Groundwater Management and Allocation Models: A Review

Table S1. Classification of different quantitative simulation groundwater models in the literature

Author (year)	Simulation		Uncertainty	Optimization	Game theory or Conflict resolution	Surface water models	Time step	Case study
	Quantity	Quality						
[1]	MODFLOW						Monthly	Hypothetical
[2]	MODFLOW-96						Monthly	Hill Country, USA
[3]	WatFlow						Annual	Oro Moraine, Canada
[4]			MCS and fuzzy logic-based alpha-cut					Vannetin basin, France
[5]	MODFLOW		GLUE					Hypothetical
[6]					Nash bargaining scenario -Nash non-cooperative game			El Paso, Texas and Ciudad Juarez, Mexico
[7]	ISOQUAD			CDDP and GA			3 Months	Hypothetical
[8]	MODFLOW			Linear optimization			Annual	Island
[9]	MODFLOW and UCODE						Annual	Glacial-till plain on the Jutland peninsula, Western Denmark
[10]	MODFLOW			MINLP			Annual	Upper San Pedro River Basin, southeastern Arizona, Mexico
[11]	LTM			NSGA-II			Annual	Hypothetical
[12]					Non-cooperative equilibrium			Fault zone aquifer of south-central Texas
[13]			Fuzzy α-cut					
			MCS					
[14]	MODFLOW						Monthly	Cosumnes River, California, US
[15]	MODFLOW			GA and ANN			Monthly	The southern part of Tehran, Iran
[16]					Game theory			State of Guanajuato, Mexico
[17]					Game-theoretic model			Hypothetical
[18]	MODFLOW						Annual	Ismarida plain, Northeastern Greece
[19]	FEFLOW						Monthly	Zhangye, China
[20]	MODFLOW		GLUE					Hypothetical
			BMA					
[21]	MODFLOW							North China Plain, China
[22]				CDDP-ANFIS			3 Months	Hypothetical
[23]	MOC			GA			Monthly	Hypothetical
[24]	MODFLOW					SWAT	Monthly	Korea

[25]		FSPDE, FPDE, SPDE					Hypothetical
[26]	advective mass transport		GA			Annual	Hypothetical
[27]	MODFLOW				SWAT	Monthly	Mihocheon watershed, South Korea
[28]	FEHM	NSMC / MCMC (DREAM)	AMALGAM			Annual	Yucca Flat, USA
[29]		Fuzzy-probabilistic and conventional Monte Carlo simulation					Washington, USA
[30]		Hybrid propagation				Annual	
[31]	MODFLOW and ANN		GA			Monthly	Najafabad plain, Iran
[32]	MODFLOW	AM-MCMC					Hypothetical
[33]	MODFLOW				SWAT	Monthly	Yellow River Basin, Inner Mongolia, China
[34]	AEM		PSO			Annual	Dore-France
[35]			ECACO			Daily	Hypothetical
[36]	GMS				Visual Basic	Annual	Maraghe plain, Iran
[37]	MODFLOW	MPS and SGeMS				Annual	Ølgod, Jutland, Denmark
[38]	GMS-MODFLOW 2000					Monthly	Nakuru district, Nairobi
[39]	MODFLOW					Monthly	NCP, China
[40]	ParFlow					Monthly	Klamath River, California, USA
[41]	SGMP						Haryana, India
[42]	MODFLOW	NSMC					
[43]	MODFLOW		HS			Monthly	Izmir, Turkey
[44]	MODFLOW		DE and BFGS			Monthly	Izmir, Turkey
[45]	MODFLOW		GA			Monthly	Iran
[46]				SCR social choice			Spain
[47]	MODFLOW					Annual	Egypt
[48]	MODFLOW		NSGA-II	MCSGA and NGA		Monthly	Rafsanjan plain, Iran
[49]	MODFLOW	MCS	NSGA-II			Annual	Muscat, Oman

Table S2. The research that employed surface water modeling in conjunction with groundwater modeling

Author (year)	Simulation		Uncertainty	Optimization	Game theory or Conflict resolution	Surface water models	Time step	Case study
	Quantity	Quality						
[50]	MODFLOW					SWAT	Monthly	Rattlesnake Creek basin in south-central Kansas, USA
[51]	MODFLOW					SWAT	Monthly	Kansas, USA
[52]	MODFLOW	MT3DMS				SWAT	Monthly	Bonello watershed, Italy
[24]	MODFLOW					SWAT	Monthly	Korea
[27]	MODFLOW					SWAT	Monthly	Mihocheon watershed, South Korea
[33]	MODFLOW					SWAT	Monthly	Yellow River Basin, Inner Mongolia, China
[36]	GMS					Visual Basic	Annual	Maraghe plain, Iran
[53]	MODFLOW	MT3D				SWAT	Annual	Upper Yamuna watershed, India
[54]	MODFLOW	MT3D				SWAT	Monthly	Jucar river basin, Spain
[55]	MODFLOW					SWAT	Monthly	Neishaboor plain, Iran
[56]	MODFLOW	MT3DMS		MOPSO		SWAT	Monthly	Isfahan-Barkhoar, Iran
[57]	MODFLOW	MT3DMS	DREAMzs	MOPSO		SWAT	Monthly	Isfahan-Barkhoar, Iran
[58]	MODFLOW	MT3DMS	DREAMzs	MOPSO	SCR. FB	SWAT	Monthly	Isfahan-Barkhoar, Iran

