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

ISUE 2017-4

EENSAT



EDUCATIONAL DEVELOPMENTS



LANDSLIDES IN DOMINICA



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ITC NEWS



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The EENSAT program is a network cooperation program between three Ethiopian universities. The cooperation is centered around support to the agricultural transformation agenda of the Ethiopian Government making use of geographic information management and earth observation.



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Much of this edition of ITC News focuses on Sub-Saharan Africa. We cover an inspiring four-year programme to tackle societal problems by making smart use of spatial data under a new agreement with the Ethiopian Minister of Education. GIS and UAVs are among the technologies being used. From Nigeria we bring news of a five-day training workshop on recent trends in land administration, in which the School for Land Administration Studies of the University of Twente took part. From Rwanda we have a fascinating account by ITC alumnus Dominique Mvunabandi of the work of his company Severe Weather Consult Ltd, which harnesses the power of ICT to benefit society as a whole. The issue of land rights is addressed from the perspective of its4land, a European Commission Horizon 2020 project that aims to develop innovative tools for land administration and cadastral intelligence. The project brings together eight consortium partners working with stakeholders in Ethiopia, Kenya and Rwanda.

In the Caribbean, meanwhile, the scale of the devastation wrought by Hurricane Maria on the island of Dominica last September is brought home vividly in Cees J. van Westen's and Jiangiang Zhang's article on the large-scale landslide inventory carried out by a team from the University of Twente. From Athens, Greece, Mariana Belgiu reports on a short course devoted to cropland mapping using satellite image time series

DIPPER, a spin-off company from the University of Twente, features in our article on the use of Lidar data to produce high-quality 3D maps. The company's self-developed software marks a breakthrough, enabling data to be processed at ten times the normal speed.

With regard to academic achievement, the latest edition of the ARWU Shanghai Ranking of World Universities confirms the high regard for the work of the Faculty of Geo-Information and Earth Observation, with news that ITC ranks sixth in the field of Remote Sensing.

We also unveil some major changes to ITC's programmes during the next academic year, when we are due to launch our renewed Master's in Geo-Information Science and Earth Observation and a new Master's in Spatial Engineering.

We take a moment to salute the appointment of ITC alumnus Amon Murwira as Zimbabwe's Minister of Higher Education, Science and Technology Development. We are proud to say that Amon is the fifth ITC alumnus to attain government office.

We hope you enjoy this issue of ITC News and feel inspired by the social good achieved through the use of geo-information - and by the work of ITC and its alumni around the world.

Virtually yours,

Jorien Terlouw Editor

V A N FEATURES

Reinforcement of Geo-Information Knowledge Network in Ethiopia

Ethiopian Educational Network to Support Agricultural Transformation (EENSAT)

Chiel Stroeven

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By making smart use of spatial data during the development of new policy, Ethiopia can more effectively tackle the societal problems it faces, such as food security, water management and climate change. However, this requires a reinforcement of the knowledge network. To achieve that goal, the Faculty of Geo-Information Science and Earth Observation (ITC) at the University of Twente in the Netherlands will collaborate with Ethiopian partners in the next few years.



In October 2017, ITC signed an agreement with the Ethiopian Minister of Education and the universities of Bahir Dar, Addis Ababa and Mekelle. The fouryear programme is primarily being funded by the Dutch organisation for internationalisation in education (Nuffic),



EENSAT research area

elements will be quality as well as the skills required in the job market.

through its Innovative Capacity Building programme, ITC and the Ethiopian Ministry of Education. The programme is in line with the Ethiopian government's Growth and Transformation Plan (GTP) and the Multi-Annual Strategic Plan of the Dutch Embassy in Ethiopia.

The themes of food security, water management and climate change were selected, as they are extremely complex and closely related issues that constitute major modern-day challenges for Ethiopia. The use of spatial data can make an important contribution to coping with these issues. These topics serve as the primary point of departure for the activities within the network, but attention is also being paid to other relevant matters such as spatial issues with regard to land ownership and risk management in the field of disaster relief.

The goal of the programme is to boost Ethiopia's ability to capitalise on spatial data when planning and monitoring local and regional development. This is done by incorporating technology such as Geographical Information Systems (GIS) and earth observation and more innovative applications using UAVs (unmanned aerial vehicles or drones), mobile technology and crowdsourcing. The programme consists of three domains: education, research and outreach.

Education

In the education domain support is provided to enhance the level of relevant curricula through the introduction of the latest knowledge, techniques and practices. Attention is devoted to curriculum review, improved governance and management of education, and the system of quality assurance. Other elements to be introduced are distance-based education and blended training. All are supported by appropriate IT infrastructure and audio-video recording capabilities to enhance the quality of the training materials and for other outreach purposes. Additional staff development activities are planned for new elements within curricula. Also, support to maintain the infrastructure is incorporated in the project design. During the curricula review process, the guiding

Technical and Vocational Education and Training institutes (TVETs) are supported through a cascade approach to enhance the quality of the technical and vocational education and training. Educational materials developed within the project for higher education will be redesigned to support and enhance the quality of instructors at the TVET institutions affiliated with the university partners. Support can be provided on site, through distance education, but also through other means of outreach and networking. Each partner university has selected a TVET and typical departments at TVETs to be supported are the Natural Resources Management, Surveying and Land Administration departments. The requirements, e.g. for natural resource management at TVET level, should go beyond the more traditional water engineering and should include forestry management, land use planning and techniques such as GIS.

Research

To strengthen the research capacity, a coherent research programme is under development which is addressing the needs of the three partners, is in line with the GTP objectives and has a number of PhDs, MScs and (co-)supervisors working together and supporting each other. The three universities are geographically spread across the area and each partner has its own re-



HAROLD BORKENT, ITC

"For the newly designed Geo-Information Courses in Ethiopia, ITC is helping to set up classroom facilities at each university. The classrooms will be equipped with state-of-the-art equipment and infrastructure that will support the students' activities during their studies, in both classroom and distance education. Video recording facilities will also be introduced to support Distance Education trainings."



