7. THE POLITICAL GEOGRAPHY OF CLIMATE VULNERABILITY, CONFLICT, AND AID IN AFRICA

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Over the past five years, the number and types of datasets on conflict have grown considerably. Perhaps the most significant development is a "disaggregation revolution," involving the collection and dissemination of information with greater spatial and temporal detail. This includes continent-wide (e.g., the Armed Conflict Location and Event Dataset, or ACLED) and country-specific datasets (e.g., Nigeria Watch), as well as event-based datasets of various specifications (e.g., Crisis Mappers, Ushahidi). Many datasets begin coverage in the mid-1990s, coinciding with increased digitization of source material. In addition, recent innovations in data collection and management have dramatically reduced the lag between the occurrence of events and the compilation and release of related datasets. The increased availability of geocoded subnational data has opened up innumerable research opportunities, allowing scholars to move beyond state-level analysis to think about local properties of politically important phenomena.

As the revolution was occurring, the US Department of Defense announced a Minerva Initiative to support social science research. One of the first initiatives funded was the five-year Climate Change and African Political Stability (CCAPS) program led by the University of Texas-Austin. Entering its final year in 2013–2014, the mission of CCAPS is to (1) assess causal connections between climate indicators and security outcomes, including the location of vulnerable areas, (2) examine government capacity to withstand and recover from shocks, including climate ones, and (3) identify patterns of climate adaptation assistance to better serve vulnerable areas.[1] As part of that effort, CCAPS has pioneered new datasets, indices, and data platforms to display and analyze the political geography of climate vulnerability, conflict, and aid in Africa.

This chapter reports on those efforts, focusing on ACLED, the Social Conflict in Africa Database (SCAD), and the Climate Security Vulnerability Model (CSVM), with reference to efforts to map climate adaptation aid. We describe the datasets and relevant indices and discuss some of their applications, paying attention to how the diverse data can be analyzed together, particularly through our online dashboard (http://ccaps.aiddata.org/), created in partnership with Development Gateway. We conclude by summarizing valuable findings and insights and expected future payoffs as more work is completed.

The Armed Conflict Location and Event Dataset (ACLED)[2]

ACLED, the product of the Armed Conflict Location and Event Project, is the most comprehensive dataset on political violence presently available.[3] It was created to address the deficit of disaggregated data on political violence and analyses of conflict. ACLED

1 See http://www.strausscenter.org/ccaps/. This material is based upon work supported by the US Army Research Office contract/grant number W911-NF-09-1-0077 under the Minerva Initiative of the US Department of Defense.

2 This section presents work of Clionadh Raleigh and her various collaborators on ACLED, including Andrew Linke, Håvard Hegre, Joakim Karlsen, Catriona Dowd, and Lee Macias.

3 ACLED is accessible online at http://www.acleddata.com/. The website provides a comparison between ACLED and other event data sources (http://www.acleddata.com/wp-content/uploads/2012/08/Dataset-Typology-Overview.pdf).

covers all African states from January 1997 to the present with updating in near-real time—coding lags behind events by only a month.[4] More limited coverage is offered for select unstable states, including Haiti, Myanmar, and Pakistan. As of 2013, information on over 75,000 discrete events has been collected. Extensions to all of South Asia and the Middle East are planned for 2014. The data are derived from a variety of sources, concentrating on reports from war zones, humanitarian agencies, and research publications.

Methodology

ACLED is designed to present a realistic assessment of violent political activity within a state, depicting as closely as possible what kind of conflict is happening on the ground. Although conflict data projects apply increasingly consistent frameworks and methodologies to the collection of data, the data are not always directly comparable. For that reason, ACLED is likely to look different, due primarily to three innovative features: the use of atomic data structures, the types of groups that are included, and the multiple ways in which it quantifies conflict rates.

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With an atomic data structure, the scale and parameters of units are consistent across each entry. An ACLED event is defined as a "single altercation where often force is used by one or more groups for a political end" (Raleigh, Linke, and Dowd 2012). Each altercation is coded as a discrete event between identified actors of particular types (rebels, governments, militias, armed groups, protesters, civilians), at a specific georeferenced location, on a single day, which is generally the lowest level of disaggregation possible based on source material. Events are also differentiated by type, according to whether an altercation is between armed groups (battles), an armed group and unarmed civilians (violence against civilians), or the state and demonstrators protesting peacefully or with force (protests/riots). An example would be a battle between Al Shabaab and the forces of the Transitional Federal Government of Somalia and the African Union Mission to Somalia on August 23, 2010, in Mogadishu. In addition, the dataset contains details on recruitment activities of the actors involved, outcomes such as fatalities and changes in territorial control, and the sources of information.

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4 ACLED predates CCAPS, but was expanded with CCAPS support to have Africa-wide coverage.

post-conflict violence rates in specific regions (e.g., Kivu, DRC) can be directly compared, as can rates of activity across different actors (e.g., LRA vs. M-23). Such comparisons are critical when assessing trends and patterns within a conflict, as well as phenomena like diffusion and contagion.

ACLED takes a wide view of political violence: the dataset encompasses all actors who use force for a political motivation or purpose, regardless of the number of events in which they engage or the number of fatalities that result. Political violence is changing across Africa as civil war has decreased in prevalence and activity by other non-state (e.g., militias) and civic actors (e.g., rioters) is more common. These actors often have organizational structures that are less formal, elite ties, local and regional political goals, and patterns of activity suited for their specific contexts. Integrating these events into conflict data creates a more complete picture of political violence as it is experienced in localities. It also does not bias the collection of data by focusing on events with arbitrary characteristics, such as the role of government or a threshold of fatalities. By coding along a political violence spectrum, the progression of violence among actors can be accurately measured and analyzed.

Another distinguishing premise of ACLED is that richer knowledge of the characteristics of conflict events is crucial to allow for various ways to quantify violence. The standard approach, reflected in resources like several of the datasets of the Uppsala Conflict Data Program, has been to measure conflict-related battle deaths. Yet information on fatalities tends to be subject to a greater degree of uncertainty, inaccuracy, and even bias —shortcomings of what is and is not reported in the sources—than information on the type of activity, the location, the date(s), and the actors involved. ACLED does include fatality statistics, from which rough estimates of the intensity of violence—per year, actor, etc.—may be calculated. At the same time, ACLED provides alternative proxies of the frequency and scale of violence, including the proportion of affected locations within a state, the number of active conflict actors within a state, and the number and proportion of conflicts that involve the military. These and other features of ACLED greatly increase the ability to address a variety of questions of empirical and theoretical interest.

Applications

The data and interface are designed to be accessible and relevant to the academic and policy communities and the general public. Of course, the applications are not mutually exclusive: many opportunities exist to develop research agendas and conduct analyses that have value to multiple communities—e.g., merging academic and policy interests.

