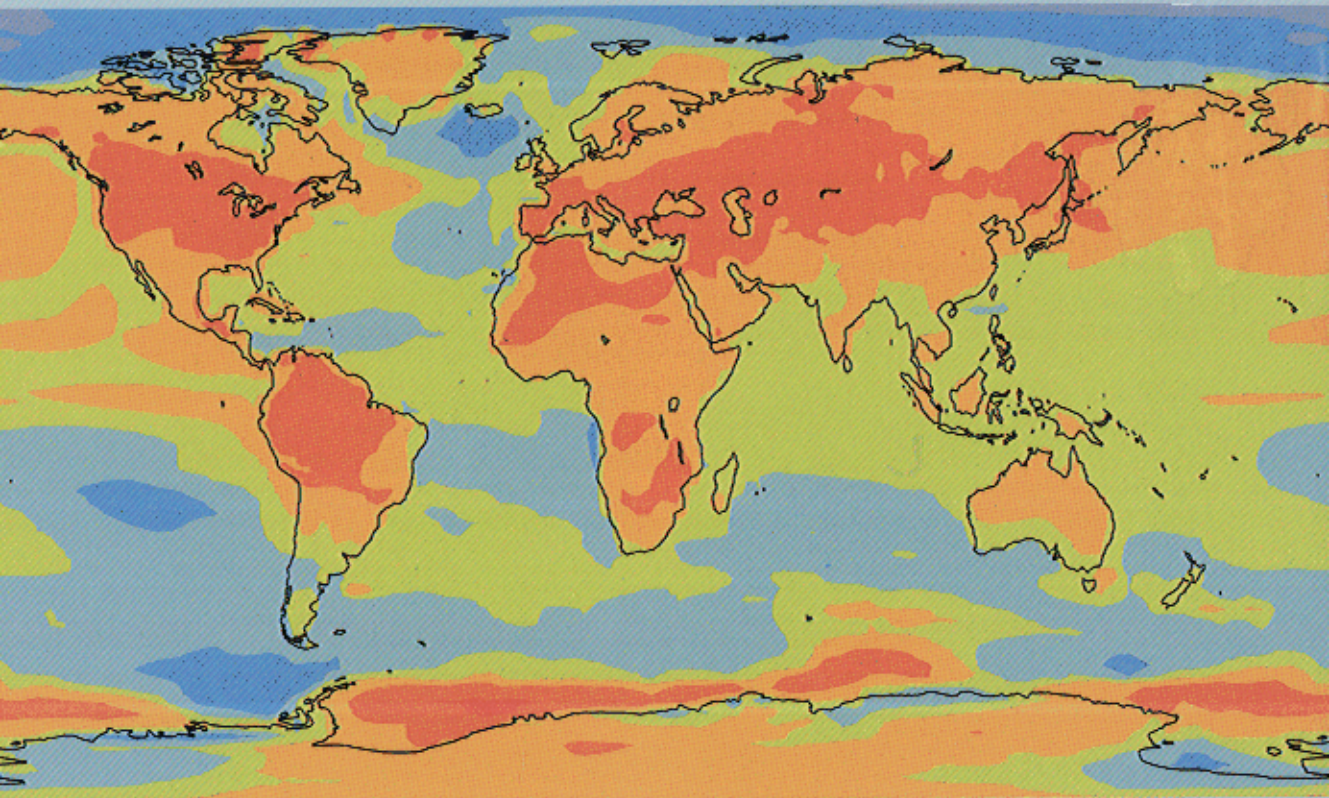


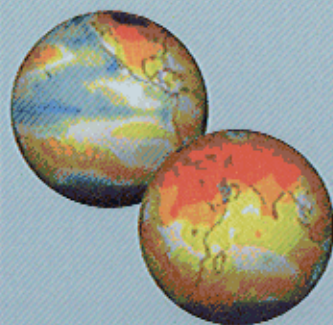
Climate Change

Causes, Effects, and Solutions



John T. Hardy

 WILEY



Contents

Preface, ix

Section I Climate Change – Past, Present, and Future, 1

- 1 Earth and the Greenhouse Effect, 3
 - Introduction*, 3
 - The Greenhouse Effect*, 3
 - Large-Scale Heat Redistribution*, 8
 - Greenhouse Gases*, 11
 - Warming Potentials*, 19
 - Summary*, 20

