SPACES II

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

Research Programme Newsletter

INSIDE THIS ISSUE:

Welcome to the sixth SPACES II Newsletter!

Our sixth research programme newsletter comes out during mid-winter in the Southern hemisphere and the hottest summer in the Northern hemisphere. The SPACES II course activities are cautiously being revived, mostly as blended/two-location events, and of course strictly following local Covid-19 meeting restrictions. Read more on our currently open courses on pages 5-6 and spread the course offers among your networks—fully funded slots are, as always, available for southern African participants.

Further highlights include reports from the virtual EGU, various field work activities, and publications on the early human impacts on the Umzimvubu catchment, as well as the policy and institutional dimensions of agroforestry.

For the purposes of our joint Springer book '*Sustainability of southern African ecosystems under global change: Science for management and policy interventions*', all SPACES II researchers will have received a link to an electronic questionnaire regarding perceptions on North-South collaborations. Please take part in this anonymous survey: the results will be published in the open-access book and used to improve similar research programmes in the future.

Thanks for your contributions and enjoy reading!

Mari Bieri (SPACES II Board / External Communications)

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Tropentag 2021, 15–17 September, Hybrid Conference, University of Hohenheim, Germany

The theme of this year's Tropentag conference is ‚Towards Shifting Paradigms in Agriculture for a Healthy and Sustainable Future'. The interdisciplinary conference brings together research in tropical and subtropical agriculture, natural resource management and rural development.

Participant registration for the hybrid conference is open at the conference website https://www.tropentag.de/

Landscape 2021: 20-22 September, Virtual conference ‚Diversity for Sustainable and Resilient Agriculture'

Landscape 2021 will bring together scientists from across disciplines with key actors to explore whether and how diversity and diversification can contribute to a more sustainable and resilient agriculture.

Registration for participation, including signing up for master classes is open until August 15th on the conference website: https://www.landscape2021.org/

Grassland Society of Southern Africa: 56th Congress, 26-30 July 2021, Surval Boutique Olive Estate, Oudtshoorn and online

The Grassland Society of Southern Africa will accept also online registrations on its 56th congress, held on the 26th-30th July. Preliminary programme and instructions of participant registration available on the conference website: https://2021gssa.dryfta.com/index.php

International Congress of Zoology, 22-24 November 2021, Virtual Congress ‚Zoology in the Anthropocene—A Holistic Integrated Approach to Conservation'

Convened by the Zoological Society of Southern Africa, the ICZ 2021 will focus on understanding and managing change under the Anthropocene.

More information and participant registration on the conference website: https://icz2021.co.za/

Joint SALLnet-ORYCS session on "Drylands in Transition" at the 50th Annual Meeting of the Ecological Society of Germany, Austria and Switzerland (GfÖ) "Ecology - Science in Transition, Science for Transition" 30 August – 1 September, 2021

Session chairs: Anja Linstädter (SALLnet), Liana Kindermann, Niels Blaum (ORYCS)

SALLnet and ORYCS organize a session with the topic "Drylands in Transition" at the 50th Annual Meeting of the Ecological Society of Germany, Austria and Switzerland. Considering that dryland ecosystems are particularly sensitive to transitions triggered by global environmental change, the session aims to link research activities targeted at a better understanding of ecological and social-ecological transitions in drylands.

It is well-known that increasing land-use pressure and climate change massively threaten ecosystem health and productivity, with negative consequences for local livelihoods and well-being. However, despite ample evidence that climate and land-use may have interacting effects on ecosystems, we still lack a mechanistic understanding on how these two global change drivers both separately and jointly affect biodiversity, and, subsequently, ecosystem functions and services in drylands.

In our session we will assemble studies focusing on rapid transitions in drylands due to tipping point phenomena, and on changing management regimes such as transitions between livestock-based and wildlife-based strategies. Presentations include observational studies, experimental studies and modelling approaches dealing with the effects of climate change and/or land-use change on dryland ecosystems.

GfÖ Conference website: https://www.gfoe-conference.de/

SALDi Technical Workshop with Stakeholders from the Komatipoort Region

On May 4th, the SALDi team member Equispectives Research & Consulting Services (Erasmuskloof, Gauteng) organized a technical workshop with local stakeholders (RCL Foods, Cane Growers Association, Mpumalanga Agriculture Forum and the Irrigation Boards) for discussing future steps of our cooperation with the aim to increase the understanding of a decline in soil productivity, reduced vegetation cover, and possibly increased soil erosion in the long term.

During this meeting we shared some preliminary Earth observation -derived land degradation parameters with our local partners, e.g. woody cover encroachment, detection of anomalies, and land surface changes in remote sensing time series, etc. We also discussed the issue of soil erosion on irrigated sugar cane fields in the Lowveld in Mpumalanga, and indicated that soil erosion (by water) occurs only on bare, sloping fields where heavy rainfall causes surface runoff. Otherwise it does not need to be of concern.

The goal of this workshop was to discuss how SALDi's project outcomes can be utilized by the stakeholders and if they have any additional requirements from the user's perspective. The SALDi team received very constructive feedback from the stakeholders, which will assist them with identifying additional uses of the data on community level (local stakeholders, commercial and subsistence farmers). The SALDi project includes a socio-economic study that entails interviews and focus group meetings with local stakeholders to determine local perceptions about land degradation.

EMSAfrica congratulates Dr Kanisios Mukwashi!

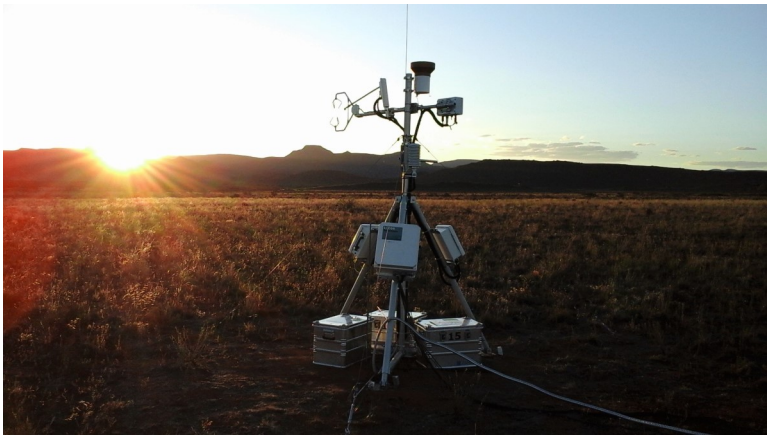
EMSAfrica is pleased to announce that Kanisios Mukwashi successfully defended his doctoral thesis 'Explaining temporal variability of and quantifying the impact of livestock grazing intensity on carbon and energy exchange in semi-arid near-natural and managed savanna ecosystems in South Africa' on the 1st of June at the University of Bayreuth. Kanisios initiated his doctoral research project with the ARS AfricaE project during the first phase of SPACES. He acknowledges the DAAD for funding the main part of this work.

EMSAfrica
Ecosystem Management Support for Climate Change in Southern Africa

Kanisios' thesis focussed on land-atmosphere CO_2 exchange using eddy covariance (EC) measurements at two sites in South Africa: a near-natural savanna ecosystem at Skukuza, Kruger National Park, and a dwarf shrub ecosystem (Nama Karoo) under sheep grazing in the Eastern Cape Province. At the Nama Karoo site, Kanisios' special interest was in investigating the amount of precipitation needed to trigger the so-called hot moments of ecosystem respiration spikes in response to rain pulses. He further studied the minimum precipitation thresholds to reach the onset of the growing season at both ecosystems.

