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The **Ground Water Division** of the Geological Society of South Africa is excited to host its 13th Biennial Conference in Durban this year. The Conference with its strong developmental agenda offers a unique opportunity for students, academics, specialists and decision-makers to be part of this expert forum to be hosted for its 1st time in KwaZulu-Natal. Delegates will not only be afforded insight into regional challenges and solutions, but are invited to join in the discussion panels and networking sessions that form part of the overall exciting Conference programme.



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Some highlights of the Conference include:

Pre-Conference Technical Tour

This planned one-day tour will commence with a visit to the Two Streams Research Catchment, one of the few remaining small catchment research areas in South Africa, to be followed by stop-overs at both the Lilani and Shu Shu Thermal Springs.

Short course on groundwater exploration

The course will offer insights (and divulge some expert "secrets") into the different techniques for different environments when exploring for groundwater.

Workshop on Groundwater & Municipalities:

This accredited workshop will introduce delegates to the resource and cover additional topics in sessions on costing and development, monitoring, management and treatment.

WRC Dialogue Session: Karoo Aquifers and Unconventional Gas Exploration

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Water resources study successfully completes first year

The first year of what promises to be the most accurate national water resource assessment of South Africa yet has been successfully completed. The Water Resources 2012 study (WR2012), funded by the Water Research Commission (WRC), is the sixth comprehensive national water resource assessment to be undertaken in South Africa.

The study is being executed by a consortium of consulting engineering firms, led by Royal Haskoning DHV (RHDHV). Its main objective is to assist decision-makers at all levels of government to make informed choices about policies concerning South Africa's water resources. One of the most important aspects of the study is the improvements being made to the WRSM 2000 catchment model, which is widely used in the South African water resource assessment process.

"The WRSM 2000 model is undergoing some major improvements," reports project leader Allan Bailey from RHDHV. "As this model has links to the models of the Department of Water Affairs for analysing yield of dams (WRYM model) and future planning (WRPM model), it is extremely important that all three models are continually improved.

Enhancements to the WRSM2000 model include the inclusion of a number of statistical graphs for checking the consistency of catchment rainfall and natural streamflow and storage yield; grouping of runoff models with similar hydrology for more rapid calibration; addition of an observed storage trace to the reservoir plot so that reservoirs with only storage data can be calibrated; extended time series output link to the WRYM model which now has the Sami surface water-groundwater interface; time series of groundwater abstractions; and added daily time step functionality for both naturalised runoff at any point in

a network adjusted for land use.

WR2012 will also for the first time create a publicly-accessible, Web-based and interactive reporting system to continually quantify both the surface and groundwater resources of South Africa. According to WRC Research Manager, Wandile Nomqophu, it was originally planned for the website to only be up and running once the project was completed in 2016, but the high level of interest in the information the project has to offer has prompted the Commission to move the date forward. It is now hoped to have the website functional before the end of the year.

Among others, the level of detail of water resources information has been broadened by including more information on reservoirs, land use/water use and other aspects compared to the previous water resource study, WR2005. New spreadsheets have been compiled which provide details of this land use/water use, which will make the future updating easier. The project also intends to incorporate recent work by other consultants on various catchments, and to update all data at least up to the 2009/2010 hydrological year.

Other progress for the year include the creation of land use/water use

spreadsheets for all 19 water management areas, with worksheets with data on dams, abstractions and return flows, irrigation, alien vegetation and afforestation. The project team has also started determining the optimal monitoring requirements in terms of rainfall, observed streamflow and reservoir records.

Bailey has completed courses on the newly improved WRSM2000 model at several universities, with great success. The purpose of the course is to make attendees aware of the various water resource models available, and how to set up and use the WRSM2000 model for a water resources system.

DEARTH OF DATA

Deteriorating monitoring of South Africa's rain and rivers remain the biggest challenge to the successful completion of the project. Spatially representative, long-term consistent records of rainfall and streamflow data are essential for achieving a high level of understanding about water resources. *The Water Wheel* reported on hydrologists' concern last year regarding the steep decline in rainfall and streamflow data in South Africa in recent years. ("Taking on the

challenges of water resource assessment', *the Water Wheel* May/June 2012).

