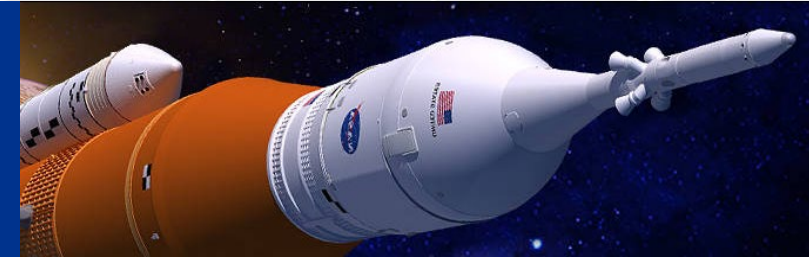


Development of a Display Tool to Quality Control Weather Balloon Data for Space Launch Vehicles Using Python



Jessica K. Headley

Charles M. Sayre, Jr.

James C. Brenton

JSEG MSFC-Natural Environments Branch

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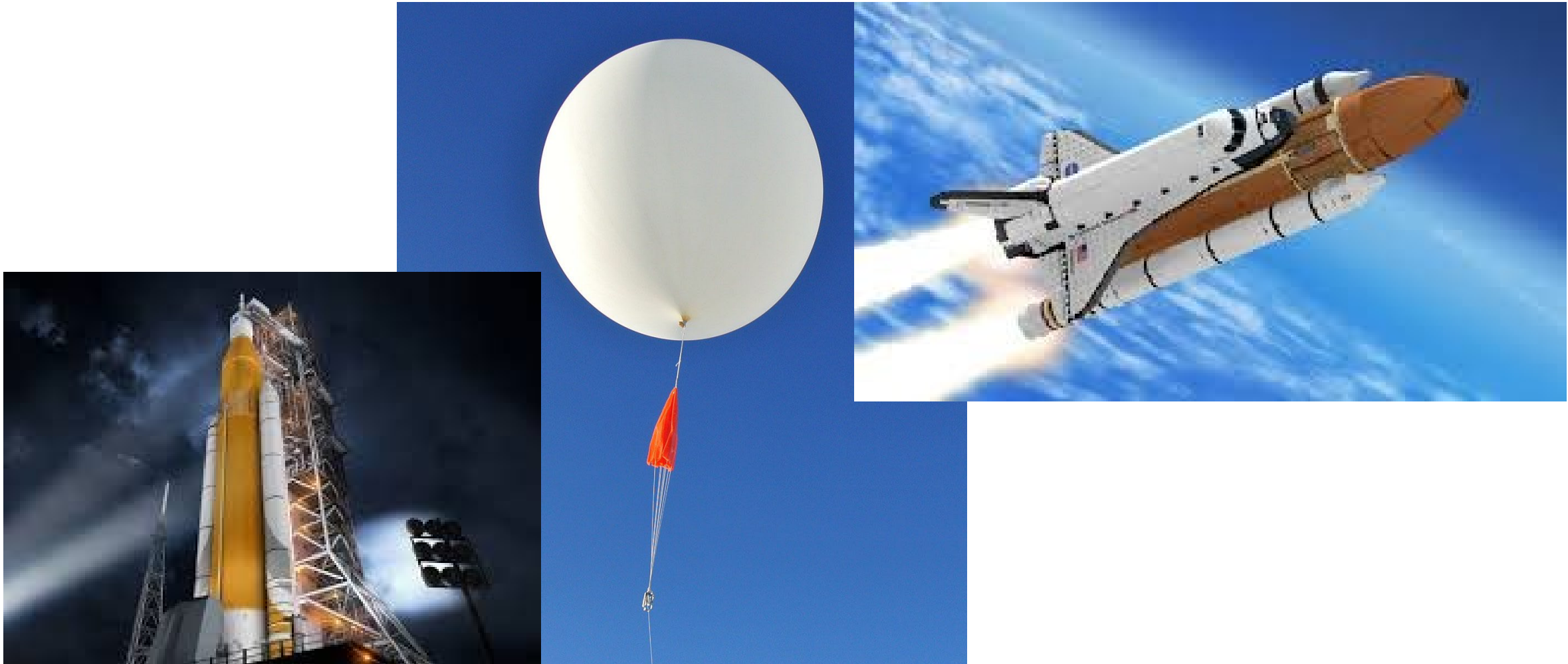
36th Conference on Environmental Information Processing Technologies

