SAEON ANNUAL REPORT 2016/17

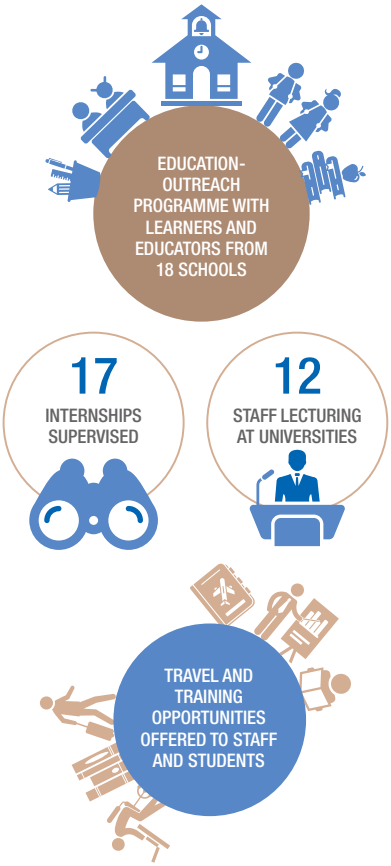
science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation | SAEON South African Environmental Observation Network

SAEON is a National Research Network and emerging National Facility that establishes and maintains environmental observatories, field stations and monitoring sites which serve as research and education platforms for long-term studies of ecosystems. These help us understand and improve our ability to detect, predict and react to environmental change. SAEON collaborates and networks nationally and internationally, and ensure that long-term ecological research data is archived and accessible as a national asset for generations to come.

Contents

MESSAGE FROM THE DEPUTY CEO:
National Research Infrastructure Platforms



SAEON has clearly become an important part of South Africa's research infrastructure and this role will be amplified in the following years.

The 2016–17 financial year again delivered a wide range of contributions resulting from the creativity and passion exuded by SAEON's personnel. For those who did not follow SAEON through its eNewsletter (www.saeon.ac.za) or Twitter account (@Saeonews), this report summarises some of the key outputs, statistics and outcomes of the government's investment in SAEON. The report demonstrates the considerable value that flowed from SAEON and should satisfy all measures of performance and efficiency. Despite the pressure from escalating financial control regulations, SAEON has managed to keep the ratio of support staff to scientific staff below 1: 6,5. Importantly, SAEON is dispersed across South Africa in order to make *in situ* environmental observations at local scales but plays a constructive international role in Global Change research. This is substantiated by the 30 international committees wherein SAEON staff members participate and its organising and hosting of international science meetings such as GCOS and the ILTER Open Science Meeting.

I am pleased to note that SAEON shares the NRF's passion for the broad transformation and normalisation of the National System of Innovation. Steady bottom-up progress is being made through various interventions such as the education-outreach programme with learners and educators from 18 schools, the support for and activities of the SAEON Graduate Student Network, the 21 SAEON staff members co-supervising 84 university research students of whom 25 have graduated, the supervision of 17 internships, the offering of travel and training opportunities to staff and students, the 12 staff lecturing at universities, the 107 popular and science engagement articles published and the 240 external users of its research platforms and services.

More than just delivering observational data, SAEON and its formally appointed research associates managed to publish 57 ISI accredited papers and authored 39 contributions to policy-making and management. Included in the latter is the data and modelling bases for the South African Risk and Vulnerability Atlas (with respect to climate change) and the South African Bioenergy Atlas which SAEON publishes and maintains online under a contract with the Department of Science and Technology.

SAEON has clearly become an important part of South Africa's research infrastructure and this role will be amplified in the following years as the Department of Science and Technology's newly allocated funding for the Shallow Marine and Coastal Research Infrastructure (SMCRI) and the Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) starts adding to SAEON's national research infrastructure. The national fiscus and the National System of Innovation can ill-afford duplication of effort and resources. Therefore, looking forward, ahead lies the vital task of integrating these two projects with the existing structure and operations of SAEON.

DR. CLIFFORD NXOMANI
Deputy CEO: National Research Infrastructure Platforms

UNPACKING SAEON'S PLACE IN THE RESEARCH LANDSCAPE

SAEON was established to provide contributions based on long-term observations to the environmental knowledge base used by the government and the private sector, especially with regard to global change. It is managed as a research infrastructure and platform from an economically neutral basis in the National Research Foundation (NRF). SAEON is not a conservation agency per se, but seeks to pose important research questions around how environmental systems function, and what the drivers and the impacts of environmental change are, on natural systems as well as on those sectors of society dependent on them for a variety of essential resources and services. Thus SAEON delivers public value by informing and supporting the sustainable management and use of ecosystems.

SAEON is guided by **scientific excellence**, the only guarantee that SAEON's outputs are adopted as reliable information to inform socio-economic decision-making within the context of changing natural processes and conditions. The South African Department of Science and Technology's (DST) Global Change Grand Challenge is the umbrella framework for SAEON's work.

SAEON was established as an institutionalised network with the mandate to support government, higher education and industry. As such, SAEON's outputs contribute to the knowledge economy and ultimately to have policy relevance. Being a network organisation, SAEON also operates outside institutional boundaries, to collaborate and widely share its available research infrastructure, databases and intellectual capacity in a meaningful way.

SAEON receives core funding from the DST to run and maintain its long-term environmental observation infrastructures and data systems, together with an environmental science engagement programme. Additionally SAEON enters into collaborations, contracts and agreements with science collaborators, stakeholders and user institutions to complement resources for the wide array of research activities.

This report covers a wide range of activities, research sites, people at work and outputs all aimed at fulfilling our mandate and making a significant contribution in the global change research sector.

SAEON is guided by scientific excellence, the only guarantee that SAEON's outputs are adopted as reliable information to inform socio-economic decision-making within the context of changing natural processes and conditions.

Natural events such as floods and drought require reliable data and measurements to inform policies.

SNAPSHOTS OF SUCCESSES

SAEON hosts first ILTER Open Science Meeting

story on page 11

SAEON scientist publishes first evidence of climate change impact on Fynbos

story on page 14

Inaugural SEAmester cruise

story on page 17

New species of sponge named after SAEON scientist

story on page 22

91 Masters & Doctoral Students supported and hosted

story on page 49

SAEON E-newsletter earns award of excellence

story on page 42

South Africa launches bioenergy roadmap

story on page 44

New Research Infrastructures on the horizon: EFTEON and SMCRI

story on page 43

Contribution to 30 International committees and working groups

story on page 8

12 staff lecturing & teaching at 5 Universities

story on page 55

10 SAEON Honorary Research Associates collaborating

story on page 55

NRF rating awarded to Dr Joh Henschel

story on page 33

SAEON SITES & INSTRUMENT ARRAYS

From a height of 3 000 m above sea level to depths of 4 000 m below the sea SAEON has research instruments which are gathering data around the clock and providing scientists world-wide with essential data.

SAEON's six nodes serve as local research hubs that establish, maintain and provide access to observation sites and research expertise in the various biomes and ecosystems of South Africa. SAEON's monitoring activities are designed as long-term programmes, which are complemented by shorter term exploratory and experimental projects to inform and guide this research.

A coordinated set of physical observation parameters are collected across terrestrial and coastal/offshore biomes which relate to weather, eco-hydrology and energy-carbon-water flux.

SAEON's six nodes serve as local research hubs that establish, maintain and provide access to observation sites and research expertise in the various biomes and ecosystems of South Africa.

For more information on the SARIR programme see http://www.dst.gov.za/images/Attachments/Department_of_Science_and_Technology_SARIR_2016.pdf

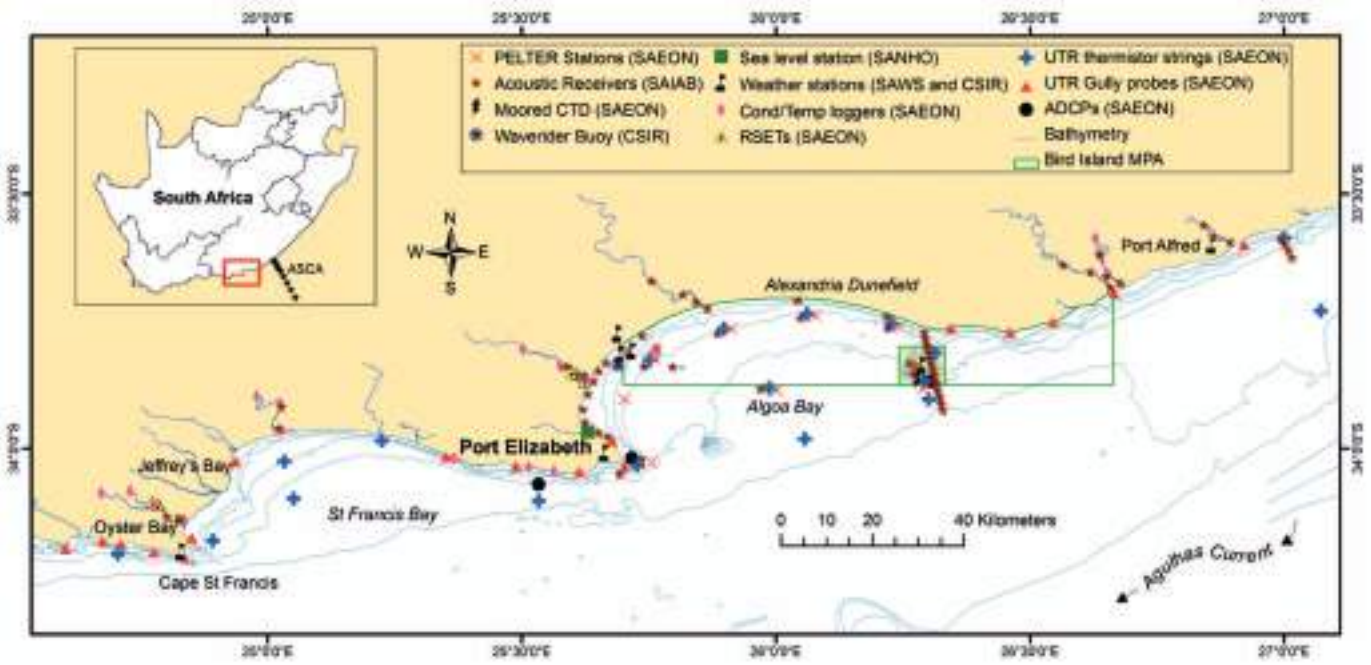
An exciting era dawns: new Research Infrastructures for SA

During the International Conference on Research Infrastructure (ICRI) held in Cape Town in October 2016, South Africa's Minister of Science and Technology committed large sums to establishing several research infrastructures in South Africa, under the framework of the South African Research Infrastructures Roadmap (SARIR). Two of these will be hosted by SAEON, namely the Shallow Marine and Coastal Research Infrastructure (SMCRI) and the Expanded Terrestrial and Freshwater Environmental Observation Network (ETFEON). Both are building on SAEON as an existing Research Infrastructure and must be interpreted as an overwhelming vote of confidence that has already given a "Big Bang" impetus to SAEON. At the same time, implementing and integrating these will be a huge challenge and one for which international expertise will be sought.

These new platforms will be supporting the ecological research community by providing open access and services whilst demanding the release of the results in the public domain. The groundwork to establish the Infrastructures has already started, and will result in significant growth in resources and human capacity.

Coastal observations in Algoa Bay LTER

The Algoa Bay Sentinel Site (ABSS) for Long-term Ecological Research (LTER) covers a network of 41 permanently moored instrument arrays continuously measuring key oceanographic variables along a 300 km coastal margin off the south-east coast of South Africa. It has two aims: (i) the Continuous Monitoring Platform (CMP) focussing on the physical oceanography of the coastal waters and (ii) the Pelagic Ecosystem Long-Term Ecological Research Programme (PELTERP), which investigates lower-trophic pelagic ecosystem dynamics over the long-term.



For a programme of this kind Algoa Bay is the ideal laboratory with its complex and dynamic oceanography owing to the regional climatology and its location relative to the south-westward expanding Agulhas Bank and southward wearing Agulhas Current. Seasonal upwelling underpins a productive pelagic ecosystem sustaining a myriad of top predators, including the iconic African Penguin, Cape Gannet, Cape Fur Seals, large pods of resident dolphins and migratory whales. Algoa Bay hosts a wide variety of habitats allowing for unique opportunities for exploratory and applied research into biodiversity management. The greater Algoa Bay region is also a vibrant socioeconomic environment, much of which interacts directly with the coastal environment, promising exciting prospects for future research into socio-ecological systems within the context of global change.

With almost a decade of uninterrupted data generation, the ABSS builds on a regional coastal research legacy spanning some 40 years, while laying the foundation for new knowledge to be gained in virtually every sector of coastal marine science by an active research community representing several universities, institutes and entities. New deployments through the Shallow Marine and Coastal Research Infrastructure (SMCRI) of moored CTDs (Conductivity, Temperature, Depth), deep water ADCPs (Acoustic Doppler Current Profiler) and data buoys in key locations will add high resolution multi-parameter physical and chemical data on current movements south and west of Algoa Bay. This near real-time data for a suite of variables will enable integration with initiatives such as the Agulhas System Climate Array (ASCA), South African National Temperature Network (SANTN), Acoustic Telemetry Array Platform, coordinated by the South African Institute of Aquatic Biodiversity (SAIAB) as a component of the Ocean Tracking Network (OTN) and the South African Estuaries Monitoring Network (SAEIS).

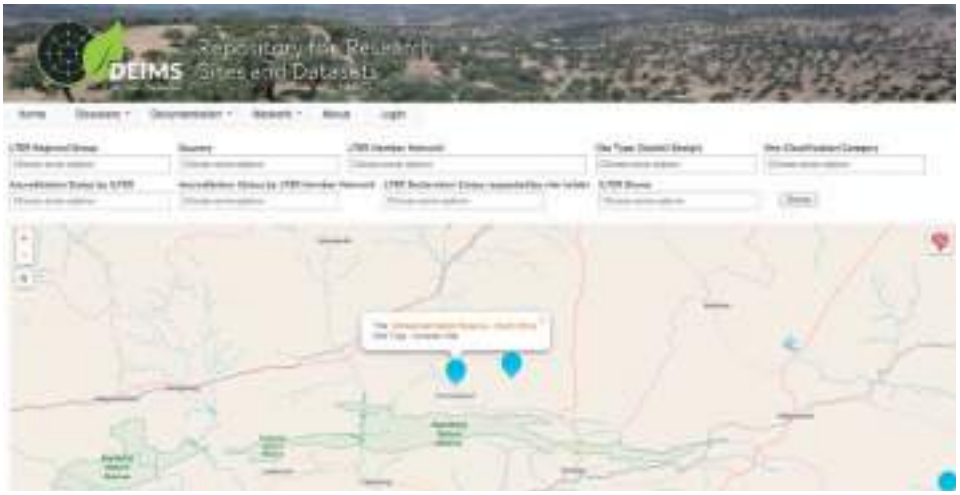
Where we do what we do: SAEON field sites documented

DEIMS (the Dynamic Ecological Information Management System) is a source of information about sites and datasets of networks dealing with ecological long-term observation and experimentation globally. This repository for research sites and datasets is a place where research organisations can lodge metadata records about their research sites and search for information about environmental research facilities globally.

Ahead of the first ILTER (International Long-Term Ecological Research Network) Open Science Meeting in October 2016, SAEON updated its sites on the recently developed ILTER DEIMS platform. Through a process of upload and testing it became apparent that the northern hemisphere and European bias of DEIMS inhibited the description of South African sites and by liaising with the DEIMS Information Management Committee it was ensured that South Africa (and Africa!) is put on the map of research sites!

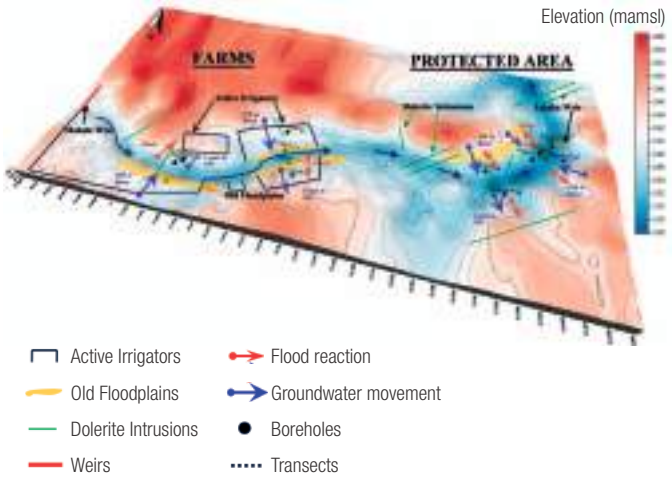
The DEIMS Metadata Model was developed with terrestrial sites in mind which consequently limited the ability to adequately describe deep ocean marine sites, as the descriptors for climate measurement in the ocean do not yet exist in the system. Through the expert advice of marine scientists SAEON has developed a proposal to modify this so that a deep ocean marine component can be incorporated into the DEIMS Metadata Model.

A total of 24 SAEON research sites were added to DEIMS before the 2016 ILTER meeting of which 17 are active. Additional sites that have since been added are marine-offshore sites – the first deep ocean marine sites for ILTER. For a list of the sites and the details go to: https://data.lter-europe.net/deims/site/list.



LETABA GROUND WATER MEASUREMENT

A section of the lower Letaba River has now been fully instrumented for measuring surface-ground water interactions. This includes three automated weather stations, and two gauging stations at either end of a 7 km stretch of the river. Twenty two boreholes on 4 transects crossing the river have been installed and flow-tested. Temperature, conductivity and water-level loggers have been installed in all of these. Geophysical profiles along and between these were conducted, as well as isotopic profiling of groundwater, river water, and riparian vegetation water. A hydrological simulation model of the study site has been constructed, allowing for detailed projections of surface and groundwater flows. Data from the site has been used by Doctoral student Shaeden Gokool (University of KwaZulu-Natal), as well as MSc student Reinhardt Raubenheimer (Free State University). Much of their research was funded by a grant from the Water Research Commission (KSA2: K5/2338), while a DST Strategic Research Infrastructure Grant was used to purchase the instrumentation.



Weather stations contribute to growing climate datasets

SAEON has more than 100 rain gauges and weather stations as part of SAEON's climate monitoring in remote regions and water catchments which form part of the water supply to major population centres. At some of these sites, long historical records provide a baseline for the monitoring programme, thanks to institutions that pre-date SAEON. Modern equipment at these sites continues the monitoring and enables remote access to data, which makes it easier for technicians to maintain a steady stream of incoming information that feed into data management systems. It also enables the provision of freely available data directly to the public in near real time.

SAEON currently has five weather stations with online published data that update every five minutes (depending on signal quality) and show weather conditions recorded in the last one to four weeks. These stations are located in the Drakensberg, Jonkershoek mountains, Cederberg and Table Mountain.

Stations like these not only contribute to SAEON's long and growing climate records, but also aid managers with information, for example about fire weather conditions on the ground. We have received feedback and interest from farmers who keep an eye on the weather in the upper catchments upstream from them, as well as from hikers and mountain rescue teams.

For a list of the online stations and links to their websites see http://www.saeon.ac.za/enewsletter/archives/2016/august2016/doc04

For more information on the weather stations contact Abri du Buys (abri@saeon.ac.za) or Kent Lawrence (kent@saeon.ac.za).

