

Contents



1 Fundamental Quantities and Units	1
1.1 Fundamental Constants.....	1
1.2 Units for Use in Atmospheric Chemistry	2
1.3 Properties of the Elements	10
2 Data Regarding the Earth	19
2.1 Physical Properties and Interior Structure of the Earth	19
2.2 Geographic Distribution of Continents and Oceans	21
2.3 Elemental Composition of the Earth's Crust	22
2.4 Sediments and Sedimentary Rocks.....	26
2.5 Composition of Gas Emissions from Volcanoes.....	30
2.6 The Hydrosphere	33
2.7 The Biosphere.....	39
3 Structure of the Atmosphere	49
3.1 Basic Properties of Air.....	50
3.2 Origin of the Atmosphere and Geochemical Cycles of the Principal Constituents.....	52
3.3 Temperature, Pressure and Density as a Function of Altitude.....	54
3.4 Global Atmospheric Mean Circulation.....	62
4 Trace Gases	69
4.1 Overview.....	69
4.2 Detailed Global Budgets of Trace Gases	77
4.3 Emissions of Trace Gases	88
4.4 Concentrations of Oxidizing Species.....	97
4.5 Trace Gases in the Stratosphere.....	106
5 The Atmospheric Aerosol	127
5.1 Characterization of the Tropospheric Aerosol	128
5.2 Global Production/Emission Rates	133

5.3	Elemental Composition of Atmospheric Particles	139
5.4	Organic Components of the Tropospheric Aerosol	162
5.5	Hygroscopicity	181
6	Gas-Phase Photochemistry	189
6.1	Solar Radiation	189
6.2	Photodissociation Coefficients	196
6.3	Absorption Cross Sections and Primary Quantum Yields	204
7	Rate Coefficients for Gas-Phase Reactions	227
7.1	General Introduction	227
7.2	Reactions of Excited Oxygen Species	230
7.3	Reactions of Inorganic Species (Containing Hydrogen, Oxygen, Nitrogen, Sulfur)	232
7.4	Reactions and Oxidation of Organic Compounds	236
7.5	Reactions of Halogen Compounds	259
7.6	Additional Reactions	267
8	Aqueous Phase Chemistry	271
8.1	Physicochemical Properties of Water	271
8.2	Global Distribution of Clouds, Precipitation and Chemical Constituents	276
8.3	Appearance and Microstructure of Clouds	283
8.4	Solubilities of Gases and Vapors in Water (Henry's Law Coefficients)	289
8.5	Chemical Equilibria in Aqueous Solution, Dissociation Constants	297
8.6	Aqueous Phase Photochemical Processes	301
8.7	Rate Coefficients for Elementary Reactions in the Aqueous Phase	304
9	The Upper Atmosphere	315
9.1	Introduction	315
9.2	Physical Conditions in the Thermosphere	317
9.3	Solar Radiation at Wavelengths Below 200 nm	332
9.4	Absorption and Photoionization Coefficients	337
9.5	Chemistry of the Ionosphere	355
9.6	Airglow Phenomena and Spectroscopy	361
10	Measurement Techniques for Atmospheric Trace Species	373
10.1	Overview on Established Instrumental Techniques	373
10.2	Description of Analytical Methods for Trace Gases	378
10.2.1	Chromatographic Techniques	378
10.2.2	Mass Spectrometry	380
10.2.3	Absorption Spectrometry	381
10.2.4	Fluorescence Analyzers	383
10.2.5	Ozone Electrochemical Detector	385

Contents	ix
10.2.6 Chemiluminescence Analyzers	385
10.2.7 Collection Followed by Liquid Phase Chemical Analysis.....	387
10.3 Description of Aerosol Measurement Techniques.....	390
10.3.1 Number Concentration.....	390
10.3.2 Mass Concentration.....	391
10.3.3 Individual Particle Sizing and Morphology	392
10.3.4 Chemical Composition	393
10.4 Satellite Sensors	396
Glossary of Atmospheric Chemistry Terms.....	403
Index.....	433