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ALUMNI MAGAZINE
FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION
UNIVERSITY OF TWENTE

ITC NEWS

SPECIAL FEATURE
WATER IS LIFE!

CORE CLIMAX

BENEFIT OF PROTECTED EUROPEAN AREAS

FAREWELL TO MOLENAAR

GREETINGS FROM

UNIVERSITY OF CURIOUS PEOPLE.

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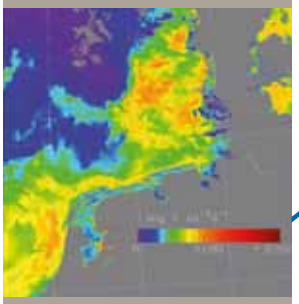

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Content

In several African countries, food production is entirely weather and climate dependent and food security is a returning annual uncertainty and risk for large groups of people. Also here, SIGMA works with local partners to increase the early warning capacities of some more fragile countries and developing states in monitoring crop yields and detecting weather and crop growth anomalies..

INTRODUCTION

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How to introduce *ITC News* 2015-1? No easy task, given the following pages cover such a wide range of subjects. Perhaps thoughts along the lines of history made, history celebrated, history in the making will offer an opening – and this is history often seen through the lens of personal endeavours.

On page 33 we say farewell to Professor Martien Molenaar, who "instead of a participant, will be an interested spectator" as he follows the future twists and turns in the path of ITC and the latest developments in the discipline that he served so well. Our next port of call is Beijing (page 29), where former vice-rector Dr Niek Rengers was presented with a prestigious award in recognition of significant contributions to China's social and economic development. While yet another awardee known to this newsletter is Dr Xiaogang (Marshall) Ma, who will receive the Andrei Borisovich Vistelius Research Award (page 23) at the IAMG conference in Germany this coming September. He will also be one of the keynote speakers during this nine-day event.

There are a number of "firsts" in this issue too. A first study to assess large-scale charcoal production changes in Somalia is the subject of an interesting article on page 21. Nor will it escape your notice that here satellites have played a key role for the first time. But satellites are nothing if not versatile and their capabilities have now been employed in counting of wildlife in Kenya (page 25) and, yes, you've guessed it already, for the first time.

Programme options for students (pages 20 & 28), the benefits of protected areas for reptiles and amphibians (page 26), the stories that plants can tell by emitting light (page 9) – People and Planet are well represented. As indeed is an element necessary to them all … *water*! Water in its many guises features in several articles, in fact too many to list the pages here but that's unlikely to prove a hindrance.

So the lecturers, students and researchers at ITC are gainfully occupied on many fronts. Nevertheless, they do occasionally find time to switch off the computer, down tools and simply Run4Fun (page 32) – or in this case Run4WWF. Hoping you too will find the time to enjoy what this latest issue of *ITC News* has to offer,

Virtually yours, Jorien Terlouw
Editor

Water is Life!

Bob Su z.su@utwente.nl

Ensuring safe water, secure food, sustainable energy, and clean environment are key challenges to our changing society. We therefore envision *"safe water resources for all"* with the corresponding mission *"Creating and Transferring Knowledge in Water Resources and Environmental Management using Earth observation and spatial information technologies"*. Better water resources management requires fundamental understanding of the water cycle, water and climate, water and ecosystem interactions, as well as the ability to quantify the impact of human activity on water resources and the Earth's climate system.

Recognizing that quantitative earth observation, numerical hydrometeorological modelling and data assimilation provide a powerful tool for quantifying hydro-climatic variabilities to effectively address water management issues, we have focused our efforts on advancing process understanding in land surface processes and their interactions with the atmosphere. As such we can generate the capability and capacity to monitor worldwide water availability, extremes and food security in terms of floods, droughts, water use and water pollution. This is particularly important in developing countries where field monitoring is often lacking and where we can best contribute to supporting the Dutch policy on development cooperation.

The past years have been a time of sowing and happy harvesting by the Department of Water Resources (WRS). These have been a time of sowing because we have worked very hard to strengthen our competence in research, education and external projects in a cooperatively enabling environment. They have been also a time of harvesting, thanks to the collective efforts of our staff and students, and with strong support from our collaborating partners worldwide, we have made excellent achievements.

As can be seen in this special issue, we have further consolidated our capability in research and education in quality and sustainability. Our research have been published in some of the best disciplinary international journals and increasing PhD candidates have successfully earned their deserved doctorates. Several significant projects have been successfully implemented and several new projects acquired with important contributions to research and capacity building. We have continued to improve the quality of our education and ensured large number of student enrolment by kick-starting a joint education programme with the Capital Normal University in Beijing. ■

Prof Dr Bob Su

More information about the WRS department can be found at our website http://www.itc.nl/WRS

Quantifying Freeze-Thaw Processes using NASA's SMAP Satellite

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Soil moisture is a crucial land surface state modulating the exchange of water and heat at the land-atmosphere interface and is imperative for understanding trends and variability in climate feedbacks on the water cycle. As such, accurate soil moisture information can facilitate the identification of imperfections in the state-of-the-art climate models and may set the reference for climate scenario development.

NASA's SMAP (Soil Moisture Active Passive) mission, launched on 31 January 2015, is the first satellite that combines active and passive microwave sensing for measuring soil moisture and the related freeze-thaw state. However, providing both soil moisture and freeze-thaw state measurements under below 0°C conditions remains inherently difficult, as liquid and frozen water co-exist in the soil matrix up to several degrees below freezing point.

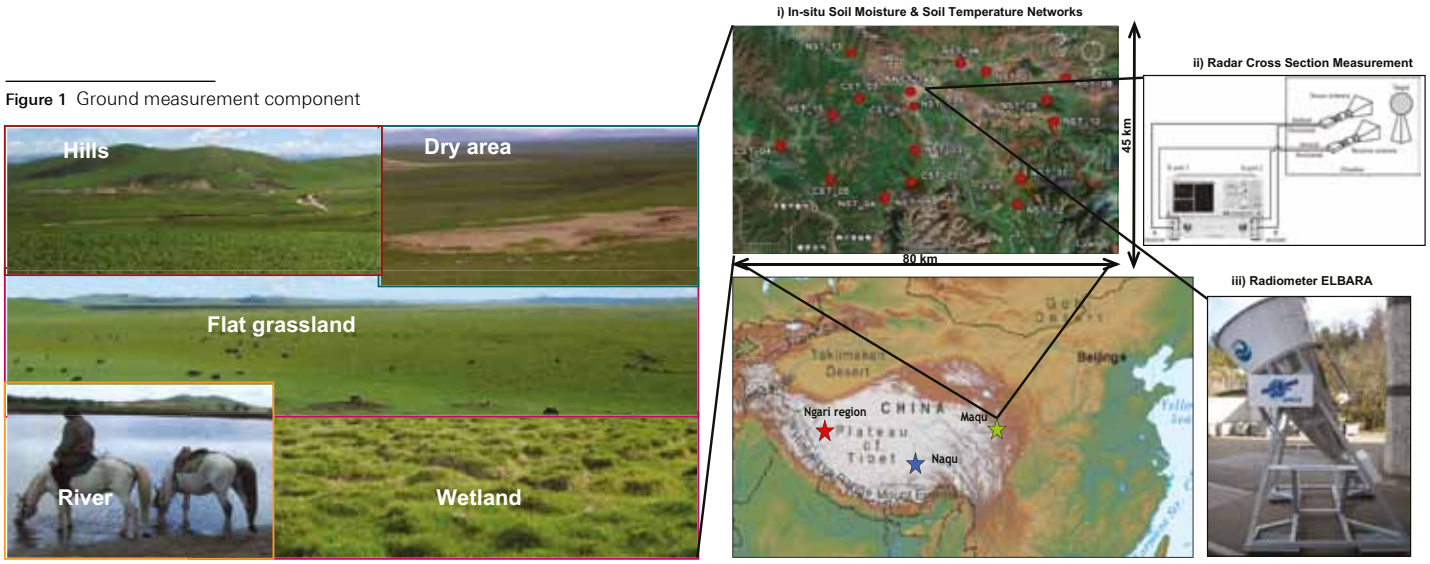
The research funded by the Netherlands Organisation for Scientific Research (NWO) is, therefore, centred on the question: How can liquid moisture in the soil be quantified when the temperature is below 0°C? This scientific problem will be approached from (a) ground measurement, (b) earth observation and (c) process modelling perspectives. Through the combination of these three components we expect that the complex earth observation of freeze-thaw processes can be unravelled.

Ground Measurements (see Figure 1)
Ground measurements of soil moisture and temperature will be provided at regional scale by three networks spread across the Tibetan Plateau. Diurnal active and passive microwave measurements will be performed with a tower-based radar and radiometer at Maqu hydro-meteorological station.

Earth Observation (see Figure 2)
The earth observation data will include the SMAP's radar-only soil moisture retrieval (3km resolution), the radiometer-only retrieval (40km resolution) and the active/passive soil moisture product (10km resolution). In addition, a physically-based observation model will be developed to simulate both active and passive microwave observations. This model will be calibrated/validated using the tower-based radar/radiometer measurements at local scale and SMAP observations at regional scale.

Process Modelling (see Figure 3)
The land surface model (HTESSEL) currently employed by the European Centre for Medium-Range Weather Forecasts (ECMWF) has only four soil layers. Such coarse soil layering (7~89 cm) is not able to capture the subtle changes of the active layer thickness (1.33 ~3.6 cm/yr) during the freezing-thawing cycle. In this project, we will enhance the HTESSEL in simulating freezing-thawing cycles with numerical (finer soil layering) and experimental experiments (laboratory test). ■

Figure 1 Ground measurement component



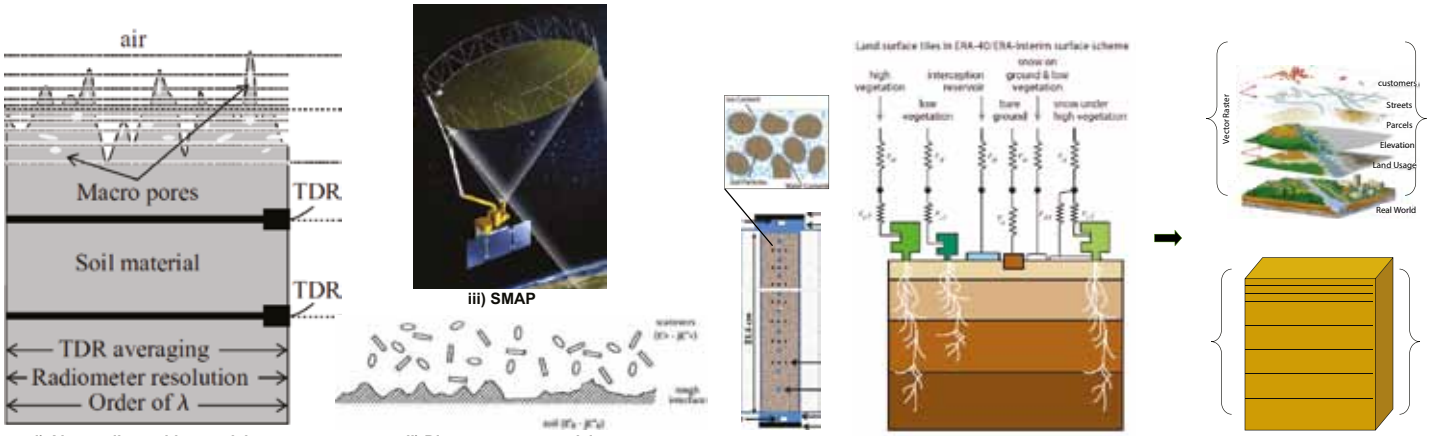


Figure 2 The observation model including the freeze-thaw process will be developed to simulate both active and passive microwave observations, which will be compared with SMAP observation

Figure 3 The ECMWF land surface model HTESSEL will be enhanced with (i) experimental and (ii) numerical experiments

Coordinating Earth Observation Data Validation for RE-Analysis for CLIMate ServiceS (CORE-CLIMAX)

Yijian Zeng y.zeng@utwente.nl

Climate change (increases in temperature, changes in precipitation and decrease in ice and snow), which is occurring around the world and thus also in Europe, has a wide range of impacts on society and the environment. Responding to environmental and societal challenges associated with climate changes, the Copernicus Climate Change Service will help to support adaptation and mitigation by providing access to several climate indicators (e.g. temperature increase, sea level rise, ice sheet melting, warming up of the ocean) and climate indices (e.g. based on records of temperature, precipitation, drought events) for both the identified climate drivers and the expected climate impacts.

