

# Annual Report 2010

## Hydrology and Water Resources Core

Head of Core: Prof. Stefan Uhlenbrook, PhD, MSc, habil.

### 1 Core staff as of 31 December 2010

Position	Name	Appointment (fte)	Research input (fte)	Remarks
Professor	Dr. habil. Stefan Uhlenbrook, MSc	0.8	0.4	0.2 FTE at TU Delft and 0.8 FTE at UNESCO-IHE; since August 2010 0.2 FTE Director of Academic Affairs a.i.(.)
Associate Professors	Jan Nonner, MSc	1.0	0.1	
	Dr. Yangxiao Zhou, MSc	1.0	0.1	
	Dr. Jan Willem Foppen, MSc	1.0	0.4	
	Dr. Michael McClain, MSc	0.4	0.1	Part-time since head of department
Senior Lecturers	Dr. Raymond Venneker, MSc	1.0	0.4	
	Dr. Shreedhar Maskey, MSc	1.0	0.4	
	Dr. Thom Bogaard, MSc	0.2	0.1	Staff exchange with TU Delft
Lecturer	Dr. Jochen Wenninger, MSc	1.0	0.4	
AIO	-	-	-	All PhD researchers are on fellowship basis
<b>TOTAL</b>		<b>7.4</b>	<b>2.4</b>	

### 2 Research and educational profile

#### 2.1 Research lines

- **Impact of global changes on hydrological processes**

The interactions between the hydrological cycle and the climate system are crucial for the hydrological response of a catchment, as the climate systems define the forcing variables (energy and water input) of the hydrological system. Beside climate change other changes impact the hydrology, for instance, land cover and land use, population (amount, density, age structure etc.), water use etc. There are many feedback mechanisms (e.g. through climate induced land use changes) involved, which are not fully understood. One major challenge that hydrology currently faces is to predict the impact of global changes on hydrological processes and water cycle dynamics. This implies the impact on spatio-temporal variable distributions of both water quantity and water quality.

Fundamental and applied research has to be carried out in this field. The HWR core concentrates on (i) the land surface processes at local and catchment scale (e.g. interception, evaporation and infiltration), (ii) the (re-) distribution of subsurface water, including soil moisture and groundwater, and (iii) hydrological extremes (i.e. floods and droughts). Experimental process studies are carried out (combined hydrometric, geophysical and tracer studies) and process-based models are further developed and applied at various scales (from plot scale to larger river basin scale) and in different hydro-climatic regions. A particular challenge is the up-scaling of local process understanding and the incorporation of these findings into large scale hydrological models to quantify the impact of changes.

- **Physical and biogeochemical processes of groundwater systems**

Another major challenge that hydrology currently faces is to connect the knowledge of quantitative groundwater hydrology, i.e. groundwater dynamics, flow pathways, residence times and mixing of different water compartments etc., with water quality. The HWR core group concentrates in this research line, on the one hand, on the fate and transport of contaminants in hydrogeological systems. Therefore, a good understanding of the water flow and contaminants transport processes is needed. Of particular interest is currently the transport of bio-colloids (i.e. viruses, bacteria, DNA) in the subsurface and its dominating controls (e.g. surface characteristics of bacteria). On the other hand, the state of the groundwater system including the physical properties of aquifers will be investigated, with particular emphasis on observations and monitoring networks.

## 2.2 Educational programme/specialisation for which the Core is responsible

- MSc Programme of Water Science and Engineering  
Hydrology and Water Resources specialisation

Staff members of the core group contribute to a number of other MSc programmes/specialisations and short courses at UNESCO-IHE and to some extent at Delft University of Technology (Uhlenbrook).

## 3 Major achievements

### 3.1 Research

- 1 PhD researcher graduated (Hodson Makurira, co-promoted with prof Savenije, MAI department, and TU Delft) and 6 new PhD researchers have started in 2010.
- 19 publications in A-category journals (according to SENSE criteria) were published in 2010 and >10 papers are currently in review in top international journals (HESS, J. of Hydrol., Hydr. Sci. Journal, Water Res. Research, J. of Contaminant Hydrol., Hydro. Processes, etc.).
- 31 papers in journals and 63 publications in total (incl. books, book chapters, conference papers, professional publications etc.) were published in 2010.
- New core-led research projects started in 2010, i.e. CHE (1 PhD student), AGLOCAP, (1 PhD and 1 MSc student), UWIRA (1 post-doc), MARAFLOWS (1 PhD student), and Ecohydrology Erdos China (1 PhD student). These projects are setting the basis for interesting research in the coming years.
- The interdisciplinary Post-doctoral Programme on Climate Change Adaptation in the Mekong River Basin (PRoACC), with a total of 8 post-docs (2 related to hydrology) started in April 2010 (directed by S. Uhlenbrook).

### 3.2 Education

- Graduation of 9 MSc students in the specialisation Hydrology and Water Resources. Two students (Ms Patricia Trambauer, Uruguay, and Ms Aline Saraiwa, Mozambique) graduated with distinction, and both are in the process of starting their PhD research at the core group.
- Contribution to the supervision of many other MSc students in other programmes at UNESCO-IHE and the Vrije University of Amsterdam (2 MSc students graduated in 2010).

### 3.3 Advisory/Capacity building projects

- Regional refresher seminar on Participatory Management of Flood Risk in the Changing Climate ((NUFFIC fund: 75 KEuro) was successfully conducted from 26 July - 2 August 2010 in Kathmandu, Nepal. The course was participated by 18 UNESCO-IHE alumni from 10 countries from the region. In addition to UNESCO-IHE lectures (Maskey, Werner, van Andel), four experts from the region (Dr. AB Shrestha, ICIMOD, Dr. DK Gautam, Dept. of Hydrology and Meteorology/Nepal, Mr AS Khan, IWM/Bangladesh and Dr. Y Huang, Hydrology Bureau of CWRC/China) contributed as guest lecturers.

