

SPACES II

Science Partnerships for the
Adaptation to Complex Earth System
Processes in Southern Africa



Research Programme Newsletter

Welcome to our second Newsletter!

This Newsletter welcomes short news and articles from all SPACES II projects, associates and stakeholders.

Based on your feedback on the first issue, our second issue is more clearly divided into two sections: short announcements and longer articles. You can scroll the first pages for information on relevant events, announcements, and short news. We also opened a new section to introduce and welcome our DAAD PhD students, who bring an important contribution to the projects. This is followed by in-depth reports on the exchange programme, and announcements and reports of our joint course programme.

The final sections are dedicated to field-work reports and research highlights, with additional focus on stakeholder interactions.

This newsletter comes out at an uncertain time, when we are experiencing COVID-19 related cancellations and postponements to our events, field trips, student exchange plans and meetings. For our next issue, we invite suggestions and stories of best-practices of working at unusual circumstances.

Enjoy reading, take care and keep well!

Mari Bieri (SPACES II Board/External Communications)

INSIDE THIS ISSUE:

02 Events

03 Short news

04 DAAD Students

07 DAAD Exchange

09 Courses

15 Research highlights

22 Stakeholder engagement

24 Field trips

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DAAD



THÜNEN

Coastal Hazards in Africa, 28-29 October 2020

This two-day conference about coastal hazards in Africa will take place in Durban, South Africa. The purpose of the conference is to bring together scientists and managers interested in African coastal zones in order to develop our understanding of these risks and hazards while considering the current state of coastal zones around Africa. Additionally, this meeting provides a platform to discuss and propose measures to address and manage these risks. (<https://chia2020.wixsite.com/chia>)



EGU General Assembly, 3-8 May 2020 (online)

Due to travel and meeting restrictions, the European Geosciences Union General Assembly is realized as an online event this year. Contributions from at least SALLnet and EMSAfrica will be part of this conference.

(https://egu2020.eu/sharing_geoscience_online.html)

4th ICOS Science Conference, 15-17 September 2020

The overarching theme of this year's ICOS science conference is „Knowledge for shaping the future – understanding the Earth's biogeochemical processes“ (<https://www.icos-ri.eu/sc2020>).



The Joint International Grassland and International Rangeland Congress 25.-30. October 2020

This congress takes place in Kenya and promotes the interchange of scientific and technical information on rangelands and grasslands. The theme of 2020 is “Sustainable Use of Grassland and Rangeland Resources for Improved Livelihoods“ (<http://2020kenya-igc-irc.rangelandcongress.org/>)

Accepted contributions of ORYCS will be part of this conference.

Jahrestagung der Afrikagruppe deutscher Geowissenschaftler 26.-27. June 2020

This meeting in at the Goethe University in Frankfurt, Germany, is organised by the Africa Group of German Geoscientists (AdG). Registrations are currently open (https://www.uni-frankfurt.de/85227590/AdG_2020)

Accepted contributions of ORYCS will be part of this conference.



SPACES II Midterm Meeting

The SPACES II Midterm Meeting, which was scheduled for 20-21 May 2020, with student workshops on 18-19 May, has been **postponed**, in line with travel and meeting restrictions, to help prevent the spread of COVID-19.

We are trying to arrange new dates as soon as the situation looks clearer. All registered participants have been informed.

DAAD CaBuDe research visit with CASISAC



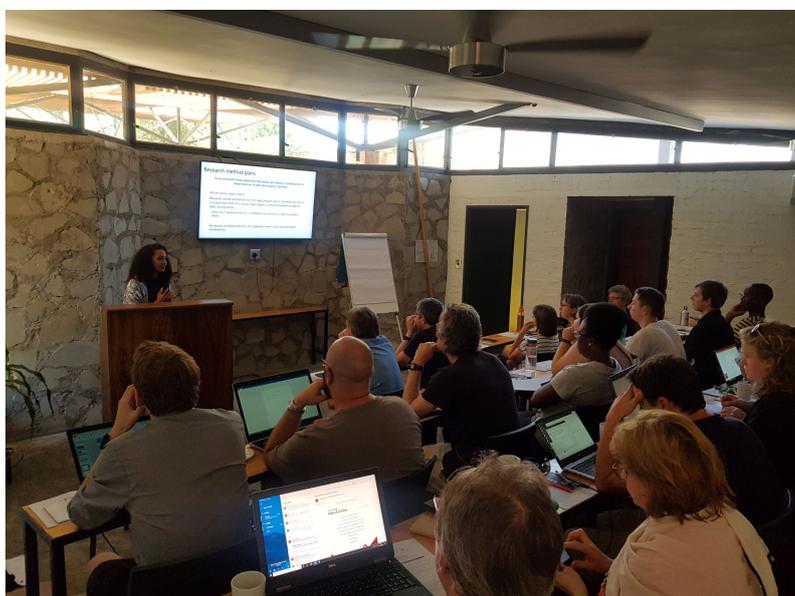
Thanks to funding provided by the CaBuDe program of DAAD, Dr. Lück-Vogel from the Coastal Systems Research Group of CSIR (Stellenbosch, South Africa) visited the Coastal Risks and Sea-Level Rise research group (CRSLR) of the Institute of Geography, University of Kiel, in December 2019. The objective of this research visit was to explore and discuss future collaboration between the two Institutes, which are both working on coastal vulnerability assessments for South Africa. During the visit, Kiel researchers had the opportunity to present the CASISAC project to Dr. Lück-Vogel, discuss with her about the methodological approaches used and the limitations of data availability encountered. On the other side, Dr. Lück-Vogel introduced the coastal vulnerability projects carried out by CSIR and gave a lecture to students of the “Sustainability” and “Environmental Geography and Management” Master Degrees of Kiel University. Finally, a future research visit of Kiel researchers to the CSIR of Stellenbosch was planned for autumn/winter 2020.

EMSAfrica Annual Meeting at Skukuza, Kruger National Park, South Africa

EMSAfrica’s second annual meeting took place 27.-29.2. at the Skukuza Science Leadership Initiative Campus, Skukuza, Kruger National Park. In addition to updating each other on research progress and planning collaborations for the next year, we dedicated one full day of this meeting to our stakeholders. Invited representatives from South African governmental and non-governmental institutions, such as SAEON, DEFF, SANParks, CSIR and UNESCO K2C Biosphere Reserve, joined discussions to steer the future direction of the project, and identify ways in which our data and products could be used in South African global change research and policy making.

Furthermore, our meeting host Laurence Kruger of the Nsasani Trust helped us to organise a “*Vegetation Modellers meet Plant Traits Experts*” -themed field trip in Skukuza. Simon Scheiter, who develops dynamic global vegetation models for EMSAfrica as well as SALLnet, held an introductory lecture on vegetation modelling. William Bond, leader of a parallel workshop on plant traits, introduced their groups’ main interests and developments (photo below right). The joint event was continued with highly stimulating discussions between the two communities—only occasionally disturbed by roaring lions and a pack of hyenas!

After the annual meeting, most of us joined the SANParks Savanna Science Network Meeting in Skukuza, presenting our results on savanna ecosystem research and enjoying meeting colleagues. Special congratulations to our Oksana Rybchak for winning the price for best student poster!



DAAD

The **DAAD (German Academic Exchange Service) CaBuDe (Capacity Building/Development) Programme** remains open to applications.

See instructions on applications via the DAAD online database at :

<https://www2.daad.de/deutschland/stipendium/datenbank/en/>

Due to the current COVID-19 situation, scholarship stays can be implemented at the earliest from July 2020. However, this situation is constantly monitored and may still change.

For additional information to scholarship holders and supervisors, please note that DAAD has established a COVID-19 info website at: <https://www.daad.de/de/coronavirus/>

Vincent Mokoka (PhD student) from the University of Limpopo, South Africa received a DAAD scholarship for an extended stay at the University of Bonn within the Grassland Ecology & Grassland Management Group. His work will focus on the effects of global environmental change on ecosystem stability components and on ecosystem performance.



Katharina Behrendt from the University of Cologne successfully applied for a scholarship within DAAD's PROMOS program. This will grant Katharina the opportunity to conduct research for her bachelor thesis in South Africa's Limpopo Province. Katharina will explore the effects of drought and grazing on functional vegetation composition and diversity, collecting her field data in the [DroughtAct Experiment](#).

Vusani Mphethe (Phd student, University of Venda, Limpopo, South Africa) stays for three months at the division of Functional Agrobiodiversity at the University of Göttingen with a DAAD scholarship. His work focuses on biological control delivered by bat species in litchi orchards in the Limpopo region.