The Service benefits from the efforts in maintaining and expanding networks of *in situ* and satellite-based observations and the reanalysis of the Earth climate and modelling scenarios, based on a variety of climate projections. To further support this effort, in conjunction with GCOS (Global Climate Observing System), FP7 climate change related projects, and ESA Climate Change Initiative projects, a coordination activity (i.e. CORE-CLIMAX) has been proposed, devoted to coordinating the identification of available physical measurements which can be reconciled with previously existing data records, to form long-term climate date records.

The project's efforts revolve primarily around Climate Data Records (CDRs), which are time series of observations that measure variables believed to be associated with climate variation and change. The creation of CDRs is an evolved process, beginning with the availability of observations. These are calibrated, geolocated and intercalibrated in order to create calibrated Level 1 data – known as a Fundamental Climate Data Record (FCDR). Following the establishment of an FCDR, it is then converted to geophysical/biogeophysical parameters by means of inversion, and the converted result is termed a Thematic Climate Data Record (TCDR). A TCDR may form a complete or partial Essential Climate Variable (ECV), which is a geophysical variable that is associated with climate variation and change as well as the impact of climate change on Earth. Once FCDRs and TCDRs have been established, they are then archived along with relevant information, including the results of peer review, validation and user feedback. This information is collectively referred to as CDR.

The CORE-CLIMAX project helps to substantiate how Copernicus observations and products (from both *in situ* and space components) can contribute to climate

change analyses, by establishing the extent to which observations complement existing CDRs. CORE-CLIMAX has assessed the European capability to provide GCOS ECV data records with an assessment tool, has coordinated a harmonized approach to validating each ECV/CDR, has identified the integration of ECVs into the reanalysis chain, and has formulated a process to compare the results of different reanalysis techniques.

Assessment Tool

It is essential to assess the capability of existing CDR development activities to ensure the prolonged generation of high-quality ECV CDRs so that they can help to produce the underpinning science that supports decisions on mitigation and adaptation for a changing Earth climate. To assess existing capacity in the most objective way possible, we need tools that provide a basis for information preservation, expectations, and a metric for progress to completeness. The system maturity matrix is such an assessment tool, which basically assesses whether the CDR generation procedures have been compliant with best practices developed and accumulated by the scientific and engineering communities. The concept behind the CORE-CLIMAX system maturity matrix can best be illustrated as shown in Figure 1.

Generic Validation Processes

It is suggested that each step of the validation process be documented, as detailed in Figure 2, to establish the traceability of a validation process. Starting with documenting how the reference dataset is generated, the generic process requires the assessment of the independence levels of the reference dataset (e.g. level 2.a – 2.g after Point 2). Furthermore, it is suggested that both the self-assessment and independent/external assessment be implemented with regard to the CDR products and the validation process, to ensure understanding of the data quality. One step further is to check the independence level of the independent/external assessment, as indicated by Point 6 with level 6.a – 6.c. For a complete validation process, the consistency of the validated CDRs (e.g. compared with the physically interrelated variables) should also be considered. The last step is to sustain the established validation facilities and procedures (e.g. codes, data archive & data versions etc.). This final step is to achieve an operational validation level at which validation activities and data release are regularly implemented.

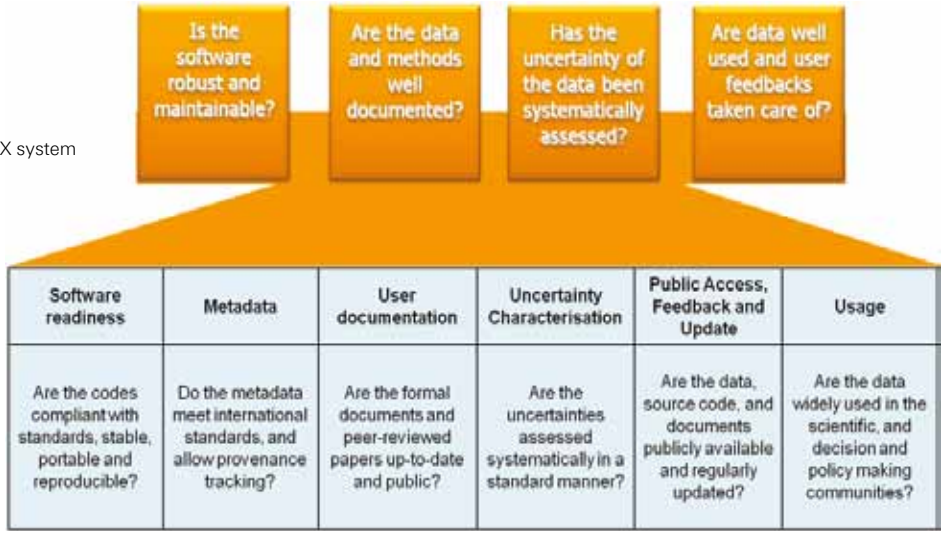


Figure 1 Illustration of CORE-CLIMAX system maturity matrix (SMM)

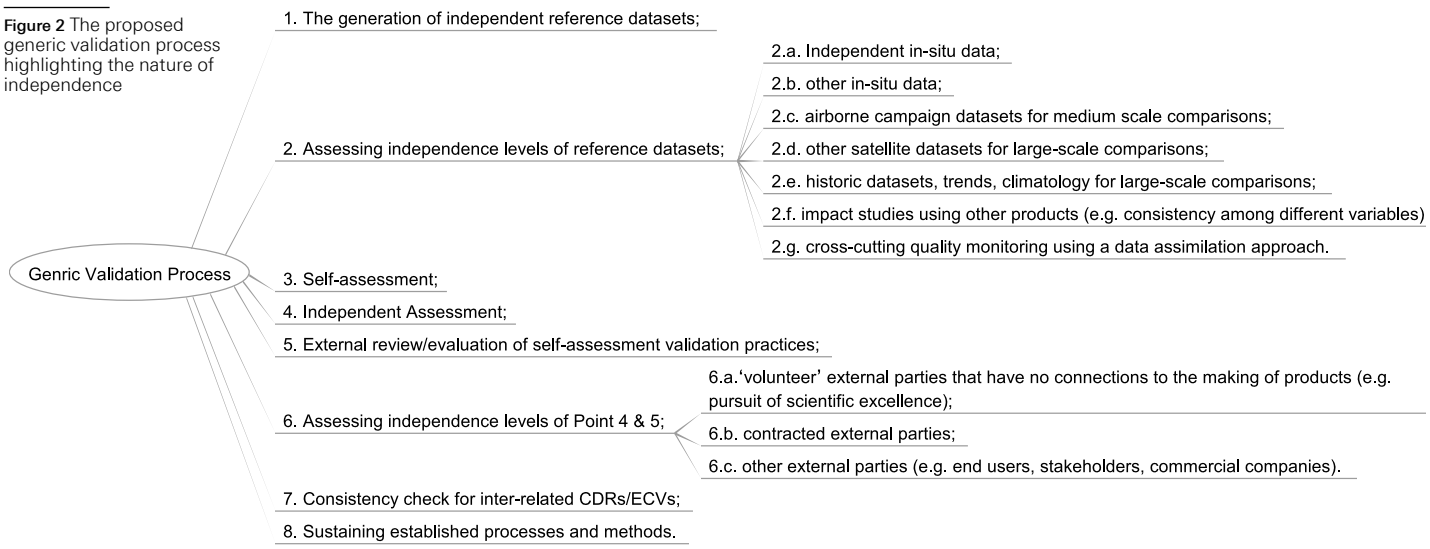


Figure 2 The proposed generic validation process highlighting the nature of independence

Reanalysis Feedback

Figure 3 Left panel: process for comparing a CDR with a pre-existing reanalysis; right panel: procedure for CDR assessment via full assimilation in a reanalysis production.

The advent of operational climate services increases the need of CDR producers to know about reanalysis needs, particularly regarding desirable CDR updates. Reanalysis needs can be effectively communicated to CDR producers as illustrated in Figure 3. The left panel illustrates the offline quality assessment procedure. The iterative loop linking "Comparison & Assessment" and "Response by CDR provider" encapsulates the fundamental peer-to-peer communication needed to convey and understand reanalysis needs. It is through this loop that (a) CDR weaknesses are reported, and (b) the CDR producer's response can be developed to a level at which CDR update plans can be formulated.

The right panel depicts a systematic process for projecting an existing reanalysis into the space observed by a CDR, followed by comparison, assessment and feedback to the CDR provider. The projection (sometimes referred to as "forward simulation" or computation of "observation equivalents") depends on the acquisition of three principal inputs: (i) CDR observational data and associated metadata, (ii) a suitable reanalysis, and (iii) tools for reading the CDR and for applying an "observation operator" to the reanalysis. The projected reanalysis, when combined with the observational CDR, constitutes "observational feedback data", which forms the quantitative basis for the CDR assessment.

Reanalysis Intercomparison

Reanalysis intercomparison activities are a key component of characterizing reanalysis uncertainties. As such, it yields information that assists users in deciding which reanalysis product might be most suitable for their particular application. The CORE-CLIMAX has developed a set of procedures for comparing reanalysis, and comparing reanalysis with assimilated observations and CDRs. In this respect, five categories of comparisons are identified:

(1) Descriptive product comparison
(2) Comparison with third party observation-based CDRs
(3) Intercomparison between different reanalyses
(4) Thematic comparison (e.g. how well the reanalysis products can be applied to understand a particular problem)
(5) Internal metrics comparison. ■

