



The Impact of Airspace Crises in the Middle East on the Operational Performance and Costs of the European Aviation Network: An Early Assessment

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Abstract

This study examines system-level patterns in operational performance and cost pressures within the European aviation network during periods of heightened geopolitical tension in Middle Eastern airspace. Using weekly data from EUROCONTROL (2025-2026), the analysis provides a multidimensional, integrated descriptive framework by jointly examining traffic volume, delay dynamics, causes of delays, and jet fuel prices. The findings show that while total traffic volume remains relatively stable, growth rates have weakened, a pattern that coincides with documented airspace accessibility constraints and network reconfiguration. Operational performance deteriorates particularly during periods of increased delays, while ATC capacity/staffing emerges as the predominant reported cause of en-route ATFM delays across the analyzed reporting periods. During periods of heightened geopolitical tensions, Europe-Middle East air traffic flows have declined, and routes have been restructured. These patterns suggest that airspace restrictions and the use of alternative corridors may be related to pressure on existing capacity bottlenecks. In parallel, sharp increases in jet fuel prices coincide with heightened system-level cost pressure. Overall, the study shows that during periods of geopolitical tension, airspace restrictions, operational indicators, and cost dynamics move together in interconnected, system-level patterns.

Keywords: Cost Pressure, European Aviation Network, Geopolitical Risk, Jet Fuel Prices, Operational Performance

JEL Codes: M16, M2, P5

Orta Doğu Hava Sahası Krizlerinin Avrupa Havacılık Ağına Operasyonel Performansı ve Maliyetleri Üzerindeki Etkileri: Erken Dönem Bir Değerlendirme

Öz

Bu çalışma, Orta Doğu hava sahasındaki jeopolitik gerilim dönemlerinde Avrupa havacılık ağına operasyonel performans ve maliyet baskısı açısından gözlenen sistem düzeyindeki örüntüleri incelemektedir. EUROCONTROL'un (2025-2026) haftalık verilerinden yararlanan analiz, trafik hacmi, rötar dinamikleri, rötar nedenleri ve jet yakıtı fiyatlarını bir araya getirerek çok boyutlu ve bütünsel bir tanımlayıcı çerçeve sunmaktadır. Bulgular, toplam trafik hacminin nispeten istikrarlı kalmasına rağmen büyüme oranlarının zayıfladığını göstermektedir; bu da belgelenmiş hava sahası erişim kısıtlamaları ve ağı yeniden yapılandırılmasıyla eş zamanlı olarak gözlenmektedir. Operasyonel performans, özellikle gecikmelerin arttığı dönemlerde bozulmakta olup, incelenen raporlama dönemlerinde en-route ATFM gecikmelerinin baskın nedeni olarak ATC kapasite/personel kısıtları öne çıkmaktadır. Jeopolitik gerilimlerin yoğunlaştığı dönemde, Avrupa-Orta Doğu trafik akışlarında düşüşler ve rota yeniden yapılandırılmalarıyla eş zamanlı değişimler gözlenmiştir. Bu örüntüler, hava sahası kısıtlamaları ve alternatif koridor kullanımının mevcut kapasite darboğazları üzerindeki baskıyla ilişkili olabileceğini düşündürmektedir. Buna paralel olarak, jet yakıtı fiyatlarındaki keskin artışlar sistem düzeyindeki maliyet baskısıyla eş zamanlı olarak gözlenmektedir. Genel olarak çalışma, jeopolitik gerilim dönemlerinde hava sahası kısıtlamaları, operasyonel göstergeler ve maliyet dinamikleri arasında eş zamanlı ve birbiriyle bağlantılı sistem düzeyinde örüntüler bulunduğunu göstermektedir.

Anahtar Kelimeler: Avrupa Havacılık Ağı, Jeopolitik Risk, Jet Yakıtı Fiyatları, Maliyet Baskısı, Operasyonel Performans

JEL Kodları: M16, M2, P5

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Introduction

The global aviation system is highly sensitive to external shocks because of its high level of network dependency. In recent years, rising geopolitical tensions have coincided with significant changes in airspace usage, traffic flows, and operational decision-making, creating new challenges for the aviation system. Conflicts in the Middle East region and the resulting airspace restrictions constitute one of the most visible examples of this effect (EUROCONTROL, 2026a; EASA, 2026).

Geopolitical developments in aviation are mostly described in terms of demand contraction, flight cancellations, or security risks. However, this approach remains insufficient to explain the more complex interactions arising from the aviation system's network structure. Airspace closures or avoidance of risky regions not only affect traffic volume on specific routes but also drive route reconfiguration, shift traffic flows to alternative corridors, and make existing capacity constraints more visible (EUROCONTROL, 2026a; EUROCONTROL, 2026b).

This situation demonstrates that the effects in the aviation system emerge not linearly, but through network-based and multi-layered mechanisms. Indeed, conflict zone warnings and airspace restrictions published by international regulatory authorities show that airlines replan operations based on safety-based risk assessments (EASA, 2026; FAA, 2026; ICAO, 2026a; ICAO, 2026b).

In this context, the impact of geopolitical tensions on the aviation system should be evaluated through interrelated indicators such as operational performance, delay dynamics, and cost structure, together with changes in traffic volume. In particular, system-level factors such as air traffic control capacity, airspace accessibility, and route-planning decisions are key elements shaping how this impact emerges. Additionally, fluctuations in energy markets and volatility in fuel prices are important contextual dimensions of system-level cost pressure during periods of heightened geopolitical tension (IATA, 2026).

This study examines patterns in operational performance and cost pressure during periods of heightened geopolitical tension at the system level within the European aviation network. Accordingly, this study uses weekly operational data published by EUROCONTROL to jointly analyze traffic volume, delays, delay causes, and fuel prices (EUROCONTROL, 2025; EUROCONTROL, 2026a). Within this scope, the findings obtained are supported by the regulatory frameworks presented by the European Union Aviation Safety Agency (EASA), Federal Aviation Administration (FAA), International Air Transport Association (IATA), and International Civil Aviation Organization (ICAO), and the impact of geopolitical risk on the aviation system is addressed from a multidimensional perspective (EASA, 2026; FAA, 2026; ICAO, 2026a; ICAO, 2026b; IATA, 2026).

In this context, the study contributes to the literature by first highlighting the relevance of airspace accessibility and capacity constraints through operational performance and delay dynamics at the system level rather than the firm level. Second, it provides an integrated descriptive framework for examining the coexistence of route reconfiguration, operational performance fluctuations, and cost pressure during periods of heightened geopolitical tension.