Amukelani Maluleke, a PhD student supervised by Stellenbosch University's Professor Guy Midgley, SAEON's Dr Gregor Feig (Manager of EFTEON, the Expanded Freshwater and Terrestrial Environmental Observation Network) and Dr Christian Brümmer of Thünen Institute in Germany, has received a DAAD CaBuDe grant for a 12-month visit at the Thünen Institute. This stay includes training on handling Eddy Covariance datasets as well as research methods which will be vital towards the successes of EFTEON and building capacity for Eddy Covariance research in South Africa. Amukelani's planned trip for May-June 2020 had to be postponed due to COVID-19, but we are looking forward to re-scheduling the exchange as soon as possible, with the support of the DAAD CaBuDe Programme.



Starting March 2020, the SALDi project team increased by a new PhD student from the Geography Department at the University of Namibia in Windhoek. **Nangula Nghiyalwa** is a lecturer in Windhoek with several international experiences, e.g. in Australia, who wants to pursue her PhD in the field of remote sensing. The working title of her DAAD dissertation proposal is: "Woody cover analysis, the impacts of bush encroachment and invasive plant species on biomass and soil moisture dynamics in semi-arid savannah ecosystems under different land uses". Geographically, she will focus on the Mokala National Park and Benfontein Nature Reserve near Kimberley, and the southern Kruger National Park to have good reference data for her analysis of spatio-temporal vegetation cover dynamics by exploiting the Copernicus Sentinel-1 and -2 data. Thanks to her start in March, Nangula joined the SALDi field trip and had thus the chance to meet generally many SPACES team members during the Savanna Science Network Meeting in Skukuza. She is being supervised by Dr. Marcel Urban and Prof. Christiane Schmulius, who both enjoyed meeting and travelling with Nangula very much.



Kuhle Ndyamboti joined the 'Remote sensing-based ecosystem monitoring' team of EMSAfrica as a DAAD-funded PhD student on the 1st of October 2019. He is currently based at the Department for Earth Observation at the Friedrich-Schiller-University Jena. His PhD focuses on the use of multi-sensor and multi-scale remote sensing datasets for understanding vegetation dynamics in the Nama-Karoo dryland ecosystem of South Africa. Particularly, the study utilizes data acquired from Unmanned Aerial Vehicles (UAVs), terrestrial laser scanning (TLS), and satellite platforms in conjunction with ancillary observations from eddy covariance (EC) flux towers, meteorological stations, and sheep stocking-rate trials to understand changes in vegetation cover in the Nama-Karoo as well as the drivers of this change. Kuhle's PhD will help decision makers to gain a better understanding of the extent at which mechanisms such as bush encroachment, grassland expansion, or degradation are occurring in dryland ecosystems.



It is with great pleasure that we welcome **Tasiyiwa Priscilla Muumbe** to the Remote sensing-based ecosystem monitoring team in EMSAfrica. She successfully applied for a DAAD scholarship for her PhD research in Germany and will start her research project at Friedrich-Schiller-University Jena in April 2020. Tasiyiwa will look at developing accurate methods for estimating biomass and carbon of savanna ecosystems using Terrestrial Laser Scanning and satellite data. She will develop accurate and robust procedures for extracting savanna vegetation parameters from TLS point clouds for both wet and dry season, compare 3D methods for extracting savanna vegetation parameters and develop a model for large scale vegetation mapping. This is the basis for quantifying carbon pools from savanna ecosystems. Tasiyiwa's research will greatly assist South African scientists in adopting accurate methods for estimating biomass, carbon and quantifying the contribution of these ecosystems to the global carbon pools and to net primary productivity.



We are very pleased to welcome **Amy Schroeder** and **Edward Muhoko** to the “Biome Shifts and Species Distribution Modeling” team in EMSAfrica. Both successfully applied for DAAD scholarships to undertake PhD research at the University of Bayreuth's Chair of Plant Ecology. Amy will explore whether the history of Iron Age settlements can explain the distribution of ecosystem states in Africa. She will combine paleo-ecological data with field observations and vegetation modelling to identify conditions that may lead to alternative ecosystem states. Her work will inform conservation authorities on potential natural vegetation and what this means for biodiversity conservation. Edward will link plant growth models with data from Earth observation satellites to attribute decadal scale vegetation changes observed over southern Africa to environmental drivers. Edward's research will thus enhance the assessment of historical and ongoing biome shifts, which will inform regional climate change mitigation and adaptation actions.



It is with great pleasure that we welcome **Mulalo Thavhana** to the vegetation modelling team in EMSAfrica. She successfully applied for a DAAD scholarship for her PhD research in Germany and will start her research project at the Goethe University Frankfurt and the Senckenberg Nature Research Society in April. Mulalo will explore future climate impacts on ecosystems and agriculture in southern Africa using the LPJ-GUESS hybrid DGVM-crop model. She will simulate natural and human landscapes of southern Africa, including crops and pastures. This is the basis for ecosystem carbon storage and crop yield projections. Mulalo's research will thus deliver key results for the assessment of climate impacts, which will support ecosystem management processes.



Photo: Amukelani Maluleke

TRACES – experiencing active exchange

Julia Gensel¹, Paul Mehlhorn², Marc Humphries³

¹University of Bremen, Germany; ²University of Greifswald, Germany; ³University of the Witwatersrand, Johannesburg, South Africa

In October/November 2019, two PhD students (University of Bremen and University of Greifswald) visited the University of the Witwatersrand in Johannesburg, South Africa as part of the TRACES project. Funding was possible through the CaBuDe scholarship, managed by the DAAD. Prof Dr Marc Humphries and his well-organized laboratory at the School of Chemistry provided the research facilities and our combined aim was the determination of organochlorine pesticides (OCPs) in samples, which we had collected on previous field trips to the Mkhuze Wetland System and Richards Bay Harbour, respectively.

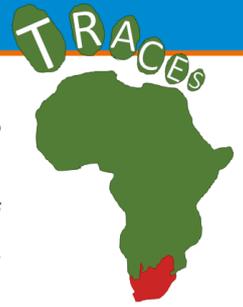


Figure 1: Main building of the University of the Witwatersrand, Johannesburg, South Africa.

OCPs were widely used for agricultural purposes in the 20th century. In 2001, an international environmental treaty signed the Stockholm Convention sought to eliminate or restrict the production and use of persistent organic pollutants, including the five major groups of OCPs. Individual compounds, such as DDT, were banned as early as the 1970s based on their risks to environmental and human health. However, in some countries, including South Africa, the use of DDT for controlling the malaria vector was accepted again. Due to their chemical characteristics (e.g. stability, lipophilicity) OCPs are bioaccumulative and can serve as suitable markers in sediments (or living biomass) to track human impact on the environment.

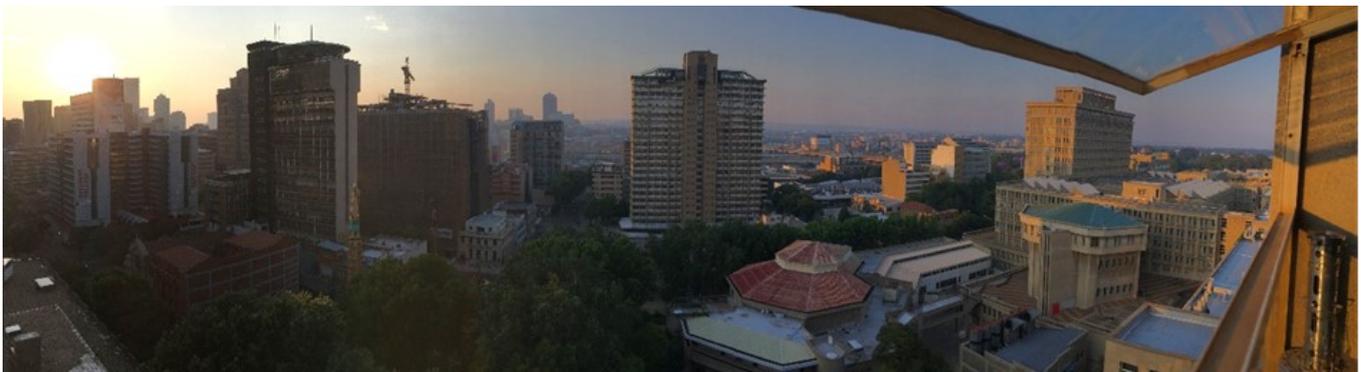


Figure 2: Skyline view of Johannesburg from the Laboratory at “Gate House”.

During our time with our cooperation partners in South Africa, we learned a new extraction technique, which allowed us to isolate our target compounds and analyse them using 2-dimensional gas chromatography coupled to a time-of-flight mass spectrometer (GCxGC-TOFMS). Together, we were entrusted with many new instruments, technologies and the kind help and supervision to solve given problems.



