

# SAEON Summit 2006 Paper Abstracts

## South African Environmental Observation Network: Vision, design and status

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Presenter: Albert van Jaarsveld is Dean of the Faculty of Science and Professor in the Department of Botany and Zoology at Stellenbosch University. He has published more than 100 research papers and received numerous awards for his research in the fields of conservation, ecology and biodiversity.

### Abstract

The South African Environmental Observation Network (SAEON), which has its origins from the scientific community, has evolved significantly over the last five years. Core government support for this emerging initiative became a reality in 2002 when the first funding commitment was made. The establishment of an ambitious, distributed national environmental observation system requires extensive partnerships, ranging from participating government departments through numerous institutions, the corporate sector to the individual researchers. Over its first three-year period, SAEON has established its credentials within the South African scientific community, expanded its regional and international relevance, created and staffed a national office, launched the first two of six envisaged observation nodes and made great strides with educational outreach. Two additional nodes are nearing completion, while all should be operational by 2007. The financial and institutional sustainability of SAEON was of paramount importance and consumed most of its energy during this establishment phase. The next three-year phase (2006-2008) will be devoted primarily to establishing the scientific sustainability of the SAEON initiative through its nodes and associated partner networks and to achieve integrated functionality.

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## International earth observation programmes

RJ (Bob) Scholes

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Presenter: Bob Scholes, a member of the SAEON technical panel, leads the Ecosystems Processes and Dynamics research group at the CSIR. His research interests include global climate change, biogeochemistry, ecosystem dynamics of savannas and earth observation systems.

The evolution of international programmes in earth observation is briefly traced, and you will be gently guided through the alphabet-soup of organizations that have a stake in this field. In particular the role of the Global Earth Observing System of Systems (GEOSS) as a coordinating and rationalizing body will be discussed. GEOSS provides, for the first time, an overarching political authorizing environment in which the many other intergovernmental, governmental and non-governmental organizations can operate. The key issue in Earth observation is seldom the actual primary observation – it is ensuring that the observations that are made can find their way in an efficient way to the end user. To satisfy this need, the systems need to be designed from a user perspective, not solely from a data provider perspective, and much attention needs to be paid to interoperability – the capacity for different contributing systems to share information. Interoperability has a lot to do with computer communication and database architecture standards, but it also requires primary observation methodological agreement and an ethos of data sharing.

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## Monitoring the human dimensions of ecosystems in South Africa

Prof Sue Parnell, University of Cape Town

ABSTRACT PENDING

Presenter: Sue Parnell is a professor of Urban Geography in the Department of Environmental and Geographical Sciences at the University of Cape Town. She has authored more than 80 research papers and serves on the editorial boards of 11 academic journals. Her current research focuses on contemporary urban policy.

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## Climate observations and modeling

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Presenter: Gerhard Schulze manages the “Observation and Infrastructure” group at the South African Weather Service.

#### Abstract

Globally, today's 72-hour forecast is as accurate as the 24-hour forecast of the 1980's. The improvements in the accuracy in particular in the southern hemisphere are truly remarkable. This improvement has come about through improved scientific understanding of atmospheric dynamical and physical processes, an increase in available data (especially remote sensing from weather satellite) and the effective assimilation of the data in numerical weather prediction models supported by dramatic increases in computer processing power. The challenge to fully realise the social and economic value of weather and environmental predictions, is to provide user-specific risk management information on all time scales, to end-users. This challenge needs a multi-discipline approach. The assimilation and parameterisation of the physical processes in the models need special attention. Assimilation and use of non-conventional real time observations such as aerosol concentration in the atmosphere, soil moisture and land use parameters must be included in the models. In particular we need to investigate, quantify and improve the relative effects of small and large-scale initial-condition uncertainty.

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### Monitoring impacts of anthropogenic climate change on ecosystems: A role for systematic ecological observation?

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Presenter: Guy Midgley is the Chief Specialist Scientist in the Global Change Research Group at the Kirstenbosch Research Centre of the South African National Biodiversity Institute.

#### Abstract

Species responses to regional and local climatic changes have provided rich information to begin assessing the vulnerability of natural ecosystems to this emerging global threat. Continuous collection of historical records of plant phenologies, for example, provided some of the earliest evidence of directional responses of the natural world attributable to regional temperature changes. More recently, recorded shifts in species' geographic ranges have further supported inferences of significant change based on records of air temperature and other physical environmental characteristics. A small number of extinctions attributable to anthropogenic climate change have raised the relevance of long term monitoring and observation even further, and developments in “joint attribution” (the observation of a species response statistically attributable to an observed or modeled climate shift) have placed such monitoring on a stronger footing. None of these critical insights would have been possible without systematic ecological observations – but even more might have been possible, especially in the southern Hemisphere and specifically in Africa, if the appropriate framework for systematic species and ecosystem observations had been in place. In this paper we will discuss the potential uses of long-term ecological research (LTER) network approaches for assessing the vulnerability of terrestrial ecosystems and biodiversity to anthropogenic climate change.

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### Long-term observation and research of agricultural systems

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Presenter: Tim O'Connor is self-employed in his environmental consultancy, Tim O'Connor and Associates, and is also an honorary professor in the Centre for African Ecology at the Department of Animal, Plant and Environmental Sciences at the University of the Witwatersrand.

#### Abstract

The potential contribution of agricultural areas to SAEON is assessed. We present a case that agricultural rather than protected areas should be the central focus of long-term ecological research (LTER) and ecosystem observation. Although complementary, we distinguish LTER from ecosystem observation. LTER is usually site-based and investigates how ecosystems work over extended timeframes. Ecosystem observation serves to provide appropriate environmental information for decision makers on an ongoing basis, increased understanding is ancillary but accrues with time. LTER

and ecosystem observation need to be driven by questions concerning the relative influence of potential agents of change on response variables of interest. The main agents of change are climate change, land transformation, land use (plus management), nutrient loading, rare events, soil erosion, geomorphological change, change in system configuration, alien plants and animals, pollution and poisons, all of which differ in their spatial and temporal dynamics. The response variables of greatest interest are biodiversity, carbon fluxes, nutrient fluxes, soils and sediment, primary and secondary productivity, disturbance regime and hydrology, all of which show extensive spatial variation in relation to environmental gradients. Confident detection of their change therefore requires a sampling approach that is spatially extensive, of high temporal resolution, and covers environmental gradients. A limited number of nodes will not suffice for observation of any response variables. Agricultural areas have to form the mainstay of an observation effort because they cover more than 80 % of the country. In addition, extant data bases on production and soils for the crop, timber and livestock industries provide the required foundation for addressing some questions. The forestry industry is used to illustrate some of the potentialities of extant databases. LTER is by necessity node-based because of logistical considerations. The extremely successful Karoo biome project at Tierberg demonstrates the advantages of LTER conducted in an agricultural environment. A review of why this programme was successful considers project planning, site selection, logistics, empirical foundations, required ingredients for successful empirical investigation of hypotheses, amenability for extrapolation of empiricism via modeling for exploring temporal perspectives, communication, and strengths, weaknesses and opportunities engendered by working in a livestock system. The success of the Karoo Biome project owes much to the choice of an agricultural system because it provided the required logistical requisites and was conceptually tractable because of reduced ecosystem complexity. The necessity of basing SAEON on agricultural systems derives from the intractability of many of its key questions if pursued in complex protected systems that lack foundation databases.

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### **Status of soil erosion, sedimentation & land cover and land use monitoring in South Africa**

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Presenter: Terry Newby is the Programme Manager: Natural Resource Monitoring, Auditing & Impact Assessment at the Institute for Soil, Climate and Water at the Agricultural Research Council. His professional interests include remote sensing, nature conservation, environmental management and research management.

#### **Abstract**

The most limiting natural resource facing primary industries in South Africa is water. It is therefore important to monitor all aspects that can impact on the quantity and quality of this resource. Land cover and land use change impacts positively or negatively on soil erosion resulting in decreased or increased sedimentation of the rivers, streams and dams in the country. This in turn impacts significantly on the quality and quantity of water. Monitoring land cover change, soil erosion and sedimentation over the long term is essential to ensure informed policy formulation and decision making for sustainable use of natural resources. A number of soil erosion, sedimentation and land cover datasets have been generated over the recent past. These include: a sediment delivery potential map (SDPM), a bare soil index (BSI) map, an erosion susceptibility map (ESM), a predicted water erosion map (PWEM) and datasets for natural resource auditing of Mpumalanga, Gauteng and two ISRDS nodes for land degradation. Two land cover datasets have been produced for South Africa from satellite data recorded in 1995 and 2000. Technologies available for monitoring include earth observation (remote sensing), modeling, expert opinion, participatory rural appraisal, field survey and scientific instrumentation. A fixed-point natural resource monitoring system for South Africa is currently under consideration by the Department of Agriculture.

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### **Terrestrial biodiversity observation systems: developing desirable, defensible and possible systems for South Africa**

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Presenter: Belinda Reyers heads up the Biodiversity and Ecosystems Services Research Group at the CSIR in Stellenbosch. Her research focuses on biodiversity, with current emphasis on the Millennium Ecosystem Assessment, an international effort to assess the consequences of ecosystem change for human wellbeing.

#### **Abstract**

Declines in biodiversity, as well as the associated impacts on human wellbeing, have triggered national and international agreements to reduce or halt this decline. The Convention on Biological Diversity's 2002 commitment "to achieve, by 2010, a significant reduction in the current rate of biodiversity loss at the global, regional and national levels" is an often

cited example and has caused a flurry of activity in the development of biodiversity monitoring systems with which to address this and other policy imperatives. We review these systems from a South African point of view, highlighting their reliance on existing data, the lack of data for many parts of the world and for many groups of organisms, and the paucity of baseline data essential for monitoring changes in rates. There is an obvious need for better, more cost-effective measures based on sound science with which to monitor rates of loss and impacts of mitigation. However, these data needs must be formulated from within a framework which gives careful consideration to the objectives of each monitoring system and is context and country specific, recognising that biodiversity monitoring is not a case of one size fits all. South Africa should focus on developing a practical, defensible and adaptable biodiversity monitoring framework which addresses both policy and research imperatives.

