
Contents

VOLUME 1

List of Contributors	xi	22	Evolutionary Computing in Hydrological Sciences	331
Preface	xxv	23	Flood Early Warning Systems for Hydrological (sub) Catchments	349
Abbreviations and Acronyms	xxvii	24	Network Distributed Decision Support Systems and the Role of Hydrological Knowledge	365
Part 1: Theory, Organization and Scale	1			
1	On the Fundamentals of Hydrological Sciences	3		
2	The Hydrologic Cycles and Global Circulation	13		
3	Hydrologic Concepts of Variability and Scale	23		
4	Organization and Process	41		
5	Fundamental Hydrologic Equations	59		
6	Principles of Hydrological Measurements	75		
7	Methods of Analyzing Variability	95		
8	Fractals and Similarity Approaches in Hydrology	123		
9	Statistical Upscaling and Downscaling in Hydrology	135		
10	Concepts of Hydrologic Modeling	155		
11	Upscaling and Downscaling – Dynamic Models	165		
12	Co-evolution of Climate, Soil and Vegetation	177		
13	Pattern, Process and Function: Elements of a Unified Theory of Hydrology at the Catchment Scale	193		
Part 2: Hydroinformatics	221			
14	Hydroinformatics and its Contributions to Hydrology: From Computation to Communication	223		
15	Digital Elevation Model Analysis and Geographic Information Systems	239		
16	Numerical Flood Simulation	257		
17	Hydrological and Environmental Modeling of Transport Processes in Rivers and Estuaries	271		
18	Shallow Water Models with Porosity for Urban Flood Modeling	285		
19	Data-driven Modeling and Computational Intelligence Methods in Hydrology	293		
20	Artificial Neural Network Concepts in Hydrology	307		
21	Rainfall-runoff Modeling Based on Genetic Programming	321		
			Part 3: Meteorology and Climatology	379
		25	Global Energy and Water Balances	381
		26	Weather Patterns and Weather Types	401
		27	Storm Systems	413
		28	Clouds and Precipitation	423
		29	Atmospheric Boundary-Layer Climates and Interactions with the Land Surface	443
		30	Topographic Effects on Precipitation	455
		31	Models of Clouds, Precipitation and Storms	463
		32	Models of Global and Regional Climate	477
		33	Human Impacts on Weather and Climate	491
		34	Climate Change – Past, Present and Future	507
			Part 4: Hydrometeorology	527
		35	Rainfall Measurement: Gauges	529
		36	Precipitation Measurement: Gauge Deployment	537
		37	Rainfall Trend Analysis: Return Period	547
		38	Fog as a Hydrologic Input	559
		39	Surface Radiation Balance	583
		40	Evaporation Measurement	589
		41	Evaporation Modeling: Potential	603
		42	Transpiration	615
		43	Evaporation of Intercepted Rainfall	627
		44	Evaporation from Lakes	635
		45	Actual Evaporation	647
			VOLUME 2	
			List of Contributors	xi
			Preface	xxv
			Abbreviations and Acronyms	xxvii

Part 5: Remote Sensing	657	77	Inverse Modeling of Soil Hydraulic Properties	1151	
46	Principles of Radiative Transfer	659	78	Models of Water Flow and Solute Transport in the Unsaturated Zone	1171
47	Sensor Principles and Remote Sensing Techniques	673	79	Assessing Uncertainty Propagation Through Physically based Models of Soil Water Flow and Solute Transport	1181
48	Ground-based and Airborne Lidar	697			
49	Estimation of Surface Insolation	713	Part 7: Erosion and Sedimentation	1197	
50	Estimation of the Surface Energy Balance	731	80	Erosion and Sediment Transport by Water on Hillslopes	1199
51	Spatially Resolved Measurements of Evapotranspiration by Lidar	753	81	Erosion Monitoring	1209
52	Estimation of Surface Temperature and Surface Emissivity	771	82	Erosion Prediction and Modeling	1221
53	Estimation of Surface Freeze–Thaw States Using Microwave Sensors	783	83	Suspended Sediment Transport – Flocculation and Particle Characteristics	1229
54	Estimation of Surface Soil Moisture Using Microwave Sensors	799	84	Floodplain Sedimentation – Methods, Patterns, and Processes: A Review with Examples from the Lower Rhine, the Netherlands	1241
55	Estimation of Snow Extent and Snow Properties	811	85	Sediment Yields and Sediment Budgets	1283
56	Estimation of Glaciers and Sea-ice Extent and their Properties	831	86	Measuring Sediment Loads, Yields, and Source Tracing	1305
57	Land-cover Classification and Change Detection	853	87	Sediment Yield Prediction and Modeling	1315
58	Characterizing Forest Canopy Structure and Ground Topography Using Lidar	875	88	Reservoir Sedimentation	1327
59	Estimation of Soil Properties Using Hyperspectral VIS/IR Sensors	887	89	On the Worldwide Riverine Transport of Sediment – Associated Contaminants to the Ocean	1341
60	Estimation of River and Water-Body Stage, Width and Gradients Using Radar Altimetry, Interferometric SAR and Laser Altimetry	903	90	Lake Sediments as Records of Past Catchment Response	1359
61	Estimation of River Discharge	919			
62	Estimation of Suspended Sediment and Algae in Water Bodies	939	VOLUME 3		
63	Estimation of Precipitation Using Ground-based, Active Microwave Sensors	951	List of Contributors	xi	
64	Satellite-based Estimation of Precipitation Using Microwave Sensors	965	Preface	xxv	
65	Estimation of Water Vapor and Clouds Using Microwave Sensors	981	Abbreviations and Acronyms	xxvii	
Part 6: Soils	997		Part 8: Water Quality and Biogeochemistry	1371	
66	Soil Water Flow at Different Spatial Scales	999	91	Water Quality	1373
67	Hydrology of Swelling Clay Soils	1011	92	Water Quality Monitoring	1387
68	Water Movement in Hydrophobic Soils	1027	93	Effects of Human Activities on Water Quality	1409
69	Solute Transport in Soil at the Core and Field Scale	1041	94	Point and NonPoint Source Pollution	1427
70	Transpiration and Root Water Uptake	1055	95	Acidic Deposition: Sources and Effects	1441
71	Freezing and Thawing Phenomena in Soils	1069	96	Nutrient Cycling	1459
72	Measuring Soil Water Content	1077	97	Urban Water Quality	1479
73	Soil Water Potential Measurement	1089	98	Pathogens	1493
74	Soil Hydraulic Properties	1103	99	Salinization	1505
75	Determining Soil Hydraulic Properties	1121	100	Water Quality Modeling	1525
76	Models for Indirect Estimation of Soil Hydraulic Properties	1145			