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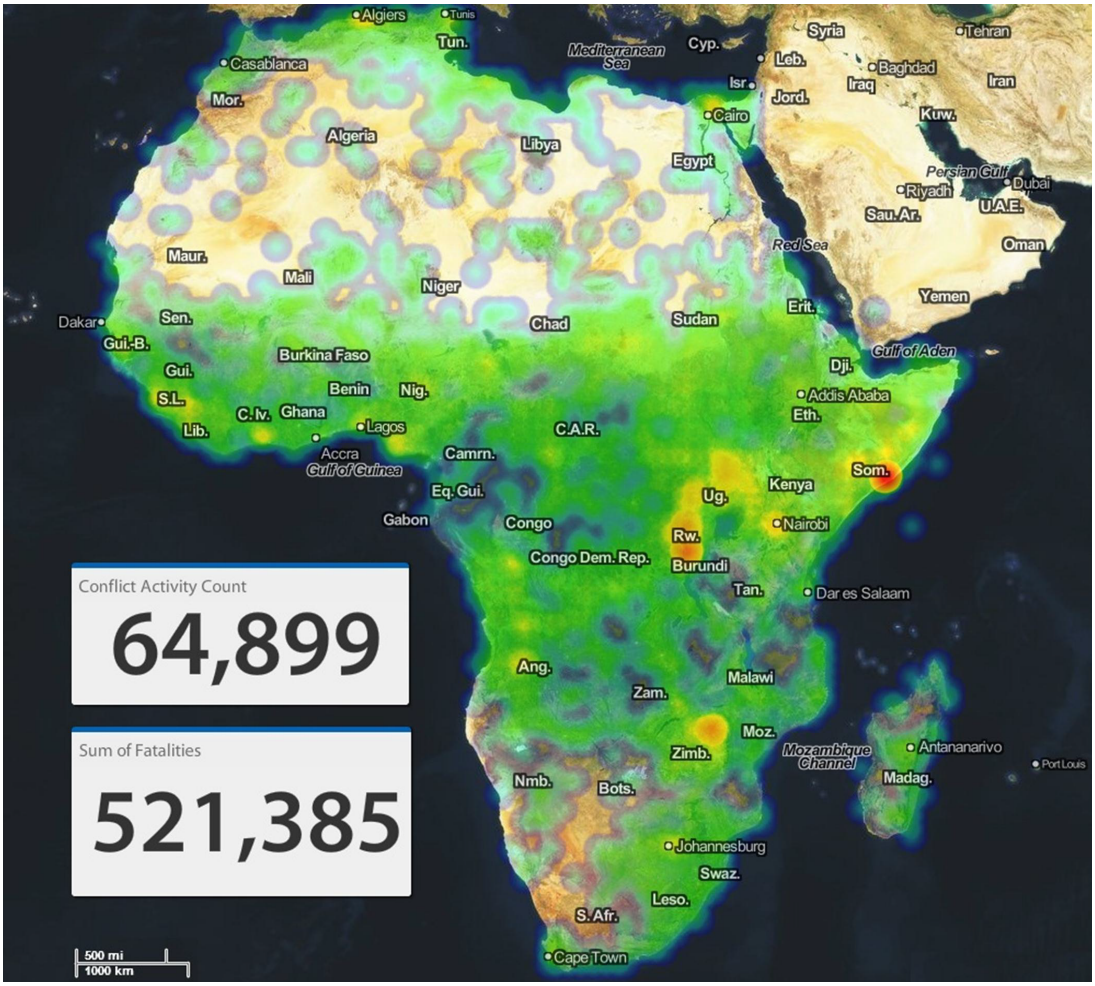
A basic descriptive use is assembling summaries of the event data, which improve comparative understandings of conflict over time and across space. Of note, the geocoding of ACLED allows users to visualize the locations of conflict activity in a manner that is both detailed in terms of the level of precision and broad in comparative scope.

Figure 7.1 Hotspot Map of Conflict Activity in Africa, 1997–2012



Source: Compiled by authors.

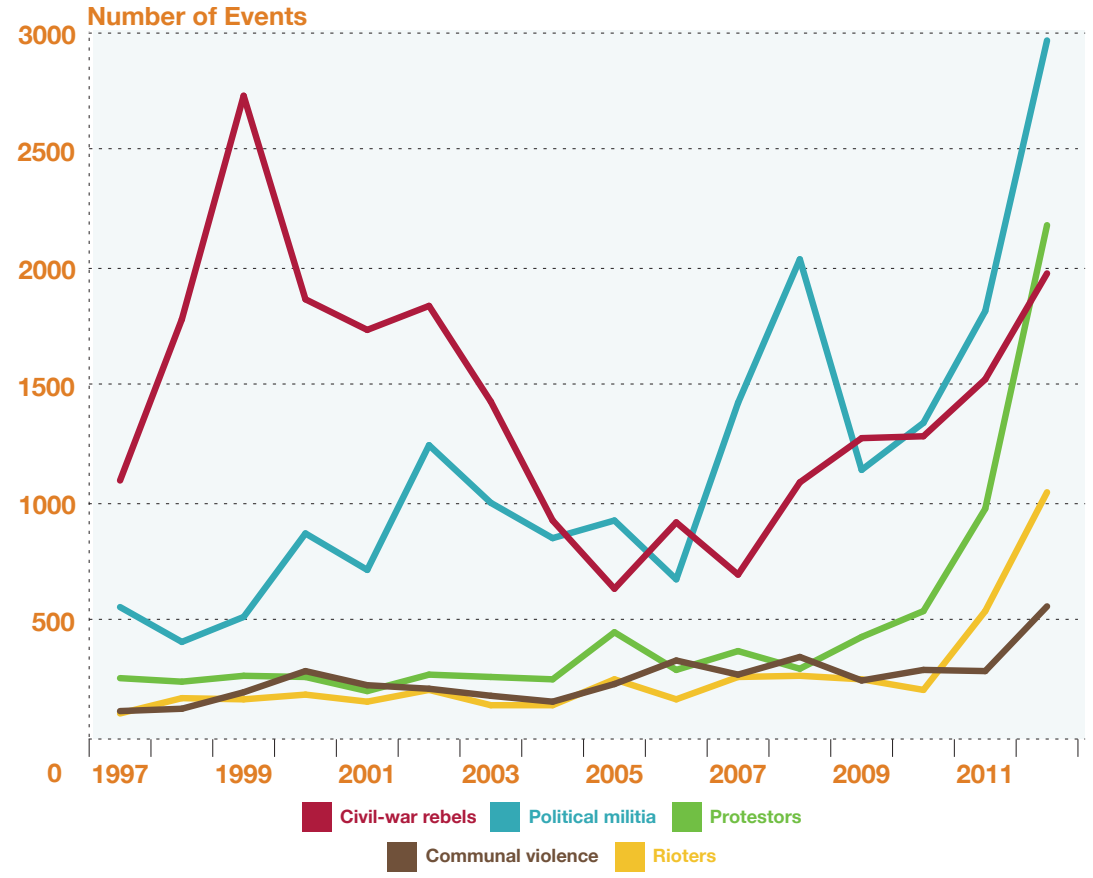
For example, Figure 7.1 maps the overall distribution of conflict events across Africa from 1997–2012. The relative frequencies of events are represented by different colors: blue for minimal, green for low, yellow for medium, orange for high, and red for very high. This depiction clearly identifies the worst hotspots of violence: in particular, large sections of Eastern Congo, Rwanda, and Burundi, the areas around Mogadishu, Somalia and Harare, Zimbabwe, and to a somewhat lesser extent Northern Uganda. Many other areas across the continent are affected, to varying degrees, while a limited number of areas—typically, places with low population densities, such as most of the Sahara Desert—are less exposed. The results corroborate what is generally known about conflict in Africa. The difference is that ACLED affords an expansive, reliable view of patterns, with the ability to draw more careful distinctions about frequency and intensity and to drill down into the data to look at specific aspects and locations of conflict.

