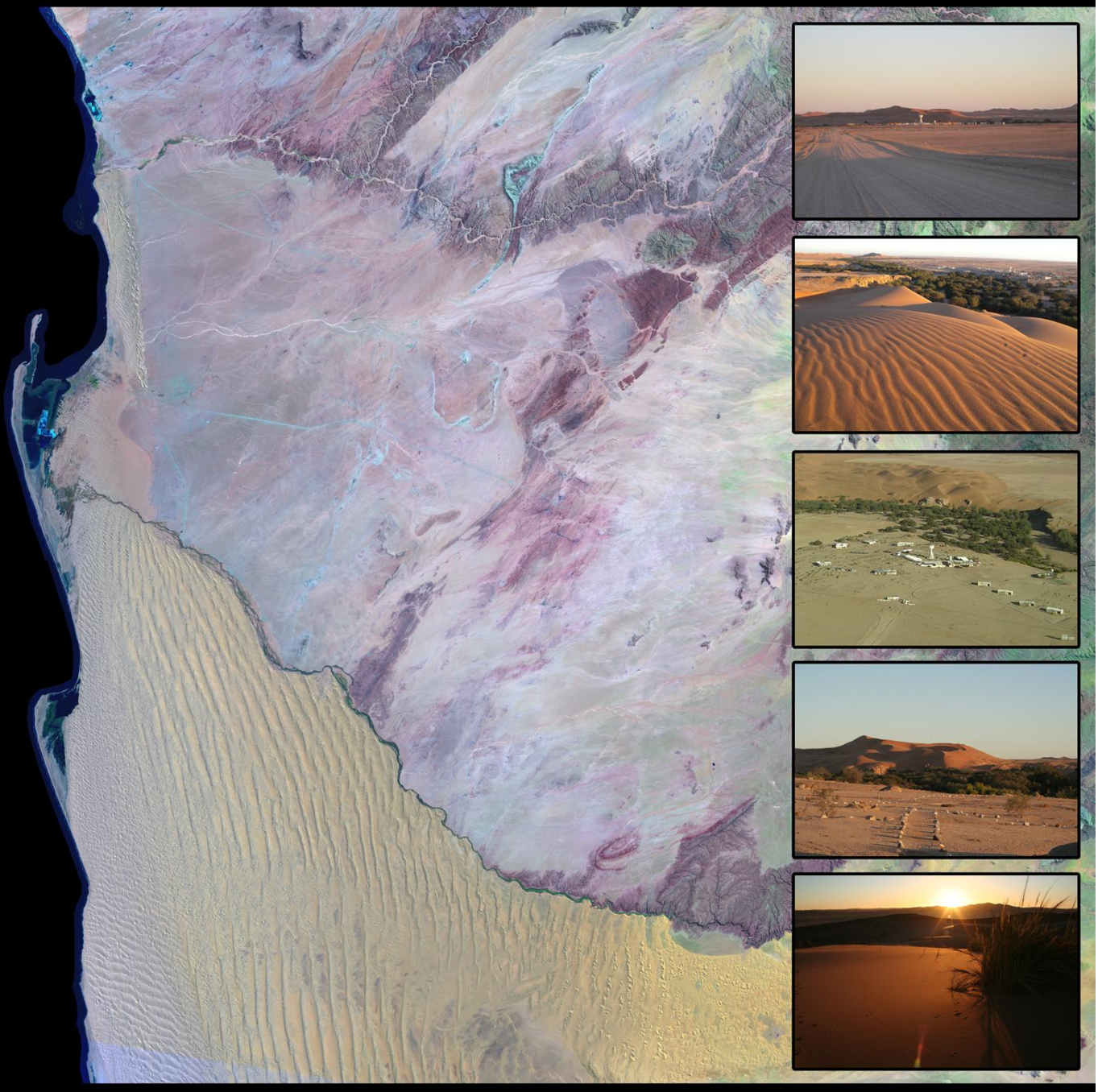
Southern African Association of Geomorphologists

Celebrating 50 Years of Namib Desert Research
Gobabeb, Namibia



The 2012 Biennial Conference - 8th to 12th September

SAAG

Royal Geographical Society with IBG
Advancing geography and geographical learning

GOBABEB
RESEARCH & TRAINING CENTRE

GEOMORPHOLOGY
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IAG – International Association of Geomorphologists

BETA – Beta Analytical

RGS – Royal Geographical Society

Order of Programme

Day 1 September 9th

0702		**Sunrise**	
0800	**0900**		**BREAKFAST**
0900	**1020**	**Chair: M Hipondoka**	**Session 1 - The Namib Sand Sea (NS)**
0900	0920	Mary Seely Frank Eckardt	Welcome Introduction
0920	0940	Kevin White	Introduction to the Namib Digital Dune Atlas (NS1)
0940	1000	Ian Livingstone	Thirty Years of Monitoring Surface Change on Namib Dunes (NS2)
1000	1020	Charlie Bristow	The age and migration of dunes in the Namib Sand Sea (NS3)
1020	**1100**		**TEA BREAK**
1100	**1200**	**Chair: P Sumner**	**Sessions 2 - Southern African Dust (AD)**
1100	1120	Robert Bryant	Etosha Pan: Dust source characteristics and emission controls (AD1)
1120	1140	Giles Wiggs	Dust emission dynamics and source area variability: field measurements for climate models (AD2)
1140	1200	Kathryn Vickery	A preliminary report on the chemistry, size and morphology of dust sampled from the Makgadikgadi Pans (AD3)
1200	**1300**	**Taimi Kapalanga**	**Tour of Gobabeb Weather Station**
1300	**1400**		**LUNCH**
1400	**1540**	**Chair:K Rowntree**	**Session 3 - Antarctic Surface Processes (A)**
1400	1420	Ian Meiklejohn	Active layer landforms and biological interactions in Western Dronning Maud Land, Antarctica (A1)
1420	1440	Christel Hansen	Aspect Control on Weathering Observed on a Blockfield in Dronning Maud Land, Antarctica (A2)
1440	1500	Werner Nel	A synoptic assessment of soil frost on Marion Island and the possible consequences of climate change in a maritime sub-Antarctic environment (A3)
1500	1520	Jan Boelhouwers	Critical assessment of the 2oC/min threshold for thermal shock weathering (A4)
1520	1540	David Hedding	Pronival ramparts: modes of genesis and diagnostic criteria (A5)
1540	**1600**		**TEA BREAK**
1600	1830	Open To All	**Workshop 1 - Dune Survey Techniques**
1600	1830	Ian Livingston	**Or Visit to Dunes with Ian Livingstone**
1851		**Sunset**	
1900			**SUPPER**
		Holmes & Meadows	**Book Launch - Southern African Geomorphology**

Day 2 September 10th

0701		**Sunrise**	
0800	**0900**		**BREAKFAST**
0900	**1020**	**Chair: V Kakembo**	**Session 5 - Quaternary in Southern Africa (Q)**
0900	0920	Martin Hipondoka	Optically Stimulated Luminescence (OSL) Dating of Sand-ridges Dynamics and the Evolution of Etosha Pan, Namibia (Q1)
0920	0940	Michael Meadows	Geomorphology and Quaternary Climate Change in Southern Africa (Q2)
0940	1000	Mark Bateman	On the formation of sand ramps: a case study from the Mojave desert (Q3)
1000	**1100**		**TEA BREAK**
1100	**1200**	**Chair: M Manjoro**	**Session 4 - Weathering and Soil Processes (WS)**
1100	1120	Paul Sumner	Rock weathering in southern Africa: review and personal perspectives (WS1)
1120	1140	Michael Loubser	The wetting and drying weathering process: a process isolation study (WS2)
1140	1200	Lesego Khomo	Controls on organic matter storage and turnover (WS3)
1200	**1300**		**Poster Session I (Chair: Student Volunteer)**
1300	**1400**		**LUNCH**
1400	**1540**	**Chair: I Meiklejohn**	**Session 6 - African Landscapes (AL)**
1400	1420	Roy Miller	Rodinian, Gondwanan and Cretaceous erosion surfaces and Cretaceous rivers in Namibia (AL1)
1420	1440	Charles Barker	Missing Surface Drainage in the Western Free State (AL2)
1440	1500	Tyrel Flügel	The mega-geomorphology of the Great African Divide (AL3)
1500	1520	Roger Swart	The Moxico Fan: a mega-fan in the interior highlands of Angola (AL4)
1520	1540	Natalie Haussmann	How well do physical geographers cite? (AL5)
1540	**1600**		**TEA BREAK**
0900	1900	All Day Event	**Workshop 2 - Field demo of DGPS, GPR and OSL**
1600	1900	Frank Eckardt	**Or Visit to Gravel Plain Saline Springs**
1600	1900	John Ward	**Or Visit to Kuiseb River**
1852		**Sunset**	
1900			**SUPPER**

Day 3 - September 11th

0700		**Sunrise**	
0800	**0900**		**BREAKFAST**
0900	**1020**	**Chair: C Barker**	**Session 7 - Rivers and Transport (RT)**
0900	0920	Kate Rowntree	Boulder transport during an extreme flood event in the Sneeuberg Mountains, Karoo, South Africa (RT1)
0920	0940	Bennie Van der Waal	Predicting sediment related habitat change in non-perennial river systems: a Geomorphological Response Model (RT2)
0940	1000	Louise Bryson	A conceptual understanding of sediment dynamics in South African catchments using a sediment flow model (RT3)
1000	1020	Rebecca Joubert	Understanding recent change in river-floodplain connectivity in the Baviaans catchment, Eastern Cape: implications for floodplain restoration (RT4)
1020	**1100**		**TEA BREAK**
1100	**1200**	**Chair: M Meadows**	**Session 8 - Catchments and Land Cover (CL)**
1100	1120	Vincent Kakembo	A classification of erosion features and characterisation of the physico-chemical soil properties in the Keiskamma catchment, Eastern Cape Province (CL1)
1120	1140	Jay Le Roux	Water erosion risk assessment in South Africa: towards a methodological framework (CL2)
1140	1200	Lindie Smith-Adao	Detailed mapping of historic geomorphic, vegetation and land cover changes along the Baviaanskloof River, South Africa (CL3)
1200	**1300**		**Poster Session II (Chair: Student Volunteer)**
1300	**1400**		**LUNCH**
1400	**1540**	**Chair: W Nel**	**Session 9 - Erosion Processes (E)**
1400	1420	Munyaradzi Manjoro	Recent changes in sediment sources in a catchment in the Eastern Cape Province, South Africa (E1)
1420	1440	Frank Mugagga	Soil erosion and conservation drivers on the slopes of Mt Elgon National Park, Eastern Uganda (E2)
1440	1500	Ryan Anderson	Topographic elevation and rainfall erosivity attributes on Mauritius (E3)
1500	1520	Ian Foster	The potential for gamma-emitting radionclides to contribute to an understanding of erosion processes in southern Africa (E4)
1520	1550	Werner Nel Jan Boelhouwers	**General SAAG Meeting** **SAAG 2012 Special Issue - Geografiska Annaler**
1550	**1600**		**TEA BREAK**
1600	1800		**Workshop 3 – Debrief: Dune Survey Techniques**
1852		**Sunset**	**Ceremony at Helga's Dune**
1900			**SUPPER**

Poster Sessions I and II in alphabetical order

Jussie Baade	Sediment yield in the Kruger National Park, South Africa – A comparison	P1
Jussie Baade	Sediment reconnaissance survey of the Wilderness Lakes, Southern Cape coast, South Africa	P2
Matthew Baddock	Sediment transport rates in the leeside of barchan dunes	P3
Mark Bateman	The Middle and Late Pleistocene Palaeoenvironment of the Modder River Valley, South Africa	P4
Stefni Bierman	The status and extent of Thufur disruption at Sani Pass, Lesotho Highlands	P5
Jan Boelhouwers	Temporal variations in rock surface temperature: Implications for thermal stress weathering in central Sweden	P6
Karabo Chadzingwa	The effects of the underlying geology and geomorphology on soil and vegetation characteristic: consequences for recovery of dam levels after a drought	P7
Rosie Dwight	Investigating rock hardness on a dolerite boulder, Komga, Eastern Cape.	P8
Carel Greyling	Palaeo-mass movements in the upper Injisuthi river valley, KwaZulu Natal Drakensberg	P9
Gareth Isenegger	Links between fur seals, geomorphology and vegetation assemblages on sub-Antarctic Marion Island	P10
Mikael Jonsson	Spatial variations of rock surface temperature: Implications for thermal stress weathering	P11
Jukka Käyhkö	Living with floods and droughts at the Angola/Namibia border – sustainable water resources in fluctuating climate in the Cuvelai catchment	P12
Nandipha Mabuza	An investigation of geomorphic connectivity in the middle reaches of the Baviaanskloof catchment, Eastern Cape , South Africa	P13
Asiphe Sahula	An Investigating the biological responses of freshwater shrimp (*Caridina nilotica*), to suspended sediment	P14
Daniel Schroeder	Bedload sediment fluxes along the Sand River, Oyster Bay headland bypass dunefield: Implications for sediment delivery to St Francis Bay	P15
Rona Schröder	Effects of rock surface temperature on rock hardness readings for the Equotip	P16
Roger Swart	Monitoring geomorphological changes in Namibia using historical and modern imagery	P17
Kathryn Vickery	Controls on dust emission in the lower Kuiseb River valley	P18

Workshop on Dryland Geomorphology

SAAG will host a workshop which will cover a range of cutting edge techniques relevant to drylands and beyond. It aims to demonstrate Differential GPS equipment, showcase Ground Penetrating Radar (GPR) equipment and introduce the use of a portable Optically Stimulated Luminescence (OSL) reader. The workshop is spearheaded by Professor Kevin White, a member of the British Society of Geomorphology (BSG) Working Group on Sand Seas and Dune Fields. The workshop has being supported by the Royal Geographical Society (RGS) and the International Association of Geomorphologists (IAG).

Day 1 - Dune Survey Techniques - Introduction

Sunday 9th September 2012: 16:30-18:30 hrs.

An introduction to dune survey techniques: Differential GPS for capturing dune elevation profiles (Kevin White). Using Ground Penetrating Radar to characterise dune sedimentary profiles (Charlie Bristow) and dating dune sands using Optically Stimulated Luminescence techniques (Mark Bateman).

The session will provide the theoretical background to the work that will be undertaken during the field workshop on the following day. There will also be a chance to look at the equipment and see how it is used. This workshop is open to all SAAG attendants.

Day 2 - Dune Survey Techniques – All day fieldwork

Monday 10th September 2012: 0900-19:00 hrs. Venue Warsaw Dune

Field demonstration of DGPS, GPR and OSL data collection on Warsaw dune, about 6 km south of Gobabeb in the Namib Sand Sea. A chance to have some hands-on experience with the equipment (Kevin White, Charlie Bristow, Mark Bateman, Ian Livingstone, Giles Wiggs, Matthew Baddock). This is a full day event. Due to logistical constraints this is largely targeted at selected students.

Day 3 - Dune Survey Techniques - Debriefing

Session 3: Tuesday 11th September 2012: 15:40-17:30 hrs.

A chance to see the data collected on Warsaw Dune the previous day, and to discuss data processing issues, methods of data presentation, etc. (Kevin White, Charlie Bristow, Mark Bateman). This workshop is open to all.

NS1: Introduction to the Namib Digital Dune Atlas

K. White (1), I. Livingstone (2), J.E. Bullard (3), R.G. Bryant (4), M. Bateman (4), C. Bristow (5) A. Baas (6) and G. Wiggs (7)

(1) Department of Geography and Environmental Science, The University of Reading, UK
(2) Graduate School, The University of Northampton, UK
(3) Department of Geography, Loughborough University, UK
(4) Department of Geography, University of Sheffield, UK
(5) Department of Earth and Planetary Sciences, Birkbeck College, University of London, UK
(6) Department of Geography, King's College London, UK
(7) School of Geography and the Environment, Oxford University, UK

A digital atlas of the geomorphology of Namib sand sea in southern Africa has been developed. This atlas, stored as a geographic information system, incorporates a number of databases including a digital elevation model (ASTER and SRTM) and other remote sensing databases that cover climate (ERA-40) and vegetation (PAL and GIMMS). A map of dune types in the Namib sand sea has been derived from satellite imagery. The atlas also includes a collation of geochronometric dates, largely derived from luminescence techniques, and a bibliographic survey of the research literature on the geomorphology of the Namib dune system. Together these databases provide valuable information that can be used as a starting point for tackling important questions about the development of the Namib and other sand seas in the past, present and future. An example analysis using atlas data, of the morphometric properties of the Namib dunes, is presented as an example of how the atlas data can be used to test geomorphological hypotheses.

