## Curriculum Vitae

Name	: <u>Dasika</u> Nagesh Kumar		
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Date of Birth	: 15 July 1963		
Citizenship	: Indian		
Marital status	: Married and 2 children		

#### Academic

#### **Doctor of Philosophy (Ph D)**

in Water Resources Systems on "*Integrated Modelling for Optimal Reservoir Operation for Irrigation*" in Civil Engineering Department, Indian Institute of Science, Bangalore. (1987-1992) **Master of Engineering (M E)** 

in *Hydrology and Water Resources Engineering* at Centre for Water Resources, Anna University, Madras. First class with Distinction. (1985-1987)

#### **Bachelor of Technology (B Tech)**

in *Civil Engineering*, V R Siddhartha Engineering College, Vijayawada, Nagarjuna University, Andhra Pradesh. First class with Distinction. (1980-1984)

#### Experience

Professor in *Dept. of Civil Engg.*, I I Sc, Bangalore. (May 2008 to date)
Associate Professor in *Dept. of Civil Engg.*, I I Sc, Bangalore. (May 2002 to May 2008)
Associate Professor in *Dept. of Civil Engg.*, I I T, Kharagpur. (Aug 2000 to May 2002)
BOYSCAST Fellow, Utah Water Research Lab, Utah State Univ., USA. (Jan to July 1999)
Assistant Professor in *Dept. of Civil Engg.*, I I T, Kharagpur. (Sept 1995 to Aug 2000)
Visiting Lecturer in *Dept. of Civil Engg.*, I I T, Kharagpur. (Feb 1994 to Aug 1995)
Scientist in *Water Resources Group* of National Remote Sensing Agency, Hyderabad, India. (Sept 1992 to Jan 1994)

#### **Publications: 105**

Journals	: 54	(International: 43; Indian: 11)
Conferences	: 51	(International: 31; National: 20)
Books	$:1^*$	( <sup>*</sup> Two volumes of edited Book)
Technical Repo	orts : 12	Under review : 8

#### **Membership in Professional Bodies**

- > Affiliate Member, American Society of Civil Engineers, USA.
- Member, International Association for Hydrological Sciences, U.K.
- Member, International Society on Multi Criteria Decision Making, USA.
- Fellow, Institution of Engineers (India), Calcutta, India
- Fellow, Indian Society for Hydraulics, Pune, India
- Member, Indian Society of Remote Sensing, Dehradun, India

Member, Indian Water Resources Society, Roorkee, India

## Awards & Distinctions

- Recipient of Young Scientist project award from Department of Science and Technology, India under 'Young Scientist Scheme' to conduct research on Artificial Neural Networks and their adaptability to Stochastic Hydrology, 1997-99.
- Recipient of BOYSCAST fellowship award from Department of Science and Technology, India to Visit Utah Water Research Laboratory, Utah State Univ., Logan, USA for 6 months (3<sup>rd</sup> Jan to 2<sup>nd</sup> July '99) for collaborative research on Climate Hydrology.
- Associate Editor, Journal of Hydrologic Engineering, American Society of Civil Engineering (ASCE), USA.
- **Best Paper Award** for the paper *Optimal design of water distribution system using Linear Programming Gradient (LPG) method* published in Journal of Indian Water Works Association for the year 1998.
- Sir Arthur Cotton Memorial Medal for the paper *Multicriterion Q-Analysis and Compromise Programming for Irrigation Planning*, published in Civil Engg Journal of Institution of Engineers (India) for the year 2001.
- Member Secretary, International Conference on Advances in Civil Engineering, Kharagpur, 3-5 Jan 2002.
- Member, Board of Appointment for selection of candidates for appointment to the posts of Lecturer, Reader and Professor in the Post-graduate Department of Civil Engineering in Bangalore University, 2003, 2005 & 2007.
- Member, International Technical Committee, International Conference on "Water and Wastewater: Perspectives of Developing Countries", IIT, New Delhi, India, 11-13 December 2002.
- Member, International Technical Committee, International Conference on "Advanced modeling techniques for sustainable management of water resources", NIT, Warangal, India, 28-30 January 2004.
- Expert Member, AICTE team to inspect private engineering colleges in Karnataka, 2005.
- **Resource Person** for workshop on 'Curriculum for Post Graduate Education' in National Institute of Technology Karnataka, Surathkal, organized under the World Bank funded Technical Education Quality Improvement Program (TEQIP), Feb 2005.
- Member, Task Team for 'Hydrological Modelling of Brahmaputra and Barak basins for flood forecasting using Doppler Weather Radar', Govt. of Assam, 2006 to date.
- **Resource Person** for workshop on 'Curriculum for Post Graduate Education' in Sri Vekateswara Univ, Tirupathi, organized under the World Bank funded TEQIP, Feb 2008.
- Member, International Scientific Committee, Water Down Under 2008, Adelaide Convention Centre, Adelaide, Australia, 15-17 April 2008.
- Member, Board of Studies in Civil Engineering (UG & PG), Bangalore University, Bangalore, for the period 2008-2011.

