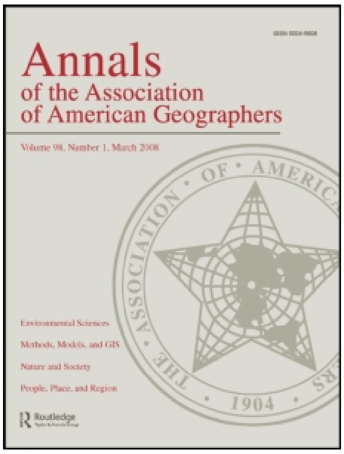

Annals of the Association of American Geographers
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t788352614

The Localized Geographies of Violence in the North Caucasus of Russia, 1999-2007

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First published on: 15 December 2010

To cite this Article O'Loughlin, John and Witmer, Frank D. W.(2011) 'The Localized Geographies of Violence in the North Caucasus of Russia, 1999-2007', Annals of the Association of American Geographers, 101: 1, 178 — 201, First published on: 15 December 2010 (iFirst)

To link to this Article: DOI: 10.1080/00045608.2010.534713
URL: http://dx.doi.org/10.1080/00045608.2010.534713

The Localized Geographies of Violence in the North Caucasus of Russia, 1999–2007

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The second Chechen war, starting in the North Caucasus in August 1999, shows few signs of a ceasefire after eleven years, although the level of violence has declined from the peaks of the war's first two years. Initially framed by both sides as a war of separatists versus the federal center, the situation is now complicated by the installation of a Moscow ally into power in Chechnya and by the splintering of the opposition into groups with diverse aims and theaters of operation. The main rebel movement has declared the establishment of an Islamic caliphate in all the Muslim republics of the North Caucasus as its ultimate goal. Fears of regional destabilization of the entire North Caucasus of Russia are propelled by reports of increased militant activism in republics adjoining Chechnya due to possible contagion effects of violence in these poor areas. Temporal and spatial descriptive statistics of a large database of 14,177 violent events, geocoded by precise location, from August 1999 to August 2007, provide evidence of the conflict's diffusion into the republics bordering Chechnya. "Hot spots" of violence are identified using Kulldorff's SaTScan statistics. A geographically weighted regression predictive model of violence indicates that locations in Chechnya and forested areas have more violence, whereas areas with high Russian populations and communities geographically removed from the main federal highway through the region see less violence. *Key Words: Chechnya, civil war, diffusion, North Caucasus, spatial-statistical analysis.*

在 1999 年 8 月北高加索开始的第二次车臣战争，十一年后，显示了较少停火的迹象，但其暴力程度已经从战争头两年的峰值下降。最初被双方定位为分离主义分子与联邦中央的战争，现在的情况因一个加进车臣权力的莫斯科执政盟友和因反对派对具不同目标和操纵舞台的多个组织的分裂而复杂化。主要反叛运动已经宣布了在北高加索地区的所有的穆斯林共和国建立一个伊斯兰哈里发为最终目标。由于在这些贫困地区暴力有可能造成了蔓延性影响，有关与车臣毗连的共和国中好战主义分子的报告进一步推动了对整个俄罗斯北高加索地区动荡的担忧。本文使用了一个大型统计数据库，该数据库记录了从 1999 年 8 月至 2007 年 8 月具有时空叙述的 14,177 件暴力事件，经过地理编码以确定精确的位置，对冲突扩散发生于和车臣共和国接壤的其它共和国这一命题提供了证据。"热点"暴力通过使用 Kulldorff 的 SaTScan 统计方法而得以确定。地理加权回归预测模型表明，车臣境内和林区有更多的暴力事件，而那些具有较高俄罗斯人口和那些地理上与主要联邦公路较远的社区具有较少的暴力。*关键词：车臣，内战，扩散，北高加索，空间统计分析。*

