South African Association of Geomorphologists

2015 Conference (19-20 September)

Sani Mountain Lodge, Lesotho

2015 SOUTH AFRICAN ASSOCIATION OF GEOMORPHOLOGISTS CONFERENCE

WELCOME

The Organising Committee would like to officially welcome all the delegates to this year's South African Association of Geomorphologists Conference, hosted at the Sani Mountain Lodge, Lesotho.

ACKNOWLEDGEMENTS

The conference organisers gratefully acknowledge the support and assistance from the following:

- Dr Frank Eckardt
- Prof. Werner Nel
- Dr David Hedding

GENERAL INFORMATION

Conference venue and accommodation

The Conference will be held at the Sani Mountain Lodge, Lesotho. Accommodation is available at the conference venue (http://www.sanimountain.co.za/).

Registration and payment

Registration for the conference will take place on Friday afternoon 18 September, presentations will take place on the 19-20 September, and an excursion will (depending on interest) take place on 21 September. Payment for the conference should have been completed before the conference but outstanding balances can be paid upon registration on 18 September.

Conference Networking

On Sunday 20 September delegates are encouraged to have dinner at the Sani Mountain Lodge. This will give delegates from the various universities an opportunity to network over dinner.

Presentations

Oral presentations will be allowed a maximum of 15 minutes, followed by 5 minutes for questions by the audience. An overhead projector, slide projector and data projector are available. Please inform the organisers in advance if software other than PowerPoint is required for the data projector. Papers have been grouped, as far as possible, into physical and human sessions based on the general submitted paper themes. Poster presentations will be allowed a maximum of 3 minutes, followed by 2 minutes for questions by the audience.

The language for presentations is English. Power Point presentations are to be copied on to the computers shortly after your arrival at Sani Mountain Lodge. Please ensure that you have a backup of your presentation as well.

Other

The venue is not located on or near the University of South Africa (Florida Campus) and, unfortunately, the organisers will be unable to provide email or other computer (*e.g*. photocopying) facilities.

CONFERENCE PROGRAMME

Friday 18 September 2015

16:00 - 18:00 Registration

18:00 - 19:00 Biannual General Meeting

19:00 - 20:00 Informal Networking Opportunity (Sani Mountain Lodge)

Saturday 19 September 2015

08:00 - 08:45 Late and Day Registration

08:45 - 09:00 Seating and announcements

08:45 - 09:00 Introduction of Speaker: Prof. Paul Sumner

08:45 - 09:00 Opening Keynote Address: Prof. Heinz Beckedahl

09:30 - 09:45 Discussion

TEA - 20 minute break

Saturday 19 September 2015

10:05 - 11:15 Paper session Chair: J.J. Le Roux

The application of environmental magnetism to determine sediment connectivity in South Africa catchments (K.M. Rowntree, Rhodes University)

A baseline survey of channel geomorphology with particular reference to the effects of sediment characteristics on ecosystem health in the Tsitsa River, Eastern Cape, South Africa (N.H. Huchzermeyer, Rhodes University)

Trends in land use and soil erosion in the Upper Tugela catchment (M. Kuse, University of Pretoria)

iThemba Labs Gauteng: Africa's first Accelerator Mass Spectrometry Facility (S.R. Winkler, iThemba Labs)

10 minute break

11:30 - 13:00 Paper session Chair: P.D. Sumner

The effect of synoptic weather systems on the landscape of sub-Antarctic Marion Island: Current knowledge and future impacts (W. Nel, University of Fort Hare)

Review and application of needle ice creep models on sediment movement, Marion Island, sub-Antarctic (C. Borg, Rhodes University)

Environmental and topographical controls on lichen colonisation of Vesleskarvet in Western Dronning Maud Land, Antarctica (G. Ayres, Rhodes University)

Rock Glaciers observed in Jutulsessen, Gjelsvikfjella Mountain Range, Dronning Maud Land, Antarctica (E.M. Rudolph et al., Rhodes University)

LUNCH - 1 hour

14:00 - 15:00 **Paper session** **Chair: F. Eckardt**

Landscape connectivity in the upper Umzimvubu River catchment: an assessment of anthropogenic influences on sediment connectivity
(B.W. van der Waal and K.M. Rowntree, Rhodes University)

Hydrodynamic modelling of flow characteristics associated with natural valley confinement: a case study of the Kompanjiesdrif Basin of the Kromrivier wetland, Eastern Cape, South Africa
(P.K. Schlegel, Rhodes University)

The fate of soil organic carbon on eroded hillslopes of rural catchments in the Ngqushwa Local Municipality, Eastern Cape Province, South Africa
(V. Kakembo, and M de Jager, Nelson Mandela Metropolitan University)

TEA - 20 minute break

15:20 - 17:00 **Paper session** **Chair: I. Meiklejohn**

Revisiting Africa's continental geomorphology
(T.J. Flügel et al., Stellenbosch University)

Inferring contemporary sediment yield from reservoir deposits in the Kruger National Park, South Africa (B. Reinwarth et al., Friedrich Schiller University)

Sediment yield contribution from gully erosion in the Mzimvubu River Catchment
(J.J. Le Roux, University of the Free State)

The TanDEM-X Kruger National Park IDEM: Accuracy and geomorphic applications
(J. Baade and C. Schmullius, Friedrich Schiller University)

An analysis of flood activity over the last two centuries based on the sedimentary deposits in the Mfolozi floodplain (C. Mbao et al., Rhodes University)

Sunday 20 September 2015

08:00 - 08:45 Late and Day Registration

08:45 - 09:00 Announcements

09:00 - 10:20 **Paper session** **Chair: W. Nel**

Landscape processes in Antarctic ecosystems (I. Meiklejohn et al., Rhodes University).

Topographic and climatic forcing observed on ground surface temperatures
(C.D. Hansen et al., Rhodes University)

A spatial and temporal analysis of active-layer dynamics in Western Dronning Maud Land, Antarctica (C. Kotze and I. Meiklejohn, Rhodes University)

Characteristics of Tafoni formation: Observations from Western Dronning Maud Land, Antarctica
(J. Rosenfels, Rhodes University)

TEA - 30 minute break

10:50 - 12:10 **Paper session** **Chair: K. Rowntree**

A spatial analysis of recent mass movement events on the Cape Peninsula, Western Cape
(E. Kartheiser et al., University of Cape Town)

The occurrence and distribution of large deep-seated palaeo-mass-movements in the Northern and Central Drakensberg, South Africa (A.C. Greyling, University of Pretoria)

Triggers of mass movement events in the Western Cape mountains: a historical perspective (C. van Wyk et al., University of Cape Town)

Rock weathering by thermal shock: an additional investigation of the critical temperature gradient required for fracture (M.J. Loubser, University of Pretoria)

LUNCH - 1 hour

13:15 - 14:15 **Paper session** **Chair: D.W. Hedding**

Rainfall erosivity on Mauritius: an overview (P.D. Sumner, University of Pretoria)

Intra-storm attributes and climatology of extreme erosive events on Mauritius, 2004 to 2008 (A. Hauptfleisch et al., University of Pretoria)

Sediment dynamics in the Tsitsa Catchment of the Eastern Cape Province, South Africa (L. Bannatyne, Rhodes University)

10 minute break

14:25 - 15:25 **Paper session** **Chair: B. Van der Waal**

The Makgadikgadi Rift Zone (MRZ) and deformation of the 945m paleolake contour (F.D. Eckardt et al., University of Cape Town)

Soil movement by burrowing mammals: a review across environments and species (N.S. Haussmann, University of Pretoria)

Using geometric morphometrics to quantify barchan shape from satellite imagery (B.J. van der Merwe, University of Pretoria)

TEA - 20 minute break

15:45 - 16:45 **Poster Session** **Chair: N.S. Haussmann**

The influence of event driven processes on sediment creation from gully erosion in the uMzimvubu River Catchment (R.L. Anderson and J.J. Le Roux; University of South Africa)

The application of forensic geomorphology in rhino poaching (South Africa) (M. de Bruin; University of Pretoria)

An Introduction to the Makgadikgadi “Piano Keys” Rift Zone (MRZ) (F.D. Eckardt et al., University of Cape Town)

The development of present day drainage patterns of central Africa (T.J. Flügel et al., Stellenbosch University)

Rock mass loss on a nunatak in Western Dronning Maud Land, Antarctica: implications for periglacial landform development and habitat facilitation (D.W. Hedding et al.; University of South Africa)

Synoptic circulation patterns and its relationship with ground thermal characteristics along an altitudinal transect on sub-Antarctic Marion Island (S. Jordaan; University of South Africa)

The effect of regional synoptic scale weather patterns on ground thermal regimes, Western Dronning Maud Land, Antarctica (J. Knox; Rhodes University)

Comparing soil displacement by burrowing mammals between arid and mesic environments (M.A. Louw et al.; University of Pretoria)

Developing a spatial geo-database for Western Dronning Maud Land, Antarctica (T. Masebe; Rhodes University)

A yield assessment of one cultivated stand of Honeybush (*Cyclopia spp*.) in the Upper Langkloof Valley (M. Sephton; Rhodes University)

River discharge dynamics, land use change and climate: The Nyoni and Amatikulu rivers (R. van Heerden; University of Pretoria)

Elephants and Rhinos as geomorphic agents and ecosystem engineers: focusing on paths and wallows (K. Vowles; Rhodes University)

To revisit and document openwork deposits on Gaika's Kop in the Hogsback area of the Eastern Cape (N. Wilmot; Rhodes University)

PRESENTATION ABSTRACTS

Environmental and topographical controls on lichen colonisation of Vesleskarvet in Western Dronning Maud Land, Antarctica

G. Ayres (1)

(1) Department of Geography, Rhodes University, Grahamstown, South Africa

Organisms that operate in the biogeographic zone of Antarctica, a unique environment compared to other landmasses, offer insight into biological processes. One such organism is the predominant and most visible biotic component on the continent: lichen. Research on lichens is, therefore, necessary to highlight the controls on their colonisation to further elucidate biodiversity patterns. The Northern Buttress of Vesleskarvet, a continental nunatak, was selected to identify environmental parameters of the landforms for lichen colonisation that, in turn, control the distribution of biodiversity, as well as to investigate the weathering impact of various lichen species on the rock. It is expected that microtopographical features provide the most suitable conditions favouring lichen colonisation and that specific features will be colonised more than others. It is also expected that certain species colonise certain microtopographical features. Habitat conditions were identified, clast characteristics were measured, microtopographical features were measured, lichen species were identified and the use of structure from motion techniques were used to create three dimensional models to be imported into Geographical Information Systems for the display of the findings. The ecosystems that lichens colonise are an ideal proxy for environmental responses, particularly in the age of climate change. The findings of this research may be used as baseline data for future studies exploring climate change and Vesleskarvet may potentially become a model system for studies elsewhere on the globe involving conservation.