Researchers involved in the Armed Conflict Location and Event Project produce monthly trend reports that highlight the evolving patterns of political violence across the

African continent in near-real time. By tracking recent activity in conflicts and comparing the locations and actors involved to what was observed in the past, using the full range of data from 1997, new patterns and sites can be detected and studied. Such analysis can also discern emergent trends that may indicate important shifts in security conditions—e.g., a rise in Islamist groups or unidentified armed groups.

Knowing who is most responsible for political violence has major implications for policy prescriptions by the international community, individual governments, and NGOs. ACLED provides a handle on this question. Figure 7.2 displays the variation in participation in conflict events by different categories of actors over the last 15 years. Early in this time period, rebel activity spiked, before tailing off through 2005. Subsequently, militia activity surged. All categories exhibited far more activity in 2011–2012, an effect largely attributable to the Arab Spring.

Figure 7.2 Conflict Activity in Africa by Actor, 1997–2012



Source: Compiled by authors.

In addition, policy makers are often interested in exploratory, prospective applications. One example is the integration of ACLED in the design and targeting of peacebuilding and conflict mitigation programming. For this purpose, assessments of risks—especially those associated with different interventions—are essential. ACLED provides relevant insight by itself and can be combined with other information to produce more contextualized understandings of complex issues that are known to have

interactive elements. In particular, the data are often used to model the volatility and diffusion of conflict during periods of increased vulnerability, such as elections, natural disasters, and food shortages. The overlap between conflict hotspots and political (e.g., borders of states and administrative units), socio-demographic (e.g., population centers, ethnic groups), environmental (e.g., natural resource deposits, rivers), and technological features (e.g., availability of electricity and cell phone service) can also be studied. These analyses present concrete evidence that international organizations, governments, officials, and civil society practitioners can use when seeking to plan appropriately and develop actionable scenarios taking account of the near- and long-term security environment. For instance, ACLED reports have examined the vulnerability of civilians to violence in Northern Uganda and Eastern DRC, a topic with obvious implications for establishing policy and funding priorities, as well as for the implementation of specific programs. At a later stage, ACLED enables evidence-based evaluations of the efficacy of interventions via the use of baselines and control cases.

A primary application of conflict data is to study the nature, drivers, and impact of violence. Of note, ACLED has been used to observe patterns of violence against civilians (Raleigh 2012). The available information permits other fine-grained descriptive analysis, such as whether the number of cattle raids differs across wet and dry seasons. In addition, ACLED is employed regularly in testing hypotheses from theoretical frameworks about political violence, with the level or onset of conflict serving as either dependent or independent variables. For example, researchers have investigated how inequality may contribute to conflict (Hegre, Østby, and Raleigh 2009), whether rioting increases before organized group violence (Krause 2011), and how violence affects elections and democratic transitions (Daxecker 2012; Weidmann and Callen 2013). Such findings can also be used for forecasting and to anticipate likely future trends.

Applications of ACLED data in the research as part of the CCAPS program include studies of how multiple types of conflict co-occur within the same state (Raleigh 2013a), institutional forms are associated with predominant forms of conflict (Choi and Raleigh 2013), and militias are becoming the dominant agent of political violence (Raleigh 2013b), as well as the spatial properties of militia movements (Raleigh and Hegre 2009; Raleigh 2010; Raleigh and Kniveton 2012; Dowd 2013). Researchers have also observed and modeled the emergence of new actor subtypes (Dowd 2013), as well as instability across specific areas (Dowd and Raleigh 2013b). The Sahel belt, in particular, has garnered significant attention as the site of a "complex emergency" (Dowd and Raleigh 2013a; Raleigh and Dowd 2013). In addition, ACLED has featured in other research that relates to the mandate of the CCAPS programs, including prominent studies on the relationship between climate change and conflict (O'Loughlin et al. 2012; Raleigh and Kniveton 2012; Scheffran, Link, and Schilling 2012; Busby, Smith, White et al. 2013), migration and conflict (Raleigh 2011), urban vulnerability (Raleigh 2013c), land use change in vulnerable settings (Alix-Garcia, Bartlett, and Saah 2012), and Somalia's recent climate and conflict crises (Maystadt, Ecker and Mabiso, 2013; Checchi and Robinson 2013).

Raleigh and Kniveton (2012) is illustrative of the depth and intricacy of analysis that ACLED facilitates. The authors focused on small-scale conflict in East Africa, where the link between resource availability and conflict is assumed to be more immediate and direct, since residents practice subsistence agriculture and pastoralism and are therefore highly dependent on climatic conditions. The analysis showed that in locations

experiencing rebel or communal conflict events, the frequency of these events increases in periods of extreme rainfall variation, irrespective of the direction of the change. Furthermore, the results lend support to both a "zero-sum" narrative, where conflicting groups use force and violence to compete for ever-scarcer resources, and an "abundance" narrative, where resources spur rent- or wealth-seeking and the recruitment of people to participate in violence. Amid the current context of uncertainty regarding the future direction of rainfall change over much of Africa, these findings imply that small-scale conflict is likely to be exacerbated by increases in rainfall variability if the mean climate remains largely unchanged; higher rates of rebel conflict will tend to be observed in

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anomalously dry conditions, while higher rates of communal conflict will be expected in increasingly anomalous wet conditions.

Another significant development, as alluded to earlier, is that the interaction between ACLED and the research mandate of CCAPS has stimulated new avenues in research on complex emergencies. Until recently, the label of "complex emergency" has largely been a reference to the complexity of devising a response to a large-scale, difficult crisis. Complex emergencies are better understood, however, as multiple, interactive crises overlapping within—and sometimes across—states over time, such as famines that occur within conflict zones and increases in food within cities affected by rioting. ACLED is being used to delineate the common types and document the hotspots of complex emergencies (Macias 2013).

