



## CV of Professor Sekhar Muddu

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DATE OF BIRTH 26 AUGUST 1963

### QUALIFICATIONS

Degree/award	Year	Discipline/field	Organisation and country
<b>Ph.D.</b>	<b>1993</b>	<b>Civil Engineering</b>	Indian Institute of Science, Bangalore, India
<b>M.E.</b>	<b>1987</b>	<b>Civil Engineering</b>	Indian Institute of Science, Bangalore, India
<b>B.Tech.</b>	<b>1984</b>	<b>Civil Engineering</b>	Jawaharlal Nehru Technological University, College of Engineering, Kakinada, Andhra Pradesh, India

### CURRENT AND PREVIOUS POSITIONS HELD

Position held	Organisation	Department	Year appointed
Professor	Indian Institute of Science, Bangalore	Dept. of Civil Engineering	2015-
Adjunct Professor	Indian Institute of Science, Bangalore	Interdisciplinary Centre for Water Research	2015-
Associate Professor	Indian Institute of Science, Bangalore	Dept. of Civil Engineering	2007-2015
Adjunct Faculty	Indian Institute of Science, Bangalore	Center for infrastructure, sustainable transportation and urban planning	2009
Assistant Professor	Indian Institute of Science, Bangalore	Dept. of Civil Engineering	1996-2007
Lecturer	Indian Institute of Science, Bangalore	Dept. of Civil Engineering	1993
Poste Rouge Fellowship	University of Paul Sabatier, Toulouse	CESBIO, OMP, Toulouse	5/2015-7/2015
Visiting Scientist	INRA, Rennes, France	SAS Laboratory (6/2012-7/2012, 2011-7/2011, 5/2010-8/2010 & 5/2009-7/2009)	2012, 2011, 2010, 2009

Poste Rouge Fellowship of CNRS	OMP, France	LMTG, Toulouse	4/2006-12/2006
Visiting Scientist	University of Paul Sabatier, Toulouse	LMTG, Toulouse	5/2005-7/2005
Visiting Scientist	Technical University Eindhoven	Mathematics & Computational Science	3/2001-5/2001
Project Leader	Transoft International, Paris & Bangalore	POLLUSOL - Computational fluid dynamics	2/1993-11/1993

## RESEARCH AREAS

I work in the research areas including groundwater hydrology, agro-hydrology, satellite hydrology and urban hydrology, and more specifically on these thematics:

- Groundwater resource assessment under the influence of climatic variations and anthropogenic effects using numerical modeling, statistical tools and field studies.
- Retrieval of near surface soil moisture from radar remote sensing (SAR) and estimating profile soil moisture using modeling and assimilation at watershed scale. Retrieval of rainfall and modeling of ET from remote sensing and assimilating into distributed hydrological models.
- Stochastic modeling of flow and reactive solute transport in heterogeneous porous media. Theoretical studies and field scale experiments.
- Integrated geochemical and hydrological studies in tropical regions using experimental watersheds.
- Modeling groundwater in urban environments for resource and infrastructure studies.
- Smart water solutions in agriculture: Integration of Sensors, Satellite & ICT tools.

### *(1) Retrieval of hydrological variables from remote sensing.*

Calibration and validation of satellite retrievals of soil moisture, evapotranspiration, crop variables (e.g. leaf area index) and soil hydraulic properties from optical and microwave remote sensing.

### *(2) Analysis of groundwater recharge, balance and behaviour at different scales in hard rock aquifers.*

Kabini Critical Zone Observatory (<http://www.cefirse.ird.fr/content/view/full/84031>) comprises of nested catchments of four orders (< 10 Km<sup>2</sup>, 80 Km<sup>2</sup>, 600 Km<sup>2</sup> and 8000 Km<sup>2</sup>) on granitic-gneissic rock aquifers of global significance. These are being investigated to develop scale dependent relationships in hard rock aquifers and methods & modelling tools to for groundwater balance and disaggregation approaches for small watershed scales. Modelling recharge in urban scenario is complex due to various conditions and this was performed for Bangalore city (600 Km<sup>2</sup>) through dedicated monitoring and modelling under BUMP project; (<http://bangalore.urbanmetabolism.asia/2017/10/17/groundwater-levels-from-2015-to-2017/>).

*(3) Effects of land use and land cover on recharge in semi-arid tropical soils.*

The semi-arid areas have relatively higher ET and lower recharge and there is high degree of uncertainty in estimates of recharge in tropical soils. Further, in this millennium, the crop choice, the farming & irrigation practices are resulting in altered recharge. Through test sites in Kabini CZO, recharge, water use efficiency and improved crop productivity are being investigated using coupled models of crop and groundwater. The CZO comprises of paired catchments - forest and agricultural – to compare between the land cover types and to study the effects of climatic variability. (<http://www.cefirse.ird.fr/content/view/full/84395>).

*(4) Modeling the water-rock interactions in tropical semi-arid catchments.*

Tropical semi-arid catchments produce a greater percentage of weathered products (e.g. calcium, magnesium, silica) to the stream and eventually to ocean through the groundwater pathway. As there were no long term observatories in tropics relative to the temperate regions little is known about the fluxes from the groundwater. Paired experimental catchments (forested and agricultural) in Kabini CZO are investigated for chemical fluxes through field experiments and modelling studies.

*(5) Analysis of nitrate transport and transformation in semi-arid soils.*

The semi-arid agricultural parts of Kabini CZO have higher nitrates in groundwater (several times higher than the drinking water limit). The mechanisms of leaching of nitrate affected by soil & crop types, land use practices, aquifer conditions in tropical semi-arid soils is relatively less known. Investigations through laboratory and field experiments combined with modelling are being pursued in test sites of CZO towards this theme.

