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A new method for boundary layer height determination based on gravity waves

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Predicting air pollution events in low atmosphere over megacities requires thorough understanding of the tropospheric dynamic and chemical processes, involving notably, continuous and accurate determination of the boundary layer height (BLH). Through intensive observations experimented over Beijing (China), and an exhaustive evaluation existing algorithms applied to the BLH determination, persistent critical limitations are noticed, in particular over polluted episodes. Basically, under weak thermal convection with high aerosol loading, none of the retrieval algorithms is able to fully capture the diurnal cycle of the BLH due to pollutant insufficient vertical mixing in the boundary layer associated with the impact of gravity waves on the tropospheric structure. Subsequently, a new approach based on gravity wave theory (the cubic root gradient method: CRGM), is developed to overcome such weakness and accurately reproduce the fluctuations of the BLH under various atmospheric pollution conditions. Comprehensive evaluation of CRGM highlights its high performance in determining BLH from Lidar. In comparison with the existing retrieval algorithms, the CRGM potentially reduces related computational uncertainties and errors from BLH determination (strong increase of correlation coefficient from 0.44 to 0.91 and significant decreases of the root mean square error from 643 m to 142 m). Such newly developed technique is undoubtedly expected to contribute to improve the accuracy of air quality modelling and forecasting systems.