Agenda

I. Quick intro: HMT-Southeast Pilot Study and webinar goals (Kelly Mahoney, Rob Cifelli)

II. HMT-SEPS Observational Data (Tim Coleman, Dan Gottas)

- GPS-Met precipitable water observations (Seth Gutman, Kirk Holub)

III. Model forecasts: ExREF (Ligia Bernadet)

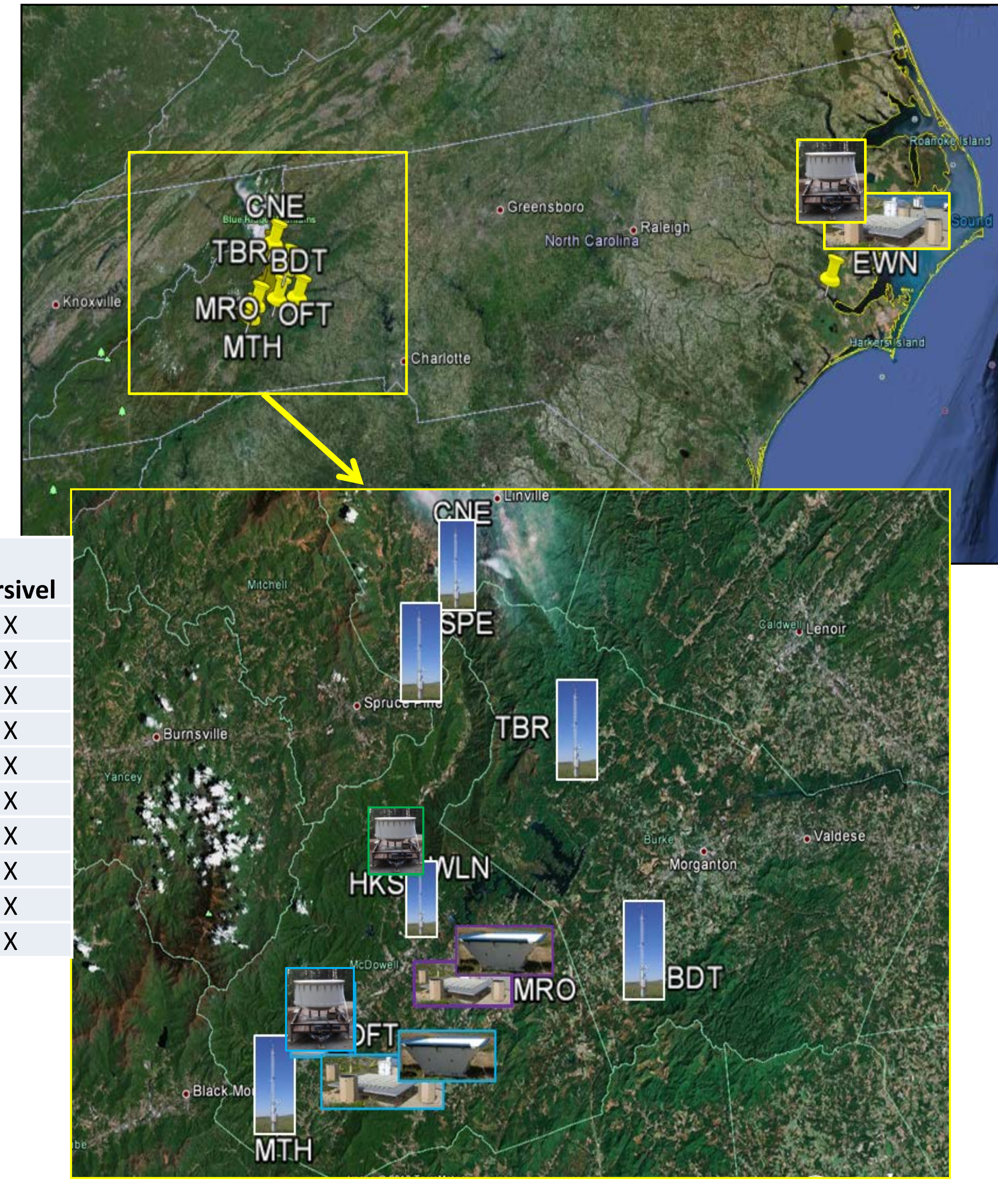
IV. Questions, discussion

Observations and Measurements in HMT-Southeast

- What instruments are deployed?
- What do they measure?
- Where are they located?
- Web tool demonstration
- Questions and Answers

HMT-SEPS instrument deployment

- NOAA’s HMT-SEPS deployment: 4 profiler sites and 6 surface meteorology sites
- Additional NASA precipitation gauge and disdrometer to be added to each of the surface sites in August/September
- Restoration of/upgrades to existing NC Div. of Air Quality Clayton, NC and Charlotte, NC wind profilers. Possible inclusion of new profiler in RTP at US EPA’s campus.



Site Name	Site ID	Elev (m)	449	915	RASS	S-band	Met	Soil Moisture	Parsivel
Brindletown	BDT	355					X	X	X
Crossnore	CNE	1008					X	X	X
Hankins	HKS	379				X	X		X
Marion	MRO	384		X	X		X		X
Mount Hebron	MTH	519					X	X	X
New Bern	EWN	3	X			X	X		X
Old Fort	OFT	421	X		X	X	X		X
Spruce Pine	SPE	833					X	X	X
Table Rock	TBR	356					X	X	X
Woodlawn	WLN	523					X	X	X

Wind Profilers

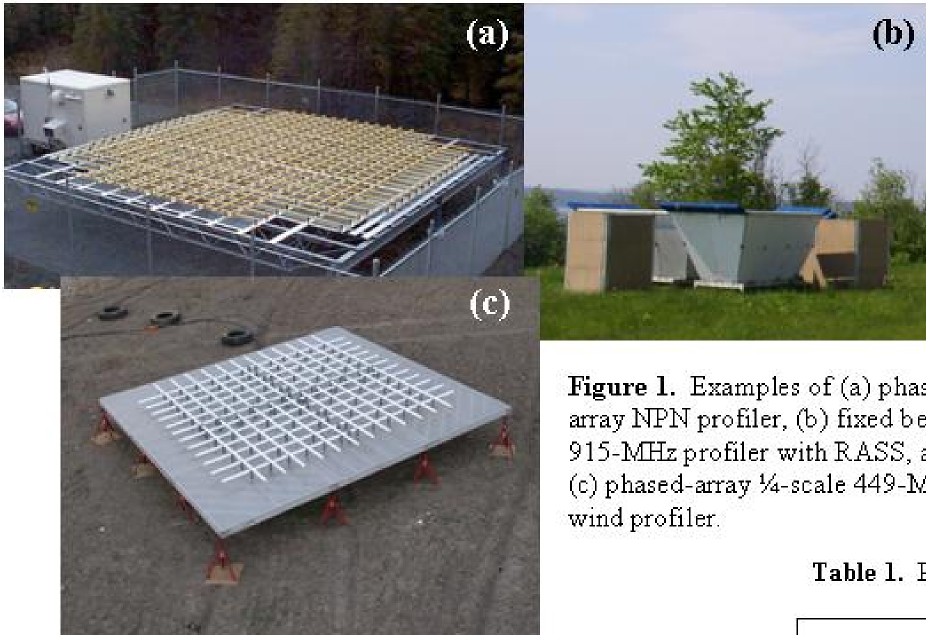


Figure 1. Examples of (a) phased-array NPN profiler, (b) fixed beam 915-MHz profiler with RASS, and (c) phased-array ¼-scale 449-Mhz wind profiler.

Table 1. Physical, operating, and sampling characteristics of wind profilers.

	404-MHz (NPN)	915-MHz (boundary layer)	449-MHz (quarter- scale)
Antenna type	Coaxial-colinear phased array	Flat rectangular microstrip patch	Coaxial-colinear phased array
Antenna diameter (m)	13	2	6
Beamwidth (deg.)	4	10	10
Peak transmit power (W)	6000	500	2000
Transmit pulse width (µs)	3.3^{P}, 20^{P}	0.417*, 0.708*^{,P}	0.708*, 2.833
Height coverage (m)	500** – 16,000	120 – 4,000	180^{+} – 8,000
Vertical resolution (m)	320$^{✝}$, 900$^{✝}$	63, 106*	106, 212*$^{,✝}$
Temporal resolution (min)	60	60	60

* These settings reflect how the profilers were operated during typical deployments. Other degraded transmit and sampling resolutions are possible.

^{P} Pulse-coding was used in selected operating modes to boost signal power and increase altitude coverage (for more information on pulse coding, see Ghebrebrhan, 1990).