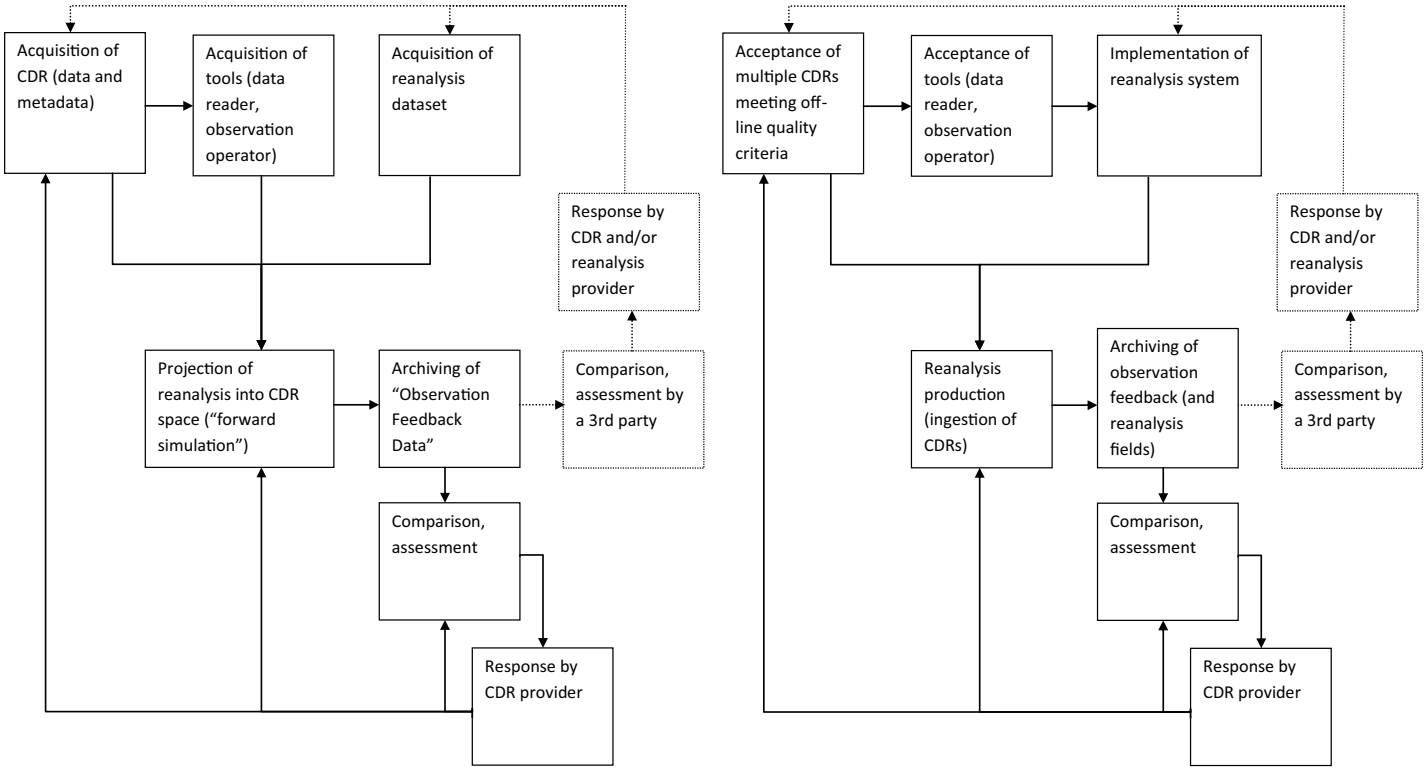
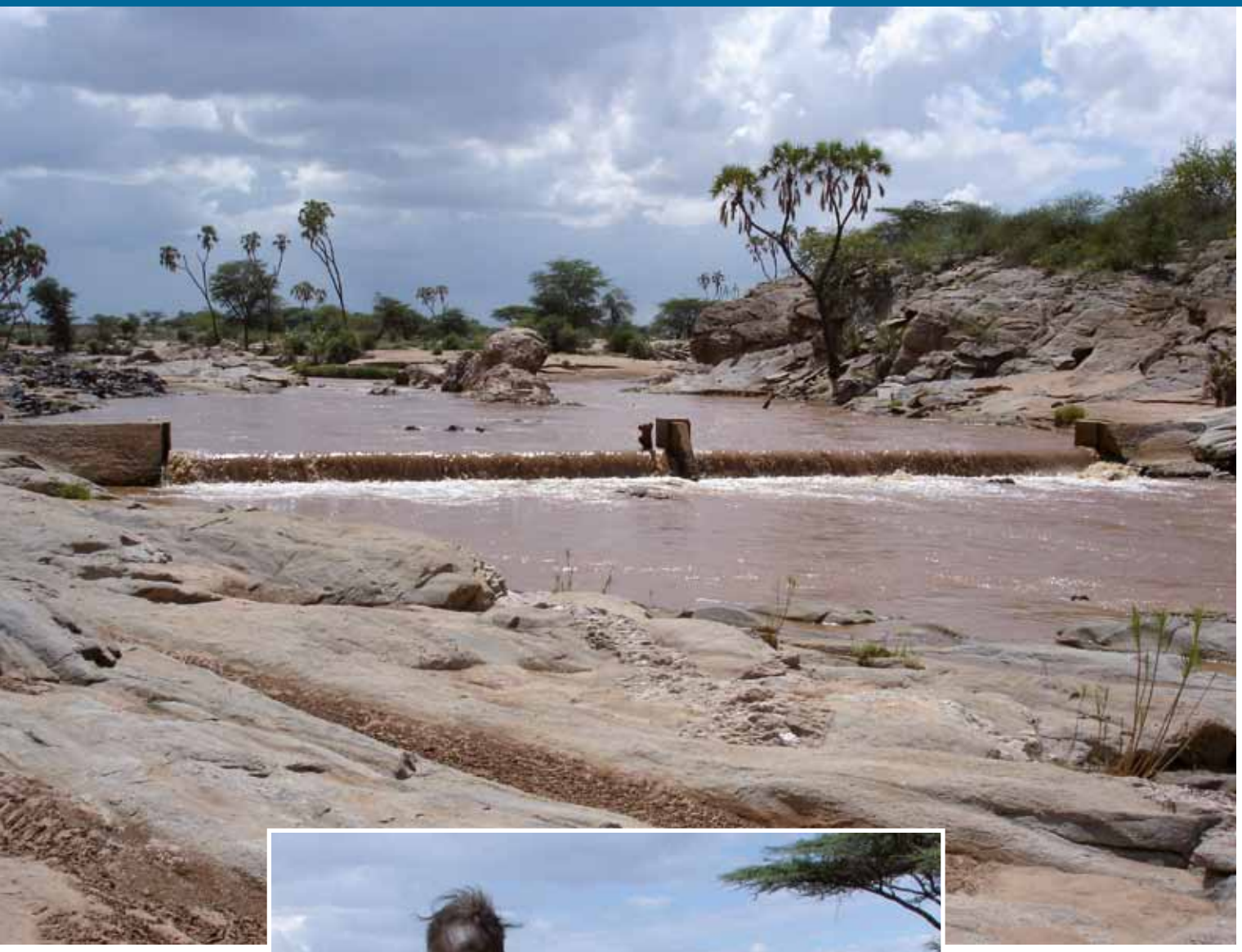


Figure 3 Left panel: process for comparing a CDR with a pre-existing reanalysis; right panel: procedure for CDR assessment via full assimilation in a reanalysis production



Climate change (increases in temperature, changes in precipitation and decrease in ice and snow) is occurring around the world and thus also in Europe and has a wide range of impacts on society and the environment.

SCOPE: Remote Sensing of Water and the Biosphere

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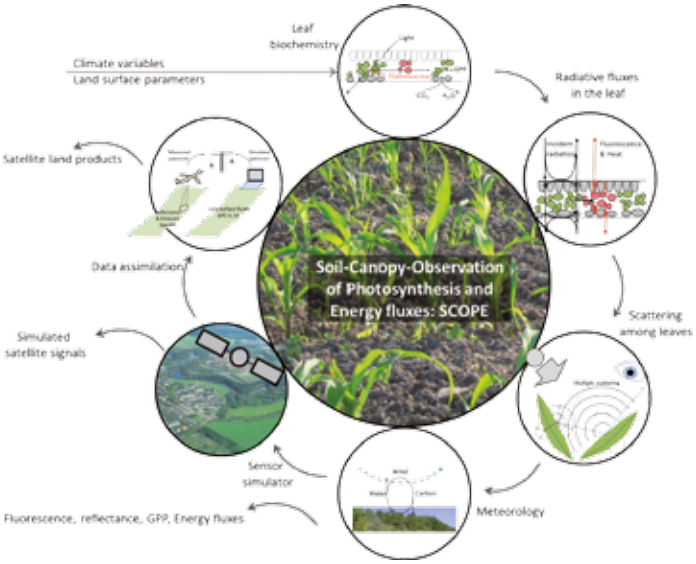
Imagine a server that takes in a massive number of real-time images from satellites in orbit, and spits out global maps of the water use and productivity of the biosphere. Areas suffering from shortage of nutrients or extreme temperatures show up on these maps. Behind these maps is a powerful algorithm that analyses subtle changes in reflected and emitted radiance that are invisible to the human eye but detectable from space.

This has been the vision of a group of people working on the SCOPE model project. It all started 11 years ago with an idea of Bob Su. At that time he had just started as a professor at ITC. He proposed bringing "radiative transfer models" (RTMs), which are commonly used in remote sensing, into earth sciences simulation models for soils, plant physiology and the atmosphere. These models showed overlap, but they had been developed by different scientific communities. Merging them would lead to more robust models for remote sensing of the biosphere.

The proposal of Su was funded by NWO, and the ECO-RTM project resulted in a simulation model for remote sensing of vegetation, which was later baptized SCOPE: Soil-Canopy-Observation of Photosynthesis and Energy fluxes.

In SCOPE we follow the radiation from the sun and the sky through the vegetation and back to a sensor. We simulate the processes that take place along this path. In this way we can obtain useful information from remote radiance measurements in the optical, near infrared and thermal domains, such as productivity, transpiration, and energy fluxes. The biggest advantage of SCOPE is that it uses the whole radiative spectrum from optical to thermal and does not rely on a specific satellite sensor. We can still use historical data of retired satellites to tune the model, as long as we know what the specifications of the sensors were.



USER SUPPORT

Students and professionals who are interested in using SCOPE can enrol in online training on the background and application of SCOPE. The online training includes recorded lectures, exercises, and open access scientific papers. The model itself is available on github.com/christiaanvandertol

Projects

SCOPE has been used to evaluate satellite data in several projects. The European Space Agency (ESA) showed interest in a very subtle signal from plants – chlorophyll fluorescence, an indicator of the photosynthetic activity of plants. Because SCOPE was already able to simulate this signal, it has been used in five ESA projects to study the feasibility of the FLuorescence EXplorer (FLEX) mission. An NWO project to study photosynthesis with SCOPE, called FLORES, started in 2014. SCOPE also plays a key role in the European collaboration project OPTIMISE, which aims at developing measurement protocols at reference sites for UAV, airborne and spaceborne remote sensing measurements of vegetation.

"My research interests are concentrated on hyperspectral remote sensing of vegetation, chlorophyll fluorescence, radiative transfer, plant physiology and the carbon cycle. My PhD research focuses on interpreting remote sensing measurements of solar-induced fluorescence (SIF) and monitoring the photosynthetic activity by using SIF."

Peiqi Yang, PhD candidate

"My research topic is rainfall interception modelling in forest canopies. I am conducting an experiment at the tower site in Speulderbos that includes micro meteorological measurements and forest structural parameters. I will use the SCOPE model as a tool to study the water and energy balance in combination with field measurements."

César Cisneros, PhD candidate

"Plants are very efficient in harvesting sunlight to grow. During the transport of photons, a very small portion leaks away; this light is re-emitted as fluorescence. While the plants adjust their metabolism – and they do this continuously – the fluorescence signal changes in spectral shape and intensity. To my own surprise we can measure this very weak signal in the field from airplanes and with satellites. It is fascinating that plants can tell us their story by emitting light. I am listening in and figuring out what they are actually telling us."

Christiaan van der Tol, author of SCOPE

"I am analysing the dynamics behind the changes in plant fluorescence and leaf pigment composition. I am using SCOPE as a tool to understand these dynamics at leaf and canopy level better."

Nastassia Rajh Vilfan, PhD candidate

"I am estimating evapotranspiration in a few chosen wetland ecosystems in parts of Europe. I opted to work with the SCOPE model first because of its designated inbuilt capabilities of a SVAT model and second because SCOPE offered me simplicity and reliability, as displayed in existing studies. This gives me confidence to use it in my research work."

Loise Wandera, ITC PhD candidate based at Luxembourg Institute of Science and Technology (LIST)

"My research topic is rainfall interception modelling in forest canopies. I am conducting an experiment at the tower site in Speulderbos that includes micro meteorological measurements and forest structural parameters. I will use the SCOPE model as a tool to study the water and energy balance in combination with field measurements."

César Cisneros, PhD candidate

Remote Sensing of Water Quality

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Ninety-seven percent of the water supply is slate water and 2% is frozen in the ice caps and glaciers, so this leaves only 1% from groundwater, rivers, lakes and reservoirs that is useable for irrigation and drinking purposes. These limited freshwater resources are at risk of pollution from dirt and toxic chemicals, which endanger human life, the aquatic ecosystem and the future of our children.

Managing water quality is a great challenge, simply because there are many contributing factors: the way we use water, practices that threaten water quality, the different pollutants and their sources, and the forcing hydrology. Knowing the processes of these factors that affect the quality of water is not sufficient: it is essential to understand how these factors combine and interact in different regions.

Water quality monitoring of lakes, rivers and coasts is an essential step towards a sustainable management of the ecological and economic services of aquatic ecosystems. At present, the monitoring practices of water managers depend largely on labour-intensive measurements, which provide only limited insight into the spatial and temporal distributions. A synoptic view and frequent coverages are, however, only possible using sensors mounted on earth observing satellites (Figure 1).

The Water Resource Department (WRS) of the Faculty ITC is leading the way in the innovative application of remote sensing for operational water quality monitoring (Figure 2), and offers the only accredited education course on remote sensing of water quality in the Netherlands.

In 2011 ITC secured an NWO project (INPLACE) to understand and quantify the carrying capacity of the Wadden Sea ecosystems in terms of biomass per trophic level. As part of this project, Suhyb Salam at ITC developed remote sensing

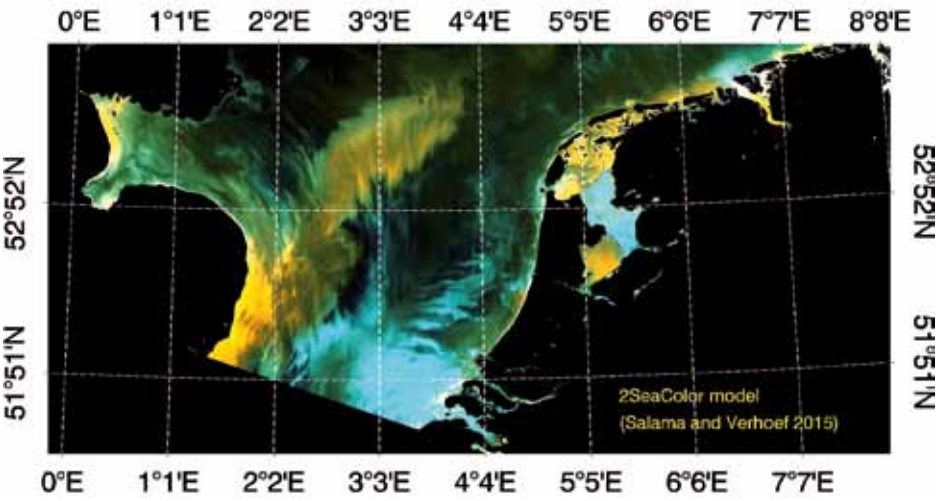

Figure 1 Water quality colour composite computed at ITC from MERIS image acquired on 23 April 2010 (red: suspended sediment, green: algae, blue: dissolved organic matter)

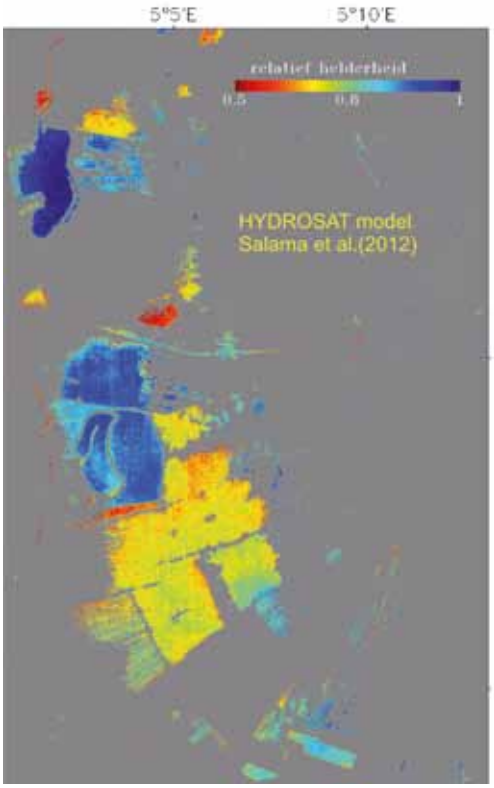

Figure 2 Water clarity relative to water depth computed at ITC from Formosat-2 image acquired on 22 March 2012 above the Loosdrechtse Plassen in the Netherlands

methods to quantify the primary productivity in the Wadden Sea environments at a spatial resolution of 300 m for water and 30 m for mudflats (Figure 3).

