



HANDBUCH  
DER  
KLIMATOLOGIE

Band 2

---

Teile J<sub>1</sub>-K

# Handbuch der Klimatologie

in fünf Bänden

Verfaßt von Prof. E. Alt, Dresden; Prof. L. Berg, Leningrad; Dr. B. J. Birkeland, Oslo; Dr. W. Borchardt †, Hamburg; Dr. C. Braak, De Bilt; Prof. Ch. F. Brooks, Blue Hill (Mass.); Prof. G. Castens, Hamburg; A. J. Connor, Toronto; Prof. V. Conrad, Wien; G. W. Cox, Pretoria; Dr. N. J. Föyn, Oslo; Dr. S. Fujiwhara, Tokio; Prof. R. Geiger, München; Prof. A. Kaminskij, Leningrad; Dr. E. Kidson, Wellington; Prof. K. Knoch, Berlin; Prof. W. Köppen, Graz; Prof. E. Kuhlbrodt, Hamburg; Dr. F. Loewe, Cambridge (Engl.); Prof. W. Meinardus, Göttingen; Prof. M. Milankovitch, Belgrad; Dr. C. W. B. Normand, Poona; Prof. T. Okada, Tokio; H. Petersen, Kopenhagen; C. L. Robertson, Salisbury; E. Rubinstein, Leningrad; Prof. K. Sapper, Garmisch; N. P. Sellick, Salisbury; Dr. W. Semmelhack, Hamburg; Prof. H. U. Sverdrup, Bergen; Prof. T. Gr. Taylor, Chicago; Prof. O. Tetens, Lindenberg; Prof. A. Wagner, Innsbruck; Sir Gilbert T. Walker, Cambridge (Engl.); Prof. R. DeC. Ward †, Cambridge (U. S. A.); Prof. K. Wegener, Graz; Prof. L. Weickmann, Leipzig.

Herausgegeben von

**W. Köppen, Graz und R. Geiger, München**

---

---

Band II, Teil J

## The Climates of North America

by

**Professor Robert DeC. Ward †**

Harvard University, Cambridge, Mass.,

**Professor Charles F. Brooks**

Blue Hill Meteorological Observatory

Harvard University, Milton, Mass.

and

**A. J. Connor, M. A.**

Meteorological Service of Canada, Toronto

Berlin 1936

KRAUS REPRINT

Nendeln/Liechtenstein

1972

# Table of Contents

## Physical Features of North America

	Page
A. General Description . . . . .	1
B. Controls of North American Climates . . . . .	3
1. General Position. — 2. Mountain Barriers. — 3. Water Bodies. — 4. Altitude. — 5. Centers of Action. — 6. Ocean Currents. — 7. Prevailing Winds.	
C. General Remarks on the Climates of North America . . . . .	6

### 1. Mexico

A. General	
1. Introduction . . . . .	8
2. The major controls of Mexican climates . . . . .	9
3. The larger climatic subdivisions . . . . .	10
4. Frequencies of weather types . . . . .	11
5. Sharp contrasts in short distances . . . . .	11
B. Temperature	
6. Mean annual temperatures: thermal regions . . . . .	13
7. Mean monthly temperatures . . . . .	14
8. Mean annual range of temperature . . . . .	16
9. Mean annual maximum and mean annual minimum temperature . . . . .	16
10. Daily range . . . . .	17
11. Classification of temperature types . . . . .	17
C. Pressure and winds	
12. General pressure distribution . . . . .	21
13. The prevailing winds . . . . .	21
14. Hot winds . . . . .	25
15. The norther. . . . .	25
16. Hurricanes . . . . .	27
D. Rainfall	
17. Mean annual rainfall . . . . .	28
18. Rainfall seasons . . . . .	29
19. Rainfall types . . . . .	30
20. Number of rainy days . . . . .	37
21. Maximum rainfall in 24 hours . . . . .	37
22. Days with snowfall . . . . .	37
E. Humidity	
23. Relative humidity. . . . .	38
24. Wet-bulb temperatures . . . . .	38
25. Evaporation . . . . .	38
F. Sunshine, Cloudiness and Fog	
26. Sunshine . . . . .	38
27. Cloudiness . . . . .	39
28. Fog . . . . .	39
G. Thunderstorms	
29. Thunderstorms . . . . .	40
30. Hail . . . . .	40