$^{+}$ This minimum detectable range has been achieved with the ¼-scale 449-MHz profilers using a 0.7-µs pulse.

** Signal attenuators prevent accurate radar reflectivity data below 1 km.

✝ Increased vertical resolution as compared to the transmit pulse length was accomplished by oversampling.

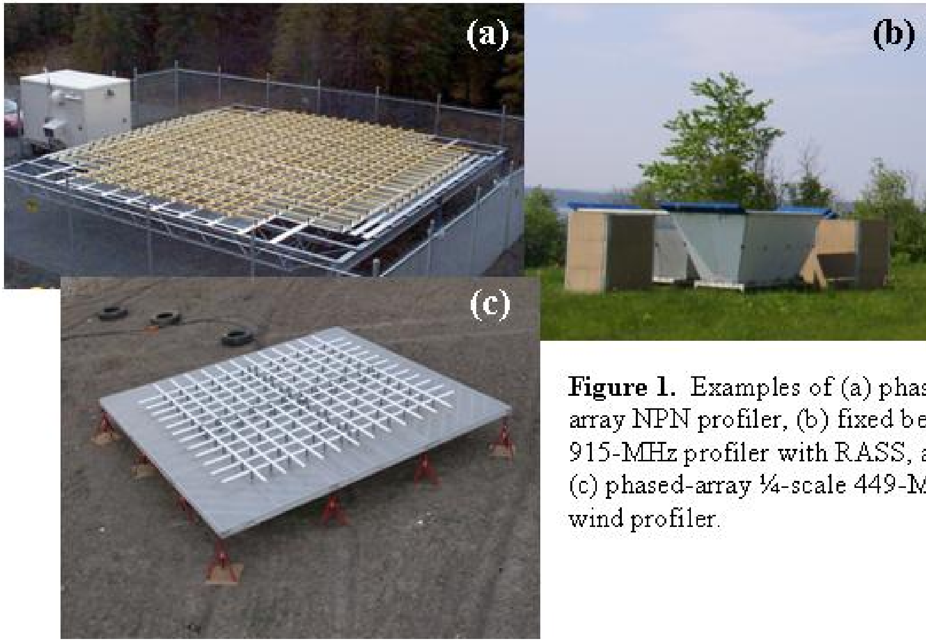


Figure 1. Examples of (a) phased-array NPN profiler, (b) fixed beam 915-MHz profiler with RASS, and (c) phased-array ¼-scale 449-Mhz wind profiler.

Wind Profilers

What they measure

- Horizontal wind speed and direction
- SNR (reflectivity)
- RASS (virtual and potential temp)
- Vertical velocity
- Snow level

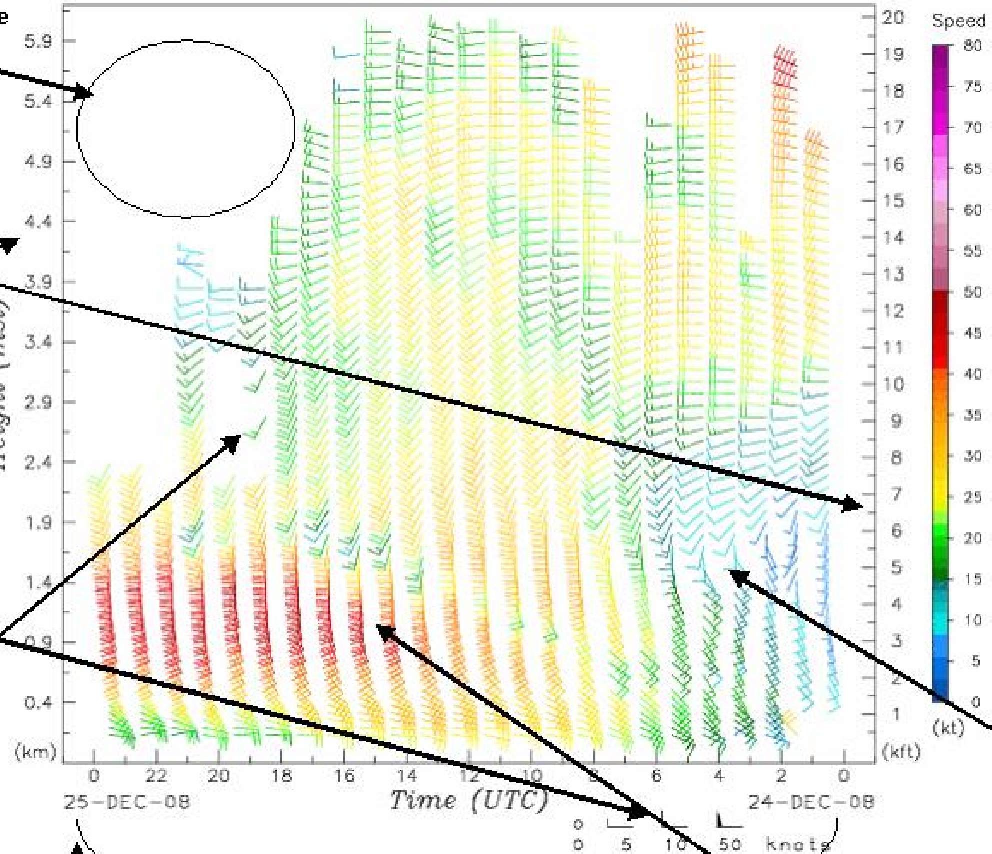
Wind Profiler Winds

A radar wind profiler measures the Doppler shift of electromagnetic energy scattered back from atmospheric turbulence and hydrometeors along 3-5 vertical and off-vertical pointing beam directions. Backscattered signal strength and radial-component velocities are remotely sensed along all beam directions, and are combined to derive the horizontal wind field over the radar. Images include wind barbs, which depict the horizontal wind speed and direction, and color-coded wind speed. These data are typically sampled and averaged for each hour, and typically have 60 m and/or 100 m vertical resolution up to ~4 km and 8 km for the 915 MHz and 449 MHz systems respectively.

Return signal from atmosphere is too weak to detect winds

Height scale in kilometers and thousands of feet on the left and right vertical axes respectively

Wind barbs depict the derived horizontal wind. Speed is represented by the barb symbols in the legend. The addition of these symbols on each barb body gives the total speed. The orientation of the barb body determines wind direction. For example, the upper arrow points to a 15 knot southwesterly wind.



Color-coded legend for wind speed contours, in knots. The dynamic range and the minimum and maximum values of the scale remain constant.

Spatial and temporal changes in wind direction can be used to identify atmospheric boundaries such as fronts.

Current Time

24-hour period with time increasing from right to left. Time convention is Coordinated Universal Time (UTC).

Spatial and temporal regions of wind speed maxima can be used to identify low-level jets.

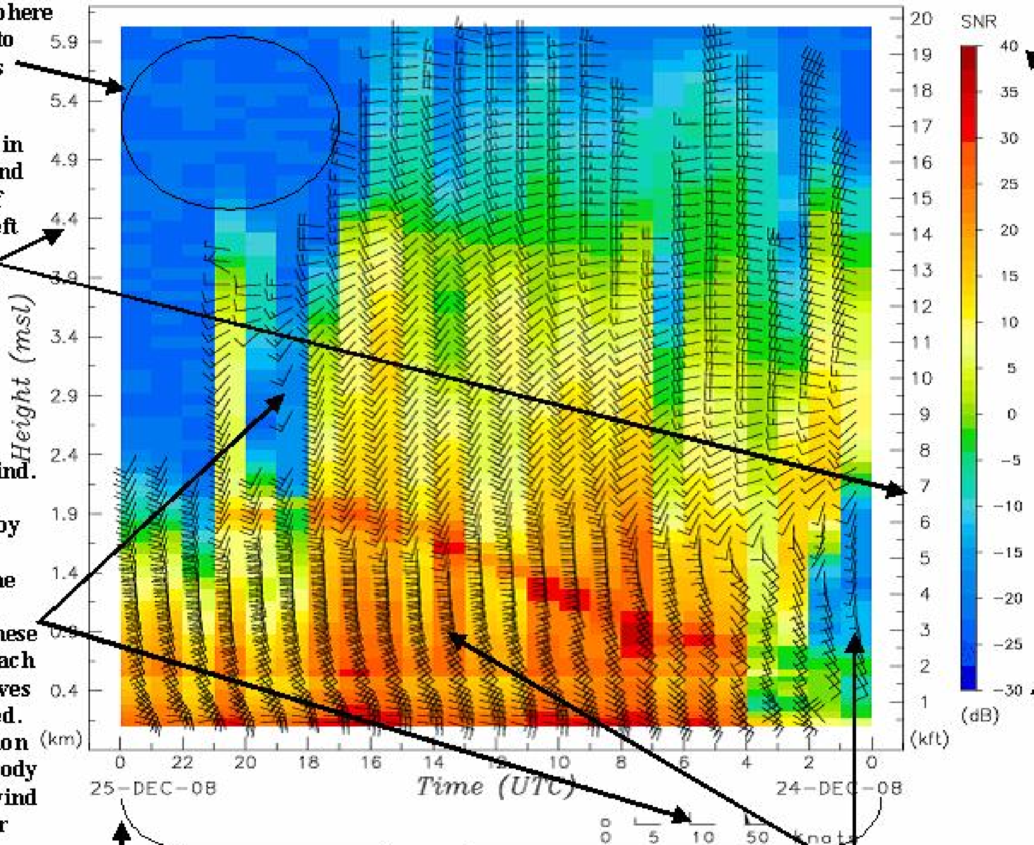
Wind Profiler Signal-to-Noise Ratio and Winds

