Date:
09 – 14 June 2024

ICMG24

Somerset West,
South Africa

15th International Conference on Military Geosciences

Unmasking the change and continuity in the nature and character of military operations

About the IAMG

http://militarygeoscience.org/about/

The International Association for Military Geosciences (IAMG) is a not-for-profit organisation, administered by its members and represented by a Council. Membership in the Association is free and open to researchers and practitioners of military geology and geography and associated fields. Membership is open to all with no distinction of religion, nationality, gender or language.

What are the Military Geosciences?

Military geosciences, as they are understood here, comprise all disciplines that are interested in military activities within a geological, geographical or, more generally, spatial context, of which those listed below are but a few examples:

- Engineering Geology
- Hydrogeology
- Geospatial Sciences
- Terrain Analysis
- Archaeology
- Historical Geography
- Geomorphology
- Environmental Science
- Geophysics
- Climatology
- Cognate disciplines

Solely created and edited by Ivan Henrico & Evert Kleynhans

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How did we get here?

Ted Rose (2 August 2015) - http://militarygeoscience.org/association-2/

"The ICMG series that gave rise to IAMG has evolved both in name and style. The first meeting, in Seattle, USA, in 1994, was intended as a one-off one-day symposium, convened under the auspices of the Geological Society of America. However, its success led to a similar meeting in the UK, at the University of Warwick in 1996, under the auspices of the Geological Society of London. A half-day meeting in Toronto, Canada, in 1998, was back again under the auspices of the Geological Society of America. Each of these generated post-conference books, published by the respective geological societies (Underwood & Guth, 1998; Rose & Nathanail, 2000; Ehlen & Harmon, 2001). In 2000, in the UK, the scope broadened from geology to terrain, attracting geographers and historians, and expanding to a three-day conference sponsored by the University of Greenwich. The conferences adopted the title 'international' and expanded to four days in 2003 in the USA at the US Military Academy, West Point. Numbering was adopted with the 6th conference at the University of Nottingham in the UK in 2005. The successful 7th conference was held at Université Laval in Quebec, Canada, in 2007. Alternating between North America and Europe, the 8th conference was in Vienna in 2009. The series continued in the USA in 2011, Europe in 2013, and the USA in 2015."

The 12th conference was held in South Africa, Stellenbosch in 2017, with the theme "The scope, reach, and impact of Military Geoscience"; the 2019 conference (13th) in Padova, Italy with the theme "Peace follows war: geosciences, territorial impacts and post-conflict reconstruction"; the 14th was held in 2022 in Charleston (SC), USA with the theme "Military Geosciences in the 21st Century: Past Lessons and Modern Challenges"; which brought us back to South Africa for the 15th iteration of the conferences with the theme "Unmasking the change and continuity in the nature and character of military operations."

ICMG24 - Innovation

Unlike previous conferences held in the northern hemisphere, the ICMG24 Organising Committee has embraced a fresh approach, introducing an exciting new element. We proudly present the first-ever international hybrid conference in military geosciences, uniting military geoscientists from around the globe, whether they join us in person or virtually.

Conference Committee
Ivan Henrico (Chair)
Hennie Smit (ret)
Babalwa Mtshawu
Jacques Bezuidenhout
Rikus Le Roux
Susan Henrico
Evert Kleynhans
Anri Delport
Eric McDonald (President of the IAMG)
Drew Craig (Secretary of the IAMG)

Conference Assistants (postgraduate students)
L. Matiwane
S. Nyembe
S. Mbatha
W.W. Mashaba
M. Mathoho
K.T. Kortman
N.V. Mathebula
L.M. Du Toit

ICMG24 Scientific Programme

ICMG24 PROGRAMME		
Day/Date	**Time**	**Event Details**
Sat, 08 June	**All Day**	**Arrival of Delegates**
Sun, 09 June	**All Day**	**Arrival of Delegates**
	18:00 - 20:00	**Welcoming Function** and **Registration** *(Conference Foyer Area - Lord Charles Hotel & Conference Centre - Somerset Suite 1)*
Mon, 10 June	08:30 - 08:55	**Registration**
	09:00 - 09:25	**Welcoming Address** by Prof Tshehla / Brig Gen De Castro
	09:30 - 10:00	**Keynote Speaker: Prof Francis A. Galgano** *Evolution and continuity in the scope of military operations: The emergence of effective sovereignty doctrine*
	10:00 - 10:25	**Tea Break**
	IN-PERSON PRESENTATION: SESSION 1 (Session Chair: Dr Ivan Henrico) *15min for presentation (Q&A after session)*	
	10:30 - 10:45	**Jacques Bezuidenhout** *The influence of geographical factors on the outcome of the Battle of Blood River, South Africa, 16 December 1838*
	10:50 - 11:05	**Mark Reed** *Environmental security revisited*
	11:10 - 11:25	**Martin Riegl & Ronan Wordsworth** *Why the right buzzwords do not work in Africa´s emerging geopolitical frontiers*
	11:30 - 11:45	**Loidi Shaamhula** *Curriculum transformation of the Bachelor of Science in Military Science (Army) (Honours) Programme at the University of Namibia*
	11:50 - 12:05	**Aldino Bondesan** *From operation Mallory Major to Blockade: the pursuit of bridges precision bombing in Veneto region (Italy)*
	12:10 - 12:25	**Rikus le Roux** *Utilizing airborne platforms for gamma emission detection of radiation sources*
	12:25 - 12:35	**Session Q&A**
	12:35 - 13:35	**Lunch Break**
	IN-PERSON PRESENTATION: SESSION 2 (Session Chair: Dr Rikus le Roux) *15min for presentation (Q&A after session)*	
	13:40 - 13:55	**Chris Fuhriman** *A geographic analysis of Afghanistan's Shahi-kot Valley as a safe haven for insurgency*
	14:00 - 14:15	**Susan Henrico** *Strengthening resilience in the Global South: the strategic role of open source geospatial technologies in civil and military domains*
	14:20 - 14:35	**Bohumil Doboš** *The Wolf I Feed: Typology of the Wagner Group in Africa*
	14:40 - 14:55	**Gerhard Herda** *Climate change in the arctic, the military consequences and security implications (CLIMARCSEC)*
	14:55 - 15:05	**Session Q&A**
	15:05 - 15:35	**Tea Break**

Mon, 10 June	**IN-PERSON PRESENTATION: SESSION 3** (Session Chair: Col (Dr) Chris Fuhriman) *15min for presentation (Q&A after session)*	
	15:40 - 15:55	**Ivan Henrico** *Mapping the scars of conflict: A geospatial analysis of temporal changes in Ukraine's urban infrastructure*
	16:00 - 16:15	**Maria Petriccione** *Mine warfare in the dolomites: reconstruction of the Lagazuoi Front and its evolution during World War I*
	16:20 - 16:35	**Louw Uys** *Parametric ship rolling in the northern Agulhas Current: a case study*
	16:40 - 16:55	**Babalwa Mtshawu** *Accuracy comparison of ordinary kriging and IDW interpolation techniques in estimating naturally occurring radioactive materials*
	17:00 - 17:15	**Joel Roskin** (Online) *Combatting the coupling of underground and urban environments for offensive and defensive guerrilla/terror war-scale Hamas engagements from, and in the Gaza Strip, southern Israeli coast*
	17:15 - 17:25	**Session Q&A**
	17:25 - 17:35	**Day's closing/Wrap-up**
	17:35 - 17:40	**Committee meeting**
Tue, 11 June	08:00 - 08:25	**Admin arrangements**
	08:30 - 16:00	**No academic programme** **Field trip: Robben Island Visit** The **bus departs at 08:30** from in front of the Lord Charles Hotel & Conference Centre. (packed lunch provided)
	16:30	**Return to the Lord Charles Hotel and Conference Centre**
Wed, 12 June	08:25 - 08:30	**Admin arrangements**
	Poster Presentations (All day) *Handin poster for display to the conference committee (Mr Sfundo Mbatha) at 08h15 - Conference Venue*	
	VIRTUAL PRESENTATION: SESSION 1 (Session Chair: Col (Prof) Mark Read) *15min for presentation (Q&A after session)*	
	08:35 - 08:50	**Peter Imanuel** *Modernizing national air forces in the 21st century: A comprehensive review from an African perspective*
	08:55 - 09:10	**Peter Schmitz** *Using Groth's pattern detection algorithm to detect possible landmine presence based on reflection changes of plants*
	09:15 - 09:30	**Hermann Häusler** *German geophysical investigations during the Second World War*
	09:30 - 09:35	**Session Q&A**
	09:40 - 10:00	**Poster Presentation Session**
	10:00 - 10:25	**Tea Break**

Wed, 12 June	**VIRTUAL PRESENTATION: SESSION 2** (Session Chair: Cdr (Prof) Jacques Bezuidenhout) *15min for presentation (Q&A after session)*	
	10:30 - 10:45	**Edward 'Ted' Rose** *Gordon Lyall Paver (1913–1988): Pioneer of South African Military Geosciences in World War II*
	10:50 - 11:05	**Peter Schmitz** *Using GIS and public available data to determine coercion into marine wildlife poaching and piracy*
	11:10 - 11:25	**Peter Doyle** *Gallipoli 1915: from 'forcing the Dardanelles' to 'evacuating the beaches'*
	11:30 - 11:45	**Peter Guth** *Using ESA Sentinel satellite imagery and online analysis to track battle damage and population forced relocations*
	11:50 - 12:05	**Aphelele Mgabisa** (Doctoral Student) *A geospatial approach to monitor the impacts of climate change on water resources in South Africa*
	12:10 - 12:25	**Tiaan Henrico, Zander Lourens & Dashlin Naidoo** (Undergraduate Students) *Bi-temporal analysis of the effects of warfare on vegetation in Gaza*
	12:25 - 12:35	**Session Q&A**
	12:35 - 13:35	**Lunch Break**
	STUDENT PRESENTATION: SESSION 1 (Session Chair: Prof Frank Galgano) *15min for presentation (Q&A after session)*	
	13:40 - 13:55	**Charlene Simataa** (Doctoral Student) *Relationship between the spatial and temporal distribution of fishing vessels and marine environment in Namibia's Exclusive Economic Zone (EEZ)*
	14:00 - 14:15	**Louis du Toit** (Doctoral Student) *Assessing shoreline dynamics in Saldanha Bay: Unmasking changes and continuities through comprehensive remote sensing data and approaches for enhanced military geoscience applications*
	14:20 - 14:35	**Nomcebo Mathebula** (Masters Student) *Geospatial analysis for detection and distribution of sinkholes at the School of Tactical Intelligence in Potchefstroom, SA*
	14:40 - 14:55	**Sfundo Mbatha** (Masters Student) *A spatial-temporal and geospatial analysis of transnational crimes on Rhino poaching in Kruger National Park from 2007-2023*
	14:55 - 15:05	**Session Q&A**
	15:05 - 15:35	**Tea Break**
	STUDENT PRESENTATION: SESSION 2 (Session Chair: Dr Bohumil Doboš) *15min for presentation (Q&A after session)*	
	15:40 - 15:55	**Lukhanyo Matiwane** (Masters Student) *Analysing the sediment transportation of the port of East London using the SWAN model*
	16:00 - 16:15	**Sipokuhle Nyembe** (Masters Student) *Utilising geospatial tools for enhancing campus planning and facility management: digitising the Saldanha campus for SU*
	16:20 - 16:35	**Kabelo Kortman** (Masters Student) *Site selection for constructing a community-scale solar PV farm using analytical hierarchy process and geographic information systems: A case of Saldanha Military Area*
	16:35 - 16:45	**Session Q&A**
	16:45 - 16:55	**Day's closing/Wrap-up**
	17:30 - 18:30	**SEMINAR - "Russia in Africa: Anti- or Neocolonial Power?"** *(Hosted by: The Embassy of the Czech Republic in South Africa & Charles University)* *Catering Included*

Thu, 13 June	08:00 - 08:25	**Admin arrangements**
	08:30 - 14:30	**No academic programme** **Field trip: Simon's Town Naval Base and IMT Armscor Visit** The **bus departs at 08:30** from in front of the Lord Charles Hotel & Conference Centre. (packed lunch provided)
	14:30	**Return to the Lord Charles Hotel and Conference Centre**
	17:00 - 20:00	**Conference Dinner** The **bus departs at 16h30** from in front of the Lord Charles Hotel & Conference Centre for Stellenbosch (Root 44 Restaurant).
Fri, 14 June	08:30 - 08:35	**Admin arrangements**
	08:40 - 09:10	**Keynote Speaker:** Prof Hennie A.P. Smit *Thirty years of the ICMG conference series: history, significance and prospects*
	STUDENT PRESENTATION: SESSION 3 (Session Chair: Lt Col (Dr) Susan Henrico) *15min for presentation (Q&A after session)*	
	09:15 - 09:30	**Wandile Mashaba** (Masters Student) *Flood causes and possible mitigations: A case study of Airforce Base Durban in 2022*
	09:35 - 09:50	**Kgomotso Botlholo** (Masters Student) *Utilizing results from previous studies in the Berg River and Kilindini Harbour to investigate and model sedimentation in East London Harbour*
	09:55 - 10:10	**Mashudu Mathoho** (Masters Student) *Assessing renewable energy readiness in military bases: a geospatial analysis of solar energy in the West Coast region of South Africa*
	10:10 - 10:15	**Session Q&A**
	10:15 - 10:45	**Tea Break**
Fri, 14 June	**CLOSING - FINAL SESSION**	
	11:00 - 12:00	**IAMG AGM** President/Chair: Prof Eric Mc Donald Secretary: Lt Col Drew Craig
	12:05 - 12:35	**Conference closing/Wrap-up**
	12:35 - 13:35	**Lunch Break**
	13:40 - 14:15	**Destination ICMG26: Where Will We Meet Next?**
	14:20 - 14:40	**Meeting for Delegates Attending the Post-Conference Excursion** *(Lobby of the Lord Charles Hotel & Conference Centre)*
	14:45 - 15:45	**Informal Closing Gathering with Snacks** (Conference Foyer Area - Lord Charles Hotel & Conference Centre - Somerset Suite 1)
Sat-Thur, 15-20 June	Varied	**Post-Conference Excursion** Delegates attending the post-conference excursion depart at 09h00 from in front of the Lord Charles Hotel & Conference Centre.

