SASSCAL

Southern African
Science Service Centre for
Climate Change and
Adaptive Land Management

PASSPORT

Republic of South Africa

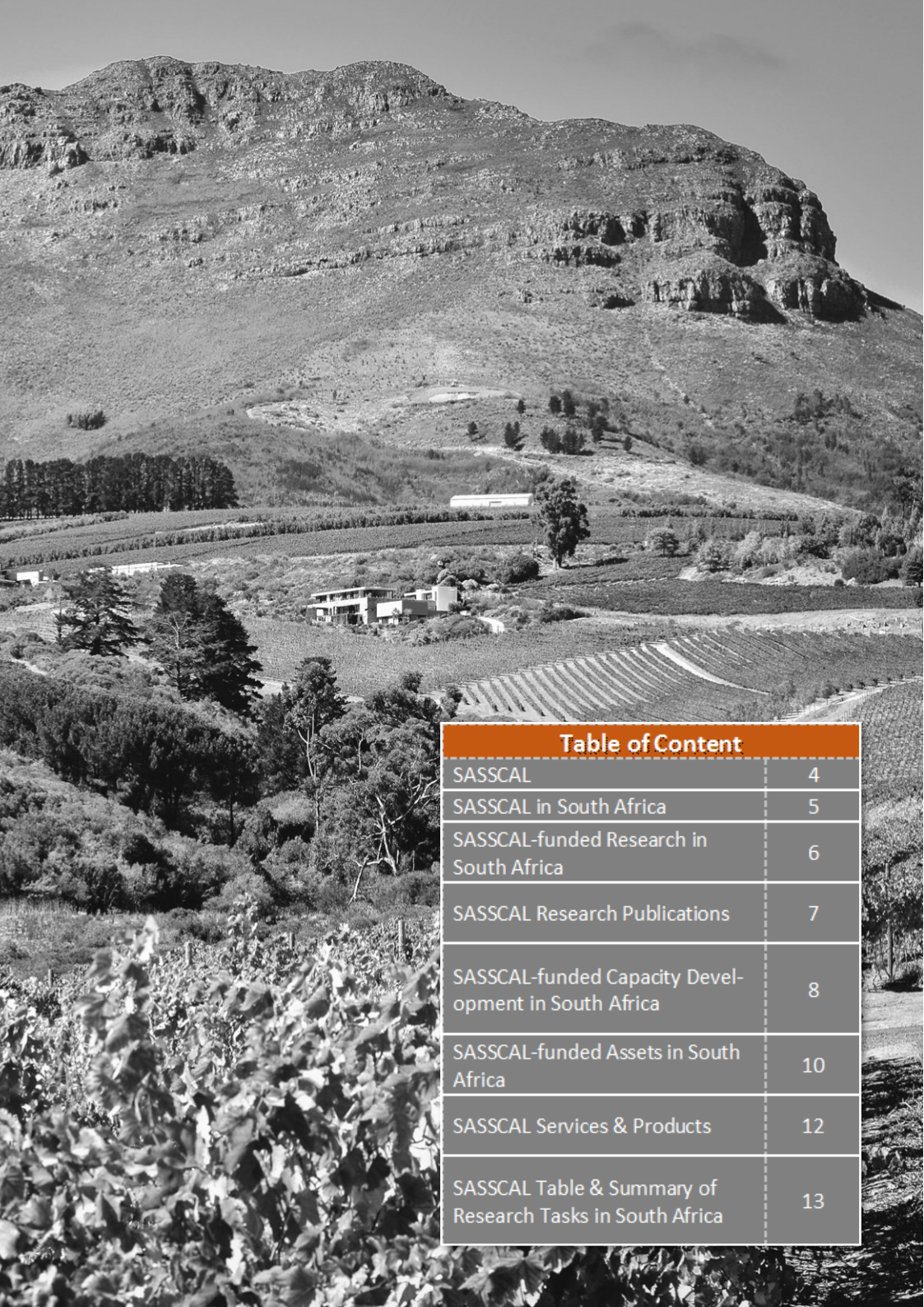


Table of Content

SASSCAL

Southern African
Science Service Centre for
Climate Change and
Adaptive Land Management

SASSCAL is a joint initiative of Angola, Botswana, Namibia,
South Africa, Zambia and Germany
in response to the challenges of global change

Vision

To be a leading regional centre in integrated climate change and adaptive land management science services for improved quality of life in southern Africa

Mission

To strengthen the regional capacity to generate and use scientific knowledge products and services for decision making on climate change and adaptive land management through research management, human capital development and services brokerage

Objectives

- to conduct research in adaptation to climate change and for sustainable land management
- to provide products, services and information for decision-making
- to contribute to the creation of a knowledge-based society through academic and non-academic capacity development programmes

RESEARCH

SERVICES & PRODUCTS

CAPACITY DEVELOPMENT

SASSCAL in South Africa

SASSCAL was initially established as the Regional Science Service Centre (RSSC) in Windhoek in 2010. The National Executing Agency of SASSCAL in South Africa is National Research Foundation (NRF), with the support of the Department of Science and Technology.