The TanDEM-X Kruger National Park IDEM: Accuracy and geomorphic applications

J. Baade (1), and C. Schmullius (1)

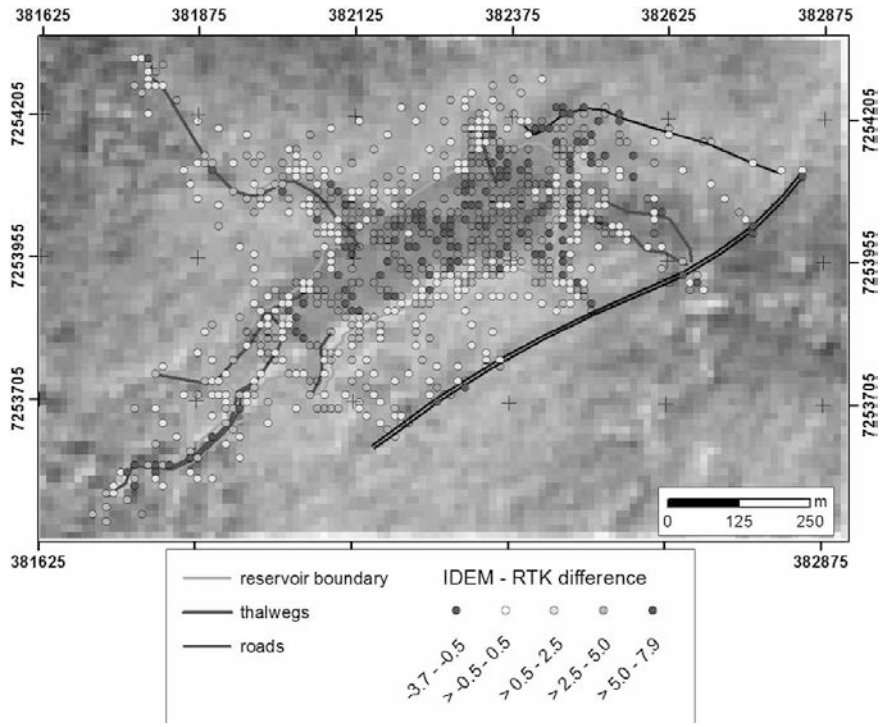
(1) Department of Geography, Friedrich Schiller University, Jena, Germany

Since 2011 the German radar satellite system TanDEM-X acquired data for a new and truly global Digital Elevation Model (DEM) covering the Earths landmasses. Now, processed data sets from the first year's acquisition (i. e. the intermediate DEM, IDEM) with a spatial resolution of up to 12 m have been made available by the German Aerospace Center (DLR) for selected regions of the World for scientific purposes. This includes six 1° x 1° tiles covering the entire Kruger National Park (KNP) in South Africa.

This contribution provides examples highlighting the unprecedented geometric resolution of this fascinating new satellite-based Digital Surface Model (DSM) as well as some of its limitations. To assess the accuracy and the effects of vegetation in the Lowveld Savanna we compared the IDEM with high-resolution RTK-GNSS ground surface measurements conducted in the framework of a geomorphological mapping of dried-out reservoirs in the southern part of KNP. These measurements provide the opportunity to analyse in detail the height differences for a) surfaces devoid of woody cover (i. e. the former reservoir areas) and b) the surroundings characterized by woody cover (Fig. 1).

In addition, we present first results on the application of the IDEM for geomorphometric analysis of catchments in Kruger National Park.

Figure 1: Height difference of IDEM and RTK ground surface points at Silolweni Reservoir, Kruger National Park, South Africa.



Sediment dynamics in the Tsitsa Catchment of the Eastern Cape Province, South Africa

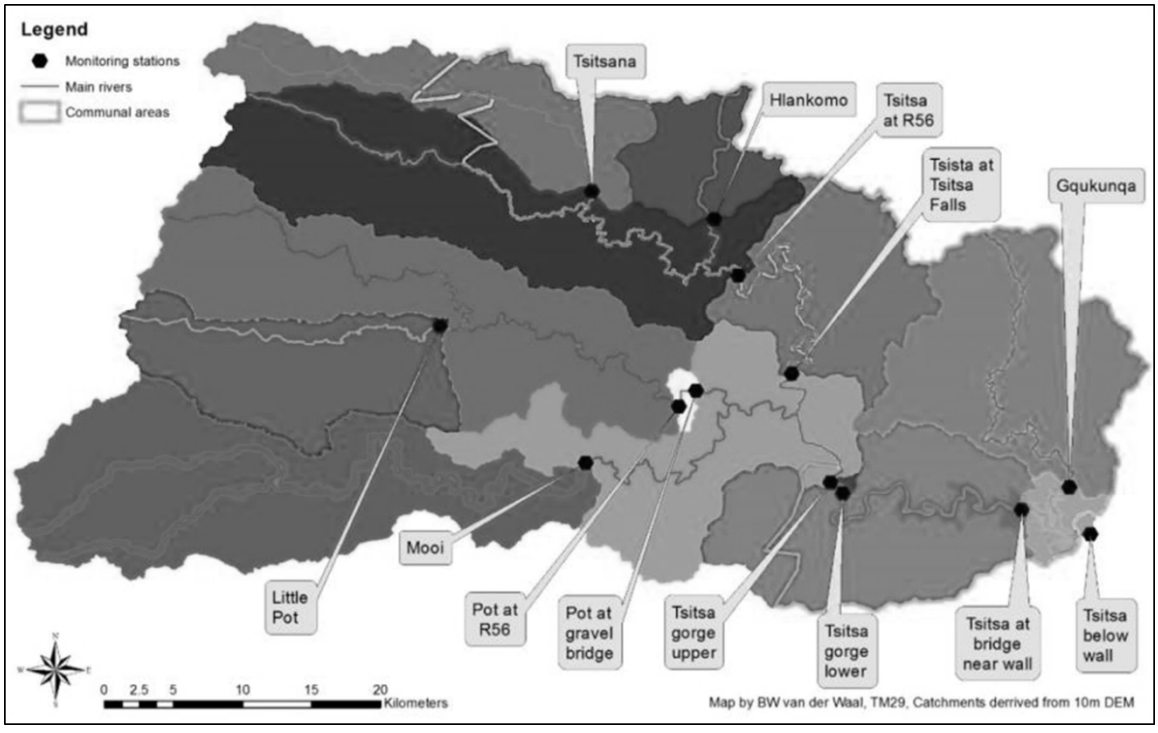
L. Bannatyne (1)

(1) Geography Department Rhodes University, Grahamstown, South Africa

The Tsitsa River is a tributary of the Mzimvubu River in the Eastern Cape Province of South Africa. The Tsitsa catchment (quaternary T35) is heavily eroded and gullied. Simulations for catchments T35A to T35E using soil erosion risk mapping and the Revised Universal Soil Loss Equation predict an average sediment yield of ~7.7 t ha^{-1} y^{-1} with a range of 1 – 22.5 t ha^{-1} y^{-1} whilst dam sedimentation rates in comparable catchments indicate an average of ~6 t ha^{-1} y^{-1}.

This Masters project aims to determine the yield and sources of suspended sediment at sub-catchment scale above the site of the proposed Ntabelanga Dam wall. Focusing on flood events, direct sampling of suspended sediment will take place at 10 suspended sediment monitoring points that have been established in the Tsitsa and its tributaries. At each site, pressure loggers have been installed, cross-sections have been surveyed and baseline flows recorded. Citizen scientists will be engaged to sample suspended sediment throughout flood flows. Cellphones and Open Data Kit applications and software will be utilised to record and manage sampling activities. Five tipping-bucket rain gauges have been installed to provide insight to spatial and temporal variation in rainfall throughout the project.

The resulting sediment concentration and yield data will allow the relative contribution of each sub-catchment to be determined and provide a baseline against which to monitor the results of the Department of the Environment's National Resources Management programmes currently underway in the catchment. Calibration of sediment yield models using this data will allow estimated siltation rates for the Ntabelanga Dam to be refined.



Monitoring points in the Tsitsa Catchment, Eastern Cape South Africa

Review and application of needle ice creep models on sediment movement, Marion Island, sub-Antarctic

C. Borg (1)

(1) Department of Geography, Rhodes University, Grahamstown, South Africa

The amount and rates of material transported by needle ice have been modeled for more than 50 years. Nonetheless, results still only show rough estimates and do not accurately match empirical evidence. The uncertainty derived from assumed causal mechanisms such as rolling, toppling and sliding, under the influence of gravity during melt, by environmental properties like topography and wind. Developing reliable needle ice creep models is important in environments where it results in considerable disturbance to ecosystem functioning. The modeling of sub-Antarctic fellfield biogeomorphic systems, and their responses to climate change, require improved modelling of sediment displacement by needle ice. This paper reviews three existing needle ice models that incorporate a variety of environmental parameters. The models' performances are tested on sediment transfer data from sub-Antarctic Marion Island to advance our understanding of slope processes and to develop new models that predict sediment movement. Parameters evaluated are heave, slope angle, frequency, and empirically measured displacement, which were recorded on Marion Island between 2007 and 2008.

The discrepancy between the models' predicted displacements and the actual displacement are used to assess their accuracy. Results indicate that surface texture and slope angle are key environmental controls on displacement. Average accuracies of 0.82%, 12.52% and 76.4% respectively, were recorded for the three models. When soil texture and slope angles were considered as controls, the model predictions improved considerably. The most accurate model overestimated displacement at low slope angles and underestimated displacement on steep slopes. The existing slope displacement models do not incorporate all variables active in predicting needle ice displacement other controls, such as wind, which add or retard displacement distance.

The Makgadikgadi Rift Zone (MRZ) and deformation of the 945m paleolake contour

F.D. Eckardt (1), T. Flügel (2), and M. McFarlane (3)

(1) Department of Environmental and Geographical Sciences, University of Cape Town, Cape Town, South Africa
(2) Department of Military Geography, Stellenbosch University, Saldanha, South Africa
(3) Bosele Investments (Pty.) Ltd., Box 66, Maun, Botswana

The southern African Kalahari hosts several terminal branches of the East African Rift System including the Okavango Rift Zone (ORZ) and the lesser studied Makgadikgadi Rift Zone (MRZ) to the east. The ORZ is seen as rift related, whereas the curvi-linear sandy ridges and the 945m contour bounding the MRZ represent an indicator of a Quaternary lake history. We identify previously unrecognized geomorphic anomalies caused principally by reshaping of the fossil shoreline features around the 945m contour. We use SRTM3 elevation data and ICEsat laser altimeter points (Global elevation data product (GLAH06)), to provide accuracy assessment of sandy crest height estimates. With this in place we can confidently attribute the pronounced discordance between the palaeo landforms and modern 945m contour to the vertical adjustment of the fossil 945 m forms. This clearly points to post paleo-lake Kalahari surface modification by tectonic movement in the MRZ.

