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Study of wind retrieval from space-borne infrared coherent lidar in cloudy atmosphere.

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Future spaceborne tropospheric wind missions using infrared coherent lidar are currently being studied in Japan and in the United States [1,2]. The line-of-sight wind velocity is retrieved from the Doppler shift frequency of the signal returned by aerosol particles. However a large percentage (70-80%) of the measured single-shot intensity profiles are expected to be contaminated by clouds [3]. A large number of cloud contaminated profiles (>40%) will be characterized by a cloud-top signal intensity stronger than the aerosol signal by a factor of one order of magnitude, and by a strong attenuation of the signal backscattered from below the clouds. Profiles including more than one cloud layer are also expected.

This work is a simulation study dealing with the impacts of clouds on wind retrieval. We focus on the three following points: 1) definition of an algorithm for optimizing the wind retrieval from the cloud-top signal, 2) assessment of the clouds impact on the measurement performance and, 3) definition of a method for averaging the measurements before the retrieval. The retrieval simulations are conducted considering the instrumental characteristics selected for the Japanese study: wavelength at 2 µm, PRF of 30 Hz, pulse power of 0.125 mJ and platform altitude between 200-400 km. Liquid and ice clouds are considered. The analysis uses data from atmospheric models and statistics of cloud effects derived from CALIPSO measurements such as in [3]. A special focus is put on the average method of the measurements before retrieval. Good retrievals in the mid-upper troposphere implie the average of measured single-range power spectra over large horizontal (100 km) and vertical (1 km) ranges. Large differences of signal intensities due to the presence of clouds and the clouds non-uniform distribution have to be taken into account when averaging the data to optimize the measurement performances.

References:

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