INTERNATIONAL IMPACT AND COLLABORATIONS

Working towards achieving the Sustainable Development Goals

During 2016 SAEON has contributed to the following Sustainable Development Goals through the research themes and projects. Where the symbols appear throughout this report, the link to the themes is indicated.

GOAL 2

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

- Projects cover ecosystem restoration; land management practices, earth system processes & large infrequent events.

GOAL 4

Ensure inclusive and quality education for all and promote lifelong learning

- Achieved through the engagement of the Science Education Outreach programme, the Graduate Student Network (GSN) and through student supervision and mentoring.

GOAL 6

Ensure availability and sustainable management of water and sanitation for all

- Projects cover ecology & hydrology of high-altitude catchments and of rivers; the impact of climate change on water yield; the management of estuaries and wetlands.

GOAL 7

Ensure access to affordable, reliable, sustainable and modern energy for alll

- Projects support the government's strategic environmental assessment for shale gas exploration and the development of the South African Bioenergy Atlas.

GOAL 13

Take urgent action to combat climate change and its impacts

- Projects cover carbon dynamics; climate & atmospheric change and the impact on ecosystems; the development of the South African Risk and Vulnerability Atlas.

GOAL 14

Conserve and sustainably use the oceans, seas and marine resources for sustainable development

- Projects are focussed on monitoring at the Algoa Bay Sentinel Site; marine protected areas; national estuaries network & offshore mooring arrays; the impact of trawling on benthic biodiversity; the South African Marine Research and Exploration Forum (SAMREF).

GOAL 15

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

- Projects cover biodiversity & biogeography; biome & land cover shifts; changing species distributions; structural changes in ecosystems & systems ecology; the dynamics of droughts and floods; impact of forestry on groundwater; the economics of restoring natural capital.

By contributing and impacting on the above goals the below goals are also realized:

GOAL 1

End poverty in all its forms everywhere

GOAL 3

Ensure healthy lives and promote well-being for all at all ages

GOAL 17

Revitalize the global partnership for sustainable development

SAEON'S INTERNATIONAL INVOLVEMENTS

During 2016 SAEON staff contributed to a number of international committees and working groups in various capacities.

- 2017 INTECOL (International Congress of Ecology) congress in Beijing Science Committee
- 2017 International Hydrological Association symposium Organising committee
- 2020 MEDECOS (International Mediterranean Ecosystems Conference) organizing committee
- Argo Steering Team
- ASCLME Steering Committee
- Associate of the Robert B. Daugherty Water for Food Institute at the University of Nebraska
- Belmont Forum Work Package 3
- DataCite Members' Assembly
- GEOBON Implementation Committee
- GEOBON Working Group 3
- ICSHMO (International Conference on Southern Hemisphere Meteorology and Oceanography) program organizing committee
- ICSU Strategic Committee for the Coordination of Data and Information
- ICSU World Data System/DSA Joint Certification Committee
- ILTER Executive Committee
- ILTER Open Science Meeting 2016 science committee
- ILTER Public Policy Committee
- INFRASUP Horison 20–20 proposal group
- IORA Academic committee
- IUCN (International Union for the Conservation of Nature) commission on Ecosystem management: Thematic group Mediterranean ecosystems, Mountain ecosystems, Redlist of Ecosystems & Climate change adaptation.
- JCOMM Observation Coordination Group (OCG): Best Practices and Standards
- Nansen Tutu Board
- SADCO (South African Data Centre for Oceanography) steering committee
- Southern Connections Committee
- WIOMSA Scientific steering committee
- Global Climate Observing System (GCOS) steering committee

The end of a term in GCOS, the beginning of a term in the JCOMM observation coordination group

In October 2016 Dr Juliet Hermes attended the 24th Global Climate Observing System (GCOS) steering committee meeting in Ecuador, concluding her 6 year term on this committee. This coincided with a national GCOS Science day based on the format pioneered by the South African Science day event, which is organised annually by the SAEON Egagasini Node. The event was well received and recommended to happen every year, so a small legacy has been left with GCOS.

GCOS interacts within each country and region through its focal points and national coordinators, as well as the relationship with other groups such as ILTER (International Long Term Ecological Research), Future Earth and WCRP (World Climate Research Program). The Ecuador meeting discussed the role of 'on the ground' research, and the importance of observations which are required for climate sciences which GCOS helps to promote. It is encouraging to note that the focus on the oceans has increased – such that this topic has become predominant at these meetings.

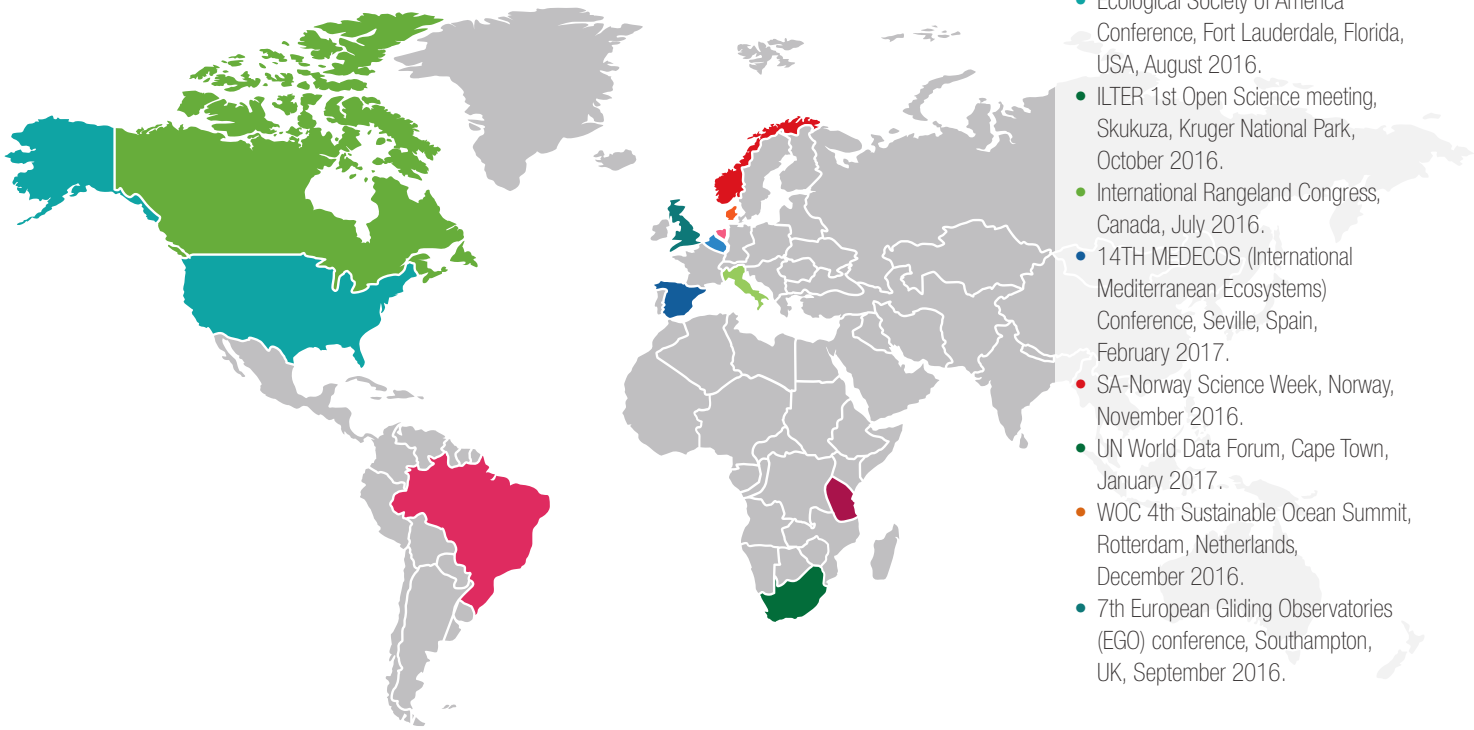
The ways in which SAEON is relevant to GCOS includes essential climate variables, considerations of long-term observational programmes that are being maintained internationally; and input with regards to influencing policy makers.

Following on from her involvement with GCOS, Dr Hermes was invited to act as the JCOMM (Joint Commission for Oceanography and Marine Meteorology Observation Coordination Group) Vice-Chair for Standards and Best Practices.

The Global Climate Observing System is sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP) and the International Council for Science (ICSU). The Food and Agriculture Organization (FAO) sponsors the Terrestrial Observation Panel for Climate (TOPC).

(link to http://www.wmo.int/pages/prog/gcos/)

International Conferences attended by SAEON staff



- 11th International Temperate Reefs Symposium, University of Pisa, Italy, June 2016.
- 2nd International Marine Science Communication Conference in Bruges, Belgium, December 2016.
- 59th meeting of the International Association of Vegetation Scientists (IAVS), Pirenópolis, Brazil, June 2016.
- 5th International COSMOS (Cosmic-ray Soil Moisture Observing System) Workshop, Copenhagen (Denmark), August 2016.
- AfroMont-Mt Kilimanjaro Mountain Research Conference, Moshe, Tanzania, February 2017.
- DBCP (Data Buoy Cooperation panel) meeting (Scripps Institute for Oceanography, USA) LaJolla, USA, October 2016.
- Ecological Society of America Conference, Fort Lauderdale, Florida, USA, August 2016.
- ILTER 1st Open Science meeting, Skukuza, Kruger National Park, October 2016.
- International Rangeland Congress, Canada, July 2016.
- 14TH MEDECOS (International Mediterranean Ecosystems) Conference, Seville, Spain, February 2017.
- SA-Norway Science Week, Norway, November 2016.
- UN World Data Forum, Cape Town, January 2017.
- WOC 4th Sustainable Ocean Summit, Rotterdam, Netherlands, December 2016.
- 7th European Gliding Observatories (EGO) conference, Southampton, UK, September 2016.

http://www.saeon.ac.za/enewsletter/archives/2017/february2017/doc08

The Antarctic Circumnavigation Expedition

Despite the global importance of the Southern Ocean, knowledge of the controls and interactions among the physical, chemical, and biological processes operating in Antarctic ecosystems is limited, largely because of a lack of *in situ* observational data. Driven by the urgent need to better understand the Southern Ocean and its ecosystems, an international, competitive open call was announced in 2015 for research proposals to participate in an oceanographic voyage around Antarctica. This Antarctic Circumnavigation Expedition (ACE) is the first project of the Swiss Polar Institute, a newly created entity founded by EPFL, the Swiss Institute of Forest, Snow and Landscape research WSL, ETHZ, the University of Bern and Editions Paulsen.

From December 2016 to March 2017, scientific teams from all over the world boarded the Russian icebreaker Akademik Treshnikov for an unprecedented expedition around Antarctica. From biology to climatology to oceanography, researchers, including 25 South Africans, worked on a number of interrelated fields aimed at better understanding Antarctica and the surrounding Southern Ocean as they followed the path of the largest oceanographic feature of the Southern Ocean, the eastward propagating, wind-driven Antarctic Circumpolar Current (ACC). Dr Tommy Bornman was co-Primary Investigator on ACE project XII, the goal of which was to use microbial diversity (phytoplankton, bacteria, and zooplankton) and metabolic activity in conjunction with measured chemical and physical parameters to develop an integrated model of the Sub-Antarctic island systems in order to better understand their role in Southern Ocean productivity. In other words, Who is there? What are they doing? Why are they doing it? What are the implications for Sub-Antarctic nutrient cycling, ecosystem function, and CO2 removal, today and in a warming world?

The expedition produced large quantities of data and biological samples, which will become the focus of several postgraduate studies during the next few years.

Smart oceans, Smart industries

Global oceans are used by many industries and sectors and the sustainable management of oceans is of critical importance. SAEON, represented by Nicole du Plessis, participated in the 4th Sustainable Ocean Summit (SOS) organised by the World Ocean Council (WOC), which was held in Rotterdam in the Netherlands from 30 November to 2 December 2016. It is the only global, multi-sector platform for leadership companies and organisations to advance corporate ocean responsibility and brought together ocean industry leaders from shipping, oil and gas, fisheries, aquaculture, ports, mining, insurance, finance, renewable offshore energy, tourism, shipbuilding, marine technology and other industries as well as other stakeholder participants (government regulators, scientists and environmental organisations).

In accordance with the theme, “Ocean 2030: Sustainable development goals and the ocean business community”, the meeting was framed around one or more of the sustainable development goals (SDGs). Nicole was invited as the SAMREF (South African Marine Research and Exploration Forum) representative to share how SAMREF had approached the oil and gas industry to collaborate with academics. Nicole provided an overview of Operation Phakisa and highlighted the benefits of scientific/academic collaboration with ocean industries.

ASCA officer receives POGO fellowship

The Partnership for Observation of the Global Ocean (POGO) and Scientific Committee on Oceanic Research (SCOR) have been offering a jointly funded short-term fellowship since 2001, which is hotly contested by applicants from countries around the world. With only a handful of applications accepted, Jethan d'Hotman, ASCA officer (and now MSc oceanography student) was honoured to be chosen. His fellowship was split between two institutions - the National Oceanography Centre (NOC) in Southampton, UK, learning about MicroCAT data validation and processing techniques and the British Oceanographic Data Centre (BODC) in Liverpool, UK, learning about data management and Argo data processing systems. At the NOC Jethan also took part in the European Gliding Observatories (EGO) conference, providing essential background for his MSc based on glider work in the Agulhas.

The training feeds directly into South Africa's mooring arrays and South Africa's Argo program. To enable this training to feed back into a South African context, the SAEON Egagasini Node hosted several follow-up meetings and workshops with the South African mooring and Argo community.

Drs David Smeed and Justin Buck and POGO and SCOR are acknowledged for this opportunity.

SAEON student acquires scarce skills in Marine Diatom identification

Phumlile Cotiyane, a Professional Development Programme (PDP) Doctoral student at Elwandle, attended the 4th International Workshop on Siliceous Microorganisms held at the University of Szczecin in Poland during October 2016. This was made possible through a South Africa/Poland collaborating grant. The workshop included hands-on laboratory activities such as slide preparation, diatom culturing for biofuel, and DNA sequencing. The event provided an incredible platform to engage with other emerging researchers and lay foundations for future collaborations with institutions abroad, thus expanding SAEON's global footprint and developing a skill set that is scarce in South Africa in terms of marine benthic diatom identification.

http://www.saeon.ac.za/enewsletter/archives/2016/december2016/doc13

SAEON hosts first ILTER Open Science Meeting

SAEON through Johan Pauw's initiative as an ILTER Executive Committee member, organized and hosted the first ILTER Open Science Meeting (OSM) in October 2016. More than 300 delegates from 35 countries, as far afield as China, Japan, India, Mexico, Austria, Germany, Spain, Italy, Portugal and the United States, met in Skukuza in the Kruger National Park to share their research, reinforcing the International Long-Term Ecological Research (ILTER) Network's status as an internationally acknowledged research network. Under the theme of *Long-term ecosystem research for sustainability under global changes*, a host of contributions - ranging from keynote speeches and network position papers to workshop sessions - were delivered, deliberated on and advanced among the global change research community.

During the conference scientists from SAEON and the Kruger National Park led field trips to long-term experiments and monitoring sites, including a series of 60-year burn plots, large animal exclosures, and the Skukuza flux tower. Linked to this, various SAEON nodes hosted pre conference trips which provided SAEON with an opportunity to showcase the work being done on the ground in South Africa.

This landmark event, was made possible through sponsorship from the South African Department of Science and Technology (DST) and the National Research Foundation (NRF) and coincided with Global Climate Change Week. Based on the overwhelming success, ILTER resolved to henceforth organise an Open Science Meeting every third year.

The OSM group picture was captured by an unmanned aerial vehicle (UAV) operated by SAEON technician Rion Lerm.

FYNBOS NODE
At a glance

While much of our research is aimed at monitoring and understanding hydrological and ecological processes in fynbos, we are also uncovering the impact of drivers of change on these.

The Fynbos Node is hosted by the South African National Biodiversity Institute (SANBI) at their research hub in the Kirstenbosch National Botanical Gardens.

Fire and drought in focus

Fire and drought have been in the public eye in the Western Cape over the last few years. As the region enters the third year of drought, most municipalities have imposed severe water restrictions and additional sources of water (desalination, aquifers and recycling) are being considered. Perhaps exacerbated by the unusually dry weather, fires have swept through much of the fynbos region, from the Cederberg in the north-west, across the Boland and through to the Kouga and Baviaanskloof Mountains in the east, and notably around Knysna causing unprecedented destruction to homes and infrastructure. These events highlight the societal impact of the environmental drivers of change that inform the SAEON Fynbos Node's monitoring and research focus.

Although fire is a natural disturbance in fynbos, interactions with extreme weather phenomena and an added fuel load from invasive alien plants or dense vegetation patches, where fire has been supressed for decades, seems to be changing the intensity of fire resulting in more damage. Long-term rainfall data archived by SAEON suggests the last three years of low rainfall around Cape Town are severe but are not the worst in one hundred years (see text box).

While much of our research is aimed at monitoring and understanding hydrological and ecological processes in fynbos, we are also uncovering the impact of drivers of change on these. Annabelle Rogers (UCT MSc graduate) has modelled how urbanisation has changed fire behaviour in the Cape Peninsula, Ebrahiem Abrahams (UWC MSc student) is showing higher rates of erosion from catchments under pines compared to fynbos following fire, Pam Sekese (UWC MSc student) and Faith Jumbi (UWC PhD student) aim to understand how land use and management interventions (e.g. invasive clearing and river rehabilitation) are influencing hydrology in catchments in the eastern fynbos region. Francois Becker (UCT MSc graduate) showed that fire suppression may have played a role in the decline of Rose's Mountain toadlet on Table Mountain.).

ONLINE WEATHER MONITORING TOOLS

The Fynbos Node has developed portals that serve real-time weather data from some of their weather stations.

- You can view the weather from the Dwarsberg (Jonkershoek, 1 214 meter above sea level) at http://lognet.saeon.ac.za:8088/Dwarsberg/index.html
- Constantiaberg (Table Mountain National Park, 890 m above sea level) at http://lognet.saeon.ac.za:8088/Constantiaberg/index.html and
- Engelsmankloof (Cederberg, 1 537 m above sea level) at http://lognet.saeon.ac.za:8088/EngCed/index.html
- For a summary of streamflow and weather records in the Jonkershoek Valley have a look at the SAEON drought monitor. http://www.ecologi.st/post/2017-04-01-Langrivier/

Using node monitoring data for improved streamflow modelling

Extensive refurbishment and expansion of monitoring equipment at Jonkershoek has provided data for improved hydrological modelling. Using rainfall data from SAEON's new rain gauge network at Jonkershoek, Siphumelelo Mbali (UWC MSc graduate), was able to simulate streamflow nearer to observed streamflow for the Langrivier gauged catchment compared to data from the historic rain gauge network. These models will be improved when we can better account for groundwater dynamics.