Part 14: Snow and Glacier Hydrology	2461	180	Short-Term Predictions (Weather Forecasting Purposes)	2791	
159	Snow Cover	2463	181	Long-Term Predictions (Climate Simulation and Analysis)	2813
160	Energy Balance and Thermophysical Processes in Snowpacks	2475	182	The Hydrological Cycle in Atmospheric Reanalysis	2831
161	Water Flow Through Snow and Firn	2491	183	Teleconnections in the Earth System	2849
162	Hydrology of Snowcovered Basins	2505	184	Global River Carbon Biogeochemistry	2863
163	Hydrochemical Processes in Snow-covered Basins	2525		Part 16: Land Use and Water Management	2877
164	Role of Glaciers and Ice Sheets in Climate and the Global Water Cycle	2539	185	Integrated Land and Water Resources Management	2879
165	Mass and Energy Balances of Glaciers and Ice Sheets	2555	186	Water and Forests	2895
166	Surface and Englacial Drainage of Glaciers and Ice Sheets	2575	187	Land Use Impacts on Water Resources – Science, Social and Political Factors	2911
167	Subglacial Drainage	2587	188	Land Use and Water Quality	2925
168	Hydrology of Glacierized Basins	2601	189	Land Use and Water Resources Under a Changing Climate	2931
169	Sediment and Solute Transport in Glacial Meltwater Streams	2633	190	Hydromorphological Quality – A Policy Template for Channel Design in River Restoration	2939
170	Modeling Glacier Hydrology	2647	191	Environmental Flows: Managing Hydrological Environments	2953
171	River-Ice Hydrology	2657	192	Public Participation in River Basin Planning and Management: Quality-of-Life Capital as an Information Aid to Sustainable Decisions	2973
172	Permafrost Hydrology	2679	193	Markets for Watershed Services	2987
			194	Inter-Institutional Links in Land and Water Management	3003
				Part 17: Climate Change	3013
			195	Acceleration of the Global Hydrologic Cycle	3015
			196	The Role of Water Vapor and Clouds in the Climate System	3029
			197	Observed Trends in Hydrologic Cycle Components	3035
			198	Role and Importance of Cryospheric Processes in Climate System	3045
			199	Role and Importance of Paleohydrology in the Study of Climate Change and Variability	3051
			200	Changes in Regional Hydroclimatology and Water Resources on Seasonal to Interannual and Decade-to-Century Timescales	3073
			201	Land-Atmosphere Models for Water and Energy Cycle Studies	3089
			202	Use of Climate Information in Water Resources Management	3103
			203	A Guide to International Hydrologic Science Programs	3119
				Subject Index	3145
VOLUME 5					
List of Contributors		xi			
Preface		xxv			
Abbreviations and Acronyms		xxvii			
Part 15: Global Hydrology	2695				
173	Global Water Cycle (Fundamental, Theory, Mechanisms)	2697			
174	Global Water Budgets – Fundamental Theory and Mechanisms	2713			
175	Observations of the Global Water Cycle – Global Monitoring Networks	2719			
176	Observations of the Global Water Cycle – Satellites	2733			
177	The Role of Large-Scale Field Experiments in Water and Energy Balance Studies	2753			
178	Modeling of the Global Water Cycle: Numerical Models (General Circulation Models)	2761			
179	Modeling of the Global Water Cycle – Analytical Models	2777			