Read Me for **UMBC Leosphere 200S Doppler lidar - PECAN FP2**

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Most data questions can/should be directed to Brian Carroll.

1.0 Data Set Overview

- This data set is the default format as processed by the commercial Leosphere software, reporting only line-of-sight (LOS) winds. We chose a scanning routine with PPIs, RHIs, and vertical stares (see section 3.0) to allow retrieval of most desired wind products.
- The lidar operated 24 hours a day with minor interruptions from June 2nd to July 15, 2015.
- The instrument was at FP2 in Greensburg, Kansas. lat/lon: 37.605915/-99.275718. Elevation was ground level, 681m ASL.
- **After completion of PECAN operations, it was found that the lidar had a constant radial velocity bias of +0.5 m/s. When using this data, be sure to subtract this offset from the radial velocities before doing any calculations.** Contact Brian Carroll with any questions regarding this.

2.0 Instrument Description

- The Leosphere 200s is a commercially manufactured coherent Doppler lidar. The manufacturer website is http://www.leosphere.com/products/3d-scanning/windcube-100s200s400s-turbulence-wind-lidar (not very informative scientifically). The instrument produces line-of-sight wind speeds derived from the Doppler frequency shift in backscattered photons off of atmospheric aerosols.

Table 1. Instrument parameters.

Parameter	Laser/lidar value
Wavelength	1.54 micron
Pulse Energy	0.1 mJ
Pulse Rate	10 kHz
Range Resolution	25, 50, 75, 100 m
Minimum Range	0.1 km
Maximum Range	3, 6, 12, 12 km

The Range Resolution and Maximum Range are paired in their respective orders, e.g. 50m resolution has a maximum detection range of 6 km (this resolution is also our primary operating mode).

The data processing is done by Leosphere's own algorithms, the exact details of which are kept private. The general scheme is to take the Doppler spectral profiles for a given range gate and chosen accumulation time, average the Fourier Transforms to isolate the signal peak, and convert that frequency (shift) to a wind speed. We only saved the Leosphere wind product for this experiment, not the raw Doppler spectral profiles, due to data storage limitations.

3.0 Data Collection and Processing

The scan routine for the duration of PECAN was constant, except for one adjustment to the vertical stare time noted after Table 2. The scan routine is presented in Table 2 and had a runtime of approximately 25/20 minutes per cycle before/after June 26th. Range resolution of 50m was used, with the first bin centered 100m from the lidar, second at 150m, and so on out to a maximum of 6km in ideal conditions.

PPI is a conical scan. RHI is a vertical slice. LOS is a single pointing direction, i.e. zenith stare.

Table 2. Lidar scan routine.

Iterations	Mode	Start Az. (°)	End Az. (°)	Start Elev. (°)	End Elev. (°)	Accumulation Time (s)	Speed (°/s)
1	PPI	0	360	5.0	-	1.00	2.5
1	PPI	0	360	7.5	-	1.00	2.5
1	PPI	0	360	10.0	-	1.00	2.5
1	PPI	0	360	20.0	-	1.00	2.5
1	PPI	0	360	45.0	-	1.00	2.5
1	RHI	80	-	0.0	60.0	1.00	2.5
1	RHI	80	-	60.0	0.0	1.00	-2.5
1	RHI	170	-	60.0	0.0	1.00	-2.5
1	RHI	170	-	0.0	60.0	1.00	2.5
600/300	LOS	0	-	90.0	-	1.00	-

- The LOS vertical stare was done for 600 seconds before June 26th 22:30 UTC, then for only 300 seconds after that date to produce more frequent profiles.
- Degrees are measured clockwise from lidar compass heading (magnetic north). Lidar heading is recorded in the header of each data file. NOAA has the appropriate magnetic declination from true north as 5.10°E±0.35°.

The main quality control for the data is the CNR. The derived radial wind speeds typically become too noisy below CNR = -29 dB. A threshold of -27 dB is a generous margin, but should safely yield accurate data in the event that the data sets are not being combed by hand.

4.0 Data Format

The data file naming convention is *WLS200S-26_yyyy_mm_dd__hh_mm_ss_PPI.rtd*, where WLS200S-26 is the instrument name, the time indicates when the file started writing (first data timestamp; UTC), and PPI is the scan type (can alternatively be RHI or LOS).

The data is in .rtd format. This can easily be opened in Microsoft Excel to explore the file structure. There are 41 lines of header with instrument parameters, including the lidar compass heading (cw from magnetic north). Line 42 indicates the data content of each column. Some columns are full of NaNs because this instrument only reports timestamp (UTC), internal temperature, azimuth, and elevation (°), and then the trio of radial wind speed (m/s), radial wind speed dispersion (m/s), and CNR (dB) per range gate of a given measurement (1 sec accumulation time). Each row below row 42 is a new measurement.

5.0 Data Remarks

N/A, but let us know if you see anything strange!