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USING A LASER AUREOLE TO INVERT LIDAR RETURN

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In a recent article[1], we theoretically studied an aureole generated by a laser beam. The strength of the signal redirected towards a sensor high above the surface by a combination of one scattering event in the marine boundary layer (mbl) and one single reflection event from the ocean surface was estimated. A model of mbl aerosol size distributions[2] was used to estimate Mie scattering for a wide range of meteorological conditions. The sea surface reflection was determined from a Gaussian model of the wave slopes[3]. These laser aureoles, which were estimated over the wide range of conditions and were normalized by the reflected laser light, were found to be highly correlated with the optical depth of the boundary layer. By estimating optical depth from the aureole, the Bernoulli-Riccati inversion of lidar return could be constrained and the inversion accuracy improved.

We have developed a Monte Carlo program to study the laser aureole generated by up to 8 orders of reflection and scattering. Initially, this program has been used to model the conditions of the original study; the aureole was generated by a narrow, 10 nsec laser pulse at 1.06 microns and measured by a receiver 10 km above the ocean surface. We found the original theoretical computation compared well with the Monte Carlo results. When multiple scatter effects were included, the normalized aureole was still highly correlated with the mbl optical depth over the range of conditions. In our presentation, we will show more detailed results from our Monte Carlo studies of the aureole. The accuracy of the aureole estimated optical depth and lidar inversions will also be discussed.

References:

1. William P. Hooper and H. Gerber (1986): Down looking lidar inversion constrained by ocean reflection and forward scatter of laser light, Appl. Opt. 5.

2. H. Gerber (1985): Infrared aerosol extinction from visible and near-infrared light scattering, Appl. Opt. 24, 4155.

3. Charles Cox and Walter Munk (1956): Slopes of the sea surface deduced from photographs of the sun glitter, Bull. Scripps Inst. Oceanogr. 6, 401.