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## Nutrient Cycling in Ecosystems

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Presenter: Mary Scholes is a professor in the Department of Animal, Plant and Environmental Sciences at the University of the Witwatersrand. She is interested in improving the productivity and sustainability of South African plantation forests by applying ecosystem-based approaches; as well as a better understanding of nitrogen, carbon and phosphorus cycling in semi-arid savanna regions.

### Abstract

There are two issues of societal importance in relation to nutrient cycling. The first is the *depletion* of nutrients in croplands and rangelands. The second is the *overabundance* of nutrients, particularly in freshwater bodies and coastal systems, where it leads to loss of biodiversity and ecosystem services through eutrophication. Nutrient cycling encompasses 15 or so elements, each with multiple forms, four media (air, soil, biomass and water), and many transformation and transport processes. Clearly, it is not cost-effective to monitor them all, even in intensive research sites. The two key elements for both fertility loss and eutrophication are nitrogen (N) and phosphorus (P). For N, the key anthropogenic inputs are atmospheric deposition and liquid waste streams. A sensitive impact indicator is the nitrogen saturation index, which rises abruptly when the absorptive capacity of the landscape is exceeded. The key anthropogenic inputs of phosphorus are agricultural, and in certain locations, mining and industry. Phosphorus fertilizer application rates and local-to-regional nutrient balances are useful tools for predicting potential problems, since P is highly conserved. Measurement of nutrients associated with sediment fluxes in rivers is important for both N and P, as well as for carbon balance. In order to put fluxes and apparent disturbances observed in present-day monitoring strategies in perspective, historical records contained in for example sedimentary records have to be established. Additionally, tools such as isotopic tracers that can be used to unequivocally differentiate between the natural and anthropogenic components of nutrient cycles need to be explored.

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## Atmospheric observation systems with specific reference to air quality

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Presenter: Kobus Pienaar is the Director of the School of Chemistry and Biochemistry at the North-West University. His research fields include atmospheric chemistry, environmental chemistry, reaction kinetics and air quality management.

### Abstract

It has long been established that emissions into the atmosphere have the potential to substantially alter the environment. This has led to the terms such as 'acid rain' to describe rain that has had its chemical composition altered significantly due to the influence of anthropogenic emissions. Research in various parts of the world has shown that the deposition of biogeochemically important trace species can have measurable ecological impacts on the long-term sustainability of a region. Deposition of chemical species plays an essential role in controlling the concentration of gases and aerosols in the troposphere. The chemical content of atmospheric deposition is the signature of several interacting physical and chemical mechanisms such as: emission and source amplitude; transport in and dynamics of the atmosphere; atmospheric chemical reactions; and removal processes. Various coordinated and uncoordinated programmes and

activities have been initiated during the last two decades to quantify the potential risk and impact of atmospheric pollutants in southern Africa. This paper will report on the main findings and current initiatives undertaken in this field.

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## **The changing water resources monitoring environment in South Africa**

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Presenter: Eberhard Braune is the Director: Water Resources Information Programmes at the Department of Water Affairs and Forestry, as well as an associate professor in the UNESCO Water Chair at University Western Cape. His work focuses on sustainable development of water resources and groundwater resources management.

### **Abstract**

The fundamental water law reform introduced in South Africa with the democratization in 1994 through the National Water Act, 1998 also has major implications for water resources monitoring and information management. While water resources management had been highly centralised and largely supply-driven, the new legislation has the purpose of achieving equity, sustainability and economic efficiency, with devolved management so that everybody can participate. Similarly monitoring that had focused on supporting the development and operation of national water infrastructure, now needs to focus on monitoring for compliance with various resource quality objectives, management targets and water use license conditions at national, regional (catchment) and local level. A new phase of science-led management can be foreseen in which water resources monitoring will require much greater attention to the relationships between the water resource status, the impacts it has received through various human pressures and the management responses to change the pressures or ameliorate the impacts. Such integrated monitoring will have to cover the traditional fields of surface and groundwater quantity and quality, with increasing focus on the air and land phases of the hydrological cycle and the various human impacts. This will add a strong social dimension and will require new approaches to appropriate governance for the crosscutting management of information. The Act provides for greater coordination and various models to achieve this are emerging at local and regional level. Various partnerships and an action-learning approach are seen as essential elements of integrating different disciplines, institutions and business processes.

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## **Coastal monitoring**

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Presenter: Ronel Nel is an ecologist with the Marine & Coast group at Ezemvelo KwaZulu-Natal Wildlife. Her expert portfolio includes sandy beach research and monitoring, as well as sea turtle research and long-term monitoring of these marine reptiles.

### **Abstract**

Societal values regarding the environment can generally be summarised under three headings i.e. (1) ecosystem integrity, (2) human health and well-being, and (3) resource sustainability. SAEON contributes to the reduction of vulnerability to long-term environmental change by obtaining, collating, and coordinating long-term data collection to measure and predict, and therefore prepare society for, environmental change. Even through the importance of these capabilities are now well-recognised, very few agencies with a responsibility in the coastal zone are participating. Consequently, few long-term national or provincial monitoring programmes exist for/in the coastal zone, especially programmes aimed at tracking changes in biodiversity. A small number of established biodiversity programmes tend to measure direct impacts such as extractive resource use or pollution, without much attention to slow, indirect or cumulative effects. Some of the best-known coastal monitoring programmes include the Maputaland Sea Turtle Monitoring Programme (43 years), Natal Sharks Board bather protection net programme (since 1988) and the National Marine Line-fish System (~ 23 years). These programmes operate from different agencies, and are mostly interpreted in isolation. In order for SAEON to make a meaningful contribution to coastal monitoring, it must establish a paradigm in which monitoring can take place. This will require the development of a conceptual model of the ecosystem components of the coastal zone and the interactions within and between them, and the identification of factors that can alter these interactions (whether natural or anthropogenic). Since it would be an unattainable task to monitor all these components and interactions, indicators representing reality need to be identified and followed through time. Simultaneously, it is

essential to collect supporting information *inter alia* management regimes, policy or legislation under which this data are collected in order to interpret data meaningfully even decades from now.

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### **Marine ecosystem observation systems**

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Presenter: Coleen Moloney is a senior lecturer in the Zoology Department at the University of Cape Town. Her main research interests involve the study of the marine pelagic ecosystem off the west and south coast of southern Africa and the implementation of an ecosystem approach to fisheries management.

#### **Abstract**

South Africa has a strong history of marine ecosystem research, but not of dedicated, sustained ecosystem observation systems. Marine ecosystem research started in 1981 with the interdisciplinary, multi-institutional Benguela Ecology Programme, which focused on the marine ecosystem of the west coast. From the 1990s, this research continued with foreign partners, including French-South African projects, the EU-southern African ENVIFISH project, and the two regional projects of the Benguela Current: BENEFIT and the BCLME. On the east coast of South Africa, there were few co-ordinated ecosystem research projects until 2002, when the African Coelacanth Ecosystem Programme started. The future development of the Agulhas-Somali Large Marine Ecosystem project should address this gap. Marine ecosystem research provides a knowledge base for developing a marine ecosystem observation system, but there are a number of challenges. International guidelines for establishing observing systems highlight three necessary components: (1) measurements, (2) data management, and (3) modeling and analysis. In South Africa, elements of all three components exist, but their effective implementation in a marine ecosystem observation system is limited by a number of factors. An effective marine observation system should be developed, guided by international best practice and modified for local conditions.

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### **National marine fisheries and environmental monitoring programmes**

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Presenter: Johann Augustyn is the Chief Director: Research, Antarctica & Islands, at Marine and Coastal Management, Department of Environmental Affairs and Tourism. He is also a research associate at the University of Cape Town. His research interests include fisheries biology, population dynamics, and ecosystem approaches to fisheries management.

#### **Abstract**

South Africa uniquely lies at the junction of two major currents, the Agulhas and the Benguela. It exhibits exceptional variability in the short and medium term and strongly contrasting conditions on the east and west coasts. South Africa is rich in fisheries resources and associated environmental data collected over more than a century. It has been a world leader in multidisciplinary studies of marine resources, from the driving forces to the top predators. Resources data focus on trends in catches, fishing effort and changes in distribution and abundance of harvested resources. They were collected by means of fisheries dependent and independent survey techniques appropriate to each particular stock. The data are complemented by comprehensive information on the environment and top predators. A number of approaches have been utilised to sample at different scales. These include: (1) macroscale and frequent satellite imagery, (2) mesoscale monthly and fishery surveys, (3) dedicated cross-shelf transects, (4) dynamic processes measurements, (5) moored buoys and coastal weather stations, and (6) integrated monitoring approaches, including modeling and simulation studies.

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### **Extra-curricular high school science education programmes and monitoring**

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Presenter: Beverley Damonse is the Executive Director of the South African Agency for Science and Technology Advancement, a business unit of the National Research Foundation. Her interests include science awareness, especially the development of relevant indicators for assessing science promotion activities.

Co-presenter: Kirsten Mahood coordinates outreach activities at the DST-NRF Centre of Excellence for Invasion Biology, Stellenbosch University. She is interested in macroecology and environmental education in the context of the new curriculum statement for grade 10 – 12.