In South Africa, SASSCAL's Mission, to strengthen the regional capacity and to generate and use scientific knowledge products and services for decision making on climate change and adaptive land management, was achieved through SASSCAL's Research Portfolio 1.0, from 2012 to 2018, and facilitated by the SASSCAL Node in South Africa.

SASSCAL-funded Research in South Africa

The map gives an overview of SASSCAL-funded research activities in South Africa:

The SASSCAL-funded Research Portfolio in South Africa, from 2012 to 2018, constituted five projects, referred to as tasks, and consisted of 25 sub-tasks. South Africa's researchers refer to these as the *Big Five*. The total budget for these five research tasks was € 3 134 845.24.

Tasks are performed under the leadership of two national partners:

Council of Scientific and Industrial Research (CSIR)

Task 131: Land cover change and adaptation to climate change impacts in southern Africa

Task 203: Climate Change and Impacts

Task 205: Adaptation strategies for the South African, Namibian and Zambian dryland forests and timber plantations to climate change

Task 229: Adaptation to climate change impacts in mixed crop-livestock

Stellenbosch University (SU)

Task 231/233: Hydrological and hydro-geological base-line data and modelling/ Risk assessment and early warning systems

Other partners in South Africa task consortiums were:

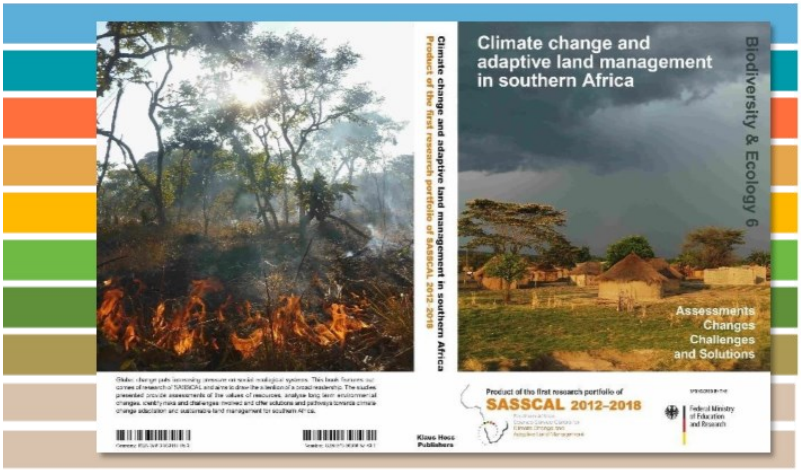
Agricultural Research Council
Applied Centre for Climate and Earth Systems (Access)
National Research Foundation (NRF)
Rhodes University
South African Environmental Observation Network (SAOEN)
South African National Biodiversity Institute
University of Kwa-Zulu Natal
University of the Western Cape
University of Cape Town
University of the Witwatersrand
University of Pretoria
Water Research Commissions

SASSCAL IN SOUTH AFRICA

5 SASSCAL-funded projects
€ 3 134 845.24
11 Institutions
80 Individuals (excluding students)

SASSCAL Research Publications

The SASSCAL Book, a culmination of six years of SASSCAL funded research, was launched at the SASSCAL Symposium in Lusaka in April 2018. The book is entitled



Colour guiding system to the chapters

"Climate change and adaptive land management in southern Africa – assessments, changes, challenges, and solutions", edited by Revermann, R., Krewenka, K.M., Schmiedel, U., Olwoch, J.M., Helmschrot, J. & Jürgens, N. and published in the book series Biodiversity & Ecology, Vol. 6, Klaus Hess Publishers, Göttingen & Windhoek.

The Book is freely available for download:
WWW.BIODIVERSITY-PLANTS.DE/BIODIVERS_ECOL/VOL6.PHP

South African SASSCAL partners authored nine of the publications featured in the SASSCAL Book and further contributed most thematic chapters in the book.

In addition to the SASSCAL Book, SASSCAL-funded researchers in South Africa authored more than 30 peer-reviewed publications and co-authored more than 50 non peer-reviewed publications. SASSCAL-funded research contributed to 12 non-peer-reviewed publications.

SASSCAL-funded Capacity Development in South Africa

Graduate Programmes

The *Collaborative Master Degree in Earth Observation, GIS and Remote Sensing* (Task 303) was officially launched on 1 November 2016 at the Namibia University of Science and Technology (NUST). The programme was developed in cooperation with the Cape Peninsula University of Technology (CPUT), the University of Botswana (UB) and the University of Zambia (UNZA). It aims to meet the capacity limitations in field of earth observation, geographic information systems and remote sensing. CPUT has participated in the development and moderation of some course materials via the academic

Curriculum Development Workshop was held at CPUT in Cape Town, South Africa in July 2014.