*(5) Smart water solutions in agriculture: Integration of Sensors, Satellite & ICT tools.*

To develop a decision support system, which utilizes a framework that combines microwave satellite observations (soil moisture and crop variables) with terrestrial data captured from network of IoT enabled soil sensors to provide smart solutions for agriculture with applications into the area of Irrigation scheduling and water management.

<https://agritech.boschindia.com/imprint>

Details are given in <http://www.ambhas.com>

## FUNDED RESEARCH PROJECTS

### Active projects

1. INGENIoS: Indo-German Network of Environmental Systems-Hydrology under Indo-German Partnership for Higher Education (IGP). Sponsored by UGC-DAAD. Duration 5 years (2020-2024). [Principal investigator].
2. Improved rainfall-runoff modelling by using satellite estimated soil moisture, under the umbrella project of "Early warning system for flood prediction in the river basins of India". Sponsored by CDAC. Duration 4 years (2019-2022). [Principal investigator].
3. Transport and transformation of pesticides from an Indian agro-system: Insights from Compound Specific Isotope Analysis (CSIA). Sponsored by International Atomic Energy Agency (IAEA). Duration 5 years (2018-2023). [Co-investigator].
4. Evaluating the soil moisture storage estimates using combination of water budget model and GRACE data. Sponsored by NRDMS, DST. Duration 3 years (2018-2021). [Principal investigator].

5. Smart water solutions in agriculture: Integration of Sensors, Satellite & ICT tools. Sponsored by IMPRINT, India. Duration 3 years (2017-2021). [Principal investigator].
6. Accompanying The adaptation of irrigated agriculture to climate CHange (ATCHA). Sponsored by ANR, France. Duration 4 years (2017-2021). [Co-investigator].
7. Estimation of higher resolution soil moisture over UK by combining active and passive microwave satellite data. Sponsored by CEH, UK. Duration 3 years (2017-2020). [Principal investigator].
8. Developing a new methodology for farm scale soil moisture estimation using radar-only model parameters modified using scattering power decomposition methods. Sponsored by SAC-ISRO, India. Duration 3 years (2017-2020). [Accepted] [Principal investigator].
9. MEERENDA: Microwave remote sEnsing for watEr Resources managEmEnt iN berambaDi wAtershed. Sponsored by CNRS, France. Duration 3 years (2017-2020). [Co-investigator].
10. An integrated study of hydrology and mineralogy for assessment of water quantity and quality in the sub-catchment/ watershed, Sponsored by IRD-France. Duration: 20 years (2001-2020) [Principal investigator].

### Completed projects

11. Upscaling Catchment Processes for Sustainable Water Management in Peninsular India. Sponsored by MoES and NERC, Indo-UK project. Duration 3 years (2016-2019). [Co-investigator].
12. Monsoon dynamics and thermodynamics from the land surface, through convection to the continental scale (INCOMPASS). Sponsored by MoES and NERC, Indo-UK project. Duration 3 years (2015-2018). [Co-investigator].
13. Bangalore Urban Metabolism Project (BUMP) – Informing better governance for urban sustainability. Sponsored by Asia, Cities Alliance, Brussels & SEI, US. Duration 2 years (2015-2017). [Co-investigator].
14. Adaptation of irrigated agriculture to climate change. Sponsored by Indo-French CEFIPRA/IFCPAR. Duration: 3 years (2013-2017). [Principal investigator].
15. What will the future be? Projecting environmental change in a warming world for semi-arid landscapes. Sponsored by DST-AISRF, Indo-Australian project. Duration: 3 years (2014-2017). [Principal investigator].
16. Development of a coupled distributed groundwater model to assimilate RS data. Sponsored by SAC-ISRO under PRACRITI-II. Duration: 2 years (2014-2017). [Co-investigator].
17. Modeling of evapotranspiration from remote sensing. Sponsored by ISRO-STC. Duration: 2 years (2015-2017) [Principal investigator].
18. Calibration and Validation of SMAP Soil Moisture Product over an Experimental Agricultural Watershed in Karnataka. Sponsored by SAC-ISRO. Duration: 2 years (2015-2017). [Principal investigator].
19. Reducing flood loss - A data-assimilation framework for improving forecasting capability in sparsely gauged regions. Sponsored by Australian Research Council. Duration: 3 years (2014-2017). [Co- investigator].
20. Stochastic modeling of groundwater flow and contaminant transport at the proposed uranium tailings pond. Sponsored by BRNS. Duration: 3 years (2012-2016). [Principal investigator].
21. Water security and infrastructure resilience under climate change. Sponsored by DST and UKIERI, Indo-UK project. Duration: 2 years (2014-2016). [Co-investigator].

