

Geopolitical, social, and military crises affecting the academic environment - a world-scale typology of AUF universities based on GIS and spatial analysis tools

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Keywords: military conflicts; universities; risk exposure, non-state actors, Shannon index

Abstract: The territorial contexts in which the universities are supposed to function become more and more complex and involve different forms of military, social and political risks. This article examines potential methodological approaches for evaluating these risks, using the network of AUF universities as a case study. The data used for the evaluation are provided by the ACLED datasets of incidents at a world scale, and they were spatialized using classical GIS tools. The first methodological approach measures the university's exposure by placing them in different distance bands around the median centers of significant state and non-state actors responsible for the military conflicts between 2021 and 2025. The output of the second approach is a multivariate typology of the AUF universities, each class describing different forms of exposure to risks. The key findings underline the fact that there are substantial disparities between the AUF regions, in terms of exposure, with severe risks in Western Africa, the Middle East and Eastern Europe. Based on the results of the research, a set of recommendations for policy design inside AUF was developed.

1. Introduction

The multiplication of military conflicts and civil disorder on a world scale has inherent impacts on the coherence of states and the resilience of societies. Typically, this multiplication of incidents is associated with an exponential spread of violence that impacts institutions, communities, infrastructures, and the overall resilience of societies. One of the institutions that is particularly exposed to military and political stress is the university. Their catchment areas, social and economic mission, capacity to shape mentalities and behaviors, and academic productivity position the university within a complex and fragile network of interactions with other actors, rendering it strongly dependent on the territorial context in which it implements its educational and scientific activities. Some available research (Waldinger, 2016) highlights the role of social and economic local capital in the functioning of universities across different geographical and historical contexts. Recent studies in the field of psychology have investigated the direct relationship between military conflicts and stress-related disorders among academic personnel and students (Pavlova and Rogowska, 2023; Aoun et al., 2013; El-Khodary and Aboudagga, 2025; Charlson et al., 2019). Approaches from demography and migration studies investigate the consequences of military and civil disorders mainly in terms of brain drain, showing how external nations can profit from the instability

(Ganguli, 2014; Borjas and Doran, 2012). When the violence is directly oriented against universities and academic environments, including scientists and researchers, the literature mentions the term *educide* (Alousi, 2022), coined after the analysis of the post-Iraqi war increase of incidents targeting universities. The practice is not new (Rodman, 2014) and resurges in specific moments (Serscikov, 2023), which the actors involved consider strategic. Even if different fields of research clearly understand the effects of military conflicts and civil disorder, we lack a synthetic overview of the university's exposure to these risks, especially from a territorial perspective, at a global scale. There are several potential explanations for this situation. From a spatial perspective, a sound and reliable dataset of universities for all countries is not available. The most comprehensive list of world universities, compiled by the International Association of Universities (IAU), is not yet geo-located. A second explanation is derived from the fact that few theoretical approaches integrate this form of risk assessment in a research frame (Elfversson and Höglund, 2021; Raleigh et al., 2023). Our investigation examines the methodological challenges of evaluating universities' exposure to military conflicts and political unrest, utilizing GIS, spatial analysis, and geostatistical tools. The data was extracted from the ACLED (Armed Conflict Location & Event Data) database and was mobilized to describe the territorial contexts in which the case study universities are located. The sample of universities includes only the members of the AUF (Agence Universitaire de la Francophonie) network.

The paper introduces two typologies of risk exposure, each of them being the output of a separate methodology of elaboration. The first classification measures and identifies the universities that are in a severe form of exposure to conflicts. It measures the position of the universities on distance bands towards the centroids of either non-state or legitimate actors that generate violence at a world scale (e.g., terrorist groups, insurgent actors, military forces, local militias, etc.), as described and categorized by ACLED. The closer the universities are to the centroids (median-centers of actors' events), for example, on the first or second distance band, the higher the risks and the potential impacts on their functioning. The second typology integrates four indicators and focuses on the local territory in which universities offer educational services. The indicators are a mix between different proxies for risk assessment - number of military and civil incidents, number of fatalities recorded in the proximity of universities, potential accessibility to violence and a spatialized version of the Shannon Index of conflicts diversity. The four indicators were included in a hierarchical clustering technique of multivariate analysis and a diagnosis of risk exposure was obtained for each AUF university. The workflow implementation is based on three phases of the spatial database creation and two main methodological objectives. Finally, the sections dedicated to discussions and conclusions highlight the relevant findings and elaborate a set of policy and decisional recommendations for AUF, along with an assessment of the study's limitations and potential new avenues of research.

2. Materials and Methods

The world-scale analysis of territorial contexts and their military and political dimensions rely on a limited number of data providers, with varying degrees of temporal and spatial resolution of the information. From a purely military perspective, one can utilize the Uppsala Conflict Data Program (Davies et al., 2025; Davies et al., 2023), which provides curated indicators describing conflicts up to 2024. In terms of terrorist events, excellent coverage is available in the Global Terrorism Database (GTD), which the University of Maryland developed as part of the National Consortium for the Study of Terrorism and Responses to Terrorism (LaFree and Dugan, 2027). However, in this case, the events are recorded only up to 2020, with few chances of an upgrade soon. The data used for our research is provided by ACLED (Armed Conflict Location & Event Data) and it reflects the cumulative situation of significant military and political incidents recorded on the 18th of April 2025, at a global scale. Our option was determined by the

high variety of the indicators, ranging from peaceful protests to acts of war and strategic development (Raleigh et al., 2023). The ACLED datasets are transmitted as .csv files and they cover different chronological extents. For example, the African dataset of raw data begins in 1997, while datasets for Europe and Central Asia are available only after 2018. A chronological cut-off of the data was imposed, and we retained the 2021–2025 period, allowing us also to include USA and Canada information (available only after 2020). The 2020 data were excluded due to the large number of worldwide protests resulting from anti-COVID sanitary measures, which created disproportionate representation of protests in the spatial database. Once the chronological extent was established, the records retained in the database described 1,440,225 incidents, spread across six separate regions: Africa, Asia and the Pacific, Europe and Central Asia, the Middle East, Latin America, the USA, and Canada. The information contained has a 4-level spatial resolution, with levels 1 and 2 describing the precise location of events at the local scale. Levels 3 and 4 are reserved for regional or national incidents, when the ACLED geolocation was not possible. The indicators are organized in a dyadic form, with 3 components: actor no. 1 (e.g., a non-state group, national military forces, civilians, or institutions), actor no.2 and the description of the conflicts (labeled as disorder type, event and sub-event type). Given the degree of spatial resolution of the incidents, we have maintained in the spatial database only the events with a fair local precision (levels 1 and 2). The datasets contain WGS84 latitude and longitude fields, allowing a straightforward mapping of the information. A rapid analysis of the event descriptors, primarily those related to the actors involved, suggested that a second review of the information was necessary. The exclusion criterion was set as follows: actors with fewer than 5 incidents and fewer than 10 fatalities during the 2021–2025-time interval are candidates for elimination from the spatial database. On average, only groups with one event and two fatalities per year are conserved. The purge produced an operational dataset populated with only 65% of the initial information, 930,154 events.