La segunda guerra de Chechenia, que empezó en el Cáucaso del Norte en agosto de 1999, muestra pocas señas de un cese al fuego tras once años de lucha, si bien el nivel de violencia ha declinado desde el pico alcanzado en los primeros dos años de la guerra. Lo que inicialmente se encuadró por ambos bandos como una guerra de separatistas contra un centro federal, se ha complicado ahora con la imposición de un aliado de Moscú en el poder de Chechenia y con la fragmentación de la oposición en grupos con propósitos y teatros de operación diversos. El principal movimiento rebelde declaró como su meta única el establecimiento de un califato islámico para todas las repúblicas musulmanas del Cáucaso del Norte. Los temores de desestabilización regional en todo el Cáucaso del Norte ruso están siendo impulsados por los informes sobre incrementos del activismo militante en repúblicas vecinas a Chechenia, debido al posible contagio de los efectos de la violencia en estas áreas empobrecidas. Las estadísticas descriptivas temporales y espaciales de una gran base de datos que cubre 14.177 hechos violentos, geocodificados con localización precisa, de agosto de 1999 a agosto de 2007, dan evidencia de la difusión del conflicto hacia las repúblicas fronterizas con Chechenia. Los "puntos calientes" de violencia se identificaron mediante el uso de estadísticas SaTScan de Kulldorff. Un modelo predictivo de la violencia mediante regresión ponderada geográficamente indica que ciertas localidades de Chechenia y las áreas de bosques tienen más violencia, mientras que las áreas con alto contenido de población rusa y las comunidades que han sido removidas geográficamente, desde la principal carretera federal a través de la región, muestran menos violencia. *Palabras clave: Chechenia, guerra civil, difusión, Cáucaso del Norte, análisis espacio-estadístico.*

Annals of the Association of American Geographers, 101(1) 2011, pp. 178–201 © 2011 by Association of American Geographers
Initial submission, July 2008; revised submission, February 2009; final acceptance, August 2009
Published by Taylor & Francis, LLC.

At the height of the Vietnam War forty years ago, Robert McColl (1969) published an article in this journal titled "The Insurgent State: Territorial Bases of Revolution." He proposed a descriptive geographic model of rebel strategies from early (mobile) attacks to later phases of a rebellion (building a parallel insurgent state with well-protected core areas) as a manifestation of a territorial imperative (McColl 1969). Using contemporary insurgencies in China, Indonesia, Indochina, the Philippines, and Greece, McColl identified rebel targeting schemata, balancing resources against the relative value of the targets. McColl concluded by stressing the viability of base areas as a factor in the eventual probability of insurgent success.

Many of the military-geographic studies published since 1969 have a similarly descriptive and avowedly territorial character. Recently, however, there are calls for the application of more rigorous methodologies both to understand the ebb and flow of fighting in war zones and for peacekeeping purposes (see, for example, the chapters in Palka and Galgano 2005). In contrast to the environmental and terrain analysis of military geography stand critical geographic accounts of massive killings of civilians in Germany and Japan during World War II (Hewitt 1983), the effects on civilians of U.S. bombings of the dikes in the North during the Vietnamese war (Lacoste 1976), the destruction of cities (Graham 2004), the "war on terror" in the Middle East (Gregory 2004), and impacts on the environment and society from militarization (Woodward 2004); however, compared to the explosion of research in other social sciences (history, political science, economics, social psychology, and sociology) concerned with the localized impacts of wars on communities and their inhabitants, the lack of geographic work is evident. This article attempts to redress this scarcity of geographic work on the localized nature of civil wars, now the predominant style of modern warfare. We harness some of the methods of spatial analysis that have developed since McColl's early work on rebellion.

In the North Caucasus region of Russia, a second post-Soviet civil war erupted in August 1999 and continues to the present. Unlike the first Chechen–Russian war of 1994–1996, the current insurgency is diffuse, diverse, geographically—and ethnically—disparate, and less visible on the world's television screens. It has evolved into simmering violence across the six ethnic republics (Chechnya, Dagestan, Karachaevo–Cherkessia, Kabardino–Balkaria, Ingushetia, and North Ossetia) and the predominantly ethnically Russian Stavropol' *kray* (Gammer 2007; Hughes 2007; Yarlykarpov 2007; Moore and Tumelty 2008; Human Rights Center "Memorial" 2008). Although highly variable and subject to the competing claims of federal and insurgent sources, the estimates of dead in the two wars range from 80,000 to 100,000, and hundreds of thousands more have been displaced or have fled to avoid violence (O'Loughlin, Kolossov, and Radvanyi 2007; International Crisis Group [ICG] 2008). Although the level of violence is down significantly from its 2001 peak, political solutions are not widely supported, and fears of regional instability due to poverty, religious and political militancy, corruption and criminality, paramilitary and police brutality, and the spread of violence from its Chechnya core are frequently expressed by Russian and international commentators (see, *inter alia*, Kramer 2005; Peuch 2005; Dunlop and Menon 2006; Russell 2007; Smirnov 2007; Moore 2008). After a long delay due to reluctance in acknowledging the changing nature of the insurgency, General Nikolai Rogozhkin, head of Russian Interior Ministry forces in the region, was quoted by *RIA-Novosti* as saying that in 2007, a surge in militant activity was registered in Chechnya, Dagestan, Ingushetia, and Kabardino–Balkaria ("Interior Troops Commander Reports a Surge in Militant Activity" 2008). Tracking and mapping the diversity of violent events (rebel attacks on security forces and installations, police arrests, military reprisals, and civilian deaths due to the fighting) over the first eight years of the second Chechen–Russian war allows analysis of this and similar claims (Moore 2008). Unlike previous studies that relied on major incidents to make a case for growing regional instability, a database of 14,177 violent events that are coded precisely by day of occurrence and geographic location offers a more reliable test of the claims and counterclaims of federal and local governments and the various insurgent groups.