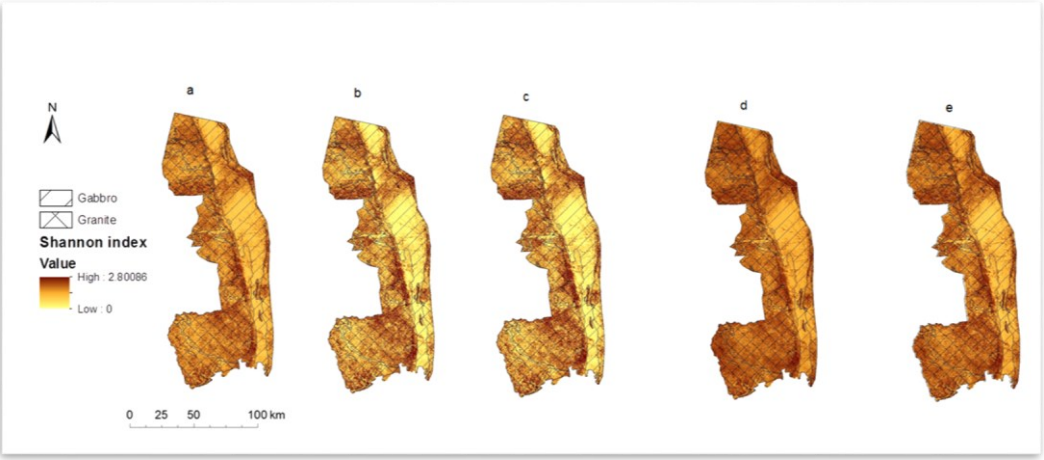
exchange within the task.

So far, a total of 35 students, who are enrolled in this program in the region, are benefitting from SASSCAL-funded scholarships. In addition to scholarships, SASSCAL also funded IT infrastructure for the programme.

SASSCAL-funded Graduate Degrees through South African Research Portfolio

SASSCAL funding supported 54 students to obtain a degree (some students are still busy with their studies):

21 PhD students (14 already graduated)
25 Master students (18 already graduated)
8 Honours students already graduated

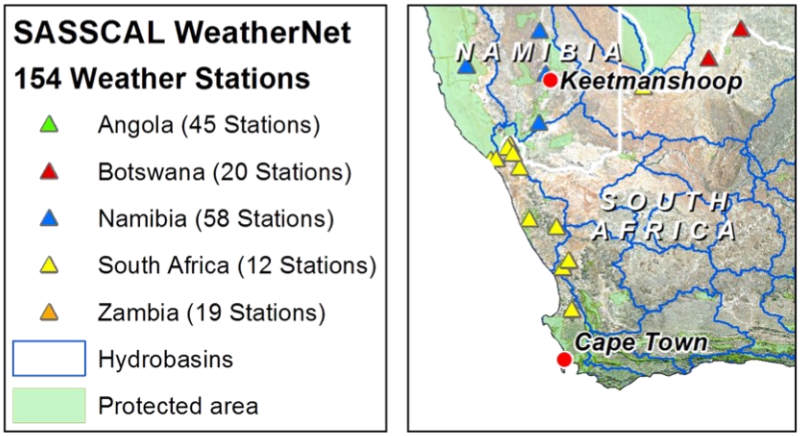


Tree species diversity diagram from Sabelo Madonsela (PhD Student) from her research on "Exploring the relationship between spectral reflectance and tree species diversity in the savannah woodlands". The diagram shows tree species diversity from the best (a) woody canopy cover (WCC) model, (b) factorial model involving $NDVI_{March}$ and WCC (c) factorial model involving $NDVI_{April}$ and WCC (d) factorial model involving $NDVI_{May}$ and WCC and (e) factorial model involving $NDVI_{July}$ and WCC.

SASSCAL's contribution to the southern African region, through the SASSCAL-funded Research Portfolio, also impacted the available research infrastructure.

The SASSCAL WeatherNet

A total of 12 automatic weather stations (AWS) of the total 154 AWS of the SASSCAL WeatherNet, are strategically distributed along the west coast of the Northern and Western Cape of South Africa, to support biodiversity and fog research.

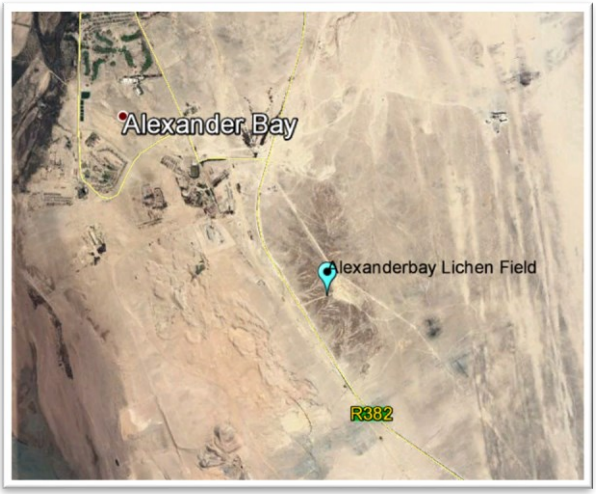


SASSCAL WeatherNet AWS in Northern and Western Cape of South Africa

All data transmitted by these stations are made available in near real-time on the SASSCAL WeatherNet (**WWW. SASSCALWEATHERNET.ORG**) and are freely accessible. The stations transmit hourly rainfall, air and soil temperature, humidity, wind speed and direction, barometric pressure, solar radiation, leaf wetness and other sensor data.

