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## Datagrams: Summit



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# MWR-HF: High Frequency Microwave Radiometer HATPRO: Humidity and Temperature Profiler

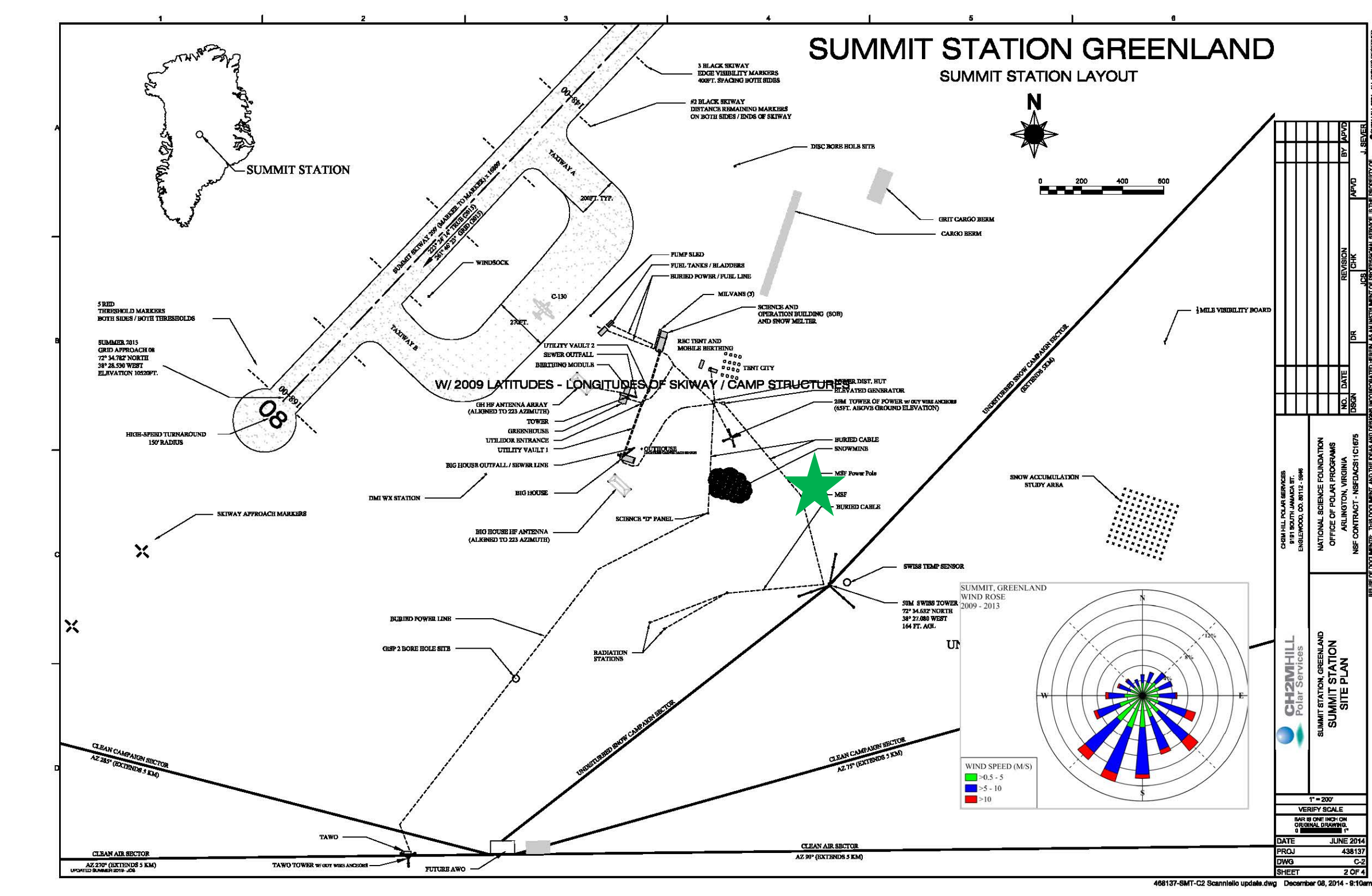
File metadata: MET, LV0, HKD, SL.HKD, BRT

| File Type                                                               | mmcr sub-folder | File Names                       | File Location NOAA ftp                             |
|-------------------------------------------------------------------------|-----------------|----------------------------------|----------------------------------------------------|
| Meteorological Sensors                                                  | MET             | smtmwrL0_YYMMDD_hhmmss.MET.nc    | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/raw/ |
| Level Zero (detector voltages)                                          | LV0             | smtmwrL0_YYMMDD_hhmmss.LV0.nc    | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/raw/ |
| HATPRO Housekeeping Data File                                           | HKD             | smtmwrL0_YYMMDD_hhmmss.HKD.nc    | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/raw/ |
| HF (slave) Housekeeping Data File                                       | SL.HKD          | smtmwrL0_YYMMDD_hhmmss.SL.HKD.nc | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/raw/ |
| Brightness Temperature (use other brightness temps in calibrated files) | BRT             | smtmwrL0_YYMMDD_hhmmss.BRT.nc    | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/raw/ |