At the Nama-Karoo site, two EC towers have been set up one kilometre apart, at sites under different intensities of past and present livestock management. Kanisios compared carbon sequestration between these two sites, finding that a site that had been overgrazed in the past but rested for eight years had slightly higher carbon sequestration compared to the gently grazed site. These results may have important implications for the design of grazing systems at similar areas.

Overall, Kanisios found that the amount and distribution of precipitation is the main determinant of gross primary production, ecosystem respiration and net ecosystem CO_2 exchange in both studied ecosystems.



Figures (top left) *field work team at Middelburg with Kanisios on the left,* ***(bottom left)*** *Study site at Middelburg, Nama-Karoo,* ***(top right)*** *study site at Skukuza, Kruger National Park. Photo credits: Thünen Institute of Climate-Smart Agriculture.*

SALDi subproject PI, Prof. H. Kunstmann, receives the Rüdiger Kurt Bode-Stiftung Water Resources Prize 2021

The leader of the South Africa Land Degradation Monitor (SALDi) subproject "Land-Atmosphere Interaction: Regional Assessment", Prof. Dr. Harald Kunstmann, has received the Water Resources Prize 2021 from the Rüdiger Kurt Bode-Stiftung during an online session of the 11th Water Research Horizon Conference in June. Prof. Kunstmann is the Chair of Regional Climate and Hydrology at the University of Augsburg and Deputy Director of the Institute for Meteorology and Climate Research – Atmospheric Environmental Research at the Karlsruhe Institute of Technology, the KIT Campus Alpin. He is as well the founding director of the Centre for Climate Resilience at the University of Augsburg, which was newly established this year.

The price was awarded to Prof. Kunstmann for his "outstanding achievements […] in the field of sustainable water resources management in water-critical, vulnerable regions of the global south, especially for the coupled atmosphere hydrology model systems that he and his team have developed, and for research on sub-seasonal to seasonal predictions (S2S) of water availability" (Deutsches Stiftungszentrum, Press Release, 2021-06-15). The motivation for his S2S research was to overcome the conflicting interests in managing large multi-purpose reservoirs in water scarce regions providing at the same time irrigation water for agriculture and hydroelectric power. Here, the regionally adapted sub-seasonal to seasonal (S2S) forecasting systems can now provide significantly improved forecasts of heat-, drought- and anomalous wet periods up to seven months ahead, and thereby allow for crucial information for sustainable decision making in water management.

Prof. Kunstmann is grateful for the third party funding provided by the BMBF and other funding agencies in the framework of projects like GROW, WASCAL, Client II, and SPACES, providing the opportunity to further develop hydro-climatic modelling tools and applying / testing them in regions where they can improve the daily life of people.

***Photo**: Harald Kunstmann (© Karlsruher Institut für Technologie)*

Introduction to Ecological Modelling (in NetLogo) 22.-26.11.2021

We are happy to announce that the registration for our short course „**Introduction to Ecological Modelling (in NetLogo)**" is open now (deadline for registrations is **July 30th**).

Our course is targeted to MSc and PhD students as well as early career researchers from SPACES II or directly associated (e.g. SASSCAL) projects who have no or very little prior experience in ecological modelling.

Using the open-source agent-based-modeling framework NetLogo (http://ccl.northwestern.edu/netlogo), participants will get an introduction into the basics of how process-based models are conceptually developed, technically implemented and how they are then finally evaluated and analysed. Guest keynote lecturers will give "spotlight presentations" on selected ongoing ecological modeling studies and will provide interesting insights into the potential application of the method

Our practical course facilitates "hands-on" experience in ecological modelling. Real ecological examples will be used to formulate conceptual models. The open source software NetLogo will then be used to implement those models technically. Students will undergo the whole process from model development over technical implementation / programming to analyzing.

The course will enable non-modeling researchers and students to get first insights into the "world of ecological modeling". This should either inspire them to further continue learning and working in this field of research or to just foster their understanding of what ecological modeling is all about. As simulation based sub-projects are nowadays part of most research projects, we consider this course also very valuable to students who are working as field ecologists. Interpreting the results of simulation-based research, as well as being able to cooperate in inter-disciplinary teams are skills that every researcher of the future will need.

For more information and the **registration link** please visit:

https://spaces.thuenen.de/courses/courses-in-2021/introduction-to-ecological-modelling-in-netlogo/

Field methods on plant ecology 23.9.-3.10.2021

The field methods in plant ecology course takes place at the Skukuza Science Leadership Initiative Campus at the Kruger National Park in South Africa. The course teaches basic field methods for plant ecology, as a series of structured field data collection and data analysis exercises. The field activities expose the students to the fundamental questions in savanna ecology, using the unique field infrastructure offered by the Kruger National Park. Data analysis will be done using a slow science philosophy, without computers, highlighting teamwork and creativity. The strategic adaptive management approach embedded in the philosophy of the Kruger National Park authorities will be used throughout, and highlighted in guest lectures.

Photo by Laurence Kruger

The course will terminate on a series of exercises where the students plan, execute and report their own field ecological project.

The course is open for applications for fully funded slots for South African students (bachelor, honours or masters programs) who are on the pathway to a doctoral program in Earth System Science. There will also be advanced bachelor students from Bayreuth University taking part.

More information and a link for registration (deadline 31 July):

https://www.spaces-training.org/courses/courses-in-2021/field-methods-for-plant-ecology/

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Summer School 2021

When: 18 - 25 September 2021

Where: - Schwerin, Germany
- Richards Bay & Cape Town, South Africa

Who: graduate students to PhDs
from Africa (Team South Africa)
from Germany (Team Germany)

Content: training in sampling and coring methods in terrestrial and aquatic settings & multimedia science communication

Costs: travel and accommodation will be covered by funds from BMBF

Application: Please send your application as one PDF including
- curriculum vitae (CV)
- letter of motivation
- letter of recommendation

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Deadline: **18 July 2021**

Contact:
Dr. Finn Viehberg
finn.viehberg@uni-greifswald.de
Dr. Jemma Finch
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TRACES SPACES2

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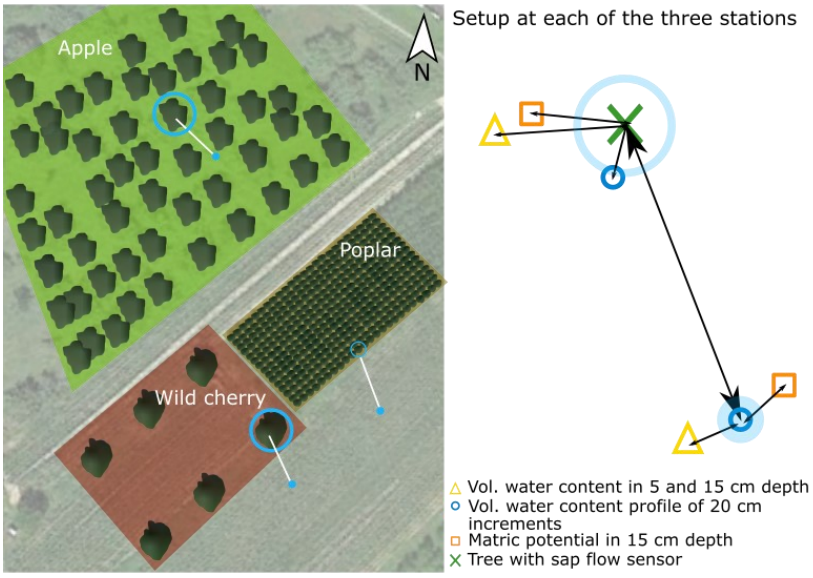
ASAP goes to Stupferich - Using a local agroforestry site as an alternative to retrieve further understanding on water fluxes