Station Information	
Country	South Africa
Latitude	-28.62496
Longitude	16.50674
Altitude	80 m *(262 ft)*
Google Earth	Weblink
Installed on	29 Sep 2015
First Data	1 Oct 2015
Station ID	858577

The AWS at Alexanderbay Lichen Field and station information



SASSCAL WeatherNet information on Alexanderbay AWS

Alexanderbay Lichen Field

18 Sep 2018 **16:15 (UTC+1)**

17.1 °C

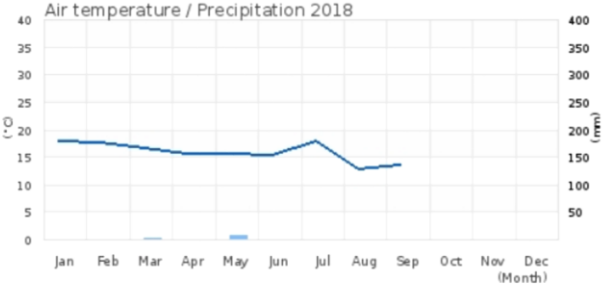
0.0 mm

Hourly values

Date	Hour	Air Temp.	Soil Temp. 10cm	Precip.	Fog1	Fog2	Wind Speed	Wind Direct.	Wind Speed (max)	Humidity	Barom. Press.	Solar Irradiance	Solar Irradiance	Battery Voltage
		[°C]	[°C]	[mm]	[mm]	[mm]	[m/s]	[deg.]	[m/s]	[%]	[hPa]	[W/m²]	[MJ/m²]	[V]
September 2018 18 Tuesday	0:15	11.6	-	0.0	0.0	-	2.1	9	2.4	93.0	-	-	-	6.98
	0:30	11.7	-	0.0	0.0	-	2.1	9	2.3	93.6	-	-	-	6.90
	0:45	12.1	-	0.0	0.0	-	1.9	9	2.1	94.1	-	-	-	6.90
	1:00	12.1	-	0.0	0.0	-	1.8	9	1.9	94.2	-	-	-	6.90
	1:15	12.1	-	0.0										90
06:47	1:30	12.0	-	0.0										90
	1:45	12.1	-	0.0										90
	2:00	11.8	-	0.0										90
18:48	2:15	11.1	-	0.0										90
	2:30	10.6	-	0.0										90
	2:45	10.9	-	0.0										90
	3:00	11.0	-	0.0										90
	3:15	10.7	-	0.0										82
	3:30	10.1	-	0.0										82
	3:45	10.3	-	0.0										82
	4:00	10.2	-	0.0										82
	4:15	10.0	-	0.0										82
	4:30	10.0	-	0.0										82

Alexanderbay Lichen Field - 2018

Weather station: Alexanderbay Lichen Field
Air temperature / Precipitation 2018

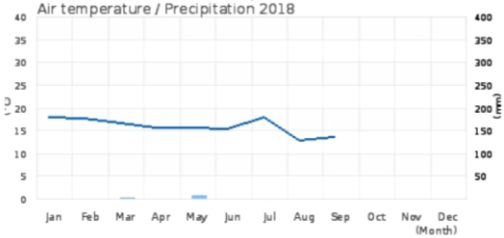


Details of monthly values (2018)

13.2 mm

Precipitation current year

Weather station: Alexanderbay Lichen Field
Air temperature / Precipitation 2018



Weather station: Alexanderbay Lichen Field
Relative air humidity 2018

SASSCAL Services & Products

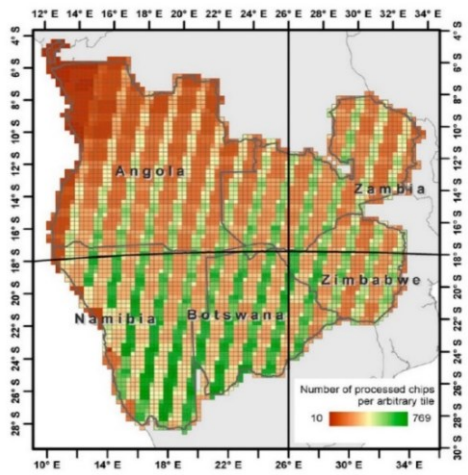
SASSCAL ensures that the research deliverables resulting through the SASSCAL-funded Research Portfolio, are made available openly and free of charge.

