



*Tenth EGU Alexander von Humboldt International  
Conference*



*GIFT - 2015  
Water!*

*Geosciences Information for Teachers Workshop*

*Addis Ababa, Ethiopia, November 18-19-2015*

# *European Geosciences Union Addis Ababa University*

## *GEOSCIENCES INFORMATION FOR TEACHERS (GIFT) WORKSHOP*

*Addis Ababa, Ethiopia, 18-19 November 2015*

Dear Teachers,

Welcome to the 10th GIFT workshop which this year will unite 81 teachers from 19 different countries. The general theme of the workshop is «Water!» and will be dedicated to the study of the hydrological challenges faced by our planet.

The water cycle, also known as the hydrological cycle, describes the continuous movement of water on, above and below the surface of the Earth. It also involves the exchange of energy, which leads to temperature changes. The water cycle significantly influences and shapes life, society and ecosystems on Earth. However, several problems are threatening water resources today, especially the unsustainable use of water and the lack of an adequate supply of usable/drinking water in many parts of the world. Such problems are complex caused by an ever increasing population, consumerism, political tensions, urbanization and changes in agricultural practice.

In addition, as the water cycle involves the exchange of heat, the effects of atmospheric global warming on the water cycle are significant: sea levels have risen, glaciers have retreated. The hydrological cycle is heavily affected by land use changes which in turn affect groundwater recharge. The problems mentioned above cause concerns in almost every sector of everyday life, and geo-engineers are seeking ways of mitigation. All water bodies are going to be affected by global warming, making knowledge of the water cycle essential for any kind of human activity. Entire regions on Earth will face extreme temperatures eventually associated with torrential rainfalls whilst other regions are likely to experience a scarcity of water and droughts.

In the one and a half days of the workshop we will have time to describe and discuss only the main aspects of the water cycle. First, of course, the crucial role that water, a key-molecule for life on Earth, has in metabolism and biodiversity on our planet. Talks will focus on global freshwater availability and distribution, overexploitation of water, strategies for sustainable use of water in the future and the threats by environmental changes. Floods in a changing world will also be described, as well as satellite observations specifically related to the water cycle

The GIFT workshop is kindly sponsored by several science organizations. We would like to continue to offer teachers the opportunity to attend GIFT and similar workshops, but this depends upon us being able to show our sponsors that teachers have used the new GIFT information and science didactics in their daily teaching, or as inspiration for new ways to teach science in their schools.

Therefore, we ask you send us reports and photographs about how you have used the GIFT information in your classrooms (email at: [education@egu.eu](mailto:education@egu.eu)). This is a very important feedback for us!

Information on past and future GIFT workshop is available on the EGU homepage. Look at <http://www.egu.eu/media-outreach/gift/gift-workshops.html>

where you can find the brochures (pdf) and also the slides of the different presentations given at the GIFT workshops for the last 8 years. Beginning in 2009, we have also included web-TV presentations, which may be freely used in your classrooms.

The Organizing Committee of the GIFT workshop

## Acknowledgements

The European Geosciences Union. EGU has supported the major share of the expenses for the GIFT workshop, but the workshop has also benefited of the generous help of:



Westermann Verlag, Braunschweig, Germany



The European Space Agency



Istituto Nazionale di Geofisica e Vulcanologia

*And we thank all the speakers who have  
contributed to this educational workshop and  
their institutions*

**European Geosciences Union – General Assembly**  
**GEOSCIENCE INFORMATION FOR TEACHERS (GIFT) WORKSHOP**

Addis Ababa, November 18-19, 2015

Gulele Botanical Garden

***Water!***

**Programme**

***Wednesday, November 18, 2016***

12:00- 12:30	<b>ARRIVAL AND REGISTRATION OF PARTICIPANT TEACHERS</b> Carlo Laj and Katja Gaenger European Geosciences union & Copernicus
12:30 – 13:30	LUNCH
13:30 -14:15	<b>WATER CYCLE, FRESHWATER AVAILABILITY AND DISTRIBUTION: THE MAJOR CHALLENGES FOR WATER IN THE NEXT 100 YEARS (VIDEO)</b> Alberto Montanari University of Bologna, Italy
14:15 – 15:15	<b>COFFEE BREAK</b>
15:15 – 15:45	<b>HOW PEOPLE AND ECOSYSTEMS ORGANIZE THEIR STORAGE REQUIREMENTS</b> Hubert Savenije Delft University of Technology, The Netherlands
15:45 - 16:15	<b>TOWARDS OPTIMIZATION OF RESERVOIR OPERATIONS FOR HYDROPOWER PRODUCTION IN EASTERN AFRICA: SEASONAL CLIMATE FORECASTS</b> Mekonnen Gebremichael Civil and Environmental Engineering Department, University of California, Los Angeles, United States
16:15 : 16:45	GENERAL DISCUSSION
17:00	<b>END OF DAY 1</b>

*Thursday November 19, 2015*

- 09:30 – 10:15      **MONITORING CLIMATE, DROUGHTS AND FLOODS: THE TRANS-AFRICAN HYDRO-METEOROLOGICAL OBSERVATORY**  
Nick van de Giesen  
Delft University of Technology  
The Netherlands
- 10:15 – 10:50      **HYDROLOGICAL CHANGES OVER HALF A CENTURY IN THE BLUE NILE BASIN, ETHIOPIA: A STATISTICAL APPROACH**  
Solomon Gebreyohannis Gebrehiwot and Kevin Bishop  
Uppsala University, Sweden
- 10:55 – 11:25      COFFEE BREAK**
- 11:30: – 12:30      **INFORMATION SYSTEMS AND TERRAIN ANALYSIS**  
Andrea Petroselli  
Tuscia University  
Viterbo, Italy
- 12:30 – 13:30      LUNCH**
- 13:30 – 14:15      **ETHIOPIA’S WATER SECURITY AND THE STATE OF WATER RESOURCES MANAGEMENT**  
Tena Alamirew  
Water and Land Resource Center, Ethiopia
- 14:15 – 15:15      **COFFEE BREAK**
- 15:15 – 15:45      **WATER, WATER EVERYWHERE AND NOT A DROP TO DRINK! (VIDEO)**  
Murugesu Sivapalan  
University of Illinois at Urbana-Champaign, USA
- 15:45 – 16:15      **PRESENTATION OF THE DIFFERENT EDUCATIONAL PROGRAMS OF THE EGU**  
Carlo Laj  
Chairman,  
Committee on Education  
European Geosciences Union
- 16:15 – 16:30      **END OF THE GIFT – 2015 WORKSHOP**

*Speakers*



Prof. Eng. Alberto Montanari  
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### **Education**

**1985-1992:** Master Degree studies in Civil Engineering

**1993-1996:** Ph.D. in Hydraulic Engineering and Hydrology

**1997-1998:** Post-Doctoral studies in Hydrology

### **Career**

**1992-1993:** High School Teacher of Mechanical Technology at the IPSIA Lombardini Professional High School of Reggio Emilia (Italy)

**1993-1998:** Seminal lecturer in hydrology at the Faculty Engineering of Polytechnic of Milan and University of Bologna

**1999-2000:** Assistant Professor in Hydrology and Water Engineering at the Faculty of Engineering of the University of Bologna

**2001-present:** Associate Professor in Hydrology and Water Engineering at the Faculty of Engineering of the University of Bologna

**2010:** habilitated for full professorship

**Presently** teaching Advanced Hydrology and Water Resources Management, Water Resources Management and River Engineering Works at the University of Bologna

### **Academic and Scientific Positions**

**2007-2011:** President of the Hydrological Sciences Division – European Geosciences Union

**2009-present:** Chair of the Union Awards and Medals Committee – European Geosciences Union

**2004-present:** Editor, Hydrology and Earth System Sciences

**2005-present:** Associate Editor, Water Resources Research

**2010-present:** Associate Editor, Survey in Geophysics

**2010-present:** Associate Editor, Hydrological Sciences Journal

**2010-present:** Chair of the Research Commission, Department DICAM, University of Bologna

**2010-present:** National Representative for Italy at the International Association of Hydrological Sciences

### **Other positions**

Alberto Montanari authored and co-authored 110 papers on international ISI scientific journals (57 contributions), conference proceedings or book chapters (53 papers) and edited special issues of scientific journals or monographs (8 contributions). Accordingly to the database of the ISI Web of Science Alberto Montanari's papers are currently 54. The total number of citations is 890. The average number of citations per paper is about 16, with a maximum of 94. The H index is 16.