Good quality data are a serious impediment to the sustainable management of South Africa's water resources, reports Nomqophu. "Not only are the observation networks shrinking, the quality is deteriorating. Apart from the troubling rainfall and streamflow data issues, which have been reported on, the research team has also discovered that reservoir data records – key to analysing the water resources of South Africa – have declined alarmingly, with quite a number of missing data and suspect readings."

The WR2012 project is not the only research project suffering as a lack of quality, reliable data. Other hydrology-related WRC-funded research projects have reported similar concerns, and there have been calls from the hydrology community for the WRC to intervene. Discussions with data collecting agencies have revealed sharp budget cuts for water data collection as well as shrinking human capacity. "The budget figures mentioned are hardly enough to maintain a few data stations, let alone a national observation network," says Nomqophu.

Some data collection agencies, such as the South African Weather Service, have begun selling the data to make up funds to maintain data monitoring networks. Obtaining data for research that is in the interest of the country (for example, climate change) has now become an expensive exercise. It has been recommended that a task team be formed to address the issue, and this recommendation is now being pursued. The WRC is also looking to establish a central home for water data from all its projects where hydrological data is collected.

WR2012 is due for completion in April, 2016.



New from the WRC

Report No. 1906/1/12

A short-term heavy rainfall forecasting system for South Africa with first implementation over the Gauteng Province (LL Dyson; CJ Engelbrecht; K Turner; S Landman)

The project set out to develop an ingredients-based rainfall forecasting system for the summer rainfall areas of South Africa and specifically the Gauteng Province. Daily rainfall climatology was developed for Gauteng in order to better understand heavy rainfall over the province. Several sounding derived parameters were calculated for Irene and this was consequently used to investigate the thermodynamic conditions associated with heavy rainfall over Gauteng. A lightning climatology was constructed over Gauteng and the lightning characteristics associated with heavy rainfall were identified.

Report No. KV 303/12

Microbial pathogens in the Umngeni River, South Africa (J Lin; A Ganesh; M Singh)

As water demands increase, there are some concerns that need to be addressed to ensure protection of public health and the health of the environment. South Africa's water resources have been under increasing threat of pollution due to rapid demographic changes, which have coincided with the establishment of informal human settlements. Public water systems rely on bacterial indicators (i.e. coliforms) for monitoring water quality. However, it has been shown that bacterial indicators are often poorly correlated with the presence of other microorganisms.

Report No. KV 309/12

Soil-plant carbon stocks in the Weatherley catchment eight years after conversion from grassland to forestry (RM Lebenya, CW van Huyssteen & CC du Preez)

Soil and vegetation play a vital role in the global carbon cycle because carbon exchange is affected by both. Thus change in land use may result in either a loss or gain of carbon in the soil-plant system. This study was conducted in the Weatherley catchment in the northern Eastern Cape province, a former grassland area.

Before afforestation, a baseline study on soil organic matter was conducted on the areas designated for a selection of tree species. This study was a continuation of the aforementioned study with the aim to quantify the soil and biomass carbon stocks eight years after afforestation.

Report No. 1883/1/12

Natural organic matter in drinking water sources: Its characterisation and treatability (J Haarhoff; B Mamba; R Krause; S van Staden; T Nkambule; S Dlamini; KP Lobanga; F Corry)

The design of potable water treatment plants is conventionally based on physical and microbial properties of the raw water, such as colour, turbidity, odour, pathogenic bacteria and others. A relatively recent addition to this list is natural organic matter, normally crudely quantified as total organic carbon. Natural organic matter is, however, not a stand-alone problem, but affects water quality in many ways. It could be responsible for the colour, undesirable taste and odour of natural waters, it is a source of nutrients for heterotrophic bacteria, it inhibits precipitation processes which form the backbone of drinking water treatment, and so on. Without a deeper understanding of natural organic matter in South African raw water supplies, and its treatability by different treatment technologies, water treatment plant design and operation will not be able to deal with increasing natural organic matter levels in a predictable and satisfactory way. This project aimed to close this knowledge gap.