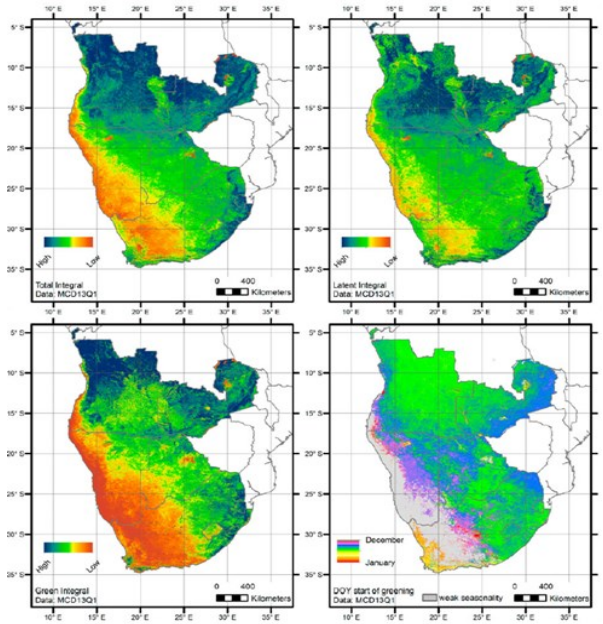
All research publications and deliverables, from all the SASSCAL-funded research, will be accessible via the ***SASSCAL Data and Information Portal***:

WWW.SASSCAL.ORG/SASSCAL-DATA-AND-INFORMATION-PORTAL/

It is noteworthy to highlight that besides the invaluable research results stemming from the South Africa portfolio, deliverables from other SASSCAL research of interest to South African partners include, but are not limited to:

- Full Landsat archive processed to surface reflectance (This data collection contains 1 912 733 images stored in 4 524 tiles of 30 x 30 km^2 (28 TB)) (University of Trier)





(left top) Number of processed Landsat images per tile, (right) phenological layers

- 4 Phenological metrics for SASSCAL countries: total integral, related to overall biomass, latent integral associated with standing biomass, green integral, day of year of start of greening (University of Trier)
- Fire regime related parameters from 2000 to 2015: fire frequency, seasonality and intensity (University of Trier)
- Global Urban Footprint (DLR)
- Regional Climate Change Projections for CORDEX-Africa (GERICS)
- EasyRemo climate modelling software (GERICS)

SASSCAL Table of Research Tasks

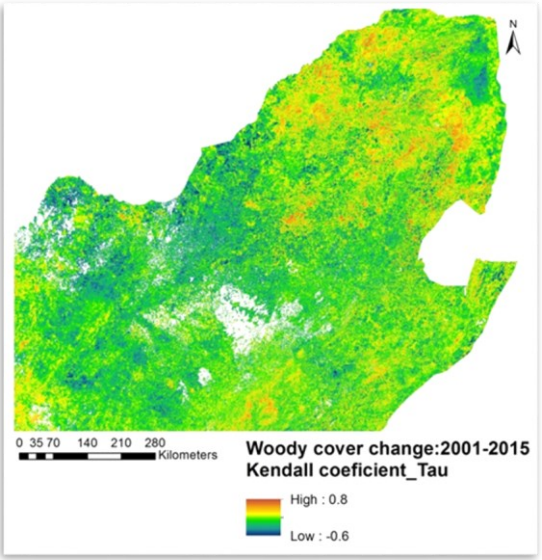
Task ID	Task Name	Lead	Budget (Euro) UHH*	Budget (Euro) KfW**
Agriculture				€ 277 147.00
229	Adaptation to climate change impacts	CSIR	€ 576 000.00	
Biodiversity				
131	Land cover change and adaptation to climate change impacts in southern Africa	CSIR	€ 582 809.00	
Climate				
203	Climate Change and Impacts	CSIR	€ 582 097.00	
Forestry				
205	Adaptation strategies for the South African, Namibian and Zambian dry-land forests and timber plantations to climate change	CSIR	€ 601 762.00	
Water				€ 180 580.00
231 & 233	Hydrological and hydro-geological	SU	€ 179 420.20	
	Risk assessment and early warning systems	SU	€ 155 030.04	
			€ 3 134 845.24	

*From 2012 to 2015, the budget was provided through the University of Hamburg (UHH)
**From 2015 to 2018, the budget was provided through the KfW Bank