The Social Conflict in Africa Database (SCAD)[5]

SCAD is designed to provide the academic community and policy analysts with a tool for studying non-violent and violent contentious events across Africa.[6] All countries with a population of one million or greater are included. This is not the first data resource on conflict events in Africa. Others have looked at protest behavior (Scarritt and McMillan 1995; Bratton and Walle 1997), communal violence (Meier, Bond, and Bond 2007), coups d'état (McGowan 2003), armed conflict (Raleigh et al. 2010), and other distinct conflict types. While these resources are quite useful, SCAD has several advantageous features. One is comprehensive information on a wide variety of conflict types, encompassing both violent events, including riots and armed clashes between actors at a level of severity short of civil war, and peaceful events, such as mass demonstrations and strikes. A second is a transparent data collection methodology. The third is an intuitive framework for understanding the who, what, when, where, and why behind an event.

5 This section is based on the collaborative work of Idean Salehyan and Cullen Hendrix.

6 SCAD is accessible online at http://www.scaddata.org.

Methodology

Currently, SCAD (version 3.0) contains nearly 8,000 social conflict events in Africa spanning the period from 1990–2011; the dataset is updated on an annual basis. To identify events, the SCAD research team conducts keyword searches of Associated Press (AP) and Agence France Presse (AFP) newswires. AP and AFP were selected because of their English and French language coverage, wide geographic reach, the quality of the reporting, and online accessibility in the Lexis-Nexis archives. Relying instead on local sources has benefits, but the team decided against doing so, since cross-national comparisons would be difficult. Of particular concern, countries such as Eritrea and Zimbabwe do not have a free press and are not likely to report accurately on contentious politics. This circumstance, in addition to uneven availability of news through online archives, would mean better reporting on some cases relative to others. By comparison, AP and AFP are more transparent, and original stories are easier to consult when learning about an event. A filtering of events is conducted using five keywords: *protest*, *riot*, *strike*, *violence*, and *attack*. Based on several analyses, these keywords are sufficient to capture the most significant events, while making the task of manually sorting through thousands of articles manageable. The search results are then sifted to identify valid events (e.g., "attack" often appears in stories about sporting events, but those items are usually immaterial to SCAD). Relevant information on the events is coded by research assistants. Intercoder reliability checks are conducted by double-coding 10 percent of the country-years.[7]

Each record in SCAD is a unique conflict event (unlike in ACLED, where each record is a day of an event). While most events last a single day, some can persist for weeks or even months. A conflict is classified as a single event if the issues, actors, and targets are the same and the action in question occurred in a chronologically continuous manner. For example, the "Arab Spring" protests in Tunisia lasted for several weeks before President Ben Ali resigned, but these protests are considered to be a single, sustained protest event for purposes of SCAD. By contrast, a series of strikes in 1996–1997 by the Swaziland Federation of Trade Workers targeting the central government is coded as multiple events, because of long gaps in the group's activities.

SCAD is intended as a resource for information on *social* conflict. As such, cases pertaining to interstate (i.e., two sovereign states engaging in violence against one another) and intrastate (i.e., an organized group using violence to challenge government authority) armed conflict are excluded. To accomplish this, the SCAD coding procedure screens out events that were part of organized armed conflicts, as defined by the Uppsala Conflict Data Program's Armed Conflicts Database (ACD), which requires at least 25 battle-related deaths in a calendar year (Gleditsch et al. 2002).[8] SCAD does contain some information on anti-government attacks by organized actors, so long as these attacks do not meet the criteria for inclusion in the ACD (e.g., violence did not reach 25 deaths).

7 Specifically, Cohen's Kappa statistics are computed on each of the variables. The results indicate substantial agreement among independent codings of the data. When the protest, riot, and strike subcategories are collapsed into three (rather than six) types, however, intercoder reliability increases significantly.

8 For periods of armed conflict, as defined by the ACD, SCAD contains a placeholder row, indicating that a conflict was underway. The start and end dates are provided, along with summary information about the conflict, as well as the ACD event ID number, to facilitate data mergers. For most purposes, users can treat the ACD civil wars listed in SCAD as a distinct type of event, to be included in analyses, as these are made to conform to the SCAD data structure. Reports of individual battles are not included, unlike with ACLED (Raleigh et al. 2010). Users wanting more information about armed conflicts are advised to consult the ACD.

SCAD contains several pieces of information about each event. Start and end dates are listed. The type of action is coded as one of the following: 1) organized demonstration; 2) spontaneous demonstration; 3) organized riot; 4) spontaneous riot; 5) general strike; 6) limited strike; 7) pro-government violence; 8) anti-government violence; 9) extra-government violence; 10) intragovernment violence. Descriptions of these types can be found in the SCAD Codebook. SCAD contains a column for escalation, which indicates whether or not the type of action changed during the course of the event (e.g., peaceful protests turn into violent riots). Next, the actor(s) and target(s) involved in the event are listed as a text field. Actors can be specific if identified with a particular group (e.g., Inkatha Freedom Party) or generic (e.g., "students"). SCAD provides the number of participants, in categories, along with the number of deaths during the event. A repression field indicates the use of lethal or non-lethal force against the actors. Location information is also given, including the particular town(s) or village(s) name, the type of location (urban, rural), and latitude and longitude coordinates based on standard gazetteers, which can be used in geospatial analyses. SCAD classifies the issues at stake in the event, relying on a 14-point scheme.[9] Finally, a short event narrative is provided.

Applications

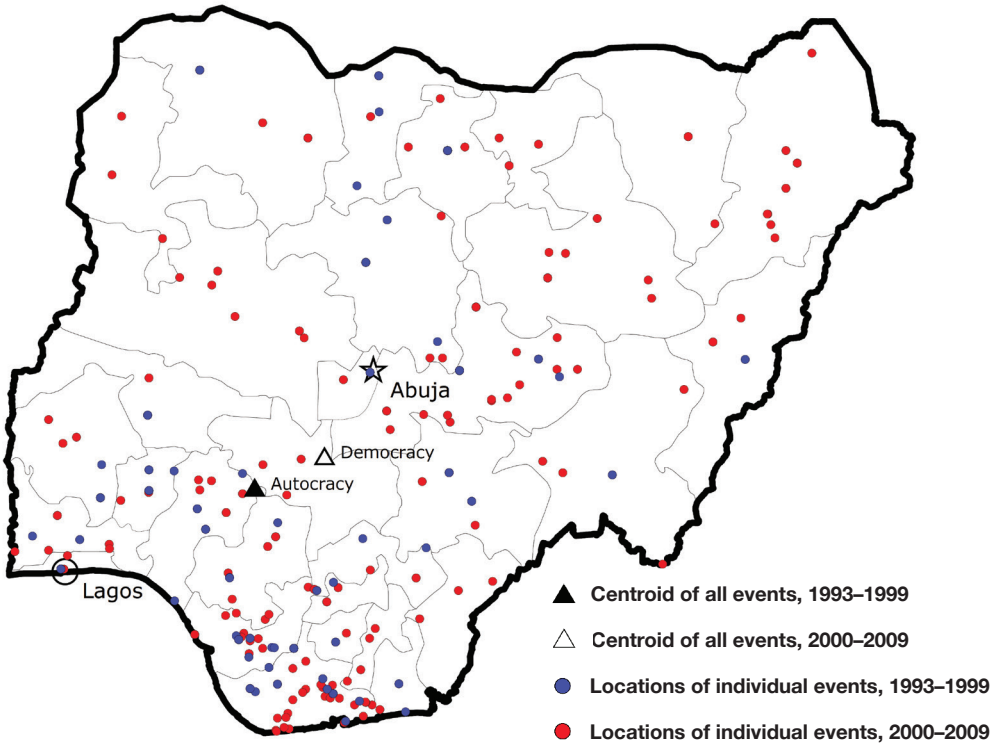
Because of its diverse contents, SCAD is a versatile resource that enables quantitative analyses, qualitative case studies, and geospatial analyses. In particular, SCAD has been used to study the determinants of social conflict (Hendrix and Salehyan 2012; Hendrix 2013; Salehyan 2013; Smith 2013). Other questions that can be examined include the frequency and outcomes of violent and non-violent events in a given country, the use of repression by government actors, and contentious issues like elections and food prices.