### 3.4 Society

- Core members are active members of a number of professional organisations such as IAHS, AGU, EGU, UNESCO-IHP, IFI, WMO-CHY, CERG, etc.
- Prof Uhlenbrook serves in a number international science steering committees and is member of the editorial boards of the following journals: Hydrology and Earth System Sciences (since November 2004), Hydrological Sciences Journal (since January 2006) and Hydrologie und Wasserbewirtschaftung (Hydrology and Water Management, in German; since 2008). In addition, he is the editor the volume no. 2 (Hydrology) of the five volumes reference work 'Treatise in Water Sciences', to be published by Elsevier in February 2011 (chief editor: Peter Wilderer, TU Munich).  
He served in several Scientific Committee of International conferences such as, HydroPredict 2010 (Prague, September 2010), European Geophysical Society (convener Education session) and EGU Leonardo Conference (November 2010).

He gave several keynote lectures at international conferences including an invited presentation on climate change impacts on water cycle dynamics at the COP-16 meeting in Cancun, Mexico (December 2010).

- Dr. McClain serves on the steering committees of the Freshwater Program of Diversitas, the Global Environmental Flows Network, and the Water Footprint Network.
- Dr. Bogaard is guest editor HP special issue and Engineering Geology special issue (both due in 2011), and treasurer of Treub Maatschappij (Organization for supporting research in the tropical regions). In addition, he is member of the board of the CERG (Centre European des Risques Geomorphologique (Specialized Centre of Council of Europe EUR-OPA Major Hazard Agreement), and he served as member International Scientific Committee International Conference Mountain Risks: Bringing Science to Society (November 2010 Firenze, Italy)
- Dr. Maskey gave an invited lecture in the Boussinesq Lecture Series 2010, Royal Academy of Sciences, Amsterdam, the Netherlands, on the Melting of Snow and Glaciers in the Himalayas.
- Dr. Venneker is a member of the IAHS Working Group on Education in the Hydrological Sciences.
- The staff members of the core contributed to the review of papers to a number of key water journals.

- **Miscellaneous**

## 4 Research

### 4.1 Research projects initiated during 2010

- Start of implementation of PProACC - Post-doctoral programme for research on Climate Change Adaptation with special emphasis on the Mekong River basin; 8 post-docs started in April 2010 their research projects. Cooperation with many partners in the Mekong countries including, AIT Bangkok, Hanoi WRU, Chinese Academy of Sciences, MRC, CRC etc. (Uhlenbrook (project director), Venneker, Maskey)
- CHE - Conserving Hydrological and Ecological functions through payment for watershed services, with special reference to South-Central Bolivia; 1 PhD student started in March 2010, unfortunately, he has left the project in September due to illness. Co-operation with Universiteit Amsterdam, Universidad Mayor de San Simón and Fundación Natura Bolivia. Inception workshop in March 2010. (Uhlenbrook)
- UWIRA - Impact of untreated wastewater on natural water bodies: Integrated risk assessment. Institute of Environmental and Water Studies at Birzeit University (Birzeit, Palestine), Water and Environmental Studies Institute at An-Najah National University (Nablus, Palestine) and the Palestinian Water Authority (Al-Bireh, Palestine) (Wenninger, Uhlenbrook). Inception workshop in May 2010.
- MaraFlows - Environmental Flows for People and Ecosystems in the Mara River Basin, Kenya/Tanzania, funded by DUPC and USAID at total level of €638,338 over four years; project coordination and co-supervision of 2 PhD students (McClain, Mul, Uhlenbrook, O'Keeffe); partnering with University of Dar Es Salaam (Tanzania) and Egerton University (Kenya). The inception workshop was held in May 2010.
- DEWFORA - Improved Drought Early Warning and FOREcasting to strengthen preparedness and adaptation to droughts in Africa; an EU FP7 research project. The project officially starts in January 2011. UNESCO-IHE's team is led by Dr S. Maskey. The main contribution of UNESCO-IHE is in the development of a hydrological model (coupled with meteorological forecasts by ECMWF) for drought forecasting in selected river basins in Africa. Patricia Trambauer, a HWR graduate (2010), will join the project as a full time PhD researcher. (Maskey, Trambauer, Uhlenbrook, van der Zaag)

### 4.2 On-going research projects/activities (indicating partners, budget and funding source)

- Blue Nile Hydrosolidarity project - In Search of Sustainable Catchments and Basin-wide Solidarities; Transboundary Water Management of the Blue Nile River Basin; funded by NWO-WOTRO and DUPC (led by Prof P van der Zaag, MAI department), co-supervision of PhD students Mr Ermias Terefi and Mr Sirak Terlak and post-doc Mr Melesse Temesgen (Uhlenbrook, Wenninger)
- SCUSA - Integrated approaches and strategies to address the Sanitation Crisis in Unsewered Slum Areas in African mega-cities (SCUSA), led by Dr. JW Foppen; collaboration with Makerere University and the Kampala City Council in Uganda; supervision of PhD student Mr Philip Nyenje and overall project management (Foppen, Uhlenbrook)
- ECOLIVE - Ecology of Livelihoods, Nyando wetland, Kenya, funded by DUPC (led by Dr A van Dam, ER department), supervision of PhD student Mr Patrick Khiza (Wenninger, Uhlenbrook)
- RISKOMAN - Risk-based operational water management for the Incomati River Basin (RISKOMAN), funded by DUPC and led by Prof P. van der Zaag (MAI department); collaboration with Eduardo Mondlane University in Mozambique and Komati Basin Water Authority in Swaziland; co-supervision of PhD student, Aline Saraiwa, (van der Zaag, Uhlenbrook)

