



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

## Faculty of Natural and Agricultural Sciences

Fakulteit Natuur- en Landbouwetenskappe  
Lefapha la Disaense tša Tlhago le Temo



[www.up.ac.za/cgis](http://www.up.ac.za/cgis)

# 2016 Annual Report

Centre for Geoinformation Science (CGIS)

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## Message from the Director

2016 was an exciting year of new beginnings for CGIS. Prof Greg Breetzke joined UP and CGIS. His focus on geospatial analysis is an important contribution to the current mix of research expertise. Dr Joel Botai changed his role from lecturer to extraordinary lecturer. New collaborations were initiated with the UP Departments of Statistics and Family Medicine respectively. The first student exchanges to the Karlsruhe University of Applied Sciences took place, a first German student visited South Africa, and the first summer school took place in Karlsruhe, Germany. YouthMappers is a global network of student-led chapters that participate and organize mapping activities, and UP was one of the inaugural YouthMappers chapters. Finally, joint research was initiated with the Technical University of Delft in the Netherlands and the Katholieke Universiteit in Leuven, Belgium.

At the same time, there was continuity in collaborations with our local partners, such as the Agricultural Research Council (ARC), CSIR, HartRAO and the South African National Space Agency (SANSA). We continue to be actively involved in the local and international geoinformatics community through Geo For All, the International Cartographic Association (ICA), the International Society for Photogrammetry and Remote Sensing (ISPRS), the South African Bureau of Standards (SABS), the International Organization for Standardization (ISO), the South African Committee for Spatial Information (CSI), and the South African Geomatics Council (SAGC). The Unit for Geoinformation and Mapping continues to provide UP staff and students with cartographic and geoinformation services and support, and we continue to educate students about geoinformatics.

Through new beginnings and continuity in collaborations, community engagement and GISc services, support and education at UP, we work towards the CGIS vision of achieving excellence in GISc research, education, professional development and community engagement by being an internal platform, a facilitator of collaborations, and a partner to the South African geoinformation industry.

Once again, thank you to all of you who make CGIS what it is!

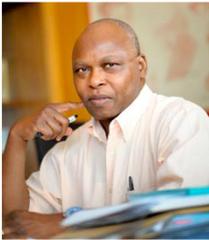
Prof Serena Coetzee  
CGIS: Director  
October 2017

# The CGIS team

## 1. Advisory Board

The Advisory Board provides strategic direction and advice regarding marketing, as well as research, education and training, professional development, community engagement, and capacity building in CGIS; it also advises on operational decisions, reviews the annual budget and reviews the realization of the vision and the execution of the mission.

### 1.1 Chairperson



**Prof Jean Lubuma**

Chairperson: CGIS Advisory Board

Dean: Faculty of Natural and Agricultural Sciences, University of Pretoria

### 1.2 Representatives of key stakeholders



**Dr Herman Booysen**

Past National Chair: Geo-information Society of South Africa (GISSA)



**Dr Derek Clarke**

Vice-President: International Cartographic Association (ICA)



**Adri de la Rey**

GIS Manager, Technology, Eskom



**Gavin Fleming**

Chair: OSGeo Africa and Managing Director: Kartoza



**Ashwell Jeneke**

Deputy Director-General: Statistical Support and Informatics, Stats SA



**Dr Jane Olwoch**

Managing Director: SANSA Earth Observation South African National Space Agency



**Magnus Rademeyer**

Managing Director, AfriGIS



**Sanet Eksteen**

Esri Education, Esri South Africa

### 1.3 Heads of collaborating departments and schools at the University of Pretoria



**Prof Andries Engelbrecht**

Head: Department of Computer Science

## 1.4 Ex officio members



**Prof Paul Sumner**  
Head: Department of Geography,  
Geoinformatics and Meteorology



**Prof Serena Coetzee**  
Director: CGIS

## 2. Staff and collaborators



**Ingrid Booyesen**  
Senior Cartographer, Head:  
Unit for Geoinformation and  
Mapping



**Dr Joel Botai**  
Extraordinary Lecturer,  
Affiliation: South African  
Weather Service (SAWS)



**Prof Greg Breetzke**  
Associate Professor



**Dr George Chirima**  
Collaborator  
Affiliation: Agricultural  
Research Council (ARC)



**Prof Ludwig Combrinck**  
Extraordinary Professor,  
Affiliation: HartRAO



**Dr Antony Cooper**  
Extraordinary Lecturer,  
Affiliation: CSIR



**Joos Esterhuizen**  
Lecturer



**Nompumelelo Kleinboo**  
Administrative assistant  
(BWS project)



**Graeme McFerren**  
Collaborator and Contract  
Lecturer, Affiliation: CSIR



**Tebogo Mokwena**  
DST/NRF sponsored intern  
April 2016 – Mar 2017



**Dr Renaud Mathieu**  
Extraordinary Senior  
Lecturer, Affiliation: CSIR



**Cilence Munghemezulu**  
Lecturer



**Erika Pretorius**  
Technical Assistant



**Victoria Rautenbach**  
Lecturer  
CGIS student representative



**Dr Peter Schmitz**  
Extraordinary Lecturer,  
Affiliation: CSIR



**Petronella Tizora**  
Cartographer, Unit for  
Geoinformation and



**Philemon Tsele**  
Lecturer



**Dr Konrad Wessels**  
Extraordinary Lecturer,  
Affiliation: CSIR

### 3. Postgraduate students

In 2016, 19 Masters and 25 doctoral students were associated with CGIS through their research. They were enrolled for Masters and PhD studies in Geography, Geoinformatics and Information Technology with their supervisors from the UP Departments of Geography, Geoinformatics and Meteorology (GGM), Computer Science, Plant Science, Animal and Wildlife Sciences, as well as the Agricultural Research Council (ARC), CSIR, HartRAO, the South African National Space Agency (SANSA), the South African Weather Service (SAWS), the Technical University of Vienna (TU Vienna), University of Zürich and University of the Witwatersrand. Degrees are conferred by the respective departments, schools and faculties.

#### 3.1 Masters students

Paul Barasa	MSc Geoinformatics	Dr Joel Botai (SAWS) and Prof Ludwig Combrinck (HartRAO)
Michelle Bester	MSc Geoinformatics	Philemon Tsele (GGM) and Dr Joel Botai (SAWS)
Yvette Bevis	MSc Geoinformatics	Prof Serena Coetzee (GGM) and Victoria Rautenbach (GGM)
Sean Cullen	MSc Geoinformatics	Dr Joel Botai (SAWS) and Dr Abubekar Hassen (Animal and Wildlife Sciences)
Mauritz de Bruin	MSc Geoinformatics	Dr Peter Schmitz (CSIR) and Prof Paul Sumner (GGM)
Niell du Plooy	MSc Geoinformatics	Dr Peter Schmitz (CSIR)
Joos Esterhuizen	MSc Geoinformatics	Prof Paul Sumner (GGM)
Melissa Hankel	MSc Geoinformatics	Prof Serena Coetzee (GGM), Philip Frost (CSIR) and Graeme McFerren (CSIR)
Susan Henrico	MA Geography	Prof Serena Coetzee (GGM) and Dr Antony Cooper (CSIR)
Samy Katumba	MSc Geoinformatics	Prof Serena Coetzee (GGM)
Bhekani Khumalo	MSc Geoinformatics	Dr Joel Botai (SAWS) and Dr George Chirima (ARC)
Madodomzi Mafanya	MSc Geoinformatics	Philemon Tsele (GGM) and Dr Joel Botai (SAWS)
Mbali Mahlayeye	MSc Geoinformatics	Dr Joel Botai (SAWS) and Dr Abel Ramoelo (CSIR)
Zinhle Mashaba	MSc Geoinformatics	Dr Joel Botai (SAWS), Dr George Chirima (ARC) and Prof Ludwig Combrinck (HartRAO)
Lisa Mbwia	MSc Geoinformatics	Dr Joel Botai (SAWS) and Prof Ludwig Combrinck (HartRAO)
Christiaan Schutte	MSc Geography	Prof Greg Breetzke (GGM) and Prof Marion Meyer (Plant Science)
Lourens Snyman	MA Geography	Prof Serena Coetzee (GGM)
Petronella Tizora	MSc Geoinformatics	Dr Antony Cooper (CSIR), Alize le Roux (CSIR), Gerbrand Mans (CSIR)
Wesley Walford	MSc Geoinformatics	Prof Serena Coetzee (GGM) and Dr Terence van Zyl (Wits)

#### 3.2 Doctoral students

Abiodun Adeola	PhD Geoinformatics	Dr Joel Botai (SAWS) and Dr Jane Olwoch (SANSA)
Omolola Adisa	PhD Geoinformatics	Dr Joel Botai (SAWS), Dr Daniel Darkey (GGM) and Dr Hassen Abubekar (Animal and Wildlife Sciences)
Yahaya Aliyu	PhD Geoinformatics	Dr Joel Botai (SAWS) and Prof Hannes Rautenbach (SAWS)
Antony Cooper	PhD IT	Prof Serena Coetzee (GGM) and Prof Derrick Kourie (Computer Science)