1. Conceptual Framework

Air transportation is a complex network system because of intensive simultaneity and multi-centered decision processes. Therefore, in the face of external shocks, performance is shaped not only by airline decisions but also by system-level interactions. Recent air transportation literature shows that research is increasingly concentrated around network structure, resilience, system vulnerability, irregular operations, and delay propagation. In this context, studies reviewing the current state of air transportation research identify geopolitical conflicts, airspace closures, capacity contractions, and network resilience as key topics in the sector. Similarly, recent studies examining connections and resilience characteristics in the air transportation network structure at the system level emphasize that performance depends not only on market size or demand but also on interactions between network layers (Başpınar et al., 2023: 2; Wandelt et al., 2025: 1).

Studies examining how air transportation networks respond to shocks show that networks should be evaluated not only at the moment of initial disruption but also during post-disruption reorganization. Studies using the network theory approach have revealed that resilience in the air transportation system is closely related to network structure, the existence of alternative routes, and recovery capacity (Dunn & Wilkinson, 2016: 39). An empirical study comparing United States (US) and European air transportation networks also showed that different network structures exhibit different resilience profiles to disruptions (Başpınar et al., 2023: 2). More recent studies examining the resilience of cities' air accessibility against disruptions argue that resilience should be addressed not only at the airport scale but also at the city and multi-airport service area scale (Sun et al., 2020: 1).

Studies in the literature have strongly demonstrated that delay is not a singular operational deviation. Still, it is a network phenomenon that propagates across airports, routes, aircraft rotations, and connected passenger flows. Campanelli et al. (2016: 12), who compared delay propagation in US and European air traffic networks, showed that propagation patterns differ depending on network structure and system characteristics. Studies on the characterization and prediction of air traffic delays show that local delay indicators alone are insufficient, and that the delay conditions of other nodes in the network are also explanatory (Rebollo & Balakrishnan, 2014: 231). More recent studies characterizing delay propagation in air traffic networks show that delays propagate in certain directions and at certain intensities across the network (Li & Jing, 2021: 1). Similarly, Wang et al. (2022: 1) showed that delay propagation in airport networks operates at different time scales and argued that distinguishing short-, medium-, and long-term delay propagation channels is analytically important. Guo et al. (2025: 1), who examined delay propagation in regional air transportation systems using a complex network approach, and Chen et al. (2024: 1), who explained propagation through a multilayer perception approach, demonstrate that delay dynamics are now addressed not by classical descriptive statistics but by network-based and data-driven methods.

Additionally, the literature emphasizes that delay is related not only to traffic volume but also to connected passenger structure, route topology, airport role, and central nodes in the system. Kim & Park (2021: 1) show that airport and route classification is critical for understanding delay propagation patterns. Sismanidou et al. (2022: 1) highlight the role of

connected passengers in delay propagation, showing that in some nodes delay is distributed unequally not only operationally but also across network geography. Accordingly, recent studies argue that delay modeling has become a rapidly growing field across different dimensions, from data to methodology, and that in the future, network structure, forecasting, and resilience concepts will become even more intertwined (Li & Yao, 2025: 1).

Irregular operations arising from geopolitical tensions, airspace closures, strikes, meteorological disruptions, and security threats not only cause flight cancellations or delays; they also create a multi-layer recovery problem that must be managed simultaneously at the aircraft, crew, passenger, and route levels. Studies on this subject emphasize the importance of an integrated recovery approach. Hu et al. (2016: 97) showed that recovery models addressing aircraft and passengers together provide more realistic results in irregular operations management. The day-ahead aircraft routing approach has demonstrated that it is possible to manage irregular operations more proactively by linking route decisions with primary delay forecasts (Birolini & Jacquillat, 2023: 379). Review studies in irregular operations also show that recovery is now addressed not in isolation but through integrated decision structures that consider systemic complexity (Santana et al., 2023: 1; Wu et al., 2025: 1). This line supports viewing the impact of geopolitical shocks as a network-based recovery problem, independent of firm performance.

Recent studies argue that disruptions in the air transportation system should not only be reacted to, but that delay and disruption risks should also be reduced during the planning stage. The resilient scheduling approach emphasizes optimizing scheduling decisions together with delay risks (Özkan Aksu & Temiz, 2021: 417). Similarly, proactive recovery approaches show that preventive decisions through airport slot networks and aircraft rotations can reduce losses (Zang et al., 2024: 1). The common point of the studies is that performance should be evaluated not only through output indicators but also through pre-disruption resilience capacity. Therefore, understanding the aviation system's response to geopolitical shocks remains incomplete without considering delay, route change, and capacity constraints together. Studies examining network responses to long-term disruptions reveal that airline and airport networks not only shrink but, in some cases, are reconnected; some routes are relocated, and accessibility is affected asymmetrically (Sun et al., 2020: 7). This literature shows that geopolitical risk is not only a security or regulatory problem, but also a problem of network reconfiguration.

Finally, although the central role of fuel in airline cost structure is already well known, recent studies and sector-focused empirical monitoring tools show that external shocks are rapidly reflected in airlines through fuel prices and operational costs. IATA's Jet Fuel Price Monitor data and analyses show that fuel costs are decisive in airlines' cost structures and can vary significantly in the short term (IATA, 2026). Given the impact of geopolitical developments on energy markets, rising fuel prices combined with route extensions and rerouting create dual-channel cost pressure. Accordingly, unit prices rise while consumption increases. Therefore, the impact of geopolitical risk on aviation should be evaluated not only with traffic loss or delay but also with cost structure.

When the relevant literature is evaluated together, it is clear that air transportation literature has matured in three ways during 2015-2026. First, the idea that aviation performance

should be addressed at the network level, not the firm level, has strengthened (Başpınar et al., 2023: 1; Wandelt et al., 2025: 1). Second, mechanisms such as capacity constraints and network propagation have come to the forefront in explaining delays and irregular operations (Campanelli et al., 2016: 12; Li & Jing, 2021: 9; Wang et al., 2022: 13; Chen et al., 2024: 12; Guo et al., 2025: 22). Third, the resilience and recovery literature has begun to address post-disruption recovery as a multi-layer systemic problem rather than a set of singular operational decisions (Hu et al., 2016: 97; Birolini & Jacquillat, 2023: 379; Wu et al., 2025: 1).