Key Notes

Evolution and continuity in the scope of military operations: The emergence of effective sovereignty doctrine

Prof Francis A. Galgano [a,*]

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Keywords: Effective Sovereignty, Failing State, Ungoverned Space, Military Geography, Houthi, Red Sea

Abstract:

The character of military operations has fundamentally evolved since the end of the Cold War. The former superpower's bifurcation of global strategic space, while dangerous, was state-centric and essentially normalised by doctrines of international relations. Indeed, although the security landscape has changed, the Iraqi invasion of Kuwait (1990), the Russian invasion of Ukraine (2022), and ongoing military operations in the Gaza Strip (2023) attest that state-centric threats will continue to represent an extant hazard to peace and security. However, the new reality of global strategic space is conditioned by the proliferation of nonstate–centric threats in the form of violent nonstate actors (VNSA) which has led to a far more unstable global security environment.

An examination of the security landscape suggests that VNSAs are enabled by two related and emergent trends. First, the number of failing states has increased by 48% since 1990. Second, the proliferation of failing states has resulted in large areas of ungoverned space from which VNSAs can export violence with little effective interference from the sovereign state from which they are operating. Such is the case of the Houthi Rebels in northwestern Yemen who began to attack Red Sea shipping in November 2023, thus endangering global commerce. Such threats now play growing a role in the global security calculus as the US and the West attempt to respond. This paradigm has been termed the Effective Sovereignty Doctrine, which contends that in situations in which security is threatened because a sovereign government fails to exercise adequate control over an ungoverned area; states may reserve the right to take any action deemed necessary to counter the threat. Accordingly, long-standing and well–established diplomatic protocols as well as international doctrines and the principles they engender must now be considered in light of this doctrine.

This presentation examines the problems of failing states and ungoverned space along with the evolution of the Effective Sovereignty Doctrine since 1990. It uses the Houthi attacks on commercial shipping in the Red Sea as a case study, among others, to explore the efficacy of this doctrine.

Thirty years of the ICMG conference series: history, significance and prospects

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Keywords: International Conference on Military Geosciences, International Association for Military Geosciences.

Abstract:

In October of 1994, two geologists, Professors Jim Underwood (Kansas State University), and Peter Guth (United States Naval Academy), convened a modest, one-day symposium on "Military Geology in War and Peace." This symposium formed part of the annual meeting of the Geological Society of America and was sponsored by the Engineering Geology Division of the Society. Speakers from two countries, the United Kingdom and the United States of America presented papers, the start of increasing international attendance at the ICMG conferences.

Due to the somewhat unexpected popularity of the symposium, a follow-up was organised, marking the start of thirty years of (almost) biennial conferences. Over time, the exclusive emphasis on geology of the first symposium evolved into a more inclusive, military geosciences focus, while the accepted format expanded to a week of presentations, interspersed with field trips to places of geoscientific interest.

During the tenth ICMG meeting, a formal society, the International Association for Military Geosciences (IAMG), was proposed and accepted. This conference was held in Aviemore, Scotland, in 2011, and Professor Edward PF (Ted) Rose was elected as the first honorary President of the new society.

Thirty years later, we can look back on 14 successful ICMG conferences and 13 years of the IAMG. But what is the significance of the conference series and the Association? And where do we go from here? This presentation aims to briefly trace the history of the ICMG and IAMG and then to try and answer these two existential questions.

Acknowledgements

The bulk of the historical overview was sourced from an article on the history of the IAMG by Edward PF Rose, published in Scientia Militaria, South African Journal of Military Studies, Vol 46, Nr 1, 2018. The valuable insight of other longtime contributors to the ICMG series is also gratefully acknowledged.

Oral Presentations

The influence of geographical factors on the outcome of the Battle of Blood River, South Africa, 16 December 1838

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Keywords: Battle of Blood River, Voortrekkers, Zulu, geographical factors

Abstract:

Technological advances changed how military operations have been conducted comprehensively over the past centuries. The armies of today and how they do battle are fundamentally different from the armies and battles of only a few decades ago. However, one element of battles remained constant over the years - the geographical factors that form the backdrop against which these battles take place. While geographical factors almost always play a role in the outcome of any military operation, in some battles, their influence can be crucial.

One such battle where geographical factors, and the interpretation and use of the battlefield geography, played a significant part in the outcome was the battle of Blood River. This battle was fought on 16 December 1838 during the war between the Voortrekkers and the Zulu in the KwaZulu-Natal area of present-day South Africa. Although many myths and different interpretations of what transpired on the day of the battle pervade the discourse on the battle, it was a pivotal clash in many respects. This, and the role that geographical factors had on the outcome of the battle, warrant investigation.

This presentation will investigate the battle of Blood River by extracting the significant geographical features from written accounts of the battle and remote sensing imagery and relating them to the outcome of the battle.

From operation Mallory Major to Blockade: the pursuit of bridges precision bombing in Veneto region (Italy)

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Keywords: precision bombing, WW2, UXO, warfare risk

Abstract:

Between 1943 and 1945, Allied forces conducted the Italian Campaign to liberate the territory from Nazi-Fascist forces. The combat strategy for the advancement of ground troops included air force support; the need to block the movement of enemy troops and their supplies led the Allies to adopt the decision to strike key communication routes and civilian targets such as railways, railway stations, and bridges with air raids.

A prime example of this strategy was Operation Strangle, conducted from March to May 1944, which aimed to destroy the Germans' ability to move supplies, fuel, materials, and reinforcements, thus achieving the strategic goal of eliminating or significantly reducing the need for an Allied ground offensive in the region. During the operation, medium bombers and fighter-bombers were employed over an area of 150 square miles (390 km²) from Rome to Pisa and from Pescara to Rimini, and approximately 20,000 tons of bombs were dropped on targets such as railway tunnels, marshalling yards, bridges, and tunnels; the result was the cutting off of about ten major supply arteries, but this was not enough to prevent the Germans from moving sufficient forces and resources to check Allied offensives. Additional air operations were therefore necessary, starting from the Po Valley, affecting the Veneto region and in particular, between mid-1944 and the end of the war, the Po bridges on the border with Emilia-Romagna with Operation Mallory Major and the numerous railway and road bridges of the Adige, Brenta/Bacchiglione and Piave rivers with Operations Wowser and Blockade.

The bombing of bridges posed a major challenge for the Allied Air Force, both due to the small size of the target and the presence of German flak, although most aircraft were equipped with targeting systems. In addition, weather conditions limited air operations and bombing accuracy; clouds and fog, especially in the winter months, limited visibility and thus reduced the proportion of attacks using visual sighting techniques and negatively affected these attacks with a consequent loss of bombing accuracy.

This study analyses the effectiveness of the bombings by illustrating four case studies of bridges in the Veneto region that were heavily bombed between September 1944 and April 1945; the two bridges over the Brenta River, located in the municipalities of Fontaniva (PD) and Vigodarzere (PD), were hit about 120 times, the two bridges over the Piave River, located in the municipalities of Nervesa della Battaglia (TV) and San Donà di Piave (VE) underwent about 130 bombings (Fig. 1).

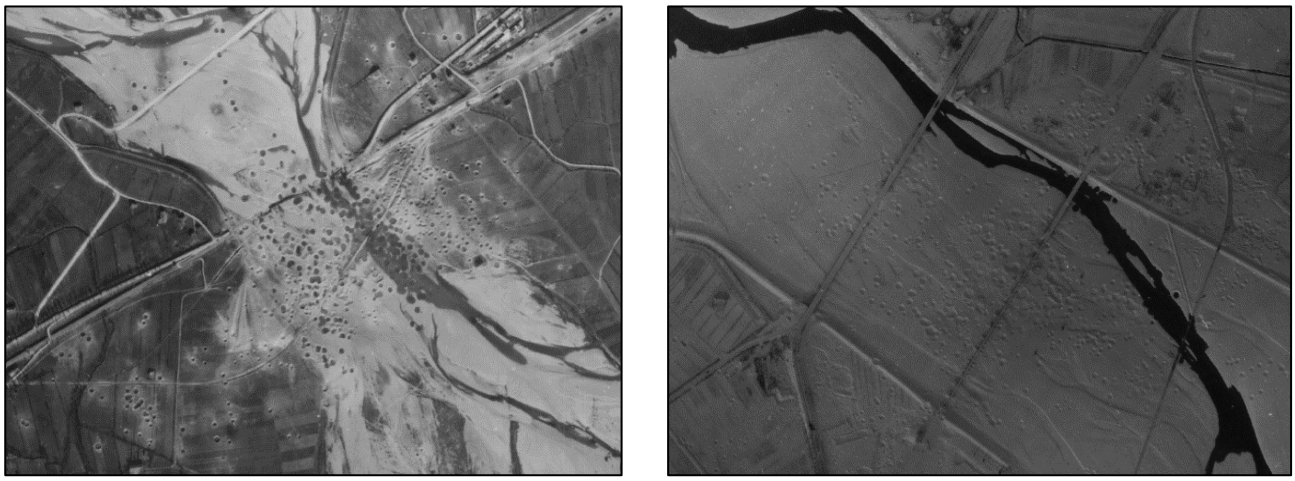

Figure 1. Bombed bridges in Fontaniva and Nervesa. (AFN-ICCD Archives)

The availability of archival sources from the National Archive UK, AFHRA and NARA and the digitisation of RAF and USAAF aerial photographs held at the Aerofototeca Nazionale - Istituto Centrale per il Catalogo e la Documentazione (ICCD-Ministry of Culture) in Rome, allowed the reconstruction of the temporal sequence of the air raids and the mapping of the craters of each bombing in a GIS environment. To assess bombing accuracy, CEP (Circular Error Probable) and MPI (Main Point of Impact) values were used to count the impact points of the ordnance and to compare the values between them.

The comparison revealed an indication of the best technique to be used for the in-depth study of the areas affected by the bombings, and above all the delimitation of the areas with the highest concentration of fallen bombs. This favours studies of war risk assessment as it helps to focus the area of investigation and the use of appropriate instrumentation in investigations for the search of unexploded ordnance, with a considerable saving of time and resources.

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Utilising results from previous studies in the Berg River and Kilindini Harbour to investigate and model sedimentation in East London Harbour

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Keywords: sediment, sediment transport, dredging

Abstract:

East London Harbour is a commercial harbour located to the Southeast of South Africa, in the Eastern Cape province (Theron, 2004). The port has a rich history heavily intertwined with military significance, especially during colonial and apartheid periods (Tankard, 1988). Currently, the harbour is serving as a maritime facility for commercial shipping. Like most harbours situated in a river mouth, the port is plagued by sedimentation challenges. Sediment build-up has an impact on navigation channels reducing their depth. Regular dredging operations are constantly carried out to remove sediment with high-cost implications.

All sediment contains varying concentrations of naturally occurring radionuclides, potassium (^{40}K), thorium (^{232}Th) and uranium (^{238}U). Previous studies have utilised these radionuclides as tracers and were effective in modelling the erosion and deposition of sediment and have found potassium-rich mud depositions at point bars and around flow-obstructing objects (Bezuidenhout, 2020). A relationship between thorium and uranium was also found, originating from the geological origins of the sediment.

This study presents an analysis of the East London Harbour by relating previous studies on natural radionuclides in waterbodies by considering the geological origins of its sediment and the physical characteristics of the area. The sediment from the Buffalo River flowing into the harbour exhibits similar geological origins as the study performed in the Berg River in Velddrif, South Africa (Henrico, et al., 2022) and Mwache River in Mombasa, Kenya (Botlholo, et al., 2024). Similar deposition characteristics are therefore predicted in the East London Harbour. Due to this similarity, a comparable relation between thorium and uranium in the sediment is also predicted. The man-made structures surrounding the port create obstructions in the flow of the river, which should result in the deposition of sediment. Sedimentation is also expected at the point bars. Deposition of the sediment at the bridges built over the Buffalo River is expected to be excessive, due to its construction at the location of point bars.