- ISOWUE - Experimental investigations of water fluxes within the soil-vegetation system using isotopes to improve water use efficiency, part of the IAEA's Coordinated Research Project (CRP): Quantification of Hydrological Fluxes in Irrigated Lands Using Isotopes for Improved Water Use Efficiency. Supervision of MSc students (Wenninger).
- EXACT - Small scale water treatment and artificial recharge project. Total budget: 2.3 million Euro (DUPC funded). Principal partners are the Ministry of Water and Irrigation of Jordan, the Palestinian Water Authority and the Israeli Water Authority (Nonner, Petrusevski, Sharma, Ghebramichael).
- AGLOCAP - Adaptation to Global Change in Agricultural Practices, with a case study in a Himalayan River Basin in Nepal, in collaboration with Asian Institute of Technology, Thailand, and Depart of Irrigation, Nepal. Two PhD students (Mr. D. Bhatt at UNESCO-IHE and Mr. Agarwal at AIT) and one MSc student (Mr. Pradhan) joined the project in 2010. (Maskey, Uhlenbrook, Prasad, Schulz)
- Ecohydrology Erdos China - Project funded by the Netherlands Asian Facility for China programme and the Chinese government. A research catchment has been instrumented to monitor the complete hydrological cycle and its interactions with ecosystems. One sandwich PhD student (Mr Yang Zhi) and one post-doc (Mr Yihun) with China University of Geosciences are carrying out major their research activities in this project. The results will provide scientific bases for sustainable water resources management and ecosystem projection in the cold semi-arid Erdos plateau of China (Zhou, Wenninger).

### 4.3 Other relevant research activities and participation in relevant events during 2010

- S. Uhlenbrook is editor of the volume no. 2 (Hydrology) of the five volumes reference work 'Treatise in Water Sciences', to be published by Elsevier in February 2011 (chief editor: Peter Wilderer, TU Munich). The volume no. 2 will consist of 25 chapters (30-40 pages each chapter) written by multiple authors; a significant part of the reviewing and editing process has been done in 2010.
- S. Uhlenbrook is co-editor of a special issue of the International Journal Hydrology and Earth System Sciences (HESS) on 'Climate, Weather and Hydrology of East African Highlands'. The issue will consist of about 20 paper; a significant part of the reviewing and editing process has been done in 2010.

### 4.4 List of on-going and new PhD research projects in 2010

	PhD fellow, country	Promotor(s)	Supervisor(s)	Title research project	Start year	Proposal accepted	End year
1	H. Makurira, Zimbabwe	H.H.G. Savenije, S. Uhlenbrook	J. Rockstroem, A. Sezanje	Water productivity in rainfed agriculture: upgrading agricultural output in arid and semi arid tropics through smallholder water system innovations	2004	2005	2010
2	D. Love, Zimbabwe and UK	P. van der Zaag, S. Uhlenbrook	R. Owen, S. Twomlow	Integrated modelling of water resources in the Mwenezi and Mzingwane subcatchments, Limpopo river basin	2005	2005	2011
3	K. Kittiwet, Thailand	B. Schulz, S. Uhlenbrook	S. Suriyadi	Flood management and land use in the Chi River basin, Thailand	2005	2006	2011
4	I. Masih, Pakistan	S. Uhlenbrook	A. Mobin, V. Smaktin, S. Maskey,	Hydrology and water balance analysis for sustaining food security and environmental services in Karkheh River Basin, Iran	2006	2006	2011
5	C.L. Wong, Malaysia	S. Uhlenbrook	R. Venneker	Assessment and modelling of large-scale hydrological variability in Peninsular Malaysia	2006	2007	2011?
6	G. Lutterodt, Ghana	S. Uhlenbrook, J.W. Foppen	J.W. Foppen	Effects of surface characteristics of Escherichia coli on transport in saturated porous media	2007	2007	2011
7	O. Munyaneza, Rwanda	S. Uhlenbrook	J. Wenninger, S. Maskey, Wali	Water resources assessment and prediction in the Rwandan catchments	2008	2009	2012
8	E. Teferi, Ethiopia	S. Uhlenbrook	Belay Simane, J. Wenninger	Past-present-future land use in the Blue Nile and impacts on hydrology	2008	2009	2012

9	S. Tekleab, Ethiopia	S. Uhlenbrook, H. H.G. Savenije	Y. Mohammed, J. Wenninger	Hydrological processes and modelling in the Blue Nile river basin	2008	2009	2012
10	P. Nyenje, Uganda	S. Uhlenbrook,	J.W. Foppen	Hydrological Implications of improved sanitation in slum areas, Kampala, Uganda	2008	2010	2012
11	P. Khiza, Kenya	S. Uhlenbrook,	J. Wenninger, A. van Griensven	Hydrology of Nyando wetland, Kenya (ECOLIVE project)	2009	2010	2013
12	Yurong Hu, China	S. Uhlenbrook,	S. Maskey	Climate Change Impacts in the Upper Yellow River	2009	2009	2013
13	H. Calderon, Nicaragua	S. Uhlenbrook	J.W. Foppen	Development of innovative tracer methods to observe surface water-groundwater interactions in seasonal rivers	2009	2010	2014
14	C. Orup, Uganda	S. Uhlenbrook	JW Foppen, M. Mul, S. Maskey	Surface water-groundwater interactions in dryland rivers, Pangani catchment, Tanzania	2009	2010	2014
15	Yang Zhi, China	S. Uhlenbrook	Y. Zhou J. Wenninger	Surface water-groundwater interactions in Erdos Plateau, China	2009	2010	2014
16	A. Saraiwa, Mozambique	S. Uhlenbrook, P. van der Zaag	-	Hydrological predictions for risk-based operational water management for the Incomati River Basin	2010		2014
17	D. Bhatt, Nepal	S. Uhlenbrook	S. Maskey	An integrated approach for adapting agriculture and water management to global changes - with a case study of a Himalaya river basin in Nepal	2010		2014
18	E. Natumanya	S. Uhlenbrook	M. McClain M. Mul	Spatial-Temporal Dynamics of Flow Regime and Water Resources in the Mara Basin, Kenya	2010		2014

