Editorial

Andrew P. Sturman

Centre for Atmospheric Research,
Department of Geography,
University of Canterbury,
Private Bag 4800,
Christchurch, New Zealand
Email: andrew.sturman@canterbury.ac.nz

Biographical notes: Andrew P. Sturman is a Professor in the Department of Geography, and was founding Director of the Centre for Atmospheric Research at the University of Canterbury, Christchurch, New Zealand. His research interests are in atmospheric boundary layer processes and phenomena, and their significance for air pollution, wind energy and agricultural activities. He has published three books (including *The Weather and Climate of Australia and New Zealand* and *The Physical Environment: a New Zealand Perspective* with Nigel Tapper and Rachel Spronken-Smith, respectively), over 80 journal articles, several book chapters and numerous conference papers and technical reports. He is leader of the government-funded air pollution research programme at the University of Canterbury and was awarded the Edward Kidson medal of the Meteorological Society of New Zealand in 2003 for his research on air pollution.

Of all air pollutants, particulates represent a major threat to human and environmental health, especially in urban areas. There is still much to learn about sources and quantities of particulate emissions, in particular those emitted by gross emitters such as domestic heating, industry and transportation. Monitoring particulates continues to be fraught with problems, including the metrics that are used, such as particle number, mass and surface area. Particle size distribution (PM_1, $PM_{2.5}$, PM_{10}) is also an issue, particularly with regard to expected health impacts. New monitoring methods are being developed including fixed monitors, mobile samplers, remote sensing and satellite techniques. There is also uncertainty over possible detrimental health effects of particulates of natural (e.g. sea salt, volcanic ash, dust, pollen and soil) versus anthropogenic (e.g. milk powder, bulk storage, coal, cement, fertilisers, mining) origin, and there is a lack of knowledge of the effects of secondary particulates in contributing to both measured concentrations and their health impact. The purpose of this special issue is to publish the latest results of research into aspects of particulate air pollution in urban environments. Key features of this area of study include such things as source characteristics of particulate air pollution, monitoring methods for particulate air pollution, exposure assessment and health effects, toxicology of particulate air pollution, health effects of particulates of natural versus anthropogenic origin, secondary particulates, and dispersion and chemical modelling of particulate air pollution.

This Special Issue examines a number of these topics, including the nature of particulate material found in urban environments, their temporal variability and their geochemical characteristics. Contributions on source apportionment of air particulates, new samplers and health impacts are also included, as well as examination of meteorological controls of spatial and temporal variation of particulate matter pollution.

The results presented in this Special Issue identify a strong correlation between ultrafine particulates and NO_x in an environment dominated by vehicle emissions, while other research illustrates the complex interaction of emissions and chemical processes in the development of secondary particulates. The chemical nature of particulates from different sources is also examined, in relation to both the dispersion of lead from motor vehicle emissions and differentiating particulates from crustal, marine and anthropogenic sources. Source apportionment of particulates is shown to be an important tool for identifying a range of possible sources, such as motor vehicles, secondary emission, domestic combustion and sea salt.

Application of different statistical techniques to time series of particulate pollution is shown to provide a means for predicting future concentrations, and their performance is evaluated. A personal sampler adapted for use in measuring particulates from transport sources during rush hour is also evaluated and found to oversample at low wind speeds, although it is more efficient at higher wind speeds. In this study, modelling tools were developed that can be used to test new sampler configurations without the need for expensive wind tunnel testing.

The Special Issue also includes examination of effects of air pollution on human health and well-being in environments dominated by particulate emission sources. Health impact assessment is based on the exposure–response approach, which identifies a significant contribution to cardiovascular and respiratory hospital admissions resulting from PM_{10} levels. Evidence is also provided that particulate air pollution contributes to non-notifiable health issues such as restricted activity. In this case, people's health is impaired to the extent that they are unable to perform their normal duties, such as school attendance and gainful employment.

In the final section, the role of atmospheric processes in the dispersion of particulate air pollution is examined in two studies. The first examines new techniques of monitoring the vertical dispersion of suspended particulates. The second investigates mesoscale variations in wind and thermal structure over a major urban area that affect pollution dispersion using both observations and models.

This Special Issue, therefore, provides a snapshot of contemporary research into particulate air pollution in urban environments, illustrating the diverse range of research currently being conducted in different parts of the world. The international flavour of this research is reflected by papers contributed by scientists from Korea, China, Turkey, Tunisia, Italy, Brazil, Ireland, Greece, Canada, New Zealand and Iran. The proportion of the world's population living in cities (currently about 50%) continues to grow rapidly, while understanding of the environmental and human health impacts of particulate pollution is also increasing. Evidence indicates that even low concentrations of particulate matter in the air can have significant health impacts, so that if urban growth is not balanced by cleaner air the incidence of cardiovascular and respiratory disease is likely to increase. Development of air quality management strategies to ensure that the air in urban environments improves in quality as the population increases needs to be based on good scientific investigations such as those included here.