



World Survey of Climatology Volume 12

Climates of Central and South America

edited by

Werner SCHWERDTFEGER

Department of Meteorology

University of Wisconsin

Madison, Wisc. (U.S.A.)



ELSEVIER SCIENTIFIC PUBLISHING COMPANY
Amsterdam-Oxford-New York 1976

Contents

Chapter 1. INTRODUCTION

by W. SCHWERDTFEGER

The atmospheric circulation over Central and South America	1
References	11

Chapter 2. THE CLIMATE OF ARGENTINA, PARAGUAY AND URUGUAY

by F. PROHASKA

Introduction	13
Wind	13
The westerlies of the mid-latitudes (Patagonia and Tierra del Fuego)	14
Wind direction, 14—Wind velocity, 15	
The wind regime of the subtropical high-pressure systems	17
Area of influence of the Pacific anticyclone with prevailing southerly winds, 17—	
Area of influence of the Atlantic anticyclone with prevailing northeasterly winds, and easterlies and southeasterlies, 18	
The wind regime of the continental subtropical low	21
The wind regime of the cordillera and the Altiplano	22
Cloudiness	23
Western Paraguay, northwestern Argentina: maximum in summer and minimum in winter	25
Uruguay, Argentine mesopotamia, pampa and the eastern Chaco: small annual range with maximum in winter	27
Central and eastern Paraguay, western Chaco, southern pampean sierras: double annual wave	28
Cuyo: small annual range and low degree of cloudiness	28
Patagonia	30
Relation between cloudiness and number of clear and cloudy days	31
Duration of sunshine	32
East puna	33
The northwestern provinces	34
Chaco and central Argentina	35
Argentine-Uruguayan mesopotamia, La Pampa, Cuyo and Patagonia	35
Tierra del Fuego	35
Global radiation	36

Contents

Temperature	36
Annual averages	37
Monthly averages	37
Vertical temperature gradient	38
Annual variation	43
Daily variation	44
Maximum temperatures	47
Minimum temperatures	48
Soil temperatures in Argentina	49
Humidity	50
Vapor pressure	50
Relative humidity	54
Evaporation	56
Precipitation	57
Tropical regime with a single maximum	60
Continental summer rains of the subtropics	62
Transitional zone to the maritime winter rains of the subtropics	63
The winter rains of the temperate latitudes	64
The uniform rainfall distribution throughout the year of the subpolar region	65
Rainfall variability	66
Days with precipitation	67
Thunderstorms	69
Appendix—Climatic tables	70
References	71
General climatic descriptions, data, bibliographies	71
Special regions and elements	72

Chapter 3. THE CLIMATE OF CHILE

by A. MILLER

Introduction	113
The arid north	117
Central Chile	122
Southern Chile	125
Appendix—Climatic tables	129
References	129

Chapter 4. THE CLIMATE OF PERU, BOLIVIA AND ECUADOR

by A. M. JOHNSON

Introduction	147
Precipitation	150
General	150
Eastern lowlands	155

Andes—eastern slopes	156
Andes—central	157
Andes—western slopes	164
Coastal plain and islands	165
Temperature	172
General	172
Eastern lowlands	175
Andes—eastern slopes	176
Andes—central	176
Andes—western slopes	178
Coastal plain and islands	179
Radiation, sunshine and cloudiness	182
Surface winds	185
Acknowledgements	188
Appendix I—Dynamic and energetic factors which cause and limit aridity along South America's Pacific coast (by H. H. Lettau)	188
Appendix II—High thunderstorm frequency over the subtropical Andes during the summer; cause and effects (by W. Schwerdtfeger)	192
Appendix III—The water-budget of Lake Titicaca (by W. Schwerdtfeger)	195
Appendix IV—Station pressure values vs. elevation of places in the high mountains (by W. Schwerdtfeger)	199
Appendix V—Climatic tables	199
References	200

Chapter 5. THE CLIMATE OF BRAZIL

by L. R. RATISBONA

Introduction	219
Climatic factors	219
Latitude	220
Relief	220
Nature of the surface	221
Pressure centres	222
Air masses	225
Climatic elements	226
Winds	226
Cloudiness	229
Duration of sunshine	230
Distribution, 230—Annual variation, 232	
Temperature	232
Average temperature, 233—Maximum temperatures, 236—Minimum temperatures, 237—Anomaly in temperature, 237—Annual variation, 238—Annual range, 240—Continentality, 240—Daily variation, 240—Day to day variation, 241—Warm days and nights, 242	
Moisture	242