Table S3. Classification of different qualitative simulation groundwater models in the literature

Author (year)	Simulation		Uncertainty	Optimization	Game theory or Conflict resolution	Surface water models	Time step	Case study
	Quantity	Quality						
[59]	MODFLOW	MT3D		Bundle-Trust			Annual	Na'aman Aquifer, Western Galilee, Israel
[60]	MODFLOW	MT3D	Monte Carlo	Monte Carlo Simple Genetic algorithm and Noisy Genetic algorithm			Annual	Hypothetical
[52]	MODFLOW	MT3DMS				SWAT	Monthly	Bonello watershed, Italy
[61]	MODFLOW	MT3DMS	Spatial bootstrap				Daily	Hypothetical

Author (year)	Simulation Quantity	Simulation Quality	Uncertainty	Optimization	Game theory or Conflict resolution	Surface water models	Time step	Case study
[62]	MODFLOW	MT3D	Monte Carlo	GA				Hypothetical
[63]	MODFLOW	MT3D					Monthly	Balasore coastal basin, India
[64]	MODFLOW	MT3D		NSGA-II	YCRT		Monthly	Tehran aquifer, Iran
[65]	MODFLOW	MT3DMS		MINOS			Annual	hypothetical
[66]	MODFLOW	SWAT					Annual	Ras Sudr, Egypt
[67]	MODFLOW	MT3D		NSGA-II	RSBT		Monthly	Tehran aquifer, Iran
[68]	SAHYSMOD	SAHYSMOD					Seasonal	Haryana State, India
[69]	MODFLOW	MT3D	FPPA				Annual	Hypothetical
[70]	MODFLOW	MT3D	FOK	NSGA-II			Annual	hypothetical
[53]	MODFLOW	MT3D				SWAT	Annual	Upper Yamuna watershed, India
[71]		PGREM3D	MCMC				Daily	Hypothetical
[54]	MODFLOW	MT3D				SWAT	Monthly	Jucar river basin, Spain
[72]	MODFLOW	MT3D					Monthly	Nile Delta, Egypt
[73]	MODFLOW	MT3DMS		NSGA-II			Monthly	Najaf Abad plain, Iran
[74]	MODFLOW	MT3DMS	Monte Carlo	NSGA-II	SCR Fallback Bargaining		Monthly	Kavar-Maharloo aquifer, Iran
[56]	MODFLOW	MT3DMS		MOPSO		SWAT	Monthly	Isfehan-Barkhoar, Iran
[75]	MODFLOW	MT3DMS		Multi-objectives optimization	Non-cooperative game theory		Monthly	Bad-Khaledabad, Iran
[57]	MODFLOW	MT3DMS	DREAMzs	MOPSO		SWAT	Monthly	Isfahan-Barkhoar, Iran
[58]	MODFLOW	MT3DMS	DREAMzs	MOPSO	SCR. FB	SWAT	Monthly	Isfahan-Barkhoar, Iran

Table S4. The research employing optimization models in conjunction with simulation

Author (year)	Simulation Quantity	Simulation Quality	Uncertainty	Optimization	Game theory or Conflict resolution	Surface water models	Time step	Case study
[59]	MODFLOW	MT3D		Bundle-Trust			Annual	Na'aman Aquifer, Western Galilee, Israel
[7]	ISOQUAD			CDDP and GA			3 Months	Hypothetical
[76]	MODFLOW			Linear optimization			Annual	Island
[10]	MODFLOW			MINLP			Annual	Upper San Pedro River Basin, southeastern Arizona, Mexico
[11]	LTM			NSGA-II			Annual	Hypothetical

