Insurgency and Inaccessibility

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Abstract
A widely held belief within policy and practice holds that that rough terrain and other physical obstacles to power projection hinder public surveillance, lower counterinsurgency capability, and generally constitute an important facilitator of rebellion. Likewise, sociocultural exclusion and alienation from the core are widely assumed to increase latent conflict risk through their influence on identity formation and perception of collective grievances. However, there is no scientific consensus on the empirical strength or significance of such a relationship, and many quantitative studies fail to find a robust link between a country’s geographical or ethno-demographic characteristics and its estimated conflict risk. This paper represents a first comprehensive evaluation of how physical and sociocultural inaccessibility relate to contemporary civil wars. Drawing on recent advances in geographic information systems (GIS) and georeferenced indicators of terrain, settlement patterns, ethnopolitical status, and armed conflict, we put the purported causal relationship to empirical test. An empirical analysis of civil conflict events across Africa since 1989 gives considerable support to the proposed theoretical framework, revealing that the various dimensions of inaccessibility exert complementary effects on local conflict risk.
**Introduction**

The importance of physical geography in determining the nature and fate of rebellion has been observed by political and military leaders throughout the history of warfare. In his manual on guerilla warfare, the Argentine Marxist revolutionary Ernesto “Che” Guevara (1961: 29) developed his doctrine on guerrilla war around the notion that rebels are favored by “zones difficult to reach, either because of dense forests, steep mountains, impassable deserts or marshes.” The role of human geography as a determinant of conflict dynamics has received less explicit attention. Yet, cultural cleavages shape participation and support in many contemporary conflicts, especially where ethnic lines overlap with deep economic and/or political cleavages (Cederman et al. 2013). Civil wars rarely are orchestrated by movements close to the regime; instead, the large majority of active insurgencies involve marginalized groups that have strongholds in the remote countryside. Indeed, a notable feature of today’s armed conflicts is their tendency to cluster along peripheral state borders that cut across traditional ethnic minority homelands (Brancati 2006; Horowitz 1985; Walter 2006).

Rugged landscape, rural hinterlands, and distinct cultural traits are central elements in the notion of inaccessibility. The concept is best depicted as a center-periphery continuum, where inaccessibility increases with the extent of mountainous or forested terrain, distance from major population centers and government strongholds, and local dominance of minority ethnic affiliation. Inaccessibility of any of these kinds is widely believed to reduce state capacity and counter-insurgency capability by obstructing public surveillance, identification of local allies, and projecting police and military power (Fearon and Laitin 2003). Under a ceteris paribus assumption, countries shaped by one or more of these inaccessibility dimensions should have a higher latent risk of armed conflict. To our knowledge, no study to date provides an explicit and rigorous assessment of the inaccessibility-conflict dynamics.

This paper investigates how inaccessibility shapes the nature of modern insurgencies. Aided by recent advances in geographic information systems (GIS) data and technology, we develop complementary indicators of local inaccessibility, which are then systematically compared with data on local conflict outbreak and prevalence. Through a detailed analysis of post-Cold War civil conflict occurrence across Africa, we find considerable empirical evidence to support expectations: Civil conflict events tend to concentrate in remote parts of countries, in locations characterized by substantial rugged terrain, and in areas inhabited by ethnic minority groups. The analysis further corroborate earlier findings that local conflict risk is higher in more densely populated areas, close to regional population centers, in relatively poor areas, and in areas surrounded by violent activity.

**Inaccessibility**

Accessibility, put simply, reflects the potential for interaction (Song 1996). It is a relational concept that concerns the nature of association between two entities, be they geographic locations or social actors. Extent of accessibility can be understood as a function of the interaction opportunity between two locations, discounted by a negative exponential function of distance (and other causes of friction) between them. The concept of accessibility thus is closely linked to the notion of social inclusion (Farrington and Farrington 2005). For a society to achieve social inclusion, a certain level of accessibility must be offered. Accessibility in this sense is fundamentally related to life opportunities; a central government’s ability to deliver public goods, such as health and education but also law and order, depends on its ability to access the population.
The term inaccessibility as used in this paper is best understood by considering the concept of state penetration, i.e. the extent to which a central government manages to project political and military authority throughout its territory. State penetration is not uniform across space: Where inaccessibility is high, state penetration is low and vice versa. Yet, much of the contemporary literature on state capacity and civil war tends to treat capacity in a uniform, state-level manner with little consideration of subnational variation in the state’s ability to monitor and control the population (e.g., Besley and Persson 2010; Braithwaite 2010; Fjelde and de Soysa 2009; Hendrix 2010, 2011; Sobek 2010).

