ABSTRACT

Mobile monitoring provides robust measurements of air pollution. However, resource constraints often limit the number of measurements so that assessments cannot be obtained in all locations of interest. In response, surrogate measurement methodologies, such as videos and images, have been suggested. Previous studies of air pollution and images have used static images (e.g., satellite images or Google Street View images). The current study was designed to develop deep learning methodologies to infer on-road pollutant concentrations from videos acquired with dashboard cameras. Fifty hours of on-road measurements of four pollutants (black carbon, particle number concentration, PM2.5 mass concentration, carbon dioxide) in Bengaluru, India, were analyzed. The analysis of each video frame involved identifying objects and determining motion (by segmentation and optical flow). Based on these visual cues, a regression convolutional neural network (CNN) was used to deduce pollution concentrations. The findings showed that the CNN approach outperformed several other machine learning (ML) techniques and more conventional analyses (e.g., linear regression). The CO_2 prediction model achieved a normalized root-mean-square error of 10–13.7% for the different train-validation division methods. The results here thus contribute to the literature by using video and the relative motion of on-screen objects rather than static images and by implementing a rapid-analysis approach enabling analysis of the video in real time. These methods can be applied to other mobile-monitoring campaigns since the only additional equipment they require is an inexpensive dashboard camera.