Contents

	se Northern Hemisphere	
List	t of contributors po	ige viii
Pre	face	xi
List	t of abbreviations	xiv
1 I	ntroduction	A 0.1
1.1	The climate system	1
1.2	Patterns, processes, and teleconnections	8
1.3	ESSAY: Problem climates or problem societies? (Glantz)	10
1.4	Examples of general climate websites	23
1.5	References	24
2 (Oscillations and teleconnections	25
2.1	History and definitions	25
2.2	The North Atlantic Oscillation (NAO)	29
2.3	The North Pacific Oscillation (NPO)/Pacific Decadal	
	Oscillation (PDO)	30
2.4	The Pacific North American Oscillation (PNA)	31
2.5	The Madden–Julian Oscillation (MJO)	33
2.6	The Quasi-biennial Oscillation (QBO)	34
2.7	The Arctic Oscillation (AO) and the Antarctic Oscillation (AAO)	36
2.8	ESSAY: ENSO and related teleconnections (Allan)	38
2.9	Examples of oscillations and teleconnections websites	54
2.10	0 References	54
3 T	Tropical climates	59
3.1	Introduction	59
3.2	The climate controls	59
3.3	ESSAY: The Quasi-biennial Oscillation and tropical climate	
	variations (Cerveny)	67
3.4	Human activities and problem climates in the tropics	74
3.5	ESSAY: Remote sensing of Amazonia deforestation and	
	vegetation regrowth: inputs to climate change research	
	(Mausel, Lu and Dias)	70
3.6	Chapter summary	90

793 ESSAY: Variability of urban climates (Grimmasusinile ebutital-elbbit412)

4.1 Introduction 4.2 Data availability 4.3 ESSAY: Reanalysis (Giles) 4.4 Using reanalysis 4.5 The Northern Hemisphere 4.6 Mid-latitude circulation and teleconnections in the Southern Hemisphere 4.7 Chapter summary 4.8 Examples of mid-latitude websites 4.9 References 4.9 References 4.126 5 Climate of the polar realms 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climate reconstructions 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites	3.7 Examples of tropical climates websites	91
4.1 Introduction 4.2 Data availability 4.3 ESSAY: Reanalysis (Giles) 4.4 Using reanalysis 4.5 The Northern Hemisphere 4.6 Mid-latitude circulation and teleconnections in the Southern Hemisphere 4.7 Chapter summary 4.8 Examples of mid-latitude websites 4.9 References 4.9 References 4.1 Introduction (Wendler) 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 4.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climate reconstructions 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites	3.8 References	91
4.1 Introduction 4.2 Data availability 4.3 ESSAY: Reanalysis (Giles) 4.4 Using reanalysis 4.5 The Northern Hemisphere 4.6 Mid-latitude circulation and teleconnections in the Southern Hemisphere 4.7 Chapter summary 4.8 Examples of mid-latitude websites 4.9 References 4.9 References 4.1 Introduction (Wendler) 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 4.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climate reconstructions 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites		
4.2 Data availability 4.3 ESSAY: Reanalysis (Giles) 97 4.4 Using reanalysis 104 4.5 The Northern Hemisphere 106 4.6 Mid-latitude circulation and teleconnections in the Southern Hemisphere 114 4.7 Chapter summary 125 4.8 Examples of mid-latitude websites 126 4.9 References 126 5 Climate of the polar realms 131 5.1 Introduction (Wendler) 132 5.2 ESSAY: Antarctic climate (Wendler) 133 5.3 Upper air circulation and wind 142 5.4 Surface pressure variations 143 5.5 Cyclogenesis and cyclonicity 146 5.6 Antarctic climate and ENSO 148 5.7 Polar night jet and stratospheric ozone depletion 149 5.8 ESSAY: Arctic Climate (Wendler) 151 5.9 Arctic general circulation 161 5.10 Surface pressure and wind 161 5.11 Extra-tropical cyclones 163 5.12 Polar night jet and stratospheric ozone depletion 165 5.13 Concerns about future warming 166 5.14 Chapter summary 166 5.15 Examples of polar websites 167 5.16 References 168 6 Post-glacial climatic change and variability 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	4 Middle-latitude climates	96
4.3 ESSAY: Reanalysis (Giles) 4.4 Using reanalysis 4.5 The Northern Hemisphere 4.6 Mid-latitude circulation and teleconnections in the Southern Hemisphere 4.7 Chapter summary 4.8 Examples of mid-latitude websites 4.9 References 5 Climate of the polar realms 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 4.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 6 Post-glacial climatic change and variability 6.1 Introduction 170 6.2 Determining past climate through the use of proxies 6 Post-glacial climatic relimates in the Northern Hemisphere (Ziclinski) 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 6.6 Examples of paleoclimate websites	4.1 Introduction	96
4.4 Using reanalysis 4.5 The Northern Hemisphere 4.6 Mid-latitude circulation and teleconnections in the Southern Hemisphere 4.7 Chapter summary 4.8 Examples of mid-latitude websites 4.9 References 4.9 References 4.9 References 4.10 5.1 Introduction (Wendler) 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 6.6 Examples of paleoclimate websites	4.2 Data availability	96