Unfortunately, three PhD researchers stopped their research in 2010 without finishing their PhD degree: Mr. Basha Jamil (illness), Mr. Wang (new topic with other supervision team) and Mr. Mauricio Auza (illness).

#### 4.5 Conferences: oral presentations, posters, invited papers, conference sessions

##### Prof. S. Uhlenbrook

- 30 Nov - 4 Dec, Conference of Parties, COP-16, Cancun, Mexico, invited presentation on 'Scientific basis of climate change impacts on water cycle dynamics', member of panel discussion on climate change adaptation and water
- 27 Oct-29 Oct, Victoria Falls, Zimbabwe, WaterNet Conference, member of scientific committee and oral presentation
- 17-20 Oct, Vienna, Austria, IAEA Workshop on use of isotope data in catchment hydrology, invited presentation
- 26 Sept-2 Oct, Tokyo and Tskuba, Japan, invited presentation at ICHARM-UNU Symposium on Flood Management, Attendance of ICHARM International Advisory Committee Board meeting
- 21-24 September, Prague, Czech Republic, International Conference HydroPredict 2010, keynote speaker and chair of a session
- 25 Feb-6 March, Beijing, China, Climate Change in Asian Rivers Workshop (lecture), guest-lectures at Tsinghua University Beijing and Chinese Academy of Sciences, and visit of YRCC Zhenzhou and field visit and lecture
- 8-12 February 2010, Pietermaritzburg, South Africa, keynote lecture at International Workshop on Biofuels and Water, field visits of experimental investigations of impacts of large-scale biofuel production

### Dr. Michael McClain

- 1-3 December, Frankfurt, Germany, International Conference: Biodiversity and the Millennium Development Goals - Challenges for Research and Action Water resource management for biodiversity conservation: new partners and the right tools, invited speaker
- 28 October, Zurich, Switzerland, Seminar for the Master of Advanced Studies in Sustainable Water Resources, invited speaker
- 6-10 September, Stockholm, Sweden, World Water Week, session chair
- 2 June, Bogotá, Colombia, Second International Environment Fair, keynote speaker
- 23-24 February, Berlin, Germany, International Workshop for BioFresh Network, invited speaker

### Dr. J. W. Foppen

- 26-27 January: Explaining sticking efficiency variations of 54 Escherichia Coli strains during transport in saturated ultra-pure quartz sand, Invited Presentation EPA Pathogen Transport Meeting, Washington, USA.
- 20-22 September: Organiser UNESCO-IHE PhD seminar, Delft.
- 23-25 September: Co-organiser SENSE A1 Course, Delft.
- 18 November: Preliminary research results 'Integrated approaches and strategies to address the Sanitation Crisis in Unsewered Slum Areas in African mega-cities', Invited Presentation UNESCO-IHE Governing Board, Delft.

### Dr. Y. Zhou

- 30th November 2010, Xi'an, China, invited presentation at Chang'an University, School of Environment Science & Engineering, New developments in analytical solutions to groundwater flow: consequences for defining well protection areas

### Dr. R. Venneker

- 18 January: Two oral presentations at the Seminar on water resources and hydrology in Malaysia, Department of Irrigation and Drainage Malaysia and UNESCO-IHP Malaysia.
- 20 January: Oral presentation at the Post-graduate on water sustainability, University of Technology Malaysia, Johor Bahru, Malaysia.

### Dr. Thom Bogaard

- May 2010: Convener, Mountain Risks session at EGU, Vienna, Austria.
- May 2010: Convener: Hydrological process knowledge in landslide research session at EGU, Vienna, Austria.
- May 2010: Coordinator Young Scientists Outstanding Poster Prize, Hydrological Sciences division, EGU, Vienna, Austria.
- Nov 2010: Looking to catchment in colors EGU Leonardo Topical Conference Series on the hydrological cycle. Oral presentation and poster presentation
- Member International Scientific Committee and poster presentation at International Conference 24 - 26 November 2010 Firenze, Italy Mountain Risks: Bringing Science to Society

## 4.6 Research output

### 1. PhD theses

- Hodson Makurira, 2010: WATER PRODUCTIVITY IN RAINFED AGRICULTURE - Redrawing the rainbow of water to achieve food security in rainfed smallholder systems. PhD thesis, UNESCO-IHE and Delft University of Technology; defended on 21 June 2010 (Promoters: H.H.G. Savenije (MAI department and TU Delft) and S. Uhlenbrook)

### 2. Academic publications

#### 2.a1 *In refereed journals (A – category)*

- Masih, I, S Uhlenbrook, S Maskey & MD Ahmad, 2010. Regionalization of a conceptual rainfall-runoff model based on similarity of the flow duration curve: A case study from a semi-arid Karkheh basin, Iran. J Hydrology, 391 (2010) 188–201, doi: 10.1016/j.jhydrol.2010.07.018.
- Masih, I, S Uhlenbrook, S Maskey & V Smakhtin, 2010. Streamflow trends and climate linkages in the Zagros Mountains, Iran. Climatic Change doi: 10.1007/s10584-009-9793-x.
- Masih, I, S Maskey, S Uhlenbrook & V Smakhtin, 2010. Assessing the impact of areal precipitation input on streamflow simulations using the SWAT model. J American Water Resources Association (JWARA) doi: 10.1111/j.1752-1688.2010.00502.x.