References:
Bullard, J.E., White, K. and Livingstone, I. 2011 Morphometric analysis of aeolian bedforms in the Namib Sand Sea using ASTER data. Earth Surface Processes and Landforms, 36, 1534–1549. DOI: 10.1002/esp.2189.

Livingstone, I., Bristow, C., Bryant, R.G., Bullard, J., White, K., Wiggs, G.F.S., Baas, A.C.W., Bateman, M.D. and Thomas, D.S.G. 2010 The Namib Sand Sea digital database of aeolian dunes and key forcing variables. Aeolian Research, 2, pp. 93-104. doi:10.1016/j.aeolia.2010.08.001.

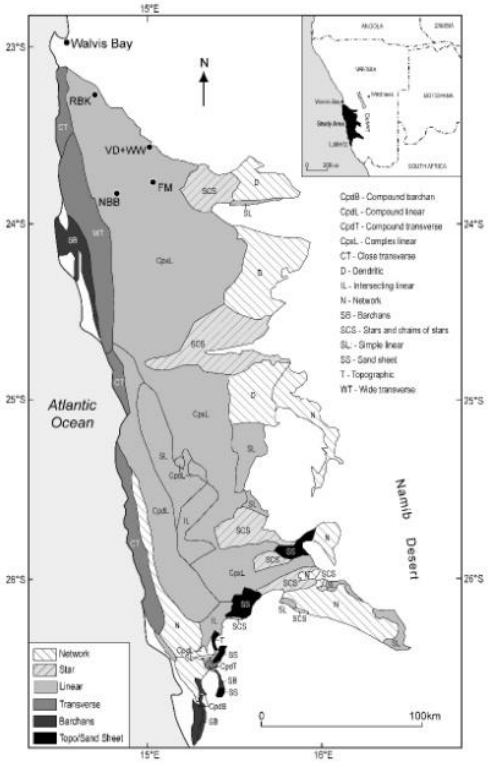

Figure 1: Dune type map from the Namib digital dune atlas

NS2: Thirty Years of Monitoring Surface Change on Namib Dunes

Ian Livingstone

School of Science and Technology, The University of Northampton, United Kingdom

Studies in the Namib Sand Sea have provided important information about the dynamics of individual dunes, and much of this information has been central to a wider understanding of the geomorphological development of global sand seas. Following an overview of single-dune studies in the Namib, this presentation will concentrate on the repeated surveys that have been carried out since 1980 at two sites on Visitors' Dune, a complex linear dune approximately 8 km south-east of Gobabeb. These surveys provide clear evidence that the dune is active and that its morphology changes in response to variability in the seasonal and annual wind climate.

References:

Bullard JE, White KH, Livingstone I 2011 Morphometric analysis of aeolian bedforms in the Namib sand sea using ASTER data. *Earth Surface Processes and Landforms* **36** 1534-1549.

Livingstone I 1989 Monitoring surface change on a Namib linear dune, *Earth Surface Processes and Landforms* **14** 317-332.

Livingstone I 2003 A twenty-one year record of surface change on a Namib linear dune, *Earth Surface Processes and Landforms* **28** 1025-1031.

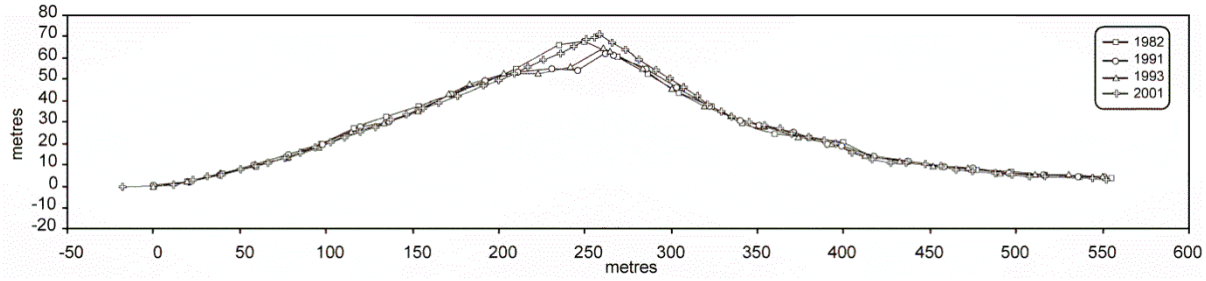

Figure: Cross profiles from repeated surveys of one of the transects on Visitors' Dune (from Livingstone 2003)

NS3: The age and migration of dunes in the Namib Sand Sea

C. Bristow (1), N. Lancaster (2) and G.A.T. Duller (3)

(1) School of Earth Sciences, Birkbeck University of London, Malet Street, London WC1E 7HX, UK
(2) Institute of Geography and Earth Sciences, University of Wales, Aberystwyth, Ceredigion SY23 3DB, UK
(3) Desert Research Institute, 2215 Raggio Parkway, Reno, Nevada 89512,

A review of the available optical dating of linear dunes in the Namib Sand Sea shows that the dunes which have been dated are all mid to late Holocene in age. These ages indicate that the linear dunes in the northern part of the Namib Sand Sea have been actively migrating during the Holocene leaving no evidence of relic Pleistocene dunes. A break in sand accumulation between 5200 BP and 2400 BP is attributed to a change in climate with an associated change in the prevailing winds, or an increase rainfall (Bristow et al 2007). Optical ages for linear dunes at the southern end of the sand sea reveal late Pleistocene (22.51 ± 1.41 to 15.6 ± 1.31 ka) and early Holocene (10.42 ± 0.66 to 8.79 ± 0.79 ka) sand accumulation (Bubenzer et al. 2007) with gaps that might be attributed to breaks in deposition but could also be attributed to dune migration. Optical ages for a star dune in the northeastern part of the Sand Sea include evidence for preservation of Pleistocene dune deposits at the base of a star dune. This new data shows that dunes were present in the Namib Sand Sea during the Pleistocene and can be preserved within the eastern part of the Sand Sea. They also appear to indicate the stability of a star dune relative to the linear dunes, such that the star dune contains a much longer record of aeolian dune activity than the linear dunes.

References:

Bristow, C.S. Duller, G.A.T. & Lancaster, N. (2007) Age and dynamics of linear dunes in the Namib Desert. Geology 35, 555-558.

Bubenzer, O. Bödeker, O. & Besler, H., (2007) A transcontinental comparison between the southern Namib Erg (Namibia) and the southern Great Sand Sea (Egypt). Zbl. Geol. Paläont. Teil 1, 7-23.

AD1: Etosha Pan: Dust source characteristics and emission controls

R.G. Bryant (1), Eckardt, F. D., (2) Vickery, K., (2) Hippondonka, M., (3) Murray, J. E., (4) and Abrhams, D. (1)

(1) Department of Geography, University of Sheffield, United Kingdom
(2) Department of Environmental & Geographical Science, University of Cape Town, SA
(3) Department of Geography, University of Namibia, Namibia
(4) Space and Atmospheric Physics, Imperial College, London, United Kingdom

Etosha Pan is a large endorheic ephemeral lake situated in the eastern part of Etosha National Park in the semi-arid north of Namibia. Etosha Pan sits in a basin 1000m amsl, has a surface area of approximately 5000 km^2 and is the centre of the Owambo Basin towards the inland interior of northern Namibia and Southern Angola above the Great Escarpment. This pan has been highlighted as one of the largest sources of Mineral Aerosol (dust) in the Sothern Hemisphere (Bryant, 2003; Mahowald et al., 2003). The dust cycle of major source regions can impact significantly on regional climate through a range of land/atmosphere interactions. Nevertheless our understanding of spatial and temporal controls on dust emission within this major source region, and their links to regional climate, are poorly understood. Multiple time series of remote sensing data are presented depicting aerosol concentration in the vicinity of the pan (either AI or AOT) and plume identification/location: (a) N7-TOMS (1980-1992), (b) EP-TOMS (1997-2000), (c) OMI (2004-2009), and MSG-SEVIRI (2004-2012; e.g. Vickery 2010). Seasonal characteristics of wind velocities and directions are presented, and together with detailed aerosol characterisation, these data depict a clear seasonality in dust emission and transport from the basin, significant inter-annual variability in aerosol loadings, and evidence of significant inter-event variability in plume chemistry. Important aspects of the spatial and temporal behaviour of the dust cycle of ephemeral lakes can often be related directly to controls on dust emission exerted by variability in shallow groundwater depth and periods of surface inundation (e.g. Mahowald et al., 2003; Bryant et al., 2007; Reynolds et al., 2007). An additional time-series of remote sensing data (AVHRR, SPOT-VGT, MODIS) recording seasonal trends in ground water levels and inundation within the Basin are presented for the period 1980-present. Generally (e.g. from 1983-2004) surface water was found to interact with < 30% of the pan surface and then often for relatively short periods (often < 3 months). Recently, however, Etosha Pan has experienced extensive periods of flooding and inundation (>80% basin cover, lasting for up to 12 months). Thus, data from extreme wet and dry periods over the last 20 years can be used in conjunction with records and locations of dust emissions for the same periods to examine links between dust emission and surface hydrology; thereby allowing, for the first time, a tentative characterisation of the emission potential of the pan surface.

References:

Bryant, R.G., (2003). Monitoring hydrological controls on dust emissions: preliminary observations from Etosha Pan, Namibia, Geographical Journal, 169(2) 131-141. doi:10.1111/1475-4959.04977

Bryant, R.G., Bigg, G.R., Mahowald, N.M., Eckhardt, F.D., and Ross, S.G., (2007). Dust emission response to climate in southern Africa. Journal of Geophysical Research - Atmospheres, 112, D09207. doi:10.1029/2005JD007025

Mahowald, N., Bryant, R.G., del Corral, J. and Steinburger, L. (2003). Ephemeral lakes and desert dust sources. Geophysical Research Letters, 30(2) 1074-1078. doi:10.1029/2002GL016041

Reynolds, R.L., Yount, J.C., Reheis, M., Goldstein, H., Chavez, P., Fulton, R., Whitney, J., Fuller, C., Forester, R.M., 2007. Dust emission from wet and dry playas in the Mohave Desert, USA. Earth Surf. Proc. Landf. 32, 1811–1827.

Vickery, K. J., (2010) Southern African dust sources as identified by multiple space borne sensors. Unpublished MSc Thesis, University of Cape Town

AD2: Dust emission dynamics and source area variability: field measurements for climate models

G.F.S. Wiggs (1), J. King (1), F.D. Eckardt (2), D.S.G. Thomas (1), R.G. Bryant (3), J. Nield (4), K. Vickery (2) and R. Washington (1)

(1) School of Geography and the Environment, Oxford University Centre for the Environment, United Kingdom
(2) Department of Environmental & Geographical Science, University of Cape Town, Rondebosch
(3) Department of Geography, University of Sheffield, Sheffield, United Kingdom
(4) Department of Geography and Environment, University of Southampton, United Kingdom

Climate models must account for aeolian dust in order to avoid large radiative and dynamical errors. The simulation of the dust cycle depends on a wide range of earth system components but begins with realistic representation of source areas. However, there are very few measured data from dust source regions and none of emission processes operating at model grid-box resolution. This paper introduces initial results from the Do4 Models (Dust Observations for Models) project that aims to understand the variability in dust emission processes at relevant scales for climate modelling and to evaluate the value added with source area measurement.

Data are presented from a field campaign across a 12 km x 12 km grid cell in Sua Pan, Botswana, from July to October 2011. 11 meteorological stations were deployed consisting of anemometer arrays, sediment transport detectors, high-frequency dust monitors, soil moisture meters, net radiometers, and shallow well networks. Further data were gathered across the grid on the dynamics of surface characteristics and erodibility parameters that impact upon erosion thresholds. Our data show for the first time the substantial variability in erodibility of an apparently homogenous surface in both time and space as a result of changing moisture and crustal characteristics, coupled with irregularity in erosivity due to variations in surface roughness. Such variability results in the identification of dust emission 'hot-spots' even within the area of a single regional climate model grid cell. This dataset provides a starting point from which to construct and test new dust emission schemes at scales relevant for climate modelling that incorporate the sensitivity of erosion thresholds to small changes in surface and atmospheric conditions.

AD3: A preliminary report on the chemistry, size and morphology of dust sampled from the Makgadikgadi Pans

K.J. Vickery (1), R. Washington (2), G.F.S. Wiggs (2), J. King (2), D.S.G. Thomas (2), R.G. Bryant (3), K. Gray (4) and F.D. Eckardt (1)

(1) Department of Environmental & Geographical Science, University of Cape Town, South Africa
(2) Oxford University Centre for the Environment, United Kingdom
(3) Department of Geography, University of Sheffield, Sheffield, United Kingdom
(4) Centre for Minerals Research, Department of Chemical Engineering, University of Cape Town, South Africa

Despite the increased awareness, our understanding of southern Africa dust remains rudimentary. To skilfully model and determine the role of aerosols in biogeochemical cycles, radiation budgets and predict future weather and climate, the morphology and chemical composition as well as the emissive behaviour of sources needs to be known. We present results for air and surface samples including chemistry, morphology and size analysis which were collected as part of DO4 (Dust Observation for Models).

Four BSNE trap samples as well as surface fluff sampled from within the 12 km^2 array were analysed using Malvern, QEMSCAN, ICP and XRD. The psd of the samples showed a fining trend with increased trap height from the lowest sample comprising of 20% clay and silt up to almost 30% in the highest trap. There was a strong bias towards entrainment of finer sediments relative to the fluff which comprised of only 12% silt and clay. QEMSCAN samples, split into 3 size fractions (-53 µm, 53-75 µm and 75-106 µm), were run against a comprehensive list of 255 minerals, with over 27 000 complete grains counted per sample. The results show that the dominant minerals are quartz, halite, thernardite mica, calcite and feldspar; further the relative contributions of these mineral vary only slightly by grain size and between samples both surface and airborne. QEMSCAN results correlated well with ICP and XRD analysis and illustrate the potential of QEMSCAN as an effective tool for multi-parameter analysis of dust.