JULIA LEVENTI, ITC

"The education-related part of EENSAT refers to a proposed constructive educational approach to quality education in Ethiopia. The universities of Addis Ababa, Bahir Dar and Mekelle, in cooperation with ITC, will revise existing curricula and redesign their Geo-information courses, to align them more closely with the demands of a changing job

market. We envisage that by the end of the project, the Ethiopian partners will have the capacity to deliver the redesigned Geo-information courses, via face-to-face and distance education programmes, at both university and technical and vocational training knowledge levels."

search mandate related to the neighbouring geography. This posed a challenge in terms of identifying a common study area and three watersheds were therefore selected as research locations (upper Beshilo, Tana and Tekeze catchments). Each partner university will have its main activities in the nearest watershed and validation studies will be conducted in the others.

Quantitative and qualitative applied MSc and PhD studies will be conducted in the fields of agriculture, sustainable natural resource management, food security, surveying, geo-information technology and natural and computational sciences, which are all relevant to the demands of the labour market. Instrumentation such as automated weather stations will be installed to quantita-







ANDY NELSON, ITC

"A coherent research programme is being developed by the three partner universities with the support of ITC. It is based on applied geo-information science that contributes to the aims of the Growth and Transformation Plan (GTP). EENSAT will support PhD and MSc students working in a common geography across the Tezeke, Tana and Beshilo basins on

research topics related to food security, water resources, climate change, disaster management and land administration."

tively analyse the water and energy cycles as well as equipment to analyse plant spectral response(s). This will be supported by low-cost ground reception stations to acquire near real-time satellite-based observations and derived products that are relevant to atmosphere, land, water and climate research applications. UAVs will be used for detailed image acquisition.

PhDs will be recruited from existing staff at the partner universities through an openly announced application process, following the procedures applicable at the partner universities. MSc research topics will be selected so that they support and contribute to the overall PhD topics. There will be a feedback loop to incorporate results obtained from the research programme into the education, so that local case studies can be further developed and integrated into the main curricula.

Outreach

Various outreach activities and events have been defined. These activities should enhance the sustainable collaboration within the education network and between the education network and public and private sector stakeholders. As well as disseminating research findings, the outreach activities should provide relevant extension services to key stakeholders such as development agents, assist in the identification of research and education profiles and stimulate spin-off and entrepreneurship opportunities through valorisation of research output, new product and service creation and other forms of collaboration with the private sector. The activities should lead to a gradual expansion of the network, incorporating more educational institutes, but should also engage other public and private stakeholders. The evolution of the network will be monitored throughout the project.

The wheels were put in motion during the programme's kick-off in Addis Ababa on 5 October 2017. Various stakeholders from a wide range of sectors attended the official kick-off, particularly to discuss and give advice on the EENSAT programme. Since then, three major activities have started: first, the revision of curricula at the three universities; second, the selection of candidates for the PhD studies; and third, the selection, procurement and configuration of equipment for the classrooms.

For further information go to www.eensat.org



Computer facilities for classrooms at the Ethiopian universities of Addis Ababa, Bahir Dar and Mekelle











Recent Trends in Land Administration: Societal Needs, Technology and Organisation

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In September 2017 a five-day training workshop on "Recent trends in land administration: societal needs, technology and organisation" was organised by the African Regional Institute for Geospatial Information Science and Technology (AFRIGIST), the School for Land Administration Studies of the University of Twente (ITC) and the Dutch Kadaster International, jointly with UN-Habitat's Global Land Tool Network (GLTN).

AFRIGIST, formerly known as the Regional Centre for Training and the host university, the representative of the Federal University of Aerospace Surveys (RECTAS, initiated in 1972), is a network of West African countries (Benin, Burkina Faso, Cameroon, Ghana, Mali, Niger, Nigeria and Senegal) through which training, research, consultancy and advisory services in geo-informatics are developed and exchanged. The centre is housed on the Obafemi Awolowo University campus in Ile-Ife, Nigeria, where the workshop also took place. AFRIGIST offers diplomas, professional Master's and Master of science degrees in geo-information technology. Members and affiliates of AFRIGIST have a longstanding history with ITC, as became clear from the many alumni present and speaking during the opening ceremony. The workshop was an opportunity to reconnect and discuss the current scene of land administration and the context of geo-information use in West Africa.

The workshop was attended by participants from seven West and Central African countries, who presented and discussed land administration and geo-information frameworks, the associated past and current challenges, as well as future directions for their respective countries.

Fifteen delegates from eight countries attended the workshop's opening ceremony (see photo page 8). The workshop was officially opened by Surv. Ebisintei Awudu, Surveyor General of the Federal Republic of Nigeria and First Representative of the Nigerian Government on the AFRIGIST Governing Council, who emphasised the importance of the event in bridging capacity gaps in geo-information use and land administration in the region and looked forward to continued collaboration. Other delegates at the opening ceremony included AFRIGIST's Executive Director Dr. Adewale Akingbade, experts and resource personnel, members of AFRIGIST's Governing Council, representatives of

Technology, Akure (FUTA), the representative of the University of Abobey-Calavi, Benin Republic, the Director of the Early Warning Directorate of the Economic Community of West African States (ECOWAS) and a representative of the Nigerian Army.

Representing ITC, Prof. Jaap Zevenbergen presented on "Concepts and Functions of Land Administration" and "The Need for Innovations in Land Administration". This presentation was complemented by a presentation on GLTN's innovative approaches by Rebecca Ochong from GLTN - UN-Habitat. Dr Christine Richter's presentation on "Access to and Integration of Geo-information" was delivered via Skype, which - serendipitously - served to demonstrate the benefits of digital ICTs in



His Royal Highness, Oba A.I. Abewuyi making a presentation during the workshop (photo Rebecca Ochong,

circumventing geographic distance. From the Dutch Kadaster International, Co Meijer explained solutions for cadastre development and the challenges in digitisation of land records and workflows across African countries. Rebecca Ochong also discussed the importance of considering gender relations in land rights and administration in Africa. From GLTN, Solomon Njogu was also present, and participants greatly appreciated GLTN's practical sessions on the use of the Social Tenure Domain Model (STDM) software for documenting land rights. Each presentation was followed by questions and answers. A lot of time was devoted to group discussions, interactions and learning, which resulted in the draft action plans for participants' respective home organisations and countries.

