# CPI Data Analysis Output

## Introduction

CPI\_FPI\_DA is CPI’s data analysis program to derive airglow winds and temperature data products from the FPI image data acquired by CPI’s 6300 A (Red Line) and 5577 A (Green Line) FPI systems.

The following section describes the text data files and plot images generated as output by the data analysis program.

The next section describes aspects of the data quality and annotations that must be taken into account while interpreting the data. Please make sure to read this section before using the data in your analysis.

## Output Files

The CPI\_FPI\_DA program produces winds and temperature data product files, as well as plots derived from these data files.

The output folder is created as a sub-folder under the data acquisition folder for the night.

You will see the 2 output data product files:

* A \*temps.dat file, which is the temperature data product output file.

For example, the temperature data product file for data acquired by the Redline instrument at Millstone Hill Observatory on Dec 18, 2016 has the filename: mh161218\_temps.dat, where mh is the two-letter observatory code, and 161218 is acquisition date in YYMMDD format.

* A \*winds.dat, which is the winds data product output file. For the above example, the winds.dat filename is mh161218\_winds.dat
* Note: For Greenline instruments, the filename format includes another 2 characters which represent the experiment information. For the above date, the Greenline winds and temperature filenames are mhgl161218\_winds.dat and mhgl161218\_winds.dat respectively. In other words, if the experiment code is not indicated in the filename, it always refers to the Redline experiment. This convention is also true for the filenames of the plot images described below.

The **plots** sub-folder under the output folder has 7 plots derived from the two data products files (temps.dat and winds.dat)

The data in mh161218\_temps.dat file is used to create the following plots:

1. Relative Background Vs. Universal Time: e.g. mh161218\_BKvsUT.png
2. Relative Intensity Vs. Universal Time: e.g. mh161218\_IvsUT.png
3. Temperature Vs. Universal Time : e.g. mh161218\_TvsUT.png

The data in mh161218\_winds.dat file is used to create the following plots:

1. Line-of-sight Winds vs. UT : e.g. mh161218\_LOSvsUT.png
2. Meridional and Zonal Winds Vs. Universal Time: e.g. mh161218MZ\_vsUT.png
3. Wind Gradient vs. Universal Time: e.g. mh161218\_Grad\_vsUT.png
4. Clock-dial Wind Vector plots, e.g., mh161218\_winds\_dialplot.png

## Data Products File Format:

### Temperature Data Product File Format

This section describes the format of the temperature data products file, i.e. \*\_temps.dat file:

The first 19 lines of the temperatures data products file contain information about the experiment setup and a summary of the temperature analysis for the night. Following that is the header line and detailed table of temperature data products.

The header fields are:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Field | Description | Data Type | Valid values /Range | Units | Interpretation |
| image | Image sequence number of the sky image for this data product element. | Int | - | - | monotonically increasing sequence number. |
| tmid | Acquisition Time, in UT | Double |  | Hours | Number of hours (in UT) since the acquisition start date. |
| Etime | Error bar for tmid | Double | 0 - 1.0 | Hours | Used for plotting horizontal error bars in plots. |
| AZ | Azimuth angle, in degrees. Indicates the direction of observation. | Float | 0 – 360 |  | Together with the zenith angle (zn), it defines the look direction. |
| ZN | Zenith angle, in degrees | Float | 0 – 90 |  | Zenith : {Zn = 0, Az = don’t care]  North : {Zn = 45, Az = 0]  East: {Zn = 45, Az = 90]  South: {Zn = 45, Az = 180]  West: {Zn = 45, Az = 270] |
| signal | Signal strength, or, Relative intensity of the sky signal | Float |  | ADU/pixel | Relative brightness of the signal |
| Esignal | +/- Error estimate for Signal strength | Float |  | ADU/pixel | Error estimate, used to plot vertical error bar for signal |
| bkgnd | Relative background intensity | Float |  | ADU/pixel | Background, in ADU/pixel |
| Ebkgnd | +/- Error estimate for relative background intensity | Float |  | ADU/pixel | Error estimate, used to plot vertical error bar for background |
| temp | Temperature, in Kelvin | Float |  | K | Derived temperature |
| Etemp | +/- Error in Temperature | Float |  | K | Error in derived temperature |
| moon | Percentage of the moon synodic cycle. | Float | 0 – 100 |  | Moon phase, in percent |
| code | Data quality code | Int | 0,1, 2 |  | Data quality. 0=>Trustworthy, 1=>suspicious?, 2=>Dubious |

### Winds Data Product File Format

The header fields and file format description of the winds data products file is as follows:

We measure winds by measuring the fringe positions in the four cardinal directions and comparing them to the fringe position in the zenith direction.

 Table below is a sample winds.dat file, which will be used to explain how the winds data is organized. Also, more information on the instrument and the analysis procedure online is available at www.neutralwinds.com/redlinedescribe.html

The first 19 lines of the winds data file contain information about the experiment setup, and a summary of the winds analysis for the night (Some of these lines may be blank lines). Following that is the detailed results for the winds analysis in each of the 4 directions.

The following format is used to present results from wind measurements in each of the four directions:

1. The first line for each section indicates the number of images taken in that direction, the HMAX and emission layer values used in the winds analysis. In the attached file, we have 41 measurements looking in the north direction, HMAX value used is 250 km and emission layer value used is 210 kms.

2. The next couple of lines indicate the column names and units for each column.

- rec is the image number

- UT1 is the acquisition start time in UT.