Studies of natural radionuclides in waterbodies enhanced the understanding of sedimentation challenges in the Port of East London and could provide possible mitigation measures.

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The Wolf I Feed: Typology of the Wagner Group in Africa

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Keywords: Wagner Group; Africa; Russia; typology

Abstract:

Wagner Group is often portrayed as a hybrid organisation. Nonetheless, the vague descriptions of its nature are not sufficient to understand its activities. Using typologies of violent non-state actors, the contribution develops a conceptual study aiming at placing the group in the existing systems. It is being analysed on cases from southern Africa, the triangle of Libya, Sudan and the Central African Republic, and the Western and central Sahel. The group´s activities resemble those of a PMSC, a paramilitary organisation, and a criminal organisation but given the specifics of the Russian environment, it is the closest to the paramilitary organisation.

Gallipoli 1915: from ‘forcing the Dardanelles’ to ‘evacuating the beaches’

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Keywords: Gallipoli Peninsula, Dardanelles Straights, North Anatolian Fault Zone, First World War, naval campaign, amphibious landings, trench warfare, water supply, evacuation

Abstract:

This paper presents a review of the impact of terrain on the Gallipoli Campaign from March 1915 to January 1916, building on two previous ICMG presentations, at ICMG 6 (Nottingham) – looking specifically at the landings (Doyle, 2008), and at ICMG 11 (Las Vegas) – looking at the peculiarities of ‘badland’ topography of the ANZAC Sector (Doyle, 2016). It builds on these and studies from recent authors to examine the totality of the impact of terrain on the campaign in all its stages, from the perspective of terrain presenting the stage upon the unwitting actors played in 1915, which would ultimately have a significant effect on its outcome.

The Dardanelles Straits and the Gallipoli Peninsula are part of the North Anatolian tectonic zone, and movements of its component faults, including the Anafartalar thrust fault that tracks across the peninsula, led to coastal offsetting and tectonic uplift. This created a rugged terrain that had a major role to play in influencing its outcome.

The Gallipoli Campaign was fought by the Entente Powers (principally the British and French empires) against the Ottoman Empire in 1915, focussed primarily on opening the Dardanelles Straits between European Turkey and Asia Minor. This had the aim of permitting a naval force to steam through the Sea of Marmora to threaten the Ottoman capital, Constantinople (Istanbul) with the hope of removing the Ottoman Empire from the Central Powers and maintaining trade links with Russia.

The failure of the naval force committed the Entente powers to a physical landing on the Gallipoli Peninsula (Fig. 1), at first primarily to support the naval campaign, before descending ultimately into trench warfare effectively carried out by the Ottomans, containing the Allied land forces to beachheads close to those captured on the opening days of the campaign.

Drawing upon work carried out over the past thirty years or so, this review looks at the impact of terrain on the prosecution of the campaign as a whole, from the failure of the British and French navies to ‘force the Dardanelles’ by ships alone in March 1915 to the effectiveness of the Ottoman defence, the development of trench warfare and the problems of resource supply, right the way through to evacuation of the beaches in January 1916, the campaign in tatters.

The outcome of this campaign would have a lasting influence on the planning of all subsequent amphibious landings, and this paper will take a terrain-centric approach to examining it.

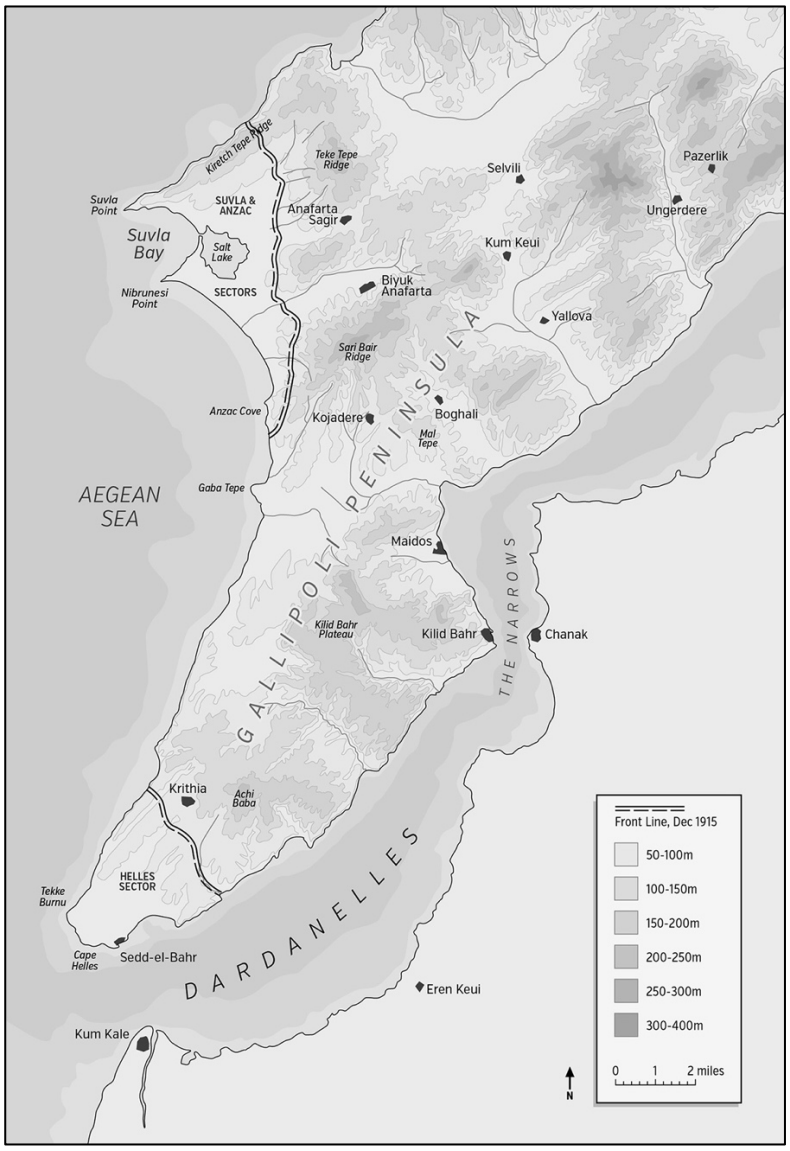

Figure 1. The Gallipoli Peninsula and the Dardanelles Straits, showing topography and the maximum extent of Allied occupation (Image: Peter Doyle)

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Assessing shoreline dynamics in Saldanha Bay: Unmasking changes and continuities through comprehensive remote sensing data and approaches for enhanced military geoscience applications

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Keywords: shoreline dynamics, coastal erosion, Saldanha Bay, Synthetic Aperture Radar, Unmanned Aerial Vehicle.

Abstract

Shoreline dynamics is a critical area of study within coastal geomorphology, focusing on the changes that occur along the coastlines over time (Bird, 2008). These changes are influenced by a combination of natural processes and human activities (Nicholls & Cazenave, 2010). Monitoring shoreline dynamics provides valuable information for decision-making regarding coastal development, conservation, and strategic military installations (Boak & Turner, 2005). In the context of Saldanha Bay, coastal erosion is a significant and complex issue. While it is a natural process, human activities have increased its rate and severity (Murray, et al., 2020). Effective management of coastal erosion requires an understanding of the natural coastal dynamics and the impacts of human activities which drive it (Boak & Turner, 2005).

This comprehensive study leverages a variety of remote sensing data and methodologies to assess shoreline dynamics in Saldanha Bay, focusing on the interplay between natural processes and military activities. By employing diverse remote sensing techniques, the research aims to reveal underlying changes and continuities in coastal environments. Techniques for monitoring shoreline dynamics include field surveys, aerial photography, satellite imagery, and numerical modelling (French, 2001).

In this study, specific attention was given to the application of Synthetic Aperture Radar (SAR) and Unmanned Aerial Vehicle (UAV) sensors to gain a better understanding of the driving factors behind coastal erosion. SAR proved a valuable tool for gaining an understanding of the changes in wave energy and refraction over time, a powerful driving force behind coastal erosion. The data collected from the UAV provided a better understanding of the location and scale of coastal erosion. Combining these datasets provides valuable insights into the relationship between wave energy refraction, and coastal erosion. Overlaying these datasets with manmade developments within the bay also provided insights into the effect of human activities on coastal erosion.

This knowledge is vital for military geosciences, as it supports the development of effective coastal management strategies, risk assessments for military installations, and planning for future military operations in coastal areas, aligning with the conference theme of understanding the evolving nature and character of military operations.

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A Geographic Analysis of Afghanistan's Shahi-kot Valley as a Safe Haven for Insurgency

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Abstract

Situated in Afghanistan's Arma Mountains, the Shahi-Kot Valley saw considerable action during two Afghan insurgencies: the mujahideen rebels fighting against the Soviet occupation in the 1980s, and the al Qaeda and Taliban defence against the American invasion in the 2000s. In this paper, we evaluate the Shahi-Kot Valley's viability as an insurgent haven through the lens of McColl's (1969) seven geographic attributes of ideal guerrilla areas. We examine both insurgencies for the following geographic attributes: an area that has political opposition to the central government, political instability at the national level, access to important military and political objectives, proximity to international borders, terrain favourable for military operations and security, economically self-sufficient, and continuous occupation of the guerilla base.

We find that Shahi-kot Valley satisfies each of McColl's seven geographic attributes in both case studies, despite differing political circumstances, decades of separation and technological advancements, and dissimilar military tactics and capabilities. For the Soviets, technological and numerical superiority could not overcome the geographic advantages (human and physical) of the defending guerillas. In the American case two decades later, the invading force successfully captured the valley but failed to meet its objective of destroying the insurgent army and blocking the passages into Pakistan. We conclude that the occurrence of two successful insurgencies centred in the Shahi-Kot Valley underscores the immutable importance of geographic factors in military operations while demonstrating the continued utility of McColl's framework for understanding irregular warfare.

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Unmasking the change and continuity in the nature and character of military operations

Using ESA Sentinel satellite imagery and online analysis to track battle damage and population-forced relocations

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Keywords: Sentinel-1 satellite, Sentinel-2 satellite, web-based remote sensing, military terrain analysis

Abstract:

The increasing quantity, quality, and availability of satellite imagery bring the eye to the sky to record and publicise events. News organisations now routinely use commercial satellite imagery with 0.5 to 2.5 m resolution with near daily coverage, but the European Space Agency's (ESA) Sentinel satellites provide 10 m imagery every few days, and their Sentinel-1 synthetic aperture radar (SAR) can see through clouds and collect at night. The imagery appears on the web within a day of collection, and the EO Browser (https://apps.sentinel-hub.com/eo-browser/) allows users to rapidly select and compare imagery. The 10 m resolution shows the results from floods, fires, or ship collisions with bridges and the resulting bottleneck in maritime traffic.

Figure 1 shows three views of the Gaza conflict area from March 2023 and March 2024, to highlight changes at the same point in the annual cycle. All six images clearly show the border wall, and highlight the differences on the two sides of the border. The top two images show true colour; there is much more barren earth in 2024 compared to 2023, and many of the large white greenhouses have been destroyed, particularly near the border. The middle two images show the NDVI, which measures the health of vegetation. East of the border wall, many more fields are fallow or recently harvested. To the west, there might be more vegetation near the wall, but within the more urban areas, much of the vegetation appears to have been destroyed. The bottom pair of images shows the SAR imagery, with a colour scheme that emphasises urban features, many of which have been destroyed near the northern border wall. Although the scale of the imagery is not ideal, it suggests that the regular returns from the buildings and streets have been disrupted by the military operations.

Traditionally remote sensing required users to understand both the scientific principles, and the mechanics of sophisticated and complex software platforms, and to manage large data sets. The EO Browser manages access to an 8-year archive of imagery, provides a dozen well-chosen display modes each for Sentinel-1 and Sentinel-2 with the ability for further customisation, overlays roads and place names if desired, and exports labelled images. By lowering the bar to entry, the EO Browser lets anyone explore imagery to track natural disasters, wars, the euphemisms employed by politicians, or operations designed to destroy crops or infrastructure and force civilians to displace. As long as the users understand the limitations of the 10 m scale, the imagery records events and shines a light on actions that some would like to hide. Journals will continue to use higher-resolution commercial imagery, but everyone can verify the reports for themselves and rapidly look at larger areas.

