metadata in header and footer lines, with a variable number of data lines in between. Line contents are determined from an identifier at the beginning of the line: “S” lines for sounding data, “P” for pre-launch data, “A” for launch observation, and “COM” and other identifiers for metadata. Data lines are arranged in fixed width columns, with a standard set of data parameters reported. Header lines above the data lines give the column contents and units, and footer lines below the data lines give additional metadata about the sounding.

The data is reported in time order for both upsondes and dropsondes.

NCAR GAUS Upsonde files

The GAUS file includes metadata in header and footer lines, with a variable number of data lines in between. Line contents are determined from an identifier at the beginning of the line: “S” lines for sounding data, “P” for pre-launch data, “A” for launch observation, and “COM” and other identifiers for metadata. Data lines are arranged in fixed width columns, with a standard set of data parameters reported. Header lines above the data lines give the column contents and units, and footer lines below the data lines give additional metadata about the sounding.

The data is reported in time order for both upsondes and dropsondes.

NCAR MCASS Upsonde files

The MCASS file includes metadata in header and footer lines, with a variable number of data lines in between. Line contents are determined from an identifier at the beginning of the line: “S” lines for sounding data, “P” for pre-launch data, “A” for launch observation, and “COM” and other identifiers for metadata. Data lines are arranged in fixed width columns, with a standard set of data parameters reported. Header lines above the data lines give the column contents and units, and footer lines below the data lines give additional metadata about the sounding.

The data is reported in time order for both upsondes and dropsondes.

NCAR CLASS Upsonde files

The CLASS file starts with a 15 line header section, followed by a variable number of data lines. The data lines are arranged in fixed width columns. A mandatory set of 21 data parameters is reported, even though a number of these (specifically the “quality” values) are always marked with a missing value indicator.

The data is reported in the sequence of decreasing pressure, i.e. from the surface upward, regardless of the direction of the sounding.

NCAR GLASS Upsonde files

The GLASS file starts with a 15 line header section, followed by a variable number of data lines. The data lines are arranged in fixed width columns. A mandatory set of 10 data parameters is reported.

The data is reported in the sequence of decreasing pressure, i.e. from the surface upward, regardless of the direction of the sounding.

Comma Separated Values (CSV)

The “Comma Separated Value” file format is used for data interchange between Aspen and other software. This is the recommended file format for users who are importing data from an instrument that doesn’t produce other specific input file types. It is a free form structure, with one data record per line, and the fields in a record separated by commas. A CSV file can be read directly into Microsoft Excel, and the data will be correctly organized in the spreadsheet.

For input to Aspen, certain conventions must be followed within the CSV file. Each line begins with an identifier, followed by one or more fields. The order of the lines is generally not important, within the following guidelines:

- The first line must be:

FileFormat,CSV

- After the first line, the launch time must be provided on lines as follows:

Year,2001
Month,08
Day,01
Hour,17
Minute,58
Second,34

- The launch observation data or other metadata may be optionally provided in lines labeled with the parameter name (case-insensitive) from the list of examples below:

```
latitude,17.42451,"units=deg"
longitude,126.50004,"units=deg"
pressure,1002.6,"units=hPa"
temperature,28.6,"units=deg C"
rh,82.7,"units=%"
speed,7.5,"units=m/s"
direction,261.4,"units=deg"
altitude,15.5,"units=m"
gpslatitude,15.5,"units=m"
comments,"180 sec, 4-8 sat, eye drop,"
datatype,"AVAPS SOUNDING DATA, Channel 2"
equipmenttype,"8"
platformtype,"WC 130"
platformid,"65-0963"
project,"RAINEX"
flight,"RF04"
agency,"NCAR"
ptuwindtimediff,"-0.06"
radiationcorr,"0"
trackingtype,"08"
sondeid,"980730027"
sondetype,""
operator,"Nick"
soundingdescription,"D20000609_220604.1 345327 STEPS 200
0 june 9 flt1"
launchobssource,"IWGADTS Format (IWG1)"
launchobstime,"07:11:24"
sondemodel,"RS904"
launchsite,"R/V Tommy Thompson"
thermosensor,"Vaisala RSS904"
```