Boston, MA

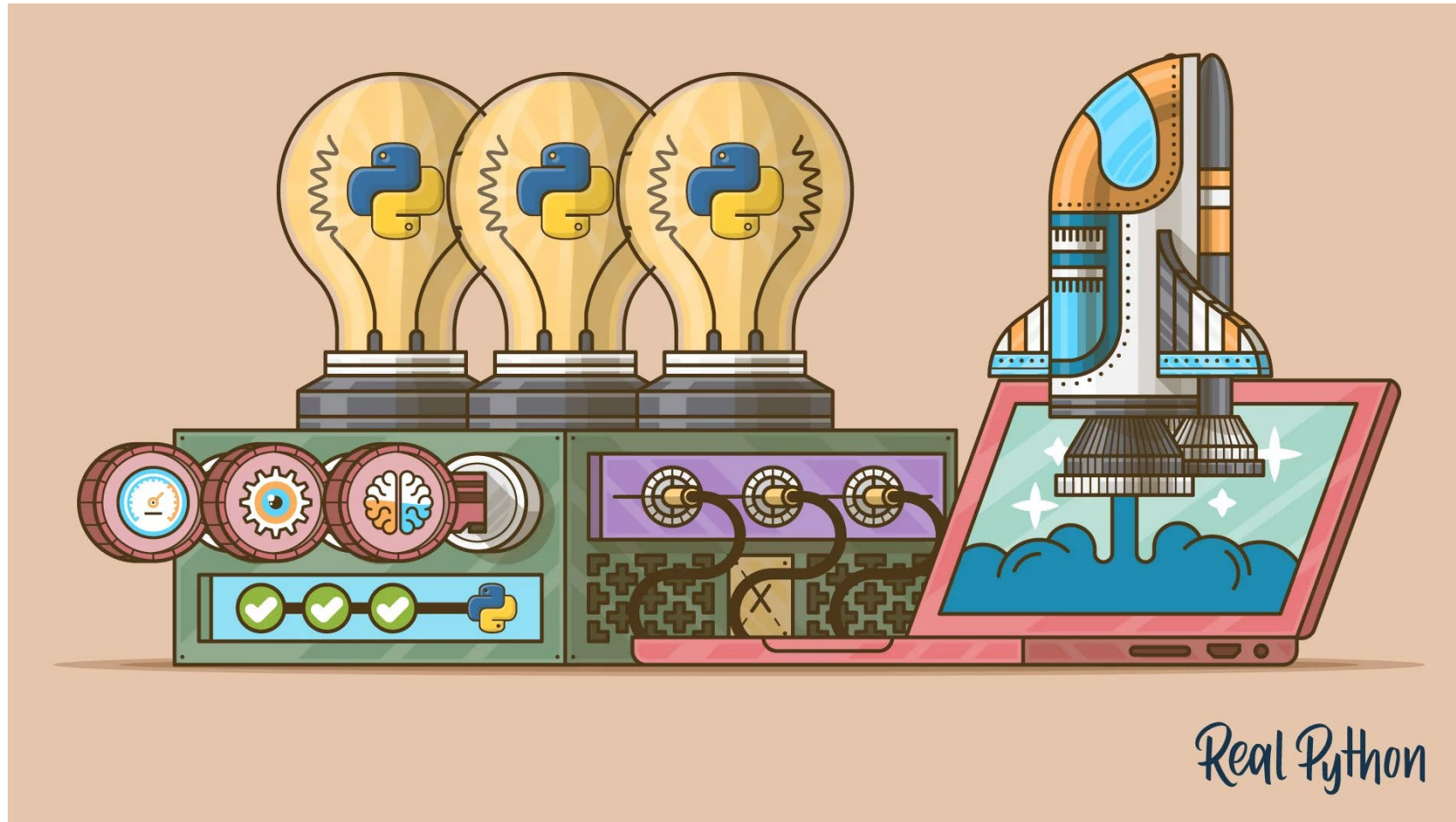
Jessica.k.headley@nasa.gov

JACOBS[®]