Writing within the context of international interaction and interstate conflict, Boulding’s (1962; see also Pickering 2012) seminal loss of strength gradient (LSG) model postulates that a state’s strength peaks at its home base and declines as power is projected across distance. The amount of power at disposal depends not only on the total state capacity (“home strength”) and the distance across which power is projected but also on the cost of power projection, determined by the LSG. Whether a conflict of interest between a pair of actors is likely to escalate to the use of military force then depends on the distribution of available power. Where the projected power of state A is substantially higher than the local power of state B, state B should give in without resistance. Only where the actors appear to be equal, or where there is uncertainty about their relative strength, should we expect a military contest to materialize.

Adapted to a domestic setting, the LSG model can be taken to express extent of projected state capacity or local control. As indicated in the left panel of Figure 1, a weak rebel group (R) that is located close to the Government’s (G) core should be defeated (or decide not to rebel) since the projected state power (the slope from line GH) is higher at the rebel’s headquarters (R) than their home strength (RK). On the right, however, the equally weak but peripheral rebels are able to withstand the central government given the latter’s inability to project sufficient amount of military force to location R’. At a more general level, this is akin to Lichbach’s (1995: 84) assertion that “if the dissidents’ strength approaches that of the regime, the regime usually falls.” See Buhaug (2010) for a more extensive elaboration of this model.

**Figure 1. The domestic LSG model**

Within the context of empirical civil war research, the notion of inaccessibility has been restricted to imply physical remoteness, where country-level statistics of mountainous terrain and, in a smaller set of disaggregated studies, distance to the capital, are the main indicators...
of state penetration. While important, these factors only reveal half the story. In this paper, we also consider the human and social terrain, which captures central dimensions of sociocultural inaccessibility. This includes aspects of ethnicity as well as its political and economic configuration. Where physical inaccessibility can be said to provide opportunities for rebellion, cultural inaccessibility may be equally important in shaping people’s motivation for engaging in a conflict against the state. The following sections expand on the two dimensions of inaccessibility before we discuss in more detail how they relate to armed conflict.

Physical inaccessibility
There are two general determinants of physical accessibility: distance from the point of origin and the terrain that has to be traversed. Grundy (1971: 45) provides a model of guerilla confrontation where:

... the context of guerrilla warfare, military space could be expressed in symbolic form as:

\[ MS = M_i^2 + Ob + San - CT, \]

where \( MS \) = Military space; \( M_i^2 \) = Square mileage; \( Ob \) = Obstacles; \( San \) = Access to a sanctuary in a neighboring state; \( CT \) = Effective and defensible communications and transport networks. In this way a few square miles of mountainous jungle may be as strategically invulnerable as, let us say, a hundred square miles of prairie or, perhaps, a thousand square miles of flat plain crisscrossed by roads and telephone wires and dotted with airstrips and radio transmitters.

Absolute distance pertains to the geographical distance between points of interest, one of which typically is the capital city or another government stronghold. Since power diminishes as it is projected across distance, it follows that areas further away from state presence are less accessible, or can only be accessed with higher costs. The linear (or logarithmic) distance to the capital gives some indication of de facto periphery, but it clearly is a crude approximation of state penetration. For instance, a straight-line distance measure ignores geographic features such the type of terrain, the political landscape along the way (e.g., whether the shortest distance crosses the ocean or a foreign country), and extent of infrastructure available.

It is not difficult to imagine more nuanced and theoretically appropriate quantifications of local inaccessibility. One such factor is the prevalence or absence of developed roads and other infrastructure. As detailed by Herbst (2000), roads can serve as proxies for broadcasting of authority, and nowhere more so than in poor, developing societies. The importance of communication network is especially prominent in countries with challenging political geographies. Herbst’s typology of African countries contains two such kinds: the first includes very populous countries with an uneven, scattered settlement pattern whereas the second group contains countries with a small, densely populated area and large, scarcely populated hinterlands. It is the vast areas between the main settlement clusters that the regimes struggle to exert authority over, making these countries “seem almost impossible to govern” (Herbst 2000: 152).

A second and complementary physical determinant of inaccessibility is terrain. High mountain ranges and dense forests are fundamental determinants of interaction, migration, and development and constitute natural barriers of nation-states. It is no coincidence that some of the most backward human communities today are found in inescapable parts of Borneo and the Amazonas rain forest. Modern technology, notably telecommunication, is less
affected by topography than traditional modes of transport and communication, but it is not immune to geographic friction. We are still probably several decades away from proper cyber wars, where geographical distance may be truly irrelevant.