22. Hydrometeorological feedbacks and changes in water storage and fluxes in northern India. Sponsored by MoES-NERC Indo-UK Project. Duration: 4 years (2011-2015) [Co- investigator].
23. Sensor network based cyber physical Infrastructure for continuous monitoring of water distribution networks. Sponsored by Robert Bosch Cyber Physical Systems, IISc & IBM. Duration: 2 years (2014-2016). [Co-investigator].
24. Assessing groundwater storage changes and sustainability due to climate change in the semi-arid watersheds of South India. Sponsored by CSIR-India under the COPEC project. Duration: 3 years (2011-2015). [Principal investigator].
25. R&D activities and Capacity building in the area of Sump Pump Model studies (Farakka Stage - III) involving both Physical Modeling as well as CFD model development. Sponsored by NETRA - National Thermal Power Corporation. Duration: 1 and half years (2014-2015). [Co-investigator].
26. Energy and mass exchange in vegetative systems. Sponsored by ISRO-SAC. Duration: 3 years (2012-2015). [Principal investigator].
27. Estimation of soil hydraulic properties in a catchment using agro-hydrological models and microwave remote sensing. Sponsored by ISRO-STC. Duration: 2 years (2013-2015) [Principal investigator].
28. SPMU based solar water pump and smart controller. Sponsored by Cyber Physical Systems, IISc. Duration: 1 year (2014-2015). [Co-investigator].
29. Development of land parameter retrieval techniques and tools for polarimetric SAR data analysis. Sponsored by ISRO-SAC. Duration: 3 years (2010-2013) [Principal investigator].
30. Validation of MT rain rate products and its application in hydrology in the Kabini river basin. Sponsored by ISRO-DOS. Duration: 3 years (2010-2013) [Principal investigator].
31. Assimilation of remote sensing data for modeling the land surface fluxes at watershed scale using a distributed hydrological model. Sponsored by ISRO-STC. Duration: 2 Years (2010-2012) [Principal investigator].
32. Sustainable groundwater management in an urban environment. Sponsored by Arghyam-NGO. Duration: 3 years (2008-2011) [Principal investigator].
33. Socio-economic Assessment of the rural Vulnerability of water users under stressors of global changes in the Hard rock area of South India. Sponsored by ANR-France. Duration: 3 years (2009-2011) [Co- investigator].
34. Retrieval of root zone soil moisture from near-surface measurements. Sponsored by ISRO-STC. Duration: 2 Years (2008-2010) [Principal investigator].
35. Characterization of groundwater flow regime in fractured aquifer system. Sponsored by AICTE-GOI. Duration: 3 Years (2006-2009) [Principal investigator].
36. Hydro-bio-geochemical cycles in two experimental watersheds of South India. Sponsored by Indo-French CEFIPRA/IFCPAR, India, Duration: 3 years (2005-2008) [Co- investigator].
37. Application of integrated surface water and groundwater models using remote sensing and GIS for Gundal river basin. Sponsored by ISRO-STC. Duration: 2 years (2003-2005) [Principal investigator].

### CONSULTING PROJECTS

Conducted more than 30 consulting projects in the areas of urban groundwater hydrology, hydraulic model studies for pump-sump design, and hydraulic analysis & design of surge protection systems for water supply projects. Details are given in <http://civil.iisc.ernet.in/~muddu>

1. Development of groundwater flow model and preparation of aquifer management plans. Central Ground Water Board, (2018-2020). [Principal investigator].

2. Lake Restoration and Hydrological Assessments - Phase II. Bangalore International Airport Ltd. (2020 -). [Co-investigator].
3. Integrated hydrological assessment, Monitoring and documentation Project (2014-2019). Karnataka Watershed Department & World Bank (Sujala Phase III Project) [Principal investigator].
4. Lake Restoration and Hydrological Assessments - Phase I. Bangalore International Airport Ltd. (2018-19). [Co-investigator].
5. Analysis and evaluation of the spatio-temporal patterns of the satellite retrieved soil moisture and evapotranspiration in Cauvery River Basin. Cauvery Neervari Nigam Limited, Bangalore, June 2017 [Principal investigator].
6. Evaluation of Scheme of Ground Water Management & Regulation (2012-17). Report prepared for Central Ground Water Board, Ministry of Water Resources, River Development & Ganga Rejuvenation, Govt. of India., 31p, July 2017 [Co-investigator].
7. Hydrogeological study along the tunnel of upper Badhra project. Karnataka Neervari Nigam Limited, Bangalore, July 2009 [Principal investigator].
8. Brief study on hydrogeology and land use changes along the Bagur-Navile tunnel in Channarayapatna Taluka of Hassan district. Karnataka Neervari Nigam Limited, Bangalore, Oct 2010 [Principal investigator].
9. Geo-Hydrological studies along the Metro- rail alignment in Bangalore. Bangalore Metro Rail Corporation Ltd., Bangalore, June 2007 [Principal investigator].
10. Sump model study for BAHR STPP Stage I (3x660MW) CW pump house. M/s. Kirloskar Brothers Ltd., Pune, December 2007 [Co- investigator].
11. Hydraulic model study for raw water pump sump and forebay – SIPAT Stage II. M/s. Degremont Ltd., New Delhi, September 2007 [Co- investigator].
12. Sump model study for SIPAT STPP Stage I (3x660MW) CW pump house. National Thermal Power Corporation, New Delhi, March 2005 [Co- investigator].
13. National Circumstances: Forests, other natural eco-systems and water resources – “write-up” project, M/s. Winrock International, New Delhi, November 2003 [Co-investigator].
14. Impact of Iron Ore mining in the Kudemukh National Park. Karnataka Forest Department, Jan. 2001 [Co- investigator].
15. Sardar Sarovar canal drinking water supply project, M/s. Montgomery Watson Consultants, August 2000 [Co- investigator].
16. Surge studies for Churu pipe line project – PL1 (Parts 1-3), M/s. Bhooratnam & Co., Secunderabad, July 1997, July 1998, December 1998 [Co- investigator].
17. Surge analysis for Mhaisal lift irrigation scheme (Stages 3 & 4), Irrigation Department, Government of State of Maharashtra, Pune, October 1998 [Co-investigator].
18. Surge studies for the pumping main from Thadoli to Baghera, M/s. Bhooratnam & Co., Secunderabad, August 1998 [Co- investigator].
19. Surge protection system for water supply scheme to Industrial growth centre, Dharwad, Karnataka Industrial Areas Development Board, Bangalore, December 1997 [Co- investigator].
20. Surge Analysis for Takari lift irrigation scheme (Stages 1 & 2), Irrigation Department, Government of State of Maharashtra, Pune, September 1997 [Co-investigator].