The workshop organisation, coordinated by Mor Awa Dieng, Head of Cartography Department, and the hospitality laid on by AFRIGIST were excellent, especially considering that a lot of time was required to provide all visitors with efficient material and digital infrastructure. Thanks to a skilled translator, the workshop was conducted in both French and English – a quite formidable challenge given the legal and technical vocabularies of the geoinformation and land administration domains.

There was ample time to get to know one another and to network. For example, participants had the opportunity to visit the Palace of the Ooni (King) of Ife. The Ooni of Ife, together with the Ife Council of Chiefs, is an influential actor in the allocation of land family and individual resource on the other. in the IIe-Ife region. A presentation was given on behalf of His Imperial Majesty by one of his senior affiliated Kings, HRH Oba A. After this successful and enjoyable workshop we hope to organ-I. Abewuyi, who explained "The traditional ways of Land Adminis- ise a similar event jointly in 2018.



Participants had the opportunity to visit the Palace of the Ooni (King) of Ife (photo Rebecca Ochong

tration and Allocation in South Western Nigeria". The speech emphasised the intimate relationship between land and society, an association which is governed by a diversity of norms in different societies, and pointed out that a major challenge for sustainable development lies in striking a just balance between land allocation for public purposes on the one hand and as a



Fifteen delegates from eight countries attended the workshop's opening ceremony

Innovative Geospatial Tools for Fit-for-Purpose Land Rights Mapping

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Mapping millions of unrecognised land rights in large parts of Sub-Saharan Africa is an ongoing challenge. The results of many existing ICT-based approaches for recognising these rights have proven to be inappropriate in many cases. Challenges include incomplete recordation and unresolved or escalated disputes that exacerbate the situation.

Therefore, a new generation of tools needs to be developed to support faster, cheaper, easier and more responsible land rights mapping. This is the main goal of its4land, a European Commission Horizon 2020 project that aims to develop innovative tools inspired by the continuum of land rights, fit-for-purpose land administration and cadastral intelligence. To deliver innovative, scalable and transferrable ICT solutions, the its4land project is using strategic collaboration between the EU and East Africa.

The innovation process incorporates a broad range of stakeholders and emergent geospatial technologies, including smart sketch maps, unmanned aerial vehicles (UAVs) and automated feature extraction, as well as geocloud services. The aim is to combine innovative technologies and to capture the specific needs, market opportunities and readiness of end-users in the domain of land tenure information recording in Eastern Africa. Moreover, the tools target both top-down and bottom-up approaches and thus support formal land registration processes as well as informal, community-based land resource documentation. The project consists of a four-year work plan, €3.9m funding and eight consortium partners collaborating with stakeholders from six casestudy locations in Ethiopia, Kenya and Rwanda. Major tasks include tool development, prototyping and demonstration for local, national, regional and international interest groups. The case locations cover different land uses such as urban, periurban, rural smallholder and (former) pastoralists.

University of Twente (Faculty ITC) leads the project and is responsible for two of the four technical work packages: *Fly and Create* and *Automate it*. (Figure 1)

"Fly and Create"

The advent of low-cost, reliable, user-friendly and lightweight UAVs has created new opportunities for collecting timely, tailored, detailed and high-quality geospatial information, facilitating data acquisition on temporal and spatial scales that remains





Figure1 its4land project phases

unachievable for traditional remote-sensing platforms. Based on this idea, "Fly and Create" aims to design, test and validate a UAV-driven workflow for land tenure data acquisition. To achieve this goal, this work package follows a logical approach that will first study policy and legal developments regarding UAV regulations, with a particular focus on regulatory frameworks for UAV flights in East Africa. Based on the outcomes of this legal prerequisite for the successful implementation of UAV flights, a prototyping phase will provide guidelines for the design of efficient operational workflows to meet end-user needs. Data acquisition workflows encompass the whole operational UAV procedure, including flight planning and preparation, field work, data processing and quality assessment. Results and insights from the prototyping phase will provide the basis for scaled workflows. A comparative analysis of the current UAV regulations shows that although all UAV regulations are aimed at one common goal minimising the risks for other airspace users and for people and property on the ground - national UAV regulations differ markedly. Ongoing regulatory changes and political instability pose major challenges for the use of UAVs in Rwanda, Kenya and Ethiopia. Aside from the legal setbacks in East Africa, initial test flights in Germany have produced excellent results. Current analyses demonstrate high geometric accuracies that can be achieved by means of direct georeferencing. This insight minimises or even eliminates the need to measure ground reference points. Once the flight permissions are granted, the UAV-based data acquisition workflows are ready to be applied in all six case locations of its4land.

"Automate it"

Aims to design and implement a tool for automated boundary delineation for cadastral mapping through indirect surveying techniques. This is done by automatically extracting visible cadastral boundaries from UAV data. The tool will enable those boundaries to be edited and finalised. It aims to improve current mapping procedures in terms of cost, time and accuracy. This innovation is based on the assumption that a large proportion of cadastral boundaries are evidenced physically by objects such as hedges, fences, stone walls, tree lines, roads, walkways or waterways. The automatically extracted outlines require further (legal) adjudication that allows the incorporation of local knowledge from a human operator.

The synthesised workflow for automatic boundary extraction consists of image segmentation, line extraction and contour generation (Figure 2).

For image segmentation, the globalised probability of boundary (gPb) contour detection (Figure 3) was found to be applicable for an initial detection of visible boundaries. However, the global optimisation of the method did not allow the processing of large images and the UAV data was reduced in resolution, leading to reduced localisation quality.

The aim of the proceeding workflow step is to improve the localisation quality and verify initially detected candidate boundaries: for line extraction, simple linear iterative clustering (SLIC) superpixels (Figure 4) were found to coincide to a large extent with object boundaries in terms of completeness and correctness. For contour generation, gPb contour detection and SLIC superpixels are combined and processed in a semi-automatic tool that allows a subsequent final delineation of cadastral boundaries. The tool is the focus of ongoing work and will be implemented as a publicly available QGIS plugin.