- Lutterodt G., Foppen, J.W.A., Maksoud, A, Uhlenbrook, S., 2010 Transport of Escherichia coli in 25 m quartz sand columns. *Journal of Contaminant Hydrology*, doi:10.1016/j.jconhyd.2010.09.010.
- Tom Gleeson, Jonathan VanderSteen, Marios A. Sophocleous, Makoto Taniguchi, William M. Alley, Diana M. Allen and Yangxiao Zhou, 2010, Groundwater sustainability strategies, *nature geoscience*, Vol. 3, pp378-379
- Wong, C. L., Venneker, R., Jamil, A. B. M., Uhlenbrook, S., 2010: Development of a gridded daily hydrometeorological data set for Peninsular Malaysia. *Hydrological Processes*, n/a. doi: 10.1002/hyp.7654.
- Teferi, E., Uhlenbrook, S., Bewket, W., Wenninger, J., Simane, B., 2010: The use of remote sensing to quantify wetland loss in the Choke Mountain range, Upper Blue Nile basin, Ethiopia. *Hydrol. Earth Syst. Sci.*, 14, 2415-2428.
- Love D., Van der Zaag, P., Uhlenbrook S., Owen, R.J.S., 2010: A water balance modeling approach to optimizing the use of water resources in ephemeral sand rivers. *River Research and Application*, DOI: 10.1002/rra.1408.
- Uhlenbrook S., Mohamed Y., Gragne A.S., 2010: Analyzing catchment behavior through catchment modeling in the Gilgel Abay, Upper Blue Nile River Basin, Ethiopia. *Hydrol. Earth Syst. Sci.*, 14, 2153–2165.
- Masih I., Uhlenbrook S., Maskey S., Ahmad M.D., 2010: Regionalization of a conceptual rainfall–runoff model based on similarity of the flow duration curve: A case study from the semi-arid Karkheh basin, Iran. *Journal of Hydrology* 391 (2010) 188–201.
- Makurira H., Savenije H.H.G., Uhlenbrook S., 2010: Modelling field scale water partitioning using on-site observations in sub-Saharan rainfed agriculture. *Hydrol. Earth Syst. Sci.*, 14, 627-638.
- Love D., Uhlenbrook S., Corzo-Perez G., Twomlow S., Van der Zaag P., 2010: Rainfall-interception-evaporation-runoff relationships in a semi-arid catchment, northern Limpopo basin, Zimbabwe. *Hydrological Sciences Journal*, vol. 55, issue 5, pp. 687-703. DOI: 10.1080/02626667.2010.494010
- Love D., Uhlenbrook S., Twomlow S., Van der Zaag P., 2010: Changing hydroclimatic and discharge patterns in the northern Limpopo Basin, Zimbabwe. *Water SA (ISSN 0378-4738 Print)*, Vol. 36, No. 3, 335-350.
- Nyenje P.M., Foppen J.W., Uhlenbrook S., Kulabako R., Muwanga A. 2010: Eutrophication and nutrient release in urban areas of sub-Saharan Africa — A review. *Science of the Total Environment*, 408, 447–455, doi:10.1016/j.scitotenv.2009.10.020.
- Foppen J.W., Lutterodt G., Roeling W.F.M., Uhlenbrook S., 2010: Towards understanding inter-strain attachment variations of Escherichia coli during transport in saturated quartz sand. *Water Research*, 44, 1202–1212, doi:10.1016/j.watres.2009.08.034
- Arthington AH, RJ Naiman, ME McClain & C Nilsson. 2010. Preserving the biodiversity and ecological services of rivers: new challenges and research opportunities. *Freshwater Biology* 55: 1-16 doi:10.1111/j.1365-2427.2009.02340.x.
- Steele-Dunne, S. C., M. M. Rutten, D. M. Krzeminska, M. Hausner, S. W. Tyler, J. S. Selker, T. A. Bogaard, and N. C. van de Giesen (2010). Feasibility of Soil Moisture Estimation using Passive Distributed Temperature Sensing. *Water Resour. Res.*, 46, W03534, doi:10.1029/2009WR008272, 2010
- Westhoff, M.C., Bogaard, T.A, and Savenije, H.H.G. (2010) Quantifying the effect of in-stream rock clasts on the retardation of heat along a stream. doi:10.1016/j.advwatres.2010.02.006 (On line march 2010).
- Penna D., Stenni B., Sanda M., Wrede S., Bogaard T.A., Gobbi A., Borga M., Fischer B.M.C., Bonazza M. (2010). On the reproducibility and repeatability of laser absorption spectroscopy measurements for  $\delta^2\text{H}$  and  $\delta^{18}\text{O}$  isotopic analysis. doi:10.5194/hess-14-1-2010. *Hydrol. Earth Syst. Sci.*, 14, 1551–1566, 2010.

#### 2.a2 *In refereed journals (B – category)*

- Kuntiyawichai, K., Schultz, B., Uhlenbrook, S., Suryadi, F.X., Van Griensven, A., 2010: Comparison of flood management options for the Yang River Basin, Thailand. *Irrigation and Drainage*. Published Online November 22, 2010. DOI: 10.1002/ird.596.
- Wenninger, J., Beza, D.T., Uhlenbrook, S., 2010: Experimental investigations of water fluxes within the soil-vegetation-atmosphere system: Stable isotope mass-balance approach to partition evaporation and transpiration. *Physics and Chemistry of the Earth*, 35(13-14), 565-570.

