

Air Quality Monitoring using Low-cost Sensors in Nicosia

G. BISKOS

Climate and Atmosphere Research Centre (CARE-C), The Cyprus Institute

Air pollution is associated with negative effects upon human health, leading to some 7 million premature deaths per year worldwide as shown by recent estimates from the World Health Organization (WHO). In addition to that, air pollution has detrimental environmental effects as among others it accelerates climate change, leads to acid rain, and changes soil chemistry that in turn affects plant growth and groundwater quality. It is therefore not surprising that the environmental impacts of air pollution are associated with economic repercussions in the order of multiple trillion Euros per year globally according to the Organization for Economic Co-operation and Development (OECD).

Traditional Air Quality Monitoring (AQM) is carried out by analytical instruments installed at fixed stations. The number of AQM stations used in national networks worldwide varies depending on the size and the economic wealth of each country. For Cyprus, AQM is carried out by the Department of Labour Inspection (DLI) of the Ministry of Labour, Welfare, and Social Insurance, which employs a total of nine (9) stations throughout the country, including two (2) located in Nicosia. The location of these stations is selected after considering whether it is representative for a wider region and near to major air pollution sources, as well as other practical factors such as availability of power supply and safety of the site.

Existing AQM monitoring networks that employ a small number of stations can be adequate for regulatory purposes and getting an overall picture of air pollution. To determine the potential impacts of air pollution on human health and on the environment, however, we need to monitor the concentrations of the most harmful pollutants with a spatial coverage that is far higher compared to that of existing AQM networks. This can be achieved by using stationary and/or mobile platforms with miniaturized integrated gas sensors that have a suitable limit of detection, small response times, and low cross sensitivity. Moreover, it is desired the sensors be made low-cost, energy efficient, and robust.

Researchers at the Cyprus Institute working on the AQ-SERVE project, have designed and built a low-cost AQM system that can measure the concentration of the most important air pollutants, and have installed it in one of the AQM monitoring stations of DLI in Nicosia (see [Figure 1](#)). The low-cost AQM system employs sensors for measuring the concentrations of CO, NO₂, O₃, SO₂ and Particulate Matter. Although most of these sensors report measurements that compare well with those recorded by the analytical instruments at the station (see [Figure 2](#) that shows comparison of CO concentrations measured by both systems over three consecutive days), some require further development and calibration before they can meet the requirements for use in AQM. Currently, the researchers at the Cyprus Institute are focusing their efforts towards improving the accuracy, lifetime and reliability of these low-cost sensors using novel ways of synthesizing

sensing material, and at the same time explore their use in mobile platform including drones and Unmanned Aerial Vehicles.



Figure 1: Picture of the low-cost Air Quality Monitoring system developed by researcher of the Cyprus Institute (left) and of the system installed at the DLI station (right).

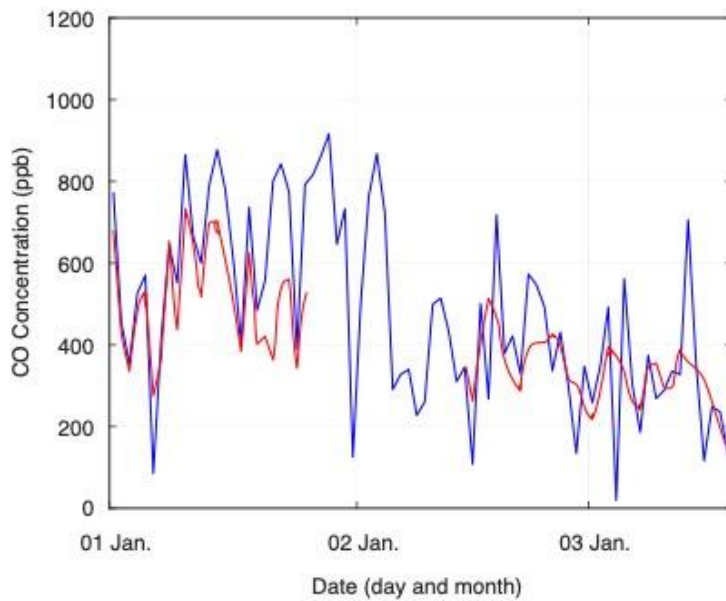


Figure 2: Comparison of the concentration of Carbon Monoxide measured by the analytical instruments of DLI (blue line) and the Air Quality Monitoring system developed by the Cyprus Institute (red line).