

## Table of Contents

1	The	Atmosphere and its Attributes	1
	1.1	Origination of Atmosphere	1
	1.2	Composition of Atmosphere	2
		1.2.1 The Orbit of Atmosphere	4
	1.3	The Compulsion and Compression of Air	5
	1.4	The Concept of Heat and Mass Transmission	7
		1.4.1 Adiabatic Variation in Heat and Temperature	8
		1.4.2 Air and Water Vapor	8
	1.5	Heat Layering and Composition of Atmosphere	11
	1.6	The Atmospheric Global Circulation	14
		1.6.1 The Matrix of Walker Cell	17
	1.7	References	19
2	The	Global Ocean	20
	2.1	Ocean: A Basin of Climate	20

	2.2	Water a	and its Properties	22
		2.2.1	Heat Capacity: Balance of Temperature by	
			the Oceans	22
		2.2.2	Water Bodies: The "Dissolving Agent" and	
			their Composition	25
		2.2.3	Salinity of Sea Water and its Variations	27
		2.2.4	Correlation of Density	28
	2.3	The Oc	eans of Earth and their Accumulation	29
	2.4	Ocean	Surface and the Flow of Current	32
		2.4.1	Periphery of Current: Eastern and Western	
			Boundaries	33
	2.5	Flow of	Ocean Water across the Planet	35
	2.6	The Mo	otion of Water Cycle	40
	2.7	Referer	nces	41
3	Asso	ociation	of Ocean and Air	42
	3.1	An Ove	erview of Ocean-air Association	42
	3.2	Ocean-	-air Interactions and their Exchange Mechanism	43
		3.2.1	Ocean-atmosphere and Sulfur Transposition	44
		3.2.2	Ocean-atmosphere and Carbon Transposition	45
		3.2.3	Reaction of Air-sea	45
	3.3	El Nino	Southern Oscillation	46
		3.3.1	Ocean-atmosphere Interaction	50
		3.3.2	Evaluation of the El Nino	51
		3.3.3	Global Temperature and its Effects	52
		3.3.4	El Nino: Climatic impacts	53
		3.3.5	Tropical Cyclone activity and El Nino	54
		3.3.6	El Nino and its Socio-economic Impacts	54
		3.3.7	Climate Forecast	56
	3.4	Modes	of Ocean-air Variability	57
		3.4.1	Pacific North American Pattern	57
		3.4.2	North Atlantic Oscillations	58
		3.4.3	Indian Ocean Dipole (IOD)	59
		3.4.4	Tropical Atlantic Variability (TAV)	61
		3.4.5	Arctic Oscillation	62
		3.4.6	Antarctic Oscillation	63
	3.5	Referer	nces	64

viii

Tab	le of C	Contents	ix
4	Carb	oon Cycle and Carbon Reservoirs	65
	<ul> <li>4.1</li> <li>4.2</li> <li>4.3</li> <li>4.4</li> <li>4.5</li> <li>4.6</li> <li>4.7</li> <li>4.8</li> <li>4.9</li> </ul>	The Carbon Cycle and its Mechanism 4.1.1 The Slow Carbon Cycle 4.1.2 The Fast Carbon Cycle 4.1.3 Alteration in the Carbon Cycle 4.1.4 Ocean and its Acidification Vagueness in the Carbon Cycle 4.2.1 Contribution of Atmosphere 4.2.2 Contribution of Land An Overview of the Carbon Cycle Utilization of Carbon Dioxide: Rescuing the Carbon Cycle Carbon Dioxide-Enhanced Oil Recovery Usage of Carbon Dioxide by Next Generation Technical Challenges Looking for Solutions References	66 66 70 72 74 75 75 78 80 82 83 84 83 84 85 86 87
5	Radi Char	ation Balance: A Scientific Framework for Climate	88
	5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8	An Overview of Radiation Balance 5.1.1 Balance of Net Radiation 5.1.2 Planetary Albedo 5.1.3 Outgoing Long Wave Radiation Management of the Balance Electromagnetic Radiation Greenhouse effect Earth's Radiation Balance Geographical and Seasonal Variations in Energy Balance Influence of Atmosphere References	88 89 90 91 92 93 96 98 102 104
6	Clim	ate System and its Attributes	105
	6.1 6.2 6.3 6.4 6.5 6.6	An Overview of the Climatic Framework System of Earth's Climate Climatic Forcing Balance of Radiation Forcing Factors of Combined Greenhouse Gases Aerosols	105 106 108 109 110 112

