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Long-term study of urban mixing layer height over Sofia, Bulgaria

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Knowledge of the mixing layer (ML) is vitally important as it controls vertical diffusion of near surface pollutants and thus mixing layer height (MLH) limits dispersal volume for these emitted from the surface substances and consequently regulates their concentration. Therefore, MLH is key information about air quality and its role is much more significant in urban areas as they are densely populated and pollution sources are abundant. Regardless of having important significance in cities, urban MLH is seldom monitored and reported. Recently ground based remote sensing instruments are utilized for continuous observation of MLH evolution as they provide vertical profiles of atmospheric parameters that can serve as tracers for the process of mixing. A Jenoptik's ceilometer CHM15k has been continuously operated for several years in Sofia, Bulgaria, reporting vertical distribution of backscatter signal. Estimated from ceilometer data MLHs are verified against determined ones from radiosonde profiles around time of balloon launching. We investigate the diurnal, seasonal and annual variations of urban MLH over Sofia. The importance of synoptic-scale processes on MLH and its evolution is also studied. Significant agreement between MLHs determined by both instruments is registered in summer months, especially if the process of mixing is dominated by thermally driven turbulence. In cold part of the year MLHs retrieved from the ceilometer has tendency to outreach retrieved ones from the radiosonde. We attribute the lack of agreement between MLHs derived from both instruments to different tracers that are used. The low consistency between MLHs determined from the ceilometer and radiosonde in winter is imputed to incomplete overlapping of ceilometer, which deteriorates its ability to detect low MLH in winter