Better-than-new LIDAR provides 24/7 atmospheric aerosol data

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Improved data processing from this Raman lidar is helping researchers better determine how aerosols affect cloud formation and climate. The instrument, at the Southern Great Plains site in Oklahoma, sits behind a domed vestibule (front) that protects it from the elements

(PhysOrg.com) -- A team of researchers from eight institutions led by Pacific Northwest National Laboratory has solved a software and hardware problem that had perplexed scientists studying atmospheric aerosols for climate research. Not only did they fix the problem, but the instrument now performs better than it did when it was new.

Getting accurate data is the cornerstone of making predictions about how the climate will change as carbon dioxide concentrations continue to rise in the atmosphere. Much of the uncertainty in projections of global

climate change is due to the complexity of clouds, aerosols, and cloud-aerosol interactions and to the difficulty of incorporating this information into climate models. Aerosols, tiny particles suspended in the atmosphere, absorb and scatter sunlight, which can contribute to climate change. By calibrating all measurements to consistent standards, the data can help reduce scientific uncertainties in computer models used to simulate climate change.

A lidar, similar to a radar that calculates distances by bouncing sound off of objects, measures how light bounces off aerosols in the sky. An analysis of ground-based Raman lidar data from the Atmospheric Radiation Measurement (ARM) Climate Research Facility's Southern Great Plains site in Oklahoma showed that the lidar's aerosol measurements were off by 50 percent in 2003. Built 10 years earlier, this Raman lidar was designed to take measurements continuously, night and day. To fix the problem, researchers upgraded the electronics and other hardware. By 2005, the refurbished and upgraded Raman lidar was back in business. But when researchers investigated more data in 2006, the data still looked off compared to benchmark data collected by a NASA instrument known as the Ames Airborne Tracking Sunphotometer.

In order to make the data understandable, the researchers turned to the computer program that processed the raw signals. They knew what a portion of the data-water vapor-should look like after processing based on other instrument measurements. PNNL researcher Dr. Rob Newsom adjusted the signal processing algorithm for the Raman lidar data so that for a 6 months study period it produced the known water vapor results. Then he applied the corrected algorithm to the rest of the data. The new approach of doing the signal processing resulted in a significant improvement in the quality of the science data products. Rather than being off by 50 percent, the Raman lidar was within 8 percent of the airborne sunphotometer standard. Now, improved data collection processing for the Raman lidar will provide plenty of quality data to help

determine how aerosols affect cloud formation and the energy balance from the sun.

More information: B. Schmid, C.J. Flynn, R.K. Newsom, D.D. Turner, R.A. Ferrare, M.F. Clayton, E. Andrews, J.A. Ogren, R.R. Johnson, P.B. Russell, W.J. Gore and R. Dominguez. August 2009. Validation of aerosol extinction and water vapor profiles from routine Atmospheric Radiation Measurement Program Climate Research Facility measurements, *J. Geophys. Res.*, 114, D22207, doi:10.1029/2009JD012682, Nov. 28, 2009.

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