

Development of a Display Tool to Quality Control Weather Balloon Data for Space Launch Vehicles Using Python



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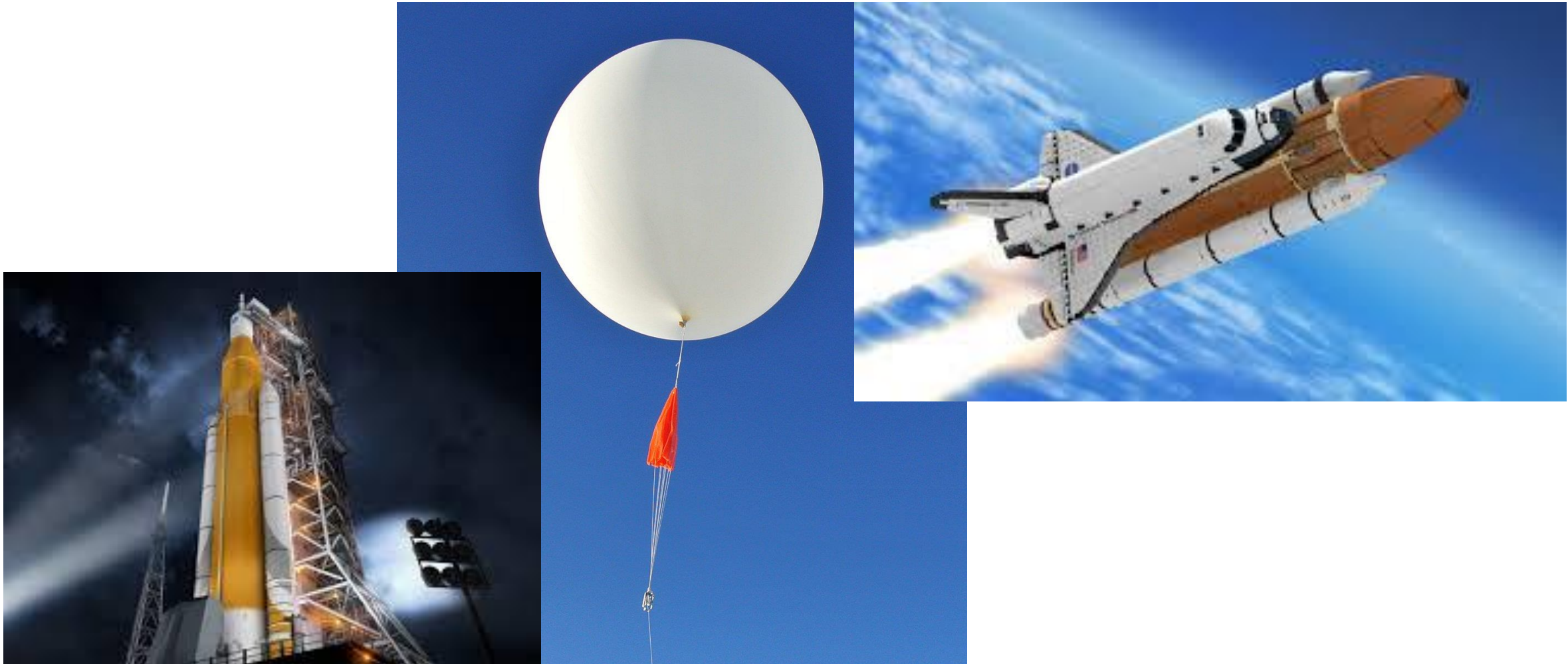
36th Conference on Environmental Information Processing Technologies