#### Abstract

According to a political declaration following the World Summit on Sustainable Development (WSSD 2002) "sustainable development requires a long-term perspective... in policy formulation, decision-making and implementation". This session addresses implementation at the crucial level of human skills development along the education pipeline and across the broader public. According to the revised curriculum statement of the National Department of Education, the curriculum seeks to create a lifelong learner who is confident and independent, literate, numerate, multi-skilled, compassionate, with respect for the environment and the ability to participate in the society as an active citizen. National Facilities like SAEON (and others within the NSI) are ideally positioned to make significant contributions to the development of this much-needed new generation of scientists that transcend disciplinary boundaries. The aim of the SAEON Science Education Outreach Program is to integrate long-term ecosystem research into both secondary and tertiary education. Benefits of individual nodes and the cross-cutting node network as ideal platforms to create research rich environmental science education and monitoring environments will be outlined, with emphasis on current and proposed model(s) that innovatively combine scientists, graduate students, educators and learners. It will also be shown how these local initiatives of 'learning science by doing' can be effectively linked to wider national programmes to enhance engagement with science and technology. The model also provides opportunities to engage with locally relevant topics that link to global science networks. The limbovane: Exploring South African Biodiversity and Change Outreach Project of the DST-NRF Centre of Excellence for Invasion Biology (CIB) will be discussed as an example of current work by the CIB in this area.

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### Geospatial technologies and geo-information science for persistent environmental monitoring

Gavin J Fleming

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Presenter: Gavin Fleming joined Mintek at the beginning of 2006 to work in the field of environmental decision support. Before that, he worked at the CSIR in spatial modeling, analysis and application design. He is interested in the application of these models and technologies for sustainable development.

#### Abstract

Monitoring environmental change is a multidimensional, multidisciplinary challenge. Our environment is a complex system with countless components and interactions. We have monitored the environment for a long time, from early weather observations to hundreds of parameters today. There is an abundance of data, but not the capacity to process and interpret it all. Only interpreted data can make a difference to policies. Almost all environmental, social and economic observations can be considered geospatial data. These can come from any source, be it satellite or questionnaire, and be in any format. Geospatial technologies are the hardware and software tools that allow us to manage geospatial data. Geo-information science, drawn from a collection of disciplines, gives us the tools to analyse and interpret geospatial data. Together, these are essential for capturing, storing, processing, fusing, integrating, analysing, modeling, communicating, publishing and presenting the data and information upon which a multi-scale, multi-domain programme such as SAEON will depend. Technologies, standards and best practices exist today that promise to provide the platform for persistence, collaboration and dissemination of data and information envisaged by SAEON. This paper gives a brief overview and evaluation of some historical, current and planned monitoring systems across various domains that exploit a variety of geospatial technologies. It identifies critical gaps, such as the lack of repetitive, consistent, information-rich land cover monitoring that will underpin much other research. It concludes with recommendations of some services and products that SAEON should deliver.

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### A proposed service-oriented architecture for SAEON

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Presenter: Laurie Barwell works for the Natural Resources and the Environment group at the CSIR. A civil engineer by training, he specialises in coastal environmental engineering, integrated environmental management and has a special interest in managing large integrated projects, especially those that promote the sharing of knowledge amongst researchers and other stakeholders.

## Abstract

SAEON aims to establish a network of distributed observatory nodes where researchers will be able to input new data, discover and access existing data, analyse and add value to the data, discover, access or add new information, interact with existing analysis tools and share knowledge. A service-oriented architecture design is proposed that is fully open source and open standards compliant with interoperability addressed by adherence to industry standards, with open GIS consortium specifications as core to the spatial information. To meet the needs identified above, a prototype geoportal, underpinned by a content management system, is presented. Furthermore, the concept of unified geoframes that enable inter-thematic and inter-node collaboration is promoted. The learning derived from certain national level data management systems is considered and the required governance and operations support infrastructure to ensure data integrity and known quality is discussed. The paper concludes with broad commentary on future needs and challenges of connecting and delivering quality data and information via SAEON, now and in the long-term.

## **POSTER ABSTRACTS**

Poster # 1

### **Monitoring climate change effects on an altitudinal gradient**

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Global circulation models indicate that the Western Cape will become hotter and drier. Many fynbos areas will in future experience climate conditions currently associated with the Succulent Karoo. This could ultimately result in biome shifts. Ecotones, transitional areas between biomes, are considered important to monitor for the early detection of climate change-related biome shifts. The northern slope of Jonaskop (Rivieronsderend Mountains, Western Cape), an altitudinal gradient spanning a natural transition between fynbos and Succulent Karoo, has been identified as a key site for monitoring the effects of climate change on fynbos, including shifts in species and biome ranges. Weather stations across the gradient allow fine scale linking of species distributions and vegetation processes to climate variation. Distributions of 286 species have been mapped for monitoring purposes. Phenological monitoring of fynbos species revealed that variation in growth across the gradient is due to sensitivity to high temperatures. Exposing fynbos species to experimental drought indicates that species with high relative growth rates are most sensitive to reduced rainfall. Rainfall reliability was found to be important for maintaining optimum growth. A transplant experiment found that different soil types associated with fynbos and Succulent Karoo are not barriers to invasion. The effects of climate change on the post-fire regeneration stage of fynbos were tested when fynbos seedlings were transplanted into the Succulent Karoo. Conclusions are that climate change will affect fynbos vegetation dynamics, with dominance shifting to slow growing water conservative species. The seedling stage is the most vulnerable climate change, and fires are likely to facilitate Succulent Karoo invasion of fynbos areas.

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Poster # 2

### **Air quality monitoring of the South African Highveld using an airborne platform**

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South Africa has one of the largest industrialised economies in the southern hemisphere and is a significant source of anthropogenic and natural aerosols and trace gases. The Aerocommander 690A research aircraft has been used to obtain data from a series of flights over major source areas. The Aerocommander is a pressurized, twin-engine turboprop aircraft. It is equipped with various instrumentation used for the collection of data. Trace gas concentrations, aerosol concentrations and state parameters are logged at 1-second intervals. The airborne platform allows detailed and accurate monitoring of baseline pollution levels and also allows for the identification of air pollution hotspots over industrial areas and other point sources. Therefore, it allows for the evaluation, integration and comparison of different measurements monitored from different point sources. The mapping and monitoring of the South African Highveld was conducted in an



intensive campaign during late summer (7-18 March 2005). The Mpumalanga Highveld, the Vaal Triangle and Springs were found to be major hotspots of trace gases and various other chemical compounds, especially SO<sub>2</sub>. These measurements support the notion that the industrialised Highveld is one of the major source regions of air pollutants and greenhouse gases in the southern hemisphere. Therefore accurate pollution inventories are thus a key necessity in air quality monitoring and problem area identification in South Africa. The poster will cover the processes of data collection and air quality monitoring on the Aerocommander during field campaigns including the results obtained from the Highveld case study.

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Poster # 3

### **Aerosol loading over the South African Highveld**

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The Highveld region of South Africa contributes significantly to aerosol loading over southern Africa because of its importance as an industrial, mining and farming base. Aerosols affect climate by absorbing or reflecting incoming solar radiation, and by affecting cloud microphysics, cloud albedo and precipitation. The physical and optical properties of industrial and urban aerosols over the Highveld region of South Africa were analysed between the early winter months of May-June 2002 and 2003 and the early summer months of October-November 2002. Synoptic circulation systems were examined, in as far as they affect the horizontal transport of aerosols over the Highveld region. Measurements of aerosol optical depth from the ground to the top of the atmosphere and aerosol size distribution characteristics over the Highveld region were collected using hand-held haze meters and a CIMEL sun photometer. The aerosol optical thickness (AOT) observed over the region during early winter and early summer indicates high turbidity. In early winter 2002 optical depth ranged between 0.05 to 0.7 with an average of 0.14. In early summer AOT values ranged from 0.05 to 0.6. The average AOT during early summer was 0.24. The Angström exponent parameter had a wide range of 0.8 to 2.4 in early winter and early summer 2002 and early winter 2003. This indicates a wide range of particle sizes are present over the Highveld region. The values obtained are derived from the influences of aeolian dust, coarse mode industrial particles and also to a small extent fine mode biomass burning aerosols.

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Poster # 4

### **Ants, altitude and change in the northern Cape Floristic Region**

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Climate-modeling exercises have demonstrated that the Cape Floristic Region (CFR) is highly sensitive to climate change and will apparently lose much of its northern limits over the next few decades. Because there is little monitoring of diversity in this area, ant assemblage structure was investigated within the main vegetation types in the Greater Cederberg Biodiversity Corridor (Western Cape, South Africa). We sought to determine how ant assemblage structure differs between the main vegetation types (Strandveld, Mountain Fynbos and Succulent Karoo), how restricted ants are to the major vegetation types, and which environmental variables might underlie differences in the ant assemblages. Sampling was undertaken during October 2002 and March 2003 across an altitudinal gradient ranging from sea level to approximately 2000 m above sea level and down again to 500 m above sea level. Pitfall traps were used to sample ants at 17 altitudinal bands. Biotic and abiotic environmental variables were collected at each sampling site. Temperature explained significant proportions of the variation in species density and abundance, and, together with area and several vegetation variables contributed significantly to the separation of the assemblages in the major vegetation types and biomes. Fourteen ant species were characteristic of certain vegetation types and altitudes. Several of these species contributed to the differences between the assemblages. There are thus likely to be substantial and complex changes to ant assemblages as climates change in the northern CFR. Ongoing monitoring of this transect over the next ten years will reveal the nature and pace of the change as it unfolds.

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Poster # 5

## Long-term monitoring of the vegetation in the Goegap Nature Reserve in Namaqualand, South Africa

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Namaqualand is a semi-desert area situated in the winter rainfall region of South Africa hosting the world's richest succulent flora, and is the only arid area to classify as a global hotspot of biodiversity. After the Goegap Nature Reserve was fenced in 1969 and all livestock removed, a long-term monitoring project was initiated to record possible vegetation changes under the reduced grazing pressure. The first monitoring was done in 1974 when two line transects, of 1 km each, were surveyed. These surveys have been repeated annually covering a period of more than 30 years.

