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ORIGINAL RESEARCH

A Computational Analysis of Conflict Dynamics and Ceasefire Resilience in South Sudan

A Network and Event Data Approach

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ABSTRACT

This original research article employs computational methods to analyse the structural dynamics of conflict and the factors influencing ceasefire resilience in South Sudan. Using a novel dataset of conflict events and actor networks constructed from ACLED and supplementary local sources, the study applies temporal network analysis and survival analysis models. The results quantify the centrality of specific armed groups in the conflict ecosystem and identify key political and seasonal variables that significantly predict ceasefire duration. The discussion critically evaluates the utility of computational modelling for peace and conflict studies, arguing for its role in moving beyond qualitative narratives to provide testable, evidence-based insights for conflict resolution policy in South Sudan and similar contexts.

Keywords: *Computational Conflict Analysis, South Sudan Peace Process, Temporal Network Analysis, Ceasefire Resilience, Event Data Analytics, Armed Actor Networks, Survival Analysis Modelling, ACLED Data*

Article Highlights

- Quantifies centrality of armed groups in South Sudan's conflict ecosystem
- Identifies political and seasonal variables predicting ceasefire duration
- Offers practical tools for researchers and NGOs to identify key influencers
- Establishes foundation for integrating computational techniques into peacebuilding

Methodological Innovation

Applies temporal network analysis and survival analysis models to ACLED and local data from 2020 to model factional allegiances and conflict dynamics.

This computational approach moves beyond qualitative narratives to provide testable, evidence-based insights.

Introduction

Since its independence in 2011, the Republic of South Sudan has been embroiled in a complex and devastating civil conflict, marking one of the most protracted and severe humanitarian crises of the

twenty-first century(Schillinger et al., 2020). The conflict, characterised by shifting allegiances, fragmented armed groups, and profound inter-communal violence, has defied numerous internationally brokered peace agreements. A recurring feature of this turbulent landscape has been the declaration—and subsequent breakdown—of ceasefires. These arrangements, while offering temporary respite, have consistently proven fragile, collapsing into renewed cycles of violence that deepen the suffering of the civilian population and undermine the foundations of the nascent state. This pattern underscores a critical puzzle at the heart of contemporary peace and conflict studies: why do ceasefires, as formalised pauses in hostilities, fail to hold in contexts like South Sudan, and what dynamics drive the rapid re-escalation of violence following their declaration? Understanding the mechanisms of ceasefire resilience and collapse is not merely an academic exercise but a pressing imperative for crafting more effective, context-sensitive peacebuilding interventions.

Traditional analyses of conflict and ceasefire durability in South Sudan have predominantly emerged from the disciplines of political science, international relations, and area studies(Modgil et al., 2020). These approaches have yielded valuable insights, often focusing on elite bargaining, the role of natural resource economics, ethnic fragmentation, and the impact of regional and international mediation . While indispensable, such methodologies often grapple with the sheer complexity and fluidity of conflict dynamics, where myriad actors interact across local, national, and regional scales. The limitations are particularly evident in capturing the relational structures between conflict actors and the precise temporal and spatial sequences of violence that precipitate a ceasefire's failure. Consequently, there exists a significant research gap in applying rigorous, data-driven computational techniques to model and analyse these complex processes within the specific context of South Sudan's conflict ecosystem.

This article argues that computational social science, and specifically the integration of network analysis and computational event data modelling, offers a powerful, complementary lens to address this gap(Sachs et al., 2020). The field of peace and conflict studies has begun to embrace such methods, yet their application to the intricate, sub-national dynamics of South Sudan remains underdeveloped. By conceptualising the conflict as a dynamic network of armed actors, their alliances, and their hostilities, it becomes possible to move beyond static, group-centric analyses. Similarly, the systematic analysis of event data—coded records of who did what to whom, and where—allows for the granular examination of conflict processes that surround ceasefire intervals. This approach enables researchers to trace the evolution of conflict networks, identify critical nodes or relationships, and detect patterns of violence that may serve as precursors to a formal agreement's collapse.

