Policy Brief

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The Evolving Structure of the U.S.–Iran–Israel Conflict:

MCEA and NMF Analysis of Analytical Days 1–159 Using MCCM v2.3.4

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Key Judgments

- **Phase III marked the conflict's decisive structural shift.** Mean Multi-Component Escalation Assessment (MCEA) increased from 0.716 in Phase II to 0.840 in Phase III, and reached 0.980 on Day 140. The shift was systemic rather than purely military: kinetic escalation, rule contestation, information amplification, uncertainty, resilience erosion, and external-node exposure intensified together.
- **Phase II was an early-warning phase of compositional change.** Although average systemic pressure remained close to Phase I levels—0.716 compared with 0.699—the underlying mechanism mix shifted toward greater institutional stress, external-node pressure, information amplification, and actor coupling.
- **Persistent systemic pressure was led by** uncertainty, risk signaling, aggregate strategic stress, rule contestation, narrative polarization, information amplification, and actor coupling.
- **Non-negative matrix factorization (NMF) reveals four recurring co-activation patterns that aggregate MCEA alone cannot identify.** These patterns capture kinetic and physical disruption, rule-order and external-node coupling, resilience and normative-stability erosion, and institutional-information network pressure.
- **Three exploratory daily clusters distinguish different pressure configurations at similar aggregate levels.** These clusters should be treated as diagnostic regimes rather than substitutes for the formal Phase I–III structure.
- **Effective warning requires monitoring cross-layer configurations and resilience loss, not only visible strike intensity.** The most dangerous transition occurs when military, institutional, informational, economic, and network pressures reinforce one another while stabilizing mechanisms weaken.

Executive Summary

This policy brief examines the evolving structure of the U.S.–Iran–Israel conflict across 159 analytical days using the Multi-Domain Conflict and Coupling Model (MCCM) v2.3.4, the Multi-Component Escalation Assessment (MCEA), non-negative matrix factorization (NMF), and exploratory k-means clustering. The results show a limited rise from Phase I to Phase II, followed by a decisive structural break in Phase III. Mean MCEA increased from 0.699 in Phase I to 0.716 in Phase II, then rose to 0.840 in Phase III—17.27% above Phase II. The series peaked at 0.980 on Day 140.

The Phase III rise was not a simple increase in military activity. Escalation dynamics, rule and institutional contestation, narrative warfare, uncertainty, transmission mechanisms, resilience erosion, and external strategic-node dependency intensified together. The ten-layer topographic view shows that the shift was distributed across the conflict system rather than confined to a single layer. The largest persistent contributions came from uncertainty, state risk signaling, aggregate strategic stress, rule contestation, narrative polarization, information amplification, and actor coupling.

Exploratory NMF identifies four recurring co-activation patterns: kinetic escalation and physical disruption; rule-order and external-node coupling; resilience and normative-stability erosion; and institutional-information network pressure. Three daily clusters show that similar aggregate pressure levels can conceal different internal configurations. These exploratory results add diagnostic resolution but do not replace the formal Phase I–III structure.

The central policy conclusion is that systemic escalation occurs when military, political, informational, institutional, economic, and network pressures reinforce one another while resilience mechanisms weaken. Effective warning therefore requires monitoring mechanism configurations, not only individual strikes or headline military indicators.

Why This Matters

Traditional conflict monitoring often privileges visible military activity: strikes, casualties, deployments, and territorial effects. The U.S.–Iran–Israel conflict demonstrates why that is insufficient. Military operations interact with maritime risk, energy flows, institutional contestation, information amplification, alliance behavior, and the exposure of external strategic nodes. Contemporary assessments of the conflict likewise emphasize the danger of self-reinforcing escalation, the vulnerability of chokepoints and civilian infrastructure, and second- and third-order effects that extend beyond the immediate theater (Gordon, 2026; Govella & Nakano, 2026; Yacoubian, 2026a, 2026b).

MCCM v2.3.4 tracks 35 mechanisms across ten analytical layers. MCEA estimates how high systemic pressure is; the ten-layer topography shows where recorded intensity is distributed over time; NMF identifies which mechanisms repeatedly co-activate; and clustering shows which daily configurations recur. Together, the methods separate magnitude, structural distribution, latent composition, and regime recurrence.

Analytical Note

This brief uses a frozen 159 × 35 MCCM v2.3.4 weighted matrix covering Analytical Days 1–159. Phase I covers Days 1–95, Phase II Days 96–131, and Phase III Days 132–159. Each analytical day runs from 12:00 p.m. Eastern Time to 12:00 p.m. Eastern Time the following day using the America/New_York time zone. A separate 1,019-event Canonical Event knowledge base preserves source provenance and structured event information; because most newly added events lacked independently resolvable event times, publication dates were not substituted and the event database did not overwrite the formal daily matrix.

MCEA is the equal-weight average of 35 risk-oriented mechanism values. Seven stability-oriented mechanisms—LC, NSI, EET, SCI, WJC, DRI, and MLI—are inverted before aggregation. Threshold Risk is a separate logistic diagnostic applied to the raw MCCM mean using $\theta = 0.82$ and a slope of 12. The ten-layer contour uses raw within-layer means; stability-oriented inversion is not applied in that visualization. The Negotiation Feasibility Index (NFI), derived from selected MCCM-linked indicators of control, institutional compatibility, signaling stability, agreement design, enforcement capacity, and time-arbitrage risk, is normalized to the 0–1 interval and reported only as a supplementary diagnostic. NFI Risk is defined as 1 − NFI, such that higher values indicate lower negotiation feasibility. NFI is neither part of the MCEA calculation nor an additional MCCM layer.

The analytical outputs comprise 159 daily MCEA records, 1,590 layer-contribution records, 5,565 mechanism-contribution records, four retained NMF components (relative reconstruction error = 0.081922), and three exploratory clusters (silhouette coefficient = 0.471726).