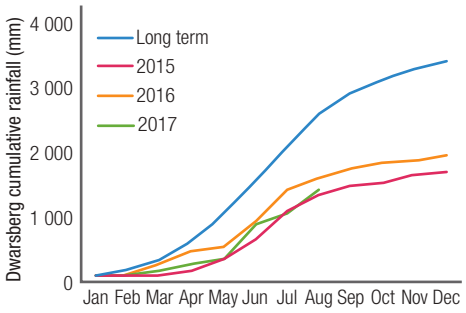
RESEARCH PLATFORMS

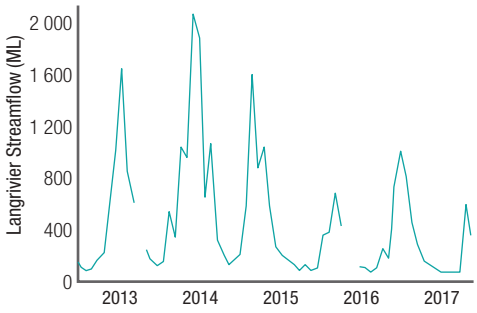
- Constantiaberg HydroMet site
- Cape Point vegetation plots
- Table Mountain micro-climate array
- Peninsula Fire plots
- Hospital Bend HydroMet site
- Jonkershoek HydroMet site
- Elandsberg
- Baviaanskloof, Kromme, Kouga HydroMet and vegetation plots
- Cederberg Met sites
- Lelievlei Forest plots
- Agulhas Plain wetlands

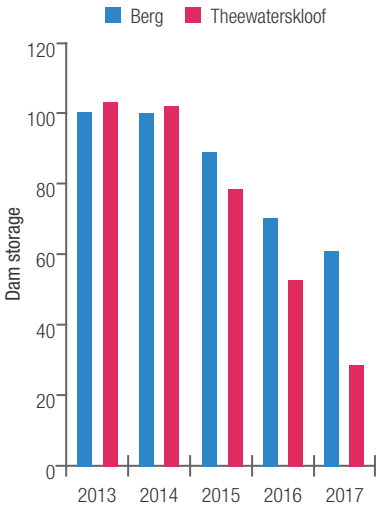
RESEARCH SPECIALITIES

- Changing vegetation
- Ecohydrology
- Long-term weather records
- Biome shifts
- Wetlands
- Fire ecology
- Remote sensing
- Modelling

Rainfall and dam levels in Cape Town







Data from SAEON's high elevation weather stations above Jonkershoek suggests that 2015–2017 are the driest years since recording started in 1945. Streamflow at Langrivier in Jonkershoek has declined substantially since the current drought commenced (2015). Dam storage is declining despite similar amounts of rain falling in the three years of the drought. However, rainfall records from the Stellenbosch goal (not shown here) show a particularly long series of consecutive dry years from 1926–1940, so analysis of longer time series are required before we can unequivocally ascribe the current drought as climate change.

FYNBOS

Research highlights

Wetlands on the Agulhas Plain

The Agulhas Plain is home to a unique wetland system on the southern-most tip of Africa. This system contains the third largest freshwater lake in South Africa, Soetendalsvlei, only beaten in size by Lakes Sibaya and Fundudzi. The variability of the underlying geology ensures a diversity of seasonal and perennial, saline and fresh water pans and lakes, linked by a network of rivers to the Heuningnes estuary at De Mond, a Ramsar site. The area is also a globally Important Bird and Biodiversity Area (IBA). However, over half the study area is considered Critically Endangered, and only a quarter, found in the protected areas, is Least Threatened. Many of the wetlands have been classified as important freshwater resources. Threats to the functioning of this wetland system include agricultural activities, alien vegetation, habitat alteration, water abstraction, and other human activities.

Wetlands play an important role in regulating the quality and quantity of the region's water resources. For example, they filter pollutants in the landscape, mitigating the impact of these further downstream. Another function is that they act as permanent or intermittent "wet islands" providing water to plants and animals in an otherwise arid terrestrial environment.

In recent years, a concerted effort has been made to conserve the water resources in the catchment through partnerships such as the Agulhas Biodiversity Initiative, Nuwejaars Wetlands Special Management Area, CapeNature and SANParks. Alongside these partnerships, SAEON and the University of the Western Cape are collaborating on hydrological research on the Agulhas Plain. This includes assessing the water quantity and quality throughout the catchment, as indicators of the effects of the surrounding land use on the water resources. We also aim to understand connectivity of the ground and surface water in the rivers and wetlands in the catchment. An exciting development has been the re-introduction of hippos in Waskraalsvlei which may help us understand how these megaherbivores engineered the landscape in the past. These projects help us to understand the ecological and hydrological role and interactions of the different wetlands and rivers within a broader landscape and ultimately improve future management decisions.

Long-term vegetation surveys yield evidence of climate change impacts on fynbos communities

While we've known that climate change will affect our ecosystems, we don't know how much it needs to change before we'll detect an impact, or how that impact plays out across ecosystems that differ in their fundamental ecological processes. Climate change signals are further confounded by other environmental stressors, making it difficult to detect clear impacts that can be ascribed to particular change drivers.

The SAEON Fynbos Node has maintained a set of permanent vegetation survey plots that were established in the Cape of Good Hope Section of Table Mountain National Park in 1966. These sites have been resurveyed in 1996 and again in 2010, providing the longest known vegetation survey record in the fynbos. In a recently published study, Dr Jasper Slingsby and collaborators found that fynbos at this site is already responding to changing climate, with plots that experienced longer periods of consecutive hot and dry days in the first year after fire showing a significant reduction in species. These periods of extreme weather kill plants in the sensitive regeneration phase, and the record shows that such periods are increasing in duration. The interaction between fire and climate change may affect flammable ecosystems worldwide, and is of particular concern in regions subject to severe summer droughts and temperature extremes, such as southern Australia, California and parts of the Mediterranean Basin.

While the consequences of these changes for the structure and function of fynbos are largely unknown, the species worst affected included restios and sedges, herbs, and species that sprout from underground storage after fire. These components of the vegetation are the key in determining the rate of vegetation recovery after fire and make up the majority of the fine fuel load, with potential to alter the fire regime, carbon storage, hydrology, geomorphology/geochemistry and habitat for other biodiversity. The more we begin to understand these kinds of interactions and their impacts, the better we can anticipate what is to come, and the more prepared we can be.

Read more on this research at: www.pnas.org/cgi/doi/10.1073/pnas.1619014114 and http://www.saeon.ac.za/enewsletter/archives/2017/april2017/doc02 and watch the explanation at https://www.youtube.com/watch?v=-xSHX8ZK_KM

Understanding the hydrological processes in the Baviaanskloof catchment

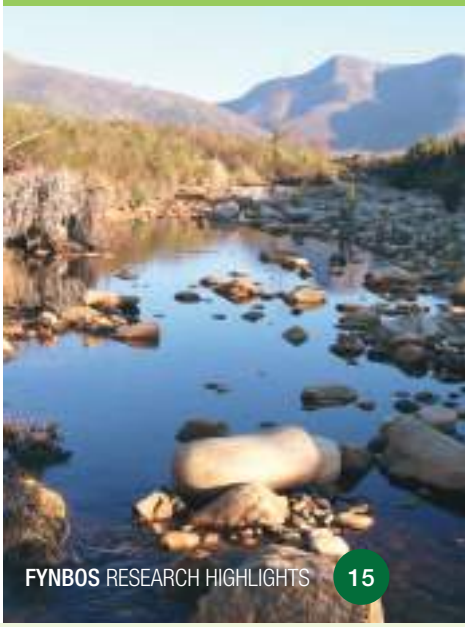
The catchment areas in Cape Fold Belt mountain ranges provide critical water resources to cities, towns, and agriculture of the semi-arid Cape. This mountain belt extends from the Cederberg to Cape Town and eastward to Port Elizabeth. Its catchments have steep fractured rock mountains and coarse sediment filled valleys that result in complex surface-subsurface flow paths for water reaching rivers and reservoirs. Hydrologic models allow us to apply our understanding of catchment processes to predict impacts of climate and changing land cover, such as afforestation. Large arid catchments, like those of the Cape Fold Belt, require more complicated models because a significant proportion of flow is underground. A better understanding of hydrological processes in the region will improve prediction and management of future water resources. To this end the SAEON Fynbos Node supports hydrologic monitoring and research in several mountain catchments, such as the Baviaanskloof in the Eastern Cape.

The Baviaanskloof and Kouga Rivers feed into the Kouga Reservoir, the single largest water supply source in the Algoa region, serving the growing city of Port Elizabeth and surroundings. Despite receiving a meagre 300 mm in mean annual rainfall, there is perennial outflow from the Baviaanskloof to the reservoir thanks to groundwater recharge during wet periods. Substantial loss of vegetation cover due to livestock grazing in sensitive sub-tropical thicket has increased surface runoff and erosion on hillslopes during storm events. Concerns are that this overgrazing is influencing the catchment's hydrology: increasing flood intensities, decreasing recharge, and decreasing base-flow in dry periods.

Read more at http://www.saeon.ac.za/enewsletter/archives/2016/december2016/doc05 and http://dx.doi.org/10.1016/j.ecoser.2017.03.003

Through collaboration between SAEON, Living Lands (a NGO), and the Department of Environmental Affairs (Natural Resource Management) (DEA-NRM), a network of monitoring sites for rainfall, temperature, streamflow, and groundwater levels was established in the Baviaanskloof. SAEON post-doctoral fellow Julia Glenday has been using this data to improve hydrological models. Concurrent surface and groundwater measurement at various spatial scales has given useful insights. For example, after large winter storms, floodplain groundwater levels rose several meters, peaking weeks after an event, while mountain tributary streams (surface water inputs to the floodplain) only flowed for a few days immediately after storms. This indicates that much of the recharge of the floodplain aquifer came from the mountains as sub-surface flow.

Postdoctoral fellow Julia Glenday has been working on data collection and analysis in the Baviaanskloof.



The data and hydrological model are now informing participatory processes on catchment management among local and national stakeholders.

EGAGASINI NODE
At a glance

Understanding the complex interplay of physical and biological ocean processes, ecosystems and biodiversity will improve our ability to manage marine environments sustainably.

EGAGASINI – Waves of knowledge

For centuries we have regarded the ocean as an inexhaustible supply of food, a transportation route, and a site for recreation and leisure. However, worldwide the marine ecosystem is under severe threat, from collapsing fish populations to climate change-driven coral mortality. In order to understand and adapt to current and future changes, we need to understand the complex interplay of physical and biological ocean processes, ecosystems and biodiversity. This will improve our ability to manage marine environments sustainably and better respond to changes in weather and climate patterns.

The Egagasini Node is now running at full capacity. We have a number of large contracts funded through DST with international relevance, all of which are gaining momentum and have dedicated project managers, students and interns. The biodiversity component has grown, as has the modelling component.

The education program continues to lead curriculum based marine education and our follow up with learners is very successful. One of the learners participating in the first science camps and is now enrolled for a Masters Degree. We have also been very involved in SEAmester, South Africa's floating university, and staff on the node serve on a number of international marine research organizations helping to contribute to global marine research, while maintaining a significant South African presence in these international research endeavours.

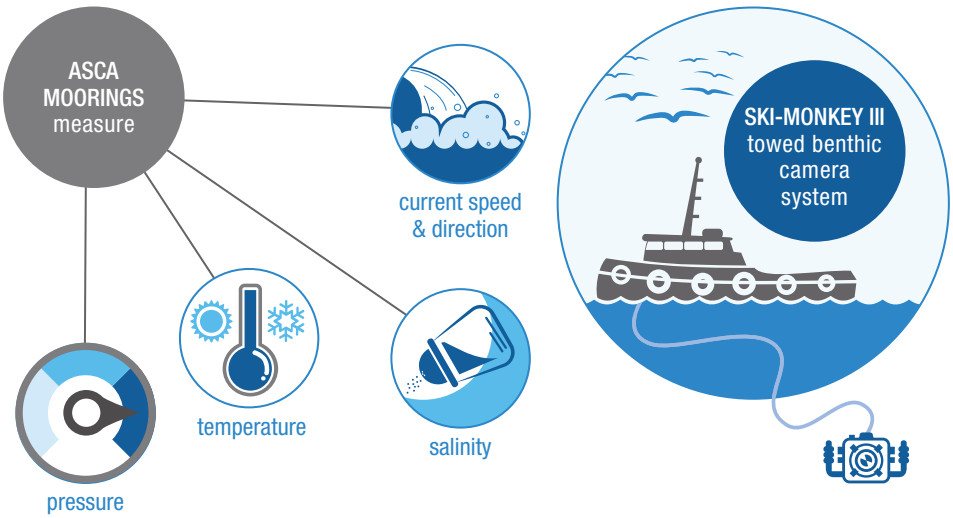
RESEARCH SITES

- Agulhas current
- Childs Bank, West Coast
- Offshore from Orange River Mouth to Port Elizabeth
- Algoa Bay
- Benguela Jet
- Coastal shelf of South Africa
- South Western Indian Ocean
- South Eastern Atlantic Ocean

RESEARCH SPECIALITIES

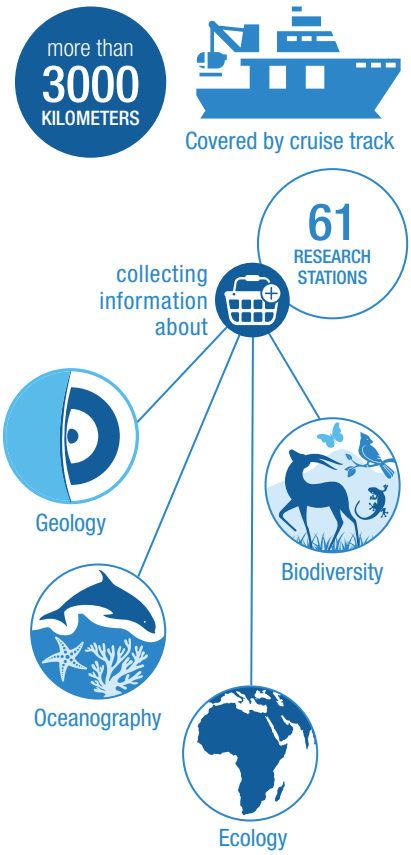
- Agulhas current dynamics
- Wind driven circulation
- Oceanographic & coastal modelling
- Large scale observing programs
- Benthic invertebrate taxonomy, biodiversity & ecology
- Benguela Jet & the South East Atlantic Ocean interactions

EQUIPMENT AT THE PLATFORM



Staff from the Egagasini Node participated in the African Coelacanth Ecosystem Programme (ACEP) ''Deep Secrets" research cruise during September and October 2016. The aim of the cruise was to explore shelf edge and slope ecosystems from Robben Island on the West Coast to the outer shelf off the Kei River Mouth via the very tip of the Agulhas Bank. The cruise track covered more than 3000 km collecting information about the geology, oceanography, biodiversity and ecology at 61 research stations. Most of the stations were below 200 m, providing new insights into South Africa's poorly studied deep sea ecosystems. The researchers used a towed camera and a Go-pro in specialized underwater housings to shed light on a range of never seen before habitats. The deepest station surveyed was at a depth of 1 035 m off Knysna and represents the deepest visual biodiversity survey in South Africa to date. The data is used to support improved integrated ecosystem based management in multiple sectors in South Africa. This cruise is a joint initiative with the Oceans and Coast Branch of the Department of Environmental Affairs and the Department of Science and Technology facilitated through the Presidential Operation Phakisa Oceans Economy Laboratory. The expedition was led by Dr Kerry Sink, a scientist at the South African National Biodiversity Institute (SANBI).

THE DEEP SECRETS CRUISE AT A GLANCE



EGAGASINI

Research highlights

Why deeper insights into the Agulhas Current can shed light on climate patterns

The Agulhas Current transports warm tropical Indian Ocean water southwards along the South African coast. It affects the rainfall along the east coast and interior regions of South Africa by providing the latent heat of evaporation needed for onshore winds to pick up moisture and carry it inland.

The current also sets the backdrop for local ecosystems which contribute to South African fisheries. Friction between the current and the continental shelf edge drives upwelling of nutrient rich bottom water. This in turn promotes high levels of phytoplankton – the grass of the ocean which sustains the aquatic food web.

The complex nature of the Agulhas Current has made it very difficult to simulate using ocean models. Until 2010 oceanographers were only able to observe the Agulhas Current with snapshots of data from deploying instruments during research cruises.

To measure the ocean's response to climatic changes (alterations in heat and salt fluxes and shifts in wind patterns), continuous monitoring is needed. These monitoring lines (known as 'mooring arrays') are made up of instruments placed throughout the water column (up to 4 000 m deep!). They measure current speed, direction and temperature at extremely frequent intervals.

The first array, the Agulhas Current Time-series (ACT) experiment, ran from 2010 to 2013. This consisted of moorings placed across the Agulhas Current just off the coast of Port Elizabeth. In 2015 it was replaced by the Agulhas System Climate Array (ASCA). These moorings are currently measuring how the dynamics of the Agulhas Current are changing with time, providing scientists with vital information on the current's behaviour and the local implications for South Africa. It is crucial that this in-situ monitoring of the Agulhas Current system continues to allow scientists to detect changes in the current over time. The data will help oceanographers improve their models for understanding how variations in the current affect local and global ocean circulation and our climate.

This article by PDP PhD student Katherine Hutchinson appeared in the 'The Conversation' on 18 July 2017.

See full article here: http://theconversation.com/why-deeper-insights-into-the-agulhas-current-can-shed-light-on-climate-patterns-69497

ASCA teams up with floating university for SEAmester landmark cruise

Imagine attending university lectures on board of a state of the art research vessel, experience life of an oceanographer and environmental scientist at sea, engage in hands-on data collection and network with a diverse group of young scientists, while having loads of fun! This is what SEAmester was all about.

SEAmester, the brainchild of Prof Isabelle Ansorge from the Oceanography Department at the University of Cape Town (UCT), is a training course at sea where students participate in an intense lecture series combined with deck work to gain practical experience on physical and biological oceanography. ASCA is a large, international programme performing ground-breaking science. It was an excellent match to combine a research cruise with student training. The purpose of the cruise was to validate the data derived from ASCA moored instruments and obtain biological (plankton) samples from a largely understudied area, while also enabling postgraduates to gather data for their projects.

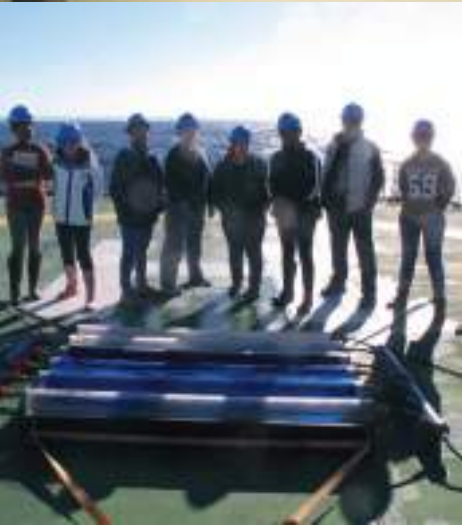
During July 2016 a group of specially selected students, lecturers, scientists and technicians, embarked on the SA Agulhas II for a voyage that took them to the heart of the Agulhas current off the coast of the Eastern Cape. As part of the SAEON education programme 2 learners and a teacher were also on board. While the students were attending lectures the researchers and technicians were deploying instruments, gathering samples and data which would later keep the students busy as part of the practical component of the course.

The on-board research activities included collecting Ship-borne Acoustic Doppler Current Profiler (S-ADCP) data, recording the strength and direction of currents throughout the entire voyage. A Continuous Plankton Recorder (CPR) was also deployed, collecting plankton, to enable comparison with samples from a similar transect followed during the previous ASCA cruises. Zooplankton and microplastics were collected in vertical bongo nets at several stations.