Ivan Henrico	PhD Geoinformatics	Prof Ludwig Combrinck (HartRAO)
Lauren Hankel	PhD Geoinformatics	Prof Serena Coetzee (GGM) and Dr Peter Schmitz (CSIR)
Sibusiswe Hlela	DPhil Geography	Prof Serena Coetzee (GGM) and Antony Cooper (CSIR)
Olalekan Isioye	PhD Geoinformatics	Dr Joel Botai (SAWS) and Prof Ludwig Combrinck (HartRAO)
Edward Kurwakumire	PhD Geoinformatics	Prof Serena Coetzee (GGM) and Dr Peter Schmitz (CSIR)
Precious Mahlangu	PhD Geoinformatics	Dr Renaud Mathieu (CSIR) and Dr Konrad Wessels (CSIR)
Russell Main	PhD Geoinformatics	Dr Konrad Wessels (CSIR) and Dr Renaud Mathieu (CSIR)
Ermos Malahlela	DPhil Geography	Dr Joel Botai (SAWS) and Dr Jane Olwoch (SANSA)
Webby Miyoba	PhD Geoinformatics	Dr Joel Botai (SAWS) and Prof Ludwig Combrinck (HartRAO)
Mbali Mlangeni	PhD Geoinformatics	Prof Ludwig Combrinck (HartRAO)
Cilence Munghemzulu	PhD Geoinformatics	Dr Joel Botai (SAWS) and Prof Ludwig Combrinck (HartRAO)
Ivan Muzondo	PhD Geoinformatics	Dr Joel Botai (SAWS) and Prof Ludwig Combrinck (HartRAO)
Laven Naidoo	PhD Geoinformatics	Dr Renaud Mathieu (CSIR) and Dr Konrad Wessels (CSIR)
Kuhle Ndyamboti	PhD Geoinformatics	Dr Renaud Mathieu (CSIR) and Dr Konrad Wessels (CSIR)
Marisa Nickola	PhD Geoinformatics	Prof Ludwig Combrink (HartRAO), Dr A de Witt (HartRAO) and Prof J Böhm (TU Vienna)
Wiafe Owusu-Banahene	PhD Geoinformatics	Prof Serena Coetzee (GGM)
Victoria Rautenbach	PhD Geoinformatics	Prof Serena Coetzee (GGM) and Dr Arzu Çöltekin (University of Zürich)
Bolelang Sibolla	PhD Geoinformatics	Prof Serena Coetzee (GGM) and Dr Terence van Zyl (Wits)
Kisco Sinvula	PhD Geoinformatics	Prof Serena Coetzee (GGM)
Dinao Tjia	PhD Geoinformatics	Prof Serena Coetzee (GGM)
Philemon Tsele	PhD Geoinformatics	Prof Ludwig Combrinck (HartRAO)

# 2016 Highlights

Activities in 2016 continued to contribute towards achieving the CGIS vision: striving to be an internal platform for GISc at UP, a facilitator of collaborations in GISc research and education, and a partner to the GISc industry. Highlights of 2016 activities are provided in this section.

## 1. Internal platform at UP

CGIS aims to be an internal platform at UP from where the excellence of UP individuals and teams involved in GISc research, education and training, professional development and community engagement is supported and strengthened. Information about such internal activities is provided in this section.

### 1.1 Unit for Geoinformation and Mapping (UGM)

The UGM (represented by Ms Ingrid Booysen and Ms Petronella Tizora) delivers mainly GIS and cartographic services and support to students and staff from various departments in almost every faculty at UP regarding geoinformation and mapping. The Department is also the custodian for GIS software licenses for the University of Pretoria. It also provides geospatial and geographic information on a local server and people can access the data on campus. Apart from services to the Department of Geography, Geoinformatics and Meteorology, the departments of Architecture, Consumer Science, Landscape Architecture, Town and Regional Planning, Environmental Health, Consumer Science, Geology, Civil Engineering, Plant Sciences, Veterinary Sciences, Zoology and Entomology, Animal and Wildlife Sciences, Historical & Heritage Studies, Anthropology and Archaeology, the Centre for Environmental Studies, Department of Construction Economics, UP Natural Hazard Centre Africa and the Centre for the Advancement of Scholarship received UGM assistance in 2016.

The UGM liaises and acquires (either by contract, MOU or public domain data) with various institutions for geographic information, such as cadastral data, floodline and stormwater channel information, points of interest, stand (erf) numbers, street addresses and aerial photos from the City of Tshwane. Satellite imagery from SANSA (South African Space Agency) especially the SPOT satellite data are provided to the University on an annual basis. Other datasets include Eskom's categorized Spot Building Count and environmental spatial data from SANBI (South African National Biodiversity Institute), the Department of Water Affairs and the Department of Environmental Affairs. Updated National Map Series data on a 1:50 000 (vector and raster data), 1:250 000 and 1:500 000 scale is acquired on an annual basis from the Department of Development and Land Affairs, section National Geospatial Information (NGI). Historical data is acquired upon request. The South African Census attribute data is available from a desktop with the SuperCross software in the UGM. SuperCross allows cross tabulations of all kinds of surveyed parameters for Census 2011 (from Statistics South Africa). The output, if correctly designed, can be linked directly to the various administrative units of South Africa in any GIS for analysis and representation. The SuperCross software is freely available to students and staff on the UGM server (FIRE\campus) for installation onto their own desktops or notebooks. Earlier demographic attribute data from Census Years, 1996, 2001 are also electronically available to be manipulated for use in the GIS system.

Esri ArcGIS and ENVI (remote sensing) software licenses were again purchased (with the aid of faculty funds) for the year of 2016. These commercial software packages are used for training purposes in various departments and across various faculties to mainly undergraduate students but also to Geoinformatics postgraduates. All enrolled students and staff of UP can install the ArcGIS software on their notebooks for off-campus use for a year. After that the license needs to be renewed.

In addition to the annual ArcGIS software site license, ESRI offers various types of learning material (Web Courses, Training Seminars, Massive Online Open Courses (Moocs), Tutorials and applicable videos), to members of this academic institution for free. Students and staff need to be registered by the ArcGIS administrator (which is housed in the Unit for Geoinformation and Mapping) to be a member of the organization of UP. Except for the abovementioned advantage, the person also has access to ArcGIS Online with an endless map gallery to use in ArcMap (NDVI maps, background terrain maps, Landsat imagery, Open Source street maps, and many more). Academic departments having used these ArcGIS functions in 2016, are students from the Departments of Geography, Geoinformatics and Meteorology, Centre for Wildlife Management, Centre for Environmental Studies, Geology, Plant Science, Architecture, Landscape Architecture, Theology, Zoology and Engineering.

Under- and postgraduate students are supported with step-by-step user-friendly manuals for some of the software products (e.g. ArcGIS, SuperCross for Census 2011 data).

Except for the various site- and orientation maps the cartographers electronically compile for journals, dissertations and theses, they recommend trustworthy websites to students where specific geospatial datasets are required, and assist students with projecting their layers, cleaning the data, manipulating the data, geoprocessing, statistically analysing and visualising the data.

During the year personnel at the UGM prepares, on a continuous basis, information panels (including maps) for a 'conservation interpretation and support' project on the description and interpretation of the geology and the identification of geological features in the Kruger National Park. One of the purposes of the project is to identify sites of geological, geomorphologic and associated processes active in the formation of geological features in the park. Posters (maps, photo's, graphs, artwork, explanatory notes) and models of geological features or landscapes (sitiescapes) are included in exhibitions in the park with the aim to introduce, inform and educate the general public on the geological landscape and associated geosites in the Kruger National Park. The maintenance of the Park's Conservation Information Panels and Exhibits is an ongoing project.

UGM staff have also been involved in writing or co-authoring peer-reviewed articles and chapters in academic books on various research topics in 2016. Proof of these articles been recorded in the University of Pretoria's RIM (Research Information System).

### **1.2 Undergraduate teaching**

Undergraduate geoinformatics modules are not only included in the BSc Geoinformatics degree, but also in many other degrees presented in the Faculties of Natural and Agricultural Sciences; Education; Humanities; and Engineering, Built Environment & Information Technology:

- BSc Environmental Sciences, Faculty of Natural and Agricultural Sciences
- BSc Geography, Faculty of Natural and Agricultural Sciences
- BSc Meteorology, Faculty of Natural and Agricultural Sciences
- BSc, Faculty of Natural and Agricultural Sciences
- BSc Information technology, information and knowledge systems (GIS elective group) (Faculty of Engineering, Built Environment and Information Technology)
- BScArch, BScLArch, Faculty of Engineering, Built Environment and Information Technology
- BA, B Political Sciences, B Heritage and Cultural Sciences, B Sports Psychology, Faculty of Humanities

Apart from the above, many students from these faculties register for geoinformatics elective modules. A wide range of software products IS used in teaching geoinformatics modules to ensure that students grasp the geoinformatics theory and fundamentals, and do not get used to pressing buttons in software. The most widely user products are listed below.

- |                          |                   |                        |                          |
|--------------------------|-------------------|------------------------|--------------------------|
| - AfriGIS GISlike        | - deegree         | - Enterprise Architect | - PostgreSQL and PostGIS |
| - AfriGIS JavaScript API | - ENVI, ENVI IDL  | - Leaflet JS API       | - Quantum GIS (QGIS)     |
| - ArcGIS                 | - Erdas           | - MapWindow            | - R (statistics)         |
| - GeoDa                  | - MapInfo         | - OpenLayers API       | - Rasdaman               |
| - GeoServer              | - Microsoft Excel | - OpenStreetMap        | - SAGA                   |

### **1.3 Geoinformatics project**

UP has a long-standing partnership with the Viva Foundation, in the Alaska informal settlement in the City of Tshwane, to improve the safety of the informal settlement dwellers. The Viva Foundation aims to transform informal settlements and other high-priority poverty areas into stable and economically viable communities ([www.viva-sa.co.za](http://www.viva-sa.co.za)). Amongst others, the Viva Foundation coordinates the South African People's Response Initiative (SAPRI) project, which provides the settlement dwellers with panic buttons that can be used to call for assistance in case of emergencies. Since 2015, the final year geoinformatics students have contributed to the SAPRI project that is currently paper based, by mapping the most southern part of Alaska immediately surrounding the Viva centre. Viva community care workers accompanied the students to introduce them to the community members and to provide them with additional information about the community and its history.

Over the course of four days, 24 final year students captured and updated the locations of 1800 dwellings in Alaska, as well as information about each dwelling, such as the address and the use of the dwelling (e.g. home, tuck shop or shebeen). This digital information was handed to the SAPRI project. In addition, the students developed applications for the following: 1) data collection and analysis for the Viva Foundation school; 2) platform to enable recycling in the community; 3) management of the communal taps; 4) to log hazards in the community and to alert of these hazards; and 5) a mobile panic button to supplement the SAPRI project. Each of these addressed a specific need in the community. Project results are available at <http://www.up.ac.za/en/centre-for-geoinformation-science/article/2255428/geoinformatics-final-year-projects>.



The GMT 320 team at the Viva Foundation in the Alaska informal settlement in Mamelodi

This community project was integrated into the academic activities of the semester module, GMT 320 (Geoinformatics project). The module provides a unique first learning opportunity for the students to be involved in a real project with a client. Up until then, students work with hypothetical scenarios where “perfect” data and a breakdown of the solution are provided to them. For GMT 320, students have to implement the entire project management process, capture their own data, and then implement an innovative solution with the data they have captured. GMT 320 is also a first opportunity to work with handheld and differential global positioning system (GPS) devices and to gain fieldwork experience. This experience is invaluable to the students who will plan projects and capture data in the field during their professional careers.