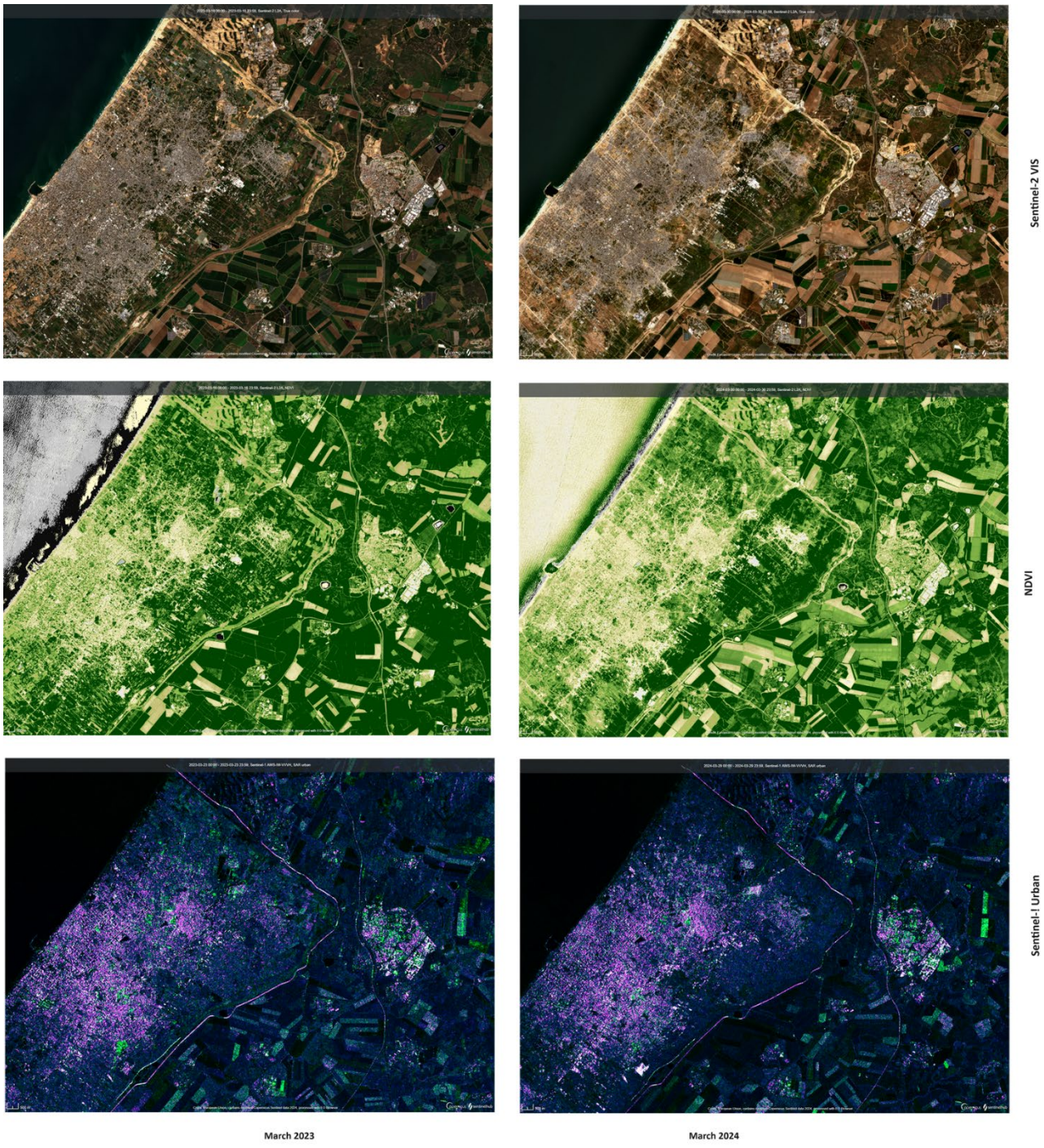

Figure 1. Sentinel-1 and Sentinel-2 imagery for northeastern Gaza, March 2023 and March.

Acknowledgements

I appreciate the open access to the ESA's Sentinel program and the power of the free EO Browser.

German geophysical investigations during the Second World War

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Keywords: Geophysical investigations, Military geology teams, Strategic raw materials, Underground investigations, Western Air Defence Zone

Abstract:

Based on the Mineral Raw Materials Act of December 4, 1934, the German Geological Survey carried out geophysical investigations to secure strategic raw materials in Germany and the occupied countries. From 1936 onwards, the Ministry of Aviation constructed a bulwark opposite the French Maginot Line, termed the "Westwall". In the years 1939 to 1940, seismic and geoelectric underground investigations were carried out for the expansion of the Western Air Defence Zone, the „Luftverteidigungszone West“, which consisted of anti-aircraft foundations made of concrete. From 1939 to 1944, geoelectric units (“Erdelektrische Trupps”) were affiliated with military geology teams (hereinafter referred to as MGT) of the German Wehrmacht.

These military geology teams carried out underground investigations for army high commands in various theatres of war. In March 1941, five geoelectric units were installed in the Geological Equipment Group (“Geologen-Geräte-Gruppe”) of the Engineer Department of the Inspection of Engineers and Fortresses in the Army High Command. Four of these units were used again later in the same year for underground investigations of the Western Air Defence Zone. The fifth unit supported MGT 16 in southern Russia and the Ukraine. Also in 1941, two further units carried out geoelectrical measurements for groundwater investigations for MGT 12 in North Africa, and then in 1942 for MGT 4 on the Channel Island of Alderney. From 1941 to 1943 an intensive geoelectric campaign was carried out in French Flanders by a geoelectric unit assigned to MGT 5. In 1943 and 1944 reports on groundwater investigations for battalion and regimental command posts document the work of geoelectric units of MGT 21 in the General Government and in northern Russia respectively, and of MGT 32 in Croatia.

Mapping the scars of conflict: A geospatial analysis of temporal changes in Ukraine's urban infrastructure

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Keywords: urban damage analysis, GIS and remote sensing, conflict impact, Ukraine cities, temporal change detection, post-conflict recovery, Built-up Area Index (BAEI)

Abstract:

This research utilises Geographic Information Systems (GIS) and remote sensing to analyse the temporal changes in urban buildup within Ukrainian cities (Figure 1) affected by the ongoing conflict since 2022.

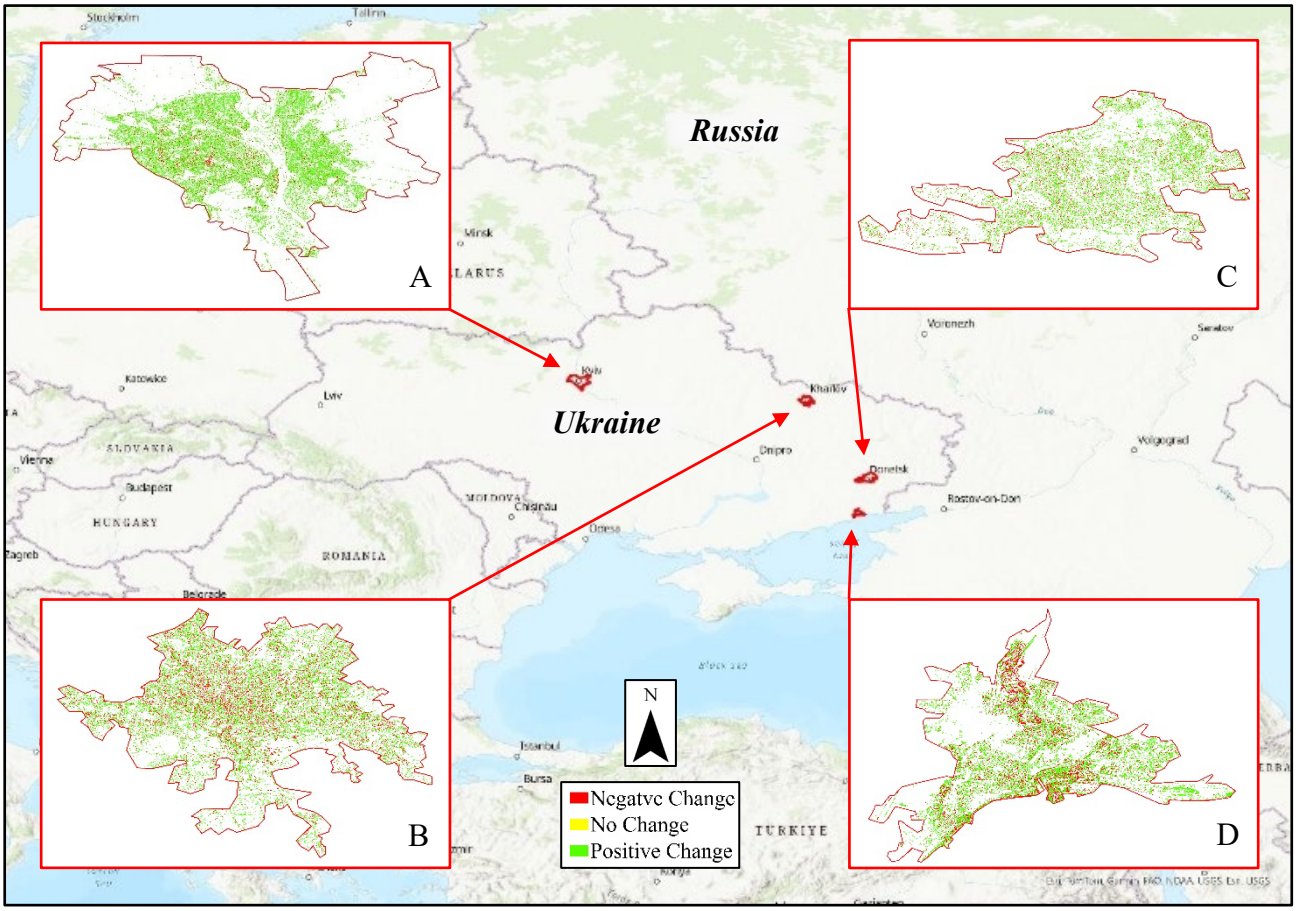

Figure 1. Orientation and inset maps of conflict-affected areas in Ukraine since 2022. The main map provides an orientation of Ukraine and Russia, highlighting the geographic context of the ongoing conflict. Insets illustrate close-up views of four key cities, each marked to show their respective locations and extent of urban changes: (A) Kyiv, (B) Kharkiv, (C) Donetsk, and (D) Mariupol.

The study employs Sentinel 2 satellite imagery, supplemented by the Built-up Area Extract Index (BAEI), to conduct a systematic analysis that maps and quantifies the transformation in urban structures in the cities of Donetsk, Kharkiv, Kyiv, and Mariupol. The methodological approach combines the use of ArcPro 2.8.0 for initial data processing with a raster calculator to create indices that were visually evaluated. Histograms helped in identifying areas of urban buildup, which were further analysed using the 'Extract by Attribute' and change detection tools to delineate and categorise areas that showed negative change (decreases), no changes, and positive change (increases) based on a temporal comparison of pre- and post-conflict images.

The preliminary findings (Table 1) reveal that Donetsk, Kharkiv, and Mariupol experienced substantial decreases in built-up areas, with reductions of 17.46%, 28.24%, and 28.29% respectively. In contrast, Kyiv exhibited a smaller decrease of only 9.4%, suggesting less extensive damage. This may reflect the effectiveness of air defences in protecting the capital city. Additionally, factors such as elevation, the timing of imagery acquisition, and seasonal variations could influence these results. Environmental conditions, including cloud cover, atmospheric phenomena, and vegetation growth, along with technical aspects like image resolution, also play crucial roles in affecting the accuracy and interpretation of satellite data.

The results provide a quantified visualisation of the war's impact on urban infrastructure, essential for stakeholders, including humanitarian organisations, who rely on precise data to plan effective post-conflict recovery. This study not only underscores the utility of GIS and remote sensing in conflict analysis but also highlights their importance in strategic planning for urban recovery, thereby contributing to the development of informed and resilient post-conflict urban landscapes.

Table 1. Changes in urban built-up areas in Ukrainian cities during the ongoing conflict since 2022

NEGATIVE CHANGE (DECREASE)		
City	**Percentage %**	**Area (km^2)**
Donetsk	17.46	19,47
Kharkiv	28.24	27,25
Kyiv	9.40	16,92
Mariupol	28.29	13,75
POSITIVE CHANGE (INCREASE)		
City	**Percentage %**	**Area (km^2)**
Donetsk	82.54	92,04
Kharkiv	71.76	69,24
Kyiv	90.60	163,03
Mariupol	71.71	34,86

Strengthening resilience in the Global South: the strategic role of open source geospatial technologies in civil and military domains

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Keywords: resilience, Global South, open source geospatial technologies, civil and military domain

Abstract:

In an age marked by increasing environmental, social, technological, and security challenges, the need for resilience across civilian and military sectors has never been more critical. This paper examines the transformative role of open source geospatial technologies in fostering resilience, providing a perspective through which disaster management, urban planning, environmental conservation, community engagement, and military strategic operations can be significantly enhanced.

Open source geospatial tools, with their inherent qualities of accessibility, adaptability, and collaborative potential, emerge as vital resources in improving situational awareness, enabling participatory decision-making, and devising innovative solutions to complex problems. By reviewing case studies and applications, this study demonstrates the crucial role these technologies play in not only enhancing disaster response and designing resilient infrastructures but also in advancing military readiness and strategic capabilities in dynamic operational environments. The incorporation of open source geospatial technologies within military operations highlights their value in strategic planning, threat assessment, and the coordination of complex logistics, thereby bolstering operational resilience and tactical effectiveness.

