

| The **SAEON** Story | **2007** | | | | **2011** |



SAEON
South African Environmental
Observation Network



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| detect | translate | **predict** |



SAEON | A brief introduction |



As global change tightens its grip on our planet, people's lives and livelihoods are put at risk by droughts, floods, storms, heat waves, loss of biodiversity, loss of productivity and land degradation. Amidst this uncertainty, society needs reliable information to understand why and how our world is changing to help us cope with these changes and plan for the future. This is why the South African Environmental Observation Network (SAEON) exists.

SAEON operates as a leader, broker and collaborator in the field of long-term environmental observation, with a strong focus on networking and relationships. The organisation acts as a catalyst to bring about cohesion between fragmented environmental research programmes and ensures that long-term data is properly archived. SAEON also nurtures future scientists via its outreach programmes, support for research students and internships for young science graduates.

“SAEON is committed to helping policy-makers access and review relevant scientific evidence to help them formulate appropriate environmental policies.”

SAEON's vision is a comprehensive, sustained, coordinated and responsive South African environmental observation network that delivers long-term reliable data for scientific research and informs decision-making; for a knowledgeable society and improved quality of life.

Vision |

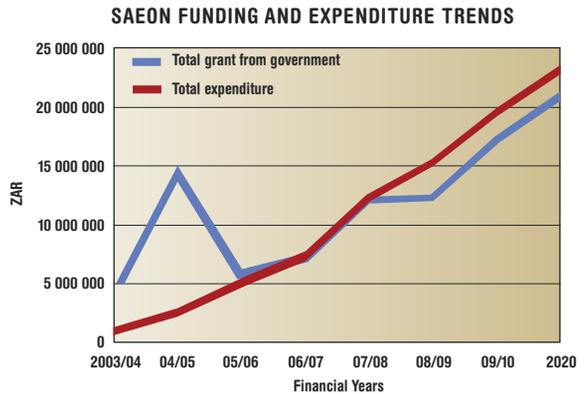
SAEON's mandate is to detect, translate and predict environmental change in South Africa.

Mandate |

Structure and funding

SAEON consists of six research nodes across South Africa and a national office in Pretoria. Information from the nodes is connected via a dynamic information management system.

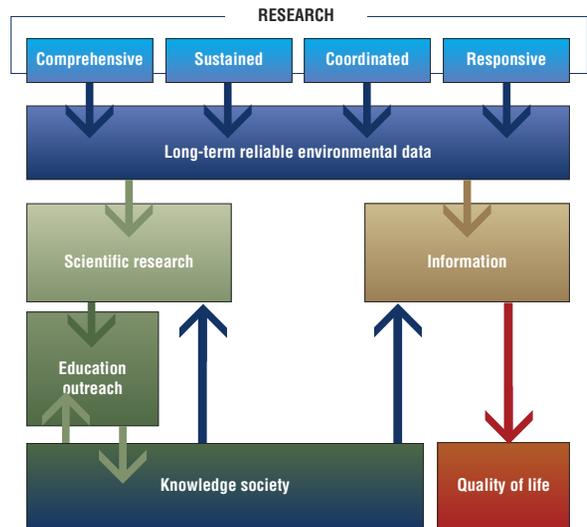
As a non-profit, public-good organisation, SAEON's core funding comes from government via the Department of Science and Technology (DST). The National Research Foundation (NRF) is responsible for SAEON and appoints an advisory board to oversee its strategic direction, policy framework and progress.



Milestones

Already in the mid-1980s a group of scientists recognised the need to coordinate long-term research in South Africa and started working towards this goal. A series of meetings and symposia between 1987 and 2001 culminated in the first DST grant to SAEON in 2002. Starting out with just one staff member at the time, SAEON has grown to 50 full-time staff members by 2011, with more than 60 projects spread across its six research nodes.

THE SAEON VALUE DELIVERY SYSTEM



2002

SAEON National Office established

2003

First meeting of SAEON Advisory Board and Technical Steering Committee

2004

Launch of SAEON; SAEON Ndlovu Node and educational outreach programme

2005

Launch of geospatial data portal project and electronic newsletter

2006

First SAEON Summit; launch of Graduate Student Network

2008

Launch of Egagasini Node

2010

Second SAEON Summit and launches of Elwandle and Fynbos Nodes

2011

Arid Lands and Grasslands-Forests-Wetlands Nodes become operational

“As our understanding of the importance of biodiversity and healthy ecosystems improves, we become more aware of the economic and social value of long-term environmental monitoring.”



LOCATION OF SAEON'S NATIONAL OFFICE AND SIX NODES



Bridging research, **policy and action**

SAEON – with its six fully fledged research platforms, core science framework, solid database and information management infrastructure, and strong team – delivers sound scientific products relevant to environmental governance and sustainable development in South Africa. A fully operational SAEON contributes to environmental and science policy processes at local, national and international levels.



SAEON is a key policy instrument

**Imraan Patel: Chief Director: Sector Innovation and Global Change,
Department of Science and Technology (DST)**

SAEON IS AN IMPORTANT PART of DST's ambition to build a system which ensures scientific evidence is used to inform and improve policy making.

Environmental observations are vital to South African policy around economic and social development. We need historic data to monitor change on Earth, in our seas and in the atmosphere. SAEON is creating a legacy of data that will be critical to future research and decisions.

The trend in South Africa and globally is to recognise the environment as central to everything we do, and to make decisions based on how it is changing. This requires research and observation, development of skills, and investment in the science base.

SAEON's specific role lies in its contribution to a legacy of environmental observations for future researchers and policy makers. Networks are difficult and complex to establish, but SAEON has built a good foundation and taken the lead in the development of a coordinated

process of data collection and sharing which takes account of policy requirements.

Having already made a significant contribution to our understanding of how to make a network function effectively, SAEON is a network in which members feel free and able to share results. We look forward to enhancing that.

The next task is to expand significantly its networking activity and the number of contributing partners.

SAEON is contributing to the development of research skills and attracting new talent into science. It has a good track record and is well-placed to expand and deliver what is needed by DST and the wider South African science establishment.

SAEON also supports DST's wider objectives, particularly the Global Change Grand Challenge in DST's 10-year innovation plan.



In decades to come, the organisation will be a crucial source of information for government's environmental policies, making an important contribution to the quality of life of future generations increasingly threatened by climate change. Society is ever in need of this type of evidence-based information to improve our current situation and plan for future prosperity.

Filling an important gap in SA science

Albert van Jaarsveld: CEO,
National Research Foundation



FOR EFFECTIVE DETECTION of environmental trends, and to distinguish human impact from natural trends, we need data spanning forty years or more. By focusing on long-term monitoring SAEON fills this important gap in the local science, environment and policy community. Apart from the collection of data, SAEON plays a vital role in verifying data from other sources.

Like SAEON, the United Nations' new Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) aims to strengthen the role of science in policy making. The sister body to the Intergovernmental Panel on Climate Change (IPCC), IPBES is recognised by science and policy communities as the mechanism to gather and analyse information for decision-making about biodiversity, ecosystem services and human livelihoods. Thanks to SAEON, South Africa has an excellent springboard for providing the kind of long-term biodiversity and ecosystem data that will be required by IPBES.

We urge the policy community to give more guidance to SAEON about their requirements. It should be a two-way conversation between scientists and policy makers, with SAEON in a brokerage role.

The brokerage role is one into which SAEON needs to grow. Having established its nodes and information management infrastructure, it now needs to make everything work together to fulfil the vision of a totally networked platform for long-term environmental observations.

In addition to monitoring and data collection, SAEON will be at the forefront of new technology adoption and deployment. And, in the longer term, it should become a planning and training resource too.

Steering the SAEON ship through the anchoring phase

Mbangi Nepfumbada: Chair, SAEON Advisory Board

WITH ALL NODES OPERATIONAL, SAEON is now positioned to innovate and navigate the space in which it operates including contributing to national transformation imperatives. In decades to come, it will be a crucial source of information for government's environmental policies, making an important contribution to the quality of life of future generations who will be increasingly threatened by climate change.

Long-term monitoring from an ecosystems perspective is critical and is very well located in a structured, national programme, integrated with the National Research Foundation and reporting to the Department of Science and Technology (DST).

Long-term monitoring is not for the fainthearted. It's neither a quick nor easy process. Decision-makers want to see things happen in the shortest possible time, so it becomes critical for SAEON to sell itself well. Moving forward there will have to be a lot more engagement aimed at raising visibility, generating interest and bringing in funding.

SAEON's highly regarded data is of great mutual interest to government, universities and business. It allows individual departments and agencies to cross check their run-of-the mill monitoring. By providing these relevant products, SAEON becomes a good value proposition.

SAEON's core funding base has to be broadened beyond DST. The absence of investment from other departments is recognised as a challenge. The strategy to succeed would involve getting the buy-in of officials at operational level, so that value-added collaborative opportunities are identified and promoted as key areas of future investment.

The recent publication of *Observations on Environmental Change in South Africa* creates awareness

and demonstrates the potential coordinating and leadership role of the network. The book provides an opportunity for people to better understand the organisation, to identify the gaps and get involved.

Improved knowledge and understanding derived from the observation systems provides feedback for continuous transformation of the way South Africa tackles global change. SAEON provides comprehensive and reliable data and information about environmental change in the long-term. Faced by a changing and uncertain world, society is ever in need of this type of evidence-based information to improve our current situation and plan for future prosperity.



During 2010/11 SAEON produced 14 scientific publications, as well as the flagship book, *Observations on Environmental Change in South Africa*. In true SAEON spirit it's a collaborative effort featuring over 100 authors, only a handful of them in-house. This demonstrates the coordinating and leadership role we play. The book is for policy advisors and students alike: it fosters an understanding of the environmental realities in the country. *Observations on Environmental Change in South Africa* was launched, along with an associated policy booklet *Combat Change with Change*, during August 2011.

These books may be downloaded from www.saeon.ac.za



A fully fledged SAEON spreads its wings and soars

Johan Pauw, SAEON managing director

HUMAN SOCIETY DEPENDS on a healthy and competitive environment. In an ever-changing and uncertain world, society constantly needs reliable data and evidence-based information to help improve the situation and plan for future prosperity. A long-term observation system like SAEON is essential to help understand the dynamics that determine the status of the environment in South Africa. This remains the core objective of SAEON.

We have made substantial progress with the process of supporting environmental research at large. SAEON is the only South African organisation with the mandate and the means to do this.

The past five years have been characterised by phenomenal growth, not only in terms of sheer size and output, but also maturity. While our focus remains squarely on the three pillars of observation science, information management and education outreach, we continue fine tuning and improving our organisational response to changes in our working environment. With the six envisaged nodes now operational, we've shifted gears and moved into production mode.

A golden thread running through all the landmark events of SAEON's continued development is stakeholder involvement and consultation. As the organisation develops and evolves, we adapt the way we run the business.

The concentration of ecosystem research at the six fully functional observatories now provides meaningful opportunity for the coordination and acceleration of environmental research programmes, as well as enhanced quality of outputs and cost-effectiveness.

The observation platforms and data management systems are ready to be implemented as national research platforms by the network partners, research students and international collaborators. As with true research platforms, the bulk of our researchers and students are based at universities and science councils. We provide equipment and access to research sites throughout the country. We've come of age, we're sustainable, we're responsive and we are starting to provide data not just for ourselves but for others.

SAEON now covers all terrestrial, coastal and marine systems in and around the country and we engage in the entire research-development-innovation value chain.

A fully operational SAEON also contributes to environmental and science policy processes in South Africa. We bridge research, policy and action at local, national and international levels. We strive to make sound contributions by offering a wide range of quality data for evidence-based opinion.

Any national policy process has multiple participants and it is difficult to measure the quality and quantity of SAEON's policy contributions. However, when such policy contributions are published, it becomes something tangible. A case in point is South Africa's Second National Communication under the United Nations Framework on Climate Change for which SAEON coordinated two chapters and contributed to a third. The document was issued by the Department of Environment Affairs in 2010.

At provincial and local government level, the organisation may produce technical reports, node scientists regularly contribute to meetings and workshops related to the management of protected areas, SAEON may assist and provide frameworks for the coordination of responses to establish, monitor, mitigate and adapt to the impacts of climate change in the provinces or municipalities.

Whereas SAEON aspires to provide full and open access to its data, its brand as a comprehensive long-term environmental observation system and data provider – with a successful education-outreach programme, has been established and is associated with value for society.

OBSERVATION
DATA
OUTREACH

| SAEON'S Three Pillars |

Observation, data and outreach

SAEON's cornerstones



The three cornerstones that support all SAEON's activities are: ■ A custom-designed observation network across South Africa and its surrounding oceans; ■ Long-term data and value-added environmental information; ■ Educational outreach activities designed to inspire future scientists.

Observation science – the foundation of the SAEON network

ALL NATURAL SYSTEMS change over time – some changes are due to the natural variability in ecosystems, while others are driven by people. To understand fully and be able to mitigate or adapt to global change, scientists must distinguish between these two types of drivers of change in the natural world.

By observing ecosystems over decades – and even longer – scientists document indicators of change and generate evidence-based information that helps us to understand global change. These crucial insights then feed into environmental management decisions, conservation planning, human settlement and land use policies.

“SAEON measures the agents thought to cause change, as well as a wide range of responses that ecosystems might show to such change,” explains Prof Tim O'Connor, one of the architects of SAEON's scientific approach to environmental monitoring.

A myriad of potential agents is considered including climate change, land use, harvesting, sea level rise, ocean currents, river flows, pollution, poisons, invasive alien organisms and ultraviolet radiation. Scientists can measure and monitor physical changes reflecting these agents as a basis for interpreting corresponding changes in the make-up of ecosystems and the manner in which they function. Accordingly, responses such as biodiversity (richness, composition and structure of species), primary and secondary production, biogeochemical cycling, hydrological functioning and geomorphological change (soil erosion, sedimentation) are monitored.

“The concentration of ecosystem research at SAEON observatories helps to coordinate and speed up environmental research programmes over space and time. This means that we get higher quality research outputs that are also more affordable.”

– Prof Tim O'Connor, observation science specialist, SAEON

Prof Tim O'Connor led the development of SAEON's core science framework and is advising on the network's scientific approach across the spectrum of relevant disciplines.

“Data on physical changes tell us whether the environment is actually changing over the long-term and, if so, in what way,” explains Johan Pauw, SAEON’s managing director. “By studying the functioning of entire ecosystems, we can flag concerns regarding the impact of a changing environment on ecosystem services – such as clean air and water.”

SAEON’s observation nodes

Each of SAEON’s six nodes acts as an environmental observatory with its own field equipment and constellation of observation sites. Each observation site is an open-air or underwater ecosystem laboratory, and is continually monitored. Jointly, these six nodes represent the diverse landscapes, coastal areas, and the

offshore marine environments of South Africa. Their observations cover the main biomes of South Africa, including large marine systems, coastal habitats, savanna, fynbos, grassland, wetland, forest, arid ecosystems, and freshwater aquatic environments.

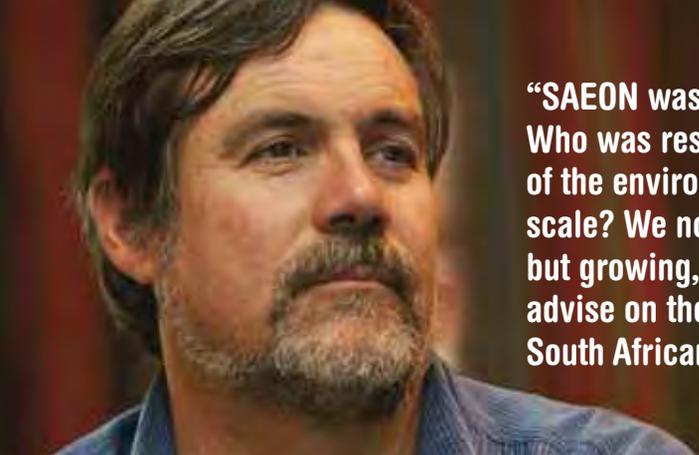
SAEON’s mandate is to concentrate on *in situ* (ground-based and surface/underwater) observation. Where possible, this is combined with satellite imagery and other remote-sensing observations, and aided by modelling.

SAEON’s observation system infrastructure is fully shared with participating organisations, making the research done more cost-effective and ensuring continuous peer review of the SAEON system.



“Reliable records of environmental change are vital for detecting trends and determining their causes. Without these we would be much more uncertain of what the future holds. SAEON is playing a key role by championing the collection and maintenance of long-term data sets and their use for research and education.”

– Dr David Le Maitre, ecologist and hydrologist, Natural Resources and the Environment, CSIR



“SAEON was set up to fill an important gap. Who was responsible for long-term observations of the environment, particularly at ecosystem scale? We now have a national network, sparse but growing, to help us detect, understand and advise on the many changes taking place in the South African environment.”

– Dr Bob Scholes, Research Group Leader – Ecosystem processes and dynamics, CSIR

“Even small improvements in discoverability or accessibility of relevant data can have a big impact in environmental science. SAEON’s ambitious shared data platform opens up new dimensions in research.”

– Wim Hugo, systems engineer, SAEON



Long-term data helps us to understand our changing world

QUALITY DATA CAPTURED over decades and longer provides the baselines for research to detect and analyse trends in environmental change. This data is expensive to gather and is never static. It needs to be analysed and enhanced to help people interpret it and to provide policy-makers with clear evidence. At SAEON, every effort is made to keep up with cutting-edge IT infrastructures and tools to optimise the way data is managed and presented, and to add maximum value to the data and metadata.

The scientists who generate and use environmental data work in diverse disciplines and represent a vast number of organisations. This means that data often becomes fragmented and isolated. When a single custodian takes responsibility for preserving and sharing valuable data sets, it benefits current and future researchers. SAEON fulfils this role and goes several steps further preserving, processing, enriching and sharing valuable research data.

A dedicated steering committee, chaired by Dr Wayne Goschen, oversees SAEON’s information activities. A major focus is to ensure that knowledge is made accessible to as many researchers and other potential users as possible via a range of online products, as well as by publishing popular and scientific articles.

SAEON’s data management backbone was developed in collaboration with the CSIR and the DST. The data management infrastructure is managed by systems engineer Wim Hugo.

Multi-level information access via SAEON’s data portal

SAEON’s data portal on the shared platform includes data and metadata from many other organisations, for example data from the Department of Environmental Affairs, the South African National Biodiversity Institute, the Agricultural Research Council, the Council for Geoscience and the CSIR’s Satellite Applications Centre.

SAEON also coordinates and co-sponsors domain-specific data centres such as the Southern African Data Centre for Oceanography. By July 2011 the SAEON data portal housed 650 metadata records from seven providers grouped as follows:

Data by region

Results are available for South African provinces, sub-Saharan Africa, and the main ocean regions around southern Africa.

Data by biome

SAEON assembles data for long-term preservation and is structured into biome-specific nodes.

Data by data set

The SAEON data portal houses metadata from a large number of providers and networked organisations.

SAEON's shared platform – a multi-functional nerve centre

SAEON has developed a comprehensive data management infrastructure – a so-called 'shared platform' – that hosts SAEON's own data portal, as well as those of several other research organisations. It is a resource for the referencing, discovery and archiving of data sets and information, as well as for the sharing and dissemination of data. This shared platform allows for economy of scale, while all participating organisations benefit from its joint development.

The system provides access to data through a metadata repository aggregated from collaborators, partners, and linked sites. Researchers who access the shared platform are also able to use cutting-edge data management tools to search for specific information and to create geospatial visualisations of specific data sets.

By using the facilities provided for packaged searches and Global Earth Observation System of Systems-compliant search services, stakeholders, communities, and partners can access the clearinghouse metadata repository in predefined ways to support research themes.

SAEON has also recently completed components that allow query formulation pages and search results to be seamlessly embedded in other systems. Stakeholders can thus contribute to the shared platform's metadata repository, host data in its infrastructure, and utilise its search and visualisation components, all from external systems.

“Data is SAEON's currency. Without data, we cannot decipher the changes in our environment or even begin to understand the impact of people on the natural world. Long-term data gives us evidence and new insights to help formulate crucial environmental policies. In everything we do, we promote free and open access to data.”

– Johan Pauw, managing director, SAEON

The metadata repository is capable of accepting and working with a range of well-established metadata standards. It allows the composite visualisation of distributed data sets, provided that access is automated and standardised. The platform also provides collaboration, sharing, and content composition facilities for the distributed creation and management of value-added themes, discussions, blogs, community pages, and more.

Due to its ability to archive, search and discover spatial data and other information and tools in a secure environment, the shared platform enables SAEON to share and integrate spatial information and data sourced from a variety of providers connected via a web-based network.

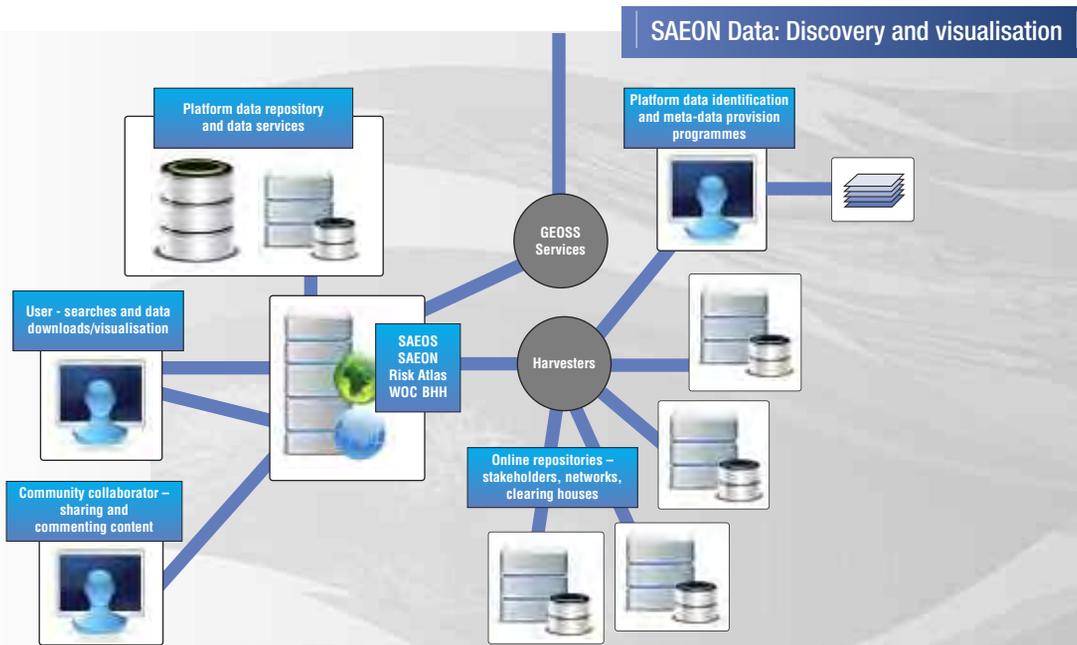
“A key benefit of SAEON's shared platform is its ability to harvest metadata from stakeholder systems, integrate the data linked to the metadata and produce a single point of contact to the end-user” – Wim Hugo, systems engineer at SAEON



Via this shared platform, researchers at SAEON's six nodes can input new data, access and integrate existing data, analyse and add value to the data, and share knowledge.