However, the literature still has an important gap. Delay propagation, network resilience, irregular operations management, and cost pressure are generally examined in separate sub-literatures. The coexistence of changes across these dimensions during periods of heightened geopolitical tension has received less attention. Especially in the context of the European aviation network, studies examining traffic growth, operational performance, causes of delay, route reconfiguration, and cost pressure together at the system level remain limited. In this direction, the present study considers traffic, performance, delay, and cost indicators jointly rather than focusing on a single indicator. Thus, the study provides an integrated descriptive framework for identifying interconnected and multi-layered system-level patterns observed during periods of heightened geopolitical tension.

2. Methodology

This study examines system-level patterns in the European aviation network during periods of heightened geopolitical tension through operational performance and cost-pressure indicators. While the literature mostly addresses geopolitical risks in aviation through demand contraction or flight cancellations, this study aims to offer a more holistic framework by examining patterns in network structure, operational performance, and cost dynamics during periods of heightened geopolitical tension. In this respect, the study aims to identify and interpret patterns observed at the system level rather than at the firm level.

The research is based on descriptive quantitative data analysis supported by qualitative-oriented document analysis. The study used operational data covering weekly observation periods, obtained from EUROCONTROL's "European Aviation Overview" reports, which are published every two weeks (EUROCONTROL, 2025; EUROCONTROL, 2026a). Thus, "weekly" refers to the period covered by the analyzed data, whereas "every two weeks" refers to the publication frequency of the reports. These reports regularly provide key operational indicators such as traffic volume, Air Traffic Flow Management (ATFM) delays, causes of delay, and jet fuel prices, and enable comparative analysis at the system level. In addition, to evaluate the impact of geopolitical risk on aviation operations within an institutional framework, Conflict Zone Information Bulletins (CZIB) published by EASA, airspace restrictions implemented by the FAA, and conflict zone management framework documents developed by ICAO were also included in the analysis (EASA, 2026; FAA, 2026; ICAO, 2026a; ICAO, 2026b). To evaluate the cost dimension, EUROCONTROL data were considered alongside Jet Fuel Price Monitor data published by IATA and compared with global trends (IATA, 2026).

Within the scope of the analysis, the reporting periods covered by EUROCONTROL's European Aviation Overview publications for 2025 and 2026 were examined comparatively.

The researcher did not select the weeks in the dataset at discretion. Instead, the analysis's temporal coverage followed EUROCONTROL's publication schedule, with weekly observation periods drawn from reports issued every two weeks. Accordingly, the analyzed weeks correspond to the reporting periods for which EUROCONTROL publications provided comparable operational indicators during the study period. This approach reduces the possibility of researcher-driven selection bias, as the temporal units included in the analysis were determined by the reporting structure of the primary institutional data source rather than by ex post selection based on observed outcomes. The study analyzed four main indicator groups: traffic volume and growth rates, operational performance indicators (ATFM delays and punctuality rates), causes of delay, and jet fuel prices. By evaluating these indicators together, the study addressed patterns in the aviation system during periods of heightened geopolitical tension within a multidimensional framework.

The research seeks to answer the following main questions:

- What patterns are observed in traffic growth dynamics in the European aviation network during periods of heightened geopolitical tension?
- What changes are observed in operational performance indicators and delay structures during these periods?
- To what extent do the observed patterns in airspace restrictions, route changes, and operational indicators coincide with system-level capacity constraints?
- How do jet fuel price movements and related cost pressures evolve during periods of heightened geopolitical tension?

In line with these questions, the data collection and analysis process followed three stages. First, the relevant indicators were manually extracted from the selected EUROCONTROL European Aviation Overview reports and organized according to reporting year, week, and indicator category. To ensure comparability across reporting periods, the analysis retained the units and definitions used in the original institutional reports. The extracted data were classified into four groups: (i) traffic volume and annual growth rates, (ii) total ATFM delay and arrival and departure punctuality rates, (iii) reported causes of delay, and (iv) jet fuel prices and short-term price changes. Second, we conducted descriptive comparisons across the selected reporting periods. We compared traffic volumes, growth rates, delay indicators, punctuality rates, and fuel prices between the corresponding reporting periods of 2025 and 2026. We examined changes in Europe-Middle East traffic flows and delay structures during periods of heightened geopolitical tension. The comparison used absolute values, percentages, annual changes, and short-term changes as reported in the original EUROCONTROL publications; no additional statistical transformations or inferential tests were applied. Because aviation activity varies seasonally, we considered seasonality when interpreting the descriptive comparisons. The analysis partly addresses this issue by evaluating annual growth rates and year-on-year changes reported by EUROCONTROL, in addition to absolute traffic and performance indicators. These measures provide a more contextually comparable basis than comparisons based solely on absolute traffic volumes. However, the reporting weeks available for 2025 and 2026 do not correspond to identical calendar weeks, and the descriptive research design does

not include statistical seasonal adjustment or an econometric procedure to isolate seasonal effects. Therefore, the possible influence of seasonality cannot be fully excluded, and the observed patterns are interpreted alongside documented geopolitical developments and institutional evidence rather than attributed exclusively to geopolitical factors. Third, we evaluated the patterns identified through these descriptive comparisons alongside EASA, FAA, ICAO, and IATA documents. We used these institutional sources for contextual interpretation and triangulation, not as additional quantitative datasets. This procedure enabled the study to examine operational indicators, cost dynamics, airspace restrictions, and regulatory developments within an integrated descriptive framework.

Given the descriptive research design, the study does not aim to establish causal relationships between geopolitical developments and changes in aviation performance indicators. Rather, the analysis identifies temporal patterns, co-movements, and system-level associations among traffic flows, operational performance, delay structures, and fuel prices during periods of heightened geopolitical tension. Institutional documents and regulatory sources contextualize these observed patterns and discuss plausible mechanisms through which geopolitical disruptions may be associated with changes in the European aviation network. Accordingly, the findings should be interpreted as descriptive and associational evidence rather than as estimates of causal effects.

The study covers the European air traffic system within the EUROCONTROL network, with particular attention to Europe-Middle East traffic flows. The temporal scope of the analysis was deliberately limited to the 2025 and 2026 reporting periods to examine emerging system-level patterns associated with the recent geopolitical developments observed in 2026. Since 2026 constitutes the primary period in which the developments examined in this study emerged, 2025 was used as the most recent reference period for contextual comparison. We considered extending the analysis to a substantially longer historical period. However, we did not adopt this approach in the present research design because earlier years were characterized by structurally different conditions in European aviation, particularly the exceptional effects of the COVID-19 pandemic and the subsequent recovery period. Including these heterogeneous periods solely to extend temporal coverage could reduce the analysis's contextual comparability.