Ref							Temporal	Study Area
[15]	MODFLOW			GA and ANN			Monthly	The southern part of Tehran, Iran
[77]	(GS/RF)			CMA-ES				Hypothetical
[22]				CDDP-ANFIS			3 Months	Hypothetical
[62]	MODFLOW	MT3D	Monte Carlo	GA				Hypothetical
[23]	MOC			GA			Monthly	Hypothetical
[64]	MODFLOW	MT3D		NSGA-II	YCRT		Monthly	Tehran aquifer, Iran
[65]	MODFLOW	MT3DMS		MINOS			Annual	hypothetical
[26]		advective mass transport		GA			Annual	Hypothetical
[28]	FEHM		NSMC	AMALGAM			Annual	Yucca Flat, USA
			MCMC (DREAM)					
[67]	MODFLOW	MT3D		NSGA-II	RSBT		Monthly	Tehran aquifer, Iran
[31]	MODFLOW and ANN			GA			Monthly	Najafabad plain in westcentral, Iran
[34]	AEM			PSO			Annual	Dore-France
[35]				ECACO			Daily	Hypothetical
[70]	MODFLOW	MT3D	FOK	NSGA-II			Annual	hypothetical
[43]	MODFLOW			HS			Monthly	Izmir, Turkey
[44]	MODFLOW			DE and BFGS			Monthly	Izmir, Turkey
[45]	MODFLOW			GA			Monthly	Iran
[48]	MODFLOW			NSGA-II	MCSGA and NGA		Monthly	Rafsanjan plain, Iran
[49]	MODFLOW		MCS	NSGA-II			Annual	aquifer-Muscat, Oman
[73]	MODFLOW	MT3DMS		NSGA-II			Monthly	Najaf Abad plain, Iran
[78]	MODFLOW		Monte Carlo	NSGA-II	SCR Fallback Bargaining		Monthly	Tashk-Bakhtegan river basin, Iran
[74]	MODFLOW	MT3DMS	Monte Carlo	NSGA-II	SCR Fallback Bargaining		Monthly	Kavar-Maharloo aquifer, Iran
[56]	MODFLOW	MT3DMS		MOPSO		SWAT	Monthly	Isfahan-Barkhoar, Iran
[75]	MODFLOW	MT3DMS		Multi-objectives optimization	Non-cooperative game theory		Monthly	Khaledabad, Iran
[57]	MODFLOW	MT3DMS	DREAMzs	MOPSO		SWAT	Monthly	Isfahan, Iran
[58]	MODFLOW	MT3DMS	DREAMzs	MOPSO	SCR FB	SWAT	Monthly	Isfahan, Iran

Table S5. The research employed uncertainty analyses in conjunction with simulation

Author (year)	Simulation		Uncertainty	Optimization	Game theory or Conflict resolution	Surface water models	Time step	Case study
	Quantity	Quality						
[4]			MCS and fuzzy logic-based alpha-cut					Vannetin basin, France
[5]	MODFLOW		GLUE					Hypothetical
[79]	BIGFLOW		Monte Carlo					Plain of Tadla, Morocco
[13]			Fuzzy α-cut					
			MCS					
[61]	MODFLOW	MT3DMS	Spatial bootstrap				Daily	Hypothetical
[20]	MODFLOW		GLUE					Hypothetical
			BMA					
[62]	MODFLOW	MT3D	Monte Carlo	GA				Hypothetical
[25]			FSPDE, FPDE, SPDE					Hypothetical
[28]	FEHM		NSMC	AMALGAM			Annual	Yucca Flat, USA
			MCMC (DREAM)					
[29]			Fuzzy-probabilistic and conventional Monte Carlo simulation					Hanford site, Washington, USA
[30]			Hybrid				Annual	
			propagation					
[32]	MODFLOW		AM-MCMC					Hypothetical
[69]	MODFLOW	MT3D	FPPA				Annual	Hypothetical
[70]	MODFLOW	MT3D	FOK	NSGA-II			Annual	hypothetical
[71]		PGREM3D	MCMC				Daily	Hypothetical
[37]	MODFLOW		MPS and SGeMS				Annual	Ølgod, Jutland, Denmark
[42]	MODFLOW		NSMC					
[80]	GFLOW		Monte Carlo					Wisconsin. USA
[49]	MODFLOW		MCS	NSGA-II			Annual	aquifer-Muscat, Oman
[81]	MODFLOW		GLUE				Monthly	Birjand aquifer, Iran
[78]	MODFLOW		Monte Carlo	NSGA-II	SCR-Fallback Bargaining		Monthly	Tashk-Bakhtegan river basin, Iran
[74]	MODFLOW	MT3DMS	Monte Carlo	NSGA-II	SCR-Fallback Bargaining		Monthly	Kavar-Maharloo aquifer, Iran
[57]	MODFLOW	MT3DMS	DREAMzs	MOPSO		SWAT	Monthly	Isfahan-Barkhoar, Iran

| [58] | MODFLOW | MT3DMS | DREAMzs | MOPSO | SCR. FB | SWAT | Monthly | Isfahan-Barkhoar, Iran |

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