SAEON's shared platform is now also used for the following initiatives:

- The CSIR's GSDI (GeoSpatial Data Infrastructure) portal, which aims to reference and disseminate all spatial data available from CSIR.
- The South African Risk and Vulnerability Atlas (SARVA).
- The South African Earth Observation System, funded by the DST, that functions as a gateway between South African earth observation data custodians and GEOSS.
- A prototype World Data Centre for Biodiversity and Human Health in Africa (WDCBHH), which will enable the first world data centre outside developed countries to be established.
- Several smaller initiatives, including a "BioEnergy Atlas" for South Africa, a "GeoHazards Portal", the "Oceans-Africa Portal", and an access point for socio-economic data are in conceptualisation or development stage.



“Long-term data sets provide huge potential for a variety of analyses to investigate changes over time and to provide a baseline for future monitoring studies.”

– Victoria Goodall, data scientist, SAEON Fynbos Node

Inspiring future scientists

HANDS-ON OPPORTUNITIES to participate in environmental monitoring projects can change young people's lives and inspire them to pursue a career in science. This is the philosophy behind educational outreach at SAEON where the emphasis is on the depth of the engagement, rather than on reaching large numbers of learners and teachers.

"Everything we do must contribute to our overall objective of increasing the number of learners who register for tertiary science studies," says education specialist Sibongile Mokoena, SAEON's national outreach coordinator. While she admits that this is a huge challenge – and an area where it is difficult to measure impact – she is not intimidated. "It forces us to keep on exploring innovative ways to really make a difference."

A matrix of learner- and teacher-focused activities at SAEON nodes across the country – consisting of school-based monitoring programmes, teacher support workshops, science camps and field trips – makes up SAEON's outreach portfolio. SAEON works with schools in the geographic areas surrounding its nodes, focusing on Grade 9-11 teachers and learners in life sciences, physical sciences, mathematics and geography. "Participation is voluntary," Mokoena explains, "but once schools begin to experience the benefits, they are usually hooked, despite the hard work that comes with the territory of hands-on monitoring!"

Mokoena is particularly excited about SAEON's science camps that she singles out as flagship projects. A recently developed model allows selected learners to participate over three years, starting with an introductory science camp in grade nine, while grade tens begin to collect data and grade eleven learners acquire skills to analyse, interpret and present the data.

SAEON also provides opportunities for groups of teachers to get hands-on data gathering experience by joining researchers on field trips, coastal surveys or deep sea research cruises. Teachers must show how they will use the data that they have collected in the classroom.

"Data handling is in the maths and science curriculum, but most teachers don't have practical examples to make it real and relevant," Mokoena explains. "Participating in SAEON's teacher workshops helps teachers to move away from a purely text-book approach to real-life science teaching."

Since the internship programme of the Department of Science and Technology kicked off, SAEON has hosted four graduates as interns – each of them for a full year. These young graduates work side-by-side with scientists and education officers at SAEON head office and nodes. SAEON involves scientists across the country to help design the programmes and materials for science camps and other educational events. A network of education experts from universities, government and environmental education organisations advises the SAEON outreach programme.



Even though the emphasis is on quality engagement rather than numbers, SAEON's outreach efforts have a significant reach. Since 2007, more than 70 hands-on training events have involved 715 teachers and close to 10 100 learners.

School-based monitoring projects

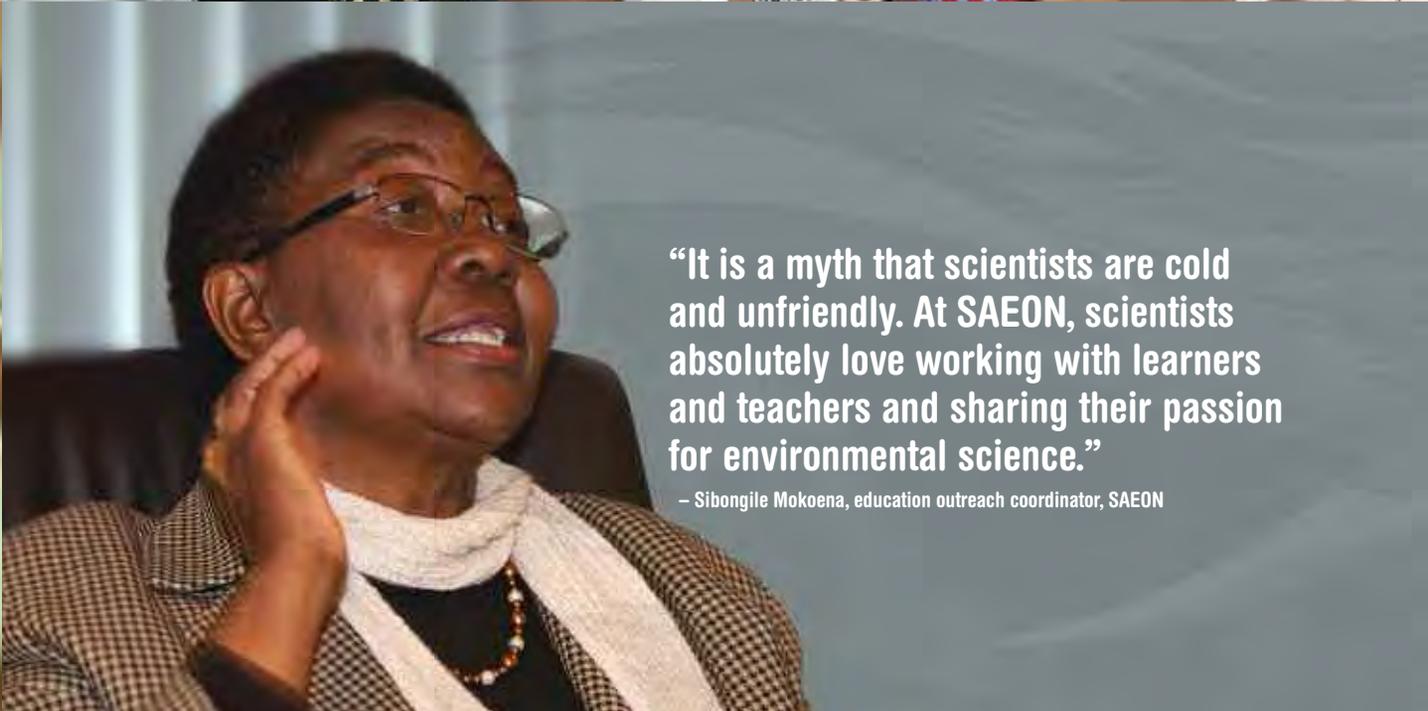
SAEON has established eight school-based monitoring projects at 24 schools, focusing on the following topics:

SAEON Ndlovu Node: Tree monitoring, and weather and climate monitoring

SAEON Elwandle Node: Sustainable fishing; weather and climate monitoring

SAEON Egagasini Node: Data from Argo floats – ocean monitoring

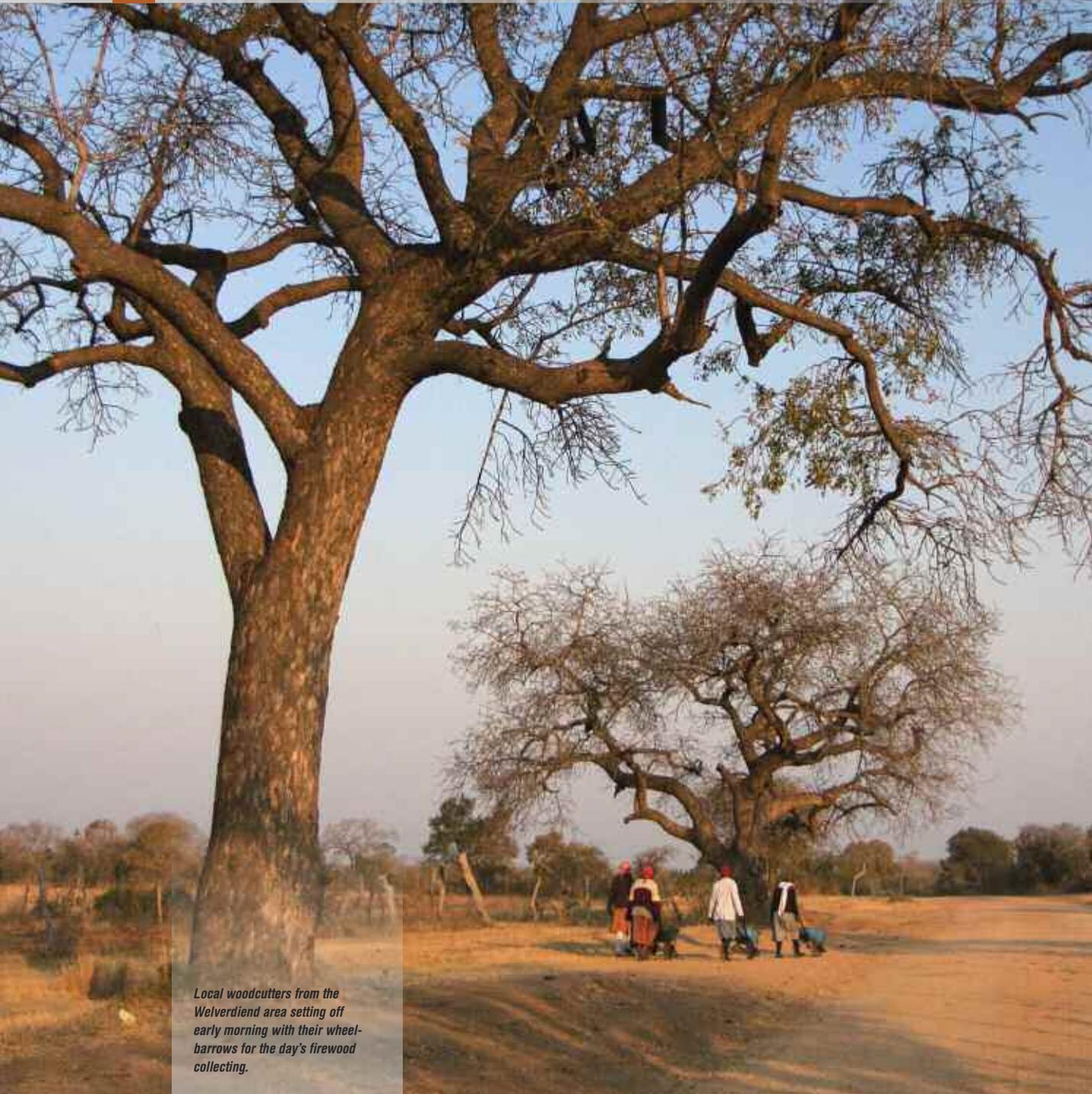
SAEON Fynbos Node: Weather and climate monitoring



“It is a myth that scientists are cold and unfriendly. At SAEON, scientists absolutely love working with learners and teachers and sharing their passion for environmental science.”

– Sibongile Mokoena, education outreach coordinator, SAEON

Ndlovu Node was named after the elephant as a key driver in savanna systems. *Ndlovu* means elephant in the Nguni languages. The Nguni, Sotho and Tswana names for the elephant mean ‘the forceful one’ and ‘the unstoppable one’.



Local woodcutters from the Welverdiend area setting off early morning with their wheelbarrows for the day's firewood collecting.



SAEON Ndlovu Node

Understanding change in the iconic African savanna

Environmental change in north eastern South Africa is being eagle-eyed by the Ndlovu Node, which focuses on long-term research and monitoring of the savanna biome according to three themes: savanna observatories, mountain observatories and hydrological observatories.

AN ARRAY OF STUDY SITES – some inside protected areas, others within rural communities, some on misty mountaintops and others in flowing rivers – are being established for long-term research on the basic drivers of change. These include anything from fire, elephants and changing climate, to firewood harvesting, rising carbon dioxide (CO₂) levels and pollution.

The node, the oldest of SAEON's research platforms, became fully operational in 2006 and is hosted by South African National Parks (SANParks). The offices and laboratory are located at the Phalaborwa access gate to the Kruger National Park (KNP) and the Greater Limpopo Transfrontier Park.

Between 2007 and 2011, the node established 18 research projects at core and affiliated sites. Most of these are long-term projects intended to detect and understand changes over a period of many years or decades.

Over the years ecological research inside the KNP has grown, but research in the rest of South Africa's savanna remains less intense and uncoordinated. Ndlovu is stepping in to fill the gaps, expanding research well beyond the Kruger and drawing together universities, as well as private and public bodies in the environmental field. The node tracks down and archives historical environmental data for the savanna biome and facilitates new research in areas where rapid environmental change is occurring.

- A savanna ecosystem consists of a combination of trees and grasses, with the trees sufficiently widely spaced to allow light to reach the grass below.
- One factor common to all savanna environments is strongly seasonal rainfall, with a wet summer and dry winter.
- Threats to the biome include: inappropriate fire management, under- or over-stocking of game, tree cutting, alien plants and climate change.
- Savanna covers approximately 20% of the Earth's landmass, 40% of Africa and 46% of terrestrial southern Africa.



“Liaison with scientists and students at a postgraduate level, as well as collaboration with researchers active in the region is an ongoing priority.”

– Dr Tony Swemmer, SAEON Ndlovu node manager

“Liaison with scientists and students at a postgraduate level, as well as collaboration with researchers active in the region is an ongoing priority,” says node manager Dr Tony Swemmer. “Contemporary environmental change can only be understood if we have a long-term, detailed and consistent research record, with sufficient variables to address the complexities of global change.”

Through the activities of the node and the associated network of partners from academia, the conservation sector and members of the general public, over the next several years, SAEON will be in a position to draw together the physical and biological data necessary for detecting, understanding and adapting to global change in the South African savanna.

Savanna observatories Structure and diversity under threat

A network of nine study sites has been established throughout the central Lowveld to unravel the drivers that are changing the structure and diversity of savannas. Both bush encroachment (or bush thickening) and bush thinning are of interest. “These sites will provide baseline data to detect the impacts of global climate change and rising CO₂,” explains Swemmer. “The growth and survival of dominant tree species is crucial to understanding the changes currently occurring in our savannas, and we need to determine their responses to different land uses and land management practices.”

Education outreach is integrated into the research, with local schools joining the Ndlovu network of collaborators. Tree monitoring projects have been set up on the grounds of some schools and learners help to gather data which feeds into SAEON’s database, helping to provide a rich store of environmental observation for researchers from all over the continent and abroad.

Intensive research is being done at one of the savanna observatory sites, located in the communal lands surrounding a rural village. Here trees provide a vital ecosystem service, in the form of a free supply of energy for warmth and cooking. The node is monitoring the rate of fuelwood harvesting to determine whether or not it is sustainable.

Other work in rural savannas involves the resampling of historical vegetation surveys, to determine how decades of fuelwood harvesting have altered the nature of savannas around rural villages.

The node’s latest venture into socio-ecological research in rural areas involves the monitoring of vegetation and the supply of multiple natural resources around nine rural villages in the Bushbuckridge Municipality. The project is a collaborative effort with social-ecology scientist Dr Wayne Twine who heads up the Sustaining Natural Resources in African Ecosystems programme at WITS Rural Facility.

Mining is another human activity driving major environmental changes in South Africa, and in order to better understand the long-term consequences of



mining on savanna ecosystems, the node has partnered with a local copper mine operated by the Palabora Mining Company. The node has taken over biodiversity monitoring at the mine, monitoring both protected areas neighbouring the mine, and mine dumps undergoing rehabilitation.

Africa is a region highly vulnerable to climate change due to ecological and socio-economic factors, but is also the continent least covered by studies on climate change. A critical aspect of understanding and projecting global climate change is the exchange of CO₂ and other greenhouse gases between ecosystems and the atmosphere, and data on this is badly needed for African ecosystems. To help fill this gap, the Ndlovu Node has been supporting A-rated scientist Dr Bob Scholes and colleagues with a CSIR-led project to measure carbon fluxes in KNP. Currently there are two flux towers which use sophisticated equipment mounted on a tall mast to continuously measure how much CO₂ the surrounding vegetation and soil absorb during the day and release at night.

Can fuelwood keep the home fires burning?

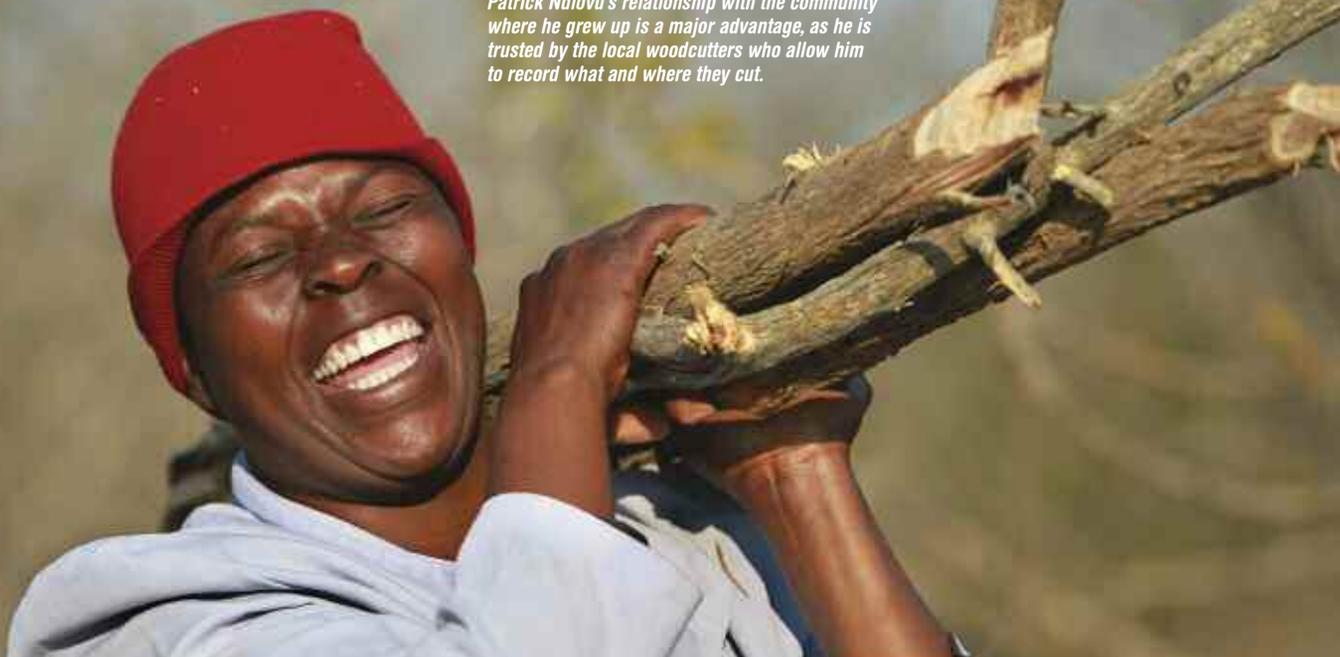
WHILE THE COLLAPSE of wood supply in rural areas in the central Lowveld was predicted from studies conducted in the early 1990s, tree densities have not declined and harvesting continues. However, the threat of a collapse in the near future remains, particularly with the advent of global climate change.

Understanding what determines the ability of rural ecosystems to produce wood remains a key question in South African ecology. In order to contribute to answering this question, the Ndlovu Node has initiated a long-term monitoring project at Welverdiend village, in a remote part of Mpumalanga bordering the Kruger National Park. The data for the investigation is collected by the node's field assistants Patrick Ndlovu and Mightyman Mashele who grew up in Welverdiend and are familiar with the languages spoken. Their relationship with the community is a major advantage, as they are trusted by local woodcutters who answer their questions and allow them to record what and where they cut.

Due to the long-term nature of SAEON, this project will run long enough to determine rates of wood supply under differing conditions of both climate and demand.



Patrick Ndlovu's relationship with the community where he grew up is a major advantage, as he is trusted by the local woodcutters who allow him to record what and where they cut.



Taking tloU to task: the elephant debate continues |

DESPITE DECADES OF RESEARCH and an imposing bibliography on elephant ecology, experts still disagree on the question of whether there are “too many” elephants or not. The long-term implications of southern Africa’s ever increasing elephant populations for the overall biodiversity of protected ecosystems have yet to be determined.

“Whenever elephant impacts are discussed, conservation managers always indicate that they need more data,” says Ndlovu landscape ecologist Dr George Chirima.

Studies have generally been too short lived to inform policies for elephant management and long-term research is needed. The Kruger National Park (KNP) set up elephant exclosures with electrified fencing that keeps out elephants, but allows smaller herbivores to move freely. This provides a valuable research tool for disentangling the impacts of elephants from those of other herbivores. The Ndlovu Node has initiated a project to produce long-term data on elephant impacts and takes advantage of research infrastructure such as these exclosures.

While it is clear that elephants can and are changing the structure of ecosystems by breaking, pushing and uprooting trees, it is not clear what the long-

term consequences of such changes will be for the thousands of other species that inhabit these ecosystems.

Chirima has begun synthesising previous research, with more than 300 published and non-published articles on the topic located to date. Most publications underscore the need for more data. The node is utilising its network of tree monitoring sites, of which some are impacted by elephants and some protected from elephants, to advance this research.



Mountain observatories Tracking change up altitudes and down latitudes

Global change is already affecting the mountainous regions of the world, with clear evidence of altered weather patterns and the upslope shift of certain species. Yet in South Africa, little long-term environmental monitoring of our mountains is taking place. This is something which is desperately needed if we are to detect and respond to the looming impacts of a changed climate.

In order to address this gap SAEON has established several mountain observatories across the country. Included are two Ndlovu Node core sites at high points on the Limpopo escarpment, with two more under development.

The two established sites are located at Haenertsburg in the Wolkberg and at Lajuma in the Soutpansberg. “The primary aim of these sites is to detect the impact of global climate change on grassland ecosystems. Mountain grassland ecosystems are highly threatened and important for regulating water flow from catchments,” explains Swemmer. “They are crucial to long-term environmental monitoring, because this is where we are likely to see the earliest and most severe impact of climate change.”

In eastern and central South Africa the savanna, which characterises the lower slopes, gives way with increasing altitude to a mosaic of grassland and afro-temperate forest, with the highest mountain peaks harbouring unique and restricted vegetation communities. Environmental parameters such as temperature and annual precipitation interact with fire to define the range and composition of these biomes in the region.

The area surrounding the small town of Haenertsburg, situated in the foothills of the Limpopo Drakensberg, supports grassland, savanna and forest vegetation types of remarkably high biodiversity. “Much of the research we are doing at this site is based on similar long-term projects being conducted in the northern hemisphere,” says Ndlovu biodiversity scientist Dr Dave Thomson, “Our research questions have been adapted to suit the local situation, and will provide locally and globally relevant answers.”

Projects of various scales – from monitoring individual and species level responses to climate change through to mapping large scale shifts of the grassland and savanna biome are being undertaken. It is hoped that the data coming through will answer some of the tricky questions being asked about these complex systems.

The second site is located inside a nature reserve, nestled on the southern slopes of the Soutpansberg. Lajuma Mountain Retreat stretches up to the highest



peak in the range. Dr Ian Gaigher, formerly of the University of Venda and the owner of Lajuma, established a research centre on the reserve in 2003. Hundreds of postgraduate students and volunteer research assistants have lived and worked there. Lajuma contains a number of isolated populations of rare plant and animal species that are perched on the peaks of the Soutpansberg, and are likely to disappear with even small changes in climate. Another collaborator at this observatory is Dr Stefan Foord (University of Venda) who has established a transect of sites that run through Lajuma and right over the mountains, to study the effects of climate change on ants and other invertebrates. Both Foord and the Ndlovu Node have contributed weather stations to allow for detailed meteorological measurements across this transect.