Data

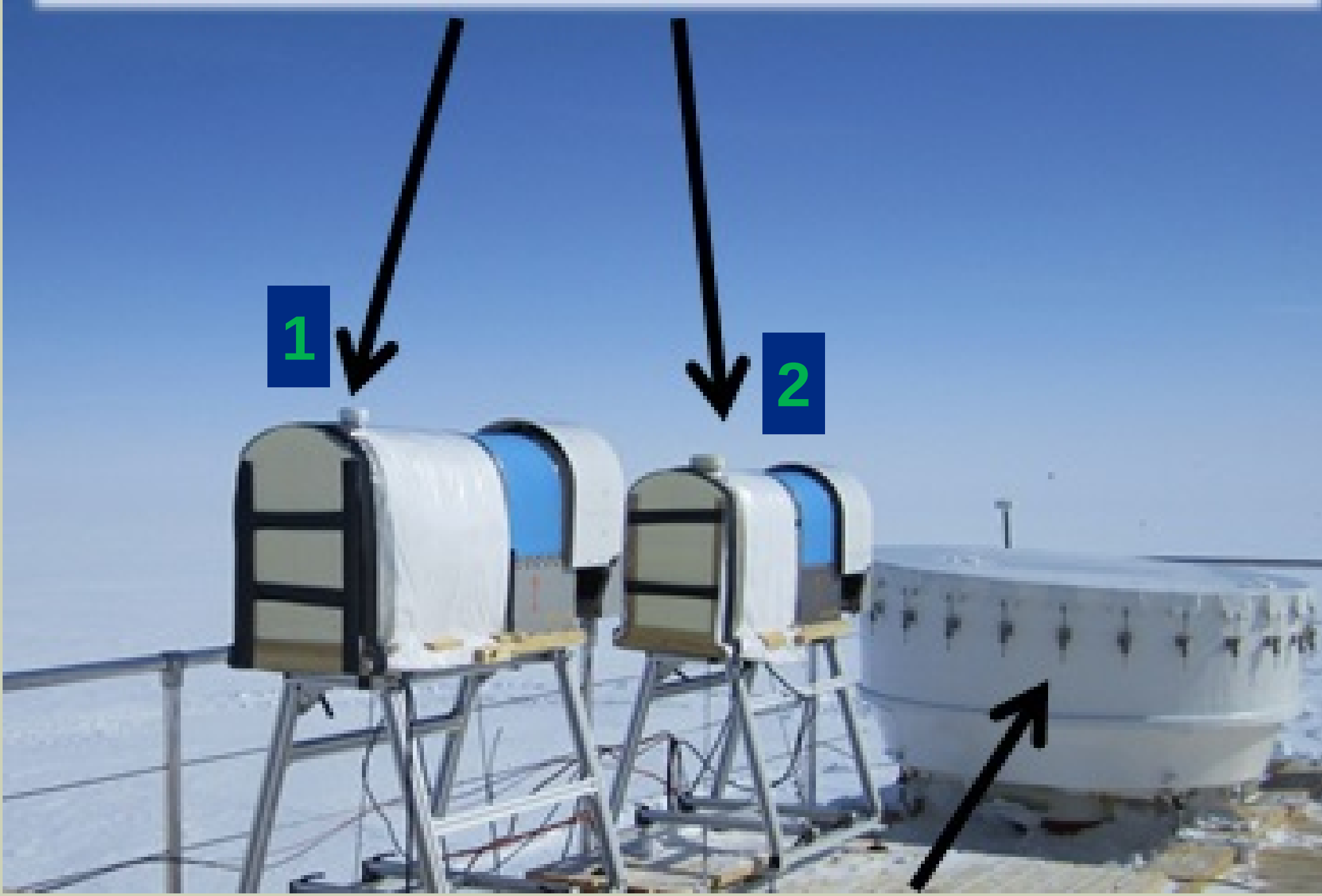
Diagnostics

Logger Info



★ Indicates current location of instrument

### Microwave Radiometers: PWV, LWP, T



Quicklooks

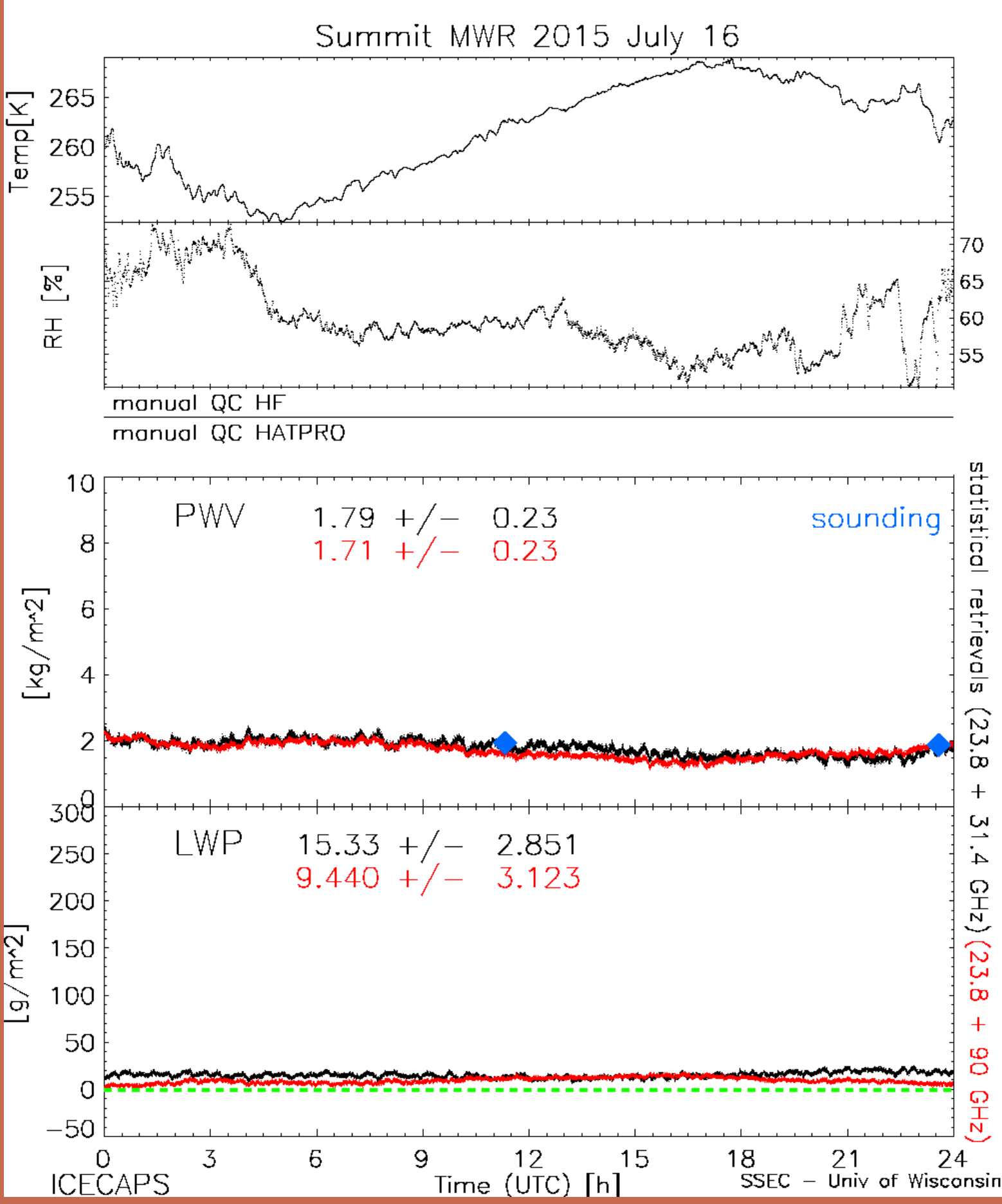
Processing

Automated calibration and application of multichannel retrievals for water vapor, cloud liquid water, and temperature profiles.