Figure 3: Julia and Paul in the Preparation Room of the ENVIROGEOCHEMlab

Aside from our daily laboratory-workload, we used the time to socialize: We had a few lunches with fellow students, visited Dr. Anja Hallacker from the DAAD, ongoing Honours student's presentations or discussed politics and science during our morning coffee table with Marc. Our visit afforded us the opportunity to finish our measurements successfully and enjoy South African hospitality, culture, landscape and lifestyle. We had a great time at the School of Chemistry and built a lasting relationship that will serve to enhance our cooperation.



Figure 4: Lab coat with the emblem of the University of the Witwatersrand.

APSIM Advanced and Dynamic Vegetation Modelling

Registrations open until 29th March

Course dates 24-28 August 2020

This course will introduce participants to the principles and advanced application possibilities of crop simulation models (CSMs) and dynamic vegetation models (DVMs). The course takes place in Göttingen, Germany.



Full course descriptions & registrations:

www.spaces-training.org



Training Workshop in Ecological Field Methods

Course dates 23-27 November, 2020 (Registrations will open in June)

An international team of SALLnet ecologists will offer a training workshop in state-of-the-art ecological field methods. The course will be jointly organized by members of four universities - the Universities of Bonn and Göttingen in Germany, and the North West University and University of Venda in South Africa. Focusing on grassland and savanna ecosystems in South Africa's Limpopo Province, a wide range of field methods - both from plant ecology and animal ecology - will be introduced and applied in the field, followed by a joint data analysis. Participants will therefore gain experience in all steps of ecological field research. Methods include pollinator and flower visitor sampling, herbivory assessments, estimation of biomass production, and sampling of plant functional traits. Many methods used in this workshop are standardized measurements suitable for a Rapid Ecosystem Function Assessment (REFA; Meyer et al. 2015), which enables a comparison of different study sites. The workshop is intended for MSc and PhD Students from South Africa or from other SPACES II countries. German students can be accepted in exceptional cases. A number of funded slots (travel & accommodation) are available for this workshop.



SPACES II Integrated Training Programme and COVID-19

Please note that opening courses in South Africa for registration as part of the SPACES II Programme is currently on hold. All courses for the next months have been cancelled due to COVID-19.

We look forward to continuing planning when situation normalizes and finding ways to provide virtual training where possible. In situations where course participants have been accepted but a course is cancelled, we will do our best to schedule new dates that fit the accepted participants.

Physical-based modelling of land degradation processes

POSTPONED due to COVID-19 (originally end of March 2020)

After intensive six months of preparation, involving SALDi members from Jena, Augsburg and Tübingen, as well as colleagues from Thünen-Institute, the 1st SALDi Summer School had to be postponed, very unfortunately, due to the COVID-19 crisis. Originally, the Summer School on Modelling of Land Degradation Processes offering a course by M. v. Werner (from GEOGNOSTICS) on basics in EROSION 3D, a physically based soil erosion model and a course on Open-source hydrometeorological modelling with WRF-Hydro was scheduled to take place at the end of March 2020 at the University of Pretoria's Department of Geography, Geoinformatics and Meteorology. We sincerely hope, that we are able to re-schedule the event, which was elaborated in close cooperation with Dr. C. Hansen from UP. All eighteen participants from four southern African nations were informed about the postponement and will be contacted once we reschedule the event.



Agroforestry in Temperate and Dryland Ecosystems

POSTPONED due to COVID-19 (original dates 29.06. - 10.07.2020)

Due to the spread and containment of the COVID-19 virus, the ASAP coordination team have taken the decision to postpone the ASAP training School to a date yet to be determined in Spring 2021. This decision hangs on the health and wellbeing of all participants and trainers, and is observant of all current restrictions on movement. All participants who have a confirmed place on the course will be automatically offered a place to attend the course next year; more information will follow.



The Nansen Tutu TRIATLAS Summer School on Ocean, Climate and Marine Ecosystem



The first Nansen Tutu TRIATLAS/BANINO Summer School on Ocean, Climate and Marine Ecosystem was held last January in Cape Town, hosted by the Nansen Tutu Center and the Department of Oceanography of the University of Cape Town. 35 young researchers (Masters students, PhD students, Postdocs) from 13 different countries with expertise from the fields of oceanography, climate and marine ecosystems, got together for 10 days of lectures and group discussions on January 14-20, 2020.



Fig. 1. The participants of the Nansen Tutu TRIATLAS Summer school on Ocean, Climate and Ecosystem in Cape Town, South Africa, in January 2020. (Photo: Martin Schmidt)

Fig. 2 Hout bay Harbour (Photo: Arthur Prigent)

The content of the summer school was composed of two daily sessions:

- Morning lectures, to provide a common background on observations, theory, analysis and modelling techniques to the participants.
- Afternoon group work, to allow the participants to exchange and discuss within an interdisciplinary group, on the possible future changes of the ecosystem and ocean dynamics, based on the analysis of observations, conceptual understanding and modelling studies.



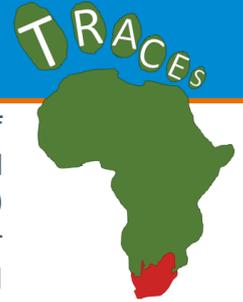
On the weekend, social activities were organized to enhance social interactions within the group.



Figs 3 & 4: Afternoon group work; participants on top of Lions head (Photos: Noël Keenlyside)

This summer school was a successful first attempt to initiate an interdisciplinary research group aiming at filling the gaps in our understanding of marine ecosystems and their futures changes in the tropical Atlantic Ocean.

From Zulu culture, fieldwork and safari - a diary about the Train-Me summer school of TRACES



From 5th to 11th September 2019, the Chair of Physical Geography at the University of Greifswald and the University of KwaZulu-Natal jointly organized a summer school sponsored by DAAD in Richards Bay, KwaZulu-Natal, South Africa. From over 60 applicants, four African and four German students were selected. The aim of the summer school was to introduce students to practical experience in sampling and drilling field techniques, with a focus on methods commonly used in the geological and environmental sciences. Additionally the participants gained an insight into the local Zulu culture. Together we posted a blog about their experiences on the summer school website (<https://geo.uni-greifswald.de/trainme/>). Here is an abridged version:

Day 1

Rain, it's bucketing down! After a 20 h journey, us, three geography students from Greifswald: Caroline, Isabella and Marius, our photographer Magnus, and Dr. Finn Viehberg arrived at Durban airport. Here we met Eugene (Iziko Museums Cape Town, South Africa) and Jeff (Copperbelt University, Zambia) and continued to Richards Bay - our final destination.

There, Prof. Torsten Haberzettl, Paul Mehlhorn (both lecturers from the University of Greifswald), Moteng (University of Witwatersrand, South Africa) and Balemogeng (Okavango Research Institute, Botswana) were already waiting for us. After we got to know each other, Torsten, Finn and Paul introduced us to our study area and we discussed the plan for the next day.



Photos: Magnus Schult

Day 2

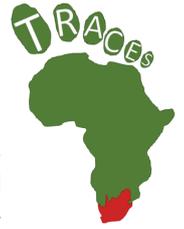
More rain! The Zulu culture is an integral part of the South African history. We visited Shakaland, a Zulu museum village, where a local guide showed us Zulu cultural traditions and fighting techniques.

The Goedertrouw Dam - our next destination - serves as a fresh water reservoir. We decided to take a sample for subsequent water analyses and were introduced to the necessary procedures.

The day passed quickly. Back in Richards Bay we met Dr. Jemma Finch (University of KwaZulu-Natal), who joined in for the next few days. As the actual field research begins tomorrow, we packed our rental cars. It is a lot of equipment - we are very excited.

Days 3 & 4

Bright sunshine! Today our destination was a dry bay near Richards Bay Harbour. Here we were introduced to different coring techniques and managed to recover our first sediment cores. Subsequently, we described the cores in terms of colour, carbonate content and organisms. Together with Jemma we collected pollen samples, which she then prepared for analyses using a field-method she used during her PhD. Tired but happy we returned to our accommodation. When working with large devices, teamwork is essential. It was great fun. At the end of the day, we had a look at our pollen under a microscope!



Days 5 & 6

Today our group explored Lake Mzingazi. Local policemen helped us loading our boat and off we went on the lake. We used different devices to sample the lake bottom and water. In the heat of the moment, we even forgot our lunch break. At the deepest point of the lake, we placed a rope with temperature loggers, which we recovered again on the following day. We wanted to find out whether the lake has different temperatures at different water depths. According to the recordings of the loggers, this is not the case.

