Dataset Title
Radiometer Data at Bennett Site

Dataset Author
Courtney Weeks Karkkainen
cweeks@ucar.edu
National Center for Atmospheric Research, Research Applications Laboratory
3450 Mitchell Lane, Boulder CO 80301
303.497.2824

Time of Interest
20161121-20170106 (Time reported in UTC)

Area of Interest
43.14956, -115.261, 2273.2 m MSL

Data Frequency
~4 minutes per scan; ~10-30 seconds between angles

Data Spatial Type
Point measurement

General Dataset Description
The Radiometrics MP-Series microwave profilers deliver continuous temperature, humidity, and liquid soundings to 10-km height. The MP-3000 uses 21 K-band channels and 14 V-band channels and provides all-weather rain effect mitigation and multiple elevation scans. The U.K. Met Office demonstrated that measurement error is much smaller than natural uncertainty inherent in use of radiometer or radiosonde soundings for numerical weather forecast applications.

Microwave profiling methods make use of atmospheric radiation measurements in the 22 to 60 GHz region. Temperature profiles can be obtained by measuring the radiation intensity, or brightness temperature, at points along the side of an oxygen feature at 60 GHz. By scanning downward from line center, where the opacity is so great that all signal originates from just above the antenna, onto the wing of the line, where the radiometer “sees” deeper into the atmosphere, the instrument can obtain altitude information. Emission at any altitude is proportional to local temperature and density of oxygen; thus the temperature profile can be retrieved.

Water vapor profiles can be obtained by observing the intensity and shape of emission from pressure broadened water vapor lines. The water vapor line at 183 GHz is used for vapor profiling from satellites. The high opacity of this line hides the unknown emission emanating from the earth’s surface, eliminating this error source, but precluding profiling to low altitudes. The 183 GHz line is too opaque for observations from the ground, except in extremely arid

environments. The line at 22 GHz is too transparent for effective profiling from satellites, but is suitable for ground based profiling in most areas. The emission from water vapor is in a narrow line at high altitudes and is pressure broadened at low altitudes. The intensity of emission is proportional to vapor density and temperature. Scanning the spectral profile and mathematically inverting the observed data can therefore provide water vapor profiles.

Limited resolution cloud liquid water profiles can be obtained by measuring the contribution of cloud liquid water to atmospheric spectral features of varying opacity. Surface relative humidity, temperature, and barometric pressure are measured by the Profiling Radiometer and used in the determination of profiles. Additionally, a vertically pointed infrared thermometer (IRT) indicates the presence of cloud, and measures cloud base temperature if clouds are present. Knowing cloud base temperature yields the vapor density at cloud base (at saturation), and combined with the retrieved temperature profile, yields cloud base altitude.

Advanced specifications are as follows:

Calibrated Brightness Temperature Accuracy[1]	0.2 + 0.002*|TkBB-Tsky| [2]
Long Term Stability	<1.0 K / yr typical
Resolution (depends on integration time)[3]	0.1 to 1 K
Brightness Temperature Range[4]	0-400 K
Antenna System Optical Resolution and Side Lobes • 22-30 GHz (for MP-3000A & MP 1500A) • 51-59 GHz (for MP-3000A & MP 2500A) • 170-183.31 GHz (for MP-183A)	 4.9 - 6.3° -24 dB 2.4 - 2.5° -27 dB 1.0 - 1.1° -30 dB
Integration Time (user selectable in 10 msec increments)	0.01 to 2.5 seconds
Frequency Agile Tuning Range • Water Vapor Bands • Oxygen Band • Minimum Frequency step size	 22-30 GHz 170-183.3 GHz 51-59 GHz 2.0 MHz @ 30 GHz 4.0 MHz @ 60 GHz 12.0 MHz @ 180 GHz
Standard Factory-Calibrated Channels • 22-30 GHz Band • 51-59 GHz Band • 170-183.3 GHz Band	 21 channels 14 channels 15 channels
Pre-detection channel bandwidth (effective double-sided) • 22-30 and 51-59 GHz Bands • 170-183.3 GHz Band	 300 MHz 1000 MHz
Surface Sensor Accuracy • Temperature (-50° to +50° C) • Relative Humidity (0-100%) • Barometric Pressure (800 to 1060 mb)	 0.5° C @ 25° C 2 % 0.3 mb [(5)]