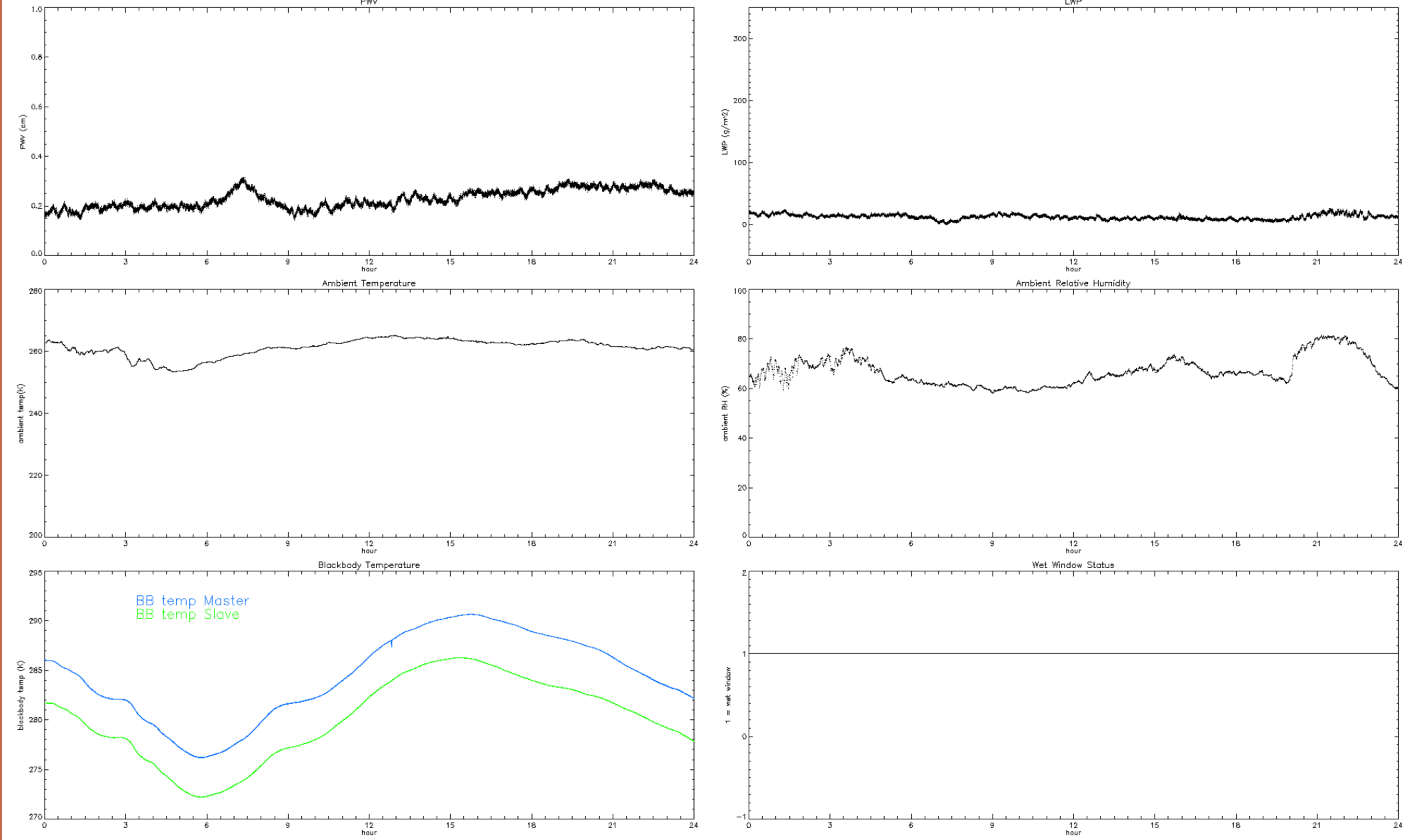
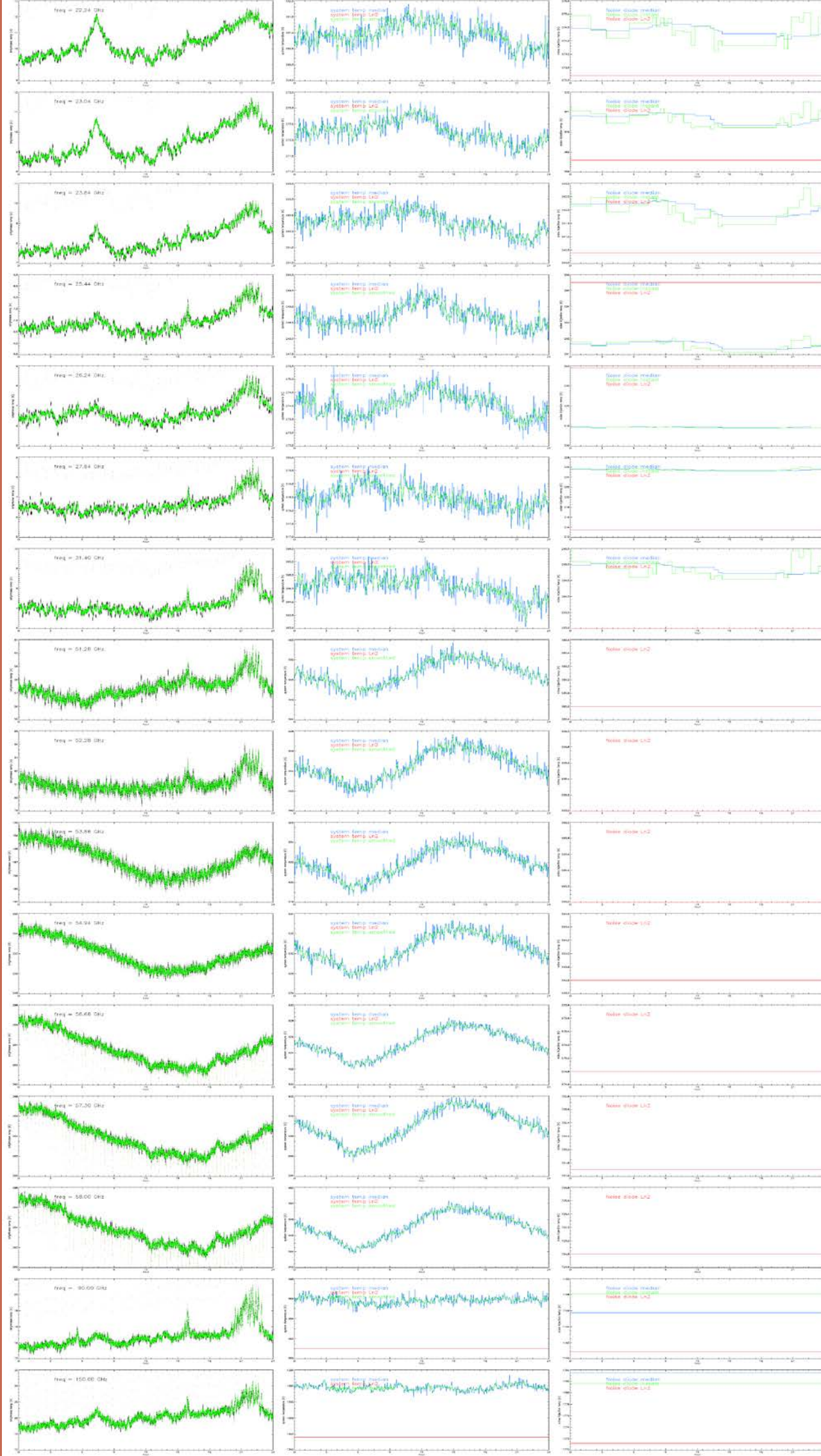
References:

- 1) Liljegren JC, 2000: Automatic self-calibration of the ARM microwave radiometers. Microwave Radiometry and Remote Sensing of the Environment, P. Pampaloni and S. Palencia, Eds., 433-443, VSP Press, Utrecht, The Netherlands.
- 2) Turner, DD, SA Clough, JC Liljegren, EE Clothiaux, K Cady-Pereira, and KL Gaustad, 2007: Retrieving liquid water path and precipitable water vapor from the Atmospheric Radiation Measurement (ARM) microwave radiometers. IEEE Trans. Geosci. Remote sens., 45, 3680-3690.

| Instrument Details                           |                                                                                                                                                       |       |       |       |                                                                                                                                                       |       |       |       |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|
| Specifications                               | 1                                                                                                                                                     |       |       |       | 2                                                                                                                                                     |       |       |       |
| Measurement                                  | Precipitable water vapor, liquid water path, temperature                                                                                              |       |       |       | Precipitable water vapor, liquid water path, temperature                                                                                              |       |       |       |
| Serial #                                     | R-150+90-07/003                                                                                                                                       |       |       |       | R-DPR-07/007                                                                                                                                          |       |       |       |
| Instrument Manufacturer                      | In-house build; no specific manufacturer                                                                                                              |       |       |       | In-house build; no specific manufacturer                                                                                                              |       |       |       |
| Type                                         | RPG: MWRHF                                                                                                                                            |       |       |       | RPG: HATPRO                                                                                                                                           |       |       |       |
| Location                                     | Roof of the MSF                                                                                                                                       |       |       |       | Roof of the MSF                                                                                                                                       |       |       |       |
| Calibration factors                          | Tip Curve calibration; Scanning Strategy: $T_b = (V_{\text{sky}}/G)^{1/\alpha} - T_{\text{sys}}$                                                      |       |       |       | LN2 calibration; Scanning Strategy: $T_b = (V_{\text{sky}}/G)^{1/\alpha} - T_{\text{sys}}$                                                            |       |       |       |
| Additional Corrections Applied (y/n/explain) | <a href="http://www.radiometer-physics.de/rpg/html/Products_Radiometers.html">http://www.radiometer-physics.de/rpg/html/Products_Radiometers.html</a> |       |       |       | <a href="http://www.radiometer-physics.de/rpg/html/Products_Radiometers.html">http://www.radiometer-physics.de/rpg/html/Products_Radiometers.html</a> |       |       |       |
| K-band                                       | Center                                                                                                                                                | 22.24 | 23.04 | 23.84 | 25.44                                                                                                                                                 | 26.24 | 27.84 | 31.40 |
|                                              | Bandwidth                                                                                                                                             | 0.230 |       |       |                                                                                                                                                       |       |       |       |
| V-band                                       | Center                                                                                                                                                | 51.26 | 52.28 | 53.86 | 54.94                                                                                                                                                 | 56.66 | 57.30 | 58.00 |
|                                              | Bandwidth                                                                                                                                             | 0.182 | 0.179 | 0.188 | 0.170                                                                                                                                                 | 0.704 | 0.927 | 1.854 |
| HF                                           | Center                                                                                                                                                | 90.0  | 150.0 |       |                                                                                                                                                       |       |       |       |
|                                              | Bandwidth                                                                                                                                             | 2.000 |       |       |                                                                                                                                                       |       |       |       |



Example Plots:



Home:

<http://www.esrl.noaa.gov/psd/iasoa/>

Data:

<http://www.esrl.noaa.gov/psd/iasoa/dataataglace>

Home:

[www.archive.arm.gov](http://www.archive.arm.gov)