A radar wind profiler measures the Doppler shift of electromagnetic energy scattered back from atmospheric turbulence and hydrometeors along 3-5 vertical and off-vertical pointing beam directions. Backscattered signal strength and radial-component velocities are remotely sensed along all beam directions, and are combined to derive the horizontal wind field over the radar. Images include color contours of signal-to-noise ratio and wind barbs, which depict the horizontal wind speed and direction. These data are typically sampled and averaged hourly, and typically have 60 m and/or 100 m vertical resolution up to ~4 km and ~8 km for the 915 MHz and 449 MHz systems respectively.

Return signal from atmosphere is too weak to detect winds

Height scale in kilometers and thousands of feet on the left and right vertical axes respectively

Wind barbs depict the derived horizontal wind. Speed is represented by the barb symbols in the legend. The addition of these symbols on each barb body gives the total speed. The orientation of the barb body determines wind direction. For example, the upper arrow points to a 15 knot southwesterly wind.



Color-coded legend for signal-to-noise ratio (SNR) contours, in decibels. The dynamic range and the minimum and maximum values of the scale remain constant. Higher (lower) values of SNR are associated with increased (decreased) backscattered energy.

Current Time

24-hour period with time increasing from right to left. Time convention is Coordinated Universal Time (UTC).

Higher values of SNR correspond to backscatter from precipitation, and are correlated with precipitation rate. Lower values of SNR are associated with backscatter from clear-air turbulence.

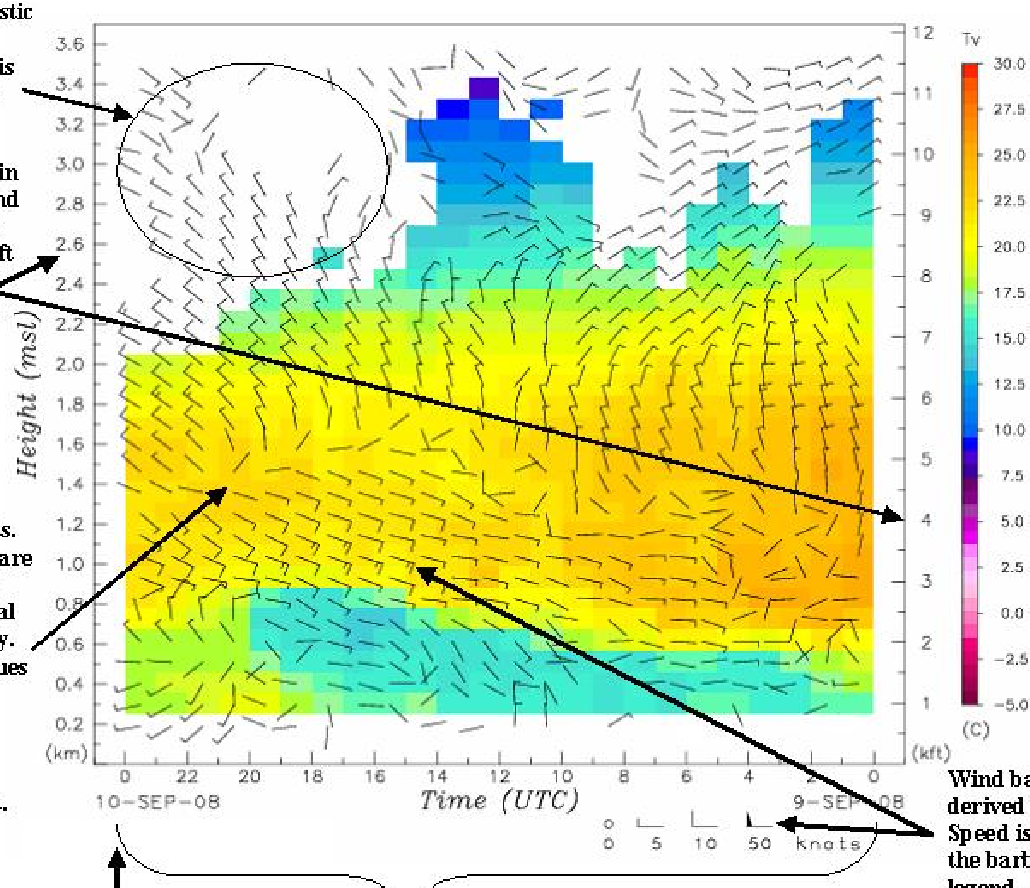
Wind Profiler Temperature

A radio acoustic sounding system (RASS) is used in conjunction with the wind profiler to measure atmospheric virtual temperature. Images include contours of virtual temperature without the vertical radial velocity removed, and the derived horizontal winds depicted with wind barbs. These data are typically sampled and averaged for five minutes each hour, and typically have ~60 m vertical resolution up to ~1.5 km and 3.5 km for the 915 MHz and 449 MHz systems respectively.

Return acoustic signal from atmosphere is too weak to detect

Height scale in kilometers and thousands of feet on the left and right vertical axes respectively

Color fill represents virtual temperature measurements. These values are not corrected for the vertical radial velocity. Non-zero values of vertical velocity will produce an error in this measurement.



Color-coded legend for virtual temperature contours, in Celsius. The dynamic range of this scale remains constant, and the minimum and maximum values of the scale vary according to season and geographical location.

Current Time

24-hour period with time increasing from right to left. Time convention is Coordinated Universal Time (UTC).

Wind barbs depict the derived horizontal wind. Speed is represented by the barb symbols in the legend. The addition of these symbols on each barb body gives the total speed. The orientation of the barb body determines wind direction. For example, the upper arrow points to a 15 knot east-southeasterly wind.

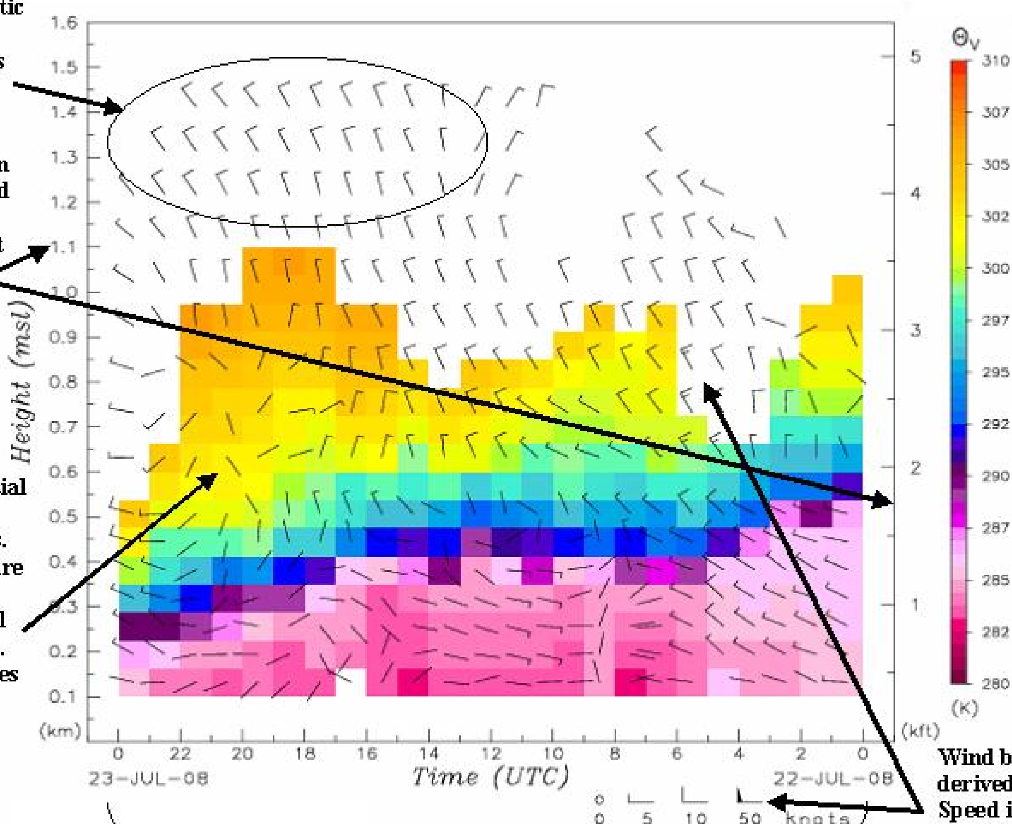
Wind Profiler Virtual Potential Temperature

A radio acoustic sounding system (RASS) is used in conjunction with the wind profiler to measure atmospheric virtual temperature. Using collocated near-surface measurements of temperature, relative humidity, and pressure, vertical profiles of virtual potential temperature are derived. Images include contours of virtual potential temperature without the vertical radial velocity removed, and the derived horizontal winds depicted with wind barbs. These data are typically sampled and averaged for five minutes each hour, and typically have ~60 m vertical resolution up to ~1.5 km and 3.5 km for the 915 MHz and 449 MHz systems respectively.