- UT2 is the acquisition end time in UT.

- UTMid is the mid-value between UT1 and UT2.

- LOS <<direction>> is the cosine-corrected horizontal component of the line-of-sight winds wind vector in m/s measured in the specified direction (N, S, E, W).

- iLOS <<direction>> is the time-interpolated,  cosine-corrected horizontal component of the line-of-sight winds in m/s measured in the direction opposite to the LOS direction. For example, while reporting the LOS winds in the north direction, we also report the time-interpolated wind measured in the south direction.

- Meridional Winds, calculated as the average of the LOS and iLOS values.

- Grad is the wind gradient

- Code is the data quality code [Please see Note on Criteria for determining Data Quality].

3. Following the column names, a pair of lines is generated with the wind results for each image taken in that direction. The first line contains the column values for the columns described above. The second line beginning with '+/-' indicates the error bars for the corresponding column values above. For example, in the data file attached, wind measurements and the error values for record 6 (the first winds record, in the north direction) are as follows:

+/- 0. 1015 m/s for the LOS N measurement of 26.81 m/s,

+/- 0. 2381 m/s for the iLOS S measurement of 59.32 m/s,

+/- 0.3358 m/s for the meridional wind measurement of 43.07 m/s

+/- 0.3108 m/s for the wind gradient measurement of -38.700 (m/s)/500km

4. This data is repeated for all four directions - North, South, East and West.

5. The final section is the relative vertical wind velocity using the zenith positions. The format is similar the winds results in the 4 cardinal directions.