- To designate a dropsonde sounding, include a line:

```
Ascending,"false"
```

- A “Fields” line defines the data fields and their order, for the succeeding “Data” lines. For an input CSV file to be read properly by Aspen, the following data field names (case-insensitive) must be used:

Fields	Aspen utilization
--------	-------------------

time pressure	Required input data fields
temp rh rh1 rh2 speed direction latitude longitude altitude ascent sats gpsalt	These data fields will be utilized if provided
others	Other data fields in input will be ignored

- The “Units” lines documents the units of each data field. Note that the units shown here must be adhered to; Aspen will not make units conversions. At least the time and pressure fields must be provided:

Units, sec, mb, deg C, %, m/s, deg, deg, deg, m, deg C, m/s, m/s, m/s

- The “Data” lines follow after all of the preceding records.

Some other rules apply:

- Long strings should be enclosed in quotes.
- Don’t include commas in strings
- Capitalization is not important.
- The data series must be ordered in time
- Time tags less than zero will be ignored
- Don’t use reserved strings in the first field of a line.
- “Fields” must come before “Data”
- Missing data are simply represented by empty fields, i.e. two commas in

succession, or a trailing comma on the end of a line, indicating that the last field is missing.

The following demonstrates a small CSV file:

```
FileFormat,CSV
Year,2001
Month,08
Day,01
Hour,17
Minute,58
Second,34
Pressure,57.6,"units=mb"
Temperature,-59.9,"units=deg C"
RH,, "units=%"
Speed,7.9,"units=m/s"
Direction,92.0,"units=deg"
Latitude,30.9909,"units=deg"
Longitude,-119.5005,"units=deg"
Altitude,19610.0,"units=m"
Ascending,"false"
Fields,Time,Pressure,Temperature,RH,Speed,Direction,Latitude,Lo
ngitude,Altitude,Dewpoint,Uwnd,Vwnd,Ascent
Units,sec,mb,deg C,%,m/s,deg,deg,deg,m,deg C,m/s,m/s,m/s
Data,0.3,,,,,,,,,,,
Data,0.8,,,,,,,,,,,
Data,11.8,,,11.52,69.53,,,,,-10.79,-4.03,
Data,38.8,71.06,-60.33,,8.23,104.25,30.99129,-119.50375,1829
5.7,,,-7.98,2.03,-39.94
Data,51.8,77.01,-63.75,,8.67,160.11,30.99174,-119.50441,1779
9.7,,,-2.95,8.15,-36.35
Data,66.3,83.86,-62.29,,,30.99267,-119.50520,17276.1,,,,-35.06
Data,75.8,88.52,-64.99,,8.95,119.15,30.99295,-119.50592,1694
4.3,,,-7.82,4.36,-34.01
```

Vaisala MW41 Upsonde files

Aspen can read in ASCII text files from the MW41 radiosonde system, but will not apply quality control procedures as this is done by the MW41 software and should not be duplicated. The use case for this is using Aspen to convert from MW41 format to other more widely used formats for sounding data.

WMO TEMP messages

Aspen can extract levels information from a WMO TEMP message. Aspen will not attempt to apply QC to a WMO message, but the data it contains can be examined in the Levels tab or plotted in the XY Graph or Skew-T tabs. In this case Aspen is used for data visualization rather than data processing.

Output File Formats

Note that the file formats are not complete; i.e one format will contain information that another format does not support. Thus, the CSV and netCDF formats can document the configuration parameters used in the processing, whereas the CLASS format does not support inclusion of this information.

Data product	File output formats
Raw data	CLASS EOL CSV netCDF
QC data	CLASS EOL FRD CSV netCDF BUFR
XY graph image	PNG JPG PDF
Skew-T image	PNG JPG SVG
Levels data	CSV



NCAR CLASS upsonde files

The CLASS file starts with a 15 line header section, followed by a variable number of data lines. The data lines are arranged in fixed width columns. A mandatory set of 21 data parameters is reported, though a number of these (specifically the “quality” values) are always marked with a missing value indicator.