## RECOGNITIONS

1. National Award for Excellence in Geoscience & Technology for the year 2018 from Ministry of Earth Sciences, Government of India.
2. INC-IAH Smt. Savitri Memorial Award for Excellence in Groundwater Science for 2018.

3. Satish Dhawan Young Engineer Award in "Earth Sciences" for the year 2010 from Karnataka State Government.
4. Co-Chair, Working Group on Water Resources (WGVIII/4) for 2012-2016 in the Commission VIII (Remote Sensing Applications & Policies) of the International Society of Photogrammetry and Remote Sensing.
5. Associate Editor, Hydrological Sciences Journal, January 2020.
6. Editorial Board, Proceedings of Institution of Civil Engineers, UK - Water Management, July 2015-November 2019.
7. Associate Editor, Frontiers in Water: Water and Hydrocomplexity, since Dec. 2018.
8. Associate Editor, Journal of Groundwater Research, since 2013.
9. Visiting Professor fellowship, IRD France , 2017 & 2018.
10. Poste Rouge Fellowship, OMP-Toulouse, France, 2015.
11. NGRI-AHI Distinguished Lecture for the year 2013.
12. Member, Working Group on Water Database Development and Management for the 12th Plan (2012-2017), Planning Commission, India, 2011.
13. Member, Project Appraisal and Monitoring Committee (PAMC), Hydrology and Cryosphere, Ministry of Earth Sciences. Govt. of India, 2012-2016.
14. Member of the Committee for "Reassessment of Water Resources Potential of India", Ministry of Water Resources, River Development & Ganga Rejuvenation, 2016.
15. Member of the Central Level Expert Group for overall re-assessment of ground water resources of the country, Ministry of Water Resources, India (2010-12) & (2015-2018).
16. Member, Executive Committee, Karnataka State Natural Disaster Monitoring Center, Government of Karnataka, India (2004- to date).
17. Invited by the National Academy of Engineering, USA as a speaker at the Second Indo-American Frontiers of Engineering Meeting, 28th February – 1st March, 2008, Irvine, USA.

#### THESIS ADVISOR & MENTOR:

Degree	Currently Supervising	Supervised
Master	1	27
PhD	10	16
Post-Doc	2	6
<b>Total</b>	<b>13</b>	<b>49</b>

#### *Post-Docs*

1. Dr Soumendra Banja. (Aug. 2019- ) Geochemical modelling in groundwater applications. Raman post-doctoral fellow of IISc in ICWaR. Dr. Soumendra obtained his PhD from IIT Khargpur and was a member in the laboratory of Professor Abhijit Mukherjee.
2. Dr. Rajesh Rajendran (2018-). Groundwater modelling in Cauvery Basin. MoES-NERC UPSCAPE Project.
3. Dr. Tripti Muguli. (2017-2018). Gas emission studies in agricultural plots. National Postdoctoral Research Fellow (SERB-DST). Dr. Tripti Muguli is currently DST-INSPIRE Faculty Member at NCESS, Trivendrum.
4. Dr. Raghavendra Jana. (2017-2018). Soil moisture modelling. Karnataka Watershed Project – Sujala III. Dr. Raghu Jana is currently a Research Scientist at

Centre for Computational and Data Intensive Science and Engineering, Skolkovo Institute of Science and Technology (SkolTech), Moscow, Russia.

5. Dr. Sat K Tomer. (2015-2016). Soil moisture modelling and remote sensing. ICWaR-CEH (UK) Project. Dr. Sat Kumar Tomer is CEO, Satyukt Analytics Pvt Ltd., Bangalore. (<http://www.satyukt.com>).
6. Dr. Parag S. Narvekar. (2015-2016). Soil moisture modelling and RS. Hydrology Project-SujalaIII. Dr. Parag Narvekar is Director, Sensartics Pvt Ltd. (<http://www.sensartics.com>).
7. Dr. Priyanka Jamwal (2010-2012). Characterising and analysis of Nitrates in surface and groundwater in a semi-arid irrigated tropical watersheds.; Dr. Priyanka is currently a Fellow in ATREE, Bangalore (<http://www.atree.org/faculty>).
8. Dr. Murugan Ramaswamy (2013-2014). Stochastic modeling of groundwater flow and contaminant transport at the proposed uranium tailing pond. Dr. Murugan is currently research scientist at NCESS (MoES), Trivendrum. And formerly was a post doc fellow at Verschuren Centre for Sustainability in Energy and the Environment, Cape Breton University.

