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OPTICAL REMOTE SENSING TECHNIQUES FOR REMOTE SENSING OF THE EARTH'S ATMOSPHERE

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Summary

NASA entered a new era in the 1990's with the approval of several space-based remote sensing missions employing laser radar (lidar) techniques. Following the steps of passive remote sensing and then active radar remote sensing, lidar (light detection and ranging) sensors were a logical next step, providing independence from natural light sources, and better spatial resolution and smaller sensor size than radar sensors. The shorter electromagnetic wavelengths of laser light also allowed signal reflectance from air molecules and aerosol particles. The smaller receiver apertures allowed the concept of scanning the sensor field of view. However, technical problems with MOLA I, LITE, MOLA II, VCL, and SPARCLE during that decade led to concern at NASA about the risk of lidar missions. An external panel was convened to make recommendations to NASA. Their report in 2000 strongly advocated that NASA maintain in-house laser and lidar capability, and that NASA should work to lower the technology risk for all future lidar missions. A multi-Center NASA team formulated an integrated NASA strategy to provide the technology and maturity of systems necessary to make Lidar/Laser systems viable for space-based study and monitoring of the earth's atmosphere. In 2002 the NASA Earth Science Enterprise (ESE) and Office of Aerospace Technology (OAT) created Laser Risk Reduction Program (LRRP) and directed NASA Langley Research Center and Goddard Space Flight Center to carry out synergistic and complementary research towards solid-state lasers/lidars developments for space-based remote sensing applications.

An area of Earth science instrument technology that will see increased technology advancement is in solid-state lasers, specifically, lasers for light detection and ranging (lidar) and differential absorption lidar (DIAL). These measurement techniques are finding uses in several Earth science areas, including: atmospheric chemistry, water vapor, aerosols and clouds, wind speed and direction, pollution, oceanic mixed layer depth, land-locked ice, sea ice, vegetation canopy and crop status, biomass, vegetative stress indicator, surface topography, and others. While much of this science has been ongoing over the past decade using lasers, the measurements have been made almost exclusively from the ground or from aircraft. Advancements in these science areas could benefit from improved spatial and temporal coverage by using space-based lasers for remote sensing.

The LRRP has invested in several critical areas, including: advanced laser transmitters to enable science measurements (tropospheric ozone, carbon dioxide water vapor, winds, and altimetry). The LRRP is focused into four areas: laser transmitter, laser diode, laser frequency conversion and lidar receivers/detectors. This presentation will provide an overview of the lidar techniques; the NASA's Laser Risk Reduction Program (LRRP) and the progress made at NASA LaRC towards laser risk reduction efforts for space-based remote sensing of the earth's atmosphere.