Svenja Hoffmeister and Sibylle K. Hassler, Institute for Water and River Basin Management, KIT, Karlsruhe, Germany

Adjusting our work plan due to the COVID-19 travel restrictions, we put effort in trying to find a suitable nearby location for measurements of water fluxes in agroforestry systems (AFS). As a solution, we installed equipment close to Karlsruhe on a demonstration AFS operated by the LTZ (Federal Agricultural Technology Centre).

The system is structured in three compartments, alley-cropping of timber species combined with crops, a short-rotation poplar field combined with crops and a traditional fruit orchard combined with grass. This is a unique opportunity for direct comparison of different AFS systems under the same weather conditions. This season, the crop field lies fallow and thistles have taken over the field. For comparison between the three systems, we equipped each with a number of different sensors (two types of volumetric water content via TDR, soil matric potential and sap flow sensor). At each of the three sites, we have two measurement points, one close to the tree (wild cherry, poplar and apple, respectively) and one away from the tree root zone. This way we want to extract information on the trees' influence on the water dynamics. The data will be complemented by publicly available meteorological data from a weather station on site. Installation took place in May 2021, and we aim to collect data until autumn 2021 before the fields will be prepared for the next growing season.



Figures (above left) *Overview of the overall setup and the arrangements of sensors at each of the three stations, (**below left**) Setting up the power supply and the logger, (**above right**) An apple tree in the fruit orchard equipped with a sap flow sensor, (**below right**) One of the six measurements points. Two types of TDRs are installed next to each other and adjacent to TDR profile sensors (plastic tube). The matric potential sensors are on the other side of the tube.*

SALLnet field work on arable lands, rangelands, and tree orchards

SALLnet focuses on how the resilience of the multi-functional landscapes in southern Africa can be enhanced. To do so, we are developing and testing new approaches and methods for more sustainable land-use, with a focus on the interactions between the connected land-use types: arable lands, rangelands and tree orchards.

Winter cover crops experiment resumed in Limpopo

SALLnet's work area "Arable lands" focuses on closing livestock feedgaps with winter forage crops. Therefore, field experimentation on C3 cover crops were planned for two years and two distinct sites in Limpopo (Thohoyandou, Syferkuil). Covid-19 restrictions prevented the accomplishment of this task in the 2020 season. Nevertheless, in collaboration with the South African partners the experiment was resumed for the winter season (June 2021) at both sites. Lead research assistants Mr. Kabisheng Mabitsela (University of Limpopo) and Mr. Segolo Phasha (University of Venda) are in charge of the experiment and timely data collection, remotely coordinated by PhD student Sala Lamega (University of Goettingen). The experiments plots were 3m x 2m and set up in a randomised complete block design with four replications at each site and two sowing dates (early, late). The C3 species selected for the trials are as follows: hairy vetch (*Vicia villosa* L.), Egyptian clover (*Trifolium alexandrium*), winter rapeseed (*Brassica napus* L.), and winter rye (*Secale cereale*). The data will serve to setup, calibrate and evaluate crop models for modelling exercises on forage intensification for feed gaps risk mitigation and farm productivity.

Figure: *Field trial at Syferkuil* ***(left)*** *and at Thohoyandou* ***(below).*** *Photos: Kabisheng Mabitsela, Segolo Phasha*

A drought simulation experiment for macadamia trees

One of the main foci of SALLnet's work area 'Effect of climate change and management interventions on ecosystem services of arable land and macadamia orchards in Limpopo region' is on macadamia trees water use dynamics. Alongside intensive experiments aimed at monitoring macadamia tree transpiration, phenology and productivity over two years, PhD student Thomas Bringhenti started a drought simulation experiment, with the support of colleagues from both the University of Goettingen and the University of Venda.

The aim of this study is to understand the response of macadamia trees to an induced drought in Limpopo, South Africa. Limpopo has been affected in recent years by severe droughts related to ENSO. Furthermore, this region is characterized by unevenly distributed annual rainfalls, rarely exceeding 1,000 mm. As a consequence, macadamia trees require supplementary irrigation for good yields and optimal nut quality. Nevertheless, concerns are rising about the future availability of water resources for irrigation in the area, due to decreasing rainfall amounts (IPCC 2007) and depleting groundwater levels (Makungo et al., 2017). Thus, it becomes of utmost importance to understand how a prolonged drought would affect adult macadamia trees, and in particular to determine the critical level of soil moisture beyond which trees exhibit water limitations through reduced daily transpiration and water use.

To this purpose, a simulated throughfall-exclusion experiment was implemented on two orchards (one with HAES 849, the other with Beaumont macadamia cultivars) at Neuhof farm in Limpopo. In each orchard, three trees were excluded from irrigation and plastic covers were placed over roof-like structures under the trees' canopies, in order to prevent throughfall (the rain that would normally reach the ground after passing through the tree canopy) from infiltrating into the soil. Further three trees in each orchard were selected as controls and received a weekly total irrigation of 210 litres per tree over two applications. Weather parameters (rainfall amounts, temperature, air humidity, solar radiation and wind speed) and soil moisture are continuously monitored in both orchards. Furthermore, sap flux density (a measure of tree transpiration) is also continuously measured for all selected trees by means of Granier sap flow sensors. Daily tree water use amounts were calculated by summing up hourly transpiration over daytime period.

Preliminary results show a clear decrease of soil water content under the treated trees compared to the controls, after less than two months from the start of the experiment. We expect that such decrease will in turn lead to a considerable reduction in transpiration and water use of macadamia trees. The acquired knowledge on the soil moisture threshold beyond which tree transpiration is reduced will help to accordingly adjust the irrigation management under drought conditions and limited water availability.

Figures. *Building of structures supporting throughfall-exclusion plastic covers under macadamia trees at Neuhof farm in Limpopo, March 2021. Photos: Thomas Bringhenti*



Developing farm-type specific and spatially explicit risk management options

The main aim of SALLnet's 'Economic modelling' work area is to investigate the effects of present and future agri-relevant risks on the production activities and economic performance of different farm types in the Limpopo region. The first step was to conduct surveys from small-scale and large-scale farmers in the Limpopo province to understand the status quo of the agricultural sector with regard to farm structures, farm types, land-use options, agri-relevant risks, risk exposure and risk management options of farms.