Return acoustic signal from atmosphere is too weak to detect

Height scale in kilometers and thousands of feet on the left and right vertical axes respectively

Color fill represents virtual potential temperature measurements. These values are not corrected for the vertical radial velocity. Non-zero values of vertical velocity will produce an error in this measurement.



Color-coded legend for virtual potential temperature contours, in Kelvin. The dynamic range of this scale remains constant, and the minimum and maximum values of the scale vary to accommodate the range of measured values over the period.

Wind barbs depict the derived horizontal wind. Speed is represented by the barb symbols in the legend. The addition of these symbols on each barb body gives the total speed. The orientation of the barb body determines wind direction. For example, the upper arrow points to a 15 knot northwesterly wind.

Current Time

24-hour period with time increasing from right to left. Time convention is Coordinated Universal Time (UTC).

Wind Profiler Snow Level

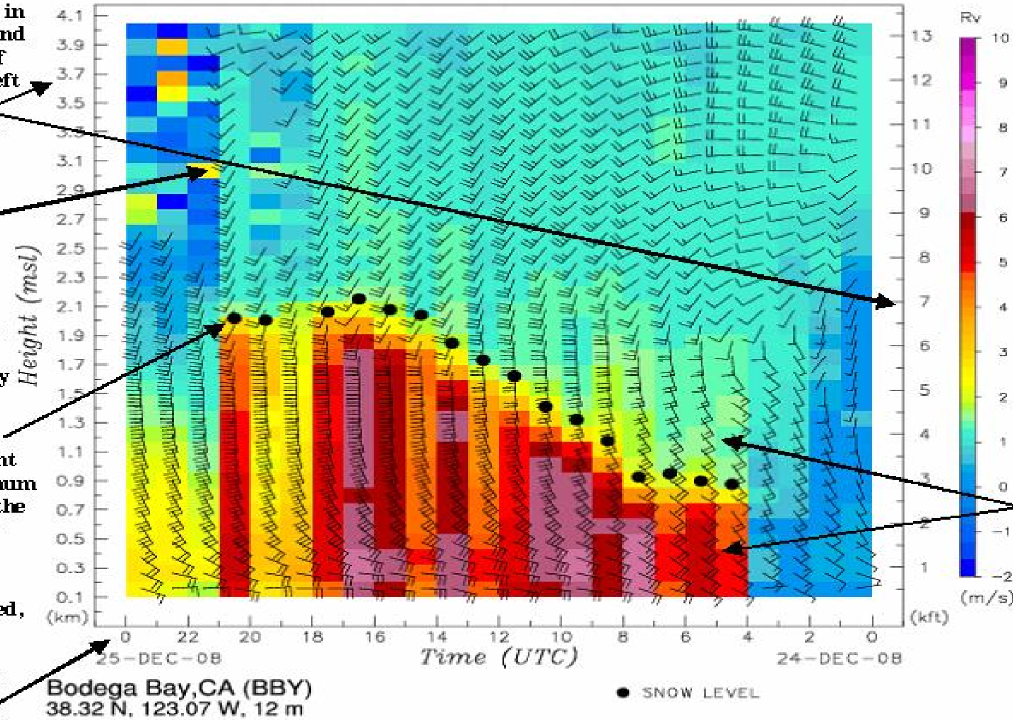
A radar wind profiler measures the Doppler shift of electromagnetic energy scattered back from atmospheric turbulence and hydrometeors along 3-5 vertical and off-vertical pointing beam directions. During ice-induced precipitation events, backscattered signal strength and radial-component velocities exhibit unique behaviors at the altitude where snow transitions to rain, which is referred to as the radar bright band. Images include color contours of vertical radial velocity and circular symbols to depict the height of the maximum SNR within the radar bright band, as derived from an automated bright-band detection algorithm. These data are typically sampled and averaged hourly, and typically have 60 m and/or 100 m vertical resolution up to ~4 km and ~8 km for the 915 MHz and 449 MHz systems respectively.

Height scale in kilometers and thousands of feet on the left and right vertical axes respectively

Wind barbs depict the derived horizontal wind. For example, the arrow points to a 20 knot southwesterly wind.

Algorithm – derived height of the maximum SNR within the radar bright band.

24 hours of data displayed, with time increasing from right to left. Time convention is Coordinated Universal Time (UTC).



Color-coded legend for vertical radial velocity contours, in meters per second. The dynamic range and the minimum and maximum values of the scale remain constant.

The vertical radial velocity during precipitation estimates the fall velocity of hydrometeors. Above the bright band, snow falls at slower speeds than rain below the bright band.

Time (UTC)	2330	2230	2130	2030	1930	1830	1730	1630	1530	1430	1330	1230
Snow Level (m)	none	none	none	2018	2005	none	2063	2152	2077	2042	1847	1731
Snow Level (ft)	none	none	none	6619	6576	none	6766	7058	6812	6697	6058	5677
Sfc Temp (C)	8.45	8.26	8.25	8.16	8.11	7.40	7.12	7.04	7.03	7.07	7.02	6.96

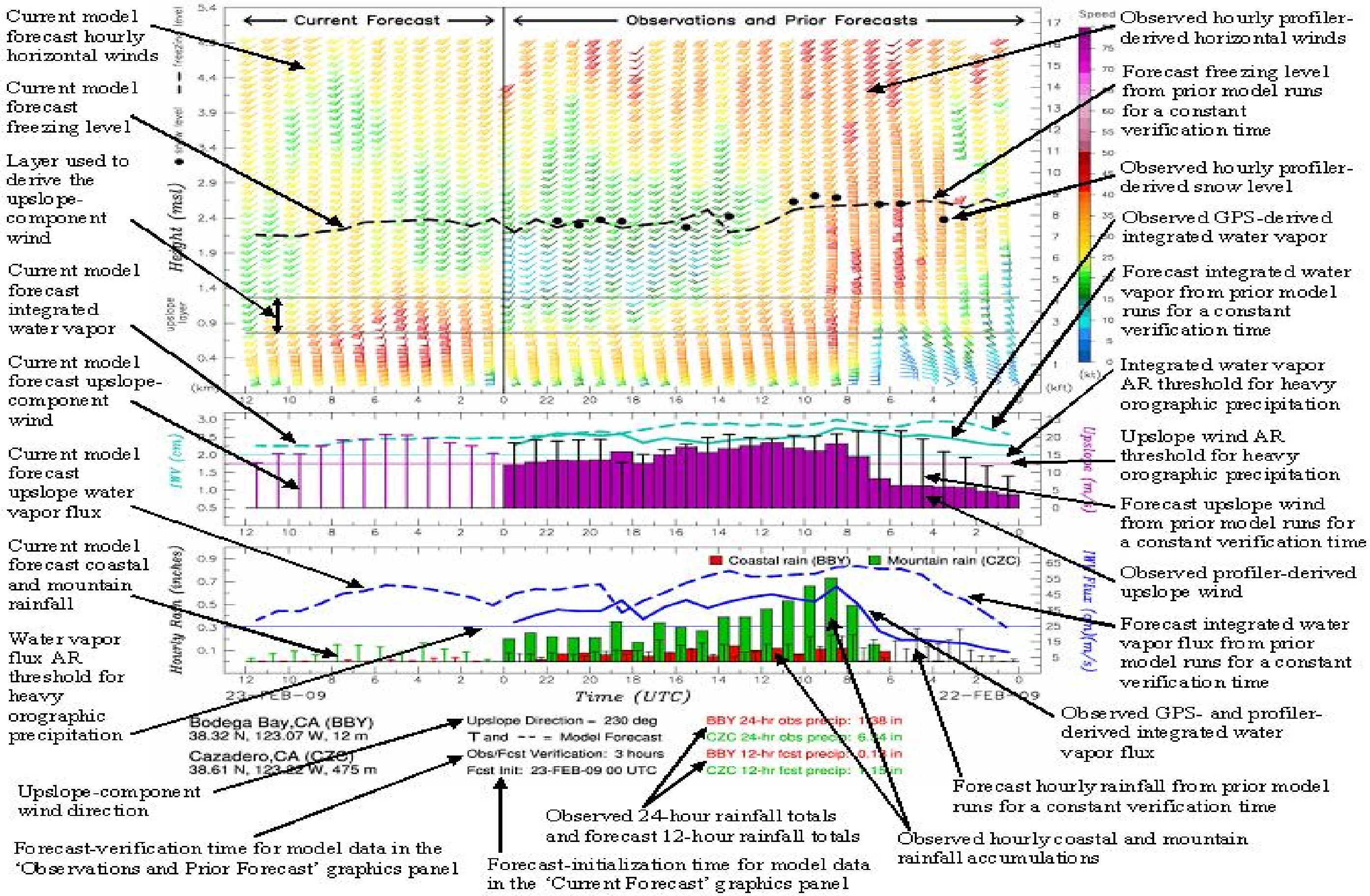
Time (UTC)	1130	1030	0930	0830	0730	0630	0530	0430	0330	0230	0130	0030
Snow Level (m)	1621	1411	1320	1174	927	949	898	877	none	none	none	none
Snow Level (ft)	5316	4628	4329	3850	3040	3112	2945	2876	none	none	none	none
Sfc Temp (C)	6.93	6.92	6.80	6.87	6.93	6.75	7.21	7.33	7.50	7.50	7.70	8.22