Report No. TT 436/12

Wetland Health and Importance Research Programme Volume 4: Development of a tool for assessment of the environmental

condition of wetlands using macrophytes (F Corry)

This report is one of the outputs of the Wetland Health and Importance research programme, funded by the WRC. The programme represents Phase II of the National Wetlands Research Programme, and was broadly aimed at assessing wetland environmental condition and socio-economic importance. Vegetation has proven useful as indicators of the present environmental state of wetlands. This study was a first attempt at creating a comprehensive phyto-assessment of wetland condition for South Africa.

Report No. 1805/1/12

The development and testing of an integrated hydro-economic model to evaluate the financial impact of curtailment decisions on a farm case study in the Crocodile catchment (B Grové; M Frezghi; A Pott & N Lecler)

In water-scarce South Africa, water is already over-allocated in many catchment areas. Water managers will try to address the over-allocation so as to meet the assurances of water supply required by the various water-user and water-use sectors in the catchment. The Second Edition of the National Water Resource Strategy emphasises the need for 'smart water management' to complement traditional engineering and technology-based approaches to water management. Smart water management entails, among others, the inclusion of business principles and sustainability into water management – with strong stakeholder involvement in the planning

and managing of water resources. An important stakeholder group in the water sector is irrigated agriculture, which accounts for around 62% of all surface- and groundwater use in the country. In many instances, irrigated agriculture is seen as a

potential source of water for reallocation to other water-use sectors due to the perceived inefficiencies and potential to achieve water savings. Currently, the Mhlathuze catchment is undergoing compulsory licensing to reconcile imbalances in that catchment. The research reported in this document contributes towards improved decision-making and operational management at both catchment and water user association level, through the development of an integrated hydro-economic modelling framework. This framework allows water managers to test various catchment-scale water management scenarios on irrigators' security of water supply and the resulting impact on irrigation farming profitability and livelihoods.

Report No. 1898/1/11

Water use optimisation in industry: Development of a mathematical model for wastewater minimisation in a multipurpose batch plant (T Majazi; O Adekola; D Nonyane)

The nature of products produced from batch chemical plants is generally such that the effluent generated is extremely toxic. The quality and purity specifications of products from pharmaceutical industries require that the cleaning operation of the processing units be strictly controlled. Consequently, large volumes of solvents and cleaning agents are commonly used, this leading to high liquid waste volume. From these observations, it is desirable to minimise the production of such effluent at worst and eliminate it at best. Two unique investigations were considered in this report. The aim of the first investigation was to develop a mathematical technique to minimise wastewater generation in multipurpose batch processes operated over a long time horizon, i.e. industrial-scale problems, with significantly reduced computational difficulties. The aim of the second investigation was to develop a wastewater minimisation methodology that incorporates wastewater generation in batch plants.



Report No. 1937/1/11

Beneficiation of agri-industry effluents. Extraction of anti-oxidation phenolics from apple and citrus wastewaters coupled with fermentation of residual sugars to ethanol or other value-added products (SG Burton; C Mupure; KA Horne; S Jones & P Welz)

Fruit processing industries produce a considerable amount of wastewater which must be treated before the water is discharged. Beneficiation of this wastewater has potential economic and environmental benefits. Fruit processing wastewater contains phenolic compounds and polyphenols that have antioxidant activity and other valuable properties. These, and other compounds in the wastewater, have many commercial applications and thus it is worth investigating methods for their recovery. This research, among others, characterised complex wastes from fruit industries; developed and customised new extraction processes for obtaining antioxidants; investigated and optimised fermentation of residuals after extraction; and investigated commercialisation aspects.

Report No. 2017/1/12

User acceptance and functioning of mobile communal sanitation facilities in informal settlements of South Africa (A Lagardien; C Muanda & A Benjamin)

The provision of water and sanitation services to previously unserved communities is a South African development priority. In recent years, a strong drive from the South African government to attain basic water and sanitation throughout the country has been widely applauded and acknowledged in all communities. In order to reach this target, several sanitation technologies, including mobile communal sanitation facilities have been developed and implemented countrywide. However, it has been found that technical innovations often lack sustainability due to a lack of attention, provision and implementation of adequate operational requirements and community involvement. This study draws on local and international experience and investigates the approaches to evaluation in the context of the three case studies in informal settlements in order to develop a framework that can be used

to assess mobile communal sanitation facilities acceptance and functioning from user perspectives.