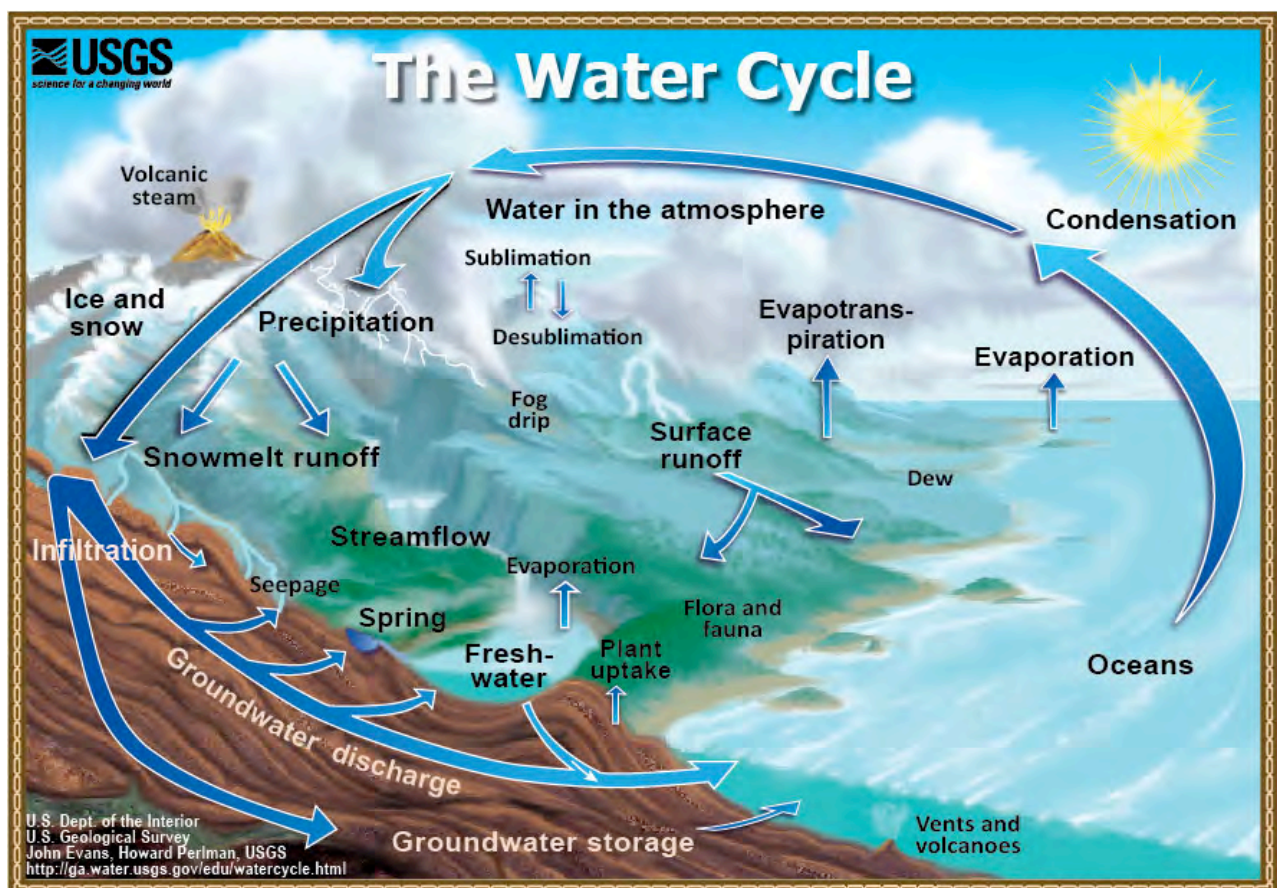
He was invited to delivered 15 featured talks in hydrology at national and international scientific conferences. He was coordinator of two national research projects on Uncertainty Estimation in Hydrology and coordinator of 12 Consulting Projects funded by Public Administrations, Water Managing Agencies and Professionals in Italy.

# The Exciting Travel of a Drop Along the Water Cycle

Alberto Montanari  
University of Bologna ,  
Bologna, Italy

We believe we are familiar with the water cycle. In fact, we were taught its basic principles in our childhood already. We also know that the world is experiencing water problems, related to water shortage, pollution and security. However, the truth is that humans still do not know what actually happens to a rain drop after it landed on the earth surface. We can see the final results of rainfall occurring, because we observe water in rivers, lakes and sea. But how a drop actually reaches such water bodies is still a mystery. This is one of the reasons why floods and droughts are difficult to predict and manage, and water resources management is still a challenge.

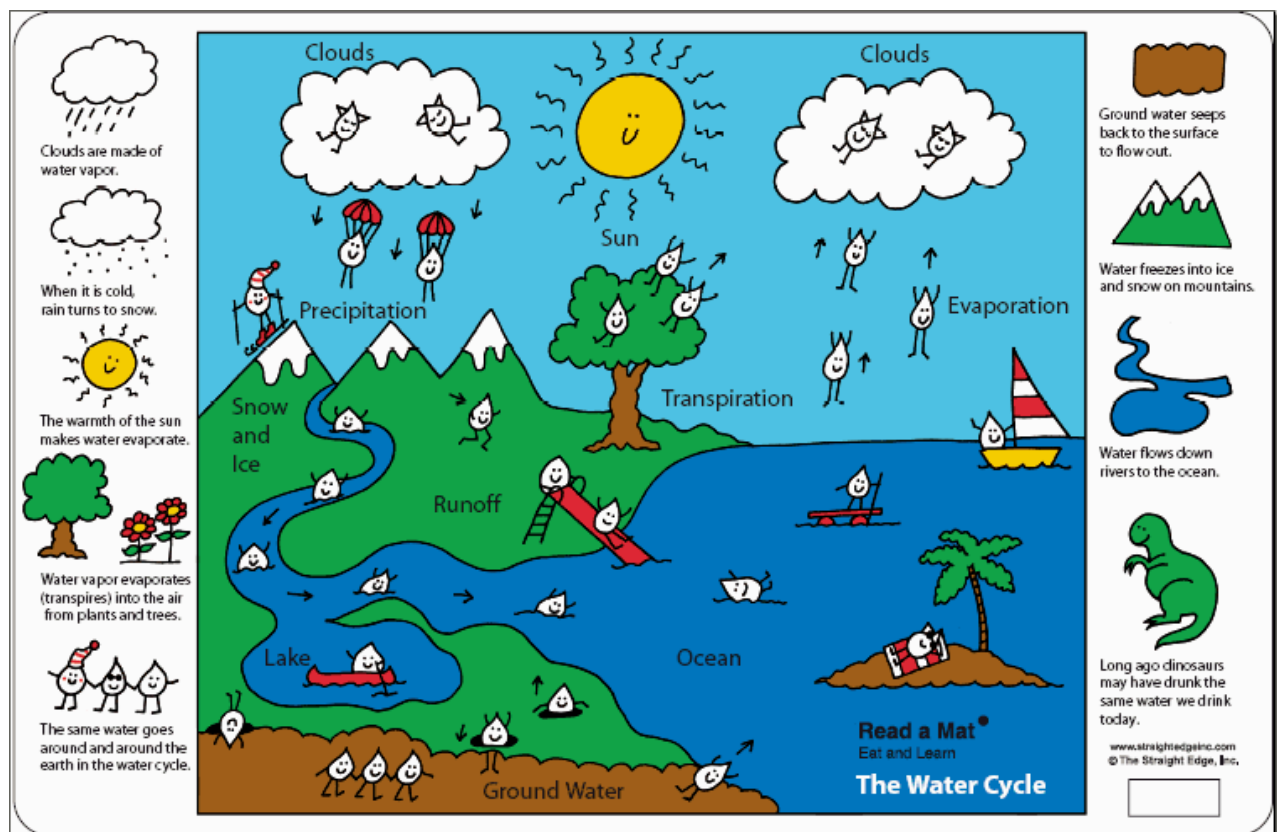
Hydrology is the science of the water cycle and hydrologists try to improve our knowledge of the travel of water through the earth system, for the sake of improving scientific understanding and supporting water resources engineering and water resources management.



From: <http://ga.water.usgs.gov/edu/watercycleprint.html>

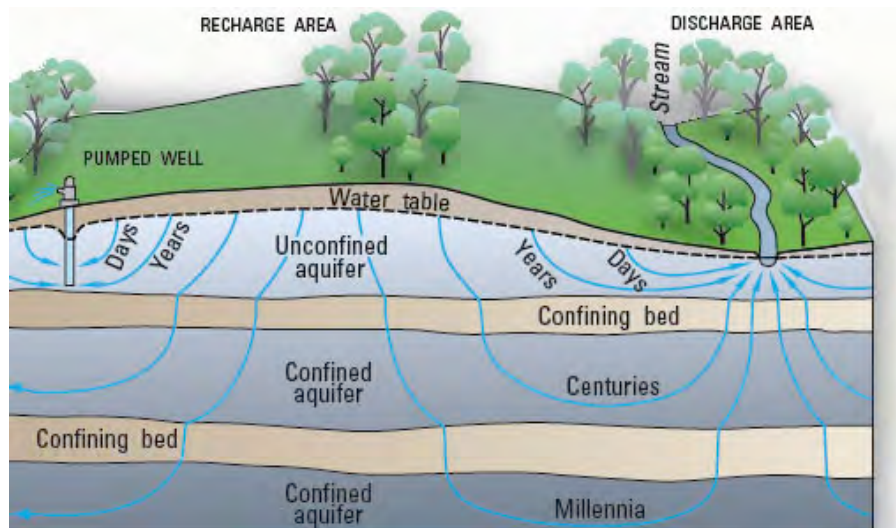
The water cycle is a circular trip that can be started everywhere. Classical hydrology assumes that the trip begins from the clouds, after water has condensed to form a drop. Earth's gravity pulls the drop down to the surface, but once it starts falling there are many places for the drop

to go, depending also on wind direction. The drop can land on a leaf in a tree, in which case it would either evaporate or subsequently fall on the ground under the tree. If it evaporates, it heads to the clouds again. If the drop falls on the ground it starts moving downstream by flowing either on the earth surface or underground. Actually, how rain separates between surface water and groundwater is not fully known. Human action is likely to modify the trip of the drop through, for instance, river diversion, river flow withdrawal or groundwater pumping. Most of the human-used water is sprayed on crops, from where it mainly evaporates, therefore originating the so-called “blue-to-green flow diversion”. Only a small amount of water is utilized for civil uses, therefore ending up in house water taps and other civil destinations. From these places the drop is likely to reach a sewer system, then a water sanitation plant and finally a receptor water body, from which it travels towards the ocean, to be ready to evaporate back in the sky.



