



Mark Maslin

CLIMATE

A Very Short Introduction

OXFORD

Mark Maslin

常州大学图书馆藏
CLIMATE
A Very Short Introduction
书 章

OXFORD
UNIVERSITY PRESS

OXFORD

UNIVERSITY PRESS

Great Clarendon Street, Oxford, OX2 6DP,
United Kingdom

Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide. Oxford is a registered trade mark of
Oxford University Press in the UK and in certain other countries

© Mark Maslin 2013

The moral rights of the author have been asserted

First Edition published in 2013

Impression: 2

All rights reserved. No part of this publication may be reproduced, stored in
a retrieval system, or transmitted, in any form or by any means, without the
prior permission in writing of Oxford University Press, or as expressly permitted
by law, by licence or under terms agreed with the appropriate reprographics
rights organization. Enquiries concerning reproduction outside the scope of the
above should be sent to the Rights Department, Oxford University Press, at the
address above

You must not circulate this work in any other form
and you must impose this same condition on any acquirer

British Library Cataloguing in Publication Data

Data available

ISBN 978-0-19-964113-0

Printed in Great Britain by
Ashford Colour Press Ltd, Gosport, Hampshire

Climate: A Very Short Introduction

VERY SHORT INTRODUCTIONS are for anyone wanting a stimulating and accessible way in to a new subject. They are written by experts, and have been published in more than 25 languages worldwide.

The series began in 1995, and now represents a wide variety of topics in history, philosophy, religion, science, and the humanities. The VSI Library now contains more than 300 volumes—a Very Short Introduction to everything from ancient Egypt and Indian philosophy to conceptual art and cosmology—and will continue to grow in a variety of disciplines.

Very Short Introductions available now:

- | | |
|---|---|
| ADVERTISING Winston Fletcher | ARISTOCRACY William Doyle |
| AFRICAN HISTORY John Parker and Richard Rathbone | ARISTOTLE Jonathan Barnes |
| AGNOSTICISM Robin Le Poidevin | ART HISTORY Dana Arnold |
| AMERICAN HISTORY Paul S. Boyer | ART THEORY Cynthia Freeland |
| AMERICAN IMMIGRATION David A. Gerber | ATHEISM Julian Baggini |
| AMERICAN POLITICAL PARTIES AND ELECTIONS L. Sandy Maisel | AUGUSTINE Henry Chadwick |
| AMERICAN POLITICS Richard M. Vellely | AUSTRALIA Kenneth Morgan |
| THE AMERICAN PRESIDENCY Charles O. Jones | AUTISM Uta Frith |
| ANAESTHESIA Aidan O'Donnell | THE AVANT GARDE David Cottington |
| ANARCHISM Colin Ward | THE AZTECS David Carrasco |
| ANCIENT EGYPT Ian Shaw | BACTERIA Sebastian G. B. Amyes |
| ANCIENT GREECE Paul Cartledge | BARTHES Jonathan Culler |
| ANCIENT PHILOSOPHY Julia Annas | BEAUTY Roger Scruton |
| ANCIENT WARFARE Harry Sidebottom | BESTSELLERS John Sutherland |
| ANGELS David Albert Jones | THE BIBLE John Riches |
| ANGLICANISM Mark Chapman | BIBLICAL ARCHAEOLOGY Eric H. Cline |
| THE ANGLO-SAXON AGE John Blair | BIOGRAPHY Hermione Lee |
| THE ANIMAL KINGDOM Peter Holland | THE BLUES Elijah Wald |
| ANIMAL RIGHTS David DeGrazia | THE BOOK OF MORMON Terry Givens |
| THE ANTARCTIC Klaus Dodds | BORDERS Alexander C. Diener and Joshua Hagen |
| ANTISEMITISM Steven Beller | THE BRAIN Michael O'Shea |
| ANXIETY Daniel Freeman and Jason Freeman | THE BRITISH CONSTITUTION Martin Loughlin |
| THE APOCRYPHAL GOSPELS Paul Foster | THE BRITISH EMPIRE Ashley Jackson |
| ARCHAEOLOGY Paul Bahn | BRITISH POLITICS Anthony Wright |
| ARCHITECTURE Andrew Ballantyne | BUDDHA Michael Carrithers |
| | BUDDHISM Damien Keown |
| | BUDDHIST ETHICS Damien Keown |
| | CANCER Nicholas James |
| | CAPITALISM James Fulcher |
| | CATHOLICISM Gerald O'Collins |

THE CELL Terence Allen and
 Graham Cowling
 THE CELTS Barry Cunliffe
 CHAOS Leonard Smith
 CHILDREN'S LITERATURE
 Kimberley Reynolds
 CHINESE LITERATURE Sabina Knight
 CHOICE THEORY Michael Allingham
 CHRISTIAN ART Beth Williamson
 CHRISTIAN ETHICS D. Stephen Long
 CHRISTIANITY Linda Woodhead
 CITIZENSHIP Richard Bellamy
 CIVIL ENGINEERING
 David Muir Wood
 CLASSICAL MYTHOLOGY
 Helen Morales
 CLASSICS Mary Beard and
 John Henderson
 CLAUSEWITZ Michael Howard
 CLIMATE Mark Maslin
 THE COLD WAR Robert McMahon
 COLONIAL AMERICA Alan Taylor
 COLONIAL LATIN AMERICAN
 LITERATURE Rolena Adorno
 COMEDY Matthew Bevis
 COMMUNISM Leslie Holmes
 THE COMPUTER Darrel Ince
 THE CONQUISTADORS
 Matthew Restall and
 Felipe Fernández-Armesto
 CONSCIENCE Paul Strohm
 CONSCIOUSNESS Susan Blackmore
 CONTEMPORARY ART
 Julian Stallabrass
 CONTEMPORARY FICTION
 Robert Eaglestone
 CONTINENTAL PHILOSOPHY
 Simon Critchley
 COSMOLOGY Peter Coles
 CRITICAL THEORY
 Stephen Eric Bronner
 THE CRUSADES Christopher Tyerman
 CRYPTOGRAPHY Fred Piper and
 Sean Murphy
 THE CULTURAL REVOLUTION
 Richard Curt Kraus
 DADA AND SURREALISM
 David Hopkins
 DARWIN Jonathan Howard
 THE DEAD SEA SCROLLS Timothy Lim
 DEMOCRACY Bernard Crick
 DERRIDA Simon Glendinning
 DESCARTES Tom Sorell
 DESERTS Nick Middleton
 DESIGN John Heskett
 DEVELOPMENTAL BIOLOGY
 Lewis Wolpert
 THE DEVIL Darren Oldridge
 DICTIONARIES Lynda Mugglestone
 DINOSAURS David Norman
 DIPLOMACY Joseph M. Siracusa
 DOCUMENTARY FILM
 Patricia Aufderheide
 DREAMING J. Allan Hobson
 DRUGS Leslie Iversen
 DRUIDS Barry Cunliffe
 EARLY MUSIC Thomas Forrest Kelly
 THE EARTH Martin Redfern
 ECONOMICS Partha Dasgupta
 EDUCATION Gary Thomas
 EGYPTIAN MYTH Geraldine Pinch
 EIGHTEENTH-CENTURY
 BRITAIN Paul Langford
 THE ELEMENTS Philip Ball
 EMOTION Dylan Evans
 EMPIRE Stephen Howe
 ENGELS Terrell Carver
 ENGINEERING David Blockley
 ENGLISH LITERATURE Jonathan Bate
 ENVIRONMENTAL
 ECONOMICS Stephen Smith
 EPIDEMIOLOGY Rodolfo Saracci
 ETHICS Simon Blackburn
 THE EUROPEAN UNION
 John Pinder and Simon Usherwood
 EVOLUTION Brian and
 Deborah Charlesworth
 EXISTENTIALISM Thomas Flynn
 FASCISM Kevin Passmore
 FASHION Rebecca Arnold
 FEMINISM Margaret Walters
 FILM Michael Wood
 FILM MUSIC Kathryn Kalinak
 THE FIRST WORLD WAR
 Michael Howard
 FOLK MUSIC Mark Slobin
 FORENSIC PSYCHOLOGY
 David Canter
 FORENSIC SCIENCE Jim Fraser
 FOSSILS Keith Thomson

| | |
|--|--|
| FOUCAULT Gary Gutting | INDIAN PHILOSOPHY Sue Hamilton |
| FREE SPEECH Nigel Warburton | INFORMATION Luciano Floridi |
| FREE WILL Thomas Pink | INNOVATION Mark Dodgson and David Gann |
| FRENCH LITERATURE John D. Lyons | INTELLIGENCE Ian J. Deary |
| THE FRENCH REVOLUTION William Doyle | INTERNATIONAL MIGRATION Khalid Koser |
| FREUD Anthony Storr | INTERNATIONAL RELATIONS Paul Wilkinson |
| FUNDAMENTALISM Malise Ruthven | ISLAM Malise Ruthven |
| GALAXIES John Gribbin | ISLAMIC HISTORY Adam Silverstein |
| GALILEO Stillman Drake | ITALIAN LITERATURE Peter Hainsworth and David Robey |
| GAME THEORY Ken Binmore | JESUS Richard Bauckham |
| GANDHI Bhikhu Parekh | JOURNALISM Ian Hargreaves |
| GENIUS Andrew Robinson | JUDAISM Norman Solomon |
| GEOGRAPHY John Matthews and David Herbert | JUNG Anthony Stevens |
| GEOPOLITICS Klaus Dodds | KABBALAH Joseph Dan |
| GERMAN LITERATURE Nicholas Boyle | KAFKA Ritchie Robertson |
| GERMAN PHILOSOPHY Andrew Bowie | KANT Roger Scruton |
| GLOBAL CATASTROPHES Bill McGuire | KEYNES Robert Skidelsky |
| GLOBAL ECONOMIC HISTORY Robert C. Allen | KIERKEGAARD Patrick Gardiner |
| GLOBAL WARMING Mark Maslin | THE KORAN Michael Cook |
| GLOBALIZATION Manfred Steger | LANDSCAPES AND GEOMORPHOLOGY Andrew Goudie and Heather Viles |
| THE GOTHIC Nick Groom | LANGUAGES Stephen R. Anderson |
| GOVERNANCE Mark Bevir | LATE ANTIQUITY Gillian Clark |
| THE GREAT DEPRESSION AND THE NEW DEAL Eric Rauchway | LAW Raymond Wacks |
| HABERMAS James Gordon Finlayson | THE LAWS OF THERMODYNAMICS Peter Atkins |
| HEGEL Peter Singer | LEADERSHIP Keith Grint |
| HEIDEGGER Michael Inwood | LINCOLN Allen C. Guelzo |
| HERODOTUS Jennifer T. Roberts | LINGUISTICS Peter Matthews |
| HIEROGLYPHS Penelope Wilson | LITERARY THEORY Jonathan Culler |
| HINDUISM Kim Knott | LOCKE John Dunn |
| HISTORY John H. Arnold | LOGIC Graham Priest |
| THE HISTORY OF ASTRONOMY Michael Hoskin | MACHIAVELLI Quentin Skinner |
| THE HISTORY OF LIFE Michael Benton | MADNESS Andrew Scull |
| THE HISTORY OF MATHEMATICS Jacqueline Stedall | MAGIC Owen Davies |
| THE HISTORY OF MEDICINE William Bynum | MAGNA CARTA Nicholas Vincent |
| THE HISTORY OF TIME Leofranc Holford-Strevens | MAGNETISM Stephen Blundell |
| HIV/AIDS Alan Whiteside | MALTHUS Donald Winch |
| HOBBS Richard Tuck | MAO Delia Davin |
| HUMAN EVOLUTION Bernard Wood | MARINE BIOLOGY Philip V. Mladenov |
| HUMAN RIGHTS Andrew Clapham | THE MARQUIS DE SADE John Phillips |
| HUMANISM Stephen Law | MARTIN LUTHER Scott H. Hendrix |
| HUME A. J. Ayer | MARTYRDOM Jolyon Mitchell |
| IDEOLOGY Michael Freeden | MARX Peter Singer |
| | MATHEMATICS Timothy Gowers |

THE MEANING OF LIFE Terry Eagleton
MEDICAL ETHICS Tony Hope
MEDICAL LAW Charles Foster
MEDIEVAL BRITAIN John Gillingham
and Ralph A. Griffiths
MEMORY Jonathan K. Foster
METAPHYSICS Stephen Mumford
MICHAEL FARADAY Frank A. J. L. James
MODERN ART David Cottington
MODERN CHINA Rana Mitter
MODERN FRANCE Vanessa R. Schwartz
MODERN IRELAND Senia Pašeta
MODERN JAPAN
Christopher Goto-Jones
MODERN LATIN AMERICAN
LITERATURE
Roberto González Echevarría
MODERNISM Christopher Butler
MOLECULES Philip Ball
THE MONGOLS Morris Rossabi
MORMONISM Richard Lyman Bushman
MUHAMMAD Jonathan A. C. Brown
MULTICULTURALISM Ali Rattansi
MUSIC Nicholas Cook
MYTH Robert A. Segal
THE NAPOLEONIC WARS
Mike Rapport
NATIONALISM Steven Grosby
NELSON MANDELA Elleke Boehmer
NEOLIBERALISM Manfred Steger and
Ravi Roy
NETWORKS Guido Caldarelli and
Michele Catanzaro
THE NEW TESTAMENT
Luke Timothy Johnson
THE NEW TESTAMENT AS
LITERATURE Kyle Keefer
NEWTON Robert Iliffe
NIETZSCHE Michael Tanner
NINETEENTH-CENTURY BRITAIN
Christopher Harvie and
H. C. G. Matthew
THE NORMAN CONQUEST
George Garnett
NORTH AMERICAN INDIANS
Theda Perdue and
Michael D. Green
NORTHERN IRELAND
Marc Mulholland
NOTHING Frank Close

NUCLEAR POWER Maxwell Irvine
NUCLEAR WEAPONS
Joseph M. Siracusa
NUMBERS Peter M. Higgins
OBJECTIVITY Stephen Gaukroger
THE OLD TESTAMENT
Michael D. Coogan
THE ORCHESTRA D. Kern Holoman
ORGANIZATIONS Mary Jo Hatch
PAGANISM Owen Davies
PARTICLE PHYSICS Frank Close
PAUL E. P. Sanders
PENTECOSTALISM William K. Kay
THE PERIODIC TABLE Eric R. Scerri
PHILOSOPHY Edward Craig
PHILOSOPHY OF LAW
Raymond Wacks
PHILOSOPHY OF SCIENCE
Samir Okasha
PHOTOGRAPHY Steve Edwards
PLAGUE Paul Slack
PLANETS David A. Rothery
PLANTS Timothy Walker
PLATO Julia Annas
POLITICAL PHILOSOPHY
David Miller
POLITICS Kenneth Minogue
POSTCOLONIALISM Robert Young
POSTMODERNISM Christopher Butler
POSTSTRUCTURALISM
Catherine Belsey
PREHISTORY Chris Gosden
PRESOCRATIC PHILOSOPHY
Catherine Osborne
PRIVACY Raymond Wacks
PROBABILITY John Haigh
PROGRESSIVISM Walter Nugent
PROTESTANTISM Mark A. Noll
PSYCHIATRY Tom Burns
PSYCHOLOGY Gillian Butler and
Freda McManus
PURITANISM Francis J. Bremer
THE QUAKERS Pink Dandelion
QUANTUM THEORY
John Polkinghorne
RACISM Ali Rattansi
RADIOACTIVITY Claudio Tuniz
RASTAFARI Ennis B. Edmonds
THE REAGAN REVOLUTION Gil Troy
REALITY Jan Westerhoff

THE REFORMATION Peter Marshall
 RELATIVITY Russell Stannard
 RELIGION IN AMERICA Timothy Beal
 THE RENAISSANCE Jerry Brotton
 RENAISSANCE ART
 Geraldine A. Johnson
 RHETORIC Richard Toye
 RISK Baruch Fischhoff and John Kadvany
 RIVERS Nick Middleton
 ROBOTICS Alan Winfield
 ROMAN BRITAIN Peter Salway
 THE ROMAN EMPIRE
 Christopher Kelly
 THE ROMAN REPUBLIC David M. Gwynn
 ROMANTICISM Michael Ferber
 ROUSSEAU Robert Wokler
 RUSSELL A. C. Grayling
 RUSSIAN HISTORY Geoffrey Hosking
 RUSSIAN LITERATURE Catriona Kelly
 THE RUSSIAN REVOLUTION
 S. A. Smith
 SCHIZOPHRENIA Chris Frith and
 Eve Johnstone
 SCHOPENHAUER Christopher Janaway
 SCIENCE AND RELIGION Thomas Dixon
 SCIENCE FICTION David Seed
 THE SCIENTIFIC REVOLUTION
 Lawrence M. Principe
 SCOTLAND Rab Houston
 SEXUALITY Véronique Mottier
 SHAKESPEARE Germaine Greer
 SIKHISM Eleanor Nesbitt
 THE SILK ROAD James A. Millward
 SLEEP Steven W. Lockley and
 Russell G. Foster
 SOCIAL AND CULTURAL
 ANTHROPOLOGY
 John Monaghan and Peter Just
 SOCIALISM Michael Newman
 SOCIOLOGY Steve Bruce

SOCRATES C. C. W. Taylor
 THE SOVIET UNION Stephen Lovell
 THE SPANISH CIVIL WAR
 Helen Graham
 SPANISH LITERATURE Jo Labanyi
 SPINOZA Roger Scruton
 SPIRITUALITY Philip Sheldrake
 STARS Andrew King
 STATISTICS David J. Hand
 STEM CELLS Jonathan Slack
 STUART BRITAIN John Morrill
 SUPERCONDUCTIVITY Stephen Blundell
 SYMMETRY Ian Stewart
 TERRORISM Charles Townshend
 THEOLOGY David F. Ford
 THOMAS AQUINAS Fergus Kerr
 THOUGHT Tim Bayne
 TOCQUEVILLE Harvey C. Mansfield
 TRAGEDY Adrian Poole
 THE TROJAN WAR Eric H. Cline
 TRUST Katherine Hawley
 THE TUDORS John Guy
 TWENTIETH-CENTURY BRITAIN
 Kenneth O. Morgan
 THE UNITED NATIONS
 Jussi M. Hanhimäki
 THE U.S. CONGRESS Donald A. Ritchie
 THE U.S. SUPREME COURT
 Linda Greenhouse
 UTOPIANISM Lyman Tower Sargent
 THE VIKINGS Julian Richards
 VIRUSES Dorothy H. Crawford
 WITCHCRAFT Malcolm Gaskill
 WITTGENSTEIN A. C. Grayling
 WORK Stephen Fineman
 WORLD MUSIC Philip Bohlman
 THE WORLD TRADE
 ORGANIZATION Amrita Narlikar
 WRITING AND SCRIPT
 Andrew Robinson

Available soon:

HAPPINESS Daniel M. Haybron
 THE PALESTINIAN-ISRAELI
 CONFLICT Martin Bunton

MANAGEMENT John Hendry
 FOOD John Krebs
 MODERN WAR Richard English

For more information visit our website
www.oup.com/vsi

Acknowledgements

The author would like to thank the following people: Anne, Chris, Johanna, Alexandra, Abbie Maslin, and Sue Andrews for being there; Emma Marchant and Latha Menon for their excellent editing and support; all the staff and friends at the UCL Environment Institute, UCL Department of Geography, TippingPoint, Rezatec Ltd, Permian, DMCii, KMatrix, and Global Precious Commodities; and last but not least Miles Irving for excellent illustrations.

Contents

Acknowledgements x

List of illustrations xi

- 1 What is climate? 1
- 2 Atmosphere and oceans 12
- 3 Weather versus climate 34
- 4 Extreme climates 45
- 5 Tectonics and climate 61
- 6 Global climate cooling 79
- 7 Great ice ages 90
- 8 Future climate change 109
- 9 Fixing climate change 120
- 10 Ultimate climate change 141

Further reading 149

Index 153

List of illustrations

- 1 Human comfort and climate **2**
- 2 Solar energy distributed over a sphere **4**
- 3 Energy transfer away from the Equator driven by angle of solar radiation **5**
- 4 Solstice and equinox caused by the tilt of the Earth **7**
- 5 Coriolis effect due to relative movement of the surface of the Earth **10**
- 6 The greenhouse effect **16**
- 7 Temperature profile through the atmosphere **17**
- 8 Heat transport away from the Equator **19**
- 9 Major atmospheric circulation patterns **21**
- 10 Major atmospheric circulation cells and jet streams **22**
- 11 Major surface ocean current **24**
- 12 Ekman surface ocean movement due to wind action **25**
- 13 Major North Atlantic surface ocean currents **27**
- 14 Temperature, salt, and density relationship for water **28**
- 15 Global deep ocean conveyor belt circulation **30**
- 16 Pacific Ocean during El Niño and normal periods **40**
- 17 Location and occurrence of major tropical storms **47**
- 18 Major hurricane landfall over a 100-year period **49**
- 19 USA tornado risk map **53**
- 20 Monsoonal system **58**
- 21 Latitudinal location of continent and the Equator–pole temperature gradient **63**

- 22 Ocean gateways both today and during the Cretaceous period **65**
- 23 Longitudinal continents and ocean circulation **66**
- 24 Ocean gateways and deep-ocean circulation **67**
- 25 Mountain rain-shadow **69**
- 26 Mountain and plateau effects on global rainfall **70**
- 27 Plateaus and ice sheet effects on atmospheric circulation **72**
- 28 Volcanic eruption effects on atmosphere composition **74**
- 29 Long-term links between tectonics, sea level, climate, biodiversity, and extinctions **77**
- 30 Global climate over the last 65 million years **81**
- 31 Mediterranean Messinian ‘Salinity Crisis’ and ‘Terminal Flood’ approximately 5 million years ago **85**
- 32 Global climate over the last 5 million years **87**
- 33 Orbital variables **92**
- 34 Comparison of Northern Hemisphere solar radiation and global sea level **95**
- 35 Ice sheet expansion in the Arctic and Antarctic **96**
- 36 Global average surface temperature over the last 120 years **110**
- 37 Past and future global average surface temperature **114**
- 38 The perfect storm: increased demand predicted by 2030 **118**
- 39 Past and future carbon emissions by country **121**
- 40 Geoengineering summary **128**
- 41 Historic proportion of carbon emissions **139**
- 42 Future locations of the continents **144**
- 43 Life on Earth over the life of the sun **146**

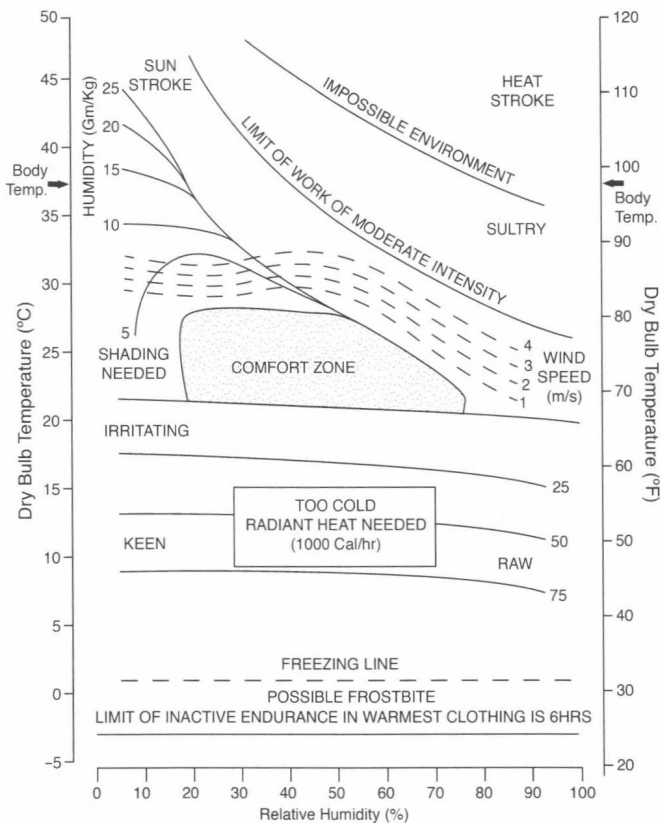
Chapter 1

What is climate?

Introduction

Climate affects everything we do in life, from the clothes we wear to the diseases we catch. This is because as humans we only feel comfortable within a very narrow range of temperature and humidity. This comfort zone ranges from about 20°C to 26°C and from 20 to 75 per cent relative humidity (see Figure 1). However, we live almost everywhere in the world, meaning that conditions are frequently outside this comfort zone, and we have learnt to adapt our clothing and dwellings to maintain our comfort. So while you may think the clothes you have hanging in your wardrobe simply reflect your fashion taste or lack of, in reality they reflect the climate in which you live and how it changes throughout the year. So you have a thick padded coat for a Canadian winter and a short-sleeved shirt for a business meeting in Rio. Our wardrobes also give hints about where we like to take our holidays. If you are a budding Polar explorer then there will very warm Arctic clothes hanging up—if you love sunning yourself on the beach, then there will be shorts or a bikini instead.

Our houses are also built with a clear understanding of local climate. In England almost all houses have central heating as the outside temperature is usually below 20°C, but few have air conditioning as temperatures rarely exceed 26°C. On the other



1. Human comfort and climate

hand, in Australia most houses have air conditioning but rarely central heating. Climate also affects the structure of our cities and how transport systems around the world operate. In Houston, Texas, there is a network of 7 miles of underground tunnels connecting all the major downtown buildings; this is fully climate controlled and links 95 heavily populated city blocks. People use the tunnel when it is raining or hot outside, because for at least 5 months of the year the average temperature in Houston is above

30°C. Similarly there are underground malls in Canada to avoid the problems of heavy snow and extreme cold.

Climate controls where and when we get our food, because agriculture is controlled by rainfall, frost, and snow, and by how long the growing season is, which includes both the amount of sunlight and the length of the warm season. So in a simplified way, rice is grown where it is warm and very wet, while wheat can grow in much more temperate climes. The climate can also affect the quality of our food, for example it is well known that the very best vintages of French wine are produced when there are a few short sharp frosts during the winter, which harden the vines, producing excellent grapes. Farmers can also 'help' the local climate, for example by growing tomatoes in a greenhouse or by irrigating the land to provide a more constant supply of water.

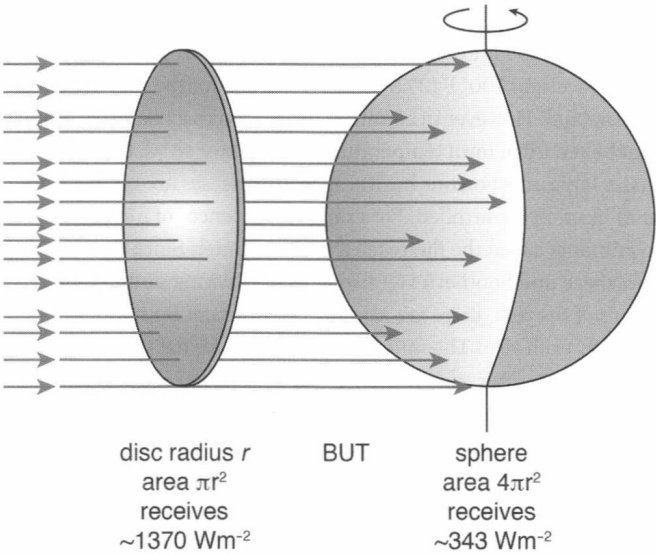
Climate also influences where there will be extreme weather events such as heatwaves, droughts, floods, and storms. However in many cases our perception of extreme events is determined by local conditions, so for example in 2003 northern Europe was hit with a 'heatwave' and 100°F (37.8°C) was recorded for the first time ever in England. However in countries of the tropics a heatwave would not be recorded until temperatures were above 45°C. Climate also has a large effect on our health, as many diseases are temperature and humidity controlled. For example incidences of influenza, commonly called the flu, reach a peak in winter. Since the Northern and Southern Hemispheres have winter at different times of the year, there are actually two different flu seasons globally each year. The influenza virus migrates between the two hemispheres after each winter, giving us time to produce new vaccinations based on the new strain of flu that has appeared in the previous six months in the other hemisphere. There have been many arguments about why flu is climate controlled and the theory is that during cold dry conditions the virus can survive on surfaces longer and so be more easily transmitted between people. Another suggestion is that vitamin D might provide some resistance or

immunity to the virus. Hence in winter and during the tropical rainy season, when people stay indoors, away from the sun, their vitamin D levels fall and incidences of influenza increase.

Hot and cold Earth

The climate of our planet is caused by the Equator of the Earth receiving more of the sun's energy than the poles. If you imagine the Earth is a giant ball, the closest point to the sun is the middle or the Equator. The Equator is where the sun is most often directly overhead and it is here that the Earth receives the most energy. As you move further north or south away from the Equator, the surface of the Earth curves away from the sun, increasing the angle of the surface of the Earth relative to the sun. This means the sun's energy is spread over a larger area, and thus causes less warming. If we lived on a flat disc we would get much more energy from the

Climate



2. Solar energy distributed over a sphere