For the small-scale farmers survey, five study areas were selected based on their climatic aridity differences, demography and socioeconomic factors. The sites were located in rural areas in the Mopani district: Mafarana, Gavaza, Ga-Selwana, Makushane, and Ndengeza. Farming systems in these areas were mainly small holdings with limited resource endowments. In February 2019, the target villages were visited with main members of the research group, including professors, PhD and master students from the University of Goettingen and Universities of Limpopo and Venda. The aim of this visit was to introduce and explain the main objectives of the research project to local farmers, to have group discussions between the research group and smallholder farmers and extension officers, and to ask for the permission from tribal authorities of each village to access farmers for conducting a survey.

After pre-testing the questionnaire, structured questionnaire interviews were conducted with the farmers in to collect information on socioeconomic, demographic, farm and household characteristics, as well input and output data of the agricultural production during the 2018-19 cropping seasons. Respondents were household heads or persons in position to make decisions on recourse allocation on farming activities and household food security. Using a purposive random sampling procedure, data were collected from 215 smallholder farmers across the five selected villages in Limpopo during March-July 2019. Translations between English and local languages (Tsonga, Pedi, Venda) were conducted by student assistants from the Universities of Limpopo and Venda and by some local farmers. All data collection processes were organized by Prof. Ayisi and his group from the University of Limpopo.

Structured surveys were sent online to the large-scale commercial farmers (mainly avocado and macadamia) after group discussion between research group and farmers in February.

Based on these surveys, biophysical results from other subprojects as well as on extended stakeholder engagements, the main tasks of this subproject are:

- Developing the farm type specific and spatially explicit risk management options regarding their effectiveness under different land use management and policy scenarios
- Investigating how efficient different farm types in Limpopo are and to what degree the presence of agri-relevant risks is the reason for potential deviations from their efficiency optimum
- Developing risk management options to support farmers in improving their long-term efficiency and/or resilience under different land use management scenarios
- Modelling the long-term agricultural development in the Limpopo region under explicit consideration of competition, agri-relevant risks and different policy options both at farm and regional level (ABM).



Figures. *SALLnet researchers Sara Yazdan-bakhsh and Hannah Redders interviewing farmers and further community members in Ndengeza and Ge-Selwana supported by translators (top); farmer's family expresses their joy about their participation in the research in Ga-Selwane (right) – June and July 2019. Photos: Hannah Redders, Sara Yazdan-bakhsh*

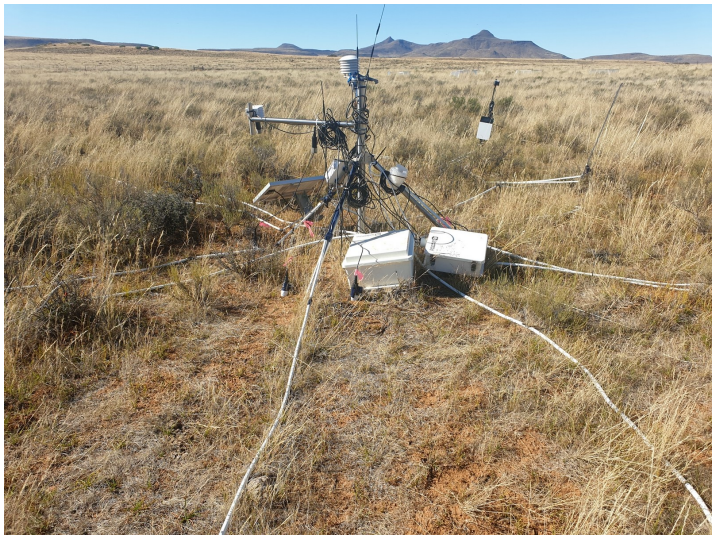
Collaborative fieldwork campaign launched under EMSAfrica by Stellenbosch University, EFTEON, Rhodes University and GADI

EMSAfrica
Ecosystem Management Support for Climate Change in Southern Africa

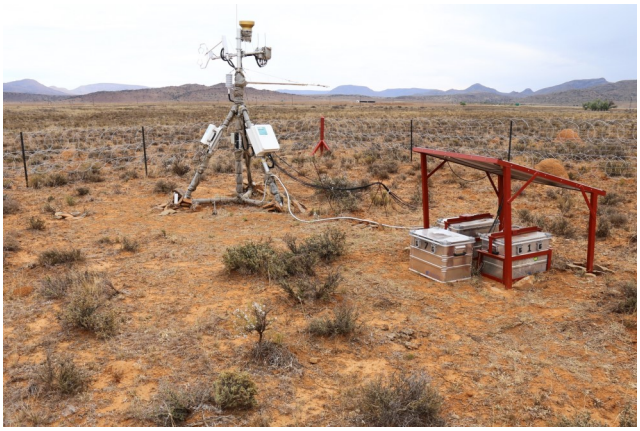
EMSAfrica project recently initiated a campaign on soil respiration measurements at the Middelburg project site in Eastern Karoo. This site hosts two Eddy Covariance (EC) flux towers, producing continuous measurements of land-atmosphere CO_2 and water exchange since 2015. The towers are located at sites one kilometre apart representing different livestock grazing intensities.

Data will be collected via permanent oxygen sensors, as well as soil respiration chamber measurements, which will be conducted during different seasons. Combining these data with the flux data from the EC towers will offer unique new understanding of the functioning of the Nama Karoo ecosystems. The data will also be valuable for the calibration and validation of the carbon cycle in vegetation models.

The field campaigns are conducted as a joint effort by EMSAfrica partners Stellenbosch University, Rhodes University, the newly established EFTEON research infrastructure, and the Grootfontein Agricultural Development Institute GADI. The Middelburg site is an active research hub hosting various experiments for EMSAfrica and other projects, as well as good local accommodation facilities.



Figures (left above and below). *New experimental setup of oxygen sensors at the Middelburg field site* ***(right above and below)*** *Eddy Covariance flux tower at the Middelburg field site. Photos: Justin du Toit*



Restart of fieldwork after COVID-19 break: first impressions from a Master-Tandem in ORYCS

Alice Cimenti[1],[3] and Manjana Tausendfreund[2],[3]
[1] University of Potsdam, Germany
[2] University of Kiel, Germany
[3] ISOE – Institute for Social-Ecological Research, Germany

After meeting and working online during the last lockdown in Germany, in April we used the opportunity to travel to Namibia. We headed to the ORYCS study area (the southern part of Kunene region) to conduct social-ecological research.

We worked in close cooperation during our fieldwork, since our two Master thesis topics complement each other. During our stay, we visited commercial and communal farmers to interview them about their perception of wildlife and local knowledge about biodiversity and policies that affect their activity. It was important for us to talk to a variety of farmers with different backgrounds and with different management types such as cattle, sheep or goat farming, game, conservation hunting and photo tourism farms as well as a mix of these. Additionally, we conducted interviews with stakeholders from different NGOs (such as Integrated Rural Development and Nature Conservation IRDNC and Namibia Professional Hunting Association NaPha) and farmers associations, ministries, and schools. The wide range of perspectives helped us to understand the social-ecological dynamics in the study area. During the three months of our field work, we also took part in the Rapid Biodiversity Assessment organized in collaboration with the Namibia University of Science and Technology (NUST), which will help to compare the state of biodiversity between areas under different management. Together with the other teams, we collected data of vegetation, small mammals, large mammals and insects, and moreover, camera traps and sound recorder were also used. It was a very nice experience that taught us a lot and allows a better integrated point of view for our master thesis.