Day 7

At 5 am in the morning, we enjoyed the sunrise on the beach. After breakfast, we packed all our equipment and drove to the uMhlatuze River. The area there was very littered. Easily we collected four full garbage bags! We then visited a mangrove swamp in the uMlalazi Nature Reserve in Mtunzini. We saw monkeys, zebras, a bee-eater and other impressive animals. With this small wildlife experience, our summer school ended and we drove back to Durban to catch our flights home.

The entire blog and more information about Train-ME: <https://geo.uni-greifswald.de/trainme/>

Authors and participants in alphabetical order: Eugene Bergh, Isabella Feldmann, Jemma Finch, Torsten Haberzettl, Balemogeng Kuyakenge, Paul Mehlhorn, Moteng Moseri, Jeffery Mwila, Marius Rohrbac, Magnus Schult, Caroline Siggelkow, Finn Viehberg



Photo: Magnus Schult

Field Methods for Plant Ecology at the Kruger National Park, South Africa

A course focusing on field methods for plant ecology was run from 17. to 28. February 2020 by Steven Higgins of EMSAfrica and Laurence Kruger of the Nsasani Trust, assisted by EMSAfrica DAAD student Amy Schroeder. The course brought together seven South African and eight German students to the Skukuza Science Leadership Initiative Campus in Skukuza (<https://tropicalstudies.org/portfolio/skukuza-research-station/>).



Left: Testing out rapid methods for tree biomass estimation

Above: Data collection on self-designed projects

The course comprised a series of structured field data collection and analysis exercises, addressing fundamental questions in savanna ecology. The unique field research opportunities offered by the Kruger National Park (herbivore exclosures, long-term fire experiments, environmental gradients) was used to collect data relevant to these fundamental questions. Each field exercise is embedded in the strategic adaptive management philosophy used by SANParks to manage the Kruger National Park. Guest lectures by SANParks scientists provided concrete examples of how strategic adaptive management works in practice and how this approach simulates an effective dialogue between science and management.

This course uses a 'slow science' philosophy where students analyse their data without the help of computers. This allows students to be mindful of the data lifecycle and promotes creativity and teamwork in summarising and visualising results. After several days of structured field data collection and analysis, the students used their experience to conduct their own field ecological project. This process started with workshoping project ideas, organically forming project groups and then planning and executing the projects and reporting on the findings.

*Right: Slow science means thinking, not clicking
(Photos by Steven Higgins)*



SALDi at the Savanna Science Network Meeting

Jussi Baade, Chris Schmillius, Andreas Kaiser and Marcel Urban, Friedrich-Schiller University Jena

During the Savanna Science Network Meeting (SSNM) 2020 in Skukuza, South Africa, which followed participation at the EMSAfrica midterm Meeting, SALDi members were present with a number of oral and poster contributions highlighting the first year's activities and outcomes. Among others, we presented the first year's time series on in situ soil moisture and precipitation data together with the Sentinel-1 derived Surface Moisture Index (Fig. 1). Other presentations concerned the remote sensing based monitoring of land surface properties and changes, reservoir siltation trends and new findings on hydrological and erosive properties of disturbed and undisturbed soils. The SSNM was as well used to meet with partners and to extend our networking activities. A joint SALDi–EMSAfrica field trip to research sites in southern Kruger National Park was a highlight for all participants (Fig. 2).

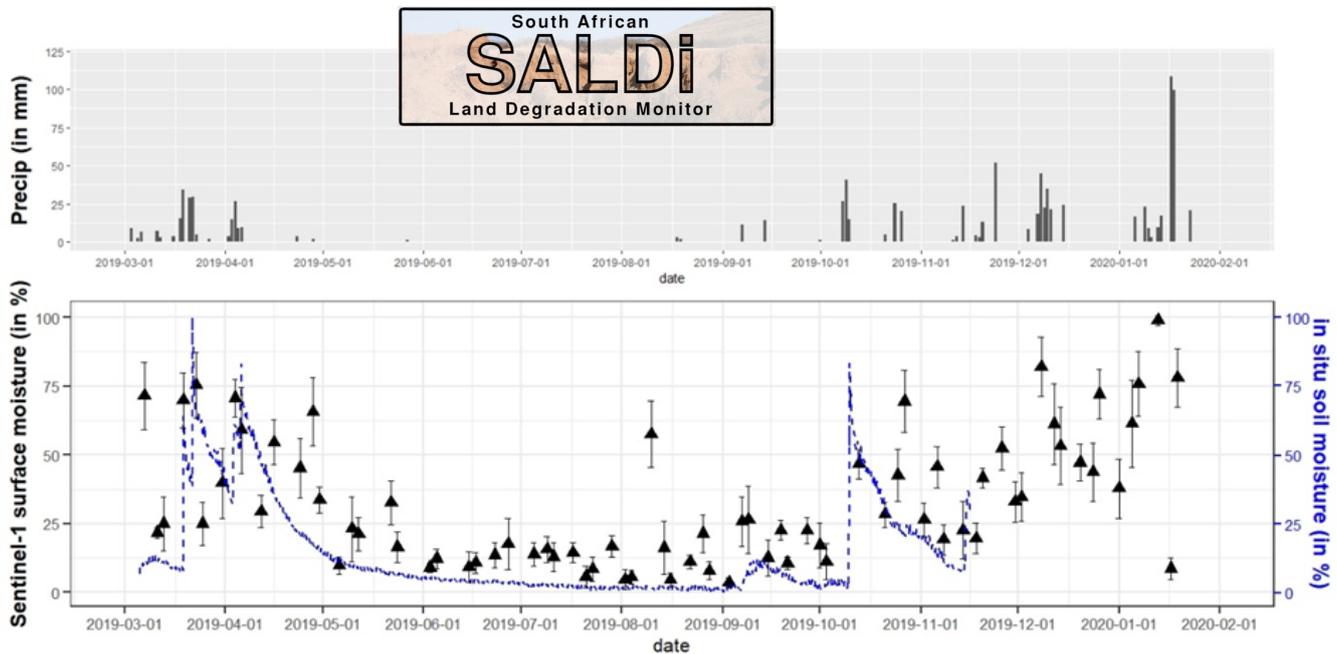


Fig. 1. First year time series of Sentinel-1 based SurfMI (Surface Moisture Index), in situ soil moisture measures (below) and daily precipitation (above) at the SALDi soil moisture site in southern Kruger National Park (precipitation data provided by SANParks). Continuous soil moisture measuring was disrupted in mid-November 2019 due to equipment failure, which has been replaced 4 March 2020 (compilation: M. Urban 2020).



Fig. 2. SALDi and EMSAfrica team members at Nkumbe lookout during the joint visit to study sites in southern Kruger National Park (Photo: J. Baade 2020)



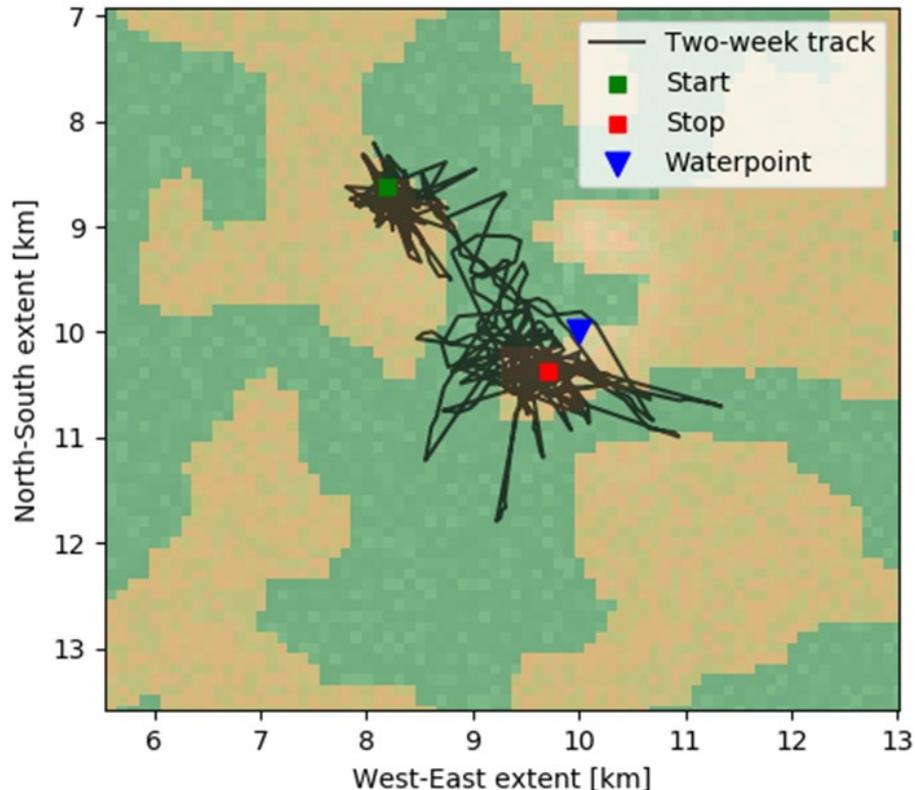
Simulating wildlife in a dynamic savanna

Dirk Lohmann, Leonna Szangolies, Christoph Lobas and Florian Jeltsch, University of Potsdam, Plant Ecology and Nature Conservation

The major aim of ORYCS is to understand ecosystem dynamics of savannas under various wildlife-based land use regimes. The core of ORYCS research is hence centered around herbivore – environment interactions and how those vary over space and time for different scenarios.