The aim of this study was to determine whether any changes in the vegetation could be detected since 1974. Rainfall as a possible force driving the changes in terms of species richness and composition was also examined. It was found that species richness of annual species revealed more changes than for perennial species. These changes did not result in an overall increase or decrease in the number of species and are therefore referred to as fluctuations. A canonical correspondence analysis revealed notable changes in species composition over the entire monitored period. In the case of the perennial species this change in composition was directional. Considering the increase in canopy cover of perennial species and the increase in palatable and decrease in unpalatable species the assumption can be made that the veld condition is improving. The annual species composition fluctuated and showed a clear relationship with rainfall.

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Poster # 6

## Evaluation of sub-surface hydrologic pathways and processes in an urban setting: a combination of artificial intelligence and remote sensing to predict and manage flash floods

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Flash floods pose a significant and frequent threat to urban populations in the developing world. Rapid landcover change from 'greenfield' type use, e.g. agriculture or unmodified veld, to developed and artificially surfaced areas has occurred with increasing frequency. These developments have rendered the mitigating capacity of natural near-surface water flow pathways defunct by redirecting water that previously would have charged subterranean conduits into concentrated surface flow. This has potentially major effects. In the long term, subterranean conduits will receive less water via these processes with possible long-term implications for water availability. Additionally we would expect more polluted runoff, as well as an increased frequency in flood events of short duration. In order that we may investigate the role of the aforementioned processes I propose a monitoring system that incorporates remote sensing techniques to evaluate landcover types and precipitation events that is then coupled to an artificial neural network (ANN) algorithm, which quantifies the complexity between the components of the system. The system is intended to produce three major practical tools, applicable at three temporal scales: (1) a nowcasting system for flash floods, (2) a re-evaluation of the validity of the 1:100 year flood lines which determine the limits for development along river courses and a resultant re-evaluation of the vulnerability of the adjacent infrastructure to flood events, and (3) a recommendation on which areas should remain undeveloped as they provide greater dividends by mitigation than real estate. This system has significant potential as both a disaster management and a sustainable development planning tool. As such it is relevant to the SAEON initiative in that it highlights the urban aspect of ecological monitoring whilst additionally providing a socially meaningful application of SAEON infrastructure and expertise in the near term.

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Poster # 7

## Monitoring a keystone plant species in the sub-Antarctic

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*Azorella selago* Hook (Apiaceae) (or the 'cushion plant') is widely distributed in the sub-Antarctic and member of a dominant genus in the region. It is a long-lived, keystone species with a hemispherical, cushion growth form that reduces wind stress, heat and moisture loss. The species has been the focus of a climate change-related research programme on South Africa's Prince Edward Islands (PEI). Climate on the PEI has changed rapidly over the last 50 years, with a decline in rainfall and increase in temperature. *Azorella selago* and its epiphytes and microarthropods have been shown to be sensitive to climate change. Twelve long-term monitoring plots were established on Marion Island in 2002, and the interaction between cushion plants and their dominant grass epiphyte has been investigated. Predictions for the ongoing

impact of climate change on this keystone species include a change in the distribution of the cushion plant and its epiphytes, increased epiphyte loads on cushion plants and an increase in cushion plant mortality. Monitoring biotic climate change impacts on Marion Island is thus critical, and provides an informative model for understanding climate change impacts elsewhere.

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Poster # 8

### **Antibiotic resistance analysis (ARA) as a potential tool for the identification of sources of air pollution and the monitoring of microbial air quality**

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Antibiotic resistance analysis (ARA) is a method commonly used in aquatic studies to track the source of bacteria. The question was posed whether this method could also be applied in the study of airborne bacteria. Studies have demonstrated a link between air pollutants and bacterial resistance to antimicrobials. This study aimed to determine the diversity and levels of antibiotic resistant bacteria in the atmosphere of industrial and residential areas and to determine whether these isolates were also resistant to generally used biocides. Seven sampling sites were selected, five in Potchefstroom and two control sites. Samples were collected directly onto nutrient agar supplemented with either ampicillin or kanamycin. More than 55% of all isolates were resistant to three or more antibiotics. Cluster diagrams based on inhibition zone diameter were analysed to differentiate isolates of different antibiotic exposure histories. Dendrograms of Gram-positive isolates formed two major clusters. Both contained isolates from industrial and residential air. However, one cluster contained a greater proportion of isolates from industrial as well as residential air samples that were potentially under influence of industrial air. Selected isolates that were resistant to a large number of diverse antibiotics and biocides had high MIC values for metals. Forty five percent of all isolates exhibited haemolysis when grown on 5% blood agar. Isolates identified included *Bacillus* sp., *Pseudomonas* and *Xanthomonas*. This study demonstrated potential effectiveness of ARA as bacterial source tracking method when identifying sources of air pollutions as well as its usefulness when monitoring microbial air quality.

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Poster # 9

### **Time series analysis of rainfall in Butana area of Sudan**

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Time series analysis of historical weather observations provides the decision maker with better understanding of what has happened in the past, and how to obtain future estimates. The long-term rainfall in the Butana area of Sudan was investigated using time series analysis of four stations (ElGadaref, WadMedani, Shambat, and Halfa). The cumulative rainfall departure (CRD) method was used to partition the entire period of rainfall records into sub-periods that present distinct change in either direction or magnitude of the trend. The statistical analysis proved that the trend of rainfall (1940 to 2004) of WadMedani and Shambat is significantly declining, while for Halfa (decreasing) and ElGadaref (increasing) the trend is not significant. At Shambat and WadMedani the CRD indicate a decreasing trend from 1968 to 1987, followed by rainfall close to the long-term mean. At ElGadaref there was a decrease during 1971 to 1974 with a recovery during 1975 to 1982 to a rainfall higher than the long-term mean, then another downward turn during 1983 to 1994. At Halfa there is a decrease from 1982 to 1993. These rainfall analyses will be combined with vegetation and other land-use analyses to assess the encroachment of the desert in the Butana.

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Poster # 10

### **A long-term study of the fish community of the East Kleinemonde Estuary, South Africa, with implications for global warming**

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Little is known about long-term changes in estuarine fish populations, and related environmental variations. As part of a long-term sampling programme, initiated in 1994, the fishes of the intermittently open East Kleinemonde Estuary have been sampled bi-annually, in summer and winter, using seine and gill nets. A total of 18 families, represented by 33 species were recorded between December 1994 and July 2005. In terms of the number of fish recorded the ten most

abundant species caught were *Gillchristella aestuaria*, *Atherina breviceps*, *Rhabdosargus holubi*, *Glossogobius callidus*, *Myxus capensis*, *Monodactylus falciformis*, *Oreochromis mossambicus*, *Liza richardsonii*, *Liza dumerili* and *Lithognathus lithognathus*. These species were consistently recorded in catches each year, but CPUE varied on an annual basis and this can often be related to mouth state. Canonical correspondence analysis indicated long-term changes in community composition, with canonical axes strongly correlated with the number of overwash events recorded in summer and the number of days the mouth was open in spring. Indicative of a warming trend, four new species of tropical fishes were recorded in the catches from 1999 onwards. *Valamugil cunnesius* and *Valamugil robustus*, which are primarily tropical species, were recorded in catches almost every year after 1999. Mean annual sea temperatures recorded at Port Alfred and East London have been increasing steadily during the past decade and this has facilitated the southward extension of tropical marine species into the warm temperate biogeographic zone. This study highlights the importance of long-term studies to understanding community changes in estuaries caused by local or global environmental variations.

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Poster # 11

### **A regional scale passive monitoring study of SO<sub>2</sub>, NO<sub>x</sub> and O<sub>3</sub>**

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Concerns on the receiving environment have been expressed about short and cumulative long term impacts of trace gases emitted from industrial Highveld. Previous investigations focused intensively on areas close to the sources major point sources in the Highveld region itself. To assess potential longer-term cumulative impacts on the environment on a regional scale, a study has been initiated to monitor trace gases using passive diffusive sampling. The study area extends over 300 km from major sources and includes most of Limpopo, the Free State and Kwa-Zulu Natal Provinces. A network of 30 monitoring sites for SO<sub>2</sub> has been operating since January 2005 and in September 2005, the number of sites was increased to 37 and samplers for NO<sub>x</sub> and O<sub>3</sub> were incorporated. In addition to trace gases, samples for measurements of sulphur (S), nitrogen (N) and carbon (C) intake by soil and vegetation were collected at each site (September 2005).

Expected outcomes of this monitoring study will include assessments of background and cumulative effects of gaseous emissions, concentration and spatial distribution maps of acid precursors (S and N compounds) as well as ground O<sub>3</sub> over potentially sensitive residential, agricultural, forestry and tourist regions. Results will be validated against air dispersion models and satellite remote sensing observations. Ecosystems sensitivity to acidification will be assessed from mappings of critical loadings and temporal levels of these trace gases. A number of sites (~5-10) will be recommended for long term environmental observation network after the project is completed.