ARM Archive

IASOA Portal

Product

Product File:

| File Type                                                                                                                                                                                                                                                                                                                                                                                           | File Names                               | File Location NOAA ftp                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------------------------------------------------------------------|
| Ingested files of all the calibrated brightness temperatures and associated calibration values. Calibration is performed very similarly to Liljegren 2000 using code developed by M. Cadetdu. Also includes statistical retrieval of LWP and PWV using two different combinations of channels described and evaluated in Miller 2012 MS thesis. Also Includes manual QC values for each radiometer. | smtmwrlosX1.a1.YYYYMMDD.hhmmss.cdf       | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/processed/                  |
| MWRRET retrieved values of LWP and PWV similar to Tuner et. al. 2007.                                                                                                                                                                                                                                                                                                                               | smtmwrret2turnX1.c1.YYYYMMDD.hhmmss.cdf  | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/mwrret/                     |
| Statistical retrieval of temperature profiles as described in Miller et.al. 2013 JGR                                                                                                                                                                                                                                                                                                                | smtmwrprof1millX1.c1.YYYYMMDD.hhmmss.cdf | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/mwrstattemptret/            |
| Quicklooks of PWV and LWP from files: smtmwrlosX1.a1.YYYYMMDD.hhmmss.cdf                                                                                                                                                                                                                                                                                                                            | smtmwr.YYYYMMDD.pwvlp.png                | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/quicklooks/                 |
| Quicklooks of brightness temp (w/ smoothed brightness temps in green) system temp, and noise diode temp from files: smtmwrlosX1.a1.YYYYMMDD.hhmmss.cdf                                                                                                                                                                                                                                              | smtmwr.YYYYMMDD.tbndsys.png              | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/quicklooks/                 |
| Quicklooks of the receiver and blackbody cavity temps from HATPRO (master) and HF (slave) as taken from the housekeeping (*.HKD) files                                                                                                                                                                                                                                                              | smtmwr.YYYYMMDD.internatemp.png          | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/quicklooks/diagnostics/     |
| Quicklooks of the brightness temps for the Summit browser from files: smtmwrlosX1.a1.YYYYMMDD.hhmmss.cdf                                                                                                                                                                                                                                                                                            | smtmwr.level1.YYYYMMDD.tbs.png           | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/quicklooks/measurements/    |
| Quicklooks of the statistical LWP and PWV retrievals from the files: smtmwrlosX1.a1.YYYYMMDD.hhmmss.cdf                                                                                                                                                                                                                                                                                             | smtmwr.level2.YYYYMMDD.pwvlp.png         | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/quicklooks/retrievals/      |
| Old (outdated) files. Updated plots: smtmwrprof1millX1.c1.YYYYMMDD.hhmmss.cdf                                                                                                                                                                                                                                                                                                                       | smtmwr.level2.YYYYMMDD.temp.png          | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/quicklooks/retrievals/      |
| Quicklooks of the temp profiles from the files: smtmwrprof1millX1.c1.YYYYMMDD.hhmmss.cdf                                                                                                                                                                                                                                                                                                            | smtmwr.level2.YYYYMMDD.tempprof.png      | ftp://ftp.etl.noaa.gov/psd3/arctic/summit/mwr/quicklooks/temp_retrievals/ |

Official Data Submission to an Archive

Data Cable

rsync

NOAA server



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Datagrams:  
Summit



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MWR-HF: High Frequency Microwave Radiometer

HATPRO: Humidity and Temperature Profiler

MET and LV0 netCDF Metadata

|                                          |                                           |                                    |
|------------------------------------------|-------------------------------------------|------------------------------------|
| File name: smtmwrL0_150715_231755.MET.nc | Path: summit\mwr\raw\                     |                                    |
| Attributes                               |                                           |                                    |
| Name                                     | Value                                     |                                    |
| 'netCDF_convention'                      | ' CF-1.0'                                 |                                    |
| 'radiometer_location'                    | ' University of Madison'                  |                                    |
| 'radiometer_system'                      | ' RPG-HATPRO'                             |                                    |
| 'serial_number'                          | ' R-DPR-07/007'                           |                                    |
| 'station_altitude'                       | '10500'                                   |                                    |
| 'station_longitude'                      | '38°27'13"" West'                         |                                    |
| 'station_latitude'                       | '72°34'41"" North'                        |                                    |
| 'comments'                               | ' Greenland Summit Station'               |                                    |
| 'Master_radiometer_software_version'     | 'V8.12'                                   |                                    |
| 'Slave_radiometer_software_version'      | 'V8.12'                                   |                                    |
| 'host_PC_software_version'               | 'V8.12'                                   |                                    |
| Dimensions                               |                                           |                                    |
| Name                                     | Length                                    |                                    |
| time                                     | 1258                                      |                                    |
| Variables                                |                                           |                                    |
| Name                                     | Long name                                 | Units                              |
| 'number_integrated_samples'              |                                           |                                    |
| 'time_reference'                         | 'flag indicating the time zone reference' | 'unitless'                         |
| 'minimum_P'                              | units                                     | mbar                               |
| 'maximum_P'                              | units                                     | mbar                               |
| 'minimum_T'                              | units                                     | K                                  |
| 'maximum_T'                              | units                                     | K                                  |
| 'minimum_H'                              | units                                     | %                                  |
| 'maximum_H'                              | units                                     | %                                  |
| 'time'                                   | 'sample time'                             | 'seconds since 1.1.2001, 00:00:00' |
| 'rain_flag'                              | Info                                      | 0 = No Rain, 1 = Raining           |
| 'env_pressure'                           | units                                     | mbar                               |
| 'env_temperature'                        | 'environmental temperature'               | K                                  |
| 'env_relative_humidity'                  | units                                     | %                                  |

|                                          |                                                                   |                                                                                                      |                                 |
|------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------|
| File name: smtmwrL0_150715_231755.LV0.nc | Path: summit\mwr\raw\                                             |                                                                                                      |                                 |
| Attributes                               |                                                                   |                                                                                                      |                                 |
| Name                                     | Value                                                             |                                                                                                      |                                 |
| 'netCDF_convention'                      | ' CF-1.0'                                                         |                                                                                                      |                                 |
| 'radiometer_location'                    | ' University of Madison'                                          |                                                                                                      |                                 |
| 'radiometer_system'                      | ' RPG-HATPRO'                                                     |                                                                                                      |                                 |
| 'serial_number'                          | ' R-DPR-07/007'                                                   |                                                                                                      |                                 |
| 'station_altitude'                       | '10500'                                                           |                                                                                                      |                                 |
| 'station_longitude'                      | '38°27'13"" West'                                                 |                                                                                                      |                                 |
| 'station_latitude'                       | '72°34'41"" North'                                                |                                                                                                      |                                 |
| 'comments'                               | ' Greenland Summit Station'                                       |                                                                                                      |                                 |
| 'Master_radiometer_software_version'     | 'V8.12'                                                           |                                                                                                      |                                 |
| 'Slave_radiometer_software_version'      | 'V8.12'                                                           |                                                                                                      |                                 |
| 'host_PC_software_version'               | 'V8.12'                                                           |                                                                                                      |                                 |
| Dimensions                               |                                                                   |                                                                                                      |                                 |
| Name                                     | Length                                                            |                                                                                                      |                                 |
| 'time'                                   | 1258                                                              |                                                                                                      |                                 |
| 'frequency'                              | 16                                                                |                                                                                                      |                                 |
| 'IR_radiometers'                         | 1                                                                 |                                                                                                      |                                 |
| Variables                                |                                                                   |                                                                                                      |                                 |
| Name                                     | Long name                                                         | Units                                                                                                | Format                          |
| 'time_reference'                         | 'flag indicating the time zone reference'                         | 'unitless'                                                                                           |                                 |
| 'Master_ID'                              | comment                                                           | '0=NO RAD,1=RPG-TEMPRO,2=RPG-HUMPRO,3=RPG-HATPRO,4=RPG-15-90,5=RPG-LHATPRO,6=RPG-150-90,7=RPG-36-90' |                                 |
| 'Slave_ID'                               | comment                                                           | '0=NO RAD,1=RPG-TEMPRO,2=RPG-HUMPRO,3=RPG-HATPRO,4=RPG-15-90,5=RPG-LHATPRO,6=RPG-150-90,7=RPG-36-90' |                                 |
| 'lon'                                    | 'GPS longitude'                                                   | 'Degrees.Minutes East'                                                                               | 'DDMM.mmmm, D=Degree, M=Minute' |
| 'lat'                                    | 'GPS latitude'                                                    | 'Degrees.Minutes North'                                                                              | 'DDMM.mmmm, D=Degree, M=Minute' |
| 'alt'                                    | 'station altitude'                                                | 'meters above mean sea level'                                                                        |                                 |
| 'time'                                   | 'sample time'                                                     | 'seconds since 1.1.2001, 00:00:00'                                                                   |                                 |
| 'frequency'                              | 'channel center frequency'                                        | 'GHz'                                                                                                |                                 |
| 'IR_wavelengths'                         | 'channel center wavelength'                                       | 'um'                                                                                                 |                                 |
| 'Master_bb_temperature'                  | 'temperature of Master radiometer ambient blackbody target'       | 'K'                                                                                                  |                                 |
| 'Master_status_flags'                    | 'Master radiometer status flags'                                  | 'unitless'                                                                                           |                                 |
| 'Slave_bb_temperature'                   | 'temperature of Slave radiometer ambient blackbody target'        | 'K'                                                                                                  |                                 |
| 'Slave_status_flags'                     | 'Slave radiometer status flags'                                   | 'unitless'                                                                                           |                                 |
| 'env_pressure'                           | 'environmental (atmospheric) pressure'                            | 'hPa'                                                                                                |                                 |
| 'env_temperature'                        | 'environmental temperature'                                       | 'K'                                                                                                  |                                 |
| 'env_relative_humidity'                  | 'environmental relative humidity'                                 | '%'                                                                                                  |                                 |
| 'elevation_angle'                        | 'viewing_elevation angle'                                         | 'degrees'                                                                                            |                                 |
| 'azimuth_angle'                          | 'viewing azimuth angle'                                           | 'degrees'                                                                                            |                                 |
| 'IR_temperatures'                        | 'infrared radiometer brightness temperature'                      | 'C'                                                                                                  |                                 |
| 'detector_voltages'                      | 'voltages detected by the microwave radiometer channels'          | 'V'                                                                                                  |                                 |
| 'alpha'                                  | 'Non-Linearity / Dicke Switch Leakage calibration parameter'      | 'unitless'                                                                                           |                                 |
| 'DeltaT'                                 | 'difference of Dicke Switch physical and radiometric temperature' | 'Kelvin'                                                                                             |                                 |
| 'gain'                                   | 'channel gain (sensitivity)'                                      | 'V / K'                                                                                              |                                 |
| 'sys_noise_temperature'                  | 'system noise temperature'                                        | 'K'                                                                                                  |                                 |
| 'noise_diode_temperature'                | 'noise diode temperature'                                         | 'K'                                                                                                  |                                 |