Table lists algorithm-derived snow level in meters and feet, and surface temperature in Celsius. Surface temperatures below freezing combined with elevated snow levels can indicate sleet or freezing rain.

White, A.B., D.J. Gottas, F.M. Ralph, and P.J. Neiman, 2002: An automated bright-band height detection algorithm for use with Doppler radar spectral moments. *J. Atmos. Oceanic Technol.*, **19**, 687–697.

Coastal Atmospheric River (AR) Monitoring and Early Warning System

Profiler and precipitation observations provided by the NOAA/ESRL Physical Sciences Division
GPS observations and model forecast provided by the NOAA/ESRL Global Systems Division



References

Jankov, I., J. Bao, P.J. Neiman, P.J. Schultz, H. Yuan, A.B. White, 2009: Evaluation and comparison of microphysical algorithms in WRF-ARW model simulations of atmospheric river events affecting the California coast. *J. of Hydrometeor.*, **10**, 847-870.

Neiman, P.J., A.B. White, F.M. Ralph, D.J. Gottas, and S.I. Gutman, 2009: A water vapor flux tool for precipitation forecasting. *Water Management*, **162**, WM2, doi: 10.1680/wama.2009.162.2.83.

Neiman, P.J., F.M. Ralph, A.B. White, D.E. Kingsmill, and P.O.G. Persson, 2002: The statistical relationship between upslope flow and rainfall in California's coastal mountains: Observations during CALJET. *Mon. Wea. Rev.*, **130**, 1468-1492.

Ralph, F.M., P.J. Neiman, G.A. Wick, S.I. Gutman, M.D. Dettinger, D.R. Cayan, and A.B. White, 2006: Flooding on California's Russian River: Role of atmospheric rivers. *Geophys. Res. Lett.*, **33**, L13801, doi:10.1029/2006GL026689.

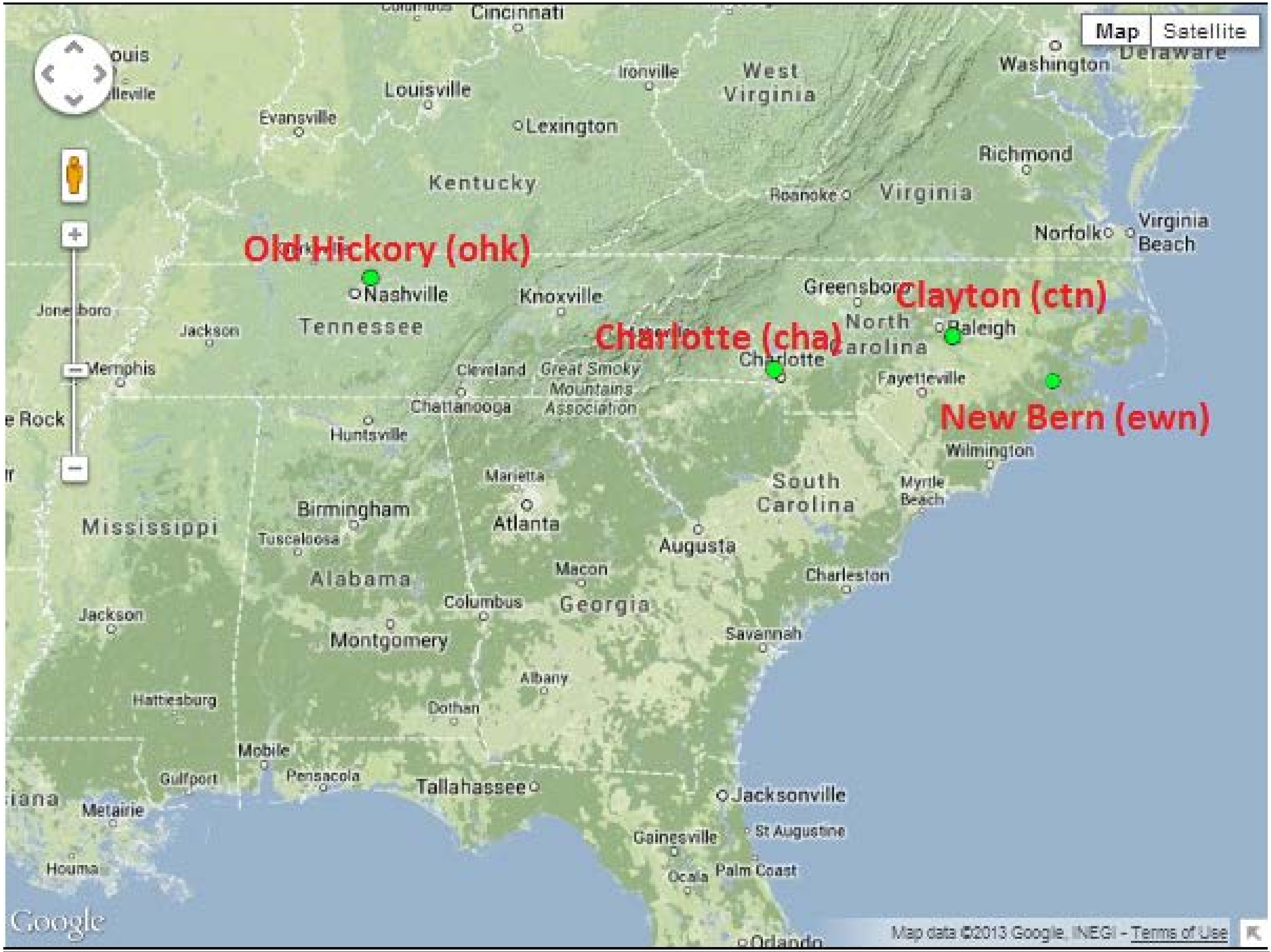
White, A.B., D.J. Gottas, E.T. Strem, F.M. Ralph, P.J. Neiman, 2002: An automated brightband height detection algorithm or use with Doppler radar spectral moments. *J. Atmos. Oceanic Technol.*, **19**, 687B697.

Yuan, H., J.A. McGinley, P.J. Schultz, C.J. Anderson, and C. Lu, 2008: Short-range precipitation forecasts from time-lagged multimodel ensembles during the HMT-West-2006 Campaign. *J. of Hydrometeor.*, **9**, 447-491.