*Table 1: Sample Winds data product file*

|  |
| --- |
| Millstone Hill RedLine Wind data  Plate gap: 1.0525 FSR: 84.0586 bin units sensitivity: 60.00000 [bin units\*(adu/pixel)]\*1/R  mh220303 flats: mh220303 quadratic background, Poisson weighting, ( sky ) moon phase: NEW ; Moon  FSR\_sky: 84.05864 bin units, 0.18857 angstroms, 8.973 km/s  Wind data corrected for instrument drift  meridional wind vectors calculated: 81  zonal wind vectoors calculated: 80  avg. LOS N (m/s): -74.8 +/- 67.2 avg. error: 2.1 avg. LOS S (m/s): -51.7 +/- 65.1 avg. error: 1.7  avg. LOS E (m/s): 10.5 +/- 103.1 avg. error: 1.7 avg. LOS W (m/s): 16.9 +/- 86.4 avg. error: 1.4  avg. meridional (m/s): -63.3 +/- 60.9 avg. error: 3.8  avg. zonal (m/s): 15.6 +/- 92.1 avg. error: 3.5  avg. vertical (m/s): 0.0 +/- 17.2 avg. error: 0.3  data quality: code=0 trustworthy; code=1 be suspicious; code=2 be dubious  Location latitude: 42.61, longitude: -71.48  SS-Analyze V05.02          41 North (postive poleward) Hmax: 250.0 emission layer: 210.0  rec UT1 UT2 UTmid LOS N iLOS S meridional Grad S->N code  hours hours hours m/s m/s m/s (m/s)/500km  6 23.45 23.47 23.46 26.81 59.32 43.07 -38.70 0  +/- 0.1015 0.2381 0.3358 0.3018  11 23.77 23.79 23.78 11.80 54.81 33.30 -51.21 0  +/- 0.0627 0.2882 0.3520 0.5413  16 23.98 24.00 23.99 17.83 31.63 24.73 -16.43 0  +/- 0.1127 0.1935 0.3076 0.2044  21 24.30 24.33 24.31 19.78 21.82 20.80 -2.43 0  +/- 0.1443 0.1794 0.3228 0.0377  26 24.51 24.53 24.52 -23.97 22.09 -0.94 -54.84 converging 0  +/- 0.1859 0.1970 0.0157 0.9142  31 24.84 24.86 24.85 -11.49 -43.29 -27.39 37.86 0  +/- 0.1028 0.5748 0.6088 0.8416  36 25.05 25.07 25.06 -17.78 -35.84 -26.81 21.49 1  +/- 0.1827 0.4135 0.5847 0.4687  41 25.38 25.40 25.39 -48.01 -11.21 -29.61 -43.81 1  +/- 0.6139 0.1609 0.8035 1.1887  46 25.59 25.62 25.60 -47.41 -24.47 -35.94 -27.30 1  +/- 0.6677 0.3977 1.0903 0.8283  51 25.93 25.95 25.94 -98.85 -53.72 -76.28 -53.72 1  +/- 1.7034 0.9982 2.7321 1.9242  56 26.14 26.17 26.15 -109.86 -64.27 -87.07 -54.28 2  +/- 2.1007 1.3191 3.4518 2.1520  61 26.47 26.49 26.48 -122.14 -99.72 -110.93 -26.69 2  +/- 2.8414 2.4396 5.2945 1.2741  66 26.67 26.70 26.68 -146.65 -122.47 -134.56 -28.78 2  +/- 4.1677 3.5334 7.7062 1.6485  71 27.00 27.02 27.01 -166.27 -119.33 -142.80 -55.89 2  +/- 6.3309 4.3716 10.6687 4.1755  76 27.21 27.23 27.22 -201.63 -130.86 -166.24 -84.24 2  +/- 7.7792 5.2176 13.0424 6.6091  81 27.53 27.56 27.55 -86.21 -167.91 -127.06 97.26 2  +/- 3.2736 7.0499 10.1595 7.7771  86 27.74 27.77 27.76 -111.31 -190.81 -151.06 94.64 2  +/- 4.1595 7.7041 11.7441 7.3577  91 28.07 28.10 28.08 -135.30 -143.04 -139.17 9.22 2  +/- 5.3618 5.4357 10.8038 0.7155  96 28.27 28.30 28.29 -150.45 -112.99 -131.72 -44.60 2  +/- 5.4827 3.9535 9.4090 3.1859  101 28.60 28.63 28.61 -100.27 -116.31 -108.29 19.10 2  +/- 3.0211 3.4909 6.5129 1.1484  106 28.81 28.84 28.83 -87.20 -119.03 -103.12 37.89 2  +/- 2.1977 3.2937 5.4521 2.0035  111 29.44 29.47 29.45 -93.91 -111.39 -102.65 20.81 1  +/- 1.8116 2.2616 4.0643 0.8241  116 29.65 29.67 29.66 -81.72 -100.23 -90.98 22.03 1  +/- 1.6596 2.0694 3.7258 0.9022  121 29.97 30.00 29.99 -179.51 -104.21 -141.86 -89.64 2  +/- 4.7116 2.5591 7.2071 4.5541  126 30.18 30.20 30.19 -196.27 -76.85 -136.56 -142.17 2  +/- 5.3615 2.0194 7.3189 7.6199  131 30.50 30.52 30.51 -104.27 -74.90 -89.58 -34.97 2  +/- 3.0796 2.2468 5.3331 2.0817  136 30.70 30.73 30.72 -143.55 -86.68 -115.11 -67.71 2  +/- 4.2723 2.7213 7.0401 4.1409  141 31.03 31.06 31.04 -131.37 -97.41 -114.39 -40.43 2  +/- 3.8705 3.0361 6.9356 2.4511  146 31.24 31.27 31.25 -133.52 -116.95 -125.23 -19.72 2  +/- 3.5456 3.2440 6.7993 1.0704  151 31.56 31.59 31.58 -114.16 -45.91 -80.04 -81.25 1  +/- 2.2575 1.0888 3.4808 3.5336  156 31.77 31.80 31.78 -94.82 -24.43 -59.63 -83.80 1  +/- 1.5894 0.3982 1.9715 2.7708  161 32.10 32.13 32.12 -65.19 11.51 -26.84 -91.30 converging 0  +/- 0.8200 0.3023 1.0426 3.5466  166 32.31 32.33 32.32 -43.11 16.95 -13.08 -71.50 converging 0  +/- 0.4786 0.1904 0.2921 1.5969  171 32.63 32.66 32.65 44.44 7.26 25.85 44.25 0  +/- 0.4372 0.0727 0.5130 0.8782  176 32.84 32.86 32.85 -52.86 20.46 -16.20 -87.29 converging 0  +/- 0.4834 0.1824 0.2925 1.5765  181 33.16 33.19 33.18 47.11 27.55 37.33 23.29 0  +/- 0.4296 0.2459 0.6736 0.4202  186 33.37 33.40 33.39 23.24 10.39 16.82 