BOOK FLYER

AIR QUALITY MODELING

Theories, Methodologies, Computational Techniques, and Available Databases and Software

Volume III - Special Issues

Editor Paolo Zannetti

Chapter Authors

Maureen E. Buono Brad Cochran Aaron Daly Phyllis G. Diosey Frank R. Freedman J.D. McAlpine Ronald L. Petersen Michael Ruby Ananthakrishna Sarma Douglas Solomon Jesse Thé Robert J. Yamartino Paolo Zannetti





Air Quality Modeling: Theories, Methodologies, Computational Techniques, and Available Databases and Software – Volume III is the third volume of a comprehensive book series on the subject of air pollution and computer modeling of air quality phenomena. The book series is available both on CD-ROM (see below) and as a <u>bound textbook</u> (search: OTHP-26). The book series is published by the <u>EnviroComp Institute</u> and the <u>Air and Waste</u> <u>Management Association</u>.

For updates, corrections, and discussion, please visit: http://www.envirocomp.org/aqm

The electronic book *Air Quality Modeling: Theories, Methodologies, Computational Techniques, and Available Databases and Software – Volume III* is distributed on CD-ROM by the *EnviroComp Institute*. The book takes an in-depth look at some special air quality issues of air pollution modeling, such as emission modeling, mesoscale meteorology, computational fluid dynamics for microscale flows, Gaussian plume and puff models, odor modeling, greenhouse gases and global climate change, modeling pre-processors and post-processors, and resources on the Web. With individual chapters written by experts in their fields, this book gives environmental professionals a solid foundation for understanding advanced modeling techniques. Together with Volume I (*flver – order form*) and Volume II (*flver – order form*), this series provides a comprehensive review of air quality modeling issues.

The electronic book is made of chapters organized in Adobe Acrobat's PDF files that can be examined using Adobe Acrobat Reader (which can be <u>freely</u> <u>downloaded</u>). The reader can use any computer platform (PC/Mac/Unix). Navigation is straightforward. The book is complete with hypertext links, references, website and email pointers, graphics, and information about chapter authors including curriculum vitae, biographies, and pictures. The Table of Contents of Volume III and the order form are presented below.

Copyright 2008 The EnviroComp Institute and Air & Waste Management Association. All rights reserved.





Table of Contents – Volume III^{1, 2}

	Preface About the Editor About the Publishers		xi xiii xv
	About the Chapter Authors/Contributors		xvii
1	The	Problem – Air Pollution	1
2	The	Tool – Mathematical Modeling	3
3	Emissions Modeling and Inventory		5
	1	Introduction to Emissions Inventory and Emissions Modeling	6
	2	Overview of Inventories	10
	3	Process-Level Codes Used in Emissions Inventories	18
	4	Emissions Estimation Techniques	21
	5	Characterization of Emissions	28
	6	Characterization of Point Sources	37
	7	Area Sources	66
	8	Fire Emissions	90
	9	Biogenic and Geogenic	92
	10	Available Emissions Models	93
	11	Estimating Emissions for Use in Air Quality Modeling	95
	12	Estimating Emissions for Air Toxic Human Health Risk Assessment	97
	13	Emissions Inventory Quality Control	100
	14	Greenhouse Gases	102
	15	Data Quality Objectives (DQO)	107
	16	Data Gap Filling	108
	17	Rule Effectiveness, Rule Penetration, and Control Efficiency	108
	18	Pollutant Monitoring and Fuel Analysis Methodologies	110
	19	Emissions Inventory Terms	116
4	Air	Pollution Meteorology	127
5	Met	eorological Modeling	129

 ¹ Chapters in italics will be provided in subsequent volumes.
 ² The table of contents for Volumes I and II can be found in this book on pages 473 and 477, respectively.

