

Contents

Preface to the Eighth Edition *xi*

About the Companion Website *xiii*

1	Introduction	1
1.1	The Development of Ideas	1
1.2	The Anthropocene	5
1.3	The Development of Human Population and Stages of Cultural Development	6
1.4	Hunting and Gathering	10
1.5	Humans as Cultivators and Keepers	12
1.6	Mining and Metals	18
1.7	Modern Industrial and Urban Civilizations	19
1.8	The Great Acceleration	21
1.9	Methods of Study	24
	Guide to Reading	25
2	The Human Impact on Vegetation	27
2.1	Human Impacts on Nature	27
2.2	Vegetation Change: Introduction	28
2.3	The Use of Fire	32
2.4	Fires: Natural and Anthropogenic	34
2.5	Some Consequences of Fire Suppression	34
2.6	Some Effects of Fire on Vegetation	35
2.7	The Role of Grazing	37
2.8	Deforestation	39
2.9	Tropical Forests	40
2.10	The Forest Transition	45
2.11	Secondary Rain Forest	48
2.12	The Human Role in the Creation and Maintenance of Savanna	49
2.13	The Spread of Desert Vegetation on Desert Margins	52
2.14	The Maquis of the Mediterranean Lands	56
2.15	The Prairies and Other Mid-latitude and High-altitude Grasslands	56
2.16	Post-glacial Vegetational Change in Britain and Europe	59
2.17	Lowland Heaths	60
2.18	Introduction, Invasion, and Explosion	61
2.19	Air Pollution and Its Effects on Plants	65
2.20	Forest Decline	67
2.21	Miscellaneous Causes of Plant Decline	70
2.22	The Change in Genetic and Species Diversity	71
2.23	Conclusion: Threats to Plant Life	72
	Guide to Reading	72

3	The Human Impact on Animals	75
3.1	Domestication of Animals	75
3.2	Dispersal and Invasions of Animals	76
3.3	Human Influence on the Expansion of Animal Populations	82
3.4	Causes of Animal Contractions and Decline: Pollution	86
3.5	Habitat Change and Animal Decline	89
3.6	Other Causes of Animal Decline	93
3.7	Animal Extinctions in Prehistoric Times	98
3.8	Modern-day Extinctions	102
	Guide to Reading	108
4	The Human Impact on the Soil	111
4.1	Introduction	111
4.2	Salinity: Natural Sources	112
4.3	Human Agency and Increased Salinity	112
4.4	Irrigation Salinity	113
4.5	Dryland Salinity	114
4.6	Urban Salinity	116
4.7	Inter-basin Water Transfers	116
4.8	Coastal Zone Salinity	116
4.9	Consequences of Salinity	118
4.10	Reclamation of Salt-affected Lands	118
4.11	Lateritization	120
4.12	Accelerated Podzolization and Acidification	121
4.13	Soil Carbon	122
4.14	Soil Structure Alteration	123
4.15	Soil Drainage and its Impact	125
4.16	Soil Fertilization	126
4.17	Fires and Soil Quality	126
4.18	Some Anthrosols Resulting from Agriculture and Urbanization	127
4.19	Soil Erosion: General Considerations	127
4.20	The Causes of Soil Erosion	128
4.21	Forest Removal	129
4.22	Soil Erosion Associated with Grazing	132
4.23	Irrigation and Erosion	132
4.24	Replacement of Grassland by Shrubland in Drylands	133
4.25	Soil Erosion Produced by Fire	133
4.26	Soil Erosion Associated with Construction and Urbanization	134
4.27	Long-term Studies of Rates of Erosion	134
4.28	Peat Bog Erosion	137
4.29	Accelerated Wind Erosion	138
4.30	Soil Conservation	140
4.31	Soils, Microbiology, and the Earth System	143
	Guide to Reading	144
5	The Human Impact on the Waters	145
5.1	Introduction	145
5.2	Deliberate Modification of River Systems Connectivity	146
5.3	Changes in River Flow	154
5.3.1	The Effects of Dams	154
5.3.2	Vegetation Modification and its Effect on River Flow	154
5.3.3	The Role of Invasive Plants	158
5.3.4	Land Drainage	158