The localization of the AUF universities was derived from the GeoJSON file available on the association's page (https://www.auf.org/les_membres/nos-membres/). It contains basic information about the members - name of the university, country and the AUF bureau of jurisdiction (e.g., AUF Europe Centrale et Orientale). There are 10 regions of administration for AUF affairs at the global scale, along with a supplementary category of non-affiliated states. The quality of the initial localization of universities was generally good, only minor interventions being needed for a correct placement of some of the AUF members in Algeria, Romania and Brazil. Their coordinates of latitude and longitude are associated with the centroid of the local administrative unit to which they belong.

At this stage of data production and management, the results of the initial steps were stored in a spatial database labeled Phase 1. In Phase 2, we have added indicators derived from the purged ACLED datasets and the AUF members' map. Two new spatial features were elaborated: the median centers of Actor 1 events (ACLED delineation) and the incidents located in a 200 km buffer around the AUF universities. These two shapefiles are used in the further development of our methodological approach, specifically for evaluating the territorial context that impacts AUF universities from a military and political perspective. The median centers of the actors involved in the conflicts are necessary in order to provide a spatial synthesis of the non-state and state actors that interfere with the university's potential service areas. Immune to spatial outliers, the median centroids are further used to evaluate the proximity of the conflict cores to the AUF members in different regions of the world. Already filtered by the number of events and fatalities, their list encompasses 1657 points (relevant actors). The 200 km buffer is a spatial cut-off distance that includes in the analysis only the incidents that can have a rapid impact on the universities. A total number of 463,823 events is retained in this case.

In Phase 3, the datasets stored in the spatial database were mobilized for the development of geostatistical typologies that describe the impact of military and political conflicts on the AUF network of universities. The workflow implemented in this phase

required a set of methodological options that strike a compromise between the usual calculus limits of spatial analysis tools and mapping constraints. Two methodological objectives were set, each responsible for generating a territorial typology of universities within broader contexts of war and civil unrest.

The first methodological objective (O1) is to assess the position of universities in association with the territories of action of state and non-state actors involved in conflicts or civil disorder. We address this problem by using a multiple-step approach. The first step is to extract the spatial footprint of actors from the ACLED dataset, which was prepared during the database creation phase. For each actor, the distance between the events and the median center is calculated. Alternative solutions are possible, but they provide unreliable results for data with a large number of spatial outliers (Croicu and Sundberg, 2012). Given the scale of the study, it was not possible to implement a network analysis of distances; however, Euclidean distances were available. In step no.2, we cumulate the number of events and the number of fatalities as distance functions starting from the median center. The cumulative values obtained can be mapped (Figure 1), as seen in the case study applied to JNIM (Jama'at Nasr al-Islam wal-Muslimin), a Salafi and Jihadist confederation comprising various terrorist organizations with an extensive operational territory in the Sahel. In this moment, this organization might be the most lethal non-state actor in Africa (Dowd and Raleigh, 2013; Yahaya Ibrahim, 2021).

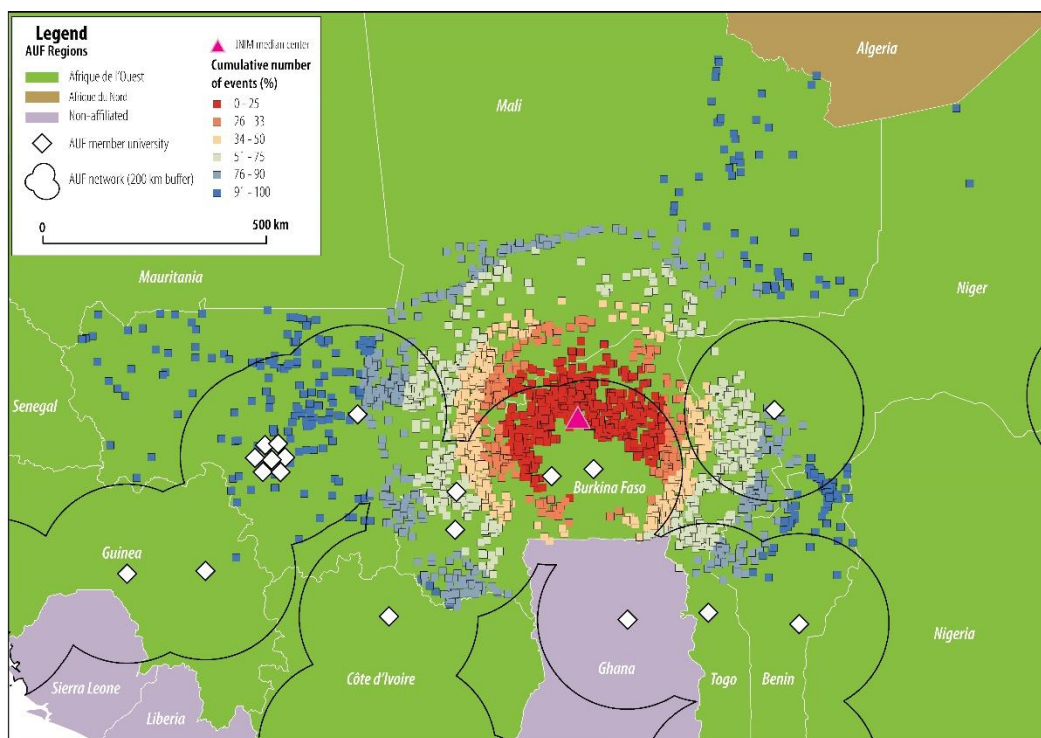


Figure 1. Mapping military incidents around AUF universities - a case study on Jama'at Nasr al-Islam wal-Muslimin (JNIM) territory of action in Western Africa

The process is iterated for all the groups or actors in the dataset (1655). Two actors were excluded from the analysis - Rioters (International) and Unidentified Armed Group (International). Their extent of incident deployment is considerable and the median center lacks relevance in the context of our research. Within the framework of Objective 1, one indicator is particularly interesting in assessing the university's exposure to risk: the cumulative number of fatalities as a function of distance from the median centers. The indicator was reclassified into 10 distance bands ranging from 1 to 10, each band containing 10% of one actor's events, during the time period of 2021-2025 (April). As the geometries of each actor's events vary, resulting from target opportunities, violence diffusion, or interfering forces, the shapes of the cumulative fatalities functions exhibit

strong dissimilarities. When mapped, the distance bands are useful for evaluating the university's exposure to risks of conflicts in the proximity, as depicted in Figure 2. The map depicts the spatial extension of the distance bands around the median centers of three selected state and non-state actors - Boko Haram, the military forces of Chad and an unidentified armed group from Chad.