5 A	Meteorological Modeling for Air Quality Applications	131
	1 Introduction	131
	2 Modeling Approaches	137
	3 Modeling Framework	142
	4 Dynamical and Thermodynamical Processes	145
	5 Physics Parameterizations	146
	6 Model Numerics	160
	7 Data Ingest	162
	8 Model Verification and Validation	163
	9 Symbols	164
	10 List of Acronyms	165
5B	Large-Eddy Simulations of the Atmospheric Boundary Layer	
5 C	Computational Fluid Dynamics of Microscale Meteorological	169
	Flows for Air Quality Applications	
	1 Introduction	170
	2 Synopsis of CFD: the Math, Assumptions, and Availability	171
	3 Simulating the Atmosphere in CFD	189
	4 Industry Opinion and Guidelines	207
	5 Validation and Verification	215
	6 Conclusion	229
6	Plume Rise	235
7	Gaussian Plume Models	237
7 A	Introduction to Gaussian Plume Models	
7B	Simulation Algorithms in Gaussian Plume Modeling	239
	1 Introduction	239
	2 Theoretical Background	241
	Extending the Plume Formulation Beyond Point Sources	253
	 Removal Processes in Gaussian Plume Modeling 	268
	- Removal Frocesses in Gaussian Frunc Wodening	200
8	Gaussian Puff Modeling	281
	1 Introduction	281
	2 Theoretical Background	285
	3 Puff Model Enhancements	301
9	Special Applications of Gaussian Models	315
10	Eulerian Dispersion Models	317
11	Lagrangian Particle Models	319
12	Atmospheric Transformations	
13	Deposition Phenomena	323

14	Indoor Air Pollution Modeling	325		
15	Modeling of Adverse Effects	327		
15A	A Modeling of Health Risks Associated with Combustion Facility Emissions			
	Odor Wodeling 1 Modeling for Odors in the Atmosphere 2 Odor Measurement 3 Odor Modeling-Related Issues 4 Odor Criteria 5 Odor Models and Modeling Techniques 6 Summary Climate Change - An Introduction to Atmosphere-Ocean General Circulation Modeling 1 Introduction	329 330 333 338 340 349 353		
	2 AOGCM Formulation3 Applications of AOGCMs	355 365		
	4 Future Development Needs and Further Readings	370		
16	Statistical Modeling	379		
16A	Air Quality Forecast and Alarm Systems			
16B	Receptor Models			
17	Evaluation of Air Pollution Models	381		
17 18	Evaluation of Air Pollution Models Regulatory Modeling	381 383		
18				
18	Regulatory Modeling A Historical Look at the Development of Regulatory Air Quality Models for the United States Environmental			
18 18A	Regulatory Modeling A Historical Look at the Development of Regulatory Air Quality Models for the United States Environmental Protection Agency Case Studies – Air Pollution Modeling at Local, Regional,	383		
18 18A 19	Regulatory Modeling A Historical Look at the Development of Regulatory Air Quality Models for the United States Environmental Protection Agency Case Studies – Air Pollution Modeling at Local, Regional, Continental, and Global Scales	383 385		
18 18A 19 20	Regulatory Modeling A Historical Look at the Development of Regulatory Air Quality Models for the United States Environmental Protection Agency Case Studies – Air Pollution Modeling at Local, Regional, Continental, and Global Scales The Future of Air Pollution Modeling	383 385 387		
18 18A 19 20 21	Regulatory Modeling A Historical Look at the Development of Regulatory Air Quality Models for the United States Environmental Protection Agency Case Studies – Air Pollution Modeling at Local, Regional, Continental, and Global Scales The Future of Air Pollution Modeling Active Groups in Air Pollution Modeling	383 385 387 389		

24A	Wind	l Tunnel Modeling of Pollutant Dispersion	397
	1	Introduction	397
	2	Theoretical Basis	399
	3	Experimental Methods and Instrumentation	406
	4	Typical Applications	418
25	Trace	er Studies	433
26	Air Q	Quality Modeling: Pre-Processing and Post-Processing	435
	1	Introduction	435
	2	Pre-Processing	436
	3	Post-Processing	440
	4	GIS in Air Quality Modeling	449
	5	Summary	452
27	Air Quality Modeling Resources on the Web		453
	1	Introduction	453
	2	Regulatory Issues	454
	3	Books	456
	4	Available Software	456
	5	Dispersion Models	459
	6	Photochemical Models	460
	7	Receptor Models	462
	8	Air Quality Forecast and Resources	463
	9	Visibility Modeling	464
	10	Publications and Information Online	465
	11	Courses Online	467
	12	Case Studies	468
	13	Resources and lists of References	470
	14	Calculation Sites	471
	Table	e of Contents – Volume I	473

Table of Contents – Volume I	4/3
Table of Contents – Volume II	477
Authors'/Contributors' Index for Volumes I, II and III	481
Subject Index for Volumes I, II and III	485