# Training

- ♦ Attended Ten weeks training program on "*Remote Sensing technology and Applications through Visual Interpretation & Digital Analysis*" at National Remote Sensing Agency Training Center, Hyderabad, Andhra Pradesh. (23-11-1992 to 29-01-1993).
- Attended training program on "*Multimedia facilities and Applications*" at Center for Continuing Education Program, I I T, Kharagpur. (Jan 1996).

# **Review Work**

	International Journals				
Sl.	Journal	Publisher	Years in which	Total	
No.			reviewed		
1	Water Resources Research	American Geophysical	1999, 2000, 2003,	5	
		Union (AGU), USA	2006, 2008		
2	J. Geophysical Research -	American Geophysical	2007	1	
	Atmospheres	Union (AGU), USA			
3	Geophysical Research	American Geophysical	2001	1	
	Letters (Atmosphere)	Union (AGU), USA			
4	Advances in Water	Elsevier	2008	1	
	Resources				
5	J. Irrigation and Drainage	American Society of Civil	2004, 2006, 2007.	5	
	Engg.	Engineers (ASCE), USA.			
6	J. Computing in Civil Engg.	American Society of Civil	2001, 2008	2	
		Engineers (ASCE), USA.			
7	J. Hydrologic Engg.	American Society of Civil	2003, 2004, 2005,	14	
		Engineers (ASCE), USA.	2006, 2007, 2008		
8	J. Water Resources	American Society of Civil	2007	1	
	Planning and Management	Engineers (ASCE), USA.			
9	J. Environmental Engg.,	American Society of Civil	2005, 2006, 2007	3	
		Engineers (ASCE), USA.			
10	Practice Periodical of	American Society of Civil	2003, 2004.	2	
	Hazardous, Toxic and	Engineers (ASCE), USA.			
	Radioactive Waste				
	Management				
11	Hydrological Sciences	International Association	2002, 2003, 2005	3	
	Journal	for Hydrological Sciences			
		Press, UK.			
12	Hydrological Processes	Wiley InterScience, UK.	2003, 2004, 2006,	5	
			2008		
13	IEEE Trans. on Systems,	IEEE, USA	2003	1	
1.4	Man, and Cybernetics A		2007		
14	IEEE Trans. on Systems,	IEEE, USA	2007	2	
15	Man, and Cybernetics B		2002	1	
15	IEEE Irans. on Fuzzy	IEEE, USA	2003	1	
10	Systems	<b>F</b> 1	2002	1	
10	Fuzzy Sets and Systems		2003		
1/	Engineering Optimization	Taylor & Francis, UK.	2005	1	
18	Meteorology and	Springer	2005	1	
10	Atmospheric Physics	Flooring	2004	1	
19	Remote Sensing of	Elsevier	2004	1	
20	Environmental Stochastic Environmental	Springer	2004	1	
20	Desearch & Dick Assert	springer	2004	1	
21	Water International	Int. Water Descurress	2001 2005	2	
21		Association Canada	2001, 2003	2	
22	Irrigation and Drainage	Wiley InterScience UV	2004	1	
22	Inigation and Drainage	whey interscience, UK.	2004		

23	Water Resources Management	Springer	2005, 2006, 2007	10
24	Flow Measurement and Instrumentation	Elsevier	2005, 2006, 2007	3
25	Environmental Modeling and Assessment	Springer	2006	1
26	Environmental Modelling & Software	Elsevier	2006, 2007	5
27	J. Applied Mathematics and Decision Sciences	Hindawi Publishing, UK.	2006	1
28	Agricultural Water Management	Elsevier	2006	3
29	Journal of Hydroinformatics	IWA Publishing, UK.	2006, 2007, 2008	6
30	Journal of Hydrology	Elsevier	2006, 2007	3
31	Physics and Chemistry of the Earth	Elsevier	2006, 2007	8
32	Information Sciences	Elsevier	2004	1
33	Nordic Hydrology	IWA Publishing, UK.	2007	1
34	International Journal of Sediment Research	Elsevier	2007	1
35	Journal of Intelligent and Fuzzy Systems	IOS Press, The Netherlands	2005	1
36	Journal of Hydro- environment Research	Elsevier	2007, 2008	2
37	Canadian Journal of Civil Engineering	University of British Columbia, Canada	2007	1
38	Optimization in Engineering	Springer	2007	1
39	Ground Water	Blackwell Publishing, USA	2008	1
40	Hydrology Research	IWA Publishing, UK	2008	1
41	J. American Water Resources Association	Blackwell Publishing, USA	2008	1
			Total	106