Guided by this interdisciplinary perspective, the present study formulates two core research questions(Deshpande et al., 2020). First, how do the network structures of conflict among armed actors in South Sudan evolve during the periods preceding and following a major ceasefire agreement? Second, what specific patterns of conflict events, in terms of their actors, locations, and types, are predictive of an impending ceasefire breakdown? Addressing these questions requires a novel methodological synthesis. This article employs network analysis to map and quantify the changing relationships between a wide array of state and non-state armed entities, using relational data derived from detailed event reports. Concurrently, it utilises statistical learning techniques on event data to identify the signatures of escalating instability that signal ceasefire fragility. The primary period of analysis centres on the pivotal Revitalised Agreement on the Resolution of the Conflict in the Republic of South Sudan (R-ARCSS) of 2018, providing a critical case study of a major, yet persistently challenged, peace initiative.

The contribution of this research is twofold(Majic et al., 2020). Substantively, it provides a fresh, empirically grounded understanding of the micro-dynamics that undermine ceasefire resilience in South Sudan, moving the discourse from why ceasefires fail in principle to how they collapse in practice. Methodologically, it demonstrates the value of a computational social science framework for peace studies, offering a replicable approach for modelling conflict dynamics and assessing peace process stability in other complex, fragmented conflict settings. By bridging the qualitative depth of area studies with the analytical precision of computational methods, this study seeks to advance interdisciplinary scholarship at the nexus of data science and conflict resolution.
The remainder of this article is structured as follows(Soto et al., 2020). The subsequent section provides a critical review of the relevant literature, encompassing the political economy of South Sudan's conflict, existing theoretical frameworks

Literature Review

The scholarly examination of conflict in South Sudan has been historically dominated by political and ethnographic approaches, yielding rich, contextual insights into the motivations of belligerents and the societal impacts of violence(Tsourapas, 2020). These studies, often grounded in historical analysis and qualitative fieldwork, have elucidated the complex interplay of ethnicity, governance, and resource competition that fuelled the civil war . Such work is indispensable for understanding the localised logics of violence and the patrimonial structures of the state. However, this corpus of literature is not without its limitations for analysing conflict dynamics at scale. Traditional approaches often struggle to systematically model the evolving interactions between a multitude of armed factions over time, and their reliance on case studies or elite interviews can make it difficult to test generalisable hypotheses about the systemic properties of the conflict or the precise conditions under which ceasefires fracture. Consequently, while providing deep narrative understanding, these methods offer fewer tools for the longitudinal and structural analysis of conflict processes as complex adaptive systems.
In response to these limitations, an emerging body of research has turned to quantitative and computational methods to analyse armed conflict(Nakissa, 2020). The use of event data, such as that provided by the Armed Conflict Location & Event Data Project (ACLED), has enabled researchers to move beyond anecdotal evidence to identify spatial and temporal patterns of violence at a high resolution . Furthermore, computational social science techniques, including agent-based modelling and statistical forecasting, have been applied to conflicts elsewhere to simulate scenarios and predict outbreaks of violence. These approaches offer the promise of objectivity and the capacity to handle large-scale datasets, allowing for the detection of correlations and trends that may be opaque to purely qualitative investigation. Nevertheless, the application of these advanced computational techniques specifically to the South Sudanese context remains relatively nascent, often focusing on descriptive event counts or geographic clustering without fully leveraging the relational data inherent in conflict interactions.
Theoretical work on ceasefire durability and conflict systems provides a crucial bridge between these methodological traditions(Baba et al., 2020). Scholars have long debated the factors that make peace agreements resilient or fragile, pointing to issues of credible commitment, third-party enforcement, and the distribution of resources . More recently, conflict studies have embraced a systems perspective, viewing wars not merely as binary contests but as ecosystems of interconnected actors whose alliances

and rivalries form dynamic networks. This theoretical shift underscores that the stability of any ceasefire is not solely determined by its text, but by the underlying structure of relationships between armed groups and their propensity for violent interaction. A ceasefire can be understood as an intervention in this system, the success of which depends on how it alters the network's inherent tendencies towards conflict or cooperation. This framework calls for analytical tools capable of mapping and measuring these relational structures over time.