For more information

you can visit www.its4land.com. If you are interested in pursuing similar research within or with ITC, contact Mila Koeva (PGM) m.n.koeva@utwente.nl or the colleagues involved in the project in ITC.

ACKNOWLEDGEMENTS:

The authors would like to acknowledge the support of the colleagues working on the project at ITC: Jaap Zevenbergen, George Vosselman, Francesco Nex and Michael Yang.



Figure 2 Sequence of commonly applied workflow steps proposed in Crommelinck et al., 2016, to extract objects related to those manifesting cadastral boundaries from high-resolution optical sensor data



Figure 3 Processing pipeline of globalised probability of boundary (gPb) contour detection and hierarchical image segmentation resulting in a binary boundary map containing closed segment boundaries



Figure 4 Processing pipeline of simple linear iterative clustering (SLIC) resulting in agglomerated groups of pixels, i.e. superpixels, whose boundaries outline objects within the image



Educational Developments at ITC

Communication Department

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At ITC we strive constantly to improve our education. We do so with input from our students but also from you, our alumni. Some major changes to ITC's programmes are set to be rolled out during the next academic year. We will launch our renewed Master's in Geo-information Science and Earth Observation and plan to start a new Master's in Spatial Engineering.

• Renewed Master's in Geo-information Science and Earth Observation Solve large-scale spatial problems related

ITC's Master's in Geo-information Science and Earth Observation will become a two-year Master's programme from September 2018. The renewed programme builds upon the existing curriculum with recognised specialisations but has a new structure and offers students more flexibility. Students can define their study path according to their professional and academic interests and make more choices in the programme.

The renewed Master's programme:

- o is more supportive for the student's learning process;
- o creates more space for learning and reflection;
- allows more flexibility for the student to develop alternative study trajectories within ITC and/or to choose courses outside ITC;
- o provides more professional and academic exposure for the students.

 New Master's in Spatial Engineering Spatial Engineering is a new Master's programme and aims to meet the growing international demand for engineering professionals with a helicopter view and expertise in spatial information science. It brings together the expertise of the University of Twente in spatial sciences, engineering and governance.

The Master's aims to train engineers to solve large-scale spatial problems related to natural disasters, the use and extraction of natural resources, and sustainable development of our environment. Solutions that cater for the needs of stakeholder groups are often a mix of engineering and physical planning, and based on spatial information. Therefore multidisciplinary thinkers are needed, who know how to operate in an international context, with a good understanding of stakeholder groups and governance issues. Official accreditation and registration is expected in 2018. In the meantime, applications are welcome.

We thank the ITC community for providing us with their input. It enables us to develop our education to ensure that our graduates have the skills, contacts and opportunities to further their career.



Second time in a row Teacher of the year Gabriel Parodi in action with a small group of students

Short course on: Cropland Mapping from Free Multi-Temporal Satellite Images

Mariana Belgiu

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From 26 to 29 November 2017, a group of 20 participants from seven countries (Greece, Cyprus, Denmark, -Germany, Romania, Turkey and Albania) attended the 'Cropland mapping from free multi-temporal satellite images' course organised in Athens, Greece.

The Earth Observation Science (EOS) department, in collaboration with Geospatial Enabling Technologies Ltd, organised a short course devoted to cropland mapping from satellite image time series (SITS). The course was held in the workshop facilities made available by the si-Cluster (Space Technologies and Applications Cluster) in Athens and was attended by 20 participants (13 female and 7 male) with a wide variety of professional backgrounds, including survey engineers, geologists, hydrologists, biologists, environmental engineers and GIS analysts.

Efficient cropland area mapping methodologies are an essential condition for the implementation of sustainable agricultural practices. The increasing spatial and temporal resolution of globally available satellite images, such as those provided by the Sentinel-2 mission, creates new opportunities to generate accurate information on the available cropland areas. During this course, participants were therefore introduced to the main methods and tools for cropland classification from Sentinel-2 SITS. Sentinel-2 data and derived information products (e.g. Normalised Difference Vegetation Index) were made available via Open Geospatial (OGC) services implemented and hosted on the getopendata platform.

The following topics were covered during this course:

 Introduction to the concepts and methods for cropland mapping from the available satellite image time series (SITS). This theoretical background was delivered prior to the practical sessions.





The course was held in the workshop facilities made available by the si-Cluster (Space Technologies and Applications Cluster) in Athens

- Cropland classification from SITS using the Semi-Automatic Classification Plugin (SCP) available for QGIS software. The course participants were instructed in the use of this plugin for cropland mapping with a special focus on the atmospheric correction of Sentinel-2 data, understanding the phenological behaviour of the investigated crops and understanding how the irregular temporal sampling and data noises might impact the classification results.
- Supervised and unsupervised classification of cropland areas from SITS with K-means clustering techniques and a Random Forest (RF) classifier using the R software environment. The theory, advantages and sensitivities of these classifiers to various user-defined parameters were discussed in detail.
- Sharing the cropland classifications generated by the course participants as Web Map Service (WMS) and Coverage Map Service (WCS) using data-sharing

functionalities implemented on the getopendata platform. The course participants were instructed in the use of other services offered by the getopendata platform, such as searching, viewing and downloading satellite data with user-defined criteria: time period search, atmospheric correction activation, multiple band selection, cloud coverage selection etc.

The course was positively evaluated by the participants, who reported that the seminar was well organised and helped them to learn new concepts, methods and tools for handling, processing and analysing SITS relevant not only to agriculture mapping but also to other application domains where advanced SITS processing and classification techniques are required.



A group of 20 participants from seven countries attended the shortcourse



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D ROJECT NEWS

Inventory of Landslides and Flooded Areas Triggered by Hurricane Maria in Dominica

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Jianqiang Zhang

Hurricane Maria, which hit Dominica on 18 September 2017, is regarded as the most destructive natural disaster that has affected Dominica in recent decades.