1. Introduction

This policy brief examines conflict-system evolution through four complementary analytical tools: MCCM v2.3.4, MCEA, ten-layer topography, and NMF with exploratory k-means clustering. MCCM structures multidomain observations; MCEA measures daily systemic pressure; the layer analysis shows its distribution across the conflict architecture; and NMF and clustering identify recurring mechanism combinations and daily configurations.

MCEA is calculated as the equal-weight mean of 35 risk-oriented MCCM mechanisms and should be read as a comparative pressure measure rather than a probability of war, collapse, or uncontrolled escalation. NMF decomposes nonnegative multidimensional observations into additive components and is widely used to identify interpretable latent structures (Lee & Seung, 1999). K-means clustering was applied to row-normalized NMF activation vectors using the standard iterative partitioning approach (Lloyd, 1982), emphasizing differences in pressure composition rather than simply separating days by total intensity. Cluster separation was assessed in part through the silhouette coefficient (Rousseeuw, 1987), and the implementation used scikit-learn (Pedregosa et al., 2011).

Taken together, the methods distinguish four related questions: how high systemic pressure was, where it was distributed, which mechanisms repeatedly moved together, and which daily configurations organized those patterns. **Table 1** summarizes the analytical role and interpretation boundaries of the four methods. Convergence across these views supports the interpretation of Phase III as a system-wide escalation rather than an increase confined to a single military, political, or informational domain.

Table 1. Analytical Design and Interpretation Boundaries

Tool	Input	Purpose	Interpretation Boundary
MCCM v2.3.4	159 days × 35 mechanisms	Structure multidomain conflict observations	Weighted observation matrix, not event counts
MCEA	Risk-oriented 35-mechanism matrix	Estimate daily systemic pressure	Composite indicator, not a probability
NMF	159 × 35 nonnegative matrix	Identify recurring mechanism co-activation	Latent patterns, not causal mechanisms
K-means	Row-normalized NMF activation vectors	Identify recurring daily configurations	Descriptive regimes, not official phases

Source: Author's analytical framework.

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2. Phase III Marks the Principal Structural Break

Mean MCEA increased only modestly from Phase I (0.699260) to Phase II (0.716214), a change of +0.016955, or 2.42%. It then rose to 0.839898 in Phase III, an increase of +0.123684, or 17.27%, relative to Phase II. The full-series peak occurred on Day 140 at 0.980000. **Figure 1** traces the daily evolution of MCEA and the raw MCCM mean alongside the supplementary NFI Risk and Threshold Risk diagnostics, while **Figure 2** confirms at the phase level that the principal increase occurred between Phase II and Phase III rather than between Phase I and Phase II.

The Day 140 peak should not be interpreted as a 98% probability of war, collapse, or uncontrolled escalation. Rather, it indicates that direct-pressure mechanisms were simultaneously elevated while stability-oriented mechanisms were simultaneously weak under the model's equal-weight structure. This pattern is consistent with external assessments emphasizing recurrent escalation, wider target sets, chokepoint pressure, and expanding regional spillovers (Gordon, 2026; Yacoubian, 2026a, 2026b).