While ORYCS empirical work will reveal movement pattern of herbivores (workpackage 2) and the corresponding features of vegetation and environmental parameters for some key situations on the ground (workpackages 2-4), simulation based approaches in ORYCS workpackage 1 will help to scale up the gained understanding of processes and system mechanics to larger temporal and spatial scales. Simulation experiments will then allow for assessments of the broad range of possible alternative management and (future) environmental scenarios.

Currently, ORYCS simulation modelers at the University of Potsdam are working on an animal functional type model. This model will simulate movement, resource use and population dynamics of large herbivores in savanna landscapes (see Figure below).





So far, we simulate static landscapes with fixed vegetation composition. In the next step, we want to include the dynamics of the most important resource from an antelope's perspective: plant biomass. Hence, we have started adapting an existing eco-hydrological savanna vegetation model (Synodinos et al. 2015) to be able to simulate this highly dynamic resource landscape for our virtual wildlife.

Tree and grass biomass will be simulated depending on soil conditions, rainfall, grazing and browsing intensity and fire. Currently, the model is parameterized with data from literature and remote sensing information (see Figure below).

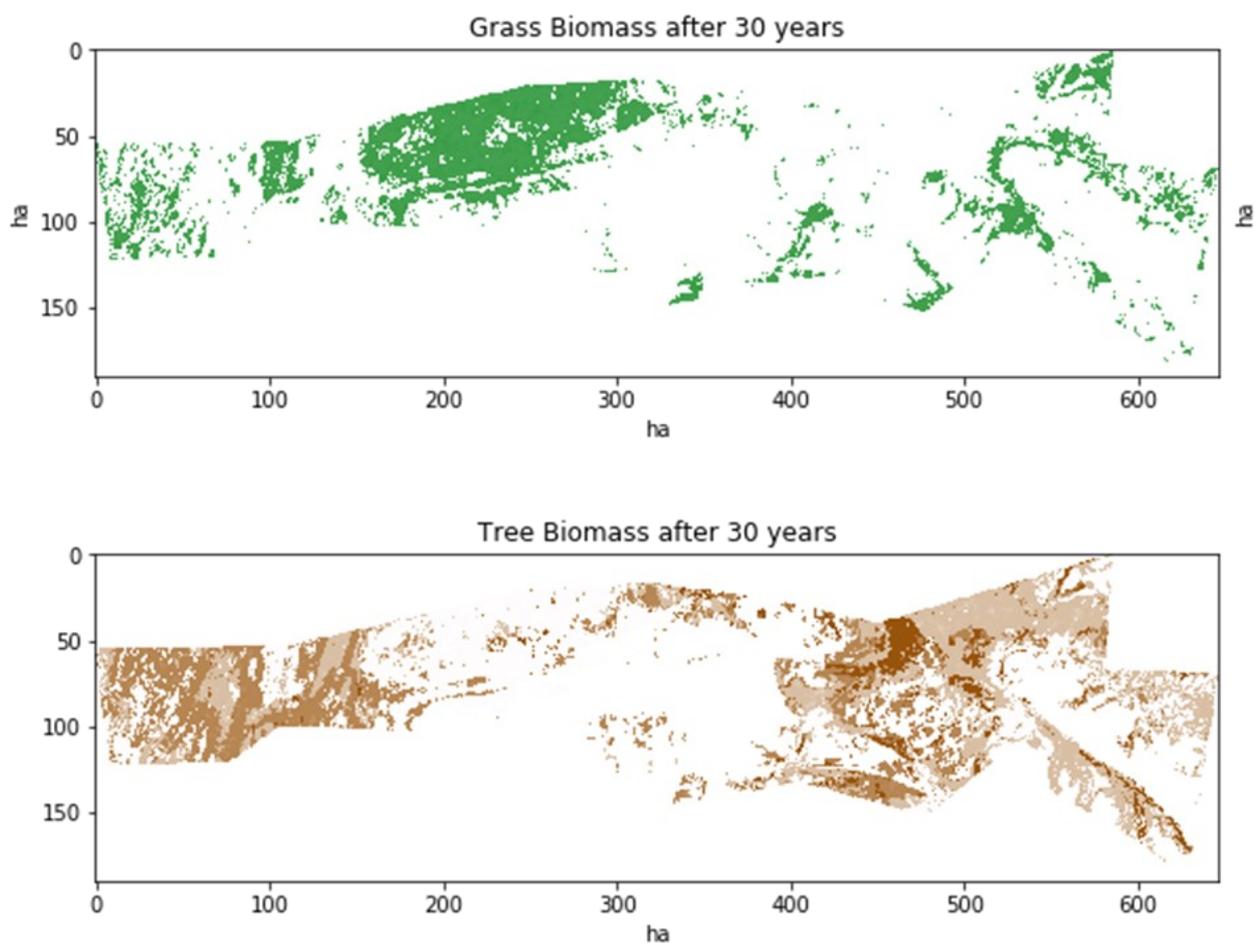


Figure. Simulated tree and grass biomass in the study region after 30 years - note biomass scarcity in mountainous areas e.g. in the center of the area.

Ecohydrological modelling of plant functional diversity

Katja Irob¹, Ben Strohbach², Angelina Kanduvarisa², Britta Tietjen¹

¹Theoretical Ecology, Freie Universität Berlin, Germany

²Namibian University of Science & Technology, Namibia



We used a simulation model (EcoHyD) that simulates vegetation growth and water fluxes in a savanna landscape. The model has been tested for different savanna sites in Namibia, which differed in soil conditions, in mean annual rainfall and in land use intensity (of cattle grazing). The results of these tests showed that cover and biomass of grasses and woody species can be well predicted across Namibia. Depending on weather conditions, soil characteristics and land use by grazing or browsing animals, we see shifts in vegetation composition and biomass, but also in soil moisture, runoff and deep drainage.

The aim of this study is to systematically evaluate the impact of different land-use strategies (e.g. which type of animals, for how long, in which densities) on the diversity of functional plant types and on several ecosystem processes. This will allow for identifying sustainable management strategies that avoid degradation and that lead to long-term provision of so-called ecosystem services and economic income.

For this project, we identified typical different functional plant types of the study region and parameterized the model to explicitly account for their particular characteristics. We calibrated the model to reflect the local environmental dynamics and run first simulations to assess the composition and cover of different functional types and soil water availability dependent on animal composition (grazing vs. browsing species) and their density. These first results are in line with our expectations: they show that total plant cover increases with decreasing stocking rate and that grass cover is generally higher in browsing scenarios. They also indicate that total cover increases with decreasing land-use intensity and that perennial grasses benefitted the most from lower stocking rates. As a result, also soil water availability improves, since less water is lost by overland flow, leading to lower erosion risk. Thus, they make us confident that the model is suited to fulfill the aim of the study.

The next step will be to integrate more plant types into the model runs and to systematically assess, which species who are most sensitive to unfavourable weather conditions or to particular land use strategies. Also, we want to better understand the role of plant diversity for increasing the resilience of savanna systems and their functions to future changes in climate or to changes in land use.

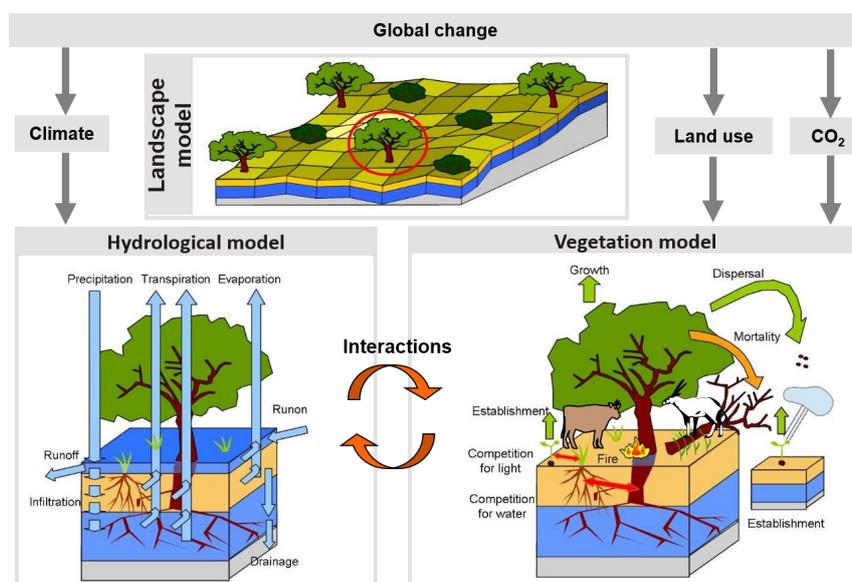


Figure. Simulation model used in this study: The landscape is divided into grid cells. In each of these cells, hydrological processes as well as vegetation related processes are calculated. The model can be used to assess long-term dynamics (e.g. 100 years) under different climate or land use scenarios.