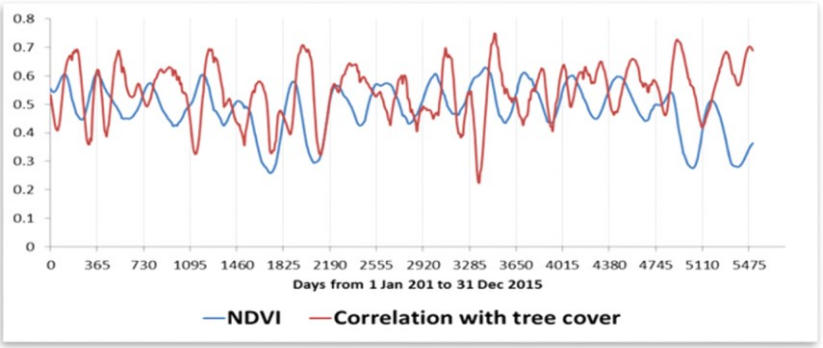
Agricultural Task 229 – CSIR

Adaptation to climate change impacts in mixed crop-livestock

Task 229 aimed to establish baseline information for adaptive management of mixed crop-livestock systems in the advent of climate change. To this end, an inventorying of rangeland biophysical parameters including biomass production, invasive species, bush encroachment, phenology and rangeland carrying capacity, was undertaken. An understanding of changing soil and plant parameters with altered climate condition and the introduction of climate-smart agriculture, was established. In addition, an understanding of the value of native forage species and their reliance to climate change (including the breeding and selection of heat tolerance Nguni cattle, sheep and goats species) and of the impacts of seasonal nutrient dynamics on forage grasses and beef production, was achieved.



	Julian Day	Date
1 quartile	153	Jun-02
3 quartile	185	Jul-04
mean	169±5 days	Jun-18
median	169	Jun-18
mode	161	Jun-10



Optimal phenological period for estimating woody cover using MODIS imagery in the savanna biome of Southern Africa

The methods and tools for rapid assessment of rangeland productivity indicators (grass biomass and tree cover) have been developed using MODIS imagery. Land surface phenology for semi-arid part of South Africa over the last 15 years has been mapped. The task developed empirical methods for mapping tree species diversity (Simpson and Shannon indices) from Landsat spectral information. A method for the assessment of bush encroachment was developed from MODIS imagery.

Climate-smart agriculture includes proven practical techniques – such as mulching, intercropping, conservation agriculture, crop rotation, integrated crop-livestock management, agro-forestry, improved grazing, and improved water management – and innovative practices such as better weather forecasting, more resilient food crops, and risk insurance. This project, seeks to promote climate-smart agricultural practices in rural communities.

Forestry Task 205 – CSIR

Adaptation strategies for the South African, Namibian and Zambian dryland forests and timber plantations to climate change

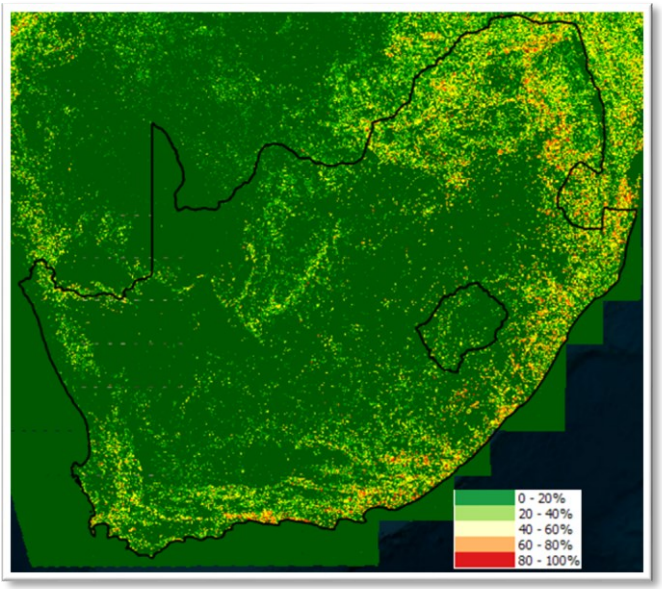
Forests provide a broad range of ecosystem and societal services, yet forests are threatened by over-harvesting, climate change and bush encroachment.

In this line, Task 205 aimed at exploring remote sensing products for estimating South Africa's, Namibia's and Zambia's woody fraction cover, which would conventionally be achieved with costly field work.

Synthetic Aperture Radar (SAR) imagery and LiDAR data were modelled with semi-automatic routines, to produce large-scale woody fraction maps.

Furthermore, the task team developed appropriate and practical adaptation strategies or interventions to manage the threats and opportunities of climate change on plantation forests. The potential markets for products, primarily from species in the genus *Eucalyptus*, have been investigated. *Eucalyptus* can be grown as

