

INTERNATIONAL GEOPHYSICS SERIES • VOLUME 28

The Urban Climate

Helmut E. Landsberg

144/2815 INSTITUT
FÜR METEOROLOGIE U. KLIMATOLOGIE
UNIVERSITÄT HANNOVER
HERRENHAUSER STR. 2 • 3000 HANNOVER 21

The Urban Climate

HELMUT E. LANDSBERG

Institute for Physical Science and Technology
University of Maryland
College Park, Maryland

1981



ACADEMIC PRESS

A Subsidiary of Harcourt Brace Jovanovich, Publishers

New York London Toronto Sydney San Francisco

Contents

Preface ix

1 Introduction

- 1.1 The Literature 1
- 1.2 Historical Developments 3
- 1.3 The Problem of Local Climate Modification 9
- References 14

2 The Assessment of the Urban Atmosphere

- 2.1 Synoptic versus Local Scale 17
- 2.2 Observational Procedures 20
- References 22

3 Urban Air Composition

- 3.1 The Urban Atmosphere 23
- 3.2 Air Standards and Observations 26

3.3	Pollutant-Weather Interactions	34
3.4	Urban Climatological Dispersion Models	44
	References	50
4	Urban Energy Fluxes	
4.1	Solar Radiation	53
4.2	Other Flux Parameters	59
4.3	Man-Made Factors in the Urban Heat Balance	71
	References	79
5	The Urban Heat Island	
5.1	Development and Growth of the Heat Island	84
5.2	Fluctuations of the Heat Island	100
5.3	Vertical Extent of the Heat Island	108
5.4	Wind Influence on the Heat Island	112
5.5	Consequences of the Urban Heat Island	118
	References	123
6	The Urban Wind Field	
6.1	Empirical Evidence for Wind Alterations	127
6.2	Vertical Wind Structure in Urban Areas	135
6.3	Urban Wind Field and Other Mesoscale Circulations	145
	References	149
7	Models of Urban Temperature and Wind Fields	
7.1	Static Models	154
7.2	Dynamic Models of Urban Flow	156
7.3	Model Applications to Air Pollution Studies	169

Contents

vii

List of Symbols	173
References	174

8 Moisture, Clouds, and Hydrometeors

8.1 The Urban Humidity Field	178
8.2 Urban Clouds	182
8.3 Urban Precipitation	186
References	207

9 Urban Hydrology

Text	211
References	222

10 Special Aspects of Urban Climate

10.1 Corrosion and Deterioration	223
10.2 Urban Noise	226
10.3 Plants in the Urban Atmosphere	231
10.4 Effects of Urban Atmosphere on Humans	235
References	251

11 Urban Planning

Text	255
References	261

Author Index	263
Subject Index	271