	Page
H. Climate and Vegetation	
31. Climate, natural vegetation and crops . . . . .	40
32. A naturalist's journey from coast to Orizaba . . . . .	42
I. Climate and Population	
33. Climatic controls over the distribution of population . . . . .	44
J. KÖPPENS Climatic Provinces . . . . .	45
K. Tables	
Explanatory notes on tables . . . . .	47
Table 1. Temperature and rain . . . . .	49
" 2. Annual amounts of rainfall (supplementary stations) . . . . .	58
" 3. Atmospheric pressure (reduced to 0° C and 45° lat.) . . . . .	59
" 4. Percentage frequency of wind directions . . . . .	60
" 5. Relative humidity . . . . .	61
" 6. Wet-bulb temperatures . . . . .	61
" 6a. Evaporation . . . . .	62
" 7. Cloudiness . . . . .	63
" 8. Clear days . . . . .	63
" 9. Cloudy days . . . . .	64
" 10. Days with fog . . . . .	64
" 11. Days with any precipitation . . . . .	64
" 12. Days with snowfall . . . . .	65
" 13. Days with hail . . . . .	66
" 14. Days with thunderstorms . . . . .	67
" 15. Days with strong wind (gale) . . . . .	67
" 16. Frost days . . . . .	68
" 16a. Days with frost . . . . .	68
" 17. Ice days . . . . .	69
" 18. Sunshine: Hours and percent of the possible . . . . .	69
" 19. Ground temperature . . . . .	69
" 22. Temperature departures 1878—1927 . . . . .	70
" 23. Pressure departures 1878—1927 . . . . .	71
" 24. Annual precipitation totals 1878—1927 . . . . .	73
" 24a. Annual precipitation totals 1855—1875 . . . . .	74
" 25. Alphabetical list of stations . . . . .	74
L. Bibliography . . . . .	76

## 2. The United States

A. Introduction . . . . .	80
B. The Larger Climatic Provinces . . . . .	83
C. Temperature . . . . .	84
1. The Larger Temperature Relations . . . . .	87
2. Sea-level Isotherms . . . . .	88
3. January Temperatures . . . . .	90
4. July Temperatures . . . . .	94
5. Mean Annual Ranges of Temperature . . . . .	97
6. Types of Annual Course of Temperature . . . . .	97
a) Eastern and Gulf Provinces. — b) Plains Province. — c) Plateau Province. — d) Pacific Province (Interior Valley). — e) Pacific Province.	
7. The Advent of Spring . . . . .	99
8. The Coming of Autumn . . . . .	99
9. The Temperature Gradients and Their Economic Significance . . . . .	99
10. Ice in Lake Ports and Northern Rivers . . . . .	101
11. The Mean Departures of the Monthly Mean Temperatures . . . . .	103
12. Absolute Range of Mean Monthly Temperatures . . . . .	103
13. Unusual Seasons; Persistent Irregularities within Seasons . . . . .	103
14. Absolute Maximum and Minimum Temperatures . . . . .	104
15. Mean Annual Maximum Temperatures . . . . .	105
16. Mean Annual Minimum Temperatures . . . . .	105
17. Absolute Range of Annual and Monthly Maxima and Minima . . . . .	108
18. Diurnal Range of Temperature . . . . .	108
19. Mean Interdiurnal Variability of Temperature . . . . .	109