Rural communities rely extensively on savanna goods for energy



Map of woody cover fraction for Zambia, Namibia, and South Africa

farm forest or woodlots, specifically in dryland situations

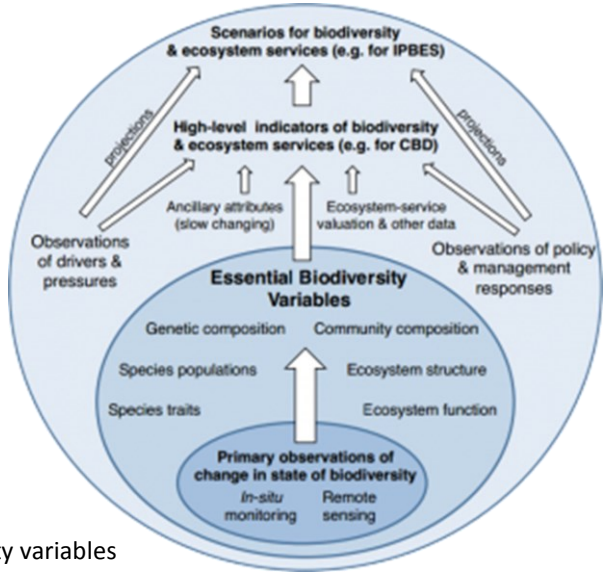
In addition, the research included plantation forest growth modelling and the assessment of plantation species adaptable to dry areas or marginal areas beyond current commercial forestry areas.

Biodiversity Task 131 – CSIR

Land cover change and adaptation to climate change impacts in southern Africa

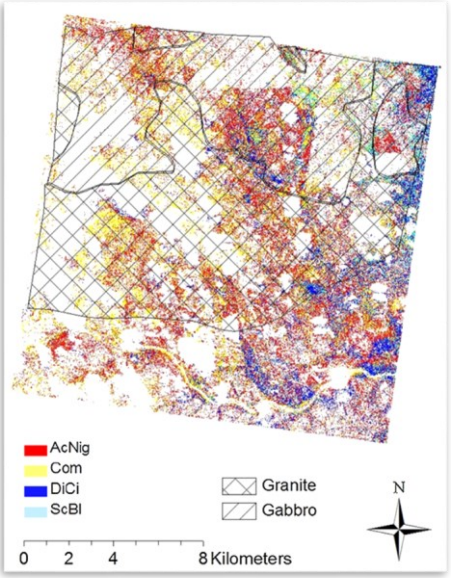
Biodiversity is a basis for human well-being. In southern Africa, biodiversity is threatened by changing land uses and management, resulting from population growth, and accelerated by climate change. Task 131 research explored the causes and consequences of land cover changes and biodiversity conservation in South Africa. Its focus was on change along a conceptual gradient of land transformation by human activities, from relatively unmanaged landscapes through to urban and intensive agricultural landscapes and how these changes are affecting the Biodiversity.

The task mapped the essential biodiversity variables using a suite of remote sensing technologies. These included floristic composition mapping as well as (i) essential variables such as vegetation height (ii) determining the



Essential biodiversity variables

Tree species map in the lowveld for optimal period April demonstrates the multi-phenology approach with over 80% accuracy



relationship between wild herbivory density data with essential biodiversity variables.

Furthermore, this study investigated the interactions of shade, herbivory and elevated atmospheric CO_2 on growth and performance of *Vachellia karroo* and has discovered some exciting interactions that help to understand woody thickening. Currently the data has been analysed to test several key hypotheses around these issues.

More specifically, some results include:

- The production of a species composition map, as a baseline for monitoring changes in the ecosystem, using remote sensing techniques
- Knowledge on invasive species distribution and dynamics mapping in the face of global climate and land use change
- Improved knowledge of modelling tree-grass dynamics, herbivory and fire using palaeo-ecological data

Climate change Task 203 – CSIR

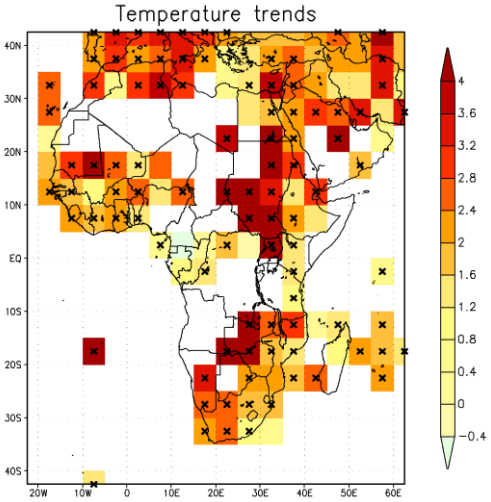
Climate Change and Impacts

In the context of Task 205, an extensive operational seasonal forecast system has been established by the CSIR, with an associated CSIR Technology Demonstrator, completed for the sea-surface temperature prediction component of this forecast system.

The southern African region is particularly vulnerable to droughts, but ironically, also partly to extensive flooding. The well-being, water security and food security of millions of communal inhabitants are directly linked to the government's ability to make quick and informed decisions, that respond to impending climatic catastrophes.