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Poster # 12

### **An assessment of land degradation in the Save Catchment of Zimbabwe**

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Lack of relevant and reliable baseline information on land degradation has been cited as a hindrance towards addressing its mitigation, hindering policy formulation in efforts to assist the affected areas and people. Identification of areas susceptible to degradation and the people affected is imperative in addressing concerns about this phenomenon. This study demonstrates the importance of baseline data and the effectiveness of remote sensing and GIS technologies as tools for the production of baseline data and/or monitoring of land degradation. GIS and remote sensing technologies were applied to detect and map susceptibility to land degradation in Buhera District, a part of the Save Catchment in Zimbabwe. Due to its capabilities to measure soil and vegetation moisture, remote sensing has evolved to become a very popular tool for measuring and monitoring land degradation. In this study, two sets of Landsat TM and ETM imagery for 1992 and 2002 were used. Three remote sensing techniques were applied for change detection, supervised and unsupervised classification with image differencing and thresholding as well as change vector analysis. Vegetation status was determined using the NDVI technique. GIS analysis using the created degradation status map, agro-ecological zones, topographic data and population density was conducted. The results of the study identified five preliminary broad categories of degradation risk ranging from very high to low. These findings could be used for planning of interventions, assessment and monitoring of degradation. Future work is recommended to further refine how this data will be used for local level planning.

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Poster # 13

### **The establishment of the long-term rainfall trends in the annual rainfall patterns in the Jonkershoek Valley, Western Cape, South Africa**

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The objective of this study is to establish whether there is a long-term decline of precipitation in all rainfall gauges within the Jonkershoek Valley, and to determine whether the rainfall relationship between the different gauges has changed over time. This will allow an assessment of the nature of possible changes of climate at the mesoscale level and reduce uncertainty about the causes of that change. There is a considerable amount of uncertainty of how global climate change will affect the climate of the Western Cape. Modellers have made predictions but these need to be verified by reference to observed data. Groups of rain gauges with long data sets are useful for undertaking this verification, but the relationship between the gauges within the group needs to be understood first. This study attempts to establish that relationship. Steep rainfall gradients in Jonkershoek Valley are tightly linked to topography and altitude; changes in observed rainfall may be the result of a shift in the direction of rainfall-producing weather systems that approach the Western Cape. The effect of these changes could be to change spatial orientation of rain shadows, these changes may be responsible for the observed decline of rainfall in a limited number of rain gauges.

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Poster # 14

### **The assessment of groundwater quality in the Kutama/Sinthumule area, Limpopo Province**

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In rural areas in South Africa, people rely on untreated water from surface and groundwater sources such as springs, rivers, wells and boreholes for domestic use. The people assume that the water is safe. However, this is not always true. By definition water is usually considered of good quality for domestic use if certain water quality parameters are within acceptable levels of concentrations according to World Health Organization (WHO) or Department of Water and Forestry (DWA) recommendations. The Kutama/Sinthumule rural area relies solely on groundwater for drinking water. Some elderly people in this rural area have brown teeth. The browning of teeth is known to be associated with high fluoride concentrations in drinking water. This study was carried out to assess the quality of groundwater in the rural area. Both chemical and physical characteristics of the groundwater were investigated. This was done during the winter and summer months to check any seasonal trends. The results of the chemical analyses generally showed that the concentration levels of all parameters (e.g. Fluoride, chloride, magnesium, potassium, and sodium) except for nitrates (NO<sub>3</sub>) were within DWA limits for drinking water. The concentration levels of fluoride in the groundwater show that the browning of teeth in some of the elderly people in the area is not due to groundwater consumption. The range of nitrate concentration values in the groundwater was 41-231mg/l whilst the DWA limit is 44mg/l. The source of nitrates is most likely from pit latrines and agricultural practices. Differences in contamination of groundwater by nitrates are greatly influenced by the type of soil, the underlying geology and the climate in the study area.

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Poster # 15

### **Using remote sensing to assess the influence of burn frequency on vegetation growth in response to rainfall, in Pilanesberg National Park**

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The aim was to test how areas of a particular vegetation type, each having experienced different burning frequencies, respond to a single rainfall event. The response was quantified using a single 16-day composite enhanced vegetation index (EVI) derived from MODIS. A burn frequency map was created using four years of data vegetation types assigned to particular burn frequencies. Five vegetation types were chosen and reclassified according to the Walker Cover Scale. The mean EVI of each vegetation type polygon was calculated and used to carry out an ANOVA analysis within and between vegetation type polygons. There are significantly different responses in EVI between areas burnt and those not burnt during the study period. We were generally unable to distinguish between different responses occurring within vegetation cover types between different burn frequencies and between cover types within burn frequencies. Vegetation growth occurs in the 16-day period over which the EVI values are averaged and so not all pixels represent identical temporal responses. Daily images, which were unavailable at the time, might address this problem. The fact that

structurally different vegetation types have different growth rates may have contributed to the lack of differences found within and between cover types and burn frequencies. Resource distribution is fundamental in governing the movement and distribution of herbivores and so techniques that can model this distribution in a spatial heterogeneous landscape are critical for an improved understanding of wildlife distribution and management of wildlife resources.

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Poster # 16

### **Adaptation of trees to the urban environment: *Acacia karroo* in Potchefstroom, South Africa.**

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Urban open spaces are of strategic importance for the quality of life of our increasingly urbanised society. Trees and related vegetation within the communities and cities are planted and managed to create or add value to the busy lives of the city dwellers. Trees in towns and cities provide significant ecosystem services and benefits, for example; decrease air temperature and water runoff, carbon sequestration and an increase in human health. Trees are a solar-powered technology that can help restore balance to dysfunctional urban ecosystems and connect people to nature and to each other. The urban environment puts a tremendous strain on trees by trenching and limiting root growth. The problem is the unknown extent of the impact of urbanisation on trees in our community. The aim of this investigation was to assess the overall anthropogenic and environmental impacts on urban trees by measuring the tree vitality of *Acacia karroo* using chlorophyll fluorescence kinetics (JIP-test) and leaf water potential using a pressure chamber. Tree vitality measurements were correlated with soil physical and chemical data. A comparative study using an urbanization gradient approach is followed in which results of trees in rural areas are regarded as controls. According to Pickett et al. (1997) the urbanization gradient provides a background for questions of ecological structure and function. Additionally a model to determine the value of trees in urban environments (SATAM) was tested. All this information would eventually contribute to develop an urban tree management programme for Potchefstroom.

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Poster # 17

### **Distribution and dynamics of grasslands and succulent shrublands along the ecotone between the Nama- and Succulent Karoo biomes**

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Ecotones are recognised as sensitive indicators of global change and thus ecological monitoring along these areas is of high priority. The ecotone between the predominantly winter rainfall Succulent Karoo and the summer rainfall Nama-Karoo biomes is characterised by C<sub>4</sub> grasses typical of the summer rainfall Nama-Karoo and succulent shrubs that predominantly grow in the winter rainfall Succulent Karoo. These two growth forms occur as either segregated adjacent communities or intermingle in one community. To obtain an ecological understanding of this community structure, we study soil parameters across gradients of grass and succulent shrub communities, and the role of competition in these communities. Competition was examined using Nearest-neighbour analysis, and a field experiment investigating the competitive interactions between adult *Ruschia robusta* shrubs and the grass *Stipagrostis brevifolia* on seedlings of conspecific and interspecific species. Preliminary results show that organic content and soil texture are the main factors in differentiating between *S. brevifolia* and *R. robusta* communities. Results from nearest neighbour analysis shows the evidence of competitive relationship between *S. brevifolia* and *R. robusta*, with *S. brevifolia* exerting a stronger competitive impact. *S. brevifolia* seedlings did not establish in *R. robusta* shrubland and competition did not matter in this regard, but competition was important in preventing the establishment of *R. robusta* seedlings in *S. brevifolia* grassland. Disjunct communities of grass and succulent shrubs are thus a result of both habitat preference (in the case of *S. brevifolia* unable to colonise *R. robusta* shrublands) and competitive exclusion of *R. robusta* in grasslands by *S. brevifolia*. In intermediate communities where both grass and succulent shrubs co-exist, the observed stronger competitive impact on *R. robusta* from *S. brevifolia* could lead to the dominance of grasslands at the ecotone. We are currently employing remote sensing techniques to investigate how the distribution of grasses and succulent shrubs has changed over the past years.

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Poster # 18

## Harmful algal blooms: A potential conservation problem in the Benguela Upwelling System?

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Because Harmful Algal Bloom events (HABs) may lead to catastrophic mortality over a range of trophic levels and also impact on fisheries, local species populations, conservation management and human health, any increase in frequency and/or toxicity of these events is of global concern. Recently this concern has been realised with reported increases in the frequency of HABs from all continents except Antarctica. A review of the literature concerning this apparent increase is supported by occurrences along the Benguela coast of western South Africa, where since 1930 there has been a slight increase in the severity of HABs and a significant increase in their frequency: since the 1960s there has been a six-fold increase in the number of HABs per decade with the period 1990-2005 experiencing the greatest number of HABs as well as the most severe in terms of associated mortality. The recent occurrence of previously unrecorded species in this region may go some way to explain this and suggests that this increase is unlikely to slow in the near future. Toxic events may have far-reaching conservation implications for coastal birds, particularly those with a shellfish diet. The African Black Oystercatcher (*Haematopus moquini*) listed as near-threatened according to the IUCN's 2004 red list, has been subject to long-term conservation efforts. One HAB event in 1978 led to the death of more than 50% of local populations, and an increase in HAB severity and/or frequency could threaten these and other coastal bird species. A model built investigating the potential impact of increasingly frequent and severe HABs on island and mainland populations of oystercatchers reveals resilience to infrequent HABs affecting up to 30% of the population. Thereafter, increasing frequency and toxicity indicate a decline in numbers and high probability of extinction. Mainland populations of oystercatchers appear more vulnerable than island populations primarily because of their lower reproductive output.