Furthermore, as explained above, the specific weeks included in the dataset were not selected at the researcher's discretion. Instead, EUROCONTROL's institutional publication schedule and the availability of comparable indicators determined them. Accordingly, the study is designed as an early-period descriptive assessment of short-term and emerging patterns at the system level rather than as a long-term trend analysis. The relatively limited number of observation periods is acknowledged as an inherent constraint of this early-period research design. Therefore, the analysis does not aim to generate definitive or broadly generalizable conclusions regarding the European aviation system. Instead, it seeks to identify preliminary patterns across the available reporting periods and interpret them within their specific operational and geopolitical context. The findings should therefore be understood as context-specific descriptive evidence that provides an initial basis for further investigation rather than as conclusive evidence of stable system-level relationships or long-term aviation dynamics. In addition, because the study uses aggregate system-level data, it does not directly reflect airline-

specific micro-level differences. Nevertheless, reliable institutional data sources strengthen the analysis's transparency and contextual relevance.

As a result, this methodological approach enables the analysis of patterns observed in the aviation system during periods of heightened geopolitical tension within a multidimensional framework by addressing traffic, operational performance, and cost dynamics together rather than through a single indicator.

3. Findings

3.1. Traffic and Growth Analysis

Table 1 shows the average daily number of flights within the EUROCONTROL network and the annual change rates for selected weeks in 2025 and 2026.

Table 1: Weekly Traffic Volume and Annual Growth Rates for the EUROCONTROL Network (2025-2026)

Year	Week	Period	Average daily flights	Annual change reported
2025	Week 6	03-09 Feb	24,776	+5% vs 2024
2026	Week 5	26 Jan-01 Feb	24,588	+2% vs 2025
2025	Week 8	17-23 Feb	26,079	+7% vs 2024
2026	Week 7	09-15 Feb	26,168	+2.7% vs 2025
2025	Week 10	03-09 Mar	26,476	+6% vs 2024
2026	Week 9	23 Feb-01 Mar	26,421	+1.7% vs 2025
2025	Week 12	17-23 Mar	26,592	+3% vs 2024
2026	Week 11	09-15 Mar	26,331	+0.8% vs 2025

Source: (EUROCONTROL, 2025; EUROCONTROL, 2026a).

Table 1 shows that the average daily number of flights within the EUROCONTROL network in 2025 and 2026 ranged from approximately 24,500 to 26,600, and that total flight volume generally remained stable. This finding indicates that system-level flight volume did not contract significantly in absolute terms during the period under review.

However, a clear divergence emerges between the two years in terms of annual growth rates. While the annual traffic growth rate in the analyzed weeks of 2025 ranged from 3% to 7%, it declined to 0.8% to 2.7% in 2026. In particular, the 0.8% growth rate observed in Week 11 of 2026 represents a marked slowdown compared with the higher growth rates reported during the analyzed periods of the previous year.

Therefore, the findings indicate that the period of heightened geopolitical tension coincided with weaker traffic growth despite the relative stability of total traffic volume. When considered together with documented airspace restrictions and traffic rerouting, this pattern is consistent with the interpretation that airspace accessibility and network routing constraints may have contributed to the observed slowdown in network growth. However, given the descriptive nature of the analysis, these findings should not be interpreted as establishing a direct causal relationship.

3.2. Operational Performance Indicators

Table 2 presents the operational performance indicators for the period under review.

Table 2: Operational Performance Indicators for the EUROCONTROL Network (2025-2026)

Year	Week	Total ATFM delay (min/flight)	Arrival punctuality (%)	Departure punctuality (%)
2025	Week 6	0.28	84.8	79.8
2025	Week 8	0.54	—	—
2025	Week 10	0.41	84.6	79.7
2025	Week 12	1.00	84.2	79.2
2026	Week 5	0.80	77.1	73.5
2026	Week 7	1.10	75.7	71.8
2026	Week 9	0.70	84.5	80.5
2026	Week 11	0.80	84.6	81.6

Source: (EUROCONTROL, 2025; EUROCONTROL, 2026a).

Note: Punctuality data were not published in the 2025 Week 8 report due to technical reasons.

When evaluated alongside total ATFM delay, arrival punctuality, and departure punctuality in Table 2, the indicators form a more holistic framework. During the period under review, total ATFM delay ranged from 0.28 to 1.00 minutes/flight in 2025 and from 0.70 to 1.10 minutes/flight in 2026. Although these values appear low in absolute terms, they create significant effects on operational performance when evaluated at the network level.

When delay levels and punctuality indicators are considered together, an inverse descriptive pattern can be observed between the two indicators during the analyzed reporting periods. Particularly in the early weeks of 2026 (Week 5 and Week 7), when delay levels increased to 0.80-1.10 minutes/flight, arrival punctuality declined to 77.1% and 75.7%, and departure punctuality declined to 73.5% and 71.8%. In contrast, in 2026 Week 9, when delay decreased to 0.70 minutes/flight, arrival punctuality increased to 84.5%, consistent with this inverse pattern.

These findings indicate that changes in operational performance coincide with variations in delay indicators during the analyzed periods. When considered alongside the en-route ATFM delay causes presented in the following section, the observed fluctuations should be interpreted within a broader operational context dominated by ATC capacity/staffing constraints, alongside period-specific contributions from weather, other factors, and ATC disruptions. Therefore, changes in punctuality and ATFM delay indicators should be evaluated within the broader operational structure of the aviation network rather than attributed to a single external factor.

These findings indicate that fluctuations in operational performance should be interpreted within a broader structure involving multiple operational disruption categories and network-level conditions. When evaluated alongside documented airspace restrictions and changes in traffic flows, the observed patterns suggest that operational performance, network reconfiguration, and broader system-level conditions coexist during periods of heightened geopolitical tension. Nevertheless, the study's descriptive design does not allow these relationships to be interpreted as direct causal effects.

3.3. Analysis of Delay Causes

Table 3 presents the distribution of the main causes of en-route ATFM delays across the reporting weeks included in the analysis.

Table 3: Main Causes of En-route ATFM Delays (2025-2026)

Year	Week	ATC capacity/staffing	Weather	Other	ATC disruption
2025	Week 6	67%	—	20%	—
2025	Week 8	84%	—	15%	—
2025	Week 10	72%	16%	—	—
2025	Week 12	75%	—	16%	—
2026	Week 5	58%	—	19%	12%
2026	Week 7	82%	9%	8%	2%
2026	Week 9	78%	—	—	—
2026	Week 11	79%	—	—	—

Source: (EUROCONTROL, 2025; EUROCONTROL, 2026a).