#### 2.a3 *In refereed journals (C – category)*

- MUNYANEZA, O., UHLENBROOK, S., WENNINGER, J., VAN DEN BERG, H., BOLT, R., WALI, U.G. & MASKEY, S., 2010. Setup of a Hydrological Instrumentation Network in a Meso-Scale Catchment- A case of the Migina Catchment, Southern Rwanda, *Journal of Nile Water Science and Engineering*, Vol.3, Issue 1, 2010, pp 61-70.
- Zhou, Y., and W. Li, 2010, Groundwater sustainability: concepts and approaches, *Journal of Hydrogeology and Engineering Geology*, Vol. 37, No. 1, pp 1-8.
- Wang L., J. Liu, T. Zhou, C. Ye, W. Li, Y. Zhou, 2010, Analysis of sustainable groundwater resources development scenarios in Beijing Plain, *Journal of Hydrogeology and Engineering Geology*, Vol. 37, No. 1, pp 9-16.
- Wang Qingbing, Duan Xiuming, Zhou Yangxiao, Li Wenpeng, 2010, Analysis of sustainable groundwater development scenarios in Jinan karstic spring basin, *Journal of Hydrogeology and Engineering Geology*, Vol. 37, No. 3, pp 1-5.

- HUO Chuanying, WEI Wenhui, ZHOU Yangxiao, LI Wenpeng, 2010, Analysis of sustainable groundwater development scenarios in the north plain of Urumqi River Basin. *Journal of Hydrogeology and Engineering Geology*, Vol. 37, No. 5, pp 1-7.
- LI Ning, Xie Wen, ZHOU Yangxiao, LI Wenpeng, 2010, Analysis of sustainable groundwater development scenarios for the Chaiwopu Basin in the Urumqi River Basin. *Journal of Hydrogeology and Engineering Geology*, Vol. 37, No.5, pp 8-14.
- Zhou, Y., 2010, A review of research methodologies on groundwater dependent terrestrial vegetations, *Earth Science Frontiers*, Vol.17, No.6, pp21-30.
- Bohté, R., Mul, M. L., Bogaard, T. A., Savenije, H. H. G., Uhlenbrook, S., Kessler, T. C., 2010: Hydrograph separation and scale dependency of natural tracers in a semi-arid catchment. *Hydrology and Earth System Sciences Discussions*, 7(1), 1343-1372.
- Tekleab, S., Uhlenbrook, S., Mohamed, Y., Savenije, H. H. G., Ayalew, S., Temesgen, M., et al. (2010). Water balance modeling of upper Blue Nile catchments using a top-down approach. *Hydrology and Earth System Sciences Discussions*, 7(5), 6851-6886.
- Hugenschmidt, C., Ingwersen, J., Sangchan, W., Sukvanachaikul, Y., Uhlenbrook, S., Streck, T., 2010: Hydrochemical analysis of stream water in a tropical, mountainous headwater catchment in northern Thailand. *Hydrolog. Earth Syst. Sci. Discuss.*, 7, 2187-2220.

#### 2.a4 *Guest editorships special issues refereed scientific journals*

- Arthington AH, RJ Naiman, ME McClain & C Nilsson, Special Issue of *Freshwater Biology* "Environmental Flows: Science and Management", Volume 55, January 2010

#### 2b *In other journals*

- Griffioen, J., De Louw, P., Orup, C., Foppen, J.W., 2010. Variatie in achtergrondbelasting van fosfaat op oppervlaktewater in een polder. *H<sub>2</sub>O* 2010/7, p. 35-38.

#### 2.c1 *Book chapters in refereed books (A – category)*

#### 2.c2 *Book chapters in refereed books (B – category)*

#### 2.c3. *Book chapters in refereed books (C – category)*

- Zhou Yangxiao and Li Wenpeng (eds), 2010, *Groundwater monitoring, information systems, modelling and sustainable development*, China Science Publishing

#### 2.d1 *Monographs*

#### 2.d2 *Editorships scientific books*

#### 2.e *Proceedings (full papers only)*

- Werner, MGF, HC Minsemius, YA Iglesias, Y Morales, S Maskey & D Love (2010). DEWFORA: Drought forecasting and Early Warning in Africa. *Procs. 11th WaterNet/WARFSA/GWP-SA symposium*, 27-29 Oct, Victoria Falls, Zimbabwe.
- MUNYANEZA, O., UHLENBROOK, S. AND J. WENNINGER, 2010. Identification of runoff generation processes during floods and low flows using hydrometric data and tracer methods in the Migina catchment in Rwanda. *EGU Leonardo Topical Conference: Looking at catchments in colors*, 10-12 November 2010, Luxembourg City, Luxembourg
- Saraiva, M.L., Wenninger, J., Uhlenbrook, S., Ndlovu, L., 2010: Experimental investigation of water fluxes in irrigated sugarcane in Swaziland using environmental isotopes *Proceedings 11th International WATERNET/WARFSA/GWP-SA Symposium*, Victory Falls, Zimbabwe, 27-29 October 2010; CD-Rom; 18 pages.
- Makurira, H., Savenije, H.H.G., Uhlenbrook, S., Senzanje, A., Rockström, J., 2010: Application of multiple methods to link field scale moisture dynamics to crop productivity in rainfed systems. *Proceedings 11th International WATERNET/WARFSA/GWP-SA Symposium*, Victory Falls, Zimbabwe, 27-29 October 2010; CD-Rom; 19 pages.