The leadership of ITC is demonstrated by the request received by WRS from the Netherlands Space Office (NSO) to set up a road map for the remote sensing of water quality science and application in the Netherlands. Through this prestigious position, WRS will continue to innovate state-of-the-art science from geo-information and earth observation and employ it in creative solutions for water quality management at local, regional and global scales. ■

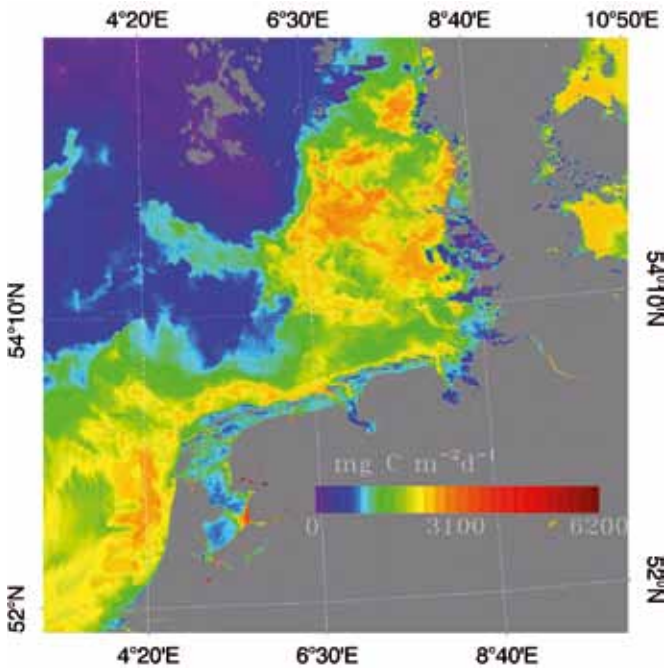

Figure 3 Primary production (the amount of carbon fixed by algae) computed at ITC from MERIS image acquired on 1 May 2011

Can Capturing Global Ecosystem Values Reduce Poverty?

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Chandra Prasad Ghimire c.p.ghimire@utwente.nl

While tropical deforestation continues at alarming rate, some of cleared land is abandoned and replaced by natural regrowth or actively replanted, so that secondary forests are now ubiquitous across the tropics.

Reforestation of degraded land in the tropics is often conducted in the expectation that disturbed streamflow regimes (commonly referred to as the 'too little – too much' syndrome) will be restored by the increased rainfall absorption afforded by soil improvement after tree planting. However, how reforestation of degraded land affects runoff generation mechanisms and streamflow is still poorly understood as most experimental studies have been conducted in non-degraded catchments. Evaporative losses (transpiration and interception) likely increase after reforestation, while infiltration rates are expected to increase and overland flow occurrence to decrease as a result of improved soil hydraulic conductivity with time after reforestation. The net result on groundwater recharge and water yield of these two opposing effects is poorly documented. To investigate this matter further, we first quantify the dominant hydrological processes (rainfall interception, transpiration, runoff generation, rainfall infiltration and percolation) operating under old-growth forest, young secondary forest and a degraded grass land in the high rainfall zone of Eastern Madagascar. Our novel empirical data will further develop and validate a widely used and freely available policy support tool (WaterWorld). Finally, we will investigate the trade-off between changes in vegetation water used and soil infiltration capacity after the reforestation. ■

View of the planted forest and degraded land near the research area in the Eastern Madagascar

Satellite Data for Optimizing Water Level Control in the Netherlands

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The ITC and CTW faculties of the University of Twente have been successful in the STW WATER 2014 programme with their research proposal Optimizing Water Availability Using Sentinel-1 Satellites (OWAS1S). Besides the two faculties of the UT, the consortium consists of Wageningen University and 12 parties from the public and private sectors that have contributed to the project both in kind and in cash.

Soil Moisture from Sentinel-1

The budget will partly be used for the appointment of three doctoral candidates, two at the UT and one at Wageningen University. The doctoral candidates will use a new European satellite, Sentinel-1, to measure with an unprecedented spatial resolution (10 m) the trafficability for agricultural vehicles and the availability of moisture for plants. It will be investigated how water management can be optimized by combining this information with existing models.

Sentinel-1 was launched in April 2014 and is the first operational Synthetic Aperture Radar (SAR) of which its data will be made freely available to the global community. *(Source: www.esa.int/)*

Not Too Wet, Not Too Dry

Dr Rogier van der Velde, one of the researchers in the project: "During the transition from the wet winter to the dry summer, Dutch water managers are confronted with a dilemma: whether to retain water or drain it away. Retention means that land remains wetter, with the result that trafficability is insufficient for performing operations, so the growing season is shortened. On the other hand, starting too early with the draining of water can cause a lack of moisture during the dry summer months, with disastrous consequences for crop growth and agricultural production."

A Sentinel-1 color composite of Enschede taken 8 October 2014 with the VV polarization displayed in Red & Blue and VH polarization in Green. *(Source: European Space Agency)*

Informed Decisions

Water authorities can use the information obtained from satellite data to make informed decisions concerning this annually recurring dilemma. Van der Velde: "This is the first time that the Dutch water sector is supporting research into the use of satellite images to optimize water management in this way." The STW WATER programme is part of Topsector Water's research and innovation agendas. OWAS1S will last for five years. ■

Water levels in the Netherlands are controlled by thousands of weirs and pumping stations *(source: www.dutchwatersector.com/)*

IWRAP: Integrated Water Resources Action Programme for Lake Naivasha

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Since 1997 staff and students of ITC have been studying Lake Naivasha in Kenya. The lake is well known for being the largest rose-producing area in the world. The roses sold at the Albert Heijn supermarkets are produced around the lake.

From 1997 to 2010 Naivasha was a popular MSc research area for students from various educational programmes without external funding. More than 80 students from some 45 different countries researched topics related to water, environment, geology/soils, vegetation, biodiversity, urban and spatial planning, health and economy using a variety of GIS and EO techniques.

In 2009 the research project Earth Observation and Integrated Assessment (EOIA) for the Governance of Lake Naivasha, with five PhD'ers and a PostDoc, was awarded by WOTRO. The formal closing workshop was held in April 2015 in Naivasha.

In 2012 the Netherlands Embassy in Kenya funded the ambitious Integrated Water Resources Action Programme (IWRAP) for Lake Naivasha, to be executed by WWF-Kenya with ITC and two Dutch water authorities as the main partners. The Water Resources Management Authority (WRMA) is one of the main beneficiaries. The project has the following activity areas:

1. Increase capacity and improved governance in WRM institutions
2. Increase knowledge and technical capacity for quantitative water resources management and monitoring
3. Increase water security through participatory forest management and income generation in the catchment
4. Payment for environmental services for the sustainable development of riparian farmland
5. Increase levels of sustainable production and good stewardship in Lake Naivasha basin floriculture
6. Strengthen institutional capacity of Imarisha Naivasha
7. Develop a financial trust to invest in the basin.

ITC has overall responsibility for activity 2, with Deltares as a subcontractor, and collaborates closely with two Dutch water authorities who assist WRMA in activity 1. Jointly with WWF and Imarisha, ITC is also responsible for activity 7.

The essence of ITC input is to assist WRMA to work more efficiently. To achieve this goal ITC concentrates on assisting WRMA in the:

- use of modern monitoring systems such as stand-alone and telemetric loggers for water and weather and the installation of a GeoNetCast receiving station
- development of a web-based open-source water information system (MajiSys), part of a much wider multi-organization environmental information system
- use of mobile platforms to collect data in the field
- implementation of an enterprise resources planning (ERP) system to keep track of all business processes in WRMA, such as accounts, stock keeping and human resources
- modelling of surface, lake and groundwater resources and the use of this in day-to-day water management, water allocation and water permitting.

The WRMA and Imarisha team is strengthened by ITC graduates under the Young Export Programme Water (YEP). Last year a GIP alumnus supported WRMA and Imarisha, and the coming year a WRS alumnus will do likewise.

Whereas IWRAP is basically a project executed by WRS and GIP, the much larger Mau-Mara-Serengeti (MaMaSe) project is truly a cross-departmental exercise, with the involvement of PGM, GIP, NRS and WRS, and focuses on the water management of the pastoral zone of the Mara basin.

The activities in Naivasha have always been intimately linked to research and continue to be so. Furthermore, last year we had ITC and WUR students who carried out their MSc research in Naivasha. Researchers at Lake Naivasha form a solid and well-established group, coming mainly from ITC, Egerton University (Kenya), Leicester University (UK), the University of Bonn (Germany) and the University of Gent (Belgium). WRS has a part-time (50%) university lecturer based at Naivasha to support our research.

The physical, economic and societal dynamics of the basin are such that capacity building of water management institutions and research never becomes dull, and new challenges constantly arise. As far as IWRAP is concerned, we still have two years to go, and capacity building at a governmental organization has its own particular challenges.

In terms of research we have heavily invested in an energy flux tower, allowing detailed environmental response to land use changes. We would like to extend this tower by incorporating more sophisticated sensors to study land use changes in even greater detail. One unique event, be it by accident, has been recorded. The energy fluxes of a bush fire recorded by a scintillometer is unique worldwide!

The ITC Research Award 2014 went to a publication dealing with the integration of various disciplines around the lake. The integration of physical and social sciences using modern approaches such as agent-based modelling, multicriteria spatial analysis and serious games is a field we would like to research within the Naivasha context in the coming year. ■

The lake is well known for being the largest rose-producing area in the world. The roses sold at the Albert Heijn supermarkets are produced around the lake

The activities in Naivasha have always been intimately linked to research and continue to be so

Stimulating Innovation for Global Monitoring of Agriculture (SIGMA)

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Global population is expected to increase to more than 9 billion by 2050. To achieve "food for all" according to UN-FAO, global food production will need to grow by 70% and up to 100% in many developing countries. Sustainable growth of agriculture is therefore imperative, requiring a thorough scientific understanding of the impact of agriculture on the environment.

SIGMA or "Stimulating Innovation for Global Monitoring of Agriculture" is part of an European (EU FP7) research contribution to GEOGLAM and addresses some of the key challenges within global agricultural food production. It intends to reinforce the G20 countries Global Agricultural Monitoring initiative on improving sustainable data for worldwide food security and commodity market transparency. SIGMA will investigate, develop and harmonize methods that make use of satellite data to monitor agricultural crops and their related environmental impacts.

ITC's contribution of this global project is in science data provision and the production and dissemination of advanced learning materials and tools for satellite-based agricultural monitoring and its environmental impacts. It is a joint effort of ITC's Water and Natural Resources Departments.