Note: The table presents selected delay-cause categories and the percentage shares explicitly stated in the source report summaries. “—” indicates that a separate percentage was not stated for the corresponding category in those summaries; it does not indicate zero. The displayed values therefore do not necessarily sum to 100%. For Week 7 of 2026, the source reports shares of 82%, 9%, 8%, and approximately 2%, yielding a total of approximately 101%. These values are retained as reported; the source does not explicitly explain the discrepancy.

As shown in Table 3, ATC capacity/staffing constituted the largest reported cause of en-route ATFM delays across all reporting weeks included in the analysis. Its share ranged from 67% to 84% in the analyzed weeks of 2025 and from 58% to 82% in those of 2026. This pattern indicates that ATC capacity and staffing constraints remained the predominant component of en-route ATFM delays throughout the reporting periods examined.

The contribution of the other delay categories varied across individual reporting weeks. In 2026 Week 5, the “other” category accounted for 19% of en-route ATFM delays, while ATC disruption represented 12%. In 2026 Week 7, weather-related delays accounted for 9%, the “other” category for 8%, and ATC disruption for 2%. Weather-related delays also accounted for 16% of reported en-route ATFM delays in 2025 Week 10. These variations indicate that additional operational and meteorological factors contributed to the composition of en-route ATFM delays in specific reporting periods. However, none exceeded the share attributed to ATC capacity/staffing.

Overall, Table 3 shows that the analyzed reporting periods were consistently characterized by the predominance of ATC capacity/staffing in the reported composition of en-route ATFM delays. When considered alongside the operational performance indicators in Table 2, this pattern suggests that fluctuations in ATFM delays and punctuality occurred within a broader operational context in which capacity-related constraints remained a prominent system-level component. However, given the study's descriptive design and limited temporal coverage, these findings should be interpreted as period-specific patterns rather than evidence of a stable long-term structure or a causal relationship with geopolitical developments.

3.4. Geopolitical Effects

Table 4 presents the changes observed in Europe-Middle East traffic flows during selected reporting weeks of heightened geopolitical tension in 2026.

Table 4: Observed Changes in Europe-Middle East Traffic Flows During the Period of Heightened Geopolitical Tension (2026)

Week	Indicator	Findings
2026 Week 9	Europe-Middle East flow	On 28 February and 1 March, -66% compared to the same days in 2025
2026 Week 11	Europe-Middle East flow	-52% compared to the same week in 2025
2026 Week 11	Global traffic commentary	The Middle East conflict significantly affected global flight volumes
2026 Week 11	Spatial reflection of delay	Tel Aviv ACC became one of the centers contributing most to en-route delay

Source: (EUROCONTROL, 2025; EUROCONTROL, 2026a).

Table 4 shows that the geopolitical effect appears most prominently in traffic flows between Europe and the Middle East. In the 2026 Week 9 period (23 February-1 March), flight flows between Europe and the Middle East decreased by 66% on 28 February and 1 March compared with the same days in 2025. Similarly, in the 2026 Week 11 period, traffic flow between Europe and the Middle East decreased by 52% compared to the same week in 2025. The same report states that the conflict in the Middle East significantly affected global flight volumes.

These findings show that regional traffic flows changed substantially during the period of heightened geopolitical tension and that these changes coincided with broader operational developments within the European aviation network. In addition, the spatial distribution of delays shows that Tel Aviv ACC was among the control centers contributing most to en-route ATFM delays during the period under review. This observation indicates a geographical concentration of operational disruptions coinciding with heightened geopolitical tension, but does not imply a direct causal relationship.

Table 5: Regional Risk Scope and Operational Reflections of EASA CZIB Warnings

Document	Scope	Meaning for the Study
CZIB: Iran and neighbouring airspace	High risk in the airspace of Iran and its surrounding areas, recommendation for cautious planning to operators	Shows that the risk is not limited to a single country and affects operational planning
CZIB: Middle East and Persian Gulf	Large-scale risk warning covering multiple countries in the Middle East and Persian Gulf region	Shows that geopolitical risk has turned into a regional airspace crisis

Source: (EASA, 2026).

The findings obtained are supported at the institutional level by airspace risk warnings and restrictions published by international regulatory authorities. In this context, the regulatory and conceptual frameworks developed by the European Union Aviation Safety Agency (EASA), the United States Federal Aviation Administration (FAA), and the International Civil Aviation Organization (ICAO) complement each other in explaining how geopolitical risk affects the aviation system.

EASA's Conflict Zone Information Bulletin (CZIB) documents define high-risk airspaces and provide clear guidance to operators for cautious flight planning (EASA, 2026). Table 5 shows that the risk structure, particularly concentrated in Iran and its neighboring airspace, has expanded to the broader Middle East and Persian Gulf. This situation reveals that geopolitical risk is not limited to a single country but has evolved into a structure affecting regional airspace integrity.

Similarly, the Special Federal Aviation Regulations (SFAR) and related NOTAMs published by the FAA include binding regulations that directly restrict civil aviation operations in high-risk regions (FAA, 2026). These restrictions, covering regions such as Iran, Iraq, Yemen, Libya, Russia, and Ukraine, directly affect flight planning processes by obliging operators to avoid certain airspaces. In this framework, the contraction in traffic observed in EUROCONTROL data should not necessarily be attributed solely to demand- or cost-based factors. The temporal coincidence of traffic contraction with regulatory restrictions on airspace access and safety-based operational measures suggests that these institutional constraints may represent relevant contextual factors in explaining the observed traffic patterns.

The conflict zone risk management approach defined by ICAO supports this process conceptually. ICAO emphasizes that flights conducted in conflict zones involve high risk and that these risks should be managed within a multi-actor structure (ICAO, 2026a; ICAO, 2026b). The Conflict Zone Information Repository (CZIR), developed within this scope, enables operators to access up-to-date risk information and encourages prioritizing safety-based assessments in flight planning and operational decision-making.

When these three institutional frameworks are evaluated together, the contraction in Europe-Middle East traffic observed in the EUROCONTROL data coincides with a period characterized by restricted airspace access, safety-based risk assessments, and regulatory constraints. Although the study's descriptive design does not allow isolation of the relative causal contribution of these factors, the institutional evidence provides important contextual support for interpreting the observed changes in traffic flows, network structure, route planning, and operational performance.

3.5. Cost Pressure

Table 6 shows the short-term changes observed in jet fuel prices in 2025 and 2026.

