Automatic ensemble retrieval and statistical analysis of atmospheric boundary layer height based on Coherent Doppler Lidar

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Abstract: An automatic ensemble and high-environmental-adaptable method for all-day Atmospheric Boundary Layer Height (ABLH) retrieval method based on Coherent Doppler Lidar (CDL) is introduced in detail in this paper. Considering the attenuation of water droplets, rain and snow to the laser energy, the ABLH retrieval cannot be realized in cloudy, rainy and snowy days. In view of this, we develop a method to recognize the complicated weather conditions mentioned above and eliminate the data of corresponding periods. The boundary layer could be classified as Stable Boundary Layer (SBL) and Convective Boundary Layer (CBL) according to sunrise and sunset information and different methods was applied to SBL Height (SBLH) and CBL Height (CBLH) retrieval. For the CBLH retrieval, the SNR based gradient methods were applied and the median of results of four gradient methods was considered as the CBLH. For the SBLH retrieval, a SNR proportion method was used and the SBLH is defined as the height at which SNR decreases to 70% ~90% of its maximum minus a background SNR. Additionally, as the ABLH is considered to be evolving continuously, the different recognition regions were set according to vertical velocity changes of the adjacent profiles to ensure that the saltation of ABLH will not appear. The ABLH results retrieved from CDL and a polarization Raman lidar show good agreement, which proves that this method is reliable. This method was applied to a long-term ABLH observation campaign in the coastal area of Qingdao and the statistical analysis of ABLH from 2020 to 2021 is presented as well. The diurnal, monthly and seasonal variations of ABLH are analyzed in detail in this paper.