**An Overview of the NASA ADM-Aeolus Cal/Val Test Flight Campaign**

Kristopher M. Bedka, Amin R. Nehrir, Michael Kavaya, Zhaoyan Liu, John Marketon, Rory Barton-Grimley

NASA Langley Research Center, Hampton, VA

Susan Kooi, James Collins, and Sharon Rodier

Science Systems and Applications, Inc., Hampton, VA

G. David Emmitt and Steven Greco

Simpson Weather Associates, Charlottesville, VA

Gail Skofronick-Jackson and Tsengdar Lee

NASA Headquarters, Washington D.C.

John Cooney and Bryan Carroll

NASA Postdoctral Fellowship Program

Universities Space Research Association at NASA Langley Research Center

Mark Beaubien

Yankee Environmental Systems, Inc.

Lidars are uniquely capable of collecting high precision and high spatio-temporal observations that have been used for atmospheric process studies from the ground, aircraft, and space for over 30 years. The Atmospheric Dynamics Mission Aeolus (ADM-Aeolus), the first-ever spaceborne Doppler wind lidar, was developed by the European Space Agency and launched in August 2018. The ADM-Aeolus Atmospheric Laser Doppler Instrument (ALADIN) observes profiles of the component of the wind vector and aerosol optical properties along the instrument’s line-of-sight direction on a global scale. Two airborne lidar systems have been developed at NASA Langley Research Center in recent years that collect measurements in support of several NASA Earth Science Division focus areas. The Doppler Aerosol WiNd (DAWN) lidar measures vertical profiles of horizontal wind speed and direction. The High Altitude Lidar Observatory (HALO) measure high resolution profiles of atmospheric water vapor (WV) and aerosol and cloud optical properties. Though new space-based missions with advanced capabilities such as Aeolus are continuously being conceived and developed, there are limitations in terms of spatial and vertical detail and measurement precision that can be accomplished from space, thus airborne remote sensing observations like those from DAWN and HALO are required to fill these observational gaps as well as to calibrate and validate space-based measurements.

Over a two-week period in April 2019 during their Aeolus Cal/Val Test Flight campaign, NASA conducted five research flights over the Eastern Pacific Ocean with the DC-8 aircraft to 1) demonstrate the DAWN Doppler wind lidar, HALO high spectral resolution lidar aerosol/cloud measurement and differential absorption lidar WV measurement capabilities across a range of atmospheric conditions, 2) demonstrate Aeolus Cal/Val flight strategies and compare DAWN and HALO measurements with Aeolus to gain an initial perspective of Aeolus performance, and 3) demonstrate how atmospheric dynamic processes can be resolved and better understood through simultaneous observations of wind, WV, and aerosol profile observations, coupled with numerical model and other remote sensing observations. This paper provides a brief description of the DAWN and HALO instruments, discusses the synergistic observations collected across a wide range of atmospheric conditions sampled during the DC-8 flights, and a summary of the validation of DAWN, HALO, and Aeolus observations and comparisons.