A third aspect of physical inaccessibility that will be considered here concerns proximity to an international border. Following the Peace of Westphalia in 1648, an international principle of non-intervention was established, in which states were not allowed to interfere with internal affairs of another state. Accordingly, regardless of the local terrain and the proximity to urban centers and other areas of government presence, having access to a neighboring country implies jurisdictional immunity and thereby increased inaccessibility.

**Sociocultural inaccessibility**

Complementing physical factors, this paper considers key aspects of human geography, in particular ethnic diversity and characteristics of the local population as well as their political and economic status. In heterogeneous societies, the political elite tend to originate from (and represent) the dominant ethnic group(s), populated in core areas of the state. Depending on the nature of the regime, the elite may attempt to impose its preferences and ideologies on the rest of the population, and exploit marginal groups (see, e.g., Hechter’s (1975) work on internal colonization). These transactions are fraught with costs, the height of which is dependent on the sociocultural distance between the core and the periphery. Areas inhabited by people with deviating preferences regarding language, minority rights, wealth redistribution, local autonomy, etc., will be harder to penetrate by the central government. Such areas can best be described as cultural peripheries (Rokkan 1999), which are liable to producing distinct identities through a process of ‘othering’ (Cresswell 1996). Higher degrees of ‘othering’ imply higher political, economic, and cultural barriers to internal structuring of the peripheral population.

Ethnicity is certainly not the only sociocultural determinant of inaccessibility; language and religion are other obvious (and often overlapping) features. Class, caste, and political ideology, too, may generate notable friction on projected state authority, although these traits tend not to be geographically clustered among the population. The political configuration of social cleavages is important in this context. While areas inhabited by minority groups are harder to monitor and control as a general rule, this is especially true when identity cleavages overlap with inequalities in basic political and/or economic opportunities and privileges in the society. In accordance with our inclusive understanding of inaccessibility, it follows that the most socioculturally isolated areas are those hosting politically excluded and economically marginalized minority populations.

**Linking inaccessibility to conflict risk**

Now that we have outlined some basic dimensions of inaccessibility, the next task is explaining how these dimensions relate to intrastate armed conflict. In doing so, it may be useful to consider first how inaccessibility affects opportunities for rebellion and then secondly how it influences peoples’ motivation to stage or join a rebellion.

**Opportunity**

The opportunity aspect of the inaccessibility-conflict link is probably the most intuitive one. While certainly not subscribing to a deterministic understanding of the role of geography, it is
clear that physical obstacles to the exercise of state control in themselves create space for competing authorities, and poor monitoring and counterinsurgency capabilities imply that such contenders may rise to local power with little warning. Beyond facilitating clandestine mobilization and local taxation, physical inaccessibility may be relevant for rebellion in at least two ways. First, rough terrain provides ample opportunities for establishing safe havens, undetectable and unreachable by governmental forces. Likewise, seeking refuge across the border (and enjoying tacit or direct support from a sympathetic neighboring government) facilitates training, regrouping, rearming, and trade. This dynamic, which is analogous to Cunningham et al.’s (2009) notion of capability to resist, is especially efficient in the early phase of a conflict and when rebels tend to be vastly outnumbered by governmental troops. Second, insurgents can take advantage of the terrain in the actual fighting and inflict disproportionate damage on the regime – what Cunningham et al. (2009) refer to as power to target.

The effectiveness of a regular army is restricted in rugged landscapes; swamps, jungles, and mountain ranges present major obstacles to armored vehicles and other heavy equipment as well as putting a strain on supply lines, and dense forest canopies hinder aerial detection. Moreover, rebels often have greater local knowledge, which further amplifies the asymmetric nature of insurgency (Arreguin-Toft 2005). A relevant example is the inability of Western forces to defeat the Taliban and al-Qaeda (and before that, Soviet’s battle against the Mujahideen) in spite of overwhelming firepower and technology. The failure of the US engagement in the Vietnam War is also partly attributable to a military doctrine poorly suited to the physical environment, and the US Army’s use of Agent Orange for defoliation operations was a deliberate (but failed) attempt to deprive the insurgents of cover and make them more vulnerable to conventional military attacks.