From: <http://ga.water.usgs.gov/edu/watercycleplacemat.html>

River water is more convenient for human exploitation than groundwater because it does not need pumping. However, often there is the problem that river water availability does not match the water demands, and therefore humans started to build dams to store water when not needed, to be used during water scarcity.



Time scales of groundwater flow.

From <http://ga.water.usgs.gov/edu/watercyclelegwdischarge.html>

Therefore, human activity induces river and groundwater depletion and is responsible for water degradation and pollution. There is a limit to the amount of water that can be used by humans without substantially compromising the quality of the environment. Estimation of such limit is needed if we want to make our societal development sustainable.

The above explanation clarifies the relevant role that humans may play in the water cycle. In fact, the study of the two way interaction between humans and water is ranking high in today's research agenda of hydrologists and social scientists. Humans are not only water users; they are rather becoming a fundamental part and a driver of the water cycle in many regions of the world.

The above described processes are partly random. In fact, the trip of the water drop in several instances develops by chance. The processes that bring the drop downstream are governed by physical laws, but these latter are however satisfied along several different pathways for the drop itself. Therefore, the trip direction is chosen randomly in many occurrences. It follows that inherent uncertainty affects hydrological processes, therefore limiting their predictability to varying extent. This is an important issue that must be considered when trying to understand and model hydrological processes.

This talk will focus on the travel of a drop along the water cycle and will emphasize what we know, what we do not know and what we guess. We will analyze the distribution of water in the earth and the most relevant challenges for water resources management. An overview will be presented of open research issues and modeling approaches in hydrology. Finally, a vision will be outlined for the future of hydrology and water, which is more and more requiring an interdisciplinary and coordinated research effort.

Information at:

<http://water.usgs.gov/>

<http://water.usgs.gov/droplet/>

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Prof. H.H.G. Savenije

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Prof. Savenije studied at the Delft University of Technology, in the Netherlands, where he obtained his MSc in 1977 in Hydrology. As a young graduate hydrologist he worked for six years in Mozambique where he developed a theory on salt intrusion in estuaries and studied the hydrology of international rivers.

From 1985-1990 he worked as an international consultant mostly in Asia and Africa. He joined academia in 1990 to complete his PhD in 1992. In 1994 he was appointed Professor of Water Resources Management at the IHE (now UNESCO-IHE, Institute for Water Education) in Delft, the Netherlands. Since 1999, he is Professor of Hydrology at the Delft University of Technology, where he is the head of the Water Resources Section.

In 2008 he received the Henry Darcy Medal of the European Geosciences Union for outstanding contributions to Hydrology and Water Resources Management.

In 2010 he received the 'Leermeesterprijs' (Master Award) of the TU Delft, which is an annual award for the most distinguished teacher.

Prof. Savenije has published widely in the fields of hydrology, estuary hydraulics and water resource management. Recently he published a book on "[Salinity and Tides in Alluvial Estuaries](#)". He is chief executive editor of Hydrology and Earth System Sciences (HESS) and editor in chief of Physics and Chemistry of the Earth. He is the incoming President of IAHS (the International Association for Hydrological Sciences) and was President of Hydrological Sciences of the European Geosciences Union (EGU), and Past-President of the International Commission on Water Resources Systems of IAHS. He has organised several regional and international water conferences, and has wide-ranging experience in Africa, Asia and South America.

He (co-)authored 145 scientific articles in international journals and has graduated more than 150 MSc students and 25 PhD students in the fields of hydrology and water resources management.

# **How people and ecosystems organize their storage requirements**

Hubert Savenije  
Delft University of Technology, The Netherlands

At the start of the Anthropocene, one of the first things human society undertook was to tap water from the natural system: designing wells, diverting river water, harvesting rainwater, tapping groundwater by underground tunnels (qanats), and building canals and aqueducts to convey the water to where it was needed. Although sometimes highly complex engineering works, this was only a first step towards manipulating the natural system. In guaranteeing access to water, people soon realized that it was necessary to create sufficient storage to offset the high variability of hydrological fluxes in the natural system. The building of reservoirs dates back to 3000 BC, when the first reservoir was built in the Middle East, not surprisingly in an area with high hydrological variability.

A classical engineering way for designing the size of a reservoir is the Rippl (1883) diagram, where tangents to the accumulated inflow determine the required storage. It is a logical method for people to size the storage required to satisfy long-term water demand. Using this principle, many societies have regulated their rivers, trying to level out the natural variability of the climate. But are people unique in tempting to even out climatic fluctuations or to bridge periods of drought? The hypothesis is that ecosystems do the same.

In contrast to a mechanistic model of the hydrological reality, where the moisture storage capacity in the root zone is simulated by a fixed parameter, we should realize the root zone is actually part of a living ecosystem, which is able to adjust itself to climatic variability. This maximum root storage capacity is a crucial parameter in all hydrological models, regulating not only the moisture available for transpiration by vegetation, but also the threshold above which runoff is generated. In contrast to what is generally assumed, this crucial hydrological parameter is alive! The hypothesis is that ecosystems adjust their root zone gradually to periods of drought or wetness, and that the maximum root zone storage is essentially a function of climate and land cover independent of soil characteristics such as porosity or permeability. Using a Ripple diagram approach for the dimensioning of root zone storage appears to yield an estimate of the required storage that a surviving ecosystem must have created to overcome a critical periods of drought.

This hypothesis has been tested in nine sub-catchments of the Ping river in Thailand and has been validated in 420 catchments across the USA, and proven to be remarkably accurate. The method presented here is a completely new and independent way of estimating a key hydrological parameter on the basis of climatic information.



**Mekonnen Gebremichael, Ph.D.**

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## Education

Ph.D., (2004), University of Iowa  
M.S., (1999), Twente University, the Netherlands  
B.Sc., (1992), Haromaya University, Ethiopia

## Research Interests

My research interests are understanding and prediction of hydrological fluxes on a range of spatial and temporal scales, advancing the use of satellite observations for water resource applications, uncertainty analysis of hydrological estimations and forecasts, transboundary river basin management, water resource management and governance in developing countries, and impact of hydrological and climate changes on vector-borne diseases.

## Selected Awards and Honors

- 2010: AGU Hydrological Sciences Early Career Award
- 2010-12: UConn Al-Geib Professorship
- 2009: IBM Faculty Award
- 2008-11: NASA New Investigator Award
- 2009-Present: Membership in NASA Precipitation Science Team
- 2007-2012: Membership in AGU Precipitation Committee
- 2012: Membership in IAHS Task Force to formulate a new scientific decade initiative
- 2008-Present: Membership in WMO International Precipitation Working Group
- 2008-Present: Membership in IAHS Statistical Hydrology Working Group

# **Towards Optimization of Reservoir Operations for Hydropower Production in East Africa: Seasonal Climate Forecasts (Leonardo Lecture)**

**Mekonnen Gebremichael**

Civil and Environmental Engineering Department,  
University of California, Los Angeles, United States

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Hydroelectric generation and interconnections are the major priority areas of Infrastructure Development in Africa. A number of hydropower projects are currently being developed in East Africa in order to meet the energy demands of the fast growing economy in sustainable and climate-resilient manner. However, the performance efficiency of existing hydropower systems in Africa is much lower (about 30% in some cases) than their design capacity.

This study proposes a decision support system (DSS) that integrates climate forecasts and remote sensing products into modeling and optimization of the hydropower systems in order to achieve reliable reservoir operations and enhance hydropower production efficiency.

The DSS has three main components; climate system, hydrologic and water resources system, and optimization system. The climate system comprises of tools and interfaces for accessing, customizing and integrating climate forecasts and remote sensing data.

The North America Multi-Model Ensemble (NMME) seasonal retrospective forecasts for the East Africa Power Pool (EAPP) region are compared with the TRMM rainfall estimates and the CPC unified gauged rainfall data. The errors of the NMME seasonal forecasts have portrayed significant spatial and temporal variability in the EAPP region. The root mean square errors of the seasonal forecasts are relatively higher for wetter locations and months. However, the skills of the NMME seasonal forecasts are not significantly depreciating with lead time for the study region.