Hurricane Maria, which hit Dominica on 18 September 2017, is regarded as the most destructive natural disaster that has affected Dominica in recent decades. The hurricane killed 30 people and 34 were declared missing. According to the Post-Disaster Needs Assessment, Hurricane Maria resulted in total damage of EC\$2.51 billion (US\$931 million) and losses of EC\$1.03 billion (US\$382 million), which amounts to 226 percent of 2016 gross domestic product (GDP). Maria damaged most of the houses and farmland infrastructures and left the mountainous country blanketed in a field of debris. Highly intensive rainfall triggered widespread floods and a tremendous number of landslides. A largescale landslide inventory was carried out by a team from the University of Twente, using five scenes of Pléiades satellite imageries with a resolution of 0.5m, which were obtained on 23 September and 5 October after the hurricane and made available through UNITAR-UNOSAT. In addition, a series of Digital Globe Images were used that were collected for the Google Crisis Response through a KML layer. The images were visually interpreted by image interpretation experts and landslides were mapped as polygons, separating scarp, transport and accumulation areas. The landslides were also classified into types. Unfortunately, due to cloud coverage in all available images

A total of 9,960 landslides were identified, including 8,576 debris slides, 1,010 debris flows and 374 rock falls, with areas of 7.30km², 2.50km² and 0.50 km² respectively. The total area of landslide is 10.30 km², which covers 1.37 percent of the island. The source of landslides amounts to 3.30km², with the remaining 7.0 km² being transportation and deposition areas. Almost all of the rivers flooded due to intensive rainfall. The flooded area is 13.03km², covering 1.74% of the island. Dominica will face some new problems for mountain hazards in the coming years, as many of the fresh scarps may produce more debris, and many tree trunks are still on the slopes or in the river channels. With so many fresh landslides in the upper catchments, it is likely that debris flows will be triggered with rainfall thresholds that are substantially lower than before the hurricane. Hurricane Maria damaged the forest cover dramatically, changing the conditions for hazard initiation. Without the protection of vegetation, more new, shallow landslides could occur in the near future. A series of cascading hazards may occur, such as landslides or debris flows blocking rivers and resulting in outburst floods. More detailed evaluation of the post-Maria hazard and risk situation is therefore very important.



Shore of Dominica pre Hurricane Maria



Same shore of Dominica post Hurricane Maria



The following shape files are available:

Name	contents
Dominica_landslide_ boundary	Classification of land- slides, debris flows, rock falls and flooded areas.
Dominica_landslide_ part	Classification of land- slides and flooded areas according to their part (scarp, transport, accumulation)
Image_boundary	Boundaries of the images used for interpretation
Cloud	Cloud coverage on available images

Attributes:

Dominica_landslide_boundary		
	Code	Meaning
Туре	DF	Debris flow
	DS	Debris slide
	RF	Rock fall
	SS	Flood plains with sediments
Code	Landslide ID code	
Descrip	Which elements are damaged (houses, roads etc.)	
Area	Area of the feature	
Date	Date of images used	
Dominica_landslide_part		
Part	D	Deposits
	S	Scarp
	SS	Stream sediments
	Т	Transport part of the landslide (no deposition)
	TD	Transport and deposition part of the landslide
Туре	DF	Debris flow
	DS	Debris slide
	RF	Rock fall
	SS	Flood plains with sediments
Code	Landslide ID code	
Descrip	Which elements are damaged (houses, roads etc.)	
Area	Area of the feature	
Image_boundary		
Date	Date of Pléiades images	
Code	Code of images	
Number	ID number of Pléiades images used	



In Memoriam Emeritus Professor Isaak (les) Zonneveld [1924–2017]

Emeritus Professor Isaak (les) Zonneveld passed away at the age of 93 on 18 December 2017. Prof. Zonneveld was a member of Faculty ITC from 1966 till 1989. On behalf of the ITC community, we have sent our sincere condolences to his family and friends.

In 1943, after graduating from high school, les Zonneveld went into hiding in a wetland area known as The Biesbosch. This wilderness captured his scientific interests in landscape-ecology that would last throughout his further career and life. When hiding, he joined a partizan group and went into active services for the Allied Forces. They awarded les with a scholarship that enabled him in 1946 to register at the Agricultural University Wageningen, where he obtained his MSc-degree in Tropical Forestry. In 1951, the Netherlands Soil Survey Institute provided les with his first official appointment. The work required him to study in detail the dynamics of soils and the responses/succession of vegetation within, yes indeed: The Biesbosch.

Then, notably, every year from 1950 onwards, les managed to take semi-oblique photos of a particular area of The Biesbosch from a transmission tower. The use of aerial photo interpretation to study



les, taking a photo of The Biesbosch, from a transmission tower (Cartoon by D.vd Zee)



Febr.2002: Presentation by les of a book containing selected examples of landscape ecology applied for NRM (IALE Pub-81)

landscapes and its dynamics got further embedded in his ecology toolkit when les participated in the ITC soil survey course of 1955. Successively, in 1960, he defended his doctoral dissertation titled *'The sweetwater biology of The Biesbosch'*. les obtained his PhD degree with nothing less than a *'Summa cum Laude'*.

In 1963, les Zonneveld entered the service of the FAO, to join an aerial soil survey project in NW-Nigeria, which led to the



les, proudly explaining his map of The Biesbosch (Cartoon by D.vd Zee)

production of a Geomorphologic and Lithologic features map of the Sokoto and Rima river basins. In 1966, les accepted the position of Associate Professor of Vegetation Survey at the ITC, which was then still located in Delft (Inaugural address on 14 Nov.1968). He combined this function later with a professorship of Vegetation Mapping by special appointment at the Agricultural University of Wageningen (Inaugural address on 28 Jan.1982). les developed a mature landscape guided

holistic vegetation mapping approach that required 3D aerial photograph interpretation skills and a proper understanding of the ecological processes at play.¹ The method was taught to generations of international ITC-students who in-turn applied it with enthusiasm to map and understand natural resources management (NRM) issues as occur in their home situations.