Remote hinterlands or rugged terrain should not have a substantive influence on local conflict risk in all societies, however. In developed countries with extensive and well-functioning local administration (e.g., taxing authorities, police), physical inaccessibility may have little relevance for national security. But in weaker states, physical obstacles to interaction are conducive to “unauthorized sequestering of resources by violent specialists as well as to seizure or damage of persons and property along the edges of authorized political claim making” (Tilly 2003: 134).

**Motivation**

Physical and sociocultural periphery can affect individuals’ and groups’ willingness to challenge the central government by violent means. Recall that inaccessibility implies costly interaction. This is relevant not only for the exercise of military control but for all kinds of center-periphery interaction, including health care, schooling, and other public services. As outlined above, backward areas may be associated with higher latent opportunities for anti-regime movements, but they also tend to enjoy fewer privileges than – or be targets of explicit discrimination by – the power holders.

Peripheral location and sociocultural alienation are also important in shaping unique identities and preferences and may contribute to raising collective awareness of (perceived) unjust treatment by the core, all of which may increase the motivation to mobilize against the state. Although preferences are affected by individuals’ unique experiences, they will also be influenced by a score of common background factors, such as religion, language, economic welfare, education etc. For this reason, there is a positive relationship between geographic
and ideological proximity (Alesina and Spolaore 2003), whereby the geographic distance between two points often serves as a good indicator of distance of preferences.

**Empirical evidence**

A glimpse at today’s insurgencies provides many examples of conflicts that are fought in rural and peripheral areas where the state has limited reach: The Afar and Ogaden rebellions in remote parts of Ethiopia, the Nagaland and Manipur insurgencies in northeastern India; the separatist conflicts in Patani (Thailand) and Mindanao (the Philippines); and more lately the retreat of Al-Qaeda in the Islamic Maghreb to the Ifoghas Mountains in Mali. The relationship between a country’s share of mountainous or forested terrain and the risk of civil war has also been subject to more systematic scientific scrutiny – if normally only as a control variable. The findings from these studies are generally weak and inconsistent (Hegre and Sambanis 2006). The conflicting results might be ascribed to data and methodology issues; different studies cover different time periods and apply diverging operational definitions of conflict and terrain. A more serious concern is that studies using nation-level aggregates often suffer from a mismatch between data and the hypothesized causal mechanism. Country-level aggregates do not contain information about the local variance of geographic features. Empirical evidence shows that most civil wars, especially separatist conflicts, are restricted to limited areas of the host countries (Dittrich Hallberg 2011), and these conflict zones rarely cover a representative subset of the countries’ terrain (Buhaug and Lujala 2005). Perhaps somewhat surprisingly, spatially disaggregated studies to date have not been more successful in establishing a robust terrain-conflict link (Buhaug and Rød 2006; Rustad et al., 2008).

There is more systematic evidence in favor of the distance indicators. Several recent studies report that subnational conflict risk is higher in location at some distance from the capital city (Buhaug and Rød 2006; Clayton 2013) or other urban centers (Raleigh and Hegre 2009). Available empirical evidence further suggests that conflict events are more likely close to borders (O’Loughlin et al. 2012; Wischnath and Buhaug 2014), often involve transnational ethnic groups (Cederman et al. 2013), and conflicts that abut or cross borders also last longer on average (Buhaug et al. 2009; Raleigh and Kniveton 2012).

The notion that grievances related to social/cultural marginalization might affect the risk of conflict is not new (e.g., Gurr 1970), but due to data limitations it is only quite recently that this proposition has been subject to systematic large-N testing at the theoretically appropriate subnational (group) level. For example, Buhaug et al. (2008) and a follow-up study by Cederman et al. (2009) postulate, and find, that ethnic groups settled in remote locations more often engage in conflict against the center. Later studies have reported a similar pattern for economic activity and spatial inequality, where the poorest parts of countries are more conflict prone, ceteris paribus (Buhaug et al. 2011; Cederman et al. 2011).

With the exception of Weidmann (2009), few studies have attempted to evaluate the relative importance of opportunity and motivation in explaining the purported geography-conflict association.