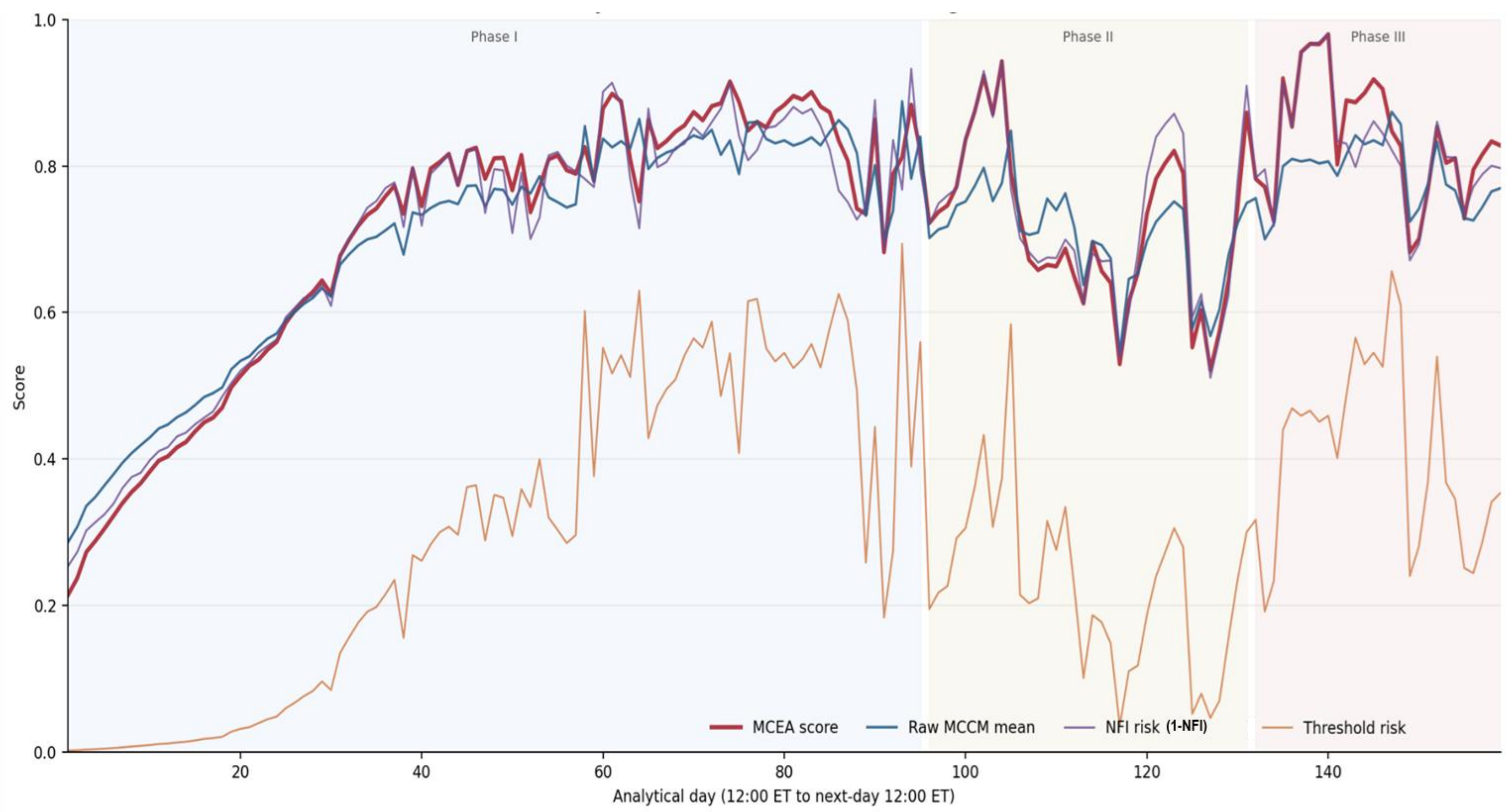

Figure 1. Daily MCEA and Raw MCCM Mean, With Supplementary NFI Risk (1 − NFI) and Threshold Risk.

Note: NFI risk is reported only as a supplementary diagnostic. Threshold Risk is a separate nonlinear diagnostic for which θ = 0.82 applies to the raw MCCM mean, not to MCEA.

Source: Author's calculations from the frozen MCCM v2.3.4 159 × 35 weighted matrix and derived analytical outputs.

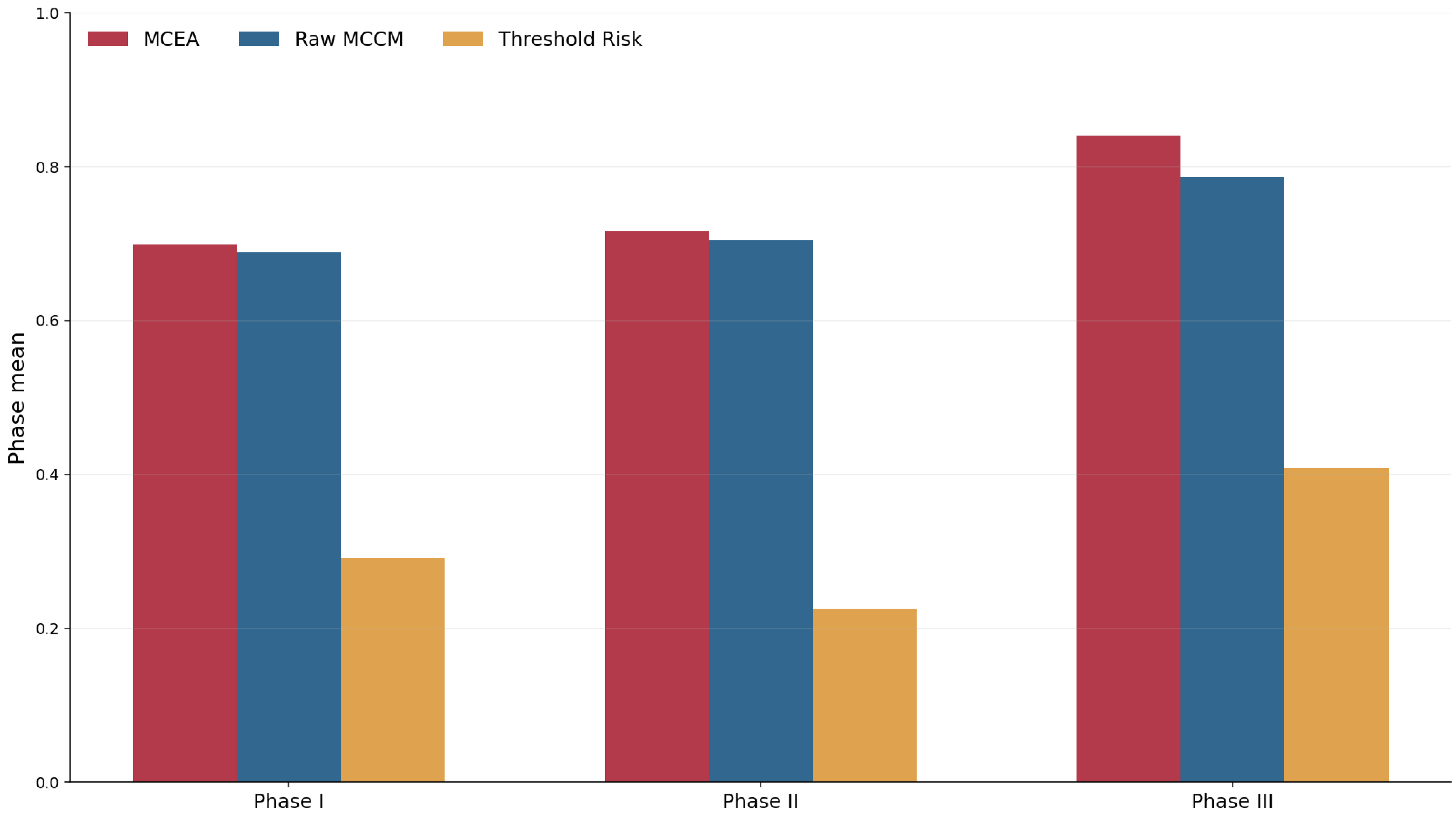

Figure 2. Phase-Level Comparison of MCEA, Raw MCCM Mean, and Threshold Risk.

Source: Author's calculations from phase summaries derived from the frozen MCCM v2.3.4 159 × 35 weighted matrix and associated diagnostic outputs.

3. The Escalation Was Cross-Layered, Not Simply Kinetic

The ten-layer decomposition shows that Phase III was not produced by one military variable or one domain. Escalation Dynamics made the largest additive contribution over the full series, but Rule and Institutional Order, Narrative Warfare, Normative/Uncertainty/Risk, Transmission, and External Strategic Node Dependency were also major components. Because the ten MCCM layers contain different numbers of mechanisms, additive layer contributions reflect both risk levels and the number of mechanisms assigned to each layer; they should not be interpreted as direct measures of within-layer intensity.