Over the past half century, the scientific study of war has evolved from mathematical models of superpower arms races to understanding the distributions of conflicts through use of economic and political correlates of states at war and, recently, a more focused attention on the characteristics of civil wars in the post-Cold War era as interstate conflicts are now very rare (Collier and Hoeffler 2001; Sambanis 2002; O'Loughlin 2004). The most recent development is disaggregating conflict data down from the country level to regions and localities under the rubric of geographic research on war (GROW). Because civil wars are usually concentrated in specific regions within a state (e.g., Assam within India) and country-level analysis is thus inappropriate (Buhaug and Gates 2002; Buhaug and Lujala

2005; Raleigh 2007; O'Loughlin and Raleigh 2008), this impetus demands detailed information, typically events data (specific violent events coded for place, time, actor, target, and type). Since the numerous large and well-trodden data sets in conflict studies are helpful only in setting the overall study dimensions (Raleigh and Hegre 2005), our study fits this new attention to localized violence. Unlike earlier works, we adopt an explicit spatial-analytical perspective to map and understand violence over time and between places. Specifically, our study (1) offers a descriptive account of the ebb and flow of conflict in the North Caucasus between August 1999 (start of the second war in the region) and August 2007 through cartographic and geo-statistical analysis of dispersion–concentration trends; (2) tests the hypothesis of diffusion of conflict from Chechnya with its important implications for regional stability and for Russia's regional politics; and (3) examines the ratio of violence (events per population) in the region's 143 *rayoni* (counties) and major cities in relation to key political, environmental, and demographic factors in a geographically weighted regression (GWR) analysis.

The Study of Civil Wars and Their Geographical Disaggregation

The limitations of so-called country-year approaches that generate a large *N* by multiplying all countries and all years (typically since 1945) are evident. In revisiting the literature published on the subject where conflict typically is represented in less than 5 percent of the country–year cells, there are multiple and compound explanations of civil wars, such as greed (economic) and grievance (ethnically based), locations of rebel and government targets and bases, environmental factors (terrain and forest), institutional factors (effective governance and possibilities for expressing dissent), and historical factors (the legacies remaining from previous conflicts in specific locales). The most cited study concluded that civil war presence in a country in a particular year is related to the factors that encourage insurgency (poverty, weak governments, unstable politics, rough terrain, and large populations), and the authors undermine arguments that diverse ethnic populations experience more conflicts (Fearon and Laitin 2003). In fact, a higher rate of diversity can be more stabilizing than a permanent majority–minority struggle because control of the state apparatus by an ethnic majority can instigate insurgency (Cederman and Girardin 2007).

The main debate in the civil war literature has been between those who pursue greed explanations that emphasize the economic and resources incentives to fight and those who emphasize creed and examine differences according to ethnicity, religion, and (increasingly) geographic location (Collier and Hoeffler 1998; de Soysa 2002; Collier et al. 2003). A major World Bank research project has highlighted the evident economic incentives to rebel, especially among young men (Collier 2000; Collier and Hoeffler 2001; Sambanis 2002; Collier et al. 2003). Geographer Philippe Le Billon has contributed to this debate by drawing attention to the uneven distribution of lootable resources (e.g., diamonds, oil, forest products, gold) that can pay for rebellions and thus become the focus of government–rebel actions, coupled with a strong involvement of outside interests (corporate, criminal and government; Le Billon 2001 2008; Le Billon and Cervantes 2009).

The geographic dimension of civil war study, however, still suffers from a weak conception of possible environmental effects on war onset, frequency, and location. Among the limitations of country-level study is the assumption of an even distribution of conflict within a country when it is obvious that most countries experience civil conflicts only in selected locales. Use of country-level data also tends to ignore nonstate actors and international cross-border influences for which information is difficult to obtain. Specifically, without geo-located information on conflict events (battles, attacks, reprisals, raids, arrests, etc.), it is not possible to track the to-and-fro of conflict that McColl (1969) identified as a missing piece of the puzzle. Only with such data can rebel strategies and tactics, as well as government responses, be analyzed and explanations for the relative concentration in certain places pursued.