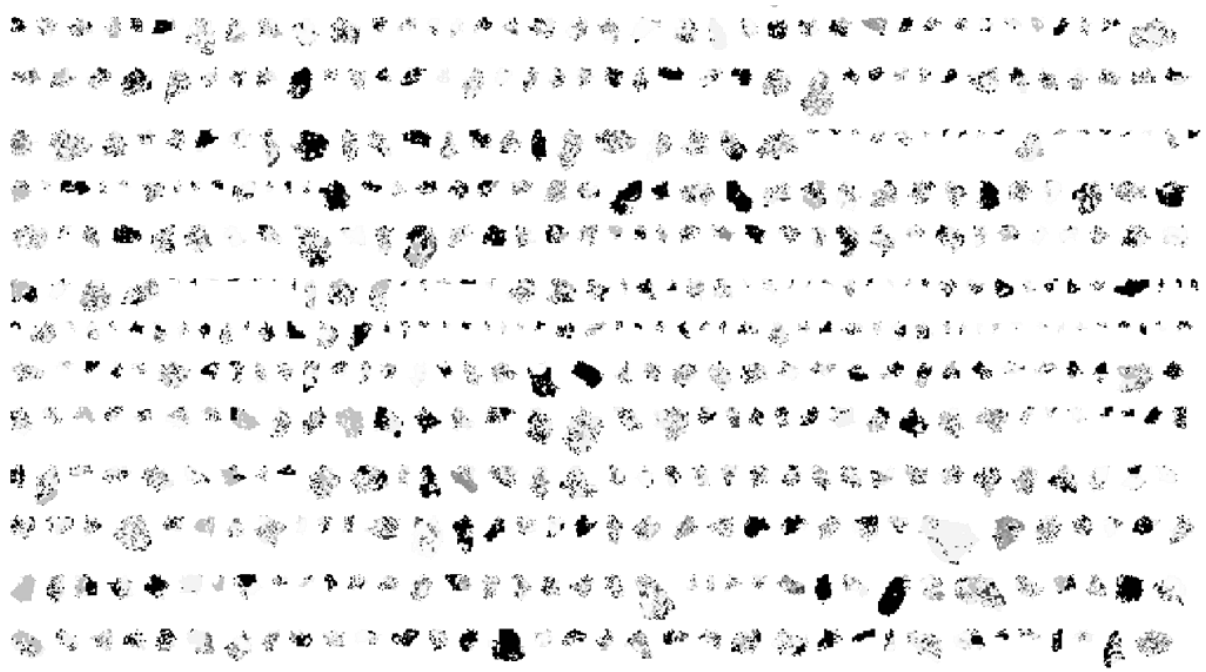

Figure showing the highly detailed output from QEMSCAN, plotting mineralogy to grains – from the I4F sample

A1: Active layer landforms and biological interactions in Western Dronning Maud Land, Antarctica

I. Meiklejohn (1), J.E. Lee (2), P.C. le Roux (2), and S.L. Chown (2)

(1) Department of Geography, Rhodes University, Grahamstown
(2) Centre for Invasion Biology, Stellenbosch University, Stellenbosch

The study considers how landscape processes affect environmental heterogeneity in the active layer of Western Dronning Maud Land, Antarctica. In turn, we consider the impact of environmental heterogeneity on patterns of biodiversity using two specific case studies, namely the distribution of the mite *Maudheimia wilsoni* and nine species of lichen. Maximum soil moisture content acconts for as much as 80% of the variance in the abundance of *M. wilsoni*. Higher moisture content in cracks at the boundaries of polygonal cracks results in a distinctive spatial distribution of the species. The second study shows that the weathering of bedrock and clasts in openwork blocky deposits provides a habitat for the colonisation of lichens. Feedback through biogenic weathering contributes to further weathering and the production of a substrate, which, in turn, provides a habitat for colonisation by mosses and invertebrate species.

References:
Lee, J.E., le Roux, P.C., Meiklejohn, K.I. & Chown, S.L. 2012,. Species distribution modelling in low-interaction environments: Insights from a terrestrial Antarctic system. *Austral Ecology. In Press*.

A2: Aspect Control on Weathering Observed on a Blockfield in Dronning Maud Land, Antarctica

C. Hansen

Department of Geography, Rhodes University, Grahamstown

Understanding the development of openwork block accumulations has the potential to further our understanding of rock weathering, the control of geological structure on landforms, the production of substrates for biological colonisation, and the impacts of climate change. Research into the morphology and characterisation of a blockfield was conducted on the Northern Buttress of the Vesleskarvet nunatak, Western Dronning Maud Land, Antarctica (2°W, 71°S). Aspect control on weathering and erosion on the blockfield was investigated during the 2010/11 and 2011/12 Austral summers by measuring rock hardness (using a Schmidt Hammer and an Equotip 3), orientation, dip as well as clast axis characteristics (length, orientation, dip). Findings showed that rock weathering is greatest on Vesleskarvet where snow cover is lowest and that snow may protect clasts in certain environments.

A3: A synoptic assessment of soil frost on Marion Island and the possible consequences of climate change in a maritime sub-Antarctic environment

W. Nel

Department of Geography and Environmental Science, University of Fort Hare

Marion Island (46˚ 54' S, 37˚ 45' E) is located in the sub-Antarctic which has a distinct periglacial environment that is sensitive to climate change. Diurnal soil frost is the most important geomorphic process occurring on the island and this paper aims to understand the synoptic weather circulation pattern associated with summer soil frost occurrence in a sub-Antarctic environment. Preliminary results from automated microclimate measurements in the interior of Marion Island show that summer soil frost is dependent on Antarctic air mass circulation. This occurs exclusively during post-cyclonic airflow after the passage of a cold front connected to a mid-latitudinal cyclone and subsequent ridging in of the South Atlantic Anticyclone behind the cold front, or when a series of low pressure systems passes over the island. The duration and intensity of soil frost cycles are dependent on the duration of post-cyclonic Antarctic air mass circulation. Summer soil frost on Marion Island is driven by a complex interaction between the latitudinal position of the passing cyclone, the latitudinal position of the ridging anticyclone as well as the trajectory of the air mass circulation. The data suggest that predicted trends in synoptic climate change in the sub-Antarctic may lead to non-linear responses in soil frost dynamics.

A4: Critical assessment of the 2^{o}C/min threshold for thermal shock weathering

Boelhouwers, J. and Jonsson, M.

Department of Social and Economic Geography, Physical Geography, Uppsala University, Sweden

Rock surface temperature changes in excess of 2^{o}C/min have been argued to result in permanent strain in rock, notably in cold regions. We critically assess this threshold value based on both empirical and theoretical considerations.

High temporal resolution rock surface temperatures from Antarctica and Sweden indicate high frequencies of threshold crossings during both warming and cooling phases on both fine- and coarse grained igneous rock. However, despite frequent occurrence of temperature changes at >2^{o}C/min, rock surface weathering on Swedish glacially polished and striated granite surfaces is all but absent at sites that have been sub-aerially exposed since 4 ka BP.

A pilot study on rock surface temperature mapping with a FLIR B50 IR camera shows large intra- and inter-granular temperature variations on the surface of medium-grained granite in central Sweden. Rates of temperature change over 2°C/5s are common with adjacent cells obtaining temperature gradients in excess of 2°C/mm. Spatial temperature patterns appear closely related to rock minerals: greater spatial and temporal variance is found at mineral centres compared to their boundaries, as well as across mineral boundaries.

Despite the high rates of temperature change measured we reject the use and supposed importance of a rate of 2^{o}C/min as a critical value for permanent strain. This is based on i) lack of empirical basis for this value, ii) contrasting results from acoustic emission studies, iii) varying strength properties of different rock types, iv) lack of actual strain resulting from short-term temperature variations, v) lack of corroborating field evidence. Based on the presented discussion the role of thermal shock in cold regions is questioned and renewed emphasis is placed on the importance of absolute temperature and combined measurement of temperature and calculation of resulting strain. We further highlight the potential of spatial thermal strain analysis at various scales by use of IR camera.

A5: Pronival ramparts: modes of genesis and diagnostic criteria

D.W. Hedding

Department of Geography, University of South Africa, Florida

Actively-forming pronival ramparts are discrete debris accumulations found below steep cliff faces at the foot of snowbeds or firn fields in periglacial and glacial environments. When relict, pronival ramparts can easily be confused with moraines, protalus rock glaciers and mass movement debris accumulations. The misidentification of pronival ramparts can be attributed to the poor understanding of modes of rampart genesis, the failure to recognise the significance of topography in rampart development and the inappropriate use of existing diagnostic criteria. Various diagnostic criteria have been suggested by several authors. Unfortunately, many diagnostic criteria stem from research on relict features and research on actively-forming pronival ramparts has shown that certain of the existing diagnostic criteria are no longer deemed useful. This presentation will review the suggested diagnostic criteria of pronival ramparts and demonstrate, using examples from southern Africa, how diagnostic criteria have been used incorrectly in the past.

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Q1: Optically Stimulated Luminescence (OSL) Dating of Sand-ridges Dynamics and the Evolution of Etosha Pan, Namibia

M.H.T. Hipondoka (1), B. Mauz (2), S. Packman (2), J. Bloemendal (2), R Chiverrell (2) and J Kempf (3)

(1) University of Namibia, Private Bag 13301, Windhoek, Namibia.
(2) Roxby Building, University of Liverpool, Liverpool L69 7ZT United Kingdom
(3) Institut für Geographie und Geologie, Julius-Maximilians-Universität Würzburg, Am Hubland, 97074 Würzburg, Germany

Previous studies on sand ridges in and around Etosha Pan, Namibia, concluded that the pan formed courtesy of aeolian deflation. Islands in the pan were regarded as remnants of that deflation process, while sand ridges on the pan's fringes represented depositional end member. To assess this theory, we sampled sediments of two islands, the pan floor, and the inner and intermediate sand ridges on the fringes of the pan. Dated sediments using Optical Stimulated Luminescence (OSL) technique were taken from the upper 20-60 cm, 180 – 240 cm and 430 cm depth. Results show that some of the upper surface ages among these features marginally overlap. Sediments taken from 180 - 240 cm depth revealed that the inner sand ridge is the youngest (3.46 ± 0.23 ka), followed by islands (4.70 ± 0.28 ka) while the next sand ridge further inland from the pan margin is oldest (21.56 ± 2.09 ka). This oldest age overlaps with the 18.94 ± 1.29 ka age derived from sediments of the upper surface of the pan floor. Coupled with geomorphic assessment, these ages diagnostically point to sand ridges at Etosha Pan as shorelines displaying a hallmark of transgressive and regressive sequences, which is a common feature for hydrologically-closed lakes. The current configuration of the Etosha Pan is therefore related to the waning and waxing of its water body and that its current playa status is a consequent of climate forcing, neo-tectonic and low gradient of its upstream channels.

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Q2: Geomorphology and Quaternary Climate Change in Southern Africa

M.E. Meadows

Department of Environmental & Geographical Science, University of Cape Town, Rondebosch 7701, South Africa.

The concept of change through time is fundamental to an understanding of landscapes and the processes that form them. Indeed, landforms – both individually and in groups - are manifestations of the complex set of relationships between underlying geological structure and a range of temporally variable environmental processes. Thus, geomorphology is more than the simple description of contemporary landscapes and processes; as a science it must seek explanations as to how changing environmental conditions have influenced processes over time and left their imprint on the landscape. This chapter explores the evidence for such changes, the legacy of geologically recent climate changes on the southern African landscape and the relevance of this to an understanding of how geomorphology may respond to future environmental changes, more especially those invoked through human activity. Without doubt, the answer to questions as to how landscapes will adjust to climate changes of the future lies in a more thorough understanding of the past, and southern Africa is no exception.

Q3: On the formation of sand ramps: a case study from the Mojave Desert

M.D. Bateman(1), R.G. Bryant (1), I. Foster (2,3), I. Livingstone (2) and A.J.Parsons(1)

(1) Sheffield Centre for International Drylands Research, Winter Street, Sheffield S10 2TN, UK.
(2) School of Science and Technology, The University of Northampton, Northampton NN2 6JD, UK.
(3) Geography Department, Rhodes University, Grahamstown 6140, Eastern Cape, South Africa.

Sand ramps are dune-scale sedimentary accumulations found at mountain fronts and consist of a combination of aeolian sands and stone layers resulting from other geomorphological processes associated with hillslope and fluvial activity. Their complexity and their construction by wind, water and mass movement means that sand ramps potentially hold a very rich store of palaeoenvironmental information. However, before this potential can be realised a full understanding of their formation is necessary.

Our new work based on the evidence from the Soldier Mountain sand ramp in the Mojave desert, that their formation appears strongly controlled by a 'window of opportunity' when sediment supply is plentiful and cease to develop when this sediment supply diminishes and/or the accommodation space is filled up. Contemporary observations of stone movement indicate movement rates in insufficiently fast to explain how stone horizons could have been moved across and been incorporated into sand ramps on multiple occasions. Stone horizons found within the aeolian sediments lack evidence for soil development and are interpreted as very short-term events in which small streams moved and splayed discontinuous stone horizons across the sand ramp surface before aeolian deposition resumed.

Our study suggests that sand ramps cannot easily be interpreted in terms of a simple model of fluctuating palaeoenvironmental phases from aeolian dominated to soil/fluvial/colluvial dominated episodes. As a result their palaeoenvironmental significance and indeed how sand ramps are distinguished from other dune forms requires amendment.

WS1: Rock weathering in southern Africa: review and personal perspectives

P.D. Sumner (1) and K.I. Meiklejohn (2)

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

Weathering studies in southern Africa over the past two decades are reviewed, including contributions to defining the contemporary weathering environment, the use of weathered products in palaeoenvironmental interpretations, experimental or laboratory studies and applied weathering. Given the involvement of South African-based geomorphologists, studies on sub-Antarctic Marion Island are also considered. Although the southern African climate is diverse, rock temperature data from different locations can be remarkable similar. Few field data on rock moisture and the control of rock properties have been forthcoming while laboratory studies and simulations have been relatively rare. Studies on Marion Island demonstrate an apparently active weathering environment but rates appear to be very slow. Weathering within palaeoenvironmental studies has emphasised a climatic approach to landform interpretation and has not significantly advanced our understanding of process-product relationships. In contrast to this "consumer" approach, applied weathering studies provide the best opportunities for "producers" of weathering knowledge but the scalar linkage associated with explaining landforms remains a challenge. Downscaling of field methods in applied studies, such with the weathering of rock art, has also emphasised this scale disparity and further highlighted the disassociation of weathering process from climate. Revising our conceptual approach by placing emphasis on the role of rock properties in the context of energy transfer and product removal may provide a platform for future studies.

WS2: The wetting and drying weathering process: a process isolation study

M.J. Loubser

Department of Geography, Geoinformatics and Meteorology, University of Pretoria, South Africa

A process isolation study for the wetting and drying weathering process was conducted on a variety of basalts and sandstones over a period of 5 months. The physical properties (porosity, micro-porosity, saturation co-efficient, water absorption capacity, mass, surface hardness) of the samples were determined at the beginning and end of the 5 month experimental period and compared. In spite of extreme care taken during the experimental procedure, the results differed considerably from what was expected. These differences are believed to have been caused by a suite of weathering processes that operated within the system at a very low level of intensity. The results measured were thus a synergistic combination of an array of weathering processes rather than just the single process that was the object of the study (wetting and drying). The questions that must be asked are therefore: is a process isolation study physically possible or will these local variances always interfere, and if this is the case, how then should weathering studies proceed in future?

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WS3: Controls on organic matter storage and turnover

L. Khomo (1), S. Trumbore (2), C. Bern (3), and O. Chadwick (4)

(1) Botany Department, University of Cape Town, Rondebosch
(2) Max-Planck Institute, Jena, Germany
(3) USGS, Denver, USA
(4) UC California, USA

Soil organic matter (OM) is stabilized by different mechanisms depending on environmental conditions. In Brazilian oxisols, OM is bound to iron oxides while in Hawaiian andisols, OM is bound to non-crystalline minerals. Oxisols and andisols are end-members in a litho-climosequece consisting of wet felsic and wet mafic soils respectively. What stabilizes OM in felsic to mafic soils under arid (450 mm) to sub-humid (740 mm) MAP? We use a six-soil lithosequence of rhyolite (felsic) to picrite (mafic) under 450 mm MAP in Kruger Park. More OM was stored in mafic soils (6 %), this OM had the slowest turnover of about 2000 years as estimated by radiocarbon. Felsic soils had less than 1 % OM with a 300 to 800 year turnover. We identified two controls on OM storage and turnover, OM quality and secondary mineral concentration and composition. OM quality was indexed by the c:n ratio and delta13C, both indicate the degree of microbial processing of carbon. The oldest OM, in mafic soils, was the most processed implying that decomposition in those soils was limited by low nitrogen. Mafic soils also had the highest concentrations of extractible Fe and Al, combined with the greatest amount of 2:1 clays, all properties which increased OM persistence due to strong bonds and adsorption onto material with large surface areas. Therefore the storage and turnover of carbon in a variety of parent materials and climates can be explained by decomposition and fixation onto clays and Fe and Al oxi-hydroxides.