Figure 3 shows the additive contribution of each layer to daily MCEA, while **Figure 4** shows when multiple layers occupied high-intensity regions simultaneously. Together, the two figures distinguish each layer's additive contribution to daily MCEA from its within-layer temporal intensity.

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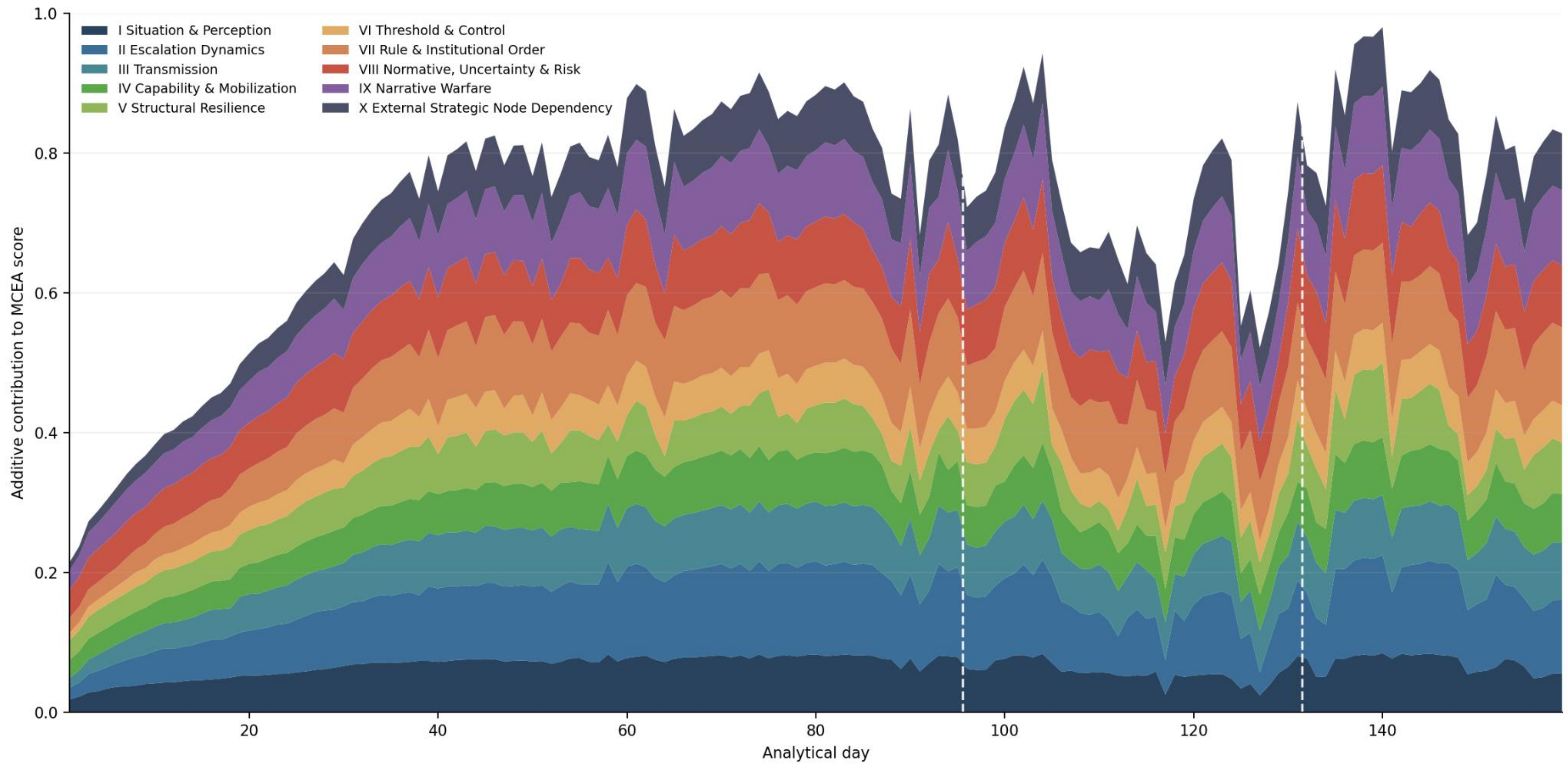

Figure 3. Ten-Layer Additive Contributions to Daily MCEA.

Note: Because the ten MCCM layers contain different numbers of mechanisms, additive contributions should not be interpreted as direct measures of within-layer intensity.

Source: Author's calculations from MCCM v2.3.4 ten-layer assignments and MCEA layer-contribution outputs.

3.1 Analytical Triangulation Across MCEA, Layer Topography, and NMF

The three views answer different but connected questions. MCEA identifies the magnitude of systemic pressure; **Figure 4** shows how recorded intensity is distributed across the ten MCCM layers over time; and NMF identifies recurring mechanism combinations beneath those patterns. Read together, they strengthen the interpretation of Phase II as compositional reorganization and Phase III as broader cross-layer synchronization.