Product Access: http://www.esrl.noaa.gov/psd/data/obs/

Contacts: Paul.J.Neiman@noaa.gov Daniel.Gottas@noaa.gov

HMT-SE Wind Profilers (as of 7/31/2013)



3 GHz and FMCW Precipitation Profilers

Table 1. S-band profiler characteristics

Frequency (GHz)	2.875
Antenna diameter (m)	2.4
Average transmit power (W)	20
Peak power (W)	360
Beamwidth (deg)	2.5
Range resolution (m)	45, 60, 105, 420
Time resolution, nominal (s)	30
Doppler technique	FFT
Estimated sensitivity (dBZ*e* at 10 km)	−14

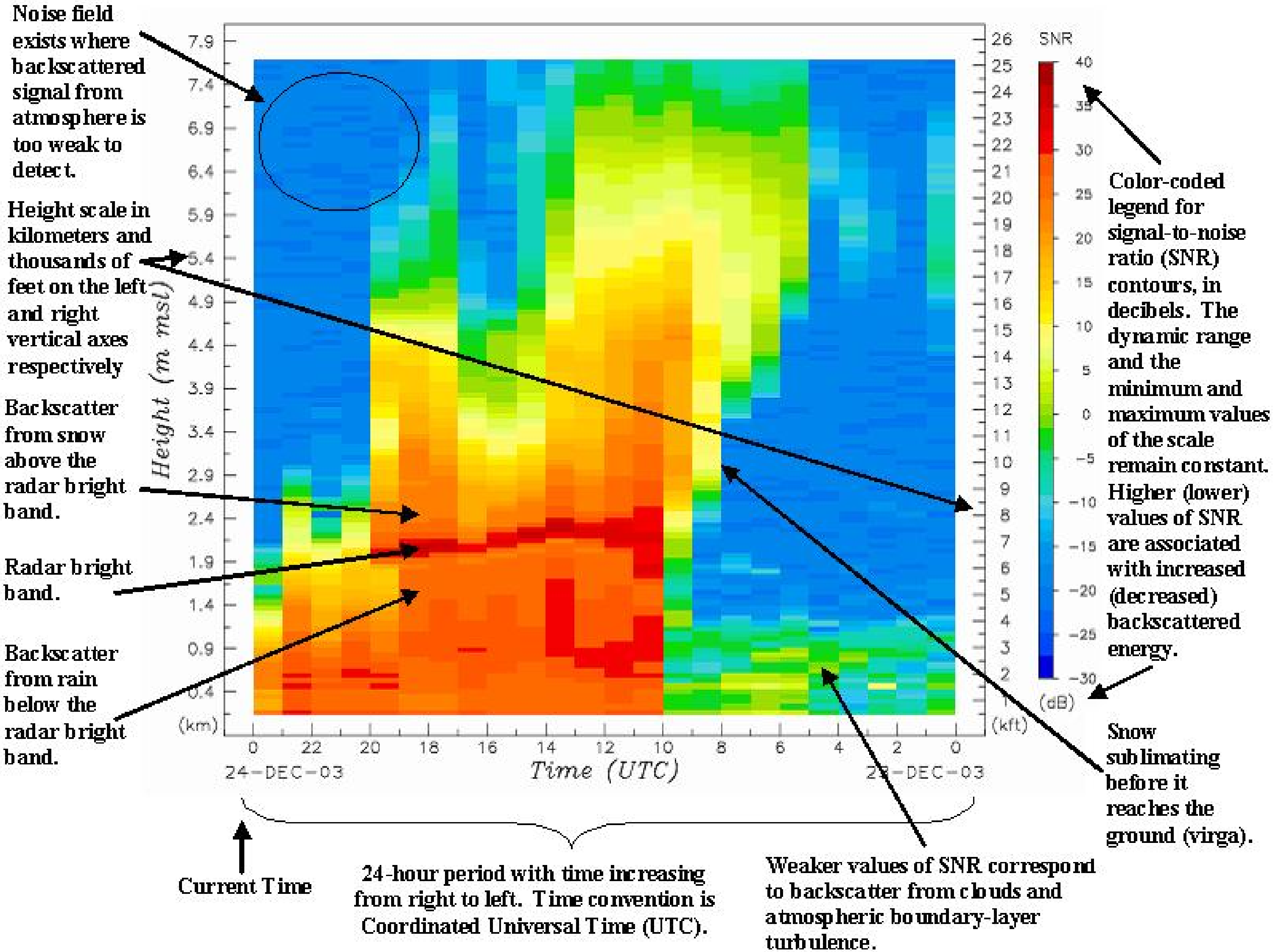
3 GHz and FMCW Precipitation Profilers

What they measure

- SNR (reflectivity)
- Vertical velocity
- Snow level

S-band Precipitation Profiler Reflectivity

An S-band precipitation profiler measures the magnitude and Doppler shift of electromagnetic energy scattered back from hydrometeors and clouds along a vertically pointing radar beam. Images include color contours of signal-to-noise ratio, which is related to precipitation distribution and intensity. These data are typically sampled and averaged hourly, and have a 60 m vertical resolution up to ~8 km.



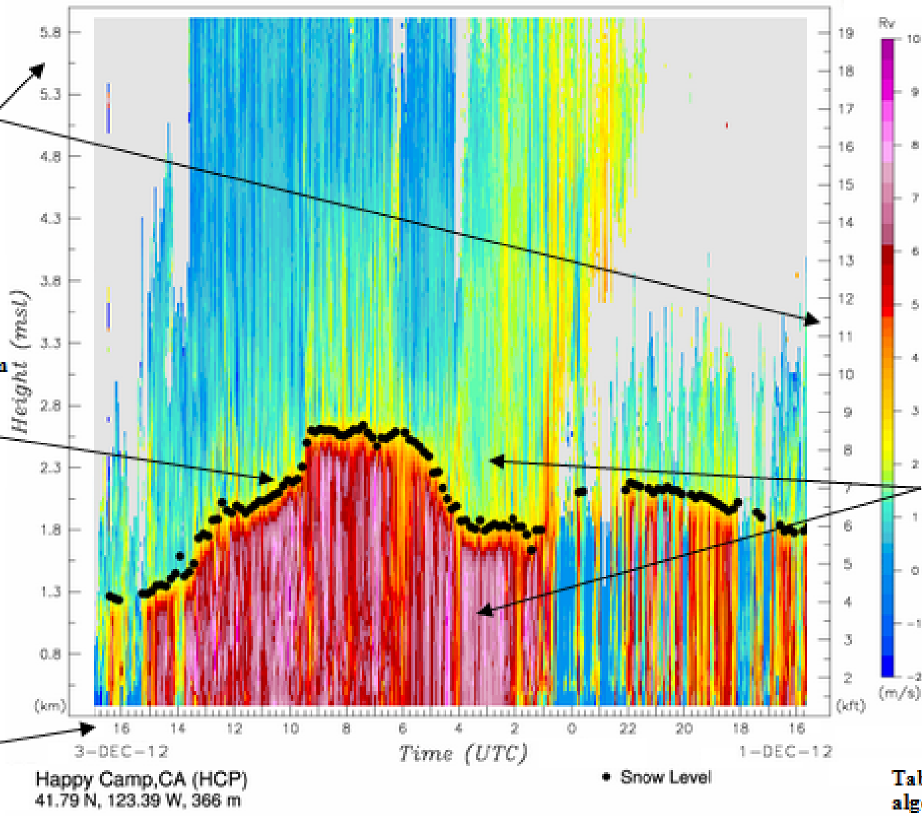
S-band Precipitation Profiler Snow Level

An S-band precipitation profiler measures the magnitude and Doppler shift of electromagnetic energy scattered back from hydrometeors and clouds along a vertically pointing radar beam. During ice-induced precipitation events, backscattered signal strength and radial-component velocities exhibit unique behaviors at the altitude where snow transitions to rain, which is referred to as the radar bright band. Images include color contours of vertical radial velocity and circular symbols to depict the height of the maximum SNR within the radar bright band (or snow level), as derived from an automated bright-band detection algorithm. The vertical radial velocity and SNR data are sampled every ~30 seconds, and typically have 40-60 m vertical resolution up to ~8 km. The bright-band detection algorithm produces averaged snow-level heights every 10-15 minutes, when bright-band precipitation is present.

Height scale in kilometers and thousands of feet on the left and right vertical axes respectively

Algorithm – derived height of the maximum SNR within the radar bright band (also known as snow level). Values are averaged and produced every 10-15 minutes.

24 hours of data displayed, with time increasing from right to left. Time convention is Coordinated Universal Time (UTC).



Color-coded legend for vertical radial velocity contours, in meters per second. The dynamic range and the minimum and maximum values of the scale remain constant.

The vertical radial velocity during precipitation estimates the fall velocity of hydrometeors. Above the bright band, snow falls at slower speeds than rain below the bright band.