	Indian Journals					
Sl. No.	Journal	Publisher	Years in which reviewed	Total		
1	Journal of Institution of Engineers (India)	Institution of Engineers (India), Kolkata	2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007	20		
2	Current Science	Indian Academy of Sciences, Bangalore.	2005, 2006, 2007	7		
3	Journal of Earth System Science	Springer & Indian Academy of Sciences, Bangalore.	2004, 2006, 2007, 2008	7		
4	Sadhana	Indian Academy of Sciences, Bangalore.	2003, 2005, 2008	3		
5	Hydrology Journal	Indian Association of Hydrologists, Roorkee.	2003, 2004, 2005	4		
6	Journal of Hydraulic Engineering	Indian Society for Hydraulics, Pune	2006, 2007, 2008	4		
7	Journal of IISc	Indian Institute of Science, Bangalore.	2003, 2004	2		
			Total	47		

	Conferences	
Sl. No.		Total
1	International Workshop and Conference on Construction management and	1
2	First Indian International Conference on Artificial Intelligence (IICAI-03), Hyderabad, India. December 18-20, 2003.	3
3	International Conference on Hydrlogical Perspectives for Sustainable Development (HYPESD-2005), IIT, Roorkee, India, February 23-25, 2005.	3
4	2nd Indian International Conference on Artificial Intelligence (IICAI-05), Pune, India. December 20-22, 2005.	4
5	15th Congress of APD – IAHR, IIT, Madras, August 7-10 2006.	2
6	17th IASTED International Conference on Modelling and Simulation (MS 2006), Montreal, Canada, May 24-26, 2006.	1
7	International Conference on Advances in Mechanical Engineering, SRM Institute of Science and Technology, Chennai, India, December 14-16, 2006.	1
8	3rd National Conference on Fluid Mechanics and Fluid Power (NCFMFP 2006), IIT, Bombay, India, December 7-9, 2006.	3
9	International Conference on Civil Engineering in the New Millennium: Opportunities and Challenges (CENeM-2007), Bengal Engineering and Science University, Kolkata, India, January 11-14, 2007.	2
10	3rd Indian International Conference on Artificial Intelligence (IICAI-07), Pune, India, December 17-19, 2007.	5
11	4th International Conference on Water Resources and Environment Research (Water Down Under 2008), Adelaide, Australia, April 15-17, 2008.	4
	Total	29

	Miscellaneous		
Sl. No.		Years in which reviewed	Total
1	Project proposal, Council for Scientific and Industrial Research (CSIR), New Delhi.	2005	1
2	Project proposal, DST-DAAD, Department of Science and Technology (DST), New Delhi.	2004, 2005	2
3	Project proposal, NRDMS, Department of Science and Technology (DST), New Delhi.	2003	1
4	Project proposal, International Foundation for Science (IFS), Stockholm, Sweden.	2005	1
5	Project proposal, Indian National Committee on Hydrology (INCOH), NIH, Roorkee.	2006, 2007	2
6	Project proposal for EMCaB, Indira Gandhi Institute of Development Research, Bombay.	2000	1
7	Technical Report, National Institute of Hydrology, Roorkee.	2004	2
8	Technical Report, National Institute of Hydrology, Kakinada.	2003	1
9	Review of 'Khosla Award' nomination, IIT, Roorkee.	2002	1
10	Review of 'Young Engineer' nomination, Indian National Academy of Engineering (INAE), New Delhi.	2003	1
	Total		13