- Nyenje, P.M., Foppen, J.W., Uhlenbrook, S., Kulabako, R., Muwanga, A., 2010: Hydrochemical characterisation of contaminated catchments and aquifers in slums sub-Saharan Africa. Proceedings 11th International WATERNET/WARFSA/GWP-SA Symposium, Victory Falls, Zimbabwe, 27-29 October 2010; CD-Rom.
- Saraiva, A.M.L., Tilmant, A., Uhlenbrook, S., Van der Zaag, P., 2010: Risk-based operational water management for the Incomati River Basin. Proceedings 11th International WATERNET/WARFSA/GWP-SA Symposium, Victory Falls, Zimbabwe, 27-29 October 2010; CD-Rom; 11 pages.
- Kuntiyawichai, K., Schultz, B., Uhlenbrook, S., Suryadi, F.X., Werner, M., 2010: Appropriate flood mitigation framework through structural and non-structural measures for the Chi River Basin, Thailand. Proc. 8th Annual Mekong Flood Forum, May 26 - 27, Vientiane, Lao PDR: paper 3-3-2, 1 - 12 pages.
- Kuntiyawichai, K., Schultz, B., Uhlenbrook, S., Suryadi, F.X., Corzo, G.A., 2010: Comprehensive flood mitigation and management in the Chi River Basin, Thailand. Proc. 7th International Symposium on Lowland Technology, September 16 - 18, Saga, Japan, 314 - 322.
- Corzo, G.A., Barreto W., Love, D., Uhlenbrook, S., 2010: HBVx: A semi-distributed hydrological modelling tool with multi-criteria calibration. In Liang, Shei-Yui (Ed.): 9th International Conference in Hydroinformatics, HIC 2010, Tianjin, CHINA, World Scientific Publishing Company, 8 pages.
- Wong, C.L., Venneker, R., Uhlenbrook, S., 2010: Analysis and modelling of runoff from two distinct river basins in Peninsular Malaysia. Conference Proceedings of the HydroPredict Conference, 20-24 September 2010, Prague, Czech Republic; 11 pages.
- Uhlenbrook S., Douwen W., Bresser T., Ranasinghe R., 2010: PProACC - An integrated Post-doctoral Research Programme on Adaptation to Climate Change in the Mekong River Basin. Meeting Climate Change Challenges in Transboundary Basins: Role of Sciences, UNU-ISP, CECAR series 4, Pg. 155-162
- Pfister L., Fencia F., Uhlenbrook S., 2010: How can we create generalizable hypotheses from small basin studies? In: Status and Perspectives of Hydrology in Small Basins (Proceedings of the Workshop held at Goslar-Hahnenklee, Germany, 30 March–2 April 2009). IAHS Publ. 336, 201-208.
- Chiffard P., Kirnbauer R., Zepp H., Tilch N., Didszun J., Zillgens B., Schumann A., Uhlenbrook S., 2010: Tracing runoff generation processes through different spatial scales in low and high mountain ranges. In: Status and Perspectives of Hydrology in Small Basins (Proceedings of the Workshop held at Goslar-Hahnenklee, Germany, 30 March–2 April 2009). IAHS Publ. 336, 90-95.
- Wong C.L., Venneker R., Jamil A.B.M., Uhlenbrook S., 2010: A daily high-resolution gridded hydrometeorological data set in Peninsular Malaysia, In: Postgraduate Seminar on Water Sustainability, Yusop, Z., Ali, M.M.Y. and Azman, S. (eds), Universiti Teknologi Malaysia, 20 January 2010. Water Research Alliance, UTM, page 28-46.
- Venneker R., Wong C.L., Jamil A.B.M., Uhlenbrook S., 2010: Water resources assessment in Peninsular Malaysia using a hydrological land surface model, In: Postgraduate Seminar on Water Sustainability, Yusop, Z., Ali, M.M.Y. and Azman, S. (eds), Universiti Teknologi Malaysia, 20 January 2010. Water Research Alliance, UTM, page 13-27.
- Uhlenbrook S., Venneker R., Wong C.L., Jamil A.B.M., 2010: Current and future challenges for hydrology in the humid tropic, In: Postgraduate Seminar on Water Sustainability, Yusop, Z., Ali, M.M.Y. and Azman, S. (eds), Universiti Teknologi Malaysia, 20 January 2010. Water Research Alliance, UTM, page 69-75.
- Wong C.L., Venneker R., Jamil A.B.M., Uhlenbrook, S., 2010: Hydrological modelling of the Pahang and Kelantan River Basins, Malaysia, The 1st IWA Malaysia Young Water Professional Conference, Kuala Lumpur, 2-4 March 2010. Water Research Alliance, UTM, Paper No.247.
- KRZEMINSKA, D.M. , T.A. BOGAARD, S.C. STEELE-DUNNE (2010). On the potential of high temporal and spatial resolution soil temperature monitoring for hazard analysis of rainfall-induced landslide. Pp. 321-326. Proceeding conference on Mountain Risks: bringing science to society (Ed. JP Malet, T. Glade, N. Casagli). Florence 2010. ISBN 2-9518317-1-5
- PETERS, E.T.J.-P. MALET, T.A. BOGAARD (2010). Multi-sensor monitoring network for real-time landslide forecasts in early warning systems. Pp. 335-340. Proceeding conference on Mountain Risks: bringing science to society (Ed. JP Malet, T. Glade, N. Casagli). Florence 2010. ISBN 2-9518317-1-5

## 2.f Scientific reports ordered by an external contractor

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## 3. Professional publications and products (incl. IP)

- LN 0189/10/1, Hydrology - An Introductory Course, P.J.M. de Laat, Y.A. Mohamed, M.L. Mul, J.W. Wenninger, 2010

## 4. Publications for the general public (optional)

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## 5. Other results of scientific esteem and acknowledgement

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## 6. Unpublished conference papers

- More 30 abstracts were presented posters or oral presentations during international conferences.