**Propositions**

Based on the reasoning outlined above, the general expectation to be tested in this paper can be expressed as follows: Local civil war risk increases with extent of inaccessibility. From this, we formulate a set of testable hypotheses that refer to specific aspects of physical and sociocultural inaccessibility. We do not necessarily expect all aspects to be equally important.
For example, having access to safe havens across the border may well compensate for lack of rugged terrain. At the same time, it is not inconceivable that some of these factors are mutually reinforcing, meaning that the total estimated effect of being located at a distance from the capital and in mountainous areas may be larger than the sum of the individual effects. The first concerns the relative location of an area:

**H1:** Local civil war risk increases with physical distance to the government.

Next, we consider the notion that availability of safe havens, by means of rough terrain or neighboring territory, increases conflict risk by making prospective rebels harder to detect and defeat through conventional military means:

**H2:** Local civil war risk increases with proximity to potential safe havens.

Finally, sociocultural inaccessibility should increase conflict risk by obstructing state monitoring of the local population, generating grievances related to lack of political and material privileges, favoring creation (and manipulation) of distinct local identities, and making defection less likely:

**H3:** Local civil war risk increases with sociocultural distance to the government.

**Data and Research Design**

In order to test these propositions, we make use of the most recent version of PRIO-GRID (Tollefsen et al. 2012). PRIO-GRID provides a global grid network with a resolution of 0.5 x 0.5 decimal degrees, comprising 64,818 unique terrestrial cells in a single cross section, excluding oceans and unpopulated areas (notably Greenland and the poles). In contrast to administrative entities, grid cells are inherently apolitical units that are fully exogenous to the phenomenon of interest in this study. Furthermore, the grid framework is consistent in space and time which makes them ideal for statistical analysis of spatiotemporal processes.

PRIO-GRID contains one realization per calendar year. Each cell is assigned to the country to which the majority of its land area belonged at the outset of the year, thereby allowing mixing spatial data on e.g. population and terrain with country-level information on political system and economic growth rates. For this analysis, we cover all years between 1989 and 2010, for which high-resolution geo-referenced conflict event data are available. Since the inaccessibility indicators are largely time-invariant, we use a simple cross-sectional data structure for the main models; factors that do change over time are set to represent the beginning of the period. Moreover, the analysis is limited to the African continent, which is the spatial coverage of the conflict data.

The outcome of interest in the empirical analysis is civil conflict events. We use spatial data capturing the dynamics of civil conflicts, based on data from the UCDP Georeferenced Event Data (Sundberg and Melander 2013). These data provide details on the precise location of civil conflict events (we excluded intergroup and one-sided violence), which were aggregated over time to give the total cell-specific count of the number of reported conflict events since 1989. Given the highly skewed cell-specific count distribution, we use a log-transformed count as the dependent variable in the regression models.
A generous number of measures of inaccessibility are used to capture the concept’s various dimensions. Hypothesis 1, on distance to the government’s core areas, is represented by the straight-line distance (log km) to the national capital, measured from the centroid of each cell. While intuitive and simple, this variable ignores the type of terrain that has to be traversed, the quality of the infrastructure, and the fact that governmental strongholds extend beyond the capital city. Two complementary measures of rough terrain are used to test Hypothesis 2, on the availability of safe havens. The first gives the share of the cell covered by dense forests whereas the second is an index of mountainous terrain. The forest cover indicator is derived from the Globcover 2009 satellite imagery (Bontemps et al. 2009), while the mountain data is computed using the UNEP’s definition of mountainous terrain (UNEP-WCMC 2002). The fourth and final measure of physical inaccessibility, which also relates to Hypothesis 2, gives the straight-line distance (log km) from the cell centroid to the nearest neighboring country, inversed to let higher values denote greater extent of remoteness. All four indicators were normalized (i.e., bounded within the interval [0, 1] to facilitate direct comparison and the construction of inaccessibility indices).

Sociocultural inaccessibility (Hypothesis 3) is represented by a simple dummy measuring whether the cell hosts a minority ethnic group. This variable is created from the GeoEPR dataset (Wucherpfennig et al. 2011), which maps all politically relevant ethnic groups around the world since 1946. According to this source an ethnic group is politically relevant if at least one significant political actor claims to represent its interests in the national political arena, or if the members of the group is systematically discriminated against in the domain of public politics. The minority variable indicates whether each cell contains a local population that does not belong to the largest ethnic group in the country.