AL1: Rodinian, Gondwanan and Cretaceous erosion surfaces and Cretaceous rivers in Namibia

R. McG. Miller

Consulting Geologist, Windhoek, Namibia

Remnants of the highly planar, pre-Nama erosion surface of latest Rodinian age are still preserved just south and southwest of Helmeringhausen and in the Duwisib area west of Maltahöhe. Similarly, bevelled hill tops west of Khorixas represent remnants of the Gondwanan, pre-Karoo surface. Prominent ridges of vertically dipping basal Damara arkoses of the Nosib Group south and east of Windhoek have relatively uniform elevations of 1650 to almost 1800 m over several 10s of kilometres. In places, gaps in these otherwise continuous ridges are utilised by present-day rivers. The gaps may represent old Dwyka glacial valleys that flowed south off the Windhoek Highlands. The bevelled ridge tops and a few isolated inselbergs with similar elevations may be the only remnants of the beveled pre-Karoo surface that is now well above the surrounding African Surface(?) plains in this area. The elevations of these remnants can readily be extended to the beveled 1900 m and 2000 m elevations of the extensive Eros Mountains and the Khomas Hochland east and west of Windhoek, respectively. However, the lack of obvious glacial valleys in these two latter regions makes ascribing an age to the bevel problematic.

None of these re-exhumed pre-Cretaceous surfaces nor any of the other high-elevation mountains and mountain ranges in Namibia retain even the slightest remains of the African Erosion Cycle regolith. The regolith must have been extensive but without a protective capping, it has been removed by subsequent erosion. The deeply weathered regolith is preserved in at least three regions in Namibia: (i) below a capping of Kalahari gravels cemented by pedogenic calcrete in the Weissrand of the Mariental area and south thereof, (ii) below silcrete in the Sperrgebiet, and (iii) below the groundwater calcrete of the Etosha Calcrete Formation north of Kamanjab. Red clay of variable thickness capping Karoo basalt in northeastern Namibia may also represent the African Surface regolith. The bevels of the Eros Mountains and the Khomas Hochland may represent composite Gondwana-Cretaceous surfaces. The Namibia bedrock bevel north of the end-Cretaceous Sperrgebiet silcretes (as distinct from younger and very local silcretes associated with small pan deposits) is considered to represent a lower elevation African Surface. High rainfall during the warm and wet Cretaceous hothouse cut river systems up to 300 m deep into the pre-Kalahari basement. One of these was the palaeo Aranos River of southeastern Namibia which flowed into the palaeo Kalahari River and thence into the palaeo Orange River. The deep Cretaceous weathering also produced thin regolith profiles on erosion terraces deep down in the Aranos River basin. The thick Cretaceous section in the Orange Basin offshore attests to this high Cretaceous rainfall and Cretaceous erosion of the interior of Southern Africa. Another river system arose south of Grootfontein, flowed initially in a northeasterly direction, turned north in the area east of the Otavi Mountainland and then took a turn to the northwest into the Owambo Basin. Drilling has not penetrated deep enough to locate the outlet of this river.

AL2: "Missing" Surface Drainage in the Western Free State

CH Barker

Department of Geography, University of the Free State, Bloemfontein, South Africa

A casual inspection of topographic maps covering the western Free State region (secondary catchments C4, C5, C6 and part of C9) shows a lack of well developed and integrated surface drainage compared to the well developed, dendritic patterns to the east of the study area. The primary aim of the investigation is to determine reasons for this phenomenon.

The research is based on modelled surface drainage from a digital terrain model compared to the distribution of *inter alia* mapped streams, land types, lithology and pans. Different scenarios, based on various landscape evolutionary models from literature, were created to relate the current directional trends of streams and the longest axis of pans to postulated drainage patterns. The paper reports on results obtained from various models to determine the possible location of the "original" drainage and consequently hypothesise on the development of the western Free State landscape.

It is the author's contention that sandy material transported from the north-west, covered existing drainage disrupting the "normal" course of main streams thus contributing significantly to the formation of the pans which currently exist in the area.

AL3: The mega-geomorphology of the Great African Divide

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

(1) AEON, Department of Environmental & Geographical Science, University of Cape Town, Rondebosch
(2) AEON, Geoecodynamics Research Hub, c/o Dept Botany and Zoology, University of Stellenbosch, Stellenbosch

Africa has a unique bi-modal topography of which approximately two thirds of Africa is of low elevation (< 600 m.a.m.s.l) with the remaining third having a mean elevation > 1000 m.a.m.s.l. The Congo-Zambezi watershed occurs in an area where a rapid change from low elevation (~ 400 m.a.m.s.l) to high elevation (~ 1100 m.a.m.s.l) is observed. This watershed divides the world's 2nd (Congo) and 21st (Zambezi) largest rivers in terms of volume. Understanding the evolution of these large rivers and their associated tributaries is of fundamental importance when investigating landscape evolution in south-central Africa.

Profiles from the Congo and Zambezi basins are presented to highlight the contrast of the topography of south-central Africa. The morphology of these rivers preserves evidence for formative events in the recent evolution of the landscape and, by extension, episodes that have reshaped the surfaces of bi-modal Africa.

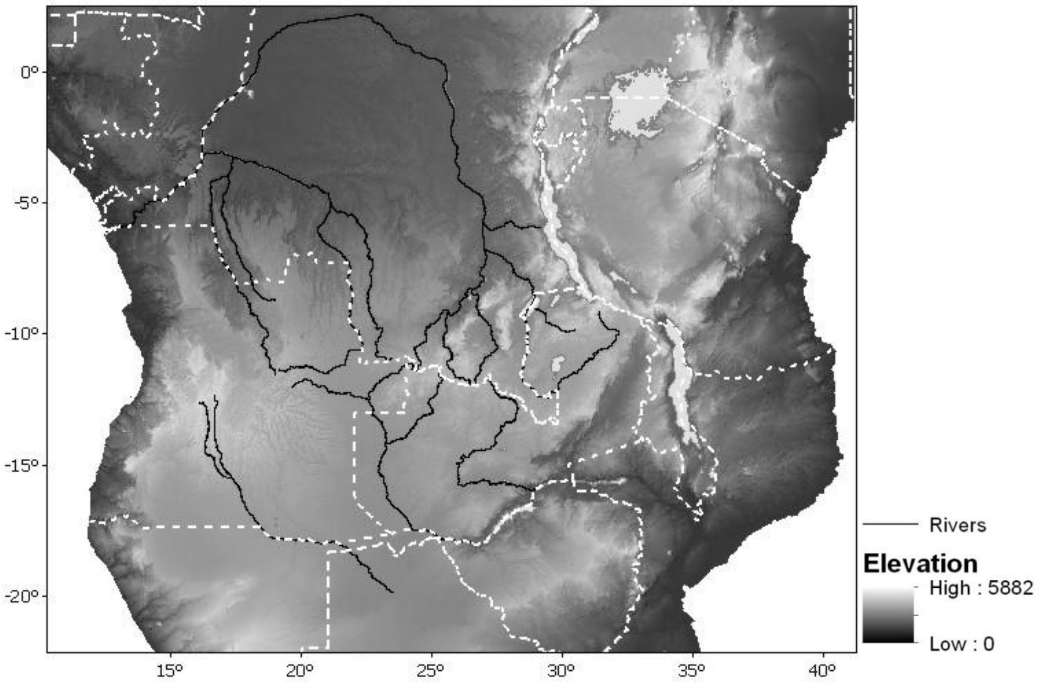

Figure: South-central Africa showing studied rivers. Rivers flowing northward form part of the Congo Basin (average elevation ~ 400 m.a.m.s.l(and rivers flowing southward are part of the Zambezi drainage basin (average elevation ~ 1000 m.a.m.s.l).

AL4: Moxico Fan: a mega-fan in the interior highlands of Angola

R. Swart

BlackGold Geoscience, P.O. Box 24287, Windhoek, Namibia

The interior highlands of Angola are a major water sump for southern Africa: several major rivers either have their source in this area or major tributaries are derived from these highlands. These rivers include the Kwanza, Kunene, Cuvo, Okavango/Cubango, Casai, Zambezi and Congo.

The advent of digital topographic data, both regional and detailed, as well as affordable software for visualising this data has enabled new overviews and understanding of the nature of these highlands. Colour shading at 50m intervals has shown the presence of a south-east facing mega-fan which covers an area of over 270,000 sq km. The fan is over 670km wide and 450km long. Maximum heights of the fan above the regional land surface are in the order of 300m. Major rivers such as the Cubango have incised into the surface of this fan but a series of cross- sections clearly shows the overall concave-up morphology of the fan. Existing geological mapping shows that the sediment cover is Cretaceous-Cenozoic in age. This fan has been termed the Moxico Fan after the region in Angola in which much of the fan occurs.

A major fan such as this must have had significant relief to the north-west where the sediments where derived from. The north-east trending edge of the fan Is coincident with an extension of the offshore Benguela-Lucapa fracture zone. This is also coincident with a zone of kimberlite intrusions.

More work needs to be done to understand the nature of how the fan is built, timing of this sedimentation and the nature of the source rock and the uplift.

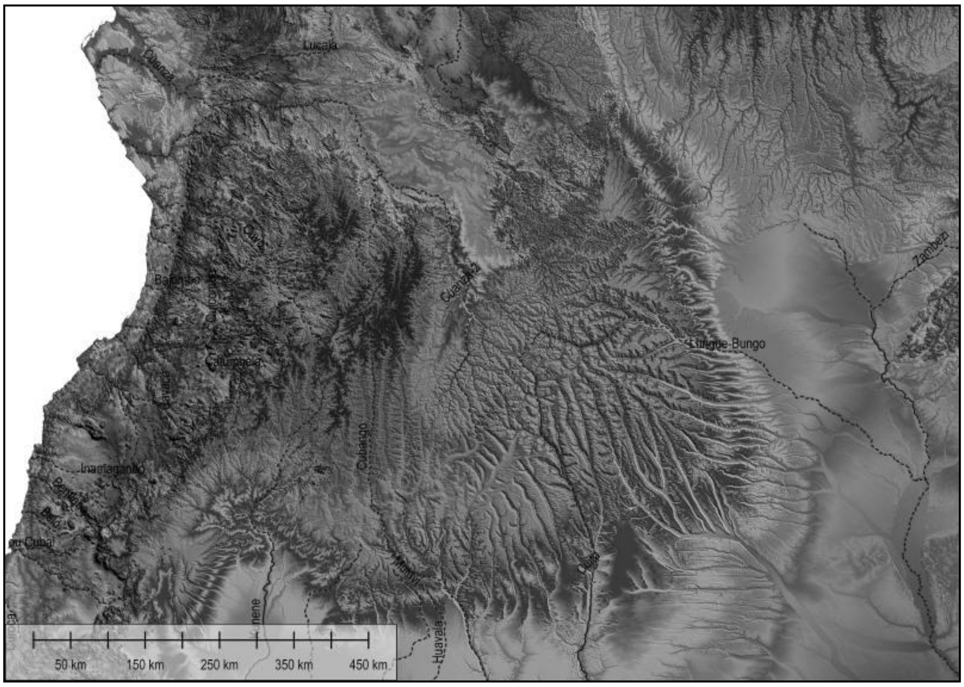

Figure: DEM of central Angola showing the Moxico Mega-fan and some of the major river systems sourced from this area. The DEM is colour coded at 50m intervals to enhance small variations in topography. The DEM was created using SRTM data and GlobalMapper software.

AL5: How well do physical geographers cite?

N.S. Haussmann (1), A.J. Bumby (2), M.J. Loubser (1) and T. McIntyre (3)

(1) Department of Geography, Geoinformatics and Meteorology, University of Pretoria
(2) Department of Geology, University of Pretoria
(3) Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria

Sloppy citation practices can be annoying. Miscitations not only provide a disservice to authors and readers alike (Gavras, 2002), but can also hamper scientific progress within a field. Accurate citation practices are therefore important, both from an ethical and a scientific point of view. To quantify citation accuracy in physical geography, we followed the methods of Todd et al. (2007). Six papers from all journals listed under “Physical Geography” in the Thomson Reuters ISI Web of Knowledge Science Citation Index were downloaded (120 papers in total). From each of these papers (the primary papers), a reference was randomly selected from the reference list and the statement that it was supporting was searched for within the primary paper’s text. The refereed secondary papers were read by all four authors, who subsequently classified the appropriateness of the citation according to four categories: clear support, no support, ambiguous and empty citation (when the cited article simply cites other articles that support an assertion). The final decision on a citation’s appropriateness was determined by the classification of the majority, with the verdict being in favour of the primary article’s authors if there was any doubt. Preliminary results show that approximately 12% of citations offered no support to the statements they allegedly support. A further 22% were ambiguous and 9% were empty. In total therefore, more than 40% of citations in physical geography are not entirely appropriate. This result is both concerning and surprising when compared to other fields (see Todd et al., 2007).

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RT1: Boulder transport during an extreme flood event in the Sneeuberg Mountains, Karoo, South Africa

K.M. Rowntree

Department of Geography & Catchment Research Group, Rhodes University, South Africa

On 9th February 2011 an extreme rainfall event over the Compassberg Mountain in the Sneeuberg of the eastern Karoo gave rise to severe flooding. A flood wave of ~5 m deep broke an in-channel storage weir on Ganora farm, causing large blocks from the weir wall to be carried downstream and deposited over a 500 m reach, providing an opportunity to map the transport of large boulder sized material. The blocks consisted either of irregularly shaped concrete containing large cobble aggregate or of shaped quartzite blocks. Thirty five blocks were recovered below the weir two months after the flood. For each block, the a, b and c axes were measured, the location identified using a GPS and the travel distance estimated by plotting the points on Google Earth. The volume of each block was estimated from the dimension measurements, taking account of the observed shape of the block, and the mass was determined by assuming the specific gravity of concrete to be 2.403 and of quartzite to be 2.7. The largest block, estimated to weigh 20 tonnes, travelled a distance of 28 m from the weir. The furthest distance at which a block was recovered was 509 m for a shaped quartzite block weighing 0.19 tonnes. The relationship between distance moved and block weight can be expressed by a power relationship with a coefficient of determination of 0.51. These findings provide evidence that large bed material can be transported significant distances during a single extreme flood event, especially in sediment rich water. Large volumes of silt, sand and fine gravel would have been released when the weir broke, allowing 'rafting' of large material down the channel.

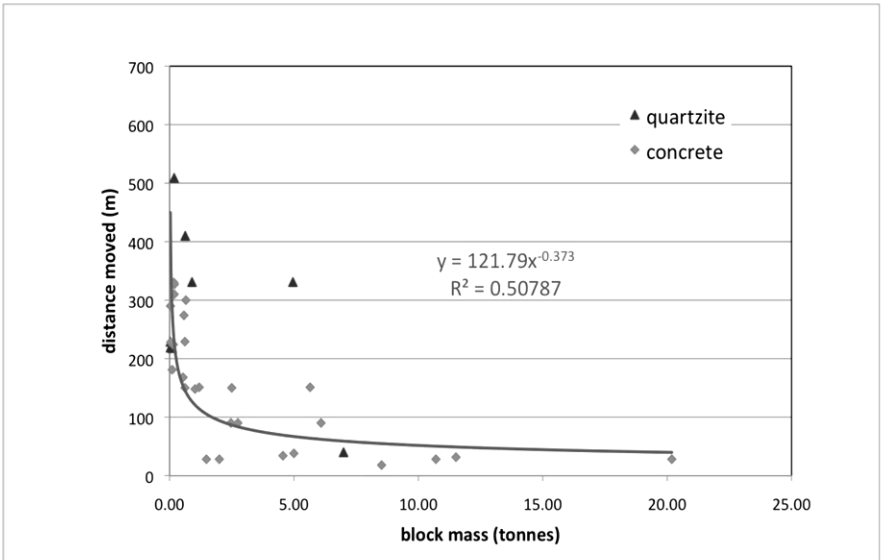

Figure: Block movement below the broken weir at Ganora farm.