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

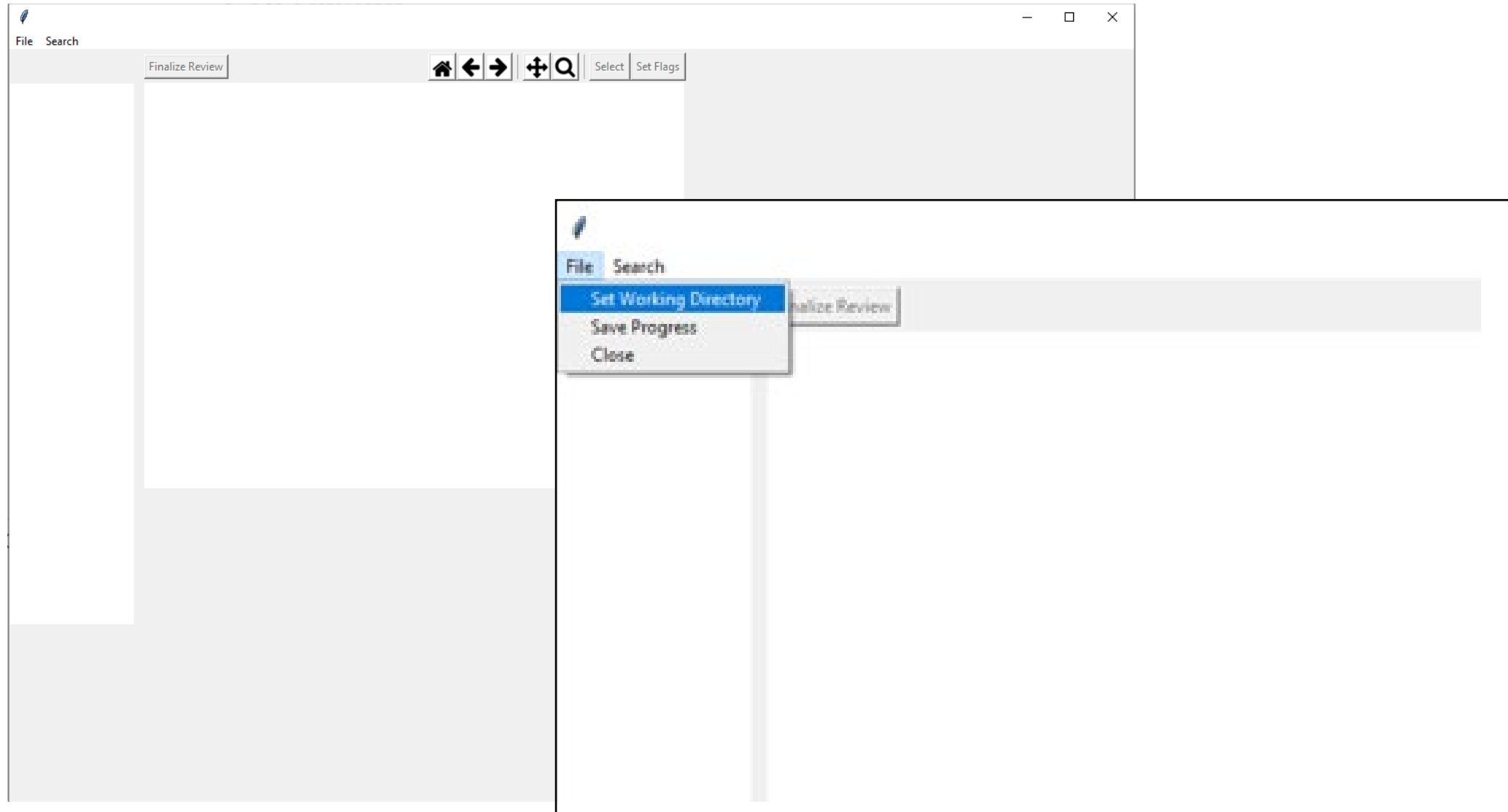


NASA has implemented policies that allows for use of versatile open source software.