Revisiting Africa's continental geomorphology

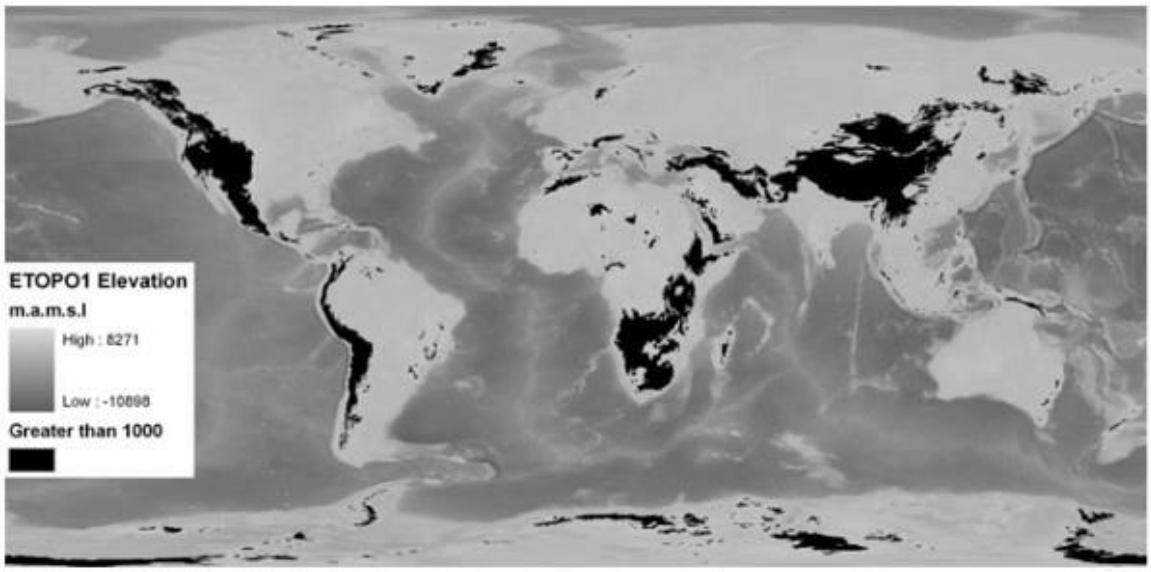
T.J. Flügel (1), F.D. Eckardt (2), and F.P.D. Cotterill (3)

(1) Department of Military Geography, Stellenbosch University, Stellenbosch, South Africa
(2) Department of Environmental & Geographical Science, University of Cape Town, Cape Town, South Africa
(3) Department of Botany and Zoology, Stellenbosch University, Stellenbosch, South Africa

One of Africa's distinctive topographic aspects is its unique, bimodal elevation: low in the north and west (average < 600 m.a.s.l) and high in the south and east (average >1000 m.a.s.l) (see Figure 1). This has resulted in many researchers viewing Africa's landscapes as belonging to either the low or the high group, with several seeking a common cause for either group, assuming like regions have common geodynamic origins. The development of the continent's topography may be better understood by studying the boundaries between high and low Africa. The Congo-Kalahari Watershed (CKW) represents such a boundary. With a smooth, seasonally wet tableland in the centre, the Angola highlands in the west and the East African Rift System (EARS) in the east, this regional watershed incorporates the macro-landforms of the high Kalahari Plateau and the low Congo Basin and the meso-landforms of the EARS.

This presentation argues that the CKW comprises of three distinct geomorphic zones. The central, smooth region is the oldest having been relatively stable since the break–up of Gondwana. The western region is topographically rougher, having undergone substantial changes in the Cenozoic through the headwater erosion of the coastal rivers. The eastern region is the youngest and topographically roughest, having undergone substantial modification in the Neogene due to tectonic activity associated with the extension the Western Branch of the EARS. The acknowledgement of these distinct landscapes may lead to the conciliation of various interpretations and suggested causes of Africa's present day mega-geomorphology.

Figure 1: The topography and bathymetry of the world. Black regions indicate areas of elevation higher than 1000 m.a.s.l. These elevated zones corresponds to large mountains systems along the margins of continental boundaries, except for Africa. In the south and east, the majority of Africa's elevation is around 1000 m.a.s.l., being of low relief. The digital terrain model is from the ice free version of ETOPO1 2009.



The occurrence and distribution of large deep-seated palaeo-mass-movements in the Northern and Central Drakensberg, South Africa

A.C. Greyling (1)

(1) Department of Geography, Geoinformatics and Meteorology, University of Pretoria, Pretoria, South Africa

Large deep-seated palaeo-mass-movements are ubiquities in the Drakensberg mountain range. This study aims to assess the occurrence and the distribution of these palaeo-mass-movements and to document their extent in the Central and Northern Drakensberg, which is the first critical data needed to understand their origins. An identification criterion was created as a standard to define a consistent method with typical features such as river deflection and topographic structure. Thirty sites are identified through the use of aerial photography and topographic maps. Through a similar criterion, verification of these sites occurred in field, following a visual interpretation into their, cause and age as well as their size and type. Twelve of the thirty sites were confirmed and detail geomorphological maps were drawn up. Their origins are thought to be derived due to an uplift along the Ciskei-Swaziland axis which caused a renewal in erosion power of rivers, resulting in over steepened slopes. Lithological control, and the Neogene uplift are key attributes in the concentrated distribution of deep-seated mass-movements found in the Drakensberg.

Topographic and climatic forcing observed on ground surface temperatures

C.D. Hansen (1), I. Meiklejohn (1), and W. Nel (2)

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(2) Department of Geography and Environmental Science, University of Fort Hare, Alice, South Africa

GST (Ground near-Surface Temperature) is measured in the uppermost centimetres of the soil and reflects temperatures of the top-most layer of the active layer. It provides an indication of the thermal regime of the ground and may be used as an indicator of permafrost. Factors known to affect soil temperature dynamics include topography, moisture availability, sediment characteristics, snow cover depth, as well as ambient air temperatures and wind speeds. Climatic and topographic forcing on GST were evaluated for the Northern Buttress of the Vesleskarvet nunataks in western Dronning Maud Land using data collected over three field seasons. Ground and ambient air temperatures, as well as data on slope gradient, slope orientation, snow cover, wind speeds and direction were collected. Analyses show that both ambient and ground surface temperatures significantly vary across the study site. For the periods under investigation average and modal GST is generally below 0°C, with diurnal ranges approximating 30°C. During storm events GST stabilise, with little variation observed and soil temperatures respond to ambient temperatures within a 24-hour period. GST is significantly correlated to ambient air temperatures and wind speeds with warmer regimes observed for the western and northern portion of the nunatak. ANOVA and Fisher's LSD tests suggest that external parameters such as topography (slope gradient but not aspect) and solar radiation received (for the period under investigation) influence site-specific GST. Findings indicate that mean summer solar radiation received exerts the greatest control on GST and that topographic influence should be considered when analysing and inferring trends from GST.

Intra-storm attributes and climatology of extreme erosive events on Mauritius, 2004 to 2008

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(2) Department of Geography and Environmental Science, University of Fort Hare, Alice, South Africa

Topographical complexity and high rainfall intensity of the tropical island of Mauritius provides the ideal environment to investigate the intra-storm attributes and general climatological characteristics of rainfall events. Hundred and twenty extreme erosive events from six automated Mauritius Meteorological Services weather stations were analysed over the period 2004 to 2008, and provides the first detailed intra-storm analysis for tropical island environments. Extreme events were found to vary both in rainfall depth and duration, but all the stations indicated a clear exponential distribution of cumulative kinetic energy content of rainfall over time. Extreme rainfall intensities display noticeable temporal differences between the stations in different climatic regions. All the stations received more than 80% of the potential kinetic energy content generated within the first 2500 minutes of storm duration, as well as 80% of the cumulative rainfall available. Rainfall events at the stations indicated a high proportion of rainfall being generated within the first half of the storm duration and extreme erosive events included both tropical cyclone and non-tropical cyclone related weather systems and poses substantial erosion risk.

Results indicated that the intra-storm attributes of the rainfall received on Mauritius is most strongly dependent on the geographic location, and that although the extreme events on Mauritius share common characteristics, no two events are exactly the same and no two stations in this region show comparable storm pattern distributions. Therefore, the extreme rainfall events suggest that the structure of the erosive rain displays too much spatial difference for a small number of stations to be representative of the entire island. Further research is necessary to determine the relationship between the storm structure and the synoptic conditions experienced on Mauritius.

Soil movement by burrowing mammals: a review across environments and species

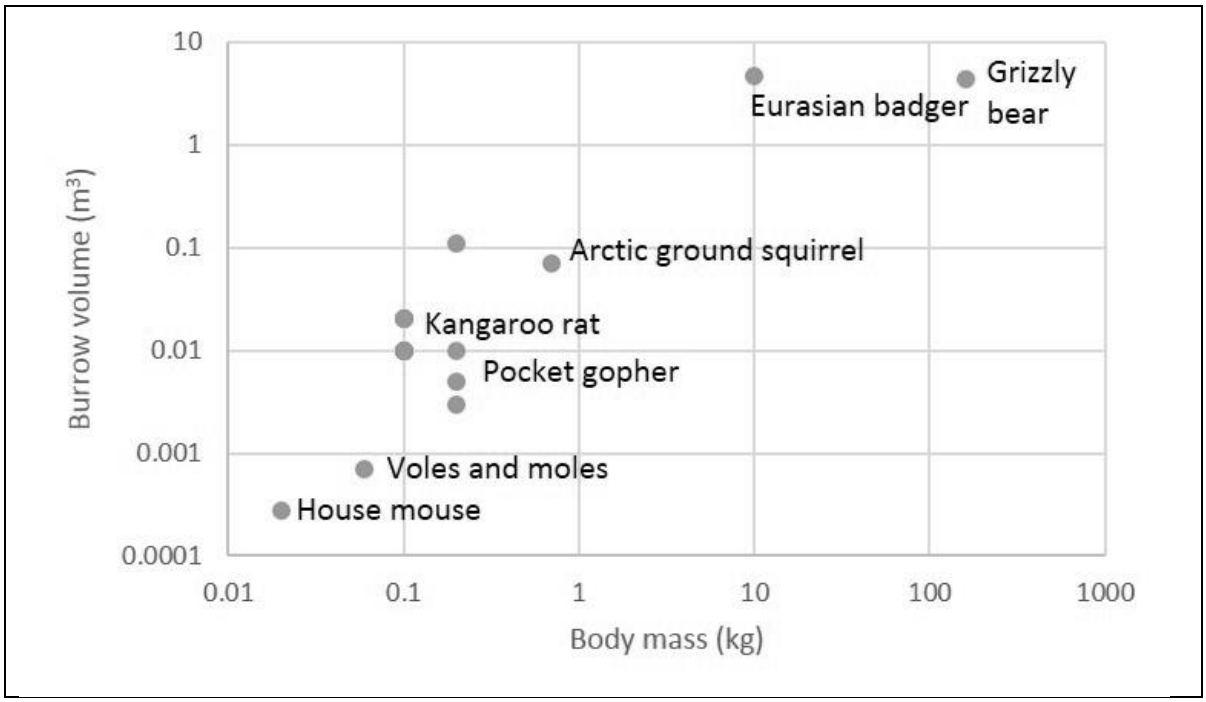
N.S. Haussmann (1)

(1) Department of Geography, Geoinformatics and Meteorology, University of Pretoria, Pretoria, South Africa

Animal burrowing plays an important role in soil translocation in many environments. By digging for food and shelter, burrowing mammals often change soil chemical and physical properties, creating habitats for other organisms. As a consequence, many, if not most, burrowing mammals have at some point been called ecosystem engineers. From a geomorphic point of view, reviews exist on the volumes and rates of sediment removal by burrowing mammals in arid environments (Kinlaw, 1999; Whitford and Kay, 1999) or by single species, specifically pocket gopher (Smallwood and Morrison, 1999), but none of these compare animal burrowing between environments and across species. Here I present data from a review on the geomorphic consequences of mammal burrowing across a variety of species, specifically comparing periglacial with arid environments. Burrow densities varied from a few per hectare for kangaroos rats in the Chihuahuan desert to a few thousand per hectare for pocket gophers in a similar environment. Mean burrow volumes also varied largely and showed a clear increasing trend with increasing animal body size (Figure 1). However, for small rodent species (<1kg) no clear differences in either burrow volumes or total volumes of sediment excavated per hectare were found between periglacial and arid environments. In general, estimates were difficult to interpret, because of variation in burrow definitions, methods and units of reporting.

References:
Kinlaw, A. (1999) A review of burrowing by semi-fossorial vertebrates in arid environments. Journal of Arid Environments, 41, 127-145.
Smallwood, K. H. & Morrison, M. L. (1999) Estimating burrow volume and excavation rate of pocket gophers (Geomyidae). The Southwestern Naturalist, 44, 173-183.
Whitford, W. G. & Kay, F. R. (1999) Biopedturbation by mammals in deserts: a review. Journal of Arid Environments, 41, 203-230.

Figure 1: Relationship between body mass (kg) and mean burrow volume (m^3) for burrowing mammals.

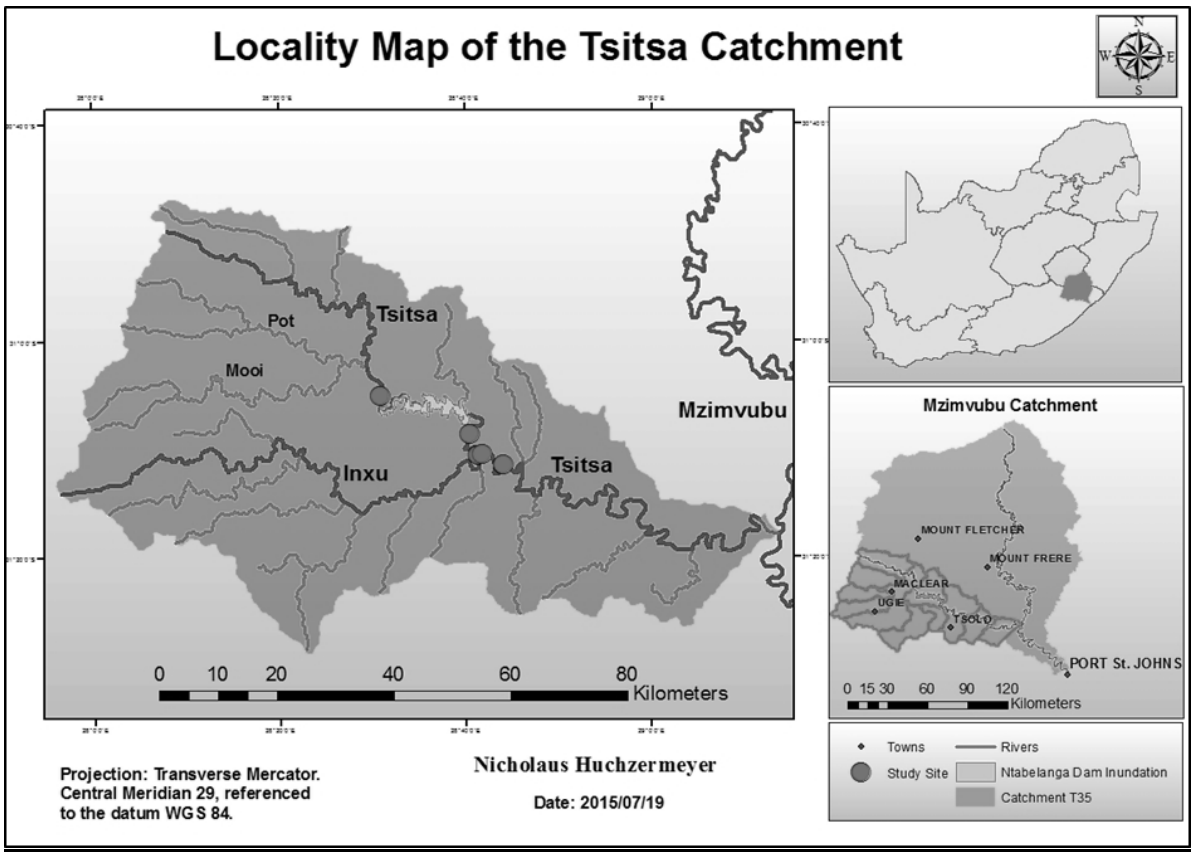


A baseline survey of channel geomorphology with particular reference to the effects of sediment characteristics on ecosystem health in the Tsitsa River, Eastern Cape, South Africa

N.H. Huchzermeyer (1)

(1) Department of Geography, Rhodes University, Grahamstown, South Africa.

Fluvial systems are dynamic systems in which variables in a catchment and river channels affect the morphology of river reaches. South African rivers are increasingly being exposed to stresses from a combination of factors, one of the most prevalent being the impacts of dams which result in varying sediment yields and flow regimes. The sediment load combined with flow characteristics for respective river channels provides the physical habitat for aquatic ecosystems. The damming of the Tsitsa River, through the construction of the Ntabelanga Dam, will change the overall downstream geomorphology. This creates an opportunity for research in the pre- construction window. Over the next two years this Masters project will focus on monitoring the current condition of the Tsitsa River by completing a baseline survey of the channel geomorphology with specific reference to the influence of sediment on river habitats and ecosystem health. Five sites were established in variable reaches of the Tsitsa River, proximal to the proposed Ntabelanga Dam, each including a range of features that can be monitored for their response to the dam. Physical variables, water quality and biota will be monitored seasonally to note changes in habitat quality. A baseline survey of the present geomorphology and associated instream habitats of the selected sites has been conducted through cross- sectional surveys of channel topography, water slope surveys, discharge measurements and visual and quantitative assessments of substrate. Level loggers were installed at each site to collect continuous data on variations in depth and temperature. Monitoring surveys were conducted to characterise dynamic habitat arrangements and macroinvertebrates, in terms of fine sediment accumulation. The relationship between ecological, physical and water quality characteristics in the Tsitsa River will aid further research in the area as well as create a better understanding of the influence of sediment on river habitats and ecosystem health.



The fate of soil organic carbon on eroded hillslopes of rural catchments in the Ngqushwa Local Municipality, Eastern Cape Province, South Africa

V. Kakembo (1), and M de Jager (1)

(1) Department of Geosciences, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The fate of soil carbon on eroded lands was investigated along hillslopes of several rural catchments in Ngqushwa Local Municipality Eastern Cape Province, South Africa. Samples were collected from eroded hillslopes, run-on and downslope sink zones along transects in four catchments experiencing severe erosion forms. Whereas sediments in sink zones of many stream channels are associated with upstream sources, sink zones in the catchments of the present study are adjacent to severe gully sites, where connectivity with stream channels has been established.

SOC content was determined by the dry combustion method. Investigations revealed topographically driven dynamics, whereby SOC content was found to be greater within concave microtopographic zones, which acted as hillslope run-on zones, as well as in the stream channel sink zone, where sediment predominantly from adjacent gullies had accumulated. The lower slope and convex hillslope sections, which constitute the erosion zone had lower SOC content. A topographically driven model of carbon distribution could therefore be developed by extrapolating these results to other catchments with similar erosion conditions. This could inform soil restoration and management strategies in degraded rural catchments.

A spatial analysis of recent mass movement events on the Cape Peninsula, Western Cape

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This study examines the factors - both natural and anthropogenic - that contribute to mass movement activity on the Cape Peninsula, Western Cape. The method employs ground-truthed satellite imagery, based on Google Earth, to develop a series of morphometric and other characteristics including dimensions, slope angle, underlying geology and land use. We develop a morphological classification of mass movement features based on a dataset of 46 landslides. Predisposing factors are indicated by the fact that most of these features originate on steep topography underlain by Table Mountain Group sandstone with an average slope angle of 32 degrees. Anthropogenic factors are also considered important controlling elements, since more than half (56%) of the landslides are associated with recent wildfires, road or footpath construction or alien vegetation clearance. Most of the features were initiated during an unseasonably extreme rainfall event that occurred during the period 15th to 16th November 2013. The results suggest that the extensive wildfires that raged across the Cape Peninsula in the late summer of 2015 predispose the affected areas to future mass movement events and that such areas need to be closely monitored. This paper indicates the potential of free remote sensing products in developing a more complete understanding of extreme events and their geomorphic consequences.

A spatial and temporal analysis of active-layer dynamics in Western Dronning Maud Land, Antarctica

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Permafrost and active-layer dynamics in the Antarctic plays an important role within terrestrial landscapes/ecosystems and as a climate change indicator, however it remains less thoroughly researched than its Northern-Hemispheric counterpart. Despite advancements made by ANTPAS on the permafrost and active-layer monitoring network in the Antarctic, observational gaps still exist. Western Dronning Maud Land (WDML) has been identified as one of these gaps, necessitating further research on permafrost dynamics and the influence of climate parameters thereon. Such elucidation is critical to both the cryospheric and life sciences. Variations in the surface climate of Antarctica can be seen as a result of inter-annual variations in atmospheric circulation, enhancing permafrost degradation and active layer thickening which directly affects soil processes such as sorting and cryoturbation. Ground temperatures down to ca. 60 cm depth from WDML are analysed from 2009 to 2014. The study sites exhibit seasonal freezing, periglacial landforms, and altitudinal variation, ranging between ca. 450m asl to ca. 1300m asl. Using ground thermal regime and regional climate data, we characterize the spatial and temporal variability of the active-layer in the Ahlmannryggen and Jutulsessen areas of WDML. Current analysis suggests a correlation between the SAO (Semi-Annual Oscillation) and measured ground temperatures, particularly during the transitional season of the SAO in May and September. Defining the relationship between climate and the ground thermal regime will improve the understanding of permafrost dynamics and landform morphology in continental Antarctica.

Trends in land use and soil erosion in the Upper Tugela catchment

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Each year, approximately 75 billion tons of soil are eroded from the world's terrestrial ecosystems and the majority of agricultural land in the world is losing soil at rates of between 13 tons/ha/year and 40 tons/ha/year. This study adds to the understanding of the relationship between soil erosion and land use. In South Africa, a high percentage of biodiversity is not confined within designated conservation areas: rangelands possess a higher percentage of biodiversity. A historical analysis of the Former homeland areas, commercial farms and Royal Natal National Park in the upper Tugela catchment was conducted over a seventy year period using aerial photographs and ArcGIS. Study site visits were conducted for ground-truthing purposes, to obtain onsite imagery and to validate the findings from the research. The results expressed that there were a higher number and more extensively developed gullies in the Former homeland areas, which form part of the rural area of the study site, compared to the commercial farm areas. Erosion in the area according to SARCUSS framework, evolved from being primarily sheet erosion (without rilling) in 1964, to intricate gully patterns in 2014. The study also showed that there was a relationship between population and vegetation: as the number of households increased from 1964 to 2014, the vegetation in the area declined. High resolution imagery and elaborate data is of great value for future studies of this nature.