### PhD

1. Subash Yeggina (2020). Spatial downscaling and analysis of satellite and ground-based rainfall for hydrological modelling. (Subash is currently working with Satyukt Analytics Pvt. Ltd., Bangalore).
2. Buvaneshwari, S. (2018). Impact of agricultural systems on the spatial heterogeneity of groundwater quality in a semi-arid tropical catchment: Characterisation and Modelling. (Joint guidance with Prof. M. S. Mohan Kumar) (Buvaneshwari is currently a post-doc as a Hydro Nation International Fellow of Scotland).
3. Naveen Kumar, G. (2017). Novel upwind and central schemes for various hyperbolic systems. (Joint guidance under IMI with Prof. S.V. Raghurama Rao). Dr. Navin Kumar Garg is currently a post-doc fellow at Southern University of Science and Technology (SUSTech), China and formerly a post doc fellow at TIFR, Bangalore.
4. Eswar R. (2016). Modelling evapotranspiration from satellite data using semi-empirical models: Applications to the Indian sub-continent. Dr. R. Eswar is Assistant Professor, Department of Civil Engineering, Indian Institute of Technology Bombay; formerly post-doc fellow at NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA. Eswar was currently a post-doc at JPL, CalTech.
5. Ruhi, A. (2016). Novel discrete velocity Boltzmann schemes for incompressible flows. (Joint guidance under IMI with Prof. S.V. Raghurama Rao). Dr. Ruhi is currently a post-doc at University of Mainz, Germany.
6. K. Sreelash (2014). Estimation of root zone soil hydraulic properties by inversion of crop model using ground or microwave remote sensing observations. Dr. K. Sreelash was formerly CNES post-doc fellow in INRA PACA, UMR EMMAH, Avignon, France. (<http://www.umr-emmah.fr/>) and currently a Scientist at NCESS (MoES), Trivendrum.
9. Sat K. Tomer (2013). Soil moisture modeling, retrieval from microwave remote sensing and assimilation in a tropical watershed. Dr. Sat Kumar Tomer was a post-doc in CESBIO, Toulouse, France. [http://www.cesbio.upstlse.fr/index\\_us.htm](http://www.cesbio.upstlse.fr/index_us.htm) and currently a . Dr. Sat Kumar Tomer is CEO, Satyukt Analytics Pvt Ltd., Bangalore. (<http://www.satyukt.com>).
7. Yusuf Javeed (2010). Analysis of groundwater dynamics in semi-arid regions: Effect of rainfall variability and pumping. Prof. Yusuf Javeed is a Professor at National Institute of Engineering, Mysore <http://www.nie.ac.in/civ/faculty/>).



8. B. Siva Soumya (2009). Analysis of precipitation controls on hydrochemistry of a groundwater system: Application to upper Cauvery river basin, South India, Dr. Siva Soumya is working as Member of Technical Staff (Environmental Engineer), dar al-handasah, Pune, <http://www.dargroup.com/>).
9. Abhijit Chaudhuri (2006). Stochastic analysis of flow and solute transport in heterogeneous porous media using perturbation approach. Dr. Chaudhuri is working as an Associate Professor at Indian Institute of Technology, Madras <http://apm.iitm.ac.in/fmlab/abhijit/>).
10. K.V. Hayagreeva Rao (2005). Studies of solute transport and geochemistry in porous media: Numerical modeling and applications. Dr. Hayagreeva Rao is working as a Senior Research Engineer, General Electric, Jack F. Welch Technology Center. <http://ge.geglobalresearch.com/locations/bangalore-india/>).
11. P.K. Majumdar (2007). Modelling of single and multiple recharge wells in layered aquifers (- Joint guidance with Prof. K. Sridharan and Prof. G.C. Mishra; Dr. P.K. Majumdar was formerly Scientist F at National Institute of Hydrology, Roorkee <http://www.nih.ernet.in/> and currently Professor in an Engineering College in Gujarat).
12. G. Suresh Kumar (2003). Numerical Modeling and analysis of solute transport in a single fracture. Prof. Suresh Kumar is currently working as an Professor at IIT Madras. [http://www.oec.iitm.ac.in/Suresh\\_kumar\\_home.html](http://www.oec.iitm.ac.in/Suresh_kumar_home.html)).
13. Santosh. G. Thampi (2002). Studies on the transport of sorbing and biodegrading solutes in heterogeneous porous media. Prof. Thampi is working as a Professor at NIT Calicut. <http://nitc.ac.in/index.php?url=users/view/85/7/3>).
14. S. Jyothish (1999). A hybrid finite volume method for reactive solute transport in groundwater (Joint guidance with Prof. M.S. Mohan Kumar). Dr. Jyothish is working as Member Technical Staff, Verizon, Irving, TX, USA).
15. M. K. Nagaraj (1999). Parameter estimation of regional groundwater systems (Joint guidance with Prof. K. Sridharan). Prof. Nagaraj is working as a Professor at NIT, Surathkal <http://www.nitk.ac.in/index.php?q=935.html>).
16. K. S. Hari Prasad (1996). Analysis of Unsaturated Flow in Soils: Numerical Modelling and Applications (Joint guidance with Prof. M.S. Mohan Kumar). Prof. Hari Prasad is working as a Professor at Indian Institute of Technology, Roorkee <http://www.iitr.ac.in/~CE/suryafce>).
17. Ponni M. George (*under progress*). Modeling the base flow in head water catchments of peninsular Indian rivers.
18. T. Bharathi (*under progress*). Stochastic modeling of radionuclides in groundwater system. (Joint guidance with Prof. C.S. Manohar).
19. U. Deepti (*under progress*). Modeling soil moisture and solute transport in shallow semi-arid soils under cropping. (Joint guidance with Prof. M. Sudhakar Rao).
20. K. Rajsekhar (*under progress*). Modeling the root zone soil moisture using ENKF methods with surface soil moisture & soil temperature.
21. Venkat N. (*under progress*). Modeling of flow and solutes in river systems (Joint guidance with Prof. Prosenjit Ghosh of CES).
22. Baibaswata Bhaduri. (*under progress*). Modeling the residence times in groundwater systems in nested catchments.
23. Abhishek Chakraborty (*under progress*). Modeling the carbon fluxes in Kabini CZO. (Joint guidance under ICWaR with Prof. Lakshminarayana Rao of Center for Sustainable Technology). (PMRF awardee).
24. Shubham Goswami (*under progress*). Coupled models of surface and groundwater to investigated hydrological impacts of climate change. (PMRF awardee).