At each station a CTD cast collected water samples for calibration and analysis of phytoplankton identification, microbe analysis, flow cytometry, nitrogen isotope analysis, chlorophyll a analysis, nutrient analysis, primary production analysis, microzooplankton samples and phytoplankton community composition. With all these deployments the students were kept busy around the clock!

On the return leg four Argo floats were deployed by the two learners assisted by SAEON staff. These floats have been adopted by high schools around the Cape Peninsula as part of the ARGO programme and form an important part of the science education programme.

Read more at http://dx.doi.org/10.17159/sajs.2016/a0171



SAEON would like to acknowledge and thank the Department of Science and Technology and the National Research Foundation for partly funding the trip, the Department of Environmental Affairs for making the Agulhas II available; Professor Isabelle Ansorge and her team for leading the cruise; the crew and Captain of the SA Agulhas II; Chief scientist Gavin Louw and the rest of the Department of Environmental Affairs staff; the scientists, lecturers, students and learners involved; and lastly, the weather in making the cruise extremely successful.

Investigating a century of change: revisiting South Africa's earliest trawl surveys

Understanding the state of historical fish communities and their ecosystems is critical to enable informed management of current fish stocks. Without historical baselines, it is difficult to determine changes in fish population densities, compositions or the distribution of species. A project to investigate such baselines and assess long-term change on South Africa's south coast was inspired by the rediscovery and digitisation of a historical dataset that sampled trawl-catches prior to substantial human impact. A government-appointed researcher, John Gilchrist, initiated trawl surveys around South Africa's coast in 1897–1904. His job was to document "what the seas around the coast really contain and the best way of developing them practically" (Department of Agriculture, 1897). Before this time, fishing effort had consisted of beach seining or line-fishing from small open boats or the shoreline, which meant that these initial trawl surveys captured a rare snapshot of seafloor ecosystems at a time when they were in a near-pristine state.

To get the most from these historical data, they needed to be compared to recent catches at the same locations and using the same methods. Substantial changes in trawl technology and their undefined influence on the abundance, size and species of fish caught meant that the best comparison would be achieved by replicating historical methods and gear in a long-term repeat experiment. The aim of this PhD project by Jock Currie was therefore to conduct such repeat trawl surveys and quantify how the fish communities had changed during a ~111 year period, due to mounting human pressures.

The historical trawl gear was carefully reconstructed, using literature and photographs for the design, dimensions, materials and methods of fishing. An early 'Granton otter trawl' net had been used, together with flat wooden otter boards. In 2015, three sites were successfully re-surveyed from a chartered commercial trawler, using the replicated gear and methods.

Survey results revealed that the demersal catch assemblage had transformed substantially over time. Changes included heavy depletion of kob (*Argyrosomus* spp., absent in the resurveys), panga (*Pterogymnus laniarius*) and east coast sole (*Austroglossus pectoralis*), which had dominated historical catch composition. Instead, resurvey catches were largely made up of gurnards (*Chelidonichthys* spp.), horse mackerel (*Trachurus trachurus*), spiny dogfish (*Squalus* spp.), hake (*Merluccius capensis*) and white sea catfish (*Galeichthys feliceps*).

These long-term comparisons, using minimally-disturbed baselines, revealed drastic transformation of the fish assemblage during a century of industrialisation, which points to trawling-induced alteration of benthic habitats and substantial changes in ecosystem structure. Although their impacts are difficult to disentangle, both fishery pressures and climate change have likely affected these fish communities. The results have implications for fished and un-fished species, ecosystem management, environmental monitoring and the ecosystem approach to fisheries management. Some of the main recommendations included:

- Incorporation of historical data into species, ecosystem and stock assessments to improve the understanding of past dynamics prior to relatively data-rich recent periods.
- Maintaining and strengthening long-term monitoring programs, such as the annual demersal trawl survey led by the government fisheries department (DAFF). These are critical to detect and adapt to climate change and to enable science-based management action based on the realities of resource abundances.
- Focused research to understand the habitat effects of inshore trawling in South Africa and the effectiveness of current management measures.
- More effective management interventions to enable the recovery of depleted populations investigated here (particularly kob, east coast sole and white stumpnose). Improved management could entail greater enforcement, catch reductions or moratoria, reducing market demand for over-exploited species, gear limitations and enhanced spatial management measures, including strengthened/expanded marine protected areas and fisheries management areas.

Then and now: the trawl net from 1897 and the reconstructed replica used in this study.

ELWANDLE NODE
At a glance

South Africa has in recent years become one of the international leaders of coastal long-term ecological research through the efforts of SAEON in the Algoa Bay Region.

Climate and global change has had a significant impact on the coastal zone of South Africa. Sea levels are rising (2.6 mm/year from 1980 to 2008 and 6.5 mm/year from 2009 to 2015 in Port Elizabeth), with increased intensity of storm surges, extreme weather events (floods and drought), increased variability in ocean temperatures, invasion of exotic species and increased acidification of the oceans. Despite these changes and the significant impact they will have on the economy and our social well-being, very few observations have been made to understand the drivers and the response variables of climate and global change in the ocean space. South Africa has in recent years become one of the international leaders of coastal long-term ecological research through the efforts of SAEON in the Algoa Bay Region. The array of sensors and research platforms currently in place, and those proposed in the Shallow Marine Coastal Research Infrastructure, will place South Africa and its scientists at the forefront of climate and global change research in the coastal zone.

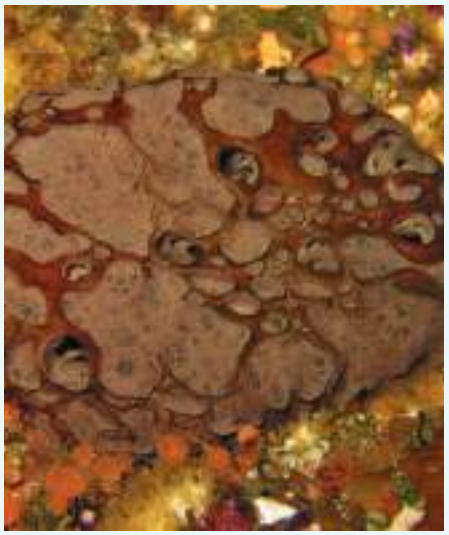
NEW SPECIES OF SPONGE ON THE AGULHAS BANK NAMED AFTER SAEON SCIENTIST

During a diving survey on the Alphard Bank, Dr Toufiek Samaai, the leading sponge scientist in southern Africa, noticed an unfamiliar sponge. He took a picture and asked his buddy-diver Dr Albrecht Götz to cut the specimen off the reef.

After closer examination in the lab, it became clear that a new species had been discovered. Three years later a scientific manuscript with a first description was published: Samaai T. et al. 2012. *Zootaxa* **3395***:* 33–45.

A section in this publication reads: "*Etymology: Named after Dr Albrecht Götz, South African Environmental Observation Network, for assistance on the Agulhas Shelf survey.*"

http://www.saeon.ac.za/enewsletter/archives/2016/december2016/doc03



EQUIPMENT AT THE PLATFORM

- Acoustic Doppler Current Profilers (ADCP)
- Underwater Thermistor Arrays
- Gully Underwater Temperature Recorders
- CT sensors measuring temperature and salinity
- Rod-Set Elevation Tables measuring sediment accretion/ erosion in estuaries
- Free cast and moored CTDs
- Microscope Laboratory
- Water Quality Laboratory and Sediment Laboratory
- Coastal bongo & phytoplankton nets
- YSI multiparameter probe
- Research Vessel *Honckenii*: 8.5 m Rubber inflatable boat
- Research Vessel *Calanus*: 9.3 m Catamaran

Living stromatolites

Stromatolites are layered, rock-like structures created by algae. Fossil stromatolites are known from 3.7 billion year old rocks making them the earliest known life on earth. Remarkably, stromatolites still exist in today's world. Several unique colonies of these stromatolites were recently discovered in South Africa on rocky coasts where freshwater seeps into marine pools, representing extraordinary model ecosystems and opportunities in which to study life's evolutionary past. The highest concentration of these are found between Cape Recife (Port Elizabeth) and Oyster Bay in the Eastern Cape.

Stromatolites are constructed by cyanobacteria (blue-green algae) and diatoms that precipitate calcium carbonate as a by-product of metabolic activities, thereby building up of layers like tree rings. The interplay between the $CaCO_2$ enriched groundwater and the sea is critical in determining the species richness and dominance not only of the cyanobacteria and the diatoms, but also the macroalgae, macrophytes, invertebrates and fish that call these unique ecosystems home. The fresh water stromatolite pools are regularly inundated with seawater followed by flushing with nutrient and $CaCO_2$ rich groundwater to create a highly variable and osmotically stressful environment.

The stromatolites, the first to be discovered in African waters, form part of the long-term observations in the Algoa Bay Sentinel Site. The SAEON Elwandle Node plays a leading role in a major research project led by Prof Renzo Perissinotto of the Nelson Mandela University (NMU). This research has already uncovered revealing aspects of modern stromatolite biology and its evolutionary context with 10 publications in leading international journals over the past three years, and more to follow as the multi-institutional, multi-national and multi-disciplinary team of scientists continue their research on this unique coastal ecosystem.

doi:10.1111/1462-2920.13116

RESEARCH SITES

- Algoa Bay Sentinel Site (includes St Francis Bay)
- National Estuaries Network (Kromme, Gamtoos, Swartkops, Kariega)
- National Coastal Temperature Network
- Marine Protected Area (MPA) Network: (Amathole, Tsitsikamma, Addo Elephant National Park)
- Sea-level rise Network in estuaries (Swartkops, Kromme, Knysna, Mlalazi, Inxaxo, Mngeni and Nahoon)
- Tufa Stromatolite sites
- Kelp monitoring sites (Betty's Bay; Tsitsikamma ; Table Mountain)

RESEARCH SPECIALITIES

- Physical oceanography
- Phytoplankton ecology and taxonomy
- Zooplankton ecology and taxonomy
- Estuarine ecology and hydrodynamics
- Sedimentology and geomorphology
- Coastal and estuarine biogeochemistry
- Operational Oceanography
- Coastal craft operations and maintenance
- Research Diving

Tufa stromatolite barrage pool near Port Elizabeth

ELWANDLE

Research highlights

Estuaries in the face of Global Change: towards understanding the resilience of vulnerable coastal ecosystems

Estuaries are dynamic coastal ecosystems constantly adjusting to changes occurring over time and place. Future changes in climate in conjunction with mounting human impacts, however, have the potential to alter estuarine ecosystems beyond their current variability states. The key processes likely to impact upon estuaries under global change include sea-level rise, changing rainfall, freshwater abstraction, water quality, sedimentation, water temperature, urbanisation and ocean acidification.

Projecting future implications for estuaries is a complex task demanding knowledge of patterns and processes on regional and catchment scale, which in itself may be unique to a particular system or types of systems. Accurate and consistent field data representing relevant variables forms the foundation of this knowledge.

In 2011 SAEON and partners identified 13 estuaries for long-term monitoring as part of the Department of Water and Sanitation's South African Estuaries Monitoring Network, four of which are located within the Algoa Bay Sentinel Site. Monitoring involves continuous and seasonal sampling of key environmental and biological variables to understand present states and the variability within individual systems that represents the baseline against which future changes can be quantified and understood. Data collected will contribute to the South African Estuaries Database (SAED) and form part of the SAEON managed South African Estuaries Information System (SAEIS), a platform designed to facilitate free dissemination of data to interested parties. These data will additionally provide important opportunities for research linking catchment to coast problems, with great potential to expand into innovative inter-disciplinary studies spanning the socio-ecological and socio-economical fields. Sustaining long-term monitoring of climate variables and key estuarine processes is paramount if we are to determine responses to potential climate change impacts, limitations to resilience and future adaptation strategies.

Sea-level rise and the implication for intertidal salt marshes

Global sea-levels have risen between 0.17–0.21 m during 1901–2010 with a mean rate of 2.3 mm.yr^{-1} since 1971, but increasing to 3.2 mm.yr^{-1} from 1993–2010, and to 3.7 mm yr^{-1} at present. If coastal wetlands are to survive rising water levels, they must be able to grow and rise up at a rate such that surface elevation gain is sufficient to offset the rate of sea-level rise (SLR).

The SAEON Elwandle Node and the Nelson Mandela University tested whether intertidal salt marshes were able to accumulate sediment at a rate equal to or higher than the rate of current and predicted sea level rise by determining: 1) how the estuarine habitat has responded to change over the past seven

decades; 2) the main physical drivers of the salt marsh and 3) the response of sediment elevation to sea level rise. To test this Rod Set Elevation Tables (RSETs) were established in the lower, middle and upper reaches of the Knysna, Swartkops and Kromme Estuaries in 2009.

Results indicated that the most important drivers of salt marsh species distribution were elevation and soil moisture and that most of the changes that have taken place were as a result of development. Results from the Swartkops Estuary indicated that despite a relative sea-level rise of 1.82 ± 0.49 mm.yr^{-1} (1978–2014) in Port Elizabeth, the intertidal salt marsh is accreting sediment at a higher rate than historical sea-level rise. It is anticipated that most salt marshes will be able to keep pace with accelerated sea level rise due to inland migration and biophysical feedback processes. However, the limited upland area (drowned river valleys) and hard structure barriers constructed in most of our estuaries will make it likely that these highly productive salt marsh areas will decrease or be lost as sea -levels continue to rise.

Nelson Mandela University is leading a new Water Research Commission project in collaboration with SAEON Elwandle Node and other partners that will expand the RSET network to five mangrove estuaries along the East Coast of South Africa. doi:10.1016/j.sajb.2016.05.003

Evaluating different monitoring methods when sampling with remote underwater video systems

A lot of of thought and planning goes into the design of scientific studies in order to minimise methodological biases, optimise sampling effort and increase the accuracy of, and confidence in the findings of a study. In the context of marine fisheries, SAEON and SAIAB initiated studies on monitoring fish using baited remote underwater stereo-video systems (stereo-BRUVs). These consist of a frame holding two underwater cameras mounted to provide an overlapping field of view which is centred on a bait container about 1.5 m in front of the camera. The bait draws a large variety and abundance of reef fish and invertebrates into the view of the cameras, while the overlapping field of view from the stereo-cameras allows the size of the animals to be accurately measured. To better understand the potential benefits and biases of stereo-BRUVs numerous methodological studies have been conducted.

A recent paper by PhD student Denham Parker (doi:10.1016/j.ecolmodel.2016.04.006) compared the ability of fishing and stereo-BRUVs to detect population trends in a commercially important line-fish species, red roman. He found that the data collected by the stereo-BRUVs did not suffer from the limitations of conventional fishing and as such was better able to detect accurate trends in the biomass of adult roman. In a second paper from his PhD (doi: 10.1016/j.fishres.2016.02.025) Denham clearly illustrated that stereo-BRUVs sampled a greater diversity of species and was less prone to natural variability compared to fishing.

A study by Masters student Nicolas Schmidt explored the relationship between fish and their habitat, and tested if the presence of bait potentially biased this observed relationship. His results demonstrated that while the bait clearly influenced the fish communities it mostly enhanced our ability to detect the associations between fish and their habitats.

Research conducted by masters student Roxanne Juby, who used stereo-BRUVs to investigate both diurnal (active at day) and nocturnal (active at night) marine fish, shed light on South Africa's poorly understood nocturnal reef fish communities. She found that the fish communities undergo distinct day-night shifts in community composition, species richness and abundance and highlighted the importance of including nocturnal sampling when aiming to gain a comprehensive understanding of our fish communities, to include the nocturnal species and those inhabiting dark depths.

Read more at: http://www.saeon.ac.za/enewsletter/archives/2016/october2016/doc05 and http://www.saeon.ac.za/enewsletter/archives/2017/february2017/doc03

GRASSLANDS-FORESTS-WETLANDS NODE

At a glance

The SAEON Grasslands-Forests-Wetlands Node develops platforms that investigate the changes in ecosystem services through human and global change impacts.

The grasslands provide essential ecosystem services such as water provision, flood mitigation, nutrient cycling, soil retention, carbon mitigation (through efficient soil carbon storage), rangelands, recreation and provision of consumptive goods. The SAEON Grasslands-Forests-Wetlands Node develops platforms that investigate the changes in these services through human and global change impacts. A greater understanding of the processes that regulate these services is obtained through long term *in situ* observations in grasslands, as well as in forests and in wetland areas. The platforms developed are in montane areas (high altitudes) and in low altitude coastal areas with a focus on benchmark (pristine), degraded/transformed and restored sites.

Members of the NRF Executive Team visited Okhombe, a community driven project that looks at grassland restoration methods.

Our higher rainfall grasslands have the potential to be converted to forests, either through plantation forestry or the expansion of indigenous trees. The consequences of such drastic landcover change for stream flow have been studied for decades in gauged streams set up in the 1950s and now maintained by SAEON. However little is known about the potential role of land use – landcover change and biological feedbacks on earth system processes. What is the net effect of these changes on ecological functioning and the consequences for ecosystem services essential for society? These questions lie at the core of the research done at the Grasslands-Forests-Wetlands Node.

EQUIPMENT AT THE PLATFORM

Cathedral Peak Sentinel site:

3 HIGH ALTITUDE automatic weather stations

3 LOWER ALTITUDE automatic weather stations

SCINTILLOMETER AND EDDY COVARIANCE SYSTEM measure energy and carbon fluxes

YSI MULTIPROBE

1 METEOROLOGICAL STATION with Ground-level Nipher Shield and Fog gauges

6 STREAMFLOW gauging weirs

26 RAIN GAUGES (tipping bucket)

COSMIC RAY PROBE measures soil moisture

SOIL RESPIRATOR (LiCor 8100)

At our Maputaland Coastal Plain Sentinel site, the following instruments are installed

OTT MF PRO FLOWMETER measures streamflow

29 BOREHOLES Monitor Groundwater levels

2 AUTOMATIC WEATHER STATIONS

8 CAMPBELL SCIENTIFIC HEAT PULSE VELOCITY SYSTEMS measure tree transpiration

EDDY COVARIANCE SYSTEM measure energy and carbon fluxes

YSI MULTIPROBE (physio-chemical variables)

COSMIC RAY PROBE measures soil moisture

Weather station encourages local community to monitor climate

A thumbs-up from the rooftop signals a successful installation at the Bambanani Primary School in the Drakensberg. An automatic weather station was deployed at the school, expanding the node's monitoring sites in the Drakensberg Mountains while incorporating the site into its science engagement programme. The weather stations provide data which will fill an important data gap for the node's science programme, but will also be used as a teaching resource to stimulate interest in scientific research.

RESEARCH PLATFORMS

- Mesic high altitude grassland:
  - Cathedral Peak
  - Ukhombe
  - Bambanani
  - Two Streams
- Subtropical low altitude grassland:
  - Maputaland coastal plain
  - iSimangaliso Wetland Park
  - Vazi Pan area

RESEARCH SPECIALITIES

- Hydrology
- Hydrometeorology
- Land cover/Land use
- Vegetation ecology
- Ecophysiology

GRASSLANDS-FORESTS-WETLANDS

Research highlights

Playing with Fire – the Brotherton long term fire experiment

Before 1980, 'Brotherton' was not much more than an allotment of mountain grassland high in the uKhahlamba Drakensberg. Now, Brotherton is known as a first class long-term research site synonymous with fire. The Brotherton story began when Colin and Terry Everson were asked: why is fire needed in these beautiful pristine mountain grasslands? Why burn so frequently, are you not destroying this ecosystem with fire?