RT2: Predicting sediment related habitat change in non-perennial river systems: a Geomorphological Response Model

B.W. van der Waal (1) and K.M. Rowntree (1)

(1) Geography Department, Rhodes University, South Africa

Protection of aquatic ecosystems is a legal requirement emanating from the water laws of many countries globally and in Africa. Methods to assess environmental flows are being developed and applied throughout the world, with an emphasis on perennial rivers. South African scientists are addressing environmental flow needs for non-perennial rivers by developing a Decision Support System that integrates expert knowledge into a decision support system, based on mathematically defined response curves. Geomorphologists play a key role in predicting the long-term change in ecosystem structure following water related developments. In this paper we explain the process whereby we are developing geomorphic response curves that can be used to predict habitat related channel change in rivers for which there is limited hydrological or geomorphological data.

RT3: A conceptual understanding of sediment dynamics in South African catchments using a sediment flow model

L.K. Bryson (1,2), D.A. Hughes (1) and K.M. Rowntree (2).

(1) Institute for Water Research, Rhodes University, Grahamstown
(2) Department of Geography, Rhodes University, Grahamstown

Increased sediment concentrations in rivers and sediment deposition in reservoirs have significant implications for land and water resources in South Africa. A simple sediment flow model that can work in data poor environments would be an important tool by providing a conceptual understanding of sediment dynamics in catchments.

A simple sediment model is proposed for catchments in South African which extends previously developed sediment models through the addition of a scientifically based sediment delivery module that takes account of changing connectivity within a catchment. The model will provide information at temporal and spatial scales that reflect the timing and pattern of sediment movement in response to rainfall events. The Pitman hydrological model will be used to predict the runoff from those peak rainfall events that in turn would provide flood peaks for use in the sediment model. The Modified Universal Soil Loss Equation (MUSLE) will be used to determine the spatial distribution of soil erosion in the catchment. A sediment delivery component will be developed to route sediment from hillslope sources to the final reservoir sink.

The sediment flow model will be calibrated for two small catchments in the Karoo and the model will be verified against this extensive historical sedimentation record. The sediment flow model will also be calibrated for larger catchments in South Africa where flow and sediment records are available.

The conceptual framework for the sediment flow model will be presented, indicating the methods proposed for the sediment flow model. Leading on from this a quantitative model of the sediment flow will be developed.

RT4: Understanding recent change in river-floodplain connectivity in the Baviaans catchment, Eastern Cape: implications for floodplain restoration

R. Joubert (1), W.N. Ellery (1) and K. Rowntree (2)

(1) Department of Environmental Science, Rhodes University, Grahamstown
(2) Department of Geography, Rhodes University, Grahamstown

The concept of landscape connectivity broadly refers to the degree of hydrological and sedimentary linkage between different landscape compartments (e.g. hillslope-channel and channel-floodplain linkages); in river catchments, connectivity determines the ease with which sediment is transferred through a catchment and the response (erosion or deposition) of rivers to disturbances (Brierley *et al*., 2006). Recent (last 30 - 40 years) channel incision along a reach of the Baviaans River, in the Eastern Cape of South Africa, has resulted in dis-connectivity between the river and adjacent floodplain through reduced over-bank flooding together with effective channelling of water and sediments away from the main floodplain during flood events. This has resulted in floodplain wetland desiccation and decreased capacity of the river to attenuate flood flows and provide water to local and downstream communities. In this study we investigate the role of human and natural disturbances in driving recent channel incision and floodplain degradation in the Baviaans catchment, and the role of connectivity in determining river response. Preliminary findings suggest that changes in catchment land-use (and associated land cover), human engineering of the main river and tributary streams, and changing rainfall regimes have been important in promoting recent channel incision. We also suggest that the response of the river (through channel incision) to these disturbances has been determined by the nature and degree of connectivity between the main river and large tributary streams along the degraded floodplain reach. These findings have been important for appraising planned floodplain restoration strategies for the Baviaans catchment.

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CL1: Classification of erosion features and characterisation of the physico-chemical soil properties in the Keiskamma catchment, Eastern Cape Province

V. Kakembo (1) and P. Mhangara (1)

(1) Geosciences Department, Nelson Mandela Metropolitan University

Soil erosion is a widespread environmental problem in many catchments of the Eastern Cape Province. The Keiskamma is one of the catchments characterised by severe land degradation associated with soil erosion, thicket degradation and deteriorating riparian vegetation. There is a close coupling between land use/cover dynamics and degradation trends witnessed in the catchment. In the present study, Object Oriented classification of satellite imagery was used to map soil erosion features and valley infill in ephemeral stream channels as a means of demonstrating the major sediment transfer processes operating in the Keiskamma catchment. The Mahalanobis distance method was used to compute the topographic thresholds for gully erosion. To understand the effect of soil characteristics in severe forms of erosion, laboratory analyses were undertaken to determine the physico-chemical soil properties.

The classification of erosion features and valley infill showcased the vegetation enrichment in the ephemeral streams which is occurring at the expense of high soil losses from severe gully erosion on the hillslopes. This in turn has led to an inversion of grazing patterns within the catchment, such that grazing is now concentrated within the ephemeral stream channels. Soil chemical analyses revealed a high sodium content and low soluble salt concentration, which promote soil dispersion, piping and gully erosion. The presence of high amounts of illite-smectite in the catchment also accounts for the highly dispersive nature of the soil even at low SAR values. Significant amounts of swelling 2:1 silicate clays such as smectites cause cracking and contribute to the development of piping and gullying in the catchment. Measures to curb environmental degradation in the Keiskamma catchment should encompass suitable ecological interventions that are sensitive to the socio-economic challenges facing the people in communal areas.

CL2: Water erosion risk assessment in South Africa: towards a methodological framework

J.J. Le Roux

Department of Geography, Geoinformatics and Meteorology, University of Pretoria, South Africa

With the increase in human impacts on the environment, especially in terms of agricultural intensification and climate change, there is a need to assess and continually monitor the erosion process and contributing factors. In most countries, however, especially in developing countries such as South Africa, there is an absence of standardized methodological frameworks that deliver comparable results across large areas as a baseline for regional scale monitoring. Due to limitations of scale at which techniques can be applied and processes assessed, this study implemented a multi-process and -scale approach to support establishment of a methodological framework for South African conditions. The approach includes assessment of (i) sheet-rill erosion at a national scale based on the principles and components defined in the Universal Soil Loss Equation, (ii) gully erosion in a large catchment located in the Eastern Cape Province by integrating eleven important factors into a GIS, and (iii) sediment migration for a research catchment near Wartburg in KwaZulu-Natal by means of the Soil and Water Assessment Tool. A methodological framework with three hierarchical levels is then presented for South Africa. The framework illustrates the most feasible erosion assessment techniques and input datasets for which sufficient spatial information exists, and emphasizes simplicity required for application at a regional scale with proper incorporation of the most important factors. The framework is not interpreted as a single assessment technique but rather as an approach that guides the selection of appropriate techniques and datasets according to complexity of the erosion processes and scale dependency.

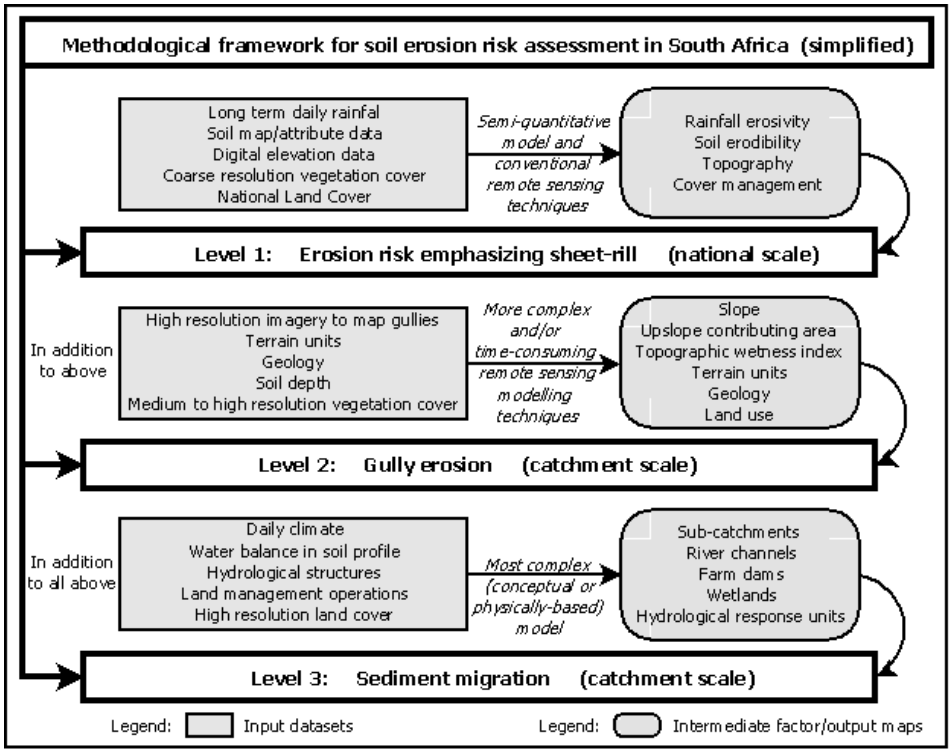

Figure 1: Methodological framework for soil erosion risk assessment in South Africa (simplified).

CL3: Detailed mapping of historic geomorphic, vegetation and land cover changes along the Baviaanskloof River, South Africa

L. Smith-Adao (1,2), K. Rowntree (2) and J. Nel (1)

(1) CSIR, Natural Resources and the Environment, PO Box 320, Stellenbosch 7599, South Africa
(2) Rhodes University, Geography Department, PO Box 94, Grahamstown, 6140, South Africa

River system function and structure are strongly linked to the catchment of which they are a part off. Catchment controls (e.g. geology and climate) and channel controls (e.g. flow discharge and sediments) are important in controlling channel morphology. The former determine the runoff and sediment regime of the river while the latter control the stability of the channel. Catchment factors control the rates of hill slope erosion and the potential for sediment storage in the system. Channel factors determine sediment entrainment and transport which is directly related to stream power, the product of discharge and channel gradient. Together these two sets of control mechanisms determine geomorphic form and process within a spatiotemporal context. However, many present-day problems in fluvial geomorphology require a historical view. Dealing with these problems necessitate an understanding of how a system has adjusted and evolved over space and time, otherwise the ultimate controls on and changes to the system will not be fully captured. In this study three sets of historical aerial photographs (1960 to 2007), supported by field checks, are used in a GIS spatial analysis to document the geomorphic, land cover and vegetation changes of the Baviaanskloof River catchment, Eastern Cape Province. Mapping was limited to an unconfined study site in the valley. This study aims to examine the relationship between fluvial styles, valley floor morphology and vegetation distribution patterns in a semi-arid environment. The methods and procedures that were used to collate the data are briefly described, together with the study results.

E1: Recent changes in sediment sources in a catchment in the Eastern Cape Province, South Africa

M. Manjoro (1), K. Rowntree (2), V. Kakembo (3) and I.D.L. Foster (4)

(1) Department of Geography and Environmental Sciences, North West University, South Africa
(2) Department of Geography, Rhodes University, South Africa
(3) Geosciences Department, Nelson Mandela Metropolitan University, South Africa
(4) Department of Environmental and Geographical Sciences, University of Northampton, United Kingdom

In view of addressing the severe soil erosion and sedimentation challenges facing many catchments in South Africa, there is increasing recognition of the need to include sediment control strategies within catchment management. Information on the potential catchment sediment sources and their temporal variation is important if an integrated understanding of the impacts of land use and climate change on catchments is to be achieved and to help targeted measures for soil erosion and sediment control. Statistically verified composite fingerprints and a multivariate fingerprinting procedure incorporating Monte Carlo simulations were used to reconstruct sediment source dynamics in the floodplain of the Mgwalana Catchment in the Eastern Cape, South Africa between 1950 and 2010. The study showed that grassland (grazing) areas have consistently been a major source sediment for the floodplain since the 1950s (40 - 83%), followed by abandoned cultivated land (37 - 40%). Since 1965 the contributions from abandoned and cultivated land peaked slightly, although grassland areas still remained the dominant sediment source. The results were consistent with observations from other studies in relation to the impact of livestock grazing on soil erosion in the Eastern Cape. In terms of surface/subsurface sources, the general long term trend showed that surface sources (57%) were slightly more dominant than subsurface sources (43%). However, the contributions from subsurface sources showed a consistently growing trend since 1965. This trend indicates an increase in the importance of gully erosion from late the 1960s. This information should be considered as a significant advance in our understanding of the sediment source dynamics in the catchment.

E2: Soil erosion and conservation drivers on the slopes of Mt Elgon National Park, Eastern Uganda

F. Mugagga (1) M. Buyinza (2) and V. Kakembo (3)

(1) Department of Geography, Geo Informatics and Climatic Sciences, Makerere University, P O Box 7062, Kampala, Uganda
(2) Directorate of Research and Graduate Training, Makerere University, P O Box 7062, Kampala Uganda
(3) Department of Geosciences, Nelson Mandela Metropolitan University, P O Box 77000, Port Elizabeth, South Africa

Most soil erosion forms including mass wasting, gullies and rills occur mainly on steep cultivated land (Mugagga et al., 2012). Recent studies have characterized soils on Mt Elgon slopes as vertic, which are extremely susceptible to erosion, particularly debris and mudflows (Mugagga et al., 2011; Mugagga et al., 2012). This paper investigates the main soil conservation drivers and techniques employed on the slopes of Mt Elgon. Primary data were obtained through household interviews, observations, and field measurements conducted in Tsekululu Sub County, Bubulo County, Manafwa District, Eastern Uganda between May and August 2008. The sampled parishes were stratified according to their distance from the Park boundary.

Cultivation onto the critically steep slopes (36º – 58º) was noted to have induced a series of shallow and deep debris flows in the area. The most common soil conservation techniques in the area include structural measures like terraced farming, construction of water ways, check dams, retention walls and gull controls. Farmers have also adopted different biological measures including alley cropping, bamboo plantation in gullies, mulching and applied organic and inorganic fertilizers to control soil erosion. However, adoption of conservation techniques by park adjacent communities is constrained by land tenure insecurity. It is recommended that Collaborative Forest Management Initiatives addressing the security of park adjacent communities be formulated and implemented in the area. Success thereof will be achieved if the politicians, Park Authorities and local communities jointly participate in their design and implementation.

References:

Mugagga, F., V. Kakembo., M. Buyinza. (2011): Land use changes on the slopes of Mount Elgon and the implications for the occurrence of landslides. *Catena* (2011), doi:10.1016/j.catena.2011.11.004

Mugagga. F., V. Kakembo., and M. Buyinza (2011): A Characterization of the Physical Properties of Soil and the Implications for Landslide occurrence on the Slopes of Mount Elgon, Eastern Uganda. *Natural Hazards*. DOI: 10.1007/s11069-011-9896-3

E3: Topographic elevation and rainfall erosivity attributes on Mauritius

R.L. Anderson (1), P.D. Sumner (1) and W. Nel (2)

(1) Department of Geography, Geoinformatics and Meteorology, University of Pretoria, South Africa
(2) Department of Geography and Environmental Science, University of Fort Hare, South Africa.

The tropical island of Mauritius is subject to frequent erosive rainfall events due to its location and elevated central topography. Occasional cyclones also potentially threaten loss of soil and may accelerate land degradation. Rainfall erosivity plays an important role in determining the "R-factor" in the USLE and RUSLE equations, which are commonly used in determining the soil loss of an area. The 30-minute erosivity index (EI_{30}) was used to calculate erosivity from rainfall recorded at 6-minute intervals at five automated Mauritius Meteorological Services rainfall stations for the period 2003 – 2008. A contrast is drawn between the elevated central interior, with annual rainfall around 4000mm, and the rain-shadowed western lava plains of the island where 600mm of rainfall falls per year. Stations on the western plains recorded 25% of the erosivity experienced by stations in the interior and large differences were found in the number of erosive events, erosive rainfall totals, and seasonality of erosivity between the west and the interior. Three methodologies used in calculating EI_{30} were compared and it was found that set 30-minute intervals do not identify the peaks of event intensities found when using shorter-period resolution data. The Modified Fournier Index (which uses monthly and daily rainfall data) was also used to calculate erosivity. Compared with the EI_{30} method (using 6-minute interval data) MFI overestimates rainfall erosivity due to the high rainfall totals received annually, particularly in the wet central interior.