Table 6: Changes in Jet Fuel Prices and Short-Term Trends (2025-2026)

Year	Week	Fuel Price (\$/gallon)	Reported Change Information
2025	Week 6	2.26	+9% compared to early December 2024
2025	Week 8	2.26	0% change
2025	Week 10	2.12	-6% compared to two weeks earlier
2025	Week 12	2.13	+1% compared to two weeks earlier
2026	Week 5	2.29	+4% compared to two weeks earlier
2026	Week 7	2.29	0% change
2026	Week 9	2.45	+7% compared to two weeks earlier
2026	Week 11	4.57	+87% compared to two weeks earlier

Source: (EUROCONTROL, 2025; EUROCONTROL, 2026a).

Table 6 shows that jet fuel prices in 2025 followed a relatively narrow range, approximately 2.12-2.26 dollars/gallon. In the first weeks of 2026, prices moved within the range of 2.29-2.45 dollars/gallon with limited increases; however, a significant jump occurred in Week 11, reaching 4.57 dollars/gallon.

This value in 2026 Week 11 indicates an 87% increase from two weeks earlier and represents the sharpest price increase in the analyzed period. This pattern suggests that jet fuel prices can be highly volatile over short periods and coincide with intensified system-level cost pressure.

These findings indicate that, when traffic volume remains stable in absolute terms, but growth momentum weakens, sudden increases in fuel prices coincide with intensified cost pressure within the aviation system.

Jet fuel price data in EUROCONTROL reports also align with global trends presented in the Jet Fuel Price Monitor published by IATA (IATA, 2026).

IATA data show that jet fuel prices followed a relatively stable trend throughout 2025, with a limited upward trend in the first months of 2026. This trend is consistent with EUROCONTROL data, which remained within a narrow band throughout 2025 and showed a gradual increase in early 2026.

In contrast, towards March 2026, when geopolitical developments intensified, a more pronounced upward trend in jet fuel prices emerged. When evaluated together with the sudden price spike observed in Week 11 in EUROCONTROL data, this upward movement coincides with increased volatility in global energy markets and heightened geopolitical uncertainty.

Within this framework, when the global price trends presented by IATA and the sudden price increase observed in EUROCONTROL data are evaluated together, the findings indicate heightened short-term cost volatility occurring within a broader context of increasing pressure in global energy markets. However, the analysis's limited temporal coverage does not allow this movement to be interpreted as evidence of a persistent structural shift in fuel price dynamics. Therefore, the findings indicate that cost pressure increased alongside heightened geopolitical developments. Given the study's descriptive design, however, the observed fuel price movements cannot be causally attributed to geopolitical developments alone. This general trend is summarized with the IATA data presented below.

Table 7: Jet Fuel Price Trends According to IATA Data (2025-2026)

Period	Trend
2025	Relatively stable
Early 2026	Limited increase
March 2026	Increasing trend strengthens

Source: (IATA, 2026).

Table 7 shows that jet fuel prices followed a relatively stable trend in 2025, increased modestly in the first weeks of 2026, and then rose more sharply, particularly toward March. This pattern is consistent with the sharp price spike observed in Week 11 in EUROCONTROL data.

Taken together, these findings suggest that the short-term increase in jet fuel prices during the analyzed period reflects heightened cost volatility rather than sufficient evidence of a structural shift in fuel price dynamics. Distinguishing between a temporary price fluctuation and a persistent structural change requires a longer observation period and broader time-series analysis than the present study covers. Therefore, the sharp increase observed during the 2026 reporting period should be interpreted cautiously as a short-term cost development occurring simultaneously with heightened geopolitical uncertainty and volatility in global energy markets. Although the magnitude and rapidity of the increase matter for interpreting cost pressure within the aviation system, the available aggregate data do not allow evaluation of airline-specific cost exposure, operational responses, or decision-making processes. The descriptive data also do not allow establishing the persistence of this increase or its independent relationship with geopolitical developments. Accordingly, the findings provide evidence of intensified short-term cost pressure during the period under review rather than evidence of a permanent structural transformation in fuel price dynamics.

3.6. Interpretation of Findings

The findings indicate that periods of heightened geopolitical tension in Middle Eastern airspace coincide with interconnected changes in traffic flows, route configurations, operational performance, capacity constraints, and cost indicators. Given the descriptive nature of the research design, the relationships among these dimensions are not interpreted as a causal chain. Instead, the findings are organized within a descriptive framework that illustrates how the observed patterns coexist and may interact at the system level. In particular, the 52%-66% contraction observed in Europe-Middle East traffic flows during the analyzed weeks of 2026 is evaluated alongside documented airspace restrictions, rerouting activities, operational indicators, and fuel price movements.

In this framework, the findings can be organized around the following interrelated system-level patterns:

(1) Airspace access risks and route reconfiguration

Periods of heightened geopolitical tension coincide with increased uncertainty regarding airspace accessibility and with documented changes in route planning. The contraction observed in Europe-Middle East flows is consistent with documented flight reconfiguration through alternative routes rather than widespread cancellations.

(2) Cost pressure and fuel prices

Jet fuel prices reached 4.57 USD/gallon in 2026 Week 11 and rose 87% in a short period, showing sharply increased cost pressure. This pattern indicates that cost developments constitute an important contextual dimension when interpreting operational conditions during the period under review.

(3) Capacity constraints and delays at the network level

The distribution of the main causes of en-route ATFM delays shows that ATC capacity/staffing constituted the largest reported category across all reporting weeks included in the analysis, with its share ranging from 58% to 84%. Weather, other factors, and ATC

disruptions contributed to the delay composition in specific reporting periods but did not exceed the share of ATC capacity/staffing. This pattern indicates that the operational performance fluctuations observed during the analyzed periods occurred within a broader network context characterized by prominent capacity and staffing constraints. Accordingly, changes in punctuality and ATFM delay indicators should be interpreted in relation to broader system-level operational conditions rather than as outcomes attributable to a single source or external factor.

(4) Fluctuation in operational performance

Punctuality indicators point to a significant decline, particularly in the early weeks of 2026, with a partial recovery in the following weeks. This pattern reveals that operational performance is sensitive to short-term shocks.

(5) Slowdown in traffic growth and cautious capacity management

The findings show that although total traffic remains stable, growth rates have weakened. This pattern is consistent with a period of increased uncertainty and constrained network growth; however, the aggregate data used in this study do not allow direct observation of firm-level capacity management decisions.

(6) System-level determinants

Taken together, the observed changes in operational performance and traffic dynamics coincide with network-level capacity constraints, cost pressures, and heightened geopolitical uncertainty. These interconnected patterns support a system-level interpretation of aviation network performance while remaining within the analysis's descriptive scope.

