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Multi-scale Modelling and Satellite Remote Sensing of Aerosol and Trace Gases over European Megacities

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Aerosols and trace gases are major pollutants that adversely affect human health and visibility. To date, the information of aerosol and trace gas properties and their spatial and temporal variations is still limited. Satellites provide a wealth of new information and rich opportunities to improve our understanding of physical and chemical processes of aerosols and trace gases such as emissions, transport and deposition. We have developed a new method to retrieve the aerosol and trace gas properties from the measurements of multi-wavelength sensors such as the Ozone Monitoring Instrument (OMI) and the Moderate Resolution Imaging SpectroRadiameter (MODIS) and multi-angle sensors such as the Multiangle Imaging SpectroRadiameter (MISR). In order to improve satellite retrievals, the global chemistry transport model (GEOS-Chem) and Model-3/Community Multiscale Air Quality model (CMAQ) are used to simulate and constrain the complicated aerosol and trace gas properties and distributions. The high level of pollution episodes over Europe in the year of 2003 have been investigated using modelling and satellite data. Major pollutants such as NO2, SO2, O3 and Particulate Matter (PM) have been examined at regional scales over the megacities such as London and Paris. Our results show that the mean aerosol loading and tropospheric O3 concentration over most of European megacities were found to exceed EU air quality limit values during strong heat wave in 2003. The point and mobile emission sources have strong impact on urban air quality. The high values of absorbing aerosol concentration have also been found over urban areas. Strong aerosol absorption in megacities due to increasing anthropogenic emissions will lead to an enhancement in the solar heating rate and an increase in the intensity of severe heat waves.