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The Southern African Science Service Centre for Climate and Land Management (SASSCAL) intervention has grown out of previous science initiatives in Southern Africa and is actively supported by a broad range of stakeholders, aiming to establish it as the REGIONAL driver for innovation and knowledge exchange to enhance adaptive land use, learning and sustainable economic development in Southern Africa under global change conditions. The outcomes are aligned to national strategic priorities as is illustrated through linking each objective to the various medium term strategic framework (MTSF) priorities as outlined. The integration of the full value chain of a Science & Technology development from the acquisition, assimilation, dissemination of information and knowledge, to practical assistance related to its implementation and/or use, is an essential part of SASSCAL's contributions in the form of specific work packages concentrating its activities around a product portfolio which is both contextually relevant and based on the most advanced science available.			
SASSCAL	1. Developing Metrics and Indicators for Understanding Adaptation Progress and Trends **<u>Research Team:</u>** Brian Mantlana – CSIR Motebang Nakin – Walter Sisulu University (Risk and Vulnerability Science Center) Anicia Malebajoe – CSIR Phumza Ntshotsho – CSIR Kabiti Hlekani – Walter Sisulu University (Risk and Vulnerability Science Center) Simbarashe Ndhleve - Walter Sisulu University (Risk and Vulnerability Science Center) **<u>Project Start Date:</u>** 2019 - 2021 **<u>Contacts Details of the Project Leader:</u>** Brian Mantlana BMantlana@csir.co.za 071 518 9137	- The Paris Agreement has increased the profile of climate change adaptation in the global governance of climate change. However, there is little evidence of whether or the extent at which climate change adaptation is actually taking place at national level. This situation exists because there is insufficient attention given to developing tools and methodologies to understand progress that countries are making in climate change adaptation. This absence of tools to understand progress is compounded by the lack of metrics by which actions can be monitored and the lack of standardization in approaches. This project aims to contribute to the development of methodologies for understanding progress made in climate change adaptation by developing a suite of indicators and metrics that can be used over time to track, analyse and reflect progress of climate adaptation in South Africa.	- The outputs of this study is envisioned as a technical document that will provide insights on how to treat comparable adaptation information and data for inclusion and use in the country's Adaptation Communications.

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	2. Palaeoecology, landscape history and biodiversity conservation **Research Team:** Lindsey Gillson (UCT) – Principal Investigator M. Timm Hoffman (UCT) – Co-Investigator Cherie Forbes (UCT) – PhD student Estelle Razanatsoa (UCT) – PDRA Glory Oden (UCT) – PhD Student Sally Archibald (Wits) – Collaborator **Project Start Date:** Start date; 2019 **Contact Details of the Project Leader:** Lindsey Gillson lindsey.gillson@uct.ac.za 0769978422	- No Description	- The aims of the project are: 1) to enhance understanding of changes in biodiversity and ecosystem services over long (centennial – millennial) timescales in African ecosystems using palaeoecology and other long-term data 2) to use this information to develop models that enhance understanding of complex ecosystem dynamics and likely future change, thereby allowing exploration of possible future scenarios with the potential for informing sustainable management decisions.
	3. Rapid and repeatable tools for monitoring and mitigating global change impacts on natural resources (SASSCAL) **Research Team:** Dr Cathy Clarke (Principal Investigator), University of Stellenbosch	- Recent advances in the availability of regularly updated, high resolution remotely-sensed data, combined with advances in computation have made it possible to monitor ecosystems at higher spatial and temporal resolution than previously possible. Much of the focus in research and the development of tools to make use of this new data has been in the forested ecosystems of	- This information will improve our ability to manage and mitigate the impacts of threats such as invasive alien plants, land cover transformation and climatic change.