Two students, Samantha Chamberlain and Zizo Vunguvungu, wrote a blog post for the YouthMappers blog about their experiences and lessons learned from mapping the informal settlement of Alaska, see <http://www.youthmappers.org/single-post/2016/11/02/Mapping-the-informal-settlement-of-Alaska-South-Africa>.

The geoinformatics project was selected as one of the winners of the GeoForAll Cartographic Challenge, and as a result the project was featured on a poster prepared by the International Cartographic Association (ICA) Commission on Open Source Geospatial Technologies. The poster is part of the collection of posters about the contribution of cartography to the United Nations Sustainable Development Goals (SDGs).

#### 1.4 Winning students

A peer-reviewed conference paper by **Zinhle Mashaba**, a Masters student at the Centre for Geoinformation Science (CGIS), was voted the **best academic paper at the Geomatics Indaba 2016**, held from 12 to 14 September 2016 at Emperors Palace, Kempton Park. Geomatics Indaba 2016 had two paper categories, one for general papers and another for peer-reviewed papers. The peer-reviewed papers are published in a special issue of the South African Journal of Geomatics.



Zinhle Mashaba’s paper was voted the best academic paper at the Geomatics Indaba 2016

Zinhle’s paper was entitled “*Evaluating spectral indices for winter wheat health status monitoring in Bloemfontein using Landsat 8 data*”. Spectral indices derived from remotely sensed satellite images give an indication of crop vigour early in the season. However, not much research has been done on investigating which indices are best related to winter wheat health status in South Africa. The research focused on identifying spectral indices that can be used for crop monitoring so that farmers can modify their irrigation programs or applications of fertilisers, pesticides or herbicides to improve wheat growth in stressed areas. This particular application can help to ensure food security, as wheat is a staple food for most South Africans. Additionally, farmers can save money on doing manual field surveys because satellite images cover a large area. Zinhle’s research was funded by the Agricultural Research Council (ARC).

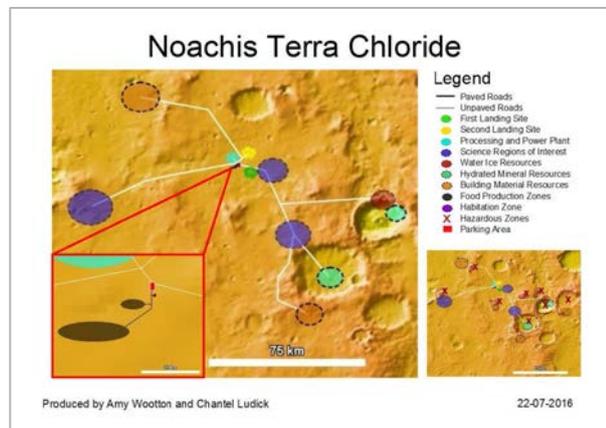


Kathryn Arnold receives the 2016 Esri Young Scholar Award from Jack Dangermond (President, Esri)

**Kathryn Arnold** won the **Esri Young Scholar Award** for her third-year project titled, 'A GIS-based response time and risk analysis of municipal firefighting services in the Alaska informal settlement'. Winning this award entitled Kathryn to attend the Esri User Conference in San Diego (USA) in June 2016. The conference was attended by 16,000 geographic information system (GIS) users, managers and developers, and featured more than 300 moderated sessions, as well as technical training.

The practical component of Kathryn's project was dubbed the Alaska Fire Management Project, and was conducted between July and November 2015. With a focus on shack fires in the informal settlement of Alaska (in Mamelodi East, Pretoria), the project used the ArcGIS software and the ArcGIS Web AppBuilder to measure response times and analyse the risk associated with municipal firefighting services. The final deliverables of the project included a web application, 3D models and hardcopy maps that visualised areas at high risk for fires in the Alaska informal settlement.

**Amy Wootton and Chantel Ludick**, both final-year Geoinformatics students in 2016, were placed third in the student section of the **International Cartographic Association's (ICA) Mars Exploration Zone Map Design Competition**. They received a geological map of Mars as the prize. NASA is planning a space mission to Mars in the 2030s. To support this mission, the planetary science community proposed 47 landing sites or exploration zones in 2015. The aim of the ICA's Mars Exploration Zone Map Design Competition was to contribute to the mapping of each of these landing sites to aid in the selection of the final landing site.



The map by Amy Wootton and Chantel Ludick for the ICA's Mars Exploration Zone Map Design Competition

Amy and Chantel mapped the Noachis Terra Chloride. Noachis Terra Chloride is well known for its abundance in chloride deposits, and a crater found within this region of interest contains features correlated with subsurface water ice. The purpose of this map is to create a visual representation of the Noachis Terra Chloride Exploration Zone, in order to aid explorers by mapping the selected exploration zone.



Team Apex PentaVertix

Front left to right: Valentine Ragoasha and Sedgeley Penniken. Back left to right: Kevin Potgieter, Daphney Vunguvungu and Frikan Erwee.

The two teams from UP, Apex PentaVertix (Daphney Vunguvungu, Frikan Erwee, Kevin Potgieter, Sedgeley Penniken and Mabutsu Valentine Ragoasha) and the Alaskan Assimilators (Samantha Chamberlain, Larissa

**Two UP teams were among the top 12 finalists in the Responsive Cities Challenge**, with more than 100 entries received nationally. This is an open data challenge organised by the Open Government Partnership South Africa (OGP SA), the Open Data Institute (ODI) and a number of local partners such as the Innovation Hub and youth IT organisation, Geekulcha, and aims to encourage developers, designers, researchers and entrepreneurs to use available open data from various cities across South Africa to develop applications, stories and visualisations that can help residents work better with local government.

Pillay, Lehlohonolo Thiipe and Dominic Marule), were comprised of third year Geoinformatics students. The students entered their solutions for the challenges of respectively Ekurhuleni (*How can we use open data to assist residents that are at risk?*) and eThekweni (*How can eThekweni Municipality use open data to better connect government to citizens?*).

Team Apex PentaVertex was announced as the national winners of the Responsive Cities Challenge in early December, winning R60 000 along with an additional R300 000 seed funding for their prototype, VivaImpilo, which is a web-based business intelligence warning system aimed at providing relevant information to the communities within Ekurhuleni. Tiyani Nghonyama, COO and CTO of Geekulcha, said he was proud of the winning team. *'VivaImpilo created a system that will add value to the various communities within Ekurhuleni by providing an easy, effective way for the municipality to gather and analyse data to produce useful information for public use. This provides the capability to identify new opportunities, and to implement an effective strategy based on insights gained from the data,'* he explained.

**Tshepo Mamabolo**, a third year Geoinformatics student, was selected as the **overall winner for the Pretoria event of the International Open Data Day**. In South Africa, the open data quest movement has been rising in popularity. The concept of an open data quest was started by SciBraai and Code4SA. It is a South African initiative that encourages individuals from various backgrounds to discover and use South African open data to find interesting stories and create powerful visualizations. In 2016, to celebrate International Open Data Day, CGIS partnered with OpenUP (previously Code4SA), Geekulcha and Open Data Durban to host an open data quest in Cape Town, Durban and Pretoria. The aim of the event was to explore and create meaningful visualisations about local government budget (open) data from the South African National Treasury.



Participants in the Pretoria event of International Open Data Day, together with Mr Tiyani Nghonyama from Geekulcha on the far right.

At the Faculty of Natural and Agricultural Science Dean's Award Ceremony in May 2016, the **top 2015 students in Geoinformatics** were awarded for their achievements as follows:

- Best student in BSc (Hons) Geoinformatics: **Wickes van Heerden**. Prize money sponsored by GeoTerralimage.
- Best BSc (Hons) Geoinformatics project: **Wickes van Heerden**. Prize money sponsored by AfriGIS.
- Best Honours student in Remote Sensing: **Thorgny Fjastad**. Prize money sponsored by the South African National Space Agency (SANSA).
- Best BSc Geoinformatics graduate: **Kathryn Arnold**. Prize money sponsored by CONSAS Conferences.
- Best third year Geoinformatics student in Remote Sensing. **Kathryn Arnold**. Prize money sponsored by the South African National Space Agency (SANSA).



Wickes van Heerden with Dr Fanie Ferreira (GeoTerralimage)



Wickes van Heerden with Ms Marna Roos (AfriGIS)



Thorngny Fjastad with Dr Jane Olwoch (SANSA)



Kathryn Arnold with Dr Jane Olwoch (SANSA)



Kathryn Arnold with Mr Rajendh Salig (CONSAS Conferences)

## 2. Facilitator of collaborations

CGIS aims to be a facilitator of UP GISc research collaborations, education and training and professional alliances within South Africa and abroad. Ongoing and new collaborations are described in this section.

### 2.1 Agricultural Research Council (ARC)

In 2016, the CGIS collaboration with the Geoinformatics Division of the Agricultural Research Council (ARC)-Institute for Soil, Climate and Water (ISCW) was led by Dr George Chirima (ARC), Dr Joel Botai (SAWS), Mr Philemon Tsele and Mr Cilence Munghezulu, both from UP. Currently, the ARC has various projects that focus on agricultural applications. For example, remote sensing techniques are used to monitor the health status of various crops (wheat, maize, etc.) and to develop models that allow prediction of crop yield, grazing capacity, ecological modelling, climate systems and land cover/use applications.

The ISCW hosts databases that are national assets, including remote sensing, climate, soil and agriculture datasets. These datasets are used to model the risk and develop early warning systems that have wide application in earth science. CGIS students get exposure to these facilities and datasets, and the opportunity to contribute to the ongoing research at the ISCW. The skills that students acquire are more provide additional opportunities, beyond UP's current infrastructure. Therefore, ARC-ISCW is an important partner to CGIS.

In 2016, the Geoinformatics Division of the ARC hosted one CGIS Masters student, Ms Zinhle Mashaba and co-supervised the Honours project of Ms Janique Savy. Through this collaboration, Ms Zinhle Mashaba published one research article and Ms Janique Savy completed her project for BScHons Geoinformatics. The students benefited from the ARC through co-supervision by Dr George Chirima, financial support, the use of ARC equipment (spectrometer) and state-of-the-art laboratories and databases. The ARC also supported fieldwork for Mr Madodomzi Mafanya, an MSc student in Geoinformatics, by providing field equipment, such as the spectrometer, as well as services of an ARC Chief Research technician.

Notable accolades include Ms Zinhle Mashaba winning the best student peer reviewed paper at the Geomatics Indaba 2016 Conference. International travel to Germany was funded by the ARC for Ms Zinhle Mashaba to present her research at the International Crop Modelling (iCropM2016) Symposium in Germany.