Global evapotranspiration datasets for agricultural land are being generated, derived from own developed and thoroughly validated algorithms, including ground validation using JECAM or joint experiment for agricultural monitoring sites found over the world. Estimation of the important evapotranspiration component remains one of the most challenging parts of the global water cycle, due to its complex interrelationship with the landscape, weather and climate. (see figure 1)

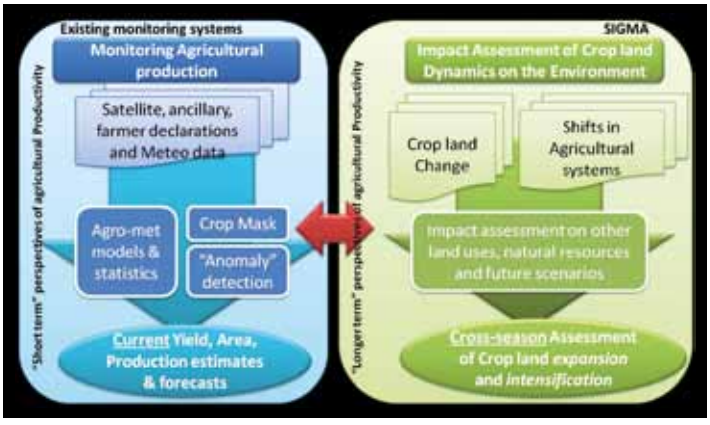

Figure 1

Also here, in Ethiopia, SIGMA works with local partners to increase the early warning capacities of some more fragile countries and developing states in monitoring crop yields and detecting weather and crop growth anomalies at an early stage

Satellite monitoring of crop ET is also an independent measure of agricultural water use and productivity, and the project will contribute valuable information on fresh water consumption by agriculture in important cereal producer nations like Ukraine, Russia, China, African countries, Brazil, Argentina and European Union countries.

In several African countries, food production is entirely weather and climate dependent and food security is a returning annual uncertainty and risk for large groups of people. Also here, SIGMA works with local partners to increase the early warning capacities of some more fragile countries and developing states in monitoring crop yields and detecting weather and crop growth anomalies at an early stage, so food security and relief can be organized timely and local or regional famines avoided.

The e-learning based scientific education materials developed within Sigma are a joint effort of ITC with FAO, the principal UN actor in food and agriculture and other science partners in Russia and China, Austria, Belgium and the Netherlands. ■

Inkomati-Usuthu Catchment Management Agency (IUCMA)

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Two years ago Gabriel Parodi gave a presentation on our education and research for visitors from the Groot Salland Water Authority and a group of South African watermanagers from the Inkomati Catchment Management Authority (now called the Inkomati-Usuthu Catchment Management Agency - IUCMA). This presentation was the beginning of more contacts and exchange with the Groot Salland Water Authority and the South Africans and the kick-start for a large project in South Africa financed by Partners for Water.

The project is led by Hydrologic, an Amersfoort-based Dutch SME which develop ICT-based solutions for water problems, one of their software tools is the HydroNET Water Control Room. The project objectives are to demonstrate the added value of the Water Control Room to the catchment authorities in South-Africa and to train them how HydroNET can be applied for water-related problems and solutions such as drought and flood damage.

It is complex project supported by a large consortium in the Netherlands – with besides the partners mentioned above also with KNMI, E-Leaf and WineJob. At the other end in South Africa beneficiaries are:

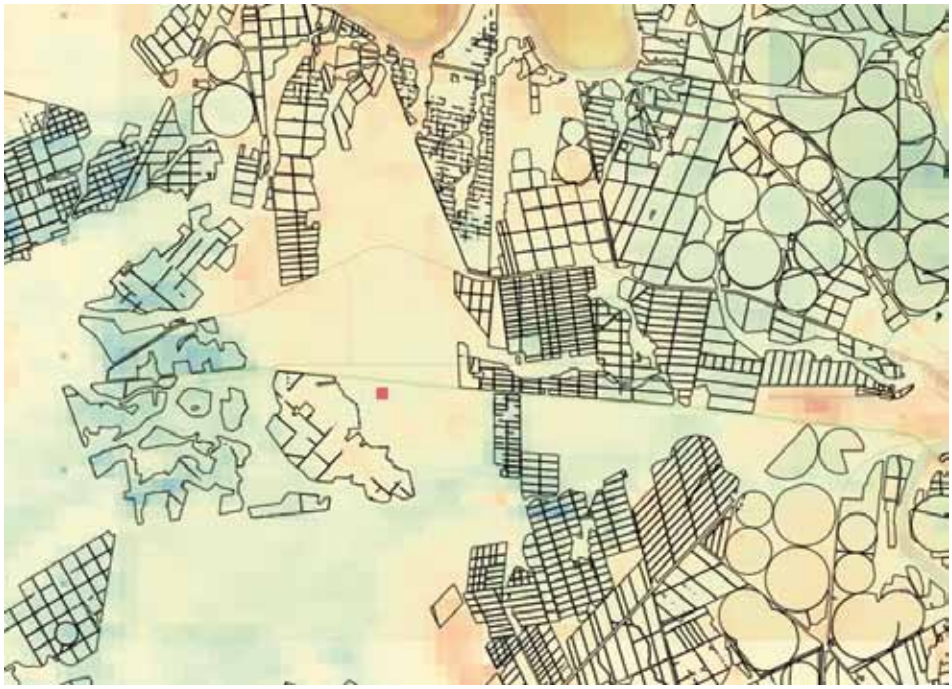
- South African Weather Service (SAWS) responsible for providing all meteorological information in South-Africa.
- Inkomati-Usuthu Catchment Management Agency (IUCMA): the first out of 9 Catchment Management Agencies in South-Africa which will be established the coming years.
- eThekwini Water and Sanitation (EWS): South-Africa's leading and most innovative drinking water utility which works together closely with the Netherlands via the Centre of Expertise.
- The department of Agriculture of Western Cape Government (WCG) and local wine-farmers at the Western Cape.

By giving these beneficiaries access to the HydroNET Water Control Room with tailor made dashboards and applications and by providing training, they can improve their decision making process and make better and smarter use of the limited water resources.

ITCs' role is the establishment of a GEONETCast receiving station at the IUCMA and the development of dedicated applications for the HydroNET Water Control Room based on data from GEONETCast.

In 2014 a GEONETCast receiving station was established at the headquarter of the IUCMA in Nelspruit. ITC staff have visited IUCMA to provide on the job-training on GEONETCast -related operations and EO applications for Water Resource management. The following three data products are developed: 250 meter resolution images of daily actual and potential evapotranspiration(based on MSG (SAF-LSA) and MODIS) and a downscaled Soil Wetness Index map based on ASCAT-data. A plug-in for ILWIS for the down-scaling procedure has been developed. Users of the HydroNET Water Control Room will get access to the training materials related to the above described 'apps'.

It is interesting to see where 'just' a presentation to some interested outsiders can lead to….. ■



Komatipoort Actual Evapotranspiration map, 1 April 2013

Uncertainties of Space-Based Data Sources for Water Resource Assessments

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Nowadays advancements in hydrological and water resource assessments rely on hydro-meteorological and terrain data from various data sources. Some 20 years ago, most data used were from field measurements, although there was wide consensus that *in situ* data were not representative for areas larger than local scale.

With the advent of space technology, much emphasis in water resource management has been on the use of data from remote sensing (read images) and from climate circulation models (read projections). Although there have been major advancements in the delivery and availability of such data to serve multi-objective or multicriteria integrated water resource assessments, exploration and exploitation of their information content remains a major challenge. At many water management organizations it is common to directly use data on the assumption that these data are accurate and at the same time reliable. However, in science and literature there is wider consensus that actually data are not directly applicable, signifying an important challenge to explore the true information that is embedded in images and projections. The follow-up to this challenge is to optimally use the information to improve on water management and hydrological modelling approaches which, as indicated, historically relied on measured *in situ* data only.

Although hydro-climatic information can be obtained from a series of satellite images or projections to represent, for example, rainfall patterns, soil moisture dynamics, snow cover, actual evaporation or even flood extent, this does not necessarily imply that the information embedded in such time series is more representative than processed and/or interpolated data from field observations. Currently (some) consensus has been reached on this aspect, although in certain work fields there is still much debate and unawareness. This is caused partly by overly high expectations concerning (i) advancements in satellite observation techniques and improved retrieval algorithms, and (ii) the fact that estimates from satellites and climate models are available at recurrent or fixed time intervals with coverage over large spatial domains. Actually, these observation characteristics have triggered the high expectations regarding the use of satellite data for water resource management and modelling. Currently much emphasis is on combining different information streams to improve reliability. Here examples include morphed and/or merged products such as CMORPH, TRMM3B42 and MPE rainfall products.

A first step in assessing the accuracy and reliability of satellite data and the data from climate circulation models is to collect ground truth data at selected locations in space and identified instants in time, which should be close to the satellite overpass time. A first impression can be gained by visual inspection, and here reference is made to Figure 1, which shows scatterplots of rainfall data. Clearly daily observations by the satellite do not match well with *in situ*-based counterparts and thus the information content supplied by the images is relatively low. Similar scatterplots can be shown for other rainfall products (e.g. TRMM, MPE, PERSIAN) and signify that hydro-climatic data from satellites require correction in time and space domains to make the data effective. In correcting, much emphasis is on assessing effects on the cumulative distribution of daily rainfall, the occurrence of normal, dry and wet years, the representation of rainfall anomalies, and rainfall volumes that largely affect hydrological catchment behaviour. An example of the application of uncorrected data in a rainfall-runoff model in the Gilgel Abay catchment, Lake Tana basin, Ethiopia, is shown in Figure 2 and indicates pronounced differences in the simulated hydrographs.

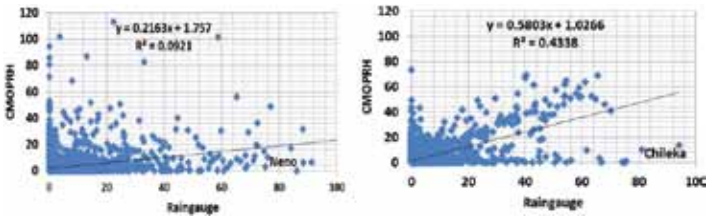

Figure 1 Scatterplots showing relation between Climate Prediction Center morphing technique (CMORPH) and rain gauge daily rainfall estimates for (a) Neno and (b) Chileka stations (Zambezi River basin) *(Habib, Haile and Rientjes, 2014)*

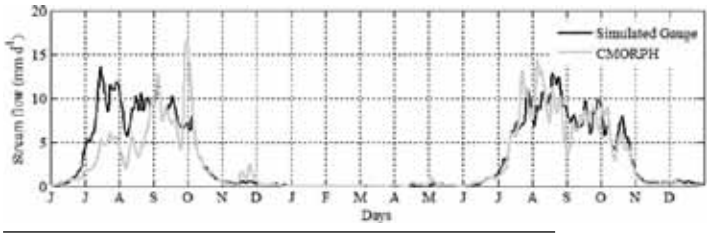

Figure 2 This rainfall-runoff model in the Gilgel Abay catchment, Lake Tana basin, Ethiopia, indicates pronounced differences in the simulated hydrographs

Recent studies for a range of rainfall satellite products indicate similar findings and signify the need to further develop advanced bias correction techniques, improve retrieval algorithms and improve satellite sensors, with the overall aim of improving estimation reliability and accuracy.

Similar to satellite images, reliability and accuracy must also be tested for projections of climatic models. An example is shown in Figure 3, which shows results of climatic projections from eight dynamically downscaled regional climate models (RCMs), made available through the Coordinated Regional Climate Downscaling Experiment (CORDEX-Africa) dataset. Findings indicate pronounced differences and errors (Figure 4) in rainfall amount for all months of the year. This also signifies the need to improve estimates by making RCMs more reliable in their performance at first, and to make estimates more accurate to better match reference data from a base line period before using them as a tool for hydrological impact assessments for future time periods.

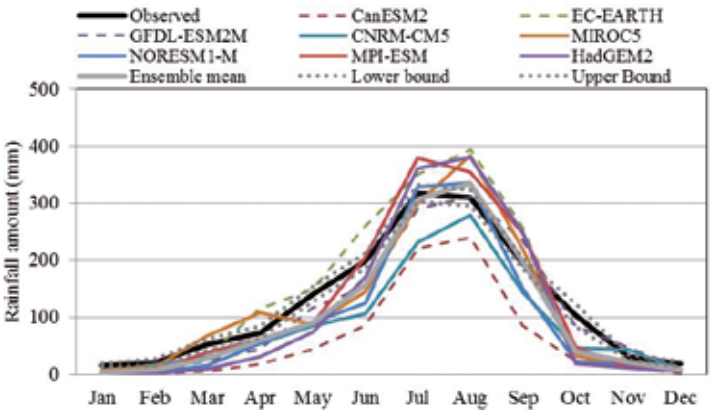

Figure 3 Annual rainfall cycle over the Upper Blue Nile basin from dynamically downscaled climate model simulations and gauged data at monthly base. Note that upper and lower bounds of the confidence interval of the observed mean are also shown. *(Haile and Rientjes, 2015)*

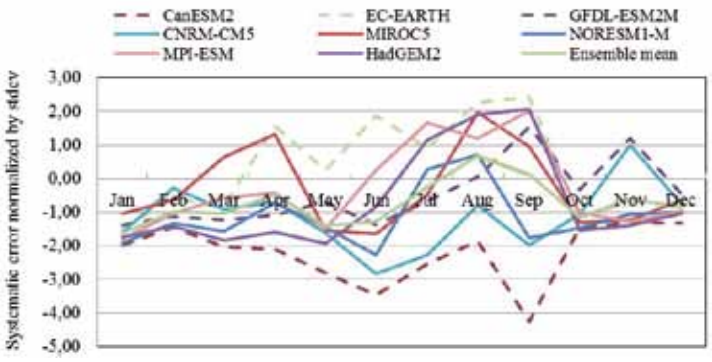

Figure 4 The monthly systematic error of the climate model rainfall data after normalization with the standard deviation of the monthly observed rainfall

An example of a number of gridded network-based products for the Upper Indus basin in the Himalayas is shown in Figure 5. Products tested are state of the art and include the Climate Research Unit (CRU) TS3.1; the Global Precipitation Climatology Centre (GPCC) gridded observation reanalysis product; the APHRODITE dataset; the Global Precipitation Climatology Project merged precipitation-observation product; the ERA-Interim atmospheric reanalysis (1979-2013) product; and the EC-Earth, a GCM (re)forecast from 1950 to the present. Also for the Upper Indus area, differences are shown in precipitation estimates. Although each estimate may be considered "accurate", the differences indicate that products are not always reliable. However, to ascertain which product is most reliable is far from easy.