Manjana's thesis focuses on human-wildlife interactions. The aim is to identify which direct and indirect wildlife-based services (benefits) and disservices (costs) emerge in farmers' communities and how they differ within the local area. The first impressions have shown that all farmers across different land-use types are experiencing a variety of costs such as loss of livestock from predators or water installation and fence destructions. From the perception of the interviewed farmers, elephants and hyenas are causing most of the problems and both their populations are perceived to have drastically increased during the last years. However, most of the plain species like oryx and springbok are seen to bring benefit across all farm types for additional income or own consumption. Most of the farmers feel strongly connected to wildlife and it is viewed to belong to Namibian farmland. These are only examples, and the collected data will be further investigated and analyzed in the following months. This will help to understand the attitudes towards certain wildlife species and provide insights on how conflicts arise, as well as what leads farmers to tolerate living in a shared landscape with wildlife.

Figure 1. *Planning our route to the different farms.*

Alice's thesis focuses on farmers' perceptions of the rangeland and conservation laws and policies that affect their activities. She will study how these regulations influence the farm management. Moreover, the local knowledge about biodiversity and its possible relation with regional and national policies will be investigated. This will provide insights on how the farmer's perception of biodiversity contributes to land management choices. The latter, inevitably, influences nature conservation efforts.

Every interview brought new perspectives and anecdotes into the picture. The farmers were asked what biodiversity is for them. A variety of answers were given, ranging from "the creation of God" to "the living together with nature". There were laughs when they had to think of the insects in their farms, as well as complains or praise towards the government and its policies.

Everyone has a different story. All farmers feel the responsibility to look after their land and to preserve nature, but each one in their own way.

Figure 2. *Although cheetahs are not welcomed by many farmers, some see them to have great value because they bring a variety of benefits from tourism.*

Figure 3. *Our house on wheels for one month.*

Woody Cover Change Detection

SALDi Team (Contact Marcel Urban: marcel.urban@uni-jena.de)

The quantification of woody cover allows the derivations of climatic and/or anthropogenic influences on the vegetation and thus an indication of possible degradation processes. During the first project phase, we produced a wall-to-wall woody cover map for the Kruger National Park (KNP) for the year 2016 utilizing Sentinel-1 time series and airborne Light Detection and Ranging (LiDAR) data (Urban et al. 2020). Spatial cross-validation revealed an overall Root Mean Squared Error (RMSE) of 22.8 % for a spatial resolution of 10 m, 15.8 % for 30 m, 14.8 % for 50 m and 13.4 % for 100 m.

The KNP and surrounding regions offer an ideal test area for the development of the woody cover parameter due to its size, heterogeneous vegetation structure and availability of additional reference data. The Random Forest algorithm was trained for predictions for 2016 and 2019. Calculating the differences between these two years, a first estimate of woody cover changes over this 3-year period could be derived (Figure 1 - center map). The map illustrates Sentinel-1's radar capabilities to detect changes in plantations due to harvest cycles. Both, increasing and decreasing trends are visible in the extensive forest plantations west and south of KNP (small region 1 and left images) due to harvesting respectively regrowth of forest compartments. Also, gradual changes in grass and shrub canopies can be monitored, e.g. regrowth after fire or senescence caused by droughts (small region 2 and right images).

During the next phase, we will make use of the open-access LiDAR data from the Global Ecosystem Dynamics Investigation (GEDI) for classifying woody cover in all SALDi study regions.

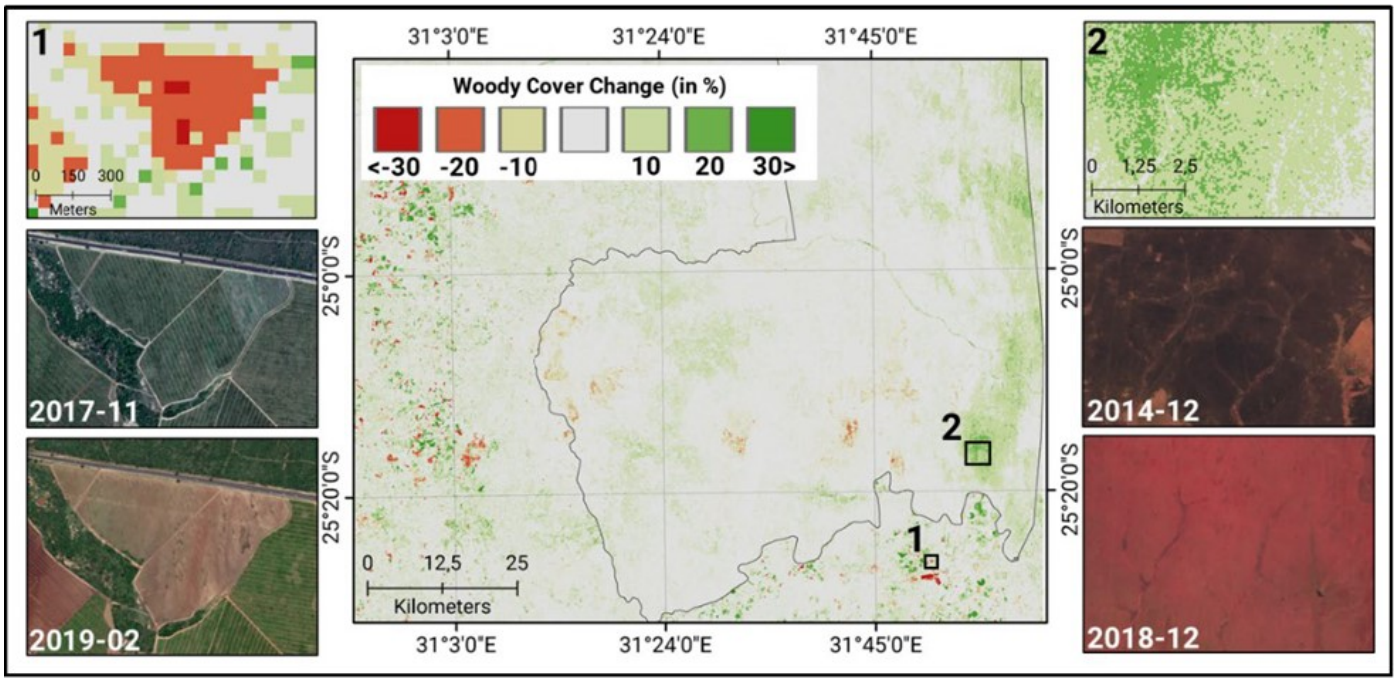


***Figure 1**. Woody cover vegetation changes at 50 m resolution between 2016 and 2019 in southern KNP is indicated by a black line (DEA 2020) and surrounding areas. Change estimates are based on two woody cover products from Sentinel-1 radar data and airborne LiDAR for training. Percentages are relative numbers concerning the woody cover ranges from 0-86 % in 2016 and 0-88 % in 2019. Example area 1: woody cover decline due to harvested plantations (image data: Google, Maxar Technologies); example area 2: woody cover regrowth after fire event (image data: Landsat-8, RGB = bands 5-4-3, derived from EO Browser, Sinergise Ltd.).*

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Session on Land degradation in Savanna Environments at the vEGU 2021

South African SALDi Land Degradation Monitor

Hilma Nghiyalwa, J.J. Le Roux, Theunis Morgenthal & Jussi Baade

Due to the COVID-19 pandemic, the 2021 General Assembly of the European Geosciences Union (EGU) gathered online at the end of April. Within the Inter- and Transdisciplinary Session (ITS) 'The role of the Geosciences in the UN Sustainable Development Goals' the SALDi project organized a hybrid PICO session on "Land degradation in Savanna Environments - Assessments, Dynamics and Implications". The session aimed to explore the range of methodological approaches used to assess land degradation, its dynamics over the spatial and temporal scales and the implications for society and interactions with different Earth's spheres. The contributions to the session could be based on fieldwork, remote sensing or modelling approaches, specific physical or socio-economic aspects of land degradation such as management, land cover change, soil erosion or based on discussion of land degradation at a broader societal context.