## **2.2 CSIR Built Environment**

CGIS has a long-standing collaboration with CSIR Built Environment. Collaboration is mainly in the form of lecturing and postgraduate student supervision, but there are also other activities, such as assistance with replacement teaching when lecturers are on sabbaticals, and collaboration on joint research projects.

The CSIR Built Environment has currently two extraordinary lecturers in the Department of GGM, Dr Antony Cooper and Dr Peter Schmitz. Dr Schmitz takes responsibility (as contract lecturer) for the GIS 705, *Advanced geospatial data*, module in the BScHons Geoinformatics program. Dr Cooper contributes to lectures in COS 787, *Spatial databases*, and GIS 703, *GIS professional practice*, and in future, GIS 701, *Research Methods*. Furthermore, Dr Schmitz and Dr Cooper supervise Honours, Masters and PhD students, while Mr Gerbrand Mans co-supervises a Masters student and Ms Alize le Roux supervises Masters and Honours students.

Discussions are currently underway with the Green Scorpions from the Department of Environmental Affairs about establishing a baseline for natural cycad populations using the methodologies described in Mauritz de Bruin's Master's dissertation.

Niell du Plooy completed his MSc in Geoinformatics on the effects of leached TNT on plants and submitted it for examination. The project continues with plants in a greenhouse to confirm under controlled conditions the findings of the field experiment.

## **2.3 CSIR Meraka Institute**

The CSIR-Meraka Institute is an operating unit of the CSIR focused on Information and Communication Technology (ICT). CSIR-Meraka aims to contribute research and development outputs towards enhancing quality of life and economic competitiveness in South Africa and the continent through ICT. One of Meraka's five competence areas is Earth Observation Science and Information Technology (EOS IT) which focuses on 1) the extraction of geospatial information from large amounts of diverse observational (e.g. satellite earth observation, vessel positioning system) and modelled data for multiple applications and 2) building operational geospatial IT systems with an emphasis on using open standards and the latest geovisualization techniques. There are various collaborative activities between CGIS and CSIR-Meraka.

Dr Konrad Wessels is an extraordinary lecturer in the Department of GGM. He supervises postgraduate students and advises on the content of all the remote sensing modules in the department. He has also contributed with lectures and practicals, as well as practical assignments within GMA 705. Mr Graeme McFerren takes responsibility (as contract lecturer) for the GIS 706, *Internet GIS*, module of the BScHons Geoinformatics program. He also supervises Honours and Masters students, and explores joint R&D efforts with students. Dr Terence van Zyl, formerly from Meraka and now from Wits, co-supervises a number of students in the department.

## **2.4 CSIR Natural resources and the environment (NRE)**

The CSIR's Earth Observation (EO) research group in the NRE unit provides remote sensing research leadership in the field of Ecosystems Earth Observation in South Africa using LiDAR, hyperspectral, multispectral and Synthetic Aperture Radar (SAR) data products coupled with robust image analysis techniques and tools.

Collaboration between CGIS and the CSIR's EO research group has led to the provision of: (1) guest lectures on specialised EO topics (SAR and LiDAR technology, forest and rangeland assessment); (2) hands-on practical exercises on LiDAR, SAR and hyperspectral data; (3) access to specialised remote sensing equipment (GAMMA state-of-the-art SAR software, spectroradiometer, dark chamber for spectrum analysis, LAI meters); and (4) cutting-edge EO research activities to the CGIS under- and postgraduate students. In particular, experts within the EO research group, such as Dr Renaud Mathieu and Dr Abel Ramoelo provide substantial inputs in all the remote sensing modules (i.e. GMA 220, GMA 320 and GMA 705) and also for assisting with the design and execution of cutting-edge laboratory exercises that are well synchronized with the theory, particularly for the advanced remote sensing module (GMA 705) offered at postgraduate level.

Furthermore, this collaboration has led to joint supervision of various specialised EO research topics for postgraduates (4 PhD students) and subsequent publications of results in high impact journals in the field of remote sensing. The collaboration has led to 14 peer-reviewed papers published in ISI journals in the last three years. Laven Naidoo will complete his PhD on the use of optical and SAR data for monitoring woody cover in South African landscapes in 2017 and Russell Main is investigating hyper-temporal SAR technology with empirical and deterministic models for mapping woody biomass. Overall, the collaboration facilitates the exchange of knowledge and key technical skills between students and experts from the CSIR's EO research group, coupled with exposure to sophisticated remotely sensed data products, analytical techniques and equipment.

## **2.5 HartRAO**

CGIS and the Hartebeesthoek Radio Astronomy Observatory (HartRAO) have a long standing collaboration that is led by extraordinary professor Ludwig Combrinck (acting director of HartRAO) and Dr Joel Botai (recently moved from UP to South African Weather Service and now an extraordinary lecturer in the Department of GGM). HartRAO can be categorized as a geodetic and astronomical observatory. It has 26 m and 15 m Very Long Baseline Interferometry (VLBI) radio telescopes, Satellite Laser Ranging (SLR) (MOBLAS-6), Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) station, and a network of Global Navigation Satellite Systems (GNSS) stations. The observatory is currently building a VLBI2010 Global Observing System (VGOS) antenna with improved tracking and observational accuracies (mm) as well as a Lunar Laser Ranging (LLR) system.

The observatory defines modern geodesy and its high accuracy requirements in practice. It offers an opportunity for students at CGIS to learn about modern geodesy in practice, as this forms an integral part of the CGIS curriculum. Once a year, third year students have the opportunity to visit the observatory to complement the theory they learn in class. Prof Combrinck has provided supervision and financial support to Honours, Masters and PhD students and HartRAO also has post-doctoral opportunities in the field of geodesy.

Students supervised and co-supervised by Prof Combrinck and Dr Botai in the field of geodesy at CGIS are: Mr Cilence Munghemezulu (PhD Geoinformatics), Mr Philemon Tsele (PhD Geoinformatics), Mr Ivan Muzondo (PhD Geoinformatics), Mr O Isioye (PhD Geoinformatics), Mr Webby Miyoba (PhD Geoinformatics), Miss Lisa Mbwia (MSc Geoinformatics), Miss Zinhle Mashaba (MSc Geoinformatics) and Mr Paul Barasa. Many of these are international students from different countries in Africa, including Nigeria, Kenya and Zambia.

The aim of Mr Tsele's project is to develop a mathematical model for monitoring and controlling thermal variations on the Lunar laser ranging (LLR) telescope system based in HartRAO, and their effects on the operational and optical performance of the telescope. There is global interest in the modelling approach considered for implementing this project in comparison to existing approaches for different telescope systems, and how this will impact on the overall pointing accuracy of the telescope. In particular, the aforementioned mathematical model currently being developed is expected to contribute toward the achievement of a stringent pointing accuracy requirement of about 0.5 arcseconds to the retroreflectors mounted on the lunar surface. Such an achievement would guarantee future enhanced tests of Earth-Moon system dynamics e.g., Moon's motion around Earth, relative acceleration of both the Earth and Moon toward the Sun as well as the Moon's gradual recession from the Earth and consequent effect on the Earth's ocean tides. South Africa is expected to have the first LLR telescope located in the Southern Hemisphere; this would be an addition to the only five capable LLR stations based in the Northern Hemisphere at McDonald Observatory (Texas, U.S.A), Observatoire de la Côte d'Azur (France), Apache Point Observatory (New Mexico, U.S.A.), Matera (Italy) and Wettzell (Germany).

Mr Munghemezulu's PhD project is also linked to the HartRAO LLR project, and concerns the development and characterization of the very stable and accurate timing system required to measure the time-of-flight of laser pulses to the Moon and back. Both Mr Ivan Henrico and Mr Olalekan Isioye submitted their PhD theses at the end of 2016. Miss Lisa Mbwia and Mr Paul Barasa will in addition to the training received for their MSc studies, also undergo training on Satellite Laser Ranging (SLR), in particular using the newly installed Russian SLR at HartRAO. The data obtained will be used for their future studies, as they both plan to commence with PhDs after completion of their MSc degrees.

## **2.6 Karlsruhe University of Applied Sciences, Germany**

Since September 2015, the Baden-Württemberg Stiftung has supported the 'Geomatics and Participation Summer School – a study of and research in the tension field between a European technology region and an African emerging country.' The project between UP and Karlsruhe University of Applied Sciences (HsKA) falls under the Baden-Württemberg-STIPENDIUM für Studierende – BWS plus programme. The project runs for three years and project funding amounts to 125,000 €. The purpose of the project is to initiate long-term collaboration between German and South African universities, e.g. through a summer school at each university during which students of both universities collaborate on a project. A number of student exchanges are also planned.

In 2016, the first summer school was hosted in Karlsruhe, Germany. Smartphone apps were developed to facilitate increased citizen participation in nature conservation. Eight Honours students from UP and six Masters students from HsKA participated in the summer school, coordinated by Prof Dr Gertrud Schaab and Mr Christian Stern from the Faculty of Information Management and Media at HsKA. Prof Serena Coetzee and Dr Victoria Rautenbach from UP accompanied the South African students. The summer school comprised lectures, hands-on development, fieldwork testing and some social activities to get to know each other and the country. More information about the summer school is at <https://www.hs-karlsruhe.de/en/the-university/about-hska/press-releases/geomatics-participation-summer-school.html> and the students' impressions of the summer school are reflected in a blog at <https://bwsgeomaticsandparticipation.wordpress.com/>.



The South African Consul-General, Mr George Monyemangene, greets the participants of the 'Geomatics and Participation' Summer School (Photo: John Christ/HsKA)



Summer school participants at the Rastatter Rheinaue nature conservation area, close to Karlsruhe in Germany

Two BSc Hons Geoinformatics students, Kathryn Arnold and Kathleen Godfrey, departed in September 2016 to Karlsruhe. They will complete the winter semester from October 2016 to mid March 2017 at the HsKA. They will receive credits for the modules completed in Germany towards their UP BScHons Geoinformatics degrees.

In 2017, a winter school will be hosted in Pretoria, another two Honours students will complete the winter semester at the HsKA, and we are also expecting a research visit by a HsKA Masters student.