Combining theoretical insights with practical applications, this research underscores the essential role of open source geospatial technologies in addressing the multifaceted challenges of the contemporary landscape. This highlights the importance of open source geospatial technologies in both strengthening global resilience and supporting defence and security objectives.

Bi-temporal analysis of the effects of warfare on vegetation in Gaza

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Keywords: NDVI, temporal analysis, Gaza Strip, vegetation analysis, warfare

Abstract:

This study presents a comprehensive analysis of vegetation dynamics in the Gaza Strip (Figure 1a) during the 2023 Israel-Hamas war (ongoing), utilising the Normalised Difference Vegetation Index (NDVI) as a primary tool for assessing changes in vegetation. Employing ArcGIS Pro 3.2.2 for spatial analysis, a per-pixel change detection technique was employed to compare NDVI values, aiming to identify and quantify alterations in vegetation cover within the region. Per-pixel change detection was employed due to the high resolution of the Sentinel-2 imagery, enabling changes to be observed at the pixel level. The NDVI, a globally recognised remote sensing index, offers a robust measure of plant health and vegetation density by calculating the difference between near-infrared (which vegetation strongly reflects) and red light (which vegetation absorbs) from satellite imagery.

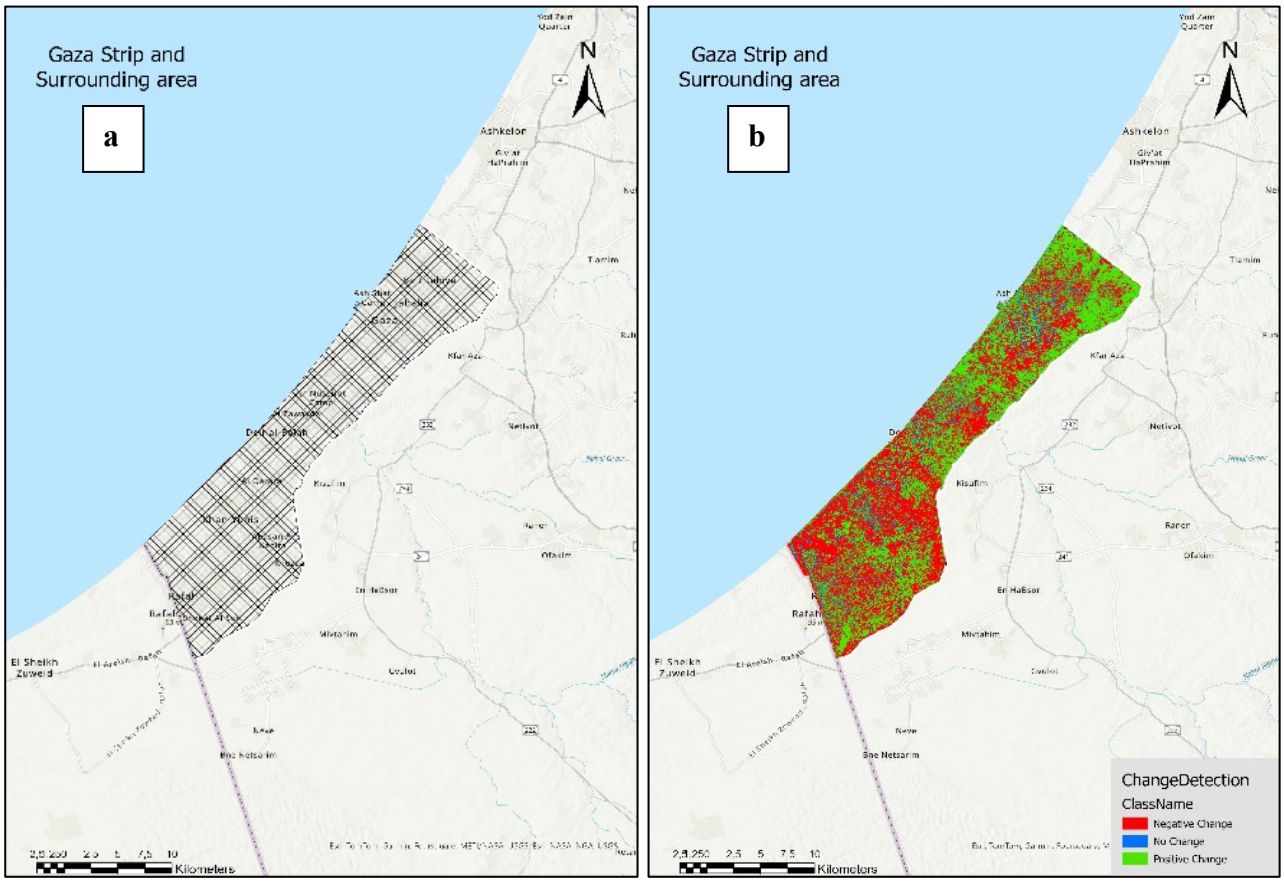

Figure 1. (a) Study area: analysing the impact of warfare on Gaza's vegetation over time; (b) Change detection of the NDVI of the Gaza Strip from March 2023 to March 2024.

The methodology involved generating NDVI maps for early March 2023 and early March 2024, followed by a detailed pixel-by-pixel comparison to detect changes in vegetation cover. This approach enabled precise pinpointing of areas depicting significant vegetation growth or decline within the Gaza Strip. The study's findings reveal critical insights into the spatial distribution of vegetation changes (Figure 1b), its potential link to the ongoing warfare and subsequently the impact of refugee migration, as well as other environmental factors. The results from the change detection analysis offer valuable information regarding the effects of the targeted attacks in the area.

Furthermore, this research underscores the utility of NDVI in environmental studies, demonstrating its effectiveness in monitoring vegetation dynamics over time. The application of such technologies is essential for the timely detection of ecological changes, providing a basis for informed decision-making in the military geoscience environment. This study contributes to the growing body of knowledge on vegetation monitoring and change detection, highlighting the impact of military activities on vegetation while underscoring the importance of ongoing observation and analysis of ecological systems within politically sensitive and environmentally challenged regions such as the Gaza Strip.

Climate change in the arctic, the military consequences and security implications (CLIMARCSEC)

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Keywords: Arctic security, Climate Change, Multi-National Forces

Abstract:

The Arctic region's climate is changing at an increased rate, up to four times faster than the global average. This enables more activity in the high north from both, Arctic and non-Arctic nations. As a consequence of easier access to resource extraction, fisheries, and ecotourism, the competition among countries may increase together with the strategic importance of the Arctic, which leads to both: risks and opportunities. Although from a military perspective, there is a strong focus on the strategic sphere, the geosciences (e.g. meteorology, hydrology, geology or geography) play a fundamental role in understanding the current and future situation in the Arctic region.

The CLIMARCSEC project within the US-led Multinational Capability Development Campaign (MCDC), led by Norway and involving multiple nations aims to identify and address governance and capability gaps in Multinational Forces (MNF) operations in the Arctic, particularly focusing on command, control, communication, and coordination capabilities necessary for effective operations such as Search and Rescue (SAR). The Austrian Institute of Military Geography contributes to the assessment of situational awareness and adds a non-NATO and non-arctic country perspective.

There are significant capability and coordination gaps among MNFs that hinder their ability to address the challenges effectively. Gaps include insufficient resources and outdated equipment, a lack of joint command structures, and limited domain awareness from sea to space. The project's emphasis on proposing solutions that transcend national boundaries underscores the importance of collaboration and information sharing among Arctic nations.

By focusing on future capability requirements, CLIMARCSEC is ensuring that military forces are adequately prepared to adapt to evolving Arctic conditions and emerging threats. This forward-looking perspective is instrumental in addressing the unique challenges for operations such as SAR posed by climate change, geosciences and geopolitical dynamics in the Arctic.

Modernising national air forces in the 21st century: A comprehensive review from an African perspective

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Keywords: modernisation, Air Force, Africa, Strategic Partnerships, capacity building, Geopolitical dynamics, emerging technologies, Defence policy

Abstract:

The current systematic review critically assesses the approaches, obstacles, and possibilities associated with the enhancement of national air forces in the African context during the 21st century. By conducting a thorough examination of contemporary literature, policy papers, and expert opinions, this investigation illuminates the distinct socio-political, economic, and technological elements influencing the development of air power capacities in African countries. The results demonstrate a varied array of endeavours geared towards bolstering Air Force potential, spanning from updating fleets to investing in training and infrastructure.

Nevertheless, obstacles like scarce resources, deficiencies in institutional capacity, and intricate geopolitical dynamics present significant challenges to successful modernisation endeavours. Drawing upon the amalgamation of findings, suggestions are put forth for decision-makers, Defence strategists, and concerned parties to address these obstacles and streamline the modernisation process. Additionally, this examination pinpoints numerous areas for prospective exploration, such as the influence of emerging technologies, the significance of regional collaborative frameworks, and the repercussions of evolving security challenges. By adding to a more profound comprehension of the forces that detail the modernisation of African air forces, this study aims to enhance scholarly discussions and guide strategic policy-making within the domains of Defence policy and national security.

Site selection for constructing a community-scale solar PV farm using analytical hierarchy process and geographic information systems: A case of Saldanha Military Area

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Keywords: Site Selection, Solar PV Farm, Geographic Information Systems, Saldanha Military Area, Analytical Hierarchy Process

Abstract:

South Africa's heavy reliance on coal-powered generators, coupled with the failure to construct new power plants to replace ageing infrastructure, has resulted in the introduction of load shedding by Eskom. These power outages, lasting between 2 and 10 hours per day (stages 2 to 6) depending on the stage of load shedding implemented by Eskom, aim to protect the national grid from collapse due to an inability to meet current energy demand. Institutions such as the Military Academy rely on microgrids powered by diesel generators to sustain their operations during these periods. However, the use of diesel generators is both costly and environmentally unfriendly. The construction of a PV solar farm presents a potential solution to these challenges, but site selection is a complex process involving multiple criteria and factors classified as Multi-Criteria Decision Making (MCDM).

This paper aims to identify a suitable site for constructing a PV solar farm at the Saldanha Military Area using the Analytical Hierarchy Process (AHP) and Geographic Information Systems (GIS). The selection criteria encompass climate factors (Annual solar radiation, annual surface temperature), orographic characteristics (slope, aspect), environmental considerations (land use), and economic factors (distance to roads, distance to miniature substation). It is important to acknowledge the following limitations during the process of site selection: protected areas and water bodies. This study utilises readily available geospatial data from various sources for visualisation and analysis using the ArcMap 10.8.1 software. The results obtained by this study indicate that the approach of integrating GIS and MCDM is indeed an effective and cost-efficient method for determining land suitability.

The approach highlighted by this study offers valuable insights and a methodological framework that can benefit other institutions in conducting similar research by providing a successful solution for spatial decision support in solar PV farm site selection. This research contributes to the effort of transitioning towards renewable energy sources, thereby enhancing energy security and sustainability in regions facing similar challenges.

Utilising airborne platforms for gamma emission detection of radiation sources

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Keywords: UAVs, gamma emission detection, radiation sources, orphan sources, radiation safety

Abstract:

The detection and identification of radiation sources are critical for both military operations and public safety. The advent of airborne platforms, particularly unmanned aerial vehicles (UAVs), has revolutionised the capabilities for radiation monitoring and detection.

In military contexts, the ability to rapidly detect and map radiation fields is invaluable. UAVs equipped with gamma spectrometers can conduct wide-area surveys, providing real-time data on radiation levels without exposing personnel to hazardous environments. This capability is particularly relevant in scenarios such as nuclear facility monitoring, battlefield assessments following the use of radiological dispersal devices, and the safeguarding of military bases from radiological threats. The agility and versatility of drones allow for rapid deployment and the ability to access areas that are challenging for ground-based teams, enhancing operational readiness and response times.

Beyond military applications, UAVs offer significant advantages in the detection of orphan sources—radioactive materials that have been lost, stolen, or abandoned and pose a serious public health risk. Traditional methods of locating these sources can be time-consuming and require substantial human resources. UAVs, on the other hand, can quickly cover large areas, including difficult terrains and urban environments, thus improving the efficiency and effectiveness of search operations.

UAVs can also be utilised for the radiometric mapping environment, which can be harnessed in military applications for terrain analysis and reconnaissance. By employing gamma-ray spectrometry, military units can rapidly identify soil types, which aids in assessing the suitability of terrain for vehicle movement, establishing fortifications, and planning construction. This capability enhances situational awareness and operational planning in diverse and unfamiliar environments.

This work explores the integration of drone technology with gamma radiation detectors to identify and localise radiation sources efficiently. It will discuss the technical aspects of integrating gamma detection equipment with UAVs, including data acquisition and the interpretation of gamma-ray spectra. The advancement in military applications, geosciences and public safety is presented. By leveraging UAV technology, we can enhance our ability to detect, identify, and mitigate radiological threats, thereby safeguarding both military personnel and civilians from the dangers of radiation exposure.