Overall, eleven contributions were submitted to and presented during this session and 40 participants took part in the session. About ten participants were SALDi partners invited by the coordinator. The themes covered ranged from dust emissions and gully erosion to the assessment of land degradation on a national scale. Methodological aspects covered field work techniques, remote sensing and different modelling approaches. More details are available open access online @ https://meetingorganizer.copernicus.org/EGU21/session/40480#vPICO_presentations.

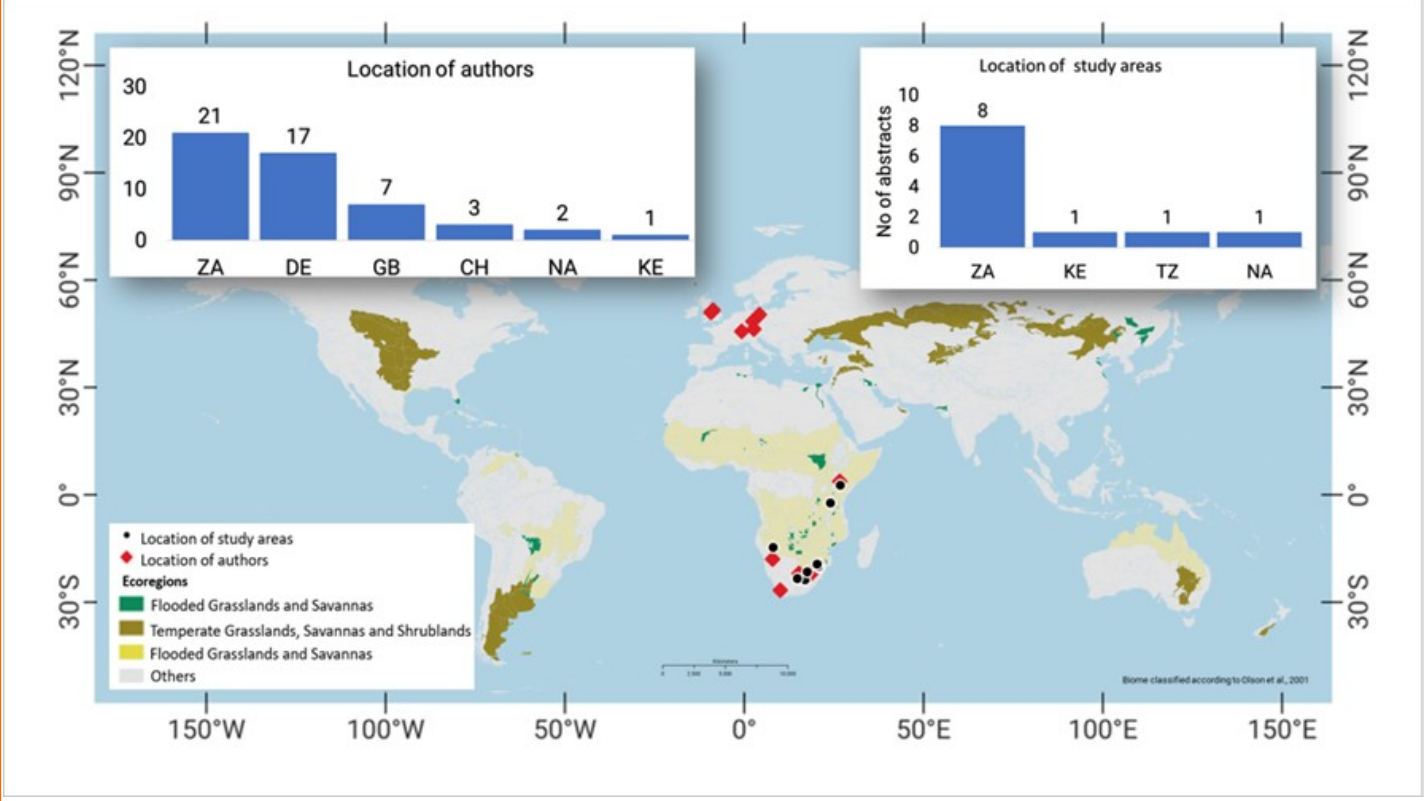

***Figure 1**. Global distribution of savanna biomes, study sites and ‚origin' of scientists in the session on land degradation in savanna environments (data source: own survey, terrestrial ecoregions of the World map modified from Olson et al. 2001)*

Figure 1 (previous page) provides an overview of the global distribution of savanna biomes as well as study sites and the origin of the scientists who contributed to the session. The study sites covered savannas in East African and Southern Africa. The majority of study sites discussed in the session were located in South Africa, an artefact of the involvement of the SALDi project. The studies presented were conducted in four countries, namely Kenya, Tanzania, South Africa and Namibia. The later study being presented by colleagues from the SPACES II ORYCS project.

The origin of the presenters and co-authors contributing to the session showed an inter-continental pattern (Figure 1), with authors and co-authors usually originating both from Africa and Europe. More specifically, authors came from countries such as Kenya, United Kingdom, Switzerland, Germany, South Africa and Namibia. For the total 11 submitted abstracts, about 53 % of those have scientists originating from the southern hemisphere and about 47 % from the Northern Hemisphere. The location of the authors presented a good indication and is a nice representation of the scientific synergic collaboration pattern between the southern and northern hemisphere. This pattern also indicates an exchange of research ideas between the two continents and is a good indication that land degradation in the African savannas is receiving a wider research interest strengthened by these synergies.