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Summit



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MWR-HF: High Frequency Microwave Radiometer

HATPRO: Humidity and Temperature Profiler

HKD, SL.HKD, and BRT netCDF Metadata

|                                          |                                           |                                    |                                                         |
|------------------------------------------|-------------------------------------------|------------------------------------|---------------------------------------------------------|
| File name: smtmwrl0_150715_231755.HKD.nc | Path: summit\mwr\raw\                     |                                    |                                                         |
| Attributes                               |                                           |                                    |                                                         |
| Name                                     | Value                                     |                                    |                                                         |
| 'netCDF_convention'                      | ' CF-1.0'                                 |                                    |                                                         |
| 'radiometer_location'                    | ' University of Madison'                  |                                    |                                                         |
| 'radiometer_system'                      | ' RPG-HATPRO'                             |                                    |                                                         |
| 'serial_number'                          | ' R-DPR-07/007'                           |                                    |                                                         |
| 'station_altitude'                       | '10500'                                   |                                    |                                                         |
| 'station_longitude'                      | '38°27'13'"" West'                        |                                    |                                                         |
| 'station_latitude'                       | '72°34'41'"" North'                       |                                    |                                                         |
| 'comments'                               | ' Greenland Summit Station'               |                                    |                                                         |
| 'Master_radiometer_software_version'     | 'V8.12'                                   |                                    |                                                         |
| 'Slave_radiometer_software_version'      | 'V8.12'                                   |                                    |                                                         |
| 'host_PC_software_version'               | 'V8.12'                                   |                                    |                                                         |
| Dimensions                               |                                           |                                    |                                                         |
| Name                                     | Length                                    |                                    |                                                         |
| time                                     | 128                                       |                                    |                                                         |
| Variables                                |                                           |                                    |                                                         |
| Name                                     | Long name                                 | Units                              |                                                         |
| 'time_reference'                         | 'flag indicating the time zone reference' | 'unitless'                         | '0 = local time, 1 = UTC'                               |
| 'enable_flags'                           |                                           |                                    |                                                         |
| 'time'                                   | 'sample time'                             | 'seconds since 1.1.2001, 00:00:00' | 'reference time zone indicated in field time_reference' |
| 'alarm_flag'                             | 'Info'                                    | '0 = OK, 1 = Alarm'                |                                                         |
| 'ambient_Target1_temperature'            | 'units'                                   | 'K'                                |                                                         |
| 'ambient_Target2_temperature'            | 'units'                                   | 'K'                                |                                                         |
| 'receiver1_temperature'                  | 'units'                                   | 'K'                                |                                                         |
| 'receiver2_temperature'                  | 'units'                                   | 'K'                                |                                                         |
| 'stability_rec1'                         | 'units'                                   | 'K'                                |                                                         |
| 'stability_rec2'                         | 'units'                                   | 'K'                                |                                                         |
| 'free_flash_memory'                      | 'unit'                                    | 'kBytes'                           |                                                         |
| 'quality_flags'                          |                                           |                                    |                                                         |
| 'status_flags'                           | 'radiometer status flags'                 | 'unitless'                         |                                                         |

|                                             |                                           |                                    |                                                         |
|---------------------------------------------|-------------------------------------------|------------------------------------|---------------------------------------------------------|
| File name: smtmwrl0_150715_231749.SL.HKD.nc | Path: summit\mwr\raw\                     |                                    |                                                         |
| Attributes                                  |                                           |                                    |                                                         |
| Name                                        | Value                                     |                                    |                                                         |
| 'netCDF_convention'                         | ' CF-1.0'                                 |                                    |                                                         |
| 'radiometer_location'                       | ' University of Madison'                  |                                    |                                                         |
| 'radiometer_system'                         | ' RPG-HATPRO'                             |                                    |                                                         |
| 'serial_number'                             | ' R-DPR-07/007'                           |                                    |                                                         |
| 'station_altitude'                          | '10500'                                   |                                    |                                                         |
| 'station_longitude'                         | '38°27'13'"" West'                        |                                    |                                                         |
| 'station_latitude'                          | '72°34'41'"" North'                       |                                    |                                                         |
| 'comments'                                  | ' Greenland Summit Station'               |                                    |                                                         |
| 'Master_radiometer_software_version'        | 'V8.12'                                   |                                    |                                                         |
| 'Slave_radiometer_software_version'         | 'V8.12'                                   |                                    |                                                         |
| 'host_PC_software_version'                  | 'V8.12'                                   |                                    |                                                         |
| Dimensions                                  |                                           |                                    |                                                         |
| Name                                        | Length                                    |                                    |                                                         |
| time'                                       | 1381                                      |                                    |                                                         |
| Variables                                   |                                           |                                    |                                                         |
| Name                                        | Long name                                 | Units                              |                                                         |
| 'time_reference'                            | 'flag indicating the time zone reference' | 'unitless'                         | '0 = local time, 1 = UTC'                               |
| 'enable_flags'                              |                                           |                                    |                                                         |
| 'time'                                      | 'sample time'                             | 'seconds since 1.1.2001, 00:00:00' | 'reference time zone indicated in field time_reference' |
| 'alarm_flag'                                | 'Info'                                    | '0 = OK, 1 = Alarm'                |                                                         |
| 'ambient_Target1_temperature'               | 'units'                                   | 'K'                                |                                                         |
| 'ambient_Target2_temperature'               | 'units'                                   | 'K'                                |                                                         |
| 'receiver1_temperature'                     | 'units'                                   | 'K'                                |                                                         |
| 'receiver2_temperature'                     | 'units'                                   | 'K'                                |                                                         |
| 'stability_rec1'                            | 'units'                                   | 'K'                                |                                                         |
| 'stability_rec2'                            | 'units'                                   | 'K'                                |                                                         |
| 'free_flash_memory'                         | 'unit'                                    | 'kBytes'                           |                                                         |
| 'quality_flags'                             | 'radiometer quality flags'                | 'unitless'                         |                                                         |
| 'status_flags'                              | 'radiometer status flags'                 | 'unitless'                         |                                                         |

