Title: CLAMPS2 Doppler Lidar VAD Data
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1.0 Dataset Overview

These files contain 24 hour periods of data collected from the CLAMPS2 Halo Streamline XR+ Doppler lidar. The Doppler lidar conducts regular conical scans at a set elevation angle. These data are then passed through a typical VAD algorithm to retrieve horizontal wind speed and direction profiles. These data were collected during the CHEESEHEAD project.

1.1 Date range: 19 September -- 11 October 2019.
1.2 Location: Prentice Airport Site; 45.54 N, 90.28 W, 475 m elevation
1.3 Estimated data availability

2.0 Instrument Description

The Halo Streamline XR+ is a commercial platform. The Doppler lidar (DL) is an active remote-sensing instrument that provides range- and time-resolved measurements of radial velocity, attenuated backscatter, and signal-to-noise ratio (SNR). The principle of operation is similar to radar in that pulses of electromagnetic energy (infrared in this case) are transmitted into the atmosphere; the energy scattered back to the transceiver is collected and measured as a time-resolved signal. From the time delay between each outgoing transmitted pulse and the backscattered signal, the distance to the scatterer is inferred. The radial or line-of-sight velocity of the scatterers is determined from the Doppler frequency shift of the backscattered radiation. The DL uses a heterodyne detection technique in which the return signal is mixed with a reference laser beam (i.e., local oscillator) of known frequency. An onboard signal-processing computer then determines the Doppler frequency shift from the power spectra of the heterodyne signal. The energy content of the Doppler spectra can also be used to estimate attenuated backscatter. The DL operates in the near-infrared (IR;1.5 microns) and is sensitive to backscatter from micron-sized aerosols. Aerosols are ubiquitous in the lower troposphere and behave as ideal tracers of atmospheric winds. In contrast to radar, the DL is capable of measuring radial velocities under clear-sky conditions with very good precision – typically ~10 cm/sec (Newsom and Krishnamurthy 2020). It is important to note that DL scans are fully user configurable, so special attention should be paid to the scan strategy applied for this dataset.

Instrument specifications:

Max range	12 km (aerosol load dependent)
Min. range	50-90m
Nyquist Limit	~39 m/s
Range gate	Configurable, 18-60m
Precision	Velocity: <0.2 m/s

3.0 Data collection and processing:

For the CHEESEHEAD campaign, the CLAMPS2 Doppler lidar collected PPI scans at 60 deg elevation every 5 minutes. The Doppler lidar provides range-resolved, line-of-sight measurements of radial velocity, intensity (signal-to-noise ratio [SNR]+1), and attenuated backscatter. In the case of PPI scans meant for VAD analysis, these data are passed through a VAD code to produce profiles of horizontal wind speed and direction. Vertical velocity is also provided, but it is not as high quality as vertical velocity more directly measured by vertical stares. The provided files provide the intensity field (SNR+1), which can be used as a 'filter' for noise. A good rule of thumb cutoff is 1.01.

4.0 Data format:

Data are provided in netcdf format. The typical naming convention is clampsdlvad1turnC2.c1.YYYYMMDD.HHmmss.cdf, following closely to ARM file naming convention. The files have time and height dimensions.

Variables provided:

Name	Dimension	Unit
base_time	Single value	Seconds (since 00 UTC 1 Jan 1970)
time_offset	Time	Second (since base_time)
hour	Time	Hours since 00UTC this day
height	Height	km AGL
wspd	Time, Height	m/s, wind speed
wdir	Time, Height	Deg, wind direction
rms	Time, Height	m/s, RMS between observed velocity & VAD fitted value
intensity	Time, Height	Unitless, SNR+1

lat	Time	Deg N, latitude
lon	Single value	Deg W, longitude
alt	Single value	m MSL, altitude above mean sea level

5.0 Data Remarks

Note that a heading value should have been applied to the Doppler lidar to rotate the winds appropriately. Always verify this has been done, since it is not always applied by default.

Data should be consistently available, but note that periods of precipitation, fog, or other very low cloud may limit the level to which good data are collected.

6.0 References

Newsom, R. K., R. Krishnamurthy, 2020: Doppler lidar (DL) handbook. DOE Office of Science Atmospheric Radiation Measurement (ARM) Program (United States). DOE/SC/ARM/TR-101.