Report No. KV 299/12

A preliminary study to identify pathology present in fish in the lower Olifants River following a large crocodile mortality event (KDA Huchzermeyer)

Pansteatitis is a nutritional disease that follows on consumption of large amounts of polyunsaturated fats. The reduction in tissue vitamin E levels associated with such a diet is exacerbated where dietary fats have become rancid. In the Kruger National Park (KNP), pansteatitis in fish and crocodiles has been shown to be a serious and increasing problem in large man-made lakes fed by rivers arising in polluted catchments. The objective of this study was to identify the range of pathologies present in fish in the lower Olifants and Letaba rivers within the KNP, to determine the significance of these pathologies in terms of pollution and the development of pansteatitis in crocodiles, to differentiate such pathologies from non-pollution related pathology as would be expected in free-living fish in these rivers and to identify improved sacrificial and non-sacrificial methods of monitoring the fish health in KNP rivers.

Report No. 1527/1/12

Floating media flocculation as re-treatment for capillary ultrafiltration in drinking water treatment (EP Jacobs; SM Bradshaw; B Brika; IH Verster; VL Pillay)

This project resulted from a study conducted at the Nahoon Dam of Amatola Water, where the operability and performance of a locally fabricated capillary ultrafiltration process was evaluated on turbid water. The pretreatment technique used, coagulation followed by floating media flocculation, proved sufficient and the study on drinking water provision using high-turbidity water as feed was successfully concluded. However, problems were experienced in securing filter media suitable for the floating media flocculation process. A follow-up study was then launched to, among others, develop floating media separation (FMS) media of uniform size and fixed negative and positive residual charge; develop

FMS media with enhanced adsorption capacity and different specific gravities; develop compounding formulae including foaming and bubble agents to prepare closed-cell floating media with different specific gravities and enhanced adsorption capacity; and develop a protocol to maximise bed-shear during short-interval backwash to increase the net water production rate of FMS.

Report No. 2005/1/12

Optimisation of waste stabilisation ponds by combining duckweed-based and algal-based systems (G Pockock; H Joubert)

Wastewater stabilisation pond technology is one of the most important natural methods for wastewater treatment, especially in rural areas. This study aimed to develop a conceptual process design for a combined system, based on laboratory-scale experimental work. After conducting a thorough literature review it was found that while there was a wealth of information available on the design considerations for algal pond systems, there was a lack of information on duckweed-based systems, particularly with respect to the optimal growth conditions, expected nutrient uptake rates and recommended harvesting rates for removal of nutrients from the system. This study therefore focused on duckweed-based treatment.

DVD: A Journey into the use of social franchising principles in water services operation and maintenance – The Eastern Cape experience

This three-part DVD provides a quick visual overview of the experiences and lessons from a three-year collaborative project which piloted a social franchising partnership approach to the operation and/or maintenance of infrastructure. Based on pioneering research funded by the WRC, and with funding from Irish Aid and the support of the Eastern Cape Department of Education and Amatole District Municipality, the pilot successfully services (i.e. undertook the routine maintenance) of the sanitation facilities at nearly 400 schools in the Butterworth district, and the toilets of 400 households in Govan Mbeki Village, Idutywa, Eastern Cape.

DVD Nr. TT 517/12

Ethnographic research methods to better understand household water practices (I van den Berg & S Slabbert)

It is, for several valid reasons a challenge to obtain valid, reliable data from rural populations. Research instruments are often not suitable for use among rural communities because of their design. The problem with data collection may be further impaired by the fact that many rural people are functionally illiterate. The WRC initiated a study aimed to test the viability of an ethnographic participative technique, i.e. the use of digital media in the form of a video camera, to do research about water-related issues in rural communities. In addition, its intention was to inform communication and education campaigns aimed at effective water management.

