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Simulating Heavy Pollution Events in Dublin

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Aerosols play an important role in the extreme events of air pollution and climate change. Despite the decades efforts, air pollution models are still unable to simulate the heavy pollution events very well due to the complicated aerosol chemical composition, size distribution and spatial and temporal variations. Recently, the aerosol mass spectrometer (AMS) was deployed in Dublin to determine the chemical composition and concentration of submicron aerosols at high temporal resolution. The organic aerosol (OA) was found to dominate the aerosol composition (>50 %) in the heavy pollution events. The particular matter concentration (PM1) was measured to exceed 200 μg m-3 on 19 November, 2016 and 22 January, 2017.

In this study, we try to use the WRF-Chem model to simulate the heavy organic aerosol episodes in Dublin. However, the model fails to rebuild the heavy pollution events no matter what emission datasets (EDGAR, EMEP, TNO, NEI or RETRO) we use. To have better simulation results, we have examined the sensitivities of simulation results to the emissions, meteorological parameters (planetary boundary layer height) or spatial and temporal resolutions. We use the method of integrating multiscale modelling with available measurements to improve our simulation results. We find that the enhancement of local emissions with the reference of measurements including diurnal variation is the most effective way to rebuild the heavy pollution events. The heavy organic aerosol episodes in Dublin are found to be contributed mostly from local emission sources (peat burning). The lack of accurate speciation and temporal profiles in current emission datasets should be greatly concerned, particularly the significant underestimation of organic carbon (OC) emissions. The uncertainties in current emission datasets will hamper us to forecast the heavy air pollution events accurately and improve the early warning system from forecasts, hence it is imperative to improve the emission inventories using the new method of integrating top-down and bottom-up approaches with available measurements.