The data is reported in the sequence of decreasing pressure, i.e. from the surface upward, regardless of the direction of the sounding.

NCAR EOL dropsonde files

The EOL file starts with a 15 line header section, followed by a variable number of data lines. The data lines are arranged in fixed width columns. A fixed set of 17 data parameters is reported. The data is reported in the sequence of decreasing pressure, i.e. from the surface upward, regardless of the direction of the sounding.

More information about the EOL format is available on the [EOL website](https://www.eol.ucar.edu/system/files/v4.EOL%20Sounding%20Data%20File%20Format_0.pdf)
(https://www.eol.ucar.edu/system/files/v4.EOL%20Sounding%20Data%20File%20Format_0.pdf)

NOAA HRD FRD dropsonde files

The FRD file starts with a 21 line header section, followed by a variable number of data lines. The data lines are arranged in fixed width columns. A fixed set of 18 parameters is reported, though a number of these are always set to zeros.

The data is reported in the sequence of increasing time for both up and drop soundings.

Comma Separated Values (CSV)

The “Comma Separated Value” file format is used for data interchange between Aspen and other software. It is a free form structure, with one data record per line, and the fields in a record separated by commas. A CSV file can be read directly into Microsoft Excel, and the data will be correctly organized in the spreadsheet. See the [Input File Formats section \(page 73\)](#) for more information on how Aspen CSV file are formatted.

Levels data is also provided in CSV format, where the file contains the data from the table in the Levels tab.

NetCDF files

[Network Common Data Form \(netCDF\)](#) (<https://www.unidata.ucar.edu/software/netcdf/>) is a binary, array-based, self-describing data format that is commonly used for earth science data. Sounding data is stored in a series for each variable, indexed by time. Metadata is stored as attributes of either specific variables or the entire file. When possible, Aspen netCDF output is compliant with the [Climate and Forecast \(CF\) Conventions](#) (<http://cfconventions.org/>) for file structure and metadata.

In-depth documentation of Aspen netCDF output is available on the EOL website for [radiosondes](#) (https://www.eol.ucar.edu/system/files/NCAR_EOL_ISF_radiosonde_NetCDF_data_files_0.pdf) and [dropsondes](#) (https://www.eol.ucar.edu/system/files/NCAR_EOL_ISF_dropsonde_NetCDF_data_files_4.pdf)

WMO BUFR files

BUFR messages report both one-second averages of the entire quality controlled sounding profile and the contents of the calculated levels. BUFR files use a binary format specified by the World Meteorological Organization’s [Manual on Codes \(no. 306\)](#) (<https://www.wmo.int/pages/prog/www/WMOCodes/ManualonCodes.html>). Aspen codes sounding data as B/C25 (binary equivalent of TEMP, TEMP SHIP, or TEMP MOBIL) or B/C26 (binary equivalent of TEMP DROP), depending on the sounding file.

WMO TEMP files

TEMP messages report specially encoded levels data in ASCII text. The contents and formatting of TEMP messages is determined by the World Meteorological Organization's [Manual on Codes \(no. 306\)](#) (<https://www.wmo.int/pages/prog/www/WMOCodes/ManualonCodes.html>). Aspen codes sounding data as TEMP (FM35), TEMP SHIP (FM36), TEMP DROP (FM 37), or TEMP MOBIL (FM 38) depending on the sounding file.

Graphics files

Aspen can save graphics products in several file formats. SVG and PNG format are higher resolution than JPG and therefore preferred.

NASA ICARTT files

The [ICARTT](#) (<https://www-air.larc.nasa.gov/missions/etc/IcarttDataFormat.htm>) data format is used by NASA for dropsonde and other airborne atmospheric data. It is an ASCII format with a metadata header followed by data.

Aspen does not produce ICARTT files natively, however, Sean Freeman at CSU has written a Python converter from Aspen netCDF to ICARTT. Please contact the aspen mailing list if you would like a copy of the conversion code.