Table 1 lists the inaccessibility indicators. See maps and the table in the Appendix for details on the spatial distribution of these indicators, as well as descriptive statistics of all variables used in the analysis reported below.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Operationalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical distance (H1)</td>
<td>Distance to the capital (log km), normalized [0, 1]</td>
</tr>
<tr>
<td>Safe haven (H2)</td>
<td>Mountains (log %), normalized [0, 1]</td>
</tr>
<tr>
<td></td>
<td>Dense forest (log %), normalized [0, 1]</td>
</tr>
<tr>
<td></td>
<td>Proximity to border (log inverse km), normalized [0, 1]</td>
</tr>
<tr>
<td>Socio-cultural distance (H3)</td>
<td>Ethnic minority population (dummy), [0, 1]</td>
</tr>
</tbody>
</table>

In the interest of parsimony, the models presented here include a limited set of controls. Previous research suggests a positive relationship between population size and local conflict risk (e.g., Hegre et al. 2009). Hence, we include an indicator of (log) cell population, derived from the Gridded Population of the World v. 3.0 dataset (CIESIN 2005). Population estimates are available in five-year intervals beginning in 1990; missing values for other years were replaced by linear interpolation. For this analysis, we use the 1990 estimate.

A second, robust predictor of civil conflict is low economic development (Hegre and Sambanis 2006). At a subnational scale, Buhaug et al. (2011) reported that relatively impoverished areas have a higher risk of conflict outbreak, whereas other studies have found inter-group inequalities to increase local civil war risk (Østby 2008; Cederman et al. 2011). Data on local income levels were obtained from the G-Econ dataset (Nordhaus 2006), which
provides estimates of economic output at a 1 x 1 degree resolution for the year 1990. Disaggregated to PRIO-GRID, we constructed a measure of (logged) gross cell product (GCP) per capita, similar to the nation-level GDP per capita measure.

As a third control, we include a measure of the average travel time (in logged minutes) from the cell centroid to the nearest city of at least 50,000 people (Nelson 2008). These estimates are based on information on land transportation networks, such as roads, railroads, and navigable rivers; the environmental context, including elevation, slope, and forest cover; and political factors (i.e., national boundaries). The original travel time data come in a very high resolution, 0.01 x 0.01 decimal degrees; our indicator gives the mean cell value. The data are from the year 2000, although we assume that they are reasonably representative for the entire post-1989 period. Accounting for proximity to regional urban centers is probably important as rebel attacks necessarily occurs where government forces and representatives are present (radio and police stations, army barracks, etc). Accordingly, while the inaccessibility argument assumes better opportunities for insurgent activities in remote hinterlands, tactical considerations (and possible bias in media reporting) imply that we should expect most violent activities to occur in the vicinity of urban centers.

A final set of controls are included to account for spatial and temporal dependencies in the data, as well as country-wide drivers of latent conflict risk. Conflict in one unit often affects the risk of conflict in neighboring units, and failing to account for such spatial dependence violates the assumption of unit independence (Bivand et al. 2008). Hence, we include a spatial lag of conflict that measures the (logged) mean conflict rate (number of events) among adjacent cells in the same country in the sample period. Moreover, all models are specified with country fixed effects to account for unobserved differences between countries. Moreover, we exclude observations that are considered highly unlikely to host conflict events; i.e. coastal grid cells with only a small sliver of land territory (<100 km²) and cells with extremely low population density, such as deserts and high mountain ranges (<1 per km²). This returns a valid sample of 7,465 grid cells across Africa.

**Results**

As a preliminary test of how our physical inaccessibility indicators relate to violent conflict events, and also an inspection of how they relate to each other and to the controls, we generated a set of bivariate scatter plots (Figure 3). With the possible exception for population, we see no clear effect whereby an increase in an exogenous variable is associated with an increase (or decrease) in the density of conflict events. Equally interesting in this context, however, we also note that there is no strong covariation pattern among the inaccessibility indicators.\(^1\) This is an important observation as it implies that the various measures indeed capture complementary dimensions of remoteness.

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\(^1\) The two most overlapping physical inaccessibility indicators are forest and distance to capital (r=0.12). If we also account for the binary socio-cultural inaccessibility, it relates most strongly to forests (r=0.20). The overall most powerful bivariate correlation in Figure 3 is between population and distance to major city (r=0.62). Although this could raise concerns about multicollinearity bias, regression diagnostic tests revealed that that is not likely to be a problem here.
Next, we put our propositions to test in a more appropriate multivariate regression framework (Table 2). We begin by estimating a baseline model with controls only (Model 1) and then introduce the inaccessibility factors in sequential models (Models 2–6). The final model includes all parameters simultaneously (Model 7).