### **2.7 Katholieke Universiteit Leuven, Belgium and Technical University of Delft, Netherlands**

During her sabbatical in 2016, Prof Serena Coetzee visited Prof Joep Crompvoets at the Katholieke Universiteit Leuven in Belgium and Prof Jantien Stoter and Dr Bastiaan van Loenen at the Technical University of Delft in the Netherlands. The aim was to conduct joint research on the development and use of standards for making geospatial data from local authorities available and accessible (see also visit to TU Delft below). The focus was on addresses, because they are typically created and maintained within a municipality, but used beyond the jurisdictional boundaries of an individual municipality.

The Netherlands government has established 12 base registers as a central source of vital information about citizens, companies and organizations. The aim with the registers is to create a single authentic source of reference of such quality that government can use the information in its work without further investigation. The registers are essential for service delivery by the government to its citizens, but also play a role in maintaining public order and safety, in combating fraud and in policy development.

One of these registers, the *Basisregistraties adressen en gebouwen (BAG)*, includes address data. BAG is both a source of reference for the current state of addresses, as well as a register of authentic documents that provide the justification for and background of each current address. A large number of stakeholders coordinate the collection, quality control and dissemination of this register. Prof Coetzee interviewed representatives of these stakeholders.

The 'Centraal ReferentieadressenBestand' (CRAB) is a digital authoritative address dataset for Flanders, one of three regions in Belgium. In the context of an information-driven government, addresses play an important role in linking different kinds of government-related information to each other. For reliable linking, different authorities have to use the same addressing terminology and address data. Municipalities are responsible for maintaining the address data, while the Flemish government has ownership of the authoritative dataset of addresses. Government departments in Flanders are obliged to use CRAB address data and to report any errors detected in the data (reference).

Joint papers about the BAG and CRAB research results respectively are in preparation, and a comparative paper between BAG and CRAB are in preparation.

### **2.8 South African National Space Agency (SANSA)**

SANSA's mandate is "to provide for the promotion and use of space and cooperation in space related activities, foster research in space science, advance scientific engineering through human capital and support the creation of an environment conducive to industrial development in space technologies within the framework of national government policy".

Since 2011, there has been on-going collaboration between SANSA and CGIS. This collaboration is characterized by: (1) joint supervision of MSc and PhD Geoinformatics students'; (2) provision of postgraduate bursaries to both local and international students; (3) organized field trips to SANSA in order for students to get exposure to ground space station equipment and the associated operations such as satellite signal tracking and receipt; (4)

provision of satellite-derived imagery or Earth Observation (EO) data products as well as, lending of specialised remote sensing equipment, such as the hand-held spectroradiometer for acquisition of hyperspectral insitu measurements; and (5) calls for participation in capacity building workshops focusing on EO Science and satellite image processing for both students and staff. For the past few years, SANSA has also sponsored student prizes for the best third year student in remote sensing, and the best Honours student in remote sensing.

These opportunities have been realised through CGIS with remote sensing lectures by Dr Joel Botai and Mr Philemon Tsele in the past 5 years, due to continued support and commitment by SANSA's executive leadership, in particular Dr Sandile Malinga and Dr Jane Olwoch, who is also an extraordinary lecturer in the department.

### **2.9 UP Department of Family Medicine**

Since 2016, CGIS collaborates with the Department of Family Medicine, primarily on data collected through their Community Oriented Primary Care (COPC) project. COPC is an internationally recognised set of principles and practices that has been developed to support universal health care. It is organised to provide comprehensive services to individuals and families in geographically defined communities. Services are based on health information that is collected from, analysed and used to respond to local health needs according to the Equity Principle. This ensures that every one with the same need gets the same attention, and that resources are put where the needs are greatest – both in system terms (ward health teams in communities) and service terms (prioritising local individual, family and community needs). Health services are organised from and responses are tailored to the information collected from specific individuals and families living and working in defined geographic places. In this way COPC requires that services are integrated around users – i.e. they are person and family centred and they support relationship, information and service continuity.

In 2016, two Honours students, Claudio Duarte and Ruhee Maharaj, completed their Honours projects on data collected by COPC community health workers. Claudio evaluated different geo-masking methods for protecting the COPC household location information privacy, while Ruhee developed a tuberculosis vulnerability index. A number of new Masters students were assigned topics related to COPC data and will start working on these in 2017.

### **2.10 UP Department of Statistics**

Prof Gregory Breetzke (CGIS) has established a working relationship with Dr Inge Fabris-Rotelli from the Department of Statistics. Prof Breetzke and Dr Fabris-Rotelli recently published a paper in the ISI-rated *Australian and New Zealand Journal of Criminology* and are currently collaborating on another project that is investigating the spatial diffusion of crime around schools in Khayelitsha, Cape Town. They are currently in discussions about jointly supervising Honours students from 2018 onwards.

## **3. Community Engagement**

CGIS members are actively engaged with the geoinformatics community as part of their education and research, both locally and internationally. Selected involvements are described in this section.

### **3.1 Geo For All**

CGIS has been a member of Geo For All since 2012. Geo For All is the Open Source Geospatial Foundation's (OSGeo) Committee for Educational outreach and works in close collaboration with the International Cartographic Association (ICA), the International Society for Photogrammetry and Remote Sensing (ISPRS), the United Nations GIS and other partners worldwide in our mission for making geospatial education and opportunities accessible to all. Central to mission of Geo For All is the belief that knowledge is a public good and that open principles in education will provide great opportunities for everyone. Though the members of our community hail from many different backgrounds, we all seek to eliminate the digital divide and empower all as full citizens and contribute to building open knowledge for the benefit of society and for future generations.

In 2016, Victoria Rautenbach was honoured as Geo For All GeoAmbassador for her enthusiastic contribution to open source / open data / open education work at the University of Pretoria. She uses open source software, such as QGIS, GeoServer and PostGIS, in the modules that she teaches and she is the first port of call for open source software support for students. She engages students in open data events and has arranged a number of events to introduce geoinformatics to schoolchildren.

## GeoAmbassador of the month – Victoria Rautenbach

Posted on November 3, 2016 by Suchith Anand

It is my great pleasure to introduce **Victoria Rautenbach** from the Centre of Geoinformation Science (CGIS) at the University of Pretoria (UP) in South Africa, as our GeoAmbassador. It is even more great pleasure to have another GeoAmbassador **Dr. Serena Coetzee** (the GeoForAll chair of Africa and who all of our colleagues will already know) who nominated Victoria for us. I have been always amazed and inspired by the work that Serena and colleagues have been doing in South Africa. I first met Serena at ICC Dresden in 2013 where she also presented her ideas at the ICA Commission meeting of Open Source Geospatial Technologies meeting. I have not yet got the opportunity to meet Victoria but I am aware of her great work and contributions to Open Principles in Geo Education. I want to thank Serena for introducing to us a great colleague as our GeoAmbassador of the month and sending us all the details.



Announcement of Victoria Rautenbach as GeoAmbassador of the month on the website of the ICA Commission on Open Source Geospatial Technologies

<http://opensourcegeospatial.icaci.org/2016/11/geoambassador-of-the-month-victoria-rautenbach/>

The Geo For All labs have identified some collaborative research and education areas (e.g., OpenCitySmart, GeoAgriculture), and there are some significant collaborations going on across different nodes (see map of lab locations), such as the NASA Europa Challenge. The labs are continuously seeking for opportunities to improve their collaboration in education and research, and CGIS participates in these initiatives.



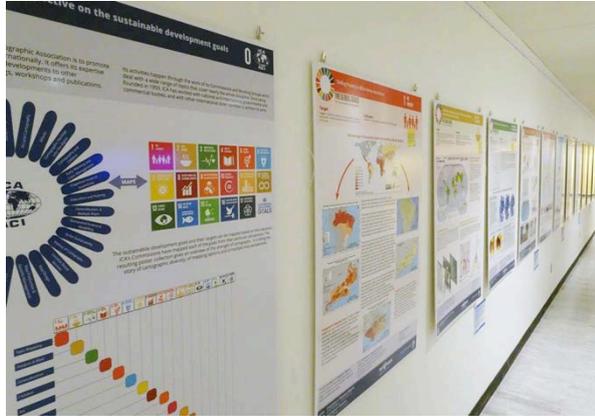
Locations of 120+ Geo For All labs (Source: GeoForAll website, <http://www.geoforall.org/locations/>)

### 3.2 International Cartographic Association (ICA)

Dr Peter Schmitz is the Chair of the *ICA Commission on Map Production and Geoinformation Management* (<http://mapproduction.icaci.org/>). The Commission presented a Workshop on Service-Oriented Mapping: From SDI to thematic webmaps (in German language) in the form of a pre-conference hands-on workshop during the 64th German Day of Cartography on 13 June 2016 in Potsdam. The second activity in 2016 was the Commission's stream at the 2016 Geomatics Indaba, however, owing to few papers received it was slotted into the general academic track of the conference.

Serena Coetzee is the Chair of the *ICA Commission on SDI and Standards* (<http://sdistandards.icaic.org>). A Commission meeting was held on the weekend before the AGILE 2016 conference in Helsinki (Finland) in June 2016. The meeting was used mainly to initiate research on a paper about Academic SDIs (spatial data infrastructures), aimed for submission to the International Cartographic Conference 2017 in Washington DC (USA).

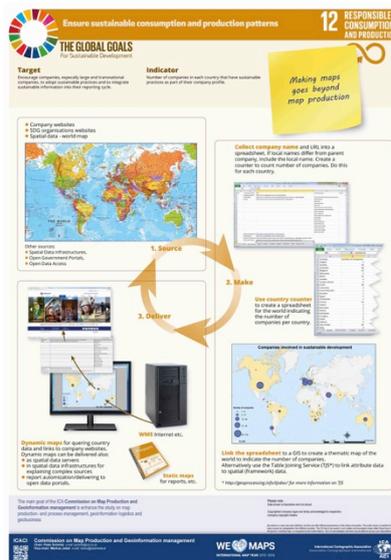
Both Commissions contributed to the ICA's poster collection with a cartographic perspective on the United Nations Sustainable Development Goals (SDGs). CGIS also contributed to the poster prepared by the ICA Commission on Open Source Geospatial Technologies. The poster collection gives an overview of the strength of cartography, telling the story of cartographic diversity, of mapping options and of multiple map perspectives. The collection was exhibited at the United Nations Headquarters in New York (USA) during the 6th Session of the Committee of Experts on Global Geospatial Information Management (UN-GGIM) in August 2016. The posters are downloadable from <http://icaci.org/maps-and-sustainable-development-goals/>.