# **Examination of PhD Theses**

Sl.	Institute/ University	Years in which	Total
No.		examined	
1	Victoria Univ. of Technology, Melbourne, Australia.	2001, 2007	2
2	Indian Institute of Science, Bangalore.	1998	1
3	Indian Institute of Technology, Bombay, Mumbai.	2001, 2007	2
4	Indian Institute of Technology, New Delhi.	2007	1
5	Indian Institute of Technology, Kharagpur.	2004, 2005,	5
		2006, 2007	
6	Birla Institute of Technology and Science, Pilani.	2005	1
7	NIT, Durgapur, University of Burdwan.	2001	1
8	NIT, Nagpur, Nagpur Univeristy.	2002	1
9	Andhra University, Visakhapatnam.	2002, 2004	2
10	Anna University, Chennai.	2005, 2008	2
11	S.V. University, Tirupathi.	2005	1
12	University of New South Wales, Australia	2008	1
	Total		20

# **Sponsored Research & Consultancy**

	<b>F</b> 11	<b>T</b> 7 <b>1</b>		
	Funding	Value		
Title	Agency	( <b>Rs.</b> )	Duration	Investigators
Use of Climatic	SERC, Dept.	11,14,560	Jun 2004	D. Nagesh Kumar (PI)
Inputs in Reservoir	of Science and		to	P.P. Mujumdar
<b>Operation Models</b>	Technology,		Jan 2008	
	Govt. of India.			
Development of a	NRDMS,	8,90,299	Sep 2004	P.P. Mujumdar (PI)
Simputer-Based	Dept. of		to	D. Nagesh Kumar
Decision Support	Science and		Mar 2007	
System for Water	Technology,			
User Associations in	Govt. of India.			
Canal Command				
Areas				
Assessment of Water	INCOH,	30,74,000	Feb 2006	P.P. Mujumdar (PI)
Resources under	Ministry of		to	D. Nagesh Kumar
Climate Change	Water		Feb 2009	V.V. Srinivas
Scenarios at River	Resources,			
Basin Scale	Govt. of India.			

## **Sponsored Research Projects:**

SERC – Science and Engineering Research Council

NRDMS – Natural Resources Data Management System

INCOH – Indian National Committee on Hydrology

## **Consultancy Projects:**

Title	Funding Agency	Value	Duration	Co-
		( <b>Rs.</b> )		Consultants
Review of Hydrology and	Karnataka Power	1,23,500	May '02	P.P. Mujumdar
Power Studies for KHEP	Corp. Ltd.,		to	
Stage II	Bangalore		Dec '03	
Flood Routing Studies	NAWAD	50,400	Apr '04 to	P.P. Mujumdar
	Council, Madurai		Jun '04	
Integrated Reservoir	Narmada Control	16,50,000	Feb 04	P.P. Mujumdar
Operation Studies for	Authority, Indore		to date	-
Reservoirs in Narmada Basin				
Water Res. Assessment and	IWMI, Colombo	3,48,345	Jul '05	V.V. Srinivas
Management in Malaprabha	through their		to	
Reservoir System of the	Hyderabad office		Jul '06	
Krishna River basin				
Evaluation of Proposals for	Bhakra Beas	1,20,000	Jan '08	
Development of Real-time	Mgmt. Board		(One	-
DSS for Operational Mgmt of	(BBMB),		month)	
reservoirs of BBMB	Chandigarh			
Technical negotiations with	BBMB,	48,000	April '08	
selected consultant for	Chandigarh		(One	-
development of RT-DSS for			month)	
operation of reservoirs of				
BBMB				

NAWAD - National Waterways Development; IWMI - International Water Mgmt Institute

## Earlier while working in IIT, Kharagpur (1994-2002)

- Artificial Neural Networks and their adaptability to Stochastic Hydrology, D.Nagesh Kumar, sponsored by Dept. of Science and Technology under 'Young Scientist Scheme', 1997-99.
- Computer Assisted Instructions for Geotechnical Testing, C.S. Rao, D. Nagesh Kumar, Jan '99 to July 2000, sponsored by AICTE.
- *Modifications/Alternatives for the proposed Stepped Spillway structure of Jambhira earth dam*, C.R.S.Pillai and D.Nagesh Kumar, **consultancy project** to Orissa state govt., 1995.
- *Rain Water Harvesting Scheme for BRNML*, S.N. Ghosh, V.R. Desai, D. Nagesh Kumar, consultancy project to Bharatiya Reserve Bank Note Mudran Limited (BRNML), Salboni, Midnapur District, West Bengal, 2001.

