Abstract

The Doon valley located in the foothills of the Indian Himalayan region, is recently undergoing rapid urbanisation. Hence, in this study, we investigate the variation of black carbon mass concentration (BC) and biomass burning generated black carbon mass concentration (BC_{bb}) for one year (October 2017 to September 2018) using ground-based observations. We also present here the relationship of BC with meteorological parameters and effect of transport. Using three different case studies we explain the dominant role of local meteorological conditions and effect of long-range transported aerosols impacting the study site in different seasons. Satellite and reanalysis datasets were also used to strengthen the analysis. A seven channel Aethalometer (AE-33) was used to measure real-time BC at the study site. Seasonal analysis indicates a winter maximum (9.45 ± 2.65 μg m^{-3}) followed by post-monsoon (6.94 ± 1.52 μg m^{-3}), pre-monsoon (5.35 ± 1.46 μg m^{-3}), and lowest in the monsoon season (3.36 ± 0.62 μg m^{-3}). The daily mean ground-based BC had a moderately positive correlation with Modern-Era Retrospective analysis for Research and Applications, version-2 (MERRA2) BC (r = 0.52) and Copernicus Atmosphere Monitoring Service (CAMS) BC (r = 0.74), these correlations get better when compared with monthly datasets. Effect of local emissions and long-range transport was studied intricately using wind rose, Conditional Bivariate Probability Function (CBPF), and Concentration Weighted Trajectory (CWT) analysis. Case studies of high BC_{bb} specifically in the months of November, January, and May precisely segregated the dominant effect of meteorology and transport phenomena in different seasons. Primarily during the months of November and May, the long-range transport of aerosols from regions dominated by crop residue burning and forest fires, respectively, increased the BC_{bb} concentration over the study site. While during January, emissions generated from local burning activities for space heating and cooking, aided by lower temperatures, increased the BC_{bb}, indicating the dominant role of meteorology. These results were further substantiated through the aerosol subtypes acquired from the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite.