CLIMATES OF THE BRITISH ISLES
Present, Past and Future

Edited by
Mike Hulme and Elaine Barrow

London and New York
## CONTENTS

<table>
<thead>
<tr>
<th>List of Plates</th>
<th>xii</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Figures</td>
<td>xiii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xix</td>
</tr>
<tr>
<td>List of Contributors</td>
<td>xxi</td>
</tr>
<tr>
<td>Preface</td>
<td>xxv</td>
</tr>
<tr>
<td>Foreword</td>
<td>xxvii</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>xxx</td>
</tr>
</tbody>
</table>

### CHAPTER 1: INTRODUCING CLIMATE CHANGE

**Mike Hulme and Elaine Barrow**

Changing Views of Climate  
Outline of the Book  

### PART 1: THE BRITISH ISLES CLIMATE

### CHAPTER 2: EXPLAINING THE CLIMATE OF THE BRITISH ISLES

**Trevor Davies, P. Mick Kelly and Tim Osborn**

Introduction  
Global-scale Radiation and Heat Balances  
The General Circulation  
Surface Pressure Patterns  
Links with the Ocean  
Air Masses  
Smaller Weather Systems and Local Influences  
The Scene is Set  

### CHAPTER 3: DESCRIBING THE SURFACE CLIMATE OF THE BRITISH ISLES

**Elaine Barrow and Mike Hulme**

Introduction  
Surface Air Temperature  
Precipitation: Amount and Frequency  
Other Climate Variables: Sunshine, Humidity and Wind Speed
PART 2: RECONSTRUCTING THE PAST

CHAPTER 4: THE CLIMATES OF PAST AGES
Brian Funnell
Introduction
Climate in the Pre-Cenozoic Era
The Approach to the Present Ice Age
The Present Ice Age
Glacial Cycles in the British Isles
The Last Interglacial–Glacial Cycle
Conclusions

CHAPTER 5: RECONSTRUCTING LATE-GLACIAL AND HOLOCENE CLIMATES
Keith Briffa and Tim Atkinson
Introduction
The End of the Last Great Ice Age
The Younger Dryas in the British Isles
The Holocene Period
Conclusions

CHAPTER 6: DOCUMENTING THE MEDIEVAL CLIMATE
Astrid Ogilvie and Graham Farmer
Introduction
The Importance of Source Analysis
The Sources and Data
Strategy and Methodology
Presentation of the Data
Sea-ice Incidence in the North Atlantic
Conclusions

PART 3: MONITORING THE PRESENT

CHAPTER 7: OBSERVING AND MEASURING THE WEATHER: A BRIEF HISTORY
John Kington
Introduction
The Pre-instrumental Period
The Beginning of Instrumental Observing
The Advent of the Modern Instrumental Period
Today's World of Observations
The Role of the Amateur Observer
CHAPTER 8: CLASSIFYING THE WINDS AND WEATHER 153
P. Mick Kelly, Phil Jones and Keith Briffa
Introduction 153
Weather Types 154
The Lamb Classification 155
Relationships with Temperature, Precipitation and Other Weather Variables 157
The Annual Cycle in the Circulation over the British Isles 165
The Past Record of Circulation Changes 168
Towards More Detailed Classification 169

CHAPTER 9: THE CHANGING TEMPERATURE OF 'CENTRAL ENGLAND' 173
Phil Jones and Mike Hulme
Introduction 173
Historical Variability of Temperature 174
Relationships Between CET and Atmospheric Circulation 183
Relationships Between CET and Northern Hemisphere Temperatures 184
Daily Temperature Variability 189
Conclusions 195

CHAPTER 10: PRECIPITATION VARIABILITY AND DROUGHT 197
Phil Jones, Declan Conway and Keith Briffa
Introduction 197
The Geographical Variability of Precipitation 198
The Historical Variability of Precipitation 199
Daily Precipitation Variability 203
Snowfall 211
Droughts 214
Conclusions 218

CHAPTER 11: WIND: RESOURCE AND HAZARD 220
Jean Palutikof, Tom Holt and Andrew Skellern
Introduction 220
Wind Climatology of the British Isles 220
Wind as a Resource: The Analysis of Average Wind Speeds 223
Wind as a Hazard: Storms and High Wind Speeds 232
Conclusions 240

CHAPTER 12: THE AIR THAT WE BREATHE: SMOGS, SMOKE AND HEALTH 243
Peter Brimblecombe and Graham Bentham
Introduction 243
Early History of Air Pollution 243
The Twentieth Century 245
The Pollutants 246
Indoor Air Pollution 253
Health Issues 257
The Future 259
CONTENTS

CHAPTER 13: 'PHEW! WHAT A SCORCHER': WEATHER RECORDS AND EXTREMES 262
Michael Dukes and Philip Eden
Introduction 262
Pitfalls in the Study of Extremes 262
Summer Heat Waves and Winter Warmth 265
Freezing Winters and Cool Summers 268
Deluge and Drought 272
Snowfalls, Blizzards and Ice-storms 279
Severe Gales and Record Gusts 285
Smogs, Fogs and Record Sunshine 288
Conclusions 293

PART 4: FORECASTING THE FUTURE 297

CHAPTER 14: FORECASTING THE BRITISH ISLES WEATHER 299
Clive Pierce, Michael Dukes and Graham Parker
Introduction 299
A Historical Perspective 300
Weather Forecasting Today 307
Numerical Weather Prediction Models 315
Practical Weather Forecasting: The Human–Machine Mix 318
Weather Service Provision 319
Weather Forecasting: The Future 322

CHAPTER 15: GLOBAL WARMING AND THE BRITISH ISLES 326
Sarah Raper, David Viner, Mike Hulme and Elaine Barrow
Introduction 326
The Greenhouse Effect 326
Global and Regional Climate Change 330
Climate Change in the British Isles 335
How Climate Change Might Affect the British Isles 335
Conclusions 338

CHAPTER 16: CLIMATE BEYOND THE TWENTY-FIRST CENTURY 340
Clare Goodess and Jean Palutikof
Introduction 340
Predicting Climate Thousands of Years into the Future 341
The Past as a Guide to the Future 341
Modelling the Next Glacial–Interglacial Cycle 343
Anthropogenic Effects: Why the Future Won’t be Like the Past 347
Contradictions and Uncertainties 353
Climate Research: The Next Twenty-five Years 355
APPENDICES
A Climate Maps of the British Isles 360
B The Lamb Catalogue, 1972–95 365
C The Daily Central England Temperature, 1961–95 390
D Listings of Climate Datasets 403

Glossary 418
Name index 427
Index of place names 430
General index 434