х		Clima	ate Change
	6.7 6.8 6.9 6.10	<ul> <li>6.6.1 Sulfate Aerosols</li> <li>6.6.2 Fossil Fuel Black Carbon Aerosol</li> <li>Alteration in the Land-use</li> <li>Framework of Climate Forcing</li> <li>Strength and Weakness of the Forcing Concept</li> <li>References</li> </ul>	113 115 116 119 121 123
7	Hist	ory of Climatic System	124
	7.1 7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.9 7.10 7.11	Origination of Climate An Outlook of the Ice Age Study of Paleoclimatology Earth's Orbital Attributes and Milankovitch Matrix 7.4.1 Study of Heliocentrism 7.4.2 An Outlook of the Orbit and its Events 7.4.3 Earth and the Orbit 7.4.4 Milankovitch Theory Five Million Years of Climate One Hundred Thousand Years of Climate Change A Lesson from the Distant Past: The Paleocene-eo Thermal Maximum Effects of PETM Causes Retrieval References	124 126 127 128 129 129 130 130 132 134 cene 137 137 138 140 141
8	Hist	ory of Mankind and Climatic Changes	142
	8.1 8.2 8.3 8.4	History of Mankind An Outlook of Climatic Changes Climate Proxies 8.3.1 Importance of Paleoclimatology Early to Mid Holocene Climate Change and Human Development 8.4.1 Agriculture 8.4.2 America 8.4.3 Sub-Saharan Africa 8.4.4 East Asia	142 144 148 151 152 153 155 155 156
	8.5 8.6	Rise and Fall of Civilizations References	157 160

Table of Contents			
9	Observation of the Change		
	9.1 9.2 9.3 9.4 9.5 9.6 9.7	Beginning of the Change A Century of Warming Precipitation and Drought Constraints of the Water Resources Severe Storms and Other Extreme Events The Sensitive Arctic References	161 166 168 171 175 179 180
10	Gree	enland, Antarctica and Sea-level Rise	181
	10.1 10.2 10.3 10.4 10.5 10.6 10.7 10.8	An Overview of the Arctic Regions Sea Level Rise and the Contributing Factors Ocean Warming Impact of Sea Level Rise The Greenland Ice Sheet The Antarctic Ice Sheet Future Sea Level Rise References	181 182 186 186 187 189 191
11	Clim	atic Matrix and the Future	197
	11.1 11.2 11.3	<ul> <li>A Framework of the Climatic Matrix</li> <li>11.1.1 Mechanism of Climatic Matrix</li> <li>11.1.2 Testing of Climatic Matrix</li> <li>Peering into the Future</li> <li>Responding to our Climate's Future</li> <li>11.3.1 The Copenhagen Diagnosis</li> <li>11.3.2 Harsh Consequences of the 'Small Decisions'</li> </ul>	197 198 198 200 202 203 205
	11.4	<ul> <li>11.3.2 Change for the Better</li> <li>Response towards Climate Changes</li> <li>11.4.1 Climate Change</li> <li>11.4.2 Global Warming and Climate Changes</li> </ul>	205 205 206 207 207
	11.5	<ul> <li>11.4.3 Manking and Climate</li> <li>Cognitive Preparation for an Altering Climate</li> <li>11.5.1 Greenhouse Gases</li> <li>11.5.2 Regulation of Climatic Change: Meeting</li> <li>Energy Needs</li> </ul>	209 210 211
	11.6	Role of NASA in the Regulation of Climate Change	212

xii		Climate Change
11.7 11.8	Steps to Adapt to Climate Change References	215 217
12 Clim	ate Change Risk in an Unknowable Future	218
12.1	Emission Uncertainties	218
12.2	Climate Risk	222
12.3	Climate Change and Human Strife	226
	12.3.1 Rising Sea Level and Coastal Region	227
	12.3.2 Dangerous Seaways	228
	12.3.3 Fish and Food Security	228
	12.3.4 Migration	228
12.4	12.3.5 Water Weaponization	229
12.4	12.7.1 The Greenhouse Effect	229
	12.4.1 Warming of Farth	229
	12.4.3 The Climate System Exhibits Variabilit	z jo
	of Nature	232
	12.4.4 The Rising Level of GHG Emissions an	d
	Concentration	233
	12.4.5 Association of the Human Activities w	vith
	the Net Effect of Warming on Climate	235
	12.4.6 Feedback Process in Climate System	236
	12.4.7 Freshwater Resources	236
	12.4.8 Ecosystem and Biodiversity	238
12.5	References	238
13 Futu	ire of Energy	239
13.1	Energy Dynamics	239
13.2	Outline of the Global Sphere	242
13.3	Coal and its Attributes	244
	13.3.1 Detriments of Burning Coal	245
13.4	Bridge Fuel: Consumption of Natural Gas	247
13.5	wind Energy and Solar Energy The Nuclear Dewer Diant	250
13.0	Hydropower	253 255
יכי 12 פ	References	∠ <u>,</u> 260
15.0		200
Index		261