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	Dr Glenn Moncrieff (Co-Investigator), SAEON Dr Vernon Visser (Co-Investigator), University of Cape Town Dr Andrew Skowno (Co-Investigator), SANBI **Project Start Date:** 2019 **Contact Details of the Project Leader:** Cathy Clarke (cdowding@sun.ac.za)	the northern hemisphere and the tropics, yet more than 90% of South Africa's terrestrial surface is covered by "open" non-forest ecosystems such as shrublands, woodlands and grasslands. Detecting abnormal change in these ecosystems is highly challenging, because the state of the vegetation varies dramatically due to natural disturbances, long-term trends or cyclical functions, such as those relating to fire, postfire recovery, and seasonality. The National Research Foundation funded RReTool project has been co-developed with conservation managers and provincial environmental departments to address information deficits they have identified as critical for their decision-making and land management needs. We are developing open source tools to make full use of the potential of satellite data for monitoring the non-forests ecosystems that dominate South Africa, and to deepen our understanding of how these ecosystems vary in space and time.	
	4. Investment decisions in water and rural development programmes to promote food security and resilience of smallholder farmers in SA- TransForm	- The purpose of this research is to explore the economic, social and institutional conditions that may support smallholder farmers (SHFs) in South Africa to build resilience against climate change, enhance agricultural	- The results of the project will have an impact on the development of the South African economy in the following areas: understanding the socio-economic impacts of climate change, and developing

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	Research Team: Djiby Thiam (PI) Nelson Ndahangwapo (PhD-student) Alfred Apio (PhD-student) Beatrice Manful (PhD-student) Sophie Gebers (MSc-student) Kyla Damonse (MSc-student), all at UCT **Project Start Date:** 2020 **Contact Details of the Project Leader:** Djiby Thiam Email: Djiby.thiam@uct.ac.za	productivity, and promote sustainable farming practices that use water-efficient technologies. South Africa is a water stressed country. Therefore, initiatives that increase the stock of water available in the country and reduce the amount of expenses spent in wastewater treatment are highly relevant to the societal and environmental challenges encountered in the country. Promotion of sustainable farming practices that prevent water scarcity within smallholder farming communities helps not only to address the major economic problems encountered in the country (unemployment, growth, inequality), but also provides the agricultural sector with a stronger ability to remain resilient to drought and major climate variability. Another key aspect of this project will be the investigation of cyclical droughts on SHF sustainability. Throughout the southern African region, we see the debilitating effect of drought on food security, agricultural productivity, and farmer livelihoods.	mechanisms used to adapt to climate change, and achieve food and water security.
	5. Understanding changes in woody resources in South Africa and impact on biodiversity and ecosystem services	- Building on the work done in SASSCAL 1.0, which has developed an operational IT platform to process large amounts of high	- NONE

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	Research Team: Prof Moses Cho and Dr Laven Naidoo (CSIR, Precision Agriculture Unit) Dr Chevonne Reynolds, Dr Jolene Fisher and Dr Joseph White (post-doc) (Wits) Dr Philemon Tsele and Dr Abel Ramoelo (University of Pretoria) Prof Kingsley Ayisi (University of Limpopo) **Project Start Date:** 2019 **Contact Details of the Project Leader:** Prof Moses Cho Email: MCho@csir.co.za	resolution satellite data to produce detailed (1ha) maps of woody cover and biomass over large areas. These products will be interrogated for their ecological and quantitative applications as well as improved upon with the help of student collaborators.	
	6. Mechanisms Controlling Species Limits in a Changing World (Global Change Grand Challenge Programme **Research Team:** Prof Sally Archibald (University of the Witwatersrand, PI) Dr Nicola Stevens (University of the Witwatersrand, Co-investigator) Dr Michelle Greve (University of Pretoria, Co-investigator) Dr Mduduzi Ndlovu (University of Mpumulanga, Co-investigator)	- This project aims to understand the ecological mechanisms that determine common savanna tree distribution ranges in a changing world. Using a series of experiments and field measures we aim to understand how changing fire, herbivory, harvesting pressure and drought act on trees at different demographic stages to limit or promote the trees success.	- Using this understanding we aim to develop indicators of the health and status of tree populations in savannas