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Poster # 19

### Demographic profile of marula trees inside and outside an elephant enclosure

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This project is part of a research effort to model the effect of elephant browsing on the marula trees. The model requires data on growth, recruitment and mortality of marula trees. The research was undertaken in the Kruger National Park. The study areas were selected in nkuhlu enclosure close to Skukuza and the buffalo enclosure close to Satara. The buffalo enclosure is found in *Sclerocarya caffra*/*Acacia nigrescens* landscape on basalt and the nkuhlu enclosure is found in the thickets of the Sabie and Crocodile landscape on granite. The objective of this study is to determine the size structure of marula tree, and the size class of marula prone to browsing by elephant. The results can be used to quantify the elephant damage to the marula population in the Kruger National Park. Modeling will be necessary to determine when structural diversity of the marula population in the *Sclerocarya caffra*/*Acacia nigrescens* and the thickets of the Sabie and Crocodile landscapes is being lost; and clear threshold of potential concern would be formulated against such change can be measured in order to revise certain management practice where necessary to protect marula tree species in the Kruger National Park

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Poster # 20

### The evaluation of veld condition after the eradication of *Rhigozum trichotomum* in the southern Kalahari, South Africa

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Extreme cases of rangeland degradation are visible in the Kalahari. Dunes become bare, while interdune areas are invaded by the shrub *Rhigozum trichotomum*. These plants increase to very high densities where the grass layer is removed, and can suppress grass germination once established. *Rhigozum trichotomum* productivity is low and the shrub contributes very little to grazing capacity. In this study four different *R. trichotomum* encroached sites were treated with herbicide over a period of ten years. After treatment the areas were managed through a rotational grazing system. Linepoint surveys were conducted to determine the species composition of the different sites. Results show that the degraded area is visibly recovering following only one year after the control of the shrubs. Two years after the application of the herbicide the annual grass species, *Schmidtia kalihariensis*, shows a high abundance in the treated area, while the climax perennials, *Stipagrostis ciliata*, *S. obtusa* and *Centropodia glauca* occurs in the five years and ten years after treatment sites. The occurrence as well as the distribution of these climax species in the five and ten year sites increases the grazing capacity in the study area from 257 ha/LSU to 32 ha/LSU. From the results of this study it is clear that after

the eradication of *R. trichotomum* shrubs and with good management strategies natural grazing areas in the Kalahari can be restored to such an extent that it can be utilized by the land user within a period of five years.

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Poster # 21

### **Ndlovu Node: the establishment of an environmental science outreach program**

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Having been initiated in 2004, the environmental science outreach program has been a keystone activity in the growing SAEON Ndlovu Node. Developing the program to its current state has required going through a number of stages. This poster will take readers through the developmental stages to the current status where we are engaged in a set of activities that are couched within an environmental science outreach strategy. The strategy outlines ways of addressing the legacy of poor information, knowledge and, in some cases, skills available to educators as well as providing opportunities for learners to engage in practical environmental science projects. In addition the programme actively seeks to promote national initiatives such as National Science Week where educators learners and the general public are exposed to presentations and displays of local science in action. This is, of course, too much for the node staff and the poster will present ways in which we have leveraged resources through partnerships.

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Poster # 22

### **Ndlovu Node: a logic for determining a core site for long-term monitoring**

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The mandate of the SAEON Technical Steering Committee is establish a core monitoring site at each node. It is envisaged that this site (approximately 1km<sup>2</sup>) will serve as the focus of intensive monitoring conducted by node staff and will provide long-term data sets to the public at large. There are a number of criteria that this core site should meet in terms of representivity, logistically accessible, security of tenure etc. However, the mandate is broad. This poster details the process that has been adopted and the logic that has been developed to narrow the options down to the final site (or possibly two sites). It details an interactive GIS process (not unlike conservation planning processes) where inappropriate sites are excluded as well as stakeholder workshops where the benefits of the remaining areas (such as existing legacy data) are maximised.

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Poster # 23

### **limbovane: Exploring South African biodiversity and change**

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The limbovane Project is for Grade 10 life science learners based within the National Curriculum Statement (NCS). The project will assist Grade 10 teachers and learners to implement the NCS, by providing them with the tools and know-how to implement a project in the outdoors and to collect their own data that can be used in the classroom using information technology. Learners collect ants in pristine and/or modified environments. Data will be shared among the ten schools taking part in the project. Schools receive a reference collection, a microscope, a computer and an electronic key to identify the ants. In conjunction with the schools project, a team from the Universities of Sheffield and Stellenbosch will be collecting ant data from additional pristine and disturbed sites in the Western Cape. Close to each school a control site in a nature reserve has been selected. Additional pristine sites were selected so that pristine sites form two East-West transects through the fynbos biome and Nama-Karoo respectively. Ants will be collected using pitfall traps in March and October each year till 2015. The project will provide baseline data on patterns of ant distribution. Data will be used to examine how ant species composition is related to factors like rainfall patterns, vegetation structure and habitat modifications. The fynbos biome is expected to be heavily impacted by environmental change over the next 50 years. As the data from the limbovane project is spatially explicit and temporally replicated, it can be used to assess these changes.

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Poster # 24



## Long-term variability of protected inshore linefish populations in the Tsitsikamma National Park marine protected area – implications for monitoring programmes

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The Tsitsikamma National Park (TNP) is the oldest, and one of the largest (320 km<sup>2</sup>), 'no-take' Marine Protected Areas in Africa. After 40 years of protection, fish communities in the TNP provide the best example of pre-exploitation inshore ecosystems available today. An important function of the TNP is the protection of reef fishes, the most critically depleted component of South Africa's linefishery. A declared state of emergency in this fishery has precipitated a number of restrictions aimed at recovering fish density and ecological balance. It is therefore essential to get reliable information on population parameters to evaluate the effectiveness of these measures. An ongoing, high-resolution tagging, catch and effort survey within a research fishing area (ca. 5 km of coastline) of the TNP started in 1995. Since then, more than 13,000 fish have been caught while fishing effort was stratified over both temporal (seasonally and annually) and spatial (habitat type) scales. Using this dataset, generalised linear models (GLMs) identified high levels of natural variability in population structure over time. Although environmental and abiotic factors were measured, they could not completely explain the observed inter-annual differences in fish densities and sizes. The results suggest that monitoring programmes of marine inshore resources must exceed five years to obtain reliable information.

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Poster # 25

## Monitoring the acid-base properties of South Africa's freshwater ecosystems: A need for revised protocols

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Acidification is considered the most important of the primary chemical stresses in freshwater ecosystems. Environmental acidification results from both natural causes, including for example the labilisation of organic acids excreted by vegetation in catchments, and anthropogenic causes such as agricultural activity and industrial pollution. Although there are existing Department of Water Affairs and Forestry (DWAF) long-term water quality records of pH and other chemical properties of South Africa's river systems and dams, these records have not been used to investigate long-term trends and changes. It is critical that such attempts be made, particularly in regards to establishing critical loads in freshwater ecosystems. Critical loads have been defined as "the highest load that will not cause chemical changes leading to long-term harmful effects in the most sensitive ecological systems". An evaluation of DWAF's monitoring records show a significant temporal shift in river water pH values across South Africa at around 1990. Since then average river water pH values are higher than before across South Africa, in some cases by as much as 1.5 pH units. In addition, the amplitude of the seasonal signal is reduced and the degree of geographic variability observed is smaller. It is difficult to conceive of a controlling factor, either natural or anthropogenic, that would have induced such a dramatic shift in pH across such varied monitoring sites. The most likely explanation for the observed shift in the pH of South Africa's freshwater ecosystems lies in revised pH measuring protocols introduced by the DWAF during the late 1980's to early 1990's. The new protocols prescribe the lab-measurement of pH on HgCl<sub>2</sub>-poisoned samples. pH is the most non-conservative of water properties and anything but *in situ* measurements will yield erroneous results. The implication is that, currently, the pH status of South Africa's freshwater system is not correctly monitored and is therefore unknown. In order to re-establish reliable records that can be used to establish and monitor critical ecosystem parameters such as degree of acidification, current measurement protocols need to be reconsidered.

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Poster # 26

## Data and knowledge management in BIOTA AFRICA

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BIOTA AFRICA (BIODiversity Monitoring Transect Analysis in Africa) represents an integrated, transdisciplinary research approach for sustainable use and conservation of biodiversity in Africa. BIOTA AFRICA aims to make valid scientific statements about the current status and future development of the biodiversity in hot spot areas of the African continent. For this ambitious objective it is necessary to achieve an absolutely reliable data foundation. Ongoing research activities create a high amount of information, being interesting not only for single working groups or disciplines, but for numerous user communities. Therefore data have to be managed under the aspect of sustainability and to be protected from any

chance of loss. Knowledge management supports the process of collecting, refining and supplying of knowledge in BIOTA AFRICA.

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Poster # 27

### **New AgroMet WebBank**

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Climate and weather data form the backbone of applied Agrometeorology. Currently, well-developed networks of climate monitoring exist in South Africa and the ARC-ISCW has developed the AgroMet Climate Databank, which forms the foundation of many research activities and advisory services in both the public and private sectors. Climate data is obtained from various climate-monitoring organisations across the country. These include the ARC-ISCW climate-monitoring network, the South African Weather Service, the Department of Water Affairs and Forestry, commodity research stations, universities, private landowners and other sources. Data in the Climate Databank spans a period of over 100 years, from 1900 to the present. At the end of 2004 the ARC-ISCW AgroMet Division identified the need to develop a sleeker, faster and more user-friendly database and the current AgroMet WebBank came into being. The AgroMet WebBank consists of an Informix database server, Web Mathematica for calculations and a Java graphical user interface (GUI). The ultimate goal of the ARC-ISCW system upgrade is to provide timely weather data to researchers and the agricultural community, particularly the resource poor rural farmers, in support of the utilisation of the region's fragile environmental resources. The WebBank was not only developed as a data management system, but also to have the functionality to calculate an assortment of applicable statistics, indices and algorithms. Mainly agricultural managers, consultants and individual farmers use this information, but being web-based, it will be accessible to anyone with an interest in climate information. This presentation aims to give an overview of the functionality of the ARC-ISCW AgroMet WebBank.