|                                          |                                           |                                    |                                                                                                                     |
|------------------------------------------|-------------------------------------------|------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| File name: smtmwrl0_150715_231755.BRT.nc | Path: summit\mwr\raw\                     |                                    |                                                                                                                     |
| Attributes                               |                                           |                                    |                                                                                                                     |
| Name                                     | Value                                     |                                    |                                                                                                                     |
| 'netCDF_convention'                      | ' CF-1.0'                                 |                                    |                                                                                                                     |
| 'radiometer_location'                    | ' University of Madison'                  |                                    |                                                                                                                     |
| 'radiometer_system'                      | ' RPG-HATPRO'                             |                                    |                                                                                                                     |
| 'serial_number'                          | ' R-DPR-07/007'                           |                                    |                                                                                                                     |
| 'station_altitude'                       | '10500'                                   |                                    |                                                                                                                     |
| 'station_longitude'                      | '38°27'13'"" West'                        |                                    |                                                                                                                     |
| 'station_latitude'                       | '72°34'41'"" North'                       |                                    |                                                                                                                     |
| 'comments'                               | ' Greenland Summit Station'               |                                    |                                                                                                                     |
| 'Master_radiometer_software_version'     | 'V8.12'                                   |                                    |                                                                                                                     |
| 'Slave_radiometer_software_version'      | 'V8.12'                                   |                                    |                                                                                                                     |
| 'host_PC_software_version'               | 'V8.12'                                   |                                    |                                                                                                                     |
| Dimensions                               |                                           |                                    |                                                                                                                     |
| Name                                     | Length                                    |                                    |                                                                                                                     |
| time'                                    | 1258                                      |                                    |                                                                                                                     |
| number_frequencies'                      | 16                                        |                                    |                                                                                                                     |
| Variables                                |                                           |                                    |                                                                                                                     |
| Name                                     | Long name                                 | Units                              |                                                                                                                     |
| 'time_reference'                         | 'flag indicating the time zone reference' | 'unitless'                         | '0 = local time, 1 = UTC'                                                                                           |
| 'integration_time_per_sample'            | 'integration time for each sample'        | 'seconds'                          |                                                                                                                     |
| 'frequencies'                            | 'channel center frequency'                | 'GHz'                              |                                                                                                                     |
| 'time'                                   | 'sample time'                             | 'seconds since 1.1.2001, 00:00:00' |                                                                                                                     |
| 'rain_flag'                              | 'Info'                                    | '0 = no rain, 1 = raining'         |                                                                                                                     |
|                                          |                                           |                                    |                                                                                                                     |
| 'elevation_angle'                        | 'viewing_elevation angle'                 | 'degrees (-90 - 180)'              | '-90 is blackbody view, 0 is horizontal view (red arrow), 90 is zenith view, 180 is horizontal view (2nd quadrant)' |
| 'azimuth_angle'                          | 'units'                                   | 'DEG (0°-360°)'                    |                                                                                                                     |
| 'TBs'                                    | 'units'                                   | 'K'                                |                                                                                                                     |



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Datagrams:  
Summit



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MWR-HF: High Frequency Microwave Radiometer