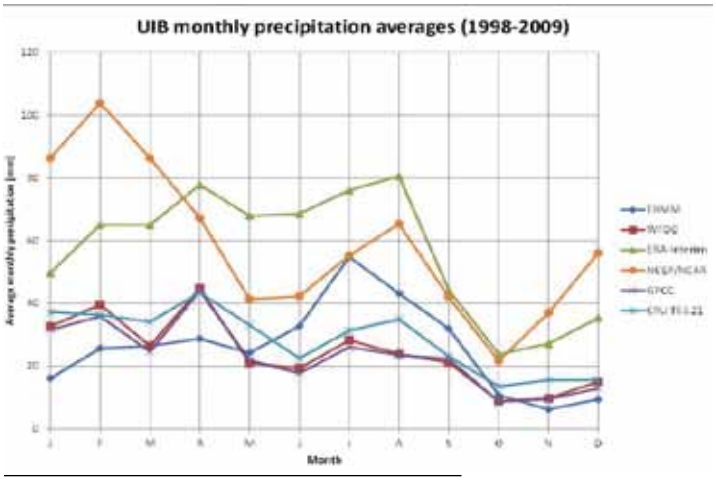

Figure 5 Intercomparison of the climatology of the precipitation products *(Reggiani and Rientjes, 2014)*

In conclusion, there is still great need to improve estimates of hydro-climatological variables by space technology. Although the currently available satellite and climate projection products have largely improved assessments in water resources and hydrology, much effort is still needed to improve the reliability of the products not only through improved sensors, models and satellites (e.g. ESA Sentinels) but also through retrieval algorithms and bias correction techniques. ■

An MSc International Joint Training Programme: An Expansion of the Water Programme in Education

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One of the unique challenges of the ITC MSc programmes in general is to achieve excellence with students from a wide variety of nationalities and cultures, and related but certainly different backgrounds, languages, skills and individual characters. All meet the same day in a class coming from all corners of the world. This requires a unique cast of teachers and methods. Technology helps in achieving excellence, but new ideas and facilities are needed in a world becoming every day more expensive and more demanding.

For years ITC has initiated collaborations with other organizations and Institutes, but the internationalization of education has led to stricter rules concerning qualifications and agreement in the Joint Educational Programmes. Within this framework, the Water department has developed a joint approach that adapts extremely well to the present conditions. A test experience was carried out with the Capital National University (CNU) in Beijing, China.

Present MSc Water Programme at ITC

The MSc Water programme at ITC (WREM) lasts 18 months, divided into modules of three weeks. A module can be seen as a "unit of knowledge" that students with an adequate background might attend. In total there are 15 teaching modules in the programme before reaching the MSc writing period. The structure and content of the programme is crucial for the construction of a suitable Joint MSc Programme.

In brief, the WREM programme consists of:

- three foundational modules on the core business of ITC: remote sensing, GIS and distant data assimilation
- one domain module: remote sensing and GIS in the water world
- four modules on the hydrological process and remote sensors: the water cycle from the Earth and from satellites.
- two specialization modules on water modelling for groundwater, surface water, and environment and water quality
- one common module on research skills
- two modules on advanced topics concerning water and remote sensing
- two modules in support of writing the MSc proposal
- six modules on research and thesis development that culminate in the MSc thesis defence and a degree.

Alternative Joint Programme that Works

We can do many calculations but in the case of the Netherlands study costs can be reduced only if the student stays in the Netherlands as little as possible. How can the same level of excellence be achieved while reducing the time spent under tuition by ITC staff?

The Water department has initiated a programme whereby students stay in the Netherlands for the period required by law to gain the same MSc degree as any regular ITC student, but spend the rest of the time in their own countries – most importantly – supervised by ITC staff and local staff and conducting research into topics of interest to their own countries.

A test was carried out at CNU in Beijing. Gabriel Parodi and Lichun Wang from the Water department were sent to Beijing with the important mission of imparting the same knowledge of the ITC core programme on remote sensing and GIS at CNU. The core component of ITC is carried out for all ITC students with the input of more than 15 staff for three months.

The course adaptation worked effectively. With the effort and commitment of the Chinese counterpart, the course ended in success and the first seven Chinese students taking part in this project are now continuing the regular MSc programme in Water Resources. They are already at ITC and expecting to return to China after the 15 modules for their fieldwork component. A once-in-a-lifetime experience! ■

The first seven students taking part in this joint programme at CNU, Beijing

RESEARCH NEWS

High-Resolution Satellites Monitor Southern Somalia's Charcoal Production

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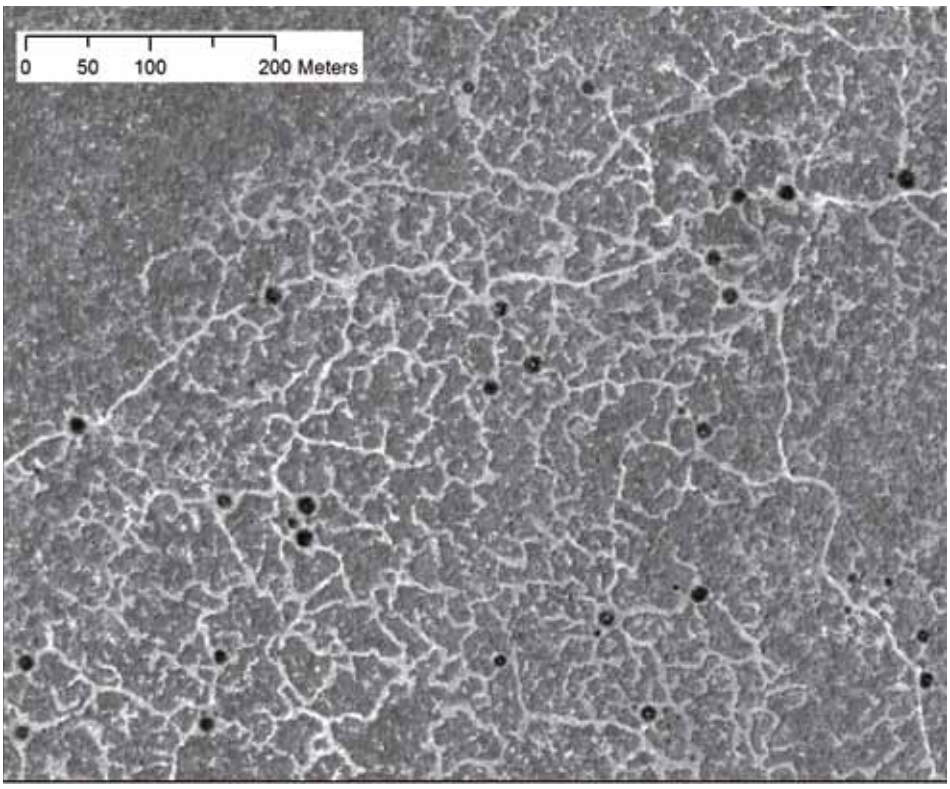
Despite a UN ban on charcoal export from Somalia, large quantities are transported each year to the Arabian Peninsula. Charcoal is a major source of income for the terrorist group Al-Shabaab. The production of this so-called "black gold" is killing many valuable trees and degrading Somalia's environment. However, the Al-Shabaab presence has not allowed anyone to enter their territory in southern Somalia to understand precisely what is happening. In a recently published study by ITC NRM student Michele Bolognesi, for the first time satellites revealed where and when charcoal is produced over a large area.

Charcoal Production in Somalia

In Somalia charcoal is produced in "kilns"; a type of oven. Trees are extracted from the immediate surroundings. The timber of cut trees is piled up, covered with iron sheets, and buried with sand. After the oven burns for up to a week, the sand and sheets are removed. The timber has then turned into charcoal, which is put in bags and transported to harbours on the Indian Ocean. Road block taxation during this transport is an important way in which terrorist groups such as Al Shabaab profit from this trade. At the kiln site, a circular dark scar of burnt soil and small charcoal pieces remains on the ground. And there are a few precious Acacia trees less!

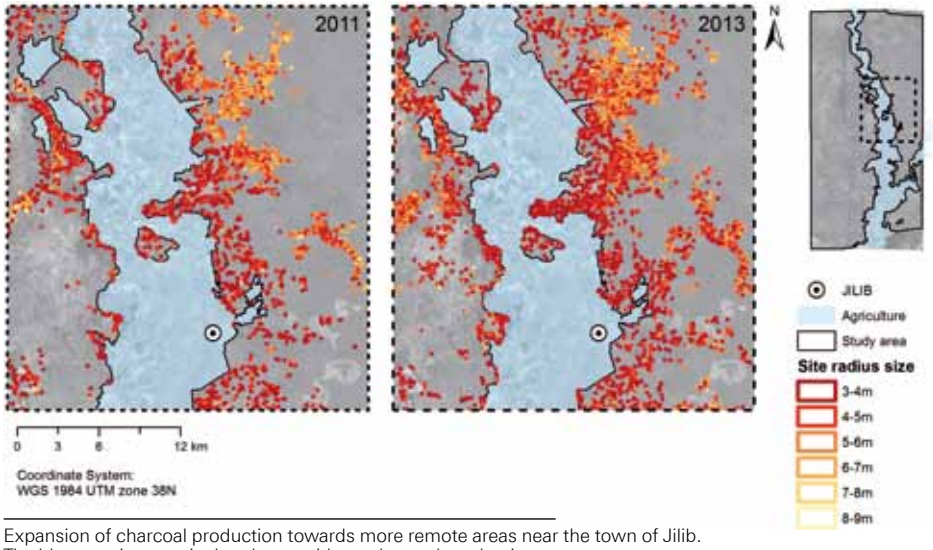
Detecting Charcoal Production with Satellites

These circles can be observed from high-resolution images, such as those obtained from WorldView-1. To facilitate the analysis of large areas, Michele developed a semi-automatic detection method using eCognition software. The method consisted of defining rules that allowed the charcoal production sites (or kiln scars) to be separated from their environment. By setting threshold values on reflection, size, and



Example of charcoal production sites on WorldView-1 imagery of 2011

shape parameters, kiln scars could be accurately identified. Michele then compared images from 2011 and 2013 for a large area (4700 km^2) in southern Somalia, to assess precisely where and how much charcoal was produced. Considering the sites detected exclusively for 2013, an average production of 24,000 tonnes of charcoal and a 2.7% tree loss for the two-year interval were estimated, using literature-based and local-knowledge-based assumptions on likely kiln ranges and tree parameters. Moreover, he found that production is gradually expanding into new areas, increasingly degrading Somalia's environment. This is expected to negatively affect the food security of the local population in an area where drought and conflicts already cause considerable stress. In fact a negative spiral emerges, as charcoal production is one of the very few survival strategies left.



Expansion of charcoal production towards more remote areas near the town of Jilib. The blue area is an agricultural area without charcoal production

Next Steps

This is the first study to assess large-scale charcoal production changes in Somalia. However, a need exists for monitoring charcoal production at national level. This would facilitate greater understanding and monitoring of environmental degradation, and enable an analysis of which other groups potentially profit from the charcoal trade. The increasing availability of high-resolution images makes a national system within reach. Moreover, environmental degradation due to the – mostly illegal and/or unregulated – charcoal trade is not confined to Somalia, so this study may serve as an example for monitoring charcoal production elsewhere. Besides the use of panchromatic WorldView-1 imagery, we also have an interest in exploring whether results can be scaled up for larger areas by considering multi-spectral and multi-temporal data. One example is the upcoming five-day revisit 10m-resolution Sentinel-2 mission of the European Space Agency, which will offer freely accessible data to all.