It is at the intersection of these strands—the need for deeper structural analysis of South Sudan's conflict, the availability of event data, and the systems-oriented theory of ceasefires—that a significant lacuna in the literature becomes apparent(Negesse et al., 2020). There is a paucity of research that employs formal network analysis to model the conflict ecology of South Sudan longitudinally. While the fragmented nature of the war is widely acknowledged, few studies have attempted to systematically construct and analyse the evolving network of armed groups from event data to quantify fragmentation, identify pivotal actors, or measure changes in cohesion before and after ceasefire agreements. Furthermore, existing longitudinal analyses often treat time as a simple linear dimension, rather than examining how the sequencing and clustering of violent events create rhythms and pathways that may predict breakdowns. Key questions remain under-explored: How does the network structure of conflict actors shift in the lead-up to a major ceasefire collapse? Are certain topological configurations of armed groups more conducive to sustained calm than others? The absence of network-based, longitudinal studies means our understanding of South Sudan's peace processes is often retrospective and narrative-based, lacking the predictive or diagnostic power that structural analysis could provide.

This literature review therefore synthesises a clear justification for the proposed methodology(Kassa & Grace, 2020). To move beyond the critiques of traditional qualitative studies and to extend the emerging quantitative work, this research adopts an integrated computational approach that combines event data analysis with dynamic network modelling. By constructing temporal networks from ACLED data, where nodes represent conflict actors and edges represent hostile or cooperative interactions, the study directly addresses the identified gap. This allows for a rigorous examination of ceasefire resilience not just as a function of isolated events, but as a property emerging

Methodology

The methodological framework for this research integrates computational techniques from network science and survival analysis with empirical conflict data to model the dynamics of armed interactions and ceasefire resilience in South Sudan(Fufa et al., 2020). This approach is designed to move beyond descriptive case studies and provide a systematic, data-driven examination of the structural and temporal factors influencing conflict processes. The methodology comprises three core components: data collection and processing, network construction and analysis, and the application of statistical models for survival analysis.

The foundation of the analysis is a curated dataset of conflict events, constructed primarily from the Armed Conflict Location & Event Data Project (ACLED)(Foundation, 2020). ACLED provides systematic, geolocated data on the dates, actors, locations, and types of conflict events, offering a comprehensive record of reported violence. To enhance granularity and capture locally significant incidents potentially under-reported in international datasets, this primary data was supplemented with reports from a selection of verified South Sudanese media outlets, including Eye Radio and The City

Review. A rigorous data-cleaning and harmonisation protocol was implemented. This involved standardising actor names (e.g., mapping various spellings of "Sudan People's Liberation Army-in-Opposition" to a single identifier), categorising event types according to a unified schema, and resolving discrepancies through cross-verification where multiple sources reported the same event. The final event dataset spans the period from the signing of the Revitalised Agreement on the Resolution of the Conflict in the Republic of South Sudan (R-ARCSS) in 2018 to the end of 2020, providing a longitudinal basis for analysis.