Flood causes and possible mitigations: A case study of Airforce Base Durban in 2022

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Keywords: cut-off lows, rainfall, floods, causes, mitigation, KwaZulu-Natal, Durban

Abstract:

On the 11th and 12th of April 2022, between 200 and 400 mm of rainfall was received in several parts of KwaZulu-Natal. This extreme rainfall was caused by a series of cut-off lows (pressure systems) that formed as an after-effect of La Nina. These heavy rains caused floods that claimed over 448 lives. Over 40,000 people were displaced. Infrastructure was damaged and over 13 000 homes were destroyed. Torrential rain waterlogged and flooded Transnet's container depot and blocked the N2 with containers. There was severe damage to the water system, electricity system, kitchen, and hangar of Air Force Base Durban.

This research paper aims to delineate the causes of floods and explore possible mitigative measures that can be taken to minimise flood damages at Airforce Base Durban. Satellite images and weather station records around Durban indicate that regular cut-off lows in the Indian Ocean induce heavy rainfall that caused different types of floods in April 2022 in Durban. A Digital Elevation Model was created and used to conduct terrain analysis, watershed analysis, and flood simulation for the study area. The GIS applications supported the findings, that river floods, urban floods, released water floods, and coastal floods are the types of floods the study area is prone to. Each of the flood types, likely to affect the military base is provided with possible ways to minimise damage. Future research that can be conducted on flood mitigation in the study area is also recommended.

The research established that Airforce Base Durban was built in an area that was originally prone to floods. To remedy the conditions, the Umlazi river was diverted and canalised. However, the counteractions that were taken do not halt the regular falling heavy rainfall, and the military base still gets affected by floods. The South African National Defence Force plans to move Airforce Base Durban to a new location. This paper, therefore, recommends that the South African National Defence Force must implement its plans to move the military base from its current location to King Shaka International Airport or an alternative location.

Geospatial analysis for detection and distribution of sinkholes at the School of Tactical Intelligence in Potchefstroom, SA

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Keywords: sinkholes, School of Tactical Intelligence, geospatial tools, environmental hazards

Abstract:

The presence of sinkholes in dolomitic landscapes is often overlooked making them one of the environmental hazards that tend to be neglected leading to a lack of concern and awareness. In South Africa, a majority of sinkhole studies have been conducted in Gauteng, leaving a gap in academic research on sinkholes in other dolomitic areas such as Mpumalanga, North West, Limpopo, and the Northern Cape. This study focuses on the School of Tactical Intelligence, which is located in Potchefstroom, North West. The area is distinguished by its dolomitic nature making it susceptible to sinkholes. Dolomitic environments are vulnerable to dissolution, which causes the soil to fall into rock cavities, resulting in sinkholes. Effective monitoring and early warning systems are crucial for the detection and distribution of sinkholes.

This study aims to use geospatial analysis tools for the detection and spatial distribution of sinkholes at the School of Tactical Intelligence. Although it is not easy to determine the exact cause of sinkholes, various factors create conditions conducive to sinkhole development. This study ought to determine the influencing factors that cause sinkholes. Understanding these factors enables the detection of areas susceptible to sinkholes. While traditional in situ methods for detecting sinkhole distribution are effective, they have inherent limitations such as high costs, labour-intensiveness, and time-consuming. This paper explores the application of geospatial tools focusing on GIS, remote sensing, and statistical modelling, to effectively map and predict environmental hazards such as sinkhole formation. By utilising these tools, precise identification of sinkhole locations and patterns becomes feasible.

The study further evaluates geographical changes in the terrain over time by identifying surface abnormalities, temporal variations, and spatial patterns that may indicate possible sinkhole distribution. Utilising geospatial tools and ArcGIS 10.8.1, the study detects areas susceptible to sinkhole formation. Through the integration of geospatial analysis tools, this study contributes to the advancement of sinkhole detection, ultimately enhancing the understanding of environmental hazards and reducing costs by avoiding expensive repairs, fatalities, and infrastructure damage. The findings of the study are expected to show measurable changes in the spatial distribution of sinkholes over time and as well as indicate possible influencing factors causing the sinkholes.

Assessing renewable energy readiness in military bases: a geospatial analysis of solar energy in the West Coast region of South Africa

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Keywords: Renewable energy, Site selection, Geospatial analysis, Solar energy adoption, Military bases readiness, Multi-Criteria Decision-Making, Climate change mitigation

Abstract:

The imperative for renewable energy adoption within military installations, particularly in regions prone to energy crises like South Africa's West Coast, underscores the necessity for strategic planning and implementation. This study employs a geospatial analysis framework to assess the readiness of military bases in South Africa's West Coast region for solar energy adoption. Utilising GIS-based tools and multi-criteria decision-making methods, the study evaluates solar irradiance levels, terrain characteristics, land suitability, and infrastructure compatibility to identify optimal sites for solar panel deployment. Through a systematic evaluation of solar energy potential, budgetary constraints, and spatial dynamics, this research brings to light, the optimal deployment strategies and contributes to broader sustainable development and climate change mitigation goals.

The research delves into four key military installations on the West Coast of South Africa, namely: Air Base Ysterplaat, Air Force Base Langebaanweg, 4 Special Forces Regiment, Saldanha Naval Base, and subsequently the South African Military Academy or rather the Saldanha Military Area. By integrating data on solar resource availability, geographic features, and military operational requirements, the research provides actionable insights for strategic decision-making. The desired outcome of this research is the successful identification of suitable areas within the military bases for building solar farms. This achievement would facilitate cost savings, mitigate climate change by reducing reliance on fossil fuels, and ensure an uninterrupted energy supply for critical military operations. Additionally, the study addresses noise pollution concerns associated with generator use, enhances operational efficiency, and contributes to South Africa's broader goals of sustainable development and climate change mitigation.

Furthermore, the findings of this study are expected to inform policy interventions, infrastructure investments, and technological innovations necessary for a successful transition towards renewable energy sources within military contexts. By leveraging abundant solar resources and overcoming implementation challenges, the research seeks to enhance energy security, resilience, and sustainability for South Africa's military installations and contribute to a greener and more secure future.

Analysing the sediment transportation of the port of East London using the SWAN model

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Keywords: wave energy distribution, wave-induced currents, sediment transport

Abstract:

The Port of East London was established in April 1847 at the river mouth of Buffalo River, South Africa. The port served as a military outpost to supply troops fighting in the 7th Frontier War. Over the years, the Port of East London has developed to be a commercial river port under Transnet National Port Authority capable of hosting alongside large vessels like the SA Navy replenishment vessel SAS DRAKENSBERG and RoRo ships. This study employs the Simulating Waves Nearshore (SWAN) model with the hydrographic data collected by SAS PROTEA to analyse the port's wave climate and predict sediment build-up within the area. The accumulation of sediment in this port can have a significant impact on navigation, port infrastructure, and the environment. Understanding the wave climate plays a crucial role in predicting sediment transport and accumulation patterns.

The methodology involves collecting historical wave data from multiple sources, including wave-buoys, in-situ depth soundings, meteorological records, and bathymetric data from the SA Navy Hydrographic Office. Using GIS and Matlab for analysis, the SWAN model is utilised to simulate the wave climate, considering factors such as wave height, period, direction, and spectral characteristics. Calibration and validation of the SWAN model are performed using observed wave data to ensure model accuracy and reliability.

The anticipated results will be in the analysis of wave energy distribution and wave-induced currents, to assess sediment transport pathways. The influence of external factors, such as currents, wind patterns, tides, and storm events, on wave dynamics and sediment transport is also considered in the analysis. The findings will contribute to a better understanding of sediment dynamics in the port environment and support decision-making for sediment management practices. By integrating SWAN modelling with sediment transport models, the study enhances the prediction of sediment accumulation patterns and aids in optimising dredging schedules, sediment disposal methods, coastal protection measures, and future military operations. This research promotes sustainable port operations and environmental stewardship in the Port of East London.

A spatial-temporal and geospatial analysis of transnational crimes on Rhino poaching in Kruger National Park from 2007-2023

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Keywords: illegal, Geographic Information Systems, Transnational crime, rhino poaching, borders

Abstract:

South Africa is home to a significant portion of the world's rhino population, making it a prime target for poachers who seek to profit from the illegal trade of rhino horns. This trade poses a serious threat to the rhinoceros populations globally, with the Kruger National Park (KNP) in South Africa being one of the epicentres of this illicit activity. Transnational crimes and rhino poaching refer to the illegal activities conducted across national borders, specifically concerning the poaching of rhinos for their horn. This study employs spatio-temporal and geospatial analysis techniques to understand the dynamics of transnational crimes associated with rhino poaching in the KNP. Utilising a combination of Geographic Information Systems (GIS), statistical methods (geostatistics), and interviews with a sample of 20 security forces from different security agencies. This study aims to conduct a spatio-temporal and geospatial analysis of the extent of transnational crimes on rhino poaching in the Kruger National Park from 2007 to 2023.

Through integrating various datasets, including rhino poaching incidents, socio-economic indicators, security forces(law enforcement) efforts, and environmental factors, this research seeks to uncover the complex interactions between human activities and the environmental conditions driving rhino poaching in the KNP. Furthermore, by examining the spatial distribution of poaching incidents over time, across geographical features and the proximity of the KNP and the other surrounding countries, this study will further identify spatial patterns, temporal trends, and key geographic factors influencing the incidence of rhino poaching.

The findings of this research ought to contribute to the development of targeted strategies for combating rhino poaching and disrupting transnational criminal networks operating in the KNP. By identifying high-risk areas and temporal hotspots, security force agencies and conservation organisations can better allocate resources and implement preventative measures to protect the rhino populations and preserve the ecological integrity of the KNP ecosystem.

A geospatial approach to monitor the impacts of climate change on water resources in South Africa

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Keywords: Climate Change, Water Resources, South Africa, Remote Sensing, GIS, Spatio-temporal Model

Abstract:

Climate change poses a significant threat to South Africa's water resources, impacting both quantity and quality. This study investigates these impacts using a geospatial approach. The research employs a two-phase methodology, namely (1) Phase 1: A comprehensive literature review will explore existing knowledge on climate change and water resources in South Africa; and (2) Phase 2: Empirical research will involve: (a) Direct measurement of water quality and quantity in twelve of South Africa's largest dams across six hydroclimatic zones; (b) Analysis of historical and current water resource data from the Department of Water and Sanitation (DWS); (c) Utilising satellite-based (e.g., Sentinel-2A, Landsat-8) and ground-based (spectroradiometer) observations to monitor changes.

The research will leverage the strengths of remote sensing, including freely available data from agencies like SANSA, ESA, and USGS. High temporal and spatial resolution for time series analysis and wide area coverage. Spectral information for creating spectral signatures for satellite data analysis. Ground-based spectroradiometer data will be statistically processed to create spectral signatures for satellite observations.

A key outcome will be the development of a spatio-temporal model using ArcGIS Pro software. This model will serve as a selection and monitoring tool to identify water resources facing water quantity and quality challenges. This research on water resources in South Africa is highly relevant to the military for several reasons:

- Planning and Logistics: Knowing water availability helps plan troop movements, especially in dry regions where water scarcity can hinder operations.
- Securing Water Sources: The research can identify crucial water sources for military use, particularly in remote or contested areas with limited infrastructure.
- Disaster Response: Understanding water risks helps the military prepare for and respond to disasters by providing clean water and sanitation to affected populations.
- Infrastructure Security: The research helps assess vulnerabilities in water infrastructure, allowing the military to develop strategies to protect these vital resources.
- Climate Change Adaptation: The findings can assist the military in adapting to climate change by incorporating climate data into planning and implementing sustainable water practices.

Accuracy comparison of ordinary kriging and IDW interpolation techniques in estimating naturally occurring radioactive materials

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Keywords: Interpolation, kriging, Inverse Distance Weighting, Mean Prediction Error, Root Mean Square Error

Abstract:

Spatial interpolation requires two basic inputs: known points and an interpolation method. However, the choice of a spatial interpolation method can greatly impact the quality of prediction and spatial variability of site-specific natural radionuclides in sediments. Ordinary Kriging (OK) is often proposed as a statistical technique with superior mathematical properties such as a minimum error variance. However, the robustness and simplicity of Inverse Distance Weighting (IDW) motivate its continued use.

The objective of this study is to compare the prediction accuracy of the two most frequently used interpolation techniques (Ordinary Kriging and Inverse Distance Weighting) in determining the degree of spatial variability of natural radionuclides in the sediments of Port Reitz, Mombasa, Kenya. The comparison of these two interpolation methods was achieved by using the total error of cross-validation and validation statistics. Mean Prediction Error and Root Mean Square Error were calculated and combined to determine which interpolator produced the lowest Total Error. The interpolator that produced the lowest Total Error portrays the most accurate predictions of the study area. The natural radionuclides (40K, 232Th, 238U) dataset was collected in Port Reitz, Mombasa using the DUGS which consists of a 3" × 3″ NaI (Tl) scintillation detector, a TB-5 multichannel analyser (MCA) from Amptek®, and an external computer that interfaces with the hardware for data logging and processing. The total number of sample points collected was 8674 across the study area.