E4: The potential for gamma-emitting radionclides to contribute to an understanding of erosion processes in southern Africa.

I.D.L. Foster (1,2), K.M. Rowntree (2), J. Boardman (3) and T.M. Mighall (4)

(1) School of Science & Technology, University of Northampton, Northampton, UK
(2) Department of Geography, Rhodes University, Grahamstown, South Africa.
(3) Environmental Change Institute, Oxford University, Oxford, UK
(4) Department of Geography & the Environment, University of Aberdeen, Aberdeen, UK

Several early studies pointed to the fact that ^{137}Cs could be detected in soils and sediments in southern Africa (e.g. Kulander & Stromquist, 1989; Owens & Walling, 1996). Despite the relatively low southern hemisphere fallout of this predominantly nuclear weapons-testing derived isotope, few studies have continued to explore the potential for ^{137}Cs and other gamma-emitting radionuclides to be used for understanding erosion processes and erosion history. For the last 9 years, we have been evaluating the potential for ^{137}Cs and ^{210}Pb to be used for constructing chronologies in a range of depositional environments including dryland and permanently flooded reservoirs and hillslope fan and floodout deposits. We have also explored the potential for short-lived cosmogenic and other long-lived primordial nuclides to act as sediment fingerprints to aid in reconstructing changes in sediment sources in the same range of depositional environments.

This paper will review the evidence to date and evaluate the potential, and limitations, of a range of gamma-emitting radionuclides to be used for understanding and managing erosion and land degradation problems in southern Africa.

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Kulander, L. &, Stromquist, L. (1989) Exploring the use of top-soil ^{137}Cs content as indicator of sediment transfer rates in a small Lesotho catchment. Zeitschrift fur Geomorphologie, 33, 455–462.

Owens, P.N. & Walling, D.E. (1996) Spatial variability of ^{137}Cs inventories at reference sites: an example from two contrasting sites in England and Zimbabwe. Applied Radiation Isotopes. 47,699–707.

P1:Sediment yield in the Kruger National Park, South Africa – A comparison

J. Baade (1)

(1) Department of Geography, Friedrich-Schiller-Universität, Jena, Germany

Human-induced soil degradation is a wide spread phenomenon in South Africa and soil erosion rates reported are among the highest in the world. In addition to human disturbance, unfavorable environmental conditions are mentioned to explain the situation. But data on 'natural' erosion from undisturbed sites are rare. This poster presents an assessment of sediment yield as an integrate measure of soil erosion, deposition and sediment transport from five catchments located entirely within Kruger National Park (KNP). KNP has been spared from agricultural development for a century and represents a near to natural geo-ecosystem in the semi-arid savanna biome. Sediment yield estimates are based on a survey of reservoir deposits in the south-eastern KNP. Reservoir life time ranges from 40 to 60 yrs and the size of the catchments from 8 to 100 km^2. The result show distinct relations of long-term average sediment yield (SY) and area-specific sediment yield (SSY) with catchment size. Other drivers of erosion, like soil properties, relief and vegetation show no major impact. But this might be an artifact of the proximity of the selected reservoirs. Sediment yield in south-eastern KNP can be considered low when compared to other reservoir data from South Africa (Rooseboom et al. 1992) and the World. SY varies from 130±45 t yr^{-1} for the 8 km^2 catchment to 1,130±230 t yr^{-1} for the 100 km^2 catchment. SSY is 55±15 t km^{-2} yr^{-1} for catchments of 12±3 km^2 and 11±2.4 t km^{-2} yr^{-1} for the 100 km^2 catchment (Baade et al. 2012).

References:
Baade, J., Franz, S. & Reichel, A. (2012) Reservoir siltation and sediment yield in the Kruger National Park, South Africa: a first assessment. - Land Degradation and Development. [doi:10.1002/ldr.2173, available online 2012-06-26].
Rooseboom, A., Verster, E., Zietsman, H.L. & Lotriet, H. (1992) Sediment transport in rivers and reservoirs - *A Southern African perspective*. Water Research Commission Report 297/1/92. Sigma Beta Consulting: Stellenbosch.

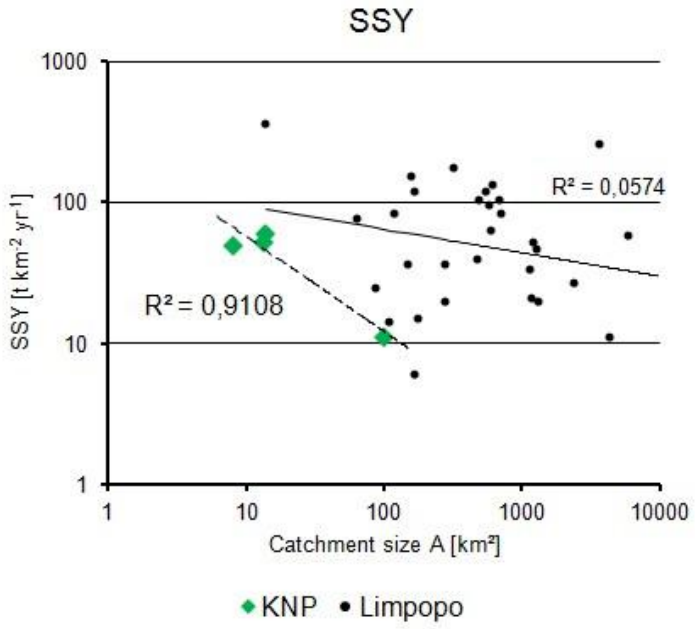

Figure: Comparison of area-specific sediment yield (SSY) for KNP reservoir catchments and reservoir catchments in the Limpopo basin (Limpopo data from Rooseboom et al. 1992)

P2: Sediment reconnaissance survey of the Wilderness Lakes, Southern Cape coast, South Africa

J. Baade (1), B. Reinwarth (1), S. Franz (1), T. Haberzettl (1), T. Kasper (1), G. Daut (1), K. Kirsten (2), L. Quick (2), M.E. Meadows (2), and R. Mäusbacher (1)

(1) Physical Geography, Institute of Geography, Friedrich-Schiller-University Jena, Germany
(2) Department of Environmental & Geographical Science, University of Cape Town, Cape Town, South Africa

The southern Cape coast between George and Knysna provides a unique combination of climatic and geomorphic properties. It is located in the rather small year-around rainfall belt characterized by mountain fynbos vegetation. Geomorphologically the coastal plain is made up of sub parallel dune cordons with intercalated depressions holding wetlands and lakes. Within the framework of a bilateral German-South African research project a sediment reconnaissance survey was conducted at Eiland-, Ronde-, and Swartvlei during which short gravity cores (< 1 m) were recovered. In the laboratory, sedimentological and geochemical properties of these cores were investigated.

Radiography and grain size distribution which were analysed in 1-cm-intervals show distinct variations in all records (Fig. 1). These are most likely caused by variable runoff and sediment fluxes from the catchments. Despite considerable differences of the studied ecosystems the sedimentary records exhibit some similarities. In the upper 0.4 m, the cores from Eiland- and Swartvlei show a clear decrease in mean grain size. It is hypothesized that this is attributable to increased sediment yield from the catchment following changes of vegetation patterns pre-dating the arrival of European settlers. Strengthened fining in the upper 0.2 m, rising concentrations of Al and decreasing concentrations of elements supposedly characterizing marine input, like B, Ca and Sr indicate an intensified minerogenic sediment yield to the lakes. These recent changes were most likely caused by land use induced soil erosion and other anthropogenic impacts in the 20th century. Further investigations, e.g., pollen analysis, are necessary to scrutinize these preliminary interpretations.

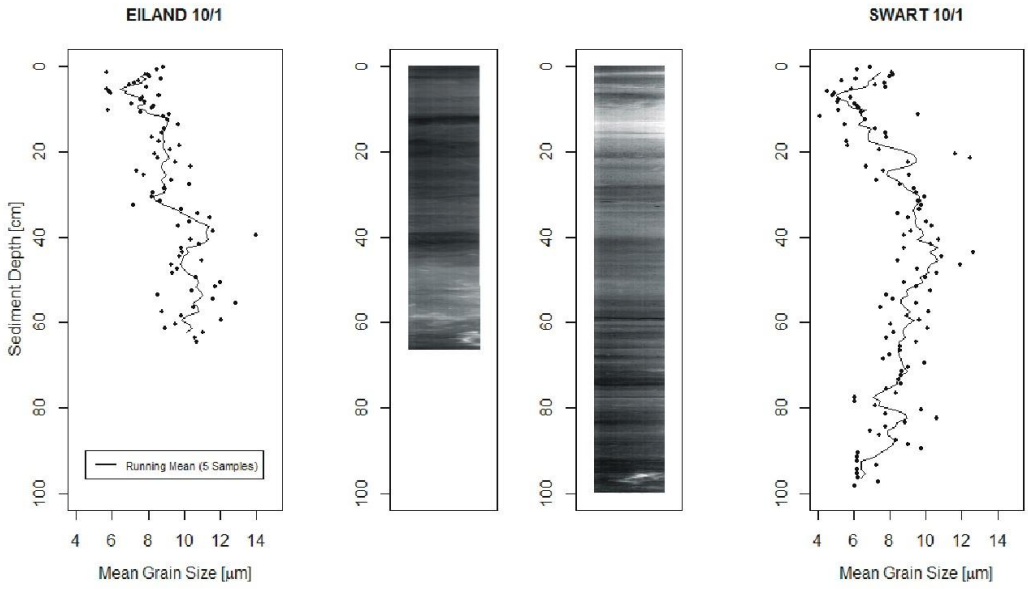

Figure 1: Radiography and mean grain size for the Eilandvlei (left) and Swartvlei (right) sediment records

P3: Sediment transport rates in the leeside of barchan dunes

M.C. Baddock (1), I. Livingstone (2) and G.F.S. Wiggs (3)

(1) Atmospheric Environment Research Centre, Griffith University, Australia
(2) School of Science and Technology, The University of Northampton, United Kingdom
(3) School of Geography and the Environment, Oxford University, United Kingdom

Understanding the interactions between migrating dune forms such as the merging, calving and spawning exhibited by mobile bedforms is a topic attracting considerable debate and enquiry in contemporary aeolian geomorphology.

For barchans, a suite of interactions between migrating dunes has been recognised. Interactions occur as dunes of different sizes move at different rates, and smaller, faster upwind dunes 'catch up' and then begin to influence larger, slower downwind dunes. The airflow and sand transport patterns within the space separating a pair of interacting bedforms are of primary interest for interaction dynamics, but measurements of process data remain rare for this geomorphologically significant region.

This research reports and discusses the implications of variations in sand transport rates measured in the lee of barchan dunes from the Skeleton Coast dunefield of Namibia. The crosswind and downwind patterns and pathways of sand transport in the lee of isolated barchans were observed, and these are compared to the situation for a pairing of linked barchan dunes, where the downwind bedform was aligned to an upwind dune horn. In the latter case, the transfer of sediment via the horn from related upwind to downwind dune is quantified for given wind conditions.

P4: The Middle and Late Pleistocene Palaeoenvironment of the Modder River Valley, South Africa

M.D. Bateman(1), B. Bousman(2,3), J. Brink(4,5),H. Meier(5), G. Trower(4), R. Grün(7), D.l Codron(8,4), L. Rossouw(9), C. Bronk Ramsey(10), S. Thornton-Barnett(2) and L. Scott(11)

(1) Sheffield Centre for International Drylands Research, Geography Department, University of Sheffield, UK
(2) Department of Anthropology, Texas State University-San Marcos, USA
(3) GAES, University of the Witwatersrand, Johannesburg, RSA
(4) Florisbad Quaternary Research Department, National Museum, Bloemfontein, RSA
(5) Centre for Environmental Management, University of the Free State, Bloemfontein, RSA
(6) Department of Geology, Baylor University, Waco, USA
(7) Research School of Earth Sciences, Australian National University, Canberra, AUS
(8) Clinic for Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, CH
(9) Department of Archaeology, National Museum, Bloemfontein, RSA
(10) Oxford Radiocarbon Accelerator Unit, University of Oxford, UK
(11) Department of Plant Sciences, University of the Free State, Bloemfontein, RSA

Long-term palaeoenvironmental records are rare in southern Africa but extremely important in learning about Middle and Late Pleistocene human activities and adaptations as well as environmental shifts in response to climate changes. Where these records exist they often require careful analysis to understand the true palaeoenvironment fluctuations due to intrinsic bias incorporated in them by their mode of preservation and nature of deposition, e.g. cave deposits, spring mounds. Here we report on new analysis and dating of Middle Stone Age (MSA) and Later Stone Age (LSA) occupations at the Erfkroon site in the western Free State's Modder River valley. A number of terraces have been identified with the oldest terrace, dating to the Middle Pleistocene, containing fossilized faunal remains and occasional artifacts. Numerous MSA and LSA artifacts are found in the two Late Pleistocene terraces that span the period from at least 120 ka to 10ka. Faunal remains occur throughout the terrace deposits. Partially articulated *Equus capensis*, *Megalotragus priscus* and *Damaliscus niro* skeletons were recovered in a lower unit of a Late Pleistocene terrace, while in an upper unit of the same terrace human processed remains of plains game, such as *Connochaetes gnou*, *Megalotragus priscus*, *Equus capensis* and *Phacochoerus* sp., are abundant. Stable isotope and phytolith results indicate widespread C_4 plant environments except for a brief period in the Late Pleistocene at the LGM when there is a marked shift to C_3 plant communities including C_3 grasses. These results provide new information on Late Pleistocene climatic fluctuations in the grassland biome, the dual nature of wetland and open plains Florisian faunal species, and modern human adaptations in the interior grasslveld.

P5: The status and extent of Thufur disruption at Sani Pass, Lesotho Highlands

S. Bierman

Department of Geography, Geoinformatices and Meteorology, University of Pretoria

Thufa fields are common in the Lesotho Highlands of Southern Africa. The standard parameters for thufa development have been widely studied in different environments but few studies report on break-up or disintegration of these features. Field observations and measurements made in a tributary valley of the Sani River provide information on the present condition and extent of disintegration of thufa. Investigations done by Grab (1994) in the Mohlesi Valley in Lesotho provide a baseline for this study. Some of the observations made in the Mohlesi Valley differ from the observations made in the Sani River area. Observations and measurements indicate that thufa break-up is an active process in the vicinity of Sani Pass and can be contributed to factors such as extent of slope drainage, animal activity, effects of seasonal ice, surface water, influence of needle ice, altitude, slope angle and orientation.

Reference:

Grab, S.W., (1994), Thufur in the Mohlesi Valley, Lesotho, Southern Africa, *Permafrost and Periglacial Processes,* 5, 111-118.

P6: Temporal variations in rock surface temperature: Implications for thermal stress weathering in central Sweden

Boelhouwers, J. and Jonsson, M.

Department of Social and Economic Geography, Physical Geography, Uppsala University, Sweden

This study tests the hypothesis that high rates of temperature change (dT/dt) at the grain scale can result in granular disaggregation in medium-grained granite in middle Sweden. We use two empirical approaches. First, a high resolution, year-round record of rock surface temperatures is measured at 10s interval. Second, long-term grain-scale surface weathering is assessed on glacially polished rock surfaces.Over the period 4-28 June 2012 rock surface temperatures reached just over 40^{o}C, with warming/cooling rates >> 2^{o}C/min of 10s duration (2mm) for 10-16% of time, rapidly decreasing to 0% at 10min interval (15mm). Values show a high theoretical potential for grain scale thermal stress weathering. In contrast, observations of post-glacial weathering of glacially polished bedrock (exposed 6.5ka BP) show pitting of ca 3mm. Other Nordic studies report surface lowering of ca 0.2mm ka^{-1}.
We conclude that dT/dt >2^{o}C/min does not lead to observable strain or long-term weathering effects in the Nordic environment. Based on results from previous acoustic emission studies, we attribute this primarily to the limiting role of absolute temperature, the Kaiser effect and highly resistant bedrock.