The forecast errors vary from one model to another. Here, we present the skills of NMME forecasts, the physical factors and mechanisms that affect the skills. In addition, we discuss our methodology that derives the best seasonal forecast from the NMME seasonal forecasts, and show how the forecast errors propagate through hydrologic models into hydrological forecasting.





**Prof. Dr. Nick van de Giesen**

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Netherlands

Since July 2004, Nick van de Giesen has held the Van Kuffeler Chair of Water Resources Management of the Faculty of Civil Engineering and Geosciences. He teaches Integrated Water Resources Management (CT4450) and Water Management (CT3011, 2005). His main interests are the modeling of complex water resources systems and the development of science-based decision support systems. The interaction between water systems and their users is the core theme in both research portfolio and teaching curriculum. Since 1 April 2009, he is chairman of the Delft Research Initiative Environment ([www.environment.tudelft.nl](http://www.environment.tudelft.nl)).

Before coming to Delft University, he worked from 1998 to 2004, at the Center for Development Research of Bonn University, with as main activity the scientific coordination of the GLOWA Volta Project. From 1994 to 1998, he did Post-Doctoral research on the hydrology and management of inland valleys at WARDA, Cote d'Ivoire. He received his Ph.D. from Cornell University for his work on wetland development in Rwanda. At Wageningen University, he did his M.Sc. in irrigation engineering.

**Main research projects**

*Distributed Temperature Sensing:* An important focus of recent research concerns the application of Distributed Temperature sensing (DTS) to water management problems. DTS allows for precise measurement of temperature along a fiber optic cable. The length of the cable may go up to 10 km and temperature will be measured at each meter. Accuracy will increase with the duration of the measurement. For measurements of 30 seconds, an accuracy of 0.1 K can be obtained, improving to 0.02 K for measurements of 30 minutes.

The applications have been numerous, leading to many scientific publications in recent years (see below). The first application concerned groundwater inflow into a small stream in Luxembourg. Subsequent applications include finding illicit sewer connections, finding seepage zones in canals, determining soil moisture content, and determining atmospheric temperature profiles. Important partners are Oregon State University, University of Nevada Reno, and Ecole Polytechnique Fédérale de Lausanne. Regular workshops are organized to help scientists become familiar with this interesting technique (see [ctemps.org](http://ctemps.org)).

*Small Reservoirs Project:* This project seeks to develop planning tools for the siting, construction, and management of ensembles of small reservoirs in the Volta basin (Ghana and Burkina Faso), the Limpopo basin (Zimbabwe), and the Sao Francisco basin (Brazil). The basic idea is to determine the optimal density of small reservoirs from a hydrological, marketing, and environmental point of view (see [www.smallreservoirs.org](http://www.smallreservoirs.org)).

## Monitoring Climate, Droughts and Floods: The Trans-African Hydro-Meteorological Observatory

*Nick van de Giesen*

Water Resources Management  
Delft University of Technology  
Netherlands  
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Monitoring Africa's environment is an important challenge if the continent's resources are to be used in an optimal and sustainable manner. Food production and harvest predictions would profit from improved understanding of water availability over space and time. Presently, the African observation network is very limited. National governments and regional planners do not have the data to make proper decisions regarding investments in water resources infrastructure.

The idea behind this project is to build a dense network of hydro-meteorological monitoring stations in sub-Saharan Africa; one every 30 km. This asks for 20,000 of such stations. By applying innovative sensors and ICT, each station should cost not more than \$500. The stations would be placed at schools and integrated in the educational program. The data will be combined with models and satellite observations to obtain a very complete insight in the distribution of water and energy stocks and fluxes.

Within this project, we have built a prototype of an acoustic disdrometer (rain gauge) that can be produced for a fraction of the costs of a commercial equivalent with the same specifications. The disdrometer was developed in The Netherlands and tested in Tanzania for a total project cost of €5000. In 2013 and 2014, we ran sensor design competitions at African universities. See: [tahmo.org](http://tahmo.org).

**eWaterCycle:** This project will develop a high-resolution global hydrological model. The project is a cooperative effort by Utrecht University, the Netherlands eScience Center, and TU Delft. This model was developed in Utrecht and is called PCRGLOB-WB. The model will be parallelised in order for it to be run very fast on a CPU cluster or a super computer. The final ambition is to run the model at a grid of 100m x 100m, with as first intermediary step a global grid of 10km x 10km. The model will be assimilated with measurements collected on the ground and by satellites. Because the main computational bottle neck for this development is the memory directly accessible by the CPU's, a special data assimilation algorithm will be developed in order to keep model development scalable. A beta version of the model runs operationally at <http://forecast.ewatercycle.org>.



*Acoustic disdrometer*

### *Design*

Design of the station is mainly governed by operational requirements. The station should be:

- Robust
- Cheap (<€300)
- Self calibrating
- Cross calibrating

And have:

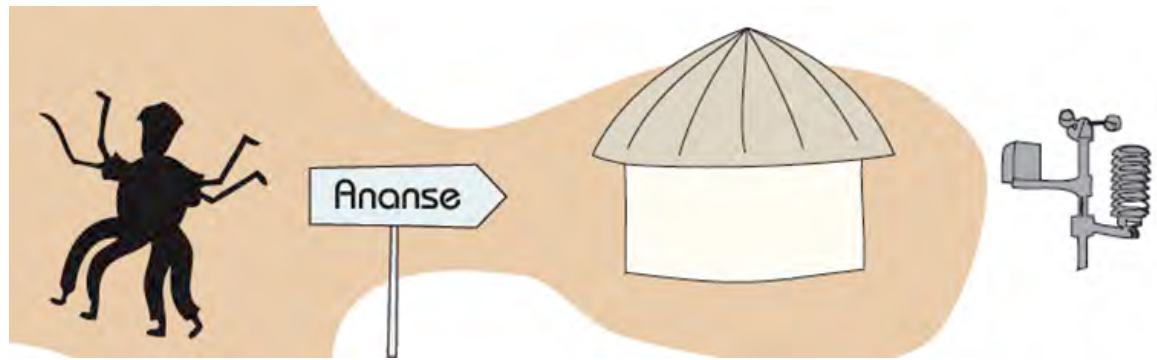
- No moving parts
- No cavities

The African environment is rather unforgiving due to extreme heat, dust, insects and birds. In addition, the technical infrastructure to maintain weather stations is also very limited. The idea is to make the station sufficiently cheap to simply be able to replace them when they would fail. The average life span should be five years or more.

An interesting first example of a new sensor was the development of an acoustic raingauge (see picture). This raingauge measures the impact of individual raindrops. Because the relation between the terminal speed and size of raindrops is well known, one can derive drop size from the energy in the acoustic signal. The sensor is very robust and has no moving parts. At the moment, this sensor has been tested in Tanzania and Zambia.

### *Operation*

In the 2012 summer, several field trials will take place to test some important aspects of the project. The objectives of the trials are twofold. First, we want to know what problems will be encountered in the field under African conditions of a very robust weather station. Special attention will be given to the impact of insects, birds, and extreme solar radiation. Second, hands-on experience is to be gained with data communication protocols and GPRS availability. In principle, cell phone coverage in Africa is very good and in some ways the services offered, such as micro-payments through SMS, are ahead of services at other continents. Also in remote areas there tends to be coverage but a single provider often does not cover the complete country, causing additional complications in terms of contracts, etc. Network outages and poor signal strength during rainstorms are additional challenges. Finally, although within-country data collection normally is unproblematic from a legal point of view, use and communication of these data outside the country of origin is still often subject to complicated rules and arrangements.



### *Education*

Perhaps most interesting for the GIFT workshop is the educational side of the project, and feedback from the teachers would be much appreciated. In the short term, we try to develop a crowd sourcing activity at African university campuses to support the *Design* part of the project. More directly relevant is the idea to deploy the stations at high schools. The main reason is to ensure continued functioning of the weather station through good social embedding but the additional benefit would be to educate a generation of students with an affinity for measuring environmental parameters.

A companion curriculum for environmental sciences would be an important part of the program. A first study was performed at two Junior High Schools in Ghana in 2011 ([http://tahmo.org/TAHMO\\_Report\\_Miranda\\_Pieron.pdf](http://tahmo.org/TAHMO_Report_Miranda_Pieron.pdf)). This study made clear that there have to be very direct links between the measurements and the daily context of students and citizens. An interesting dilemma, open for discussion, is that from an operational point of view, one would like to have a monolithic untouchable station, whereas, from an educational point of view, one would like to have a transparent and touch-inviting design. To be discussed during the GIFT workshop would be the question to what extent and how one can combine a robust design with an inspiring educational package.



