

File Revision Date:

27 September 2019 15.00

Data Set Description:

PI: R. Sica

Instrument: Purple Crow Lidar

Site(s): [Environment Sciences Western Field Site](<https://www.uwo.ca/esw/>)

Measurement Quantities: Rayleigh-scatter temperature and water vapour mixing ratio

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Reference Articles:

1. Sica, R. J. et al. Lidar Measurements Taken with a Large-Aperture Liquid Mirror.1. Rayleigh-Scatter System. *Applied Optics* 34, 6925-6936 (1995).

2. Argall, P. S., Sica, R. J., Bryant, C. R., Algara-Siller, M. & Schijns, H. Calibration of the Purple Crow Lidar vibrational Raman water-vapour mixing ratio and temperature measurements. *Canadian Journal of Physics* 85, 119-129 (2007).

3. Sica, R. J. & Haeferle, A. Retrieval of temperature from a multiple-channel Rayleigh-scatter lidar using an optimal estimation method. *Applied Optics* 54, 1872-1889 (2015).

4. Sica, R. J. & Haeferle, A. Retrieval of water vapor mixing ratio from a multiple channel Raman-scatter lidar using an optimal estimation method. *Appl. Opt.* 55, 763-777 (2016).

Instrument Description:

The measurements used were obtained in the spring and summer of 2012 by The University of Western Ontario's Purple Crow Lidar (PCL) at its new location, the Environmental Sciences Western Field Station (43.1°N, 279°W, 275 m altitude). This facility is about 20 km northeast of the PCL's original location. The PCL is a large power-aperture monostatic lidar, which is described in detail in [1], with some significant upgrades for these measurements. The transmitter is now a Litron Nd:YAG laser that outputs 1000 mJ per pulse at 532 nm with a repetition rate of 30 Hz. The photocount measurements were obtained from three channels: a Hamamatsu R7400 photomultiplier, outputted in analog and digital mode to a Licel transient recorder and a Hamamatsu R5600 photomultiplier, outputted in digital mode to a SRS 430 multichannel scalar averager. Both counters accumulated returns over the same 1800 laser shots (~60s), at 7.5 m height resolution for the Licel analog (LLRa) and HHR channel and at 24 m for the LLR digital (LLRd) channel. The LLRd detector is attenuated with a neutral density filter, chosen to keep the count rate linear from the time when the system's mechanical chopper.

Algorithm Description:

First-principle optimal estimation method on the raw measurements as described in [3] and [4] above.

Expected Precision/Accuracy of Instrument:

Varies with height; a detailed uncertainty budget is given in [2] and [3].

Instrument History:

For details of the changes in the lidar see Ali Jalali's PhD thesis, which details a reprocessing of the entire PCL data set: Validating and highlighting the advantages of the optimal estimation method for Rayleigh lidar middle atmospheric temperature retrievals, [Electronic Thesis and Dissertation Repository University of Western Ontario](<https://ir.lib.uwo.ca/etd/5957/>), 5957, 2018.