Sixth Observation Year in SALLnet's DroughtAct Experiment

SALLnet asks how the resilience of the multi-functional landscapes in southern Africa can be enhanced under climate change. To do so, the project conducts case studies and designs a modelling and upscaling framework to use field and experimental findings, both at farm and regional level, and – involving regional stakeholders in the entire research process – SALLnet develops integrative risk management strategies and policy recommendations for sustainable land use.

SALLnet's work package 2 on rangelands and agroforestry focuses on the delivery of multiple ecosystem services (ESs) of Limpopo's rangelands and agroforestry systems, and evaluates ecosystem stability in the face of climate change.

The DroughtAct Experiment is a large-scale field experiment maintained by SALLnet work package 2 since the year 2013. The experiment addresses two main research questions: (1) What determines rangelands' stability in the face of drought?; and (2) What are suitable management interventions to avoid degradation in the face of drought? The experiment is located at the Experimental Farm of the University of Limpopo, South Africa. It combines resting treatments with treatments of centennial-scale drought. Data collection in the DroughtAct Experiment is now in its 6th year. Treatment effects are clearly visible, in particular the effect of a prolonged, severe drought (see figure below).

Data collection during the current growth period will continue until May 2020.



Reducing climate-induced risk to maize production in the Limpopo region

The “Integration and Synthesis” work package of SALLnet integrates the results of those work packages whose common goal is to study the effects of climate variability and change, socio-economic factors and change processes, resource management and targeted management interventions on the different ecosystem services of the three main land use types (farmland, pasture and plantations) in the Limpopo region.

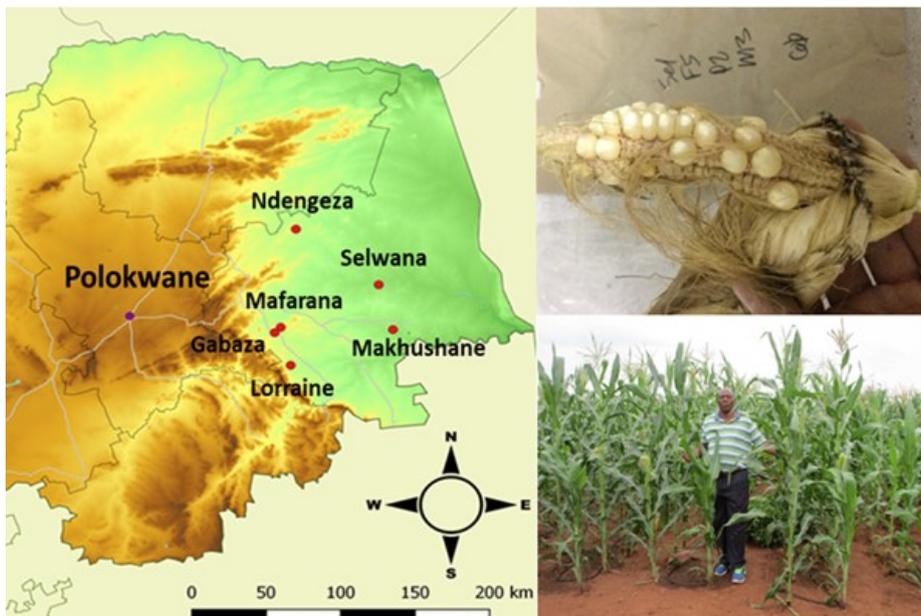


Current work investigates the extent to which the combination of genotype, drip irrigation, and nitrogen fertilizer can reduce climate-induced risk to sustainable intensifying maize production in the Limpopo region. We use the empirical data collected during the April-May 2019 field campaign to set-up and run the APSIM crop model. Field data collected quantifies soil properties and key management aspects, such as cultivar choice and plant-density, for smallholder farmers across a climate gradient in Limpopo. This simulation study has been run using historical weather data for key sites, and will be tested under future climate scenarios. This work has been presented at the iCROPM conference in Montpellier, France at the beginning of February.

Ground-truthing of the first maize growing season in villages across a climate gradient is complete – soil samples taken still in the lab.

Data acquisition finished for: set-up of the APSIM crop model for smallholder management, as well as yield potential. While soil property data existed for some of the villages, the samples taken in 2019, being analyzed in the lab now add to this database. All biomass harvests and soil properties have been geo-referenced.

Carlotta May completed her MSc thesis (December 2019 defence), which consisted of a household survey of arable smallholder farmers in Limpopo.



*Left: SALLnet core villages,
Above right: Maize yield – not so good,
Below right: Maize smallholder*

Quantifying the shade cast by windbreak trees in South Africa

The shade cast by windbreaks may affect the growth of crops or trees grown between, due to reduction in light, therefore, a reduced photosynthetic potential. Research to gauge the magnitude of this shading effect is lacking, efforts to model the shading of single trees in Europe has begun, but linear features as well as measurements at other latitudes has not yet been explored. The utilisation of hemispherical photography is proposed as a method of obtaining parameters that describe the light regime in these systems. Binarized hemispherical photographs (see fig 1) collected on transects perpendicular to established windbreaks can be analysed to obtain values describing the light regime. Initial experimentation has shown a clear depression in light availability (see fig 2) as a result of windbreak trees (for the species *C. cunninghamiana*) that is dependent on windbreak size. Future efforts will be devoted to modelling shading as a function of windbreak parameters.

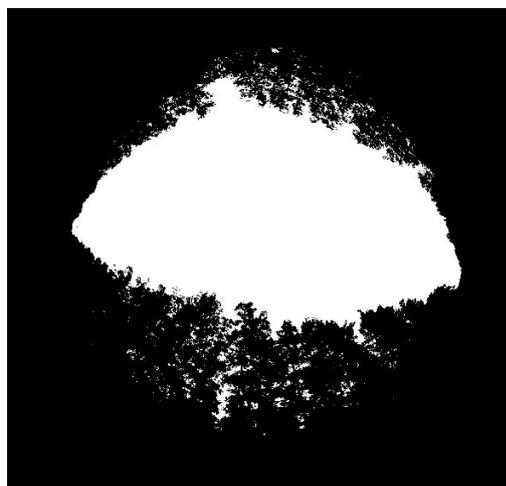


Fig 1: Raw (left) and binarized (right) hemispherical photos of windbreaks

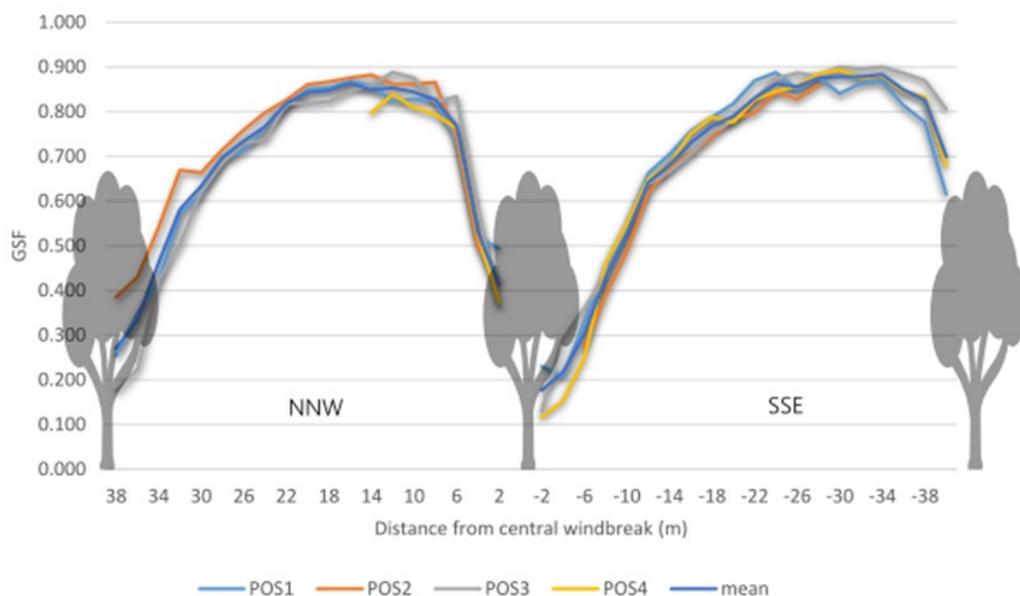


Fig 2: provisional results showing shade cast along transects (NNW and SSE) in an agroforestry system. (Global site factor (GSF) refers to full shade = 0 and full light conditions = 1 as a description of the light regime).