Boston, MA

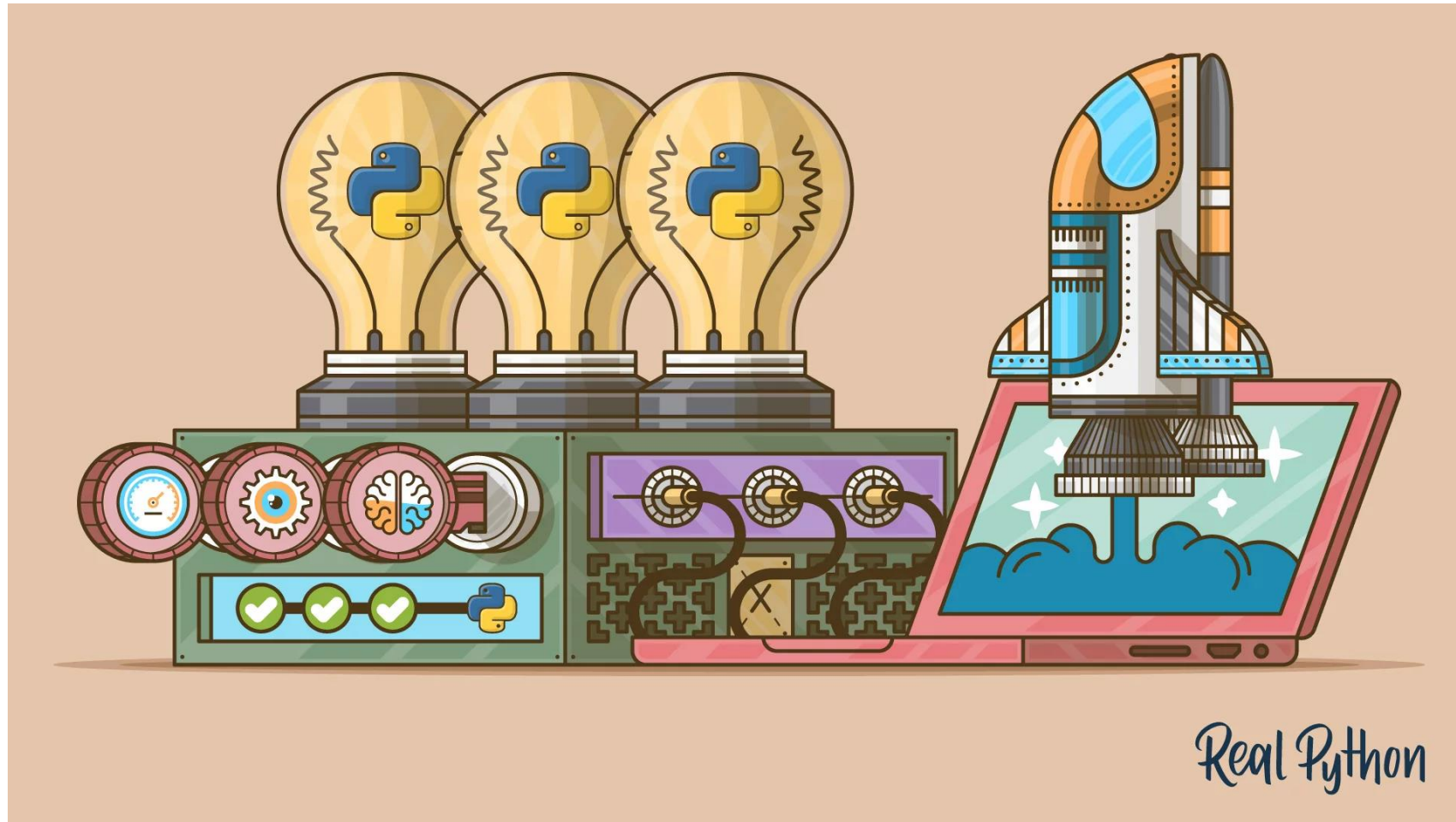
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The MSFC Natural Environments Branch defines and assesses the natural environment for space vehicle design and operations.