These researchers stated that fire had been an integral part of grasslands for a long time based on paleo evidence and other research. Now, they faced the challenge of demonstrating this and developing a best use practice for fire in the most important water catchment area of South Africa, the Drakensberg Mountains. In collaboration with other scientists Colin and Terry set up an experiment burning at frequencies ranging from one to eight years, and complete protection. They also tested the impacts of burning grasslands within different seasons. Using the Brotherton field trial and meticulous demographic studies of grass species in the area they demonstrated that frequent fire is really important for maintaining healthy diverse grasslands.

SAEON is interested in the Brotherton field trials for a number of reasons: We know that global change is altering the fundamental abiotic template for all species in these grasslands. These changes have cascading effects on ecosystem functioning, and by understanding the reaction of species and ecosystems to change this will help us test predicted impacts of global change. Among predicted impacts is loss of biodiversity, changes in production of water and/or storage of carbon in the grasslands. Hydrologists and earth system scientists have set up experiments to examine the effects of the various fire treatments over time, the potential effects of warming of these grasslands with open-top warming chambers and variation in rainfall infiltration in response to the different fire treatments.

An excited team that included Colin and Terry Everson resampled all Brotherton plots in late April and early May. Working together in a unique collaboration, Ezemvelo KwaZulu-Natal Wildlife and SAEON are ensuring the continuation of this multi-decadal fire experiment.

Streamflow & historical rainfall data: what it tells us

The high altitude catchments of the uKhahlamba Drakensberg, are important headwater catchments for water supply to the economic regions of Gauteng and KwaZulu-Natal. However, much uncertainty surrounds environmental change and its impacts on hydrological responses, particularly in these high altitude catchments. Using the historical data (1950–1990) collected in the Cathedral Peak research catchments, an initial analysis has been undertaken to assess whether any changes in the temperature, rainfall and streamflow patterns are evident for these areas.

Consistent increases in minimum, maximum and mean temperature records indicated warming through this period. The historical rainfall records at a daily and monthly level indicated a drying through the historical record, particularly in autumn. Decreasing trends were also evident in the historical streamflow which correspond to the drying trends shown in the rainfall. However, the decreases in streamflow were stronger than those in the rainfall. During this period the land use in the catchments remained constant, thus changing climate appears to be the cause behind reduced streamflow across all time steps and seasons.

Monitoring resumed in the Cathedral Peak catchments in August 2012, thus a short current period of rainfall and streamflow data was available to compare with the historical data. The comparison showed an increase in the number of rain days in summer and winter, an increase in the number of events greater than 20 mm in summer and autumn and an increase in the 2-day maximum rainfall. These results suggest changes in the rainfall patterns and extremes. However, due to the shortness of the record and the influence of the recent drought, it could not be established whether there is a general wetting or drying trend between the historical and current period.

The comparison of the streamflow records showed a general decrease in flows between the historic and current periods; however this could be attributed to the recent drought. The recent drought was one of the most severe droughts that have occurred during the monitoring of the Cathedral Peak catchments. The previous lowest mean annual precipitation (MAP) recorded in the catchment area was 959 mm in 1970, compared to 742 mm in 2015. It was also the first time during monitoring that streams in any of the catchments stopped flowing, with Catchment VII drying for a short period of time. As more rainfall data is continually collected we will better understand the changes occurring in the uKhahlamba Drakensberg that will ultimately impact on the water supply to KwaZulu-Natal and Gauteng.

Read more at http://www.saeon.ac.za/enewsletter/archives/2017/february2017/doc06

Cosmic-ray technology enables PhD student to travel the world

Cosmic-ray technology is an innovative technique of estimating area-average soil moisture by measuring the neutron intensity above the land surface. The technology is novel in South Africa, with only five static instruments and one rover (movable unit) in the country. This technology can be used for many important applications linked to water resources management, including flood and drought forecasting.

SAEON is fortunate in that hydro-meteorologist Professor Colin Everson is leading the collaborations associated with these instruments in South Africa and he is supervising PhD student Thigesh Vather's study on the use of cosmic-ray technology for hydrological applications.

Since starting his PDP-funded PhD in June 2016, Thigesh has been fortunate to attend the fifth International COSMOS workshop, which was hosted in Copenhagen, Denmark, in August 2016. The workshop demonstrated how cosmic ray technology is applied globally, as well as bringing together the pioneers of this technology. More recently he visited Nebraska and spent a month at the University of Nebraska-Lincoln (UNL), where he was mentored by Dr Trenton Franz, Assistant Professor of Hydrogeophysics. The main purpose of this visit was to learn how to best carry out and calibrate cosmic-ray rover field surveys and learn new techniques and applications of this technology.

SURVIVAL AND LIFE EXPECTANCY OF THE TREE *PROTEA ROUPELLIAE*

Fire is the primary management tool for maintaining the exceptional plant diversity of the Drakensberg Mountains. Certain species are conspicuous by their dominance and may serve as indicators of general system trends. Examples include the tree proteas (*Protea roupelliae, Protea caffra*) that form savanna in this montane grassland region.

Concern has emerged over the past few decades that tree protea populations were declining but there was no consensus about the most appropriate fire regime for ensuring their persistence. The Department of Forestry was faced with this challenge over 40 years ago when a formal fire experiment was undertaken for 14 years in *P. roupelliae* woodland, and the demographic response of this species was studied. Unfortunately the results were never published.

SAEON supported the original ecologists and now honorary research associates, Dr Francois Smith and Ed Granger to resample the sites and publish the original work. Their paper (doi:10.1111/aec.12459) evaluates regeneration, growth, mortality and longevity across a range of fire-return intervals and seasons. An expected benefit of a long fire-return interval was nullified by the devastation of an eventual high intensity fire. A winter biennial burning regime was the best treatment for the tree population.

See DOI: 10.1111/aec.12459

Plantation Forestry, Hydrology & long-term catchment monitoring

It is widely accepted that the expansion of commercial forestry has had negative hydrological consequences on a catchment scale. However, it is also acknowledged that plantation forestry is an important contributor to the economy. In water-stressed catchments there is still a high demand for the expansion of commercial forestry and there is an urgent need for new alternative land-use activities that will still provide viable economic and resource outputs, while simultaneously achieving an equitable balance in water resource demand.

Changes in land-use principally bring about a change in the hydrological cycle by altering the water lost by plants and soil (evapotranspiration or ET). At Cathedral Peak SAEON has setup long-term experiments to monitor changes in ET using eddy covariance flux measurements in montane grasslands. These grasslands represent the natural or baseline vegetation.

Over the past year SAEON scientists have expanded these measurements to include commercial wattle plantations at the Two Streams Research catchment in the KwaZulu-Natal midlands and in indigenous forest, pine and eucalyptus plantations in the Manzengwenya area near Vasi pan on the Zululand Coastal Plain. SAEON is now supporting three of these technically demanding ET and carbon flux stations at each site, while a fourth site in the Fynbos Node is planned in the near future. A mobile flux station has been developed to provide additional measurements of other land-use types, bringing the total of eddy-covariance flux sites to five.

At Two Streams SAEON is preparing for the clear felling of the wattle in October 2017 and subsequent replanting with eucalypts with the aim of making a major contribution to the current genus exchange debate (see text box below). At Vasi the aim is to explore hydrological impacts of alternative land-use options since commercial forestry plantations are being held responsible for the dramatic ground water depletion in the area.

The Genus exchange debate explained

On 23 October 2015 the Department of Water and Sanitation (DWS) published draft Genus Exchange (GE) regulations for SFRA (Streamflow Reduction Activity) water users. This was to account for the situation where growers are replacing previously low water use species (e.g. pine) with higher water users (e.g. Eucalyptus spp.). These described the proposed definitions, principles and process for GE within the commercial forestry industry. Forestry South Africa (FSA) consulted its legal advisors and made a submission to the DWS in December 2015, primarily from a legal standpoint. The legislation as proposed by DWS is currently a subject of hot debate.

Mobile eddy covariance system measuring pine ET

ARID LANDS NODE
At a glance

The SAEON Arid Lands Node manages several sites and collaborates with other institutions in projects at different locations.

The hyper-arid to semi-arid lands of South Africa stretch across 5 provinces and include 5 biomes, namely Desert, Succulent Karoo, Nama Karoo, Arid Savanna, and Karoo Escarpment Grassland. The SAEON Arid Lands Node manages several sites and collaborates with other institutions in projects at different locations in this area, covering several habitats and landscapes.

During one of the field trips, SAEON research associate Sue Dean explains long-term monitoring in answer to a question by the SAEON field technician Tshililo Ramaswiela

Arid Zone Ecology Forum 2016: Reflecting on Tierberg past and future

The Arid Zone Ecology Forum (AZEF) which took place in Prince Albert in October 2016 was not only an opportunity to reflect on the past 30 years of research at Tierberg LTER, but also to shape the future of arid zone research. Johan Pauw officially opened the conference. He highlighted the contribution of the research conducted at Tierberg LTER to current knowledge of Karoo ecosystems and the sterling effort by the individuals who made it happen, including Richard and Sue Dean.

Richard and Sue, who are also SAEON Honorary Research Associates, were given lifetime achievement awards by AZEF to honour their work in advancing ecological sciences in arid areas. In addition to their research, they played a major role in establishing and running the Tierberg Karoo Research Centre, keeping it going despite financial challenges and eventually handing the management (and datasets) over to SAEON. The Arid Lands Node was one of the sponsors of the conference, funding student attendance and student prizes.

http://www.saeon.ac.za/enewsletter/archives/2016/december2016/doc08

EQUIPMENT AT THE PLATFORM

4
AUTOMATIC WEATHER STATIONS

Transect of 16
TEMPERATURE LOGGERS

TIERBERG RESEARCH HUT
and infrastructure

SAEON's involvement with potential shale gas developments

A burning question concerns how South Africa will get ready for shale gas mining. Accordingly, SAEON in collaboration with other institutions, in 2015 and 2016 conducted a review of biodiversity and ecological impacts, as well as knowledge gap analyses of the Upper Karoo. The review was reported in the Strategic Environmental Assessment of Shale Gas Development. In preparation for observing environmental changes in the Upper Karoo, about 30 Square Kilometre Observatories were established across the Upper Karoo in collaboration with SANBI. These will be monitored in future, so as to detect broad-scale environmental changes brought about by industries such as shale gas mining, to enhance knowledge, capacity and governance to manage risks, benefits and uncertainties concerning such industries. Irrespective of the future of the gas industry in South Africa, the SAEON programme will go a long way towards tracking the development trajectory of the Karoo into the future. This will help guide decisions and practice concerning the environment.

NRF rating awarded to Dr Joh Henschel

Dr Joh Henschel, of the SAEON Arid Lands Node, was awarded a C1-rating by the National Research Foundation (NRF) in 2016.

In 2013 Dr Henschel joined the SAEON Arid Lands Node in Kimberley as node manager. Since then he has thrown his full weight into the research of the arid lands, and this has now been aptly rewarded. Being awarded a C1 rating signifies an established researcher who, on the basis of the high quality and impact of recent research, has considerable international recognition and who has substantially advanced knowledge and understanding in his/her research field.

Joh has a wide area of expertise, from marine biology to hyena behaviour and community ecology, but his real interest is in arid environments and in spiders (arachnology). He is also an excellent popular science writer and has published a book of short articles and a poetry volume relating the marvels of life in the arid environments.

RESEARCH PLATFORMS

- Tierberg Long Term Ecological Research (LTER) site
- Wolwekraal Nature Reserve
- Square Kilometer Array (SKA) LTER
- Karoo Grazing Trials LTER, Grootfontein and Carnarvon
- Karoo Square Kilometer ecosystem Observatories (SKO's)
- Karoo Monitoring Pentad
- Karoo Escarpment Transects at Compassberg
- Lower Vaal & Orange Rivers

RESEARCH SPECIALITIES

- Land use change
- Dryland wetlands
- Ecological consequences of infrequent climatic events such as frost
- Ecosystem engineering by termites and locusts
- Ecosystem implications of broad-scale developments

ARID LANDS

Research highlights

Don't judge a pan by its cover – digging into the dry wetlands of the Northern Cape

Depressional wetlands, colloquially known as pans, are prominent features in arid regions, and the Northern Cape landscape is peppered with them. They differ from the familiar wetlands in humid regions, which are continuously inundated systems with saturated soils, by only being inundated every few years. When these pans become flooded after sufficient rainfall, invertebrates like shrimps, bugs, beetles and flies hatch out and algae grow. Inevitably, water birds then flock to feast in the resurrected systems. These events are however short-lived due to the high evaporation rates of the region, but organisms living in pans are well adapted to rapidly benefit from wet conditions and to secure the next generation before pans dry up again.

The variable scale of wetness over space and time and the unpredictable rainfall regime of the province pose challenges for sampling protocols during wet spells. Consequently, very little information is available on these ephemeral wetlands. They are subject to various threats, including livestock agriculture, crop farming, salt mining, damming, ploughing to enhance infiltration, alien invasion, recreational activities and even land speed record attempts! The recent shift of land use to mining, renewable energy and energy transfer has not only increased actual or potential anthropogenic pressure on the wetlands, but also highlighted the necessity to learn more about these ecosystems.

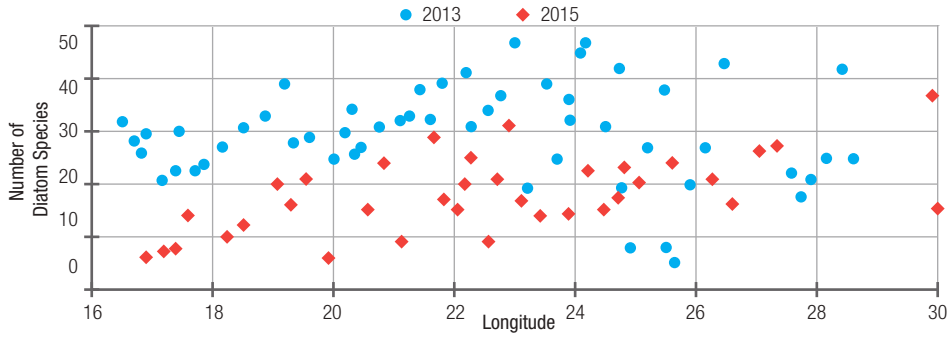
SAEON launched a research project which aims to characterise ephemeral pans in the Northern Cape by using remote sensing and in-situ sampling protocols to establish a long-term monitoring framework. By studying the biodiversity of pans and their structure, functioning and underlying processes, Dr Betsie Milne, PDP postdoctoral fellow will evaluate the drivers of changes in these systems in relation to global and land use change. Not only will this project achieve ground-breaking research, but it will allow SAEON to provide much-needed information to land managers and decision makers on the management and conservation of these life-giving pans.

http://www.saeon.ac.za/enewsletter/archives/2016/december2016/doc06

Orange River Diatoms – beginning to end

When in 2013 three canoeists embarked on their journey from the source of the Orange River to its mouth, recording observations and collecting samples for SAEON all along the way, little did they realise that they would collect 190 species of diatoms, with as many as 47 species in a single sample! The diversity of diatoms changed along the length of the river, being far more variable in the Upper Orange (upstream of the confluence with the Vaal) than lower down.

Ongoing data analyses by the North-West University and the SAEON Elwandle Node indicate that an alien invasive species dominates diatom numbers in stretches of the river bordering irrigated lands. A comparison with samples obtained in 2015 by canoeists who followed the Vaal River from its source to the Orange River Mouth, indicate a drastic decrease in diatom species numbers at most stations. The maximum number of species recorded in a sample decreased to 43 and only 169 taxa were recorded, of which 44 were not recorded in 2013.



The causes of these major changes after a mere two years require more study. One cannot, for example, attribute the changes to changes in water quality as a result of industrial and agricultural development along these rivers without more data.

This project is a collaboration between SAEON Arid Lands Node, Elwandle Node and Prof Jonathan Taylor from North West University.

Doctoral PDP student Juan Swanepoel is standing atop a 'heuweltjie' (termite mound) which occur across large parts of the the arid lands as slightly raised mounds with distinct plant communities when compared to the surrounding vegetation. Juan is studying the spatial pattern and distribution of these heuweltjies, along with other biological variables to find whether an increased density of heuweltjies results in a higher overall productivity in the landscape.

Monitoring the iconic quiver tree

The common quiver tree (*Aloidendron dichotomum*, previously *Aloe dichotoma*) is a widespread and iconic succulent tree species distributed across the arid and semi-arid winter and summer rainfall regions of Namibia and South Africa. The species is found in the Nama and Succulent Karoo biomes and has been suggested as an indicator suitable for monitoring climate change impacts in areas where complete biological inventories are lacking. Over the past 20 years, numerous studies have highlighted large-scale mortality for quiver trees at various localities in Namibia and South Africa. Local mortality in many of these populations has been attributed to climate change in addition to factors such as animal damage, disease, wind-throw and theft.

For systematic monitoring in the future, a monitoring protocol combining several methodologies used over the years by various institutions has been developed by SAEON and Northern Cape nature conservation officials. The protocol was tested by collecting data for 12 quiver tree populations situated throughout the Nama and Succulent Karoo biomes of the Northern Cape. The data were analysed in order to illustrate the applications for long-term monitoring purposes.

The baseline data collected for the Northern Cape populations indicated that there is a wide variation in population demographic characteristics between the different populations. The study highlighted that the choice of population surveyed is of critical importance and that a wide range of populations in close proximity to one another, in addition to different sites situated far apart have to be surveyed in order to produce an unbiased assessment of population changes.

Contrary to previous studies, South African quiver tree populations appear to be in good health and are growing in numbers.

See http://dx.doi.org/10.1016/j.sajb.2017.01.008 and http://www.saeon.ac.za/enewsletter/archives/2017/june2017/doc02

Vegetation dynamics after an experimental fire at Tierberg-LTER

The Tierberg long term ecological research site (LTER) is situated in the Succulent Karoo biome which is a fire-free system. It is known that an increase in grasses can change fire-free environments to fire-prone environments as has been observed in the eastern Karoo in recent decades.

SAEON assessed the effects of fire eight years after an experimentally induced burn in the species-rich Succulent Karoo Biome in anticipation of possible future grass invasions. On fire-disturbed plots vegetation cover and abundance had not returned to pre-fire levels. Plants belonged to two groups, namely, either non-succulent resprouters or succulent reseeders. The resprouters exhibited a rapid recovery and initially dominated burnt plots. Succulent seedlings established slower, but after eight years, occurred in higher numbers on the burnt plots than the unburnt plots. After fire, recovery of abundance and cover of long-lived, woody non-resprouter non-succulents was slow relative to resprouting non-succulents and reseeding succulents.

For the complete publication, see http://dx.doi.org/10.2989/10220119.2016.1173098

1001 KILOMETRES OF LTER ACROSS THE KAROO

Environmental ecologists from across the globe attended the Arid Lands node ILTER pre-conference tour from 6–9 October 2016. The tour visited sites of field experiments initiated 30–80 years ago, as well as a range of new and future topical studies. It began in the Succulent Karoo (at the 30-year old Tierberg-LTER site and the Wolwekraal Nature Reserve), and touched on several new Square Kilometre Observatories (SKOs) in the Lower- and Upper-Karoo before visiting the 2 500 m high Compassberg while learning about long term monitoring in order to understand climate change up this altitudinal gradient, the highest point in the arid region. At the world's oldest continuous grazing trials on Grootfontein, Middelburg, the meaning of *80 years, still going… still changing…* was amply demonstrated. Finally, after hearing about long-term monitoring of South Africa's most significant river, the Orange, the tour concluded in the amazing grasslands near Bloemfontein.