As evidenced in the baseline model, the control variables behave much as expected and in accordance with previous literature. On average, conflict events tend to cluster in more populated and poor areas of countries, and the models also confirm the distinct diffusive feature of armed conflicts. Units with one or more neighboring units experiencing conflict are also expected to witness more violence.\(^2\)

Models 2–6 show the results for the five complementary inaccessibility measures. Overall, we find much support for our notion that conflicts tend to cluster in areas at the margins of, or outside, state control: Battle events frequency increases with distance from the capital city, increases with extent of local mountainous and forested terrain, and in areas inhabited by ethnic minority groups. Only the proximity to border indicator failed to produce a statistically reliable effect, although the positive sign of the coefficient (indicating more events closer to the border) is consistent with the theoretical model outlined above. Importantly, Model 7 shows that the effects of our key explanatory variables are robust to controlling for alternative dimensions of inaccessibility, thereby providing evidence in support of all three hypotheses.

\(^2\) An inherent challenge with using time-varying information in a static analysis is accounting for reverse causality. Part of the very powerful effect of neighboring violence on the estimated frequency of conflict events may be caused by nearby events having occurred as a consequence of earlier violence in a given location. See the discussion on sensitivity tests for further details and how this potential problem was addressed.
Given the encouraging findings from Table 2, we next evaluate three simple indices that combine some, or all, of the inaccessibility measures. The first index, $a_1$, is founded on the logic of substitution, whereby high inaccessibility on one dimension may compensate for lack on inaccessibility on other dimensions. The $a_1$ index thus takes the maximum cell value among the four normalized indicators of physical inaccessibility. We decided to keep the sociocultural dimension separate, given the crude binary operationalization of that concept. The results are shown in Model 8, Table 3. As expected, we find the index to be highly significant, and the size of the effect is larger than the largest individual effect estimated in Model 7, even if the model’s total explained variance is marginally lower.
Figure 2. Spatial distribution of inaccessibility across Africa

a1: Maximum physical inaccessibility

a2: Mean physical inaccessibility

a3: Mean physical and sociocultural inaccessibility
Next, we explore a somewhat different logic, whereby the inaccessibility dimensions are considered complementary to each other. Index a2 thus represents the average cell value among the four physical inaccessibility measures. Given that most of the component variables had statistically and substantively significant effects in the full Model 7, we expect this index to perform slightly better than the first variant. Model 9 supports this anticipation and thus gives further evidence of the complementary nature of these inaccessibility dimensions.

Lastly, we investigate a joint physical and sociocultural inaccessibility index that gives the mean cell score among all five variables. For simplicity, we assigned equal weight to these dimension, although one might certainly argue that deviating local language or religion constitutes a bigger hurdle to state consolidation and control than being located close to a neighboring state. In any case, the simple a3 index again supports the notion that remote areas are more likely to see (enduring) violent challenges to state authority than core areas of states.³

### Table 3. Insurgency and inaccessibility indices

<table>
<thead>
<tr>
<th></th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
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<tbody>
<tr>
<td>lnGED</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a1 Max physical inaccessibility</td>
<td>0.209**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.054)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a2 Mean physical inaccessibility</td>
<td></td>
<td>0.337**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.061)</td>
<td></td>
</tr>
<tr>
<td>a3 Mean combined inaccessibility</td>
<td></td>
<td></td>
<td>0.361**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.057)</td>
</tr>
<tr>
<td>Minority</td>
<td>0.053**</td>
<td>0.055**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.018)</td>
<td></td>
</tr>
<tr>
<td>Distance to city</td>
<td>-0.118**</td>
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<td>-0.116**</td>
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<td>Population</td>
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<td>0.060**</td>
<td>0.060**</td>
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<td></td>
<td>(0.007)</td>
<td>(0.007)</td>
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<tr>
<td>Income</td>
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<td>-0.050**</td>
<td>-0.052**</td>
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<tr>
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<td>(0.021)</td>
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<td>(0.011)</td>
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Note: OLS with country fixed effects; standard errors in parentheses; ** p<0.05, * p<0.1

Taken together, the empirical models offer strong evidence in support of all three hypotheses. We found that battle events in civil conflicts in contemporary Africa tend to cluster in areas far from the national capital, in areas characterized by mountains and dense forests, and in areas hosting minority populations. This pattern is robust to accounting for local population density, proximity to major cities, local economic activity, as well as the conflict frequency in adjacent locations.