As described earlier, a major advantage of SCAD is the availability of geospatial data. The applications of this data can be illustrated by examining how the patterns of conflict shifted during the recent era of democratization in Nigeria. During the military rule of Sani Abacha, violence was relatively contained by the repressive nature of the state. Many authors note that after democratization, the incidence of rioting and communal conflict rose significantly (Bolaji 2010; Ikelegbe 2005; Ukiwo 2003). This explosion of visible forms of social unrest has been attributed to democratization coupled with weak state institutions, long-standing ethnic cleavages, and competition over Nigeria's natural resources, at least in the short term. First, electoral competition at the federal and state level has led to conflict and intimidation during election campaigns (Bratton 2008). Second, ethnic antagonisms, fuelled by local politicians and armed militia groups—such as the Oduduwa People's Congress, based among the Yoruba—have been on the rise, as communal groups compete for power and influence (Ukiwo 2003; Ikelegbe 2005; Eifert, Miguel, and Posner 2010). In this regard, one of the most significant cleavages in Nigeria has been between Christian and Muslim populations. Decentralization under democratic rule provided room for many northern states to enact shari'ah law, exacerbating religious tensions that have resulted in deadly riots (Bolaji 2010). The post-military government has not demonstrated the will or capacity to contain violence in the north, including by the militant group Boko Haram. Third, the Niger Delta has become increasingly violent

9 The issue codes are (1) elections; (2) economy, jobs; (3) food, water, subsistence; (4) environmental degradation; (5) ethnic discrimination/issues; (6) religious discrimination/issues; (7) education; (8) foreign affairs/relations; (9) domestic war, violence, terrorism; (10) human rights, democracy; (11) pro-government; (12) economic resources/assets; (13) other; (14) unknown, unspecified.

as militia groups attack government forces, sabotage oil facilities, and kidnap oil workers (Oyefusi 2008). Finally, climate change, increasing aridity, and shifting settlement patterns have deepened competition over water and land resources, particularly in the north (Obioha 2008). Disputes over land use rights are especially apparent between sedentary farmers and nomadic pastoralists.

Figure 7.3 Conflict Events in Nigeria—Autocratic vs. Democratic Regimes



Source: Compiled by authors.

Figure 7.3 displays a map that overlays the locations of events of social conflict—including peaceful protests and violent unrest—across Nigeria during the Abacha era (1993–1999) and the subsequent period of democracy (2000–2009).[10] Several interesting patterns emerge from an analysis of the two periods, providing systematic quantitative evidence that confirms many of the arguments in the existing literature. First, the frequency of events increases, with an average of 31 events (violent and non-violent) per year during the Abacha regime and 61 events per year afterward.[11] In addition, the spatial distribution of events has also shifted. During the period of military rule, conflicts were mostly confined to the southern part of the country. Only a handful of northern states (e.g., Kaduna, Kano, Katsina) experienced notable unrest. After democratization, however, a significant cluster of events around the Niger Delta was offset by a major expansion of

10 Abacha died in 1998, and Olusegun Obasanjo was inaugurated on May 29, 1999. Since 2000 was the first full calendar year during which Nigeria was under democratic rule, this is used as the dividing line. The maps display Nigerian federal states under the latest (1996) specifications of federal borders.

11 Further analysis of SCAD reveals that the average number of violent events was just 13 events per year during the 1990s, compared to 35 per year during the 2000s.

conflict among the northern states. For instance, Borno state, in the far northeastern corner, experienced no significant social unrest during the 1990s, but exhibited several conflicts during the 2000s. Indeed, all of Nigeria's 37 states have experienced overt conflict in the latter period, unlike in the earlier period. Figure 7.3 also shows the centroid—or geographic centerpoint of all events—for the recent periods of autocracy and democracy in Nigeria. As can be seen, the center shifts to the north and east in the 2000s, consistent with the observation that the Muslim-Christian divide has been the basis for significant conflict in recent years. The ability to document and visualize these sorts of patterns, with greater rigor and precision, represents a major benefit of geolocated data such as SCAD.

In connection with the Minerva-funded CCAPS project, SCAD has also been used to study environmental influences on conflict. For example, Hendrix and Salehyan (2012) examine how deviations from normal rainfall patterns (e.g., drought, extreme rain) affect social conflict. Rainfall is positively related to civil war, with wetter years more likely to suffer from violence as resources become more available to militant organizations. Abnormally dry and wet years are associated with all types of political conflict, including non-violent unrest, violent conflict, and anti-government conflict. Understanding such factors in the timing and location of violence can yield better forecasts about where unrest may occur, enabling policy makers to develop better intervention strategies.

The Climate Security Vulnerability Model (CSVM)[12]

Similarly, CSVM focuses on the security consequences (including the risk of conflict and violence) of climate change throughout Africa at the subnational level.[13] The aim is to identify locations of chronic vulnerability, with as fine-grained resolution as possible, so that decision makers can anticipate potential trouble spots and direct attention and resources accordingly. Areas within Africa are ranked relative to the rest of the continent, rather than the rest of the world. The sources of physical exposure used in the model are based on historic data on climate-related hazards. The findings are triangulated by comparing projections of future climate change (Busby, Gulledge et al. 2012), as well as collaborating directly with climate scientists on future projections of climate exposure (Cook and Vizy 2012; Vizy and Cook 2012; Busby, Cook, Vizy et al. 2013). In addition, CSVM is externally validated through extensive groundtruthing with local experts (Berenter 2012a; Berenter 2012b), plus comparisons with other models. The model has been updated twice as better subnational data have become available and project directors reflected on comments from local experts in and on Africa.[14]