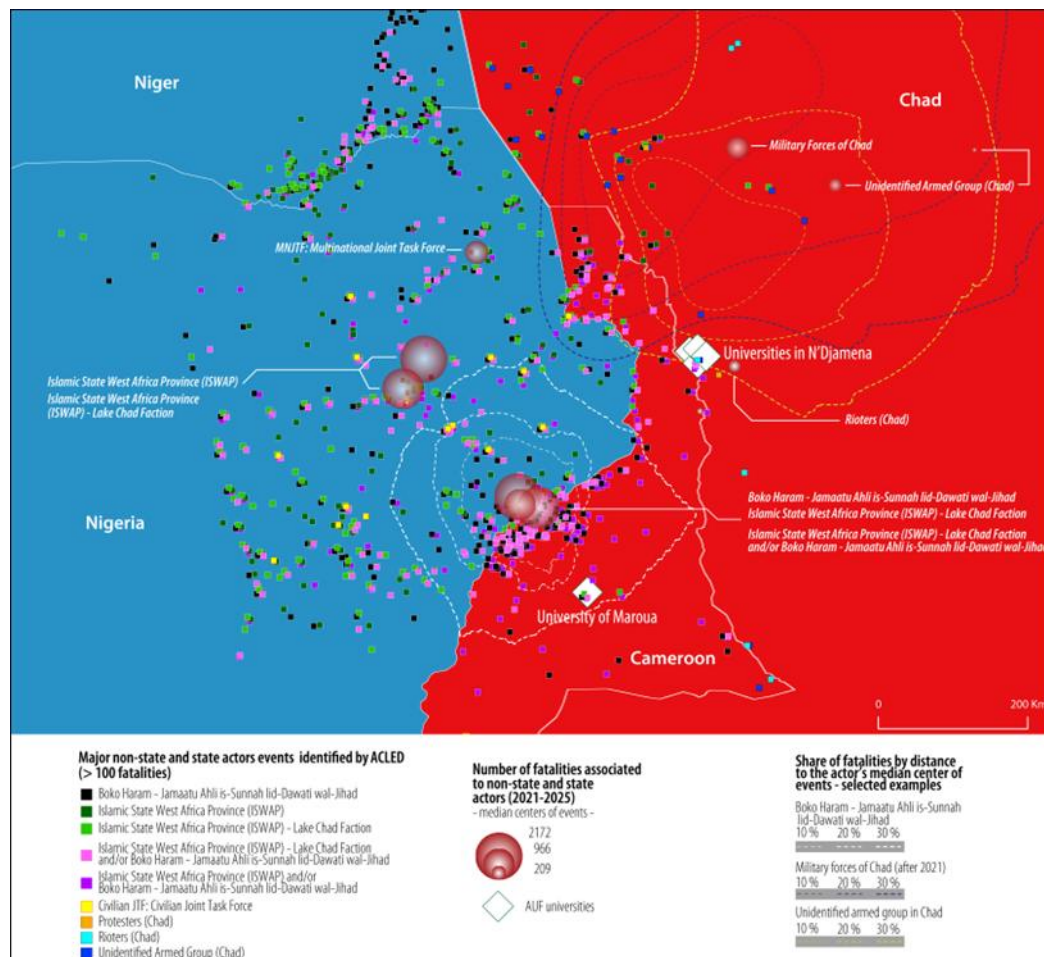


Figure 2. Universities' location on different distance bands around the median centers of violent military actors (Boko-Haram, Military Forces of Chad and an unidentified armed group in Chad).

In the last 10 years, Boko Haram and its early spin-off (the Islamic State's West Africa Province) have been examples of radicalization and extreme violence targeted against civilians and educational facilities. Its presence on the map also raises questions regarding the possibility of weighting the distance bands according to the hierarchy of the analyzed actors. Due to visualization and mapping limitations, the map excluded the other 10 groups operating in the study area (Islamic State and its satellites, local anti-jihadist militias, or legitimized armed forces, other than the military). According to the map, the University of Maroua, in North Cameroon, is placed in the third distance band of cumulative fatalities produced by Boko Haram, at less than 200 km from the terrorist group's median center. The AUF establishments from N'Djamena (Chad) are in the same situation - 3rd distance band in the territory of action of an unidentified armed group acting at the national scale. They are also located in the 4th distance band of Chad's military forces' area of intervention.

The map analysis indicates that the territories of action of ACLED actors are overlapping in multiple cases. Consequently, a university might find itself in a "cross-fire" situation, enduring pressures from multiple groups with varying intensities. Following the qualitative classification of the cumulative number of fatalities around the

median centers of political, military and social actors described in the ACLED database, an AUF university or member can be located in one of the 10 bands of distance. If the values are low (1, 2, or 3), it can be considered that exposure to military conflicts or civil disorder is high, moderate for bands 4 to 6, and less concerning for distance classes ranging from 7 to 10. The median centers of the points' distribution can be interpreted as a gravity center of the conflicts and the proximity to this spatial synthetic indicator is a good proxy in evaluating the local and regional territorial threats impacting the AUF network. For each university in the dataset, we have calculated the location within one of the actors' distance bands of cumulative fatalities. This investigation allowed us to evaluate the spatially associated political and military risks. Table 1 presents the synthesis of the approach implemented within the framework of Objective 1, which involves an assessment of the severe military and political risks affecting AUF universities.

Table 1. Position of AUF universities in the actors' distance bands of cumulative fatalities around the median centers

AUF official regional delineation	Distance bands - share of cumulative fatalities									
	DB1 ¹	DB2	DB3	DB4	DB5	DB6	DB7	DB8	DB9	DB10
AUF - Afrique Australe et Océan Indien	28	4	3	0	5	0	3	0	1	15
AUF - Afrique Centrale et Grands Lacs	38	23	4	6	11	12	40	5	14	31
AUF - Afrique de l'Ouest	51	3	8	15	4	18	3	3	13	32
AUF - Afrique du Nord (Maghreb)	5	3	0	46	0	33	0	13	15	48
AUF - Amériques	32	1	9	13	6	20	12	48	4	9
AUF - Asie-Pacifique	4	1	2	3	18	4	0	2	4	14
AUF - Caraïbes	12	12	3	2	5	1	6	2	0	9
AUF - Europe Centrale et Orientale	35	8	3	2	0	5	0	0	28	117
AUF - Europe Occidentale	46	23	12	29	0	103	11	10	60	170
AUF - Moyen-Orient	74	16	15	6	13	4	14	8	9	19

¹ DB stays for distance bands around the actors' median centers. Only the first 3 actors are included in the statistics, for illustration purposes.