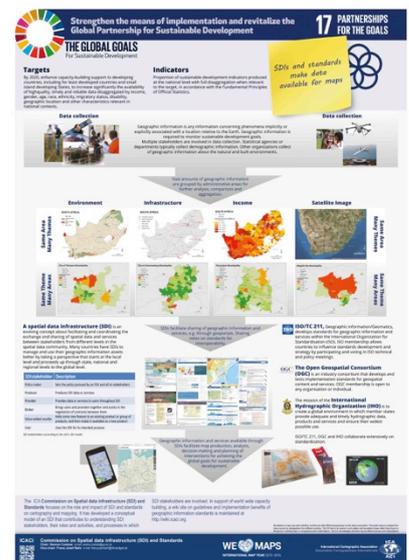
ICA poster collection on UN SDGs exhibited at the United Nations in New York (USA) in August 2016



UN SDG 10: Reduce inequality within and among countries (prepared by the ICA Commission on Open Source Geospatial Technologies)



UN SDG 12: Ensure sustainable consumption and production patterns (prepared by the ICA Commission on Map Production and Geoinformation Management)



UN SDG 17: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development (prepared by the Commission on SDI and Standards)

### 3.3 International Society for Photogrammetry and Remote Sensing (ISPRS)

Victoria Rautenbach is actively involved in the ISPRS. She was reappointed as the research secretary of the ISPRS working group (WG) WG IV/9 Geovisualization, Augmented and Virtual Reality (previously, II/6, Geographical Visualization and Virtual Reality). She is responsible for the day-to-day operations of the WG, e.g. updating the website and maintaining a social media presence together with the other leadership of the WG. In 2016, the XXIII ISPRS Congress took place in Prague, Czech Republic. The WG organised four sessions and two special sessions during the Congress. The WG's blog was redesigned in 2016, see <https://geoviz.casa.ucl.ac.uk>.

### 3.4 Standards development in South Africa and internationally

Antony Cooper, Serena Coetzee and Victoria Rautenbach actively participate in standards development in South Africa and have been nominated by the South African Bureau of Standards (SABS) to represent South Africa at the plenary meetings of the technical committee, ISO/TC 211, *Geographic information/Geomatics*, of the

International Organization for Standardization (ISO) ([www.iso.org](http://www.iso.org)) for several years now. While the South African Bureau of Standards (SABS) supports their travel and accommodation for the meetings. In Dr Cooper's case, the CSIR sponsors his time involved in standardization.

The three share their international experience with their South African colleagues by presenting short courses on geographic information standards, by presenting at workshops and conferences, by arranging workshops, by participating in the sub-committee on Standards of the Committee for Spatial Information (CSI), and by taking on leadership roles in the local standards development community. Serena Coetzee chairs the ISO/TC 211 Program Maintenance Group (PMG) and actively participates in the development of the ISO 19160 suite of addressing standards. Antony Cooper is convenor of Working Group 7, *Information Communities*, and leads the project for ISO 19126, *Geographic information – Feature concept dictionaries and registers*, and chairs the Ad hoc group on classification issues. Victoria Rautenbach chairs the ISO/TC 211 Advisory Group on Outreach. The three also actively contribute to the development of South African standard standards, such as SANS 1883 (addressing) and SANS 1876 (feature instance identifiers). A guide for standards implementation was written by the three authors and is now freely available online, see [wiki.icaci.org](http://wiki.icaci.org). Students are encouraged to participate in standards development and a number of them are now involved.

UP is a member of the Open Geospatial Consortium (OGC), one of only very few African members, see [www.opengeospatial.org](http://www.opengeospatial.org). OGC is an international industry consortium of more than 500 companies, government agencies and universities participating in a consensus process to develop publicly available interface standards. Examples of standards are the Geography Markup Language (GML), Keyhole Markup Language (KML) and Web Map Service (WMS). OGC membership gives students access to the OGC portal with the latest information on standards development and happenings at the OGC.

### **3.5 South African Committee for Spatial Information (CSI)**

The Committee for Spatial Information (CSI) is a statutory body established by the Spatial Data Infrastructure Act, No 54 of 2003. Serena Coetzee represents the Council on Higher Education on the CSI and chairs the Subcommittee on Education and Training, and Antony Cooper represents the CSIR on the CSI and chairs the Subcommittee on Standards.

### **3.6 South African Geomatics Profession Council**

Two staff members are registered with the South African Geomatics Profession Council: Joos Esterhuizen, as Surveyor (S0414) and Serena Coetzee as GISc Professional (PGP1245). Serena is a member of the Council, nominated by the Council on Higher Education, since 2015.

### **3.7 YouthMappers**

YouthMappers is a global network of student-led chapters that participate and organize mapping activities. YouthMappers embodies the ideal of a global community that collaborate to better the world. On 12 May 2016, the University of Pretoria's CGIS lab officially became an inaugural YouthMappers chapter. Dr Brent McCusker, Associate Chair of Geography at the University of West Virginia, visited UP and asked the students about their projects. He also invited students to further their GIS careers by applying for fellowships and grants through the network. The CGIS YouthMappers chapter focuses on three main activities: field mapping of the Alaska informal settlement (see also information about the geoinformatics project), student map-a-thons, and community engagement.



CGIS YouthMappers map-a-thon, October 2016



The YouthMappers International Team, November 2016, Zomba, Malawi

A number of student map-a-thons were held in 2016, typically lasting an hour or two. The main map-a-thon was held in October 2016 with the aim of contributing to the Peace Corps efforts in Botswana, an aim defined by the Humanitarian OpenStreetMap Team (HOT), to improve the base map for 45 sites in Botswana. The students YouthMappers mapped buildings and roads that would ultimately support long-term development and HIV projects in Botswana. The group used OpenStreetMap and MapSwipe during the map-a-thon. Apart from contributing to the HOT task, the map-a-thon was a social event for CGIS YouthMappers to round off a good year.

Sean Cullen and Michelle Bester, both busy with their MSc Geoinformatics at UP, were selected to participate in the first International Joint Youth Mappers training in November 2016 in Zomba, Malawi. The event allowed the YouthMappers from the two chapters to exchange information and share experiences. They were also trained to use various OpenStreetMap platforms. Dr. Brent McCusker demonstrated the JavaOSM (JOSM) application for offline mapping and further explained how the information that YouthMappers are mapping will be used for decision-making. A YouthMappers blog post about the event is available at <http://www.youthmappers.org/single-post/2016/11/29/The-First-International-Youth-Mappers-Exchange-between-Malawi-and-South-Africa-Part-One>.

## 4. Partner to the geoinformation industry of South Africa

CGIS aims to be a partner to the South African geoinformation industry in support of GISc research, education and training, professional development, community engagement. A few highlights from 2016 are presented here.

### 4.1 2016 CGIS mini-conference

The 2016 CGIS mini-conference showcased 'GISc in research at UP'. In addition to the presentations by postgraduate students, three exchange students presented about their experiences: Yvette Bevis about her experiences as a South African students on a research visit to the Karlsruhe University of Applied Sciences in Germany; Anna Mantel from the Karlsruhe University of Applied Sciences in Germany related experiences as an intern at the City of Johannesburg Metropolitan Municipality; the eight Honours students presented their participation in the summer school at the Karlsruhe University of Applied Sciences in Germany; and Roy Krijger from the Saxion University of Applied Sciences, Deventer, Netherlands about his work on safety and security in public transport as an exchange student in South Africa. Despite venue challenges due to the student protests, approx. 75 students and professionals attended the mini-conference. Presentations are listed below.

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#### **Modeling land use change in the Western Cape Province**

*Petronella Tizora, MSc Geoinformatics, supervised by Alize le Roux, Antony Cooper, Gerbrand Mans*

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#### **Experiences of a South African exchange student at the Karlsruhe University of Applied Sciences, Germany**

*Yvette Bevis, UP exchange student to the Karlsruhe University of Applied Sciences, Germany*

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#### **A geographic accessibility analysis in Limpopo Province: Current and optimal provisioning of Thusong Service Centres**

*Lourens Snyman, MA Geography, supervised by Serena Coetzee*

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#### **Experiences of a Dutch exchange student working on safety and security of public transport in South Africa**

*Roy Krijger, Exchange student from the Saxion University of Applied Sciences, Deventer, Netherlands, hosted by Maryna Storie*

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#### **Analysing the practical feasibility of using FOSSGIS in military operations**

*Susan Henrico, MA Geography, supervised by Serena Coetzee, Antony Cooper*

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#### **Monitoring and analysis of growing vegetation endangering the operation of power lines in South Africa using multi-spectral satellite imagery**

*Michelle Bester, MSc Geoinformatics, supervised by Philemon Tsela, Joel Botai*

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#### **Determining pasture quantity using remote sensing in the Kalahari area**

*Sean Cullen, MSc Geoinformatics, supervised by Joel Botai, Abubeker Hassen*

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#### **Experiences of a German intern at the City of Johannesburg**

*Anna Mantel, Exchange student from the Karlsruhe University of Applied Sciences, Germany, hosted by Marcelle Hattingh at the City of Johannesburg Metropolitan Municipality*

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#### **Geomatics & Participation – reflection by the South African students**

*UP Honours students who participants in the July 2016 Summer School at the Karlsruhe University of Applied Sciences, Germany*

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#### **Analysing the influence of TNT on Southern African trees, grass and shrubs using in-situ hyperspectral data**

*Niell du Plooy, MSc Geoinformatics supervised by Peter Schmitz*

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#### **Evaluation of Fire Danger and Fire Potential Indices in South Africa**

*Melissa Burgess, MSc Geoinformatics, supervised by Phillip Frost, Serena Coetzee, Graeme McFerren*

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#### **Modelling dryland winter wheat yield using remotely sensed imagery and agro-meteorological parameters**

*Zinhle Mashaba, MSc Geoinformatics, supervised by Joel Botai, Georg Chirima, Ludwig Combrinck*

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#### 4.2 Awareness of geoinformatics as a career

In 2016, CGIS hosted three events to introduce school learners of various ages and backgrounds to geoinformatics. Geoinformatics is a fairly young science and unknown to the general public. Thus, events like these are critical to introduce the geoinformatics discipline to school learners and to inspire them to be passionate about mapping.