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

GUI Design



GUI Design

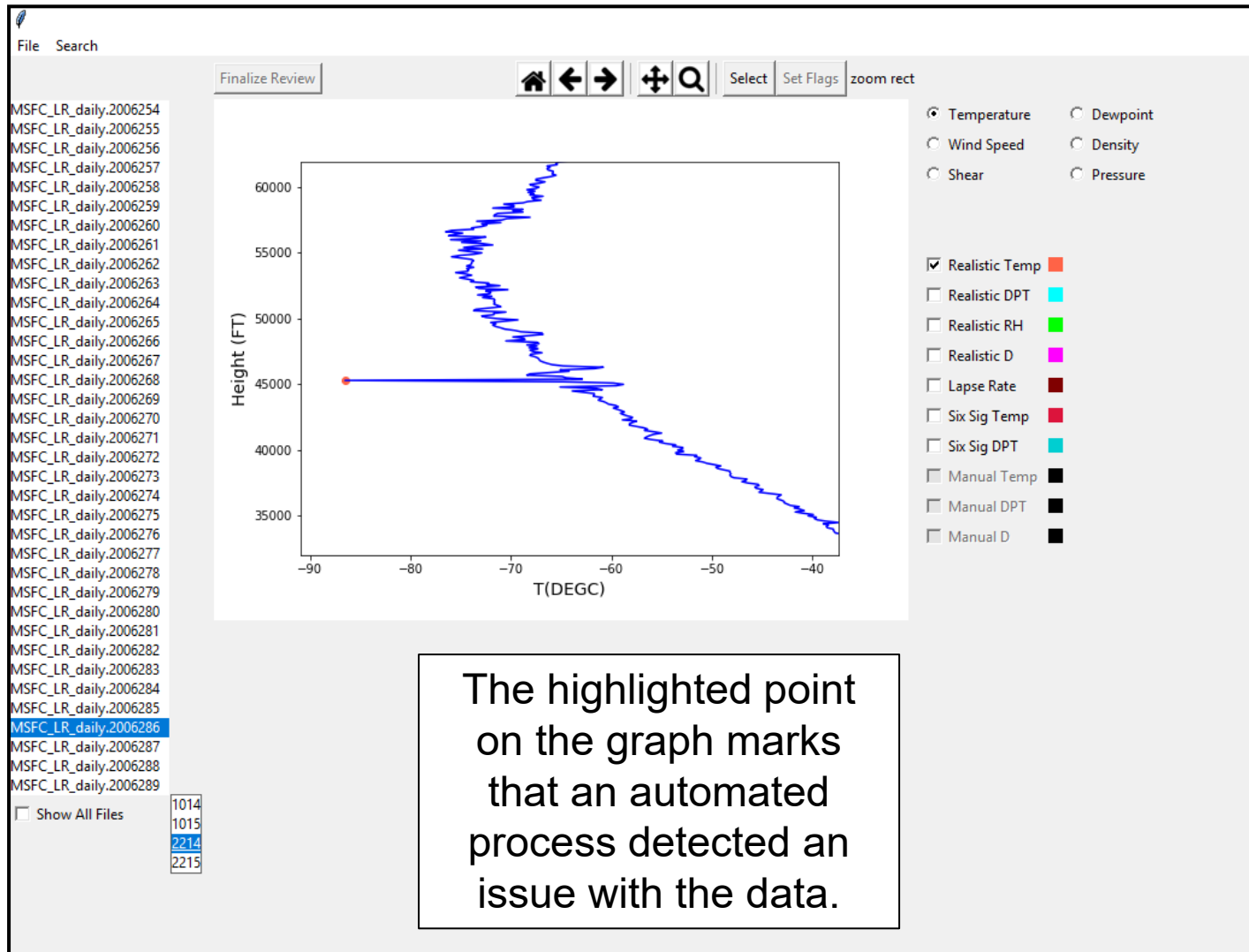
The screenshot displays a software interface for data review. On the left, a list of file names is shown, with a callout box labeled "Time Stamps of file" pointing to the first two entries: "MSFC_LR_daily.1995005" and "MSFC_LR_daily.1995006". Below this list, a callout box labeled "File Names" points to the entire list. In the center, a plot titled "No Flags Tripped" shows "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 data, showing a general downward trend with some fluctuations. A callout box labeled "Plots" points to this plot. On the right, a "Variables" panel contains several options: "Temperature", "Wind Speed", "Shear", "Dewpoint", "Density", and "Pressure" (all with radio buttons); "Realistic Temp", "Realistic DPT", "Realistic RH", "Realistic D", "Lapse Rate", "Six Sig Temp", "Six Sig DPT", "Manual Temp", "Manual DPT", and "Manual D" (all with checkboxes). A callout box labeled "Variables" points to the "Dewpoint" and "Density" options. Another callout box labeled "QC Flags" points to the "Realistic Temp" and "Six Sig Temp" options. The interface also includes a menu bar with "File" and "Search", a toolbar with navigation icons, and a "Finalize Review" button.