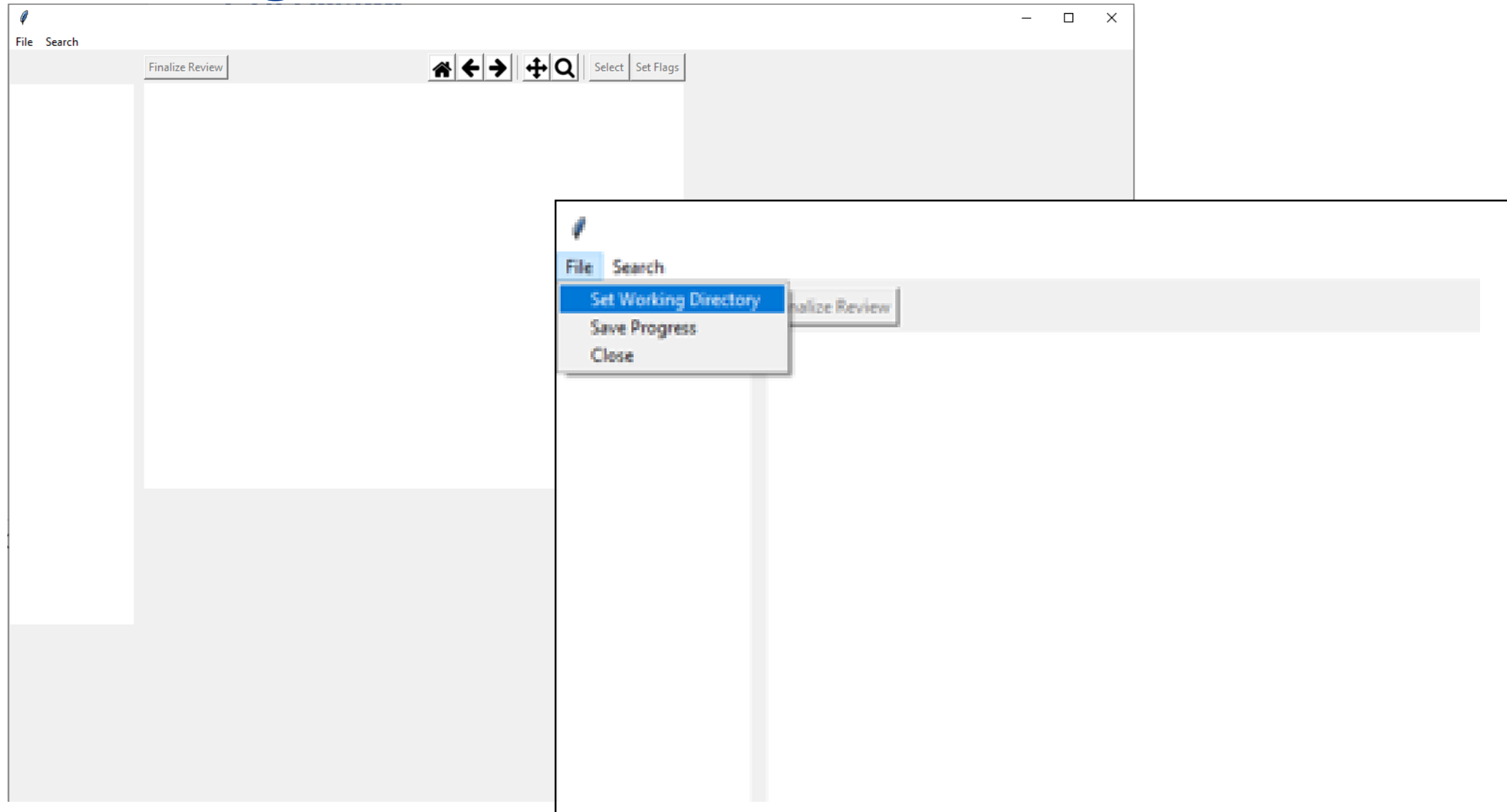


NASA has implemented policies that allows for use of versatile open source software.



