

CART Raman Lidar

Mexico Fires Data Images

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Introduction

The RAMAN Lidar is used primarily for measuring the amount of water vapor and aerosol content in the atmosphere. The CART Raman Lidar is stationed at the Southern Great Plains (SGP) site of the DOE (Department of Energy) Atmospheric Radiation Measurement (ARM) program in Oklahoma, USA. The Raman Lidar runs continuously unattended for many days and the researchers at the SGP site obtain the information. The Raman Lidar is one of many laser radar systems that are used to detect aerosol backscatter.

The CART Raman Lidar (light detection and ranging) is a fully computer automated system that measures the amount of water vapor, nitrogen and aerosol particles in the atmosphere. The Raman Lidar is an optical analog of a radar system which sends pulses of laser radiation into the atmosphere instead of the radio waves transmitted by a radar (radio detection and ranging).

The CART Raman Lidar is a custom machine developed for the use of the ARM program. Raman lidar systems detect selected species by monitoring the wavelength-shifted molecular return produced by vibrational Raman scattering from the chosen molecule or molecules.

Lidar Components

System enclosure (including optical mounting system, window/hatch assembly, climate control, and utilities): produced by Orca Photonic Systems, Inc.

- Laser: Continuum Model 9030 frequency -tripled Nd:YAG laser (30 Hz, 400 mJ pulses at 355 nm)
- Laser beam expander: 15x unit produced by CVI, Inc.
- Receiving telescope: 61 cm diameter f/9.3 Dall-Kirkham system produced by Optical Guidance Systems
- Dichroic beam splitters and narrow band interference filters: produced by Barr Associates
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- Photo multipliers: Thorn EMI Electron Tubes Model 9954B
- Amplifiers: Phillips Scientific Model 6950
- Discriminators: Phillips Scientific Model 6904
- Multichannel scalars: Santa Fe Energy Research Model MCS-100
- Data acquisition environment: National Instruments LabVIEW 3.1

Data Analysis & Conclusion

By analyzing the data images downloaded from the ARM website, we are able to conclude that the aerosol particles contained in the smoke from the fires are flowing northward towards the United States and ultimately, Oklahoma. This is verified by the work of Dr. Meng-Dawn Cheng who calculated backward trajectories of air passing over the ARM field site on the days indicated. There were special assumptions made about the data images which include:

- The areas where there are vertical white "spaces" indicate that the lidar system may have been shut down or went off-line.
- The white areas in the middle of the color coded images are areas where the backscatter count is very high.
- Areas where there is a black background with blobs of colored boxes indicate that there is some type of lower cloud attenuating the lidar pulse so that no real signals are being recorded.

This data was also compared to the Integrating Nephelometer at the ARM site. On the days when the Raman Lidar reported high aerosol haze low to the ground, the Nephelometer measurements were off the scale, meaning that the amount of aerosol particles in the haze layer were very high.