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## EDUCATION

BSc Forestry, Haramaya University 1993  
MSc Farm Forestry (Forest Hydrology), Wondo Genet College of Forestry 2005  
PhD Environmental Assessment (Forest Hydrology), Swedish University of Agricultural Sciences, Sweden 2012

## CAREER

Postdoc Researcher: Uppsala University, Sweden September 2014 - August 2015  
Assistant Professor: Addis Ababa University, Ethiopia April 2012 - August 2014; September 2015 - now  
Watershed management planning expert: Bahir dar, July 1996 - June 2003

## RESEARCH INTERESTS

1. the role of forests in different parts of the water balance
2. the tradeoff between carbon and water in forest development

## PUBLICATIONS AND SERVICES

Gebrehiwot, S.G. 2015. Forests, Water and Food security in the northwestern highlands of Ethiopia: knowledge synthesis. *Environmental Science and Policy* 48, 128-136.  
Gebrehiwot, S. G., Ilstedt, U., Gärdenäs, A. I., & Bishop, K. 2011. Hydrological characterization of watersheds in the Blue Nile Basin, Ethiopia. *Hydrology and Earth System Sciences*, 15(1), 11-20.  
Advising 3 PhD and more than 4 MSc students

## AWARDS AND HONORS

Swedish Institute's (SI) Guest Scholarship Award for the period September 2014 to August 2015, hosted at Department of Earth Sciences, Uppsala University, Sweden



Kevin Bishop  
Professor  
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## EDUCATION

BA 1983 (*summa cum laude*) with honors in Philosophy and Geology, Haverford College  
MSc 1986 (*with distinction*) in Engineering Hydrology, Imperial College, London  
PhD 1993 in Geography, Cambridge University, supervisor Prof. Richard J. Chorley

## CAREER

Professor 2010- , Dept. of Earth Sciences, Uppsala University  
Professor of Environmental Assessment at SLU, Uppsala Campus, 1997 -2013  
Guest Professor, University of Colorado, USA 2001-200

## RESEARCH INTERESTS

Defining human impact on aquatic ecosystems with a focus on atmospheric deposition and forestry. Leading two separate 5-year research programs – “Quantifying Weathering for Sustainable Forest Management ([www.slu.se/QWARTS](http://www.slu.se/QWARTS)), and The Sino-Swedish Mercury Management Research Framework ([www.slu.se/SMAREF](http://www.slu.se/SMAREF)). Some specific ongoing projects include: identifying the age and origin of CO<sub>2</sub> degassing from headwaters using radiocarbon dating and identifying hotspots of mercury methylation in the landscape using genomic techniques. He has also been working in Ethiopia for the last decade on how forests influence the water regime, and on an aquatic assessment of the Lake Tumba Landscape in the Democratic Republic of the Congo.

## PUBLICATIONS AND SERVICES

Gebrehiwot, S.G., Seibert, J., Gardenas, A.I., Mellander, P.-E. and Bishop, K. (2013)  
Hydrological change detection using modeling: Half a century of runoff from four rivers in the Blue Nile Basin. *Water Resources Research* 49(6), 3842-3851.  
Bishop, K., Beven, K., Destouni, G., Abrahamsson, K., Andersson, L., Johnsson, R., Rodhe, J., Hjerdt, N. (2009) Nature as the “natural” goal for water management: A Conversation. *Ambio*. **38**(4):209-214.

## AWARDS AND HONORS

Teaching Excellence Fellowship from the Swedish Foundation for International Cooperation in Research and Higher Education (2001-2002)  
Marshall Scholarship for study in Britain, (1983-1986)



# **The Forest Cover – Water Yield Debate: Implications for land management in Ethiopia**

Kevin Bishop (1, 3) and Solomon Gebreyohannis (1, 2)

(1) Uppsala University, Department of Earth Sciences, Uppsala, Sweden  
(kevin.bishop@slu.se), (3) Swedish University of Agricultural Sciences, Department  
of Aquatic Sciences and Assessment, (2) Addis Ababa University, Ethiopian Institute  
of Water Resources

"Are forests good for water" remains a hotly contested scientific question. Despite both its importance and apparent simplicity, we have difficulty knowing enough about how the water regime reacts to land use change to make water-wise decisions regarding the forest management alternatives facing individuals, communities and governments. Scientists still argue about how the presence of forest influences the availability of water. There has been a tendency in some circles to focus on trees as thieves of water because they take water from catchments and put it back up into the atmosphere. Research that focuses on small watersheds where a local water budget can be established, however, misses the potential importance of forests on a regional scale with regard to the importance of returning water vapor to the atmosphere so that it can fall as rain again... In the face of global warming and climate change, the preservation and extension of forest cover is likely to play an increasingly important role in the maintenance and improvement of available water supply. But given the complexity of the science, and the scale issues involved when contrasting local management vs. regional and global issues, it is difficult to know how to include water in forest management. It is therefore not surprising that there can be disparities between national-level water resource management policies and community-level understanding. Even at the local level, upstream/downstream perceptions of land-water management issues and practices can be quite different. Thus, it is often challenging to get community perception integrated into water management, even when there is agreement on the value of local knowledge. The gap between policy and perception is exacerbated by a lack of scientifically based understanding and data-based decision support. Using the situation in Ethiopia as a starting point, the relation between land cover and water over the past half century has been explored using both traditional methods (runoff records, statistical analysis, and change detection modeling), as well as an exploration of community perception. The main findings were that no major, consistent changes in the flow regime despite ongoing land degradation could be detected. Any hydrological changes there were watershed specific. The study of forest cover change also revealed that while there were some general differences in the timing and extent of deforestation, each watershed had its own land-use story. The community perception showed that the relationship of forest cover change and flow regime is not as simple as deforestation bringing loss (or increase) of dry season flow. According to the elders, forest and flow relationships are watershed specific, even sub-watershed specific. The lack of a clear relationship between forest cover change and flow regime at the temporal dimension could be attributed to scale of watersheds and the likely uncertainty in measurements of flow extremes.



Andrea PETROSELLI

Assistant Professor

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## EDUCATION

Master Science Degree in Hydraulic Engineering at Perugia University, Italy, obtained discussing an experimental thesis concerning leaks detection using flow transients in pressurized pipes networks. Expert in following softwares: Autocad, SAP, INFOSTRU, HEC2, G.I.S. (ArcInfo, Idrisi, JGRASS), Matlab, Visual Fortran, FLO2D, RiverFLO2D.

## CAREER

2004 – now: permanent position of Assistant Professor in Hydraulics and Watershed Management for DAFNE Department (Department of Agriculture and Forestry ScieNcEs) in Tuscia University: teacher of the following courses: “Hydraulics and Irrigation”, “Hydrology”, “Water Resources Management” and “Watershed Management” for students of bachelor degrees and master science degrees.

Hydraulic Unit Leader for several International programs in collaboration with other teams of Tuscia University, as the Italy-FAO–Nepal project “Promotion of Olive Production and Consumption in Nepal”.

Member of **GISTAR** - GIS Terrain Analysis Research Group ([www.gistar.org](http://www.gistar.org)), a web portal for researchers and professionals involved in the investigation, developing and application of GIS-based terrain analysis tools for hydrologic and geomorphic models.

Member of **MechHydroLab** - Mechanical Engineering for Hydrology and Water Science ([www.mechhydrolab.org/](http://www.mechhydrolab.org/)), a multidisciplinary laboratory composed of mechanical engineers, hydrologists and water scientists having the goal to combine mechanical engineering technologies and hydrological sciences toward the development of novel experimental systems for advanced environmental monitoring.

## RESEARCH INTERESTS

Hydrology and watershed management at basin scale; GIS; rainfall-runoff models; floods prevention and protection; environmental monitoring and modelling.

## PUBLICATIONS AND SERVICES

PETROSELLI A., “LIDAR Data and Hydrological Applications at the Basin Scale”, GIScience & Remote Sensing, 2012, 49, No. 1, p. 139–162, DOI 10.2747/1548-1603.49.1.139

PISCOPIA R., PETROSELLI A., GRIMALDI S., “A software package for the prediction of design flood hydrograph in small and ungauged basins”, Journal of Agricultural Engineering 2015; XLVI:432, 74-84, doi:10.4081/jae.2015.43227



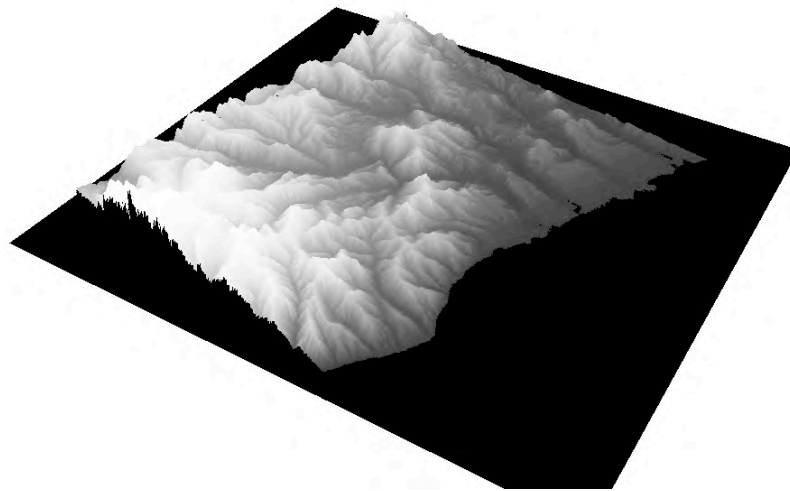
# GEOGRAPHIC INFORMATION SYSTEMS (GIS) AND TERRAIN ANALYSIS

Andrea Petroselli  
Tuscia University  
Viterbo, Italy

Geographic Information System (GIS) mainly it is a computer based technology which provides the tools for collecting, editing, storing, retrieving, analyzing and displaying spatial data.