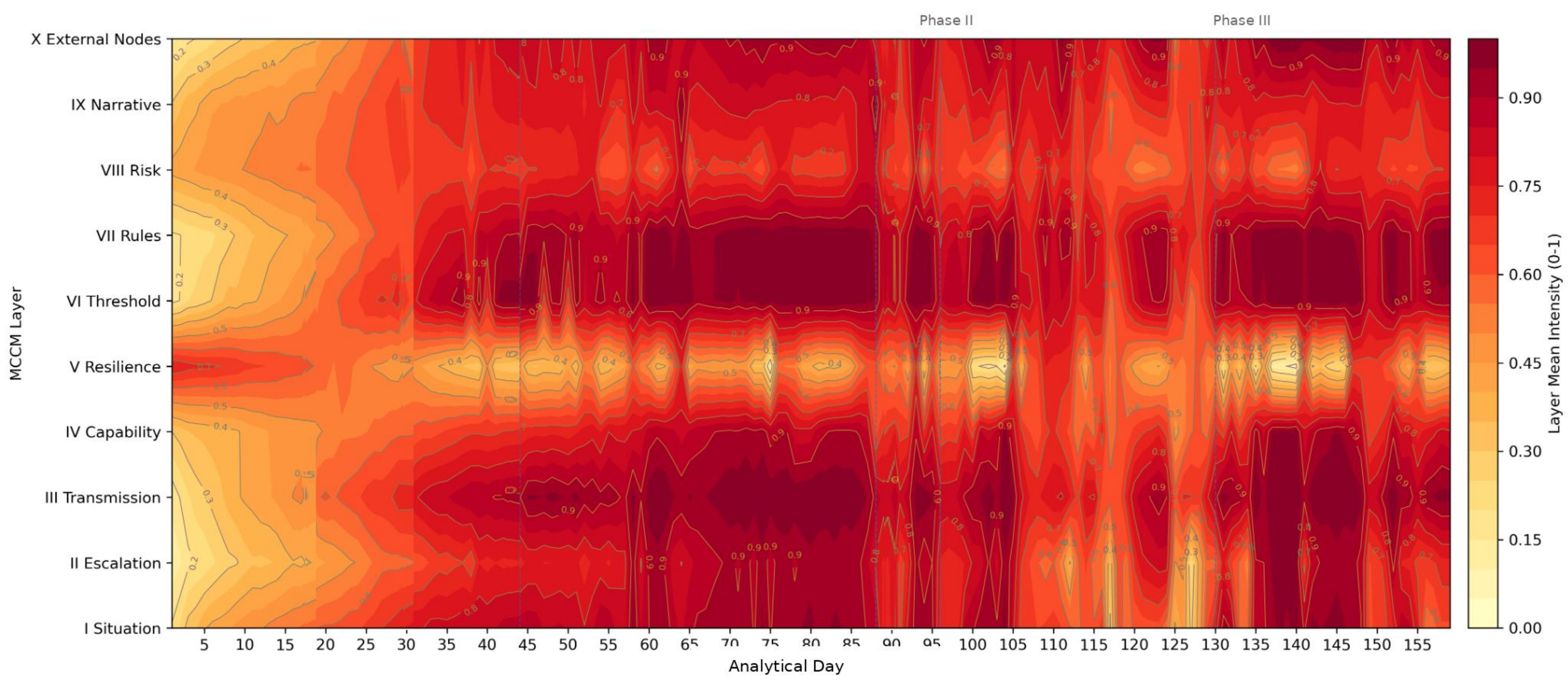

Figure 4. Temporal Topography of Ten-Layer Conflict Intensity, Analytical Days 1–159.

Note: Phase II shows substantial redistribution across layers without a comparable rise in aggregate MCEA, whereas Phase III shows broader high-intensity synchronization. Dashed vertical lines indicate the inherited Phase II and Phase III boundaries; they were not generated by MCEA, NMF, or clustering.

Source: Author's calculations from the formal MCCM v2.3.4 159 × 35 weighted matrix and ten-layer assignments. Layer values are raw within-layer means and are not risk-oriented; stability-oriented mechanisms are inverted only in MCEA calculations.

3.2. Persistent Mechanism Drivers

The seven largest mean risk-oriented contributions were Latent Uncertainty Band (LUB), State Risk Signaling (SRS), Aggregate Strategic Stress Index (ASSI), Rule Contestation Index (RCI), Narrative Polarization Ratio (NPR), Information System Amplification Index (ISAI), and Actor Coupling Index (ACI).

Figure 5 shows their relative position within the full set of 35 mechanism contributions. Their prominence suggests that the conflict's systemic character was sustained by uncertainty, state signaling, aggregate stress, rule contestation, narrative polarization, information amplification, and actor coupling—not only by direct battlefield intensity.