Additional Information

Michele Bolognesi was an MSc student in the Natural Resource Management Programme at ITC and graduated in March 2014. His MSc project was supervised by Anton Vrieling and Louise van Leeuwen (ITC), and was carried out in close collaboration with FAO-SWALIM (Somalia Water and Land Information Management Project) and the Joint Research Centre in Italy. WorldView-1 imagery was provided by the U.S. Department of State (USDS). Michele is currently based in Mexico, from where he performs GIS and remote sensing consultancy work, including charcoal production site detection in Kenya. This research was recently published in *Energy for Sustainable Development.* ■

For more information e-mail:
mic.bolo@gmail.com (Michele) or
a.vrieling@utwente.nl (Anton)

Preparing a charcoal production site *(photo taken near Mogadishu by Human Relief Foundation (hrf.co.uk))*

Truck transporting bags of charcoal *(photo in northern Somalia, courtesy of Ugo Leonardi)*

ITC Alumnus Receives the IAMG's 2015 Research Award

John Carranza John.carranza@jcu.edu.ac

The Andrei Borisovich Vistelius Research Award is one of the four major awards given by the International Association for Mathematical Geosciences (IAMG). The Andrei Borisovich Vistelius Research Award is given to a young scientist of no more than 35 years of age for promising contributions in research in the application of mathematics or informatics in any field of the earth sciences.

I have known Marshall since I became involved about eight years ago, as one of his supervisors, in his PhD research project, at ITC concerning the use of ontology and vocabulary to address data interoperability issues in various knowledge or scientific domains, such as geology. His good command of mathematics was advantageous in his research project, and he soon demonstrated the ability to illustrate the key concepts of a topic, such as geological time scale. In his PhD work, he worked closely with colleagues in the research projects OneGeology, OneGeology-Europe and INSPIRE on harmonizing earth and environmental data across nations. He took the lead in summarizing the characteristics of data interoperability as discoverability, accessibility, decodability, understandability and usability on the technical side, and legality and ethicality on the social side. His satisfactory performance in scholarship and research is evidenced by his attainment of a doctorate degree and by publications of his research findings, mainly in the IAMG journal *Computers & Geosciences*.

The IAMG presents a healthy environment for the development of Marshall's career as a geoinformatics researcher. Presenting his research outputs at IAMG conferences continuously from 2005 to 2011, Marshall saw a wide platform for addressing the issues of geodata interoperability – the internet. During that period, he also translated into Chinese the book *Geoscience after IT* by Dr T.V. Loudon, one of the founding members of the IAMG. The vision and ideas presented in that book inspired Marshall to make a thorough review of his previous work, and initiated his application to ITC for PhD study.

Marshall has leveraged his scholarly work to a new level since he began his postdoctoral work in the USA. His recent work on the provenance of global change information addresses a crucial need for transparent scientific workflows and credible scientific findings, as global change information becomes both more abundant and increasingly important. Moreover, well-curated provenance information also facilitates informed and rational policy and decision making. His work on ontology for provenance documentation was used by the Global Change Information System in the U.S. Global Change Research Program to enable provenance tracing of the Third National Climate Assessment report. The work was published in high-level journals, namely *Nature Climate Change* and *Environmental Modelling and Software*.

Marshall's work in the ongoing 10-year 5M US$ global environmental reconnaissance research project the Deep Carbon Observatory (DCO) created a cyber-enabled platform for linked science, providing a virtual observatory for more than 1000 earth scientists around the world.

Marshall's current work highlights the topic semantic eScience, which addresses the gap between Semantic Web researchers and general science researchers (e.g. earth sciences). The former have largely focused on formal semantic representation languages and/or general-purpose applications, with inadequate consideration of specific scientific areas. The latter, though increasingly dependent on the Web, have no coherent agenda to explore the potential advantages that Semantic Web technologies enable. Semantic eScience is to foster the growth and development of data-intensive scientific applications based on Semantic Web methodologies and technologies, as well as related knowledge-based approaches. In this field, an essential task is to develop a robust semantic eScience framework. While Marshall's work is focused on topics in geosciences, outputs of the semantic eScience research will provide approaches to deal with the data deluge in different scientific areas and will offer insights on how to better conduct data-intensive researches in a digitally enhanced environment.

WHO WAS ANDREI BORISOVICH VISTELIUS?

He was was born on 7 December 1915 in Petrograd, which was later named Leningrad and is now Saint Petersburg. He graduated as a mineralogist from the University of Leningrad in 1939 and continued there until defending his thesis in geology and mineralogy in 1942. At 32, an early age by Soviet standards, the Moscow Institute of Petroleum awarded him a DSc degree in geology. From 1942 to 1946, he was senior petrologist for the All-Union Petroleum Institute, and from 1946 to 1950, he was director of the Branch of Operating Methods of the same institute. He served as director of the Laboratory of Mining and Geology of the All-Union Salt Institute from 1950 to 1952. From 1952 to 1961, he was senior scientist at the Laboratory of Aerial Methods of the Academy of Sciences of the USSR. From 1961 until his death, he was the director of the Group of Mathematical Geology, and later of the Laboratory of Mathematical Geology in Leningrad, both under the aegis of the Order of Lenin V. A. Steklov Mathematical Institute of the Academy of Sciences of the USSR. He was a prolific scientist and virtually all geological subjects attracted his interest, which involved the introduction of mathematical and stochastic methods to handle geological problems.

Marshall has not only shown that he is enthusiastic and diligent in learning and exploring new things, but has also demonstrated his ability to be a vibrant team player – a quality that is essential to achieve success in research. He has also demonstrated leadership qualities.

From the perspective of developments in quantitative geology, my views on Marshall's accomplishments are as follows. Daniel Merriam (one of the past presidents of IAMG) proposed four stages in the developments of quantitative geology: (i) Formative (1833-1895), (ii) Exploration (1895 – 1941), (iii) Development (1941-1958), and (iv) Automated (1958 to present). Andrei Vistelius championed and pioneered mathematical geology during the Development stage to the Automated stage (Information age). The latter stage started when Christian Krumbein and Larry Sloss introduced the use of computers to process geological data and formulate geological concepts. During those stages, developments in quantitative geology in general in the East and West went along independently and partly in parallel in response to developments in science. In addition to these four stages, we are now in the Intelligent stage (2000? to present) whereby data are transformed into information and then into knowledge. Marshall's work follows a somewhat reverse direction to answer the question: What can we do to use knowledge obtained from data to facilitate future data processing, especially if we encode knowledge in a machine-readable format and use it in the context of the Web of Data? Even though we have the internet, the Web and the Big Data, we also have problems with data interoperability. Although we may not be able to achieve consensus on every topic under research, we can leverage the facilities to promote interoperability among datasets as well between researchers' work. Marshall's work on geoscience ontology and vocabulary faces the Web and addresses data interoperability issues on a global level, and he is committed to reshaping the Web from a Web of Documents into a Web of Data. With Marshall's contributions to developments in the present Intelligent stage, the history of independent/parallel developments in quantitative geology between the East and the West prior the 1990s is unlikely to repeat itself.

Phd defence of Marshall Ma at the University of Twente, November 2011

Marshall's excellent academic records and community service make him one of the leading early-career research professionals in geoinformatics and data science. Seeing his promising contributions to the application of informatics and mathematics in earth sciences, and seeing his companionship with the geoinformatics and geomathematics communities, it was a profound pleasure and honour for me to nominate him for the Andrei Borisovich Vistelius Award of IAMG for the year 2015. ■

On 30 March 2015, Marshall was informed by Qiuming Cheng (also a Vistelius awardee, and current president of IAMG) that he is the 25th Andrei Borisovich Vistelius Research awardee. As the current Vistelius awardee, Marshall will be a keynote speaker at the next IAMG conference, to be held in Freiberg, Germany, from 5 to 13 September 2015, at which time he will be presented with the award, which includes an engraved plaque bearing his name.

CONGRATULATIONS MARSHALL! KEEP UP THE GOOD WORK.

Marshall was nominated by John Carranza, Associate Professor of James Cook University (Townsville campus, Australia) who is also an ITC alumnus (1989–1990, 1993–1994, 1997–2002) and former staff member (2001–2012)

Wildlife Counting for First Time by Satellite

Zheng Yang john.young1989@gmail.com

My name is Zheng Yang and I studied at ITC from 2010 to 2012 for my MSc degree. My research topic was spotting and counting wildlife from space. Now I am doing a research project on unmanned aerial vehicles (UAVs) at the University of Bristol, UK, for my PhD. The study I conducted at ITC not only made a meaningful contribution to wildlife conservation and sharpened my skills, but has also greatly enhanced my current PhD project.

Although knowledge of population dynamics is vital for managing and conserving wildlife, population survey of wildlife has always posed a great challenge for researchers. Traditional methods of counting wild animals, such as aerial survey or ground counts, not only disturb animals but can also be labour-intensive and costly. This is especially the case when it comes to large open areas with an abundance of wildlife resources – for example, the Masai Mara National Reserve, Kenya, where more than 1 million wildebeest and zebra migrate across approximately 1000 miles every year.

So how can this situation be improved with the help of the latest remote sensing technology? By using satellite scenes! New, commercially available Geoeye-1 satellite images push the limits of spatial resolution to an unprecedented level of 50 cm, which offers great potential for spotting medium- to large-sized wildlife such as wildebeest and zebra. I was thrilled to bits when Dr Tiejun Wang, my supervisor at ITC, proposed the possibility of conducting such a study. I vividly remember the poster he presented on MSc Day 2011.

But how? It is the very first time such an attempt has been made and only a very limited number of studies could be referred to in the area of automated wildlife census. Moreover, processing such high-resolution satellite imagery is a real challenge because of the unprecedented complexity of the background, along with the very high spatial resolution. Thanks to my supervisors and colleagues, who are experts in wildlife conservation, I was able to establish the link between the animals in the real world and the objects in the images. In the meantime, finding a solution to image processing seemed feasible after learning a new approach: object-based image analysis instead of traditional methods relying purely on pixels. This solved the issue of background complexity as well as enabling the incorporation of expert knowledge. I would say that it would have been almost impossible to accomplish this study without such strong resources at ITC.

The results of the study show for the first time that it is feasible to directly spot and count large wild animals on an individual basis in an open savannah environment from space. This approach can be used to provide an estimate of the total number of animals, irrespective of species. This is useful information in a system such as the Mara-Serengeti ecosystems, where wildebeest and zebra congregate in such high densities and where it is difficult to estimate their numbers reliably from sampling approaches made on the ground or from the air. It therefore provides a complementary and alternative approach to the conventional wildlife survey techniques.

The ecological significance of this study indicates that technical development in remote sensing can greatly promote current methods of conservation. Furthermore, it also suggests the necessity of improving the utilization of fast-developing technology and the rapidly increasing data resources accompanying it. This will require not only great efforts in technology development such as data mining, but more importantly seamless connection with expert knowledge of the specific areas. ■

PROJECT NEWS

What is the Benefit of Protected European Areas for Reptiles and Amphibians?

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In a new project at the University of Twente, researchers of the Faculty ITC will contribute to a project where the benefit of European protected areas to a large array of species will be analysed. Within the European Union, the Natura 2000 network constitutes a pan-European network of protected areas which are designated to protect specific species or ecosystems that are considered of importance. However, probably many more species benefit than only those few specifically targeted.

In the new project for five species groups (Reptiles & Amphibians, Birds, Mammals, Butterflies and Plants), the relevance of Natura 2000 protection will be assessed. This will be done by analysing the overlay between species presence and the extent of the Natura 2000 areas across Europe. Natura 2000 areas cover almost 20% of the land surface of the 28 EU member states. They already make a major contribution to the economy of Europe by providing a vital range of goods and (ecosystem) services that contribute to jobs and human wellbeing.

The research will be conducted by researchers from the Department of Natural Resources (NRS), Dr Bert Toxopeus, Dr Kees de Bie and Dr Thomas Groen. Groen: "Biodiversity in Europe is decreasing, so sustainable protection of flora and fauna is needed. Through the Natura 2000 areas, Europe is aiming at the sustainable and enduring protection of nature, and intends to prevent nature in Europe from becoming uniform. Although a large number of species are specifically targeted for protection, we want to find out whether Natura 2000 areas also benefit other species. Staff from ITC will look specifically at what the benefit will be for reptiles and amphibians."

