Robert Wilby

Statistical downscaling: overview and application to future climate change impacts in urban areas

Overview of session

It is widely acknowledged that considerable uncertainty is attached to climate change projections at regional scales and that some form of climate "downscaling" is needed to generate climate scenarios at length scales less than 50km. Climate change scenarios for urban landscapes are particularly problematic to produce due to localised effects of the land-surface, including urban heat islands and air quality variations. Although slightly less than 50% of the world's population currently live in cities, this is expected to rise to more than 60% in the next 30 years. Urbanisation has also resulted in the rise of the 'megacity' – currently over 300 cities have more than 10^6 inhabitants and 14 exceed 10^7, rising to over 500 and 21 respectively by 2015 (UN, 2001). Therefore, climate change and human health in urban areas is set to become an area of increasing research interest. Early studies have already pointed to significant urban warming *in addition* to that expected for surrounding rural areas, particularly during summer nights. Similarly, the European heatwave of summer 2003 highlighted the vulnerability of urban populations to extreme weather events.

Finer resolution climate change information for use in impact studies is usually obtained from high-resolution regional climate models (RCMs) or via statistical downscaling (SD) methods. SD methods are particularly useful in heterogeneous environments with complex physiography or steep environmental gradients (as in island, mountainous or land/sea contexts). Indeed, SD may be the only practicable means of generating climate scenarios for point-scale processes such as soil erosion or urban drainage systems. A further advantage of SD methods over RCMs is their low computational demand. This can allow generation of large ensembles of climate realizations and the exploration of some aspects of climate uncertainty (due to SD model parameters and/or natural climate variability). SD schemes are also very flexible in the sense that for any local variable with predictability, a trans-scale relationship can usually be found. To date, SD methods have been applied to a range of exotic predictands including snow cover, storm surges, heat islands, slope stability, spawning and flowering times, lake-stratification and water quality.

This session will comprise four main blocks. First, a general overview of statistical downscaling techniques and their contribution to climate change impact assessment. This part will cover the main strengths and weakness of SD techniques, drawing on recent inter-comparison studies involving SD versus SD, as well as SD versus RCM evaluations. Second, a more detailed description of the Statistical DownScaling Model (SDSM) including underlying principles and recent applications. Third, background to two detailed case studies involving the use of SDSM for exploring climate change impacts on the urban heat island and air quality of London, UK. This will draw on material from the London Climate Change Partnership (2002) scoping study of climate change impacts. Finally, a hands-on workshop in which delegates will use SDSM to explore the present and future behaviour of London's air quality and urban heat island.

Supporting references

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Biography

Robert Wilby graduated with a degree in Geography from Loughborough University, UK in 1987, followed by a PhD in 1991. Since this time he has been developing research and consultancy interests in the field of hydroclimatology – the interface between long–term climate variability and freshwater environments. Between 1996 and 1999 he was seconded from the University of Derby, UK to the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, to evaluate statistical techniques for regional climate simulation. An aspect of this work involves modelling high–resolution climate change scenarios using General Circulation Model (GCMs) output, so called statistical "downscaling". Future climate scenarios have then been used to model a range of potential hydrological impacts (including changes in snowpack, flooding and water resources in the Western United States, eutrophication of Suwa Lake in Japan, and water resources in the UK). In 2002 he became a Reader in Physical Geography at King's College London where he taught modules in hydrology, environmental management, and regional climate change. During this time he was involved in the London Climate Change Partnership's scoping study of climate impacts on the environmental systems of London. Other research interests include the development of flood forecasting techniques using artificial neural networks, seasonal forecasting of droughts and summer low flows, surface water acidification modelling and the estimation of critical loads. In 2003 he became the Climate Change Science Manager for the Environment Agency of England and Wales. This involves managing a diverse portfolio of projects on climate change impacts and adaptation for water resources planning, flood risk management, ecosystems responses, long-term river-flow reconstruction and radioactive waste management.