The first three bands reflect the most severe risks due to proximity to conflicts and they present a geographical distribution that is counterintuitive, in some aspects. For example, the AUF bureau responsible for Western Europe is relatively under strong pressure, with a large number of universities locations in the first distance band. This situation is explained by the strong concentration of AUF members in some metropolitan areas (Paris, Lyon, Toulouse, etc.), a concentration that is spatially linked to the presence of two sets of incidents - actions due to the National Police Forces of France and an unidentified armed group operating on French territory.

Following the same logic, an overview of the distance bands, numbers 9 and 10, reveals that the AUF members of the Western and Central-Oriental European Bureaus have the most significant number of locations (230 and 145, respectively). This suggests that the universities in these two regions of AUF management are least affected by military conflict and civil disorder. The intermediate situations, assimilated to locations in distance bands 4 to 6, are rather specific to the Maghreb and Asia-Pacific AUF regions. The results of the intersection between the actor's orbits of violence and the universities were conserved in Phase 3 of the spatial database elaboration. For each university, an assessment of risk exposure is available and operational for mapping purposes. Table 2 provides an example of data visualization for some of the most exposed universities and AUF establishments (members). Their situation is particularly interesting, with a triple position on the first distance band around actors' median centers and with a significantly

reduced average distance to these points. Such is the case for educational facilities in Khartoum, Addis Ababa, Kampala, as well as Mexico City, Ramallah, and Nablus.

Table 2. Position of AUF universities in the actors' distance bands of cumulative fatalities around the median centers

AUF member	City	Country	AUF Region	Location in DB1 ¹	AD1 (km) ²
University of Gezira	WadMedani	Sudan	AUF - Moyen-Orient	3	4.34
El Nilein University	Khartoum	Sudan	AUF - Moyen-Orient	3	4.65
University of Khartoum	Khartoum	Sudan	AUF - Moyen-Orient	3	4.65
University of Sudan for Science and Technology	Khartoum	Sudan	AUF - Moyen-Orient	3	4.65
Birzeit University	Birzeit - Ramallah	Palestina (West-Bank)	AUF - Moyen-Orient	3	5.88
Commerce School of Makerere University	Kampala	Uganda	AUF - Afrique Centrale et Grands Lacs	3	11.87
University of Addis Abeba	Addis-Abeba	Ethiopia	AUF - Moyen-Orient	3	15.51

¹ DB1 stays for distance band no.1 around the actors' median centers. Only the first 3 actors are included in the statistics, for illustration purposes.

² AD1 signifies the average distance to the nearest 3 median centers of ACLED-designated actors.

The case of Sudanese and Ethiopian universities is an illustration of how national geopolitical agendas collide (Afriyie, 2024; Abdellatif et al., 2025; Afriyie et al., 2023), directly impacting the educational systems in both countries. Even if this exposure is not associated with physical destruction of the infrastructure, it leads to a deterioration of the general environment needed for education and research. This evaluation will provide input for the first classification of the AUF members, with an emphasis on the degree of severe exposure to conflicts and civil disorder, in line with the approach proposed by our first methodological objective.

The second methodological objective addresses the same problem of the AUF universities' typology, integrating it this time in a multivariate framework. Due to the size of the events database, with over 900,000 incidents recorded, a spatial constraint was imposed for the analysis. We use a buffer range of 200 km around the AUF universities and members, and we extract all the events that intersect this buffer. For each university, a set of four indicators is calculated:

Indicator no.1 (I1): the stock of incidents available in a 200 km radius around the universities.

Indicator no. 2 (I2): number of fatalities signaled by ACLED in the same range. The values are weighted using an exponential function with a negative slope, spanning 50 km, and then summed.

Indicator no. 3 (I3): an evaluation of event proximity based on the weighting values used for the construction of the previous indicator. Values close to 1 are linked to a high proximity and concentration of events in the universities local territorial context.

Indicator no. 4 (I4): the local Shannon index of incident diversity. The ACLED datasets contain a hierarchized set of descriptors that describe the nature of the conflict or the civil disorder in which the actors are involved (field label Sub-event). The values are used for the index elaboration.

Except for the local Shannon Index of conflict diversity, the three other indicators are scaled between 0 and 1. The variables were further used in a hierarchical clustering tool, aiming for a statistically sound classification of the AUF universities and

members. The typology is based on 7 classes, with an 86% variance between classes (using Ward's method and a Euclidean distance matrix). Each indicator introduced in the hierarchical clustering tool has its particularities. I1 exhibits significant internal variance due to the geographical concentration of events in the world's military hotspots. To reduce this variance, a mathematical correction was applied to the data, using the following formalization:

$$I1_u = \frac{\log \sum_i^j E}{\text{Maxlog} \sum_i^j E'} \quad (1)$$

where:

i = the nearest event to an AUF university, in a 200 km buffer

j = the most remote event to an AUF university, in a 200 km buffer

E = events located in a 200 km buffer

The second indicator (I2) is basically a highly used measure of the spatial accessibility (Stepniak and Rosik, 2013; Gutiérrez et al., 2010) of universities to fatalities in the local territory.

$$I2 = \sum e^{a \text{Dij}^2} F_i, \text{ where } a = \ln(0.5)/S^2 \quad (2)$$

where:

Dij = distance between an incident producing fatalities and an AUF university j

S = distance decay function's inflexion point (e.g., 50 km)

Fi = number of fatalities recorded for event i

The weighting function can assign more importance to events located near universities, penalizing incidents at greater distances, according to the inflexion point chosen by the user (Figure 3). In our case, the inflexion point of the negative-exponential kernel was fixed at 50 km, a value that approximates, in many circumstances and territorial contexts, an hour of time accessibility (drive).