“Collaborations at Lajuma increase the geographical extent of the node and present the opportunities to promote research relevant to SAEON. We would like to see this site develop a reputation as one of the premier sites to study climate change in a terrestrial environment in South Africa,” adds Swemmer.

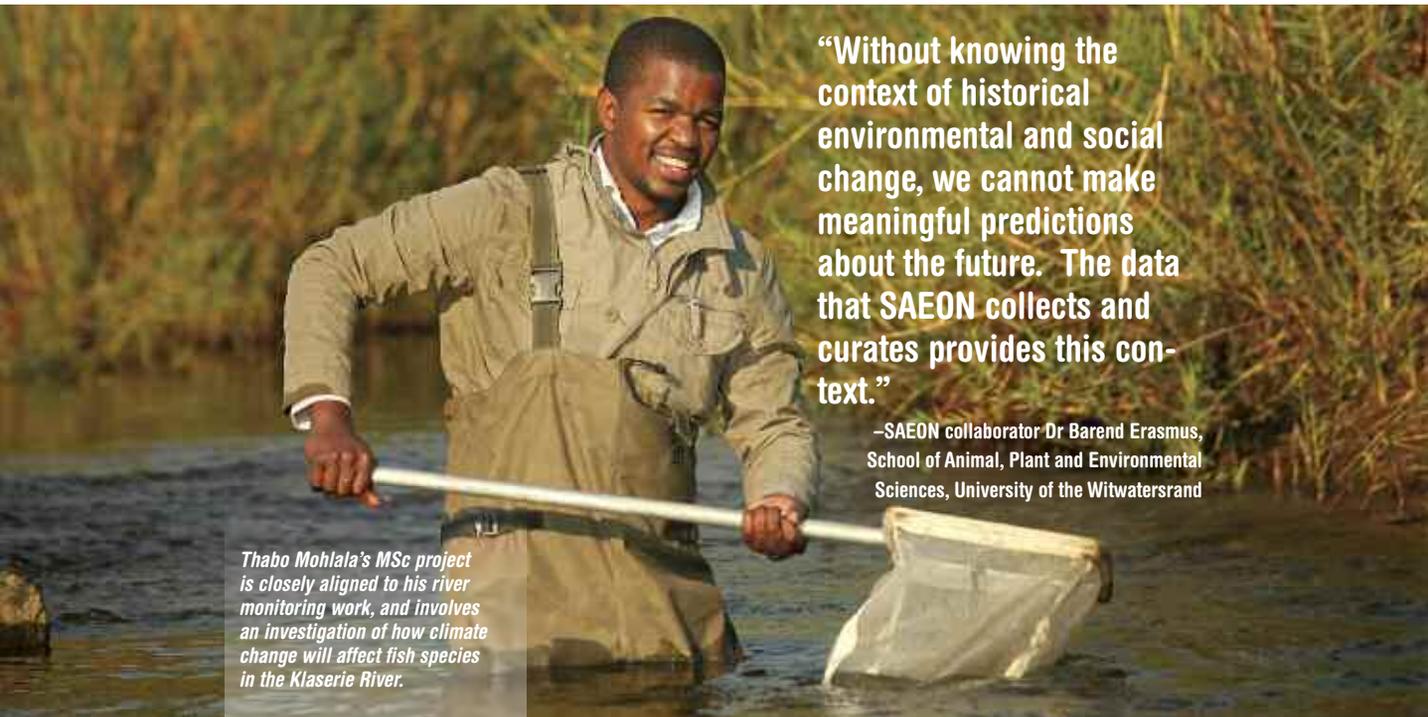
The Ndlovu team is developing two additional mountain observatories at Marakele National Park in the Waterberg Mountains and at Mariepskop in the Ukhahlamba-Drakensberg escarpment. These two sites will substantially expand the node’s footprint. In addition to studying effect of altitude, these additional sites will allow for comparisons of the effect of latitude over the strong moisture and temperature gradients of north-eastern South Africa.

Hydrological observatories Eyeballing changes along the once mighty Olifants

The Ndlovu Node’s hydrology research focuses on the lower Olifants River and its tributaries. Ten sites are sampled at weekly to monthly intervals to investigate how pollution and reduced water flows affect aquatic ecosystems.

The condition of the rivers at these sites ranges from pristine to degraded, and their locations also allow for an assessment of how protected areas help clean up polluted water.

Ndlovu rivers technician Thabo Mohlala is responsible for data collection at these sites, and has been trained to sample water chemistry, aquatic insects and fish by Prof Paul Fouche (University of Venda) and Wynand Vlok (formerly from the University of Limpopo), who assisted the node with the design of the project. Data is shared to and fro with the two large mines in Phalaborwa, whose activities have always posed a threat to the integrity of the lower Olifants. Mohlala’s MSc project is closely aligned to his river monitoring work, and involves an investigation of how climate change will affect fish species in the Klaserie River. Thabo also assists Joe Sibiyi with the node’s education programme by regularly demonstrating techniques to assess water quality to teachers, learners and undergraduate students.



“Without knowing the context of historical environmental and social change, we cannot make meaningful predictions about the future. The data that SAEON collects and curates provides this context.”

—SAEON collaborator Dr Barend Erasmus, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand

Thabo Mohlala’s MSc project is closely aligned to his river monitoring work, and involves an investigation of how climate change will affect fish species in the Klaserie River.

Additional hydrology research at the node involves the monitoring of a rehabilitated wetland in the headwaters of the Sand River, an important tributary of the Sabie River.

Stewarding savanna research data

In order to archive and share data, the Ndlovu Node makes use of the Metacat online information management system, in collaboration with KNP. The vast amount of research data being accumulated by KNP is similar to that being collected at the node, and data management has been built in parallel with the Kruger Park system. The freeware system used was developed by the National Centre for Ecological Synthesis and Analysis in the US, and has been adopted by the US LTER and other international long-term ecological research networks.

In addition to data collected by staff or students of the Ndlovu Node, a large amount of data has been donated by private individuals and companies, retired academics and research institutions. Acquiring such data requires building relationships with a network of partners who buy-in to the data sharing ideals of SAEON.

The fall...and fall of Mapungubwe's riverine forest?

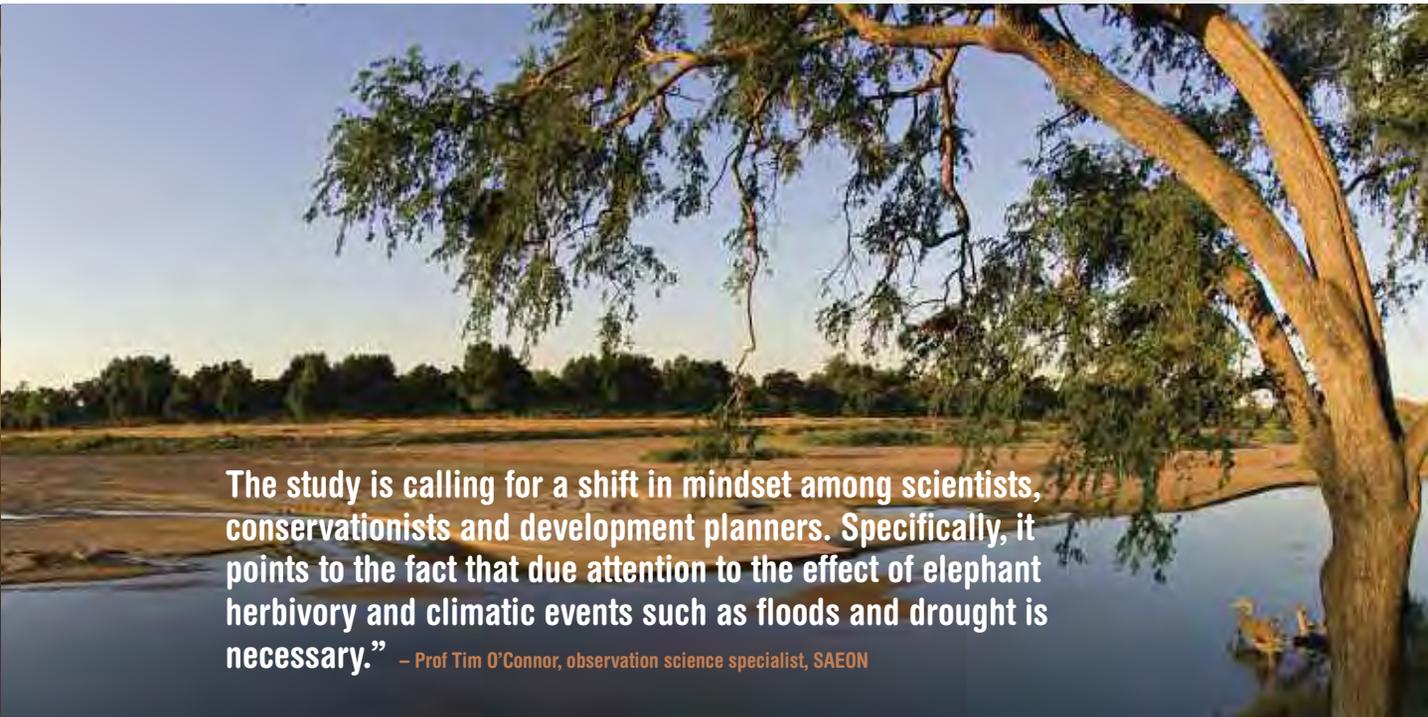


THE GREEFSWALD FOREST along the Limpopo River, a verdant tract snaking through the otherwise semi-arid savanna of the northern South African border, is increasingly threatened by natural and anthropogenic activity. SAEON is

tracking the impact of water abstraction, droughts, floods and elephants on this unique habitat.

This dense riverine forest is classified as a distinct forest type, making it a vegetation community of great scientific significance. It has offered utilitarian value to human communities stretching as far back as the Mapungubwe kingdom between 900 and 1300 AD. Some of the larger trees have been around for centuries. As a riverine forest, it makes a contribution to the biodiversity of the area that far outweighs its relatively small extent and is also vital for protecting the water catchment.

This project compares time series data with a baseline survey of the vegetation carried out in the 1980s as the point of reference in assessing changes. The study enters its fifteenth year in 2011 and the trends produced have been intriguing. "The preliminary findings suggest that human activities such as water abstraction for mining might not have the same degree of impact as elephant herbivory and climate change," says principal investigator Prof Tim O'Connor, "The study is calling for a shift in mindset among scientists, conservationists and development planners. Specifically, it points to the fact that due attention to the effect of elephant herbivory and climatic events such as floods and drought is necessary."



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– Prof Tim O'Connor, observation science specialist, SAEON

Exciting the next generation

Schools and the general public actively contribute to collecting useful environmental data, which in turn creates greater awareness of growing environmental problems and encourages learners to pursue careers in the environmental sciences.

Ndlovu's outreach coordinator Joe Sibiya conducts science camps for learners from grades nine to eleven, with assistance from other node staff and external scientists. This initiative aims to encourage learners to pursue careers in environmental sciences, with real-world scientists exposing them to environmental problems currently faced by society, and explaining how science can help solve these problems.

Sibiya also facilitates the running of scientific projects on grounds of several schools in the vicinity. The Southern Cross Wildlife School for example is a fully fledged node collaborator and assists with the sampling of tree monitoring plots on its grounds within the Raptor's View Wildlife Estate at Hoedspruit.



At Majeje High School in the rural town of Lulekani, learners gain hands-on knowledge by assisting with the collection of vegetation data within exclosures set up by the node to demonstrate the effect of grazing and cropping on natural vegetation, and the supply of natural resources. An automated weather station has been set up at the school, as well as three other local schools, to generate data on temperature and rainfall that will be used by teachers to teach numeracy skills in the classroom, and scientists analysing the effect of climate change on rural ecosystems.

The node regularly conducts projects to raise awareness of environmental issues with the general public. This includes biodiversity days, run in collaboration with the Kruger to Canyons (K2C) Biosphere Reserve and others to showcase the impressive biological diversity of the region, and highlight threats to this diversity. In 2010 the Ndlovu Node worked with K2C to involve over 100 volunteer observers (including learners, teachers, biodiversity specialists and industry representatives) at eight riverside survey sites. By carefully selecting sites inside and outside protected areas and up- and downstream of potential disturbances, the organisers hoped to raise awareness of rivers, both in terms of the ecosystem services they provide and of the impact of development on them.

At the end of the four-hour sampling period, the teams of weary volunteers regrouped at the Ndlovu offices to compile their final inventories. Over 1 000 species were recorded across the eight sites.

The Ndlovu team has set the benchmark for citizen science projects. The node has involved amateur birders in annually recording the arrival date of key migra-

"We coordinated a seminar for local grade 11 biology learners under the theme 'Burning for Biodiversity' to increase awareness among learners about the role of fire and invertebrates in the conservation of savanna systems. It was good to see the lively interaction between the learners and the presenters. In the discussion session learners were made aware of the threats that frequent fire poses to biodiversity."

- Joe Sibiya, SAEON Ndlovu Node outreach coordinator



tory species, which in time will indicate if climate change is affecting migratory patterns. Volunteers on foot assisted with mapping the distribution of mopane trees at the southern end of their range within KNP. This provided baseline data needed to detect the southward expansion of this keystone species, as is predicted to occur in response to global climate change. The calendar gardens project gets schools to plant specific species that flower at different times of the year. Over time, differences in flowering times will indicate the effects of climate change. This is just a sample of the successful projects undertaken to date.

Helping transform science into policy

SAEON contributes to environmental and science policy processes in South Africa at local and national levels. Node scientists regularly contribute to meetings and workshops related to the management of SANParks parks. During 2010, Thompson helped draft the Mpumalanga Climate Change Response Strategy which provides a framework for the co-ordination of provincial responses to establish, monitor, mitigate and adapt to the impacts of climate change in the province. Thompson also presented at the Mpumalanga local government summit on climate change to increase awareness at municipalities to 'on the ground' climate change issues.

At local level, the node regularly liaises with industry, in the form of the two local mines (PMC and Foskor). In rural areas, results from node-based research are fed back to local leaders along with recommendations for improved management of communal lands.

Chopping down trees in the name of science

In these times of concern for the environment and efforts to combat global climate change, planting trees is highly regarded. Cutting down trees is not. However, this is exactly what the Ndlovu Node has been doing.

Trees play a vital role in regulating the flow of carbon and water between ecosystems and the atmosphere. The amount of carbon stored by trees and the rate at which trees grow and absorb more carbon out of the atmosphere is vital information, both for carbon credit projects and for global climate models.

In order to provide more of the basic data upon which these complex models are built, the node has been "harvesting" trees at a strip-mining site where the trees are destined to be bulldozed. Harvesting involves taking detailed measurements of a tree's dimensions before cutting it down and weighing it. By doing so, future estimates of carbon stored in living trees can be made for other sites where harvesting is not an option (such as inside Kruger National Park). For selected trees, roots are also dug up to be weighed, as nearly 30-50% of a tree's weight (and carbon) is located below ground.

Harvesting a range of tree species, in different types of ecosystems, is needed in order to make reliable estimates of biomass and carbon stocks over large areas. The project was given a major boost in 2010 through collaboration with Matt Colgan, a PhD student from Stanford University in the US who uses cutting edge technology to estimate tree biomass from above. The lidar (light detection and ranging) data was obtained from the "Carnegie Airborne Observatory" – a customised sensor fitted to a light aircraft – which was especially flown over the site. This enabled them to measure accurately and efficiently the dimensions of a large number of trees.





SAEON Elwandle Node

Loosely translated, *elwandle* means “coast or sea” in Xhosa, and “at or on the sea” in Zulu, thus adding a uniquely South African flavour to the node. Some colourful Xhosa idioms use the word: *Umke namanga-bangaba aselwandle* – He has gone in pursuit of the (fabulous) birds of the sea, applied to the ambitions of one whose aspirations are never likely to be realised.



SAEON Elwandle Node

We can't afford to just coast along



South Africa's almost 3 000 km long coastline and associated marine environment is one of its most important national assets. We need to understand the global climate change drivers in the coastal zone to ensure informed decision making regarding the protection of our precious estuaries, shallow reef communities, rocky shores, beaches and fragile dune ecosystems. This is the role of the Elwandle Node, established in 2007, and responsible for the long-term ecological research of the country's coastal-inshore systems.

TODAY THE NODE PROVIDES a significant platform for marine research, providing instrumentation, data systems, dive units, remote operated vehicle pilots and skippering. The node manages large multi-disciplinary and multi-institutional coastal and inshore marine research; it has an inflatable research boat, a taxonomy laboratory and sought after capital intensive research equipment.

The South African coastline boasts extraordinary biodiversity which supports numerous local communities and plays a major role in regulating our climate.

- The almost 3 000 km long South African coastline is a national asset.
- There are over 250 estuaries or river mouths along the coast.
- Two thirds of estuaries are located on the east coast since the eastern region receives most of SA's rainfall.
- Some 20% of the coast is protected.
- The Exclusive Economic Zone, surrounding continental South Africa and the Prince Edward Islands, has an under water area of 1,535,539 km², which is more than the 1,221,037 km² dry land area of the country.

“Marine science is significantly more expensive to run than terrestrial science, so we have a strong emphasis on inter-institutional collaboration, sharing research vessels, equipment and management expertise.”

– Dr Tommy Bornman, SAEON Elwandle Node manager, SAEON



“Marine science is significantly more expensive to run than terrestrial science,” explains node manager Dr Tommy Bornman, “So we have a strong emphasis on inter-institutional collaboration, sharing research vessels, equipment, management expertise and even a dive unit with partners such as the South African Institute for Aquatic Biodiversity (SAIAB).

The Elwandle Node is hosted by SAIAB in Grahamstown. A research facility of the National Research Foundation (NRF), SAIAB is well placed to provide open access to data for the broader marine and coastal community. This growing and active facility has excellent collaborative networks that are also international. Coastal and marine resources provide opportunities for economic and social activities that include: fisheries, agriculture, mineral resource exploitation and a range of development opportunities. The coast and its many estuaries are also highly valued for recreation. The sustainability of these resources is important since they constitute a rich and diverse national asset which is sensitive to human-induced and environmental pressures. The single greatest driving force for environmental change that poses a threat to resources in the coastal zone is population growth. Thirty per cent of the South African population lives along the coast.

In addition, as SAIAB managing director and former Elwandle Node manager Dr Angus Paterson notes, “Marine and terrestrial forces both impact on the coastal environment. It’s a double whammy. Estuaries for example are affected by freshwater abstraction upstream, but also by the impact of sea-level rise.”

The bioregion approach – core and affiliated sites

The Elwandle Node has adopted a bioregion approach to its research, setting up core and affiliated sites in the different coastal bioregions. The first core site launched in 2007 was the Algoa Bay sentinel site which falls within the warm temperate Agulhas bioregion and today comprises a multi-disciplinary and multi-institutional project gathering baseline data and monitoring ecosystem changes from St Francis Bay in the west to Port Alfred in the east.

The other bioregions are the subtropical east coast bioregion and the cool temperate west coast bioregion. SAEON is planning a feasibility study during 2011/12 for establishing a second core site. This would possibly focus on the monitoring of estuaries on the east coast, with the core site being located in the iSimangaliso Wetland Park. Affiliated study sites already exist in both the other bioregions and Elwandle is looking at expanding opportunities for long-term monitoring in the St Lucia area, where it will work with the new Grasslands-Forests-Wetlands Node and on the west coast where it will cooperate with the Egagasini and Arid Nodes.

The rationale behind prioritising the Agulhas bioregion in 2007 was that despite having the highest number of estuaries along the coastline, it had very few monitoring activities. Estuaries are a key facet of SAEON’s coastal node and very susceptible to long-term change. There was a paucity of long-term ecological



Revealing the hidden ocean dynamics of Algoa Bay

research data for the region and this was further complicated by high subsistence use of the coastal zone in this bioregion. Several research institutions and universities are in close proximity. This has allowed for effective platform management through research supervision and sharing of equipment and people.

The Algoa Sentinel Site programme was initiated in 2007 by the Elwandle Node and in 2008, SAEON's Egagasini Node, responsible for the marine offshore environment, joined the programme as an equal partner.

Algoa Bay offers significant opportunity for integrated socio-economic and ecological long-term monitoring and research. The bay supports a metropolitan area, Port Elizabeth, with a population of over a million people, two harbours and a large industrial area. Two island groups occur within the contour of the bay and it has a full range of habitats with good examples of sandy beach, estuarine, rocky shore, island, sub-tidal reef, sub-tidal soft sediment and dune ecosystems. Algoa Bay includes the extension of the Greater Addo Elephant National Park.

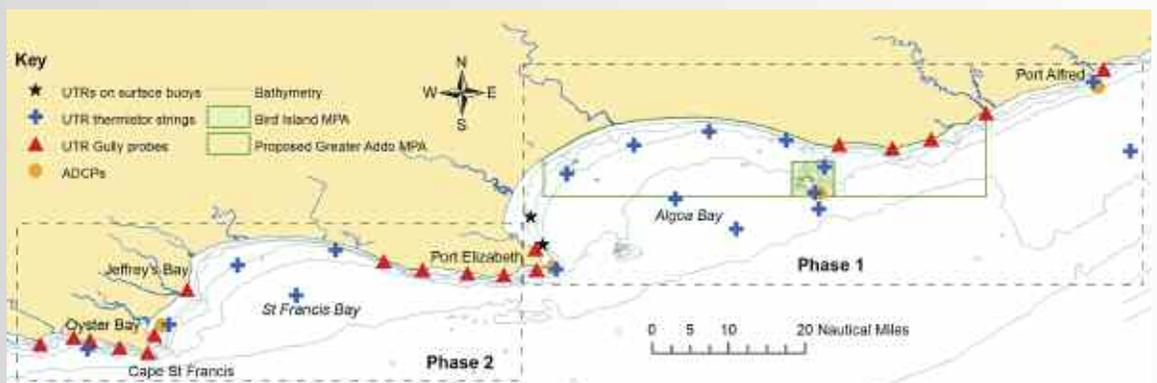
Additional core sites will be phased in as and when funding and logistical considerations allow. The core site concept provides an opportunity to focus long-term ecological research and monitoring on specific areas so that continuity in data can be assured.

Map of St Francis Bay and Algoa Bay showing continuous monitoring platform and monthly sampling stations

IN THE ALGOA BAY REGION, interactions between nearshore, coastal and deepwater oceanographic processes, local weather systems, bathymetry and shoreline orientation result in interesting ocean dynamics that remain largely unstudied. Understanding the pelagic and benthic environment of Algoa Bay is undertaken by Elwandle Node, while Egagasini Node concentrates on understanding ocean dynamics.

The knowledge and data gained from the physical study led by Dr Wayne Goschen support more than 17 marine biological and biological oceanographic projects in the region. The study will also help local industry in the form of harbour maintenance, coastal infrastructures, beach development, pollution, fishing and aquaculture, and marine protected areas.

Instruments measuring physical variables such as underwater temperature recorder arrays, current meters and nearshore gully probes (see image below) have been deployed from Port Alfred to Cape Recife and plans are already in place to extend this continuous monitoring platform down to the Tsitsikamma coast and up the Wild Coast.



