

Urban Meteorology

WEDNESDAY 15 FEBRUARY 2006

Leek to London via Birmingham – urban meteorology experiments for air pollution modelling – Dr Douglas Middleton, Met Office doug.middleton- at -metoffice.gov.uk

The Met Office has been involved in field experiments to study meteorology in urban areas. The primary motivation was to measure parameters that are important for atmospheric dispersion, and to create a dataset which can be used to validate assumptions used in dispersion models. Even with today's computing power it is still necessary to have simple descriptions that rely upon a good physical understanding of the factors that influence the dispersion of urban pollutants. Equally, it is necessary to understand how fast the polluted air advects over and around the city. The aim of this talk is to summarise the experimental technique which has been developed during three campaigns in the UK. The talk draws upon the work of the European COST 715 Action "Meteorology applied to Urban Air Pollution Problems" to highlight some current questions in urban meteorology. It ends by discussing the scope for well designed experiments that will advance our knowledge of the physics upon which dispersion modellers rely and which influences the quality of the air that most people breathe

The attack of the toxic mist – why we study urban aerosol dispersion – Dr Ian Longley, University of Manchester ian.longley- at -manchester.ac.uk

Vehicle emissions are getting cleaner and the days of dirty diesels and smoke-stained buildings seem to be over. Yet recent analyses have calculated that more than twice as many people die right now in British cities due to urban air pollution than in road traffic accidents. In the nineties it became clear that breathing airborne particles was linked to ill-health even at everyday concentrations. However most people appear to be unaffected due perhaps to their different physiology, lifestyles or exposure. The role of atmospheric science is to help characterise our exposure - what kind of particles do we inhale, what are their physical and chemical characteristics, how does this dose vary in time? The key is to understand how particles are dispersed and how they react. This presentation will review the evidence for the toxic effect of particulates, and will show observations from recent field campaigns in the UK that are bringing us closer to understanding how the threat to our health can be mitigated.

The Dapple project – wind and turbulence measurements in central London – Prof Alan Robins, University of Surrey a.robins- at -surrey.ac.uk

The EPSRC funded DAPPLE project included field and wind tunnel measurements and computational predictions of wind fields in and above a central London street network (Marylebone Road - Gloucester Place). Some features of these measurements will be discussed to illustrate important aspects of local scale urban canopy winds. More detailed mappings from the wind tunnel, together with flow visualisation, will be used to describe behaviour at a major road intersection. Pollutant and tracer concentration measurements will be introduced to provide further insight into the wind and turbulence fields. Some mass flux balances from combined flow and concentration measurements will then be discussed. The objectives of remaining analysis and plans for further experimental work will be summarised.

Understanding urban climates: measuring and modeling surface-atmosphere exchanges – Prof Sue Grimmond, Kings College London sue.grimmond- at -kcl.ac.uk
Approximately half of the worlds' population live in urban areas. By 2025, the United Nations predicts that more than two thirds of the global population will live in cities: around 6 billion people. Urbanization leads to the development of distinct urban climates that affect conditions both within and beyond cities. The best known effect is the urban heat island; temperatures in cities tend to be higher than in the surrounding countryside. Ultimately, urban climate effects are due to differences in the exchanges of heat, gases, and momentum between the city and its pre-existing landscape. Thus understanding, prediction, and mitigation of urban climate effects are intricately tied to knowledge of surface-atmosphere exchanges. In this talk, methods for measuring such exchanges will be presented, along with results from measurement and modeling studies conducted in a range of urban areas in North America, Europe and Africa. Current understanding of surface-atmospheric exchanges both within and between cities, and fundamental surface and atmospheric controls will be outlined. The implications for air quality, urban hydrology, carbon dynamics, and weather forecasting will be discussed.

Keeping buildings cool in a warming climate – Prof Stephen Belcher, University of Reading s.e.belcher- at -reading.ac.uk
In this talk I will describe a piece of work recently completed in a collaboration between the Department of Meteorology at the University of Reading, and Ove Arup and Partners, on the impacts of climate change on controlling the internal environment of buildings – a major factor in designing good and energy efficient buildings. Current projections suggest that the temperature of southern UK is predicted to be close to Mediterranean by 2080s, but clearly we are not currently building Mediterranean buildings! Our analysis was able to suggest low energy strategies for keeping buildings cool as the climate warms. The project illustrates more generally the thinking needed for assessing the impacts of climate change.

Mesoscale meteorology over large urban areas – Prof Julian Hunt, University College London (in collaboration with Robert Bornstein, Andrew Orr, Jo Fernando, Marco Princevac) jcrh- at -cpom.ucl.ac.uk

Over large urban areas the meteorology and atmospheric environment are affected by local variations over mesoscale distances, whether natural or artificial. In open flows the velocity and temperature fields are perturbations to the incident flow. Linearised theory and simulations show how there are marked changes in the wind field, inversion layer and cloud processes over the urban area, depending on the inversion height dynamics, the relative size of the area, and on whether the increase in surface resistance is more or less dynamically significant than the increase in surface heating or cooling. For local, buoyancy driven flows over small urban areas in narrow valleys, or located on high slopes, mesoscale flows adjust locally to the heating and cooling and local terrain slopes. But for urban areas in wide valleys, where air flows circulate over a diurnal time scale, there are large phase lags between the flow and the forcing, and down slope flows are driven by density currents from higher slopes. These studies show why continuous remote sounding and data assimilation can contribute to local weather and environmental forecasts, and estimates of risk probabilities and average statistics.