- 2 Past Climate Change: Lessons from History, 23
 - Introduction*, 23
 - Past Climate Change – Six Historic Periods*, 24
 - Methods of Determining Past Climates and Ecosystems*, 29
 - Rapid Climate Change*, 34
 - Lessons of Past Climate Change*, 35
 - Summary*, 36

- 3 Recent Climate Change: The Earth Responds, 39
 - Introduction*, 39
 - Atmospheric Temperatures*, 40
 - Water Vapor and Precipitation*, 43
 - Clouds and Temperature Ranges*, 43
 - Ocean Circulation Patterns*, 45
 - Snow and Ice*, 46
 - Sea-Level Rise*, 48
 - Animal Populations*, 49
 - Vegetation*, 50
 - Attribution*, 51
 - Summary*, 52

- Future Climate Change: The Twenty-First Century and Beyond, 55
 - Introduction*, 55
 - Global Climate Models*, 56

Feedback Loops and Uncertainties, 60
Scenario-Based Climate Predictions, 67
Regional Climates and Extreme Events, 70
The Persistence of a Warmer Earth, 71
Summary, 73

Section II Ecological Effects of Climate Change, 75

- 5 Effects on Freshwater Systems, 77
Introduction, 77
Surface and Groundwater, 78
Drought and Soil Moisture, 86
Lake and Stream Biota, 86
Human Infrastructure, 89
Wetlands, 89
The Cryosphere, 89
Managing Water, 93
Summary, 95
- 6 Effects on Terrestrial Ecosystems, 99
Introduction, 99
Geographic Shifts in Terrestrial Habitats, 101
Vegetation–Climate Interactions, 107
Effects of Disturbances, 108
Loss of Biodiversity, 109
Implications for Forest Management and Conservation Policy, 112
Summary, 114
- 7 Climate Change and Agriculture, 117
Introduction, 117
Effects of Agriculture on Climate Change, 118
Effects of Climate Change on Agriculture, 120
US Agriculture, 121
Global Agriculture, 123
Summary, 128
- 8 Climate Change and the Marine Environment, 131
Introduction, 131
Sea-Level Rise, 132
Ocean Currents and Circulation, 135
Marine Biogeochemistry, 138
Marine Ecosystems, 140
Summary, 148

Section III Human Dimensions of Climate Change, 151

- 9 Impacts on Human Settlement and Infrastructure, 153
Introduction, 153
Energy, 154
Environmental Quality, 158
Extreme Climatic Events, 159
Human Settlements, 160
Infrastructure, 162
Summary, 167
- 10 Effects of Climate Change on Human Health, 171
Introduction, 171
Direct Effects of Heat Stress, 172
Infectious Diseases, 174
Air Quality, 179
Interactions and Secondary Effects, 181
Summary, 181
- 11 Mitigation: Reducing the Impacts, 187
Introduction, 187
Capture or Sequester Carbon Emissions, 187
Reduce Global Warming or Its Effects by Geoengineering, 188
Enhance Natural Carbon Sinks, 190
Convert to Carbon-Free and Renewable Energy Technologies, 191
Conserve Energy and Use It More Efficiently, 201
Adapt to Climate Change, 206
Taking Action, 206
Summary, 208
- 12 Policy, Politics, and Economics of Climate Change, 211
Introduction, 211
International Cooperation – From Montreal to Kyoto, 212
Meeting Kyoto Targets, 214
Post-Kyoto Developments, 217
The Politics of Climate Change, 220
Kyoto Without the United States, 221
Benefits and Costs of Mitigating Climate Change, 224
The Future – What is Needed?, 227
Summary, 227

Appendixes

- A Units, 231
- B Abbreviations and Chemical Symbols, 233

CONTENTS

- C Websites on Climate Change, 235
 - General*, 235
 - Journal Articles and Literature on Climate Change*, 236
 - Climate Change Education*, 236
 - Websites by Chapter Subject Area*, 236
 - Conservation and Environmental Action Groups*, 240
 - Industry Groups*, 240

- Index, 241