“The Algoa Bay study site is ideal as it allows for monitoring of nearshore upwellings, rocky intertidal zones, sandy beaches, coastal dunes, estuaries, offshore islands and reefs, harbours, the fishing industry and it features a large marine protected area. All of the above characteristics allow for good, comparative, issues-driven long-term environmental research.”

– Dr Tommy Bornman, SAEON Elwandle Node manager

Charting new waters in marine protected areas

To develop management strategies that work towards the sustainable utilisation of marine resources, the effects of climate change need to be separated from anthropogenic exploitation. One way to do this is to make use of reference monitoring sites that are void of direct human impact and act as control sites. No-take marine protected areas (MPAs) can be regarded as large-scale ecological experiments that exclude a top predator (humans), and as such have profound ecological, social and economic implications. No-take MPAs are recognised for their broader utility in managing biodiversity and ecosystem resilience.

Research in the MPA key thrust area within the Elwandle Node is spearheaded by Dr Albrecht Götz and focuses on the marine and inshore parts of the Tsitsikamma and Greater Addo National Parks, as well as the Table Mountain MPA. The node is looking at expanding into the Stilbaai MPA, where it will cooperate with CapeNature.

“The Tsitsikamma National Park long-term ecological research and monitoring site is the largest and oldest no-take park in South Africa and has excellent baseline datasets,” explains Götz. “There are numerous opportunities looking at long-term trends in fish recruitment, population dynamics and ecosystem productivity.

The Table Mountain initiative on the other hand is very exciting as it involves scientific monitoring and examines the potential for community-driven research and monitoring by recreational divers.”

The associated Fish and Invertebrate (FIN) reef monitoring programme (<http://www.fin.org.za/>) is an exciting citizen science initiative which gets recreational scuba divers to assist with the monitoring and conservation of the marine resources found on the reefs of the Table Mountain MPA. The end product of this project will be a subtidal reef monitoring handbook that brings together monitoring protocols developed in this study and elsewhere around South Africa to suit different environmental conditions. The protocols will provide coastal managers and researchers with a comprehensive description of the costs and benefits of the different monitoring approaches and move towards standardising long-term monitoring techniques around the coastline.

During 2010, Elwandle was appointed by the iSimangaliso Wetland Park Authority to document and monitor the biological colonisation of two shipwrecks in the nearshore region of Cape Vidal. The wrecks lie just outside of the MPA’s southern boundary. The monitoring focuses on the marine life on each of the barges and the surrounding seafloor, in comparison with that of the surrounding natural reef.



The wrecks will in time provide dive opportunities as well as environmental, educational and research/scientific benefits. The research team consists of eight scientists and four citizen scientists, including the well-known fish taxonomist Dr Phil Heemstra and the popular author and underwater photographer Dennis King. One of the highlights for Elwandle during its management of the African Coelacanth Ecosystem Programme (ACEP), a flagship programme of SAIAB, was the deployment during 2010 of the technologically advanced uKwabelana research vessel and its remotely operated vehicle (ROV) for underwater observations. The launch of uKwabelana, was hailed as a significant event in the history of marine research in Africa.

“The *uKwabelana* and submersible ROV have the potential to place the DST, NRF and research partners at the forefront of marine physical and biodiversity sciences regionally and globally,” said Paterson at the launch. “By generating new, cutting-edge knowledge of the largely unexplored and unknown offshore marine environment, South African marine science will be on par with the rest of the world.”

Understanding the influence of coastal upwelling

THE EFFECTS OF POTENTIAL CHANGES in coastal upwelling due to climate change cannot be efficiently predicted until we have a better understanding of the processes. When an upwelling of cold deepwater occurs, it brings nutrients to the surface. Climate change affects the frequency and intensity of such events.

Although there has been focused research on the impact of upwelling on the biological productivity along the west coast of South Africa, similar investigations conducted on the south-east coast are lacking. Knowledge of how climate change might impact on the productivity of the nearshore environment along the south-east coast will allow for better management of resources in the region.

This project aims to investigate the response over time of the nearshore, pelagic environment to wind-enhanced upwelling events off Port Alfred and the influence this will have on the productivity of Algoa Bay. The response will be measured in terms of nutrient concentrations; phytoplankton production; community structure and biomass; and zooplankton community structure and biomass.



Data highlights

The sourcing, collation, archiving and dissemination of long-term data series is a priority area of the SAEON Elwandle Node. The need for a consolidated searchable data repository for abiotic and biotic data for the coastal region is vital and the development of this thrust is a key priority of data scientist Shaun Deyzel.

Deyzel and his team have made great progress with several important data initiatives, including the South African Estuaries Information System, the South African estuaries management plans database and the national coastal water quality monitoring database. The node assisted in upgrading Bayworld's marine mammal strandings database by computerising the data and making it more accessible to researchers. It also helped compile a marine linefish bibliography database.

Estuaries constitute one of the most utilised and productive zones on our planet. Much of our coastal economy is based on the sound management of these systems. Despite their importance, the key custodians of these systems, the Department of Environmental Affairs and the Department of Water Affairs, did not have a national database on estuaries. Elwandle set about an extensive consultation process which has resulted in the creation of a fully-fledged national estuaries information system.

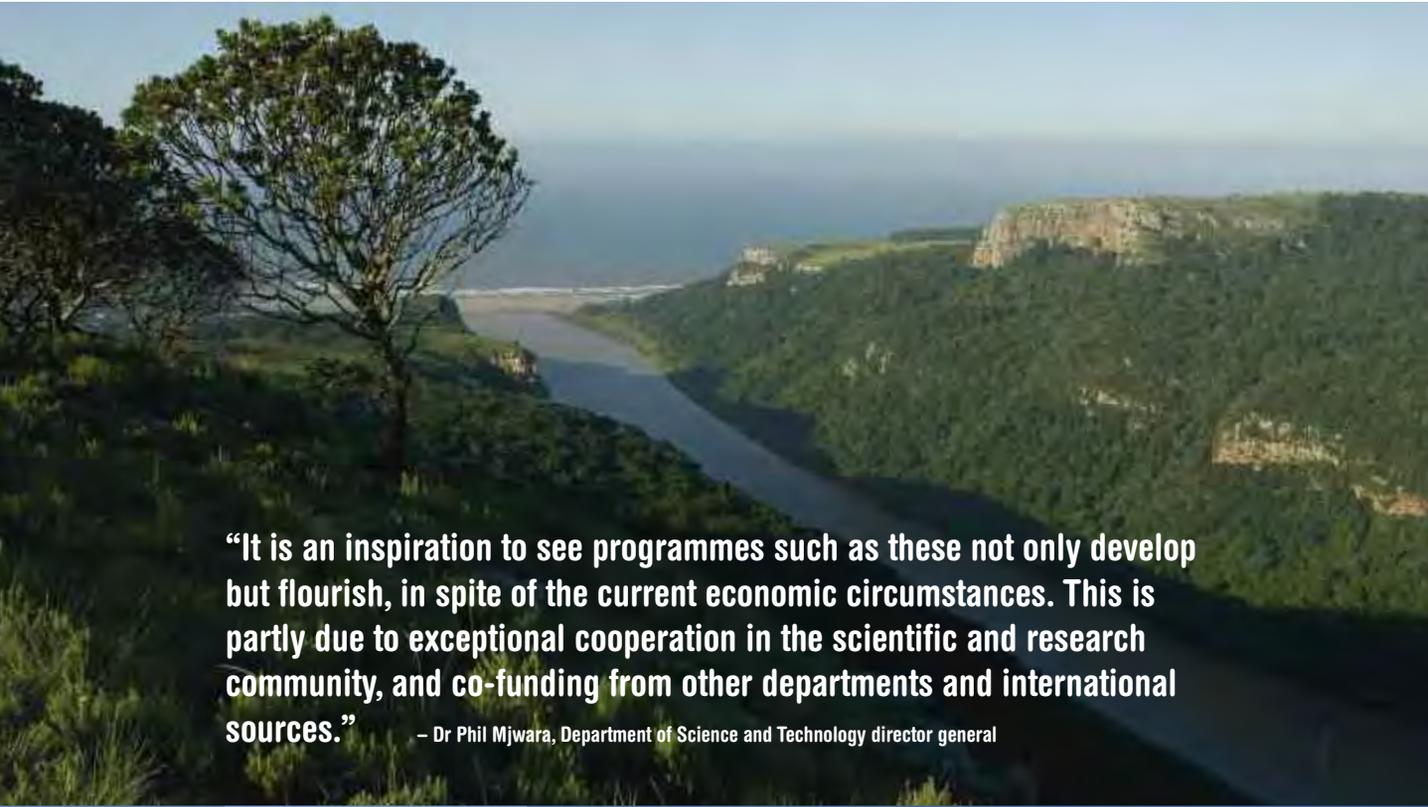
The Elwandle Node has many ongoing long-term monitoring projects that will add data to marine and coastal databases over time.

Capacity building and transformation

Elwandle employs the services of DST/NRF interns and have over the years also taken on numerous students from previously disadvantaged backgrounds as part of its capacity building initiative. In light of the chronic shortage of young scientists (in particular black scientists) entering the system, it was recommended that these monitors use the data that they collect while working for SAEON for MSc degrees.

The opportunity of combining the monitoring roles into a cyclical capacity building exercise has worked well. The supervision of the student monitors by scientists allows for immediate use of the research platform provided by SAEON.

The node teamed up with the Transnet National Ports Authority (TNPA) on another innovative project to nurture young black natural scientists and add to the next generation of coastal professionals. In addition SAEON, together with ACEP, has assisted in the training and research projects of six BSc Honours students from the University of Fort Hare (three in 2010 and three in 2011) and plans are to continue this successful programme into the future.



“It is an inspiration to see programmes such as these not only develop but flourish, in spite of the current economic circumstances. This is partly due to exceptional cooperation in the scientific and research community, and co-funding from other departments and international sources.”

– Dr Phil Mjwara, Department of Science and Technology director general

Keeping an eye on cetaceans

WHALES AND DOLPHINS are often considered icons for conservation as they can be used as indicator species for the environment they occupy. Although the Eastern Cape waters are known for their high diversity in marine mammals, no research on whales and dolphins had been carried out in Algoa Bay since 1998. In 2008 a project kicked off to determine the seasonal and geographical distribution of cetaceans in this bay.

Preliminary analysis of the data collected indicates that there are definite differences in habitat preference between the different species, as well as some seasonal patterns. Probably the most excit-

ing result to date is the observation of numerous cow-calf pairs of both humpback and southern right whales in the bay. This appears to indicate that Algoa Bay can be considered again as a nursery area for these animals; potentially also a calving ground.

This is a recent development as prior to 2000 whales were only rarely seen in the bay, possibly due to their low population numbers post whaling. As the populations increase the animals appear to “spread out” and use areas where they have not been observed in recent decades. This study is led by Dr Stephanie Plön, a marine mammal scientist jointly appointed by SAIAB and Bayworld, in collaboration with SAEON.



Innovative parataxonomy training programme for disabled people

The node has implemented an innovative programme that involves the recruitment and training of disabled, previously disadvantaged people as parataxonomists. After rigorous interviews, three physically disabled persons, Lungisile Kolithi, Lulama Poni and Colley Mpako were enlisted in a laboratory technician internship programme.

Working at Elwandle, where the focus is on the coastal environment, the interns were trained in basic plankton identification, sediment analysis, field work, data entry and front-of-house activities.

“The internship went better than expected. The parataxonomists are highly motivated and have even done contract work for external research organisations. Having people with disabilities in the work environment has been a growth experience for all staff.”

– Former SAEON Elwandle Node manager Dr Angus Paterson

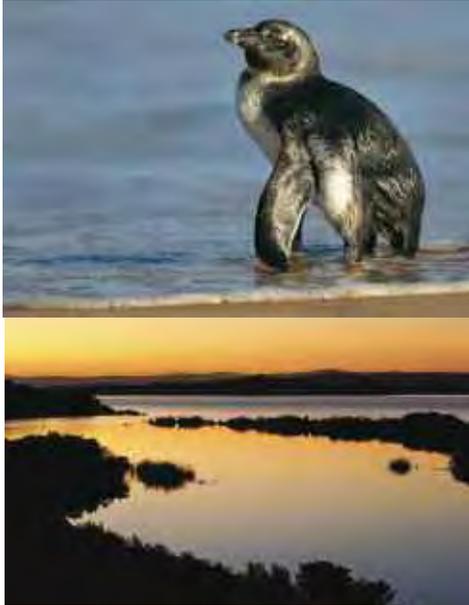
Currents of change in environmental education

Through the generosity of the Murray & Roberts' corporate social responsibility programme, the Elwandle Node runs weather and climate education projects at six schools, along with educator support, learner support, awareness platforms and integration of scientists. The weather monitoring and global warming awareness activities give learners a better understanding of global warming and its impacts, but also assist them in developing innovative adaptation measures.

Learners track data for their school on a continuous basis and record daily variations in wind speed and direction, air pressure and humidity. They learn to interpret, analyse and generate information from quantitative measurements, which is easily integrated across all learning areas in a school syllabus. In short, learners are being nurtured to acquire those vital scientific enquiry abilities listed as a priority in SAEON's education outreach strategy.



The node also makes the most of its geographic advantage, being based in the town that hosts the annual national science festival. SAEON has participated in SciFest Africa for five consecutive years. Elwandle was particularly prominent in 2010, the International Year of Biodiversity, when education outreach officer, Nozi Hambaze, facilitated a sold-out workshop titled 'Coastal influences on our climate'. "We followed a hands-on approach in the workshop which gave learners the opportunity to observe record, analyse and interpret data," says Hambaze.



Among other exciting research projects at the Elwandle Node are:

- An investigation into whether marine protected areas should be set aside for top predators such as African penguins.
- A study of the population dynamics of white sharks in Algoa Bay.
- Estuaries research in the north-eastern region of the Eastern Cape.
- A long-term interdisciplinary, multi-institutional project monitoring the occurrence of zooplankton in some of the estuaries of the former Transkei coast.
- A review of the current status of coastal and estuarine water quality monitoring initiatives.
- Biogeography of coastal phytoplankton and zooplankton of South Africa.
- An assessment of the intertidal and subtidal benthic communities around Sardinia Bay MPA, Port Elizabeth.
- Influence of predicted climate change and sea level rise on the diversity, distribution, abundance and community composition of salt marsh in the Swartkops, Kromme and Knysna estuaries.
- Development of a management plan and long-term monitoring protocol for Greater Addo Elephant Park Marine Protected Area.



The word “fynbos” comes from the Dutch word “fijnbosch” meaning “fine-leaved bushes”.



“The human side of data management is critical – getting people to understand the value of preserving data and to provide them with simple tools to achieve this.”

– Victoria Goodall, data scientist, SAEON Fynbos Node



SAEON Fynbos Node

Research to safeguard South Africa's unique fynbos heritage

Since the earliest human inhabitants at the southern tip of Africa, people have been exploring and exploiting the region's rich plant biodiversity. Building on indigenous knowledge about fynbos, South African researchers have made major contributions to knowledge about these complex ecosystems which have subsequently influenced ecosystem studies worldwide.

Why is the Cape Floral Kingdom so unique?

- It is the smallest of the six plant kingdoms, but is one of the richest in plant species diversity. It occupies about 0.5% of the territory of the African continent, but is home to close to 20% of the continent's plant species.
- It harbours about 9 500 different species – 6 000 of which are found nowhere else on Earth.
- It is recognised globally as one of the world's 18 biodiversity hotspots.
- About three-quarters of all plants in the South African Red Data Book (listing threatened and endangered species) occur here and about 1 700 of its plant species are under threat.

TODAY, SCIENTISTS ARE ALSO attracted to the challenges of protecting these unique habitats from a range of threats including expanding cities and towns, clearing of land for agriculture, misuse of fire, mounting pollution and spreading infestations by invasive alien plants.

SAEON's Fynbos Node, hosted at the Centre for Biodiversity Conservation of the South African National Biodiversity Institute in Cape Town (SANBI), provides a platform for long-term monitoring that will help us understand how climate change and human activity are impacting on fynbos ecosystems. The node helps manage the considerable body of existing knowledge and makes data available to scientists, city planners, land use managers and other decision makers. Although activities at the node kicked off in 2008, it was formally launched during the International Year of Biodiversity – on 6 October 2010.



“The longer you are in environmental science, the more you respect long-term data.”

– Dr Nicky Allsopp, SAEON Fynbos Node manager

“The launch of SAEON’s Fynbos Node was widely hailed by the observation science community as important and timely,” says SAEON managing director Johan Pauw. “Huge volumes of fynbos research data were not digitised or not supported by metadata, and was therefore in danger of being lost.”

Activities at the Fynbos Node are integrated, as far as possible, with other relevant role players in fynbos, for example with Cape Action for People and the Environment.

The node also works closely with CapeNature and SANParks for access to important observation sites and data. “Partnerships are very important to our work,” emphasises Dr Nicky Allsopp, Fynbos Node manager. “Our partners provide us with data and opportunities to do research and guide our priorities in monitoring global change.”

“The fynbos biome with its extremely high plant species richness and high levels of endemism is an unparalleled system on a global scale and, hence, long-term environmental observation made possible by the SAEON Fynbos Node will assist in understanding the threats and opportunities resulting from global change.”

– Derek Hanekom, Deputy Minister of Science and Technology



“With their science-based evidence that alien plants use considerably more water than natural vegetation and their point of departure that alleviating poverty could be linked to preserving water and biodiversity, fynbos researchers were foremost among those who helped bring to life the *Working for Water* programme, which has offered livelihood opportunities to tens of thousands of people, while at the same time protecting our biodiversity and threatened water catchments.”

– Derek Hanekom, Deputy Minister of Science and Technology
(at the launch of the Fynbos Node on 6 October 2010)



New insights from old data

“MY ROLE IN SAEON has given me a new appreciation of data management,” says Dr Nicky Allsopp who was appointed as the first manager at the Fynbos Node in January 2008. “I did not quite realise just how challenging it would be to work with and interpret diverse data sets from a wide range of collaborators.”

“Historical data sets are invaluable in helping us to plan for the future,” she explains. “Decades ago scientists did not know that climate change would become a big concern, but the fact that they collected climate data makes it possible for us to look at old data with a new perspective, resulting in new insights into environmental change over time.”

“Similarly, the data we gather now will feed into future science. Therefore, we should not be too narrowly focused when we design our monitoring protocols.”

Allsopp admits that affordability can be a limiting factor. “We have to prioritise when it becomes too expensive to include all the parameters we would like to monitor,” she says. “And, before we take on a new project, we have to be sure that we will be able to sustain the monitoring for many years.” Long-term research is also vulnerable to politics and policy changes that may lead to funding interruptions or even the complete shut-down of work done over decades.

Monitoring fynbos presents particular challenges. “There are more than 9 500 plant species in the Cape Floral Region and most of them occur only in very specific places, making it problematic to monitor species along gradients,” she explains.

While Allsopp agrees that peer-reviewed, scientific publications are important, she feels that more emphasis should be placed on the role of scientists to translate scientific outcomes in a way that is meaningful and relevant to society. “Working in a long-term environment presents specific problems in terms of how our outputs are evaluated, as well as for sustaining and growing funding,” she says. “That is why good relationships with policy-makers and funders are crucial to our success, and we all have to share a responsibility for advancing a broad understanding of the value of long-term environmental research.”



“By working in synergy with our partners, we create a much richer research environment and that helps us reach our goals much more effectively.”

Fire and fynbos

Fynbos needs fire for survival and renewal. Fire every 10 – 15 years helps to maintain high species diversity. Fire stimulates growth by releasing nutrients into the soil, while the smoke stimulates seed germination. But, fires in the wrong season (such as in winter, instead of late summer) or fires that occur too frequently (so that plants do not have time to set seed) are a major threat. More research is required to fully understand the dynamics of fire in fynbos and inform optimal fire management policies.

SAEON is in favour of a fire monitoring programme across fynbos to coordinate the management of fire in the future. SAEON is currently supporting PhD student, Tineke Kraaij, in her investigation into fire seasonality in the southern Cape where the all year rainfall regime may have influenced the adaptation of plants to season of fire differently to the winter rainfall region.



SAEON rescues and revives monitoring at Jonkershoek

Mountain ranges in the Western Cape supply life-supporting water to the province's people and industries. But, the future of this water source is at risk due to the spread of thirsty alien invader plants and declining rainfall, as well as changes in the nature of rainfall (more intense downpours interspersed by longer dry spells).

Given these challenges, a long-term data set on how the eco-hydrology of a key water-delivering region – the Jonkershoek Valley near Stellenbosch – responds to human impacts and weather patterns, is a priceless scientific legacy.

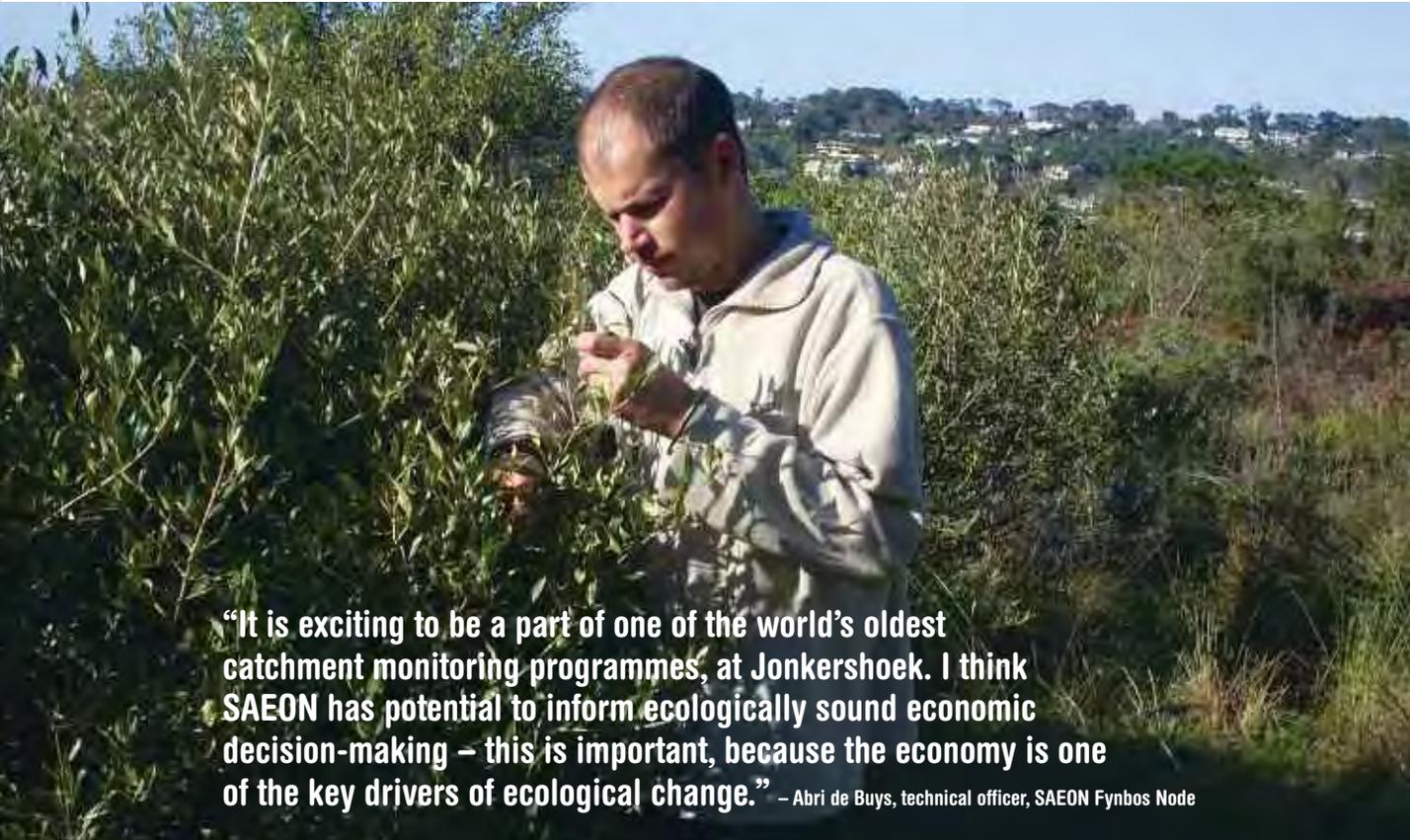
Soon after becoming operational in 2008, SAEON's Fynbos Node rescued just such a data set consisting of stream-flow measurements and related weather data gathered in the Jonkershoek Valley over a period of close to 80 years. At the time, there was a possibility that this long-term monitoring programme would cease due to changing priorities and funding constraints. Fortunately, SAEON was able to negotiate an

agreement with the Department of Water Affairs (DWA), as well as with the CSIR, to preserve the historical data and sustain the collection of stream-flow measurements. To ensure the integrity of the flow data, the weirs were cleaned of sediment accumulated over many years.