Basically GIS is a mix of hardware, software and data that the analyst can use to manipulate territory and take decisions.

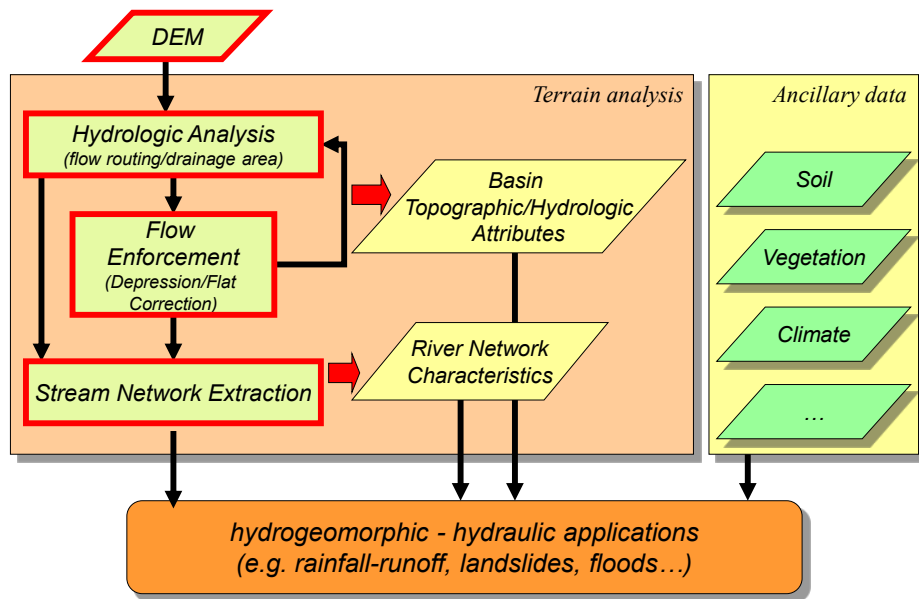
Many applications for GIS involve the environment issue; from an hydrogeomorphologic point of view, the starting point is the Digital Elevation Model (DEM), i.e. a tridimensional representation of territory that the computer can handle for a series of operations.



The first part of the presentation describes how GIS can be useful for a variety of applications.

The second part of the presentation is focused on the Terrain Analysis (TA), i.e. the estimation of hydrogeomorphic attributes from DEMs such as slope, aspect, flow directions and so on.

TA is a preliminary operation useful for a series of applications, such as hydrological ones (extraction of river networks from DEMs), hydraulic ones (flood prone areas estimation), geomorphological ones (shallow landslide prone areas estimation) and so on.





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personal webpage (if available)

### EDUCATION

University of Agricultural Sciences, Austria	Water Resource Management	PhD, 2002
Canfield University, UK	Rural Engineering	MSc, 1992
Alemaya University of Agriculture, Ethiopia	Agricultural Engineering	BSc, 1987

### CAREER

Teaching/Learning graduate supervision – the areas of water and land resource management.  
Researcher – in the broad areas of soil and water resource engineering and management

### RESEARCH INTERESTS

water resource management, sustainable land management, hydro-sedimentology, agro-climate, irrigation and drainage,

### PUBLICATIONS AND SERVICES

1. Gebere, S. B., T. **Alamirew**, Broder J. Merkel and Melesse, A. M.. Performance of High Resolution Satellite Rainfall Products over Data Scarce Parts of Eastern Ethiopia. Remote Sens. 2015, 7(9), 11639-11663; doi:10.3390/rs70911639
2. Mersha, A. C. de Fraitura, A. Meharia, I. Masiha and T. Alamirew, 2015. Integrated Water Resources Management: Contrasting principles, policy, and practice, Awash River Basin, Ethiopia. Water Policy doi:10.2166/wp.2015.049.
3. Shawul, A. A., T. Alamirew, A. M. Melesse, and S. Chakma, 2015. Climate Change Impact on the Hydrology of Weyb River Watershed, Bale Mountainous Area, Ethiopia. In: A.M. Melesse and A. Abitew (ed) Landscape Dynamics, Soils and Hydrological Processes in Varied Climates. Springer Science Publisher, Heidelberg, doi:10.1007/978-3-319-18787-7.
4. Gebrie, S. B., T. Alamirew, B. J. Merkel, A. Melesse., 2015. Land use and Land cover change impact on groundwater recharge: the Case of Lake Haramaya Watershed, Ethiopia. In A. M. Melesse and A. Abtew (eds). Land scape dynamics, soils and hydrological processes in varied climates. Springer Geography. DoI 10.1007/978-3-319-18787-7-1.
5. Birhanu, K. T. **Alamirew**, M. O. Dinka, S. Moges and D. Aklog. 2014. Optimizing reservoir operation policy using chance constraint nonlinear programming for Koga Dam, Ethiopia. Water Resources Management. 28 (14):4957-4970.

# **Ethiopia's Water Security and the State of Water Resource Management**

**Tena Alamirew**

Water and Land Resource Center, Ethiopia

Ethiopia pushes to emerge from livelihood that is characterized by marginal struggles for survival to prosperous middle income country. The push for economic growth and development is land and water centred. One of the positive outcomes of such push is the fact that Ethiopia has just attained the Millenium Development Goal (MDG) on water supply.

The strong tie between hydrological variation and Geo Data Portal (GDP) in Ethiopia means water security is the principal environmental risk for Ethiopia's economic endeavour. Against the public perception that 'Ethiopia is endowed with water resources', guaranteeing water security for the poor and for productive enterprise is hampered by multiple factors including:

- a) extreme climate variability,
- b) competition on water resources,
- c) 'fragile' institutional capacity to plan, execute programs and to factor complex environmental and social dimensions and climatic variability in investment programs,
- d) intricate past and current socio political landscape that leads to water resources management challenges and
- e) low storage capacity of the hydrologic compartments such as aquifers, soil water, surface water courses and lakes.

The external climate and population pressures and the intrinsic vulnerability of the socio-economic-environmental systems have led already to remarkable negative outcomes. Remarkable among them are

- a) massive famine and population displacement in 1970's and 80's
- b) depletion of water sources and related consequences,
- c) erosion of 'cultural landscapes' and customary water management institutions in pastoralist regions,
- d) 'stationary emergency' in water supply of major urban and pre urban centers,
- e) massive land degradation, pollution, and salinization of soils and abandonment of farming,
- f) low sustainability of water infrastructure etc.

The aims of this talk are

- a) to demonstrate water security as the principal environmental risk in Ethiopia and the horn of Africa and

b) to provide key examples and features of the risk defining elements (hydro climatic hazards, social-political-environmental vulnerability) the various outcomes.

Some element of needs as well as opportunities for technological innovation and institutional strengthening as a way of mitigating risk will be briefly discussed. Furthermore Ethiopia's ongoing programmatic efforts to curb the risks (e g Sustainable Land Management Program) shall be discussed in terms of the results they deliver. Although the topic is largely based in cases emerging from Ethiopia its implication is wider than the geographic scope covered here.

## Murugesu Sivapalan

Professor of Civil and Environmental Engineering & Professor of Geography



**Date of Birth:** April 19, 1953. Sri Lanka

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E-mail: [sivapala@illinois.edu](mailto:sivapala@illinois.edu) Website: <http://www.geog.uiuc.edu>

### Education

<b>Ph.D.</b> , Civil Engineering, <i>Princeton University</i>	1986
<b>M. A.</b> , Civil Engineering, <i>Princeton University</i>	1983
<b>M. Eng.</b> , Water Resources Engineering, <i>Asian Institute of Technology, Thailand</i>	1977
<b>B. Sc. Eng. (Hons)</b> , Civil Engineering, <i>University of Ceylon, Peradeniya, Sri Lanka</i>	1975

### Prizes, Awards and Honors

<b>Doctores Honoris Causa:</b> <i>Delft University of Technology, The Netherlands</i>	2012
<b>Robert E. Horton Medal:</b> <i>American Geophysical Union (AGU)</i>	2011
<b>Hydrological Sciences Award (HSA):</b> <i>American Geophysical Union (AGU)</i>	2010
<b>International Hydrology Prize (IHP):</b> <i>International Association of Hydrologic Sciences (IAHS)</i>	2010
<b>Centenary Medal:</b> <i>Commonwealth Government of Australia</i>	2003
<b>John Dalton Medal:</b> <i>European Geophysical Society (EGS, now EGU)</i>	2003
<b>Fellow:</b> <i>American Geophysical Union (AGU)</i>	2003
<b>Fellow:</b> <i>Australian Academy of Technological Sciences and Engineering (FTSE)</i>	2001
<b>Fellow:</b> <i>Modelling and Simulation Society of Australia and New Zealand (MSSANZ)</i>	2001
<b>Biennial Medal (Natural Systems):</b> <i>Modelling and Simulation Society of Australia and New Zealand</i>	2001
<b>Life Member/Fellow:</b> <i>The International Water Academy (TIWA), Oslo, Norway</i>	2000