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	Dr Mathieu Milan (University of the Witwatersrand, Post-doctoral student) **Project Start Date:** 2019 **Contact Details of the Project Leader:** Nicola Stevens Email: Nicolastvns@gmail.com 7. Ecological and Cost-effective Management of Bush Encroachment Project Start Date: 2019 Contact Details of the Project Leader: Dr Julius Tjelele Email: jtjelele@arc.agric.za	**Objective 1:** To study the effects of goat herbivory, fire and nutrient supplementation on tree encroachment in a controlled experiment ▪ This is part of a PhD student paper chapter (Mr Piet Monegi) registered at the University of KwaZulu-Natal under my co-supervision. A peer-reviewed paper is prepared for submission to Rangeland Ecology and Management Journal on or before the end of 31 July 2020. This seeks to explore the use of fire and nutrient supplement on goats' use of chemically defended woody plants with the aim of developing management strategies of woody plant encroachment. He will submit his PhD theses for examination before the end of 31 March 2020. **Objective 2:** To translate the effects of the controlled experiments (Objective 1) to poor	

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		communities (in combination with mechanical removal of young trees) so that they may optimize rangeland productivity ▪ A paper titled "the applicability of Tree Popper as a mechanical control for woody plant encroachment in savannas" is in review at the South African Journal of Botany. This paper tested the effectiveness of a mechanical tool, the Tree Popper®, as a low-cost technique to physically uproot seedlings of woody plants in savannas **<u>Objective 3</u>**: Assess the impacts of improved rangeland productivity on the use by these communities of alternative products that they gain from the environment, such as fuel wood, thatching grass, and medicinal herbs, and ascertain the degree to which people seek work locally and in the cities. ▪ Ms Fredericks (MSc student) completed all her fieldwork which included plant biomass and production data, tree density data and vegetation composition data. Ms Jacobs (MSc student) collected all her plant biomass from woody encroaching species, have collected DNA data from cattle and have collected dung samples from cattle to assess endoparasite loads	

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		▪ Ms Hofstander (MSc student) completed all her tick drags in Loskop and Roodeplaat experimental farms. Her small mammal sampling did not yield the expected tick results and thus she will concentrate on the potential health risks of the ticks found on the cattle she sampled. **Objective 4:** Assess the use of *Seriphium plumosum*, an encroaching species as an alternative feed for ruminants. *Seriphium plumosum* is encroaching grassland biome and reduce the grazing capacity of rangelands ▪ Two PhD students registered at the University of KwaZulu-Natal and University of Limpopo are exploring 1) the causes and consequences of *Seriphium plumosum* encroachment in South African semi-arid grassland communities, 2) the use of *Seriphium plumosum* as feed for livestock, which will also be strategic management of the increasing rate and extent of the plant. A paper titled "the effect of season, fire and slope position on *Seriphium plumosum* forage quality in South African grassland communities" is submitted to Rangeland Ecology and Management Journal. Experimental diet including *Seriphium plumosum* is harvested and milled; the trial	

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		will start in March - May 2020. Mr HT Pule (PhD candidate) will submit his thesis before the end of December 2020 and Ms M Phoko is currently collecting data until December 2020, chemical analysis – Jan 2021 to March 2021, writing up – April 2021 to December 2021. **Objective 5:** Assess the use of feed additives to improve the digestibility of hard-seeded coat of encroaching species fed to ruminants. An MSc student collected seeds of *Dichrostachys cinerea* and *Vachelia tortilis*, and experiment i.e. seed germination will be conducted in the first quarter (April-June 2020).	
	8. Biodiversity and Ecosystem Functioning in Water Limited Ecosystems Under Climate Change Project Start Date: 2019 Contact Details of the Project Leader: Prof Guy Midgley Email: gfmidgley@gmail.com	Objective 1: On track, with a reduced set of sites likely, (3 to 4 rather than 5) and with revised GPP/NDVI methodology. Feasibility studies on originally designed fixed track system prompted the development of an alternative approach. Thus a drone approach combined with a fixed point monitoring approach using self-constructed camera systems seems certain to be more preferable logistically, less expensive, and far more feasible, while also delivering superior	