Sl.		Sponsoring Agency	Duration	Target Group	Course	
No.	Course				Fee (Rs.)	
1	Web-based Course	NPTEL <sup>&amp;</sup> , Ministry	2004-2007	Open to staff	5,00,000	
	on 'Optimization	of Human Resource	(course	and students		
	Methods'	and Development,	develop-	of Engg.		
		Govt. of India.	ment time)	colleges		
2	Streamflow	Irrigation Mgmt.	Nov.	Engineers of	3,60,000	
	Generation,	Training Institute	11-23,	PWD, Govt.		
	Forecasting and	(IMTI), Trichy,	2002	of Tamilnadu		
	Data Extension <sup>+</sup>	Tamilnadu				
3	Statistical Methods	IMTI, Trichy,	Feb. 17 to	Engineers of	3,60,000	
	in Hydrological	Tamilnadu	March 1,	PWD, Govt.		
	Data Processing <sup>+</sup>		2003	of Tamilnadu		
4	Open Channel	IMTI, Trichy,	June	Engineers of	3,96,000	
	Hydraulics <sup>+</sup>	Tamilnadu	16-27,	PWD, Govt.		
			2003	of Tamilnadu		
5	Open Channel	IMTI, Trichy,	May	Engineers of	2,64,000	
	Hydraulics <sup>*</sup>	Tamilnadu	02-06,	PWD, Govt.		
			2005	of Tamilnadu		
6	Optimal Reservoir	Bhakra Beas Mgmt.	May	Engineers of	1,20,000	
	Operation <sup>*</sup>	Board (BBMB),	15-16,	BBMB,		
		Chandigarh	2005	Chandigarh		

#### Short Term Courses/ Training Programs Organised

<sup>&</sup> NPTEL – National Program on Technology Enhanced Learning

<sup>+</sup> Jointly organized with Prof P P Mujumdar and Prof S Vedula

\* Jointly organized with Prof P P Mujumdar

#### Earlier while working in IIT, Kharagpur (1994-2002)

- Organised AICTE sponsored Summer school on System Techniques and Computer Applications in Water Resources, 31 June - 11 July 1997, Civil Engg Dept., IIT, Kharagpur (Coordinator: D. Nagesh Kumar).
- Organised AICTE sponsored short term course on Advanced Information Technology Applications to Civil Engineering, 4-15 December 2000, Civil Engg Dept., IIT, Kharagpur, (Coordinators: D. Nagesh Kumar and S.V. Barai).

## Academic & Administrative Activities at IIT, Kharagpur (1994-2002)

- Subjects taught at **Post Graduate level (M.Tech)**
- Hydrologic Analysis and Design; Water Resources Systems; Irrigation Engineering; Design of Hydraulic Structures; Remote Sensing Applications in Water Resources; Computer Applications in Water Resources
- Subjects taught at Under Graduate level (B.Tech) Hydrology and Irrigation; Advanced Hydrology; Remote Sensing and its Applications; Water Resources Engineering; Mechanics; Engineering Drawing and Computer Graphics; Design and drawing for hydrology and Irrigation; Civil Engineering lab-I (Water Resources).
- Introduced a **new Elective** 'Remote sensing applications in water resources' at PG level
- Professor-in-charge, Water Resources Engg Section of Civil Engg Dept, June 2000 to May 2002.
- Member, Departmental Academic Committee (UG), June 2000 to 2002.
- Member, Departmental Academic Committee (PG&R), June 2000 to 2002.
- Member, Departmental Administrative Committee, 1998.
- ▶ In-charge, Departmental Computer laboratory, 1997-2000.
- Convenor, Computer Coordination Committee, 1997-2000.
- ➢ Time-table in-charge, 1997.
- Secretary, Faculty body of Civil Engg Dept, 1997-99.
- Faculty in-charge, Admission & Registration of M.Tech students, 1997-99.
- Faculty in-charge, Research scholars admissions, 1997-99.
- Member Secretary, International Conference on Advances in Civil Engineering, Kharagpur, 3-5 Jan 2002.