5.3.5	Groundwater Exploitation	160
5.3.6	Urbanization and its Effects on River Flow	160
5.4	The Human Impact on Lake Levels	162
5.5	Changes in Groundwater Conditions	168
5.6	Water Pollution	171
5.7	Eutrophication	177
5.8	Pollution by Acid Rain	178
5.9	Deforestation and its Effects on Water Quality	180
5.10	Thermal Pollution	181
5.11	Pollution with Suspended Sediments	182
5.12	Marine Pollution	182
	Guide to Reading	185
6	Human Agency in Geomorphology	187
6.1	Introduction	187
6.2	Landforms Produced by Excavation	188
6.3	Landforms Produced by Construction and Dumping	192
6.4	Ground Subsidence	192
6.5	The Human Impact on Seismicity and Volcanoes	198
6.6	Accelerated Sedimentation	200
6.7	Sediment Transport by Rivers	203
6.8	Deliberate Modification of Channels	205
6.9	Non-deliberate River Channel Changes	208
6.10	Arroyo Trenching and Gullies	213
6.11	Accelerated Mass Movements	216
6.12	Accelerated Weathering and the Tufa Decline	219
6.13	Reactivation and Stabilization of Sand Dunes	220
6.14	Accelerated Coastal Erosion	223
6.15	Changing Rates of Salt Marsh Accretion	229
	Guide to Reading	231
7	The Human Impact on Climate and the Atmosphere	233
7.1	World Climates	233
7.2	The Greenhouse Gases – Carbon Dioxide	235
7.3	Other Gases	236
7.4	Ozone Depletion and Climate Change	239
7.5	Aerosols	239
7.6	Global Dimming and Global Brightening	241
7.7	Vegetation and Albedo Change	242
7.8	Forests, Irrigation, and Climate	244
7.9	The Possible Effects of Water Diversion Schemes	244
7.10	Lakes and Climate	245
7.11	Urban Climates	245
7.12	Deliberate Climatic Modification	250
7.13	Geoengineering	252
7.14	Urban Air Pollution	252
7.15	Air Pollution: Some Further Effects	256
7.16	Stratospheric Ozone Depletion	263
7.17	Conclusions	265
	Guide to Reading	266
8	The Future: Introduction	267
8.1	Introduction	267
8.2	Changes in the Biosphere	271

8.3	Climate and Geomorphology	278
	Guide to Reading	282
9	The Future: Coastal Environments	283
9.1	Introduction	283
9.2	The Steric Effect	284
9.3	Anthropogenic Contributions to Sea-Level Change	284
9.3.1	Reduction in Lake-Water Volumes	284
9.3.2	Water Impoundment in Reservoirs	285
9.3.3	Groundwater Mining	285
9.3.4	Urbanization and Runoff	285
9.3.5	Deforestation and Runoff	285
9.3.6	Wetland Losses	285
9.3.7	Irrigation	286
9.3.8	Synthesis	286
9.4	Permafrost Degradation, Melting of Glaciers, and Sea-Level Rise	286
9.5	Ice Sheets and Sea-Level Rise	286
9.6	How Fast are Sea Levels Rising?	287
9.7	The Amount of Sea-Level Rise By 2100	287
9.8	Land Subsidence	287
9.9	Coral Reefs	289
9.10	Salt Marshes and Mangrove Swamps	292
9.11	River Deltas	296
9.12	Estuaries	297
9.13	Cliffed Coasts	298
9.14	Sandy Beaches	298
9.15	Conclusions	300
	Guide to Reading	300
10	The Future: Hydrological and Geomorphological Impacts	301
10.1	Introduction	301
10.2	Rainfall Intensity	302
10.3	Changes in Tropical Cyclones	302
10.4	Runoff Response	304
10.5	Cold Regions	305
10.6	Changes in Runoff in the UK	307
10.7	Europe	307
10.8	Geomorphological Consequences of Hydrological and Other Changes	309
10.9	Weathering	310
	Guide to Reading	311
11	The Future: The Cryosphere	313
11.1	The Nature of the Cryosphere	313
11.2	The Polar Ice Sheets and Ice Caps	313
11.3	Valley Glaciers and Small Ice Caps	316
11.4	Predicted Rates of Glacier Retreat and Some Environmental Consequences	320
11.5	Sea Ice in the Arctic and Antarctic	322
11.6	Permafrost Regions	323
	Guide to Reading	328
12	The Future: Drylands	329
12.1	Introduction	329
12.2	Climate Changes in the Past	330
12.3	Future Changes in Climate in Drylands	331

12.4	Wind Erosivity and Erodibility	332
12.5	Future Dust Storm Activity	333
12.6	Sand Dunes	334
12.7	Rainfall and Runoff	337
12.8	Lake Levels	338
12.9	Sea-level Rise and Arid-zone Coastlines	338
12.10	Salt Weathering and Salinization	339
	Guide to Reading	340
13	Conclusion	341
13.1	The Power of Non-industrial and Pre-industrial Civilizations	341
13.2	The Proliferation of Impacts	342
13.3	The Inter-relationships of Changes in the Earth System	346
13.4	Human Impacts on the Environment in China	348
13.5	Are Changes Reversible?	349
13.6	The Susceptibility to Change	354
13.7	Human Influence or Nature?	356
13.8	Global Warming and Other Pressures	357
13.9	Into the Unknown	358
	Guide to Reading	359
	References	361
	Index	451