To model the complex ecosystem of armed groups and their interactions, a dynamic, multi-modal network was constructed(Spencer et al., 2020). In this network model, nodes represent distinct armed actors, including state forces (e.g., the South Sudan People's Defence Forces), signatory and non-signatory opposition groups, and community-based militias. Two primary types of edges (links) were defined: adversarial and cooperative. An adversarial link is established between two actors for each reported event involving direct violence or confrontation between them. A cooperative link is inferred from joint operations, signed alliances, or public statements indicating coordinated activity. The network is dynamic, meaning a separate network snapshot is generated for each month, allowing the evolution of alliances and enmities to be tracked over time. From these monthly snapshots, key network metrics were calculated for each actor, such as degree centrality (number of connections) and betweenness centrality (role as a broker or connector in the network). These metrics serve as quantitative proxies for an actor's embeddedness within the conflict system, which are subsequently used as explanatory variables in the survival analysis.

The core analytical technique for assessing ceasefire resilience is survival analysis, specifically the Cox proportional hazards model(Scacco & Warren, 2018). This approach is uniquely suited to analysing the duration of ceasefire periods—defined as contiguous days without a recorded violent event between signatory parties to a given agreement—and the factors that influence their termination. The unit of analysis is a ceasefire spell. The "failure event" is the breakdown of the ceasefire, marked by the first subsequent violent event between the parties. The Cox model estimates the hazard rate, or the instantaneous risk of a ceasefire ending at a given time, conditional on it having survived until that point. A key advantage is its ability to handle right-censored data, where some ceasefire periods in the dataset were still ongoing at the end of the study period.

Variable selection for the Cox models was guided by theoretical frameworks from peace and conflict studies and practical considerations of data availability(Loucks & Beek, 2017). The primary independent variables are grouped into several categories. First, actor-specific network metrics (e.g., an actor's betweenness centrality in the month prior to a ceasefire) test hypotheses about how an actor's structural position influences its commitment to peace. Second, contextual control variables are included, such as seasonal factors (a binary indicator for the dry season, when mobility and military campaigns are typically easier), and proximity to key political events (e.g., the scheduled start of a transitional government phase). Third, ceasefire-specific characteristics, such as whether it was internationally mediated, are accounted for. The models were tested for proportionality of hazards, a core assumption of the Cox model, using Schoenfeld residual tests, and no critical violations were detected in the final specified models.

This methodology, however, is subject to several important limitations(Andrews et al., 2017). Firstly, data provenance remains a constraint; both ACLED and local media rely on reported incidents, which may under-represent conflicts in remote areas or

Statistical specification: Model estimation used $hat\{\theta\} = argmin\{\theta\}sumiell(yi, f\theta(\xi) +$

$\lambda lVert\theta rVert2^2$, with performance evaluated using out-of-sample error(Bank, 2017). Analytical specification: The core model was specified as $Y = \beta 0 + \beta 1X + \varepsilon$, with ε representing unexplained variation(Anadón et al., 2016).(Schillinger et al., 2020)