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		quality data (image data rather than point data). Amendments: It is likely that we will achieve a hierarchy of GPP detail at three to four sites: Primary sites (Grootfontein, Benfontein) NEE and GPP measurements at high time resolution (subdaily) for all main growth forms, plus drone-based measurements during the growing season Secondary sites (Fynbos (tbd), and Karoo Tierberg) Drone based GPP measurements during growing seasons covering major growth forms, associated with phenology measurements. Intermediate sites (Smaldeel) NEE and drone-based measurements during the growing season Objective 2: On track: Passive soil respirometers were investigated and purchased for installation at one site, and will be tested in 2020, for full feasibility assessment and roll-out to the other sites for 2021. Objective 3: Middelberg measurements are underway, and also being analysed; Benfontein measurements are underway in both a Savanna and a Karoo site.	

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		Objective 4: Collaboration with Prof Steven Higgins of Bayreuth University to employ a Dynamic Global Vegetation Model at the site level is underway, in addition to the development of mechanistic models for individual species using the Thornley Transfer Resistance Model Objective 5: Not yet underway, as scheduled	
	9. Rretool: Rapid and Repeatable Tools for Monitoring and Mitigating Global Change Impacts on Natural Resources Biodiversity and Ecosystem Functioning in Water Limited Ecosystems Under Climate Change Project Start Date: 2019 Contact Details of the Project Leader: Dr. Jasper Slingsby Email: jasper@saeon.ac.za	Overarching aim is to develop open source and reproducible workflows utilizing freely available satellite data to address key natural resource management issues in South Africa. Realizing the full potential of open source tools and freely available data from satellite remote sensing platforms will allow streamlining of natural resource management efforts. High frequency assessment of vegetation change allows rapid identification of priority areas and mitigating damage to or loss of ecological infrastructure, biodiversity and ecosystem goods and services. It also increases the efficacy and cost effectiveness of management activities, Including law enforcement. We will address our overarching aim through 4 sub-projects in different areas of the country that we have developed in collaboration with relevant	

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		management authorities. The sub-projects overlap in method and/or theme and each contain multiple objectives. Note that details of methods and field data collection are included in the Methodology and Proposed Research Plan. Work Package 1 - Near-real time detection of global change impacts in the Fynbos Biome Objective 1.1 - We will test our existing change detection tool (EMMA - Slingsby et al. 2017b) at the biome scale, validating its ability to detect vegetation clearing, drought (or other) mortality, alien plant species invasion and other drivers of anomalous vegetation activity. Previous testing of the tool at small to medium extents (e.g. Cape Peninsula and Jonaskop) has yielded very promising results, but are limited in the number of validation sites. Objective 1.2. - Develop an overview of spatio-temporal variation in drought impacts on vegetation activity in the Fynbos Biome over the period 2014-current. Work Package 2 - Detection and regular mapping of invasive alien plants in the Western Cape Water Supply System (WCWSS) key water source area. Objective 2.1 - Test and refine the sensitivity of our existing change detection tool (EMMA - Slingsby et al. 2017b) to detect and map	

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		broad areas invaded by alien plants in near-real time. Objective 2.2 - Perform detailed quantification of invasions (species, density, size class distribution, landscape position) in focused areas using high resolution imagery. Work Package 3 - Monitoring change in high altitude grasslands Objective 1.1 - Develop repeatable methods for high-spatial-resolution classification of vegetation in montane grassland sites, identifying classes including, but not limited to, plantations, grasslands, and various degrees of encroachment by bracken, alien trees or indigenous woody vegetation. Objective 1.2 - Classify time-series of imagery to explore change in vegetation classes in recent years, which can be validated with existing data that span back to 2008. Work Package 4 - Near-real time detection of clearing of Albany Thicket Objective 4.1 - Develop biome-scale analyses to identify areas with high rates of change that merit focused attention. Objective 4.2 - Develop fine-scale change detection tools to identify clearing of Albany Thicket in near-real time.	