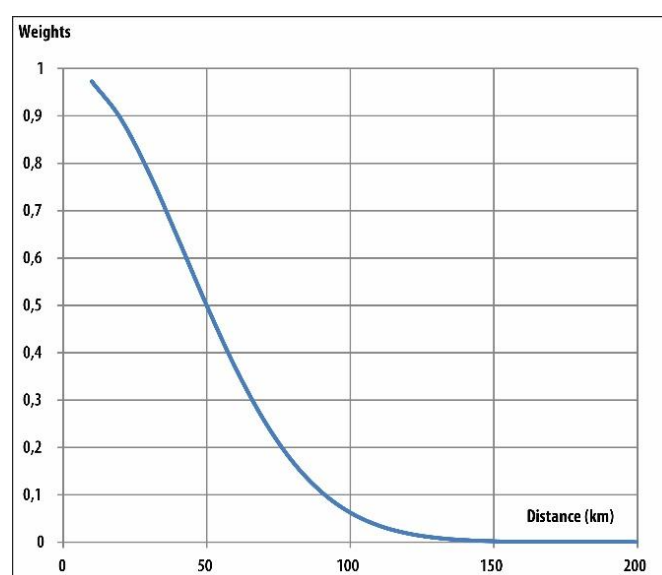


Figure 3. Weighting function based on the distance between ACLED incidents and universities

I3 reincorporates the weights obtained by implementing the negative-exponential function and uses them as a measure of event concentration around the universities. It is a ratio between the sum of weights and the total number of events recorded in a 200 km buffer around the AUF universities. When the incidents are concentrated in the

proximity of the universities, the values of the weights will be close to 1. Consequently, the ratio will also be close to 1, indicating strong concentration. Mathematically, it can be expressed as:

$$I3 = \frac{\sum_i^j W_i}{\sum_i^j E_i} \quad (3)$$

where:

i = the nearest event to an AUF university, in a 200 km buffer

j = the most remote event to an AUF university, in a 200 km buffer

E = events recorded by ACLED

I4 evaluates the degree of diversity of the ACLED events using a classic approach, the Shannon diversity index (H). By analogy to the analysis implemented in biodiversity studies (Shannon, 1948; Barrantes and Sandoval, 2009), one can categorize the types of events as species and estimate whether a territory exhibits trends in diversity. The list of ACLED event types varies from one region to another, and is more diverse for the Middle East dataset, while being less complex in the USA and Canada files. The events list includes various military actions, such as airstrikes, explosions, or battles, along with civil disorder markers, including protests, strikes, or mob violence. To be applied, the index requires an explicit spatial extent for each AUF university. It was outside the scope of this research to establish the universities' catchment areas, so we used an approximation by instrumentalizing a 200 km radius around the universities. The formalization of the index is:

$$I4 = - \sum_i^j (E_i \ln E_i) \quad (4)$$

where:

E_i = the share of an event type in the total number of events, calculated for the buffer area of 200 km radius around the AUF universities.

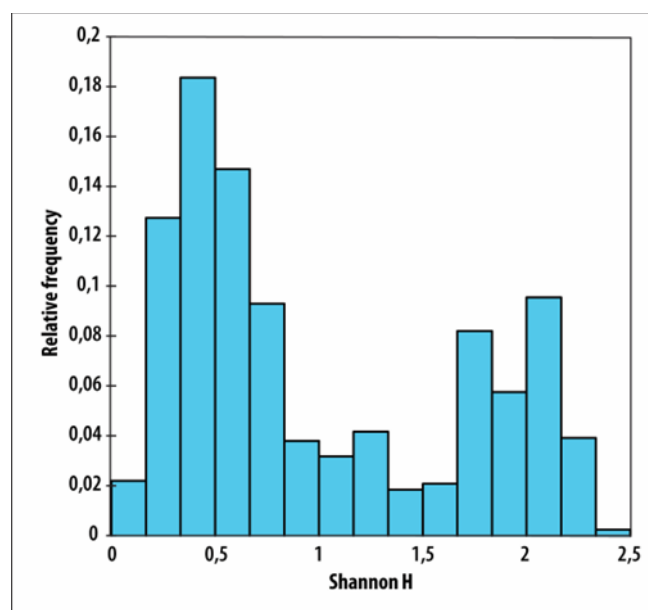


Figure 4. Histogram of the Shannon H distribution based on the relative frequencies of indicator I4 values for the AUF universities

The values of Shannon's H are challenging to interpret and are context-dependent (Spellerberg, 2008; Konopiński, 2020). Values close to 0 indicate a lack of diversity,

while a value of 1.5 suggests a moderate level of diversity. Values larger than 3.5 are specific to situations with high diversity in military and political events. By analogy with ecological studies, problems with the reliability of the indicators may occur when unconfirmed information (e.g., uncollected events) is present in the study area (Chao and Shen, 2003). The results obtained for the AUF universities in their territorial context range from 0 to 2.41, as indicated by the histogram, which suggests that the levels of diversity are mixed (Figure 4).

The data collection and integration of methodological tools in our research approach enabled us to provide two separate typologies of the AUF universities. The first one focuses on classifying educational facilities based on severe exposure to military conflicts and civil disorders (Objective 1). The risk is evaluated by considering the spatial position of universities in relation to the orbits of violence, as measured by distances to the actors' median centers. The second typology relies on the outputs of the hierarchical clustering analysis (Objective 2) and divides the set of universities into 7 classes, unequal in size. Each class encompasses potential exposure risks, ranging from almost undetected threats to universities in a very concerning situation.

3. Results

The goal of this research is to assess the role of the territorial context in evaluating the university's exposure to risk from military and civil disorder, using the AUF network as a case study. The initial typology is based on the results obtained from implementing the first methodological objective. It synthesizes the risks by selecting universities located on the first orbit of violence around the median centers of state and non-state actors. The map corresponding to this indicator synthesizes this location by the number of universities included, using proportional symbols (e.g., Addis Ababa is on the first distance band for eight actors designated by ACLED). Additionally, a measure of the average distance between universities and actors' median centers is available, clarifying the intensity of the pressures induced by the territorial contexts (Figure 5).