- Pandas
- Tkinter
- Matplotlib
- Numpy
- Tabulate
- Shutil
- Itertools

GUI Design



GUI Design

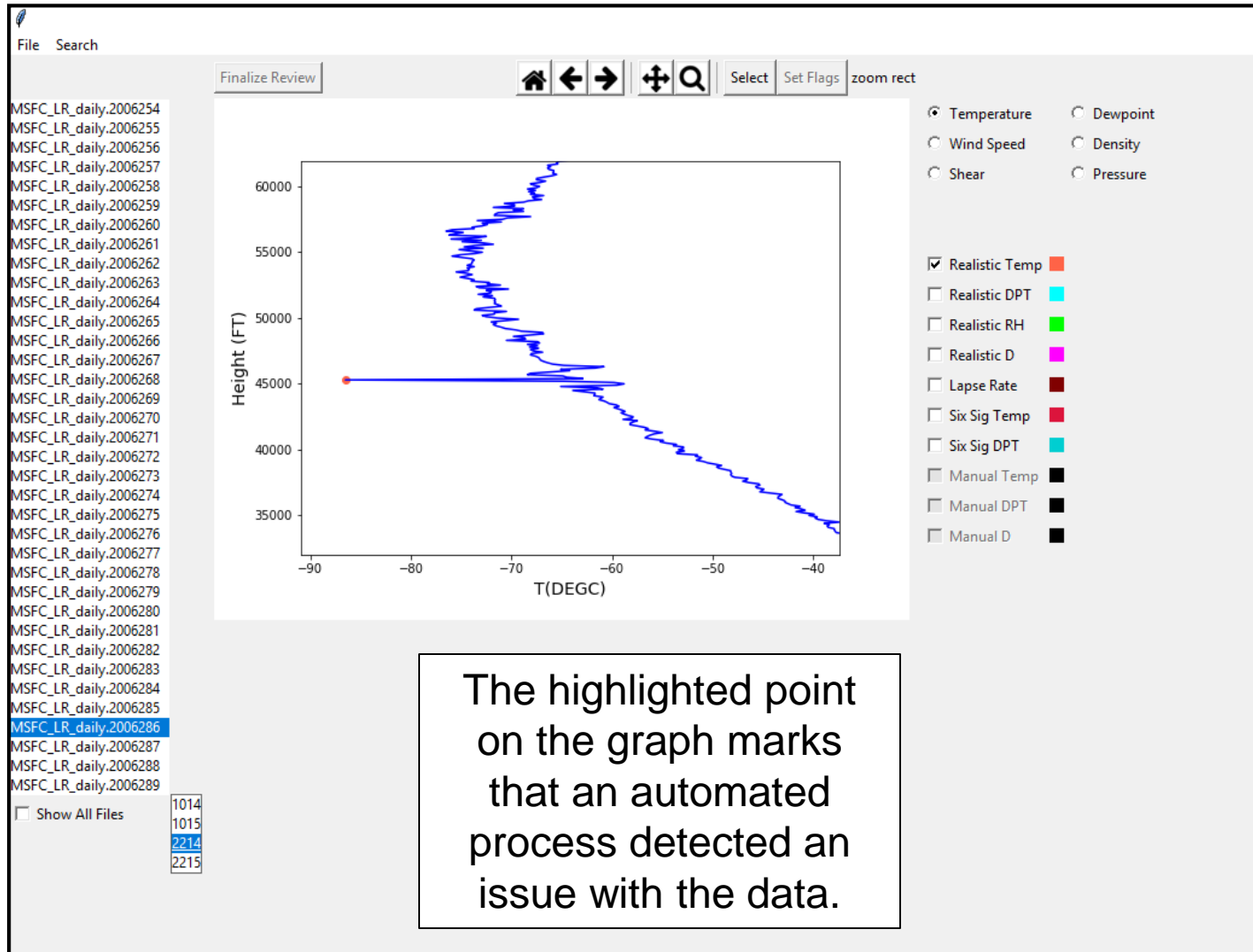
The screenshot shows a software interface for reviewing meteorological data. On the left, a list of file names is displayed, with a callout box labeled "Time Stamps of file" pointing to the first two entries: "MSFC_LR_daily.1995005" and "MSFC_LR_daily.1995006". Below the list, a callout box labeled "File Names" points to the same list. The central area features a plot titled "No Flags Tripped" showing "Height (FT)" on the y-axis (0 to 70,000) and "T(DEGC)" on the x-axis (-90 to 30). A blue line represents the temperature profile. A callout box labeled "Plots" points to this plot. On the right, a "Variables" panel contains radio buttons for "Temperature", "Dewpoint", "Wind Speed", "Density", "Shear", and "Pressure". Below this, a "QC Flags" panel contains checkboxes for "Realistic Temp", "Realistic DPT", "Realistic RH", "Realistic D", "Lapse Rate", "Six Sig Temp", "Six Sig DPT", "Manual Temp", "Manual DPT", and "Manual D". A callout box labeled "Variables" points to the top section of the right panel, and another callout box labeled "QC Flags" points to the bottom section of the right panel.