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Sediment yield contribution from gully erosion in the Mzimvubu River Catchment

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The Department of Water and Sanitation is considering water resource development in the Mzimvubu River Catchment, which is on record the only large river network in South Africa without a dam. Recent soil erosion mapping and modelling studies, however, indicate that large parts of the catchment consist of highly erodible soils with widespread soil erosion evident. These studies, nonetheless, provide no information about where material moves to or about the sediment yield because a significant part of the eroded soil will deposit again before reaching a river channel. Furthermore, most regional studies across the globe emphasize the sheet and rill aspects of the erosion cycle, but few map and/or model gully erosion at large spatial scales. Modelling the sediment yield contribution from gully erosion at a large catchment scale has not been performed in South Africa. This study developed a semi-distributed model to assess the sediment yield contribution from gully erosion including gully digitizing, segmentation of SPOT 5 imagery, gully change detection, and a rule-based sediment connectivity model in a GIS. Results indicate that gully erosion feed massive amounts of sediment into the river network, contributing approximately 20 times more to the sediment output than sheet-rill erosion. Although the average sediment yield for the catchment is 5.0 t/ha/yr, the sediment yield at the future dam outlet is 22.5 t/ha/yr. Based on sediment yield results and digital elevation data in a GIS, the life expectancy of the dam could be between 34 and 49 years without siltation prevention or control measures.

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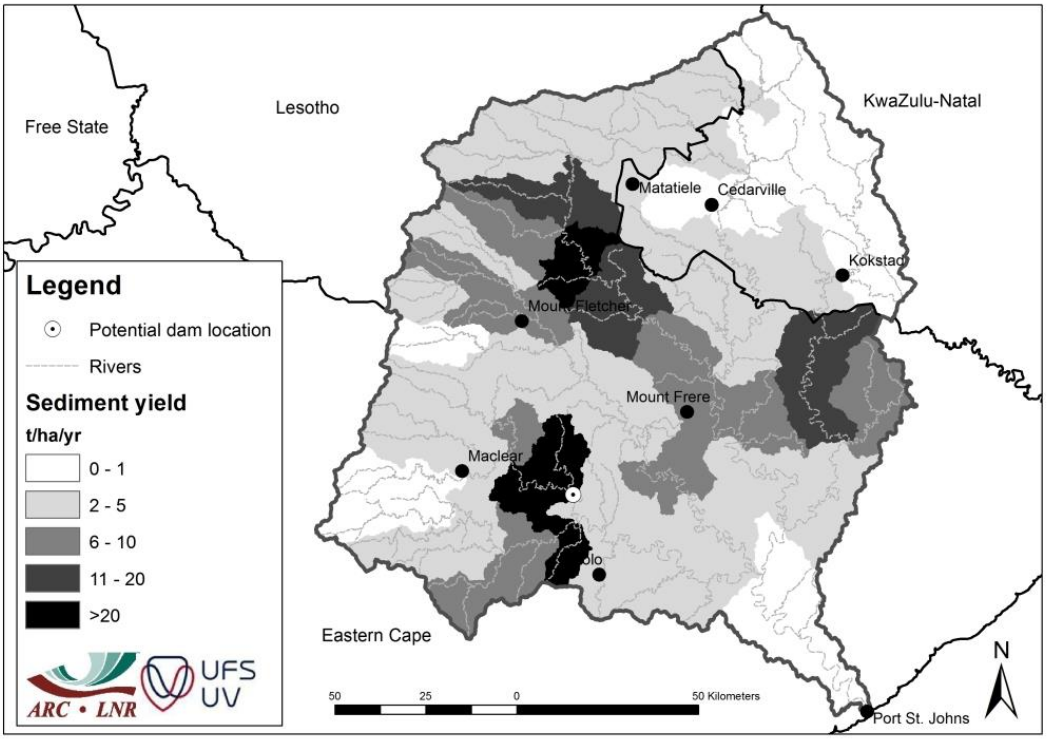
Figure 1: Sediment yield map of the Mzimvubu River Catchment



Rock weathering by thermal shock: an additional investigation of the critical temperature gradient required for fracture

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In geomorphology, the role of thermal stresses in rock decay is generally poorly understood. In particular, the exact nature of the process thermal shock has been the subject of some controversy within the larger field of rock weathering studies. One of the points of contention is the exact nature of the rate of temperature change necessary to cause a thermal fracture. Until recently, it was generally accepted that a temperature gradient of 2°C/minute would be sufficient to cause a fracture. More recent studies have shown many instances in which the 2°C/minute boundary has been breached without fracture. One suggestion as to the reason for this is that the rock must remain in a state of thermal flux in excess of 2°C/minute for a certain period of time before fracture many occur. The aim of this study was to investigate the relationship between the duration of thermal change at known thermal gradients and changes in physical rock properties for a variety of rock types. Due to the need to compare the same sample before and after heating and cooling, non-destructive testing was required. Thus, fractures were measured using a PUNDIT ultrasonic device. Thermal gradients of between 2°C/minute and 5°C/minute were tested for durations from 2 minutes up to 20 minutes. In the case of the 5°C/minute experiment, this lead to absolute maximum temperatures well in excess of that found in the field. However, useful insights into the mechanics of the process can be derived.

An analysis of flood activity over the last two centuries based on the sedimentary deposits in the Mfolozi floodplain

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Flooding is a phenomenon of widespread interest to the scientific community. Although long-term records of rainfall and flow rates do exist, records are not available over historical timescales. Sedimentary deposits have been to be shown to be useful when reconstructing a history of flood events, but research that differentiates between coastal and in-land flood events is lacking. This study aims to reconstruct the history of flooding contained in the sedimentary record of a large floodplain on the eastern seaboard of Southern Africa. Floods in this area are generally associated with one of two types of meteorological phenomena, namely tropical cyclones which produce coastal flood events and cut-off lows, which track further into the interior of the country and produce flood events that are more in-land in extent. Sediment cores from the Mfolozi River floodplain of northern KwaZulu-Nata were retrieved and individual flood events were identified and characterised using particle size distribution analysis and sediment tracing techniques incorporating environmental magnetism and X-ray diffraction analysis. Radionuclide dating methods were used to produce a chronology of the flood events in the observed sedimentary sequence. It was found that it was difficult to differentiate between coastal flood events and in-land flood events; however, evidence of large coastal flood events were identified in the sedimentary record.

Landscape processes in Antarctic ecosystems

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As part of the International Polar Year (2007-2009), a project commenced to investigate active layer environment in the Antarctic permafrost of Western Dronning Maud Land. The ground thermal regime in this sensitive environment is critical to understanding climate-landscape-biology interactions. The research and findings presented serve as a summary of almost a decade of monitoring, as well as an introduction to other papers at the conference.

We present an inventory of the landforms, data that summarises ground thermal conditions, and findings on the relationship between the geomorphology and the area's biodiversity. Ground climates in the study showed expected strong seasonal patterns, with winters being substantially cooler than the warmer summers. Inter-annual, diurnal and shorter-term air and ground temperature trends are difficult to interpret, but exhibit impacts from variations in Antarctic continental pressure systems and of synoptic-scale weather systems. The soil moisture regime is more complex than the thermal one and is integral to determining patterns of biodiversity.

It is argued that the active-layer Geomorphology in continental Antarctica provides a habitat for biodiversity from the microbial scale through to landforms. Small changes in location result in significant differences in ground-level climate and these are ideal proxies for showing landscape and biological responses to environmental changes. The landscapes are, thus, critical to the survival of the colonising biodiversity and landscape development and understanding the impacts of predicted climatic warming.

The effect of synoptic weather systems on the landscape of sub-Antarctic Marion Island: Current knowledge and future impacts

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Marion Island in the southern ocean has a hyper-maritime climate and an environment where diurnal frost processes dominate the landscape. In a diurnal soil frost environment like Marion Island, the impact of climate change on the landscape occur at a higher resolution than for seasonal and permafrost environments and needs investigation at the synoptic time scale. Results from automated and manual surface and sub-surface measurements in a variety of habitats show that the landscape on Marion Island is dominated by the passage of synoptic scale weather systems. These systems influences the thermal characteristics of soil, intensity of rainfall, snowfall, soil frost dynamics, needle ice development, aeolian erosion and a host of other abiotic processes and its direct and indirect interactions with the ecosystem. This paper reviews the current knowledge on the interaction between synoptic weather systems and the landscape and specifically addresses the possible landscape responses under a future climate.

Inferring contemporary sediment yield from reservoir deposits in the Kruger National Park, South Africa

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Between the 1930s and 1970s, more than 50 small dams have been established within the Kruger National Park (KNP) intercepting the drainage network and trapping sediment delivered from upstream areas. The reservoir catchments vary in size, climate, relief, geology, soil and land type. This sets an ideal frame for an assessment of sediment yield and soil erosion in a pristine Savanna ecosystem. In 2014, we started to map deposits in dried-out and decommissioned reservoirs located in the southern and central KNP.

GNSS-based surveying of the reservoir basins provides the water storage capacity and eventually trap efficiency. The volume and mass of post-dam deposits is determined from investigations of excavation pits and soil augering at up to 60 locations per reservoir. Samples are taken to determine horizontal and vertical variations in dry bulk density. Geochemical and grain size analysis is carried out to further characterize sediment properties. Soil samples collected in the catchment are analysed accordingly for comparative purposes.

Here, we present results for two study sites with similar size but contrasting catchment lithology, i.e., the Silolweni (granite/sandstone) and Nhlanganzwani Reservoirs (basalt/rhyolite). Variations of sediment properties within and between reservoirs are examined. The potential of geochemical and grain size parameters to assist the discrimination of the pre- and post-dam facies will be illustrated. Catchment-wide mean sediment yield reflecting 39 and 51 years of deposition in the Silolweni and Nhlanganzwani Reservoir, respectively, are calculated.

Characteristics of Tafoni formation: Observations from Western Dronning Maud Land, Antarctica

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There is a multitude of processes involved in the formation of Tafoni, which differ in shape and size across environments. Despite the extensive study of formation processes worldwide, it remains a contentious topic of discussion between scientists. Due to the near pristine nature of Antarctica, it is an important site for unbiased studies regarding past, current and future geomorphological changes. Whilst the presence of tafoni in Western Dronning Maud Land (WDML), Antarctica has been documented, the processes responsible for formation have not yet been explored. Therefore, the aim for this thesis is to locate and characterize the processes influencing the formation of tafoni in WDML, Antarctica. Particular focus will be placed on typifying size, positioning, geology and microclimate of the tafoni at different sites. Data on these variables were collected in WDML over the 2014/2015 austral summer using rock samples, rock hardness, infrared imagery, temperature probes, a portable weather station and a, b, c axis measurements. Preliminary results indicate that parent rock and micro-lithological properties of the host rock heavily influence the formation of Tafoni. Whilst, rock hardness values indicate that softer tafoni caverns are surrounded by a case hardening. Additionally, weather variables such as dominant wind direction and snowfall have been noted to influence formation. Overall, geology is a dominant role-player in the development of tafoni, which is an important mechanism for biodiversity in the Antarctic as it provides a suitable environment for lichen colonisation.

