Lidar solar background light helps studies of aerosol-cloud interactions

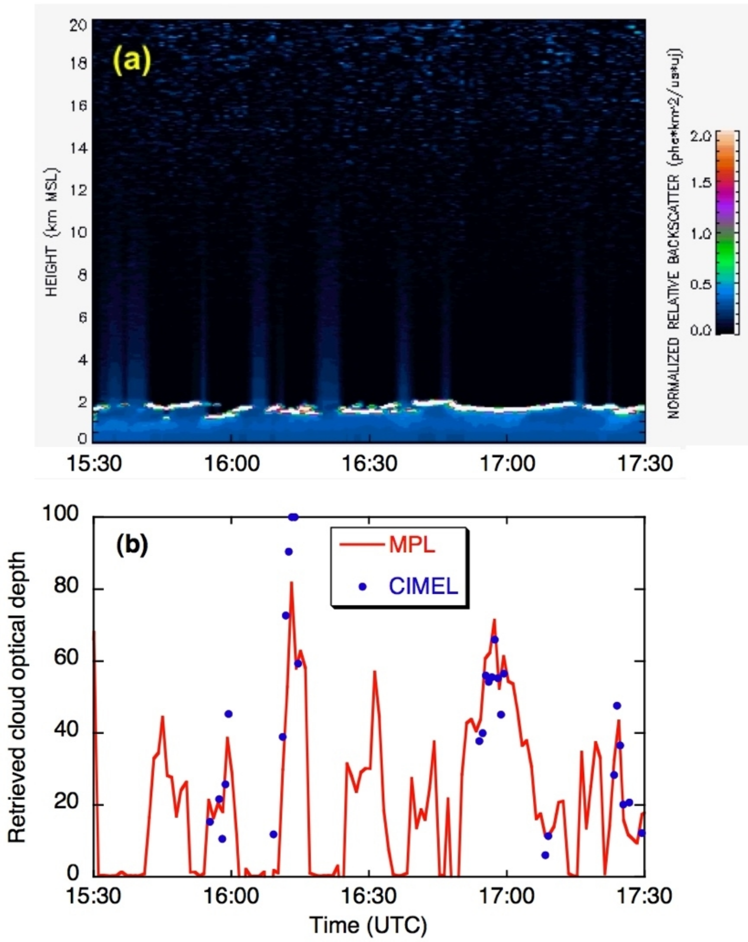

image shows that solar background light measurements from pulsed lidars can help us better understand interactions between aerosol and cloud. Lidars are commonly used to retrieve vertical distributions of aerosol and cloud layers. The underlying retrieval principle is that the returned signal is proportional to the amount of light backscattered by atmospheric molecules, aerosols and clouds. Measured photon counts are converted into attenuated backscatter profiles, and during the process a number of noise sources need to be accounted for. Solar background light is one of them. Because of limited power, the lidar pulse does not easily penetrate thick clouds, and thus it is widely believed that lidar cloud retrievals (other than cloud base altitude) are limited to optically thin clouds. We have demonstrated that lidars can retrieve optical depths of thick clouds using solar background light as a signal, rather than only noise to be subtracted, as is usually done. The upper panel is a time series of micropulse lidar (MPL) backscatter vertical profiles at NASA/Goddard Space Flight Center on October 29, 2005. Broken clouds were observed, e.g. no cloud or thin clouds at 16:40 and thick clouds at 17:00. The bottom panel shows cloud optical depth retrievals during the same time period, using MPL solar background light (red lines) and AERONET Cimel sunphotometer measurements (blue dots). Validations show that retrieved cloud optical depths agree within 10–15%. More details about this case can be found in MPL-net and this previous image. In short, one can retrieve not only aerosol properties during clear-sky periods via lidar returned signals (active remote sensing), but also the optical depth of thick clouds during cloudy period via solar background lights (passive remote sensing). This indicates that, in general, it may be possible to retrieve both aerosol and cloud properties using a single lidar. Thus, lidar observations have great potential to serve as a unique dataset allowing us to better understand how changes of aerosol in the environment impact cloud properties. The results of this research were recently published in Geosci. Remote Sens. Lett.

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