25. Rajat Kumar Sharma, External Registrant, NCESS, Trivendrum (*under progress*). Analysis of baseflow trends in selected west flowing rivers of western ghats in India.
26. C. Sarat (*under progress*). Groundwater and atmosphere feedbacks in central India. (Joint guidance with Prof. V Venugopal of CAoS).

#### *MSc(Engg.)*

1. Teddy Kizza (2013). Modeling salinity impact on groundwater irrigated Turmeric crop. Ms. Teddy Kizza is working as a scientist in National Agricultural Organisation of Uganda in Kampala.
2. S.N. Rasmi (2005). Importance of lateral flow in groundwater modeling: A case study of hard rock aquifer of Gundal sub basin.
3. Anjani Kumar (2003). Numerical modeling of aerobic in-situ biodegradation in heterogeneous porous media. Mr. Anjani Kumar is working as a Research Engineer, General Electric, Jack F. Welch Technology Center, Bangalore).
4. M. R. V. P. Narayana (2003). Application of groundwater model coupled with GIS and remote sensing for Gundal watershed.
5. C. Srinivasan (2000). Analysis of solute transport in porous media for nonreactive and sorbing solutes using hybrid FCT model.

#### *ME/MTech*

6. Soil moisture estimation using L Band SAR data. (Deepak Kumar, 2019).
7. Modelling of crop and water productivity in rainfed agrosystems of Berambadi catchment in KABINI CZO. (Kayalvizhi, S., 2018).
8. Knowledge extraction in agriculture using machine learning algorithms. (Rukmangadan, D., 2018).
9. Sandarbh A. (2017). An inter-comparison of TerraSAR-X and Sentinel-1 data behavior over different vegetation covers in Berambadi region.
10. Prajakt R. (2015). Analysis of soil moisture using ground penetrating radar.
11. Satendra K Dhiman (2013). Estimation of groundwater recharge using soil moisture modeling: Experiments in Berambadi catchment. Mr. Satendra is working as an Assistant Professor in College of Engineering, Teri, Uttaranchal.
12. Manish Gautam (2013). Groundwater modeling in Bangalore city using GRASS-GIS. Mr. Manish is working as a scientist with Indian Institute of Human Settlements, Bangalore.
13. N. Madhusudhan (2012). Lumped and distributed groundwater modeling: A case study in Gundal basin. Mr. Madhusudhan is working as Engineer with KPTCL, Karnataka.
14. Prateek Chandrayan (2011). Characterizing subsurface fracture and its hydraulic properties using Fiber Optics.
15. M. Shindekar (2011). Modeling the Groundwater in Urban-Periurban System Using PORFLOW. Mr. Mayur is working with Border Road Services, New Delhi under Indian Engineering Service.
16. Jowon Siket (2010). Spatio-temporal analysis of groundwater levels in heterogenous aquifers. Mr. Jowon Siket is working with Central Water Commission, New Delhi under Indian Engineering Service.
17. Sat K. Tomer (2008). Soil moisture modelling and assimilation using field experiments in semi arid plots. Mr. Sat Kumar is Dr. Sat Kumar Tomer is a post-doc in CESBIO, Toulouse, France. [http://www.cesbio.ups-tlse.fr/index\\_us.htm](http://www.cesbio.ups-tlse.fr/index_us.htm)
18. Pradeep V. Mandapaka (2003). Watershed modeling using remotely sensed data and SWAT. Dr. Pradeep completed his PhD at University of Iowa, USA and is a post-doc at NUS, Singapore.

19. B. Raghuram Singh (2003). Modeling of total phosphorous for lakes.
20. G. Babu Rao (2001). Parameter estimation model for dissolved oxygen in a stream.
21. J. Srinivasulu (2000). Urban storm water modeling in the Vrishabhavati sub-watershed using SWMM and GIS.
22. N. Stanley Joseph (1999). A visual basic software for risk assessment of petroleum release sites.
23. L.P. Murali Krishna (1998). Analysis and parameter estimation of non-uniform aquifers.
24. C.V. Abdul Nazir (1997). Sampling network design using genetic algorithm for inverse problem in groundwater hydrology.
25. A. Hara Gopal (1997). A numerical model for flow in an unsaturated soil.
26. V. Ramesh (1996). Analysis of multilayered leaky aquifer system.
27. P. Sreenivas Rao (1995). Modelling contaminant transport in groundwater.
28. Manish Kumar. (*Under progress*) Modeling the crop water budget and optimal groundwater irrigation water requirement.

#### *Integrated MSc*

1. Arjun, C (2016). Modeling the nitrogen gas fluxes from agricultural plots in AMBHAS experimental observatory. Arjun currently is pursuing his graduate studies under the Marie-Curie Fellowships of EU.

#### WORKSHOPS ORGANISED

1. Indo-US Bilateral Workshop on Addressing the Nexus of Food, Energy, and Water (FEW) in the Context of Societal Challenges (April 2017). Sponsored by IUSTF.[Co-Principal investigator].
2. Indo-UK Workshop on Water Quality Source Protection (30 March - 1 April, 2016). Sponsored by James Hutton Institute, Scotland.
3. Near real time forecasting of soil moisture for water resources management (2014). Sponsored by Indo-German Bilateral Agency. [Co- Principal investigator].
4. Sustainability of soil and water management in the uplands of Asia: LUC and CC in question (Dec 2013). Sponsored by SELTAR, IRD, France. [Co- Principal investigator].
5. Water resources management using microwave remote sensing. Sponsored by Indo-French Water Network. (Nov 2013). [Co- Principal investigator].
6. Indo-UK perspective on Water quality: Threats, technologies and options (August 2013). Sponsored by RSC, UK Science & Innovation Network, Shell Technology Centre. [Co- Principal investigator].

