Contents

	 List of Contributors 1 Introduction Janos J. Bogardi and Zbigniew W. Kundzewic 		page xiii	4	Aspects of uncertainty, reliability, and risk in flood forecasting systems incorporating		
1			1		wea	ther radar	30
			CZ		Robert J. Moore		
					4.1	Introduction	30
2	Inte	grated regional risk assessment and			4.2	Uncertainty in flood forecasts	30
	safe	ty management: Challenge from			4.3	Reliability and system complexity	36
	Age	nda 21	4		4.4	Risk and ensemble forecasting	38
	Adri	an V. Gheorghe			4.5	Conclusion	40
	2.1	Introduction	4	5	Pro	babilistic hydrometeorological forecasting	41
	2.2	Regional safety planning	5		Ron	nan Krzysztofowicz	
	2.3	On some organizational aspects	7				
	2.4	Techniques for interactive decision			5.1	Introduction	41
		processes in IRRASM	8		5.2	Probabilistic forecasts	42
	2.5	The use of DSS for integrated risk			5.3	Precipitation forecasting system	43
		assessment studies	8		5.4	Stage forecasting system	44
	2.6	The use of GIS technology for			5.5	Flood warning decision system	45
		IRRASM	13		5.6	Closure	45
	2.7	The Kovers approach	15		5.0		10
	2.8	Conclusions	21				
				6		od risk management: Risk cartography	
						objective negotiations	47
3	Risk	analysis: The unbearable cleverness			0. (dilard	
		luffing	22				
		lemeš			6.1	Introduction	47
					6.2	Definitions and concepts	47
	2.1	T / T /	22		6.3	"Inondabilité" method	48
	3.1	Introduction	22		6.4	Necessity and consequences of an	
	3.2	For practical purposes	23			objective negotiation	52
	3.3	Climate-change-impact scenarios:	24		6.5	Conclusions	53
	2.4	From bluffing to metabluffing	24				
	3.4	In praise of theory and robust results	25 26	-	Р		
	3.5	A reality check	26	7	-	ponses to the variability and increasing	54
	3.6	Conclusions, or a tale about unkunks,	20			ertainty of climate in Australia	54
		kunks, and skunks	28		Jona	athan F. Thomas and Bryson C. Bates	
							ix

Y

	7.1	Variability in Australia's climate and	
		hydrology	54
	7.2	Climate change	55
	7.3	Urban systems	55
	7.4	Irrigation systems	58
	7.5	Infrastructure robustness	60
	7.6	Conclusions	61
8	Deve	loping an indicator of a community's	
		ster risk awareness	62
	Norie	o Okada	
	8.1	Introduction	62
	8.2	The 1994–95 drought	62
	8.3	Measuring the "invisibles" of society	62
	8.4	A contextual analysis of the drought-related	
		social messages of newspaper articles	64
	8.5	Analysis of the observed water saving	
		phenomenon: Another examination of the	
		working hypothesis	65
	8.6	Modeling the SPRD–WSP transformational	
		mechanism: An analogy of the water saving	
		action using the "tank" model	66
	8.7	Conclusions	69
9	Dete	rmination of capture zones of wells by	
	Mon	te Carlo simulation	70
	W. K	inzelbach, S. Vassolo, and GM. Li	
	9.1	Introduction	70
	9.1 9.2	Problems arising in the deterministic	70
	9.2	determination of capture zones	71
	9.3	Determination of a capture zone by	/1
).5	Monte Carlo simulation	71
	9.4		72
	9.5		75
10	~		
10		trolling three levels of uncertainties for	-
		ogical risk models	76
		rry Fahmy, Eric Parent, and	
	Dom	inique Gatel	
	10.1	Introduction	76
	10.2	A new alert model	76
	10.3	Case study description	79
	10.4	Results	79
	10.5	Discussion	81
	10.6	Conclusions	83