	Page
20. Frost . . . . .	109
21. Average Number of Days without Killing Frost . . . . .	110
22. Minimum Temperatures Below Freezing . . . . .	112
23. Days with Temperatures Continuously Below Freezing . . . . .	112
24. Thermal Belts. . . . .	112
25. Soil Temperatures . . . . .	112
D. Pressure and Winds	
1. General. . . . .	115
2. Station Pressures . . . . .	120
3. Wind Velocity . . . . .	121
4. Days with Gales . . . . .	123
5. Cyclonic and Anticyclonic Tracks: Weather Types . . . . .	123
6. Cold Waves . . . . .	126
7. Blizzards . . . . .	128
8. The Texas Norther . . . . .	128
9. Dust and Sand Storms . . . . .	129
10. Hot Waves . . . . .	130
11. Indian Summer . . . . .	132
12. Hot Winds . . . . .	132
13. Chinook Winds . . . . .	134
14. Mountain and Valley Winds . . . . .	135
15. Land and Sea Breezes . . . . .	136
16. Upper Winds . . . . .	137
E. Rainfall	
1. Mean Annual Rainfall . . . . .	137
2. Rainfall Types and Seasons . . . . .	141
a) Missouri. — b) Ohio. — c) New England. — d) Atlantic. — e) Tennessee.	
— f) Florida. — g) North Gulf Coast. — h) Texas Coast. — i) Texas Interior.	
— j) Eastern Rocky Mountain Foothills. — k) New Mexican. — l) North	
Plateau. — m) South Plateau. — n) North Pacific. — o) South Pacific.	
3. Monthly and Seasonal Rainfall . . . . .	146
4. Annual and Monthly Variability of Rainfall . . . . .	146
5. Number of Rainy Days . . . . .	153
6. Probability of Rainy Days . . . . .	154
7. Consecutive Days With and Without Precipitation . . . . .	154
8. Droughts . . . . .	154
9. Hourly Frequency of Rainfall . . . . .	156
10. Heavy Rainfalls in Short Periods . . . . .	156
11. Snowfall . . . . .	158
12. Sleet and Ice Storms . . . . .	160
F. Humidity and Evaporation	
1. Humidity. . . . .	161
2. Evaporation . . . . .	163
3. Sensible Temperatures . . . . .	164
G. Sunshine, Cloudiness, and Fog	
1. Sunshine . . . . .	165
2. Cloudiness . . . . .	167
3. Fog . . . . .	169
H. Thunderstorms and Tornadoes	
1. Thunderstorms . . . . .	170
2. Lightning . . . . .	171
3. Hail. . . . .	172
4. Tornadoes . . . . .	172
I. Climatology of the Free Air . . . . .	175
J. General Description of the Climates of the United States	
1. The Eastern Portion . . . . .	177
2. The Gulf Climatic Province . . . . .	179
3. The Plains Province . . . . .	180
4. The Plateau Province . . . . .	181
5. The Pacific Coast . . . . .	182
K. Climate and Health . . . . .	184
1. The Eastern United States . . . . .	185
2. The Western Mountain and Plateau Region . . . . .	186
3. The Pacific Coast . . . . .	186

	Page
L. Climate and Crops	
1. General: Agricultural Regions . . . . .	186
2. Climatic Limitations of the Principal Crops . . . . .	188
M. KÖPPEN'S Climatic Provinces . . . . .	190
N. Explanatory Notes on Tables . . . . .	195
O. Tables	
Table 1. Temperature and Precipitation . . . . .	198
" 1a. Precipitation: Supplementary Stations in Western United States . . . . .	228
" 2. Annual Amounts of Precipitation . . . . .	229
" 3. Mean Pressure . . . . .	232
" 4. Percentage Frequency of Wind Direction . . . . .	234
" 5. Mean Relative Humidity at Local Noon . . . . .	241
" 6. Mean Wet-Bulb Temperature at Local Noon . . . . .	243
" 7. Cloud Amount, Daylight Hours . . . . .	244
" 8. Clear Days . . . . .	245
" 9. Cloudy or Overcast Days . . . . .	246
" 10. Days with Dense Fog . . . . .	246
" 11. Days with Precipitation of 0.25 mm or more (and Maximum Precipitation in 24 Hours) . . . . .	248
" 12. Days with Snowfall (and Days with Snow Cover) . . . . .	251
" 13. Days with Hail . . . . .	253
" 14. Days with Thunderstorms . . . . .	254
" 15. Days with Gales . . . . .	256
" 16. Frost Days (Minimum Temperature below Freezing) . . . . .	257
" 17. Ice Days (Maximum Temperature below Freezing) . . . . .	258
" 18. Mean Duration of Sunshine, in Hours . . . . .	259
" 18a. Percentage of Possible Sunshine . . . . .	259
" 19. Soil Temperatures (See also Tables C to H in Text) . . . . .	260
" 20. Daily Course of Cloudiness . . . . .	261
" 20a. Daily Course of Wind Velocity (m/s) . . . . .	263
" 20b. Daily Course of Wet-Bulb Temperature . . . . .	265
" 21. Temperature Departures from the Means: New Haven, Conn., Charleston, S. C. . . . .	266
" 22. Temperature Departures from the Means: St. Paul, Minn., St. Louis, Mo., Portland, Ore., San Diego, Calif. . . . .	271
" 23. Station Pressure Departures from the Means: New Haven, Conn., Charleston, S. C., St. Paul, Minn., St. Louis, Mo., Portland, Ore., San Diego, Calif. . . . .	276
" 24. Annual Precipitation Departures from the Means . . . . .	283
" 25. Alphabetical List of Stations . . . . .	284
Tables in the Text:	
Table A. Ice in Lake Ports . . . . .	102
" B. Ice in River Ports . . . . .	102
" C. Soil Temperatures, Bozeman, Montana . . . . .	113
" D. Soil Temperatures, Davis, California . . . . .	113
" E. Soil Temperatures, Purdue, Indiana . . . . .	114
" F. Soil Temperatures, Santa Catalina Mountains, Arizona . . . . .	114
" G. Soil Temperatures, Corvallis, Oregon . . . . .	114
" H. Soil Temperatures, East Lansing, Michigan . . . . .	115
" I. Evaporation . . . . .	164
P. United States Bibliography . . . . .	289

