NOAA ATDD Wind Lidar Metadata

Spring 2016 VORTEX-SE

PIs

Temple R. Lee (temple.lee@noaa.gov)

Michael Buban (michael.buban@noaa.gov)

Tilden Meyers (tilden.meyers@noaa.gov)

Contact

NOAA ATDD

456 S. Illinois Avenue

Oak Ridge, TN 37830

Phone: 865-576-1233

Fax: 865-576-1327

1.0 Data set overview

To support research activities during the Verification of the Origins of Rotation in Tornadoes EXperiment-Southeast (VORTEX-SE), we deployed a wind lidar from 15 March 2016 through 1 May 2016 at Belle Mina, AL (34.690227 N, 86.884308 W, 188 m above mean sea level) to derive continuous profiles of wind speed, wind direction, vertical velocity, and turbulence statistics.

2.0 Instrument description

The lidar is a WINDCUBE 100s, manufactured by Leosphere. The 100s is a pulsed Doppler lidar that emits short laser pulses that are backscattered by particles within the atmosphere. The backscattered signal is returned to the receiver and is split into blocks, or range gates, and radial velocities are determined at each of these gates (e.g. User's Manual for WINDCUBE 100s/200s/400s, 20008; Newman et al., 2015). More detailed specifications about the 100s are found in Table 1.

Table 1: Manufacturer-stated performance and specifications for the WINDCUBE 100s lidar (available from <http://www.leosphere.com/products/3d-scanning/windcube-100s200s400s-turbulence-wind-lidar>)

Precision of velocity measurements	<0.5 m s^{-1}
Wind velocity range	-30 to +30 m s^{-1}
Accumulation time	0.5-10 s
Physical range resolution	50 m
Maximum power	5 mW
Pulse width	100 ns
Wavelength	1543 nm

3.0 Data Collection and Processing

We performed a six-beam scanning pattern following the technique detailed by Sathe (2012) and Sathe et al. (2015) and implemented in more recent studies (e.g. Klein et al., 2015; Newman et al., 2016) to derive continuous profiles of wind speed, wind direction, vertical velocity, and atmospheric turbulence. The main advantage of the six-beam technique is that it reduces known systematic errors in turbulence calculations that arise when using more traditional scanning techniques, e.g. the Velocity Azimuth Display (VAD) and Doppler Beam Swinging (DBS) techniques (e.g. Newman et al., 2016). The scanning pattern that we used during the spring 2016 campaign is shown in Table 2. The first five scans were 7 s apart, which was the time required to reposition the lidar head between each scan. Following these five scans, 10 vertically pointing scans were performed 1 s apart so that there were >10 vertically-pointing scans every 2 min for consistency with collocated profiles from the microwave radiometer and Atmospheric Emitted Radiance Interferometer that comprise NSSL's Collaborative Lower Atmosphere Mobile Profiling System (CLAMPS). Each full scanning pattern lasted 45 s, and the spacing of the range gates in each scan was 50 m.

Each of the scans was saved to an individual file. For each range gate, the radial velocity, carrier-to-noise ratio (CNR), and speed dispersion were stored. Radial velocities for which the CNR was <-30 dBz were replaced with NaNs in the processed data files. Also, as a component of the post-processing, individual files were concatenated into one .txt file for each day, which are described in more detail in the next section.

Table 2: Scanning pattern for wind lidar deployed at Belle Mina, AL during the spring 2016 VORTEX-SE campaign. The scanning pattern is adopted from Sathe (2012) and Sathe et al. (2015).

Number of scans	Elevation angle (°)	Azimuth angle (°)	Accumulation time for each scan (s)
1	45	0	7
1	45	72	7
1	45	144	7
1	45	216	7
1	45	288	7
10	90	--	1

4.0 Data Format

The files for each day have the following naming convention: lidar_out_ALL_DATE. For example, the file entitled *lidar_out_ALL_03152016* was made on 15 March 2016 includes all data collected between 0000 LST and 2359 LST (LST=UTC-6). The column headers are listed in Table 3. Missing data in the files are represented by NaN.

Table 3: Description of each column contained in the lidar data files.

Column(s)	Variable Description (units)
1	Decimal day of year in 2016 in LST (LST=UTC-6)
2	Temperature inside lidar box (°C)
3	Azimuth angle of scan (°)
4	Elevation angle of scan (°)
5-103	CNR every 50 m from 100-5000 m (dBz)
104-202	Dispersion every 50 m from 100-5000 m (m s^{-1})
203-301	Radial velocity every 50 m from 100-5000 m (m s^{-1})

5.0 Data Remarks

Data between the lowest range gate and about 2000 m were reliable. Above approximately 2000 m, there was oftentimes significant degradation in signal quality, and only very limited data were available above 3000 m. There were sporadic gaps in the data record, most notably from approximate 0030 LST 13 April through 0630 LST 14 April 2016 and 0000 LST 28 April 2016 through 0700 LST 29 April 2016. We attribute these gaps, as well as other, shorter gaps to on-site power outages. Any other questions about the data set should be addressed to Temple R. Lee (temple.lee@noaa.gov).

6.0 References

Klein P., T. A. Bonin, J. F. Newman, D. D. Turner, P. B. Chilson, C. E. Wainwright, W. G. Blumberg, S. Mishra, M. Carney, E. P. Jacobsen, S. Wharton, and R. K. Newsom, 2015: LABLE: a multi-institutional, student-led, atmospheric boundary-layer experiment. *Bull. Am. Meteorol. Soc*. **96** (10), 1743-1764.

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