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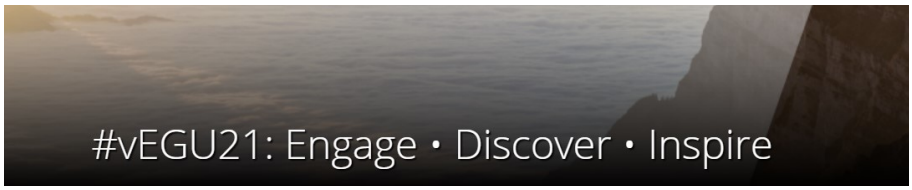

Hydrological effects of combining Italian alder and blackberry in an agroforestry system in South Africa

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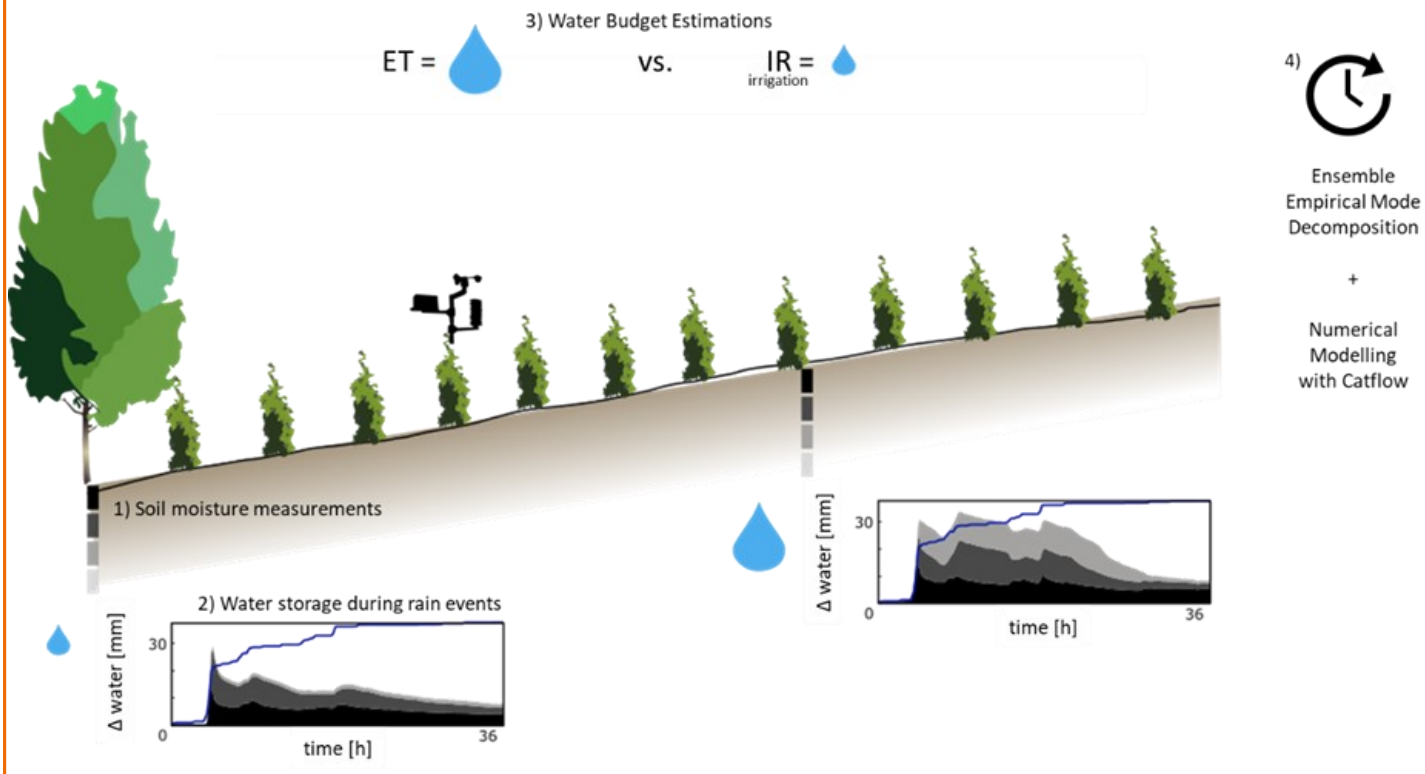


At the vEGU 2021, Svenja Hoffmeister (KIT) presented ongoing ASAP work on an agroforestry site consisting of a blackberry crop combined with alder windbreaks in South Africa. This contribution was part of the general ecohydrology session outlining the results obtained to date.

In order to assess the influence of the windbreak on the berry plot and how this varies with distance, we measured soil water content at two different locations, one at the windbreak and one within the berry crop. In the figure, you can see an intersection of the field site, showing the location of our weather station and the two measurement points, where we measured soil water content (No. 1) in four different depth increments (0-20 cm, 20-40 cm, 40-60 cm and 60-80cm).

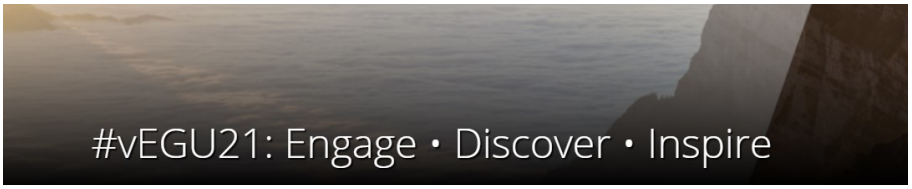
We have been able to show that soil water content is greater at the location further from the windbreak. We also observed different responses in the soil water dynamics during rain events, which is exemplified by the two soil water storage change graphs (No. 2) showing the same event. The shading represents the storage at different depths (darkest 0-20 cm depth, through 20-40 cm, 40-60 cm, to the lightest at 60-80 cm).

We then calculated the water balance (No. 3) by estimating potential evapotranspiration (ET) and the irrigation input. Potential ET, caused by high summer temperatures and strong winds, seems to be the most dominant component and exceeds the water input of the drip irrigation on the site.

However, with the observations available we observe a mismatch between input and output of the water balance. Efforts are afoot to set up a numerical model (No. 4) representing the study site to obtain better estimates of the actual ET, also considering wind and light shading effects of the windbreak. We complement this by using an empirical mode decomposition method to make the soil water content measurements more comparable between the two locations by eliminating offsets and long-term trends when analysing rain events.

With both methods, we hope to get a better understanding of the underlying processes causing the

Hoffmeister, S., Bohn Reckziegel, R., Kestel, F., Maier, R., Sheppard, J. P., and Hassler, S. K.: Hydrological effects of combining Italian alder and blackberry in an agroforestry system in South Africa, EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-2879, https://doi.org/10.5194/egusphere-egu21-2879, 2021.



Climatic and anthropogenic influences in the Umzimvubu catchment, eastern South Africa, during the past 6000 years

Annette Hahn, Frank Neumann, Charlotte Miller, Jemma Finch, Tarryn Frankland, Hayley Cawthra, Enno Schefuß, Matthias Zabel

Figures 1, 2: *The Umzimvubu catchment. Photographs by Tarryn Frankland (left) and Hayley Cawthra (right)*

The Umzimvubu catchment (Fig. 1,2) is located on the South African east coast, a particularly dynamic region in terms of climate change as it is influenced by both temperate and tropical circulation and climate systems (Fig. 3).