GUI Design

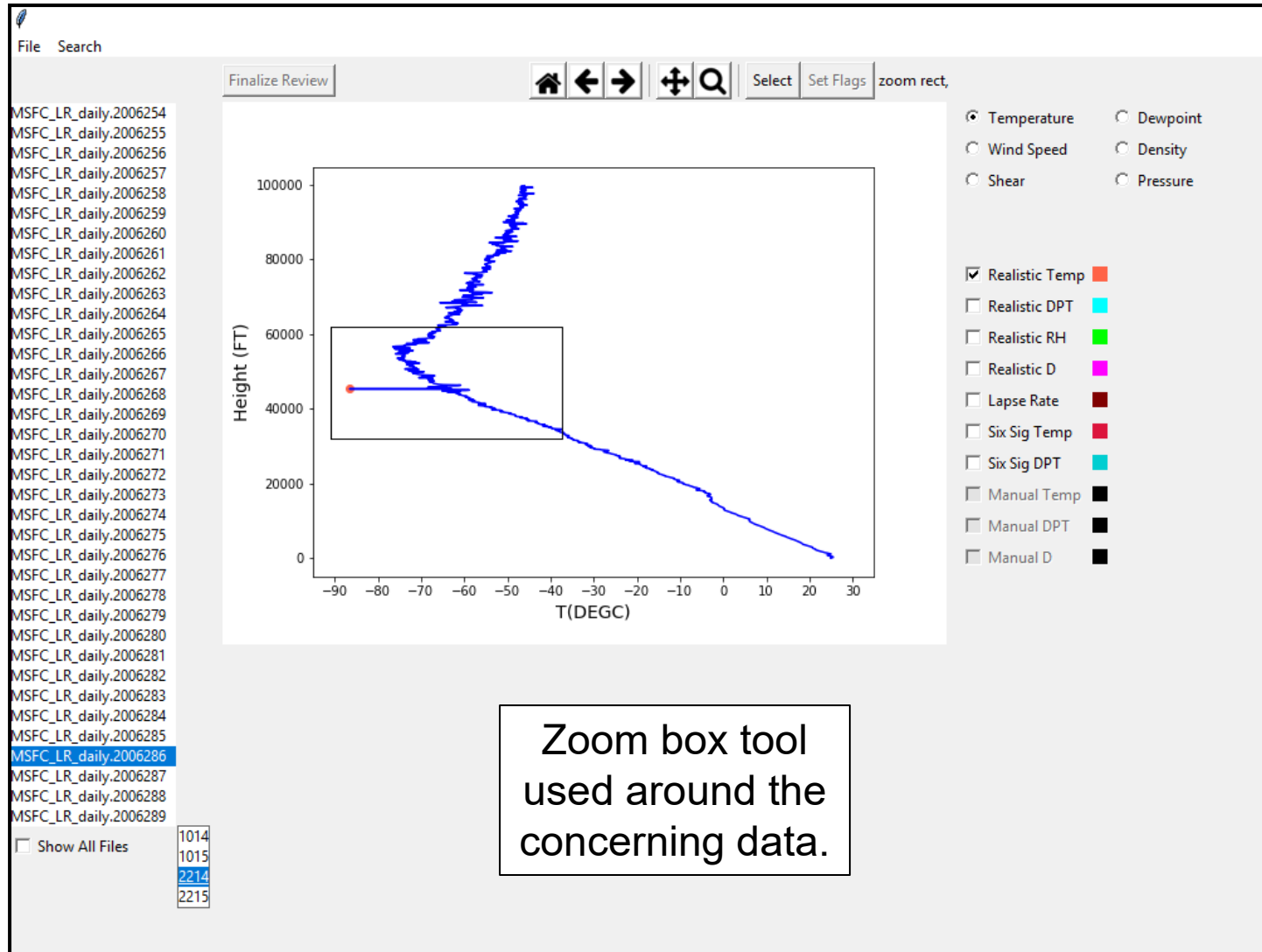
This screenshot shows a software interface with a menu bar (File, Search), a toolbar (Finalize Review, Reset original view, navigation icons, Select, Set Flags), a file list on the left, a central plot area, and a control panel on the right. The plot shows a blue line graph with a y-axis ranging from 80,000 to 100,000. The control panel includes radio buttons for Temperature, Dewpoint, Wind Speed, Density, Shear, and Pressure, and a checked checkbox for Realistic Temp with a red square indicator.