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Poster # 28

### **ARC-ISCW national weather station network**

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Climate data has become an absolutely essential into agricultural research, various crop models and every day decision making for farmers. A representative meso-climatic weather station network is therefore of the utmost importance. The AgroMet division of the Institute for Soil, Climate and Water is responsible for the provision of meso-climatic weather data for researchers, the commercial agricultural industry, as well as the small-scale farmer. The current National weather station network consists of 150 mechanical and 326 automatic (electronic) weather stations. A further 96 privately owned automatic weather stations, maintained by AgroMet, currently enhance the coverage of the network, making representative climatic data available for even more locations in the RSA. The long-term goal is to have at least one representative weather station for each homogeneous climate zone in the country.

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Poster # 29

### **ARC-ISCW climate monitoring**

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Reliable and accurate climatic data plays a fundamental role in modern agriculture. To ensure that credible climatic data is collected from a weather station network, instrumentation needs to be maintained and calibrated according to strict guidelines. It is also important to measure relevant parameters to address the needs for research, crop models and decision-making. The weather station network of the Agricultural Research Council's Institute for Soil, Climate and Water consists of mechanical and automatic (electronic) weather stations. Parameters measured include air temperature, relative humidity, solar radiation, wind speed and direction and rainfall. Elements such as reference evapotranspiration, heat units and chill units, as well as certain plant disease indices can be derived from the measured data. Data from mechanical weather stations are recorded manually on a daily basis by observers and posted to the AgroMet office where it is captured, while hourly and daily data from automatic weather stations are collected via a computer and modem, through landlines and GSM networks. A team of 9 technicians situated in regional offices is responsible for installation of

new weather stations according to WMO standards and bi-annual calibration and maintenance of the weather station network, using standard scientific procedures. Any faulty equipment is attended to within 48 hours.

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Poster # 30

### **Mopane woodland utilisation by villagers in the Greater Giyani Municipality, Limpopo Province**

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*Colophospermum mopane* is very important tree to the communities in the Greater Giyani area. However, over-use and mismanagement have deprived these communities from the full range of benefits that they could derive from their surrounding woodland. This study monitored the utilisation pattern of mopane, following previous studies. Six villages were sampled in the Greater Giyani Municipality and a total of 180 villagers were interviewed. The questionnaire targeted three sections of the community, namely the local people, the traditional leaders or chiefs and the municipality and private sector. The volume of wood used for firewood and construction was determined along with the wood used for cooking per family per day, as well as the number of villagers benefiting from selling woodland resource products. Results show that the resource is becoming scarce due to over-utilisation, which could result in minor degradation or the total devastation of the surrounding woodlands. Reasons for overuse include poverty, expansion of settlement and cultivation areas, lack of conservation education, lack of woodland management responsibility, an ineffective permit system and the weakening of traditional leaders' authority. Recommendations from the study include village-based environmental awareness campaigns, efficient use of woodland products and the amendment of the permit system to benefit the communities. In addition, relevant conservation departments need to cooperate with the private sectors and NGOs for training of existing staff in the field of biodiversity management and must encourage the sharing of biodiversity information.

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Poster # 31

### **Seasonal and inter-annual photosynthetic response of representative C<sub>4</sub> species to soil water content and leaf nutrient availability across a tropical seasonal floodplain**

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Fresh-water wetlands in semi-arid regions witness surface flooding as well as very dry soils, and rapid switches between short rainfall periods and dry spells during the rainy season - all with a seasonal, often unpredictable, spatial and temporal pattern. We studied gas exchange parameters of three C<sub>4</sub> perennial species, *Cyperus articulatus*, *Panicum repens* and *Imperata cylindrica* to environmental variables that regulate the seasonal leaf CO<sub>2</sub> and water fluxes, to determine the comparative physiological responses of plants that represent a particular microhabitat in a seasonal tropical floodplain in the Okavango River Delta in northern Botswana. For all three species, light-saturated net photosynthetic rates ( $A_{\text{sat}}$ ) and stomatal conductance ( $g_{\text{sat}}$ ) decreased with decreasing soil water content with a seasonal range for  $A_{\text{sat}}$  of approximately 5-45 mol m<sup>-2</sup> s<sup>-1</sup>, and in  $g_{\text{sat}}$  of 0.03-0.35 mol m<sup>-2</sup> s<sup>-1</sup>. The species representing the wettest microhabitat (*Cyperus*) had comparatively highest stomatal conductance ( $g_s$ ) at low leaf-to-air vapour pressure deficit ( $D$ ), highest rate of change as well as highest ratios of intercellular to ambient CO<sub>2</sub> concentration ( $C_i/C_a$ ) indicative for its adaptation to a moist growth environment that allows for non-conservative water use strategies. For all three species there were significant variations in photosynthesis fluxes from one year to another that were best associated with inter-annual variations in foliar N and P contents.

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Poster # 32

### **A knowledge geoportal framework**

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The CSIR Collaborative Spatial Analysis and Modeling Platform (CoSAMP) project developed the notion of a Knowledge Geoportal, extending the typical concept of a geoportal, whereby geoinformation and services are discovered and accessed from a central place, usually on the Internet. We propose that geospatial and associated contextual knowledge artifacts, such as documents, guidelines, process methodologies, tools and services should be made available in a similar 'onestop' fashion. This becomes particularly useful if consumers of geoinformation and services are inexperienced in the use thereof. To this end, the CoSAMP project has developed a web-based framework for organising, accessing and reusing knowledge artifacts related to geospatial information harnessing, analysis and modeling. One of the most important aspects of this framework is the concept of a workbench – a virtual container for grouping and organising knowledge artifacts along a particular theme. An example of a workbench is a place on the Knowledge Geoportal where a

user could locate and access knowledge about the processes of, and tools for searching for, discovering, verifying and composing spatial datasets into a useful analysis environment. A workbench of this nature would be termed a 'Geoassembly workbench'. This poster presents the workbench model, illustrating it with content from the CoSAMP point of view. It is believed that the workbench concept is extensible to other knowledge environments, notably SAEON, where knowledge concerning discovery of, access to and good practice in the usage of environmental monitoring information (including geoinformation) should be conspicuously available.

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Poster # 33

### **The SAEON Graduate Student Network**

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The SAEON Graduate Student Network was recently launched with its website ([www.saeon.ac.za/students/](http://www.saeon.ac.za/students/)), and currently membership stands at about 40 students. An interim committee manages the network and is planning the way forward for the student network, based on a working constitution. The first activity of the network is a one-day workshop to be held a day after the SAEON Summit. The main aims of the SAEON Graduate Student Network are to make students more knowledgeable about SAEON's programmes, to encourage students to align their research with SAEON's programmes, to stimulate and promote interactions among graduate students and between students and senior scientists, within the realm of long-term environmental research, to provide a network in which graduate students can 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, and to inform graduate students of career opportunities as they become available.

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Poster # 34

### **Evaluating the effect of rainfall on the above-ground net primary productivity of two South African grasslands using long-term data**

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Annual net primary productivity (ANPP) is a fundamental characteristic of all ecosystems, but the determinants of ANPP are poorly understood. In grasslands and savannas, ANPP is particularly important as the growth of grass communities provides forage for both livestock and indigenous grazers. Long-term studies in the USA have revealed that grassland ANPP is more variable (from year to year) than in other biomes, and that while ANPP is primarily controlled by rainfall, the effect of annual rainfall on ANPP is usually weak. This has led to speculation that variability in the timing of rainfall within the growing season may be more important than total rainfall. With global climate models predicting changes in the timing of rainfall events for most of the world's grassland and savanna regions, understanding the effect of rainfall timing is now of greater interest. In South Africa, the relationship between rainfall and grassland ANPP has been limited to a few short-term studies. However, ANPP has been measured in two rangelands experiments in South Africa for several decades. Data obtained from these experiments enabled a thorough analysis of the effect of rainfall on grassland ANPP. Thirty years' data were obtained from the Ukalinga "veld fertilization trial" initiated at Pietermaritzburg in 1950, and 27 years' data from a veld condition experiment initiated near Bloemfontein in 1977. Bloemfontein, the drier site, showed a greater annual variation in ANPP (CV = 54%) than Ukalinga (CV = 26%) as expected. There was a stronger correlation of ANPP with annual rainfall at Bloemfontein, although this relationship was weak at both sites ( $r = 0.46$  for Bloemfontein,  $r = 0.22$  for Ukalinga). A measure of rainfall timing (the average length of intervals between rainfall events) had a stronger correlation with ANPP than annual rainfall for Ukalinga and, when combined with rainfall amount, explained significantly more of the variation in ANPP at both sites ( $r^2 = 0.71$  for Bloemfontein,  $r^2 = 0.38$  for Ukalinga). Other novel results obtained were a lack of importance of previous year's rainfall, and the redundancy of large rainfall events. These results reveal the value of long-term experiments for understanding fundamental ecosystem processes. Data spanning many decades were necessary to disentangle the effects of closely related environmental variables (rainfall amount and rainfall timing). Furthermore, the patterns established from these experiments provide a rare yardstick to assess the effects of predicted climate changes on South Africa's grasslands.

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Poster # 35

## An agent-based reference model architecture for sensor web enablement

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Understanding the behaviour of ecosystems requires persistent and multi-modal observation. Advances in sensor technology and distributed computing, coupled with the development of open standards that facilitate sensor/sensor network interoperability, are contributing to the emergence of a phenomenon known as the "Sensor Web". The Sensor Web can be described as a "System of Systems" in which different sensors and sensor networks are combined to create a macro-instrument with massive and pervasive sensing capability. In this poster, we present an agent-based reference architecture that uses emerging open geospatial consortium standards and specifications for sensor web enablement. Agent-based architectures address semantic interoperability better than pure service-oriented architectures and are thus more reusable. Our reference architecture models the spatial data infrastructure that underpins the Sensor Web and can serve as a template for both the SA Environmental Observation Network (SAEON) and South African Earth Observation System (SAEOS).