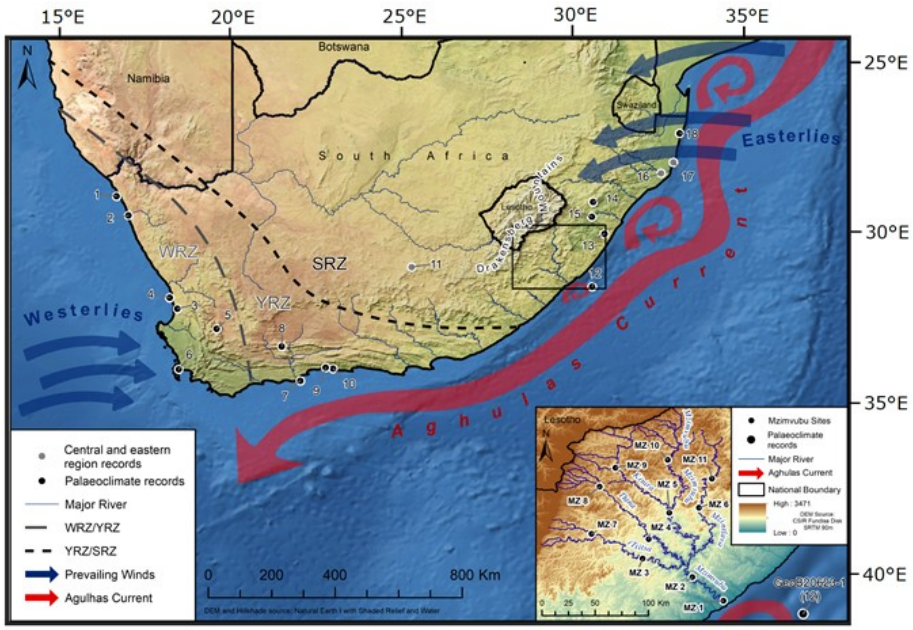


Figure 3: *Topography and bathymetry of southern Africa, and the Umzimvubu catchment area (Esri, DeLorme, GEBCO, NOAA NGDC) (Courtesy: B. Gijsbertsen).*

In a study published in April 2021 in „Quaternary Science Reviews“ (https://doi.org/10.1016/j.quascirev.2021.106938) the authors present a marine sediment record of climatic and environmental changes from offshore the Umzimvubu River recovered during the RV Meteor expedition M123 funded by BMBF SPACES in 2016. In June 2021 Taryn Frankland was awarded her Masters degree from the University of KwaZulu-Natal for her contribution to this work.

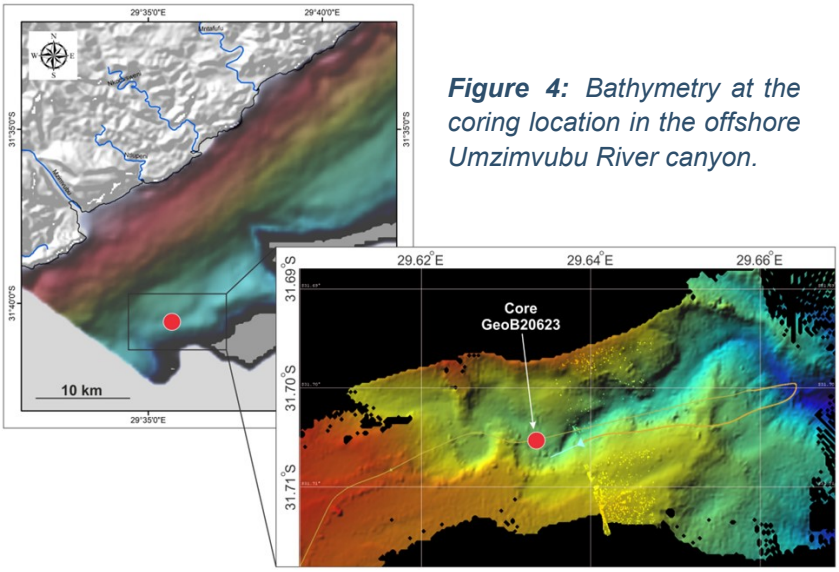


Figure 4: *Bathymetry at the coring location in the offshore Umzimvubu River canyon.*

Core GeoB20623 (Fig. 4) contains information on the regional climatic and anthropogenic influences during the last ~6000 yr. This effort was complemented by an extensive sampling of the Umzimbuvu River and its tributaries on land in several campaigns led by the University of KwaZulu-Natal. Umzimvubu catchment sampling data allow an understanding of the transmission of signals from the catchment to the marine core site. Plant-wax isotopic compositions and elemental patterns as well as palynological, burned phytolith and microcharcoal data are used to infer paleoclimatic shifts and reconstruct past human activity.

Whereas previous studies have often disregarded early anthropogenic drivers of environmental change, our study provides clear palynological evidence of Iron Age human impacts starting as early as ~1400 years ago. This includes the appearance of large grass pollen grains (>40 µm) in the record, which may be associated with cereal type grasses, and dung fungal spores which might be linked to Iron Age animal husbandry. This timing coincides fairly closely with the arrival of Early Iron Age farmers in Mpondoland. Insights into fire history are provided by fluctuations of charred particles including burned (grass) phytoliths over time. Downcore proxy analysis suggests that particularly humid conditions persisted from ~900 to ~300 cal yr BP, encompassing both the Medieval Climate Anomaly (MCA) and the Little Ice Age (LIA).

The MCA was first described by H.H. Lamb in the 1960s who summarized and evaluated a variety of European records and concluded that the period ~950–650 cal yr BP was characterized by warm summers. The term "Little Ice Age" was coined by F. E. Matthes in the 1930s describing a northern hemisphere cold spell from ~650–350 cal yr BP. The regional expression of these northern hemispheric climatic trends in southern Africa has been described in several studies, although previous paleoclimatic studies typically lack the necessary temporal resolution and chronological control to identify such short-lived episodes with confidence.

As early as ~ 1500 cal yrs BP, increased erosion rates and vegetation change indicate human activity may be reflected in the record with the arrival of Iron Age settlers. After ~300 yrs BP with the arrival of European settlers this disturbance reaches such an extent, that it overprints climatic signals in most proxy indicators.

Figure 5: *Meteor leaving Cape Town harbour. Photography by Thomas Liebe, Reederei F. Laeisz G.m.b.H. Zweigniederlassung Bremerhaven.*

How is research tackling the policy and institutional dimensions of agroforestry?

The concept of agroforestry is heralded by decades of research and development investments. However, the process of translating agroforestry into wider beneficial impacts has been slower and the results smaller across different regions. Increasingly, the role of policies and institutions has become paramount in the success of agroforestry. Supportive institutions and targeted policies are key in instigating the wider adoption and scaling up of agroforestry innovations.

Synchronously, there is an inextricable link between research and policy in the implementation of agroforestry projects. Research plays an important role in enhancing the development and adoption of agroforestry innovations. It produces information concerning the appropriateness of innovations and evaluates the contexts in which they are intended for implementation. Therefore, how has research unpackaged the issue of policies and institutions in agroforestry?

ASAP's latest publication "**Promises and potentials do not grow trees and crops. A review of institutional and policy research in agroforestry for the Southern African region**" (Ndlovu & Borrass 2021) tackles some aspects of this question. The results show that agroforestry research has been dominated by studies focused on biophysical work of agroforestry. However, the policy and institutional dimensions of are not so prominent in research and continue to be sidelined.

The article concludes that in the less developed rural areas of Southern Africa, agroforestry problems are normally socio-economic rather than biophysical in character. Therefore, research can contribute to the adoption of agroforestry by focusing on understanding the processes of policy interventions. Additionally, policy recommendations that actually reflect on the policy conditions of a particular context are likely to be accepted and actioned. Consequently, this calls for a shift towards a context specific research agenda, so that it becomes easier to communicate with policy makers without generalizations.

Ndlovu N P, Borrass L (2021). Promises and potentials do not grow trees and crops. A review of institutional and policy research in agroforestry for the Southern African region. Land Use Policy,Volume 103. https://doi.org/10.1016/j.landusepol.2021.105298