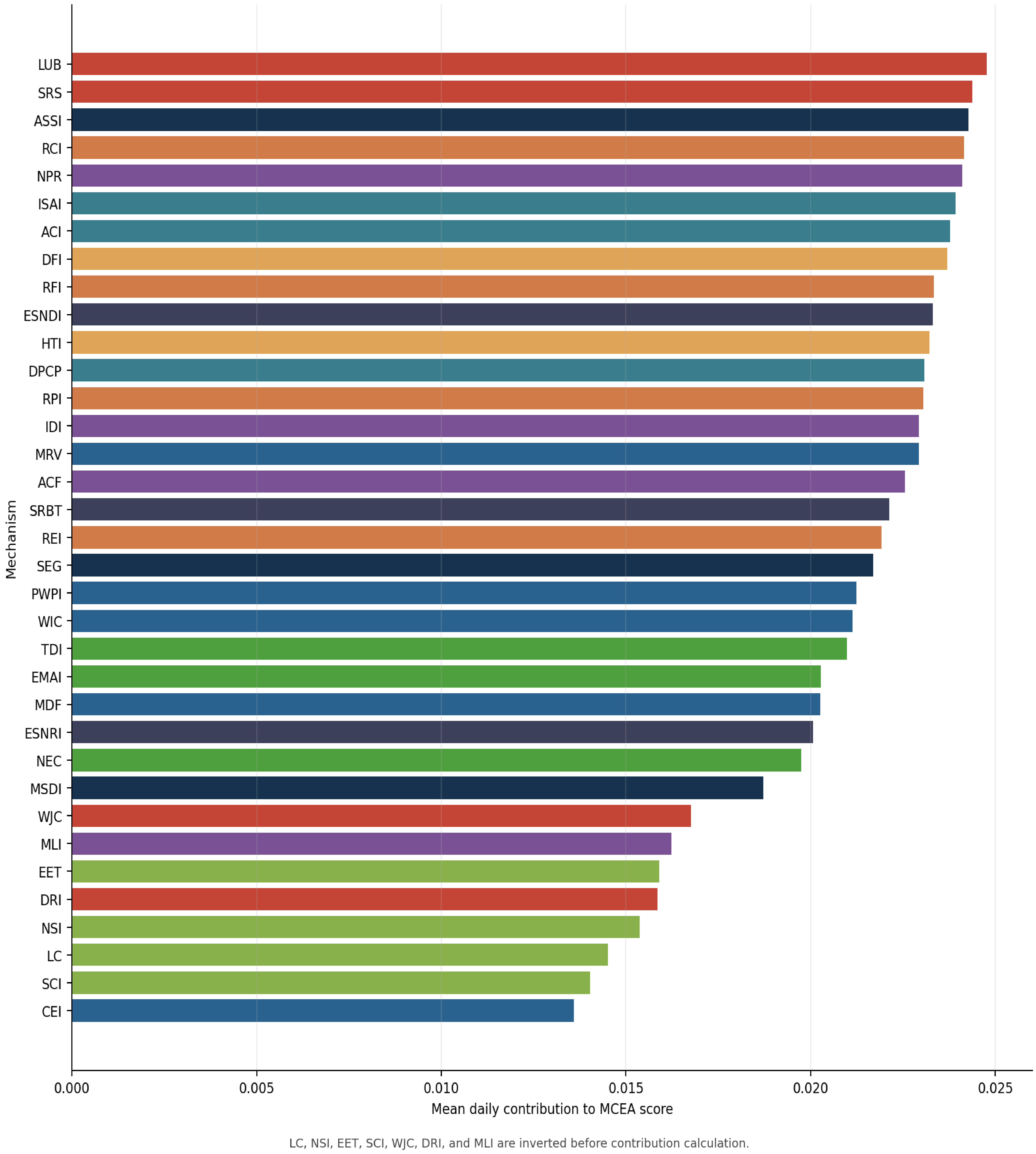

Figure 5. Mean Risk-Oriented Mechanism Contributions Across 159 Analytical Days.

Source: Author's calculations from the MCEA mechanism-contribution table; LC, NSI, EET, SCI, WJC, DRI, and MLI are inverted before aggregation.

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4. Four Latent Patterns Organize Recurring Pressure

NMF solutions with two through eight components were compared across repeated initializations. A four-component solution was retained for exploratory interpretation because it preserved low reconstruction error while producing substantively distinguishable mechanism groupings. Its relative reconstruction error was 0.081922. The labels below are substantive interpretations of the highest loadings; they are not new formal MCCM categories. **Table 2** summarizes the four retained NMF components, their interpretive labels, and their highest-loading mechanisms.

Table 2. Four-Component NMF Solution

Component	Interpretive Label	Highest-Loading Mechanisms
C1	Kinetic Escalation and Physical Disruption	WIC, SEG, MSDI, ASSI, MDF, DPCP
C2	Rule-Order and External-Node Coupling	RCI, RFI, ISAI, ESNDI, NPR, DFI
C3	Resilience and Normative-Stability Erosion	WJC, NSI, EET, MLI, LC, SCI
C4	Institutional-Information Network Pressure	ESNRI, CEI, RFI, RCI, REI, RPI

Note: Mechanisms may load meaningfully on more than one component; repeated mechanisms indicate overlapping latent structures rather than duplicate coding.

Source: Author's exploratory NMF estimation. Component labels are substantive interpretations of the highest-loading MCCM mechanisms and are not formal MCCM categories.

As **Figure 6** shows, the relative activation shares of the four components vary substantially across analytical days, even when aggregate MCEA levels are similar. Some days are dominated by kinetic and physical-disruption pressure; others by rule-order contestation and external-node exposure; and still others by resilience erosion or institutional-information coupling. The correspondence with the ten-layer topography is not one-to-one because NMF operates at the 35-mechanism level, but both analyses show that changes in aggregate pressure are accompanied by shifts in internal composition.