Besides his fame as 'les de Bies' (Professor Biesbosch) and as a vegetation scientist



Landscape Ecological Vegetation Map of Lake Manyara National Park Tanzania

we also recall les's concerns about the environment: how people degrade, pollute and destroy. He frequently blamed *'the number of people on our planet as the root cause for all misery of mankind'*, and he expected ITC-students to include population growth when addressing any NRMissue. The drive and energy les showed during many fieldwork campaigns also became legendary. A typical example: During winter on Schiermonnikoog, with vegetation hidden under a layer of snow, les happily trotted around while students slowly turned blue...

In 1981, Zonneveld's efforts contributed to the establishment of the International Association for Landscape Ecology (IALE), of which Zonneveld occupied its first chair. At present, IALE promotes itself through the slogan: 'Landscape Ecology ... process and pattern matters to sustainability in the 21st century'. Not surprisingly, les always remained critical of new developments, especially of relatively sophisticated hightech applications; he approached them as: 'toy or tool?'.

les delivered his valedictory address in the month of his 65th and ITC's 38th birthday (ITC, 15 Dec. 1989); he occupied his chair with dedication and with infectious inspiration for 21 years.

After les's retirement, he remained as active as ever: in 1999, ten years after his formal retirement and forty years after his dissertation, he published his second book on The Biesbosch. Last September, when joining the cortège of professors for the formal opening of ITC's academic year, les announced with passion a forthcoming publication by Dr. Kwa² (University of Amsterdam) that relates the 'history of ecology and the landscape through the vantage point of its means of visualization'. Using aerial survey techniques, les added landscape ecology to the map of science. He used the vantage point he had from 'his' transmission tower, to create and contribute. With gratitude, on behalf of the ITC community, we sincerely thank him for that.

¹ I.S. Zonneveld, 1995. Land ecology : an introduction to landscape ecology as a base for land evaluation, land management and conservation. 199pp, SPB Amsterdam, ISBN 90-5103-101-7 (Chinese version: ISBN 7-03-012199-6).

² Chunglin Kwa, 2018. The visual grasp of the fragmented landscape: plant geographers vs plant sociologists, Historical Studies in the Natural Sciences Vol. 48, 2018 (2), forthcoming in April 2018.



Top Spot in Shanghai Ranking: "It's a means, not an end"

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ARWU Shanghai Ranking

The ARWU Shanghai Ranking is published annually and gives an insight into the academic quality of the world's leading institutions. General university rankings are provided, as well as global rankings on specific academic subjects. Topics covered are the number of scientific publications, citation impact, the number of papers in top-rated journals and internationally collaborated papers.

R Shanghai anking

Fourth Successive Recognition for ITC's Master Programme

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For the fourth time in a row, the master programme Geo-information Science & Earth Observation receives the quality seal 'Top rated programme' in the Keuzegids Masters. The Keuzegids counts as one of the major information sources for future students and is published by independent advisory organization Centrum Hoger Onderwijs Informatie (CHOI).



Top rated programme seal

The seal for 'Top rated programme' is awarded to all programmes with 75 point and above. The score for the geoinformation programme is 92, which is exceptionally high for a programme with over 200 students, CHOI stated. Usually, such high scores are only presented to smaller educational programmes.

The score improved from 82 points last year, to 92 point now.

Prof.dr. Tom Veldkamp, dean of the faculty: "We are excited about our score and the ongoing appreciation of the students. We remain in the further development of our programme. It is a huge challenge to implement a major change in our programme and, at the same time, keep student appreciation on a high level."

Overall score

The score of the geo-information programme, which is organized at the ITC Faculty of the University of Twente, is one of the highlight's of Twente's excellent scores: The University of Twente may proudly present excellent scores in the new edition of the Keuzegids. Earlier, the University of Twente was announced Best Technical University in the Netherlands for the bachelor programmes, in the Keuzegids for master programmes, the UT has climbed to a second spot in the ranking of all fulltime universities. Eight master programmes received the quality seal 'Top rated programme'.

The average score of the master programmes at the University of Twente has gone up considerably: from 61 points (out of 100) in 2017 to 67.5 in 2018. Therewith, the University of Twente is the strongest climber of all universities. At the overall ranking of fulltime universities, the University of Twente has taken the second spot, right behind Wageningen University (68 points). Compared to the other technical universities, the UT's score is notable: Eindhoven and Delft score 63.5 en 57.5.

ITC Alumnus Amon Murwira Appointed Minister in Zimbabwe

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On Thursday 1 December 2017, Zimbabwean President Emmerson Mnangagwa named a new cabinet, which includes a familiar face: ITC alumnus Professor Amon Murwira was appointed Minister of Higher Education, Science and Technology Development.

In August 1998, Professor Amon Murwira joined the University of Zimbabwe as a staff development fellow in the Department of Geography and Environmental Science under a scholarship to undertake an MSc in Environmental Systems Analysis and Monitoring, as well as a PhD at ITC in the Netherlands. He successfully completed his MSc thesis in 2000 and immediately commenced his PhD research.

Murwira is the fifth ITC alumnus who has made it to governmental level: Dr Laurent Sedogo (Minister of Environment of Burkina Faso), Dr Mary Goretti Kitutu Kimono (State Minister for the Environment of Uganda), Dr Siti Nurbaya Bakar (Minister of Environment and Forestry of Indonesia) and Dr Wilber Ottichilo (Member of Kenyan Parliament for the Emuhaya constituency) preceded him.

It was with great pleasure that we learned of Murwira's appointment as Minister in the Zimbabwean cabinet. We congratulate him most warmly on behalf of the ITC Community and wish him success in his new duties.



Dr Amon Murwira Source: www.technomag.co.zw/2017/12/04/ amon-murwira-new-science-technology-minister/

Smart Surveyors for Land and Water Management

Liza Groenendijk

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How to build and manage a densely populated coastal country with a land area of which nearly half is below sea level? We, the Dutch know how to do just that and have done so for centuries. The role of surveyors in this endeavour has been crucial. And their role is even more crucial today when we have to protect our country against the impact of climate change causing sea level rise.