The preliminary results obtained from the comparison of the two applied interpolation methods indicated that Kriging was the most suitable method for prediction and mapping the spatial distribution of natural radionuclides in the sediments of Port Reitz, Mombasa, Kenya.

Utilising geospatial tools for enhancing campus planning and facility management: digitising the Saldanha campus for SU

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Keywords: geographic information system (GIS), global positioning system (GPS), AutoCAD, facility management, campus planning, Faculty of Military Science

Abstract:

University campuses, as hubs of knowledge, significantly shape our understanding and thinking. Optimal care and efficient spatial data storage are crucial for seamless decision-making, repairs, and maintenance. The advent of geospatial tools has revolutionised various fields, offering numerous advantages over traditional methods by integrating spatial and non-spatial data into a unified system. Incorporating Geographic Information Systems (GIS) plays an innovative role in facility management and campus planning.

This paper focuses on employing GIS as an effective tool to enhance campus planning and facility management, particularly at the Faculty of Military Science (FMS) on the Saldanha campus, located on the West Coast. The study addresses challenges encountered during the 2017 refurbishment of the South African Military Academy, where the lack of reticulation plans and maps led to inefficiencies in locating underground pipes.

By developing a GIS database that incorporates spatial and non-spatial data of FMS facilities and creating a 3-D model, this study aims to improve campus planning and facility management for Stellenbosch University. Data sources include GPS, Google Earth images, AutoCAD files, and shapefiles from ESRI. Analyses were conducted on the geospatial database, involving georeferencing and shapefile creation.

Preliminary findings indicate that data presented and shared through the ArcGIS Online platform enhances effective management and sharing of campus data. This study's success will assist in locating facilities, space management, and campus planning.

Acknowledgements

I would like to acknowledge Mr Pieter van Jaarsveld (Senior Account Manager – Western Region, ESRI South Africa) and Jermaine Hendricks (Manager: Facilities Information at Stellenbosch University) for their invaluable assistance and support in this study.

Mine warfare in the Dolomites: reconstruction of the Lagazuoi Front and its evolution during World War I

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Keywords: World War 1, White War, Dolomites, Mine Warfare

Abstract:

The Dolomites (Eastern Alps, Northeast Italy), today recognised as a UNESCO World Heritage Site, were the scene of World War I between 1915 and 1917. In this border area between the Kingdom of Italy and the Austro-Hungarian Empire, the so-called "White War" was fought in the Alps, at altitudes above 2,000 meters. The armies clashed in extreme conditions, moving on rock faces and ridges, taking refuge in crevices and building war positions exploiting the mountain morphology. The Lagazuoi mountain complex, with the nearby Tofane and Sass di Stria, represents an emblematic example of this type of warfare.

Located northeast of Cortina d'Ampezzo, in the Italian Eastern Alps, the Lagazuoi dominates the Valparola, Falzarego passes and the Val Costeana. Its strategic position made it a nerve centre of the Dolomite front; during the conflict, Italians and Austro-Hungarians fought for control of the area, giving rise to fierce clashes and excavating a complex network of tunnels and caves using mines, whose powerful explosions had a significant impact on the morphology of the Lagazuoi and its neighbouring peaks. The deep scars on the rock faces, the piles of debris at the foot of the slopes and the instability of some areas are still visible testimonies of the intensity of the fighting. Although the network of fortifications and tunnels has been partially recovered in recent times and can now be visited, many of the original works have been lost and are only traceable in military maps and old photographs. The archival material recovered from various institutions and museums has allowed the reconstruction of the front and its evolution in the period 1915-1917 in a GIS environment. Positions and trenches have been mapped, the route of the tunnels reconstructed and the digital model of the mountain peaks of the period before the mine explosions that modified their morphology.

The work has allowed an in-depth study of the war operations that took place in extreme conditions and far from the main fronts (Asiago Plateau and Isonzo-Piave) and has made it possible to understand the close relationship between alpine morphology and war actions. The study also provides a useful tool to guide any restoration work of war artefacts not yet recovered or to reconstruct those that have been lost, to expand the museum area present in the Lagazuoi-Tofane-5 Torri area.

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Environmental security revisited

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Keywords: environmental security, climate change, climate security, human security, ecological security

Abstract:

The concept of environmental security grew out of the environmental movement of the 1970s, gaining significant attention in the academic and policy communities at the end of the Cold War in the early 1990s. Early writings focused mainly on how security-related activities, including armed conflict, affect the environment, and how environmental issues might influence or drive national or international security. By the early 2000s, numerous perspectives and definitions of environmental security had evolved and were debated in scholarly literature, including more subtle ways that environmental change might influence security.

Some scholars contested the very concept of environmental security. By the 2010s, research and writing focused on environmental security diminished, to some extent replaced by discussions and debates about the relationship between climate change and security (later referred to by some as climate security) in both academic and policy settings. In recent years, conversations about environmental security are re-emerging, driven in part by an acknowledgement that the overriding focus on climate change security may be too narrow, missing other ways that environmental change influences security, and vice versa. This paper briefly traces the history of environmental security in both the academic and policy literature. Next, the paper summarises climate change-security perspectives, discussing the climate-conflict nexus, and including examples of climate security strategy and policy.

The article then explains aspects of environmental security that are excluded or neglected from the climate-security discourse, making a case for a return to a more expansive approach to environmental security. Finally, an updated definition of and framework for environmental security are proposed, with relevance to the scholarly literature, as well as national and international security policy applications.

Why the right buzzwords do not work in Africa´s emerging geopolitical frontiers

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Keywords: Sahara-Sahel region, geostrategic competition, geopolitical frontlines, security paradigms

Abstract:

Hours after the fall of the strategic city Konna in Central Mali on January 10th, 2013, interim president Dioncounda Traore appealed to the UN and France for military help. Doing nothing was also an option, but after a few hours of decision-taking President Francoise Hollande announced that Operation Servale (later Barkhane) was launched. French special forces were deployed to prevent the capture of Mopti and the Islamists´ advance to the capital Bamako. Since 2013 France maintained a strong military foothold in the Sahel through Operation Serval or multinational ad hoc Task Force Takuba Operation. In combination with the UN MINUSMA, EU Training Mission, civilian EU Capacity Building Mission, G-5 Sahel Joint Force, and the Sahel Alliance launched in 2017 the international community built a robust security architecture and invested enormous resources in stabilisation efforts in G5 countries.

Ten years later, French forces have left Mali, the government in Bamako asked for MINUSMA´s withdrawal without delay, EUTM Mali was terminated, and Russia´s Wagner Group rapidly took over the former military bases of foreign forces. It´s a direct outcome of heightened geopolitical competition in Africa´s geographic and functional spaces such as the Sahara-Sahel and infosphere. Both spaces gained geopolitical prominence as Russia deliberately exploited the situation in coup-affected Sahelian states. Russia created a perception of contradictory security paradigms by utilising information manipulation and intervention techniques.

The article investigates the causes of the EU´s strategic failure in the Sahara-Sahel geopolitical frontline. A case study of the EU´s and its member states' engagement in Mali identifies key sources of gradual strategic divergence between Mali and the EU. The Malian case is relevant because the country lies at the epicentre of armed violence and regional instability but also because of the geostrategic implications of Russia´s political and military influence in the region for regional and European stability and security. Secondly, the case of Mali illustrates the EU´s shedding influence in the Sahel – one of the world´s most fragile regions, which is its geographic priority. Methodologically the text analyses factors (from tactical to strategic level) – both on the EU and local side - that hampered effective security cooperation and, in the end, led to strategic split.

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Gordon Lyall Paver (1913–1988): Pioneer of South African Military Geosciences in World War II

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Keywords: geophysics, military geology, Second World War, South African Engineer Corps

Abstract:

Gordon Lyall Paver was born and initially educated in Johannesburg, South Africa, later in England at Charterhouse School and from 1931 at Pembroke College in the University of Cambridge. After passing Part I of the Natural Sciences Tripos examination in chemistry, geology and mineralogy, he graduated and returned to South Africa in 1934, being appointed to the Geological Survey as one of its first two geophysicists. However, in August 1940 he became one of the first three officers commissioned to found the 42nd Geological Section of the South African Engineer Corps: a unique unit.

In September the Section deployed to a base in Kenya, soon with 'Acting Captain' Paver as its second-in-command. Detachments from the Section deployed in Kenya and later in Italian and British Somaliland plus Abyssinia for earth resistivity or magnetometer surveys that guided the drilling of wells to abstract potable groundwater, helping to facilitate military operations in arid or semi-arid regions during the East African Campaign. Campaign victory assured, in September 1941 the Section under command of the newly promoted Major Paver was re-deployed to a base in Egypt. There it supported British military operations in the Western Desert of Egypt and Libya, but detachments also deployed to Syria, Lebanon, Iraq and Iran, and within the Mediterranean region more generally, notably to Cyprus, Malta, Sicily and Greece. In 1943, Paver led the teaching of military courses in geophysical methods and the compilation of a corresponding textbook; in 1945, he assisted in planning in Europe for the potential deployment of the Section to the Far East.

Demobilised after final victory as then the most senior major to be serving professionally as a geologist with British armed forces, Paver developed a career in South Africa as a groundwater consultant, including projects in Egypt, Pakistan and Cyprus. He had pioneered and mostly directed the use of geophysical surveys in support of British military operations during World War II and merited the military honours bestowed upon him for 'gallant and distinguished services.

Combatting the coupling of underground and urban environments for offensive and defensive guerrilla/terror war-scale Hamas engagements from, and in the Gaza Strip, southern Israeli coast

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Keywords: tunnels, underground warfare, Islamic Hamas terrorists, Gaza-Israel War, massacre

Abstract:

For four decades, Arab terrorists in the Gaza Strip have been furnished with weapons smuggled from and through the northern Sinai Peninsula, Egypt. Islamic Hamas began preparing to initiate war against Israel at least since its takeover of the Strip from the PA in 2007. The 7-10-24 Hamas offensive invasion into Israel from the Gaza Strip and beheading, burning, rape and slaughter of 1,200+ babies, women, children, men, soldiers and senior citizens, from 41 countries, forced the Israel Defence Forces (IDF) to invade the Strip to destroy Hamas military and infrastructure.

The IDF encountered prepared Hamas troops in fortified residential buildings and public structures, and hundreds of kilometres of fortified underground tunnel complexes (UTCs) fed by over a thousand shafts, mainly originating under such structures. Multi-story UTCs served for logistics, control, concealment and most of the tactical and strategic defensive and offensive components of the Hamas warfare. They were dug in all of the Gazan lithologies - calcareous, sandy palaeosols and loess, aeolianites and even loose sand. UTCs sometimes exceeding 50 m depth, traversed a significant part of the Strip, but were denser beneath urban areas.

Remote and on-ground detecting and destruction attempts of the shafts and UTC segments by explosions and pumped water in battle posed a globally unprecedented challenge to the IDF. Partial to significant success was feasible only by obtaining full, air-supported, control of the ground. The battle scenario of urban terrain coupled with immense UTCs, generated significant damage and destruction of Hamas-controlled structures. Explosions of UTC segments destabilised and decapitalised adjacent substrates and structures. Thus, damaged areas have to be fully torn down, scrubbed from the thick rubble cover and undergo environmental and engineering rehabilitation.

This paper presents several understandings and lessons derived from this ongoing campaign that may be relevant for near-future conflicts such as between Western forces and Islamic militias or Asian entities.

Using GIS and publicly available data to determine coercion into marine wildlife poaching and piracy

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Keywords: piracy, poaching, marine resources, communities, criteria

Abstract:

This abstract is based on a paper published in the Advances in Cartography and GIScience of the International Cartographic Association, 1, 2019 titled: Using GIS and Cartography as part of the whole-of-society approach to determine coercion into marine wildlife poaching and piracy.

This abstract looks at the profiling of coastal communities along the South African coast for possible coercion into piracy and marine wildlife crime in the context of a whole-of-society approach. The criteria and data are based on publicly available resources to do the profiling. The criteria range from access to motorised boats, history of illegal, unregulated and unreported fishing activities, poverty, unemployment, closeness to marine reserves and levels of education. The criteria for piracy are based on articles and reports on the reasons for piracy along the Somalian coast.

From the analysis, the highest risk for piracy is the southwestern Cape around Cape Town owing to the proximity to international sea routes, the ability of the local population to do deep-sea fishing and existing gang activity. The risk to marine resources is similar owing to the same reasons as for piracy. It is a known fact that gangs are involved in the poaching of abalone along the south-western Cape coast. Socio-economic risks are higher along the east coast of South Africa owing to higher unemployment, poverty and lower education levels. The SANDF is currently involved in anti-poaching and anti-piracy operations.