This screenshot shows the same software interface as above, but with a tooltip that reads "Select a region on the graph and one or more flag to open editor window" pointing to the plot area. The control panel on the right now includes additional options: Realistic DPT (cyan square), Realistic RH (green square), and Realistic D (magenta square). The y-axis of the plot is labeled "(FT)" and ranges from 60,000 to 100,000.

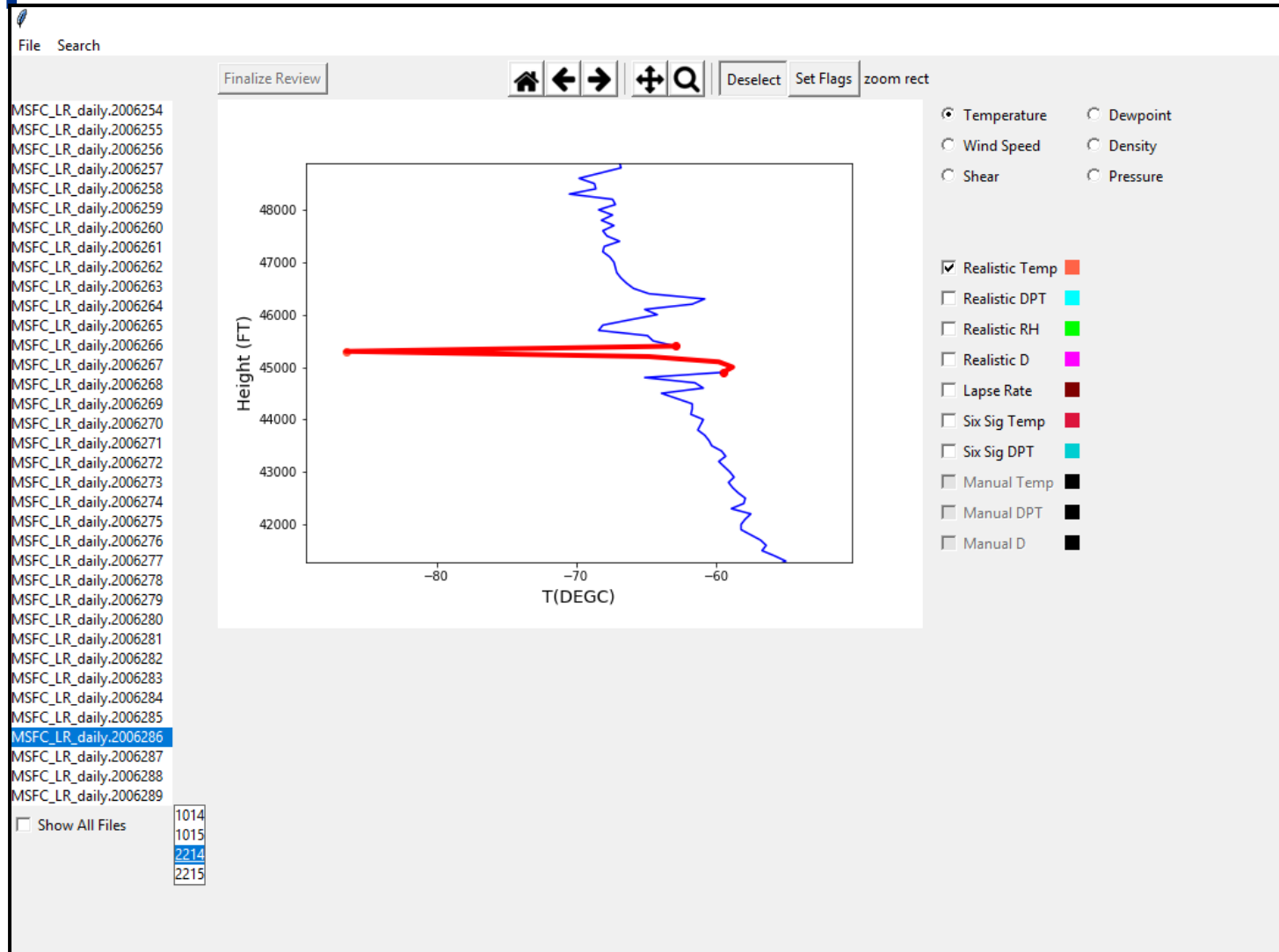
Example



Example



Example



Example

The screenshot displays a software interface for reviewing data. On the left, a list of files is shown, with 'MSFC_LR_daily.2006286' highlighted. The main area features a plot of 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 control panel on the right includes options for Temperature, Dewpoint, Wind Speed, Density, Shear, and Pressure, with 'Realistic Temp' checked. An 'Editor test' window is overlaid, showing a table with columns for ALT(FT), AutoQC, T(DEGC), and QCManualTemp. The row for ALT(FT) 45300 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 ■

Editor test

Save Manual Checks

ALT (FT)	AutoQC	T (DEGC)	QCManualTemp
20000	000001001000000000	-16.3	0 <input type="text"/>
21000	000001001000000000	-17.2	0 <input type="text"/>
22000	000001001000000000	-40.5	0 <input type="text"/>
23000	000001001000000000	-43.5	0 <input type="text"/>
24000	000001001000000000	-47.5	0 <input type="text"/>
25000	000001001000000000	-42.9	0 <input type="text"/>
26000	000001001000000000	-26.4	0 <input type="text"/>

Realistic Temp ■

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

Height (FT)