Infrared Temperature Sensor Assembly[6] (optional) Internally mounted, with window reflectance and temperature corrections for optimal accuracy	(0.5 + .007*ΔT)° C ΔT = Tambient - Tcloud
Azimuth Positioner (optional): Computer controlled automated full sky observations. • Slew Rate • Wind Speed/Operate • Wind Speed/Survive	 15°/sec 30 m/sec 60 m/sec
Brightness Temperature algorithm for *level1* products	4 point nonlinear model
Retrieval method for *level2* products	Neural Network
Calibration Systems Primary standards Operational standards	LN2 and TIP methods LN2 & Ambient Targets Black Body & Noise Diode
Environmental Operating Range • Temperature • Relative Humidity • Altitude • Wind (operational / survival)	 -50° to +35° C [7] 0-100 % -300 to 3,000 m 100 km/hr / 200 km/hr
Physical Properties • Size (height x width x length) • Weight	 50 x 28 x 76 cm 29 kg
Power requirements • Radiometer (100 to 250 VAC / 50 – 60 Hz)	 400 W max; 200 W typical
Data Interface • Primary computer port • Auxiliary port • Standard cable length[8]	 RS422 57.6 Kbaud RS422 57.6 Kbaud 30 m
Data File Formats	ASCII CSV comma separated variables

Angle scans included in this dataset are (elevation - azimuth): 90-0, 15-25, 165-25, 6-25, 6-70, 6-225, 6-270, 6-340.

File Names

2016-11-21_21-21-13_lv2.csv
2016-11-22_17-34-52_lv2.csv
2016-11-22_17-51-45_lv2.csv
2016-11-22_19-12-50_lv2.csv
2016-11-22_19-18-50_lv2.csv
2016-11-22_19-22-03_lv2.csv
2016-11-22_19-26-25_lv2.csv
2016-11-22_19-27-22_lv2.csv
2016-11-22_19-29-29_lv2.csv

2016-11-22_19-35-25_lv2.csv
2016-11-22_19-39-52_lv2.csv
2016-11-23_16-41-17_lv2.csv
2016-11-24_00-04-05_lv2.csv
2016-11-25_00-04-10_lv2.csv
2016-11-26_00-04-09_lv2.csv
2016-11-27_00-04-10_lv2.csv
2016-11-28_00-04-10_lv2.csv
2016-11-29_00-04-10_lv2.csv
2016-11-30_00-04-09_lv2.csv
2016-12-01_00-04-10_lv2.csv
2016-12-01_17-25-35_lv2.csv
2016-12-01_20-38-18_lv2.csv
2016-12-02_00-04-05_lv2.csv
2016-12-03_00-04-09_lv2.csv
2016-12-04_00-04-10_lv2.csv
2016-12-05_00-04-09_lv2.csv
2016-12-06_00-04-10_lv2.csv
2016-12-07_00-04-09_lv2.csv
2016-12-08_00-04-09_lv2.csv
2016-12-09_00-04-09_lv2.csv
2016-12-10_00-04-10_lv2.csv
2016-12-11_00-04-10_lv2.csv
2016-12-12_00-04-09_lv2.csv
2016-12-13_00-04-10_lv2.csv
2016-12-14_00-04-09_lv2.csv
2016-12-15_00-04-09_lv2.csv
2016-12-16_00-04-10_lv2.csv
2016-12-17_00-04-10_lv2.csv
2016-12-18_00-04-09_lv2.csv
2016-12-19_00-04-09_lv2.csv
2016-12-20_00-04-10_lv2.csv
2016-12-21_00-04-09_lv2.csv
2016-12-22_00-04-10_lv2.csv
2016-12-23_00-04-09_lv2.csv
2016-12-24_00-04-10_lv2.csv
2016-12-25_00-04-10_lv2.csv
2016-12-26_00-04-06_lv2.csv
2016-12-27_00-04-10_lv2.csv
2016-12-28_00-04-09_lv2.csv
2016-12-29_00-04-09_lv2.csv
2016-12-30_00-04-10_lv2.csv
2016-12-31_00-04-10_lv2.csv
2017-01-01_00-04-05_lv2.csv

2017-01-02_00-04-09_lv2.csv
2017-01-03_00-04-09_lv2.csv
2017-01-04_00-04-09_lv2.csv
2017-01-05_00-04-09_lv2.csv
2017-01-06_00-04-10_lv2.csv

Data Format
Comma separated values
Record, Date/Time, LineType
Columns Vary By LineType:
10: Tamb(K), RH(%), Pres(mb), Tir(K), Rain, Vint(cm), Lqint(mm), Cldb, Unintegrated Values
30: GPS Date/Time, Latitude, Longitude, Magnetic Variation, Status, Quality, Number Satellites, Altitude (m), DataQuality
80: ID, SNR, Az(deg), El(deg), Tamb(K), RH(%), Pres(mb), Tir(K), Rain, Vint(cm), ZVint(cm), VDly(cm), ZVDly (cm), Lqint(mm), ZLqint(mm), LqDly(cm), ZlqDly(cm), Unintegrated Values
100: Record Type, Title
200: Tamb(K), RH(%), Pres(mb), Tir(K), Rain, DataQuality
300: Int. Vapor (cm), Int. Liquid (mm), Cloud Base (km), DataQuality
400: LV2 Processor, Unintegrated Values

Data Restrictions
None

GCMD Keywords
ATMOSPHERIC WATER VAPOR