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# Climate change

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## Quantifying the health impact at national and local levels

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# Table of contents

List of tables.....	iv
List of figures.....	iv
Preface.....	1
Affiliations and acknowledgements.....	2
Glossary and abbreviations .....	3
Summary.....	4
1. Introduction to the risk factor .....	5
1.1 Quantifying health impacts from climate change.....	8
1.2 Why assess global climate change impacts at the national level? .....	9
1.3 Selecting spatial boundaries for a study.....	10
2. General method.....	12
2.1 Summary of the method .....	12
2.2 Selecting the scenarios and time period.....	13
2.3 Measurements of the exposure .....	14
2.4 Which health outcomes should be assessed? .....	18
2.5 Quantify the relationship between climate and each health outcome.....	18
2.6 Link the exposure measurement to the climate-health model.....	20
2.7 Calculate the climate change attributable burden of specific diseases .....	21
3. Detail of the method for five health outcomes .....	23
3.1 Temperature-related deaths .....	23
3.2 Deaths and injuries from coastal and inland flooding .....	28
3.3 Malaria .....	33
3.4 Diarrhoeal disease.....	38
4. Estimating climate change impacts at a country level: worked examples from the Australasian assessment	43
4.1 General method.....	43
4.2 Temperature-related deaths .....	44
4.3 Risk of death from inland flooding .....	47
4.4 Dengue .....	49
4.5 Malaria .....	51
4.6 Diarrhoeal disease.....	52
5. Discussion and policy relevance of estimates.....	55
Annex Summary results of the global assessment of the disease burden from climate change.....	56
References.....	60

## List of tables

Table 1	Estimates of confidence <sup>a</sup> in observed and projected changes in extreme weather and climate events.....	8
Table 2	A matrix of the time points, scenarios and climate models used for the Australasian assessment ..	14
Table 3	Health outcomes known to be climate-sensitive, including those for which quantitative relationships were derived for the global and/or Australasian assessments.....	19
Table 4	Summary of key information sources.....	22
Table 5	Classification of global climate into four broad zones .....	24
Table 6	Summary of temperature-mortality relationships derived from the literature: percent change in mortality for a 1°C change in mean daily temperature above or below the specified threshold .....	24
Table 7	Criteria used to calculate months suitable for <i>P. falciparum</i> malaria transmission in Africa .....	36
Table 8	Average summer temperature profile during the baseline period (1990-1999) for the main cities in the Australasian climate change and health risk assessment.....	45
Table 9	Estimates of annual deaths due to heat and cold in people aged over 65 years for the baseline year (1999), 2020 and 2050.....	46
Table 10	Estimated deaths and injuries (cases and rates) from flooding in Australia, 1970 to 2001.....	48
Table 11	Relative risk of death and injury due to flooding in 2020 for major Australian States .....	48
Table 12	Australian annual incidence of deaths and injuries due to flooding per million people for the baseline period (average from 1970-2001), and estimated for 2020 and 2050 .....	49
Table A1	Country groupings for the WHO sub regions in the Global Burden of Disease assessment .....	56
Table A2	Estimated mortality in thousands attributable to climate change in the year 2000 by cause and subregion .....	58
Table A3	Estimated disease burden in 000s of DALYs attributable to climate change in the year 2000 by cause and sub region.....	58

## List of figures

Figure 1a	Past climate - Line plot of global mean land-ocean temperature index .....	6
Figure 1b	Present climate: Map of the mean temperature throughout the year in 2005, relative to average conditions for the period 1951-1980.....	6
Figure 1c	Future climate: Projected future changes in global mean temperature over the next Century .....	7
Figure 2	Overview of the process used for quantitative estimation of the burden of disease at the global level.....	13
Figure 4	Daily time series of admissions for diarrhoea at a paediatric institute, temperature, and relative humidity, in Lima, Peru.....	39
Figure 5	Spatial boundaries used in different parts of the Australasian assessment: States and Statistical Local Areas.....	43
Figure 6	Annual number of heat-related deaths due to temperature increase <i>per se</i> and ageing for the five largest Australian cities in 2050.....	47
Figure 7	Estimated population at risk of dengue transmission under baseline climate conditions (A) and in 2050 (B).....	50
Figure 8	Monthly time-series of Aboriginal children (< 10 years) hospitalised with diarrhoea at the Alice Springs hospital, 1996 to 2002.....	54
Figure A1	Estimated deaths per million people attributable to climate change in the year 2000 .....	57

## 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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