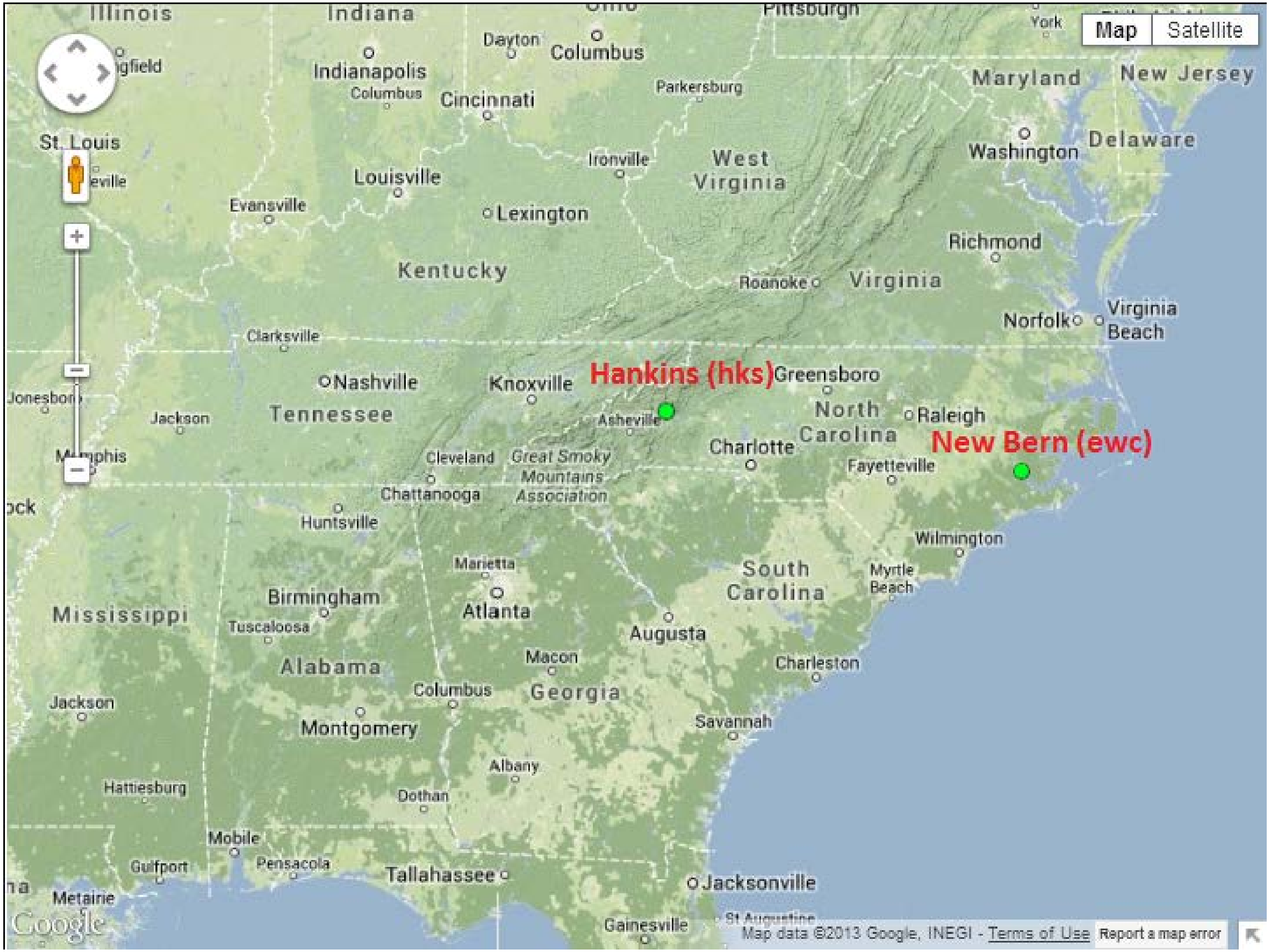
Time (UTC)	1630	1530	1430	1330	1230	1130	1030	0930	0830	0730	0630	0530	0430
Snow Level (m)	1249	1285	1352	1556	1908	1980	2087	2402	2596	2591	2538	2488	2091
Snow Level (ft)	4096	4214	4434	5103	6259	6494	6847	7878	8516	8500	8324	8160	6858

Time (UTC)	0330	0230	0130	0030	2330	2230	2130	2030	1930	1830	1730	1630	1530
Snow Level (m)	1845	1830	1797	none	2102	2118	2146	2116	2061	1989	1918	1794	1829
Snow Level (ft)	6053	6002	5895	none	6896	6947	7038	6940	6760	6525	6292	5885	6000

Table lists algorithm-derived snow level in meters and feet, and surface temperature (where available) in Celsius. Surface temperatures below freezing combined with elevated snow levels can indicate sleet or freezing rain.

White, A.B., D.J. Gottas, F.M. Ralph, and P.J. Neiman, 2002: An automated bright-band height detection algorithm for use with Doppler radar spectral moments. *J. Atmos. Oceanic Technol.*, 19, 687–697.

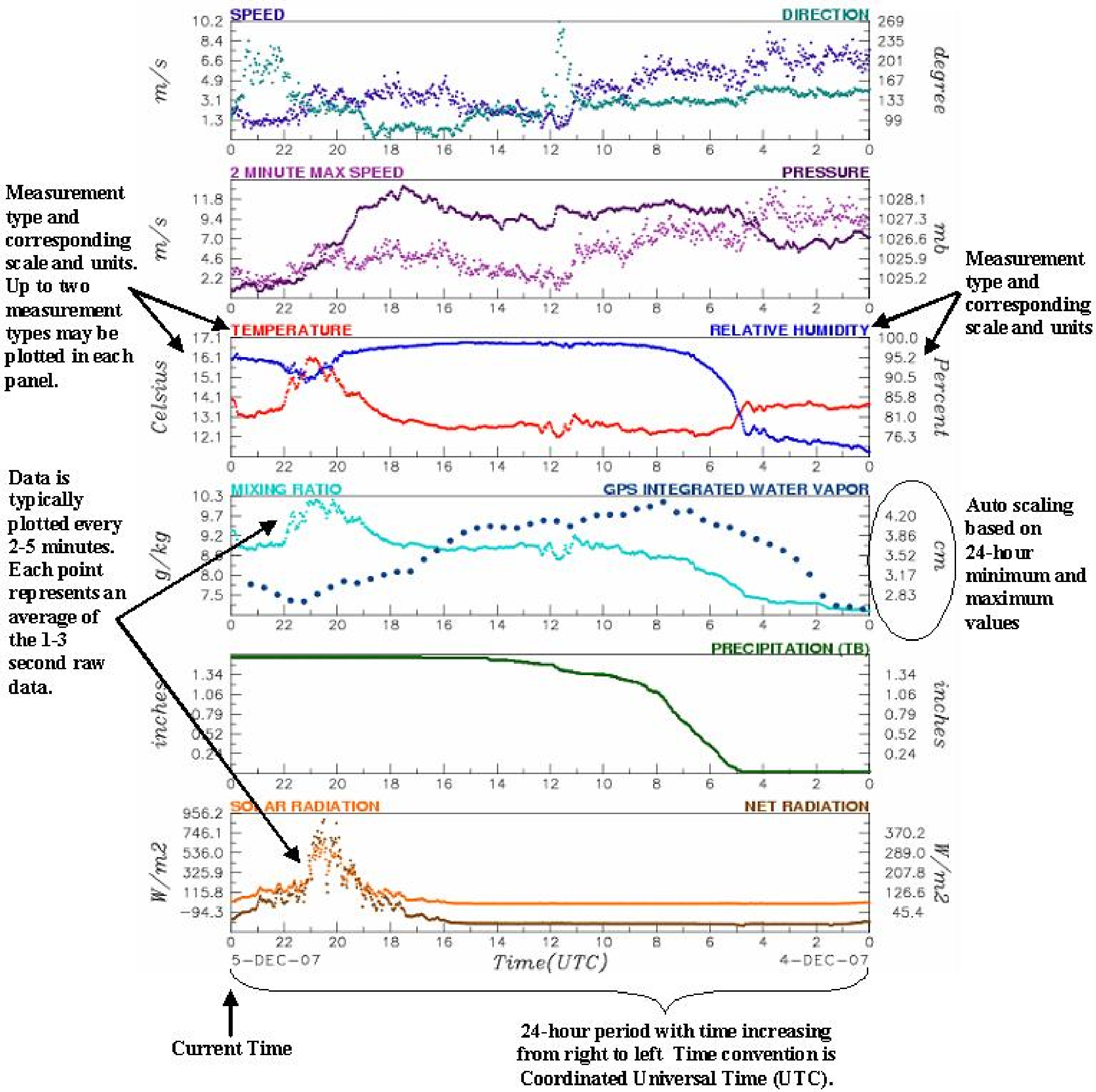
HMT-SE Precipitation Profilers: (as of 7/31/2013)