		CONT	ΓENTS
11		hastic precipitation-runoff modeling vater yield from a semi-arid	
		ted watershed	86
	Areg	ai Tecle and David E. Rupp	
	11.1	Introduction	86
	11.2	Study site characteristics	87
	11.3	Model development	88
	11.4	Analysis of results	92
	11.5	Evaluating risk and reliability in	
		water yield	96
	11.6	Summary and conclusions	97
12	0	onal assessment of the impact of climate	
		ge on the yield of water supply systems ard M. Vogel, Christopher J. Bell,	101
		ith R. Suresh, and Neil M. Fennessey	
	12.1	Introduction	101
	12.2	Model time-step for regional assessment	102
		Development of regional	
		hydroclimatological streamflow model	102
	12.4	Storage-reliability-resilience-yield	
		relationships	107
	12.5	Sensitivity of water supply system	
		behavior to climate change	107
	12.6	Conclusions	109
13	Hyd	rological risk under nonstationary	
	cond	itions changing hydroclimatological input	111
	A. B	árdossy and L. Duckstein	
	13.1	Introduction	111
	13.2	Investigation of historical series	112
		Nonstationary scenarios	113
		Hydrological risks	116
		An example of ecological risk analysis	118
		Conclusions	120
14	Fuzz	y compromise approach to water	
		urces systems planning under uncertainty nael J. Bender	122
	which	laei J. Bender	
		Introduction	122
	14.2		123
	14.3	Examples	127

14.4 Conclusions

130

CONTENTS

15	System and component uncertainties in				
	water resources		133		
	Ben Chie Yen				
	15 1	Introduction	133		
		Sources of uncertainties	133		
		Different measures of uncertainties	133		
		Methods for uncertainty analysis	134		
		Remarks on uncertainty analysis	151		
	1010	techniques	138		
	15.6	Analysis of relative contributions of			
		uncertainties	139		
	15.7	Concluding remarks	139		
		-			
16		aging water quality under uncertainty:			
		lication of a new stochastic branch			
		bound method	143		
	B. J.	Lence and A. Ruszczyński			
		Introduction	143		
	16.2	Elements of a water quality management			
		model	144		
	16.3	A probabilistic water quality management			
		model	144		
		The stochastic branch and bound method	146		
	16.5	Application of the stochastic branch			
		and bound method for managing BOD	140		
	166	discharges in the Willamette River Conclusions	148 150		
	10.0	Conclusions	130		
17	Unce	ertainty in risk analysis of water			
	resou	rces systems under climate change	153		
	Bijay	va P. Shrestha			
	17.1	Three-phase system framework	153		
	17.2	Risk and uncertainty	153		
	17.3	Hydrometeorological input and			
		climate change	154		
	17.4	Modeling and simulation	155		
	17.5	Analysis of results	155		
		Uncertainty of risk analysis	157		
	17.7	Discussion and conclusions	160		
18	Rick	and reliability in water resources			
10		agement: Theory and practice	162		
		Shamir	102		

			xi
	18.1	Introduction	162
	18.2	The role of forecasting	167
19	Qua	ntifying system sustainability using	
		iple risk criteria	169
	Dani	el P. Loucks	
	19.1	Introduction	169
		Sustainability: Some issues and challenges Defining sustainability of water resources	169
	19.5	systems	171
	19.4	Measuring sustainability of water	- , -
		resources systems	172
	19.5	Final remarks	179
20	Irrev	versibility and sustainability in water	
	resou	urces systems	181
	H. P.	Nachtnebel	
	20.1	Introduction	181
	20.2	Economy-based irreversibility	
		considerations	182
	20.3	Physically-based reversibility	104
	20.4	considerations	184
	20.4	Reversibility in environmental management	186
	20.5	-	188
21	Futu	re of reservoirs and their management	
	crite	0	190
	Kuni	yoshi Takeuchi	
	21.1	Introduction	190
	21.2	Controlling factors of future needs of	
		reservoirs	192
		Reservoir sedimentation	194
		Outlook of reservoirs in the future	195
	21.5	Reliable and robust management of	100
	21.6	reservoirs Conclusions	196 197
22	Port	ormance criteria for multiunit reservoir	
		ation and water allocation problems	199
	-	o Milutin and Janos J. Bogardi	
	22.1	Introduction	199
		Case study system	200

	٠	٠
v	1	1
Δ	1	т

CONTENTS

22.3	Genetic algorithm model	201	23.1	Introduction	209
22.4	Performance evaluation	203	23.2	The risk management process	211
22.5	Analyses and results	204	23.3	Hazard identification	212
22.6	Discussion	206	23.4	Risk assessment	212
			23.5	Risk mitigation	219
Rick	management for hydraulic systems		23.6	Concluding remarks	219

23 Risk management for hydraulic systems under hydrological loads Erich J. Plate

209