

Contents

Preface to the second edition	viii
Preface to the first edition	x
Acknowledgements	xi
List of symbols	xii
Chapter 1 The scope and controls of the climate	1
1.1 The science of climatology	2
1.2 The development of climatology	4
1.3 Climatic elements	9
1.4 The climate system	10
1.5 Climatological space and time scales	14
Box 1.A Climate applications and impacts: the use of climatological knowledge	15
Box 1.I The climate observing system	16
Chapter 2 The Earth's radiation budget	17
2.1 The nature of radiation	17
2.2 Solar radiation reaching the Earth	21
2.3 Interaction of solar radiation with the atmosphere	23
2.4 Solar radiation at the Earth's surface	25
2.5 Terrestrial radiation	31
2.6 The global radiation budget	32
2.7 Surface radiation budgets	34
Box 2.A Application of solar radiation information	36–8
Box 2.I Instruments and methods for monitoring radiation	26–8
Chapter 3 Energy and temperature	39
3.1 Surface energy budgets	39
3.2 Major surface types and their consequences	44
3.3 Temperatures at the Earth's surface	45
3.4 The temperature structure of the atmosphere	47
Box 3.A Applications of energy and temperature information	49–52
Box 3.I The measurement of temperature	52–5
Chapter 4 Moisture in the atmosphere	56
4.1 Evaporation	57
4.2 Moisture in the atmosphere	61

- 4.3 Cloud types and distribution
- 4.4 Cloud formation
- 4.5 Hydrostatic stability
- Box 4.A Application of moisture information
- Box 4.I Monitoring water in the air

Chapter 5 Precipitation

- 5.1 Precipitation formation
- 5.2 Precipitation at the ground
- 5.3 Global precipitation distribution
- 5.4 The surface water budget
- Box 5.A Applications of precipitation information
- Box 5.I The measurement of precipitation

Chapter 6 Winds and pressure

- 6.1 Atmospheric pressure
- 6.2 Air movement around a rotating planet
- 6.3 Barotropic and baroclinic conditions
- Box 6.A Applications of wind information
- Box 6.I Measurement of pressure and winds

Chapter 7 The general circulation and global climate

- 7.1 The function of the general circulation
- 7.2 The nature of the general circulation of the atmosphere
- 7.3 Large-scale effects of the surface boundary
- 7.4 Climate classification and regions
- Box 7.A Succinct and accurate climate descriptions
- Box 7.I Combining and comparing observations

Chapter 8 Tropical weather and climate

- 8.1 Tropical climates – the Hadley cell
- 8.2 Tropical climates – the monsoon regime
- 8.3 Hurricanes
- 8.4 El Niño and the Southern Oscillation
- Box 8.A Impacts: hurricanes and ENSO
- Box 8.I Monitoring the ocean surface

Chapter 9 Extra-tropical weather and climate

- 9.1 The mid-latitude baroclinic zone
- 9.2 Mid-latitude weather
- 9.3 Mid-latitude climate regions
- 9.4 Polar climates
- Box 9.A Applications old and new
- Box 9.I Observational networks

Chapter 10 Local climates

- 10.1 Factors controlling local climates
- 10.2 Interactions between surfaces
- 10.3 The urban climate

10.4	The influence of topography	192
10.5	The influence of larger-scale atmospheric features	198
Box 10.A	Airflow around obstacles: applications and impacts	188–91
Box 10.I	Defining and measuring local climates	200–1
Chapter 11	Human interaction with climate	202
11.1	The impacts of climate on humans	202
11.2	Human modifications of the atmosphere	214
11.3	Changes in the character of the surface	223
Box 11.A	Climate impacts on an electric utility	203–4
Box 11.I	Derived variables for practical use	210–13
Chapter 12	Climates of the past	226
12.1	Palaeoclimatic observations	226
12.2	Past climates	229
12.3	Mechanisms of climate change	236
Box 12.A	Climate and long-term ecological change	243–4
Box 12.I	The use of proxy variables	245–6
Chapter 13	Modelling the climate	247
13.1	A simple global energy balance model	247
13.2	Global-scale climate models	252
13.3	Regional and local climate models	258
Box 13.A	Spatial models for applications and impacts	263–5
Box 13.I	Linking models and observations	265–6
Chapter 14	Climate, climate change and the future	267
14.1	Implications of climate variability and change	267
14.2	Climate forecasts	272
14.3	Scenarios of future climates	276
Box 14.A	Estimating future climates for decision-making	288–9
Box 14.I	Monitoring for climate change	281–2
	Appendix A – SI units	290
	Appendix B – Selected World Wide Web sites	293
	Glossary	296
	Bibliography	304
	Index	312