The first event took place on 16 June with Gr. 6 to 8 learners from the Leeuwenhof Academy in Johannesburg. The event was part of the YouthMappers initiative and arranged to celebrate National Youth Day in South Africa. A total of 55 learners participated in two events: 1) mapping a building on campus using ClassiCube; and 2) participating in the Humanitarian OpenStreetMap Team (HOT) task of mapping dwellings in Mozambique for US AID. This event ran concurrently with a YouthMappers event hosted by the Texas Tech University. During the two mapping events (i.e. at UP and Texas Tech), approximately 15,000 edits were made on this task (see <http://goo.gl/qst7Vu>).



Virtual meeting with school learners visiting Texas Tech



Leeuwenhof Academy learners

The second event on 20 August was intended for school learners interested in studying geoinformatics. Various schools from around Gauteng were invited and 43 learners attended the event. The majority of learners were from schools in Mamelodi, City of Tshwane, and even a couple of learners from KwaZulu-Natal and Limpopo participated. The day started with various short talks by UP staff members, current students and a professional from the industry. The talks provided insight into what to expect after completion of a geoinformatics degree. This was followed by a scavenger hunt during which the learners collected data on campus, and thereafter they used this data to create a map. A similar event was held on 9 September with the TuksSport School's Gr 11 geography students. Learners also gained hands-on experience with geoinformatics in the GIS lab.



Geospatial Tech Day



TuksSport school learners

The feedback from the learners and students who assisted was extremely positive. All three events were successful in promoting the potential of geoinformatics as a future career. CGIS would like to thank GISSA (Geo-Information Society of South Africa) for sponsoring transportation and lunch for the learners, and Esri South Africa for sponsoring prizes for the events. Lastly, we would like to express our gratitude to all the students that assisted with these events.

#### 4.3 Enterprises UP courses for professionals from industry

The GISc professional practice course was presented between July and November 2016 by Serena Coetzee and Stuart Martin from GeoTerraImage. The course is an opportunity for many geomatics practitioners who need

this certificate in order to meet the academic requirements of the SAGC academic model required for professional registration. Other specialized courses are presented from time to time and are registered with SAGC for CPD points, thus providing an opportunity for registered GISc practitioners to continue their professional development.

## 5. Research output

CGIS aims to be a facilitator of UP GISc research collaborations, education and training and professional alliances within South Africa and abroad. Research output published in 2016 is listed with the names of CGIS authors in bold.

### 5.1 Peer-reviewed journal articles

- Adeola AM, **Joel Botai**, Olwoch J, Rautenbach CJDW, Adisa OM, Taiwo O, Kalumba A (2016). Environmental factors and population at risk of malaria in Nkomazi municipality, South Africa. *Tropical Medicine & International Health*, 21 (5), May: pp. 675 - 686.
- Ayeni A, Cho A, **Renaud Mathieu**, Adegoke J (2016). The local experts' perception of environmental change and its impacts on surface water in Southwestern Nigeria. *Environmental Development*, 17 pp. 33 - 47.
- Gerrie du Rand, **Ingrid Booyesen**, Doreen Atkinson (2016). Culinary mapping and tourism development in South Africa's Karoo region, *African Journal of Hospitality, Tourism and Leisure*, 5(4).
- Ivan Henrico, **Ludwig Combrinck**, Corné Eloff (2016) Accuracy comparison of Pléiades satellite ortho-images using GPS device based GCPs against TerraSAR-X-based GCPs, *South African Journal of Geomatics*, 5(3), pp. 358-372.
- Sibusisiwe Hlela, **Serena Coetzee**, **Antony Cooper** (2016) Evaluating a Public Sector Organisation for SDI Readiness – The Case of a South African Government Department, *South African Journal of Geomatics*, 5(2), pp. 95-107.
- Isioye OA, **Ludwig Combrinck**, Botai C (2016). Modelling weighted mean temperature in the West African region: implications for GNSS meteorology. *Meteorological Applications*, 23 pp. 614 - 632.
- Kasza Z, Van De Kerchove R, Ramoelo A, Cho A, Modonsela S, Mathieu R, Wolff E (2016). Seasonal Separation of African Savanna Components Using Worldview-2 Imagery: A Comparison of Pixel-and Object-Based Approaches and Selected Classification Algorithms. *Remote Sensing*, 8 (8), pp. 1 - 19.
- Russel Main, **Renaud Mathieu**, Waldo Kleynhans, **Konrad Wessels**, Laven Naidoo, Asner G (2016). Hyper-Temporal C-Band SAR for Baseline Woody Structural Assessments in Deciduous Savannas. *Remote Sensing*, 8 pp. 1 - 19.
- Muchuru S, **Joel Botai**, Botai C, Landman WA, Adeola AM (2016). Variability of rainfall over Lake Kariba catchment area in the Zambezi river basin, Zimbabwe. *Theoretical and Applied Climatology*, 124 (1), pp. 325 - 338.
- Cilence Munghemezulu**, **Ludwig Combrinck**, **Joel Botai**, J Quick (2016) Analysis of the performance of hydrogen maser clocks at the Hartebeesthoek Radio Astronomy Observatory, *South African Journal of Geomatics*, 5(3), pp. 325-339.
- Cilence Munghemezulu**, **Ludwig Combrinck**, **Joel Botai** (2016). A review of the lunar laser ranging technique and contribution of timing systems. *South African Journal of Science*, 112 (3), pp. 1 -9.
- Cilence Munghemezulu**, **Ludwig Combrinck**, **Joel Botai**, Botha R (2016). Design of the timing system for the new Lunar Laser Ranger proposed for the Matjiesfontein Space Geodetic Observatory in the Great Karoo, South Africa: preliminary results. *South African Journal of Geology*, 119 (1), March: pp. 91 - 98.
- Cilence Munghemezulu**, **Ludwig Combrinck**, **Joel Botai**, Zinhle Mashaba (2016) Mapping GPS Multipath: a Case Study for the Lunar Laser Ranger Timing Antenna at HartRAO, *South African Journal of Geomatics*, 5(2), pp. 142-155.
- Zinhle Mashaba, **George Chirima**, **Joel Botai**, **Ludwig Combrinck**, **Cilence Munghemezulu** (2016) Evaluating Spectral Indices for Winter Wheat Health Status Monitoring in Bloemfontein using Lsat 8 data, *South African Journal of Geomatics*, 5(2), pp. 227-243.
- Zinhle Mashaba**, **Ludwig Combrinck**, **Joel Botai**, **Cilence Munghemezulu**, Botha R (2016). Design of a web-based GNSS data management system at HartRAO: preliminary results. *South African Journal of Geology*, 119.1 pp. 117 - 124.
- Laven Naidoo, **Renaud Mathieu**, Russel Main, **Konrad Wessels**, Asner G (2016). L-band Synthetic Aperture Radar imagery performs better than optical datasets at retrieving woody fractional cover in deciduous, dry savannahs. *International Journal of Applied Earth Observation and Geoinformation*, 52 pp. 54 - 64.
- Victoria Rautenbach**, **Serena Coetzee**, Danie Jooste (2016) Results of an evaluation of augmented reality mobile development frameworks for addresses in augmented reality, *Spatial Information Research*, 24(3), pp. 211-223.
- Peter Schmitz** (2016) The Use of Supply Chains and Supply Chain Management in the Production of Forensic Maps Using Data from a Fraud Case, *South African Journal of Geomatics*, 5(2), pp. 325-339.
- Philemon Tsele**, **Ludwig Combrinck**, Botha R, Ngcobo BL (2016). A proposed mathematical model of thermal variations on the HartRAO lunar laser ranging telescope for enhanced test of earth-moon system dynamics. *South African Journal of Geology*, 119 (1), pp. 83 - 90.

- Philemon Tsele, Ludwig Combrinck, Botha R, Bongani Ngcobo** (2016). Thermal analysis of the LLR optical telescope tube assembly based in Hartebeesthoek radio astronomy observatory. *Acta Geodaetica et Geophysica*, 51 pp. 393 - 403.
- Philemon Tsele, Ludwig Combrinck, Bongani Ngcobo** (2016) A spatiotemporal analysis of the effect of ambient temperatures on the thermal behaviour of the Lunar Laser Ranging optical telescope at Hartebeesthoek Radio Astronomy Observatory, *South African Journal of Geomatics*, 5(2), pp. 373-329.
- Konrad Wessels, Frans Van den Bergh, D Roy, B Salmon, K Steenkamp, B MacAlister D Swanepoel, D Jewitt** (2016). Rapid Land Cover Map Updates Using Change Detection and Robust Random Forest Classifiers. *Remote Sensing*, 8 (11), pp. 1 - 24.

### 5.2 Peer-reviewed papers presented at refereed conferences

- Petronella Tizora, Alize Le Roux, Gerbrand Mans, Antony Cooper** (2016) Land Use and Land Cover Change in the Western Cape Province: Quantification of Changes & Understanding of Driving Factors, *Proceedings of the 7th Planning Africa Conference 2016*, 4-6 July 2016.
- Bolelang Sibolla, Terrence van Zyl, **Serena Coetzee** (2016) Towards the Development of a Taxonomy for Visualisation of Streamed Geospatial Data, *The ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume III-2, 2016 XXIII ISPRS Congress, 12-19 July 2016, Prague, Czech Republic
- Victoria Rautenbach, Serena Coetzee, Melissa Hankel** (2016) Exploratory user study to evaluate the effect of street name changes on route planning using 2D maps, *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume XLI-B2, 2016 XXIII ISPRS Congress, 12-19 July 2016, Prague, Czech Republic.
- Victoria Rautenbach, Serena Coetzee, Arzu Coltekin** (2016), Investigating the use of 3D geovisualizations for urban design in informal settlement upgrading in South Africa, *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume XLI-B2, 2016 XXIII ISPRS Congress, 12-19 July 2016, Prague, Czech Republic.

### 5.3 Peer-reviewed chapters in books

- Serena Coetzee, Victoria Rautenbach** (2016) Reflections on a Community-Based Service Learning Approach in a Geoinformatics Project Module. In *ICT Education*, edited by Stefan Gruner, ISBN: 978-3-319-47679-7, pp. 143-159.
- Joan Fairhurst, Phillip Hattingh, Paul Sumner, **Ingrid Booyesen** (2016) A history of Geography at the University of Pretoria. In *The Origin and Growth of Geography as a Discipline at South African Universities*, edited by Gustav Visser, Ronnie Donaldson, Cecil Seethal, ISBN: 978-1-928357-25-4, pp. 33- 54.