15.30 0  +/- 0.2162 0.0951 0.3104 0.2824  191 33.70 33.73 33.72 -6.45 -12.77 -9.61 7.53 0  +/- 0.0593 0.1151 0.1750 0.1371  196 33.92 33.95 33.93 -30.97 -12.66 -21.81 -21.79 0  +/- 0.2875 0.1129 0.3970 0.3966  201 34.25 34.28 34.26 -80.00 -25.37 -52.69 -65.04 0  +/- 0.6512 0.1906 0.8246 1.0180  206 34.46 34.49 34.48 -39.82 -19.53 -29.67 -24.15 0  +/- 0.2637 0.1353 0.4021 0.3272  40 South (postive poleward) Hmax: 250.0 emission layer: 210.0  rec UT1 UT2 UTmid LOS S iLOS N meridional Grad S->N code  hours hours hours m/s m/s m/s (m/s)/500km  8 23.52 23.55 23.53 59.32 23.24 41.28 -42.95 0  +/- 0.2381 0.0923 0.3295 0.3428  13 23.85 23.87 23.86 53.32 14.14 33.73 -46.64 0  +/- 0.3048 0.0821 0.3887 0.5374  18 24.05 24.08 24.07 18.56 18.29 18.43 -0.32 0  +/- 0.1265 0.1202 0.2466 0.0043  23 24.38 24.41 24.39 22.88 2.76 12.82 -23.96 0  +/- 0.1968 0.1605 0.8570 1.6019  28 24.59 24.61 24.60 21.59 -20.92 0.33 -50.61 converging 0  +/- 0.1971 0.1656 0.0057 0.8626  33 24.92 24.94 24.93 -63.12 -13.80 -38.46 58.72 0  +/- 0.6902 0.1321 0.7888 1.2043  38 25.13 25.15 25.14 -19.12 -25.18 -22.15 -7.21 1  +/- 0.2439 0.2881 0.5360 0.1744  43 25.46 25.48 25.47 -8.65 -47.78 -28.22 -46.58 1  +/- 0.1340 0.6343 0.8116 1.3398  48 25.68 25.70 25.69 -34.58 -60.24 -47.41 -30.55 1  +/- 0.5662 0.9260 1.5051 0.9698  53 26.01 26.04 26.03 -60.10 -103.23 -81.67 -51.35 1  +/- 1.1423 1.8616 3.0249 1.9021  58 26.22 26.24 26.23 -66.76 -112.74 -89.75 -54.75 2  +/- 1.4246 2.2744 3.7258 2.2727  63 26.54 26.57 26.56 -109.89 -131.37 -120.63 -25.57 2  +/- 2.7528 3.3405 6.0892 1.2907  68 26.75 26.77 26.76 -130.03 -151.25 -140.64 -25.26 2  +/- 4.0027 4.6754 8.6767 1.5584  73 27.08 27.10 27.09 -116.04 -179.32 -147.68 -75.33 2  +/- 4.4847 6.8653 11.3614 5.7951  83 27.62 27.64 27.63 -177.05 -95.94 -136.49 96.56 2  +/- 7.5017 3.6169 10.9292 7.7318  88 27.82 27.84 27.83 -199.04 -116.91 -157.98 97.77 2  +/- 7.8251 4.4402 12.2105 7.5570  93 28.15 28.17 28.16 -125.93 -140.98 -133.46 -17.92 2  +/- 4.7054 5.4072 10.1051 1.3569  98 28.36 28.38 28.37 -104.80 -138.04 -121.42 -39.56 2  +/- 3.4778 4.8736 8.3161 2.7098  103 28.68 28.71 28.69 -120.09 -95.31 -107.70 29.49 2  +/- 3.4951 2.7085 6.1952 1.6965  108 28.89 28.92 28.90 -118.42 -88.02 -103.22 36.18 2  +/- 3.1760 2.1504 5.2900 1.8543  113 29.52 29.54 29.53 -110.41 -89.43 -99.92 24.98 1  +/- 2.1343 1.7557 3.8932 0.9732  118 29.73 29.75 29.74 -94.31 -104.97 -99.64 -12.69 1  +/- 2.0316 2.3851 4.4105 0.5615  123 30.05 30.07 30.06 -107.31 -185.81 -146.56 -93.45 2  +/- 2.7242 4.9559 7.6296 4.8651  128 30.25 30.28 30.27 -58.64 -174.50 -116.57 -137.93 2  +/- 1.5981 4.8215 6.3977 7.5704  133 30.58 30.60 30.59 -79.96 -119.00 -99.48 -46.48 2  +/- 2.4486 3.5268 5.9947 2.8009  138 30.78 30.81 30.80 -90.90 -140.57 -115.73 -59.13 2  +/- 2.8926 4.1739 7.1194 3.6375  143 31.11 31.13 31.12 -99.43 -132.16 -115.79 -38.96 2  +/- 3.0806 3.7509 6.8741 2.3131  148 31.32 31.34 31.33 -127.16 -128.93 -128.04 -2.11 2  +/- 3.3391 3.2402 6.5802 0.1082  153 31.64 31.67 31.65 -20.66 -107.04 -63.85 -102.83 1  +/- 0.3894 2.0113 2.4031 3.8702  158 31.85 31.88 31.87 -26.75 -87.58 -57.16 -72.42 1  +/- 0.4037 1.4014 1.7775 2.2519  163 32.18 32.20 32.19 23.20 -56.94 -16.87 -95.40 converging 0  +/- 0.2713 0.6925 0.4024 2.2757  168 32.39 32.41 32.40 13.02 -21.50 -4.24 -41.10 converging 0  +/- 0.1395 0.4684 0.1378 1.3356  173 32.71 32.74 32.72 5.46 7.77 6.61 2.75 0  +/- 0.0518 0.4546 0.4498 0.1867  178 32.91 32.94 32.93 29.47 -29.50 -0.01 -70.21 converging 0  +/- 0.2609 0.4709 0.0003 1.7420  183 33.24 33.27 33.25 26.96 38.35 32.65 13.56 0  +/- 0.2413 0.3513 0.5914 0.2456  188 33.46 33.48 33.47 -0.19 15.65 7.73 18.86 diverging 0  +/- 0.0017 0.1761 0.1565 0.3820  193 33.78 33.81 33.80 -16.91 -15.58 -16.25 1.58 0  +/- 0.1524 0.1443 0.2969 0.0288  198 34.00 34.03 34.01 -10.16 -42.90 -26.53 -38.98 0  +/- 0.0896 0.3759 0.4664 0.6854  203 34.34 34.36 34.35 -30.53 -63.98 -47.26 -39.82 0  +/- 0.2248 0.4967 0.7148 0.6024  208 34.54 34.57 34.55 -12.91 -39.82 -26.36 -32.03 0  +/- 0.0814 0.2637 0.3408 0.4141  40 East (positive eastward) Hmax: 250.0 emission layer: 210.0  rec UT1 UT2 UTmid LOS E iLOS W zonal Grad W->E code  hours hours hours m/s m/s m/s (m/s)/500km  2 23.28 23.30 23.29 88.82 116.91 102.86 -33.44 1  +/- 0.3575 0.6493 0.9853 0.3203  7 23.48 23.51 23.50 104.89 116.91 110.90 -14.31 0  +/- 0.4626 0.6493 1.1050 0.1425  12 23.81 23.83 23.82 95.62 116.91 106.26 -25.35 0  +/- 0.5833 0.6493 1.2384 0.2954  17 24.02 24.04 24.03 114.03 106.40 110.21 9.08 0  +/- 0.8263 0.6441 1.4659 0.1208  22 24.34 24.36 24.35 132.10 97.36 114.73 41.37 0  +/- 1.1116 0.7031 1.7940 0.6469  27 24.55 24.58 24.56 126.22 106.58 116.40 23.38 0  +/- 1.1103 0.8435 1.9451 0.3906  32 24.88 24.90 24.89 131.53 106.84 119.19 29.39 0  +/- 1.4061 0.9791 2.3664 0.5835  37 25.09 25.11 25.10 113.85 115.94 114.89 -2.49 0  +/- 1.3516 1.1893 2.5426 0.0551  42 25.42 25.44 25.43 108.27 128.13 118.20 -23.64 0  +/- 1.4646 1.5539 3.0323 0.6064  47 25.63 25.66 25.65 119.31 113.23 116.27 7.23 0  +/- 1.7166 1.5215 3.2352 0.2013  52 25.97 26.00 25.98 120.48 134.52 127.50 -16.71 1  +/- 2.1633 2.2617 4.4331 0.5811  57 26.18 26.20 26.19 122.74 109.09 115.92 16.25 1  +/- 2.4461 2.0334 4.4707 0.6268  62 26.51 26.53 26.52 160.82 103.44 132.13 68.30 2  +/- 4.2402 2.4423 6.6035 3.4136  67 26.71 26.74 26.72 134.20 92.44 113.32 49.71 2  +/- 4.1348 2.5282 6.5907 2.8913  72 27.04 27.06 27.05 165.97 116.07 141.02 59.40 2  +/- 7.2072 3.9007 10.8629 4.5758  87 27.78 27.81 27.79 166.13 48.68 107.41 139.82 2  +/- 6.7365 1.7231 8.1568 10.6182  92 28.11 28.13 28.12 86.32 104.00 95.16 -21.04 2  +/- 3.4749 3.6723 7.1908 1.5901  97 28.31 28.34 28.33 6.06 101.81 53.94 -113.98 2  +/- 0.2255 3.4175 3.8161 8.0644  102 28.64 28.67 28.66 -15.97 53.50 18.76 -82.70 converging 2  +/- 0.5111 1.6281 1.1716 5.1637  107 28.85 28.88 28.86 6.77 35.97 21.37 -34.77 2  +/- 0.1843 0.9473 1.1447 1.8624  112 29.48 29.50 29.49 -59.40 19.80 -19.80 -94.30 converging 1  +/- 1.1699 0.4021 0.7920 3.7719  117 29.69 29.71 29.70 -15.35 -5.77 -10.56 -11.40 1  +/- 0.3268 0.4008 0.9580 1.0340  122 30.01 30.04 30.02 -132.56 16.22 -58.17 -177.13 converging 2  +/- 3.3986 0.6253 3.7331 11.3675  127 30.22 30.24 30.23 -40.35 19.70 -10.32 -71.48 converging 2  +/- 1.0831 0.5211 0.5503 3.8101  132 30.54 30.56 30.55 -115.25 -38.92 -77.08 -90.86 2  +/- 3.4289 1.4131 5.0920 6.0021  137 30.75 30.77 30.76 -109.66 -56.32 -82.99 -63.50 2  +/- 3.4093 1.8383 5.2889 4.0466  142 31.07 31.10 31.08 -96.06 -70.20 -83.13 -30.79 2  +/- 2.8769 2.0937 4.9689 1.8402  147 31.28 31.30 31.29 -72.72 -98.61 -85.66 30.82 2  +/- 1.8536 2.5809 4.4257 1.5921  152 31.60 31.63 31.61 -93.61 -71.10 -82.36 -26.80 1  +/- 1.7404 1.4723 3.2364 1.0531  157 31.81 31.84 31.82 -86.30 -78.86 -82.58 -8.86 1  +/- 1.2996 1.2771 2.5810 0.2770  162 32.14 32.17 32.15 -93.28 -68.03 -80.66 -30.06 0  +/- 1.0668 0.8990 1.9883 0.7411  167 32.35 32.37 32.36 -81.86 -76.75 -79.30 -6.08 0  +/- 0.8380 0.8667 1.7075 0.1309  172 32.67 32.70 32.68 -61.28 -81.53 -71.40 24.10 0  +/- 0.5615 0.8156 1.3686 0.4620  177 32.88 32.90 32.89 -82.07 -77.94 -80.00 -4.92 0  +/- 0.7133 0.7272 1.4419 0.0887  182 33.20 33.23 33.22 -77.65 -81.55 -79.60 4.63 0  +/- 0.6611 0.7610 1.4205 0.0827  187 33.42 33.44 33.43 -96.70 -78.62 -87.66 -21.52 0  +/- 0.8339 0.7440 1.5855 0.3893  192 33.75 33.77 33.76 -108.48 -86.23 -97.35 -26.49 0  +/- 0.9334 0.8040 1.7454 0.4750  197 33.96 33.99 33.98 -69.10 -84.94 -77.02 18.86 0  +/- 0.5924 0.7780 1.3658 0.3345  202 34.29 34.32 34.31 -84.34 -86.95 -85.64 3.10 0  +/- 0.5743 0.7075 1.2801 0.0464  207 34.50 34.53 34.51 -90.55 -80.99 -85.77 -11.38 0  +/- 0.5092 0.6199 1.1389 0.1511  40 West (positive eastward) Hmax: 250.0 emission layer: 210.0  rec UT1 UT2 UTmid LOS W iLOS E zonal Grad W->E code  hours hours hours m/s m/s m/s (m/s)/500km  14 23.89 23.91 23.90 116.91 102.77 109.84 -16.83 0  +/- 0.6493 0.6777 1.3343 0.2045  19 24.09 24.12 24.10 100.07 118.31 109.19 21.72 0  +/- 0.6410 0.8939 1.5244 0.3032  24 24.42 24.44 24.43 96.48 129.88 113.18 39.76 0  +/- 0.7233 1.1111 1.8167 0.6382  29 24.63 24.65 24.64 112.53 127.48 120.00 17.80 0  +/- 0.9141 1.1802 2.0858 0.3094  34 24.96 24.98 24.97 105.00 124.69 114.85 23.43 0  +/- 1.0001 1.3851 2.3696 0.4835  39 25.17 25.19 25.18 122.84 112.48 117.66 -12.33 0  +/- 1.3086 1.3793 2.6962 0.2826  44 25.50 25.53 25.51 129.92 112.59 121.25 -20.63 0  +/- 1.6370 1.5632 3.2114 0.5464  49 25.72 25.74 25.73 102.46 119.60 111.03 20.41 0  +/- 1.4470 1.8285 3.2654 0.6003  54 26.05 26.08 26.06 144.64 121.36 133.00 -27.72 1  +/- 2.5188 2.2724 4.8065 1.0019  59 26.26 26.28 26.27 87.84 131.65 109.75 52.16 1  +/- 1.7433 2.8660 4.5671 2.1708  