The tour gave an insight into the complex and fascinating ecology of the diverse arid regions of South Africa and the treasure of information that has been gained by the existing (and largely historically significant) long-term projects. The tour was capably led by SAEON's Arid Land Node Manager with the assistance of various SAEON employees and two Arid Lands Research Associates.

NDLOVU NODE

At a glance

The geographic focus is the Lowveld of the Limpopo and Mpumalanga Provinces, the adjacent mountains of the Transvaal Escarpment, the Soutpansberg and the Limpopo River.

The scientific focus of the SAEON Ndlovu Node is to determine the causes of the major environmental changes occurring in the north-eastern part of South Africa, and interpreting or predicting the consequences of these changes for society. The geographic focus is the Lowveld of the Limpopo and Mpumalanga Provinces, the adjacent mountains of the Transvaal Escarpment, the Soutpansberg and the Limpopo River. This focal area contains a diversity of ecosystems, all experiencing environmental changes that are also occurring throughout much of southern Africa and in some cases globally, thus allowing for study of environmental issues that are relevant nationally, regionally and in some cases globally. Game farms and the Kruger National Park are important in the area and provide opportunities for exploring the world with and without the African megafauna as a distinctive feature of global change in South Africa.

THE RECENT DROUGHT – A MAJOR CATASTROPHE FOR SOME, BUT NOT ALL, SAVANNAS

Much of the savanna biome experienced the lowest rainfall in recorded history between 2014 and 2016, with some areas experiencing a third year of below-average rainfall in 2016–17. This resulted in extensive dieback of grasses, and widespread deaths of livestock and game. In the areas hit hardest by the drought, even adult trees and shrubs died, which is a rare event in savannas. Changes to the composition of the grass layer have been documented at established sites of the SAEON Ndlovu Node, and an ad hoc project was completed in 2017 to document drought-induced tree mortality. Data from livestock and game counts are currently being compiled to document mortalities and to investigate in which ecosystems herbivores suffered the most.

EQUIPMENT AT THE PLATFORM

19 AUTOMATIC WEATHER STATIONS across a network of **11** sites in the Lowveld

22 BOREHOLES with level loggers

OVER **4 000** TREES tagged and measured

50 SOIL MOISTURE PROBES along a stretch of the Letaba River

2 RIVER GAUGING STATIONS

4 AUTOMATED WEATHER STATIONS **2** high altitude grassland sites

1 UNMANNED AERIAL VEHICLE (UAV) for low level aerial photography

THE GOLDEN FRUIT OF THE LOWVELD: MARULA

There are many reasons beyond the colour of the ripe fruit that the marula (*Sclerocarya birrea* subsp. *caffra*) can be considered '*golden*'. The species is an ecological, cultural and economic keystone. Trees play an important role in ecosystem functioning, providing a cool sub-canopy environment and habitat for small vertebrates and invertebrates, as well as browse for a variety of game and livestock. Further, they feature in numerous traditional ceremonies and cultural rites from birth to death, and everything in between.

Lastly, the fruit could claim its weight in gold as a key resource supporting income generation in local communities and as a primary ingredient in internationally-marketed cosmetic products and alcoholic beverages. Amy Marshall, a SAEON PDP Doctoral student, together with supervisors Dr Dave Thompson and Professors Stefan Grab (Wits) and Wayne Twine, is researching the economic and social value of marula in the central Lowveld.

Ultimately by revealing the population status of the species in non-conservation areas, together with an understanding of the interplay between changing perceptions and economic drivers, this work aims to offer solutions which ensure this resource remains sustainable for future generations.

RESEARCH SITES

- Phalaborwa mine & game reserves
- Phalaborwa rural rangelands
- Malopeni Flux Tower (Kruger National Park)
- Letaba River Hydrological Observatory
- Greefswald Forest (Mapungubwe National Park)
- Haenertsburg grassland
- Lajuma grassland (Soutpansberg)
- Letaba Exclosure (Kruger National Park)
- Lower Olifants River
- Olifants West Private Nature Reserve
- Raptors View Wildlife Estate
- Satara Experimental Burn Plots (Kruger National Park)
- South African Wildlife College
- Welverdiend rural rangelands

RESEARCH SPECIALITIES

- Vegetation dynamics
- Herbivore population dynamics
- Eco-hydrology
- Natural resource use and management

NDLOVU

Research highlights

60 years of the Experimental Burn Plots in the Kruger National Park

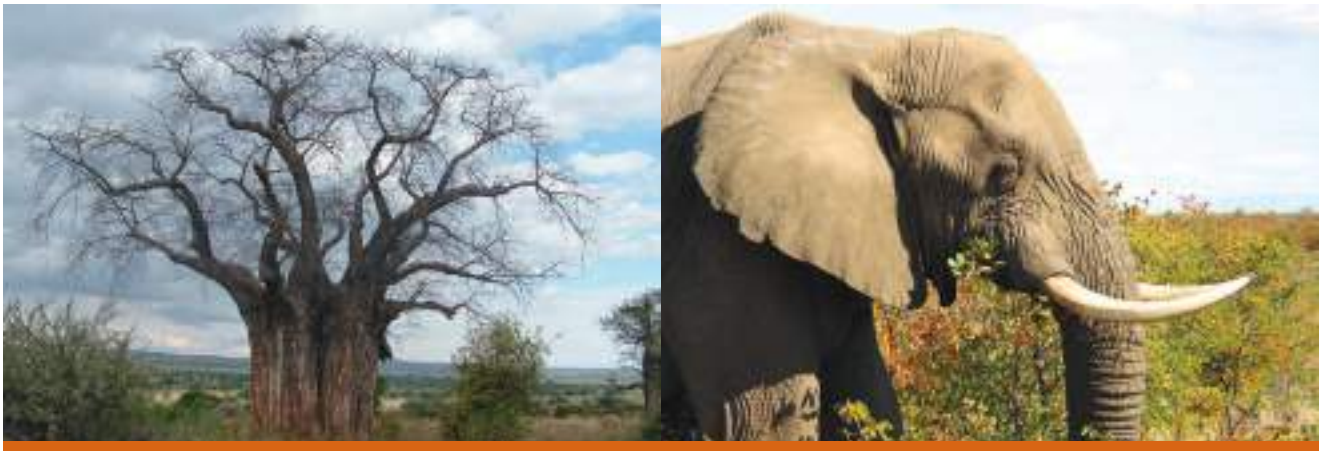
In 1954 conservation managers in the Kruger National Park initiated what would become one of the longest-running fire experiments in the world, amid concerns about the lack of information regarding the effects of fire on the fauna and flora of the park. The design was large and ambitious – four sites, each with four replicated "strings", and 12 plots of 7 ha in each string. Each plot was assigned a different burning treatment, ranging from no burning to various combinations of fire frequency and season. The vegetation of the plots was surveyed at the start of the experiment, and three times since, by either SANParks scientists or external researchers.

While results from the initial decades of the experiment provided clear insights into the effects of fire on savanna vegetation and soils, researchers encouraged SANParks to continue applying the experimental treatments (despite the large costs involved). This has provided a rare opportunity to investigate the roles of factors other than fire on the composition and functioning of savanna ecosystems.

In 2016, the SAEON Ndlovu Node and SANParks Scientific Services teamed up to capitalize on that opportunity, and resampled 60 of the plots to investigate recent impacts of elephants and atmospheric CO_2 (in the 1950s, elephant numbers in the park were still low and their impact on vegetation negligible, while atmospheric CO_2 was not much higher than pre-industrial levels).

Analysis of these data, together with the data collected in the 1950s, 1970s, 1990s and 2000s, has yielded some intriguing results. These include a clear effect of elephants at the drier sites, where tree and shrub densities have declined across all treatments. In contrast, shrub cover has increased dramatically at the site with highest rainfall, even on plots burned every year, suggesting an effect of elevated levels of atmospheric CO_2 in past decades.

http://www.saeon.ac.za/enewsletter/archives/2017/april2017/doc04



The baobab (top) and the savanna elephant (bottom) are the giants of the African continent. The destructive behaviour of the latter has attracted negative attention regarding the persistence of baobabs, but is this justified?

On the shoulders of giants: factors impacting baobab survival in the Kruger National Park

The African baobab has low dispersal capabilities, exact recruitment requirements, a life history spanning millennia, and experiences heavy utilisation; all of which reduce its ability to tolerate environmental change. Aerial surveys in the early 1990s showed few young trees but large numbers of dead old trees prompting concern over the status of the tree in the Kruger National Park (KNP).

A repeat sample of more than 700 baobabs, begun in 1995/6, has revealed some of the factors influencing this long-lived tree. Baobabs are sensitive to fire and smaller baobabs (stem diameter <2 m) were rare where fires were more frequent. Juvenile trees were most common where fire return intervals were greater than ~30 years. Young plants were also most common in warmer areas of the KNP (mean annual temperature > 23°C). Cooler areas had fewer small individuals, as well as fewer very large individuals.

Elephants are the usual suspects for baobab damage. Baobabs are quite resilient to elephant damage but the study revealed that the percentage and severity of damage to baobabs has increased in line with recent increasing elephant densities in KNP. Using their tusks to pierce bark and then strip the bark both upwards and downwards, the offender is able to 'peel' large areas of the stem. Elephants removed more bark in 2013 than they had in 1995/6. All baobabs >2 m in stem diameter had some level of damage and all individuals >3.5 m in stem diameter had moderate or more severe levels of damage, suggesting that damage accumulates over the lifespan of an individual if frequent elephant returns do not allow for recovery between visits. Smaller trees (<1 m stem diameter) either escape detection and utilisation or, more typically, are heavily and often fatally impacted.

'Long-term' monitoring of a decade or two may seem an instant in time for a baobab that lives for more than 1000 years. So the lack of seedlings since 1995 is not necessarily a cause for concern. But a three-fold increase in mortality of older trees between 1995/6–2001 and 2001–2013 is more worrying. Predicted climate warming may favour the recruitment of new individuals into the population in the future, but the survival of these recruits is reduced by impacts from two factors that can both be managed - fire and elephants.

This project formed part of the MSc study of Rob Taylor (awarded cum laude in 2016), and was made possible by the exemplary data records and data-sharing philosophies of SANParks and SAEON.

ELEPHANTS & TREES: POPULATION SIZE STRUCTURE OF TREES IN A SEMI-ARID AFRICAN SAVANNA

Deep insight about ecological dynamics can be gained from long-term monitoring, but very few of our savannas have such data for formulating management responses. Projection of future trends of woody savanna vegetation can, however, be made based on interpretation of population size structure.

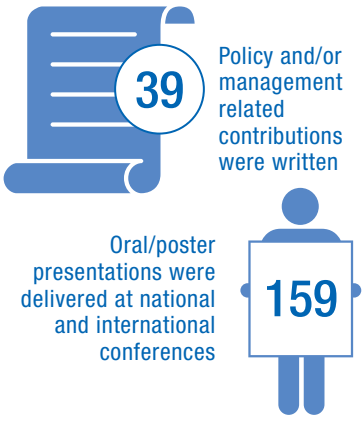
In response to concern about the potential impact of elephant reintroduction into a savanna reserve, Tim O'Connor and Victoria Goodall used mixture models to describe the size structure of 24 tree species, a novel application of this statistical technique. In their paper (doi:10.1111/aec.12485), many of the species were identified as having multiple states reflecting temporally varying regeneration, recruitment, and mortality. Vulnerability to extirpation could be inferred by the size and location of regeneration and adult states within the overall size range of a species. Results illustrate that the 24 species apparently ensure persistence based on individualistic responses to population distress.

doi:10.1111/aec.12485

A composite image of a baobab individual in northern KNP. The left side of the image is from 1995, the right from 2013. Changes in the extent of bark and stem damage are evident

Baobabs are a species favoured by elephant as a source of food. Typically, the tusks are used to 'peel' off vertical strips of bark and the moisture-rich underlying stem tissues. If repeated too frequently, the stem cannot heal and the extent and severity of damage accumulates.

PUBLICATIONS



Through publications in scientific journals, SAEON makes its mark in the global research landscape and strives to build a reputation for world-class science. SAEON also encourages its scientists to contribute their findings to the general public in the form of written, oral and film media.

Books and book chapters

SAEON staff have contributed chapters to the following books:

- Two Chapters (chapter 1 & 7) were co-authored in: Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. & De Jager, M. (eds.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7, Pretoria: CSIR. Available at http://seasgd.csir.co.za/scientific-assessment-chapters/
- Six Chapters were co-authored in: Conserving Africa's Mega-Diversity in the Anthropocene -The Hluhluwe-iMfolozi Park Story. Eds: Cromsigt, J.P.G.M., Archibald, S. & Owen-Smith, N. 2017. Cambridge University Press. ISBN: 9781107627994
- Bornman, T.G., Goschen, W.S., Theron, A.K., Campbell, E.E. & Cowley, P.D. (In Press). Case Study: Algoa Bay - building a sentinel site for long-term environmental observation. The Coastal Zone. Risk and Vulnerability Atlas.
- Hugo, W. 2017. Data Management Principles Implementation Guidelines. Chapter 3. GEO XII, Document 10.
- Hugo, W., Hobern, D., Koljalg, U., Tuama, E.O. & Saarenmaa, H. 2017. Global Infrastructures for Biodiversity Data and Services. Chapter 11 in: The GEO Handbook of Biodiversity Observation Networks. Eds: Walters, M. & Scholes, R.J. Springer. ISBN 978-3-319-27286-3 ISBN 978-3-319-27288-7 (eBook) DOI 10.1007/978-3-319-27288-7
- Todd, S.W., Hoffman, M.T., Henschel, J.R., Cardoso, A.W., Brooks, M. & Underhill, L.G. 2016. The potential impacts of fracking on biodiversity of the Karoo Basin, South Africa. In: Glazewski, J. & Esterhuyse, S. (eds) Hydraulic Fracturing in the Karoo: Critical Legal and Environmental Perspectives. Juta, Claremont. Chapter 14, p 278–301.

SAEON E-newsletter earns award of excellence

For the fourth year running, *SAEON eNews* was among the top six e-newsletters in the 'Best Electronic Publication' category of the SA Publication Forum Awards. In this national competition SAEON competed with large commercial companies. The publication received a Certificate of Merit for scoring more than 80% in the categories of writing, communication and design. The SAEON eNews is published bi-monthly and is a very effective platform for SAEON staff and students to communicate on activities and highlights.

DATA INFRASTRUCTURE & DATA PRODUCTS TO SUPPORT POLICY

SAEON has seen significant growth in the past two years in the scope and activities of its Information and Communication Technology (ICT) Team, with focus areas as follows: (Acronyms are explained in the text box below)

1. Establishment of **research data infrastructure** for **earth and environmental data** management and preservation, in collaboration with a large number of stakeholders. Within this infrastructure, a wide variety of digital objects can be managed and curated, and value-added services can be configured and developed for our stakeholders.
2. Contributions to the **establishment of open, standards driven architecture globally** in the earth and environmental sciences, with contributions to Belmont Forum, GEO and GEOSS, GEO BON, ILTER, and generalisation of this approach locally and internationally through collaborations with SASDI, NRF, DIRISA, RDA, and ICSU-WDS.
3. Leveraging open data and scientific evidence in the field of environmental, social, and engineering sciences to **develop policy and decision support products**, of which the South African Risk and Vulnerability Atlas and the recently published BioEnergy Atlas are examples.

Highlights of the past year include

1. Re-launch of the South African Risk and Vulnerability Atlas (SARVA) at the Global Change Conference in December 2016 in Durban;
2. Publication of technical guidance for data management in biodiversity observation, followed up by contributions to the Globis-B project and GEO-BON (see Box 2);
3. Inclusion of SAEON into a successful proposal for development of data infrastructure guidance related to smart agriculture and carbon monitoring in Africa (SEACRIFOG);
4. Official launch of the South African BioEnergy Atlas in March 2017 by Minister Naledi Pandor;
5. Successful establishment of a number of collaboration agreements, including the Department of Environmental Affairs and the South African Weather Services, with more to follow;
6. Initiation of the human resources and equipment procurement to establish data infrastructure for ETFEON and SMCRI, funded by DST;
7. Successful publication of data resources on behalf of stakeholders, including the National Carbon Sinks Atlas and the South African Weather Service Climate Atlas;

Increasing demands on natural resources and ecosystems demand data infrastructures providing data products that can address these challenges.

INTERNATIONAL ALIGNMENT AND CONTRIBUTIONS

SAEON plays an increasingly active role in national and international forums that promote access to scientific and research data. Internationally, SAEON is currently a member of, or has made contributions to:

- **ICSU (International Council for Science) World Data System**: Vice Chair of the Scientific Committee
- **GEO (Group on Earth Observation) and GEOSS (Global Earth Observation System of Systems)**: contributions to GEOSS-Evolve and the drafting of GEO Data Management Principles.
- **GEO BON (GEO Biodiversity Observation Network)**: participation in workgroup activities
- **Research Data Alliance**: Membership and/or chair in several working groups
- **CoDATA (Committee on Data for Science and Technology, ICSU**: Member of the Task Group for Preservation of Data in Developing Countries
- **Belmont Forum**: Working Group contributions
- New accreditation board was formed after extensive collaboration between Data Seal of Approval (DSA) and the ICSU World Data System (ICSU-WDS) to develop shared criteria for trusted repositories – with SAEON as one of the certification board members;
- Membership of **IGSN (International Geosampling Numbering)** and **DataCite**: promoting the citability of research outputs, as well as physical and digital samples.

South Africa launches bioenergy roadmap

The *BioEnergy Atlas for South Africa* funded by DST was officially launched by the Minister of Science and Technology at the CSIR International Convention Centre in Pretoria on 24 March 2017. The DST commissioned SAEON to produce the Atlas. It is a public resource aimed at supporting the development of bioenergy in South Africa.

This high-level event attracted delegates ranging from embassy, government and industry representatives to a wide spectrum of researchers in the renewable energy field. Honourable Naledi Pandor, the keynote speaker praised SAEON for the quality of its environmental research under the umbrella of the DST's Global Change Grand Challenge. She described the Atlas as "an important addition to the work South Africans are undertaking in the field of global change". The Minister was joined by representatives of the DST and SAEON MD in unveiling the web portal and hardcopy version of the Atlas.

SAEON's Chief Data and Information Officer, Wim Hugo, who served as project coordinator and principal investigator for the Atlas, gave an overview and demonstration of the Atlas, which was well received by the delegates, who were given the opportunity for questions.

http://www.saeon.ac.za/enewsletter/archives/2017/april2017/doc01

SAEON's Chief Data and Information Officer, Wim Hugo (left), who served as project coordinator and principal investigator for the Atlas, gave an overview and demonstration of the Atlas, which was well received by the delegates, who were given the opportunity for questions.

Progress with our Vision

SAEON has established an Open Data Platform (ODP) for publication, discovery, dissemination, and preservation of Earth and Environmental Data with funding from NRF and DST. This platform hosts several portals and gateways, including SARVA, The South African Earth Observation System of Systems (SAEOSS), the BioEnergy Atlas, and SAEON's own data portal. It also serves as a platform for hosting the South African Spatial Data Infrastructure (SASDI), and has been used for internationally funded exploratory work to establish Africa-wide prototypes for data management in the domains of biodiversity, human health, and socio-economic sciences.