³ Tests revealed that this result is robust to adjustments to the relative weights of the components in the index. An alternative index that assigns equal weight to minority status as to the combined effect of physical inaccessibility returns marginally weaker results than those reported in Model 10 (R²=0.458)
A limited number of sensitivity tests were carried out. First, we considered how our inaccessibility proxies behave in a time-varying setup. Using a temporal analytical design might seem odd since our focus variables are static but it has some value as it addresses a potential bias in the models reported above. Civil conflicts are not randomly distributed across space, and conflict events much less so. A common way to handle spatial autocorrelation is to introduce so-called spatial lags of the dependent variable, represented by the neighbor conflict indicator in the models above. However, in the strictly cross-sectional design with spatial lags, one risks adding right-hand-side information that could be the result, rather than a cause, of the observed outcome. Accordingly, the very powerful effect of neighboring events in the models above is partly picking up correlations that reflect a reverse causality. By running time-series models and applying a temporal lag to the neighborhood indicator, we have better control over the spatial correlation pattern, even though it comes at the expense of inflating the number of observations with very little new information added. Reassuringly, replications of Models 1–10 with annual grid data did not produce findings that deviate markedly from those reported here. Given that our variables of key interest are (largely) time invariant, and thus not susceptible to endogeneity, we find the static design more appropriate.

Second, we also considered a somewhat more nuanced measure of sociocultural inaccessibility by accounting for the political status of the local population. When adding a new dummy indicator flagging whether the minority population also was excluded from national politics (Cederman et al. 2010), the minority dummy loses most of its effect whereas the exclusion variable is highly significant. This indicates that the political configuration of the local population is more important than mere cultural distinctiveness, and that some of the effect of the minority indicators in the main models is due to ethno-political grievances rather than sociocultural inaccessibility per se. We find much sympathy with such reasoning, but we are also cognizant of the potentially very significant endogeneity problems, whereby an ethnic minority group might be politically excluded as a consequence of past violent protest or in anticipation of future mobilization (none of which processes would be picked up in our analytical design).

Lastly, we replaced the GED events data with point data on the location of the initial battle event for each civil conflict recorded in the UCDP/PRIO Armed Conflict Dataset. Probably due to the rareness of onset events, this test resulted in considerably weaker findings, although the general patterns were consistent with the inaccessibility argument.

**Conclusions**
This article has shed light on how peripheries can shape space for action and mobilization by shifting focus from the country to the sub-national local scale. More specifically, we investigated the extent to which determinants of physical and sociocultural inaccessibility – distance to the capital, proximity to the border, rough terrain, and minority population – increases local civil conflict risk.

Where previous research has limited attention to one dimension, and a single measurement of inaccessibility (if any at all), this paper has provided a more nuanced and comprehensive evaluation of the inaccessibility argument.
The findings indicate that inaccessibility is a critical factor for creating space for action and mobilization, where remote areas experience more conflict than more accessible parts of a country. First, the findings reveal that physical inaccessibility provides opportunities for rebellion. Areas located further away from the core, in rugged areas and close to neighboring countries have an increased risk of experiencing conflict. In addition, areas hosting minority ethnic populations are on average see more conflict events than areas inhabited by the majority group. Not only does the findings reveal relatively strong individual effects of the inaccessibility measures, but it also shows that the various dimensions of inaccessibility exert complementary effects on local conflict risk.

Future studies could investigate how inaccessibility relates to telecommunication. In particular, how does telecommunication infrastructure affect the level of inaccessibility, and how does this relate to conflict. Previous studies have investigated how such types of infrastructure relate to conflict (Shapiro and Weidmann 2014). Yet, it remains unclear which conflict party benefits more: the state (surveillance, propaganda) or opposition movements (mobilization). In addition, data on nightlight emission might provide information on economically developed areas (Shortland et al. 2013), providing locational information on the level of infrastructure.

It also remains to be determined whether the patterns described here are applicable to other corners of the world, and at other time periods. The fact that the notion of inaccessibility draws heavily on guerrilla doctrine and is inspired by contemporary ethnonational separatist insurgencies—which are much more frequent in South and Southeast Asia—suggests that our findings indeed can be generalized. Likewise, it remains to be determined whether physical and sociocultural inaccessibility exert similar effects on the spatial distribution of political violence outside the scope of civil war (e.g., communal conflict and one-sided violence). This is the topic of a future paper.
References


Appendix

Figure A1. Frequency of GED events, 1989–2010
Figure A2. Distance to the capital city, 1989
Figure A3. Mountainous terrain
Figure A4. Forested terrain
Figure A5. Proximity to borders, 1989
Figure A6. Maximum physical inaccessibility (a1)
Figure A7. Mean physical inaccessibility (a2)
Figure A8. Mean physical and sociocultural inaccessibility (a3)
Table A1. Descriptive statistics

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