Report No. 1924/1/12

The application of choice modelling techniques to guide the management of estuaries in South Africa – Case studies at the Sundays, Kromme, Nahoon and Gonubie River estuaries (SG Hosking – Editor)

There have developed two complementary schools of thought in South Africa on the management of its estuaries. One, motivated by the National Water Act of 1998, advocates resource directed measures and has its focus of attention on interventions to secure the minimum natural resource requirements for ecosystem functioning. The other view, motivated by the pursuit of efficiency and welfare, advocates for an economic approach to allocating and managing ecosystem goods and services. The latter views the generation of credible values for environmental goods as an important guide to their social management. This project is a contribution to the economic school of thought on managing estuaries. It builds on and extends the research objectives of a previous WRC report and presumes an important management challenge of estuaries to be optimising current welfare



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Prof Tor Ove Leikness of the Department of Hydraulic and Environmental Engineering, Norwegian University of Science and Technology has confirmed his participation as a keynote speaker

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values subject to constraints. The primary aim of this project was to generate information that assists managers toward making efficient choices.

Report No. 1960/1/12

Extreme events: Past and future changes in the attributes of extreme rainfall and the dynamics of their driving processes (CJ Lennard; L Coop; D Morison; R Grandlin)

Extreme rainfall events are often associated with significant societal and infrastructural impacts through human and animal fatalities, damage to or loss of property, loss of agricultural products, and flood insurance claims which are worth millions of Rands annually. Several studies have shown an increase in the intensity of extreme rainfall over many regions of South Africa as well as spatial heterogeneity in these changes, especially in the Eastern Cape, southern Free State and parts of KwaZulu-Natal. This study investigated changes in the characteristics of extreme rainfall by establishing relationships between existing station data and the daily synoptic states. Among others, the project team addressed the dynamical aspect of extreme rainfall in contemporary climate to provide a process-based understanding of observed changes in extreme rainfall, and built a basis for understanding future projected changes.

Report No. TT 480/12

uThukela water infrastructure refurbishment – A case study (H du Preez; A Toerien & P Dama-Fakir)

Significant improvements to existing wastewater treatment plants were achieved by uThukela Water. These improvements were achieved through a combination of refurbishment, retrofitting and replacement of equipment. The purpose of this study was to ensure that the experience gained by uThukela Water during the refurbishment and upgrades at

the wastewater treatment plants of the Amajuba and Umzinyathi Water Services Authorities is documented and disseminated to other municipalities and people working in the water industry.

Report No. 2086/1/12

Assessing the impact of expansion of bulk infrastructure on the capital requirements of water boards (K Walsh)

Water boards were established under the Water Services Act of 1997 to provide bulk water to other water services institutions and to serve as water services providers when contracted by municipalities. A number of recent initiatives have been aimed at expanding the operations of Water Boards. Expanding the areas of activity of water boards will have an impact on their financial viability, most notably on capital expenditure requirements. As a result, the WRC appointed PDG to conduct research on the impact of expansion of bulk infrastructure on the capital requirements of water boards. The project involved two main streams of work. The first stream focused on modelling the impact of expanding areas of activity on the financial viability of water boards; the second on identifying indicators for assessing the ability of water boards to access capital finance, particularly under expansion.

Report No. 1925/1/12

Establishing the fishery potential of Lake Nandoni in the Luvuvhu River, Limpopo Province (PSO Fouché; W Vlok; JC Roos; W Luus-Powell & A Jooste)

It is often stated that inland fisheries can provide an essential contribution to local and regional economies as well as sustain livelihoods. South Africa's reservoirs potentially contain fish that can be utilised as a source of food but historically these fish resources were not considered as a source of protein and as such are not commercially harvested. This project determined the fisheries potential of Lake Nandoni, in Limpopo. The main aims were to gather data on the aspects regarding the biological, ecological and physical aspects of fish in the lake so that this could be used as a guideline for a management plan for inland fisheries.

Report No. 1779/1/12

An economic analysis of the contribution of water use to value chains in agriculture (H Jordaan & B Grové)

Despite the commitment from government and the investments made to assist emerging farmers from small-holder irrigation schemes to be integrated into commercial agri-food chains, actual success stories where emerging farmers are successfully operating in commercial agri-food chains are scarce. The small number of success stories means that the objective to allow farmers to improve their livelihoods through irrigated agriculture is not met. It is noted that access to agricultural water plays a necessary role in increasing productivity, but access to water alone is not a sufficient condition to enhance productivity and alleviate poverty. The farmers have to generate sufficient levels of income from their irrigation activities in order to alleviate poverty. The main objectives of this WRC-funded project were to, among others, develop a conceptual framework based on a literature review on value-chain analysis with specific reference to water utilisation and competitiveness in agriculture; to demonstrate the application of the framework for commercial and emerging agriculture in the horticulture and field crop industries; to determine the research approach, method and models for analysis of value chains with application to commercial and emerging agriculture; and to empirically analyse and model selected value chains.