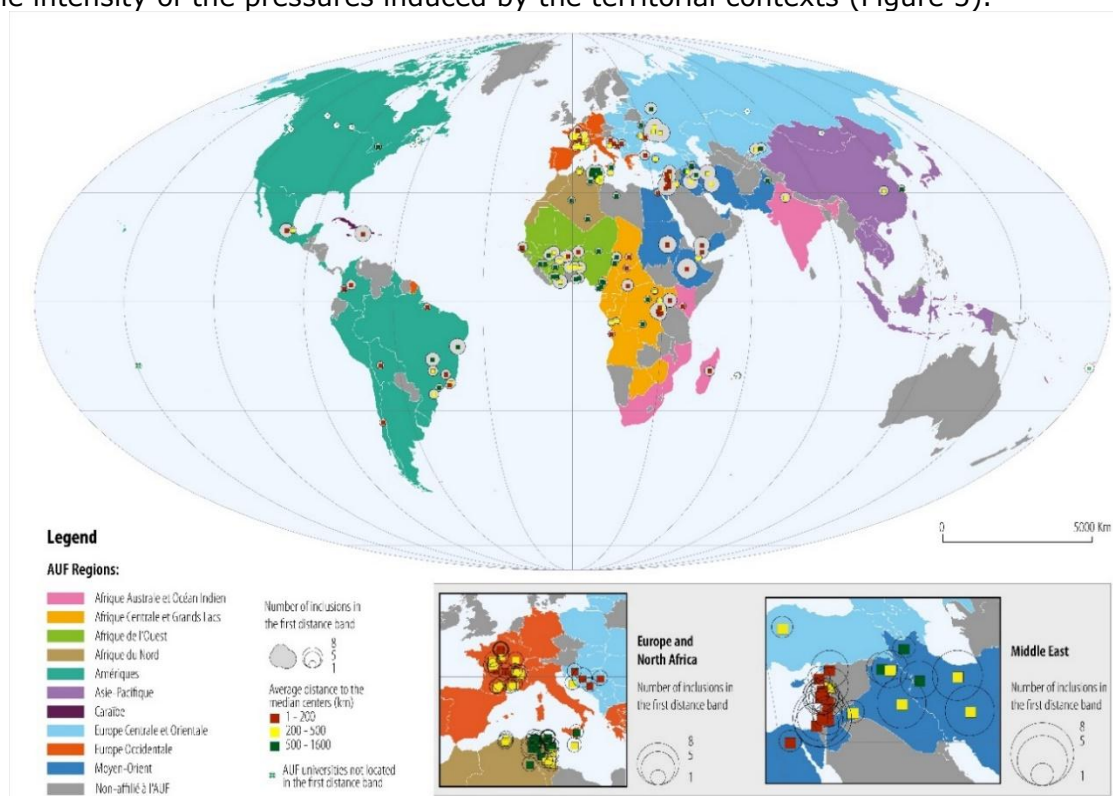


Figure 5. Exposure to military and political risks - an assessment based on the university's location on different distance bands around the actors' median centers.

The exposure level is concentrated in several regions that overlap with the most recent and intense transnational conflicts. Such is the case for the universities located in the AUF bureaus of West Africa, the Middle East, Central Africa - Great Lakes and Central-Eastern Europe. The nature of the pressure is complex and it can be analyzed by the logic of the military conflicts regionally deployed. For AUF West Africa, the emergence of the jihadist movements intersects older dyads between pastoral and sedentary populations, ethnic and sectarian clashes and geopolitical stakes of world scale (e.g., the presence of Wagner Group in Niger and Mali). A cluster of universities under strong pressure is also visible in the frontier region between the Democratic Republic of the Congo, Uganda, Rwanda, and Burundi. More precisely, the universities of Kampala and Bukavu (Congo D.R.) are placed in the first band of cumulative fatalities of 5, respectively 4, ACLED-designated actors. In the Middle East region, the conflicts have the potential to impact universities located in the complex nexus of military actions that involve Israel, the Iranian proxy groups and local separatist or terrorist actors. Based on the magnitude of exposure, there are two cities from the region of significant concern for AUF: Khartoum and Addis Ababa. In the case of the Central-Eastern European bureau, the war in Ukraine is the main pivot of violence and the diffusion of threats for the universities. Dnipropetrovsk, Kharkiv, and Donetsk are the urban environments endowed with universities that are significantly exposed to conflicts and disorder. Secondary clusters of risk exposure are visible in Brazil, Haiti and Mexico, suggesting that the challenging territorial contexts for the universities, especially by their military and political dimensions, are not limited to the already routine areas of conflicts. On the other hand, the AUF regions of the United States and Canada, Asia-Pacific and Western Europe (excepting France) host educational facilities where the risks are limited or potentially absent. From a spatial perspective, one would expect a strong discontinuity in the diffusion of violence, a discontinuity with many roots in the state's economic performance or national cultural patterns. In this case, the first typology is mainly helpful for visualizing severe threats by associating universities and conflicts based on core distance. This is why our investigation continued with a second classification of the AUF members, one that places more emphasis on proximity and integrates additional indicators.

The elaboration of this typology is based on a hierarchical clustering technique with no spatial constraints. Each class describes a particular type of AUF universities, labeled according to the intensity of territorial risks that shape the spatial context within a 200 km radius around them. Compared to the first typology proposed, the output of the multivariate analysis focuses more on the similarity of the AUF educational facilities when facing complex challenges in the proximity. These challenges are synthesized by the indicators used, including the diversity of events, distance to conflicts and civil unrest, the number of fatalities weighted by distance, and the stock of incidents described within the mentioned radius. As the focus changes from immediate exposure to risks to the broader picture of conflict areas, the number of elements included in the map increases (all 816 universities are categorized).

The hierarchical clustering analysis produced 7 classes, a number that balances the territorial complexity of the universities' contexts with the constraints of visibility. Three classes (4, 7, and 5) are grouped in a branch of the histogram characterized by a relatively calm situation. The AUF universities belonging to these types are generally located in the AUF regions of Western Europe, Asia Pacific, South Africa, the Indian Ocean, and North Africa. The first branch of the histogram regroups 4 classes (3, 1, 2 and 6), where the indicators we used describe different characteristics of the territorial contexts, this time marked by a high intensity and diversity of conflicts in the universities' proximity (Figure 6). The types are primarily located in the AUF regions of West and Central Africa, as well as the Middle East. Some bureaus of the AUF are in an intermediate situation, such as Eastern and Central Europe, the Americas, or the Caribbean. In this case, the map depicts a mix of universities facing substantial challenges and educational facilities with minor exposure to risks. The most concerning

type involves universities included in Class 1, which are populated by spatial elements located in 32 countries. In some states, such as Burkina Faso, all the AUF universities are members of this class, generating significant challenges in terms of institutional management and academic mobility. The implications of this classification are significant in terms of relevance for policy design, particularly within the decision-making framework of AUF. These consequences will be analyzed in the final parts of our investigation.