4.5 The Northern Hemisphere 4.6 Mid-latitude circulation and teleconnections in the Southern Hemisphere 4.7 Chapter summary 4.8 Examples of mid-latitude websites 4.9 References 4.9 References 4.0 Limit and the polar realms 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites	4.3 ESSAY: Reanalysis (Giles)	97
4.6 Mid-latitude circulation and teleconnections in the Southern Hemisphere 4.7 Chapter summary 4.8 Examples of mid-latitude websites 4.9 References 126 5 Climate of the polar realms 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 132 5.3 Upper air circulation and wind 142 5.4 Surface pressure variations 15.5 Cyclogenesis and cyclonicity 146 5.6 Antarctic climate and ENSO 148 5.7 Polar night jet and stratospheric ozone depletion 149 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 165 5.13 Concerns about future warming 166 5.14 Chapter summary 166 6 Post-glacial climatic change and variability 171 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Ziclinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	4.4 Using reanalysis	104
in the Southern Hemisphere 4.7 Chapter summary 4.8 Examples of mid-latitude websites 4.9 References 126 5 Climate of the polar realms 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 168 6 Post-glacial climatic change and variability 77 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	4.5 The Northern Hemisphere	106
4.7 Chapter summary 4.8 Examples of mid-latitude websites 4.9 References 126 5 Climate of the polar realms 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 132 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 146 5.6 Antarctic climate and ENSO 148 5.7 Polar night jet and stratospheric ozone depletion 149 5.8 ESSAY: Arctic Climate (Wendler) 151 5.9 Arctic general circulation 161 5.10 Surface pressure and wind 161 5.11 Extra-tropical cyclones 163 5.12 Polar night jet and stratospheric ozone depletion 165 5.13 Concerns about future warming 166 5.14 Chapter summary 166 5.15 Examples of polar websites 167 6.16 References 168 6 Post-glacial climatic change and variability 171 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	4.6 Mid-latitude circulation and teleconnections	
4.8 Examples of mid-latitude websites 4.9 References 126 5 Climate of the polar realms 5.1 Introduction (Wendler) 131 5.2 ESSAY: Antarctic climate (Wendler) 132 5.3 Upper air circulation and wind 142 5.4 Surface pressure variations 143 5.5 Cyclogenesis and cyclonicity 146 5.6 Antarctic climate and ENSO 148 5.7 Polar night jet and stratospheric ozone depletion 149 5.8 ESSAY: Arctic Climate (Wendler) 151 5.9 Arctic general circulation 161 5.10 Surface pressure and wind 161 5.11 Extra-tropical cyclones 163 5.12 Polar night jet and stratospheric ozone depletion 165 5.13 Concerns about future warming 166 5.14 Chapter summary 166 5.15 Examples of polar websites 167 5.16 References 168 6 Post-glacial climatic change and variability 171 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	in the Southern Hemisphere	114
4.9 References 5 Climate of the polar realms 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 5.10 Chapter summary 6.11 Chapter summary 6.12 Determinary 6.13 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites	4.7 Chapter summary	125
5 Climate of the polar realms 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	4.8 Examples of mid-latitude websites	126
5 Climate of the polar realms 5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites	4.9 References	126
5.1 Introduction (Wendler) 5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites		
5.2 ESSAY: Antarctic climate (Wendler) 5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 5.06 6 Examples of paleoclimate websites	5 Climate of the polar realms	131
5.3 Upper air circulation and wind 5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depeletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites	5.1 Introduction (Wendler)	131
5.4 Surface pressure variations 5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 202	5.2 ESSAY: Antarctic climate (Wendler)	132
5.5 Cyclogenesis and cyclonicity 5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 202	5.3 Upper air circulation and wind	142
5.6 Antarctic climate and ENSO 5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depeletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	5.4 Surface pressure variations	143
5.7 Polar night jet and stratospheric ozone depletion 5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depeletion 5.13 Concerns about future warming 5.14 Chapter summary 166 5.15 Examples of polar websites 5.16 References 168 6 Post-glacial climatic change and variability 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	5.5 Cyclogenesis and cyclonicity	146
5.8 ESSAY: Arctic Climate (Wendler) 5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depeletion 5.13 Concerns about future warming 5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	5.6 Antarctic climate and ENSO	148