HATPRO: Humidity and Temperature Profiler

Product netCDF Metadata

|                                                |                                                                                                                                                  |                                                                |      |           |       |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------|-----------|-------|
| File name: smtmmwrlosX1.a1.20150715.000000.cdf |                                                                                                                                                  | Path: summit\mwr\processed\                                    |      |           |       |
| Attributes                                     |                                                                                                                                                  |                                                                |      |           |       |
| Name                                           | Value                                                                                                                                            |                                                                |      |           |       |
| 'comment_00'                                   | 'Location: Summit Camp, Greenland, as part of the ICECAPS project'                                                                               |                                                                |      |           |       |
| 'comment_01'                                   | 'Experiment: Integrated Characterization of Energy, Clouds, Atmospheric State, and Precipitation at Summit (ICECAPS), Shupe et. al. 2012 (BAMS)' |                                                                |      |           |       |
| 'comment_02'                                   | 'Pls: Matthew Shupe, Von Walden, David Turner, and Ralf Bennartz'                                                                                |                                                                |      |           |       |
| 'comment_03'                                   | 'HATPRO and MWRHF from the University of Wisconsin - Madison'                                                                                    |                                                                |      |           |       |
| 'comment_04'                                   | 'Questions? Contact Dr. David Turner (dave.turner@noaa.gov)'                                                                                     |                                                                |      |           |       |
| 'comment_05'                                   | 'Calibration is performed very similarly to Liljegren 2000 using code developed by Dr. M. Cadeddu'                                               |                                                                |      |           |       |
| 'comment_06'                                   | 'date this NetCDF file was created was Fri Jul 17 04:30:08 2015'                                                                                 |                                                                |      |           |       |
| 'comment_07'                                   | '\$Id: read_cal_file.pro,v 1.5 2011/02/15 19:45:57 nbmiller Exp \$'                                                                              |                                                                |      |           |       |
| 'comment_08'                                   | '\$Id: cal2cdf_perday.pro,v 1.18 2015/07/13 16:14:39 nbmiller Exp \$'                                                                            |                                                                |      |           |       |
| 'comment_09'                                   | '\$Id: write_arm_mwr_file.pro,v 1.10 2013/05/10 14:51:35 nbmiller Exp \$'                                                                        |                                                                |      |           |       |
| 'missing_data_flag'                            | ' -999'                                                                                                                                          |                                                                |      |           |       |
| Dimensions                                     |                                                                                                                                                  |                                                                |      |           |       |
| Name                                           | Length                                                                                                                                           |                                                                |      |           |       |
| time                                           | 40521                                                                                                                                            |                                                                |      |           |       |
| Variables                                      |                                                                                                                                                  |                                                                |      |           |       |
| Name                                           | Long name                                                                                                                                        | Units                                                          | Name | Long name | Units |
| 'manual_qc_hatpro'                             | 'Manual quality control flag HATPRO'                                                                                                             | '0 or 1 or 2', '0 = good data, 1 = bad data, 2 = suspect data' |      |           |       |
| 'manual_qc_hf'                                 | 'Manual quality control flag 90/150'                                                                                                             | '0 or 1 or 2', '0 = good data, 1 = bad data, 2 = suspect data' |      |           |       |
| 'base_time'                                    | 'Time since 1970-01-01 00:00:00 UTC'                                                                                                             | 'seconds'                                                      |      |           |       |
| 'time_offset'                                  | 'Time since base_time'                                                                                                                           | 'seconds'                                                      |      |           |       |
| 'pres'                                         | 'Ambient Pressure'                                                                                                                               | 'mb'                                                           |      |           |       |
| 'tamb'                                         | 'Ambient air temperature'                                                                                                                        | 'K'                                                            |      |           |       |
| 'rhamb'                                        | 'Ambient Relative humidity'                                                                                                                      | '%                                                             |      |           |       |
| 'elev'                                         | 'Elevation Angle'                                                                                                                                | 'degrees'                                                      |      |           |       |
| 'pwv'                                          | 'Precipitable water vapor from stat retrieval using 23.8 and 31.4 GHz'                                                                           | 'cm'                                                           |      |           |       |
| 'pwv_90'                                       | 'Precipitable water vapor from stat retrieval using 23.8 and 90.0 GHz'                                                                           | 'cm'                                                           |      |           |       |
| 'lwp'                                          | 'Liquid water path from stat retrieval using 23.8 and 31.4 GHz'                                                                                  | 'g/m2'                                                         |      |           |       |
| 'lwp_90'                                       | 'Liquid water path from stat retrieval using 23.8 and 90.0 Ghz'                                                                                  | 'g/m2'                                                         |      |           |       |
| 'tkbb1'                                        | 'master radiometer blackbody temperature'                                                                                                        | 'K'                                                            |      |           |       |
| 'tkbb2'                                        | 'slave radiometer blackbody temperature'                                                                                                         | 'K'                                                            |      |           |       |
| 'irtemp'                                       | 'infrared temperature from IRT'                                                                                                                  | 'K'                                                            |      |           |       |
| 'wet_window'                                   | 'from the rain sensor'                                                                                                                           | '0 or 1'                                                       |      |           |       |
| 'lat'                                          | 'Latitude'                                                                                                                                       | 'deg N'                                                        |      |           |       |
| 'lon'                                          | 'Longitude'                                                                                                                                      | 'deg E'                                                        |      |           |       |
| 'alt'                                          | 'Altitude'                                                                                                                                       | 'm MSL'                                                        |      |           |       |
| 'tbsky22'                                      | 'sky brightness temperature, 22.24 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky23'                                      | 'sky brightness temperature, 23.04 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky24'                                      | 'sky brightness temperature, 23.84 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky25'                                      | 'sky brightness temperature, 25.44 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky26'                                      | 'sky brightness temperature, 26.24 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky28'                                      | 'sky brightness temperature, 27.84 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky31'                                      | 'sky brightness temperature, 31.40 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky51'                                      | 'sky brightness temperature, 51.26 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky52'                                      | 'sky brightness temperature, 52.28 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky54'                                      | 'sky brightness temperature, 53.86 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky55'                                      | 'sky brightness temperature, 54.94 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky56'                                      | 'sky brightness temperature, 56.66 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky57'                                      | 'sky brightness temperature, 57.30 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky58'                                      | 'sky brightness temperature, 58.00 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tbsky90'                                      | 'sky brightness temperature, 90.0 GHz'                                                                                                           | 'K'                                                            |      |           |       |
| 'tbsky150'                                     | 'sky brightness temperature, 150.0 GHz'                                                                                                          | 'K'                                                            |      |           |       |
| 'tnd_med_22'                                   | 'median noise diode temp, 22.24 GHz'                                                                                                             | 'K'                                                            |      |           |       |
| 'tnd_med_23'                                   | 'median noise diode temp, 23.04 GHz'                                                                                                             | 'K'                                                            |      |           |       |
| 'tnd_med_24'                                   | 'median noise diode temp, 23.84 GHz'                                                                                                             | 'K'                                                            |      |           |       |
| 'tnd_med_25'                                   | 'median noise diode temp, 25.44 GHz'                                                                                                             | 'K'                                                            |      |           |       |
| 'tnd_med_26'                                   | 'median noise diode temp, 26.24 GHz'                                                                                                             | 'K'                                                            |      |           |       |
| 'tnd_med_28'                                   | 'median noise diode temp, 27.84 GHz'                                                                                                             | 'K'                                                            |      |           |       |
| 'tnd_med_31'                                   | 'median noise diode temp, 31.40 GHz'                                                                                                             | 'K'                                                            |      |           |       |
| 'tnd_med_90'                                   | 'median noise diode temp, 90.0 GHz'                                                                                                              | 'K'                                                            |      |           |       |
| 'tnd_med_150'                                  | 'median noise diode temp, 150.0 GHz'                                                                                                             | 'K'                                                            |      |           |       |
| 'tnd_inst_22'                                  | 'instantaneous noise diode temp, 22.24 GHz'                                                                                                      | 'K'                                                            |      |           |       |
| 'tnd_inst_23'                                  | 'instantaneous noise diode temp, 23.04 GHz'                                                                                                      | 'K'                                                            |      |           |       |
| 'tnd_inst_24'                                  | 'instantaneous noise diode temp, 23.84 GHz'                                                                                                      | 'K'                                                            |      |           |       |
| 'tnd_inst_25'                                  | 'instantaneous noise diode temp, 25.44 GHz'                                                                                                      | 'K'                                                            |      |           |       |
| 'tnd_inst_26'                                  | 'instantaneous noise diode temp, 26.24 GHz'                                                                                                      | 'K'                                                            |      |           |       |
| 'tnd_inst_28'                                  | 'instantaneous noise diode temp, 27.84 GHz'                                                                                                      | 'K'                                                            |      |           |       |
| 'tnd_inst_31'                                  | 'instantaneous noise diode temp, 31.40 GHz'                                                                                                      | 'K'                                                            |      |           |       |
| 'tnd_inst_90'                                  | 'instantaneous noise diode temp, 90.0 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tnd_inst_150'                                 | 'instantaneous noise diode temp, 150.0 GHz'                                                                                                      | 'K'                                                            |      |           |       |
| 'tnd_ln2_22'                                   | 'LN2-derived noise diode temp, 22.24 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_23'                                   | 'LN2-derived noise diode temp, 23.04 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_24'                                   | 'LN2-derived noise diode temp, 23.84 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_25'                                   | 'LN2-derived noise diode temp, 25.44 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_26'                                   | 'LN2-derived noise diode temp, 26.24 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_28'                                   | 'LN2-derived noise diode temp, 27.84 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_31'                                   | 'LN2-derived noise diode temp, 31.40 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_51'                                   | 'LN2-derived noise diode temp, 51.26 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_52'                                   | 'LN2-derived noise diode temp, 52.28 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_54'                                   | 'LN2-derived noise diode temp, 53.86 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_55'                                   | 'LN2-derived noise diode temp, 54.94 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_56'                                   | 'LN2-derived noise diode temp, 56.66 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_57'                                   | 'LN2-derived noise diode temp, 57.30 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_58'                                   | 'LN2-derived noise diode temp, 58.00 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tnd_ln2_90'                                   | 'LN2-derived noise diode temp, 90.0 GHz'                                                                                                         | 'K'                                                            |      |           |       |
| 'tnd_ln2_150'                                  | 'LN2-derived noise diode temp, 150.0 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tsys_med_22'                                  | 'median system noise temp, 22.24 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_23'                                  | 'median system noise temp, 23.04 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_24'                                  | 'median system noise temp, 23.84 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_25'                                  | 'median system noise temp, 25.44 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_26'                                  | 'median system noise temp, 26.24 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_28'                                  | 'median system noise temp, 27.84 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_31'                                  | 'median system noise temp, 31.40 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_51'                                  | 'median system noise temp, 51.26 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_52'                                  | 'median system noise temp, 52.28 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_54'                                  | 'median system noise temp, 53.86 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_55'                                  | 'median system noise temp, 54.94 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_56'                                  | 'median system noise temp, 56.66 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_57'                                  | 'median system noise temp, 57.30 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_58'                                  | 'median system noise temp, 58.00 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_med_90'                                  | 'median system noise temp, 90.0 GHz'                                                                                                             | 'K'                                                            |      |           |       |
| 'tsys_med_150'                                 | 'median system noise temp, 150.0 GHz'                                                                                                            | 'K'                                                            |      |           |       |
| 'tsys_ln2_22'                                  | 'LN2-derived system noise temp, 22.24 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_23'                                  | 'LN2-derived system noise temp, 23.04 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_24'                                  | 'LN2-derived system noise temp, 23.84 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_25'                                  | 'LN2-derived system noise temp, 25.44 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_26'                                  | 'LN2-derived system noise temp, 26.24 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_28'                                  | 'LN2-derived system noise temp, 27.84 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_31'                                  | 'LN2-derived system noise temp, 31.40 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_51'                                  | 'LN2-derived system noise temp, 51.26 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_52'                                  | 'LN2-derived system noise temp, 52.28 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_54'                                  | 'LN2-derived system noise temp, 53.86 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_55'                                  | 'LN2-derived system noise temp, 54.94 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_56'                                  | 'LN2-derived system noise temp, 56.66 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_57'                                  | 'LN2-derived system noise temp, 57.30 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_58'                                  | 'LN2-derived system noise temp, 58.00 GHz'                                                                                                       | 'K'                                                            |      |           |       |
| 'tsys_ln2_90'                                  | 'LN2-derived system noise temp, 90.0 GHz'                                                                                                        | 'K'                                                            |      |           |       |
| 'tsys_ln2_150'                                 | 'LN2-derived system noise temp, 150.0 GHz'                                                                                                       | 'K'                                                            |      |           |       |



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Datagrams:  
Summit



Contacts

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MWR-HF: High Frequency Microwave Radiometer

