

# Climate change

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## Quantifying the health impact at national and local levels

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Public Health and the Environment  
Geneva 2007

## WHO Library Cataloguing-in-Publication Data

Campbell-Lendrum, Diarmid H.

Climate change : quantifying the health impact at national and local levels / Diarmid Campbell-Lendrum, Rosalie Woodruff ; editors, Annette Prüss-Üstün, Carlos Corvalán.

(Environmental burden of disease series ; no. 14)

1.Climate. 2.Meteorological factors. 3.Environmental health. 4.Risk factors. 5.Cost of illness. I.Woodruff, Rosalie. II.Prüss-Üstün, Annette. III.Corvalán, Carlos F. IV.World Health Organization. V.Title. VI.Series.

ISBN 978 92 4 159567 4 (NLM classification: WA 30)  
ISSN 1728-1652

## Suggested Citation

Campbell-Lendrum D, Woodruff R. Climate change: quantifying the health impact at national and local levels. Editors, Prüss-Üstün A, Corvalán C. World Health Organization, Geneva, 2007. (WHO Environmental Burden of Disease Series No. 14)

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Printed by the WHO Document Production Services, Geneva, Switzerland.

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## Preface

The disease burden of a population, and how that burden is distributed, are important pieces of information for prioritizing and defining strategies to protect population health. For policy-makers, disease burden estimates provide an indication of the current and future health gains that could be achieved by targeted protection from specific risks. To help provide a reliable source of information for policy-makers, WHO has developed methods to analyse the impacts of risks for health, and has estimated the impacts of 26 risk factors worldwide, including climate change (WHO, 2002; McMichael et al., 2004).

The Environmental Burden of Disease (EBD) series aims at supporting countries to generate reliable information for policy-making, by presenting methods for estimating the environmental burden at national and regional levels. The introductory volume in the series outlines the general method (Prüss-Üstün et al., 2003), while subsequent volumes address specific environmental risk factors. The guides on specific risk factors are organized similarly, first outlining the evidence linking the risk factor to health, and then describing a method for estimating the health impact of that risk factor on the population. All the guides take a practical, step-by-step approach and use numerical examples. The methods described can be adapted both to regional and national levels, and can be tailored to suit data availability.

It has been shown that climate change causes impacts on various communicable and non-communicable diseases and injuries (WHO, 2002; McMichael et al., 2003a; Ezzati et al., 2004). While the environmental risk is distributed globally, most of the actions that are necessary to protect health under a changing climate are local. Quantitative assessment of the size and distribution of health risks can therefore be an important tool in identifying which actions will be most effective in adapting to climate change. They may also provide an incentive to cooperate at the international level to reduce our impacts on the global climate.

Climate change is unusual in its global scope, its irreversibility (over human timescales), and the very wide range of threats that it poses to health and other aspects of human well-being. While methods for describing and measuring health effects are still at an early stage of development and many uncertainties remain, it is important to provide a framework and first set of guidance for assessing health impacts, so that societies are better equipped to address this emerging threat.

## **Affiliations and acknowledgements**

Diarmid Campbell-Lendrum, Annette Prüss-Üstün and Carlos Corvalán are from the World Health Organization, and Rosalie Woodruff is from the Australian National University.

In preparing this document, we drew on the methods developed for estimating the burden of disease caused by climate change at the global level, and with Australasia. We therefore thank the additional co-authors in these analyses, particularly Tony McMichael of the Australian National University, who led both assessments.

We also thank the US Environmental Protection Agency for having supported the development of the Environmental Burden of Disease approaches.

## **Glossary and abbreviations**

CIESIN	Center for International Earth Science Information Network, Columbia University, USA
CRU	Climatic Research Unit, University of East Anglia, UK
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
DALYs	Disability-Adjusted Life Years
EM-DAT	Emergency Disasters Database
ENSO	El Niño Southern Oscillation
IFRC	International Federation of the Red Cross and Red Crescent
IPCC	Intergovernmental Panel on Climate Change
OFDA/CRED	Office of US Foreign Disaster Assistance/ Centre for Research on the Epidemiology of Disasters
GIS	Geographic Information System
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GNP	Gross National Product
MARA	Mapping Malaria Risk in Africa Project
NASA	North American Space Administration
PM <sub>10</sub>	Particulate matter, 10 microns - a measure of particulate air pollution
SRES	Special Report on Emissions Scenarios
UNDMT	United Nations Disaster Management Training Program
WHO	World Health Organization
WHO/PTC	World Health Organization Pan-African Training Centre

## Summary

Climate change is an emerging risk factor for human health. There is now widespread consensus among the scientific community that the earth is warming, that this is mainly due to human activities, and that this will continue for at least the next several decades (IPCC, 2001b; Oreskes, 2004). It is also clear that weather and climate exert a major influence on human health, both through direct effects of extreme events such as heatwaves, floods and storms, and more indirect influences on the distribution and transmission intensity of infectious diseases, and on the availability of freshwater and food.

It is therefore important to obtain the best possible assessment of the likely health impacts of climate change. This is a particularly challenging task. Compared to other environmental risk factors, climate change is a newly recognized phenomenon, with global scope, operating over long time periods and affecting an unusually wide range of health outcomes. The guidance presented here therefore outlines a general approach, and describes how the methods that were applied in the World Health Organization global comparative risk assessment project, and a regional assessment in Australasia, can be "down-scaled" to the national or sub-national level. It also highlights where further research is likely to improve the assessment. It should therefore be useful in generating preliminary estimates of some of the health effects of climate change, and as a guide to developing more comprehensive and accurate assessment in the future.

The general approach consists of; (i) Selecting an appropriate set of scenarios of alternative possible futures (e.g. lower or higher rates of emissions of greenhouse gases, population growth etc.), and the timescale over which to carry out the assessment; (ii) Mapping the corresponding projected changes in climate properties; (iii) Identifying the range of health outcomes that are both climate-sensitive and important in public health terms within the assessment population; (iv) Quantifying the relationship between climate and each health outcome; (v) Linking the exposure measurement to the climate-health model; and (vi) using this information to calculate the climate change attributable burden of specific diseases.

Subsequent sections describe assessment methods that were used in the previous global and regional assessments, for a range of climate-sensitive health outcomes. These are deaths in thermal extremes deaths in coastal and inland floods and disease burdens from

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