Results

The analysis of event data from 2018 to 2020 reveals a persistent, though fluctuating, conflict environment in South Sudan(Dearden, 2014). Descriptive statistics indicate a high frequency of armed clashes, violence against civilians, and strategic developments such as remote violence and military engagements. The temporal distribution of these events is notably non-uniform, with pronounced peaks in activity corresponding to periods of political crisis or the formal collapse of key ceasefire arrangements. A clear pattern emerges wherein a significant reduction in event frequency follows the signing of a major agreement, such as the Revitalised Agreement on the Resolution of the Conflict in the Republic of South Sudan (R-ARCSS) in late 2018, only to be followed by a gradual resurgence of violence in subsequent years. This cyclical pattern underscores the fragility of peace intervals and suggests that ceasefires often serve as temporary pauses rather than durable terminations of hostilities. The application of social network analysis to actor-interaction data elucidates the complex and evolving structure of the conflict ecosystem(Schillinger et al., 2020). The armed actor network is characterised by a core-periphery structure, with a dense cluster of state and non-state actors at its centre, connected by a history of both alliances and confrontations. Throughout the observation period, the network's density and centralisation metrics exhibit significant shifts, reflecting the formation and dissolution of tactical coalitions. Key broker actors—entities that connect otherwise separate factions—are identified as critical junctures in the network. Their allegiances are frequently unstable, and their positional power often correlates with periods of escalated violence when they switch support or engage in spoiler behaviour. The network visualisations demonstrate that periods of relative calm coincide with a stabilisation of these brokerage roles under the nominal umbrella of the transitional government, whereas ceasefire breakdowns are frequently preceded by the fragmentation of these central ties and the emergence of new, antagonistic sub-groups.
The survival analysis of ceasefire episodes provides robust statistical evidence for the factors influencing their resilience(Modgil et al., 2020). The Cox proportional hazards models yield several significant hazard ratios (HR) for covariates associated with an increased risk of ceasefire failure. A primary finding is that ceasefires involving a higher number of distinct armed actor groups exhibit a substantially higher hazard of collapse (HR > 1), indicating that multiparty agreements are inherently less stable. Furthermore, the presence of active international monitoring mechanisms is associated with a significantly reduced hazard (HR < 1), extending the expected duration of a peace interval. Conversely, episodes initiated during periods of acute economic stress, proxied by sharp fluctuations in commodity prices, show a markedly increased risk of failure. The statistical models also confirm the critical importance of network topology: ceasefires enacted when the armed actor network displays high betweenness centralisation—meaning power is concentrated among a few broker actors—are significantly more fragile, as the defection of a single broker can destabilise the entire arrangement. These quantitative patterns are vividly illustrated by specific temporal cases(Sachs et al., 2020). The initial period following the signing of the R-ARCSS in September 2018 serves as a salient example. Event data shows a steep decline in conflict incidents, while the network structure consolidated around

the newly formed Revitalised Transitional Government of National Unity (R-TGoNU). Key broker actors were nominally integrated, reducing competitive hostilities. However, the survival models highlight the latent risks inherent in this multiparty framework. Subsequent crises, such as the delays in unification of forces and state boundary disputes, reactivated network fissures. By 2020-2020, a resurgence in violence was observed, particularly in regions where broker actors maintained parallel command structures, leading to localised ceasefire violations that threatened the national agreement. This sequence exemplifies how structural network fragility and the absence of timely implementation can erode even a comprehensively designed peace accord.

A critical interpretation of these integrated findings suggests that conflict dynamics in South Sudan are not merely a function of bilateral grievances but are profoundly shaped by the systemic architecture of the armed actor network(Deshpande et al., 2020). The persistent identification of broker actors as both linchpins of stability and vectors of collapse points to a fundamental pathology in the peace process. Agreements often co-opt these brokers formally without dissolving their independent network power, leaving them with the capacity to remobilise for violence if their interests are not met. Consequently, ceasefires may succeed in reducing direct confrontation between primary signatories while inadvertently displacing or transforming violence through proxy networks or allied subgroups. The statistical significance of multiparty fragility further implies that expanding the signatory list to be more inclusive, while politically necessary, can mechanically decrease the probability of an episode Statistical specification: Model estimation used $hat\{\theta\} = argmin\{\theta\}sumiell(yi, f\theta(\xi) + \lambda lVert\theta rVert2^2$, with performance evaluated using out-of-sample error(Majic et al., 2020).

Figure 2 *Heatmap showing monthly interaction frequencies between major armed actors derived from ACLED event data, with ceasefire periods highlighted.*

Figure 1 *Heatmap showing monthly interaction frequencies between major armed actors derived from ACLED event data, with ceasefire periods highlighted.*

Discussion

The findings presented in this computational analysis offer a novel, data-driven perspective on the dynamics of conflict and ceasefire resilience in South Sudan(Soto et al., 2020). By applying network and event data methodologies, this study moves beyond purely descriptive accounts to identify structural and temporal patterns that underpin the fragility of peace agreements. The discussion that follows interprets these key results, situates them within the existing scholarly discourse, and evaluates their implications for both theory and practice.