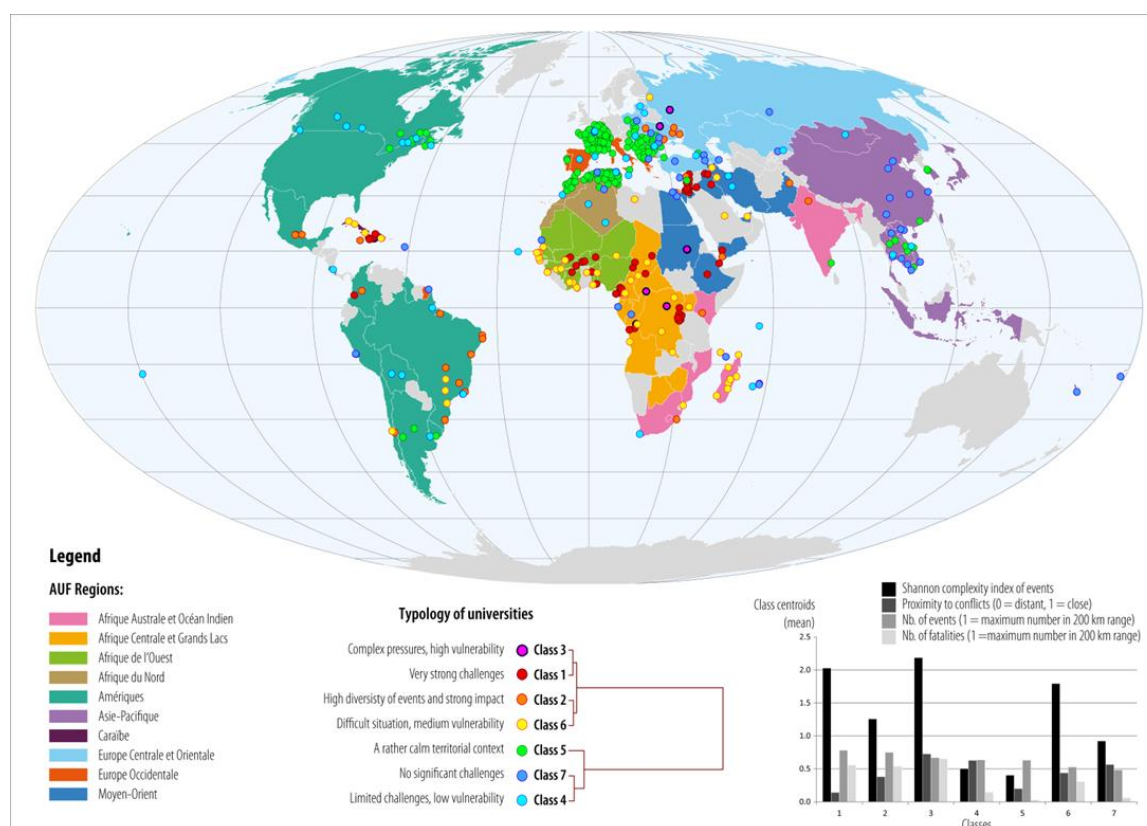


Figure 6. Typology of AUF universities based on the output of a multivariate analysis of risk assessment in a distance range of 200 km

4. Discussion

The research integrated a large quantity of data and derived a relatively high number of indicators used for the elaboration of the two typologies; however, it lacks a sound discussion of the objective limitations that one can encounter when dealing with the spatial database we created, or when replicating the workflow. The main limitations and challenges faced in implementing the methodological approaches are linked to the options and filters applied in the data management process. From this perspective, there are at least three potential topics of discussion and analysis - the first related to the inclusion of time as an explanatory variable in the diffusion of violence, the second linked to the spatial resolution of the events datasets, and the third associated with the actors exclusion from the analysis, based on the number of incidents and fatalities.

The chronological extent used for evaluating risk exposure effectively captures recent strategic developments on a global scale. However, it is less appropriate to address the dynamics of the actors' territories of conflict, particularly in the Sahel's hotspots of military activity. In the case of some actors, the chronology of their involvement in the military theatre is too complex to be encompassed within basic territorial envelopes, as is the case with the Wagner Group (Figure 7). Due to internal restructuring, the need for reliable troops on the Ukrainian front, and shifts in Russian geopolitical options, the Wagner Group's presence in the Central African Republic almost

completely faded after 2021, according to ACLED data. At the same time, the activities of this actor appear to be becoming increasingly consistent in Mali. The Wagner example illustrates how the geometries of violence are subject to instability over time, making medium- and long-term analysis more suitable.

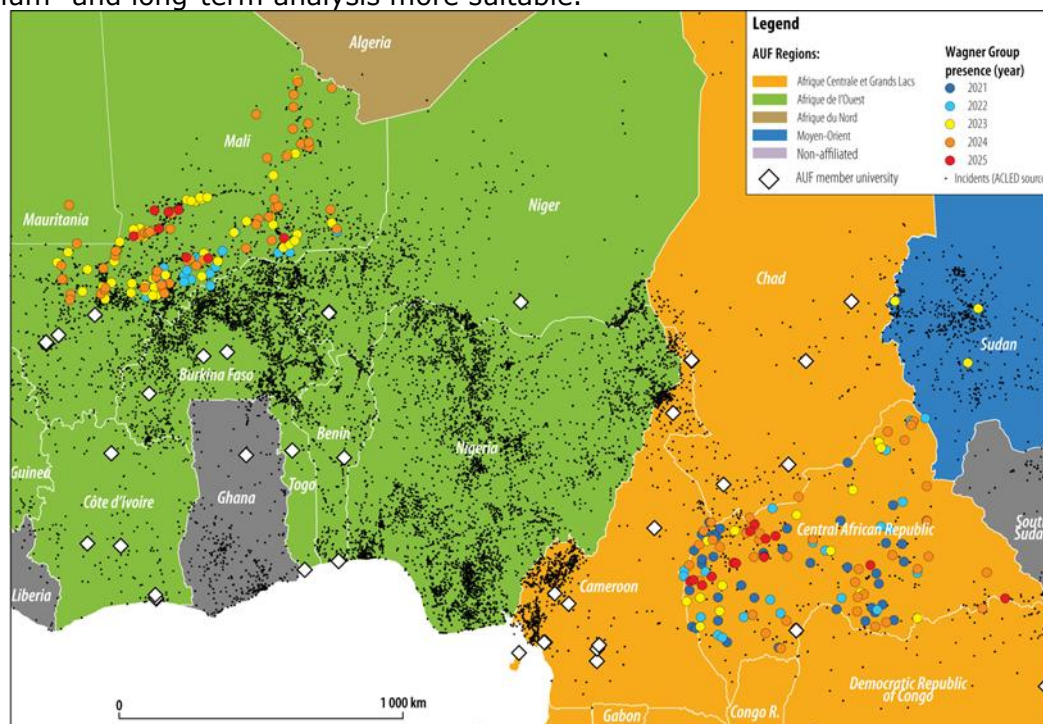


Figure 7. Chrono-spatial dynamics of Wagner Group in Western and Central Africa (2021-2025)

The spatial resolution of the events and universities can also affect the quality of the risk exposure assessment. The data collected by ACLED has multiple inputs (social media, traditional media, field observers, etc.). The accuracy of the geo-location is a topic of debate. When the data are aggregated, the level of imprecision may be attenuated; however, there is no transparent methodology for determining how much attenuation can be achieved by using distance bands of analysis (in our case), territorial delineations, or other forms of aggregation. More theoretical studies can be envisioned in this direction, eventually utilizing multiple datasets for validation (e.g., the Uppsala database, Geocon-confirmed indicators, or country-scale conflict visualization tools). Similarly, the use of spatial filters with the ACLED data can be questioned on the same logic. The outputs related to the implementation of our secondary methodological objective (a typology of universities based on local indicators of conflict and civil disorder impact) depend on a 200 km distance buffer. This cut-off value may seem arbitrary. Further studies might focus on a multiscale approach and evaluate the risks when this distance varies, especially in the case of the Shannon diversity index applied to the type of events. The data and the spatial distribution of events suggest that using a small radius will yield low values of the index, while increasing the range can lead to results depicting a higher variety of incident types.