### **Research Interests**

- Rainfall-Runoff Modeling
- Optimal Reservoir Operation Models
- Time Series Analysis in Hydrology
- Water Allocation Models
- Satellite Remote Sensing in Irrigation Management
- Disaggregation Models in Hydrology
- Artificial Neural Networks in Hydrology
- Multicriterion Decision Making (MCDM) in river basin development and management
- Fuzzy Approach for MCDM in river basin development and management
- > Evolutionary Algorithms for optimal reservoir operation
- Climate Hydrology
- > Impact of Climate Change on Hydrology of River Basins
- Downscaling of Climate Variables

# **Research Activities**

# Climate Hydrology

# • Impact of large-scale coupled atmospheric-oceanic circulation on hydrologic variables

In the recent scenario of climate change, the natural variability and uncertainty associated with the hydrologic variables is gaining importance. Assessment of hydroclimatic teleconnection for Indian subcontinent and its use in basin-scale hydrologic time series analysis and forecasting is investigated. El Niño-Southern Oscillation (ENSO) is the well established coupled Oceanatmosphere mode of tropical Pacific Ocean whereas Indian Ocean Dipole (IOD) mode is recently identified. Equatorial Indian Ocean Oscillation (EQUINOO) is the atmospheric component of IOD mode. The potential of ENSO and EQUINOO for predicting Indian summer monsoon rainfall (ISMR) is investigated using Bayesian Dynamic Linear Model (BDLM). A major advantage of this method is that, it is able to capture the dynamic nature of the cause-effect relationship between large-scale circulation information and variability in hydrologic variables. Another new method is developed to capture the dependence between the teleconnected hydroclimatic variables based on the theory of copula. The association of monthly variation of ISMR with the combined information of ENSO and EQUINOO, denoted by monthly composite index (MCI), is also investigated and a relationship is established. The spatial variability of such association is also investigated.

Having established the hydroclimatic teleconnection at a comparatively larger scale, the hydroclimatic teleconnection for basin-scale hydrologic variables is then investigated and established. The association of large-scale atmospheric circulation with inflow during monsoon season into Hirakud reservoir, Orissa, India, has been investigated. The strong predictive potential of the composite index of ENSO and EQUINOO is established including for extreme inflow conditions. Recognizing the basin-scale hydroclimatic association with both ENSO and EQUINOO at seasonal scale, the information of hydroclimatic teleconnection is used for streamflow forecasting for the Mahanadi River basin, Orissa, India, both at seasonal and monthly scale. Information of streamflow from previous month(s) alone, as used in most of the traditional modeling approaches, is shown to be inadequate. It is successfully established that incorporation of large-scale atmospheric circulation information significantly improves the performance of prediction at monthly scale. Adopting the developed approach of using the information of hydroclimatic teleconnection, hydrologic variables can be predicted with better accuracy which will be a very useful input for better management of water resources.

# • Impact assessment of climate change on hydrometeorology of Indian river basin for IPCC SRES scenarios

Knowledge of plausible implications of climate change on hydrometeorology of a river basin will prepare us for adapting to the impacts of climate changes on water resources for sustainable management and development. Among the meteorological variables, six "cardinal" variables are identified as the most commonly used in impact studies (IPCC, 2001). These are maximum and minimum temperatures, precipitation, solar radiation, relative humidity, and wind speed. Among the climate scenarios adapted in impact assessments, those given in Intergovernmental Panel on Climate Change's (IPCC's) Special Report on Emissions Scenarios (SRES) have become the standard scenarios. General circulation models (GCMs) are run at coarse spatial resolutions and

therefore the climate variables simulated by these models cannot be used directly for impact assessment on a local (river basin) scale. Support vector machine (SVM) is proposed for downscaling monthly sequences of large scale atmospheric variables simulated by third generation coupled Canadian GCM (CGCM3) to monthly sequences of hydrometeorological variables in a river basin. The monthly sequences are subsequently disaggregated to daily sequences using k-nearest neighbor (k-NN) disaggregation technique. The catchment of Malaprabha river (upstream of Malaprabha reservoir) in India is chosen as the case study to demonstrate the effectiveness of the developed models. Implications of climate change on monthly values of each of the six cardinal variables in the region are studied. Results show that precipitation, maximum and minimum temperature, relative humidity and cloud cover are projected to increase in future for A1B, A2 and B1 scenarios. The wind speed is not projected to change in future for all the aforementioned scenarios. No trend is discerned with the COMMIT scenario for any of these variables.

To assess implications of climate change on monthly streamflows in the river basin, daily sequences of the meteorological variables obtained from downscaling and disaggregation models are used as inputs to Soil and Water Assessment Tool (SWAT), besides DEM, land use/land cover and soil data. The SWAT is a physically based, distributed, continuous time hydrological model that operates on a daily time scale. The SWAT model has projected an increase in future streamflows for A1B, A2 and B1 scenarios, whereas no trend is discerned for the COMMIT scenario. Results obtained will be very much useful for effective management of available water resources in the river basin.