80000
60000
40000
20000
0

-90 -80 -70 -60

No Flags Tripped

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

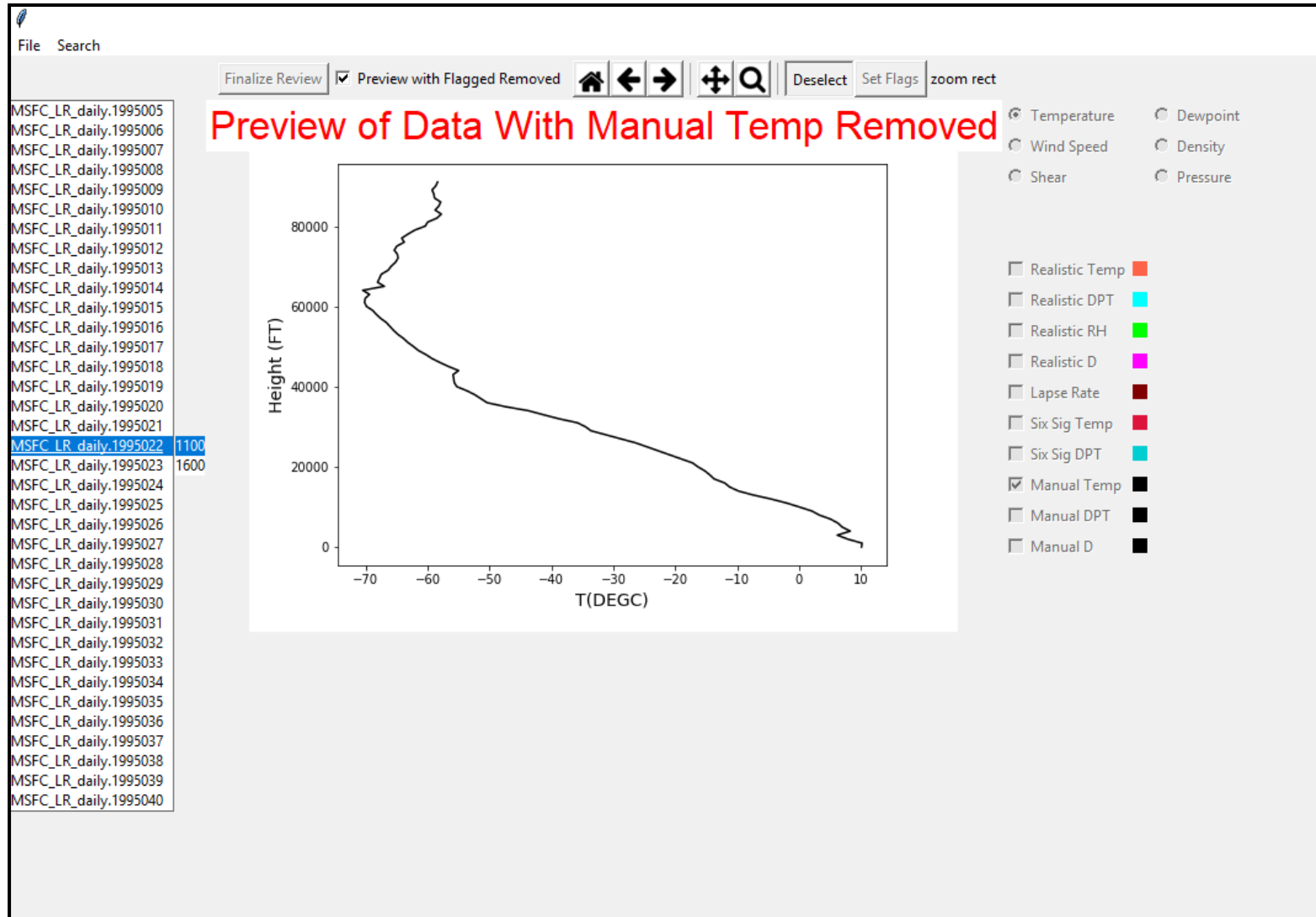
Save Manual Checks

ALT(FT)	AutoQC	T(DEGC)	QCManualTemp
20000	0000010010000000	-16.3	0
21000	0000010010000000	-17.2	0
22000	0000010010000000	-40.5	1
23000	0000010010000000	-43.5	1
24000	0000010010000000	-47.5	1
25000	0000010010000000	-42.9	1
26000	0000010010000000	-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?