During the FIG working week 2020, we will put the Smart Surveyor centre stage. We will do so by preparing current and future generations of professionals, by sharing knowledge about approaches which work, by bridging the technological and the societal perspective, by educating our

workforce, and by strengthening and developing our profession.

We invite all smart surveyors to join the FIG Working Week in the Netherlands from 10 to 14th of May 2020 in Amsterdam.





Share Knowledge, Skills and Innovative Solutions to Better Serve Society

Dominique Mvunabandi

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My name is Dominique Mvunabandi and I obtained a BSc degree in Biology at the National University of Rwanda in 2009. While in Rwanda, I served different institutions, namely the Dian Fossey Gorilla Fund International (DFGFI) and INES-Ruhengeri as a researcher and a member of the academic staff. From 2015 to date, I have been CEO of Severe Weather Consult Ltd and have worked as a visiting lecturer at both the University of Rwanda and Kigali Independent University (ULK).

I left Rwanda in September 2013 to join ITC as an MSc student for 18 months. Once there, I obtained an MSc degree in Geoinformation and Earth Observation for Natural Resources Management. I have always been very interested in the use of GIS and Remote Sensing techniques to sustainably manage natural resources in Rwanda. Why was it ITC-UT for me? I heard from ITC alumni and my employer that ITC is well known and ranked among the leading institutes in geo-information sciences and remote sensing. Moreover, ITC courses are a good fit with the needs of developing countries. I personally enjoyed my time and the atmosphere and hospitality at UT-ITC. Heavy, intensive courses are challenging for students, but the opportunity to receive well-organised supervision and coaching, to access relevant teaching materials and infrastructure facilities and to team up with colleagues has been a great experience for me to overcome the various challenges, for example during my research work (www.utoday.nl/news/60805/TomTom_voor_chimpansee & www.youtube.com/watch?v=-stemSvCWPA). Meeting people from different countries created a think-tank for me to share knowledge, skills and innovative solutions to better serve society.

After my graduation in 2015, I returned home with a good network of Dutch organisations, knowledge and experience. My intention was to start defining a way to exploit and use all of that to serve society. My professional experience with both private and public institutions motivated me to embark on a new path as a social entrepreneur and I later teamed up with colleagues Gilbert Kamau Mwangi and Walter Rwamucyo to create a social private company called "Severe Weather Consult (SWC) Ltd".

SWC has developed an innovative weather information system technology known as "iHewa" that harnesses the power of ICT,

ground weather, satellite and lightning sensor data to support education, agriculture, water, tourism and disaster management



SWC has developed an innovative weather information system technology known as "iHewa"

in Rwanda. The technology uses innovative, low-cost lightning detectors to track lightning strikes in an area and sends alerts to low-income earners in Musanze City. Sixty per cent of them are women. More specifically the beneficiaries are Musanze City residents, business people, tourists, tour guides, hotel owners and farmers living in the city neighbourhood. By integrating lightning data with robust, low-cost and automatic TAHMO station parameters (rain, wind, temperature, humidity, solar radiation and air pressure) combined with satellite data, a detailed data set of effective, time and GPS-localised weather information, predictions and alerts on floods and lightning advisory services is created and pushed to end-users.

All three of us had an idea on how to use ICT to benefit society. However, none of us was aware of how demanding the path would be to turn our dream into reality. We learned that starting a company is very difficult, challenging and may be even risky, especially for people with only a science and technology background. Although ICT is heavily promoted as the country's unique selling point in Rwanda, our team required additional skills apart from technology and science. It might still be a challenge to convince non-ICT governmental, private institutions to work with them. So our team needed to acquire some skills in business model canvas, marketing and marketing strategy, financial modelling, assumptions/market validation etc. We found these skills very valuable in taking our business to the next level. In this regard, Delft University of Technology (TuDelft), Trans-African Hydro-Meteorological Observatory (TAHMO), Truvalu.startups and VIA WATER offered intensive trainings to SWC staff on



iHewa harnesses the power of ICT, ground weather, satellite and lightning sensor data to support society

climate technology, turning technology into a viable entrepreneurial business case, business development, financial management, marketing etc.

Since January 2017, Severe Weather Consult has implemented a project working on a severe weather warning system for floods and lightning in Musanze City in Northern Rwanda. The project will test a weather monitoring platform that issues alerts on extreme weather conditions and provides useful weather information advisory services for the city's residents and neighbouring communities.

Partners in the project are:

- Government institutions (Musanze District; Rwanda Meteorology Agency-METEO RWANDA; Ministry of Disaster Management and Refugee Affairs-MIDIMAR; Ministry of Agriculture and Animal Resources-MINAGRI);
- (2) Local universities and colleges (INES Ruhengeri Institute of Applied Sciences, Kibogora Polytechnic, University of Rwanda/ College of Agriculture, Animal Sciences and Veterinary Medicine-UR/CAVEM, Kitabi College of Conservation and Environmental Management-KCCEM, Kigali Independent University-ULK, University of Lay Adventists of Kigali-UNILAK);
- (3) Regional institutions: Regional Center for Mapping of Resources for Development-RCMRD, Aokar Services Ltd;
- (4) International organisations: Delft University of Technology (TuDelft); Trans-African Hydro-Meteorological Observatory-TAHMO; Holland Green Tech Rwanda, GODAN secretariat; Truvalu.startups.

I have always been very interested in the use of GIS and Remote Sensing techniques to sustainably manage natural resources in Rwanda.

Ir. Dominique Mvunabandi, ITC Alumnus and CEO of Severe Weather Consult Ltd

ABOUT THE AUTHOR:

Dominique Mvunabandi is CEO of Severe Weather Consult Ltd in Rwanda and works as a visiting lecturer at both the University of Rwanda and Kigali Independent University (ULK)

MORE NEWS ABOUT SWC:

- www.swcrwanda.com/
- http://globalstories.tudelft.nl/story/severe-weather-consult/
- https://impactbooster.com/news/new-funding-for-severe-weather-consult
- www.viawater.nl/projects/severe-weather-warning-for-musanzecity-rwanda

Producing High-Quality 3D Maps from Lidar

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DIPPER, a spin-off company from the University of Twente, provides a breakthrough solution for processing massive volumes of Lidar data accurately and efficiently. It offers comprehensive services related to Lidar data processing and 3D scene modelling. Since the self-developed software is highly automated, a single operator working with DIPPER on a laptop can create high-quality 3D maps for 10,000 buildings within just one week – at least ten times faster than normal. The high efficiency and accuracy boost large-scale applications such as asset management, smart city, securities development and urban planning. So far, DIPPER has successfully created 3D models for five international cities.