### 3. Alaska

A. Introduction. Factors controlling Alaska's climates . . . . .	304
B. Climatic provinces . . . . .	305
1. Pacific coast and islands . . . . .	305
2. Bering Sea coast and islands . . . . .	308
3. Arctic coast . . . . .	308
4. The interior . . . . .	309
C. Climatic areas according to KÖPPEN'S classification . . . . .	310

	Page
D. Tables	
Table 1. Temperature and rainfall . . . . .	312
" 2. Annual amounts of precipitation . . . . .	316
" 3. Mean pressure (corrected for temperature and reduced to lat. 45, but not to mean sea level) . . . . .	316
" 4. Percentage frequency of wind direction . . . . .	316
" 5. Relative humidity (%) . . . . .	317
" 7. Cloud amount (0—10) . . . . .	317
" 8. Clear days . . . . .	318
" 9. Cloudy or overcast days . . . . .	318
" 10. Days with fog . . . . .	319
" 11. Days with precipitation and maximum precip. in any 24 hours (mm) . . . . .	319
" 12. Days with snowfall . . . . .	319
" 14. Days with thunderstorms . . . . .	320
" 16. Frost days (minimum temperature below freezing) . . . . .	320
" 17. Ice days (maximum temperature below freezing) . . . . .	321
" 20. Temperature departures from the mean of the period . . . . .	321
" 23. Station pressure departures from the mean of the period . . . . .	323
" 24. Annual precipitation . . . . .	324
" 25. Alphabetical list of stations . . . . .	325
E. Bibliographic references . . . . .	326
<b>4. Canada</b>	
Foreword . . . . .	331
Meteorological Observations in Canada . . . . .	332
General Remarks on the Observational Data . . . . .	335
A. The Climate of British North America	
1. Topography and Agricultural Regions . . . . .	337
a) The Cordilleran Region . . . . .	338
b) The Great Plains . . . . .	338
c) The Canadian Shield . . . . .	341
d) The St. Lawrence Lowland . . . . .	342
e) The Appalachian Region . . . . .	342
2. General Features of the Climate . . . . .	344
a) Latitude and Climate . . . . .	344
b) Topography and Climate . . . . .	345
c) Atmospheric Pressure and Modification . . . . .	351
B. Regional Climates	
1. The Pacific Coast and the Cordilleran Valleys . . . . .	357
2. The Prairies . . . . .	359
3. Ontario . . . . .	364
4. Quebec . . . . .	369
5. The Atlantic Provinces . . . . .	371
6. The Northern Regions . . . . .	374
C. Upper Air Temperatures . . . . .	375
D. Earth Temperatures . . . . .	376
E. Tables.	
Table 1. Temperature and Rain . . . . .	377
" 2. Annual Precipitation . . . . .	392
" 3. Mean Station Pressure . . . . .	398
" 4. Percentage Frequency of Wind Direction . . . . .	399
" 4a. Percentage in Cordilleran Region . . . . .	403
" 5. Mean Relative Humidity . . . . .	405
" 6. Cloudiness in Percent . . . . .	405
" 7. Average No of Clear Days . . . . .	406
" 8. Average No of Cloudy Days . . . . .	407
" 9. Days with Fog . . . . .	407
" 10. Days with Precipitation . . . . .	408
" 11. Days with Snow . . . . .	409
" 12. Days with Gales . . . . .	410
" 13. Duration of Bright Sunshine . . . . .	411
" 14. Toronto Mean Temperatures . . . . .	412
" 15. Pressure Departures: Toronto, Winnipeg, Halifax, Victoria . . . . .	414
" 16. Annual Precipitation . . . . .	418
" 17. Alphabetical List of Stations . . . . .	422