Report No. 1913/1/12

Modelled sea-surface temperature scenario considerations and southern Africa seasonal rainfall and temperature predictability (AF Beraki; WA Landman; DG de Witt; C Olivier; K Mathole & T Ndarana)

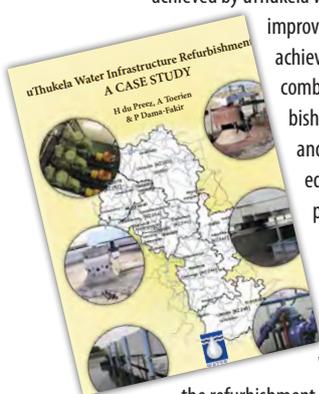
The prediction of a high-impact weather event such as a flash flood or a heat wave for particular days at a certain location several months ahead has no usable skill. However, there is some skill in predicting the anomalies in the seasonal average of the weather. The main objectives of this project were to, firstly, investigate an optimal model configuration that

includes the best available description of the surface boundary conditions as reflected in projected global sea surface temperatures, in order to force atmospheric general circulation models to produce seasonal rainfall and temperature forecasts over South Africa at lead times of several months. Secondly, the project was to develop a global sea surface temperature forecast product that includes probabilistic forecasts of El Niño and El Niña events, and lastly to conduct a comprehensive comparative analysis between a one-tiered and a two-tiered forecasting system.

Report No. KV 302/12

An evolution of the ecological flow requirements of South Africa's estuaries from a hydrodynamics perspective (L van Niekerk; S Taljaard; P Huizinga; AK Theron; SM Bergman; R van Ballegooyen)

An estuary is largely determined by the river flow it receives in all its variability from major floods to low flows. Changes in river flow in principle will affect the functioning and production of an estuary, and ultimately the ecosystem service society derived from them. The recognition that estuaries need freshwater to maintain their health and productivity and the methodology on how to determine their ecological flow requirements is a relatively new field of study. Three main countries have developed environmental flow assessment methods for estuaries, i.e. South Africa, Australia and the USA. Methods have mostly developed from practical applications, a learning-by-doing approach, with most approaches including elements of risk assessment and adaptive management. This document sets out to describe the development of the South African ecological flow requirement methods from a hydrodynamic perspective, with an emphasis on the last decade – 2000 to 2010. The document reviews the historical development of the method. It discusses the approaches to evaluating berm heights, mouth conditions, water levels and salinity ranges. The document concludes with some recommendations for future updates of the estuary ecological flow requirement methods in South Africa.



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Crocodile nerves 'super sensitive' US scientists find



Crocodilians have nerves on their faces that are so sensitive, they can detect a change in a pond when a single drop hits the water surface several feet away.

Alligators and crocodiles use these 'invisible whiskers' to detect prey when hunting. Now, a new study from the Missouri University (MU) has measured the nerves responsible for this function, which will help biologists understand how today's animals, as well as dinosaurs and crocodiles that lived millions of years ago, interact with the environment around them.

"The trigeminal nerve is the nerve responsible for detection of sensations of the face," said Casey Holliday, assistant Professor of anatomy in the MU School of Medicine. "While we have known about these sensitive nerves in crocodiles, we have never measured the size of the nerve bundle, or ganglion, in their skulls, until now. When compared to humans, this trigeminal nerve in crocodiles is huge."

The key to this measurement is a specific hole in the skull. The trigeminal

nerve is rooted inside the skull, but must travel through a large hole before it branches out to reach the crocodile's skin on its face. By examining how the skull size, brain size and ganglion size relate to each other, scientists can estimate how sensitive the face is. Eventually, Holliday hopes to measure this nerve in other ancient and contemporary species to learn more about animal behaviour.

Holliday says that this information will aid future research, including when his team will examine skulls of ancient crocodiles. Understanding this nerve and its functions could also lead to better understanding of the anatomical basis for behaviour in many living animals, including fish, electric eels, platypi and humans. "The same way that we would look at the size of the visual cortex in the brain to understand how well an animal might see, we can now look at the trigeminal nerve in animals to determine how sensitive their skin on their faces is," Holliday said.

