Climate change and vector-borne diseases of humans

Paul E. Parham1,2, Joanna Waldock3,4, George K. Christophides4 and Edwin Michael5

1Department of Public Health and Policy, Faculty of Health and Life Sciences, University of Liverpool, Liverpool L69 3GL, UK
2Department of Infectious Disease Epidemiology, School of Public Health, Faculty of Medicine, Grantham Institute for Climate Change, St Mary’s campus, Imperial College London, London W2 1PG, UK
3The Cyprus Institute, Nicosia, Cyprus
4Imperial College London, London SW7 2AZ, UK
5Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556-0369, USA

This theme issue arose out of our perception that while it is widely recognized that an important impact of climate change on human health is likely to be via effects on vector-borne disease (VBD) transmission, the complexity of the biological and non-biological susceptibility modifying pathways by which such effects arise and combine to influence transmission is less well understood. This has made reliable appraisals of the potential effects of climate change and variability on VBDs complicated and represents a serious problem in developing more robust tools to assess the risk of climate change affecting VBDs in populations residing under different social and geographic contexts. This issue thus aims to provide not only an up-to-date synthesis of current knowledge of, and key research in, the impact of various individual components of climate change (biological, non-biological, evolutionary and economic factors), but also, crucially, to reveal and highlight the need (and potential means) to address the effects of multiple factor interactions, nonlinearities and human reflexivity if we are to develop and establish a more rigorous agenda for future research, including the provision of useful informatics for informed public health policy-making, in this important area of climate change studies.

This issue is timely for several reasons. First, VBDs, such as malaria, Chagas disease and helminth infections, undoubtedly have a major impact on human health within the developing world. Second, diseases discussed in this issue also include those that are emerging and resurgent, such as dengue, West Nile disease and chikungunya, which are increasing in prevalence and geographical distribution. Key disease vectors are also currently spreading into temperate regions, including Europe, creating new vulnerable populations should disease importation occur. Establishing tools to help map vectors and/or disease transmission, determine community vulnerability and risk, and plan control strategies are therefore of vital importance for tackling both these established and emerging VBDs. This includes the key importance of addressing scientific accuracy, as projections that do not take into account the influence of uncertainties in the complex, interacting effects of vector populations, vector–pathogen interactions, climate and socioeconomic factors on VBDs are likely to be limited in their usefulness to policy-makers. We believe that bringing together experts at this juncture from different aspects of this multi-disciplinary topic to provide a synthesis of current research and establish agendas for future research will help shape the future of this growing field of study, leading to improved reliability and robustness of projections for future global and regional VBD burden in a changing climate. In addition, this theme issue highlights and emphasizes the need to translate research into outputs for use by stakeholders in planning and improving vector and disease control strategies for pathogens that affect millions of people worldwide. Improvements in VBD control strategies that take into account the effects of climatic changes will have a direct impact on human welfare through reduction in the burden of established VBDs or the prevention of VBD outbreaks in vulnerable populations.
This short collection of papers is inevitably selective, but designed to provide a balance between cutting-edge research and a review of the field, as well as addressing a wide range of key pathogens (from malaria to neglected tropical VBDs) and topics (health research, policy development, economic analysis, evolutionary studies and single component versus systems approaches to modelling climate–VBD interactions).

A further unique feature of all the included papers is an emphasis on (i) article originality, novelty and substantially contributing to our understanding of this field; (ii) links to implications for policy; (iii) ensuring that the introductory sections of all articles take the form of literature syntheses, rather than just reviews and particularly highlighting recent research (from 2008/2009 onwards); and (iv) data-driven studies and maximizing discussion of any new relevant datasets.

We believe that the selection of papers in this issue focused around such directed synthesis and the latest research, as well as the need for new ideas and solutions, will stimulate work towards addressing the ultimate question for this field, namely the challenge of disentangling the role of climate variables versus other biosocial factors known to drive VBD transmission. We are also confident that these papers will send out the message that investigating the link between climate change and VBDs, given its complexity and interface between biological and biosocial factors, is as exciting and challenging as ever, and that the ensuing epistemological, methodological and analytical discoveries and frameworks will be profoundly important for not only assessing the impact of global change on human health and welfare specifically, but also for the development of more systematic, integrated approaches to improving our understanding of infectious disease transmission and its control more generally.

It is now increasingly recognized that complex problems of human societies require new scientific approaches to better understand the fundamental drivers of their dynamics and enable interventions with appropriate policies. The papers in this issue amply highlight this perspective; moreover, they also offer ways forward in thinking about the novel approaches and integration of sciences required to meet both the theoretical and practical challenges of conducting reliable studies into producing effective solutions to human welfare problems arising from complex human-natural system phenomena, as that embodied by the complex link between climate change and VBDs in humans.

Acknowledgements. The Guest Editors would like to offer their sincere thanks to Helen Eaton, the Commissioning Editor for Philosophical Transactions of the Royal Society B, for all her invaluable help, support and patience throughout the development of this theme issue; it is greatly appreciated. We would also like to thank all of the authors for their excellent contributions and for working so closely and enthusiastically with us throughout the process. We would also like to sincerely thank all of the reviewers for their timely and extremely valuable comments and suggestions on all of the manuscripts.