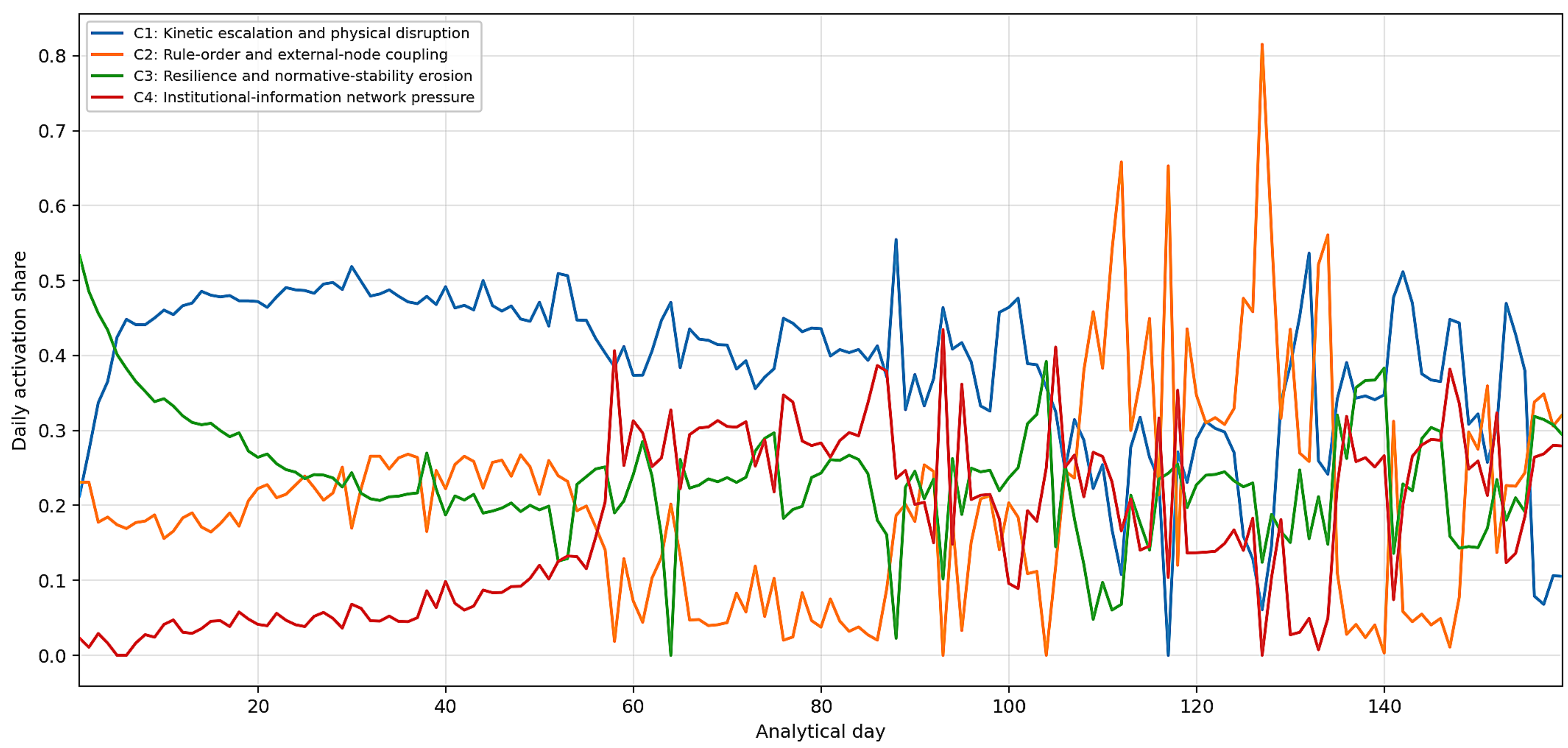

Figure 6. Daily Activation Shares of the Four Exploratory NMF Components.

Note: The figure shows changes in composition rather than changes in total pressure alone.

Source: Author's exploratory NMF analysis of the frozen 159 × 35 risk-oriented MCCM matrix.

5. Three Recurring Daily Regimes Sharpen the Phase Picture

K-means clustering was applied to row-normalized NMF activation vectors, making the clusters sensitive to mechanism composition rather than only to the magnitude of MCEA. A three-cluster solution was retained because it produced nearly the same silhouette coefficient as the four-cluster solution (0.471726 versus 0.473509), while providing a larger minimum cluster size (31 versus 13 days) and a more parsimonious policy interpretation. **Table 3** summarizes the size, mean MCEA, and descriptive interpretation of the three retained clusters. The three groups contain 61, 31, and 67 days and remain exploratory descriptive regimes rather than substitutes for the formal phases (Rousseeuw, 1987).

Table 3. Three-Cluster Regime Summary

Cluster	Days	Mean MCEA	Descriptive reading
1	61	0.846371	High-pressure mixed regime
2	31	0.699618	Rule-order and external-node regime
3	67	0.633041	Lower-pressure escalation regime

Source: Author's k-means clustering of row-normalized NMF activation vectors; cluster labels are descriptive and not official conflict phases.

Figure 7 maps the three cluster assignments against daily MCEA and shows that regime composition cannot be inferred from aggregate pressure alone. The distribution also clarifies the formal phases: Phase I is dominated by the lower-pressure escalation regime; Phase II contains a larger concentration of rule-order and external-node configurations, indicating compositional change before the major aggregate rise; and Phase III contains the highest concentration of high-pressure mixed-regime days while retaining substantial rule-order and external-node pressure. Phase III was therefore both more intense and more compositionally broad.