### Other Recognition

<b>Executive Editor:</b> <i>Hydrology and Earth System Sciences Journal</i> (European Geosciences Union)	2004–present
<b>Founding Section Editor (Hydrology and Water Resources):</b> <i>Geography Compass</i> (John Wiley)	2006-2009
<b>Founding Chair:</b> <i>IAHS Decade on Predictions in Ungauged Basins</i>	2002–2005

### Employment Record

August 16, 2005 – to present	<b>Professor of Civil and Environmental Engineering &amp; Geography</b> University of Illinois, Urbana-Champaign
November 23, 1999 – August 15, 2005	<b>Professor of Environmental Engineering</b> Centre for Water Research, University of Western Australia
June 1, 1996 – June 30, 1997	<b>Head, Department of Environmental Engineering</b> Centre for Water Research, University of Western Australia

August 15, 1995 – November 22, 1999 **Associate Professor (with tenure) of  
Environmental Engineering**  
Centre for Water Research, University of Western Australia

September 1, 1988 – August 15, 1995 **Lecturer and Senior Lecturer**  
Centre for Water Research, University of Western Australia

July 1978 – June 1981 **Civil Engineer/Senior Consultant**  
Rocks & Stones (Nig) Ltd., Ibadan, Nigeria

### **Research Interests**

The main focus of my research is on making predictions of hydrological responses in *ungauged* and *changing* catchments (i.e., catchments devoid of any response measurements) subject to human impacts (climate change, land use and land cover changes), avoiding the reliance on calibration. A basic aim of the research therefore is to understand observed space-time variabilities of and changes in a variety of hydrological responses, including extremes (within and between catchments), across spatial and temporal gradients and interpret these in terms of the underlying climate-soil-vegetation-topography- human interactions.

# **Water, water everywhere, not a drop to drink!**

Murugesu Sivapalan

University of Illinois at Urbana-Champaign

**Abstract:** *This talk will cover the critical issues underpinning the world water crisis. It will help to gain a good understanding of the causes of the water crisis and why it may yet worsen, analyzing the connections between the size and behavior of human populations and associated freshwater problems, in the context of a changing world, and exploring the avenues left to prevent and possibly reverse the worsening trends. The talk will outline the roles that science and technology can play, but also the critical role that humanity can and should play through changing their attitudes towards sustainable development, valuing both water and nature equally, and exercising leadership and stewardship at all levels: households, communities, cities, nations, and the whole world.*

Earth is the “blue planet”, with more than two thirds of its surface covered by water. Yet, the amount of fresh water actually available for human consumption is incredibly small and is becoming increasingly scarce. Even the small fraction of fresh water that is found on earth is very unevenly distributed in space and time, especially in relation to the distribution of human populations. Many parts of the world do not have enough water now to produce food for their growing populations. A lack of access to drinking water and sanitation perpetuates the cycle of poverty and instability.

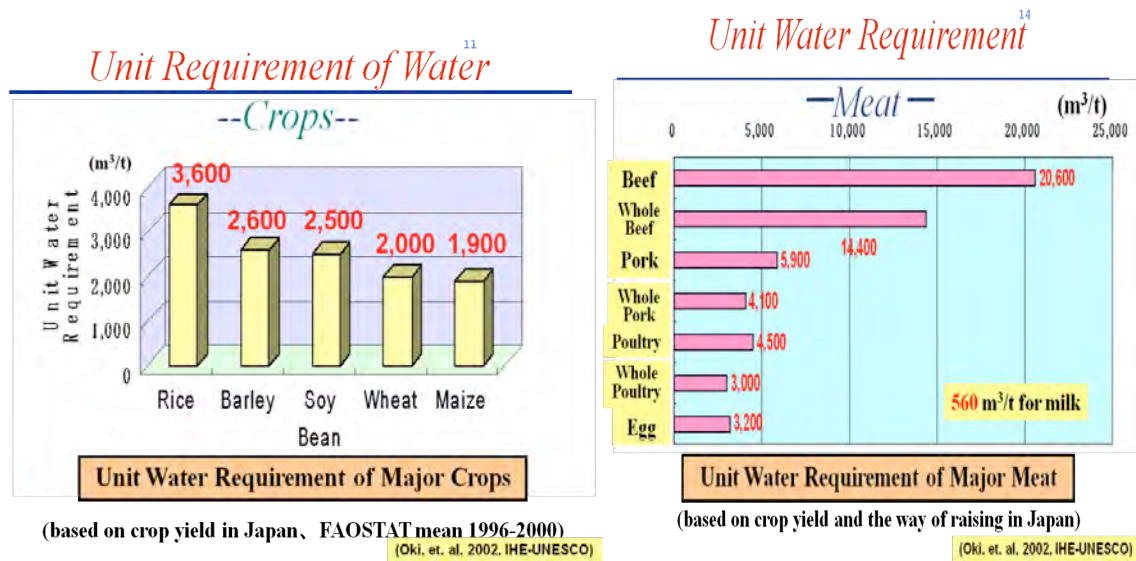
As population pressures increase on land, invariably we find that humans are beginning to degrade the very sources of water that they drink and use for food production, and in this way they adversely impact water availability. Dams that supply drinking water to cities are in danger of being polluted by nutrient exports from upstream watersheds and heavy metals from industrial sites. Large scale irrigation schemes in many countries, such as India and Australia, are giving rise to land salinization and water-logging, effectively eliminating land from any further production. Elsewhere, in the US, China, India and Egypt, countries are pumping groundwater for irrigation in excess of natural recharge rates. Clearly the world is facing a water crisis, but much of it is self-imposed. It arises through a long and entrenched legacy of unsustainable practices that have their origins, first, in our undervaluing water as a resource and our proliferation of waste, our inefficiencies in water use and our degradation of the natural environment.

The good news is that this crisis of water management need not intensify, and it can be reversed through concerted action at several levels. Water prices must rise in the future, and price structures must include the real costs of water, i.e., the cost of accessing the water, the cost to the environment through the extraction and the cost of any pollution introduced through return flows. Higher water prices will not only encourage all users to use water more efficiently, but also could generate the funds to maintain existing infrastructure and build new infrastructure. Such pricing will also save significant amounts of water to be left in-stream for environmental uses.

The water crisis is really a crisis of water for food. Engineers, managers, politicians and funding agencies have all shown a preference for large irrigation schemes to bring about substantial growth in food production. By contrast, rain-fed agriculture, more than 60% of worldwide food production, does not require major engineering works, and can be handled through small-scale land-use planning and watershed management. Rapid growth in rain-fed agriculture could be spurred through intensive research on crop breeding for rain-fed environments. Since rain-fed

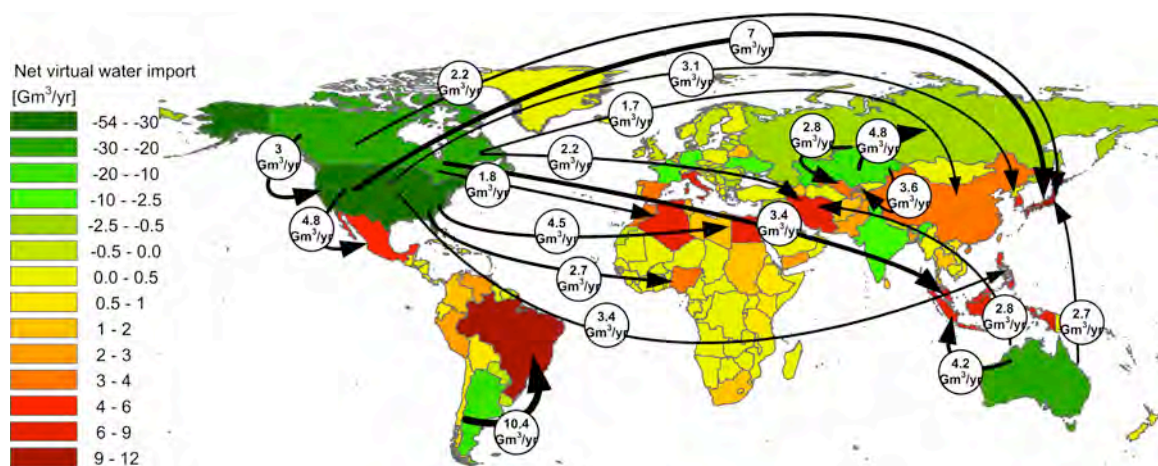


agriculture can be practiced with localized water management – harvesting and storing water where it falls – it is very cost-effective.



**Figure 1:** Unit water requirement of water for several crops, and for several types of meat (taken from Okoi et al., 2003).

The amount of water consumed in the production process of a product is labeled the 'virtual water' in a product. For example, to produce one kilogram of wheat we need about 1000 liters of water. For meat we need about five to ten times as much! So when we trade goods, especially food products, there is a virtual flow of global water (or across regions) of countries that export food (see Figure 2). Instead of producing this food themselves, and using water for the production of rice or meat, the importing country or region can utilize their water for other purposes. This results in real water savings, relieving the pressure on scarce water resources. Conversely, water-rich countries could profit from the abundance of water resources by producing water-intensive products for export.



**Figure 2:** National virtual water balances and net virtual water flows related to trade in wheat products in the period 1996–2005. Only the largest net flows (>2Gm³/yr) are shown (taken from Mekonnen and Hoekstra, 2010).

