Environmental Research, Technology Demonstration and Conference Project

ECF Project:	ECF 2020-07
Project Title:	Application of machine learning techniques in predicting primary and secondary organic aerosols
Principal Investigator:	Professor Chan Chak Keung, School of Energy and Environment, City University of Hong Kong
Total Approved Grant:	$497,180
Duration:	1/3/2021 to 31/8/2022
Project Status/Remarks:	Completed
Project Scope:	This project proposes to use machine learning techniques to predict the concentrations of primary organic aerosols (POA) (traffic and cooking) and secondary organic aerosols (SOA) components using aerosol mass spectrometry and other air quality and meteorological datasets. The project team will train and test the prediction model based on "Random Forest". The project team will then establish the dependence of ambient SOA concentrations and traffic and cooking surrogates to estimate the reduction of ambient SOA from emission controls that reduce traffic and cooking emissions. The project can potentially improve the predictions of ambient organic aerosol concentrations and provide scientific basis on the importance of reducing vehicle and cooking emissions in mitigating overall particulate matter pollution in Hong Kong.
Summary of the Findings/Outcomes:	Atmospheric particulate matter contains a large fraction of organic components. The concentration of organic aerosol (OA) particles is highly variable in the atmosphere and depends on factors such as emissions, atmospheric oxidation processes, meteorology, and transport. Due to the complex interactions among the numerous factors, accurate estimation of the effect of target factors on the OA particle concentration is often challenging. In this study, the random forest model explained more than 80% of the observed traffic-POA, cooking-POA, and OOA with high accuracy at urban and rural sites in Hong Kong. This work serves as a first case study in assessing the nonlinear effect of atmospheric conditions on the OA concentration from different sources based on machine learning algorithms. The partial dependence algorithm further enables the evolution of individual target factors in the model prediction without the influence from cofounding factors, providing a better understanding of the mechanisms of OOA formation under complex atmospheric conditions.