Using Groth's pattern detection algorithm to detect possible landmine presence based on reflection changes of plants

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Keywords: landmines, detection, clearing operations, reflectance, simulation

Abstract:

This abstract is based on a paper published in the Advances in Cartography and GIScience of the International Cartographic Association, 4, 2023 titled: Groth's algorithm to detect the possible presence of landmines using changes in the reflection of plants. Post-conflict reconstruction includes the removal of land mines and remnants of war. The CSIR conducted in-situ leaf clip readings of contaminated plants to determine the effect of TNT on plants. Indices such as Modified Red Edge Normalised Difference Vegetation Index (mNDVI705), Red Edge Position (REP) and Moisture Stress Index (MSI) did not show any significant differences between control plants and experimental plants with different TNT concentrations.

Groth's pattern-matching algorithm is designed to match several photographs of the same part of the universe. A set of triangles using dominant stars is created for each photograph and matched using an error band. If the selected triangles from the two photographs fit within the error band, then they are from the same section of the universe. Bands for the Pléiades instruments were simulated using the data from the spectrometer for each plant. The reflectance value of the band and the normalised midpoint wavelength of each Pléiades band were used to construct the triangles. The control plant triangle is then matched with the experimental plant and if the triangles do not match, then the effect of TNT on the plant is significant.

The initial results with the control plants and experimental plants are positive, especially in the 30mg TNT per kilogram of soil-contaminated plants which is similar to the leaching concentration from landmines.

Curriculum transformation of the Bachelor of Science in Military Science (Army) (Honours) Programme at the University of Namibia

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Keywords: Curriculum 4.0/5.0, curriculum transformation, 4IR(5IR) needs, graduate attributes, workplace attachment, quality assurance

Abstract:

With the increasing usage of technology, warfare has become modernised by the day. The application of geography to military operations has become more apparent, thereby emphasising the significance of Military professional education. Military professional education programmes are now emerging in developing countries. In 2014, through consultations with the Namibian Defence Force (NDF), the University of Namibia enrolled the first military professional degree in Military science to bridge the skills shortage gap and ensure sufficient well-trained personnel in the NDF. The programme equips selected officers with the knowledge, skills, and attitudes to manage the utilisation of technology within the socio-political and organisational environment in the NDF.

This paper reports on the curriculum transformation process for the undergraduate Bachelor of Science in Military Science (Army) (Honours) programme at the University of Namibia. The program was transformed to provide students with enhanced skills that use data from the physical environment to make informed decisions in military operations, align to the institutional, and national strategic goals as well as respond to 4IR (5IR) needs. Various strategic partners and stakeholders in the military sector were consulted and the programme was benchmarked to similar programmes in military geography. The outcomes of the transformation process include a change in the duration of the programme from a 4-year honours degree to a 3-year bachelor's degree, the introduction of three semesters per academic year as well as the addition of new courses to the programme. Existing course content was revised, improved, and expanded. Lastly, a workplace attachment was introduced to the programme.

The paper has demonstrated the importance of regular revision and transformation of academic programmes for them to remain relevant amid the ever-changing operating environment. Regular reviews not only satisfy student needs but also ensure that stakeholders' needs are addressed and incorporated into academic programmes.

Relationship between the spatial and temporal distribution of fishing vessels and marine environment in Namibia's Exclusive Economic Zone (EEZ)

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Keywords: Automatic Identification System (AIS); Chlorophyll-a concentration (Chl-a); EZZ; fishing effort; liner regression model; marine environmental factors, Sea surface temperature (SST)

Abstract:

Understanding the relationship between the spatial-temporal distribution of fishing vessel activities to environmental factors holds significant importance in the context of monitoring fishery resources and implementing management measures. The purpose of this study was to assess the relationship between the distribution of fishing vessel activity in Namibia's Exclusive Economic Zone (EEZ) and its association with the marine environment. This study utilised fishing effort data from the Global Fishing Watch System (GFW) and satellite data of chlorophyll-a (chl-a), and sea surface temperature (SST) from MODIS-Aqua. Through the AIS data of fishing vessels, the spatial data was gridded into 0.1°×0.1° cells and the average fishing time per square kilometre (hr/km-2) was used to calculate the spatial distribution of fishing intensity in the study for each year. Fishing effort (FE) of fishing vessels was calculated based on automatic identification system (AIS) data in the EEZ from 2018 to 2022, and the overlay maps of fishing effort and environmental factors were plotted together. Moreover, a multiple regression analysis was used to investigate the nonlinear influence of the marine environment factors on the fishing vessel distribution and activity.

The results show that other flagged countries are operating in Namibia's EEZ apart from Namibian flagged which were from Angola, South Africa, Poland, Portugal, Japan, Spain, and others. The computed annual average fishing effort indicated that Namibian flagged fishing vessels spent more time (cumulated > 96k. hours) in the EEZ than other flagged vessels. The fishing efforts increased from 2018 to 2019, decreased in 2020, increased in 2021, and decreased in 2022. The intensity of the fishing effort suggests fishing vessel operations had significant seasonal variations. Based on the overlay analyses of fishing vessel efforts, high occurrence of fishing vessels mainly occurred within the depth of 300 to 400m depth and was associated with areas of chlorophyll-a 1 to 2 mg/m3 and SST at 14-17°C. The results have shown that remote sensing data can provide valuable insights into the spatial and temporal distribution of fishing vessels as well as its relation to environmental factors.

Parametric ship rolling in the northern Agulhas Current: a case study

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Keywords: Agulhas Current, parametric rolling, ship design

Abstract:

Southbound vessels will tend to sail further offshore to make use of the fast-flowing Current, whereas northbound vessels will tend to 'hug' the coast to avoid the Current. From a shipping perspective, South Africa processed more than 4.4 million TEU containers and shipped approximately 324,000 light vehicles to South Africa, in 2022.

Parametric rolling is a fairly new concept in shipping and applies to certain specific ship designs. Ships with strengthened sterns, typically a transom design, are more prone to parametric rolling. This would thus mostly include new-generation container ships and RoRo (vehicle transporter) ships. The parameters involved in initiating parametric rolling are the ship-wave directional offset, Tpitch, Te, Troll, wavelength, and ship length. The variations in the righting lever GZ (dependent on the GM) will ultimately be a factor in the cause of parametric rolling.

The RoRo vessel Modern Drive, a sister ship of several similar designs, sustained severe damage during her passage in the Agulhas Current. She was reported to roll violently almost in a 'corkscrew' like manner. The cause of her damage, primarily internal, was presumed to be due to bad lashings. Having modelled the sea conditions and taking note of a reported roll angle of 30º, it is argued that the original cause of the damage due to broken lashings, was parametric rolling induced.

Poster Abstract & Non-Oral Submissions

VRB project: A geographical information system for bomb risk mapping in the Veneto Region (NE Italy)

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Keywords: Bomb Assessment, UXO, Historical GIS, WW1, WW2

Abstract:

Bomb Risk is considered a crucial topic, particularly in the highly anthropised regions of Northern Italy. Since 2008, risk analysis has been a mandatory process in Italy required before any excavation on a construction site of any kind. In 2012, risks from Unexploded Ordnance were added to the covered categories. Consequently, war risk analysis is a fundamental methodology necessary for both urban planning and the construction industry to proceed with fabrication plans and therefore urban growth.

The VRB project (*Valutazione di Rischio Bellico*, Unexploded Ordnance Risk Assessment) has at its main purpose the creation of Bomb Risk Maps by the elaboration and analysis in a geo-informatic context of both historical sources and ground investigations to support both public administration and the private sector. The project involves the creation of a historical Geographic Information System (GIS) approach for bomb risk mapping in approximately 2000 km^2 area in the Venetian Pre-Alps and high-plain through historical-documentary research of war journals, historic and contemporary aerial photos, LiDAR data, military maps, and thematic cartography.

Historical data found from archives were georeferenced, interpreted and integrated using a statistical approach to map bomb risk from multiple risk scenarios. Bomb craters and historical-military information were recorded in a geo-database, together with civilian objectives and UXO findings from the last ten years. The amalgamation of information was then exploited to enable the researcher to provide relevant risk mitigation practices. This research covered some unexplored themes in the study of twentieth-century war dynamics, such as the GIS-oriented analysis of the damages derived from the conflicts. This project is expected to support and enhance military history and geographical investigations in the context of the First and Second World Wars.

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World War I historical cartography: a framework for a military Historical GIS database

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Keywords: World War I, military cartography, Historical GIS, symbology, geospatial database

Abstract:

World War I military cartography has been examined from numerous perspectives, encompassing areas such as the history of cartography, military history and geoscience, critical cartography, and GIScience. However, one topic with important application implications seems to be less explored: methodologies for uniquely classifying in a GIS environment the different topographical features represented in historical military cartography.

The main objective of this research is the construction of a guide to digitising in a GIS environment the immobile or semi-mobile military elements found in historical military maps of World War I, which can incorporate the legends of different cartographic sources (Italian, English, and Austro-Hungarian cartography) and which can serve as a basis for the construction of geographic databases. The study addresses issues of digitisation in a GIS environment and the complex methodological challenges associated with them, such as issues of interpretation, georeferencing of sources and symbol classification. The guidelines take into account such needs as standardising data recording processes, simplifying database management, and the need to preserve information found in sources.

From conflict to clearance: comparing Ukraine's and Italian Warscapes over time

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Keywords: Warscapes, Ukraine, First World War, Second World War

Abstract:

The transformation of territory over time occurs due to various factors that shape landscapes, leaving lasting imprints. Human intervention has had a significant impact for centuries, considering urban expansion, industrial activities, and intensive agricultural practices. However, the most disruptive force on the landscape, especially in the last century, has been war. The First and Second World Wars upheaved vast territories, and we still hold both documentary and landscape memories today. Consider, for example, the mountainous areas along the border between Italy, Austria, and Slovenia, where the trenches from the First World War or terrain forms indicating bomb craters are still clearly visible.

In the past two years, we have witnessed the transformation of a large portion of Ukrainian territory into a warscape. The Russian invasion has significantly altered extensive areas, destroying inhabited centres with artillery and aerial bombardments, and constructing an intricate network of trenches and defence systems. Observing satellite images inevitably recalls events that occurred between eighty and more than a hundred years ago; different eras, different military technologies, different territories, yet eerily similar images.

In this study, we have harnessed the power of GIS systems to examine the areas affected by war, comparing current images of Ukrainian territory with images from the First and Second World Wars in the northeastern Italian territory.

The work undertaken casts a gaze into the future and can provide a valuable tool for war clearance, reconstruction, and territorial reorganisation, as well as a visual testament to the changes that have occurred.

Moreover, analysing the risk associated with areas impacted by wartime events will allow us to determine, at the end of the conflict, which areas pose greater challenges due to the presence of mines and unexploded ordnance.

Figure 1. San Donà di Piave (Italy) 1918, Mariupol (Ukraine) 2023

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‘Abomination of desolation’ or ‘God’s own country’: An exploration of the impact of the environment, terrain and warfighting on combatant South African soldiers during the German South West African Campaign, c.1914-1915

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Keywords: environment, terrain, warfighting, campaign, South Africans

Abstract:

On 5 May 1915, the South African forces led by Louis Botha captured Karibib in the sterile Namib desert. Recruiting posters for the campaign in local towns were taken down the following day. Two months later, the Germans surrendered. Approximately 43,000 South Africans invaded German South West Africa (GSWA). They faced a numerically weaker German colonial force of roughly 5,000 soldiers. Despite this significant discrepancy in force strength, German troops were acquainted with the arid environment, the lack of water and the rugged terrain. They used defensive tactics and the natural obstacles of the terrain to impede the advance of Union forces. Although the campaign experience varied, and if perhaps less than in East Africa, all men on either side sank in significance next to the heavy influence of the physical environment with its parched landscape, vast distances and contrasting climate.

This paper strives to offer an explorative account of the impact of the environment, terrain and warfighting on white combatant South Africans, with a particular focus on men’s bodies and minds during the German South West African Campaign.

‘A New Way Of Fighting’: The South African Experience of Mountain Warfare in Italy, 1944-1945

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Keywords: Italy, Second World War, 6th South African Armoured Division, mountain warfare

Abstract:

In 1943 the decision was taken to form a South African armoured division for service in the European theatre of operations. In due course, the 6th South African Armoured Division was constituted, and after a period of intensive training in the Western Desert, the division deployed to the Italian theatre in April 1944. Here the South Africans would be tested in a new operational environment, distinctly different to the former African theatres, and not at all conducive to armoured and manoeuvre warfare.

The Allied operational command left little room for South Africa to practice its home-grown manoeuvre doctrine in the Italian theatre. Ironically, for large parts of the campaign, the South African armour was relegated to support roles, while the infantrymen bore the brunt of the fighting across the ever-challenging built-up and mountainous terrain against extremely resolute German defenders.

This paper utilises the assault on and capture of the twin peaks of Monte Sole and Caprara di Marzabotto in April 1945 as a lens through which to investigate the South African experience of mountain warfare during the Italian campaign. In doing so, it addresses an evident gap in South African historiography regarding mountain warfare and adds to the growing scholarly debate surrounding the geography-warfare nexus.

Authors' Index

Authors are listed alphabetically.

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Thank you all for your dedication and support, which have been vital to the success of ICMG24.

Dr Ivan Henrico
Chair of the ICMG24 Organising Committee
May 2024