The study was published in *The Anatomical Record*.

Call for papers open for international water congress

The Call for Papers is open for the International Water Association World Water Congress & Exhibition to be held in Lisbon, Portugal, on 21-26 September, 2014.

The organisers are looking for contributions under various session themes to present global best practice, advances in fundamental science, innovative research, policy developments and solutions to challenges faced by water professionals worldwide. Themes include, among

others, cities and basins of the future, protecting human and environmental health, water policy and governance, water reuse and resource recovery, innovative water supply and wastewater technologies, utility management, information and communication technology and new industrial water management, technologies and processes.

The call closes on 30 September, 2013. For more information, Visit: www.iwa2014lisbon.org/

NASA study projects warming-driven changes in global rainfall

A NASA-led modelling study provides new evidence that global warming may increase the risk for extreme rainfall and drought.

The study shows for the first time how rising carbon dioxide concentrations could affect the entire range of rainfall types on Earth. Analysis of computer simulations from 14 climate models indicates wet regions of the world, such as the equatorial Pacific Ocean and Asian monsoon regions, will see increases in heavy precipitation because of warming resulting from projected increases in carbon dioxide levels. Arid land areas outside the tropics and many regions with moderate rainfall could become drier.

The analysis provides a new assessment of global warming's impacts on precipitation patterns around the world. "In response to carbon dioxide-induced warming, the global water cycle undergoes a gigantic competition for moisture resulting in a global pattern of increased heavy rain, decreased moderate rain, and prolonged droughts in certain regions, said William Lau of NASA's Goddard Space Flight Centre and lead author of the study.

The models project for every 1 degree Fahrenheit of carbon dioxide-induced warming, heavy rainfall will increase globally by 3,9% and light rain will increase globally by 1%. However, total rainfall is not projected to change much because moderate rainfall will decrease globally by 1,4%.

The models also project for every degree Fahrenheit of warming, the length of periods with no rain will increase globally by 2,6%. In the Southern Hemisphere, drought becomes more likely in South Africa, northwestern Australia, coastal Central America and northeastern Brazil.

"Large changes in moderate rainfall, as well as prolonged no-rain events, can have the most impact on society because they occur in regions where most people live," Lau said. "Ironically, the regions of heavier rainfall, except for the Asian monsoon, may have the smallest societal impact because they usually occur over the ocean."

Source: NASA

New apps tackle sanitation challenges

Mobile phone and web applications that enable people to talk to local policymakers and allow children to learn through games have won a competition for technological innovation that addresses sanitation problems in developing countries.

The three winners of the World Bank's Sanitation App Challenge – mSchool, SunClean and Taarifa – were selected from ten finalists. Each app was assessed on its originality, quality of user interface, technical feasibility, economic viability, how it tackles an identified problem and the team effort involved in its development.

One of the winners, mSchool, is a text-messaging tool that allows students, parents and teachers to report sanitation breakdowns and repairs required in schools. The tool was developed in Senegal as a platform for monitoring sanitation conditions in schools.

Another winning app, Taarifa, allows people in developing nations to link up with their local government, and is already in use in Uganda. This open-source app allows communities to report and address local sanitation issues by collecting and visualising information, and enables public officials to respond.

The last of the winners, SunClean, was developed by students at the University of Indonesia. It uses games to teach children about waste disposal and hand-washing.

Source: SciDev.net

Team of scientists mapping Africa's abandoned mines

A team of 50 geoscientists are mapping the impact of mining on human and environmental health in sub-Saharan Africa.

The project is being undertaken under the International Geoscience Programme of the United Nations Educational, Scientific and Cultural Organisation (UNESCO), with funding from Sweden.

According to UNESCO magazine, *World of Science*, the team is compiling a database and using geographical information systems to elaborate precise maps of the location of all abandoned mines in sub-Saharan Africa. At selected sites, they will study and document the rate at which specific toxic trace elements are absorbed by the soils, plants, fungi, surface and groundwater, as well as by animals and humans via the food chain.