What is Lidar?

Lidar is a remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light. It is able to create intricate threedimensional maps in places where bad weather or thick vegetation hamper traditional aerial mapping. In addition, an airborne Lidar system provides 3D data with 5cm accuracy in the vertical direction, which is much better than the 50cm accuracy achieved by dense matching from stereo images. However, current Lidar data processing involves intensive manual work, making it very expensive and time-consuming. Ultimately, most companies in the market either offer accurate 3D maps at high prices or produce affordable 3D maps with compromised quality. It is therefore extremely difficult to develop advanced Lidar applications.

DIPPER

DIPPER, a spin-off from the University of Twente (UT), was founded in December 2014 in Enschede, the Netherlands. Supported by a top research group on Lidar mapping, DIPPER has successfully turned 20 years of pioneering scientific achievements into commercial products. The company has developed novel algorithms which enable ultrafast and highly automated data processing. It also provides reliable 3D ICT services, including solar energy calculation, flood control, noise simulation and sensor layout design. With its unique technology, competence and flexibility, DIPPER can provide customised products and services tailored to the situation, application and requirement.

Level of Detail

DIPPER's technology can significantly improve efficiency by creating high-quality 3D building models with a remarkable degree of automation. The quality levels of 3D maps can be determined by how many details they provide. At Level of Detail 1 (LoD1), buildings are reconstructed in just one height, so all the building models are displayed with flat roofs. In comparison, at Level of Detail 2 (LoD2), the roof constructions including dormers can be clearly modelled in 3D. Considerable effort is needed to improve the level of detail from LoD1 to LoD2. The DIPPER software can construct 3D building models at LoD2 using Lidar data collected from a helicopter or aeroplane. When the software processes the data, the Lidar points on buildings are initially recognised and segmented into individual roof faces. The roof structures

are then inferred and primitive sub-buildings are detected and modelled. More impressively, if an error is discovered in the roof construction, the software is able to automatically recognise and memorise the error patterns and then correct repeated errors in other buildings models. This algorithm therefore maintains the high quality of the 3D model.

3D is booming

The 3D map application market is currently booming. The international market was worth USD 1.90 billion in 2015 and is predicted to rise to USD 16.99 billion by 2020 at an estimated CAGR of 55.0%, according to the market research company M&M. From a regional perspective, the Dutch government is developing its national service for large-scale 3D topography. Cities such as Amsterdam, Rotterdam



Figure 1 A 3D city scene of The Hague showing buildings, land, waterways and roads, reconstructed by automated processing software developed by DIPPER.

and The Hague (figure 1) have launched projects to invest in the use of 3D maps for city visualisation, management and communication. Moreover, companies focusing on solar energy, insurance, security and city planning are increasingly using 3D information for business development and information support purposes. Demand for affordable and accurate 3D Lidar processing and modelling is therefore growing fast, and DIPPER is ahead of this trend.

Lidar Data Processing

In 2015, DIPPER developed advanced toolkits for Lidar data processing. One important function of the toolkits is modelling the urban scene, such as buildings, terrain, power corridors and trees, with high efficiency and accuracy. This means DIPPER is able to combine 3D building models with environmental parameters and provide detailed overviews and smart suggestions for many advanced applications, including solar energy analysis, noise management, flood control and urban planning.

Meanwhile, DIPPER has established close connections with many government organisations in both the Netherlands and China, including Dutch Kadaster, municipalities and utility firms. So far, DIPPER has produced high-quality 3D maps for five Dutch cities and a Chinese power firm (figure 2). Supported by these achievements, DIPPER is also exploring business

opportunities within non-governmental organisations such as solar panel companies, insurance companies and the LoRa Alliance for the Internet of Things.

Transforming Lidar into 3D

"Our aim is to provide easy-to-use applications. We are transforming massive Lidar data into semantic and concise 3D vector data," says Biao Xiong, DIPPER's CEO. After completing his PhD degree at UT, Xiong launched the start-up with four passionate colleagues: "We have successfully processed Lidar data for city, forest, railway, power corridor and industry scenes. The data processing varies from multi-scan registration and point cloud classification to 3D scene modelling. Since we work closely and effectively in a flexible environment, we are able to respond quickly to the challenging problems raised by customers every day. DIPPER's slogan is 'Showing, Solving and Leading' and that perfectly sums up what we are trying to achieve, i.e. to show a new view of the world through 3D Lidar maps, to solve complex problems and help with smart decision-making by developing toolkits, and to lead the way in Lidar processing technology by keeping innovation alive. Moreover, as an innovative company aiming to build a bright future, DIPPER is also willing to contribute to the development of new concepts such as self-driving cars and smart city development."

Countrywide 3D Map

In 2016, DIPPER will produce a detailed 3D map of the whole of the Netherlands from airborne Lidar data. It will be the world's first countrywide 3D map at LoD2. Over the next five years, DIPPER is planning to work with other pioneering countries that are eager to obtain accurate 3D maps. As an innovative company, it will continue to invest in research and development to improve the software and workflow and to apply cutting-edge technologies including deep learning, big data mining, cloud processing for automatic interpretation and 3D modelling.

THIS ARTICLE WAS PUBLISHED IN GIM INTERNATIONAL:

www.gim-international.com/content/article/producing-high-quality-3d-maps-from-lidar



Figure 2: A 3D scene of a very-high-voltage transmission line in China showing pylons, power lines, buildings and trees. A 3D map of a transmission corridor can be used in vegetation clearance management, risk management and new plan design.



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- DTM Digital Terrain Model
- Dynamic Mapping
- Earth Observation
- Emergency Services ENC Electronic
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