GUI Design

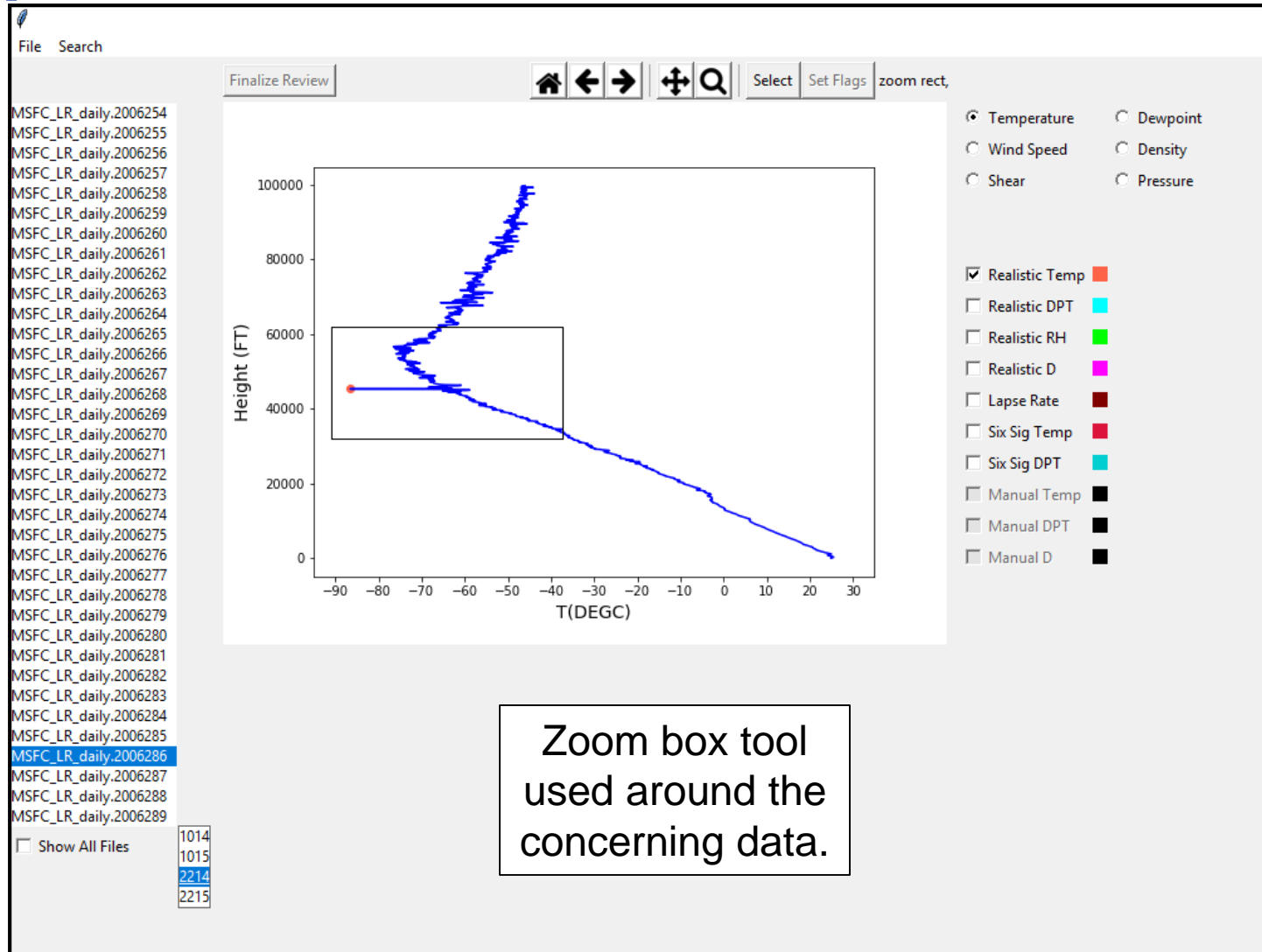
This screenshot shows a software interface with a file list on the left containing entries like 'MSFC_LR_daily.2006259' through '2006267'. The main area features a plot with a y-axis ranging from 80,000 to 100,000. A blue data series is plotted, showing an upward trend. Above the plot is a toolbar with icons for home, back, forward, and search, along with a 'Reset original view' button. To the right of the plot is a control panel with radio buttons for 'Temperature', 'Dewpoint', 'Wind Speed', 'Density', 'Shear', and 'Pressure'. A checkbox for 'Realistic Temp' is checked and accompanied by a red square icon. A 'Finalize Review' button is located at the top left of the plot area.

This screenshot shows the same GUI interface as above, but with a tooltip that reads: 'Select a region on the graph and one or more flag to open editor window'. The control panel on the right now includes additional options: 'Realistic DPT' with a cyan square, 'Realistic RH' with a green square, and a partially visible 'Realistic D' with a magenta square. The 'Realistic Temp' checkbox remains checked with its red square icon. The plot area now shows a y-axis with labels at 60,000, 80,000, and 100,000, and the unit '(FT)' is visible at the bottom left of the axis. The toolbar and file list remain the same.