64 26.58 26.61 26.60 108.21 150.86 129.54 50.77 2  +/- 2.6559 4.2008 6.7863 2.6598  69 26.79 26.82 26.80 82.50 142.03 112.27 70.88 2  +/- 2.4477 4.8924 7.1979 4.5443  74 27.11 27.14 27.13 126.49 165.98 146.24 47.02 2  +/- 4.3517 7.1589 11.3382 3.6454  79 27.32 27.35 27.33 85.06 166.03 125.54 96.40 2  +/- 2.9665 7.0271 9.6921 7.4421  84 27.65 27.68 27.67 3.30 166.11 84.70 193.82 2  +/- 0.1181 6.8173 6.5105 14.8981  89 27.86 27.89 27.87 77.30 146.47 111.88 82.35 2  +/- 2.7349 5.9328 8.4905 6.2490  94 28.18 28.21 28.20 112.30 56.27 84.28 -66.71 2  +/- 3.9640 2.2580 6.3574 5.0319  99 28.39 28.42 28.41 95.20 0.69 47.95 -112.51 2  +/- 3.0738 0.2951 21.9207 51.4361  104 28.72 28.75 28.74 40.01 -7.16 16.43 -56.16 converging 2  +/- 1.1607 0.3845 1.3586 4.6447  109 28.93 28.95 28.94 33.55 -1.32 16.11 -41.51 converging 2  +/- 0.8193 0.3048 4.1105 10.5893  114 29.56 29.59 29.57 17.79 -42.36 -12.29 -71.60 converging 1  +/- 0.3409 0.8436 0.4802 2.7984  119 29.77 29.79 29.78 -19.88 -43.21 -31.55 -27.78 1  +/- 0.4366 1.0571 1.4646 1.2898  124 30.09 30.11 30.10 27.48 -97.98 -35.25 -149.36 converging 2  +/- 0.6841 2.5303 1.7877 7.5751  129 30.29 30.32 30.30 15.02 -58.11 -21.54 -87.06 converging 2  +/- 0.4234 1.6393 1.2147 4.9094  134 30.61 30.64 30.63 -55.63 -113.19 -84.41 -68.53 2  +/- 1.7195 3.4217 5.1609 4.1899  139 30.82 30.85 30.84 -56.73 -106.44 -81.58 -59.18 2  +/- 1.9078 3.2830 5.2601 3.8153  144 31.15 31.17 31.16 -74.38 -87.46 -80.92 -15.58 2  +/- 2.1512 2.4998 4.6533 0.8959  149 31.36 31.38 31.37 -112.74 -77.67 -95.21 41.75 2  +/- 2.8316 1.8268 4.6304 2.0305  154 31.68 31.70 31.69 -58.16 -90.92 -74.54 -39.00 1  +/- 1.0498 1.5780 2.6391 1.3808  159 31.89 31.92 31.90 -91.55 -88.00 -89.78 4.22 1  +/- 1.4165 1.2429 2.6570 0.1250  164 32.22 32.24 32.23 -60.82 -89.00 -74.91 -33.55 0  +/- 0.7405 0.9811 1.7379 0.7782  169 32.43 32.45 32.44 -86.74 -76.79 -81.76 11.84 0  +/- 0.9459 0.7700 1.7115 0.2478  174 32.75 32.77 32.76 -79.90 -69.10 -74.50 12.86 0  +/- 0.7750 0.6186 1.3895 0.2399  179 32.96 32.98 32.97 -76.69 -80.98 -78.83 -5.11 0  +/- 0.6969 0.7004 1.3982 0.0906  184 33.28 33.31 33.30 -83.14 -84.88 -84.01 -2.07 0  +/- 0.7821 0.7267 1.5095 0.0372  189 33.50 33.52 33.51 -75.87 -99.56 -87.72 -28.20 0  +/- 0.7209 0.8581 1.5895 0.5110  194 33.83 33.85 33.84 -89.58 -93.79 -91.68 -5.02 0  +/- 0.8308 0.8062 1.6384 0.0896  199 34.04 34.06 34.05 -82.34 -72.61 -77.48 11.59 0  +/- 0.7484 0.5882 1.3318 0.1992  204 34.37 34.40 34.39 -88.40 -86.75 -87.57 1.97 0  +/- 0.6945 0.5491 1.2424 0.0280  209 34.58 34.61 34.59 -76.28 -90.55 -83.42 -17.00 0  +/- 0.5724 0.5092 1.0951 0.2231  38 zenith rest positions and relative vertical velocity (negative downward)  vertical velocity is relative to the nightly average  rec UT1 UT2 UTmid bin Ebin vel. z E vel. code  hrs. hrs. hrs. # # m/s m/s  5 23.41 23.43 23.42 65.239 0.2858 -14.6 0.1 0  order # 2 149.214 0.3144  order # 3 233.058 0.3341  order # 4 316.920 0.3527  order # 5 400.799 0.3723  10 23.73 23.75 23.74 65.193 0.4093 -14.1 0.1 0  order # 2 149.038 0.4489  order # 3 233.210 0.4788  order # 4 316.930 0.5066  order # 5 400.764 0.5367  15 23.94 23.96 23.95 65.227 0.5047 -13.4 0.1 0  order # 2 148.949 0.5574  order # 3 233.130 0.6014  order # 4 316.869 0.6264  order # 5 400.879 0.6731  20 24.26 24.29 24.27 65.160 0.6126 -19.1 0.2 0  order # 2 149.040 0.6714  order # 3 233.070 0.7116  order # 4 317.064 0.7654  order # 5 400.897 0.8184  25 24.47 24.49 24.48 65.112 0.6485 -0.7 0.0 0  order # 2 149.043 0.7198  order # 3 233.119 0.7730  order # 4 316.685 0.8197  order # 5 400.650 0.8567  30 24.80 24.82 24.81 65.013 0.7320 -10.5 0.1 0  order # 2 149.146 0.8061  order # 3 233.050 0.8455  order # 4 316.783 0.9236  order # 5 400.877 0.9773  35 25.01 25.03 25.02 65.257 0.8301 -15.7 0.2 0  order # 2 149.023 0.9053  order # 3 233.184 0.9961  order # 4 316.584 1.0448  order # 5 401.114 1.1211  40 25.34 25.36 25.35 65.080 1.0103 6.5 0.1 0  order # 2 148.818 1.1454  order # 3 233.072 1.2472  order # 4 316.472 1.2856  order # 5 400.755 1.3851  45 25.55 25.58 25.56 65.335 1.1312 9.9 0.2 1  order # 2 148.890 1.2366  order # 3 233.034 1.3757  order # 4 316.565 1.4360  order # 5 400.509 1.5370  50 25.89 25.91 25.90 65.586 1.3520 -4.4 0.1 1  order # 2 149.100 1.4736  order # 3 233.228 1.6106  order # 4 316.776 1.6994  order # 5 400.458 1.9278  55 26.10 26.13 26.12 65.169 1.5952 -6.9 0.2 2  order # 2 148.835 1.7163  order # 3 232.899 1.7903  order # 4 317.088 1.8759  order # 5 400.712 2.0087  60 26.43 26.45 26.44 65.520 1.8348 -20.9 0.6 2  order # 2 148.669 2.1098  order # 3 233.632 2.2086  order # 4 316.719 2.2606  order # 5 400.960 2.5584  65 26.63 26.66 26.65 65.316 2.2246 0.8 0.0 2  order # 2 148.560 2.3409  order # 3 232.948 2.6348  order # 4 317.507 2.8511  order # 5 400.249 2.7692  70 26.96 26.99 26.97 65.481 3.0313 13.7 0.6 2  order # 2 148.759 3.1538  order # 3 233.319 3.4464  order # 4 316.145 3.4335  order # 5 400.616 4.2142  90 28.03 28.06 28.04 65.773 3.0335 2.9 0.1 2  order # 2 148.459 3.1153  order # 3 232.936 3.5072  order # 4 316.019 4.1191  order # 5 401.317 4.1054  95 28.24 28.26 28.25 65.162 2.7906 26.8 1.2 2  order # 2 148.595 3.4346  order # 3 233.049 3.6602  order # 4 316.502 3.6122  order # 5 400.220 4.0363  100 28.56 28.59 28.58 64.961 2.5492 14.4 0.6 2  order # 2 148.610 2.8975  order # 3 232.493 3.0459  order # 4 316.729 3.3091  order # 5 400.809 3.5443  105 28.78 28.80 28.79 65.419 2.3095 27.0 1.0 2  order # 2 148.876 2.4747  order # 3 233.162 2.6346  order # 4 316.150 2.8718  order # 5 400.252 2.9734  110 29.40 29.43 29.42 65.156 1.6166 6.9 0.2 2  order # 2 148.896 1.8384  order # 3 233.133 1.9072  order # 4 316.390 2.2033  order # 5 400.702 2.1854  115 29.61 29.64 29.62 65.323 1.6055 5.9 0.1 2  order # 2 148.993 1.8780  order # 3 232.849 2.2491  order # 4 316.686 2.0984  order # 5 400.586 2.4544  120 29.93 29.96 29.95 65.134 2.1411 17.5 0.6 2  order # 2 148.600 2.2610  order # 3 232.347 2.3866  order # 4 316.322 2.7611  order # 5 401.122 2.8066  125 30.14 30.16 30.15 65.232 2.1101 42.9 1.4 2  order # 2 148.409 2.4202  order # 3 232.375 2.5786  order # 4 316.078 2.8254  order # 5 400.600 2.8979  130 30.46 30.49 30.47 64.935 2.3612 16.0 0.6 2  order # 2 148.754 2.9772  order # 3 233.020 3.3435  order # 4 316.307 3.2111  order # 5 400.715 3.4198  135 30.67 30.69 30.68 65.162 2.4812 44.7 1.7 2  order # 2 148.448 2.8149  order # 3 232.804 3.3385  order # 4 316.334 3.2245  order # 5 400.060 3.5521  140 30.99 31.02 31.01 65.106 2.6156 4.8 0.2 2  order # 2 148.725 2.9056  order # 3 232.978 3.1680  order # 4 316.371 3.3752  order # 5 400.976 3.4569  145 31.20 31.22 31.21 64.945 2.2935 2.6 0.1 2  order # 2 148.460 2.4219  order # 3 232.996 2.7869  order # 4 317.110 2.7824  order # 5 400.562 3.0816  150 31.53 31.55 31.54 64.974 1.7636 -19.3 0.5 2  order # 2 148.832 2.0395  order # 3 233.084 1.9861  order # 4 317.119 2.2891  order # 5 400.990 2.4123  155 31.73 31.75 31.74 65.037 1.3883 6.2 0.1 1  order # 2 148.665 1.5044  order # 3 233.053 1.7313  order # 4 316.567 1.7851  order # 5 400.773 1.8579  160 32.06 32.09 32.07 64.887 1.0346 -2.6 0.0 0  order # 2 148.779 1.1202  order # 3 232.968 1.2159  order # 4 316.653 1.2678  order # 5 401.005 1.4248  165 32.27 32.29 32.28 65.144 0.8854 1.1 0.0 0  order # 2 148.952 0.9850  order # 3 232.758 1.0804  order # 4 316.706 1.1124  order # 5 400.845 1.2048  170 32.60 32.62 32.61 65.215 0.7863 -23.3 0.3 0  order # 2 149.201 0.8925  order # 3 233.178 0.9836  order # 4 316.947 0.9955  order # 5 400.964 1.1022  175 32.80 32.82 32.81 65.190 0.7218 0.7 0.0 0  order # 2 148.943 0.8032  order # 3 233.127 0.8880  order # 4 316.845 0.9040  order # 5 400.491 0.9849  180 33.13 33.15 33.14 65.213 0.6884 -20.4 0.2 0  order # 2 148.943 0.7707  order # 3 233.258 0.8421  order # 4 317.100 0.8783  order # 5 400.813 0.9490  185 33.33 33.36 33.35 65.107 0.7306 -15.8 0.2 0  order # 2 149.115 0.8125  order # 3 233.238 0.8908  order # 4 316.855 0.9354  order # 5 400.843 0.9959  190 33.67 33.69 33.68 65.139 0.7205 -2.2 0.0 0  order # 2 148.966 0.8016  order # 3 233.069 0.8531  order # 4 316.791 0.8892  order # 5 400.665 0.9546  195 33.88 33.90 33.89 65.176 0.7377 -2.5 0.0 0  order # 2 148.942 0.8139  order # 3 233.077 0.8855  order # 4 316.807 0.9155  order # 5 400.656 0.9931  200 34.21 34.23 34.22 65.241 0.6618 -19.1 0.2 0  order # 2 149.093 0.7309  order # 3 233.263 0.7976  order # 4 317.155 0.8365  order # 5 400.654 0.8897  205 34.42 34.45 34.44 65.250 0.5277 -25.6 0.2 0  order # 2 149.183 0.5903  order # 3 233.257 0.6382  order # 4 316.847 0.6680  order # 5 401.068 0.7176  Raw data available upon request |