Scientists have also been measuring rainfall in the Jonkershoek Valley since the 1930s and they started adding temperature and humidity data in the 1970s. The weather data is a critical part of the overall long-term monitoring protocol and will be sustained as part of SAEON's commitment to long-term monitoring at Jonkershoek.

When analysing stream-flow data, a wide variety of factors must be taken into account. For example, when mountain slopes are laid bare by fires, it results in a much higher runoff. It is important to preserve the history of the events within the catchment, such as fire and the status of each plantation, to supplement the data for analysis and inference.

“Stream-flow monitoring at Jonkershoek is one of the longest-running monitoring programmes of its kind in the world – it would have been a huge loss to environmental science if monitoring had ceased or even been interrupted,” explains Victoria Goodall, Fynbos Node data manager.



“It is exciting to be a part of one of the world’s oldest catchment monitoring programmes, at Jonkershoek. I think SAEON has potential to inform ecologically sound economic decision-making – this is important, because the economy is one of the key drivers of ecological change.” – Abri de Buys, technical officer, SAEON Fynbos Node



Key findings extrapolated from long-term monitoring at Jonkershoek

The Jonkershoek data provides insights into environmental change spanning nearly eight decades. The following findings and conclusions are supported by the data:

- **Declining rainfall:** A preliminary analysis of rainfall data at Jonkershoek shows a decline of about 14% over the last 75 years and a 20% reduction in runoff from pristine catchments. Further analysis of the data is necessary to decipher the causes and to determine whether it may be linked to climate change.
- **Increasing temperatures:** Since the 1970s there appears to be an increase in the number of extremely hot days during the year.
- **Impact of plantations:** Plantations of exotic trees use more water than indigenous vegetation; they begin to affect stream-flow when trees are about five years old; water demand peaks at 15 years and then declines gradually. For every 10% of a catchment area converted to plantations, stream-flow reduces by about 30-40 mm.
- **Impact of invasive aliens:** Woody invasive species have reduced water runoff by around 7% and this will increase if invasions are not checked. Dense invasions also threaten catchment functioning in the longer term since soil erosion is higher after fires that burn through dense infestations of alien plants than through natural vegetation. This soil loss reduces the ability of the catchment to recover.

Why are many fynbos species so vulnerable?

Many fynbos species occur only at one or a few localities and may therefore easily fall victim to urban and agricultural expansion, or be pushed out by invasive alien plants. Both climate change and pollution may aggravate the threat from invasive aliens.



How the Jonkershoek research findings have been used to date

The Jonkershoek weather and water data is a valuable research asset that has already had widespread scientific and societal impacts, including:

- New hydrological models to help us predict the impact of climate change.
- Legislation has been introduced to make sure that riparian (river bank) zones are better managed, while findings have also fed into water and fire legislation.
- Scientists have been able to identify areas where new plantations can be established that would have the lowest possible impact on stream-flow.
- The “Working for Water” programme emanated from the Jonkershoek catchment research and other similar monitoring programmes. This highly successful programme aligns the clearing of invading alien plants with job creation and poverty alleviation.
- The forestry industry has introduced practices to lessen water use by plantations. Such responses to research findings have helped South Africa’s commercial forestry industry achieve Sustainable Forest Certification – a significant boost to the industry.



High-tech research tracks aliens in fynbos

Invasive alien plants can play havoc with sensitive ecosystems and pose a significant threat to biodiversity. They change the landscape by destabilising catchments which, in turn, aggravates soil erosion. They alter fire regimes, leading to changes in frequency and intensity of fires. They take up so much water that they can change the hydrology of the landscape and reduce stream-flow drastically. Alien vegetation even changes the physical and chemical composition of the soil.

In order to combat these invasions, scientists and policy makers need accurate information on where they occur and how fast they are spreading across large areas – a daunting and expensive undertaking.

Remote sensing may provide a solution for monitoring and mapping invasive species, and pinpointing priority areas for clearing. SAEON’s Fynbos Node is working with the German Aerospace Institute and the University of Würzburg in Germany to explore the use of remote sensing for these purposes.

“We are focusing on lowland sand fynbos – one of the most critically endangered vegetation types in the biome – to develop, test and refine this monitoring tool,” explains SAEON Fynbos Node manager Dr Nicky Allsopp. “This type of fynbos used to occur widely, but we have lost much of it to urbanisation, agriculture and invasive alien plants.”



“The challenge of identifying longer-term trends in highly variable climatic data is generally appreciated and at the heart of much of the debate about climate change. It is far more difficult to detect such changes in river flows. SAEON has played a critical role in ensuring that the Jonkershoek catchments continue to provide the records we need to understand how changing climates will affect water flows, and thus water supply and security in the Western Cape and nationally.”

– Dr David Le Maitre, ecologist and hydrologist, Natural Resources and the Environment, CSIR

“While remote sensing may be an incredibly useful tool to determine the current cover of invasive and indigenous vegetation across large landscapes, we need careful preparation of the remote sensing data and it needs to be verified by ground-truthing to fill in the gaps and validate our findings,” Allsopp says.

By far the most difficult part of remote sensing is the challenge of separating a consistent signal for one type of vegetation from another. “Think of trying to separate out the notes played by all the individual instruments in a symphony orchestra,” Allsopp explains. “Not only are there many different types of vegetation, but their ‘notes’ – or signals picked up by remote sensing – change as the year goes through its seasons.”

While German student, Kim Knauer, was able to detect different signals for invasive *Acacia saligna*, fynbos and grass, more work is needed to refine and test this method over time and under different climate scenarios.

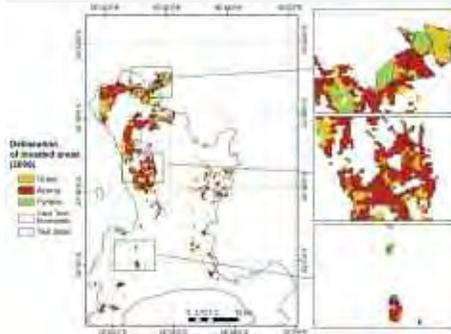
“It is very rewarding to see results – in our case lots and lots of data – and to see how it can be used in important decisions and legislation that will help us to cope with climate change.”

– George Sekonya, an intern at SAEON Fynbos Node

NASA satellites have their beady eyes on fynbos

Aboard two of NASA's satellites – Terra and Aqua – flies a sensor called MODIS (or Moderate Resolution Imaging Spectroradiometer). The Terra and Aqua satellites view the entire Earth's surface every one to two days and acquire data in 36 spectral bands, or groups of wavelengths.

The high quality data and images from MODIS make it possible for scientists to study processes occurring on the land. Studies of plant growth are further enhanced by a data product called the Enhanced Vegetation Index (EVI) which is derived from wavelengths reflected by vegetation. The EVI corrects for some distortions in the reflected light caused by the particles in the air as well as the ground cover below the vegetation.



“Our ability to collect and store data, especially using remote sensing techniques, has increased rapidly with technological advances. It is a challenge to develop analytical techniques to understand the complex processes contained within the data.”

– Victoria Goodall, data scientist, SAEON Fynbos Node

Fumes threaten Cape Town's famous fynbos

In between frequent cold fronts during the winter months, Cape Town experiences sunny, wind-free days. On these otherwise idyllic days, a thick brown haze is trapped over the city bowl. This is not only unsightly and potentially harmful to people, but may also have severe implications for the remnant fynbos ecosystems close to the metropole.

The brown haze comprises gases from vehicle exhausts, factory fumes and the burning of wood. It consists of a wide range of atmospheric pollutants including nitrogen dioxide.

SAEON's Fynbos Node, working with researchers at Arizona State University in the USA and the University of Cape Town, are investigating the impacts of this brown haze on fynbos patches close to the city. "We fear that this pollution will cause alien grasses to proliferate until they outcompete many fynbos species," says Dr Nicky Allsopp, Fynbos Node manager.

Fynbos has evolved to grow in nutrient-poor soils and does not cope well with the extra nitrogen in the air and the pollutants that are deposited onto leaf surfaces. Excess nitrogen can build up in the soils or drain into streams and ground water resulting in a cascade

of potential effects from degradation of water quality to invasion of alien plants species and loss of biodiversity.

To fully understand and monitor the complex interactions between fynbos and atmospheric pollution, scientists have to measure a wide range of climatic and physical variables. They also had to find study sites exposed to the city's brown haze, as well as others protected from pollution.

To find out exactly where and how much nitrogen is deposited and how this varies between seasons, the research team has installed 30 bulk collectors across the Cape Town metropolitan area – from the city centre to its more rural outskirts, including "high" and "low" deposition areas.

"We hope that the findings of this project can be used to inform policy makers of the pollutant thresholds required to protect the fynbos ecosystem from a potential source of degradation that is less obvious than changes in land use," says Dr Julia Angstmann, a collaborator on the "brown haze" project at the University of Cape Town.



"You can never go back to the past to re-record environmental indicators. Therefore, every bit of data gathered and archived by SAEON is valuable and irreplaceable. The work that the SAEON Fynbos Node does is incredibly useful to the research community."

– Prof Jenny Day, Zoology, University of Cape Town

A rare opportunity to track fynbos dynamics over 44 years

In 1966 renowned fynbos ecologist Hugh Taylor laid the basis for a fynbos monitoring project that is still reaping benefits today. He marked out 100 plots – each 5 x 10 m – throughout the Cape of Good Hope section of today’s Table Mountain National Park. He documented all the plants in each block and classified the flora of the reserve according to vegetation types.

Thirty years later – in 1996 – botanists Sean Privett and Richard Cowling were able to locate and re-survey 81 of the original plots. They found that, on average, 40% of the species changed, but in some plots the turnover rate was higher than 60%. Species disappeared from some plots, but colonised others, so that the composition across the entire reserve was found to be relatively stable.

By 2010, many of the original markers had been lost, but with the help of honorary Ikapa rangers SAEON’s Fynbos Node was able to pinpoint 67 of the original plots.

“To be able to analyse trends in vegetation over time, it was critically important to locate these plots accurately before more markers on the ground disappeared,” says node manager Dr Nicky Allsopp.

A new survey is now providing a picture of how species changed over a 44-year period in each of these plots, as well as across the entire nature reserve. Comparing the 2010 results with those of 1996 and 1966 will allow scientists a rare opportunity to explore how fynbos dynamics respond to global change.

Preliminary results of 26 plots analysed so far show that the number of species has declined steadily since 1966. Scientists suspect that changes in fire dynamics may be behind this decline. Species that take five years or more to produce seeds and those that do not re-sprout after fire may suffer local extinction if fires are too frequent.

“The inclusion of new survey data for the remaining 41 plots will allow us to confirm or refute the trends in species richness and composition noted for the 26 plots,” Allsopp explains.

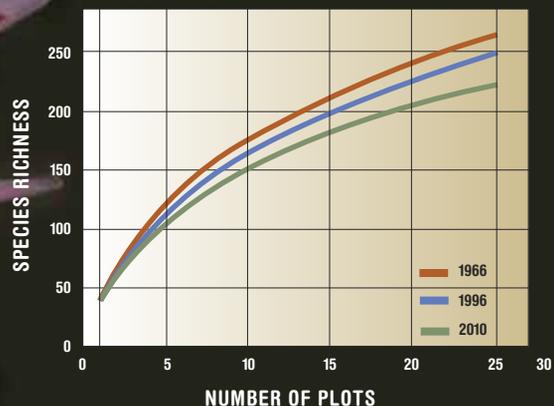
“In addition to investigating fire frequency, we also need to explore the effect of fire intensity, the season of burn and weather conditions following a fire. The current survey will also consider the influence of global change factors such as climate change or increased CO₂ levels as potential drivers of change in fire regimes.”

Data from the current survey, as well as the findings of the 1966 and 1996 surveys are archived by SAEON.



By 2010, many of the original markers had been lost, but with the help of honorary Ikapa rangers SAEON’s Fynbos Node was able to pinpoint 67 of the original plots.

Species accumulation curves for plots from all three survey periods (Stuart Hall, unpublished data).



VEGETATION MONITORING AT CAPE OF GOOD HOPE (TABLE MOUNTAIN NATIONAL PARK)

1966

Plot 37 (Hugh Taylor)



2006

Plot 37 (Jasper Slingsby)



1966

Plot 78 (Hugh Taylor)



2008

Plot 78 (Glen Moncrieff)



1966

Plot 45 (Hugh Taylor)



2008

Plot 45 (Jonathon Aronson)



1966

Plot 73 (Hugh Taylor)



2008

Plot 73 (Glenn Moncrieff)



“Sets of environmental observation data gathered over many years are not only highly valuable, but also irreplaceable. This is the currency that SAEON uses.”

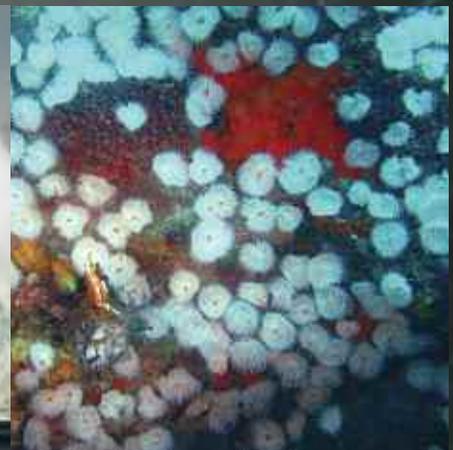
– Johan Pauw, managing director, SAEON

“SAEON has been really useful in assisting the Department of Agriculture, Forestry and Fisheries and the Department of Environmental Affairs to manage and collate data and information relevant to both fisheries and marine science, especially in the regional context. They are playing an important facilitative role in much of our regional work.”

– Dr Johann Augustyn, Chief Director: Fisheries Research and Development, Department of Agriculture, Forestry and Fisheries

SAEON Egagasini Node

Egagasini is a Zulu word meaning “place of waves” or “the place of eternal movement”.



SAEON Egagasini Node | New insights emerge from deep sea data



The world's oceans play a key role in global change, and studying changes in the ocean environment holds the key to deciphering many of the intricate changes in our natural world. With a coastline stretching almost 3 000 km and three large surrounding oceans, South Africa provides an ideal location to study the role of oceans in weather, climate and biodiversity.

"THE IMPORTANCE OF OCEANS in studying global change warranted a research node focusing on deep sea – or offshore – systems," explains SAEON managing director Johan Pauw. The Egagasini Node provides a platform for archiving and sharing the extensive body of data from decades of oceanographic and marine exploration, and encourages collaboration across the many research disciplines in the marine environment.

"Long-term monitoring of the three oceans surrounding South Africa helps us to untangle short-term seasonal changes through to decadal variability," explains Egagasini Node manager Dr Juliet Hermes. "Only once we understand this, will we be able to understand the role of oceans in climate change and the impact of anthropogenic change on oceans."

SAEON's Egagasini Node depends on a range of partners for access to historical data sets, and also for collection of new data. "Being hosted by the Cape Town offices of the Department of Environmental Affairs (DEA) is of huge benefit to the work we do, since the DEA has collected masses of physical and biological data over many decades," Hermes explains.

"For example, data on anchovy and sardine biomass confirm that these fisheries have shifted from South Africa's west coast to the south coast. It is an important challenge for scientists to determine whether this is due to natural climate variability, or caused by long-term climate change. That will help us, and the fisheries industry, to understand whether this shift is temporary or permanent."

"Since we do not have our own research vessels at Egagasini, we work closely with many partners to support monitoring in the marine environment – ranging from large-scale physical oceanography to the interrelated aspects of coastal, chemical, and biological oceanography."

– Dr Juliet Hermes, SAEON Egagasini Node manager



Focusing on data from the deep sea

Long-term, offshore observations are vital to validate and improve ocean models, explains Egagasini Node manager Dr Juliet Hermes. “Since we do not have our own research vessels at Egagasini, we work closely with many partners to support monitoring in the marine environment – ranging from large-scale physical oceanography to the interrelated aspects of coastal, chemical, and biological oceanography.”

By working together we are entrenching South Africa’s position as a major research destination and positioning SAEON as a facilitator of knowledge, she says. “Metadata helps us to create and access a broad spectrum of knowledge instead of working in isolation.”

Hermes is passionate about SAEON’s mandate to make historical and current data widely accessible to researchers, and to package relevant information for decision makers. She believes that marine research should accommodate the social, developmental and cultural needs and expectations of coastal communities, allowing people to benefit from marine resources, without depleting them.

Exploring life at the bottom of the sea

It is cold, dark and murky at the bottom of the ocean, but many diverse species live there that play a key role in marine ecosystems. “We still know very little about life on the sea bed, but we are committed to addressing these gaps in our knowledge about deep-sea habitats and the creatures that live there,” says Dr Lara Atkinson, offshore marine scientist at SAEON’s Egagasini Node.

Demersal research investigates communities living on or near the sea bed. While the primary focus of demersal trawl surveys is to assess the status of commercial fish resources such as hake, kingklip and monk, many more species are also retained in the net. This makes it possible to widen the research scope of these surveys.

For the past 25 years the Department of Agriculture, Forestry and Fisheries (DAFF) and its predecessors, have conducted regular demersal research surveys along South Africa’s west and south coasts. All vertebrate fish and cephalopods (octopus, squid and cuttlefish) landed on the deck are sorted, identified, counted (or estimated) and weighed. The diverse array of invertebrate species such as starfish, crabs, sea urchins and sponges were also recorded, but only at a coarse taxonomic level.



“Monitoring invertebrates as part of demersal trawl research will improve our understanding of life at the bottom of the sea and the role that this biodiversity plays in our oceans. With just a little extra effort and thanks to our excellent collaboration with government departments, we are gaining a wealth of new knowledge.”

– Dr Lara Atkinson, SAEON Egagasini Node

Dr Lara Atkinson, SAEON’s offshore marine scientist collecting invertebrate samples aboard a research vessel. Her work focuses on understanding marine life near the sea bed, and the impacts of demersal (sea bed) trawling on offshore ecosystems.

Scientists now realise that in-depth monitoring of the diversity and abundance of these sea-bed communities forms part of a holistic ecosystem approach to fisheries management and understanding the state of our oceans. It also helps to identify and map the location of sensitive and vulnerable habitats – typically where specific invertebrates such as cold water corals, gorgonians and sponges occur. SAEON is therefore committed towards helping to implement invertebrate monitoring as an integral part of demersal ecosystem research and is working closely with the relevant government departments (DAFF and DEA) to secure the long-term future of this research.

SAEON is also working with experts from the DEA and DAFF to collate invertebrate data and images from earlier surveys in order to compile a field guide on offshore invertebrates.

Trawling in South Africa

Trawling is defined as a type of sampling or fishing method where a large net is dragged on or just above the sea bed. The content of the net is hauled aboard and delivered onto the ship's deck. Dr Lara Atkinson's PhD was the first study in South Africa that examined impacts of sea bed trawling and she hopes to continue working with the industry to further quantify trawl impacts over a longer period. While it is generally accepted that trawling damages the sea bed to some extent, quantification of the damage and what this may mean to the environment within the South African context are not yet fully understood. The South African demersal trawl fishery was one of the first fisheries in the world to receive Marine Stewardship Council (MSC) certification – in 2004 and again in 2010. One of the conditions of this certification requires a long-term investigation of the impact of demersal trawling on the benthic habitat.

A typical demersal research survey

During January 2011 SAEON Egagasini joined a five-week demersal research survey along South Africa's west coast during which the appropriate invertebrate monitoring protocol was implemented. During this survey:

- 123 research trawls were completed, ranging from 35 m to 815 m in depth;
- 132 invertebrate species were identified to genus level;
- 47 species could not be accurately identified at sea, but were preserved for later identification.

Back at the laboratory, scientists verify and refine the identifications made at sea, for example by checking preserved specimens against those catalogued at the South African Iziko Museum and employing the expertise of local and/or international taxonomists.



A demersal catch landed on the deck before being sorted (below) and a typical range of invertebrate species from the sea bed (left).





In his role as data manager at Egagasini, Dr Wayne Goschen administers servers, designs databases, develops websites and writes code. But, he is primarily trained as a physical oceanographer and plays a leading role in investigating the ocean dynamics of the Algoa Bay region.

Goschen gets excited about SAEON's contribution to opening up marine data. "It is expensive and time-consuming to collect deep sea data and therefore some organisations guard their data closely, making it very difficult for other researchers to access it," he explains. "Since SAEON began working in the offshore region, it has helped institutions to archive their data and source many hidden data sets so that it can now be used in teaching and research."

While admitting that it is challenging to be both scientist and IT specialist, Goschen is passionate about both roles. "It is great fun to work with data and manipulate it so that valuable information can be extracted," he explains. "But, I also love the freedom of thought and expression that working in the scientific domain allows, as well as the stimulation of discovering new phenomena."

A long-term commitment in Algoa Bay

Algoa Bay is a large, crescent-shaped bay on South Africa's Eastern Cape coast. Its waters are located in the transition zone between a region dominated by the Agulhas Current to the northeast and the wide Agulhas Bank shelf dynamics to the southwest. Within the bay itself, intricate interactions between near-shore, coastal and deep-water oceanographic processes, weather systems, local bathymetry (ocean depth) and shoreline contours result in a dynamic ocean.

Because of its interesting and complex dynamics, the coastal and marine nodes of SAEON have selected Algoa Bay to implement a long-term environmental monitoring and research programme. Scientists participating in this project focus on physical variables such as sea temperature, sea level, currents and wind, which will help with the biological research in Algoa Bay. The deployment of instruments began in November 2008 and good quality data has been returned since.

"We need to fully understand the weather and ocean processes at work in Algoa Bay before we can appreciate how they influence the environment and biosphere," explains Dr Wayne Goschen, an oceanographer and data manager at SAEON's Egagasini Node. "Long-term data from the Algoa Bay sentinel site will help us to detect trends in our ocean and determine the effect of climate change. New knowledge delivered by our monitoring will also help to maintain harbours and coastal infrastructures, develop beaches, manage pollution, fishing and aquaculture and develop protected areas."