The descriptive framework presented in this study is consistent with the operational patterns reported in EUROCONTROL's analysis titled "Impact of the current Middle East crisis on European aviation". In this analysis, it is stated that a decrease of approximately 59% is observed in Europe-Middle East flights.

However, it also states that a significant portion of flights are re-planned via alternative routes rather than canceled. In this context, approximately 1,150 flights are rerouted daily on average; total flight distance has increased by approximately 206,000 kilometers; and, accordingly, daily fuel consumption has increased by approximately 602 tons.

Table 8: Operational effects of the Middle East crisis on European aviation (EUROCONTROL)

Indicator	Value	Interpretation
Change in Europe-Middle East flights	≈ -59%	Traffic contraction
Daily rerouted flights	≈ 1,150 flights	Network reconfiguration
Additional flight distance	≈ 206,000 km/day	Route extension
Additional fuel consumption	≈ 602 tons/day	Cost pressure

Source: (EUROCONTROL, 2026b).

These findings indicate that the operational patterns observed during periods of heightened geopolitical tension are not limited to changes in traffic volume. In particular, the simultaneous occurrence of rerouting and increased flight distance shows that operational pressure has a multi-dimensional structure.

In addition, when the findings on additional fuel consumption are evaluated alongside the fuel price increases identified in the study, they indicate that cost pressure is strengthened through both price and consumption channels. This pattern suggests considering multiple, potentially interrelated factors when interpreting system-level cost dynamics.

The study's descriptive framework is consistent with the conflict-zone risk management perspective outlined by Careen (2025). This perspective emphasizes that airlines' strategic and operational risk assessments inform routing decisions and depend on the quality of available information. It also highlights the importance of timely information sharing, international coordination, and contingency planning when conflict-related airspace restrictions divert traffic to alternative corridors.

Taken together, the findings in this framework show that system-level operational patterns during periods of heightened geopolitical tension cannot be interpreted solely through demand- or cost-based factors. In addition, safety-based evaluations and international coordination processes constitute relevant contextual dimensions for interpreting the observed operational patterns at the system level.

Therefore, the observed patterns of traffic contraction, route changes, cost increases, and safety-based coordination processes can be interpreted as interconnected dimensions of system-level pressure during periods of heightened geopolitical tension. Taken together, these findings provide a descriptive basis for understanding how multiple operational and cost indicators coexist and interact within the aviation system's network structure, without implying an empirically established causal mechanism.

4. Discussion and Conclusion

The findings provide preliminary evidence of interconnected descriptive patterns in operational performance, traffic dynamics, network reconfiguration, and cost pressure within the European aviation network during the analyzed periods of heightened geopolitical tension. These patterns suggest that system-level constraints and geopolitical uncertainty constitute important contextual dimensions for interpreting changes in aviation network performance. However, given the descriptive research design, the findings do not establish direct causal relationships between geopolitical developments and the observed operational and cost indicators.

First, traffic data show that total flight volume was largely maintained during the period under review, while growth rates weakened significantly. The decline in growth rates from 3%-7% in 2025 to 0.8%-2.7% in 2026 indicates that the change was characterized not by a uniform contraction in total network activity, but by weaker traffic growth during a period marked by documented constraints on airspace accessibility and network routing. This finding is consistent with the growing literature emphasizing the network-dependent nature of air transportation systems. In particular, Başpınar et al. (2023: 12) show that air transportation systems' response to disruptions is strongly shaped by network structure and resilience characteristics rather than solely by changes in traffic volume or individual airline decisions. The present findings extend this perspective by showing that, during periods of heightened geopolitical tension, relatively stable aggregate traffic volumes may coexist with weakening growth dynamics and constraints

on airspace accessibility. Thus, the results suggest that the operational implications of geopolitical uncertainty cannot be interpreted through aggregate traffic contraction alone; changes in network accessibility and the system's capacity to accommodate continued growth are also relevant analytical dimensions. Nevertheless, the descriptive nature of the present analysis does not allow the observed slowdown in traffic growth to be causally attributed to geopolitical developments.

Second, the operational performance findings are consistent with previous research on delay propagation and network vulnerability. When ATFM delays and punctuality indicators are evaluated together, punctuality rates decline during periods of increased delays, indicating an inverse pattern between these operational indicators. Analysis of the main causes of en-route ATFM delays further shows that ATC capacity/staffing was the largest reported category across all reporting weeks included in the study. At the same time, weather, other factors, and ATC disruptions contributed to the delay composition in specific periods. This finding aligns with Campanelli et al.'s (2016: 17) broader argument that delays should be understood not as isolated operational events but as network phenomena shaped by the structural characteristics of air transportation systems. This study offers a complementary descriptive perspective by showing that operational performance fluctuations during periods of heightened geopolitical tension coexist with persistent capacity-related constraints and additional period-specific operational factors within an interconnected aviation network. Unlike studies that directly model delay propagation across network nodes, the aggregate data used here do not allow identification of how individual delays propagate. Nevertheless, the findings suggest that the operational performance patterns observed during periods of network reconfiguration should be interpreted within broader operational and network-level conditions rather than being attributed exclusively to geopolitical developments.

The findings concerning traffic flows and route reconfiguration also align with recent research emphasizing the importance of network structure in shaping aviation system responses to external disruptions. Wandelt et al. (2025: 11) argue that air transportation networks respond to external shocks through complex interactions among network nodes, routes, connectivity structures, and capacity constraints. In the present study, the 52%-66% contraction observed in Europe-Middle East traffic flows, combined with the maintenance of total network traffic volume, suggests that the analyzed period was characterized by network reconfiguration rather than a uniform decline in aviation activity. This interpretation is further supported by EUROCONTROL's documented evidence concerning rerouted flights, increased flight distances, and additional fuel consumption. In this respect, the findings are consistent with the view that external disruptions may alter the spatial organization and operational configuration of aviation networks without necessarily producing an equivalent reduction in aggregate traffic volume. This study contributes to the literature by showing how regional traffic contraction and broader network continuity may coexist during periods of heightened geopolitical tension.