Samples collected from the site of major derelict mines are being analysed by the laboratories of participating institutions. Different technologies are also being tested to ascertain which give the best results for rehabilitating sites contaminated by trace metals.

On the basis of their findings, the team will then advise governments and local authorities on the best available remediation technologies and on land-use planning. It is also planned to prepare a policy brief and other materials for decision-makers.

Mining operations contribute more than 20% of gross domestic product in sub-Saharan Africa. "Like agriculture, mining is crucial for the region's economy," observes project leader Sadrack Toteu. "Decades of mining has polluted surface- and groundwater, soil and food crops. Moreover, in many countries the danger is compounded by the

lack of a precise inventory of abandoned and derelict mines. The surveys and impact assessments we are conducting will reveal the true extent of metal pollutants across the continent and their impact on human and animal health, the environment and ecosystems.

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UNESCO opens access to all publications

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) has made its digital publications available to millions of people around the world free-of-charge with an open license.

This follows a decision by the organisation's Executive Board in April. UNESCO has become the first member of the United Nations to adopt such an open access policy for its publications. The new policy means that anyone will be able to download, translate, adapt, distribute, and re-share UNESCO publications and data without paying.

"Researchers from all countries, but especially from developing and least developed countries will benefit and capitalise on open access to knowledge," said Janis Kariklins, UNESCO's Assistant Director-General for Communications and Information. "Our new policy will enable us to increase the visibility, accessibility, and rapid distribution of our publications."

By adopting this new publishing policy, UNESCO aligns its practice to its advocacy work in favour of open access and strengthens its commitment to the universal access to information and knowledge.

Starting from July, hundreds of downloadable digital UNESCO publications will be available to users through a new Open Access Repository with a multilingual interface. All new publications will be released with an open license. UNESCO will also seek ways to apply it retroactively, i.e. to works already published.

Some 2,4 billion will lack improved sanitation in 2015

Some 2,4-billion people – one third of the world's population – will remain without access to improved sanitation in 2015, according to a joint report issued by the World Health Organisation (WHO) and the United Nations Children's Fund (UNICEF).

The report, titled Progress on Sanitation and Drinking Water 2013 Update, warns that, at the current rate of progress, the 2015 Millennium Development Goal target of halving the proportion of the 1990 population without sanitation will be missed by 8% – or half a billion people.

While UNICEF and WHO announced last year that the MDG drinking water target had been met and surpassed by 2010, the challenge to improve sanitation and reach those in need has led to a consolidated call for action to accelerate progress. "There is an urgent need to ensure all the necessary pieces are in place so the world can accelerate progress and reach the MDG sanitation target," noted Dr Maria Neira, WHO Director for Public Health and Environment. "The world can turn around and transform the lives of millions that still do not have access to basic sanitation."

Among the key findings of the latest 2011 data, the report highlights the fact that one billion people still defecate in the open, while another 761 million share sanitation facilities and 693 million use facilities that do not meet minimum standards of hygiene.

To access the report and associated data, Visit: www.wwinfo.org.



Water by numbers

90% – The percentage of water-related natural disasters out of 2 557 between 1991 and 2000, according to the United Nations.

480-million – The volume of kilolitres of water lost in Gauteng in the last financial year, costing the province R8-billion, according to questions answered by the Gauteng Local Government and Housing Minister, Ntombi Mekgwe, in the provincial legislature. The main reasons for the loss were a lack of skilled staff, ageing infrastructure, a lack of information, and tariffs not reflecting the full costs of delivering water, it was reported.

2 278-million – The remaining number of households in South Africa that don't have access to safe sanitation, according to the Department of Human Settlements.

20 MW – The capacity of the proposed hydroelectricity plant in the Au-grabies National Park. The proposed project could see hydroelectricity from the Orange River Falls being used to supply electricity to nearby Kakamas, *Beeld* reported.

2 000 – The estimated number of vacancies for civil engineering professionals in local authorities, according to the South African Institution of Civil Engineering. According to the institution, the country's municipalities have been losing an average of 70 to 90 engineering staff per year since the late 1980s.

R671-billion – The amount required over the next ten years to meet South Africa's water infrastructure needs across the entire water value chain, according to Minister of Water & Environmental Affairs, Edna Molewa.