"A search on the Nairobi Convention Clearinghouse is much narrower and more specialised than a Google search, while at the same time exposing information that might not even be visible to Google."

– Dr Wayne Goschen, data manager and scientist at SAEON's Egagasini Node and South Africa's country co-ordinator for the clearinghouse



Data is golden

SAEON Egagasini Node collaborates with several key marine data suppliers to validate and archive information, and to promote the free flow of data within the marine research community. Because most marine and coastal ecosystems are trans-boundary in nature, collaboration with neighbouring countries is crucial. In addition to the intrinsic value of the data, a single shared data platform also prevents unnecessary duplication of effort. Some key partners are listed below:

- **The Department of Environmental Affairs** (Oceans and Coasts) has a long history of routine monitoring surveys and research cruises and generates large volumes of biological, chemical and physical marine data.
- **The Southern African Data Centre for Oceanography (SADCO)** is the regional oceanographic data repository. It also maintains data for the African Ocean Biogeographic Information System (Afrobis). These extensive sets of physical, geographical and biological data are accessible via SAEON's data portal.
- **The African Coelacanth Ecosystem Programme (ACEP)** is hosted by the South African Institute for Aquatic Biology, a unit of the National Research Foundation. ACEP focuses on oceanographic and marine ecological sampling on the continental shelves of the east coast of southern Africa and the south-western Indian Ocean. Researchers can access ACEP data and metadata via SAEON.

- **The Agulhas and Somali Current Large Marine Ecosystem (ASCLME)** programme aims to gather information about ocean currents and how they influence the climate, biodiversity and economies of the western Indian Ocean region. Since 2008 the project has yielded a wealth of data from research cruises along the coasts of the partner countries, namely Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, Tanzania and Somalia. Steered by the United Nations Development Programme (UNDP) and funded by the Global Environmental Fund (GEF), ASCLME encourages and assists these countries to work together in an effort to manage their marine and coastal resources.

ASCLME yields important baseline data for future marine and climate research. SAEON Egagasini plays a key role in support of sourcing, gathering, reviewing, compiling and reporting on data, and creating metadata tables of the biophysical environment, human environment, economy, policy and governance as well as planning and management.

- **The Nairobi Convention Clearinghouse (NCCH)**, an initiative of the United Nations Environment Programme (UNEP) is a 'data shop' that provides information for improved management and protection of the coastal and marine environment in the Western Indian Ocean region. SAEON is a signatory to the Nairobi Convention and is responsible for the South African portal on the NCCH. It provides a single point of entry to data sets, as well as metadata to support decision-making. The portal also allows users to visualise data as graphs and maps.

Fiona Cuff, database support, Egagasini Node, assists with acquiring data from collaborators and building databases. "It can be challenging to convince scientists to share their data, especially when they invested a great deal of effort, time and money to obtain it," she explains.

Cuff believes that SAEON's Egagasini Node performs an essential function in making disjointed and undiscovered data sets available and ensuring that valuable data is not lost over time. "It is really rewarding when we succeed in getting new collaborators on board so that we can expand our databases in support of future marine monitoring, comparisons over time and building of cutting-edge research models."



A 100-year old record of marine biodiversity

The explorations of South Africa's first government marine biologist – John D Gilchrist – go back more than 100 years. In the early 1900s, he explored South Africa's marine environment looking for resources to harvest and market. Fortunately, Gilchrist kept a detailed record of all the marine species he encountered. Associate Professors Lance van Sittert and Colin Attwood from the University of Cape Town unearthed Gilchrist's valuable records and, with support from SAEON, he facilitated the process of electronic capturing of the information. They also found and captured fishing statistics recorded in the decade after Gilchrist's death and captured 13 000 pages on film.

Argo floats – drifting and diving for science

A global fleet of more than 3 300 underwater robots are drifting in oceans around the globe in service of the global Argo project. Each robot is programmed to descend up to two kilometres and collect data at various depths before ascending again. As soon as it surfaces, the float transmits measurements of temperature and salinity via satellite to shore. Each Argo float can repeat these ten day cycles for up to five years, jointly contributing to a wealth of deep sea data.

Since the first Argo floats were deployed in 2000, they have become vital components of monitoring climate change signals in the world's oceans. The first ever African Argo float was launched in 2009 when SAEON, in partnership with the South African National Antarctic Programme, purchased and launched two Argo floats.

“Obtaining South African-owned Argo floats is of importance primarily because there are so few observations done in the oceans surrounding South Africa,” explains SAEON Egagasini Node manager Dr Juliet Hermes. “It also makes us more visible in global ocean monitoring projects and helps develop our scientific capabilities.”



“The concept of an organisation such as SAEON’s Egagasini Node that can look after and promote long-term observational series is not only useful, but essential, given issues such as climate change, the loss of biodiversity and the general degradation of the environment.” – Dr Marten Gründlingh, the Southern African Data Centre for Oceanography, CSIR, Stellenbosch

Magic planets and floating robots

SAEON is committed to boosting the number environmental scientists from previously disadvantaged groups. “We are convinced that exposing young people to the wonders of our oceans and the rich diversity of our marine fauna and flora will interest them and inspire some to choose science as a career,” explains Thomas Mtontsi, education officer at SAEON Egagasini Node.

SAEON’s participation in the global Argo programme provides an ideal platform to engage learners, since they can download data and monitor ocean behaviour from their schoolyard in real time. (Argo floats are robotic instruments that collect data on sea temperature and salinity.) Participating learners download data from SAEON’s two Argo floats in ten day cycles. They then have to produce graphs of, for example, ocean temperature against depth and salinity, and are also asked to interpret the data and draw conclusions. This real-time, hands-on involvement stimulates their interest and boosts a range of curriculum-relevant mathematics and science skills.

Some educators and learners have joined research cruises – an opportunity that helps them make sense of the data from the floats. Learners’ participation in research cruises has largely been made possible through collaboration with DAFF and the fact that scientists at these government departments are willing to share their passion for the marine environment with young people.

Oceans matter in our everyday lives

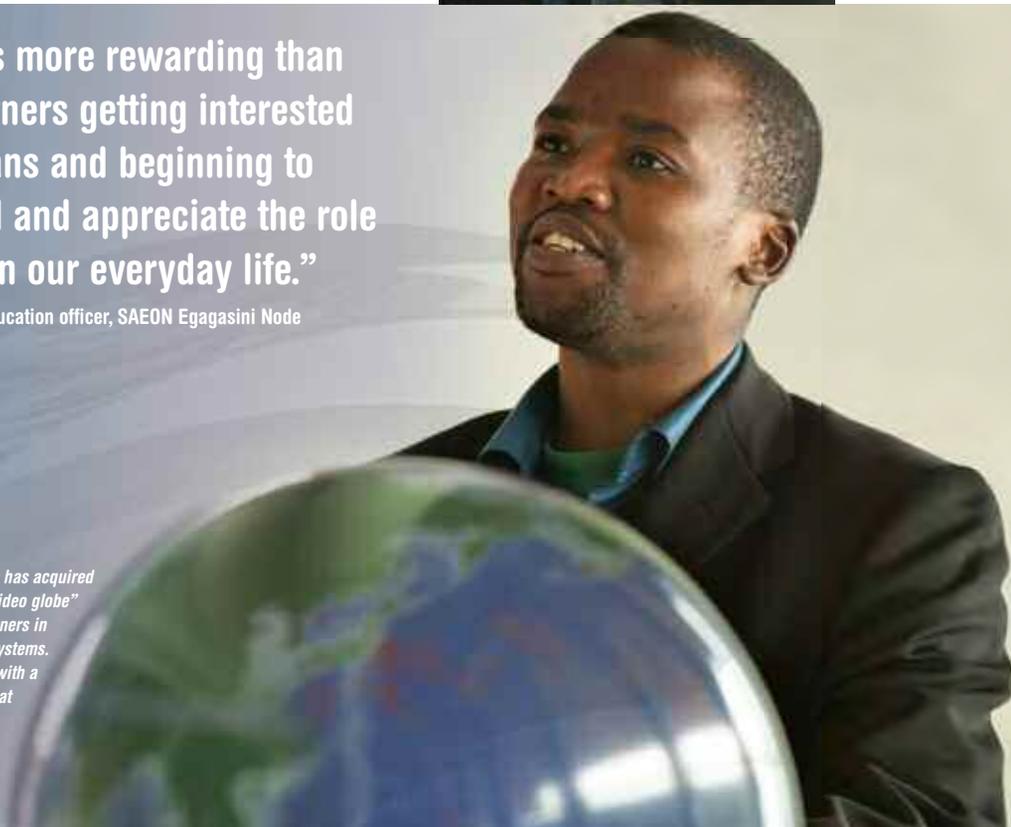
Thomas Mtontsi is passionate about bringing marine science into the classroom and helping young people understand what is happening in the oceans. He works closely with the Node’s collaborators to create ways for educators and learners to experience for themselves the work that scientists do while at sea. “Nothing is more rewarding than seeing learners getting interested in our oceans and beginning to understand and appreciate the role of oceans in our everyday life,” he says.



“Nothing is more rewarding than seeing learners getting interested in our oceans and beginning to understand and appreciate the role of oceans in our everyday life.”

– Thomas Mtontsi, education officer, SAEON Egagasini Node

SAEON’s Egagasini Node has acquired a “magic planet digital video globe” that helps to engage learners in the dynamics of global systems. It is a computer display with a sphere-shaped screen that can display information on global systems in a compelling and interactive way.





“Collaboration and long-term monitoring is the only way to detect important trends in the natural environment. This is where SAEON plays a critical role – in the sustained collection and archiving of scientifically defensible data, and in creating synergies between diverse role players.” – Dr Hugo Bezuidenhout, Scientific Services, SANParks

SAEON Arid Lands Node

More than half of southern Africa is either arid or semi-arid, but still exceptionally rich in biodiversity. Scientists warn, however, that arid lands are particularly vulnerable to climate change and that these ecosystems will have to cope with more intense and more frequent droughts in future.





SAEON Arid Lands Node

Fragile ecosystems yield vital environmental data

Living organisms in deserts and semi-deserts carve out an existence under extremely harsh conditions. Arid ecosystems are fragile and extremely vulnerable to change; they therefore respond to environmental pressures faster than others. This makes arid regions ideal open-air laboratories for scientists to study the effects of natural and human-induced environmental changes. Long-term monitoring in arid regions is an indispensable component of SAEON's environmental observation portfolio.

About one third of South Africa can be classified as arid – receiving on average less than 250 mm rainfall per year. Despite the scarcity of water, these areas are strikingly rich in biodiversity. Five of South Africa's nine biomes are represented in its arid region and eight recognised centres of floristic endemism (plants only found in a specific geographical region) occur here.

However, current climate predictions caution that the western parts of South Africa will become even drier

and this may cause many unique plant and animal species to go extinct. According to some scientific models the whole Succulent Karoo biome – one of South Africa's three internationally recognised biodiversity hotspots – may be lost. This biome is home to the world's largest diversity of succulent flora and is arguably the world's most botanically diverse arid region. SAEON's Arid Lands Node is setting up long-term observations in the semi-arid and arid areas of the Northern Cape and parts of neighbouring provinces.



“As a network, SAEON is essentially about collaboration and partnerships. We aim to add value by filling gaps and bridging existing efforts.”

– Yolandi Els, coordinator of the newly formed SAEON Arid Lands Node

The study area encompasses mainly the Dry Savanna, Nama Karoo and Succulent Karoo biomes, including several national and provincial conservation areas. Future plans include collaboration with scientists working in the cross-border parts of the Kgalagadi and Ai-Ais/Richtersveld Transfrontier Parks.

A key role of the node will be to share knowledge and exchange monitoring expertise with similar observation programmes in arid areas in the rest of Africa and around the globe.

SAEON's Arid Lands Node has been operational since January 2011. Based in Kimberley, the node is hosted by South African National Parks (SANParks).

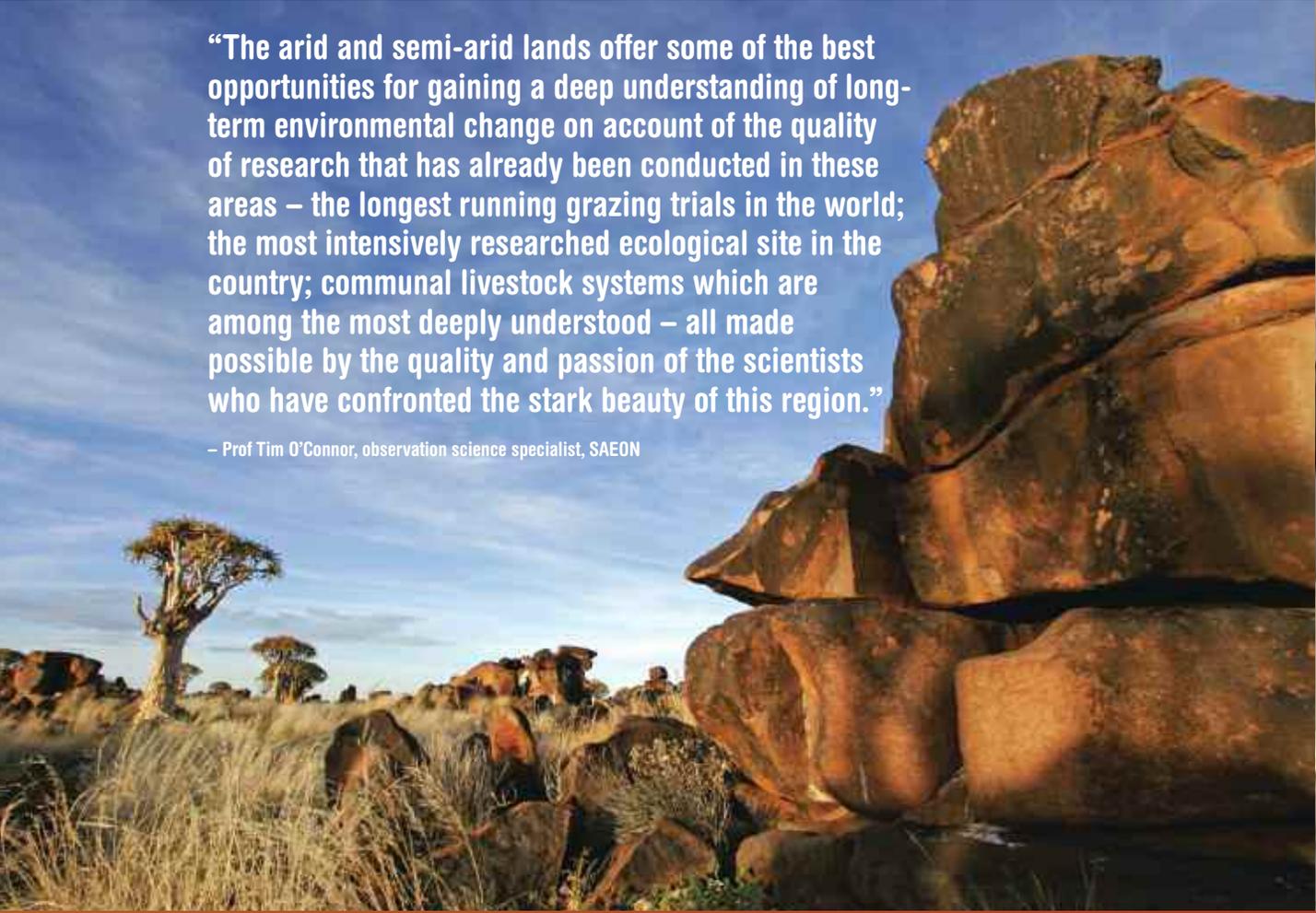
The small team at this young node – a coordinator and two field technicians for the initial year – works closely with SAEON's observation science specialist Prof Tim O'Connor and SANParks' Dr Hugo Bezuidenhout, an experienced ecologist with extensive experience of long-term monitoring.

"It is exciting to work with this young team – they are ready for the challenges of long-term monitoring in arid regions and they see new possibilities in historical data," says Bezuidenhout. "I'm optimistic about the possibility that we will re-start 20 years of monitoring in the Kgalagadi Transfrontier Park to sustain data sets about the functioning of this fragile ecosystem and I'm hopeful SAEON will play a role in much-needed monitoring of the Orange River system, including rescuing some fragments of data that may already exist."

The team at SAEON's Arid Lands Node

"As a network, SAEON is essentially about collaboration and partnerships," says Yolandi Els, coordinator of the newly formed Arid Lands Node. "We aim to add value by filling gaps and bridging efforts."

"I see SAEON's role in addressing the need to secure, consolidate and coordinate fragmented data sets applicable to the arid areas and to streamline resources



"The arid and semi-arid lands offer some of the best opportunities for gaining a deep understanding of long-term environmental change on account of the quality of research that has already been conducted in these areas – the longest running grazing trials in the world; the most intensively researched ecological site in the country; communal livestock systems which are among the most deeply understood – all made possible by the quality and passion of the scientists who have confronted the stark beauty of this region."

– Prof Tim O'Connor, observation science specialist, SAEON

into key observation sites, able to reveal most about expected environmental changes and its consequences,” she explains.

“I am excited about being part of the effort to monitor, detect and understand environmental changes over time; we really need this knowledge to inform decision-makers on the best ways to protect our natural environment for future generations.”

– Tshililo Ramaswiela, field technician, SAEON Arid Lands Node.

“I enjoy working in South Africa’s amazing natural environments, but more importantly, our work has real potential to make a difference to science and conservation. We know that all ecosystems are sensitive to change and arid systems are especially so in some very unique ways – therefore our work is sure to contribute towards the conservation of our country’s arid regions.”

– Iain Olivier, field technician, SAEON Arid Lands Node.



Projects in the pipeline

Projects at the Arid Lands Node that are currently active or in the pipeline:

- Re-sampling as well as collation and dissemination of data associated with long-term experimental grazing trials at the Grootfontein Agricultural Development Institute – the oldest experimental grazing trials in the world, running since 1937.
- Re-sampling of long-term vegetation plots in the former Vaalbos National Park, as well as archiving and preserving the data collected here since 1991. This reserve has now been de-proclaimed and subject to a land use change in the form of diamond mining and communal tenure.
- The continuation of key observations at the Tierberg Karoo Research Station.
- Establishment of climate gradient observations in the Kalahari and Karoo regions.

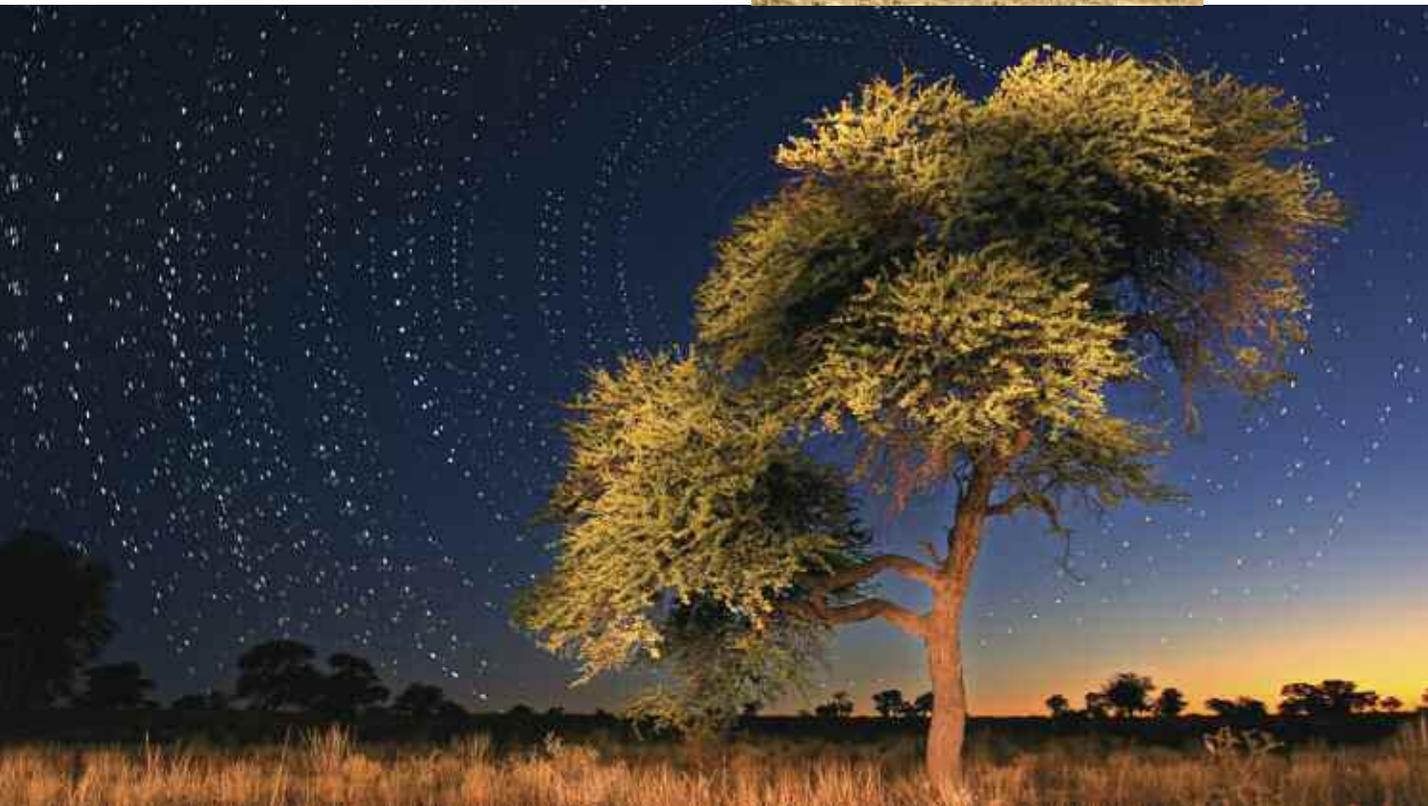
Drivers of change in arid regions

Drivers of change in South Africa's arid regions that are collectively leading to land degradation, desertification and loss of biodiversity include:

- Climate change
- Carbon loading caused by increases in atmospheric CO₂ levels
- Incorrect land management practices, e.g. overgrazing by livestock and game
- Harvesting of fuelwood and medicinal/food plants or animals
- Invasive alien species
- Pollutants and poisons like agricultural pesticides and herbicides
- Changes in river flow, groundwater and extraction of water for irrigation
- Large, infrequent events like fire and floods
- Exploitation of mineral reserves and, potentially, gas reserves

“Grazing by livestock and game is the most extensive impact on terrestrial systems in the Karoo and Kalahari regions.”

– Yolandi Els, coordinator, SAEON Arid Lands Node



The Tierberg legacy

Research at SAEON's Arid Lands Node builds on a 20-year foundation at the Tierberg Karoo Research Centre. This Centre dates back to 1987 when it was established as an ecological research observatory by the Foundation for Research Development (a predecessor of the National Research Foundation).

Despite management and funding changes over the years, the site managers – Prof Sue Milton and Dr Richard Dean – persisted with their research to document the responses of the Karoo environment to grazing and weather patterns.

Over the past 25 years, many local and foreign researchers have worked at Tierberg, collecting weather and soil data and studying its plants, birds, insects, reptiles and small mammals. This work has resulted in a wealth of knowledge about Karoo ecology and provided valuable baselines for comparative and new research.