SAEON now operates significant physical infrastructure in its own right (up to 75 TB of online storage, split between operational, test, and fail-over/disaster recovery facilities), and the ODP allows rapid deployment of new portals and gateways at relatively low cost. These provisions will increase still more in the next year or two as SMCRI and ETFEON requirements are added. SAEON also manages infrastructure and software on behalf of DEA (for MIMS and SADCO) and for ARC (National Invasive Alien Plants Survey).

SAEOSS serves as a gateway to GEOSS (GEO System of Systems) through the GEOSS Broker, exposing locally produced research outputs to a global user base, and in principle affording South African researchers access to globally available data sets.

The components for linking specific quality assured data sets to the ICSU World Data System (WDS) are also in place, and once other aspects of sustainability and governance have been addressed, portals within the ODP can be accredited as trusted repository members of the WDS. This accreditation serves as recognition by peers that the data platform is properly managed, serves quality assured data, and will be available for the foreseeable future.

Finally, the technical and licensing aspects of issuing data sets with Digital Object Identifiers (DOIs) via DataCite have also been addressed. This allows data sets to be published internationally and for data sets to be cited reliably in scholarly publications. Data sets thus become formal scientific outputs that attract a citation index.

ESSENTIAL BIODIVERSITY VARIABLES WORKSHOP DISCUSS SPECIES TRAITS

Scientific, technical and legal experts from around the world, including SAEON's Chief Data and Information Officer Wim Hugo, gathered at the 3rd workshop of the EU-funded Horizon2020 project GLOBIS-B ("GLOBal Infrastructures for Supporting Biodiversity research"), Amsterdam in March 2017. The 21 invited scientific experts discussed requirements for developing the Essential Biodiversity Variable (EBV) class 'Species traits', which cover phenology, body mass, natal dispersal distance or migratory behaviour, amongst others. The work done will inform the design of data infrastructure and supporting standards for Essential Biodiversity Variables, and follows on earlier work to define the data infrastructure generally applicable to biodiversity observation data, published by GEO BON.

http://www.saeon.ac.za/enewsletter/archives/2017/april2017/doc09

Citizen science and data: #RainMustFall #CitizenScienceMustRise

Farmers recording information about what transpires on their own land can contribute effectively to international science – citizen science par-excellence! A good example are two Eastern Cape farmers near Compassberg where SAEON has study sites. Over 143 years they have been continuously recording the characteristics and timing of every single precipitation event. They added annotations, remarks, summaries, and analyses from which they could draw practical conclusions. These are only two examples of many farmers who have not only kept records, but are now making them available to SAEON and other scientists.

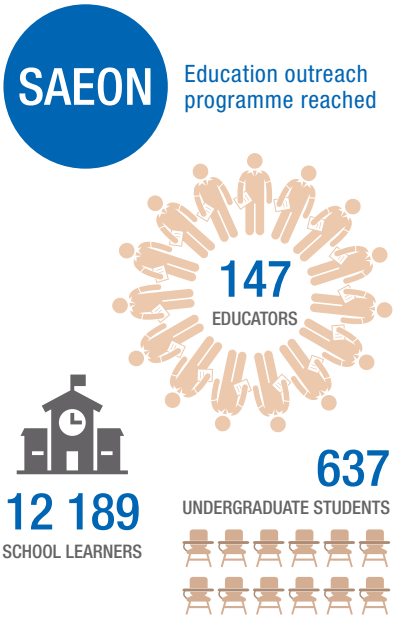
To scientists, these long strings of daily rainfall records are not just numbers to be crunched, they are also an invaluable accumulation of ongoing interpretations, demonstrating how citizen scientists themselves apply the knowledge they gain from data. With these data, scientists can analyse long-term spatial variability of rainfall events and make comparisons across many decades to establish how the quantity and the nature of precipitation is changing with global change.

Citizen science not only concerns rainfall and not only farmers; it is an invaluable tool available to every South African citizen and beyond, to make their own lives more manageable and interesting. By sharing their observations on nature, they enable scientists to obtain data on large-scale long-term processes in ways that are not otherwise possible.

The interdependence between professional scientists and citizen scientists is becoming increasingly important, and it is up to both to recognise and make the best of these mutual opportunities. Involvement of citizen scientists renders science more encompassing, as it is a two-way discussion concerning data, interpretation and understanding and application at various levels. To meet its mandate concerning detecting, understanding and advising the citizens of South Africa concerning environmental change, SAEON relies strongly on the relationship between professional and citizen scientists.

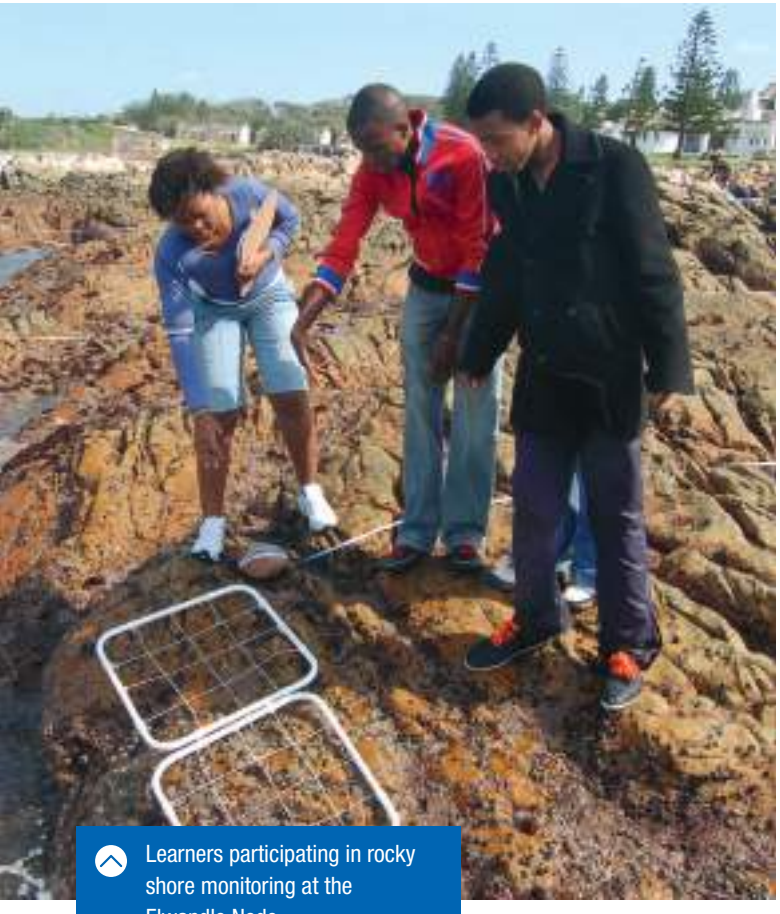
http://www.saeon.ac.za/enewsletter/archives/2017/february2017/doc01

SCIENCE ENGAGEMENT AND OUTREACH



In 2016 SAEON's education outreach programme exposed 12 189 school learners, 147 Educators and 637 undergraduate students to the science of environmental observation, data collection, analysis, reporting and dissemination of findings from small case study research projects. School learners and students were engaged in hands-on, enquiry based teaching and learning to demonstrate the value of long-term and large-scale environmental observation and monitoring.

The Fynbos team built a hydrological/landform model with rainfall simulator to illustrate how catchments and the water cycle interact. Team members Abri de Buys, Glenn Moncrieff and Ebrahiem Abrahams used SANBI's Biodiversity Career Day to discuss the importance of catchments, the hydrological cycle and climate change; to describe the roles of the different people involved; and to give learners an idea of potential career paths in environmental science.



Learners participating in rocky shore monitoring at the Elwandle Node.

Science camps: A practical experience more valuable than textbooks

Each year a selected group of learners from grade 9 & 10 participate in the SAEON science camps which is held near the SAEON nodes in 'wild places' such as the Timbavati Environmental Bush School or Eastern Cape coastal resorts. The themes for this year's camps focussed on of biodiversity, with the overall objective of strengthening the learners' scientific thinking through developing and completing their own science project, and evaluating their personal skills and goals in light of future career choices.

Learners are divided into groups with the aim of conducting small-scale comparative research projects on topics relevant to the area (such as veld condition and soil quality; weather monitoring or vegetation monitoring). On the final day each group presents the results of their research projects.

It has become customary for learners to share their thoughts on their three-year SAEON science camp experiences. Below is an adapted abstract from the diary of a learner at the Kingfisher Private School, Nyeleti Natasha Mkhabela.

Diary of a Science Camp

Friday, 30 September

The excitement of the night before was nothing compared to the excitement I think we all felt when we finally met at the SAEON offices this morning. After a longish drive we finally made it to Timbavati Environmental Bush School. It was not quite what I expected. The place is amazing! After taking a whole lot of pictures it was finally time to get down to business.

We had a quick recap of what a scientist is and does. This put us into work mode. We went out to do the first thing a scientist does – observe (the easy part); the first step into another chapter of science. We then went back to the camp to make sense of what we had observed and to ask questions. Working in teams proved to be a little hard for the Grass Muffins (Vegetation/Grass group). We had so many different characters in the group. It was close to impossible to get an answer. But we managed, luckily.

Later that night we played a career expedition game, which was fun and enlightening. It made us think further than our noses in terms of our career choices. We were challenged to find something that we use that isn't from or inspired by nature – not an easy one … (answer to be given on Monday).

Saturday, 1 October

We left early that morning for the Timbavati Communal Lands where we immediately started recording our data. It was fun working with the equipment. One of our questions was on grass species. Honestly speaking, I didn't think that there would be so many species in that spot. At first sight, all the grass looks the same. But I guess that's what it means to be a scientist: actually looking and understanding, not just a quick peek.

Recording the grasses didn't take as long as expected, but that was a good thing. Considering that Grass Muffins took forever to come to a conclusion, we got to work whilst waiting for the Soils group to finish. Today's group work went much better. Having got used to each other, we were better team mates altogether.

Sunday, 2 October

Today's tasks would be happening within the camp. We would be recording data in the Timbavati Protected Area. It was exciting being in the middle of all the 'action'. Some people were more excited than others on seeing giraffes. It was not what we expected to find, but then there was nothing we could do about it. It was almost impossible finding a spot with grass. That's when the impact of the drought really hit us like a wave (ironically comparing waves to drought).

Nonetheless, we collected our data. Our findings were far from what we expected, but then you can't always get what you want. Again we didn't take as long as expected. The girls, being brave, decided to WALK back instead of riding back. I must admit that all horrible possibilities crossed my mind during the walk, but that's what made it so much fun.

Back at the hall, our workplace, we started properly recording and analysing our data. After our final discussions we started to work on our poster. Making the poster was fun. We sang 80s songs and spoke about the weirdest things.

It was a night filled with emotions, from joy to rage to pity; working in groups is never easy. The singing and talking was a minor setback, but we managed to finish with now only three people working on the poster and the rest in bed.

Monday, 3 October

The day has come! Waking up was extra hard, considering the wet and cold weather and late night. We watched a video about the wild in other parts of Africa, a true learning experience. It was satisfying to know that it is not just the people of South Africa working on saving the natural environment of our dear continent. Many people are involved in conservation projects. It makes one want to do more than is already being done.

After adding the final touches to our poster, we rehearsed our presentation. Of course, when the real presentation came, we all went mute. All the confidence drained. A few minutes into the presentation, most of the Grass Muffins were back in their element. For me, it was better not seeing people's faces, so I took my glasses off.

See http://www.saeon.ac.za/enewsletter/archives/2016/december2016/doc15

We were impressed by what we had put together and so was everyone else, I believe. The other group also had an impressive presentation. It was nice to hear about what they've been doing and learn from them. The majority of what was said was completely new to me but it's always good to learn.

Sibongile Mokoena served SAEON for 12 years as Education Outreach Co-ordinator.

After the remarks Dave (Dr Dave Thompson, Biodiversity Scientist at SAEON's Ndlovu Node) made on our projects, he gave us a lesson on how there is a lot of thought put into every action taken in the environment.

The answer to the challenge from Friday: ... nothing. That is how important nature is, even to us.

Sadly, it was time to leave. The saddest part of it all was having to give back our name tags – the science camps were all over now. No more exploring for us. This was the last day of our amazing adventure with SAEON.

I speak for everyone when I say that we are grateful for the opportunity you have given us. Being part of this programme was an amazing experience. It opened our eyes. You've done for us more than you think or notice you have. Thank you SAEON, for everything.

SAEON salutes outgoing science education stalwart

In 2016 we bid goodbye to Sibongile Mokoena and at the same time celebrated her career as coordinator of SAEON's Education Outreach Programme. Sibongile retired from SAEON after 12 years of dedicated leadership and guidance to the Education outreach team. She has built a programme that is making an impact, not only in the lives of the learners it involves, but also in the general science engagement community.

On 6 December 2016 she was honoured with a Certificate of Recognition from the DST/NRF at the Global Change Conference hosted by the University of KwaZulu-Natal (UKZN) for her pioneering work in SAEON's Education Outreach programme.

STUDENTS

The * denotes student submitted thesis and/or graduated during the period.

ABRAHAM DABENGWA

PhD, UCT. Reconstructing palaeovegetation sequences at biome boundaries in KwaZulu-Natal and related landscape ecological processes in the late Holocene.

ALEXANDER DYER

MSc, RU. Quantitative assessment of the ichthyofauna associated with different habitats and depth zones on Walter's Shoal, a shallow seamount in the Western Indian Ocean.

ALICE MCGRATH

MSc, UCT. Re-modelling the influence of physical-biological interactions and spatial variability of sardine *Sardinops sagax* spawning areas on the transport and retention of eggs and larvae in the southern Benguela ecosystem.

AMEIL HARIKISHUN

MSc, RU. Understanding spatial patterns of diversity, distribution and abundance of benthic invertebrate communities associated with Walter's Shoal, a shallow seamount in the Western Indian Ocean.

ALLISTER STARKE

PhD, UP. The restoration of natural forest within alien invasive stands at New Forest, Kwazulu-Natal, South Africa.

AMY MARSHALL

PhD, Wits. The complex socio-ecological system of the lowveld marula bioeconomy catchment.

AMY TRENT

MSc, Wits. Mammal utilisation of artificial waterholes in the central Kruger National Park: Contemporary seasonal patterns and implications for climate change scenarios.*

ANNABELLE ROGERS

MSc, UCT. Empirical Fire Modelling in Fynbos: Understanding Fire in the Cape Landscape.
*Cum laude

APHIWE MTETANDABA

MSc, UFH. The provenance, spread and geographic extent of the 2014 *Lingulodinium polyedrum* Harmful Algal Bloom in Algoa Bay, South Africa.

ASHLEY WARNER (NEE LIPSETT)

MSc, Wits. Spatio-temporal effects of rainfall on stream/river flow in the Kruger National Park, South Africa.*

ATHI MFIKILI

MSc, NMU. Influence of sedimentological and hydrological processes on the distribution of salt marsh in the Keurbooms and Knysna estuaries, Western Cape.*

BYRON GRAY

MSc, UKZN. Towards an improved understanding of the influence of raingauge design, slope and aspect on rainfall measurement: A cross-calibration study.*

CORNE NIEMANDT

MSc, UP. Anthropogenic impacts on the highly threatened Woodbush Granite Grasslands in Limpopo, South Africa. *Cum laude

CRAIG HALEY

MSc, UCT. Distribution and habitat usage patterns of Nauticaris marionis at the sub-Antarctic Prince Edward Islands.*

DAWID SMITH

MSc, NWU. Forb and soil microbe diversity patterns of ultramafic tailings facilities at Phalaborwa.*

DEBBIE JEWITT

PhD, Wits. Land cover and climate change threats to savanna and grassland habitats in KwaZulu-Natal.*

DENHAM PARKER

PhD, RU. Long-term variability of protected marine inshore resources/Tsitsikamma National Park subtidal fish monitoring programme.*

DLAMINI THOBILE

MTech, TUT. Differential herbivore occupancy in fire manipulated savanna landscapes in the Satara region of the Kruger National Park.

DLOMO XOLISA

PhD, NMU. Coastal ocean dynamics of the Algoa Bay region.

DYLAN BAILEY

PhD, NMU. Ocean dynamics of the shelf and bays of the eastern Agulhas Bank: a process-oriented numerical modelling study.

EBRAHIEM ABRAHAMS

MSc, UWC. An analysis of post-fire catchment erosion dynamics under different land cover types, Jonkershoek, Western Cape.

FAITH JUMBI

PhD, UWC. Modelling the impacts of altered agricultural practices under prevailing climatic conditions and projected climate change scenarios on the hydrology of a semi-arid mountainous catchment. The case of Baviaanskloof, Kouga and Kromme catchments, Eastern Cape South Africa.

ELELWANI NENZHELELE

MSc, UCT. The long-term effects of heavy grazing across a fence-line separating contrasting land use practices in Namaqualand.*

ELODIE HEYNS-VEALE

PhD, RU. Trophic ecology of shallow and deep temperate reef communities in the Tsitsikamma Marine Protected Area.*

ESTEE VERMEULEN

MSc, UCT. Validating the Agulhas Current Proxy along the ASCA array.

FEHMI DILMAHAMOD

PhD, UCT/Brest University. Modeling the East Madagascar Current and the South East Phytoplankton Bloom through a coupled physical-biogeochemical model.

FEROZA MORRIS

PhD, UKZN. Improving the translation of climate forecasts to hydrological forecasts for an agricultural area.

FRANCOIS BECKER

MSc, UCT. Estimating the global population size of animals that are hard to find: the case of Rose's mountain toadlet. *Cum laude

HANA PETERSEN

MSc, UCT. An environmental gradient analysis of the vegetation types of the Upper Karoo Hardeveld.

HANNAH RAVEN

MSc, NMU. Spatial patterns and characterization of benthic epifaunal biodiversity in Algoa Bay.

HEATH BECKETT

PhD, UCT. The dynamics of forest-savanna boundaries.

JARRYD GILLHAM

MSc, UKZN. Investigating the processes of erosion and sediment yield at different scales in commercial forestry – A case study at Two Streams, KwaZulu-Natal.*

JACOBUS ROSSOUW

MSc, US. Application of plant growth promoting substances and arbuscular mycorrhizal fungi for the phytostabilisation of mine tailings.*

HUYAM ABBAS

MSc, UCT. Tree seedling recruitment in savanna and grassland.*

JOCK CURRIE

PhD, UCT. Historical species distributions and trawl baselines in South Africa.*

JOHANNES JACOBUS KELLERMAN

MPhil, UCT. Plant Ecophysiology: Variation in hydraulic traits with changing climate and CO_2.*

JUAN SWANEPOEL

PhD, UCT. Landscape Ecology of Heuweltjies.

JUSTIN DU TOIT

PhD, UKZN. Analysis of long term climate and agricultural trial data in the upper eastern Karoo.

KAREN TUNLEY

PhD, UCT. Environmental and fisheries impacts on two sole (*Austroglossus* spp.) species in South Africa.

KATHERINE HUTCHINSON

PhD, UCT. Variability of the Agulhas Current transport from 1993 to 2013 with respect to local and remote winds.

LAUREN DE VOS

PhD, UCT. Optimising the effectiveness of marine biodiversity monitoring and conservation planning in False Bay, South Africa.

LEE-ANN JACOBS

MSc, UWC. Port St. Johns upwelling.

LEONARD NDOU

PhD, UFS. Ecology of locust outbreaks in the Karoo.

