Vertical Profiles of vertical velocity and backscatter from the Space Science and Engineering Center (SSEC) Portable Atmospheric Research Center (SPARC) Doppler lidar during the CHEESEHEAD campaign

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1. Introduction

The SSEC Portable Atmospheric Research Center (SPARC, Wagner et al. 2019) was deployed at the WLEF-TV tall tower site for the duration of CHEESEHEAD. Among the instruments deployed near SPARC was a Halo Photonics Stream Line Doppler lidar (Pearson et al. 2009). This Doppler lidar was in vertically staring mode throughout the experiment to complement other nearby Doppler lidars so that a virtual tower of three-dimensional wind observations could be carried out. The present dataset contains the vertical velocity (w) and backscatter observations from the Doppler lidar.

2. Instrument Description

Doppler lidars measure the range-resolved velocity along the lidar beam as well as the backscatter. Typically, a Doppler lidar scans at a non-zero zenith angle at multiple azimuths and the velocity-azimuth display (VAD) technique is used to calculate the horizontal wind vector under the assumption that the wind field is horizontally homogeneous within the cone swept out by the lidar beam. In the cast of the present dataset, the beam was zenith-pointing only and thus the along-beam velocity is the vertical velocity.

The beam is an eye-safe 1.5 μm laser. This wavelength is short enough to be sensitive to micron-sized scatterers but long enough that molecular scattering only causes minimal impact to the observations. Since it is an active remote sensing system, there is a dead band adjacent to the surface in which no data is collected as the system switches from transmitting to receiving.

3. Data Processing

The profiles of vertical velocity and backscatter are produced by the instrument using the manufacturer's algorithm. The output takes the form of plain text files, one per hour, in a format that can be difficult to parse. To facilitate easier use by the community, these profiles have been consolidated into daily files and converted into standard netCDF files for permanent archiving at EOL.

4. Data Description

The data are stored in netCDF files with 24 hours of data per file, starting at 0000 UTC (7 PM CDT). Files are named in the following way:

sparc_wlef_doppler_lidar_YYYYMMDD.cdf

where YYYYMMDD is the date of the observation. Descriptors for the data can be found within the file metadata,and the key variables are described here:

date: date, in YYYYMMDD integer format
time: time, in decimal hours UTC.
height: height of the center of the range gate bin, in meters above ground level
pitch*: pitch (front/back tilt) of the instrument in degrees.
roll*: roll (left/right tilt) of the instrument in degrees.
backscatter: lidar backscatter signal, in m^{-1} sr^{-1}
w: vertical velocity, in m s^{-1}. Positive velocity is upward.
intensity: equal to 1 + signal to noise ratio, describes the reliability of the observation.

* The instrument was oriented to due north, so a positive pitch means that the beam was tilted towards the south (north side lifted) while a positive roll means a tilt to the east (west side lifted).

The data have a vertical resolution of 18 m and a temporal resolution of 10 s. The period of coverage is from 3 July 2019 to 11 October 2019. Since these are vertical profiles, they represent a point observation at the WLEF tall tower site.

5. References

Pearson, G., F. Davies, and C. Collier, 2009: An analysis of the performance of the UFAM pulsed Doppler lidar for observing the boundary layer. *J. Atmos. Oceanic Technol.*, **26**, 240–250

Wagner, T. J., D. D. Turner, and P. M. Klein, 2019: A new generation of ground-based mobile platforms for active and passive profiling of the atmospheric boundary layer. *Bull. Amer. Meteor. Soc*, **100**, 137 – 153.

6. Dataset DOI - https://doi.org/10.26023/J41B-5NH1-840B