The Tierberg data have been published locally and internationally as 127 peer reviewed papers and 14 doctoral and masters theses. With SAEON support, Milton and Dean have archived and ordered the Tierberg data to make the information accessible to scientists and the general public.



“The spectacular, arid landscape around the Tierberg Karoo Research Centre is not static. The vegetation is in constant, but subtle, flux – reflecting weather patterns, plant lifespans, and changes in land use. Over the past 25 years livestock on surrounding rangeland has changed from merino and dorper farming, to cattle and game. The challenge is to detect long-term trends in a stochastic environment.”

– Prof Sue Milton, RENU-KAROO Veld Restoration cc



South Africa's grasslands, wetlands and pockets of forests are dwindling, with significant impacts on biodiversity, but more importantly, threatening the continued delivery of essential ecosystem services such as water, to the people of the country. It is crucial for these biomes to be carefully observed and monitored over an extended period.

“Ezemvelo KZN Wildlife is looking forward to hosting the SAEON environmental monitoring and observation node for grasslands, wetlands and forests, as there are many synergistic opportunities that arise from this in terms of science, data and environmental management.”

—The late EKZNW CEO Khulani Mkhize, at the signing of the agreement in 2008 between SAEON and EKZNW to create the GFW Node



SAEON Grasslands-Forests-Wetlands Node | Checking the vital signs of this precious mosaic |

In South Africa, the special places where grasslands, forests and wetlands converge are as spectacular as they are fragile. Two such sites – being explored as possible sentinel sites for SAEON – are biodiversity hotspots around the Cathedral Peak area of uKhahlamba Drakensberg Park World Heritage Site (UDPWHS), and the Maputaland-Pondoland-Albany system including the iSimangaliso Wetland Park. Each potential study site therefore features a declared World Heritage Site.

Even though the Grassland-Forests-Wetlands (GFW) Node, which is hosted by Ezemvelo KwaZulu-Natal Wildlife (EKZNW) in Pietermaritzburg, only started up in early 2011, the process of implementing a set of observing facilities to deliver long-term environmental data is surging ahead, with data management hot on its heels.

South Africa's grasslands, wetlands and pockets of forests are dwindling, with significant impacts on biodiversity, but more importantly, threatening the contin-

ued delivery of essential ecosystem services such as water, to the people of the country. It is crucial for these biomes to be carefully observed and monitored over an extended period in order to understand the impact of global change.

On appointment, node coordinator Sue Janse van Rensburg was tasked with exploring potential study sites and revelled in the blank canvas. "I had to get out there, see who's doing what and where, identify the key issues and look for opportunities. We were



“The work we do will hopefully provide us with information that could be used by generations to come to enhance and improve the quality of life of all South Africans. Protecting our country’s wetlands for example is possibly the most cost-effective and sensible way of ensuring water quality in future, while ensuring appropriate land use in important catchments will ensure water security.” – Sue Janse van Rensburg, node coordinator

Why grasslands, forests and wetlands ?

- Grasslands are economically and ecologically important and under increasing threat.
- As an important driver of goods and services, it is important that grasslands remain healthy.
- Although grasslands cover 30% of SA and forests only 1%, forests are important from a biodiversity perspective.
- SA's pockets of indigenous forest are shrinking.
- There are considerable problems associated with changes in and destruction of wetlands.
- Wetlands are essential in an arid, water-scarce country such as SA, yet an estimated 50% have been destroyed or converted.
- All remaining wetlands are under threat due to land degradation and inappropriate land use and may be compounded by climate change.
- Wetlands have an important role to play in carbon storage, cleaning of water, flood attenuation and biodiversity. Water is a common theme linking grasslands, wetlands and forests.

looking for sites that are important from an ecosystems service, economics and biodiversity perspective, preferably with long-term data attached to them.

“The Cathedral Peak catchments and the iSimangaliso Park are obvious choices.” In addition, there are agricultural trials that provide valuable opportunities for untangling the difference between natural variability versus anthropogenically driven climate change impacts.

Field Technicians Basanda Nondlazi and Danne Joubert have joined the GFW team and will perform observations at research sites, conduct surveys, maintain collections and equipment, while providing general support to researchers.

The node's science framework is guided by Prof Tim O'Connor, SAEON's observation science specialist, to develop programmes within the node's brief of long-term monitoring, to attract organisations and scientists who are interested and keen to work on grasslands, forests and wetlands.



Brokering partnerships

Van Rensburg coordinates all aspects of the node, consulting the key players; forming the linkages and making sure the three pillars are catered for – observation, information and education. “Being based at EKZNW headquarters, allows convenient access to their researchers, biodiversity experts and directors. Building the relationship between node and host is easy, as there are common focal areas and synergies where our work complements theirs and vice versa.

There are considerable data on grasslands, but these are widely scattered. The GFW Node could play a valuable role in consolidating the data.

In addition to the science and the data, Janse van Rensburg is looking forward to implementing some of her many ideas for education outreach. “Both EKZNW and WESSA have some excellent school programmes, with the main focus on conservation and environmental education,” she says. “We will make use of these platforms to investigate ways of inserting long-term science monitoring into their programmes, encouraging learners to look at their natural world, measure what’s going on and hopefully gain a better understanding of its dynamics and gain an appreciation for science.”



KwaZulu-Natal is the natural home for the node, apart from the fact that grasslands and forests appear in a mosaic pattern in the province, long-term studies on grasslands and pastures are ongoing in the area and there is a critical mass of researchers in the region.

Catchment experiments resume in the barrier of spears

SAEON's work in the Cathedral Peak catchments in the Drakensberg will piggyback on earlier experiments some of which started more than 50 years ago. Using the work of those pioneer scientists, the node will apply their data for new purposes in particular to understand the impact of climate change on water delivery and add to the long-term record.

A research programme studying the change that is occurring in the grassland biome was initiated early in 2010 through a partnership comprising SAEON, EKZNW and the University of KwaZulu-Natal. The project is funded by the National Research Foundation through a grant to O'Connor and slots in nicely with the work of the new GFW Node. The project will be conducted through the node and will involve its staff.

"The aim of this study is not only to show that change is occurring in the grassland biome, but to understand the effect of different drivers of change on ecosystem structure and functioning," says O'Connor.

"This, to some extent, is an important contribution of this work as most global change studies focus mainly on establishing that change is taking place. Understanding the actual contribution of individual factors to change is important because it would lead to a targeted approach in terms of mitigation."

After a century of investigation in the Drakensberg region, scientists are still asking why is this biome grassland and not some other form of vegetation such as savanna, forest, Karoo, or fynbos? This question remains at the cutting edge of vegetation theory. Fire is an integral component of this discussion. Many argue that the grassland biome is simply a consequence of frequent fires precluding woody vegetation.

There are, however, two simple stumbling blocks. Vegetation change may be slow, thus fire would have to be precluded for an extended period, which is not easy in a fire-prone environment and requires a dedicated effort. This country is fortunate in having had a handful of visionary ecologists who initiated such experiments decades ago. Two such efforts are located in the Drakensberg region of KwaZulu-Natal at Cathedral Peak and at Ntabamhlope. These studies offer valuable insights about the relation between fire and vegetation dynamics.



The SAEON research will also yield an understanding of biome shifts, biodiversity and the threat of alien invasive plants, biogeochemical cycling and productivity, including carbon flux, hydrological functioning and sediments, as well as fire regimes.

Studying the untamed spirit of St Lucia

The other potential sentinel site being explored by the GFW Node is the biodiversity hotspot known as the Maputaland-Pondoland-Albany system. It runs along the eastern spine of South Africa and incorporates the high central plateau, inland KwaZulu-Natal and the Eastern Cape, as well as the escarpment itself.

“A sub-section of this system is the iSimangaliso Wetland Park World Heritage Site, which encompasses the Greater St Lucia system and has the mosaic of grasslands, natural forests and wetlands, as well as an estuarine component,” says Janse van Rensburg.

“On its periphery is extensive agriculture and plantation forestry. SAEON is interested in studying how the hydrological functioning of the system is impacted on by the various land uses around the park, as well as

the possible interaction between surrounding land use and climate change on the integrity of the system.”

Janse van Rensburg says that initial discussions around the iSimangaliso Wetland Park study site have been very encouraging with researchers and the two authorities in charge recognising and supporting the need for a more coordinated strategic monitoring programme, which rationalises the resources of multiple stakeholders. “No single entity could tackle this, so we’re looking at doing it in a structured way with SAEON possibly playing a facilitating role.”

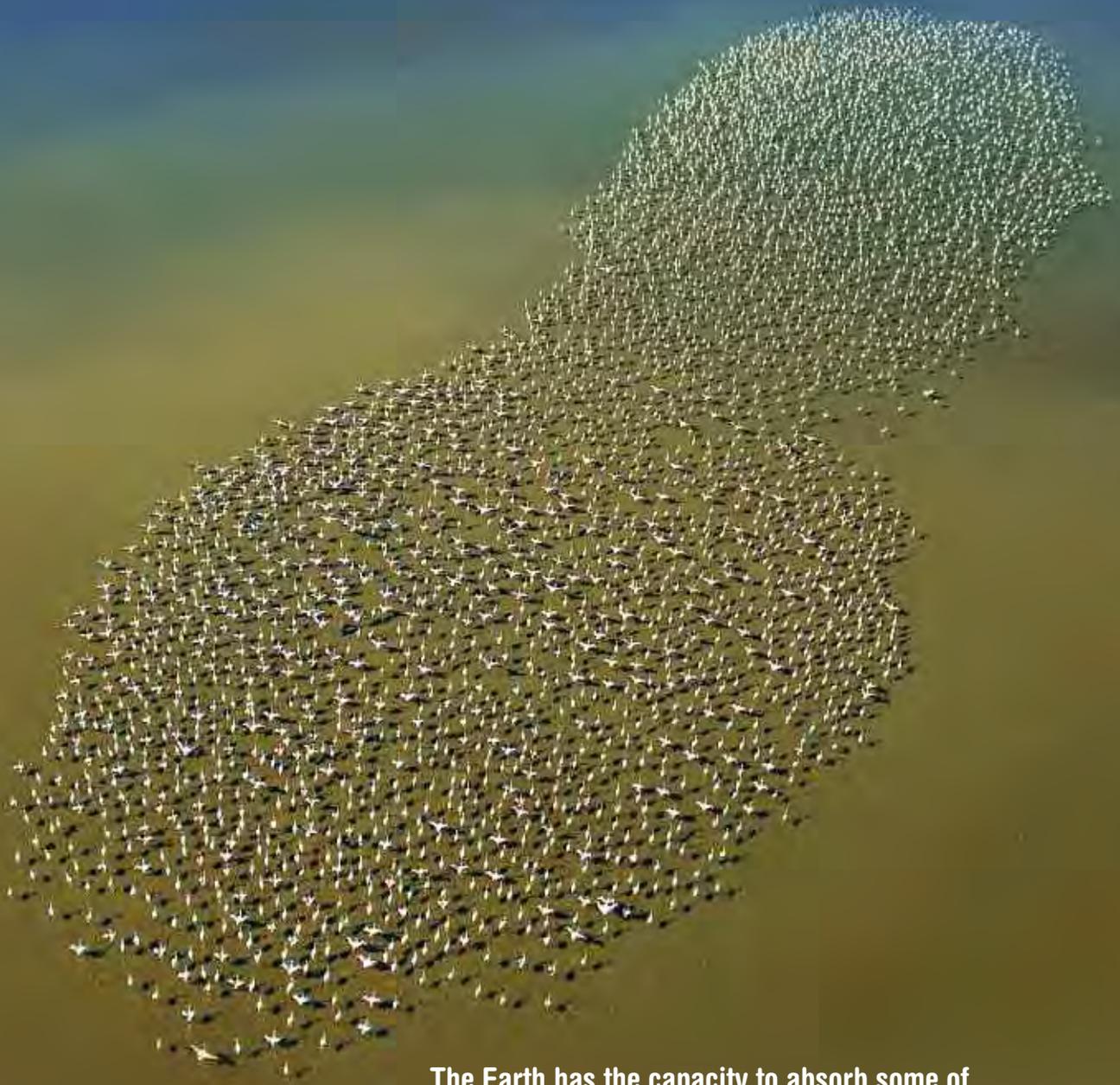
Inter node synthesis

Collaboration across nodes and rationalisation of resources is encouraged within SAEON. Hence the GFW Node conveniently ties into some of the comparable estuarine work done by the Elwandle Node, and there is some geographical overlap. The two nodes are already looking at developing joint projects in the iSimangaliso Wetland Park. There’s also an obvious link with the Fynbos Node in terms of catchments and with the Ndlovu Node in terms of vegetation research. The beauty of the SAEON model is its flexibility and the fact that it encourages sharing of resources and skills without duplication.



“The concept of biodiversity lacks resonance with decision makers; reframe it as ecosystem service delivery. We need to invest in conservation opportunities that are compelling.”

– Prof Richard Cowling, Research Professor: Nelson Mandela Metropolitan University and SAEON Advisory Board member



The Earth has the capacity to absorb some of our activities, but not all. It's time for humanity to tread lightly on the Earth, we need to make judicious use of her life support systems and biotic resources. We can no longer progress at the expense of nature.

SAEON bits and bytes

Summit 2010 – Successful observation of environmental change

The SAEON Summit, held every four years, is a standing consultative forum where SAEON and collaborators share experiences of successful design and implementation of long-term environmental change regimes in different bio-geographical regions and earth systems.

Through interactive platforms, presentations and workshops, the summit aims at engendering a better understanding of the requirements of, and methodologies for effective and efficient observation of environmental change.

The second SAEON Summit took place in October 2010 at Kirstenbosch in Cape Town. It was attended by 109 delegates over two days, including international guests from Botswana, Mexico, Namibia, the United Kingdom, and the United States. Thirteen invited talks were delivered, two by international speakers.

The 2010 Summit was opened by Marjorie Pyoos, then deputy director general of the Department of Science and Technology (DST) and a former member of the SAEON Advisory Board. The keynote address was delivered by A-rated scientist Prof Richard Cowling of the Nelson Mandela Metropolitan University who is a current SAEON Advisory Board member.

The summit attracted delegates from near and far. Among the special delegates were environmental scientists extraordinaire Prof Bert Drake (US), Prof Jonathan Silvertown (UK) and Prof Manuel Maass (Mexico). The summit also attracted big names in local environmental research such as guest speakers Prof Richard Cowling, Prof Norman Owen-Smith, Prof Colin Attwood, Prof Steven Chown, Prof William Bond, Prof Jenny Day and Dr Wayne Twine.

The theme of the 2010 Summit was “Successful observation of environmental change”. The programme was organised under the sub-themes: Coastal and marine ecosystems; Freshwater ecosystems; Terrestrial ecosystems; Approaches and methods; Environment and people; and Ecosystem data.

At the end of the summit, the Fynbos Node was officially launched by deputy minister of Science and Technology Derek Hanekom. The day after the summit was dedicated to Graduate Student Network (GSN) activities culminating in the awarding of prizes to the authors of the three best student posters.

Presentations delivered at the SAEON Summit 2010 are available for download from:

<http://data.saeon.ac.za/documentation/Presentations/2nd-saeon-summit-october-2010>

"What's needed is an environmental informatics institute, or centre of excellence, to support SAEON, to concentrate and foster scarce skills needed to interpret voluminous data and to support trans-disciplinary graduate courses in data management, theoretical modelling, statistical interpretation and decision support systems."

– Prof Norman Owen-Smith, director, Centre for African Ecology, speaking at the SAEON Summit 2010

Enticing graduates into the SAEON framework

The Graduate Student Network (GSN) creates a buzz among burgeoning scientists by organising workshops, providing training opportunities across disciplines and ecosystems, and by exposing them to the importance of long-term environmental research (LTER), data management and education outreach. At each opportunity, the postgraduates are encouraged to align their work with SAEON priorities.

The network promotes interaction among graduates, as well as between students and top scientists within the realm of LTER. The GSN constituency brings together a broad spectrum of disciplines and students working in different ecosystems, from oceans to rivers, beaches to mountains, pedosphere to atmosphere and wilds to cities.

Since its establishment, some 305 postgraduate students have been associated with SAEON, including 34 aspiring researchers who are supervised by staff or use SAEON facilities for their studies. The balance is linked to the organisation via the GSN. Some of the students who have already passed through the GSN revolving door have been employed by SAEON; others have launched funded research projects at the nodes, while others have embarked on careers in environmental fields.

SAEON understands its potential contribution to addressing imbalances in postgraduate student demography, setting itself clear goals and introducing incentives to help meet transformation targets. The GSN, which is steered by the students for the students, plays a key role in helping the organisation meet these targets.

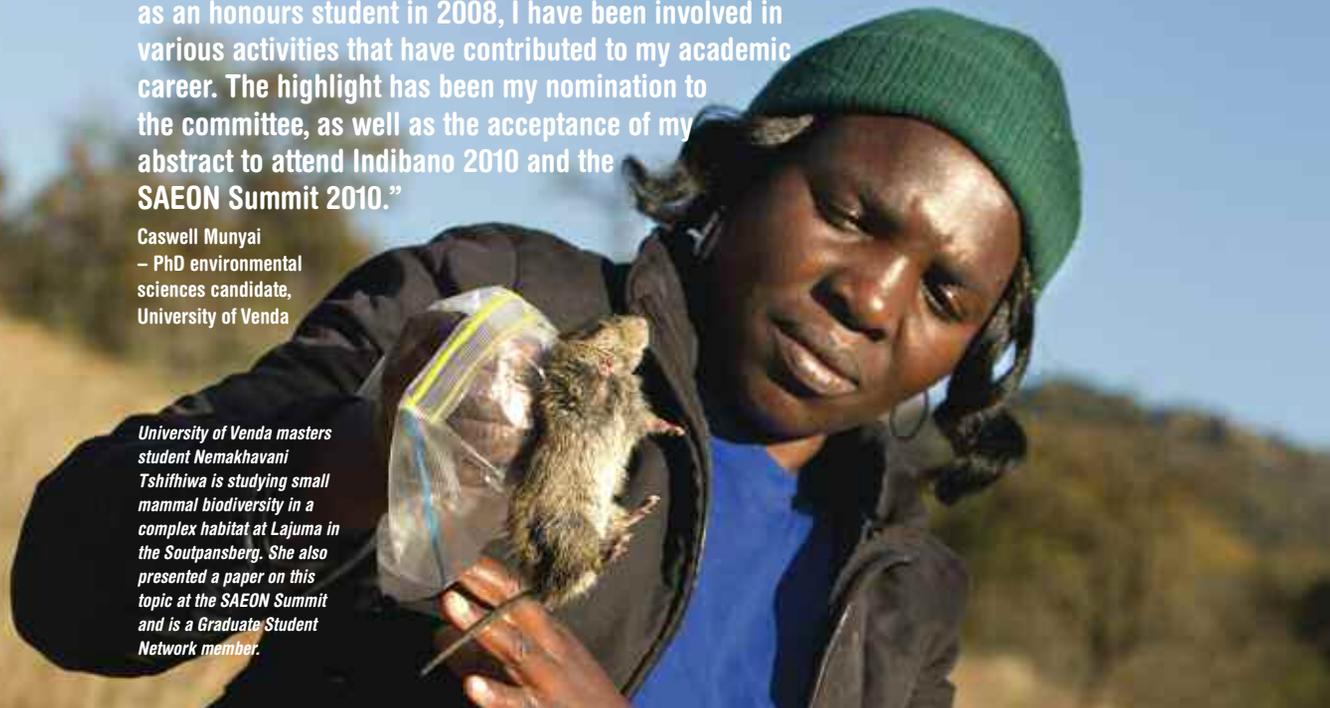
As the SAEON plan comes together and all six nodes move into full tilt, as scientific critical mass is reached and the data portal begins to burst at the seams, the opportunities presented by SAEON will entice the very best postgraduate students, not only from South Africa, but from across the globe. Long-term research sites with relevant, high quality datasets provide research students with fast-tracked opportunities to complete excellent research projects.



“GSN membership is of great value to me. Since joining as an honours student in 2008, I have been involved in various activities that have contributed to my academic career. The highlight has been my nomination to the committee, as well as the acceptance of my abstract to attend Indibano 2010 and the SAEON Summit 2010.”

Caswell Munyai
– PhD environmental
sciences candidate,
University of Venda

University of Venda masters student Nemakhavani Tshifhiwa is studying small mammal biodiversity in a complex habitat at Lajuma in the Soutpansberg. She also presented a paper on this topic at the SAEON Summit and is a Graduate Student Network member.



Citizens for Science

SAEON runs several citizen science projects that involve members of the general public in environmental observation projects. To ensure that quality data is collected, SAEON provides training for participating volunteers on standard procedures of data collection and recording.

At the Ndlovu Node amateur birders record the arrival date of key migratory species, volunteers assist with mapping of the distribution of mopane trees in the Kruger National Park, while schools plant “calendar gardens” to document the flowering times of different plants. All these data have the potential to feed into long-term climate change studies.

Four volunteers are taking part as “citizen science scuba divers” in the marine areas of the Table Mountain National Park and the iSimangaliso Wetland Park where they are helping to monitor the development of reefs on shipwrecks.

At SAEON’s Elwandle Node, recreational scuba divers are taking part in an exciting citizen science initiative called the Fish and Invertebrate (FIN) reef monitoring programme.

Ikapa voluntary rangers searched for the 100 Hugh Taylor vegetation plots established in 1966 in the Cape of Good Hope Nature Reserve, now part of SANParks Table Mountain Park. They took GPS coordinates for all relocated plots and photographed the plots, thereby assisting with an important research project at SAEON’s Fynbos Node.



The SAEON Ndlovu Node’s first citizen science project was a long-term bird survey for the Lowveld region. Citizen science projects are not only a valuable outreach tool, but also help to collect valuable data.

SAEON runs several citizen science projects. At the Ndlovu Node amateur birders record the arrival date of key migratory species, and volunteers assist with mapping of the distribution of mopane trees in the Kruger National Park.

Gathering of the future great minds of LTER in SA

Indibano, a Xhosa word meaning a “get together” or “gathering”.

Postgraduate students from different disciplines gather at the GSN Indibano, a symposium which aims to provide experiential training and insights into the different aspects of long-term studies of earth systems and biodiversity. The event is held more or less annually and is a good opportunity for students to exchange ideas, network with leading scientific authorities and gain additional training not necessarily covered in their studies.

- **GSN Symposium 2007, UCT, Cape Town**
- **Indibano 2008, De Hoop Nature Reserve, Western Cape**
- **Indibano 2010, Port Elizabeth, Eastern Cape**
- **Indibano 2011, Assegai Trails, between Kenton-on-Sea and Grahamstown, Eastern Cape**

The event is aimed at students involved in all fields of research related to long-term environmental knowledge, and especially encourages participants from “non-traditional” fields such as social studies, economics, public health and environmental education.

Networking in cyberspace

On the GSN website, research students can sign up for membership (which is free), have their projects permanently advertised, discuss their issues, and scout for study, funding and career opportunities. The site is used to inform graduate students of career opportunities as they become available.