## Optimization in Water Resource Systems

Efficient optimization techniques based on swarm intelligence and evolutionary computation principles have been proposed for single and multi-objective optimization in water resources systems. To overcome the inherent limitations of conventional optimization techniques, metaheuristic techniques such as ant colony optimization (ACO), particle swarm optimization (PSO) and differential evolution (DE) are developed for single and multi-objective optimization. To achieve robust Pareto optimal fronts for multi-objective problems, a novel approach is developed by incorporating Pareto optimality principles into PSO algorithm, called elitist-mutated multiobjective particle swarm optimization (EM-MOPSO). For effectively handling interdependence relationships among decision variables of multi-objective water resource problems, an efficient multi-objective solver, namely multi-objective differential evolution (MODE) is developed. The developed MODE algorithm is evaluated with several test problems and also applied to a case study of Hirakud reservoir to derive operational tradeoffs in the reservoir system optimization. To demonstrate the applicability of the developed optimal operating policies for real time reservoir operation, reservoir inflow forecasting models are developed using soft computing approaches viz., artificial neural networks (ANNs), adaptive network fuzzy inference system (ANFIS) and hybrid particle swarm optimization trained neural network (PSONN). These methods are then applied to a few case studies in planning and operation of reservoir systems in India.

## Multicriteria Decision Making (MCDM) in Water Resources

Multicriteria Decision Making (MCDM) has emerged as an effective methodology due to its ability to combine quantitative and qualitative criteria for selection of the best alternative.

Several MCDM techniques are adopted for selection or ranking of irrigation planning alternatives. They include (i) fuzzy logic based MCDM methods, namely, similarity analysis (SA) and decision analysis (DA), (ii) Kohonen neural networks (KNN) based classification algorithm (iii) Data Envelopment Analysis (DEA) etc. These techniques are successfully applied to several case studies such as (i) Sri Ram Sagar project, Andhra Pradesh, India, (ii) Jayakwadi irrigation project, Maharashtra, India.

# \* Remote Sensing for Irrigation Management

An unsupervised fuzzy classification technique viz., penalized fuzzy c-means algorithm (PFCM) is successfully adopted to classify irrigated area from multi-date multi-spectral remote sensing imageries (IRS LISS I data) into paddy and semi-dry cropped areas in Bhadra command area, Karnataka. Paddy and semi-dry crops were classified with much higher accuracy using PFCM when compared to conventional algorithms. Using this approach, perennial crop (sugarcane) is also discriminated from other crops. These results can be utilized for better irrigation assessment in the command area.

# **Publications**

## (in chronological order)

- 1. *Markov mixture model for streamflow forecasting*, S.Vedula, D.Nagesh Kumar and R.Srinivasan, Proceedings of conference on Hydromechanics and Water resources engineering, Bangalore, 4 May 1990, pp.136-145.
- Stochastic models of streamflow Some case studies, P.P.Mujumdar and D.Nagesh Kumar, Hydrological Sciences Journal, IAHS Press, UK, Vol.35, No.4, August 1990, pp.395-410.
- 3. *Real time optimal reservoir operation*, P.P.Mujumdar, D.Nagesh Kumar and S.Vedula, Proceedings of International conference on Computer applications in water resources, Taiwan, Vol.1, 3-6 July 1991, pp.125-133.
- 4. Seasonal irrigation allocations with soil moisture balance for variable rainfall and evaporation, D.Nagesh Kumar and S.Vedula, IAHR Asia & Pacific regional division VIII congress, Pune, India, 20-23 October 1992, pp.A251-A261.
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- 12. Integrated Reservoir Operation Studies for Reservoirs in the Narmada Basin, P.P.Mujumdar and D.Nagesh Kumar, Report submitted to Narmada Control Authority, Indore, October 2006.
- Assessment of Water Resources under Climate Change Scenarios at River Basin Scale, P.P. Mujumdar, D. Nagesh Kumar, V.V.Srinivas, MoWR Ref No. 23/52/2006-R&D, Progress report submitted to Indian National Committee on Hydrology (INCOH), Ministry of Water Resources, New Delhi, May 2007.
- Development of a Simputer-Based Decision Support System for Water User Associations in Canal Command Areas, P.P.Mujumdar and D.Nagesh Kumar, DST Ref. No. ES/11/712/2003, Project Completion Report submitted NRDMS, Dept of Science and Technology, New Delhi, June 2007.