Modelling and remote sensing play an important role in this analysis. Toxopeus: "We will apply species distribution models (SDMs) to make maps of where species are expected to occur. For such models, satellite imagery of vegetation greenness (NDVI) can be a major input." This work is part of a bigger project which is financed by the European Commission. Alterra of Wageningen University has the lead in this consortium and, with partners from the Netherlands, Italy and the UK, will look at how many species in Europe are protected by the Natura 2000 network. The Alterra-led partnership will carry out its research over the coming year, and it is expected that the results will have a wider influence in relation to a broad review that is presently being carried out by the European Commission to establish the "fitness for purpose" of current European nature legislation. The project partners are the Faculty of Geo-information Science and Earth Observation, University of Twente (ITC-UT); the Dutch Butterfly Conservation organization (De Vlinderstichting); Sovon (the Dutch Centre for Field Ornithology); the British Trust for Ornithology (BTO); and the Italian Institute for Applied Ecology (Istituto di Ecologia Applicata (IEA) – Sapienza), University of Rome. ■

ANNOUNCEMENTS

ITC Master's Top-Quality Programme

Keuzegids Master 2015

Kim Hovestad newsmagazine-itc@utwente.nl

ITC's MSc Geo-Information Science and Earth Observation can proudly bear the "Top-class programme" quality seal for a year.

Technical Medicine and Geo-Information Science and Earth Observation are the two University of Twente master's programmes that came out best in the *Keuzegids Masters 2015* (Master's Selection Guide 2015) published on Wednesday 25 March 2015.

All university master's programmes in the Netherlands are compared with one another in the *Keuzegids Masters 2015*. Programmes are awarded scores between 20 and 100 and, if they score 76 or more, they are awarded the designation '"top-class programme". Geo-Information Science and Earth Observation scored 80 points. Technical Medicine, which obtained the top-class seal last year as well, scored 78 points.

Keuzegids Masters 2015

The *Keuzegids Masters 2015* seeks to give prospective master's students a clear overview of the quality of the different master's programmes, as it considers all officially registered master's programmes of universities and universities of applied sciences (approximately 1250 in total). After the programmes have been categorized in different disciplines, they are compared with regard to content. In most cases, a quality assessment is also given based on student judgements and the assessment of the Accreditation Organisation of the Netherlands and Flanders (NVAO). Of the 750 master's programmes assessed, 82 received the designation "Top-class programme" and can be identified in the guide by the symbols ++ or +++. ■

Board of Governors congratulated ITC with this achievement and treated all ITC students and staff to specially made cake.

Prestigious Chinese Award for Niek Rengers

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The People's Republic of China has given its 2014 International Science and Technology Cooperation Award to Dr Niek Rengers (former vice-rector of ITC). This is the highest prize for foreign individuals or organizations in the field of science and technology, and honours the significant contributions Dr Rengers has made to China's social and economic development. The prize was awarded by President Xi Jinping and Prime Minister Li Keqiang in a solemn ceremony held in the Great Hall of the People in Beijing on 9 January 2015.

Dr Niek Rengers, an expert in engineering geology and geo-disaster risk assessment and management, is a retired associate professor of ITC (University of Twente) and Delft University of Technology, the Netherlands. He is also former vice-rector of the International Institute for Aerospace Survey and Earth Sciences (ITC) and past president of the International Association of Engineering Geology and the Environment (IAEG), and was a board member of the Federation of International Geo-engineering Societies. In addition he has served as an editorial board member for several international journals. He has published a large number of research papers and has authored/co-authored and edited/co-edited several books and congress proceedings.

Invited by the State Key Laboratory of Geo-hazard Prevention (SKLGP) in Chengdu and the Institute of Geology of the Academy of Sciences in Beijing, Dr Rengers embarked on the collaboration with Chinese scientists in 2006. With his theoretical background and field experience in Europe and Latin America, he helped China to establish contacts with ITC scientists to develop a geological disaster risk assessment and management system that produces huge mitigation benefits. This cooperation has been profitable for a large number of talented young Chinese students, more than ten young teachers, and 20 master and PhD students. With his support, the secretariat of the IAEG was transferred to China. This has greatly enhanced the Chinese influence and position in the field of engineering geology in the international academic community. ■

THE PRIZE

The International Scientific and Technological Cooperation Award of the People's Republic of China is a national science and technology award established by the Chinese government. It is given to foreign scientists, engineers, experts or organizations that have made important contributions to China's development through bilateral or multilateral scientific and technological cooperation. This year eight international scientists were awarded this prestigious prize.

Dr Niek Rengers, his three daughters and Professor Huang Runqiu (director of the SKLGP in Chengdu) after the award ceremony in the Great Hall of the People in Beijing

The 2014 award winners with accompanying family members, Chinese government officials, and representatives of the embassies of their home countries in China

ITC Alumnus Appointed Executive Director RECTAS (Nigeria)

Jorien Terlouw newsmagazine-itc@utwente.nl

We are proud to inform you that once again an ITC alumnus has been appointed executive director of the Regional Centre for Training in Aerospace Surveys (RECTAS). Dr Adewale Akingbade graduated from Faculty ITC (University of Twente) in 2012 and was formerly head of the Department of Cartography at RECTAS. Dr Akingbade has now been appointed executive director of the Centre.

Dr Akingbade embarked on his ITC career in 1994, when he participated in the Professional Master programme in Cartography. Some years later he returned to the faculty to pursue his MSc in Geo-Information Management (2005), after which he completed his PhD research (2012). His thesis entitled *E-Land Administration in the Context of E-Governance in Africa: An Evaluation of Nigeria's Abuja Geographic Information Systems (AGIS)* fell under the research theme People, Land and Urban Systems (PLUS) of the Department of Urban and Regional Planning and Geo-Information Management.

RECTAS was established in 1972 under the auspices of the United Nations Economic Commission for Africa (UNECA) as an educational "one-stop" solution institution that trains highly skilled manpower in the science and technology of geospatial information. Since 1991 four ITC alumni have had the honour to be executive director of this Centre consecutively. The alumni who preceded Dr Akingbade are Mr Julius Ogunlami (1991-2000), Dr Olajide Kufoniyi (2000-2008) and Dr Isi Ikhuoria (2008-2015).

On behalf of the directorate and the entire ITC network we congratulate Dr Akingbade on this achievement and we wish him good luck in leading RECTAS this term. ■

Farewell to Professor Martien Molenaar

Jorien Terlouw newsmagazine-itc@utwente.nl

Although he officially retired from ITC on 1 April 2014, it was not until 12 February this year that Professor Martien Molenaar delivered his valedictory address and took leave of his colleagues in the relaxed atmosphere of the following reception. Plans may be laid, but sometimes circumstances dictate otherwise.

As Professor Molenaar looked back over nearly five decades in a field now defined as Geo-information Sciences, it became apparent to his listeners how his long and illustrious career had been intertwined with a period of amazing technological advancement – a period that is still in progress. He enrolled as a student of land survey/geodesy in Delft at the end of the '60s, a turbulent time of student revolts. The world was changing … although GPS had yet to materialize and good strong boots still topped the list of essential equipment as students took to the field to chart topography. What's more, survey and photogrammetric instruments enjoyed a lengthy life span. In those days an investment horizon of 20 years seemed perfectly reasonable; nowadays it's more likely to be two or three years!

After completing his studies, Delft remained his base for several years but in 1973 Professor Molenaar took up a post at ITC for the first time. Computer technology was in the ascendant, making a consider-

Prof Molenaar on the day of his farewell reception with his wife, children and grandchildren

Rector Magnificus Ed Brinsma thanks Prof Molenaar for all his years of dedication to ITC. The statue is a boat on which Prof Molenaar can drift away from the University into a new life.

Prof Molenaar and Mr Beerens, former ITC directorate once more on a picture together.

On 17 December 2009, during the ceremony held to mark the 59th Dies Natalis of the Institute, Professor Molenaar and Dr Anne Flierman of the UT Executive Board signed the Deed of Conveyance whereby on 1 January 2010 ITC would become the sixth faculty of the University. At the same ceremony he stepped down as rector, having served in that capacity for nine years – a steady hand on the wheel at a time of radical change.

able impact in all disciplines, and remote sensing images from satellites were also becoming available. Research was thriving, stimulated by curiosity, energy and enthusiasm. The pressure to publish was less than it is today, so many results did not find their way into journals. In 1983 he was appointed professor of Land Survey and Teledetection at Wageningen University. Interest in the use of spatial information was rapidly gaining ground, which coincided with the arrival of GIS on the scene. Leaving ITC for Wageningen as a geodesist, he returned 13 years later as a convinced geo-informaticus.

Geo-information and Earth Observation was now the domain, but it was chiefly ITC's mission and its students that drew Professor Molenaar back to the Institute. And after four years a fresh challenge beckoned: he was invited to become rector. Direct involvement in research now made way for plans to equip the Institute for a future characterized by further technological development, yes, but also by the internationalization of education, the growing importance of social context, and new relations between government, civil and private sectors.

A surprising but warmly applauded addition to the programme of that day came when Mr Peter den Oudsten, mayor of Enschede, on behalf of Queen Beatrix of the Netherlands, presented Professor Molenaar with the medal of the Order of Orange-Nassau in recognition of the important role he had played in education, research, and national and international scientific cooperation.

A distinguished career indeed! ■

Greetings from…

NAME:

Run4WWF team

JOB DESCRIPTION::

The most International student team ever participated in the annual Batavierenrace.

ACTIVITIES:

We have 23 different nationalities in the team of 25 runners and six supporters, mostly students. Together with three dedicated drivers, they will enjoy the extraordinary atmosphere of this crazy event. This year the ITC Run4fun team will run to raise awareness and money for the protection of nature and will team up with WWF to raise funds for endangered species.

Bamboo shirts and more than 1000 euro

The ITC's Run4fun team collected over a thousand euros in the Batavierenrace. This run is Europe's largest relay race over 175 km divided in 25 stages connecting the University of Nijmegen and the University of Twente. All stages and runners were linked to endangered species urgently needing attention and protection. The environmentally-friendly shirts from bamboo, provided by WWF-Netherlands, motivated the runners in the "Bata" to go extra fast. Sponsors in and outside ITC donated money via the website: www.justgiving.nl/nl/itc-4-wwf and managed to go over the target of thousand euro.

The Team

Trainers Wan and Simon managed during the weeks before to prepare the runners well and get them in shape for the race. It never happened before that ITC's running team consisted almost fully out of students. Only two staff members had to be added to complete the number of 25 runners in the team. Important to the team were also the ten supporters. They had the responsible tasks of driving the busses, accompanying the runners on bike and screaming the runners over the finish line.

The race

It was Friday evening 24 April when the first runners travelled to Nijmegen for the start and the night stages. All nocturnal runners and animals were awake. One of the night runners explained "I was just following a red bicycle light. I was totally lost in the forest. But it was great". At 4.30 a.m., the morning team left the ITC hotel to take over the running at the restart in Ulft. They conquered the drizzling rain when the "afternoon team" took over for the stages between Barchem and Enschede centre.

The finish

The last stage was covered by both a female and a male runner. Finishing on campus is always something special. This year the runners had to deal with a surprisingly heavy rain shower just 5 minutes before arrival at the finish. The spectators witnessed the conversion of the running lane on campus into a mud pond. But somehow that seemed only to increase the fun. Especially when a giant panda splashed through the water to the finish line. Next time we will provide swimming lessons!

UNIVERSITY OF GLOBAL PIONEERS.

IN A GLOBALISING WORLD, WHAT BETTER PLACE TO KICK-START YOUR CAREER THAN A UNIVERSITY WHOSE CORE BUSINESS IS TO CROSS BOUNDARIES? OUR VERY REASON FOR EXISTING IS TO ENGAGE IN GROUNDBREAKING RESEARCH, CHART NEW ACADEMIC TERRITORY AND CONSTRUCT MULTI-DISCIPLINARY ANSWERS TO THE CHALLENGES OF TOMORROW. AS A RESEARCH UNIVERSITY WITH A STRONG FOCUS ON THE DEVELOPMENT OF TECHNOLOGY AND ITS IMPACT ON PEOPLE AND SOCIETY, WE ATTRACT AMBITIOUS, ENTERPRISING STUDENTS FROM AROUND THE WORLD. OUR HANDS-ON ATTITUDE, ALONG WITH OUR UNRIVALLED NETWORK OF INTERNATIONAL BUSINESSES AND INSTITUTES, MAKES US EUROPE'S MOST ENTERPRISING UNIVERSITY. AT OUR PARK-LIKE CAMPUS, WE OFFER A COMPREHENSIVE ARRAY OF ENGLISH COURSES IN THE FIELD OF TECHNOLOGY AND BEHAVIOURAL AND SOCIAL SCIENCES. HEADING OUT INTO THE WORLD? START HERE.

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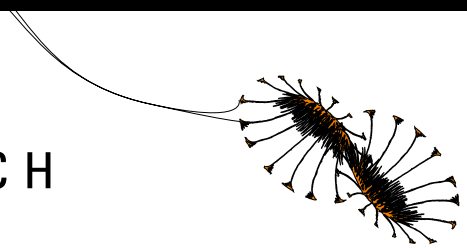

HIGH TECH HUMAN TOUCH

UNIVERSITY OF TWENTE.

ITC