5.9 Arctic general circulation 5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depeletion 5.13 Concerns about future warming 5.14 Chapter summary 166 5.15 Examples of polar websites 5.16 References 168 6 Post-glacial climatic change and variability 171 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites 202	5.7 Polar night jet and stratospheric ozone depletion	149
5.10 Surface pressure and wind 5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depeletion 5.13 Concerns about future warming 166 5.14 Chapter summary 166 5.15 Examples of polar websites 5.16 References 168 6 Post-glacial climatic change and variability 171 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites 202	5.8 ESSAY: Arctic Climate (Wendler)	151
5.11 Extra-tropical cyclones 5.12 Polar night jet and stratospheric ozone depeletion 5.13 Concerns about future warming 166 5.14 Chapter summary 166 5.15 Examples of polar websites 167 5.16 References 168 6 Post-glacial climatic change and variability 171 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites 202	5.9 Arctic general circulation	161
5.12 Polar night jet and stratospheric ozone depeletion 5.13 Concerns about future warming 166 5.14 Chapter summary 166 5.15 Examples of polar websites 5.16 References 168 6 Post-glacial climatic change and variability 171 6.1 Introduction 172 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites	5.10 Surface pressure and wind	161
5.13 Concerns about future warming 5.14 Chapter summary 166 5.15 Examples of polar websites 167 5.16 References 168 6 Post-glacial climatic change and variability 171 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites 202	5.11 Extra-tropical cyclones	163
5.14 Chapter summary 5.15 Examples of polar websites 5.16 References 168 6 Post-glacial climatic change and variability 171 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites 202	5.12 Polar night jet and stratospheric ozone depeletion	165
5.15 Examples of polar websites 5.16 References 168 6 Post-glacial climatic change and variability 171 6.1 Introduction 171 6.2 Determining past climate through the use of proxies 172 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 175 6.4 Southern Hemisphere climate reconstructions 194 6.5 Chapter summary 201 6.6 Examples of paleoclimate websites 202	5.13 Concerns about future warming	166
5.16 References 6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites	5.14 Chapter summary	166
6 Post-glacial climatic change and variability 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 202	5.15 Examples of polar websites	167
 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 	5.16 References	168
 6.1 Introduction 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 	6 Post-glacial climatic change and variability	171
 6.2 Determining past climate through the use of proxies 6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 		
6.3 ESSAY: Post-glacial climates in the Northern Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 202		
Hemisphere (Zielinski) 6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 175 201		
6.4 Southern Hemisphere climate reconstructions 6.5 Chapter summary 6.6 Examples of paleoclimate websites 194 201		
6.5 Chapter summary 6.6 Examples of paleoclimate websites 201		
6.6 Examples of paleoclimate websites 202		
		202

7 Urban impacts on climate	205
7.1 Introduction	205
7.2 Highlights in the history of urban climate research	207
7.3 ESSAY: Variability of urban climates (Grimmond)	210
7.4 Wind, cloud cover, and pressure	223
7.5 Urban canyons	227
7.6 Moisture and precipitation	230
7.7 Effects of air pollution	232
7.8 Remote sensing and the UHI	234
7.9 Mitigation of the UHI	238
7.10 Chapter summary	239
7.11 Examples of urban websites	239
7.12 References	240
8 Human response to climate change	244
8.1 Introduction	244
8.2 The Viking settlements in Greenland, AD 800-1450	245
8.3 Climate change and adaptation in Europe during the Little Ice Age	250
8.4 ESSAY: Economic impacts of climate conditions in the United	
States (Changnon)	260
8.5 Conclusions	275
8.6 Examples of climate and history websites	277
8.7 References	277
9 ESSAY: Model interpretation of climate signals: an application	
to Asian monsoon climate (Lau)	281
9.1 Introduction	281
9.2 A climate model primer	282
9.3 Modeling the Asian monsoon climate	292
9.4 Future challenges	303
9.5 Acknowledgement	305
9.6 Examples of climate modeling websites	305
9.7 References	305
10 Conclusions and the future of climate research	309
10.1 Introduction	309
10.2 Understanding the global climate system	311
10.3 The importance of communication	318
10.4 References	320
DESCRIPTION AND ADDRESS OF A STREET ADDRESS OF A STREET AND ADDRESS OF A STREET AND ADDRESS OF A STREET AND ADDRESS OF A STREET ADDRESS OF A STREE	
Other books on climatology and the climate system	321
Index	325
The color plates are situated between pages 170 and 171	