A similar interpretation emerges when viewed through the lens of network resilience and accessibility. Sun et al. (2020: 7) emphasize that aviation disruptions should be evaluated not only in terms of direct traffic losses but also through their implications for accessibility and network connectivity. These findings align with this perspective, as the observed rerouting of traffic flows and the increased visibility of capacity bottlenecks suggest that the implications of

geopolitical tension may extend beyond regional traffic reductions to the broader functioning of the European aviation network. However, an important distinction should be made between the present study and the resilience literature. Whereas Sun et al. (2020: 1) analyze resilience through network accessibility and disruption scenarios, the present research adopts a descriptive approach based on aggregate institutional indicators. Accordingly, the contribution of these findings lies not in measuring network resilience directly, but in identifying simultaneous operational patterns consistent with the broader theoretical argument that aviation disruptions should be interpreted as network-level rather than isolated regional phenomena.

In terms of cost dynamics, the 87% increase observed in jet fuel prices in 2026 Week 11 stands out as the most prominent indicator of short-term cost pressure during the analyzed period. Taken together with EUROCONTROL's reported increases in flight distance and additional fuel consumption from rerouting, this finding suggests that cost pressure may emerge through multiple, potentially simultaneous channels. On the one hand, short-term fuel price volatility increases the unit cost of fuel; on the other hand, route extensions may increase fuel consumption even when aggregate traffic volume is maintained. This finding complements previous studies of aviation network resilience and disruption management, which have predominantly focused on traffic flows, operational recovery, and delay propagation, by highlighting the relevance of cost dynamics in interpreting system-level disruption patterns. Nevertheless, the study's limited temporal coverage does not provide sufficient evidence to determine whether the observed fuel price increase represents a temporary fluctuation or a persistent structural shift. Therefore, the findings should be interpreted as evidence of intensified short-term cost pressure rather than permanent changes in airline-specific cost structures or fuel price dynamics.

When the findings are evaluated holistically, three interrelated patterns become prominent during the period of heightened geopolitical tension: (i) the coexistence of changes in traffic flows and documented airspace accessibility constraints, (ii) the simultaneous presence of network-level capacity constraints and fluctuations in operational performance, and (iii) increasing cost pressure associated with developments in energy markets and route reconfiguration. Considered together, these findings are broadly consistent with previous research on network resilience, delay propagation, and aviation system vulnerability (Başpınar et al., 2023: 8; Campanelli et al., 2016: 12; Sun et al., 2020: 7; Wandelt et al., 2025: 11). Unlike previous studies that primarily examine network resilience, delay propagation, or disruption recovery through separate analytical frameworks, the present study does not model these mechanisms directly. Instead, it provides an integrated descriptive assessment of their simultaneous manifestation alongside cost pressures during a specific period of heightened geopolitical tension.

This integrated perspective distinguishes this study from previous research. The findings suggest that geopolitical risks in aviation should not be interpreted solely through isolated outcomes such as traffic contraction, flight cancellations, delays, or fuel price increases. Instead, periods of heightened geopolitical tension may coincide with multiple interconnected system-level patterns involving changes in traffic distribution, network configuration, operational performance, capacity pressure, and cost dynamics. By bringing these dimensions together, the study contributes to the literature by providing a multidimensional descriptive

interpretation of how different operational and cost indicators coexist within a highly interconnected aviation network. At the same time, the descriptive research design requires caution: the observed coexistence of these patterns should be understood as contextually supported associations rather than evidence of empirically established causal mechanisms.

This study makes two main contributions to the literature. First, by addressing operational performance and delay dynamics at the system level rather than at the firm level, it highlights the relevance of structural factors such as capacity constraints, network configuration, and airspace accessibility in interpreting aviation network performance. Second, it provides an integrated descriptive framework for examining how traffic flows, route reconfiguration, operational performance, and cost pressures coexist during periods of heightened geopolitical tension. Rather than claiming causal effects, the study contributes by bringing together operational, institutional, and cost indicators that the existing literature generally examines separately.

However, the study has some limitations. First, the descriptive research design does not allow the study to establish causal relationships between geopolitical developments and changes in traffic, operational performance, delays, or fuel prices. The findings therefore represent temporal co-movements, associations, and contextually supported interpretations rather than causal effect estimates. Second, the temporal scope of the analysis is limited to the 2025 and 2026 EUROCONTROL reporting periods and therefore does not allow conclusions regarding long-term aviation trends. This temporal boundary reflects the study's early-period descriptive character and its objective of examining emerging system-level patterns during the geopolitical developments observed in 2026, using 2025 as the most recent reference period for contextual comparison. Although a longer time series could provide additional evidence regarding long-term dynamics, extending the present analysis to earlier years would require accounting for structurally different conditions in European aviation, particularly the exceptional effects of the COVID-19 pandemic and the subsequent recovery period. The findings should therefore be interpreted as preliminary evidence of short-term and context-specific patterns rather than as conclusive or generalizable evidence of long-term trends or stable system-level relationships. The relatively limited number of observation periods further restricts the robustness and generalizability of the findings. Although the analyzed periods correspond to the reporting intervals made available through EUROCONTROL's institutional publication schedule rather than to discretionary researcher selection, the resulting number of observations remains limited. Accordingly, the findings should be considered an initial descriptive assessment that future studies with more observation periods and longer time series should validate. Third, the descriptive research design does not allow seasonal effects to be statistically isolated from other simultaneous influences on aviation activity. Although the analysis considers annual growth rates and year-on-year changes reported by EUROCONTROL in addition to absolute indicators, the reporting periods available for 2025 and 2026 do not correspond to identical calendar weeks, and no statistical seasonal adjustment was applied. Consequently, some of the observed variation may reflect seasonal traffic conditions and other concurrent influences, including macroeconomic developments, energy market dynamics, and airline-specific strategies. The findings should therefore not be interpreted as changes attributable exclusively to geopolitical developments.

Future studies using longer time series, seasonally adjusted data, and methods capable of accounting for structural breaks, heterogeneous historical conditions, seasonal variation, and other time-varying factors, including quasi-experimental designs, interrupted time-series analyses, and difference-in-differences approaches, could provide more robust evidence regarding the long-term and causal relationships examined in this study. In addition, future research could compare the effects of geopolitical crises on aviation networks across regions, deepen cost analyses by examining the relationship between route extension and fuel consumption, and evaluate the effects of airspace restrictions on network efficiency through modeling.

In conclusion, this study identifies interconnected changes in traffic dynamics, operational performance, network structure, and cost pressure during periods of heightened geopolitical tension. By interpreting these changes within an integrated descriptive framework, the study highlights the network-dependent, multi-layered structure of the European aviation system while avoiding causal claims beyond the scope of the analytical design. Although the findings are preliminary and context-specific, they provide a basis for future research using longer time series, broader datasets, and analytical methods that can examine the causal and long-term implications of geopolitical disruptions for aviation networks.

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