Example

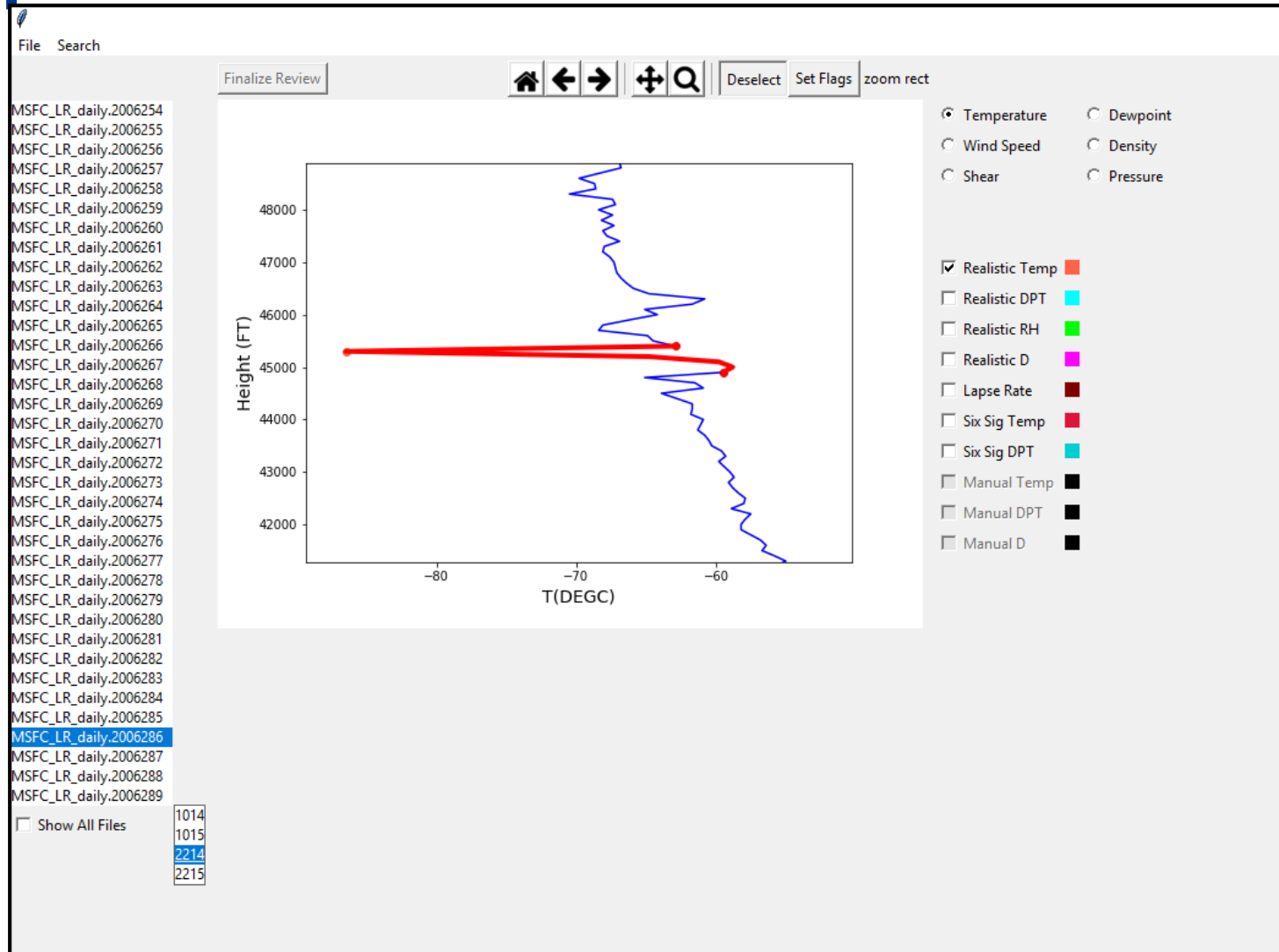


Example



Zoom box tool
used around the
concerning data.

