# RECENT ADVANCES IN DOPPLER LIDAR INSTRUMENT TECHNOLOGY AT NASA

**Bruce Gentry[1], Matthew McGill[1], Geary Schwemmer[2], Michael Hardesty[3], Alan Brewer[3], Thomas Wilkerson[4], Marcos Sirota[5], Scott Lindemann[6], Floyd Hovis[7]**

*[1] NASA Goddard Space Flight Center, Laboratory for Atmospheres, Code 613.1, Greenbelt, MD 20771*
*[2] Science Engineering Services Inc, Columbia MD; [3] NOAA ESRL, Boulder CO*
*[4] Utah State University Space Dynamics Laboratory, Logan, UT; [5] Sigma Space Corp, Lanham MD*
*[6] Michigan Aerospace Corporation, Ann Arbor, MI; [7]Fibertek Inc, Herndon, VA*

The wind field plays an important role in specifying the global initial conditions for numerical weather forecasting. In addition to improving numerical weather prediction, there is also a need for improved accuracy of wind fields to assess long term sensitivity of the general circulation to climate change and to improve horizontal and vertical transport estimates of important atmospheric constituents including water vapor, $CO_2$ and aerosols for climate applications. In spite of this significance the three-dimensional structure of the wind field remains largely unobserved on a global scale. A new satellite mission to accurately measure the global wind field is necessary to fill this important gap in the Global Observing System. Space-based Doppler wind lidar has been identified as the key technology necessary to meet the global wind profiling requirement. The 2007 US National Research Council Decadal Survey for Earth Science lists a Global Tropospheric 3-D Wind mission as one of the 15 priority missions recommended for NASA in the next decade. The NRC survey recommended a two phase approach to achieving an operational global wind measurement capability. The first recommended step is for NASA to develop and aircraft test the lidar technology, followed by a pre-operational space mission to demonstrate the measurement concept and establish the performance standards for an operational wind mission. Phase two would be to develop and fly an operational wind system in the 2025 timeframe.

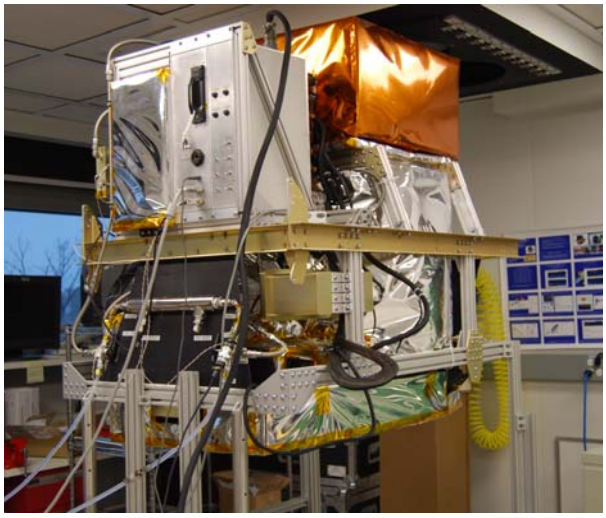

**Figure 1 - The TWiLiTE molecular Doppler lidar system configured for test flights on the NASA ER-2**

In addition to space based wind measurements, high altitude airborne Doppler lidar systems flown on research aircraft, UAV's or other advanced sub-orbital platforms will provide unique scientific benefit for studies of mesoscale dynamics and storm systems such as hurricanes. The Tropospheric Wind Lidar Technology Experiment (TWiLiTE) is a NASA Earth Science Technology Office (ESTO) Instrument Incubator Program (IIP) project to advance the technology readiness level of the key technologies and subsystems of a molecular direct detection wind lidar system on the roadmap to space. The objective of the TWiLiTE program is

to build an airborne Doppler lidar system designed for autonomous operation on NASA high altitude research aircraft such as the ER-2 or WB57. These aircraft are capable of flying well above the mid-latitude tropopause so the downward looking lidar will measure complete profiles of the horizontal wind field through the lower stratosphere and the entire troposphere. The TWiLiTE Doppler lidar system was completed in the fall of 2008 with initial engineering flights on the NASA ER-2 aircraft scheduled in early 2009. The TWiLiTE Doppler lidar system will profile winds in clear air from the aircraft altitude of 18 km to the surface with 250 m vertical resolution and a velocity precision of < 2 m/s.

In this paper, we will present an overview of new technologies developed as part of the TWiLiTE airborne Doppler lidar program and present an update on the status of the system development, integration and flight testing.