EMSAfrica meets Bushbuckridge Local Municipality Stakeholders

EMSAfrica looks at the impacts of land use and climate change on the structure and function of South African terrestrial ecosystems. We have six core research sites, situated along an aridity gradient in South Africa, and representing paired comparisons of different intensities of land use. On these core sites, we conduct a range of observations from ecophysiological experiments to land-atmosphere carbon exchange, remote sensing, and socioeconomic surveys. The data are used to develop and test models, and produce information relevant to ecosystem management. Busbuckridge, a rural former-homeland region of Mpumalanga Province, is one of our study areas.

On Friday the 6th of March, we met with a group of representatives from the Bushbuckridge Local Municipality (BLM) at the Wits Rural Facility in Acornhoek, South Africa. The aim of this meeting was to jointly find ways in which the data, products and knowledge generated by EMSAfrica could be used to provide value for land-use decision making by the BLM.



After an intensive and engaging day of discussions in plenary and topical groups, we jointly drafted a plan of next steps for our collaboration. The BLM faces major challenges related to land-use planning, such as identifying flood-sensitive areas, key resource sites, as well as better tracking the process of settlement expansion. In terms of to climate change adaptation, main issues faced by the BLM are related to temporary flooding, agricultural productivity, water security, mobility and transport, as well as tourism. Concrete overlaps in our work are mainly related with the community's land-use plans and climate adaptation strategy: EMSAfrica remote sensing and vegetation modelling teams have a key role here.



Photos: Thomas Clemen, Ulfia Lenfers, Mari Bieri

One of the specific products that EMSAfrica will be supporting BLM with is climate change education materials, especially those that help the BLM in their interactions with schools. Here, as well as with other collaboration ideas with the BLM, we would like to call out for other SPACES II projects with similar ongoing activities: *if you have relevant resources or ideas, please contact Mari (mari.bieri@thuenen.de)*. We look forward to hearing from you!

Approaching the interaction between society and wildlife

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An analysis of semi-structured interviews and stakeholder workshop conducted in 2019 sheds light on the attitudes of farmers and institutional experts towards possible developments in livestock farming, hunting for conservation purposes and wildlife management in the ORYCS study region. Different viewpoints of the stakeholders originate from diverging interests, fundamental moral values and traditional belief systems, knowledge validity, social relations and institutional procedures that may lead to conflicts among the stakeholders. For better understanding of the regulatory framing, the project also reviews legislations and policies that are determining the scope of action for both communal and commercial farmers. Despite the country's extensive policy framework that evolved over the past decades to mitigate human-wildlife conflicts, the analysis confirms that sharing a landscape and its resources with wildlife is a challenging task as evidence of other studies suggests from around the world.

As a concrete example, a tandem master's study investigates the connection between elephant movement and their natural and human environment. The research steadily reveals new insights into the influence of fences and management types on farms. All findings will be published this year to contribute to the upcoming research within the working groups of ORYCS. In close collaboration, the Namibian-German ORYCS team currently designs further tandem master's studies and the upcoming field trips in 2020.



Herd of elephants at a waterhole in Etosha Heights (Photo: Ronja Kraus)

ASAP field trip to Malawi and Zambia

Nicholas Ndlovu from the Chair of Forest and Environmental Policy, Albert-Ludwigs-University Freiburg visited Malawi and Zambia to conduct interviews with agroforestry actors in the region at the end of 2019. The current work focus is on the Institutional and Policy perspectives of Agroforestry within the SADC region. Nicholas was able to meet eight stakeholders and discuss agroforestry applications in the region and has since amassed a further 11 interviews from networking in the region.



A *Faidherbia albida* and maize agroforestry system at the ICRAF research station near Lilongwe, Malawi (Photo R Maier)

Current field trips been postponed. When travel restrictions are lifted teams from Karlsruhe Institute of Technology (KIT) will be visiting Malawi to collect data from research plots at ICRAF (World Agroforestry), while members of the CEBra team from Cottbus will be visiting research plots in Stellenbosch, South Africa to install equipment.



SALDi field work activities

Jussi Baade, Andreas Kaiser, Michael Geißler, Marcel Urban and Chris Schmallius, Friedrich Schiller University Jena

SALDi field work activities in South Africa in March 2020 included maintenance and repair of soil moisture equipment in three of the six SALDi study regions (Mpumalanga, Mokala, Pilanesberg). In the Mokala region, soil moisture probes were replaced and are now located in Benfontein Nature Reserve, which includes two flux towers and further equipment installed by SAEON and EFTEON (Dr. Joh Henschel, Dr. Gregor Feig). Furthermore, the Earth Observation Group conducted change detection validation surveys in three regions. The Soil Erosion Group conducted combined boat-based echo sounding and terrestrial laser scanning (TLS) siltation surveys of selected reservoirs around White River, Mpumalanga, as well as several rainfall simulation experiments – before the field work campaign had to be stopped because of earlier staff departures due to the COVID-19 pandemic.



The SALDi Soil Erosion Group conducting a reservoir siltation survey with boat-based echo sounding and terrestrial laser scanning at Klipkopies Dam near White River, Mpumalanga, in cooperation with the White River Valley Conservancy Board (WRVCB)(Photo: J. Baade 2020).

Cruise TRATLEQ 1 from Walvis Bay to Recife (19/09 – 26/10 2019)

The first leg of the Transatlantic Equatorial Cruise (TRATLEQ I) took place between 19th September and 26th October 2019. The group photo with all participants is shown in Figure 1. This was an interdisciplinary cruise focusing on upwelling in the tropical Atlantic, its physical forcing, its importance for biological production and plankton communities, associated chemical cycles, as well as on the current system setting the background conditions for the downward carbon export.

This cruise was the first physical, chemical, biogeochemical and biological measurement program covering a whole equatorial section from the eastern to the western boundary and from the surface to the bottom. TRATLEQ I contributed to the BMBF cooperative project BANINO in the frame of the BMBF SPACES programme.



Figure 1: Group photo with all participants during the TRATLEQ I cruise (Photo: Peter Brandt)

Besides the equatorial Atlantic, of particular interest is understanding the functioning of the coastal upwelling off Angola where the warm poleward Angola current also flows. For this purpose, there is a long-term mooring servicing off Angola at 11°S since July 2013, comprising an upward looking 75 kHz Long Ranger Acoustic Doppler Current Profiler (LR ADCP) located at 500 m depth and measuring zonal and meridional current velocities, as shown in Figure 2.