The application of environmental magnetism to determine sediment connectivity in South Africa catchments

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Sediment fingerprinting using a wide variety of tracers is a well-established method globally for establishing the source of sediment deposited in sinks such as lake and reservoir sediments, wetlands and river floodplains. An environmental magnetism laboratory was established at Rhodes University in 2009, enabling the application of mineromagnetic signatures to trace sediment in South Africa catchments. The effectiveness of environmental magnetism as a sediment tracer is reviewed using a number case studies from the Eastern Cape and the Kruger National Park. Where the underlying geology gives rise to soils with distinct magnetic signatures environmental magentism provides a cheap and simple method to establish sediment connectivity in a catchment. The technique has been applied successfully to catchments where Karoo igneous rocks can be distinguished from Karoo sedimentary lithologies. It has also been used to distinguish igneous and sedimentary lithologies in the Kruger National Park. The technique is less successful where the catchment is comprised solely of Karoo sedimentary rocks. The method has also been used to distinguish between top soils and subsoils but this has generally proved less successful in the South African environment.

Rock Glaciers observed in Jutulsessen, Gjelsvikfjella Mountain Range, Dronning Maud Land, Antarctica

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Rock glaciers are known to occur in a number of environments across the globe, yet they remain poorly understood geomorphic features and are not well documented in the Antarctic. Four slopes on Jutulsessen nunatak (72°01'S, 02°32'E) of the Gjelsvikfjella mountain range, Antarctica were investigated. A general survey was conducted assessing the morphology of the landforms to place them within the current classification of rock glaciers. The geology is predominantly gneiss and granitic gneiss, dominated by glacial cirques of various sizes. A number of glaciers occur of higher altitudes on the mountain that could act as moisture source to the active-layer on lower slopes. Assessment was made by hiking several transects across the landforms and creating a digital elevation model from interpolated heights. Tommelen and Sesseggen are suggested to be active rock glaciers with multiple sources of debris input, whereas Grjotøyra and Vassdalen are relict landforms. The presence of melt-out drainage lakes and contraction polygons on the lobe of Grjotøyra and Vassdalen, respectively, suggest the influence of active-layer processes on the present morphology of the rock glaciers. Photographic evidence supports the investigation and suggests areas for future research. These landforms could be a source of paleoclimatic information and serve as a monitoring tool for climate change. This study offers new research to this region of continental Antarctica, and contributes to the existing knowledge of rock glaciers.

Hydrodynamic modelling of flow characteristics associated with natural valley confinement: a case study of the Kompanjiesdrif Basin of the Kromrivier wetland, Eastern Cape, South Africa

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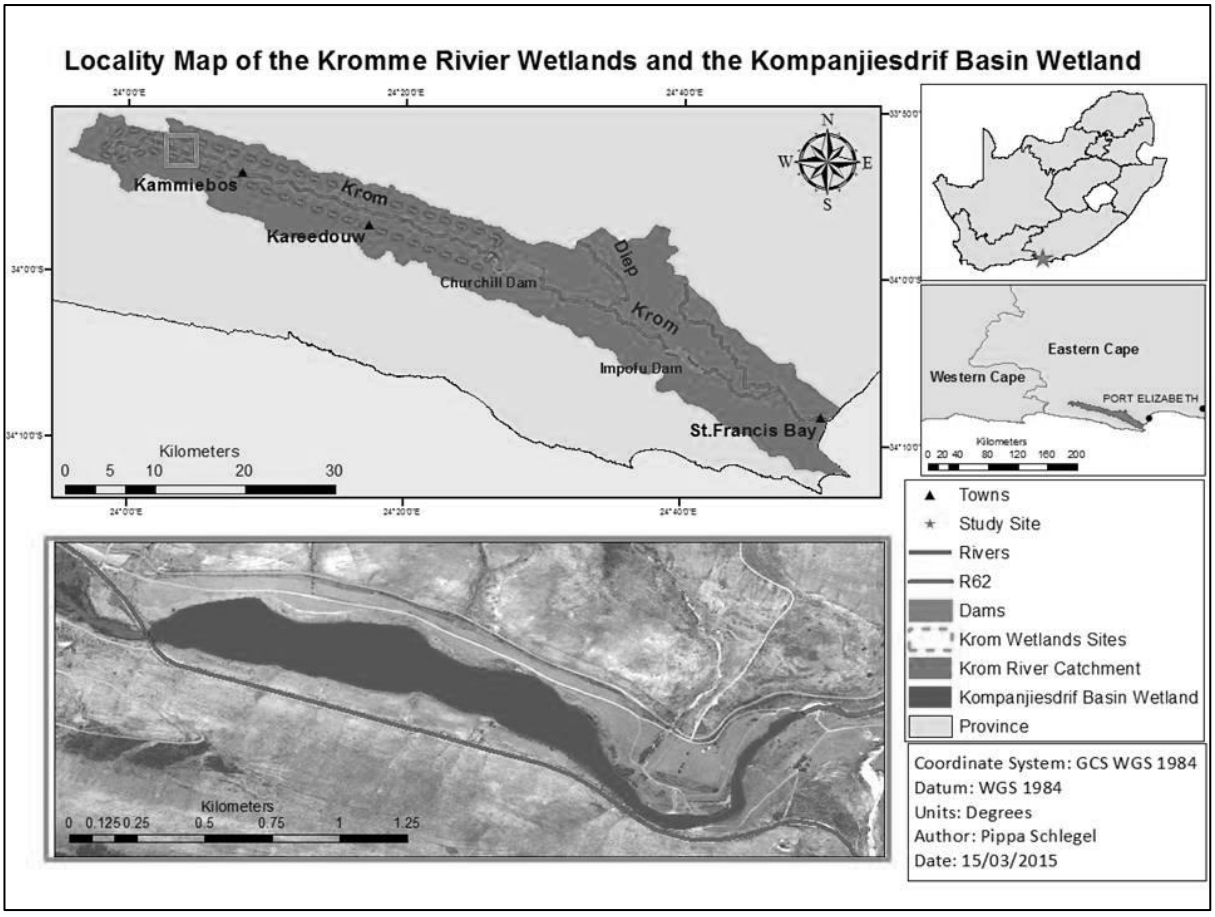
Gully erosion is a significant and widespread feature of southern African wetlands, including the Kromrivier wetland in the Eastern Cape. Gully erosion in wetlands is consistently being viewed as a major contributing factor to wetland degradation and eventual collapse. Many gullies exist in the wetland and Working for Wetlands has spent large sums of money to stabilise head-cuts with the thought that further erosion would be halted and possibly avoided altogether. Observations in the Kromrivier wetlands have revealed that most gullies in the wetland are initiated where the width of the trunk valley has been reduced as a consequence of deposition by tributary alluvial fans that impose on the trunk valley and reduce its width. As such the aim of the study is to examine variation in hydrodynamic characteristics for a range of discharges as flow in the broad Kompanjesdrif basin (~200 m wide) is confined in a downstream direction to a width of ~50 m by a combination of a large impinging left bank tributary alluvial fan that coincides with a resistant bedrock lithology. The study was done by collecting topographical survey data using a Differential Global Positioning System and a Total Station in order to create a high resolution Digital Elevation Model. Flow was recorded for low and high flow conditions using a Marsh-McBirney Model 2000 Flo-Mate as well as recording the flood extent for each flow condition. Vegetation measurements were conducted in order to calculate a roughness value across the valley floor. A two-dimensional raster based flood inundation model, LISFLOOD-FP, was then used to simulate different parameters associated with variation in flow, including velocity, water depth and stream power, thereby creating a better understanding of the formation of gullies in the wetland. This work improves understanding of the collapse of palmiet wetlands in steep-sided agricultural valleys within the Cape Fold Mountains of South Africa, and should help improve wetland management.



Rainfall erosivity on Mauritius: an overview

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Small island states are vulnerable to soil erosion due to fragile natural resource bases and, particularly in tropical environments, erosive rainfall. Many tropical islands have elevated interiors that provide for steep slopes and steep rainfall gradients from the coast to the interior. The island of Mauritius typifies such an environment with a dense population, intense cultivation and a central plateau above 550m.a.s.l. that provides for a distinct topographic effect on rainfall totals. Few islands, however, report on detailed rainfall erosivity attributes that can be effectively used in erosion modelling. The paper provides an overview of recent studies conducted on erosivity conditions on Mauritius. Findings show the contrast between the total erosivity of storm events in the interior, where precipitation totals are higher, and the rain-shadowed west coast. At an event scale, however, little differentiation is found. Large proportions of winter rainfall are also found to be erosive and non-tropical cyclone rainfall can pose a substantial erosion and flood risk. Findings reinforce the importance of using high resolution rainfall data in the computation of rainfall erosivity. Field calibration of erosion models, however, remains an important avenue for future research.

Using geometric morphometrics to quantify barchan shape from satellite imagery

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Barchans have been studied for more than a century. Until now, morphometric descriptions have been based on distance measurements along predefined axes. Such methods impose both methodological as well as conceptual constraints on future barchan research. A method, based the principles of geometric morphometrics, is proposed which represents a significant methodological departure from traditional measurements by placing emphasis on the geometric arrangement of points in space rather than the distances between them. A brief overview of contemporary barchan morphometric description is provided in order to place the new method into a proper context. The usefulness of using geometric morphometrics is demonstrated with a case study of barchan shape variability in Namibia.

Landscape connectivity in the upper Umzimvubu River catchment: an assessment of anthropogenic influences on sediment connectivity

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Landscape connectivity has been altered in many landscapes world-wide and impacts how water and sediment is routed through the landscape. Diminished ecological infrastructure can result in a reduced ability to retain water and soils that will impede future water and agricultural sustainability. In the northern Eastern Cape, the headwaters of the Umzimvubu River, land use change/land degradation over the past 50-100 years has initiated increased sediment connectivity through features such as gullies and incised river channels. The water resources of this catchment are largely undeveloped, but future development will be threatened by high suspended sediment loads. The Vuvu catchment, headwater tributary of the larger Umzimvubu River system, is used as a case study to assess how hillslope-channel and channel-valley fill sediment connectivity has changed over the past 100 years. A conceptual model of changes to sediment connectivity will be presented with recommendations for future rehabilitation.