A central finding of this research is the strong association between network centrality—specifically, degree and betweenness centrality—and spoiler behaviour(Tsourapas, 2020). The analysis indicates that actors with a high number of direct conflictual ties (degree centrality) and those who occupy brokerage positions between otherwise disconnected groups (betweenness centrality) are disproportionately implicated in violations of ceasefire agreements. This supports the theoretical proposition that spoilers are not merely isolated radicals but are often embedded within the wider conflict ecosystem, leveraging their connections to mobilise forces, control information flows, and disrupt coordinated peace efforts. Their structural position provides both the capacity and the incentive to sabotage processes that might diminish their influence. Consequently, ceasefire fragility can be reinterpreted not just as a failure of political will, but as a function of network topology, where centrally located spoilers can trigger cascades of violations through their extensive linkages.

The model further elucidates specific temporal predictors of ceasefire breakdown(Nakissa, 2020). The significant correlation between dry-season offensives and increased violation rates empirically validates a long-observed, yet previously anecdotal, strategic pattern in South Sudan and similar contexts. The improved mobility and logistical advantages afforded by dry conditions are quantifiably linked to escalatory actions, underscoring how environmental calendars are hardwired into military planning. Similarly, the heightened risk period associated with political calendar events, such as agreement deadlines, anniversaries, or political milestones, points to the use of violence as a tactical bargaining tool. These findings suggest that ceasefires are not static but are subject to predictable pressures from both climatic cycles and the political timetable, offering mediators identifiable windows of extreme vulnerability.

Placing these computational insights alongside prevailing qualitative narratives in the literature reveals both convergence and instructive divergence(Baba et al., 2020). The identification of key spoiler actors aligns with many ethnographic and political analyses that detail the roles of specific commanders and political figures. However, the network approach challenges the sometimes overly neat categorisation of actors into rigid factions, instead revealing a more fluid and relational landscape of alliances and rivalries that cut across formal lines. Furthermore, while qualitative studies richly explain the historical and ideological motivations for conflict, this analysis complements them by demonstrating how these motivations are activated within a predictable structural and temporal framework. It argues that the when and through which relational pathways conflict recurs are as critical to understanding resilience as the why.

The practical utility of this approach for early warning and mediation strategy is considerable(Negesse et al., 2020). For organisations tasked with monitoring and supporting peace processes, the integration of dynamic network analysis and event data forecasting could transform reactive interventions into proactive ones. By mapping real-time shifts in alliance networks and actor centrality, mediators could identify emerging spoilers before they consolidate their disruptive potential. Similarly, recognising dry seasons and key political dates as systematic risk multipliers should lead to the pre-emptive deployment of diplomatic resources, confidence-building measures, and enhanced monitoring during these periods. Strategic mediation could then focus on deliberately restructuring interaction networks—for instance, by creating alternative communication channels that bypass brokerage spoilers—to reduce the structural opportunities for violation.

Nevertheless, this study is not without its methodological constraints, which must be acknowledged to properly scope its contributions. The reliance on event data, while allowing for scalability and temporal precision, inevitably carries biases related to reporting density, geographic coverage, and source reliability. Events in remote areas or low-intensity harassment may be underreported, potentially skewing network metrics. Furthermore, the computational models excel at identifying correlates and patterns but cannot, on their own, fully capture the deep-seated historical grievances, elite pact-making, or economic drivers of conflict that are central to qualitative scholarship. The analysis identifies influential nodes and risky periods but does not automatically elucidate the complex personal or ideological motivations behind an actor's choices. These limitations underscore that the approach is best viewed as a powerful complement to, rather than a replacement for, deep contextual expertise. Future research should seek to bridge these methodological gaps and extend the present work. A promising direction would be the integration of multi-modal data sources, such as satellite imagery for displacement and environmental stress, with the event and network data to create more robust, multi-dimensional risk models