Vapour pressure, 242—Relative humidity, 244	244
Precipitation	244
Distribution, 245—Number of days, 245—Average intensity, 245—Maximum intensity, 248—Regimes, 248—Variability, 251	
Thunderstorms	251
Fog and haze	253
Climatic types	255
Regional characteristics	260
Some problems	264
The droughts of the northeast	264
Rains in the interior of tropical Brazil	265
The rains of the east coast	266
Acknowledgements	267
Appendix—Climatic tables	267
References	267
Additional references	269

Chapter 6. THE CLIMATE OF NORTHERN SOUTH AMERICA

by J. W. SNOW

Preliminary remarks	295
The area and climate in general	295
Chapter outline and terminology	298
French Guiana	299
Geography	299
Climate	300
General features and controls, 301—Rainfall, 302—Other elements, 305	
Surinam	305
Introduction and geography	305
Climate	307
Precipitation, 307—Diurnal distribution of rainfall, 309—Pressure and wind, 312—Storms, 313—Temperature, 314	
Guyana	321
Geography	321
Climate	322
Rainfall, 322—Other climatic elements, 325	
Venezuela	326
Introduction and geography	326
General climatic factors and climate types	327
Solar radiation, 327—Large scale circulation, 328—Climate types, 329	
Precipitation	329
Basic annual distributions, 329—Annual totals, areal apportionment, 330—North and west section, 332—Llanos, 333—Llanos pattern, 334—Guyana Highlands, 337	
Temperature	338

Dependences, 338—Areal means, 340—Basic patterns, 341—Hourly distribution, 342	342
Rainfall producers	344
Percent of rainfall per rain-day, 344—Northern Hemisphere disturbances, 345—Southern Hemisphere disturbances, 346—Equatorial trough disturbances, 346	345
South Caribbean dry zone	348
Extent and characteristics, 348—Cause(s), 351—Dry zone résumé, 357	348
Colombia	358
Introduction	358
Caribbean lowland section	360
Andes section	360
Geography, 361—Rainfall, 362—Other climatic elements, 366	366
Llanos section	368
Amazon section	369
Pacific coast section	370
Excessive rainfall, 370—Geography, 371—Climate, 371—Factors effecting the raininess, 375	370
Recapitulation	376
Appendix—Climatic tables	376
References	376
Other references and additional data sources	379

Chapter 7. THE CLIMATE OF CENTRAL AMERICA

by W. H. PORTIG

The climatological elements	405
Wind	405
Barometric pressure	410
Cloudiness	412
Sunshine	414
Temperature	414
Annual variation of temperature, 415—Temperature variation with altitude, 416—Diurnal temperature variation, 417	415
Moisture	417
Rainfall	418
Introduction, 418—Sea, 419—Central America, 424—Islands near Central America, 432—Annual rainfall totals of islands other than those near Central America, 433—Puerto Rico and the Lesser Antilles, 438	418
Thunderstorms	445
Visibility	446
Weather	447
Introduction	447
“Grosswetterlagen”	447
Local developments	448
Appendix—Climatic tables	451

References	451
 <i>Chapter 8. CLIMATOLOGY OF ATLANTIC TROPICAL STORMS AND HURRICANES</i> by M. A. ALAKA	
Classification of disturbances in the tropics	479
Sources of information	479
Hurricane formation	480
The birthplace of Atlantic hurricanes	480
Availability of latent energy, 483—Vorticity due to earth's rotation, 485	
Frequency of Atlantic hurricanes	489
Seasonal variation, 489—Secular variations and trends, 495	
Hurricane motion	496
Types of storm movements	496
Persistence and recurvature	497
Tropical cyclones affecting the United States	498
Structural aspects and related phenomena	500
The wind field	500
The pressure field	500
Rainfall and floods	501
The storm surge	505
Hurricane tornadoes	506
Acknowledgement	507
References	507
REFERENCE INDEX	511
GEOGRAPHICAL INDEX	517
SUBJECT INDEX	529