#### GRADUATE TEACHING

Developed and taught courses during 1994-2012: Groundwater Hydrology, Advanced Groundwater Hydrology, Pollution Science and Engineering, Water Quality Modelling, Remote Sensing for Natural Resources Management.

#### MEMBERSHIP OF PROFESSIONAL SOCIETIES AND INSTITUTIONS:

Member, International Association of Hydrogeologists; Member, American Geophysical Union; Member, International Association for Hydrological Sciences; Member, European Geophysical Union

## PUBLICATIONS

About 100 peer reviewed publications in Journals and book chapters in the areas of Hydrology, Water Resources and Environmental Engineering. Detailed list of other publications are given in <http://civil.iisc.ernet.in/~muddu>

<http://scholar.google.com/citations?user=faU9COIAAAAJ>

## JOURNALS

1. Buvaneshwari, S., Riotte, J., Sekhar, M., Sharma, A. K., Helliwell, R., Kumar, M. S., Braun, J. J., Ruiz, L. (2020). Potash fertilizer promotes incipient salinization in groundwater irrigated semi-arid agriculture. *Scientific Reports*. 10:3691. (<https://doi.org/10.1038/s41598-020-60365-z>).
2. Collins, S., Loveless, S., Sekhar, M., Buvaneshwari, S., Palamakumbura, R., Krabbendam, M., Lapworth, D., Jackson, C., Gooddy, D., Venkat Nara, S. N., Chattopadhyay, S. and MacDonald, A. (2020). Groundwater connectivity of a sheared gneiss aquifer system in the Cauvery River Basin, India. *Hydrogeology Journal*. (<https://doi.org/10.1007/s10040-020-02140-y>).
3. Yeggina, S., Teegavarapu, R.S.V., Sekhar, M. (2020). Evaluation and Bias Corrections of Gridded Precipitation Data for Hydrologic Modeling Support in Kabini River Basin, India. *Theoretical and Applied Climatology*. (<https://doi.org/10.1007/s00704-020-03175-7>).
4. Garg, N.K., Maruthi, N.H., Raghurama Rao, S.V. and Sekhar, M. (2019). Use of Jordan forms for convection-pressure split Euler solvers. *Journal of Computational Physics*, Volume 407, 109258, pp.1-23. (<https://doi.org/10.1016/j.jcp.2020.109258>).
5. Zribi, M., Sekhar, M., Bousbih, S., Al Bitar, A., Tomer, S.K., Baghdadi, N. and Bandyopadhyay, S. (2019). Analysis of L-Band SAR Data for Soil Moisture Estimations over Agricultural Areas in the Tropics. *Remote Sensing*, 11(9), 1122. (<https://doi.org/10.3390/rs11091122>).
6. Yeggina, S., Teegavarapu, R.S.V., Sekhar, M. (2019). A conceptually superior variant of Shepard's method with modified neighbourhood selection for precipitation interpolation. *International Journal of Climatology*. (<https://doi.org/10.1002/joc.6091>).
7. Sharma, A.K., Hubert-Moy, L., Buvaneshwari, S., Sekhar, M., Ruiz, L., Bandyopadhyay, S., Shiv Mohan and Corgne, S. (2019). Evaluation of Radarsat-2 quad-pol SAR time series images for monitoring groundwater irrigation. *International Journal of Digital Earth*. (<https://doi.org/10.1080/17538947.2019.1604834>).
8. Gomez, C., Dharumarajan, S., Féret, J.-B., Lagacherie, P., Ruiz, L. and Sekhar, M. (2019). Use of Sentinel-2 Time-series images for classification and uncertainty analysis of inherent biophysical property: Case of soil texture mapping. *Remote Sensing*, 11, 565, pp.1-20. (<https://doi.org/10.3390/rs11050565>).
9. Gaillardet, J., Braud, I., Hankard, F., Anquetin, S., Bour, O., Dorfliger, N. et al. (2018). OZCAR: The French network of critical zone observatories. *Vadose Zone Journal*, 17:180067, pp.1-24. (<https://doi.org/10.2136/vzj2018.04.0067>)