Triggers of mass movement events in the Western Cape mountains: a historical perspective

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On a global scale rainfall-induced mass movement events cause thousands of deaths every year. The consequences of these events have also proved expensive in terms of the socioeconomic impacts, as well as damage to the built environment. In the Western Cape region of South Africa, mass movement occurs on a regular basis, often causing damage to both private and public infrastructure, as well as disruption to the economy. However, the factors predisposing and triggering mass movement events in the region are poorly understood; local authorities are now calling for research on this topic in an attempt to mitigate the impacts of such events, especially given their likely increase in frequency and magnitude due to climate change. We present here an analysis of the relationship between historical rainfall and recorded mass movement events. Using chi-squared statistics, it is established that there is a dependent relationship between rainfall and the occurrence of mass movement processes such as rockfall, debris flow and mudflows. Tentative threshold values were identified using total monthly rainfall values, number of rain days, the combination of monthly rainfall and rain day values, as well as antecedent rainfall values. The majority (88%) of the mass movement events studied occurred either in months with an above average number of rain days or with above average total rainfall values. A study of individual events reveals that if between 10-20% of annual rainfall is received in the area in the week prior to an event, sufficient water accumulates on the slopes for a failure threshold to be exceeded. The paper indicates that with further research it should be possible to refine and affirm the established relationships in order to develop a mass movement prediction and early warning system based on rainfall thresholds.

POSTER ABSTRACTS

The influence of event driven processes on sediment creation from gully erosion in the uMzimvubu River Catchment

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Studies indicate that gully erosion provide key sediment sources in a range of environments often undergoing change at various scales. These changes include desertification, land degradation and denudation. Some research gaps still exist on the role that individual high rainfall events play in the development of sediment within gully systems. Historically land use and quality in the northern Eastern Cape region has changed due to overgrazing, specifically within the catchment of the uMzimvubu River. This project evaluates the role of extreme events on the creation of sediment from gully erosion on the banks of the uMzimvubu River. Using field methods combined with remote sensing techniques, the extent of previous and current gully erosion resulting from high rainfall events is investigated at local and regional scales. The project will incorporate object based analysis to determine gully development in the past 30 years of the area, with connectivity being investigated as a potential key process in sediment movement in such changing land surfaces. This study will assist in better understanding the effects of high rates of sediment deposits into the uMzimvubu River. Such deposition has implications on the livelihoods and developments dependant on the river, including a proposed dam to be built in the upper catchment.

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The application of forensic geomorphology in rhino poaching (South Africa)

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An epidemic of wildlife poaching has occurred since 2008, especially regarding rhinoceros poaching, which has a devastating effect on the future of South Africa's wildlife. It is essential to protect southern Africa's heritage by developing and adapting new research methods and techniques that can assist prosecutors to improve their successes in achieving convictions. Geomorphology reflects a fundamental principle in forensic analysis: that shape of the land influences or controls human activity, and this can be applied to geoforensics. This thesis conducted two experimental study sites which mimicked the aspects of the landscape of rhinos by utilising the landscape though a variety of physical, chemical and biological techniques. The focus of the analysis was to conclude that significant similarities could be identified between certain geomorphic aspects at a wildlife crime scene and with the aspects recovered from suspects. The study presents the results of forensic geoscientific investigations of wildlife crime in South Africa.

An Introduction to the Makgadikgadi "Piano Keys" Rift Zone (MRZ)

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The southern African Kalahari hosts several terminal branches of the East African Rift System including the Okavango Rift System ORZ (Kinabo et al 2007) and the lesser studied MRZ (Baillieul 1979). The ORZ is seen as rift related, whereas the curvi-linear sandy ridges and the 945m contour bounding the MRZ represent an indicator of a Quaternary lake history. We identify previously unrecognized geomorphic anomalies caused principally by reshaping of the fossil shoreline features (945m contour) which we attribute to recent vertical tectonic displacement and surface expression through thick Kalahari Group sediments. We also noted relict patches of replicated dunes patterns preferentially preserved on elevated horst blocks of the MRZ. Identical fault controlled dune patterns have previously also been noted in the ORZ (McFarlane and Eckardt 2007).

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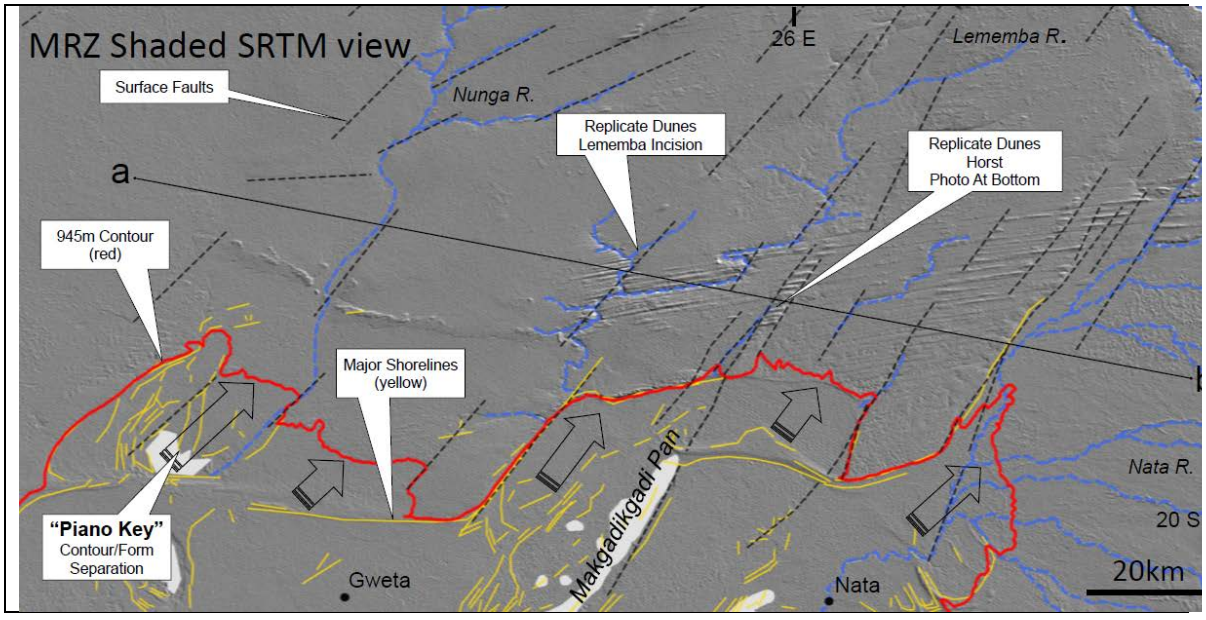
Figure 1: Makgadikgadi Rift Zone, fault blocks, drainage and modified 945 m contour.



The development of present day drainage patterns of central Africa

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The Congo Basin is an immense (*ca.* 3.6 million km^2), near-circular, intracontinental basin which straddles the equator in central Africa. This basin contains the world's second largest river, the Congo River, which has an annual discharge of 1 250 x 10^9 m^3. Despite increased interest over the last decade many details of the regions geomorphic evolution remain unknown. This poster presents an analysis of the basin's present day drainage network. The identification of differing drainage patterns may be explained by multiple phases of landscape development in the Neogene. These drainage pattern appear to be the result of autogenic fluvial processes interacting with a combination with lithologic and tectonic controls. By using evidence from biogeographic indicators in a geomorphic context, the ages of the major river emplacements can be constrained and a better understanding of the Congo Basin's Neogene evolution may be attained.

Rock mass loss on a nunatak in Western Dronning Maud Land, Antarctica: implications for periglacial landform development and habitat facilitation

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This poster presents the first rock mass loss data for uncut clasts from continental Antarctica. A rock mass loss experiment using doleritic rock samples was conducted over a seven-year period, between 2008 and 2014 at the Vesleskarvet nunataks, Western Dronning Maud Land. The data show that approximately 10% of clasts have experienced relatively large rates of mass loss. The data suggest that rock mass loss occurs in a series of events which are impossible to predict in terms of frequency and/or magnitude. However, extrapolating from the data obtained during the seven-year period indicates that rates of mass loss are slow and of the order of 1% per 100 years. Direct erosion by wind (including abrasion) as well as mechanical and chemical weathering are suggested to be responsible for rock mass loss. Rock properties, weathering environment and a lack of available moisture may be contributing factors to the slow rate of rock decay. This paper suggests that in this area of Antarctica, the slow rate of rock mass loss increases the longevity of existing periglacial landforms such as patterned ground and blockfields, but inhibits development of new patterned ground through the slow production of fines.

Synoptic circulation patterns and its relationship with ground thermal characteristics along an altitudinal transect on sub-Antarctic Marion Island

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The climate of Marion Island is driven by synoptic weather patterns which have also been suggested to influence the soil thermal characteristics. The primary aim of this work was to examine the effect of synoptic weather systems on soil temperature dynamics on an altitudinal gradient on the eastern side of Marion Island. The study specifically addresses the implications of climate change on future soil thermal dynamics in a maritime sub-Antarctic environment. Ground temperatures were obtained from three ground temperature monitoring stations on the eastern side of Marion Island. To assess the synoptic weather circulation patterns, a synoptic climate classification methodology that is based on the single station principal component (PCA) and cluster analysis were used. Results show that certain clusters were more dominant than others and over the measured time span certain synoptic weather patterns, mainly cyclonic air circulation types, have decreased while anticyclonic circulation have increased. Soil frost occurs at all three stations on Marion Island, not only under cyclonic circulations (as previously suggested) but significantly under anticyclonic air mass circulation as well. Soil frost is dependent on the duration of post-cyclonic Antarctic air mass circulation. Synoptic weather patterns are also affecting ground surface lapse rates. Changes from positive to negative lapse rates were observed and this predominantly occurred under the atmospheric circulation pattern associated with clusters that are predominantly anticyclonic. Long term climatic change as predicted by the PCA show a reduction in low pressure systems or more anticyclonic conditions affecting the island. These changes will significantly affect the soil thermal dynamics at an altitudinal scale on sub-Antarctic Marion Island.

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The effect of regional synoptic scale weather patterns on ground thermal regimes, Western Dronning Maud Land, Antarctica

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Recently (2004), the Scientific Community on Antarctic Research (SCAR), released the first Antarctic and Southern Oceans Horizon Scan, a document which identifies questions which need to be answered by Antarctic research. Two of the eighty questions relate directly to geomorphology and the active layer. As part of a broader study, this research investigated the effect of regional synoptic scale weather patterns on thermal regimes in Western Dronning Maud Land, Antarctica were investigated. Eight automated logging stations were utilised to document ground temperatures. Troll (installed in 2006), and Vesleskarvet (installed in 2009), were identified as suitable for this study and at each site hourly temperatures were measured. Specific synoptic events were separated from the seasonal and continental scale meteorological conditions. The intensity and duration of synoptic events affects the dynamism of the ground thermal regime. It is expected that synoptic events influence local regions of Western Dronning Maud Land, instead of being distributed continentally. This study is of increasing importance due to the regional effects of synoptic events being poorly understood and unknown implications of climate change on them. The results are to be used to contribute to environmental knowledge of Western Dronning Maud Land and the potential change to permafrost and active layer in these regions, and the implications thereof.