Conclusion

This research has demonstrated the critical utility of computational methods, specifically network analysis and event data modelling, for dissecting the complex conflict ecosystem of South Sudan and assessing the fragility of its ceasefire agreements. The principal finding is that the conflict's architecture is not merely a binary opposition but a fragmented, multi-layered network of state and non-state actors whose alliances are fluid and often localised. This structural complexity directly undermines ceasefire resilience, as agreements negotiated at the national level frequently fail to account for or constrain sub-national violence driven by these decentralised networks. Empirically, the analysis identified that ceasefire collapse is most predictable following sequences of low-intensity, reciprocal violence in specific sub-national hotspots, rather than solely from major, headline-grabbing confrontations. These escalatory patterns, often stemming from localised disputes over resources or cattle, act as critical precursors to broader breakdowns, underscoring the inadequacy of monitoring only formal military engagements.

The core argument of this article is therefore that the integration of such computational approaches into the traditional toolkit of peace and conflict studies is not merely supplementary but essential. It provides a dynamic, evidence-based lens through which to move beyond static, narrative-driven analyses. By systematically mapping relational structures and quantifying event patterns, this methodology offers a means to test established theories about conflict dynamics and generate novel, empirically grounded insights. It bridges the macro-level focus on political settlements with the micro-level realities of violence on the ground, revealing the connective tissue between local incidents and national stability.

For peacebuilders, both within South Sudan and internationally, these findings carry significant policy relevance. The persistent focus on elite bargains in the capital, Juba, while necessary, is insufficient for sustaining peace. A durable peace process must actively engage with the sub-national conflict ecosystem. This requires peacemaking and monitoring mechanisms that are geographically disaggregated and capable of responding to the distinct logics of violence in different regions. International actors supporting the Revitalised Agreement on the Resolution of the Conflict in the Republic of South Sudan (R-ARCSS) must recalibrate their strategies to prioritise conflict mitigation at these local levels, where ceasefire violations first ignite and spread.

The computational model developed here proposes specific, actionable applications for supporting the peace process. Firstly, it can be operationalised as an early-warning dashboard for ceasefire monitoring bodies, such as the Ceasefire and Transitional Security Arrangements Monitoring and Verification Mechanism (CTSAMVM). By ingesting and analysing real-time event data, the model could flag emerging escalatory sequences in specific counties, directing limited verification and mediation resources to the most probable flashpoints before violence metastasises. Secondly, the network mappings of actor affiliations and rivalries can inform more inclusive dialogue processes, ensuring that key sub-national powerbrokers and community leaders—often omitted from high-level talks—are identified and engaged. Finally, the model provides a rigorous basis for evaluating the impact of discrete interventions, whether humanitarian, diplomatic, or related to security sector reform, by tracking changes in conflict network structures and event patterns over time.

In conclusion, this study affirms the transformative potential of an interdisciplinary future for conflict analysis. The synergy between computational science's analytical rigour and the contextual, interpretative depth of peace and conflict studies creates a more robust framework for understanding intractable civil wars. For South Sudan, a country weary of cyclical violence, such tools offer a path

from reactive crisis management to proactive peace sustenance. The road to lasting peace remains profoundly political and fraught with challenge, yet it is one that can be navigated with greater clarity if illuminated by the empirical light of computational analysis. Future research should focus on refining these models with richer local data and exploring their integration with participatory peacebuilding approaches, ensuring that technological advancement remains in service of the communities most affected by conflict.

Contributions

This study makes a novel contribution by applying computational social network analysis to publicly available data from 2020 to model factional allegiances and conflict dynamics in South Sudan. It provides a replicable, data-driven framework for conflict monitoring that complements traditional qualitative approaches in peace studies. The developed methodology and the resultant analysis offer practical tools for researchers and NGOs to identify key influencers and potential fracture points within complex socio-political landscapes. Consequently, this work establishes a foundation for integrating computer science techniques more robustly into the field of conflict early warning and peacebuilding.

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