P7: The effects of the underlying geology and geomorphology on soil and vegetation characteristic: consequences for recovery of dam levels after a drought

K. Chadzingwa

Department of Geography, Rhodes University, South Africa

At the end of the year 2010, it was evident that Grahamstown had experienced a low rainfall year. Settlers dam, whose wall was increased by 2.3m in 1981 (Haigh *et al.,*2008), was extremely dry well into 2011, especially in comparison to its adjacent catchment of Howieson's Poort. This project was aimed at answering two questions: The first: To determine the reasons for the low levels of water in the two dams, Settler's and Howieson's Poort, at the beginning of 2011. The second: To investigate why there was a long lag time between rainfall at the beginning of 2011 and the filling up of Settler's Dam. There is a larger amount of shale stretching across the catchment of Settlers, which is the predominant rock type. However, Howieson's Poort has a combined geological composition of both sedimentary rocks-Shale and Sandstone, thus comparatively, it has more sandstone than the Settlers' Dam catchment. The Normalized Difference Vegetation Index (NDVI) was used as the measure of photosynthetic activity. There was extremely high photosynthesis of between 200 and 300 in the Settler's Dam Catchment, which means that over the years of 2010 and 2011, there was a greater increase in Settler's dam catchments' vegetation. Grahamstown has extremely variable rainfall patterns, but was dominated by coastal frontal type rain more than short-lived thunderstorms between December 2010 and August 2011, which resulted in increase infiltration and decreased runoff.

Factors such as geology, slope angle and altitude, rainfall variability as well as vegetation were found to have influenced the recharge of the dam.

P8: Investigating rock hardness on a dolerite boulder, Komga, Eastern Cape

R. Dwight

Department of Geography, Rhodes University, Grahamstown

Rock weathering is an important component of the rock cycle; it generates sediment and provides habitats for biodiversity. A measure of past weathering is rock hardness. A study was conducted on a dolerite boulder near Komga in the Eastern Cape, South Africa. A three-dimensional relief model of the boulder was developed using a differential Global Positioning System and interpolation in a Geographical Information System. Rock hardness was measured using an Equotip 3 and a Schmidt Hammer to determine the relationship between aspect and rock weathering processes. The rock hardness data were interpolated and draped over the relief model and analysed to determine spatial tendencies. Although some variation was found in measurements from each instrument, the north and north-east facing sides of the boulder were softer, indicating preferential weathering on these aspects. It is suggested that the more dynamic thermal and moisture regimes on the northern aspects resulted in accelerated weathering.

P9: Palaeo-mass movements in the upper Injisuthi river valley, KwaZulu Natal Drakensberg

C. Greyling and P. Sumner

Department of Geography, Geoinformatics and Meteorology, University of Pretoria

Few large deep-seated paleo-mass movements has been documented in the KwaZulu Natal Drakensberg but their existence appears to be ubiquitous, particularly in the slopes underlying the basalts. Such mass movements are hypothesised to have resulted from river incision and slope oversteepening subsequent to Mio-Pliocene tectonic uplifts. This study assess the occurrence and the distribution of paleo-mass-movements in a section of the Injisuthi river valley in the central region of the KZN Drakensberg. Four probable paleo-mass-movement sites were first identified through the use of aerial photography. The sites were discovered by identifying typical features such as, river deflection and valley constraint, direction of river segment flow and topographic structure. Through in-field observations further evidence was found, such as the nature of the regolith, bedrock structure and slope drainage derangement. A map of each site is presented, detailing the characteristics of the paleo-mass-movements.

P10: Links between fur seals, geomorphology and vegetation assemblages on sub-Antarctic Marion Island

G.D. Isenegger (1), N.S. Haussmann (1) and T. McIntyre (2)

(1) Department of Geography, Geoinformatics and Meteorology, University of Pretoria
(2) Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria

Examples from sub-Antarctic South Georgia show that fur seals have a notable impact on local vegetation and fresh water systems (Bonner, 1985). Although fur seals have also been noted to impact on indigenous vegetation on Marion Island and its neighbour, Prince Edward Island (Ryan et al., 2003), this impact has not been formally quantified. This study therefore aimed to investigate associations between Antarctic and sub-Antarctic fur seals, geomorphology and vegetation assemblages on Marion Island. Automated cameras were used to record the spatial and temporal distribution of fur seals in specific seal colonies, where fur seals haul out to breed and moult. Geomorphic maps were composed of these areas and the distribution of all vascular plant species, including invasives, was determined by extensive vegetation analyses. Lastly, a GIS tied the three components (fur seals, vegetation and geomorphology) of the study together, by overlaying seal density, vegetation assemblage and geomorphology maps with one another. Preliminary results show high seal activity at both sites. In addition, seals seem to occur disproportionately often in very localised areas displaying a hummocky topography (as also noted by Boelhouwers et al., 2008) and dominated by the tussock grassland habitat and species such as *Poa cookii*, *Cotula plumosa* and *Agrostis stolonifera.*

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Bonner, W.N. (1985) Impact of fur seals on the terrestrial environment at South Georgia. In: Siegfried, W.R., Condy, P.R., Laws, R.M. (Eds.) Antarctic nutrient cycles and food webs. Springer Verlag, Berlin, pp. 641-646.

Ryan, P.G., Smith, V.R. & Gremmen, N.J.M. (2003) The distribution and spread of alien vascular plants on Prince Edward Island. African Journal of Marine Science, 25: 555-562.

P11: Spatial variations of rock surface temperature: Implications for thermal stress weathering

Jonsson, M. and Boelhouwers, J.

Department of Social and Economic Geography, Physical Geography, Uppsala University, Sweden

Mechanical weathering of rocks by means of temperature variations caused by the sun, often called insolation weathering, is often debated in relation to the rate of change at a few measurement points at or below rock surface. This temporal focus, where usually the suggested 2 °C/minute threshold for permanent strain acts as a key in the argument, means that the investigation of the spatial aspect of temperature stress is lacking in extent.

The aim with this study is to use an infrared camera to explore spatial variations of temperature. In addition to testing and developing the methodology of computer aided IR image processing for thermal stress analysis, three hypotheses are tested: Does insolation cause greater strain closer to (i) the rock edges, (ii) temperature gradients between surface minerals, or (iii) west-easterly temperature gradients during the day?

The results confirm the three hypothesizes and show that spatial analysis of thermal stress by use of thermography has a potential to extend and develop the existing understanding of thermal weathering. The results also follow Molaro and McKay (2010) observations that other drivers than insolation dominate on shorter time scales.

P12: Living with floods and droughts at the Angola/Namibia border – sustainable water resources in fluctuating climate in the Cuvelai catchment

J. Käyhkö (1), P. Alho (1), F. Becker (2), R.G. Bryant (3), S.D. Gurney (4), M. Hipondoka (2), J.S. Jauhiainen (1), K. Jylhä (5), V. Kinyaga (6), N. Käyhkö (1), B. Mauz (7), C. J. Mesmer (1), S. N. Namushinga-Heita (1), A. Nehemia (8), G. L. Miguel (9), C. Riberio (10), J. Röhrig (11), T. Saarinen (1), A. Teixeira-Pinto (10), B. Vehviläinen (12), G.S.F. Wiggs (13) and K. White (4)

(1) Department of Geography and Geology, University of Turku (UTU), Finland
(2) Department of Geography, University of Namibia (UNAM), Namibia
(3) Department of Geography, University of Sheffield, UK
(4) Department of Geography, The University of Reading, UK
(5) Climate Section, Finnish Meteorological Institute (FMI), Finland
(6) Desert Research Foundation of Namibia (DRFN), Namibia
(7) Department of Environmental Sciences, University of Liverpool, UK
(8) Department of Water Affairs, Ministry of Agriculture, Water and Forestry, Namibia
(9) Science Faculty & Ministry of Research (MESCT), Universidade Agostinho Neto, Angola
(10) Lubango Campus, Universidade Privada de Angola (UPRA), Angola
(11) Institute for Social-Ecological Research (ISOE), Germany
(12) Hydrology Section, Finnish Environment Institute (SYKE), Finland
(13) School of Geography and the Environment, University of Oxford, UK

AnNa Waters studies the past, present and projected future conditions of a seasonal river system Cuvelai in the borderland of Angola and Namibia. The variable rainfall pattern causes alternating floods and droughts, whilst the river network is an important water source for 1 million inhabitants.
With transdisciplinary methodology, we explore and identify sustainable socio-ecological pathways under a changing climate. We base our aim on research on ecosystem processes in the catchment, plus climate-hydrological scenarios for the future. We merge land use traditions, innovative planning plus water management policies from communities to international level.
The project consists of three work packages:

WP1: To investigate past and present ecosystem dynamics and anthropogenic processes in the catchment giving insight into the spatio-temporal dynamics and its connection to climatic fluctuation using sedimentological and palaeoecological methods, plus a critical assessment of the present conditions within the catchment and analyses of discharge variability and inundation.

WP2: To investigate future climate, hydrology and landscape development in the catchment with AR5 greenhouse gas scenarios and CORDEX regional climate model. Outcomes will be transferred to a hydrological-hydraulic GIS model, producing scenarios of future runoff and spatio-temporal inundation patterns. Dynamic land cover change models (LCTA) will give insight to future landscape change.

WP3: Based on the findings of WP1 and WP2, to investigate the pathways of sustainable development on different scales from community level to regional planning and national-international policy, considering the future flood-drought dynamics in a changing climate.

P13: An investigation of geomorphic connectivity in the middle reaches of the Baviaanskloof catchment, Eastern Cape , South Africa

N. Mabuza

Department of Geography, Rhodes University, South Africa.

The Baviaans is a dryland river system that runs between the Kouga and the Baviaanskloof mountain ranges in the Eastern Cape, South Africa. The sustainability of this catchment is of importance to the provision of a livelihood for the local people. Water shortages are increasingly becoming a problem in this region. The research aim was to investigate how geomorphic connectivity influences the form and recent dynamics of the main channel and adjacent fans. To assess the various forms and degrees of geomorphic connectivity, alluvial features and channel morphology in the study reach were mapped using time series, the relationship between connectivity and rainfall magnitude in the area were investigated. Connectivity between the trunk and the tributaries and that between the floodplain and the trunk were studied. The alluvial fans in the catchment are inset in the floodplain acting as buffers to sediment movement into the trunk stream. This study mapped the areas of incision and the channel form. The fans were classified according to size and shape, using field mapping, Digital Elevation Models (DEM) and aerial photography, assessed the distribution of incised fans and impact on the channel-floodplain morphology. Ultimately the detailed description of the study provides information for restoration of the floodplain and the management of future channel changes through identifying the sensitive and change prone areas in the catchment.

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P14: An Investigating the biological responses of freshwater shrimp (*Caridina nilotica*), to suspended sediment

A.Sahula

Department of Geography, Rhodes University, South Africa

Processes of erosion, sediment release and sediment transport are vital components of the functioning of the Earth's ecosystems. The amount of sediment transported by rivers is important for riverine ecosystems and, specifically in this study; it influences the water quality of aquatic ecosystems and their habitats. Increased concentrations of suspended sediment and duration of exposure to suspended sediment may have substantial impact on freshwater macro-invertebrates. In this study, laboratory experiments were conducted to assess the biological effects of suspended sediment exposure on freshwater shrimp (*Caridina nilotica*). Two types of experiments were conducted: An early development (sub-lethal) trial was undertaken to assess the effect of suspended sediment on *C. nilotica* embryo hatchability; the second trial was a lethality assessment, where a ten day exposure of juvenile and adult *C. nilotica* was conducted. Results of the experiments emphasize the effect of duration-of-exposure on these organisms and the sensitivity of different life stages to suspended sediment exposure.

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P15: Bedload sediment fluxes along the Sand River, Oyster Bay headland bypass dunefield: Implications for sediment delivery to St Francis Bay

D. H. Schroeder (1) and W.N. Ellery (2)

(1) Department of Geography, Rhodes University, Grahamstown
(2) Department of Environmental Science, Rhodes University, Grahamstown

The shoreline of St Francis Bay is eroding, requiring substantial investment by the local authority in shoreline protection interventions. Where no shoreline protection measures are in place, coastal erosion is clearly evident. Sediment nourishment of the St Francis Bay beaches relies on the flux of sediment from Oyster Bay in the west through the Oyster Bay headland bypass dunefield, into the Kromme River estuary, from where sediment is delivered to St Francis Bay. The general assumption is that wind delivers sediment across the entire dunefield from Oyster Bay to St Francis Bay, but based on ongoing work it is clear that most of the sediment flux in the eastern part of the mobile dunefield is via fluvial transport to the Kromme River. This hypothesis was tested by measuring the sediment fluxes of the lower Sand River in order to determine the rate of sediment transfer in an easterly direction by water. The sediment fluxes were measured monthly in the confined section of the Sand River (east of the point where the R330 crosses the river). This was done using a Helley-Smith bedload sampler and the number of sample measurements was based on the variance between individual readings. Suspended sediment was determined monthly by measuring turbidity and relating this to suspended sediment load. Dissolved sediment load was measured, using electrical conductivity readings and relating them to the total dissolved solid concentration from evaporation of a sample of known volume.

P16: Effects of rock surface temperature on rock hardness readings for the Equotip

R.W Schröder

Department of Geography, Geoinformatics and Meteorology, University of Pretoria, South Africa

The Equotip was initially designed for measuring the hardness of metallic materials and is now widely used to measure surface hardness of rocks and other materials. This electronic device is less destructive compared to the Schmidt Hammer, and is therefore preferred by many scientists. Field protocols should be set up for the Equotip, such as those for the Schmidt Hammer, so that there can be consistency between studies done by different scientists. This could help to compare different studies. Due to the sensitivity of the Equotip, there are some external factors that influence the accuracy of the readings. This paper presents the effects of rock surface temperature on the rebound values of the Equotip Hardness Tester. In this laboratory study, six sets of sandstone and basalt samples are introduced to either direct heat for a period of four hours, controlled oven heating or left at room temperature. The results expected for this study may be that temperature does affect the Equotip hardness readings. There might also be significant fluctuations in the hardness readings when working with surface temperature of the basalt compared to the sandstone, due to differences in albedo.

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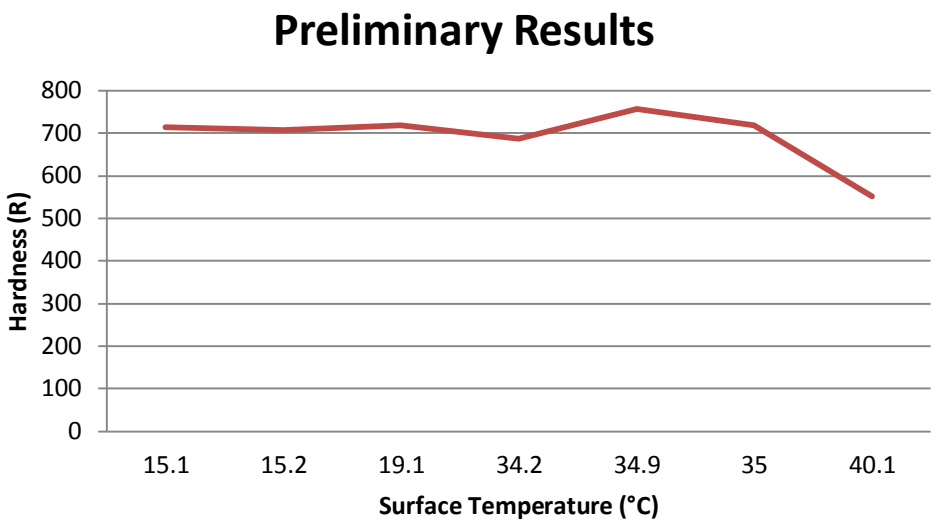

Figure: Results from a preliminary experiment

P17: Monitoring geomorphological changes in Namibia using historical and modern imagery

R. Swart

BlackGold Geoscience, P.O. Box 24287, Windhoek, Namibia

The Namib Coast is dominated by strong, high frequency south-westerly winds. Offshore this is manifested as a constant, northward directed longshore drift. The sandy coastline of the Namib is characterised by northward propagating sand spits such as found at Meob Bay, Sandwich Harbour and Pelican Point and other spits further north in Angola. These sand spits are highly dynamic and have changed significantly in historical times. Many of these changes, particularly those at Sandwich Harbour, have been dramatic and have had significant ecological consequences. Potential changes at Pelican Point could have dire consequences for Walvis bay harbour making these spits worthy of study. These changes can be mapped using a combination of old maps, air photos and modern satellite imagery.