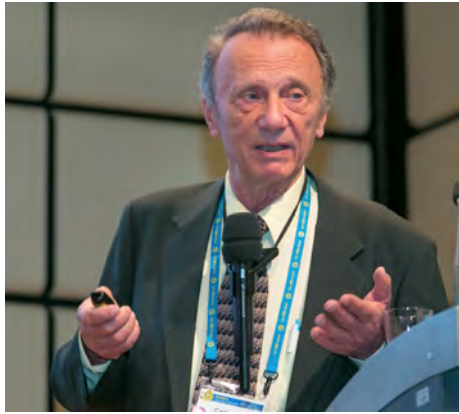
Global policies on use of water need to build on (i) the equitable pricing of water, (ii) its localized management and control, and (iii) virtual water trade, and must be underpinned by the transfer of

rights and responsibilities for operations of water management to communities that live on or close to the land. The biggest problem in arriving at such policies is our lack of information about the magnitude and distribution of accessible water resources, at all levels. Nor do we have good projections on how these will change with future climatic and land use changes. The lack of data is most severe in developing countries of the world. In our current information era, governments are cutting back on routine gauging of hydrological quantities as an unnecessary expense. Water is a billion dollar industry, and there is no justification for not investing a few millions of dollars for monitoring and developing a predictive understanding of the space-time distribution of our most basic and valuable resource. The expansion of the virtual water trade requires not only information on the space-time distribution of water resources across the globe, but also the integration of such information with global and regional economic models to guide inter-regional and international transfers of virtual water.

The way forward is therefore clear – our hopes to prevent, even reverse, the water crisis, requires us to make stark choices, along with associated sacrifices, through raising the price of water and the removal of all subsidies, encouraging the use of rain-fed agriculture and localized water management, investing the returns from higher prices into existing and new infrastructure to increase water supply, new science and technology to increase crop productivity and land and water management, and new schemes to rehabilitate and sustain degraded environments, encouraging the utilization of virtual water trade, and reforming the system of water rights on the basis of equitable allocation of water to different sectors, including especially the environment. These require strong leadership, a global vision, and a stewardship of nature, simultaneously at many levels. This is the most fundamental challenge facing humanity.

## **References**

- Mekonnen, M. M. and A. Y. Hoekstra (2010) A global and high-resolution assessment of the green, blue and grey water footprint of wheat. *Hydrol. Earth Syst. Sci.*, 14, 1259-1276.
- Oki, T., Sato, M., Kawamura, A., Miyake, M., Kanae, S. and Musiake, K. (2003) Virtual water trade to Japan and in the world, In: Hoekstra, A.Y. (ed.) Virtual water trade: Proceedings of the International Expert Meeting on Virtual Water Trade, Value of Water Research Report Series No. 12, UNESCO-IHE, Delft, the Netherlands.



## **Carlo Laj**

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Committee on Education  
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### **Education:**

Secondary school in Italy and the USA (American Field Service Exchange Student.)  
University studies at the University of Paris, PhD in Solid State Physics.

### **Career**

I have done all my scientific career as an employee of the French Atomic Energy Commission, first as a researcher in the Physics Department then in the field of geophysics.

In 1985, I was appointed as Deputy Director of the Centre des Faibles Radioactivités and Head of the Department of Earth Sciences. I created and was first director of the Laboratoire de Modélisation du Climat et de l'Environnement, which was later united with the Centre des Faibles Radioactivités to form the present Laboratoire des Sciences du Climat et de l'Environnement (LSCE).

After 3 terms as Head of Department (12 years) I stepped down to a researcher position again, until I retired. I have been an “emeritus” researcher since then, and gradually reoriented my activities towards education.

I founded the Committee on Education of EGU, and have been its Chairman in the last 11 years.

### **Research Interests:**

After my PhD I spent a few years working with critical phenomena (scattering of laser light by critical fluids) then moved into the field of geophysics.

My main interests in this new field has always been linked to the magnetic properties of sediments and igneous rocks (paleomagnetism), used with several objectives: geodynamical reconstructions (particularly in the Eastern Mediterranean and the Andean Cordillera), reconstruction of the history of the Earth's magnetic field (including the morphology of field reversals) and more recently reconstructions of environmental and climatic changes on a global scale.

I have published about 200 articles in international scientific journals and a few general popular articles in different journals.

Fellow of the American Geophysical Union (AGU).

F. Holweck prize of the French Academy of Science

Supervisor of 12 PhD students, and 8 Masters of Science

### **Educational activities:**

Chairman, Education Committee of the European Geosciences Union

Participant to different National and International Education Committees

Union Service Award for creating the Committee on Education of EGU

Excellence in Geophysical Education Award of the American Geophysical Union

# **THE EDUCATIONAL ACTIVITIES OF THE EUROPEAN GEOSCIENCES UNION**

Best practice for the science–teaching interface

C. Laj

*European Geosciences Union, Committee on Education  
education@egu.eu.*

## **Introduction**

In 2002 in Nice, France, EGU Executive Secretary Arne Richter announced a collaboration between scientists and schools all over Europe. The aim was to bring state-of-the-art science via high school teachers into tomorrow's classrooms.

Carlo Laj was appointed chair of the EGU Committee on Education (CoE) and, in 2003, the first GIFT workshop took place at the General Assembly, featuring 42 teachers from seven European countries. Since then, more than 1000 teachers have attended these workshops, which are a mixture of presentations by worldwide known scientists, hands-on experiences for the classroom and presentations by the teachers themselves to their fellow teachers

The Committee on Education of EGU has progressively developed programs and educational materials mainly aimed at secondary school teachers and pupils along 5 main axes:

- 1) Geosciences Information for Teachers (GIFT) workshops at EGU General Assemblies and more recently at Alexander von Humboldt topical Conferences
  - 2) Educational sessions at EGU General Assemblies (teachers and scientists and science educators)
  - 3) Gift Distinguished Lectures series
  - 4) Teachers at sea
  - 5) EGU-UNESCO-ESA Collaboration for GIFT workshops in Africa
- These activities are briefly described below.

## **The GIFT workshops at the EGU General Assemblies**

The program of each workshop is focused on a unique general theme, which changes every year, and which combines scientific presentations on current research in the Earth and Space Sciences, given by prominent scientists attending EGU General Assemblies, with hands-on, inquiry-based activities that can be used by the teachers in their classrooms to explain related scientific principles or topics. Also, teachers are welcomed to present to their colleagues some aspects of their own « out-of-the program » classroom activities.

The main objective of these workshops is to spread first-hand scientific information to science teachers of primary and secondary schools, significantly shortening the time between discovery and textbook, and to provide the teachers with material that can be directly transported into the classroom. In addition, the full immersion of science teachers in a truly scientific context (EGU General assemblies) and the direct contact with world leading geo-scientists are expected to stimulate curiosity towards scientific research that the teachers will transmit to their pupils.

The value of bringing teachers from several nations together includes the potential for networking and collaborations, the sharing of experiences, and an awareness of science education as it is presented outside their own countries. At all previous EGU GIFT workshops

teachers mingled with teachers from outside their own country and had lunch together with the scientists, which provided rich dialogue for all those who participated since the dialogue included ideas about learning, presentation of science content, curriculum ideas... We, therefore, believe that, in addition to their scientific content, the GIFT workshops are of high societal value.

The workshop quickly became known amongst teachers all over the European continent and, in the following years, the number of participants doubled. Due to the importance of the valuable hands-on activities, which require an intimate setting, and the limited space at the conference venue, the maximum number of participants had to be limited to 85.

Today a GIFT workshop typically includes :

- Two and a half days of workshop
- 80 participants from 20 countries (selected from 250-300 applicants)
- 8-9 conferences by worldwide known scientists present at the General Assembly
- 1 half-day practical works with specialized educators
- 1 poster session “Science in tomorrow’s classroom” where teachers are encouraged to present their out-of-the-official-program school activities and which is open to non-teachers participants (in 2012 we have had about 50 posters from the teachers attending the GIFT workshop out of a total of about 65)
- 1 visit to local institutions in Vienna (UNOOSA, IAEA...)

And each GIFT workshops starts with a visit and an ice-breaker reception at the Vienna Museum of Natural History on the Sunday preceding the workshop.

The year 2009 brought further additions to the GIFT concept. For the first time, recordings were made available as web streams and are openly accessible free of charge via the EGU website (<http://www.egu.eu/outreach/gift/workshops/>).

Also, in 2010, the Committee on Education decided to hold a « local » GIFT workshop associated with EGU Alexander von Humboldt Topical Conferences. These are a series of meetings held outside of Europe, in particular in South America, Africa or Asia, on selected topics of geosciences with a socio-economic impact for regions on these continents, jointly organized with the scientists and their institutes/institutions of these regions.

The first GIFT-AvH took place in Merida (Yucatan), the second in Penang (Malay) the third in Cusco (Peru), the fourth in Istanbul (Turkey) and the fifth here in Addis Ababa. Each time we have had a participation of 40-45 « local » teachers.

Noticeably, in the three cases it was the first workshop of the kind organized ever.