Example



Example

The screenshot displays a software interface for reviewing data. On the left, a file list shows numerous files named 'MSFC_LR_daily.2006254' through '2006289'. The main area features a plot with 'Height (FT)' on the y-axis (ranging from 42000 to 48000) and 'T(DEGC)' on the x-axis (ranging from -80 to -70). A red horizontal line is drawn at approximately 45000 FT, and a blue jagged line represents the data. A toolbar at the top includes 'Finalize Review', navigation arrows, a magnifying glass, and buttons for 'Deselect', 'Set Flags', and 'zoom rect'. On the right, there are radio buttons for 'Temperature', 'Dewpoint', 'Wind Speed', 'Density', 'Shear', and 'Pressure', along with checkboxes for 'Realistic Temp', 'Realistic DPT', and 'Realistic RH'. An 'Editor test' window is overlaid, showing a table with columns 'ALT(FT)', 'AutoQC', 'T(DEGC)', and 'QCManualTemp'. The row for 45300 FT is highlighted, with a '1' in the 'AutoQC' column. A text box below the table states: 'Saving Checks: The highlighted 1 shows that it was an automated QC check that detected this data and flagged it.'

ALT(FT)	AutoQC	T(DEGC)	QCManualTemp
44900	00001100100000100	-59.5	0
45000	00001100100000100	-58.8	0
45100	00001100100000100	-59.8	0
45200	00001100100000100	-64.8	0
45300	000 1 1100100100100	-86.5	0
45400	00001100100100100	-62.9	0

Example

Finalize Review Preview with Flagged Removed → + Q Deselect Set Flags zoom rect

Temperature Dewpoint
Wind Speed Density
Shear Pressure

Realistic Temp Realistic DPT Realistic RH Realistic D Lapse Rate Six Sig Temp Six Sig DPT Manual Temp

Height (FT)

80000
60000
40000
20000
0

-90 -80 -70 -60

MSFC_LR_daily.1995005
MSFC_LR_daily.1995006
MSFC_LR_daily.1995007
MSFC_LR_daily.1995008
MSFC_LR_daily.1995009
MSFC_LR_daily.1995010
MSFC_LR_daily.1995011
MSFC_LR_daily.1995012
MSFC_LR_daily.1995013
MSFC_LR_daily.1995014
MSFC_LR_daily.1995015
MSFC_LR_daily.1995016
MSFC_LR_daily.1995017
MSFC_LR_daily.1995018
MSFC_LR_daily.1995019
MSFC_LR_daily.1995020
MSFC_LR_daily.1995021
MSFC_LR_daily.1995022 1100
MSFC_LR_daily.1995023 1600
MSFC_LR_daily.1995024
MSFC_LR_daily.1995025
MSFC_LR_daily.1995026
MSFC_LR_daily.1995027
MSFC_LR_daily.1995028
MSFC_LR_daily.1995029
MSFC_LR_daily.1995030
MSFC_LR_daily.1995031
MSFC_LR_daily.1995032
MSFC_LR_daily.1995033
MSFC_LR_daily.1995034
MSFC_LR_daily.1995035
MSFC_LR_daily.1995036
MSFC_LR_daily.1995037
MSFC_LR_daily.1995038
MSFC_LR_daily.1995039
MSFC_LR_daily.1995040

Editor test

Save Manual Checks

ALT (FT)	AutoQC	T (DEGC)	QCManualTemp
20000	000001001000000000	-16.3	0
21000	000001001000000000	-17.2	0
22000	000001001000000000	-40.5	0
23000	000001001000000000	-43.5	0
24000	000001001000000000	-47.5	0
25000	000001001000000000	-42.9	0
26000	000001001000000000	-26.4	0

Realistic Temp

This example shows data that needs a flag that was not caught by the automated check.

Example

Finalize Review Preview with Flagged Removed → + Q Deselect Set Flags zoom rect

Temperature Dewpoint
Wind Speed Density
Shear Pressure
 Realistic Temp
 Realistic DPT
 Realistic RH
 Realistic D
 Lapse Rate
 Six Sig Temp
 Six Sig DPT
 Manual Temp

Height (FT)