# Impact Factors of Journals in which Papers are Published or under Review:

Source: Journal Citation Report - 2006 published in 2007 (ISI Web of Knowledge)

	Name of the Journal	Impact Factor	Number of	Under review	Total
			Papers		
	Journal of Geophysical Research –				
1	Atmospheres	2.800	2	-	2
2	International Journal of Climatology	2.332	2	1	3
3	Water Resources Research	1.894	2	-	2
4	Advances in Water Resources	1.648	-	1	1
5	Hydrological Processes	1.640	4	1	5
	Water Resources Planning and				
6	Management, ASCE	1.531	1	-	1
7	Agricultural Systems	1.378	1	-	1
	Journal of Irrigation and Drainage				
8	Engineering, ASCE	1.250	2	-	2
9	Hydrological Sciences Journal	1.201	3	-	3
10	Fuzzy Sets and Systems Journal	1.181	2	-	2
11	Irrigation Science	1.160	1	-	1
	Journal of Computing in Civil				
12	Engineering, ASCE	0.975	1	-	1
13	Computers & Operations Research	0.893	1	-	1
14	Nordic Hydrology	0.814	2	-	2
15	Water Resources Management	0.615	7	1	8
	Flow Measurement and				
16	Instrumentation	0.600	1	-	1
17	Irrigation and Drainage	0.598	1	-	1
18	Hydro Informatics	0.595	-	1	1
19	Engineering Optimization	0.557	1	-	1
20	Water Resources Journal	-	1	-	1
21	Atmospheric Science Letters	-	1	-	1
22	Journal of Intelligent Systems	-	1	-	1
	Total		36	6	42

## Ph D theses guided (in reverse chronology)

- 1. *Biospecies modeling for climate change* C-T Rutuja, in progress (jointly with Prof R Sukumar)
- 2. *Climate hydrology modeling using Data mining techniques* C.T. Dhanya, in progress.
- 3. Impact of Climate Change on Hydrometeorology of Indian River Basin for IPCC SRES Scenarios

A Anandhi, (jointly with Dr. V.V. Srinivas), 2007.

- 4. Impact of large-scale coupled Atmospheric-Oceanic circulation on hydrologic variability and uncertainty through hydroclimatic teleconnection Rajib Maity, 2007.
- 5. Swarm Intelligence and Evolutionary Computation for Single and Multiobjective Optimization in Water Resource Systems M. Janga Reddy, 2007.

## in IIT, Kharagpur (1994-2002)

- 6. Long-term and short-term optimal reservoir operation for flood control Falguni Baliarsingh, 2001.
- 7. Multi criterion decision making in fuzzy environment for river basin development and management, P.Anand Raj (jointly with Prof. G.L.N Sastry), 2000.

## M Tech / M.E. (PG) Projects guided (in reverse chronology)

- 1. Ant colony optimization for optimal design of water distribution systems G. Sasidhar, 2006.
- 2. *Hydrologic Time Series Analysis and Forecasting with Climatic Inputs* Rajib Maity, 2004.
- 3. *Crop Classification using Multitemporal Imagery with Penalized Fuzzy C-Means Algorithm* K. Laxmi Raju, 2003.

## in IIT, Kharagpur (1994-2002)

- 4. *End Depth in Inverted Semicircular Channels: Experimental and Theoretical Investigations* D. Ram Singh (Jointly with Dr. S. Dey), 2000.
- 5. Optimal Reservoir Operation in Fuzzy Environment D.S.V. Prasad, 1999.
- 6. Application of Genetic Algorithms for Optimal Reservoir Operation Ashok Kumar, 1999.
- 7. *River Flow Forecasting using Artificial Neural Networks* T. Sathish, 1998.
- 8. Application of Watershed Bounded Network Model for rainfall-runoff Modelling K.C. Swain, 1997.
- 9. *Model Investigations of Stepped Spillway* P.C. Nayak, 1996.
- 10. Optimal Design of Water Distribution System using Liner Programming Gradient Method T. Rama Mohana Rao (Jointly with Prof M. Bandyopadhyay), 1995.

## B Tech (UG) Projects guided in IIT, Kharagpur (1994-2002):

- 1. *Neuro-gene optimization for Engineering Problems* Samir Kumar, 1999 (jointly with Dr Sudhirkumar Barai).
- 2. *Time Series analysis and forecasting of monthly Streamflow data* K. Arun, 1998.
- 3. Application of Recurrent Neural Networks for Hydrologic time series modelling Dibyendu Sengupta, 1997.
- 4. Application of Artificial Neural Networks for Rainfall-Runoff modelling Abhijit Ray, 1996.