Comparing soil displacement by burrowing mammals between arid and mesic environments

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Burrowing mammals are agents of soil disturbance and may have a large impact on the geomorphological processes of an area (Bragg *et al*. 2005). Burrowing mammals play a role in the displacement of sediment in the landscape and can therefore be seen as agents of erosion (Whitford & Kay 1999). In this study, the density and dimensions of medium-sized mammal burrows (presumably aardvark) were determined for an arid area, Tierberg Research Station in the Karoo (176 mm annual rainfall), and a mesic area, Rietvlei Nature Reserve in Pretoria (724 mm annual rainfall). The density of burrows was lower at Tierberg than at Rietvlei, (0.67 ± 0.45 burrows/ha and 8.83 ± 15.27 burrows/ha respectively). The dimensions of 10 burrows were measured at Tierberg and 50 at Rietvlei. Burrows were generally larger at Tierberg, where the average minimum soil volume displaced per burrow was 0.62 ± 0.48 m^3, in contrast, to 0.17 ± 0.11 m^3 at Rietvlei. When taking burrow density into consideration, the average minimum volume of soil displaced at Tierberg was 0.41 ± 0.32 m^3/ha and at Rietvlei it was 1.54 ± 0.94 m^3/ha. These values are of the same order of magnitude as those reported for badger in the UK (1.07 m^3/ha, Coombes and Viles, 2015).

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Whitford W.G., Kay F.R. 1999. Biopedturbation by mammals in deserts: a review. Journal of Arid Environments, 41, 203-230.

Developing a spatial geo-database for Western Dronning Maud Land, Antarctica

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Studies conducted in Antarctica have produced a vast amount of data that are very beneficial to the world as a whole. Antarctic research is important because the environment is pristine and what happens down at the South Pole drives changes that occur over South Africa and the rest of the world. There is ample data available on the macroscopic scale but little data on the microscopic scale. It is for this reason that smaller areas such as Western Dronning Maud Land (WDML), Antarctica are being studied by the South African National Antarctica Programme (SANAP) and other researchers. The datasets that currently exist for WDML are extensive and exist in a variety of sources which makes it challenging for it to be used because it cannot easily be found and they not shared in a common database. As a result, the main aim of this project was to use GIS to develop a consolidated geo-database for data collected by SANAP researchers and other researchers in partnership with SANAP. Furthermore, a map of WDML with metadata was produced. The database also functions as a medium through which data can be shared with and by anyone. In realising this project, existing data were identified, collected and assembled for WDML. Inconsistencies in the existing data and future spatial data needs were identified through the assistance of significant WDML researchers. Therefore, the project has brought to light the need for GIS to aid in manipulating, managing, mapping and analysing digital data and the related attribute data in WDML research for more accurate conclusions to be drawn in terms of how the planet is changing.

A yield assessment of one cultivated stand of Honeybush (*Cyclopia spp*.) in the Upper Langkloof Valley

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South Africa has a long history of natural resource use, both as indigenous knowledge prior to colonisation through to commercialisation in post-apartheid South Africa. The potential for the honeybush industry in South Africa to expand is immense. The rapid growth of the industry will have to rely on commercially cultivated honeybush in order to keep up with the growing demand for the end product. The aim of the project is to quantify yield data for one stand of honeybush (*Cyclopia spp*.) this will assist in establishing standards for expected yields in the Langkloof region as well as a better understanding of yield affecting factors in the cultivation of honeybush in the upper Langkloof region of the Eastern Cape, South Africa. The question being answered is what is the likely average yield/Ha of cultivated honeybush in the greater Langkloof region? What factors limit or promote its growth and thus yield in a cultivated environment? Through soil sampling, particle size, temperature, moisture content, organic content and clay content will be gathered and compared according to yield statistics. This project utilises GIS software to spatially analyse the extent of the commercial cultivation of honeybush, along with data collected from cultivators relating to their yields and inputs. An analysis of the physical characteristics of the areas in which honeybush cultivation is taking place as well as the cultivation practices will assist in growing the fledgling industry in South Africa. This has the ability to positively impact small communities in the Western and Eastern Cape significantly effecting regional economies in a positive manner.

River discharge dynamics, land use change and climate: The Nyoni and Amatikulu rivers

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Land use changes and climate variability are known to affect environmental processes and fluvio-marine environments tend to be extremely sensitive to these impacts. Hydrological modelling has been introduced by numerous studies to explore the responses in catchment processes. Spatially distributed rainfall-runoff models furthermore provide a more holistic view of hydrological behaviour under different environmental conditions. This study implements STREAM (Spatial Tools for River basin Environmental Analysis and Management), a GIS-based water-balance model, to investigate the Nyoni and Amatikulu catchments in KwaZulu-Natal (South Africa). River and coastal morphological changes have been observed in the recent past and it is suggested that land use changes and climate variability is a major cause for this phenomena. Data from 1937 until present is used for model simulations.

Elephants and Rhinos as geomorphic agents and ecosystem engineers: focusing on paths and wallows

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The geomorphic impacts of rhino's and elephants in Shamwari Private Game Reserve, South Africa, were investigated to create baseline data that can be used as a management tool. The objectives of this study were, 1) To measure the erosive landforms resulting from elephants and rhinos. 2) To determine the impacts of rhino and elephant paths and wallows on soil physical properties. 3) To distinguish between a rhino and an elephant wallow and path. 4) To compare the impacts of rhinos and elephants on the landscape.

Two wallow sites where chosen, these areas are known to be frequently used by each species separately (from the knowledge of the game rangers). The paths adjacent to the wallows were used as path study sites. Soils were found to be more compacted around the wallows and in the centre of the paths. As distance from the paths increased, the soil compaction decreased. A lower infiltration rate was also recorded in compacted areas. Rhino wallows were found to be longer and irregular in shape and had an entrance, while elephant wallows were smaller and deeper and had no entrance. Rhino paths (secondary paths) had slight vegetation cover present (short grass) while elephant paths (main paths) had no vegetation cover (bare) as they are more frequently used, by both species as well as other animals. This is one of the reasons why these two species are classified as ecosystem engineers, including seed dispersal.

Paths and wallows for both species were found to change the soil physical properties and had high erosive potential. In conclusion elephant and rhino activity have an extensive geomorphic impact on the landscape.

To revisit and document openwork deposits on Gaika's Kop in the Hogsback area of the Eastern Cape

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The origin of openwork block deposits found on Gaika's Kop in the Hogsback area has been intensely debated. New technologies are now available that can improve the processes, involved in openwork deposit development (eg: differential GPS's and stereo photography). Frost action from Pleistocene period, slope aspect (especially favouring south facing slopes), the presence of late lying snow and the minimum snow line have been proposed as controlling factors. The lithology is dolerite that is part of the Karoo Super Group. Openwork deposits on Gaika's Kop in the Hogsback area of the Eastern Cape were revisited and redocumented. Fundamental to the study is determining whether they are autochthonous or allochthonous blockfield deposits. The findings of the study are presented together with an interpretation of the palaeoclimatic significance of the block deposit.

In Memoriam: Margaret Eleanor Marker

27 March 1932 - 12 June 2015

Margaret Marker, who has died in Northumberland in the United Kingdom at the age of 83, was, for more than two decades in her post-retirement years, the doyen of South African academic geomorphology. She arrived in South Africa in 1970 and only returned to her native Britain at the turn of the century. Sadly, the onset of dementia in 2012 spelt an abrupt end to a remarkable academic career which spanned some four decades.

Margaret successfully read for her degree in geography at St Hilda's College, the University of Oxford, and subsequently took Honours in the subject. In 1957 she was awarded, with distinction, the degree of Master of Agricultural Science at the University of Melbourne. After a short career in geography teaching in the UK, Margaret was appointed, in 1967, to the staff of the Department of Geography at the University of the Witwatersrand. She registered for a PhD which was awarded, in 1971, for a thesis entitled *Karst Landforms of the Northeastern Transvaal*. The joint promoters were Prof Peter Tyson (Wits) and Dr Marjorie Sweeting (St Hughes College, Oxford). In 1977 Margaret moved from Wits to the University of Fort Hare at Alice in the Eastern Cape. She was Professor of Geography and Head of Department at Fort Hare until her retirement.

Under her leadership, Geography at Fort Hare thrived, as did her research career. Margaret published prolifically, including a southern hemisphere limestone classic *Karst development on the Alexandria Coastal Limestone, Eastern Cape Province* in collaboration Marjorie Sweeting. Papers on aspects of the geomorphology of the Namib, coastal plains, the Lesotho highlands, and the issue of possible glaciation in the Amatola Mountains near Fort Hare followed. Indeed, it was Margaret's fascination with the physical landscapes around her, and her unquenchable curiosity, which resulted in her publishing on an extraordinarily eclectic range of topics. Her range of interests also resulted in a wide circle of academic friends, with whom she would cheerfully share ideas and data. The result was a broad range of collaborative authorships.

It must be mentioned that it was Margaret's unique contributions to research, to teaching and to promoting both geomorphology and community upliftment which earned her the respect and affection of both students and colleagues. Few realise that her outspoken championing of her students and others she perceived as vulnerable did not endear herself to the political and academic establishment of the time. Indeed, she took South African citizenship in order to make her position in South Africa more secure. When she retired from Fort Hare in 1991, past and present students gave her a memorable farewell party. Appropriately, Margaret was honoured with the award of the gold medal of the Society of South African Geographers at a ceremony at Fort Hare on 31 October 1996.

It was in her "retirement" at Knysna that Margaret was able to expand her academic interests, publishing, famously, in 1997 a paper on a Holocene sea-level low-stand, the product of foundation excavations on her Knysna property which exposed a shell midden. She continued to supervise PhD students and to contribute to teaching and research through the Department of Environmental and Geographical Science at UCT.

Despite buying a house at Eynsham near Oxford in 1992, Margaret continued to publish prolifically on southern African geomorphology, initially spending more time in South Africa than the UK. There was not a single academic geomorphologist in South Africa who Margaret did not know, and vice versa. She was particularly well disposed and kind towards young geomorphologists, and would go out of her way to assist with advice, readings, and her own formidable store of knowledge and experience.

Gregarious and generous by nature, Margaret was blessed with a formidable intellect. She nevertheless displayed infinite patience and gentle perseverance with students for whom the penny had not quite dropped. However, she would not tolerate incompetence or slackness in any form, and could make it quite clear if she was displeased. Who on the UCT field camp of the early 1990s will forget her reaction when a hapless, but anonymous student failed to secure the lid on a tomato sauce bottle and it leaked all over Margaret's rucksack! On a more serious note, her respect for each and every person she came into contact with did not necessarily extend to their

reputation. As a newcomer to South Africa, she famously crossed swords at a conference with the formidable Lester King, having had the temerity to disagree with the great man regarding an aspect of scarp retreat. A regular attendee at SAAG and SASQUA, Margaret could at times exasperate, but her personality was such that she endeared herself to everyone with whom she came into contact. She was, in short, a truly special person. Two things are certain; southern African geomorphology will miss her sorely, and we will not be privileged to see the likes of a Margaret Marker again.

Peter Holmes
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