Lidar measurements of Wind and Cloud around Venus from an Orbiting or Floating/Flying Platform

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Abstract

Given the presence of clouds and haze in the upper portion of the Venus atmosphere, it is reasonable to consider a Doppler wind lidar (DWL) for making remote measurements of the 3D winds within the tops of clouds and the overlying haze layer. Assuming an orbit altitude of 250 km and cloud tops at 60km (within the “upper cloud layer”), an initial performance assessment of an orbiting DWL was made using a numerical instrument and atmospheres model developed for both Earth and Mars. It is reasonable to expect vertical profiles of the 3D wind speed with 1 km vertical resolution and horizontal spacing of 25 km to several 100 kms depending upon the desired integration times. These profiles would begin somewhere just below the tops of the highest clouds and extend into the overlying haze layer to some TBD height. Getting multiple layers of cloud returns is also possible with no negative impact on velocity measurement accuracy.

The knowledge and expertise for developing coherent Doppler wind lidar technologies and techniques, for Earth related mission at NASA LaRC [1-3], is being leveraged to develop an appropriate system suitable for wind measurement around Venus. We are considering a fiber laser based lidar system of high efficiency and smaller size and advancing the technology level to meet the requirements for DWL system for Venus from an orbiting or floating/flying platform. This presentation will describe the concept, simulation and technology development plan for wind and cloud measurements on Venus.

References

[1] M.J. Kavaya, U.N. Singh, G.J. Koch, B.C. Trieu, M. Petros, and P.J. Petzar, "Development of a Compact, Pulsed, 2-Micron, Coherent-Detection, Doppler Wind Lidar Transceiver and Plans for Flights on NASA's DC-8 and WB-57 Aircraft," Coherent Laser Radar Conference, Toulouse, France, June 2009.

[2] G.J. Koch, J.Y. Beyon, B.W. Barnes, M. Petros, J. Yu, F. Amzajerdian, M.J. Kavaya, and U.N. Singh, "High-Energy 2-micron Doppler Lidar for Wind Measurements," Optical Engineering 46(11), 116201-14 (2007).

[3] J.Y. Beyon and G.J. Koch, "Novel Nonlinear Adaptive Doppler Shift Estimation Technique for the Coherent Doppler Validation Lidar," Optical Engineering 46(1), 0160021-9 (2007).