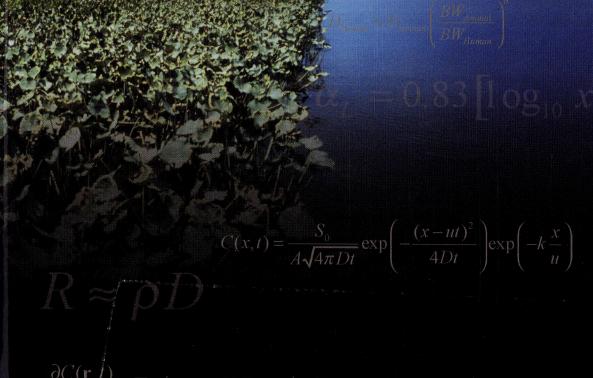


ROBERT A. FJELD

NORMAN A. EISENBERG

KEITH L. COMPTON

QUANTITATIVE ENVIRONMENTAL RISK ANALYSIS FOR HUMAN HEALTH



 $\frac{\partial C(\mathbf{r},t)}{\partial t} = \nabla \cdot (D(\mathbf{r},t)\nabla C(\mathbf{r},t)) - \nabla \cdot C(\mathbf{r},t) \mathbf{v}(\mathbf{r},t) + g(\mathbf{r},t) - d(\mathbf{r},t)$

CONTENTS

Preface		
1	Introduction	1
1.1	Risk Analysis	2
1.2	Risk	4
1.3	Contaminants in the Environment	8
	Uses of Environmental Risk Assessment	10
	Risk Assessment Process	13
	erences	19
	ditional Reading	21
Pro	blems	21
2	Fundamental Aspects of Environmental Modeling	23
2.1	Introduction	23
2.2	Modeling Process	23
2.3	Physical and Mathematical Basis for Risk Assessment Models	29
2.4	Contaminant Transport Equation	44
	erences	55
Pro	blems	55
3	Release Assessment	60
3.1	Introduction	60
3.2	Conceptual Model	60
3.3	Contaminant Identification	62
3.4	Emission-Rate Quantification	66
References		78
Additional Reading		78
Pro	blems	78
4	Environmental Transport Theory	81
4.1	Introduction	81
4.2	One-Dimensional Solutions of the Contaminant Transport Equation	83
4.3	Three-Dimensional Contaminant Transport	96
4.4	Advanced Solution Methods	97
Ref	References	
Additional Reading		100
Pro	blems	101
		vii

viii CONTENTS

5	Surface Water Transport	104
5.1	Introduction	104
5.2	Types of Surface Water Bodies	106
5.3	Sorption	109
5.4	Transport Modeling	116
References		123
	ditional Reading	124
Problems		124
6	Groundwater Transport	127
6.1	Introduction	127
6.2	Subsurface Characterization	129
6.3	Saturated Flow in Porous Media	130
6.4	Sorption	137
6.5		139
6.6	Other Considerations in Groundwater Transport	148
Ref	erences	152
	ditional Reading	153
Problems		153
7	Atmospheric Transport	156
7.1	Introduction	156
7.2	Atmospheric Dispersion	156
7.3	Atmospheric Transport Models	161
7.4	Other Considerations	172
	erences	178
	ditional Reading	179
Pro	blems	179
8	Food Chain Transport	183
8.1	Introduction	183
8.2	Concentration in Soil	186
8.3	Concentration in Vegetation	190
8.4	Concentration in Animals	195
	Ferences	197
Pro	blems	197
9	Exposure Assessment	199
9.1	Introduction	199
9.2	Dose	200
9.3	Contaminant Intake	204
9.4	Dose Calculations	209
References		216
Problems		217

	CONTENTS	ix
10 Basic Human Toxicology		219
10.1 Introduction		219
10.2 Fundamentals of Anatomy and Physiology		220
10.3 Mechanisms and Effects of Toxicity		237
References		242
Additional Reading		244
Problems		244
11 Dose-Response and Risk Characterization		245
11.1 Introduction		245
11.2 Biological Basis of Dose–Response Modeling		245
11.3 Elements of Quantitative Dose–Response Analysis		247
11.4 Dose–Response Modeling		261
11.5 Risk Characterization		267
11.6 Regulatory Implementation		270
References		277
Additional Reading		279
Problems		279
12 Uncertainty and Sensitivity Analyses		283
12.1 Introduction		283
12.2 Types and Sources of Uncertainty		283
12.3 Statistical Fundamentals		289
12.4 Uncertainty Propagation		298
References		311
Problems		314
13 Stakeholder Involvement and Risk Communication		316
13.1 Introduction		316
13.2 Stakeholder Involvement		317
13.3 Risk Communication		325
References		332

References		242
Additional Reading		244
Problems		244
11	Dose-Response and Risk Characterization	245
11.1	Introduction	245
11.2	Biological Basis of Dose–Response Modeling	245
11.3	Elements of Quantitative Dose–Response Analysis	247
11.4	1 0	261
	Risk Characterization	267
11.6		270
	erences	277
	itional Reading	279
Prob	blems	279
12	Uncertainty and Sensitivity Analyses	283
12.1	Introduction	283
12.2	Types and Sources of Uncertainty	283
12.3	Statistical Fundamentals	289
12.4	Uncertainty Propagation	298
Refe	erences	311
Prob	blems	314
13	Stakeholder Involvement and Risk Communication	316
13.1	Introduction	316
13.2	Stakeholder Involvement	317
13.3	Risk Communication	325
Refe	erences	332
Prob	Problems	
14	Environmental Risk Management	336
14.1	Introduction	336
14.2	Risk Management Process	336
	Risk Management Methods	337
Refe	References	
Prob	blems	355
15	Environmental Laws and Regulations	356
15.1	Introduction	356
15.2		230
	Protection	356

CONTENTS X

15.3 Major Federal Environmental Laws and Regulations	357
15.4 CERCLA Process	367
15.5 Additional Regulations	372
References	373
Problems	374
Appendix A Mathematical Tools	375
A.1 Special Functions	375
A.2 Laplace Transforms	376
References	380
Additional Reading	380
Appendix B Degradation and Decay Parameters	381
Index	

257