No Flags Tripped

Editor test

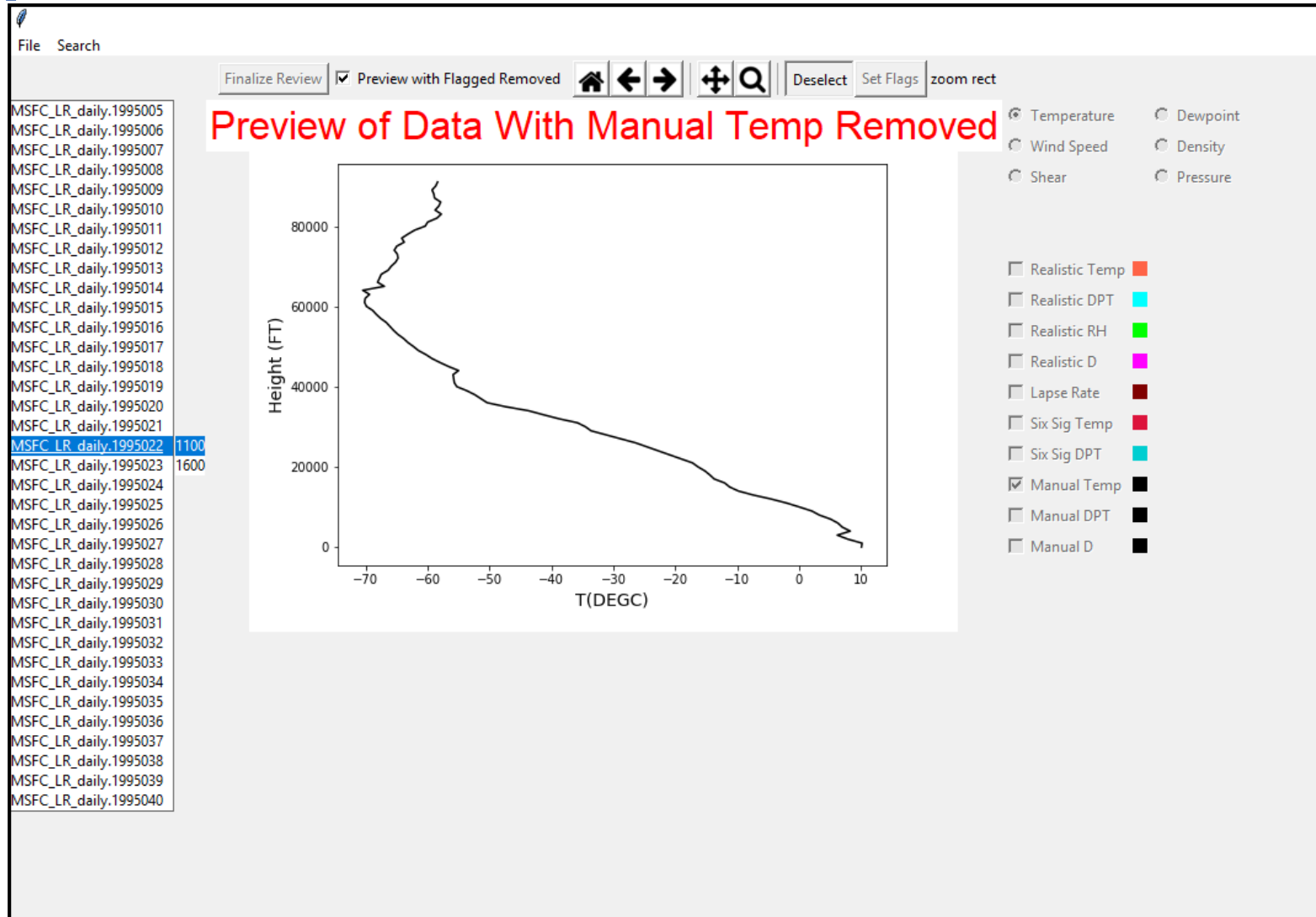
Save Manual Checks

ALT(FT)	AutoQC	T(DEGC)	QCManualTemp
20000	00000100100000000	-16.3	0
21000	00000100100000000	-17.2	0
22000	00000100100000000	-40.5	1
23000	00000100100000000	-43.5	1
24000	00000100100000000	-47.5	1
25000	00000100100000000	-42.9	1
26000	00000100100000000	-26.4	0

Realistic Temp

Setting the flags to 1 signals the GUI to add these flags to the data

Example



Summary

Functionality

- Displays balloon data
- Automated QC flags
 - Ability to manually check and add new flags
- Ability to preview data change
 - Produces output including all checks

Current Work

- Comparison with other QC processes
POR 1988-2011

Future Work

- QC process of full balloon database

Questions?