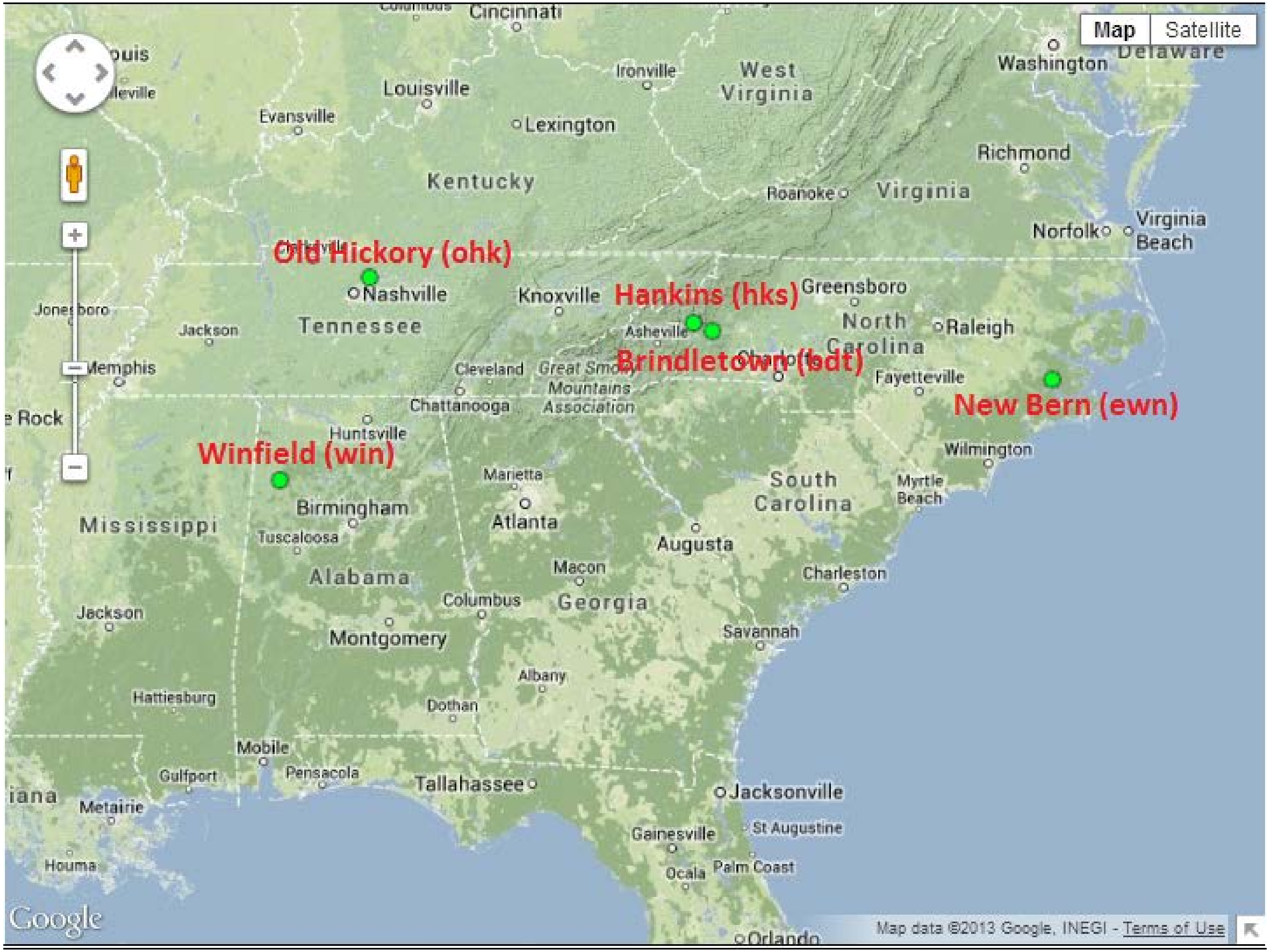
Surface Met Instrumentation

Surface Meteorology and Physics Product Description

A variety of instruments are used to measure various quantities related to meteorology, precipitation, radiation, soil, and atmospheric turbulence near the earth's surface. A standard suite of instruments are typically deployed at every site to monitor meteorological state variables. In addition, other instrumentation configurations are deployed to on a site-by-site basis to support hydrologic, surface-energy budget, and atmospheric turbulence applications.

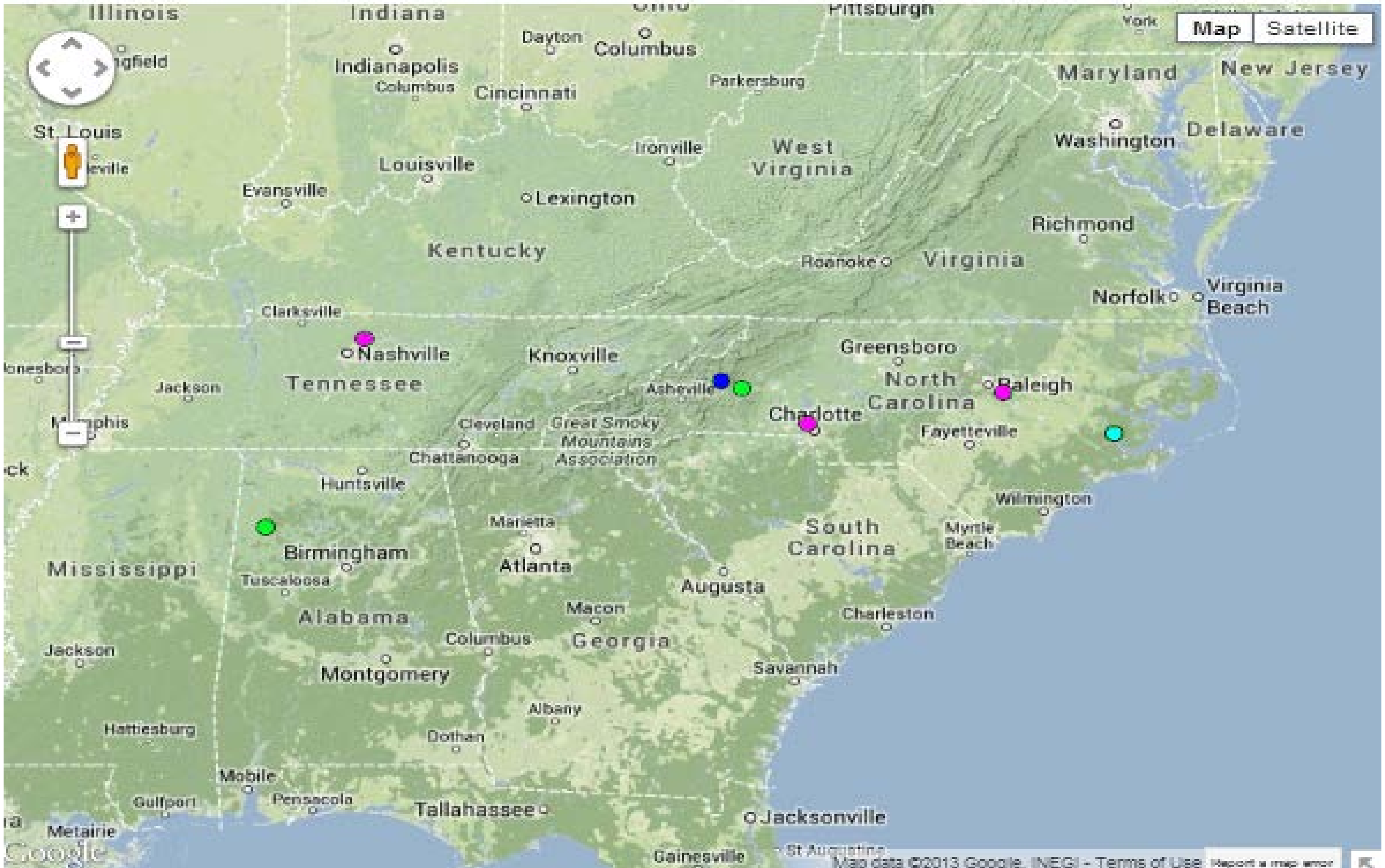


HMT-SE Surface Instrumentation (as of 7/31/2013)



All HMT-SE Instrumentation

- 449 MHz Wind Profiler + S-band
- 915 MHz Wind Profiler
- FMCW Precipitation Profiler
- Surface Met Only



Data Access and Visualization Demo

http://www.esrl.noaa.gov/psd/data/obs/datadisplay/