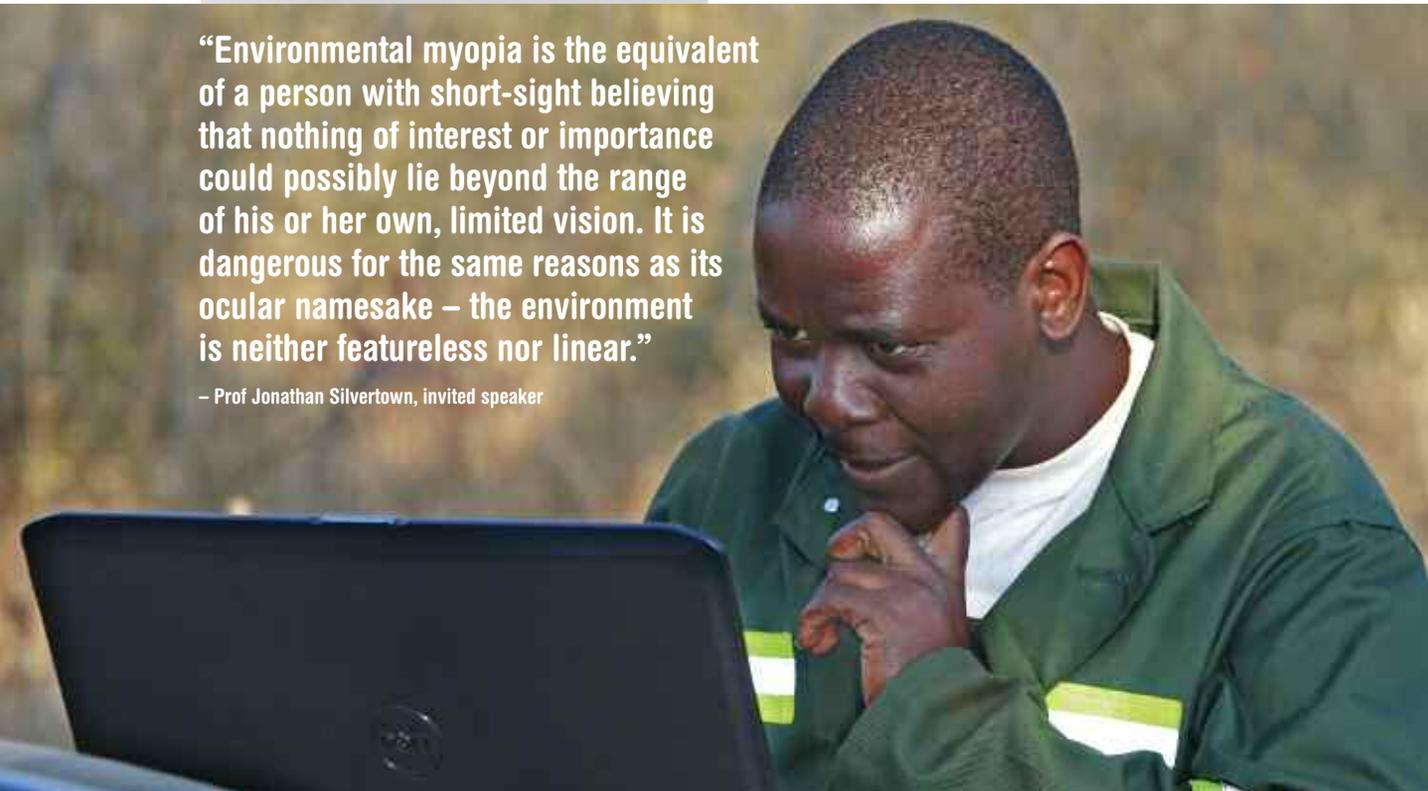
The website and GSN in general are used to generate excitement among members about the fact that they will be the next generation of LTER scientists in the country and that their research will pave the way to better management policies and protection of our environment for future generations. The website and the lively GSN Facebook page are steered by the students.

“Victoria Goodall introduced us to the SAEON data management portal, providing helpful hints on managing our data as well as encouraging us to use this excellent facility.”

– Shannon Hampton, GSN Coordinating Committee, Indibano 2010

“Environmental myopia is the equivalent of a person with short-sight believing that nothing of interest or importance could possibly lie beyond the range of his or her own, limited vision. It is dangerous for the same reasons as its ocular namesake – the environment is neither featureless nor linear.”

– Prof Jonathan Silvertown, invited speaker



Participation in the SAEON Summit

Network members attend and actively participate in the SAEON Summits, where they are exposed to presentations by top scientists and have the opportunity to interact with inspiring researchers. A “GSN day” was tagged onto the end of the 2010 Summit, where the students enjoyed networking in a more relaxed atmosphere and spent time on LTER-related excursions. The GSN also coordinates the student poster presentations for the summit. Activities at the 2010 event culminated in the awarding of prizes to the authors of the three best student posters.

Lelani Mannetti, an MSc student from Stellenbosch University (SU) came in third with her poster titled “An ethnobotanical survey of wild plant use in the southern Kalahari, South Africa”. Michelle Greve, a PhD student from Aarhus University in Denmark came second with her poster titled “The importance of herbarium records for the long-term monitoring of species: examples from African Acacia”. The winner of the day, for her poster “Determining the hydrological benefits of clearing invasive alien vegetation on the Agulhas Plain”, was Megan Nowell, an MSc student from SU.

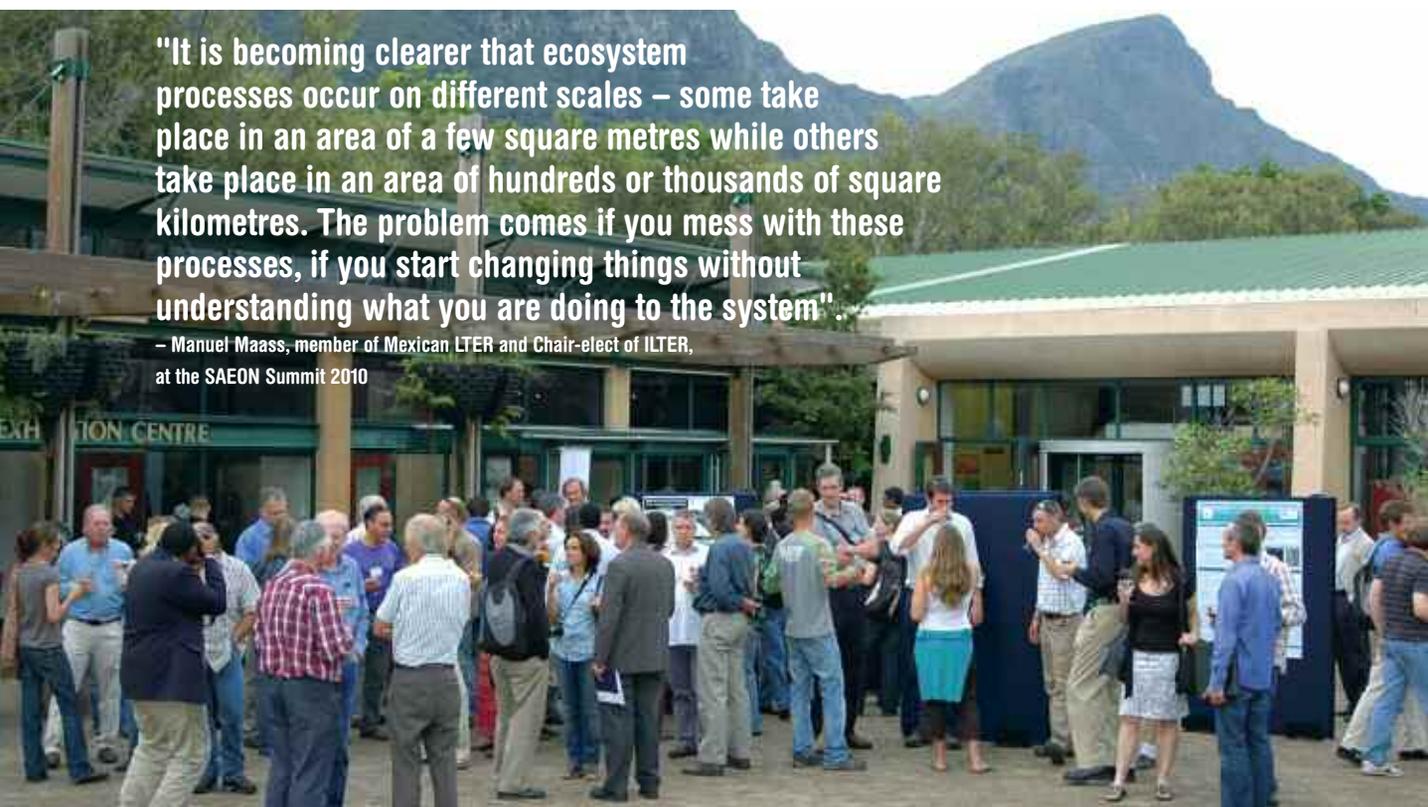
The many tools and activities of the GSN provide a network in which graduate students feel comfortable to share ideas, collaborate with one another, and get a broader understanding of ecological research with an expanded context in which to view their own research.

An expanding international presence

Observing Earth and monitoring its host of complex systems is a role no single organisation can play. Sound management of the earth system, in both its natural and human aspects, requires a multinational effort to gather information that is timely, of known quality, long-term and global. SAEON's role in this process is to provide the pieces of the puzzle that cover the southern tip of Africa.

Long-term environmental monitoring of global climate change in South Africa cannot start and end at the country's borders, or the peripheral edges of its territories out at sea. Therefore SAEON fervently and continuously expands its regional and international links.

In 2010 SAEON proudly assumed the role of host to the secretariat of the Group on Earth Observations Biodiversity Observation Network (GEO-BON).



"It is becoming clearer that ecosystem processes occur on different scales – some take place in an area of a few square metres while others take place in an area of hundreds or thousands of square kilometres. The problem comes if you mess with these processes, if you start changing things without understanding what you are doing to the system".

– Manuel Maass, member of Mexican LTER and Chair-elect of ILTER, at the SAEON Summit 2010

An international network coordinating the gathering and delivery of biodiversity change information at the global scale, GEO-BON reports to the intergovernmental Group on Earth Observations (GEO) which is in turn leading a worldwide effort to build a Global Earth Observation System of Systems or GEOSS by 2015. The latter will support sound, rational management of our planet, environment and resources.

SAEON and the South African Earth Observation System of Systems (SAEOS) were established by the Department of Science and Technology (DST) as part of its engagement with the international community in promoting an integrated global earth observation system. SAEON is continuously refined to ensure that it responds to emerging environmental issues and corresponds with the societal benefit areas of GEO.

The organisation places a high premium on:

- **Networking initiatives aimed at attracting local and international collaborators.**
- **Providing research infrastructure to the national, regional and global research community at large.**
- **Playing an active role in relevant international bodies.**

“We have an expanding international role,” says SAEON managing director Johan Pauw, “Members of the team get invited to serve on committees and so forth, but it’s a balance. We would love to do more but have to be careful to not chase international opportunities at the expense of local responsibilities. Our core business leaves little time for other engagements.”



Representation on international bodies

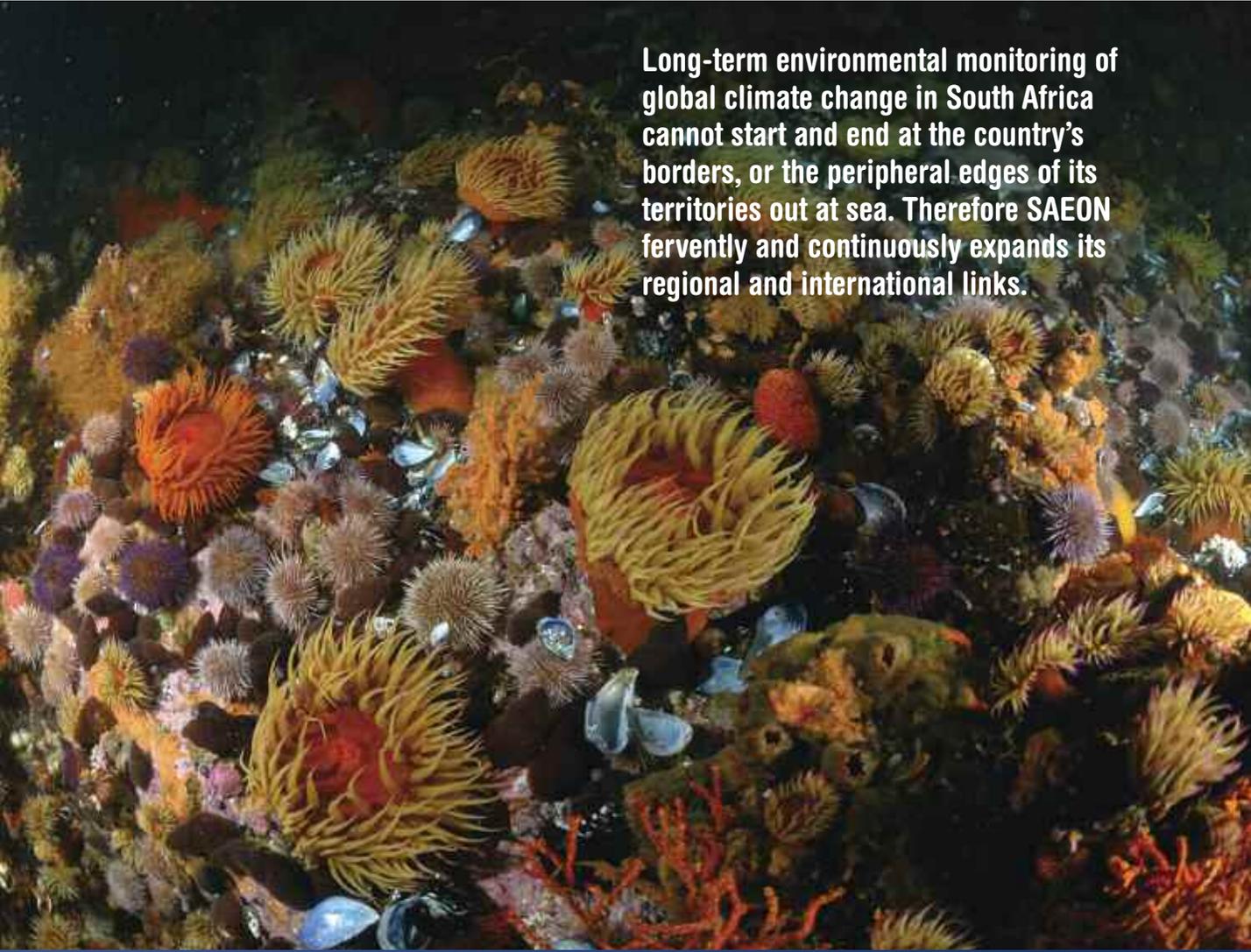
SAEON has for some time been an active participant in the International Long-Term Ecological Research (ILTER) network which has 42 member countries, covering 571 sites around the globe. It is officially represented on ILTER governing structures too. At the ILTER's 2010 business meeting, managing director Johan Pauw was requested to chair the ILTER's Public Policy Committee.

Staff members have furthermore been invited or elected to serve on a number of other international committees. These include the International Council for Science's (ICSU) ad hoc Strategic Committee on Scientific Information and Data (SCIDD), a working group of its Scientific Committee on Oceanography, as well as the organising committee of the Southern Hemisphere Meteorology and Oceanography Conference.

SAEON has direct linkages with Diversitas, a global body that coordinates biodiversity research. This relationship was strengthened when the second Diversitas Open Science Conference, Biodiversity and Society "Understanding Connections, Adapting to Change" was held in Cape Town, in 2009.

Other flagship international collaborations include the African Coelacanth Ecosystem Project (ACEP), which is managed and implemented by SAEON, as well as the Agulhas and Somali Current Large Marine Ecosystem (ASCLME) project. Initiated by the United Nations Development Programme (UNDP) and funded by the Global Environmental Fund (GEF), ASCLME aims to improve the management of waters and resources that are co-governed for the east African coastline.

SAEON also manages the data for ACEP, functions as the secretariat for the Southern African Data Centre for Oceanography (SADCO) and is active in the Western-Indian Ocean Marine Science Association.



Long-term environmental monitoring of global climate change in South Africa cannot start and end at the country's borders, or the peripheral edges of its territories out at sea. Therefore SAEON fervently and continuously expands its regional and international links.

In 2009, some of the world's main funders of environmental change research established a body called the Belmont Forum. Its aim is to align international resources to accelerate the delivery of the environmental science-derived knowledge and capabilities that society needs to address environmental change. ICSU and the International Social Science Council are invited members. SAEON is the national contact for the forum's "*Securing biodiversity-ecosystem services baseline*" theme.

Gathering developing countries for ecosystem assessment

SAEON is committed to ensuring that developing countries are not marginalised in the global effort to assess and monitor ecosystem change. This includes helping other countries in the southern African region to establish environmental monitoring projects, as well as facilitating joint regional or multinational programmes.

A case in point being the coordination of a trilateral ecosystem assessment programme for South Africa, India and Brazil.

Between 2000 and 2005, a grand exercise of synthesising and evaluating complex information on ecosystems services took place in various parts of the world. Dubbed the Millennium Ecosystem Assessment or MA this global programme was aimed at assessing the consequences of ecosystem change on human well-being, and establishing the scientific justification for the conservation and sustainable utilisation of the world's ecosystems.

South African scientists played a key role in the Southern African Millennium Ecosystem Assessment (SAfMA) component of the global programme.

DST subsequently contracted SAEON to develop a trilateral follow-up MA programme for South Africa, India and Brazil. SAEON set up a team of experts in South Africa who worked on a proposal that was registered with the MA secretariat in Japan and coordi-

The poor, who often depend directly on forests, fisheries, and agriculture for their livelihoods, tend to be most vulnerable to environmental threats. The challenge of effectively managing Earth's ecosystems and the consequences of failure will increase significantly during the 21st century. The scientific knowledge required to meet this challenge is being gathered by organisations like SAEON. Participating in the newly established IPBES, SAEON and others are helping to scientifically assess: the condition of Earth's ecosystems, potential impacts of changes to ecosystems on their ability to meet human needs, and policies, technologies, and tools to improve ecosystem management.



nated the establishment of similar teams in India and Brazil. The last leg of the initial phase was organising a trilateral sub-global assessment (SGA) workshop in Pretoria in May 2010.

Hosting international visits

International visits are a crucial aspect of international collaboration. During 2010 for example SAEON hosted visiting scientists from CSIRO in Tasmania, Australia, the Mexico LTER and the Environmental Protection Agency of Shanghai Province, China. Experiences in education-outreach were exchanged with the National Oceanographic Centre of Southampton. Presentations were made to marine science conferences in Alaska and Japan.

Acquisition of particular resources and activities

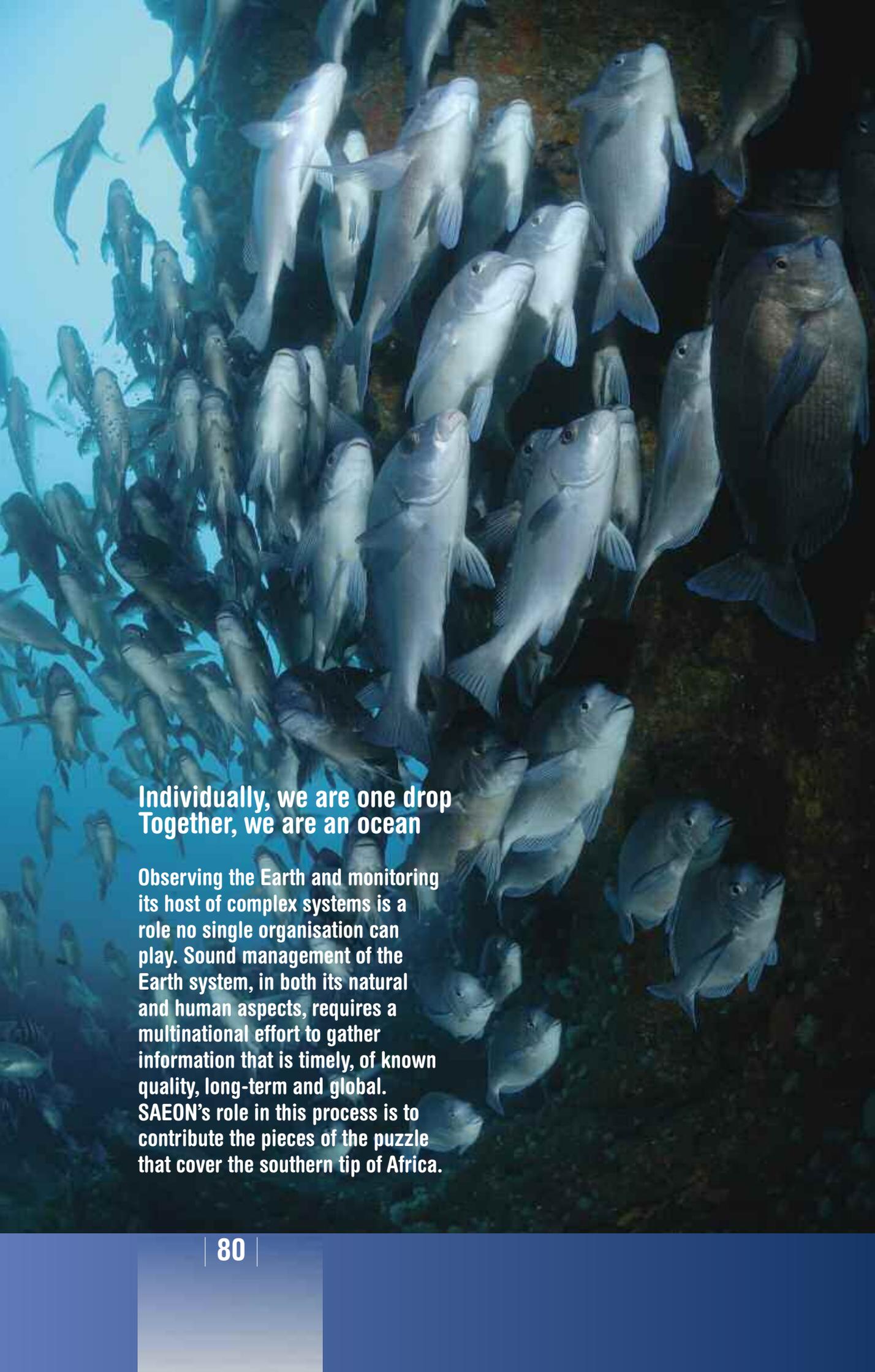
Some partnerships are partly motivated by the opportunity to contribute to global observation systems and to obtain specialised equipment and services:

- With the University of Cape Town and the ARGO global float array of the Global Ocean Observation System (GOOS) to monitor the Southern Ocean.
- With the Satellite Application Centre (SAC) regarding metadata catalogues for satellite imagery.
- With the South African National Antarctic Programme, ASCLME and ACEP regarding cruises.
- With International Long-Term Ecological Research (ILTER) to study ecosystem services at global scale.
- With GEO-BON by hosting its secretariat.

Similarly, SAEON will contribute to the realisation of a South African Earth Observation System of Systems (SAEOS) and the Global Earth Observation System of Systems (GEOSS). SAEON's Egagasini and Elwandle Nodes are partners in the ACCESS programme and its focus on ocean-atmospheric interactions and climate change.

Stakeholders





**Individually, we are one drop
Together, we are an ocean**

Observing the Earth and monitoring its host of complex systems is a role no single organisation can play. Sound management of the Earth system, in both its natural and human aspects, requires a multinational effort to gather information that is timely, of known quality, long-term and global. SAEON's role in this process is to contribute the pieces of the puzzle that cover the southern tip of Africa.

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