Finally, the inclusion of actors based on the number of events (5) and fatalities (10) can be perceived as a limitation of the study, because it ignores a significant number of events collected by ACLED. It also overlooks the actors, maintaining significant potential to grow into major threats. In some cases, an emerging actor with an efficient strategy for target prioritization may obtain significantly more visibility compared to its competitors. This competition for media visibility and coverage is not new; it is a constant in the history of terrorist groups or paramilitary factions. Its intensity is increasing in a world where media channels are multiplying exponentially, and it becomes a source of risks for infrastructures and public facilities, such as universities. In terms of study

continuation, we consider the ACLED datasets to be mature enough to be incorporated into more advanced research frameworks, aiming to identify actors with the potential to become significant threats to regional and national stability. The limitations associated with the group's inclusion occasionally intersect with the methodological problems created by the chronological scope of the events analyzed. For example, Ansar Dine (Mali) and Ansar Islam (Burkina Faso) merged, together with other jihadist organizations, in a larger actor (JNIM) (Benjaminsen and Ba, 2024; Yahaya Ibrahim, 2017). They are present in the dataset only with incident descriptions for 2021.

The list of inherent objective limitations of the study can continue with other aspects related to the overall quality of the data input in modelling the exposure to military risks (Weidmann, 2014), especially in regions with a rather poor coverage of geospatial information (Njoya Ngetar et al., 2025; Eck, 2012). However, the methodology we propose in this research responds well to these challenges because both the analysis in terms of distance bands and the hierarchical clustering offer an estimation of the risks' exposure that ignores the precision of the geolocation. We speculate that, even if some sub-sets of events are misplaced, the overall impact on the typologies is limited. Future studies can explore this hypothesis and approach the geolocation issues with appropriate tools.

The interest in obtaining relevant typologies of risk exposure for universities is not a stake only for the AUF, as other university associations, such as the AAU (Association of African Universities) or ICESCO (Islamic World Educational, Scientific, and Cultural Organization), are in a similar situation. Early warning systems and platforms for military risk visualization are already functional (Hegre et al., 2019), but they lack the tailor-made dimension of a classification based on relevant input data.

5. Conclusions

Perceived as calm and routine places to forge knowledge and provide superior education, universities are urban infrastructures that, in many countries and various territorial contexts, are located at the core of the significant conflicts shaping the geopolitical stage today. The exploratory analysis of the ACLED dataset revealed that the word 'university' is associated with 21,032 occasions, nearly four times more frequently than 'airports' (5,751 events). Tactical targets of different non-state actors or simply collateral victims of military operations, the universities are an important urban asset in conflicts and studying their level of exposure to violence is legitimate, both from a scientific and policy design perspective. Data limitations prevent an analysis of all universities worldwide; as a partial solution, we have included an option to consider only AUF universities in the study. Our research identified two methodological approaches that can be used to evaluate conflict risks. The first investigation measures the distance between universities and various state and non-state actors, a distance weighted by the number of fatalities recorded. As some groups described by ACLED establish themselves with transnational territories of action (Jiang et al., 2025), this first methodological approach is particularly suitable for well-defined territorial contexts, such as classical theaters of war (e.g., the Russian invasion of Ukraine) or Sahel conflicts. That is one of the reasons why the study considered it opportune to propose a second avenue of research, re-centering the analysis on the universities. Our second objective was to elaborate a typology of the AUF universities, based on a set of quantitative indicators that are replicable for other chronological extents or types of infrastructures (e.g., hospitals). The output of this typology is derived from a hierarchical clustering analysis and it defines 7 classes of universities, in line with their exposure to violence and risks, in a territorial context of sub-national scale. Implementing the two methodologies required an intensive use of GIS techniques and spatial analysis, starting with the management of the geolocation of ACLED events and universities, and ending with the elaboration of various indicators describing the relationship between the two major point patterns (such as the Shannon index of conflict diversity). The primary GIS challenges

are related to integrating geographical objects with complex temporal dynamics within a spatial framework that can be utilized for risk evaluation. For example, our database ends in April 2025, ignoring developments related to at least two major conflicts: Israel vs. Iran and India vs. Pakistan. For further studies, integrating real-time data with adjustments and upgrades to the university's typologies may represent an interesting methodological challenge.

In light of ongoing and emerging global conflicts, the results underline the need for higher education organizations to consider geopolitical and military factors in strategic planning, institutional management, and international academic cooperation. The security risks surrounding AUF universities are a measurable concern that demands structured and regional policy responses. AUF bureaus in Africa and Eastern Europe are a priority for these responses and strategies. Also, given the diversity of territorial, social, and economic contexts, AUF should adopt a flexible decision-making framework informed by ongoing monitoring systems and early warning mechanisms. A support platform for affected universities, covering academic mobility, participation, and institutional resilience, should be a topic of internal decisions. Moreover, a qualitative investigation into the lived experiences of AUF members in conflict-affected zones would enhance both situational awareness and future preparedness, thereby guiding the development of effective monitoring and early warning systems.

Funding: This research was funded by Projet AUF GéoPort ECO - Portail des publications géographiques francophones en Europe Centre-Orientale/AUF project GéoPort ECO - Portal to French-language geographical publications in Central and Eastern Europe. <https://www.auf.org/nouvelles/appels-a-candidatures/soutien-la-recherche-scientifique-francophone-en-europe-centrale-et-orientale-resci-eco/>

Author contributions: Conceptualization, A.R.; methodology, A.R. and O.G.; software, A.R.; validation, O.G., N.P. and M.I.; formal analysis, A.R. and O.G.; investigation, N.P. and M.I.; data curation, A.R. and O.G.; writing—original draft preparation, A.R., O.G. and N.P.; writing—review & editing, M.I.; visualization, O.G. and N.P.; supervision, A.R. and M.I.; project administration, A.R.; funding acquisition, A.R. All authors have read and agreed to the published version of the manuscript.

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