### 5.4 Other

- Greg Breetzke** (2016). GIS and its role in crime prevention in South Africa. *PositionIT*, lead editorial, 7<sup>th</sup> September, 2016.
- Greg Breetzke, Elley B and Gilbert J** (2016). *Post-quake analysis of crime and alcohol in Christchurch*. Wellington: Health Promotion Agency.
- Serena Coetzee, 2016**. *SDIs, standards, cartography and local authorities*. Keynote address: GeoCart' 2016, Wellington, New Zealand, 2 September 2016.5

### 4.5 Postgraduate students

The titles of Doctoral theses, Masters dissertations and Honours projects of students graduating in 2016 are listed below. Their supervisors were from the Departments of Geography, Geoinformatics and Meteorology (GGM), Computer Science, the UP Natural Hazard Centre Africa and from the Agricultural Research Centre (ARC), City of Johannesburg, CSIR, South African National Space Agency (SANSA) and South African Weather Service (SAWS).

#### Doctoral theses

- Abiodun M Adeola** (2016). *Application of remotely sensed environmental variables for predicting malaria cases in Nkomazi municipality South Africa*, supervised by Joel Botai (SAWS) and Jane Olwoch (SANSA).
- Antony K Cooper** (2016). An exposition of the nature of volunteered geographical information and its suitability for integration into spatial data infrastructures, supervised by Serena Coetzee (GGM) and Derrick G Kourie (Computer Science).
- Wiafe Owusu-Banahene** (2016). *Evaluating different options of integrating linked open data into standard geospatial web services for thematic mapping*, supervised by Serena Coetzee (GGM).

#### Masters dissertations

- Mauritz de Bruin** (2016). *The application of Forensic Geomorphology in rhinoceros poaching (South Africa)*, supervised by Peter Schmitz (CSIR) and Paul Sumner (GGM).
- Erika Pretorius** (2016). *Analysis of vegetation structure in a trans-frontier savanna region using in-situ observations and SPOT 5 imagery*, supervised by Paul Sumner (GGM).

## Honours reports

- Kathryn Arnold** (2016). *Impact of three Gautrain Stations on Real Estate in the City of Johannesburg between 2006 and 2015*, supervised by Alize le Roux (CSIR) and Marcelle Hattingh (City of Johannesburg)
- Claudio Duarte** (2016). *Evaluating the donut geo-masking method for protecting the COPC household location information privacy – A use case of Mamelodi, City of Tshwane*, supervised by Victoria Rautenbach (GGM) and Serena Coetzee (GGM).
- Nadine du Preez** (2016). *Developing a Web-based GIS application for accessing, analyzing and disseminating agricultural geospatial information in South*, supervised by Philemon Tsele (GGM).
- Elanie Joubert** (2016). *Potential woody structural change detection in savannah and woodland in the Lowveld using ALOS PALSAR -1 and -2 SAR and LiDAR imagery*, supervised by Renaud Mathieu (CSIR) and Laven Naidoo (CSIR).
- Aphiwe Madubedube** (2016). *Investigating the Impact of Different Types of Directions on Wayfinding Efficiency in an Informal Settlement*, supervised by Victoria Rautenbach (GGM) and Serena Coetzee (GGM).
- Ruhee Maharaj** (2016). *Towards a TB vulnerability Index using Community Orientated Primary Care data: A Mamelodi Case Study*, supervised by Victoria Rautenbach (GGM) and Serena Coetzee (GGM).
- Phillip Mogaleamalla** (2016). *Validating structure from motion (SFM) stockpile mine volume estimates using a GNSS-RTK survey simulation*, supervised by Philemon Tsele (GGM).
- Tebogo Mokwena** (2016). *Assessing the influence of light direction on the accuracy of landform perception in shaded relief maps (SRMs)*, supervised by Victoria Rautenbach (GGM) and Serena Coetzee (GGM).
- Darren Moult** (2016). *A refinement of the Fortunate Index: A means of measuring peoples' perception of service delivery*, supervised by Peter Schmitz (CSIR).
- Yashena Naidoo** (2016). *Evaluation of Different Address Allocation Systems for Informal Settlements in South Africa*, supervised by Serena Coetzee (GGM) and Victoria Rautenbach (GGM).
- Thubalakhe Potelwa** (2016). *Investigating the effect of thermal variations on the frequency stability of hydrogen maser clocks*, supervised by Cilence Munghemzulu (GGM).
- Dean Robertson** (2016). *Spatial and Temporal Analysis and Modelling of Fire Events in the City of Tshwane*, supervised by Ansie Smit (UP Natural Hazard Centre) and Alize le Roux (CSIR).
- Janique Savy** (2016). *Mapping and analysis chlorophyll-A levels along coastal regions of South Africa with the use of remotely sensed data*, supervised by Cilence Munghemzulu (GGM), Philemon Tsele (GGM) and George Chirima (ARC).
- Ntombifuthi Tshabalala** (2016). *Understanding and mapping the food environment of an informal settlement called 'Marry Me' in Soshanguve*, supervised by Antony Cooper (CSIR) and Peter Schmitz (CSIR).
- Tarryn Whittle** (2016). *Urban food environment investigation: Pretoria Gardens*, supervised by Antony Cooper (CSIR) and Peter Schmitz (CSIR).

## 6. Funding

There were two main sources of funding from which CGIS day-to-day operations were covered in 2016: an annual budget allocation from the faculty and profit allocations from Enterprises UP courses.

Research activities and travel were supported by the Agricultural Research Council (ARC), Armscor (via a funding mechanism through the CSIR); Baden-Württemberg Stiftung (BWS); CSIR/Meraka Institute; the Gauteng City Region Observatory (GCRO); HartRAO; the International Council for Science (ICSU); the National Research Foundation (NRF); the South African Bureau of Standards (SABS); the South African Weather Services (SAWS); Statistics South Africa; and US AID.

Geoinformatics student prizes were sponsored by AfriGIS, CONSAS, GeoTerraImage and the South African National Space Agency (SANSA). Prizes for the learner events to promote geoinformatics were sponsored by Esri South Africa.

The time spent on CGIS activities by the extraordinary lecturers was funded by their employers, the CSIR, HartRAO, SAWS and SANSA. The ARC, CSIR, HartRAO and SANSA also support various under- and postgraduate students with bursaries, internships and/or studentships, in some cases also with office space.

# Annex A: Constitution of the Centre for Geoinformation Science (CGIS)

University of Pretoria

## Constitution

### Centre for Geoinformation Science (CGIS)

#### Article 1 – Definition of Terms

- a) Advisory Board - As in Article 4
- b) CGIS - Centre for Geoinformation Science
- c) CGIS Director - Director of the CGIS, as in Article 6
- d) Dean - Dean of the Faculty of Natural and Agricultural Sciences
- e) Department - Department Geography, Geoinformatics and Meteorology
- f) GISc - Geographic Information Science (GISc)
- g) HOD - Head of the Department Geography, Geoinformatics and Meteorology
- h) Management Committee - As in Article 5
- i) Student representative - As in Article 5
- j) UP - University of Pretoria

#### Article 2 – Vision

In its *Vision* the UP CGIS strives to be:

- An internal platform at UP from where the excellence of UP individuals and teams involved in GISc research, education and training, professional development and community engagement is supported and strengthened.
- A facilitator of UP GISc research collaborations, education and training and professional alliances within South Africa and abroad.
- A partner to the South African geoinformation industry in support of GISc research, education and training, professional development, community engagement.

#### Article 3 – Mission

The UP CGIS aims to achieve the *Vision* statements by the following *Mission* actions:

- *Engaging* in research, education and training, professional development, community engagement and capacity building, in line with the overall strategy of UP.
- *Obtaining funding* for GISc research, education and training, professional development and community engagement by establishing new partnerships and alliances, as well as strengthening those already in existence.
- Creating high-level human resource capacity by *involving students* in GISc research, education and training, professional development and community engagement projects.
- *Transferring knowledge and expertise* through conferences, seminars, training, training events (e.g. workshops and short courses), publications and other appropriate avenues.
- *Communicating and coordinating* with other UP departments on GISc research, education and training, professional development and community engagement.
- *Collaborating* with other UP departments, universities and research institutes on GISc research, education and training, professional development and community engagement.

#### Article 4 – Advisory Board

- The Advisory Board is responsible for
  - providing *strategic direction and advice* regarding marketing, as well as the research, education and training, professional development, community engagement and capacity building in CGIS;
  - giving *advice* on operational decisions;
  - reviewing the annual *budget*; and
  - *reviewing* the realization of the vision and the execution of the mission of the UP CGIS.
- The Dean is the Chairperson of the Advisory Board.

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- The Advisory Board consists of the Dean, HOD, the UP CGIS Director (ex officio), the heads of collaborating departments, representatives of key stakeholders as identified from time to time by the CGIS Director in consultation with the Chairperson.
- The Advisory Board meets at least once a year.

#### **Article 5 – Management Committee**

- The Management Committee consists of the CGIS Director; selected members of the Department and the Department’s Unit for Cartography; a student representative as appointed by the CGIS Director; and one member per collaborating department.
- The Management Committee is responsible for:
  - coordinating CGIS research, education and training, professional development and community engagement activities;
  - evaluating, and making inputs into, the strategic plan of the CGIS;
  - evaluating, and making inputs into, the business plan of the CGIS;
  - identifying opportunities to further the vision, mission of the CGIS.
- The CGIS Director is the Chairperson of the Management Committee.
- The Management Committee meets at least once every six months.
- A quorum for the Management Committee is half of the members plus one.

#### **Article 6 – Appointment, powers, functions and duties of the CGIS Director**

The CGIS Director is appointed in terms of prevailing regulations of the University for the appointment of Directors.

- The CGIS Director is responsible for
  - preparing the annual strategic plan of the CGIS;
  - preparing the annual business plan of the CGIS;
  - preparing the annual financial report of the CGIS;
  - organising meetings as provided for in this Constitution;
  - marketing the CGIS outside and within UP;
  - fundraising for the CGIS;
  - initiating discussions with potential donors and funders;
  - financial and budget management;
  - information management; and
  - ensuring the realisation of the research, education and training, professional development activities and community engagement mandate of the CGIS.
- The CGIS Director reports to the Dean.

#### **Article 7 – Duties of the Department**

The Department will provide

- administrative support for meetings as provided in this Constitution; and
- administrative support for the operational and financial management of the CGIS.

#### **Article 8 – Approval and amendments**

The Senate Committee for Research of the University of Pretoria is responsible for the approval of this Constitution and any amendment thereof.