Similarly, barchans dunes near the coast are highly dynamic. In north-west Namibia a combination of air photos and satellite images shows that barchans that are 50m long are moving at 40m per annum. Other dune types such as transverse and longitudinal dunes are more stable.

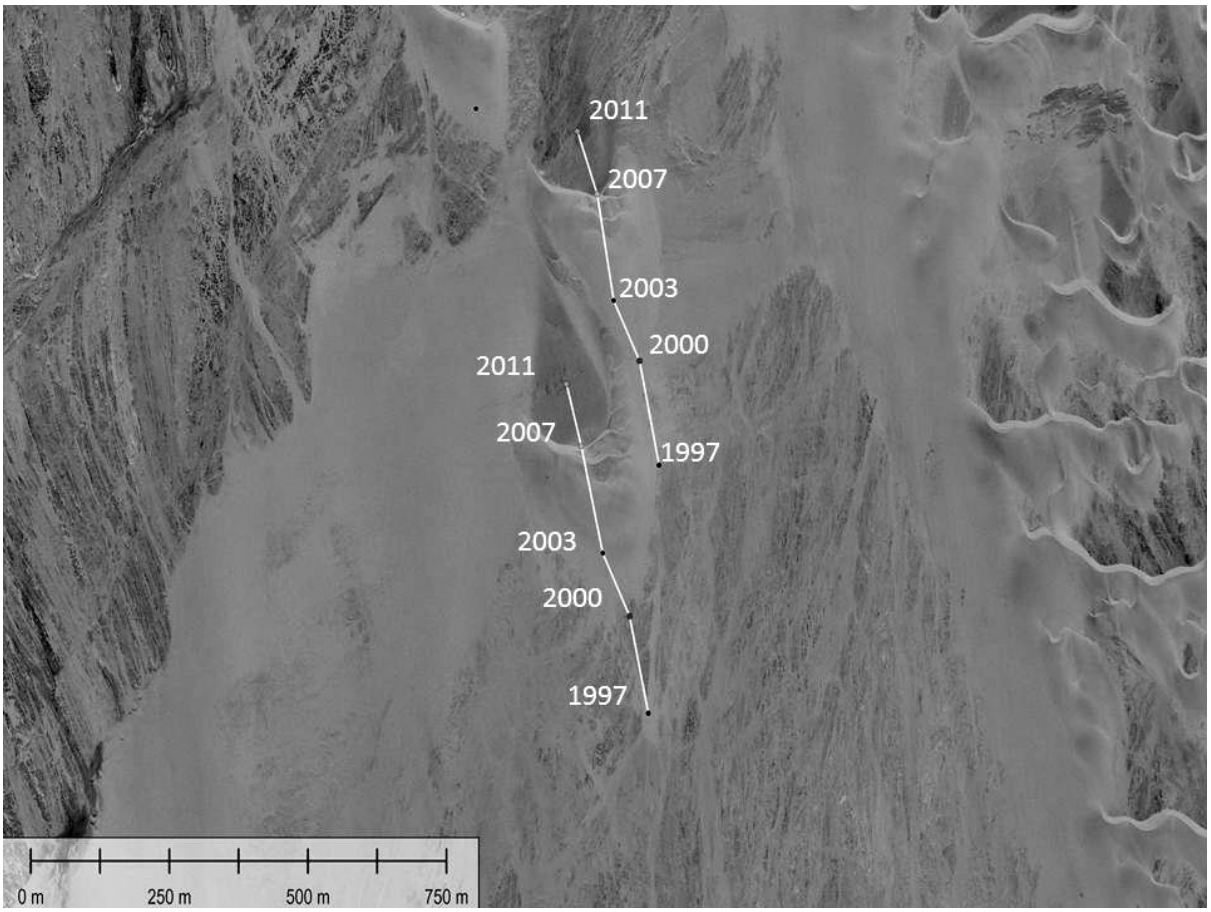

Figure: The positions of the front edge of two barchans dunes in the Skeleton Coast Park is shown image shown is an air photo from 2007. The positions of dunes in previous and subsequent years for which imagery is available are also marked.

P18: Controls on dust emission in the lower Kuiseb River valley

K.J. Vickery (1) and F.D. Eckardt (1)

(1) Department of Environmental & Geographical Science, University of Cape Town, Rondebosch

Contemporary dust source research has focussed on large inland basins as significant sources of mineral aerosols in the atmosphere (e.g. Washington et al., 2003). Smaller fluvial sources have received lesser focus despite their prevalence worldwide. One such source, the Kuiseb, was identified to be a significant dust source in southern Africa clearly highlighting the fluvial-aeolian link for emission and drawing on the importance of supply limited systems. MODIS satellite imagery combined with synoptic circulation and wind speed data were analysed to determine the importance of this system both in terms of emission frequency and a climatological perspective. Twenty two emission events were detected in four years between 2005 and 2008, occurring between April and August, driven by north easterly winds associated with a west coast trough. The ephemeral nature of the Kuiseb River was determined to be a significant contributor of sediment to the lower reaches; as the sand sea to the south did not result in any significant plumes during the four years, and only limited contribution from springs within the gravel plain. This highlights the importance of viewing sources such as the Kuiseb in a holistic approach; including the hydrology, synoptic and climatologic conditions of the region to determine the emissive potential and thus aeolian significance of smaller source and supply limited systems.

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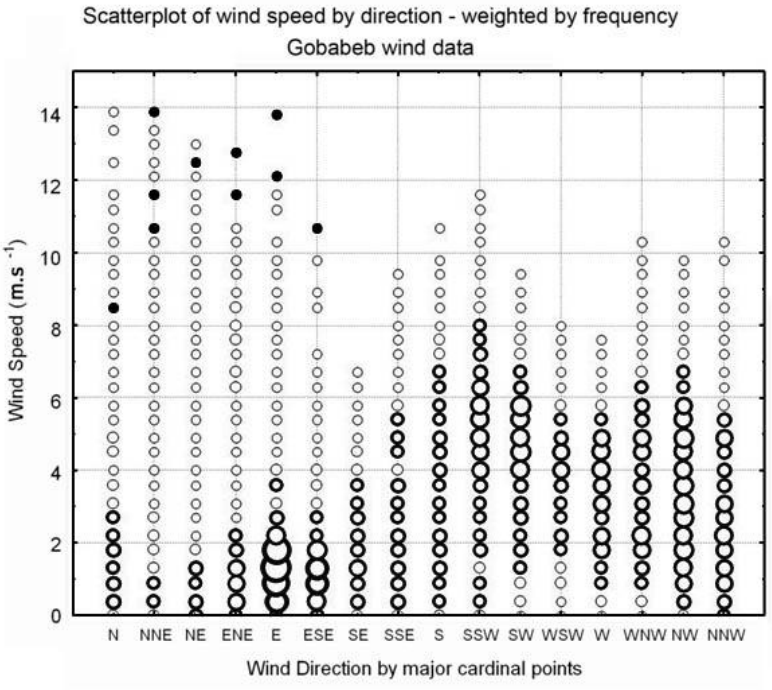

Figure: Plot of wind speed by direction (2007 and 2008) plotted such that an increase in size of the marker indicates the greatest frequency of occurrence. Solid black markers indicate conditions in which dust emission was observed. This highlights the importance of north to easterly winds of magnitudes greater then 8m.s^{-1} which are low frequency, high magnitude winds.

In Memoriam Helga Besler

Prof. Dr. Helga Besler passed away at the age of 72 in her home in Großbottwar near Stuttgart at the end of January 2012. She became one of Germany´s most famous desert researchers. In spite of fighting some health problems during the last years her death was very sudden and unexpected. Prof. Besler was very active in scientific work after her retirement in 2004 and attended international conferences regularly until last autumn. She was well known for her acknowledged reputation as an excellent geomorphologist and climatologist. She had an enormous knowledge of almost all arid regions worldwide. The first question after a scientific talk was usually kept for her and posed by her.

Prof. Besler was born on March 16th in 1939 in Sydowsaue near Stettin (today NW-Poland). At the University of Stuttgart she studied Chemistry, Physics and Geography and afterwards Political Philosophy at the University of Belfast. She graduated in 1967 with her thesis on Organic Chemistry.

The first time she got in touch with deserts was on a journey to the Negev Desert while visiting Israel. During her PhD-studies under the guidance of Prof. Wolfgang Meckelein (University of Stuttgart) she came the first time to Gobabeb to do desert research in 1969. This work ended up in her PhD-thesis "Climatic conditions and climate-geomorphological zones of the central Namib desert (Southwest Africa)". During the following years she extended her desert research to numerous arid regions but returned to the Namib again and again. Consequently, she finished her post-doctoral thesis on "The Dune Namib – Development and dynamics of an Erg". After a professorship at the University of Stuttgart she became a lecturer at the University of Zurich in 1982. In 1985 she accepted a permanent professorship at the University of Cologne and took over the responsibility of the Africa Research Section at the Institute of Geography.

Among numerous publications on desert formation in Australia, Central Asia and Africa she developed together with her team the multi-method concept of "Sand as a carrier of information in arid ecosystems" based on more than 1000 sand samples from deserts from all over the world. Many papers dealing with the granulometric classification of dune sand were published in the Zeitschrift für Geomorphologie. Her textbook "Geomorphologie der ariden Gebiete"(Wissenschaftliche Buchgesellschaft 1992) became the standard book on arid land geomorphology in the German-speaking world. Encouraged by Prof. Dr. Hanna Bremer she furthermore worked on landforms and their development of the inner tropics of South America and Indonesia. Since 1995 Helga Besler has been a principal investigator within the interdisciplinary collaborative project (SFB 389) "Arid Climate Adaptation and Cultural Innovation in Africa" (ACACIA).

Her engagement and research work during this 12-year running project culminated in the publication of her outstanding results on decoding of the formation of the East Saharan Dunes: "The Great Sand Sea of Egypt" (Elsivier 2008). Additionally she was an active member of the Inter-University Group of Namibia-Researchers (Interuniversitären Namibia Forschungsgruppe, IUNFG).

Prof. Dr. Helga Besler became a co-founder of comparative sediment-analytic desert research. Her publications were internationally noticed even outside the geo-scientific community. As a human being she will remain in our memory as a cheerful, positive and life-affirming freethinker. She always took care for her students and colleagues but allowed them latitude for their own scientific progress. Beside her scientific heritage, everyone knowing her personally will keep all her wonderful travel anecdotes in mind.

Mathias Ritter
Institute of Geography, University of Cologne

List of Delegates

Name:	Surname:	Affiliation:	E-mail:
Ryan	Anderson	University of Pretoria	paul.sumner@up.ac.za
Jussi	Baade	University of Jena	cub@uni-jena.de
Matthew	Baddock	Griffith University	m.baddock@griffith.edu.au
Charles	Barker	University of Free State	barkerch@ufs.ac.za
Mark	Bateman	Sheffield University	m.d.bateman@sheffield.ac.uk
Tamsyn	Bean	University of Pretoria	paul.sumner@up.ac.za
Stefni	Bierman	University of Fort Hare	stefnib8@gmail.com
Jan	Boelhouwers	Uppsala University	jan.boelhouwers@kultgeog.uu.se
Charlie	Bristow	Birkbeck University of London	c.bristow@bbk.ac.uk
Robert	Bryant	Sheffield University	r.g.bryant@sheffield.ac.uk
Louise	Bryson	Rhodes University	louisekbryson@gmail.com
Karabo	Chadzingwa	Rhodes University	Kchaz28@gmail.com
Hugo	De Lemos	University of Witwatersrand	hdelemos@gmail.com
Rosie	Dwight	Rhodes University	g09d0769@campus.ru.ac.za
Frank	Eckardt	University of Cape Town	frank.eckardt@uct.ac.za
Tyrel	Flügel	University of Cape Town	tyrel.flugel@gmail.com
Ian	Foster	University of Northampton	Ian.foster@northampton.ac.uk
Carel	Greyling	University of Pretoria	paul.sumner@up.ac.za
Christel	Hansen	Rhodes University	christeldhansen@gmail.com
Natalie	Haussmann	University of Pretoria	natalie.haussmann@up.ac.za
David	Hedding	University of South Africa	heddidw@unisa.ac.za
Martin	Hipondoka	University of Namibia	mhipondoka@unam.na
Gareth	Isenegger	University of Pretoria	gdisenegger@yahoo.co.uk
Mikael	Jonsson	Uppsala University	Mikael.jonsson@kultgeog.uu.se
Rebecca	Joubert	Rhodes University	rebeccajoub@gmail.com
Vincent	Kakembo	Nelson Mandela Metropolitan University	Vincent.kakembo@nmmu.ac.za
Jukka	Käyhkö	University of Turku	jukkay@utu.fi
Lesego	Khomo	University of Cape Town	lesegok@gmail.com
Jay	Le Roux	University of Pretoria	lerouxj@arc.agric.za
Ian	Livingstone	The University of Northampton	ian.livingstone@northampton.ac.uk
Michael	Loubser	University of Pretoria	michael.loubser@up.ac.za
Nandipha	Mabuza	Rhodes University	nm.mabuza@gmail.com
Munyaradzi	Manjoro	North-West University	manjoro@yahoo.com
Michael	Meadows	University of Cape Town	mmeadows@mweb.co.za
Ian	Meiklejohn	Rhodes University	i.meiklejohn@ru.ac.za
Roy	Miller	Consultant	roymm36@mweb.com.na
Frank	Mugagga	Makerere University	fmugagga@gmail.com
Werner	Nel	University of Fort Hare	wnel@ufh.ac.za
Charlie	Reichhardt	University of Pretoria	paul.sumner@up.ac.za
Mathias	Ritter	University Koln	Mathias.Ritter@uni-koeln.de

Kate	Rowntree	Rhodes University	k.rowntree@ru.ac.za
Asiphe	Sahula	Rhodes University	A.Sahula@ru.ac.za
Rona	Schröder	University of Pretoria	paul.sumner@up.ac.za
Daniel	Schroeder	Rhodes University	g08s0819@campus.ru.ac.za
Lindie	Smith-Adao	Rhodes University and CSIR	lsmithadao@csir.co.za
Paul	Sumner	University of Pretoria	paul.sumner@up.ac.za
Roger	Swart	BlackGold Geosciences cc	rogerswart@mweb.com.na
Jore	von Holdt	University of Cape Town	jorevh@mweb.co.za
Bennie	Van der Waal	Rhodes University	Bvdwaal@gmail.com
Kathryn	Vickery	University of Cape Town	kathryn.vickery@gmail.com
John	Ward		
Roddy	Ward	Retired	ward@eastcoast.co.za
Kevin	White	University of Reading	k.h.white@reading.ac.uk
Giles	Wiggs	University of Oxford	Giles.wiggs@ouce.ox.ac.uk
Scott	Yammin	University of Cape Town	YMMSCO001@myuct.ac.za

Southern African GEOMORPHOLOGY

Recent Trends and New Directions

Peter Holmes
Michael Meadows

We have often been asked, in the course of our academic careers, whether there are texts to which those (specialists and laypersons) with a serious interest in southern Africa's physical landscapes and their evolution might refer. The short answer is, outside the fields of geology and soil science, and with the exception of Bernie Moon and George Dardis' 1988 text *The Geomorphology of Southern Africa*, there is not much. *Southern African Geomorphology* aims, therefore, to fill this niche. It is an academic text, yet one, we feel, which will also satisfy the layreader who wishes to learn more about both the morphology of the southern African landscape, and the processes which have formed it.

~ *Peter Holmes and Mike Meadows*

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Gobabeb Station Map