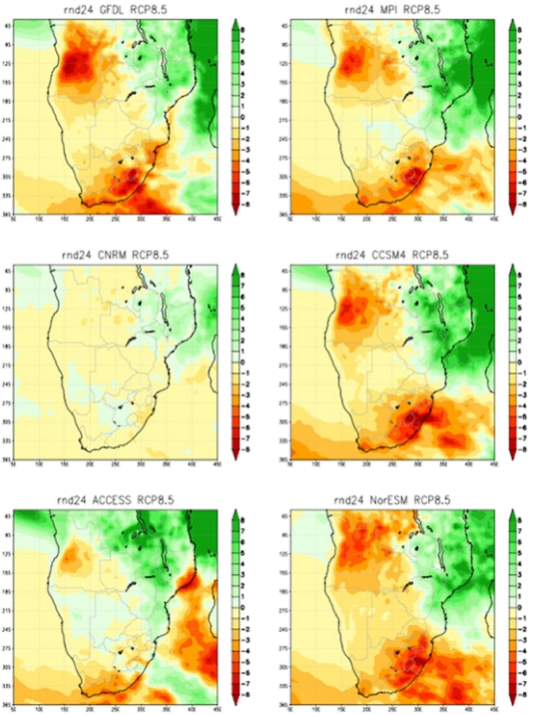
Amongst others, the CSIR forecast system gave early warning of the 2015/16 drought conditions over Africa, and is currently providing guidance in terms of prospects of anomalous rainfall over the drought-stricken southwestern Cape.

Observed trends in annual-average temperatures over Africa 1961-2010 suggest that big parts of the southern African region are becoming warmer

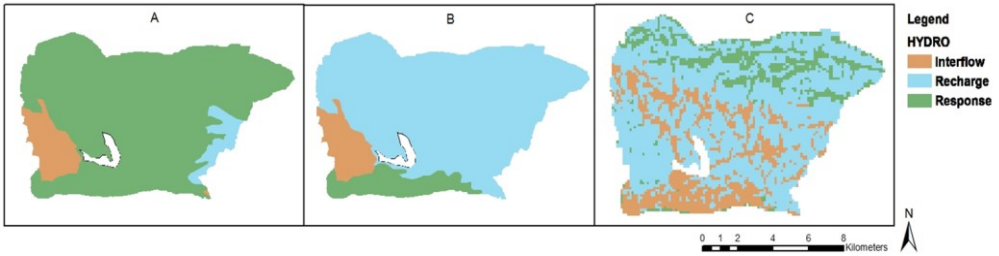


This study co-funded the work on the 2nd edition of the "Climate Risk and Vulnerability Handbook for Southern Africa" which presents the latest available scientific knowledge on the nature of climate change and its implications for southern Africa. The handbook serves as an important guide for climate and development practitioners, researchers and students. An executive summary is targeted specifically at policy-makers.

Moreover, the findings of the research conducted by the CSIR will contribute to the forthcoming IPCC Assessment Report.



*CSIR-CCAM projected change in annual average rainfall (mm/day)*10 over southern Africa for the period 2070-2099 relative to 1971-2000 under low mitigation, suggest that almost all of southern Africa will become drier. In the worst case scenario, it appears that South Africa and Angola will be most affected. Depending on the prediction model, Namibia and Zambia are also likely to become drier. The impacts are expected to affect vast agricultural areas and therefore suggest threads to the regional food security.*



*Different data sources reclassified according to hydrological soil associ\ations. **A**: Original Land Type maps **B**: Updated Land Type maps. **C**: Terrain morphological map*

Water Task 231/233 – University of Stellenbosch

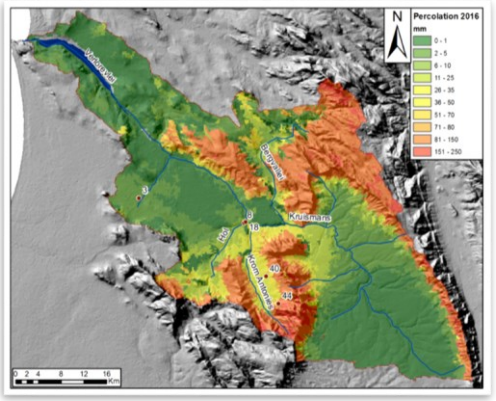
Hydrological and hydro-geological baseline data and modelling/ Risk assessment and early warning systems

In a region, that is historically plagued by frequent and long droughts, where long-term projections foresee a drier climate and where population growth adds additional pressure to water resources, an understanding of available water resources, water quality and flood prediction are key in ensuring water security for the region. To this end, hydrological monitoring sites where established in the Sandspruit Catchment, where weather and climate monitoring programs, as well as continuous monitoring telemetry was installed.

The research produced, amongst others, the following results:

- Water levels were used to model the hydrological processes of the Verlorenvlei catchment
- The Verlorenvlei/Moutonshoek groundwater system was modelled
- A digital soil mapping of the Moutonshoek, Sandspruit, Korentepoort and south coastal region was produced
- The impact of soil-physical conditions on groundwater recharge was investigated in the Sandspruit
- The hydrological and sedimentological dynamics in gully systems of the Sandspruit was explored
- The land use change impact on salt mobilisation and transport in the Langgewens system was investigated

Simulated percolation for 2016 for the Verlorenvlei catchment using the J2000 model



NOTES

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executive_director@sasscal.org

28 Robert Mugabe Avenue

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