## Data Interpretation

* Not a number (NaN) are printed in the data product files as a string of “\*” characters.
* Zonal (meridional) winds are reported as 0 m/sec when there no measurements in the East or West (North or South) measurements. The Line-of-sight winds are, however, reported. For example, if there are no West measurements for the night of observation, but 8 East measurements, then the LOS (East) winds are reported; however, the zonal wind measurements are reported as 0 m/sec, and the wind description is indicated as “No zonal V”. Likewise, if there are no South measurements for the night of observation, but some North measurements, then the LOS (North) winds are reported; however, the meridional wind measurements are reported as 0 m/sec, and the wind description is indicated as “No merid V”.

## Note on Criteria for determining Data Quality

A data quality code of 1 is assigned when any of the following is true:  
\* total residuals in the fit is greater than 25.0 a.d.u (implies moderate residual sum while fitting the data)  
\* y-intercept of the linear background fit is greater than 50 a.d.u (implies moderate background levels)  
\* signal-to-background ratio of the first order is less than 0.75  
\* moon - percentage of synodic cycle is greater than 75%  
  
A data quality code of 2 is assigned when any of the following is true:  
\* total residuals in the fit is greater than 75.0 a.d.u  (implies large residual sum while fitting the data)  
\* y-intercept of the linear background fit is greater than 200 a.d.u  (implies large background levels)  
\* signal-to-background ratio of the first order is less than 0.5  
\* moon - percentage of synodic cycle is greater than 90%  
  
Therefore, a data quality of 0 is assigned to the sky measurement only when ALL of the following are true:  
\* total residuals in the fit is less than 25.0 a.d.u   (implies low residuals while fitting the data)  
\* y-intercept of the linear background fit is less than 50 a.d.u  (implies low background)  
\* signal-to-background ratio of the first order is greater than 0.75  
\* moon - percentage of synodic cycle is less than 75%