# 5 Education

## 5.1 Modules of the Master programmes and specialisations coordinated by the Core

Programme	Name of module	Date offered	Name of coordinator
WSE	All modules (# 1-15)	All year.	J. Nonner / S. Maskey (September 2010 - ..)

## 5.2 Regular modules in which Core staff members have lectured in 2010

Programme	Name module	Name of lecturer	Topic
WSE	All HWR modules (# 1-15)	All staff members	See Handbook
ES	Environmental Systems Analysis, # 5	S. Maskey	Global spatial data and tools for ecosystem analysis
WSE	European SWAT Summer Course (HI), #13	S. Maskey	Hydrological processes in SWAT
WM	The Water Resources System, # 2	J. Nonner	Groundwater resources
ES-WM-WMI	The Water Resources System, # 2	J. Wenninger	Surface water hydrology
ES	Int'l fieldtrip and Fieldwork, #9	R. Venneker	Hydrological practices

## 5.3 MSc theses finalised during 2010

Programme	Name student	Title thesis	Supervisor/Mentor(s)
WSE-HWR	RABEARIVELO Andry Avotraniaina	Flood inundation analysis using HEC-HMS and HEC-RAS modelling systems: A case study of Antananarivo Atsimondrano in Madagascar	S. Maskey
WSE-HWR	Dang Quang Thinh	Hydrological simulation of a transboundary river basin using TRMM and gauge rainfall data	S. Maskey
WSE-HWR	Nsiah (Jackson)	Application of artificial DNA in Tracer hydrology	J.W. Foppen
WSE-HWR	Razafindrabe	Early warning system for river in Antanarive, Madagascar.	R.Venneker
WSE-HWR	Hamzah	Relations between stream flow and geomorphology in a Malaysian stream defined	R. Venneker
WSE-HWR	Baddegama Disanayakage	The effect of artificial dams on the water budget in the Madoneh catchment, Jordan. Involvement in the Exact project	De Laat
WSE-HWR	Karicho, B.	Regional Groundwater Flow Modelling in the Kano Plain, Kenya, with Emphasis on the Nyando Wetland	Y. Zhou, J. Wenninger
WSE-HWR	Saraiva, A.	Investigation of fluxes of evapotranspiration and	J. Wenninger

		percolation in irrigated agriculture using environmental isotopes. A case study: Sugar cane plantations, Incomati, Swaziland	
WSE-HWR	Trambauer	Surface water and shallow groundwater flow systems in lowland peat areas. Case study at the Zegveld experimental farm	J. Nonner

Prof. S. Uhlenbrook was the supervising professor for all listed MSc students.

#### 5.4 Other educational activities (specify type: short courses, tailor made courses, refresher seminars, online courses, and invited lectures)

Type	Name of course / topic	Lecturer
5 days Chinese Group Training at UNESCO-IHE for the project "Partnership for education and research in water and ecosystems interactions"	River modelling using MIKE 11 physically based modelling system.	S. Maskey
2 days lectures for a MSc course at National University of Rwanda (NUR), Butare, Rwanda	River hydraulics and introduction to catchment and river modelling	S. Maskey
8 days UNESCO-IHE regional refresher seminar in Kathmandu, Nepal (coordination and lectures)	Participatory management of flood risk in the changing climate	S. Maskey
3 day lecture at National University of Rwanda (NUR), Butare, Rwanda	Module 602, Water resources system and engineering	J. Wenninger
5 days training course	Water Resources Assessment in Sub-Saharan Africa: Prediction in Ungauged or Data Scarce Basins 15-19 March 2010	T.A. Bogaard R. Venneker

## 6 Advisory / Capacity building

### 6.1 Advisory projects (indicating partners, budget and funding source)

- Contributions to the NPT project in Rwanda to set up the WREM MSc programme at the National University of Rwanda (Uhlenbrook, Maskey, Wenninger)
- Integrated Water Resources Management in the Aral Sea Basin (IWRM-ASB) project in collaboration with Scientific Information Centre of the Interstate Commission for Water Coordination of the Aral Sea Basin (SIC-ICWC), Tashkent (de Schutter, Maskey, Prasad)
- Support to the establishment of the HidroEX International Centre for Education, Capacity Building, and Applied Research in Water (Funds: 125,000 Euro) (McClain)

### 6.2 Capacity building projects (indicating partners, budget and funding source)

- CapCar - Project on capacity building in water programs in higher education in the Caribbean region with the main partners the University of the West Indies. The project is involving multi-disciplinary staff of UNESCO-IHE (Funds: 500,000 Euro, EEC and DUPC) (Nonner, Brandimarte, Sharma, Ploeger, Noorman, Darvis, Kruis).
- Three activities were executed for the Ecohydrology Erdos China project. A 3-month training course for research and development was implemented from Feb to April 2010 including lectures, field visits and preliminary research on Hailiutu catchment. Instruments for measuring meteorological parameters, river discharges, soil moisture, sap flow and groundwater levels were installed in August. A project seminar was organized at Hohai University in October. 12 Chinese and 3 Dutch project members were attended. Initial results of field measurements were presented, a training programme on Ecohydrogeology was developed and will be organised at China University in March 2011. A proposal on establishing a joint research center on Ecohydrogeology at China University of Geosciences was developed and submitted to the university for the approval.

## 7 Miscellaneous

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