HATPRO: Humidity and Temperature Profiler

Product netCDF Metadata

|                                               |                                                                                                                                                  |                             |      |           |       |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------|-----------|-------|
| File name: smtmwrlosX1.a1.20150715.000000.cdf |                                                                                                                                                  | Path: summit/mwr\processed\ |      |           |       |
| Attributes                                    |                                                                                                                                                  |                             |      |           |       |
| Name                                          | Value                                                                                                                                            |                             |      |           |       |
| 'comment_00'                                  | 'Location: Summit Camp, Greenland, as part of the ICECAPS project'                                                                               |                             |      |           |       |
| 'comment_01'                                  | 'Experiment: Integrated Characterization of Energy, Clouds, Atmospheric State, and Precipitation at Summit (ICECAPS), Shupe et. al. 2012 (BAMS)' |                             |      |           |       |
| 'comment_02'                                  | 'Pls: Matthew Shupe, Von Walden, David Turner, and Ralf Bennartz'                                                                                |                             |      |           |       |
| 'comment_03'                                  | 'HATPRO and MWRHF from the University of Wisconsin - Madison'                                                                                    |                             |      |           |       |
| 'comment_04'                                  | 'Questions? Contact Dr. David Turner (dave.turner@noaa.gov)'                                                                                     |                             |      |           |       |
| 'comment_05'                                  | 'Calibration is performed very similarly to Liljegren 2000 using code developed by Dr. M. Cadeddu'                                               |                             |      |           |       |
| 'comment_06'                                  | 'date this NetCDF file was created was Fri Jul 17 04:30:08 2015'                                                                                 |                             |      |           |       |
| 'comment_07'                                  | '\$Id: read_cal_file.pro,v 1.5 2011/02/15 19:45:57 nbmiller Exp \$'                                                                              |                             |      |           |       |
| 'comment_08'                                  | '\$Id: cal2cdf_perday.pro,v 1.18 2015/07/13 16:14:39 nbmiller Exp \$'                                                                            |                             |      |           |       |
| 'comment_09'                                  | '\$Id: write_arm_mwr_file.pro,v 1.10 2013/05/10 14:51:35 nbmiller Exp \$'                                                                        |                             |      |           |       |
| 'missing_data_flag'                           | ' -999'                                                                                                                                          |                             |      |           |       |
| Dimensions                                    |                                                                                                                                                  |                             |      |           |       |
| Name                                          | Length                                                                                                                                           |                             |      |           |       |
| time                                          | 40521                                                                                                                                            |                             |      |           |       |
| Variables                                     |                                                                                                                                                  |                             |      |           |       |
| Name                                          | Long name                                                                                                                                        | Units                       | Name | Long name | Units |
| 'alpha_22'                                    | 'non-linearity parameter, 22.24 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_23'                                    | 'non-linearity parameter, 23.04 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_24'                                    | 'non-linearity parameter, 23.84 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_25'                                    | 'non-linearity parameter, 25.44 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_26'                                    | 'non-linearity parameter, 26.24 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_28'                                    | 'non-linearity parameter, 27.84 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_31'                                    | 'non-linearity parameter, 31.40 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_51'                                    | 'non-linearity parameter, 51.26 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_52'                                    | 'non-linearity parameter, 52.28 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_54'                                    | 'non-linearity parameter, 53.86 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_55'                                    | 'non-linearity parameter, 54.94 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_56'                                    | 'non-linearity parameter, 56.66 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_57'                                    | 'non-linearity parameter, 57.30 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_58'                                    | 'non-linearity parameter, 58.00 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'alpha_90'                                    | 'non-linearity parameter, 90.0 GHz'                                                                                                              | 'unitless'                  |      |           |       |
| 'alpha_150'                                   | 'non-linearity parameter, 150.0 GHz'                                                                                                             | 'unitless'                  |      |           |       |
| 'voltage_22'                                  | 'voltage, 22.24 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_23'                                  | 'voltage, 23.04 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_24'                                  | 'voltage, 23.84 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_25'                                  | 'voltage, 25.44 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_26'                                  | 'voltage, 26.24 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_28'                                  | 'voltage, 27.84 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_31'                                  | 'voltage, 31.40 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_51'                                  | 'voltage, 51.26 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_52'                                  | 'voltage, 52.28 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_54'                                  | 'voltage, 53.86 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_55'                                  | 'voltage, 54.94 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_56'                                  | 'voltage, 56.66 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_57'                                  | 'voltage, 57.30 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_58'                                  | 'voltage, 58.00 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'voltage_90'                                  | 'voltage, 90.0 GHz'                                                                                                                              | 'volts'                     |      |           |       |
| 'voltage_150'                                 | 'voltage, 150.0 GHz'                                                                                                                             | 'volts'                     |      |           |       |
| 'gain_22'                                     | 'gain, 22.24 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_23'                                     | 'gain, 23.04 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_24'                                     | 'gain, 23.84 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_25'                                     | 'gain, 25.44 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_26'                                     | 'gain, 26.24 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_28'                                     | 'gain, 27.84 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_31'                                     | 'gain, 31.40 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_51'                                     | 'gain, 51.26 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_52'                                     | 'gain, 52.28 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_54'                                     | 'gain, 53.86 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_55'                                     | 'gain, 54.94 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_56'                                     | 'gain, 56.66 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_57'                                     | 'gain, 57.30 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_58'                                     | 'gain, 58.00 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 'gain_90'                                     | 'gain, 90.0 GHz'                                                                                                                                 | 'volt/K'                    |      |           |       |
| 'gain_150'                                    | 'gain, 150.0 GHz'                                                                                                                                | 'volt/K'                    |      |           |       |
| 's_tbsky22'                                   | 'smoothed brightness temperature, 22.24 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky23'                                   | 'smoothed brightness temperature, 23.04 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky24'                                   | 'smoothed brightness temperature, 23.84 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky25'                                   | 'smoothed brightness temperature, 25.44 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky26'                                   | 'smoothed brightness temperature, 26.24 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky28'                                   | 'smoothed brightness temperature, 27.84 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky31'                                   | 'smoothed brightness temperature, 31.40 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky51'                                   | 'smoothed brightness temperature, 51.26 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky52'                                   | 'smoothed brightness temperature, 52.28 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky54'                                   | 'smoothed brightness temperature, 53.86 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky55'                                   | 'smoothed brightness temperature, 54.94 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky56'                                   | 'smoothed brightness temperature, 56.66 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky57'                                   | 'smoothed brightness temperature, 57.30 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky58'                                   | 'smoothed brightness temperature, 58.00 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_tbsky90'                                   | 'smoothed brightness temperature, 90.0 GHz'                                                                                                      | 'K'                         |      |           |       |
| 's_tbsky150'                                  | 'smoothed brightness temperature, 150.0 GHz'                                                                                                     | 'K'                         |      |           |       |
| 's_gain_22'                                   | 'smoothed gain, 22.24 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_23'                                   | 'smoothed gain, 23.04 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_24'                                   | 'smoothed gain, 23.84 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_25'                                   | 'smoothed gain, 25.44 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_26'                                   | 'smoothed gain, 26.24 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_28'                                   | 'smoothed gain, 27.84 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_31'                                   | 'smoothed gain, 31.40 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_51'                                   | 'smoothed gain, 51.26 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_52'                                   | 'smoothed gain, 52.28 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_54'                                   | 'smoothed gain, 53.86 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_55'                                   | 'smoothed gain, 54.94 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_56'                                   | 'smoothed gain, 56.66 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_57'                                   | 'smoothed gain, 57.30 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_58'                                   | 'smoothed gain, 58.00 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_gain_90'                                   | 'smoothed gain, 90.0 GHz'                                                                                                                        | 'volt/K'                    |      |           |       |
| 's_gain_150'                                  | 'smoothed gain, 150.0 GHz'                                                                                                                       | 'volt/K'                    |      |           |       |
| 's_tsys_22'                                   | 'smoothed system noise temp, 22.24 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_23'                                   | 'smoothed system noise temp, 23.04 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_24'                                   | 'smoothed system noise temp, 23.84 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_25'                                   | 'smoothed system noise temp, 25.44 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_26'                                   | 'smoothed system noise temp, 26.24 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_28'                                   | 'smoothed system noise temp, 27.84 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_31'                                   | 'smoothed system noise temp, 31.40 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_51'                                   | 'smoothed system noise temp, 51.26 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_52'                                   | 'smoothed system noise temp, 52.28 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_54'                                   | 'smoothed system noise temp, 53.86 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_55'                                   | 'smoothed system noise temp, 54.94 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_56'                                   | 'smoothed system noise temp, 56.66 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_57'                                   | 'smoothed system noise temp, 57.30 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_58'                                   | 'smoothed system noise temp, 58.00 GHz'                                                                                                          | 'K'                         |      |           |       |
| 's_tsys_90'                                   | 'smoothed system noise temp, 90.0 GHz'                                                                                                           | 'K'                         |      |           |       |
| 's_tsys_150'                                  | 'smoothed system noise temp, 150.0 GHz'                                                                                                          | 'K'                         |      |           |       |