

# **Raman Lidar Characterization of the Meteorological, Electromagnetic and Electro-optical Environment**

C. Russell Philbrick\*

Department of Electrical Engineering, The Pennsylvania State University  
University Park, PA 16802

## **ABSTRACT**

Raman lidar has provided a remarkable tool for characterizing the various properties of the lower atmosphere. The research of the Penn State University Lidar Laboratory is focused on development of Raman lidar techniques and research using five Raman lidar instruments prepared since the mid-1970's. The LAPS instrument was demonstrated in 1996 as the first prototype for an operational shipboard lidar sensor. It is the most advanced lidar instrument developed to date for profiling properties of the lower atmosphere. The LAPS sensor measures profiles with eight data channels to determine several atmospheric properties simultaneously. The single most important property for understanding the meteorological state in the lower atmosphere is the water vapor profile. The specific humidity and temperature profiles are measured directly using the vibrational and rotational Raman scattered signals. The electromagnetic parameter of most interest is the gradient in the refractive index profile, because of the influence it has on RF-propagation of radar and radio communications signals. The electro-optical parameter of most interest is the optical extinction profile at various wavelengths, because optical propagation affects aircraft operations, visual aesthetics, and optical sensor performance. Profiles of water vapor, temperature and multi-wavelength optical extinction are measured simultaneously to describe the meteorological, electromagnetic, electro-optical and air quality environmental conditions. Measurements are key in forecasting atmospheric conditions and are of major importance because of their influence on the performance of various systems. Current techniques and capabilities are described in this paper, and examples are used to indicate how well the Raman lidar performs in characterizing the atmosphere.

**Keywords:** Raman lidar, remote sensing, optical extinction, RF-refraction, aerosol properties, air quality, meteorology