

324

(4)

2/1308

World Survey of Climatology Volume 4

Climate of the Free Atmosphere

edited by D. F. REX

*National Center for Atmospheric Research,
Boulder, Colo. (U.S.A.)*

J 24 (4)

DK 551.58



ELSEVIER PUBLISHING COMPANY Amsterdam-London-New York 1969

Contents

Chapter 1. INTRODUCTION

by D. F. REX

General	1
Contents of the volume.	1
Tropospheric and stratospheric dynamics	3
Other properties of the free atmosphere.	3
References	3

Chapter 2. STANDARD AND SUPPLEMENTAL ATMOSPHERES

by N. SISSEWINE

Introduction	5
The 1962 COESA Standard Atmosphere	6
The COSPAR International Reference Atmosphere	29
Supplemental atmospheres	30
List of symbols and abbreviations	42
References	44

Chapter 3. TEMPERATURE AND HUMIDITY IN THE TROPOSPHERE

by H. L. CRUTCHER

Introduction	45
Tropopause	46
Definition	46
Heights	47
Temperature	48
Humidity	49
Temperature, vertical distributions	51
Standard atmospheres	51
Polar	51
Tropical and sub-tropical.	53
Continental.	55
Temperature lapse rates	56
Cross sections of temperature	57
Temperatures at pressure surfaces	68
Humidity	75

Data sources	79
Acknowledgments	79
References	80

Chapter 4. TROPOSPHERIC CIRCULATION AND JET STREAMS

by E. REITER

Global wind systems	85
Physical causes of large-scale tropospheric circulations	85
The dynamics of large-scale circulations and of jet streams	94
Conservative properties, 94 — Conservation of mass, 95 — Conservation of energy, 96 — Conservation of absolute vorticity, 105 — Rossby waves, 113 — Jet maxima and quasi-inertial motions, 114 — Conservation of potential vorticity, 116 — Orographic sources of long-wave perturbations, 123	
The structure of jet streams	127
Scales of atmospheric motion, 127 — The macro-structure of jet streams, 128 — The meso-structure of jet streams, 133 — The micro-structure of jet streams, 143	
Climatology of tropospheric flow	146
Tropospheric and tropopause jet-stream systems	146
Frontal jet stream, 146 — The subtropical jet stream, 154 — The tropical easterly jet stream, 158 — The monsoons of India, Southeast Asia, and Africa, 161 — The low level jet stream, 165	
Centers of action and local circulation systems	169
Extratropical cyclones	169
Tropical cyclones	173
Anticyclones	180
Local circulation systems	187
Foehn and katabatic winds	188
Diurnal circulations	190
List of symbols and abbreviations	192
References	193

Chapter 5. MAJOR CLOUD SYSTEMS

by J. H. CONOVER, W. S. LANTERMAN and V. J. SCHAEFER

Introduction	205
Physical processes	206
Formation	206
Evaporation and condensation, 206 — Convection, 207 — Lifting, 207 — Mixing, 207	
Modification	208
Dissipation	209
Classification	210
Forms	210
Names	210

Definitions and analysis	211
Extratropical systems	213
Regions and most frequent systems	213
Historical	213
A rational approach to cloud modeling	215
High-level cloudiness	216
Extratropical cyclone cloudiness	219
Other large-scale cloud patterns	229
Tropical systems	232
Amorphous cloud masses	233
Cloud bands	235
Vortex patterns	240
Summary.	244
References	244

Chapter 6. GLOBAL DISTRIBUTION OF CLOUDINESS AND RADIATION AS MEASURED FROM WEATHER SATELLITES

by J. S. WINSTON

Introduction	247
Average cloud cover	248
Seasonal averages of radiation data	257
Derivation of data	257
Charts of outgoing long-wave radiation and albedo.	259
March–May 1962, 260—June–August 1963, 264—September–November 1963, 267—December 1963–February 1964, 270	
Average latitudinal distributions of long-wave radiation and albedo	274
Acknowledgments	279
References	279

Chapter 7. DYNAMIC CLIMATOLOGY OF THE STRATOSPHERE

by W. L. WEBB

Introduction	281
Solar heating of the stratosphere.	287
Ozone	291
The lower stratosphere	292
Stratospheric meteorological observations.	302
The upper stratosphere	308
The stratospheric circulation index.	313
Temperature structure	324
Seasonal wind profiles	330
Summary.	369
Acknowledgments	372
References	373

Chapter 8. ATMOSPHERIC OZONE AND ULTRAVIOLET RADIATION

by H. U. DÜTSCH

Introduction	383
Photochemical theory	383
Equilibrium	383
Non-equilibrium	386
Total ozone.	390
Method of observation	390
Distribution of total ozone	391
Vertical distribution of ozone	396
Methods for observing vertical ozone distribution	396
Indirect methods	397
Direct methods	397
Observational results.	398
Mean vertical ozone distributions at different latitudes at the time of maximum and minimum ozone content (spring and fall)	398
Latitudinal cross sections	401
Seasonal variations	405
Individual distributions and day-to-day variations	409
Comparison between observation and theory	416
Ozone transport by the general circulation and the atmospheric ozone budget	419
Ozone in the mesosphere	422
The importance of ozone in stratospheric dynamics.	425
Influences of possible solar variability	426
The solar ultraviolet	427
List of symbols and abbreviations	429
References	430
 REFERENCES INDEX	 433
 GEOGRAPHICAL INDEX	 443
 SUBJECT INDEX	 447

NOTE OF THE PUBLISHER

Attempts have been made to use a consistent terminology and a consistent system of abbreviations and symbols. However, no changes have been made in abbreviations and symbols in illustrative material otherwise ready for reproduction. This in order not to make the volume even more expensive. Thus m.b. may occur in illustrations instead of mbar, and mps instead of m/sec. We trust this will not inconvenience readers since both kinds of abbreviation will be familiar to them.