LIESL VORSTER

MSc, UCT. The long-term impact of herbivory on the vegetation of Sanbona Wildlife Reserve.*

LISA HEBBELMANN

PhD, Wits. Factors limiting the distribution and abundance of dwarf shrubs (karoo bushes) in the Nama-Karoo.

MANISH RAMJEAWON

MSc, UKZN. Determining vegetation water use.*

MAPULA MAKWELA

MSc, UWC. Testing the validity of biodiversity surrogates in defining marine ecosystems for marine biodiversity assessment and planning.

MARTINA TREURNICHT

PhD, US. Demographic and functional determinants of large-scale population dynamics and ecological niches of 26 serotinous Proteaceae species in the Cape Floristic Region (South Africa).

MARCO PAUW

PhD, Wits. Response of riparian vegetation to the altered hydrological regime along the lower Orange River.

MARK JACOBSON

MSc, UCT. Characterisation nd prediction of the oceanic response to the weather in False Bay, using numerical methods.

MARTINUS SONNEKUS

PhD, NMU. Phytoplankton diversity of the Agulhas Large Marine Ecosystem.

MEGAN TAYLOR

MSc, UKZN. Parameterisation of the new hydrological baseline.

MFUNDO BIZANI

PhD, NMU. Zooplankton dynamics of Algoa Bay (Eastern Cape, South Africa) under varying oceanographic conditions.

MLUNGISI SHABALALA

MSc, UKZN. Improving the understanding of water and climate related hazards that pose a risk to the agricultural sector in the upper Thukela catchment.

MONIQUE NUNES

PhD, NMU. Temperature as a determinant of diatom biogeographical patterns and ecosystem processes in South Africa.

MORAEA PHILLIPS

MSc, RU. Evaluation of the effectiveness of the Amathole MPAs in protecting vulnerable reef fish species.

NASIPHI NTSHANGA

PhD, UKZN. Landscape transformation and fragmentation: setting the playing field for global change impacts in natural systems in the Cape Floristic Region.

NANETTE VAN STADEN

MSc, NWU. Herbaceous species diversity, redundancy and resilience of Mopaneveld across different land-uses.*

NEIL MALAN

PhD, UCT. Investigating the greater Agulhas System.*

NICHOLAS CONRAD SCHMIDT

MSc, RU. Optimizing detection of fine-scale relationships between reef fish and invertebrate communications using remote imagery sampling techniques.

NTHABELISENI MUNYAI

MSc, UCT. Determining the Potential drivers of C4 Grass invasion into fynbos at De Hoop Nature Reserve.

PHUMLILE COTIYANE

PhD, NMU. Environmental drivers of diatom biogeographical patterns along the coast of South Africa.

NYASHA MAGADZIRE

PhD, US. Fynbos species and community distribution limits: impacts of fire regime and biomass accumulation rates.

PAMELA SEKESE

MSc, UWC. Geomorphic analysis of river diversity and behavior in the eastern part of the Table Mountain geologic formation.

NICKY MARASCHIN

MSc, Wits. Large mammal distribution and drinking behaviour in relation to rainfall and temperature patterns in the Kalahari Gemsbok National Park: 2004 to 2012.*

REINHARDT RAUBENHEIMER

MSc, UFS. Connectivity of geohydrological processes and the interaction with surface hydrology of the Letaba River.

RAMONTSHENG RAPOLAKI

PhD, UCT. Atmospheric modelling over southern Africa and adjacent oceans.

PIETRO DINMORE

MSc, Univ of Gothenburg. Ocean dynamics in the upwelling zone of Cape Recife, Algoa Bay.

RICHARD LLEWELLYN

MSc, RU. Evaluation of two stereo-video techniques to assess the De Hoop marine protected area.

RITA STEYN

PhD, RU. Towards a cost-efficient & standardised monitoring protocol for subtidal reef invertebrates in the Agulhas Ecoregion of South Africa.

ROBERT TAYLOR

MSc, Wits. Temporal and spatial variation in the population structure of the African Baobab (*Adansonia digitata*) in the Kruger National Park, South Africa. *Cum laude

ROBYN ADAMS

MSc, US. Long-term change in offshore benthic communities at the Prince Edward Islands, Southern Ocean.

ROXANNE JUBY

MSc, RU. Diurnal changes in the composition and size structure of reef fish communities.*

SALOME MTHOMBENI

PhD, Wits. Characterisation of submerged aquatic vegetation and relating it to organic pollution in the Olifants and Selati Rivers, Limpopo Province, South Africa.

SARAH JANE HALSE

MSc, RU. Assessment of stereo-video techniques to sample shallow and deep reef fish assemblages.*

SHAEDEN GOKOOL

PhD, UKZN. Evaluating the potential of using satellite earth observation data to quantify the contribution of riparian total evaporation to streamflow transmission losses.

SHIRLEY PARKER-NANCE

PhD, RU. Long-term reef monitoring system for the Agulhas Ecoregion.

SINDISO CHAMANE

PhD, UKZN. Impact of high intensity grazing on forb diversity in South African grassland.

SIPHO NDIBO

MSc, Fort Hare. Sediment dynamics of the Swartkops Estuary.

SYLVIE KREMER-KÖHNE

MSc, Wits. An investigation into the population structure and ecology of *Aloe lettyae.*

SIPHUMELELO MBALI

MSc, UWC. Assessing high altitude rainfall and cloud water impact on stream flow in Jonkershoek catchment, Western Cape.
*Cum laude

TAMANNA PATEL

PhD, Wits. Maintaining plant diversity in a montane environment in the face of global change.

THABO MOHLALA

MSc, Wits. Impact of flood disturbance on fish community in the Klaserie River, implication for climate change adaptation.*

THAMI SHEZI

MSc, Wits. Influence of livestock grazing on plant diversity of montane grassland in the northern Drakensberg.

THIGESH VATHER

PhD, UKZN. Applications of the Cosmic Ray Probe.

THOMAS SIKHWIVHILU

MSc, UNISA. Climate factors controlling the distribution of plant species across an altitudinal gradient: A case study from Marakele National Park, Limpopo Province, South Africa.*

TIFFANY ALDWORTH

MSc, UKZN. The contribution of fog to the water balance on the eastern interior of South Africa.*

TRACY PEARTON

MSc, UKZN. An assessment of indigenous and introduced tree water use and varying land uses around Vasi North, Maputaland, KwaZulu-Natal.

TUMELO MATHE

PhD, UFH. Validation of chlorophyll and hourly temperature data using multi-temporal remotely sensed satellite imagery.

VANESSA WEYER

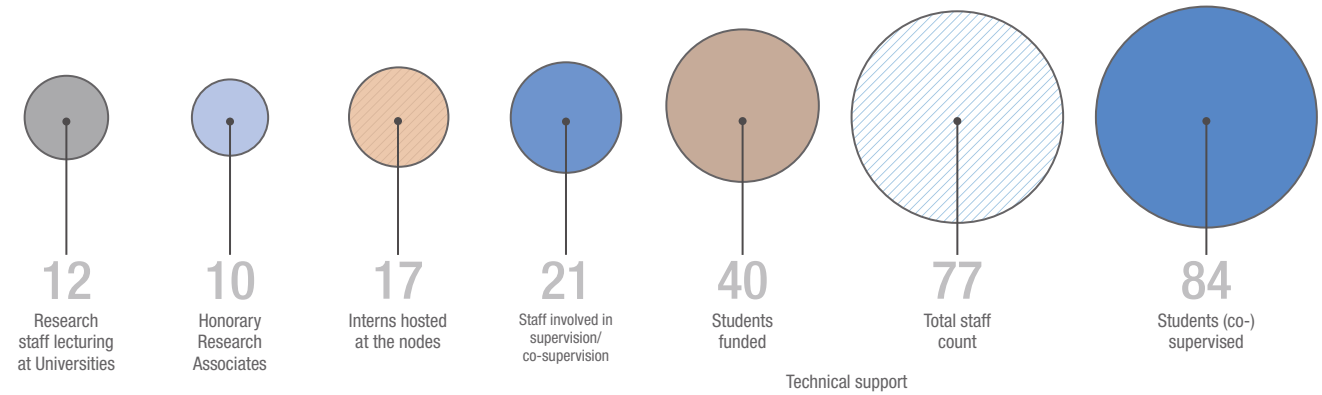
PhD, UP. Analysis of mine site biophysical environments, impacts and rehabilitation risk elements: to formulate a rehabilitation decision interface for surface coal mining.

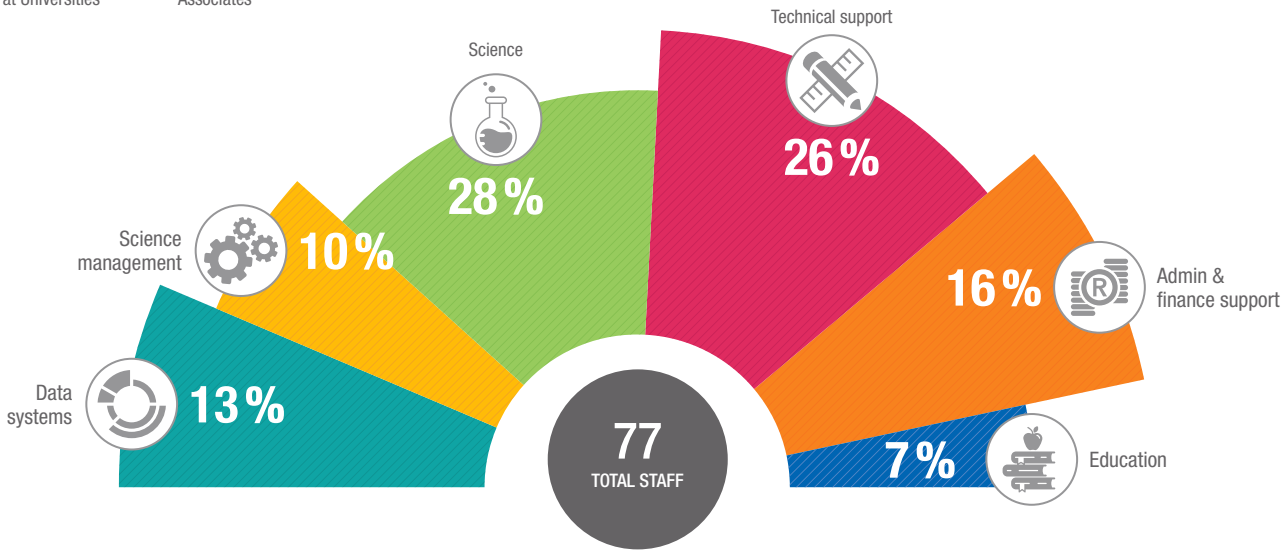
UNIVERSITIES

NMU	Nelson Mandela University
NWU	North West University
RU	Rhodes University
TUT	Tshwane University of Technology
UCT	University of Cape Town
UFH	University of Fort Hare
UFS	University of the Free State
UKZN	University of KwaZulu Natal
UNISA	University of South Africa
UP	University of Pretoria
US	Stellenbosch University
UWC	University of the Western Cape

SAEON IN NUMBERS

PEOPLE





NETWORKS

7 Collaborations with SA Research Chairs

30 Memberships to professional International Committees

18 Schools participating in the Education outreach programme

12 189 Learners involved in Education Outreach

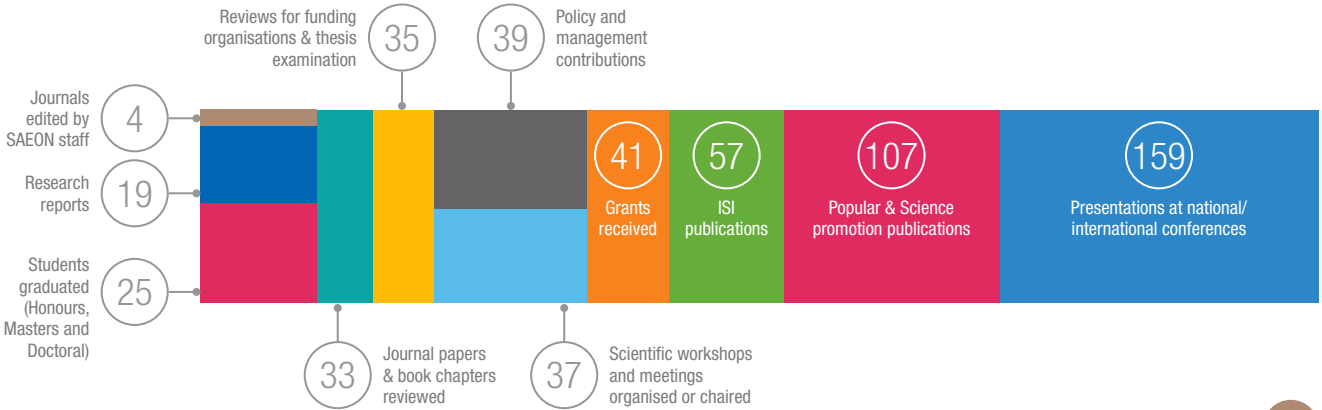
9 Joint International Agreements

50 Memberships to professional Local Committees

147 Teachers involved in Education Outreach

240 Platform Users

OUTPUTS



ABBREVIATIONS AND ACRONYMS

ABSS	Algoa Bay Sentinel Site
ACC	Antarctic Circumpolar Current
ACE	Antarctic Circumnavigation Expedition
ACEP	African Coelacanth Ecosystem Programme
ACT	Agulhas Current Time Series
ADCP	Acoustic Current Doppler Profiler
ARC	Agricultural Research Council
ASCA	Agulhas System Climate Array
ASCLME	Agulhas-Somali current Large Marine Ecosystem
AZEF	Arid Zone Ecology Forum
BODC	British Oceanographic Data Centre
BRUV	Baited Remote Underwater Video
CMP	Continuous Monitoring Platform
CODATA	Committee on Data for Science and Technology, ICSU
COSMOS	COsmic-ray Soil Moisture Observing System
CPR	Continuous Plankton Recorder
CTD	Conductivity, Temperature, Depth
DAFF	Department of Agriculture, Forestry and Fisheries
DBCP	Data Buoy Cooperation panel
DEA NRM	Department of Environmental Affairs, Natural Resource Management
DEIMS	Dynamic Ecological Information Management System
DIRISA	Data-Intensive Research Infrastructure for South Africa
DOI	Digital Object Identifier
DST	Department of Science and Technology
DWS	Department of Water and Sanitation
EBV	Essential Biodiversity Variable
EGO	European Gliding Observatories
EKZN Wildlife	Ezemvelo KwaZulu Natal Wildlife services
EPFL	Swiss Institute of Forest, Snow and Landscape research
ET	Evapotranspiration
ETFEON	Expanded Terrestrial and Freshwater Environmental Observation Network
FAO	Food and Agriculture Organisation
FSA	Forestry South Africa
GCOS	Global Climate Observation System
GEO BON	Group on Earth Observations Biodiversity Observations Network
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GSN	Graduate Student Network
IAVS	International Association of Vegetation Scientists
ICRI	International Conference on Research Infrastructure
ICSHMO	International Conference on Southern Hemisphere Meteorology and Oceanography
ICSU	International Council for Science
IGSN	International Geosampling Numbering
ILTER	International Long Term Ecological Research Network
INTECOL	International Congress of Ecology
IOC	International Oceanographic Commission of UNESCO
IORA	Indian Ocean Rim Association
IUCN	International Union for the Conservation of Nature
JCOMM	Joint Commission for Oceanography and marine Meteorology
KNP	Kruger National Park
LTER	Long Term Ecological Research
MAP	mean annual precipitation
MEDECOS	International Mediterranean Ecosystems Conference
MIMS	Municipal Information Management System
MPA	Marine Protected Area
NGO	Non-Governmental Organisation
NMU	Nelson Mandela University
NOC	National Oceanography Centre
NRF	National Research Foundation
PELTERP	Pelagic Ecosystem Long-term Ecological Research Programme
POGO	Partnership for Observation of the Global Ocean
RDA	Research Data Alliance
RSET	Remote Sensing, Environment and Development
SADCO	South African Data Centre for Oceanography
SAEIS	South African Estuaries Information System
SAEOS	South African Earth Observation System
SAIAB	South African Institute for Aquatic Biodiversity
SAMREF	South African Marine Research and Exploration Forum (Part of Operation Phakisa)
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SANTN	South African National Temperature Network
SARVA	South African Risk & Vulnerability Atlas
SASDI	South African Spatial Data Infrastructure
SCOR	Scientific Committee on Oceanic Research
SDG	Sustainable Development Goals
SKA	Square Kilometre Array
SKO	Square Kilometre Observatories
SLR	Sea Level Rise
SMCRI	Shallow Marine and Coastal Research Infrastructure
SOS	Sustainable Ocean Summit
TOPC	Terrestrial Observation Panel for Climate
UAV	Unmanned Aerial Vehicle
UCT	University of Cape Town
UKZN	University of KwaZulu-Natal
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNL	University of Nebraska-Lincoln
UWC	University of the Western Cape
WCRP	World Climate Research Program
WDS	World Data System
WIOMSA	Western Indian Ocean Marine Science Association
WMO	World Meteorological Organization
WOC	World Ocean Council

REFLECTIONS

This is the first time that SAEON has produced a single year “Annual Report”; our similar previous reports spanned five year periods. It is an obvious sign of organisational maturity which is pleasing on the one hand and yet worrying on the other hand. My pleasure is related to the critical mass and sustainability that SAEON has achieved over the past 15 years. My worry stems from the inevitable extra layers of authority that SAEON will have to incorporate going forward, moving from a rather flat structure and a place where people get to know each other well to a rather hierarchical structure, wherein organisational size and bureaucratic imperatives will start to limit the flow of information and our agility to respond to emerging opportunities. It will therefore become all the more important to attract senior managers who are facilitators and networkers rather than empire builders.

The high-level management of SAEON is particularly complex due to its geographic and disciplinary breadth, the amount of fieldwork that has to be done in remote and rough conditions, as well as the magnitude of its collaborations with universities, science councils, schools, industry, non-government organisations and government itself. This report speaks therefore more about the creativity, ethics, common sense, enthusiasm and all-round passion of SAEON personnel, students and collaborators rather than about a well-organised and controlled business. For this I applaud the great staff of SAEON and our unfailing collaborators.

I thank our outgoing Chief Scientist, William Bond, for getting us to the point of committing to an annual report and our Research Administrator, Beate Hölscher, for its compilation, editing and production. We also thank our main sponsors and principals in the Department of Science and Technology and the National Research Foundation for their continued support and guidance as we embrace the typical challenges of a fast-growing organisation.

JOHAN PAUW,
SAEON Managing Director

This report speaks about the creativity, ethics, common sense, enthusiasm and all-round passion of SAEON personnel, students and collaborators.

Credits and acknowledgments

Articles supplied by SAEON staff
Edited and compiled by Beate Hölscher
Photos supplied by SAEON staff & students, and B. Culver, M. du Plessis, J. Hölscher, R. Turner
Design and layout by Ink Design Publishing Solutions, www.inkdesign.co.za

SAEON ANNUAL REPORT 2016/17

SOUTH AFRICAN ENVIRONMENTAL OBSERVATION NETWORK

January 2018

saeon.ac.za

saeon-fynbos.org egagasini.dirisa.org elwandle.dirisa.org gfw.dirisa.org arid.dirisa.org ndlovu.dirisa.org

ISBN 978-1-86868-101-3