# Handbuch der Klimatologie

## in fünf Bänden

Verfaßt von Prof. E. Alt, Dresden; Prof. L. Berg, Leningrad; Dr. B. J. Birkeland, Oslo; Dr. W. Borchardt †, Hamburg; Dr. C. Braak, De Bilt; Prof. Ch. F. Brooks, Blue Hill (Mass.); Prof. G. Castens, Hamburg; A. J. Connor, Toronto; Prof. V. Conrad, Wien; G. W. Cox, Pretoria; Dr. N. J. Föyn, Oslo; Dr. S. Fujiwhara, Tokio; Prof. R. Geiger, München; Prof. A. Kaminskij, Leningrad; Dr. E. Kidson, Wellington; Prof. K. Knoch, Berlin; Prof. W. Köppen, Graz; Prof. E. Kuhlbrodt, Hamburg; Dr. F. Loewe, Cambridge (Engl.); Prof. W. Meinardus, Göttingen; Prof. M. Milankovitch, Belgrad; Dr. C. W. B. Normand, Poona; Prof. T. Okada, Tokio; H. Petersen, Kopenhagen; C. L. Robertson, Salisbury; E. Rubinstein, Leningrad; Prof. K. Sapper, Garmisch; N. P. Sellick, Salisbury; Dr. W. Semmelhack, Hamburg; Prof. H. U. Sverdrup, Bergen; Prof. T. G. Taylor, Chicago; Prof. O. Tetens, Lindenbergl; Prof. A. Wagner, Innsbruck; Sir Gilbert T. Walker, Cambridge (Engl.); Prof. R. DeC. Ward †, Cambridge (U. S. A.); Prof. K. Wegener, Graz; Prof. L. Weickmann, Leipzig.

Herausgegeben von

**W. Köppen, Graz und R. Geiger, München**

---

Band II, Teil K

## Klima des Kanadischen Archipels und Grönlands

- I. Übersicht über das Klima des Polarmeeres und des Kanadischen Archipels von H. U. Sverdrup, Bergen.  
Mit 12 Textfiguren
- II. Klima der Küsten von Grönland von Helge Petersen, Kopenhagen. — Mit 12 Textfiguren
- III. Klima des Grönländischen Inlandeises von Fritz Loewe, Cambridge (Engl.) — Mit 2 Textfiguren

Berlin

Verlag von Gebrüder Borntraeger

W 35 Koester Ufer 12a

1935

# **I. Übersicht über das Klima des Polarmeeres und des Kanadischen Archipels**

von

**H. U. Sverdrup**

Chr. Michelsens Institutt, Bergen

## Vorwort

Es ist noch nicht möglich, eine Darstellung der Klimatologie des Polargebietes zu geben, die in Übereinstimmung mit dem Programm für das vorliegende Werk ist; die vorhandenen Schwierigkeiten werden bei der Besprechung der Beobachtungen näher erörtert. Um trotz der mangelhaften Beobachtungen einen tieferen Einblick in das polare Klima zu geben, ist versucht worden, immer die für die klimatischen Verhältnisse bedeutungsvollen Faktoren hervorzuheben. Dabei habe ich mich zum großen Teil auf meine eigenen Beobachtungen und Erfahrungen während mehr als 6 Jahren in der Arktis gestützt.

---

## Inhalt

	Seite
Beobachtungen . . . . .	5
Temperatur . . . . .	6
Luftdruck . . . . .	14
Wind . . . . .	17
Feuchtigkeit . . . . .	19
Bewölkung, Nebel und Niederschlag . . . . .	20
Witterungsverlauf . . . . .	23
Tabellen . . . . .	26
Literatur . . . . .	30

---

## **II. Das Klima der Küsten von Grönland**

von

**Helge Petersen**

Det Danske Meteorologiske Institut, København

## Inhalt

	Seite
Einleitung . . . . .	33
Luftdruck . . . . .	35
Temperatur . . . . .	36
Niederschlag . . . . .	43
Wind . . . . .	45
Bewölkung . . . . .	47
Witterungsvorgang, Lokaleinflüsse, Föhne . . . . .	47
Tabellen . . . . .	53
Literatur . . . . .	66

---

# III. Das Klima des Grönländischen Inlandeises

Von

**Dr. Fritz Loewe**

Cambridge (England)

Scott Polar Research Institute

## Inhalt

	Seite
I. Die Oberflächengestaltung . . . . .	69
II. Die Erforschung des Inlandeisklimas. . . . .	70
III. Die klimatischen Elemente. Tabellen 71—74. — Luftdruck 75. — Sonnenschein und Einstrahlung 76. — Temperatur 77. — Luftfeuchtigkeit 85. — Nebel 85. — Bewölkung 86. — Niederschlag 89. — Wind 92. — Zusammenfassung 96	
IV. Schriftennachweis . . . . .	100

---