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Poster # 36

## The land type survey: A national information system of soil, terrain and macro-climate resources of South Africa

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The Land Type Survey is the only national coverage of soils, terrain form and macro-climate of South Africa. The Agricultural Research Council's Institute for Soil, Climate and Water (ARC-ISCW) information is maintained as a national asset by the It is available in the public domain in both hard copy and electronic digital formats. The information has been gathered by soil scientists and support staff over 30 years. It is carefully documented into land type maps, memoir books, and in digital formats. The information system comprises 7 200 land type polygons, each supported by extensive field observation of soils, with demarcation of terrain forms and macro-climates. Soil scientists have systematically traversed South Africa classifying, describing and sampling soils. Maps compiled by demarcating areas of uniform soil pattern are supported by soil, terrain and macro-climate information. The information has found widespread applications in many disciplines ranging from agricultural science, hydrology, environmental planning to those of the natural and built environments. The poster displays the Land Type Information System in broad soil patterns of South Africa in selected land type maps, in supporting soil information, and is illustrated with selected applications. Readers are encouraged to examine how it may be used in their disciplines.

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Poster # 37

## The ARC-ISCW Coarse Resolution Imagery Database

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ARC-ISCW has an archive of daily NOAA AVHRR data from 1985 to 2004. This database includes all 5 bands, the NDVI, Active Fire, and LST images. The NOAA data are used, for example, for crop production and grazing capacity estimation. MODIS data is distributed by the LP-DAAC, located at the U.S. Geological Survey's EROS Data Center. ARC-ISCW has an archive of 16-day MODIS data from 2000 to the present. This database include 16-day composites for the NDVI, RED, BLUE, MIR and NIR bands and the EVI. Other products include Nett Photosynthesis, LAI, Active Fire data and FPAR. SPOT NDVI data is provided courtesy of the VEGETATION Programme and the VGT4AFRICA project. ARC-ISCW has an archive of VEGETATION data from 1998 to the present. Other products distributed through VGT4AFRICA and GEOSUCCESS include NPP, Normalized Difference Wetness Index and Dry Matter Productivity data. Data have recently become available from the MSG SEVIRI satellite. The ARC-ISCW investigated the potential for the development of products for application in agriculture. NDVI, LST and cloud cover products were some of the initial products derived from the MSG SEVIRI data. Other products derived from MSG used weather station data. These include air temperature, air humidity and solar radiation. Information gathered from these databases is disseminated through the Umlindi newsletter to government, private organizations and the public. The information is presented at the Crop Estimates Committee once a month as well as the National Agrometeorological Committee every three months. The AGIS Development Centre is currently developing a web-based system that will provide access to all the satellite imagery archived at the ARC-ISCW.

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Poster # 38

## Global warming and fish signals from the Mngazana estuary

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The Mngazana Estuary (31°41'29"S; 29°25'24"E) is situated close to the boundary between the subtropical and warm-temperate biogeographic zones for fishes. Summer and winter fish surveys in the Mngazana during 1975-1977 are compared to more recent surveys in the same estuary during 2001-2002 (Mbande et al 2005). Results from both studies indicated that overall the tropical species dominated the ichthyofauna, especially during summer, with temperate taxa showing a trend of increased diversity during winter. Branch & Grindley, commenting on the 1975-1977 surveys, suggested that these seasonal changes in composition were linked to tropical species extending their distribution southwards during summer and temperate species moving northwards in the winter months. Although this pattern was repeated on a much reduced scale in 2001-2002, there is increasing evidence that both the proportion and variety of tropical species moving into the Mngazana Estuary during summer and remaining in the system during winter has increased, and that the proportion and variety of temperate fishes entering this system during either summer or winter in recent years has declined. Although there are some data which points to increasing marine and estuarine water temperatures in the region, the extent to which these changes account for the altered patterns in fish distribution is unknown. If the above trends continue then we predict that the subtropical/warm-temperate boundary will move southwards, thus increasing the range of tropical/subtropical fish taxa and diminishing the range of more temperate/endemic species.

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Poster 39 – 44: SAEON outreach projects

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Poster # 45

## Changes in plant available nitrogen with changes in available water in a mesic savanna

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Savannas are highly dynamic and complex ecosystems. Factors that drive the savanna system interact, making it difficult to identify and quantify the key determinants. The phenomenon of grass and tree co-occurrence in the savanna has attracted much attention from researchers throughout the years. Factors such as fire, water availability, herbivory and competition have been investigated to test their effect as drivers of the savanna. However the role of nutrients in the savanna has not received much attention. This study tests how changes in available water affect changes in nitrogen availability to plants, and ultimately nutrient stores in plants. Data on grass and tree growth in response to varying levels of soil moisture, coupled with data on available nutrients would inform us as to the importance of nutrients or water as a driver in savanna systems. Data on nitrogen mineralisation is collected on a monthly basis to capture the seasonal differences and the impact on the growth of plants. Preliminary results of an experiment where various combinations of trees and grasses are exposed to different rainfall and competition treatments are reported. Measures of available water and nutrients as well as plant phenology are determined under these different conditions. The preliminary results show that treatments with additional rainfall have higher mineralisation rates than those treatments where rainfall is reduced. Treatments with different combinations of grass and tree also showed differences in mineralization rates. These results suggest that it is a complex interplay between nutrients and water that are essential for plant growth in savanna systems.

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Poster # 46

## Mapping South African wetlands regardless of their different classifications

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South Africa, as a signatory member of the International Convention on Wetlands (Ramsar, Iran, 1971), committed itself to the management, wise use and protection of its wetland resources. A pilot study was completed within different

catchment areas in 2000. Wetland enhancement was missed during the land-cover mapping and therefore project-based Landsat that has a 30m resolution was used. The proposed model improves on mapping of wetlands. It does not map the boundaries exactly, but rather its potential wetland areas. Satellite images (SPOT or IKONOS) are free and the use of these data and information helps in enhancing and achieving the required minimum wetland-mapping standard. High-resolution pixels are used to monitor environmental impact on wetlands (i.e. impacts from mining and farming). Images that are appropriate for use need to be clearly identified and dated. Two satellite images were used to check differences between season in regions and that is why Landsat 5 Thematic Mapper (TM) and Landsat 7 Enhanced Thematic Mapper (ETM+) was used. Classification of images to derive a basic land-cover map was done and GIS-modelling to mask out other classes for example marshes to get an output was run using unsupervised classification. Pre-selected land-cover classes were used to predict where wetlands are likely to occur i.e. shrubland. The matrix was used to change wetland attributes to verify the data collected. Image processing with more object types needs to be done and mapping boundary policy needs to be adopted/developed.

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Poster # 47

### **The long-term response of Karoo vegetation to nitrogen and potassium additions at Tierberg Karoo Research Centre**

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The distinctive vegetation on termitaria in the Succulent Karoo is attributed to nutrient enrichment and physical disturbance of the soil by termites and other animals. We tested the hypothesis that nitrogen enrichment alone may lead to changes in plant community composition in the Succulent Karoo. Bi-annual applications of the nutrients nitrogen (N), potassium (K) and N plus K in 100 kg ha<sup>-1</sup> doses were applied to succulent shrub land over an 8 year period. Variables measured were live and dead cover, bare ground, rainfall, species composition and species richness. After 8 years of fertilisation, the treatment plots including nitrogen (N and N/K treatments) experienced significant increases in live cover ( $p < 0.05$ ), while dead cover was found to be significantly different across all treatment types ( $p < 0.01$ ). Annual variation in live cover within control and K plots was found to be significantly correlated with precipitation totalled six months prior to sampling ( $p < 0.05$  and  $p < 0.05$  respectively). Rainfall could not significantly account for live cover within N or N and K plots ( $p = 0.945$  and  $p = 0.940$  respectively). These results confirm that N may be a greater limiting factor for plant growth than rainfall in the semi-arid Karoo. We concluded that the variation in vegetation composition on and off termitaria in part be attributed to nitrogen enrichment. The probable mechanism for this change is that increased nitrogen levels allow weaker competitors for nitrogen to outcompete stronger competitors for other resources such as space or water. This study also has relevance for understanding vegetation changes on other nutrient-enriched patches such as those near water points and in kraals.

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Poster # 48

### **Indicators for the observation of human settlement influences and application to the SAEON nodes**

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The South African Environmental Observation Network (SAEON) came into being in 2003 with the aim of establishing a network of nodes across the country through which to implement long-term earth observation programmes across large spatial scales. It has been proved that it is no longer feasible to study ecological and social systems in isolation and nowadays it is generally realised that the integration of the human element into long-term ecological research is an urgent priority. A new emerging field of study, referred to as 'urban ecology', focuses on the study of 'social-ecological systems'. This poster will focus on a new research study on the inclusion of a human settlement element, focusing on the identification and observation of social-ecological indicators, as an integral part of the project for creating an environmental observation network in South Africa. The primary focus of the research study is the influence of human settlement activities on ecological systems. The way that these activities influence long-term changes, how ecological change influences human populations' way of life, and how to observe this phenomenon, will be addressed. The primary question underlying the research is: what is the best way to deal with the human element in observation science? The poster will highlight the aims and objectives of the study and focus on the research outcomes. The need for the inclusion of the human element in long-term biological observations is an indisputable fact. This research study will address the identification of human settlement indicators within urban ecosystems. The work will also inform discussions on the applicability of the UNESCO biosphere reserve concept to urban areas. The final outcomes of the study will be applicable to SAEON with the view of implementation in relevant SAEON nodes across the country.

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