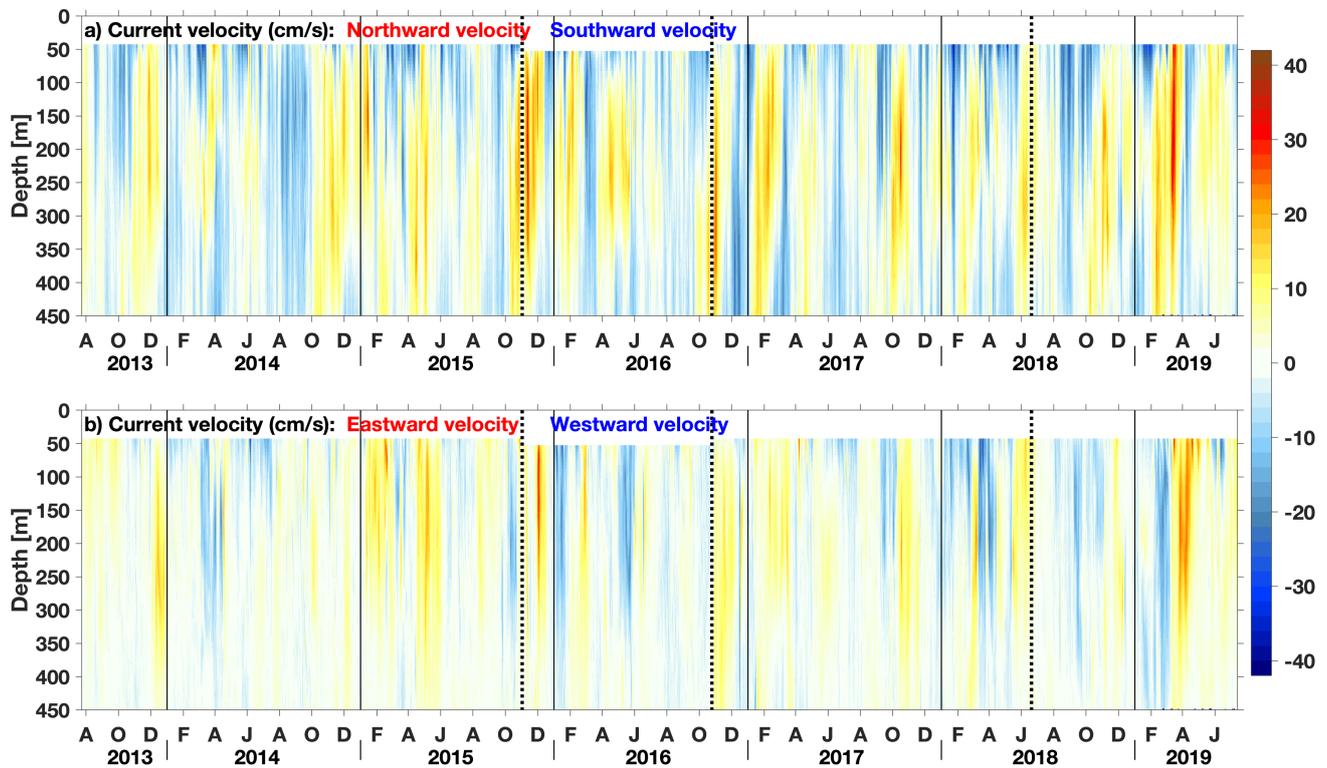


Figure 2: a) Time series of along-shore velocity inferred from moored ADCP at 11°S. Positive (negative) values indicate northward (poleward) flow. b) Same as (a) but for cross-shore velocity. Positive (negative) indicate eastward (westward) flow. Current velocities are in cm/s (Photo: Rodrigue Anicet Imbol Koungue).

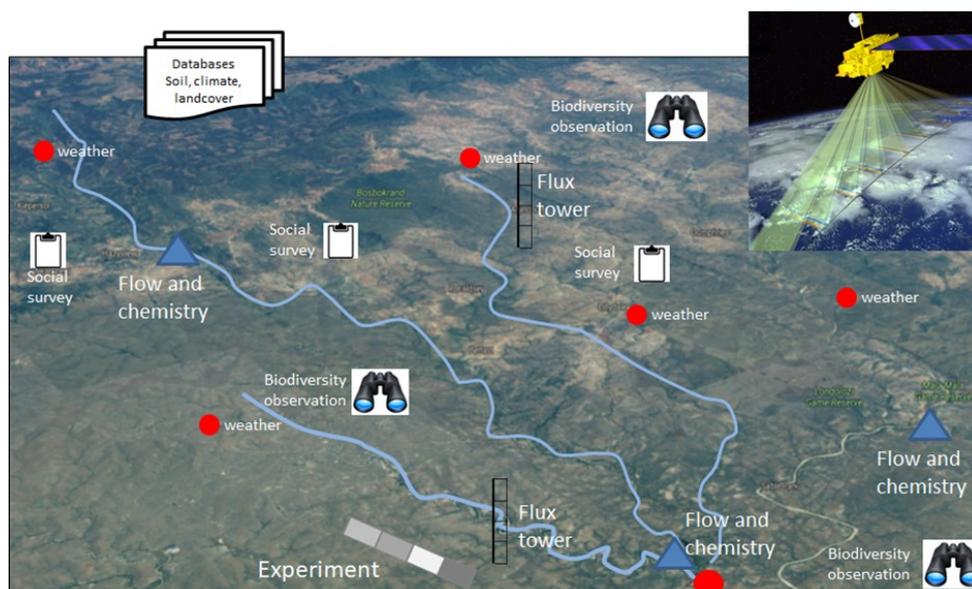
With the current measurements, we can estimate the along-shore transport of the Angola current, which could help us to assess how much equatorial Atlantic waters are transported poleward for example during an anomalously warm coastal event as was the case in 2016. These mooring records will also help studying the intra-seasonal variability present in the current velocities.

Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) & EMSAfrica: joint fieldwork of ecosystem-atmosphere CO₂

Jens Jüdt, Thünen Institute of Climate-Smart Agriculture, Tamryn Hamilton & Amukelani Maluleke, EFTEON

EMSAfrica focuses on the impacts of land use and climate change on the structure and function of South African terrestrial ecosystems. The project's six core research sites represent different intensities of land use along an aridity gradient. At the centre of each research site, there is an Eddy Covariance (EC) Flux Tower, continuously monitoring the land-atmosphere exchange of CO₂ and water vapor.

The Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) is a research infrastructure under development in South Africa. Its aim is to provide a long-term, open-access instrumented platform for the research community. This engages a multi-scale approach to observe social-ecological landscapes through coupled terrestrial and freshwater systems observation (<https://efteon.saeon.ac.za/>). The EFTEON concept is structured as six observational landscapes across South Africa – each with a heavily instrumented core site fitted with an EC flux tower and coupled freshwater system measurements and surrounded by distributed subsidiary stations.



Potential design of an EFTEON landscape incorporating existing infrastructure. The EFTEON infrastructure will provide:

- Remotely sensed imagery
- Historical data
- Continuous time-series data on meteorological and hydrological parameters, and fluxes (energy, water, carbon)
- Field samples (social-ecological surveys; biodiversity indicators; records of disturbances (floods, droughts, pests); selected chemical analyses (soil, water and vegetation))

Three EMSAfrica flux towers were set up by the Thünen Institute and South African partners under the EMSAfrica predecessor SPACES project ARS AfricaE, and three are maintained by our partners at the Council for Scientific and Industrial Research (CSIR).

In February 2020, Jens Jüdt, EMSAfrica's project engineer, started his regular EMSAfrica EC tower maintenance field trip from the northernmost tower, at the site of our University of Venda partners, at the Vuwani Science Resource Centre. This tower is unique in being located in a peri-urban setting; it will provide us a valuable comparison between carbon fluxes in a heavily human-modified landscape and a nearby natural ecosystem in Phalaborwa.

The EC towers need regular maintenance: disassembling, cleaning, and reassembling the instruments, power setups, and wiring connections, calibration, exchange of broken parts, updating software, checking logging data functions, and at times, even removing birdnests or beehives!

In addition to solving on-site technical problems and unusual situations, practical challenges include for example the need to fix a reliable internet hotspot during maintenance work days, and organise shipment of replacement equipment from the various providers.



EMSAfrica Eddy Covariance tower at the Vuwani Science Resource Centre. Right: a practical solution for using a stone as counterweight to lift up replacement instruments. Photos Mari Bieri, Jens Jüdt.



Following the Vuwani trip, Jens joined EFTEON's Chief Technician Kerneels Jaars and team members Amukelani Maluleke and Tamryn Hamilton to finalise the installation and calibration of two EFTEON test-sites deployed at the Benfontein Nature Reserve just outside Kimberley. These towers represent a hands-on learning approach towards developing effective operational procedures and a glimpse into what will eventually become the heart of the EFTEON project.



The EMSAfrica and EFTEON field teams (Kerneels Jaars, Amukelani Maluleke, Tamryn Hamilton and Jens Jüdt) completing installations at the EFTEON Benfontein field site. Photos: Amukelani Maluleke.

EFTEON actively seeks to identify and engage in the best practices for on-site management and data acquisition for these systems ahead of the EFTEON Landscape deployment.

Following the completed installation at the test-sites, the EFTEON-EMSAfrica team travelled to Grootfontein, Middelburg, Eastern Cape, where two EMSAfrica sites are located at about a kilometers distance from each other. One of our sites is under controlled grazing, while the other one has been overgrazed in the past, rested for several years, and is now again grazed. Comparisons between these two types give us valuable information on the impacts of grazing on carbon dynamics.

Arriving to the field site, we found the solar panels and batteries of one of the towers stolen, and Jens' field trip had to be extended by two weeks in order to reorganise and reinstall a whole solar power setup. With the support of our Middelburg site manager and partner Justin du Toit, and the Micrometeorology group technicians back at the Thünen Institute, Jens was able to design and install a new, stronger security system, including night cameras and steel cages (see pictures below).



Middelburg EC tower during maintenance (left); new power setup with anti-theft steel cage and frame for solar panels (right) (Photos: Jens Jüdt).

Joint field work between EFTEON and the EMSAfrica project/Thünen Institute in the framework of shared knowledge and skills development, as well as the joint Eddy Covariance Winter School (the first of which took place in Vuwani 2019, with two more courses planned), are seen as important activities by both teams.



Photo: Amukelani Maluleke