Understanding Vulnerability

Vulnerability is not purely a function of physical exposure to climate-related hazards, but also depends crucially on the number of people living in a given area, what resources they have to protect themselves, and whether their governments are willing to help them in times of need. The analysis using CSVM focuses on situations where large numbers of people could be subject to death from exposure to climate-related hazards, while recognizing that

12 This section reports on work of Joshua Busby in collaboration with Todd Smith, Nisha Krishnan, and Mesfin Bekalo.

13 The methods underlying this model are detailed in Busby, Smith, Krishnan et al. (2013a, 2013b).

14 The first iteration is examined in Busby et al. (2010), while the second set of iterations is discussed in Busby, Smith, White et al. (2013); Busby, Smith, and White (2011); and Busby, Smith et al. (2012).

such situations may or may not escalate to armed conflict. The research can therefore be distinguished from traditional climate security studies that focus exclusively on climate and armed conflict, as well as other approaches that focus more on livelihoods.[15]

Methodology

The diverse sources of vulnerability are gauged by indicators, which have been grouped into four baskets: (1) climate-related hazard exposure, (2) population density, (3) household and community resilience, and (4) governance. Each basket is reduced to an index. The four baskets, their components, and the calculation of the indices are described in the next subsection. Different types of vulnerabilities coincide in some locations but not others, as is evident when the four indices are reduced to a composite index.

A key decision in this subnational work is the unit of analysis. Previous work on this topic relied on shapes of subnational units, using the data from Global Administrative Areas (GADM) dataset.[16] Other available options include data from the Global Administrative Unit Layers (GAUL) and Map Library.[17] An exploration of the USAID Demographic and Household Surveys (DHS) data, seeking more subnational indicators for this third iteration of CSVM, revealed that DHS shapes do not always neatly coincide with GADM and that GADM does not always have the latest political divisions for some countries. Therefore, a new master shapefile was created for all level-one administrative boundaries across Africa, typically corresponding to regional boundaries of states or provinces, based on the latest shape files that are available from various sources.[18]

Findings

The first basket consists of indicators of physical exposure to climate-related hazards, including historic data on the frequency and intensity of cyclone winds, the frequency of wildfires, the presence of chronic aridity, the frequency of rainfall anomalies, and the potential for coastal inundation.[19] Each indicator is converted to a unit scale. An index for the basket is created by giving each indicator a 20 percent weight, except for chronic aridity and rainfall anomalies, which share a 20 percent weight equally, since they are meant to capture similar phenomena. The results show that the most vulnerable areas extend in a wide swath across the continent from Equatorial Guinea to Somalia, with additional pockets in North Africa, coastal Mozambique, and Madagascar. They represent the areas with the greatest historic exposure to these climate-related hazards.

Another primary concern is where large numbers of people are at risk of death from exposure to climate-related hazards. Therefore, the CSVM incorporates a measure of ambient population density—i.e., the average over 24 hours, measured at a 1 km by 1 km resolution. The data are derived from the 2011 version of LandScan, which is produced by Oak Ridge National Laboratory. The data are normalized into percentiles on a unit scale. Population concentrations are found along the Nile River in Egypt, in western Ethiopia,

15 For example, Maplecroft (2012) has produced a global climate vulnerability ranking at the subnational level. See also Wheeler 2011.

16 The GADM website is http://www.gadm.org/.

17 The GAUL website is http://www.fao.org/geonetwork/srv/en/metadata.show?id=12691. The Map Library website is http://www.mapmakerdata.co.uk.s3-website-eu-west-1.amazonaws.com/library/.

18 See Smith, Busby, and Agnihotri (2013).

19 Busby, Smith, Krishnan et al. (2013a, 2013b) provide further detail on these indicators, their scale, the sources of data, and the temporal coverage.

throughout Nigeria and coastal West Africa, in and around the Great Lakes region, along Lake Malawi, and along the Mediterranean coastline from Morocco to Tunisia. Luckily, only some of these areas are also locations that have historically exhibited high climate-related hazard exposures. Meanwhile, a number of the least populated areas—especially in the Sahel and parts of Central Africa—are locations of high climate-related hazard exposure, which is a major reason people avoid living in these areas. From a security perspective, this circumstance is fortunate.

The next basket reflects sources of resilience at the household and community levels: those that are better educated and healthier and have greater access to services, all else equal, will be more capable of withstanding and recovering from exposure to climate hazards that can pose risks to security. In fact, these same attributes are often viewed as vital as part of a more general resilience to conflict. This basket contains pairs of indicators for four categories: education, health, daily necessities, and access to health care. In this iteration of the model, updated infant mortality data was obtained and normalized to the year 2008 from the Environmental Indications and Warnings Project from the Central Intelligence Agency. In addition, new subnational data for literacy and school enrollment were derived from the USAID DHS and the UNICEF Multiple Indicator Cluster Survey (MICS). Data on underweight children and access to improved water sources were also updated to take advantage of new DHS and MICS data. Finally, some subnational information for mothers' delivery in a health facility was obtained from the DHS and MICS data. This means that subnational data are now used for six of eight indicators in this basket. All of these indicators were converted into percent ranks and normalized on a zero to one score. All four categories—and each of the constituent indicators—received equal weight in the index.[20] North Africa and Gabon are found to be the most resilient areas, whereas the least resilient areas are in northern Mozambique, Somalia, and a band that stretches from West Africa into the Sahel. A broader point is that large portions of the continent exhibit heightened vulnerability, but many of these locations overlap with lower levels of population density.

The final basket concerns governance. Since some hazards exceed the capacity of households and communities to respond, whether or not governments are willing and able to provide support can be crucial. The basket includes six indicators in five categories: government responsiveness, government response capacity, openness to external assistance, political stability, and presence of violence.[21] The indicator of the presence of violence is the only one measured at a subnational level. It encompasses all types of ACLED events for the period 1996–2012, with more weight placed on recent events.[22] Events are aggregated to the level-one administrative unit, again corresponding to subnational regional boundaries in most cases. Areas with poor governance scores include most of Somalia and Libya, half of Zimbabwe, and pockets of South Sudan, Sudan, the Democratic Republic of the Congo, and the Central African Republic. Significant portions of southern Africa have relatively favorable scores.

20 In the event a particular indicator was missing data, the other indicator would take on the full category weight.

21 Government responsiveness and capacity are captured through a diminishing weighted-average of data from the Worldwide Governance Indicators for 2008–2011. The indicator for openness to external assistance, which likely changes slowly, is obtained from the 2009 KOF Index of Globalization. Two indicators reflect the volatility of governance in a country, derived from the Polity IV data.

22 Events in 2012 get a full weight of 1, then the weight diminishes by 1/16 each year through 1997.

The indices for the baskets can be combined using various functional forms. In the analysis presented here, the physical exposure index is multiplied by the sum of the other three indices. To preserve the clarity of the unit scale, the composite index is renormalized, dividing each value by the total possible score. Values are then subtracted from 1, such that 1 represents the most vulnerable and 0 the least vulnerable.

