

Halo Photonics Doppler Lidar Deployment and Data During XPIA

A Halo Photonics StreamLine Doppler lidar was deployed approximately 130 m south of the BAO tower (at the lidar supersite) during XPIA. This instrument was on loan from the DOE's Atmospheric Radiation Measurement (ARM) program. It had previously been deployed at the ARM tropical western Pacific site in Darwin, AU since 2010. The instrument was in the process of being redeployment to ARM's Southern Great Plains site when it was used for XPIA.

Halo Photonics StreamLine Doppler lidar provides range-resolved measurements of attenuated aerosol backscatter and radial velocity, i.e. the velocity component parallel to the beam. The instrument employs an eye-safe laser transmitter operating at a wavelength of 1548nm, with a low pulse energy ($\sim 100\mu\text{J}$) and a high pulse repetition frequency (15kHz). The lidar has full upper hemispherical scanning capability. Performance characteristics of the Doppler lidars are summarized in Table 1, and Figure 1 shows a picture of it's set up during XPIA.

Table 1. Doppler lidar performance parameters.

Manufacturer	Halo Photonics
Eye safety	Class 1M
Wavelength	1.548 μm
Laser pulse energy	100 μJ
Laser pulse width	150 ns (22.5 m)
Pulse rate	15 kHz
Nyquist Velocity	19.4 ms^{-1}
Aperture	75 mm
Volume	$\sim 0.5 \text{ m}^3$
Power consumption	< 300 W
Mass	$\sim 85\text{kg}$
Temporal resolution	selectable from 0.1 to 30 seconds
Range gate size	selectable from 20 to 60m
Velocity precision	< 20 cm s^{-1} for SNR > -17 dB
Minimum range	105m
Scanning	Step-stare and continuous scan mode, full upper hemisphere
Enclosure	Weatherproof, temperature stabilized



Figure 1. The Halo Photonics Streamline Doppler lidar during XPIA.

Data collected by or derived from the Halo Photonics StreamLine Doppler lidar during XPIA includes three distinct levels of quality. The a0-level data files contain raw uncorrected measurements in the native format of the instrument (*.hpl). The azimuth data in these files are relative to the instrument rather than true north, and there was a known offset in the time tags. Users are cautioned not to base scientific conclusions on the use of a0-level data. The b1-level data files contain corrected raw measurements in netCDF format. The azimuth data in the b1-level files are relative to true north, and the time tags have been corrected to UTC. The c1-level data files contain fully QCed data products that were derived from the b1-level data. This includes profiles of wind speed, wind direction, vertical velocity variance, skewness, kurtosis, cloud base height, cloud fraction, and cloud base vertical velocity. The following provides a brief description of the data files:

- a0-level data Files
 - lidar.z06.<yyyymmdd.hhmmss>.vad_a0.hpl
 - Uncorrected PPI scan data. The Halo performed PPI scans once every 12 minutes during XPIA.
 - lidar.z06.<yyyymmdd.hhmmss>.z_stare_a0.hpl
 - Uncorrected vertical staring data.
 - lidar.z06.<yyyymmdd.hhmmss>.twr_stare_a0.hpl
 - Uncorrected slant-path stares near the 50-m level on the BAO tower.
 - lidar.z06.<yyyymmdd.hhmmss>.az_cal_a0.hpl
 - Uncorrected sector scans used for calibrating the azimuth (once per day). For XPIA we used one of the light posts next to the EHS Stadium.
- b1-level data Files
 - lidar.z06.<yyyymmdd.hhmmss>.vad_b1.nc
 - Corrected PPI scan data. The Halo performed PPI scans once every 12 minutes during XPIA.

- lidar.z06.<yyyymmdd.hhmmss>.z_stare_b1.nc
 - Corrected vertical staring data.
- lidar.z06.<yyyymmdd.hhmmss>.twr_stare_b1.nc
 - Corrected slant-path stares near the 50-m level on the BAO tower.
- lidar.z06.<yyyymmdd.hhmmss>.az_cal_b1.hpl
 - Corrected sector scans used for calibrating the azimuth (once per day). For XPIA we used one of the light posts next to the EHS Stadium.
- c1-level data Files
 - lidar.z06.<yyyymmdd.hhmmss>.wind_c1.hpl
 - Fully QCed wind profiles derived from the corrected PPI scan data.
 - lidar.z06.<yyyymmdd.hhmmss>.wstats_c1.hpl
 - Fully QCed profiles of vertical velocity statistics (variance, skewness and kurtosis) derived from the corrected vertical staring data.