10. Chaudhuri, A., Hendricks Franssen, H.-J. and Sekhar, M. (2018). Iterative filter based estimation of fully 3D heterogeneous fields of permeability and Mualem-van Genuchten parameters. *Advances in Water Resources*, 122, pp. 340–354. (<https://doi.org/10.1016/j.advwatres.2018.10.023>)
11. Mangiarotti, S., Sharma, A. K., Corgne, S., Hubert-Moy, L., Ruiz, L., Sekhar, M. and Kerr, Y. (2018). Can the global modeling technique be used for crop classification? *Chaos, Solitons and Fractals*, 106, pp. 363-378. (<https://doi.org/10.1016/j.chaos.2017.12.003>).
12. Sharma, A. Hubert-Moy, L., Buvaneshwari, S., Sekhar, M., Ruiz, L., Bandyopadhyay, S., Corgne, S. (2018). Irrigation history estimation using multitemporal Landsat satellite images: Application to an intensive groundwater irrigated agricultural watershed in India. *Remote Sensing*, 10, 893. (<http://dx.doi.org/10.3390/rs10060893>).
13. Riotte, J., Meunier, J.-D., Zambardi, T., Audry, S., Barboni, D., Anupama, K., Prasad, S., Chmeleff, J., Poitrasson, F., Sekhar, M., Braun, J.-J. (2018). Processes controlling silicon isotopic fractionation in a forested tropical watershed: Mule Hole Critical Zone Observatory (Southern India). *Geochimica et Cosmochimica Acta*, 228, pp. 301–319. (<https://doi.org/10.1016/j.gca.2018.02.046>).
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15. Robert, M., Thomas, A., Sekhar, M., Raynal, H., Casellas, E., Casel, P., Chabrier, P., Joannon, A. and Bergez, J.-E. (2018). A dynamic model for water management at the farm level integrating strategic, tactical and operational decisions. *Environmental Modeling and Software*, 100, pp. 123-135. (<http://dx.doi.org/10.1016/j.envsoft.2017.11.013>).
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31. Eswar, R., Sekhar, M., Bhattacharya, B.K. (2016). Disaggregation of LST over India: Comparative analysis of different vegetation indices. *International Journal of Remote Sensing*, (<http://dx.doi.org/10.1080/01431161.2016.1145363>).
32. Crouseilles, N., Lemou, M., Raghurama Rao, S.V., Ruhi, A., Sekhar, M. (2016). Asymptotic preserving scheme for a kinetic model describing incompressible fluids. *American Institute of Mathematical Sciences*, Vol. 9(1), 51-74. (<http://dx.doi.org/10.3934/krm.2016.9.51>).

33. Tomer, S.K., Al Bitar, A., Sekhar, M., Corgne, S., Bandyopadhyay, S., Sreelash, K., Sharma, A.K., Zribi, M., and Kerr, Y. (2015). Retrieval and multi-scale validation of soil moisture from multi-temporal SAR data in a tropical region. *Remote Sensing*, Vol. 7(6), 8128-8153 (<http://dx.doi.org/10.3390/rs70608128>).
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37. Meunier, J.D., Riotte, J., Braun, J. J., Sekhar, M., Chalié, F., Barboni, D. and Saccone, L. (2015). Controls of DSI in streams and reservoirs along the Kaveri River, South India. *Science of the Total Environment*, Vol. 502, pp.103-113. (<http://dx.doi.org/10.1016/j.scitotenv.2014.07.107>).
38. Riotte, J., Ruiz, L., Audry, S., Sekhar, M., Mohan Kumar, M. S., Siva Soumya, B. and Braun, J.J. (2014). Impact of vegetation and decennial rainfall fluctuations on the weathering fluxes exported from a dry tropical forest (Mule Hole). *Procedia Earth and Planetary Science*, Vol. 10, pp.34-37. (<http://dx.doi.org/10.1016/j.proeps.2014.08.007>).
39. Orgogozo, L., Renon, N., Soulaire, C., Henon, F., Tomer, S.K., Labat, D., Pokrovsky, O.S., Sekhar, M., Abbaou, R., Quintard, M. (2014). An open source massively parallel solver for Richards equation: Mechanistic modelling of water fluxes at the watershed scale. *Computer Physics Communications*, Vol. 185, pp.3358-3371. (<http://dx.doi.org/10.1016/j.cpc.2014.08.004>).
40. Mehta, V.K., Goswami, R., Kemp Benedict, E., Sekhar, M., Malghan, D. (2014). Metabolic urbanism and environmental justice: The water conundrum in Bangalore, India. *Environmental Justice*, Vol. 7, No.5, pp.130-137.
41. Riotte, J., Marechal, J. C., Audry, S., Kumar, C., Bedimo, J. P., Ruiz, L., Sekhar, M., Varma, M.R.R., Lagane, C. and Braun, J.J. (2014). Vegetation impact on stream chemical fluxes: Mule Hole watershed (South India) *Geochimica and Cosmochimica Acta*, Vol. 145, pp.116-138. (<http://dx.doi.org/10.1016/j.gca.2014.09.015>).
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43. Chaudhuri, A., Sekhar, M., Descloitres, M., Godderis, Y. and Braun, J.J. (2013). Constraining complex aquifer geometry with geophysics (2D ERT and MRS

- measurements) for stochastic modeling of groundwater flow. *Journal of Applied Geophysics*, Vol.98, 288-297.
44. Sekhar, M., Shindekar, M., Tomer, S. K., and Goswami, P. (2013). Modeling the vulnerability of an urban groundwater system due to the combined impacts of climate change and management scenarios. *Earth Interactions (AGU)*, Vol. 17(10), pp.1-25. (<http://dx.doi.org/10.1175/2012EI000499.1>).
  45. Sreelash, K., Sekhar, M., Ruiz, L., Buis, S., Bandyopadhyay, S. (2013). Improved modeling of groundwater recharge in agricultural watersheds using a combination of crop model and remote sensing. Special Issue of *Journal of Indian Institute of Science*, Vol. 93(2), pp. 189-207.
  46. Mehta, V.K., Sekhar, M., Malghan, D. (2013). Groundwater impacts of water consumption patterns in Bengaluru, India. *Journal of Groundwater Research*, Vol.2(1), pp.143-154.
  47. Siva Soumya, B., Sekhar, M., Riotte, J., Banerjee, A., Braun, J.J. (2013) Characterization of groundwater chemistry under the influence of lithologic and anthropogenic factors along a climatic gradient in Upper Cauvery basin, South India. *Environmental Earth Sciences*, Vol. 69 (7), pp.2311-2335. (<http://dx.doi.org/10.1007/s12665-012-2060-x>).
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