Figure 7.4 Composite Climate Security Vulnerability in Africa

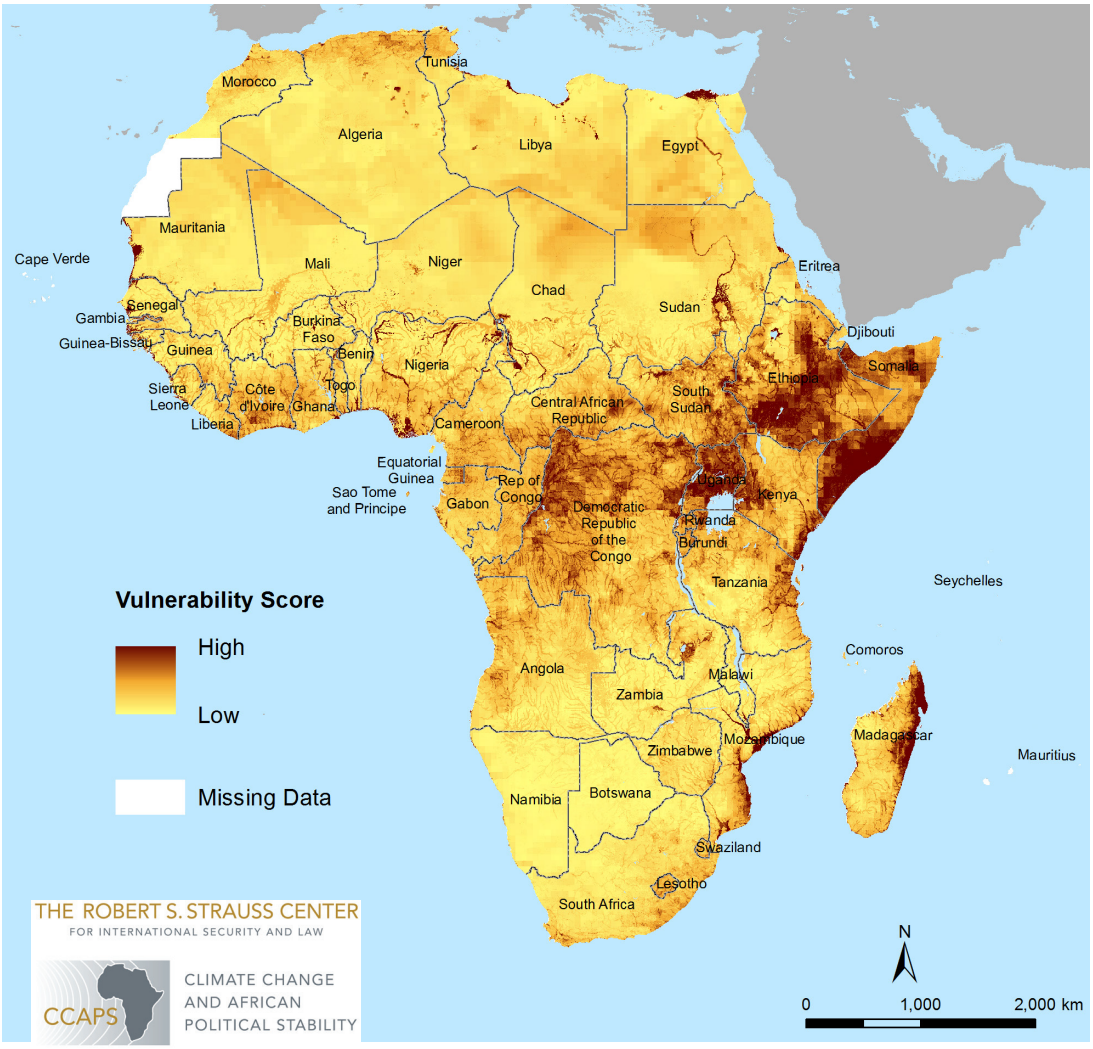


Figure 7.4 displays the map of this composite index of climate security vulnerability. Extreme levels are found across the Horn of Africa, with the maximum being in Somalia (0.85). Other areas of high vulnerability are concentrated in central and eastern Ethiopia, Uganda, pockets in the DRC, Nigeria, Egypt along the Nile, and the eastern coasts of Mozambique and Madagascar. Parts of southern Africa and North Africa rate as less vulnerable, due among other things to higher living standards and better governance compared to other parts of the continent. The lowest level of vulnerability (0.00) is observed in northwestern Ethiopia.

Extreme levels [of climate security vulnerability] are found across the Horn of Africa, with the maximum being in Somalia (0.85). Other areas of high vulnerability are concentrated in central and eastern Ethiopia, Uganda, pockets of the DRC, Nigeria, Egypt along the Nile, and the eastern coasts of Mozambique and Madagascar.

An advantage is that CSVM backs characterizations with multi-dimensional, systematic evidence that affords greater rigor and precision. The significant elements of disaggregation in the calculations and presentation of results represent a major advance, allowing finer-grained assessment that is superior to crude national-level assessments. Refinement of the model, to achieve ever more reliable statistics that improve the value as a tool for guiding research, policy, and practice, remains an ongoing process. As part of work in progress, these maps are being validated by comparing the observed patterns of vulnerability to other similar indicators such as the EM-DAT International Disaster database of climate-related disasters (CRED 2011). This dataset has limited, low-quality geographic information, but as part of the CSVM project, all climate-related disaster events over the period 1997–2011 have been geocoded (Busby et al. 2013a, 2013b).

Applications

CSVM has been used primarily to identify hot spots of chronic concern. The model has other important applications, especially when analyzed in conjunction with additional geolocated data. Indicators of interest can be overlaid on top of the map of climate-related security vulnerability to assess the extent of co-location. For example, one study assessed the extent to which foreign assistance is being delivered to the most vulnerable areas (Busby, Smith, and White 2012). Active World Bank and approved African Development Bank projects in Africa were geocoded across all sectors.[23]