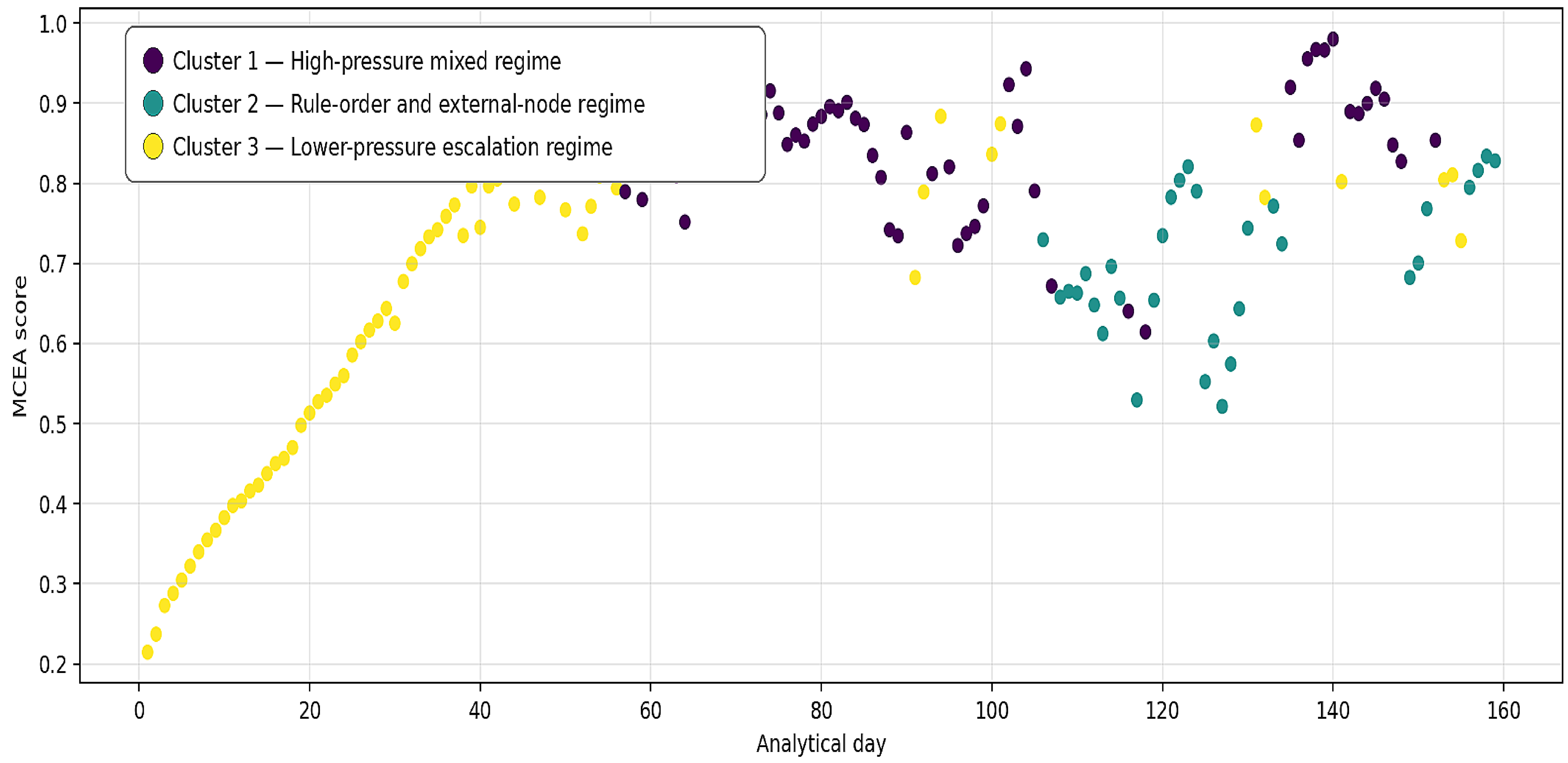

Figure 7. Three-Cluster Daily Regime Assignment Plotted Against MCEA.

Note: The clusters identify recurring pressure compositions and do not replace the formal Phase I–III structure; the legend maps colors to the three descriptive regimes.

Source: Author's k-means clustering of row-normalized four-component NMF activation vectors.

6. Policy Implications

- **Create integrated cross-domain assessment and warning cells.** Governments and regional security organizations should establish or designate integrated cross-domain assessment cells that combine military operations, intelligence, diplomacy, energy, transport, cyber, finance, and strategic communications. These cells should monitor not only changes in aggregate pressure but also simultaneous movement across several MCCM layers. A military incident should trigger elevated concern when it coincides with rule fragmentation, information amplification, decision friction, external-node exposure, or declining resilience.
- **Use compositional change as an early-warning trigger.** Phase II shows that systemic risk can increase in structure before it rises sharply in magnitude. Warning frameworks should therefore flag sustained changes in the mechanism mix even when the aggregate MCEA score remains broadly stable. Such shifts should prompt preventive diplomatic engagement, contingency planning, and targeted resilience measures before the conflict enters a higher-pressure phase.
- **Separate escalation control from resilience protection.** Decision-makers should distinguish measures designed to reduce hostile activity from those intended to preserve the system's ability to absorb disruption. Deconfliction mechanisms, signaling restraint, and crisis communication should be paired with protection of logistics, energy throughput, communications, institutional legitimacy, and recovery capacity. A decline in resilience can make an otherwise manageable level of pressure systemically dangerous.
- **Protect high-dependency external nodes.** Ports, shipping routes, transit states, energy hubs, logistics corridors, alliance facilities, communications infrastructure, and financial intermediaries should be mapped according to dependency, substitutability, and recovery time. Governments should develop alternative routes, reserve capacity, repair arrangements, emergency procurement mechanisms, and continuity plans before those nodes become crisis multipliers (Gordon, 2026; Govella & Nakano, 2026).
- **Match policy tools to the observed pressure regime.** Lower-pressure escalation would generally favor deconfliction, signaling controls, and protected communication channels. Rule-order and external-node stress may call for stronger institutional coordination, legal clarification, corridor protection, and supply-network redundancy. High-pressure mixed regimes should prompt consideration of synchronized military, diplomatic, economic, informational, and resilience measures. Applying the same policy package across distinct pressure regimes risks either underreaction to systemic escalation or overreaction to limited compositional change.
- **Define de-escalation as restored system controllability.** A reduction in strikes is insufficient if uncertainty, institutional fragmentation, network exposure, and resilience loss remain elevated. De-escalation strategies should aim to restore predictability, coordination, redundancy, signaling legibility, recovery capacity, and political decision space. The objective is not merely to suppress immediate violence but to prevent connected pressures from becoming mutually reinforcing.

Operational Warning:

The most dangerous transition is not necessarily the first increase in military activity. It is the point at which kinetic action, institutional contestation, information amplification, resilience erosion, and external-node exposure begin to reinforce one another. Once that cross-layer synchronization emerges, tactical events can generate system-wide consequences faster than conventional crisis-management mechanisms can absorb them.

7. Limitations

The formal MCEA series is derived from the frozen 159 × 35 weighted matrix rather than the Canonical Event database. Because most newly constructed events lacked resolvable event times, publication dates were not substituted and the event database did not overwrite the daily series. The two assets therefore remain analytically distinct: the event database supports provenance and future event-time reconstruction, while the weighted matrix remains the basis for the quantitative findings.

MCEA uses equal mechanism weights, and alternative weighting schemes could change the relative importance of mechanisms and layers. The ten-layer contour reports raw weighted intensities rather than risk-oriented MCEA values, especially for stability-oriented mechanisms. NMF components and k-means clusters are exploratory diagnostic structures, not causal mechanisms, official phases, or formal regime-switching states; they do not explicitly model temporal dependence, persistence, or transition probabilities and have not been independently validated against external event timelines.

Some alternative NMF initializations reached the iteration limit, although the retained solution came from converged runs. NMF, clustering, and NFI remain exploratory diagnostics intended to support analyst judgment and scenario comparison rather than automatically trigger policy decisions or replace regional expertise. NFI has not been independently validated as a complete model of negotiation feasibility.

Conclusion

The full 159-day record reveals an evolving conflict structure rather than a simple linear rise in military intensity. Phase II altered the composition of pressure before the larger aggregate increase, while Phase III combined elevated kinetic pressure with institutional contestation, information effects, uncertainty, resilience erosion, and external-node exposure. The ten-layer topography helps explain the MCEA result by showing broader simultaneous high-intensity regions. NMF, in turn, identifies the recurring mechanism combinations organizing that pressure. For policymakers, the core lesson is to monitor magnitude, cross-layer distribution, and mechanism composition together; preserve resilience; and intervene before connected pressures become mutually reinforcing.

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