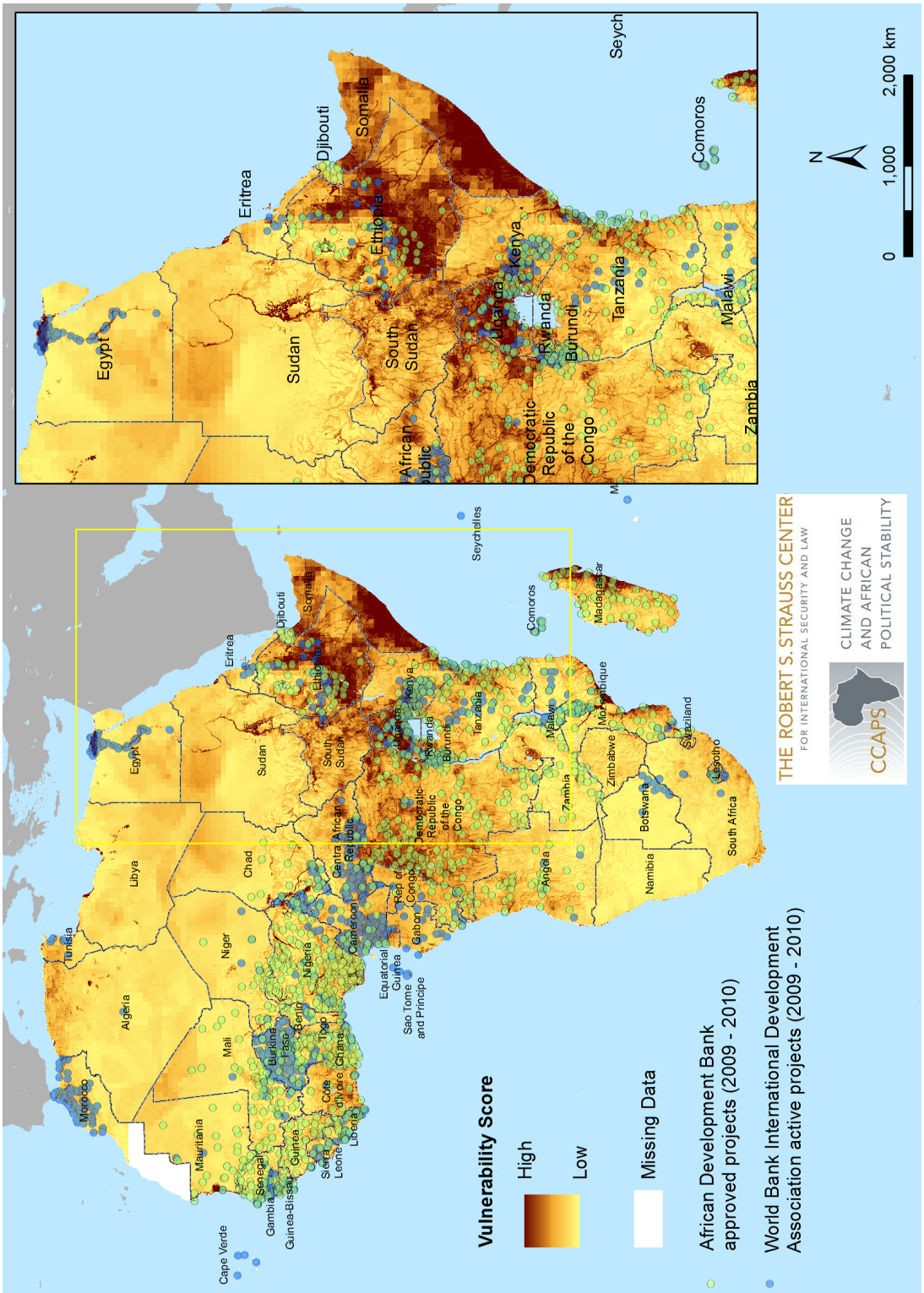
As Figure 7.5 reveals, some of the areas of greatest vulnerability, such as Somalia, received little foreign assistance from multilateral lending institutions in 2009 and 2010. Of course, the absence of a competent or even functioning government, together with widespread insecurity, heighten vulnerability and produce a setting where foreign assistance is too risky and thus discouraged. Such analysis raises questions about whether funding should be directed to countries most capable of successful implementation (e.g., Kenya and Tanzania were major beneficiaries of multilateral assistance in East Africa) or to the most vulnerable areas. These issues have been examined with respect to East Africa (Busby, Smith, and White 2012) and North Africa (Busby, White, and Smith 2010).

Some of the areas of greatest [climate security] vulnerability, such as Somalia, received little foreign assistance from multilateral lending institutions in 2009 and 2010.

Another notable angle is the intersection between climate vulnerability and US strategic interest. This has been studied by incorporating data on terrorist attacks, piracy, oil wells, minerals, and embassies. Here, preliminary findings suggest that Nigeria and Somalia in particular possess both high climate vulnerability and relatively high strategic importance (Busby et al. 2013).

23 See http://ccaps.aiddata.org/aid. Other CCAPS colleagues are pioneering the coding of adaptation-specific projects (Weaver and Peratsakis 2011; Ackerson et al. 2013).

Figure 7.5 Development Projects and Climate Security Vulnerability in Africa



CSVM also has potential to be used as a simulation tool for exploring "what-if" counterfactuals. Scenarios can be conceived that reflect a range of alternative values of the constituent indicators for particular locations. The range might encompass things such as future development objectives (e.g., increased literacy), specific interventions (e.g., deployment of peacekeeping forces), or changes in conditions (e.g., drought).

In addition, this project has generated new information resources that facilitate cross-sectoral analyses. For example, data on subnational administrative units in Africa, subnational educational attainment, and access to improved water sources are available from Smith, Busby, and Agnihotri (2013). Geocoded data on terrorism and disasters in Africa are expected to be made publicly available in 2014.

Conclusion

The diverse data sources described in this chapter enable the examination of questions related to climate change and security outcomes. More fine-grained geolocated data is essential to that enterprise since environmental variables like precipitation typically do not have a uniform distribution over national units. While conflict does not always take place proximate to where local drivers originate, the datasets described here enable scholars to assess the extent to which subnational variation matters. ACLED, SCAD, and CSVM can also be used to address topics well beyond the climate change debate. These datasets further open the door to a rich research agenda that integrates subnational geographic data into the study of security and international politics.

While subnational studies of political phenomena are gaining in popularity, methods and analysis are still at early stages. Maps of these phenomena can be compelling, but hinge on many underlying decisions, such as how to classify data, what are appropriate divisions between categories, and how many different colors or shades should represent these categories. Maps usually say little about statistical significance—they do not come with error bars—or the quality of input data. Some outputs, such as the composite maps of vulnerability described in this chapter, may be difficult to test and externally validate using econometrics, because of data limitations. ArcGIS, the leading software of mapping geospatial data, now includes more tools for geospatial analysis and econometrics. Yet much of the work in this domain still relies on simple overlays of indicators.

Even statistical analysis that takes advantage of new geospatial data sources and uses subnational units faces difficult modeling choices. The politically salient divisions are administrative regions, which vary in size within and across countries, complicating comparative analysis. Some analyses instead employ equally sized grid squares, which have the drawback of being artificial and not reflecting actual political units (Theisen 2011; Busby and Hazen 2011; O'Loughlin et al. 2012; Theisen et al. 2012). A related problem is how to ascribe event data with X,Y coordinates to larger geographic units, particularly in instances where battles, disasters, or complex emergencies affect multiple towns, provinces, or regions—but not all of them. Also, beyond the fact that news reports may have biased counts of deaths and casualties, trying to apportion these guestimates to different geographic units is potentially fraught with even greater error.

In sum, analysts have to be clear about their assumptions when using geospatial data. Ultimately, none of the work using the new data sources, methods, and mapping tools is a substitute for close and nuanced understandings of particular situations on the ground and strong foundations for theorizing and testing causal relationships.