If counterinsurgency operations are a goal of the analysis, predictive models (e.g., contagious diffusion) can be developed to anticipate future attacks on the basis of spatio-temporal trends. Geo-located data are the basis for the possible use of techniques based on geographic information systems (GIS), including spatially weighted regression modeling that emphasizes nonstationarity and coefficient drift, and geo-statistical frameworks to tackle these questions of intrastate violence (Bailey and Gattrell 1995; Maguire, Batty, and Goodchild 2005). Key ideas that lend themselves to aggregate analyses about the causes of wars drawn from the greed–creed literature can be examined at the local scale if disaggregated data are available, and such conflict data offer further benefits that are, as yet, rarely pursued in conflict study (Sambanis 2005). By connecting the local impacts of wars to the immediate and contextual nature of the communities affected, aid programs can be properly targeted and distribution points located.

Historical study of civil war violence also suggests the advantages of a geo-statistical analysis of disaggregated data. To establish the geographical distribution of revolutionary violence is a daunting task (Fitzpatrick 1978); historians have nevertheless documented the mechanics of nationalist violence by compiling data on activists and combining this information with state responses. By comparing locales of political violence with nearby locales of inactivity, they have been able to document the key roles played by social and familial networks in mobilizing nationalist agitation and offer a contextually nuanced explanation of its geography. Irish studies, in particular, have benefited from this type of work (Rumpf and Helburn 1977; Fitzpatrick 1978; Hart 1997, 1998). Typical data sources (police and military records, contemporary newspaper stories, memoirs, and interviews recording the time and place of events) allow the construction of rates of rebel mobilization and correlations with indexes of economic and demographic composition. In Ireland, for example, rebellion at the local scale was negatively associated with the strength of economic links of middle-income families to the British markets and based on agriculture exports. On the other hand, violence was positively associated with rural poverty, the presence of local activist recruiters (especially school teachers), a history of agrarian and nationalist agitation, and geographic peripherality. What is evident in Irish revolutionary study, a field that is rife with legend, bias, traditional and revisionist accounts, hagiographies, and charges of brutality and war crimes, is that every activist carried a mental map of "good" and "bad" communities—the former secure and hospitable, the latter potentially treacherous (Hart 1997). Kalyvas (2006), in the literature review for his magisterial account of the Greek civil war of the 1940s, tracked dozens of studies of similar conflicts and concluded that the key underlying dynamic is the uncertainty of who is friend and who is foe. Such uncertainty sets up a moral hazard problem (i.e., a person insulated from risk might behave differently from the way he or she would behave if fully exposed to risk). Defection, denunciation, deterrence, and both discriminate and indiscriminate violence are perpetrated on civilians by both rebel and state forces. Although Kalyvas was able to account for about two thirds of the violence among Greek villages by his rational choice model, most accounts are anecdotal, tracking local legacies of enmity and hate that stem from previous hostilities. But stereotypical ethnic wars are not always as univariate as they seem. Bax (1995) delved beyond simple accounts of primitive Balkanism to account for the intra- and interethnic atrocities perpetuated in a small village in Bosnia-Herzegovina as rational outcomes of strong clan loyalties, struggles for local economic dominance, competition by religious orders within the Catholic church, and reciprocity of brutality.

Despite the GROW initiative, much of the information collected is still highly aggregated and lacks the detailed day-to-day locality-based event information that is typical of the historical studies. Buhaug and Gates (2002), for example, analyzed yearly data and centroidal coordinates of 265 civil wars in the Uppsala conflict database from 1946 to 2000. The research agenda motivating that paper is inspired by traditional international relations topics—rebel and government resources, military strategy, terrain and distance to important objectives like capital cities, and so on. Later work (Buhaug and Lujala 2005; Buhaug and Rød 2006) extended the Uppsala conflict data analysis to more sophisticated statistical modeling, but the basic spatial information is still too coarse to facilitate localized accounts of violence. Geographic units are generally assigned a violence score that is either cumulated from the presence of conflict in a given year, indexed to the scale of violence using the number of casualties or battles, or included within the spatial range of violence around a preidentified centroid. A subset of these kinds of studies relates the ratio of violence to the economic and demographic characteristics of the districts, hypothesizing that specific economic and ethnic attributes will raise the potential for violence (Gates 2002; Murshed 2002; Murshed and Gates 2005; Raleigh 2007). Recent worries that changing climates in vulnerable world regions will lead to more conflict (through the agency of forced migration and increased competition with locals for scarce resources) have generated a flurry of interest (Homer-Dixon 1999). Although the aggregate statistical evidence for the connection is still debatable (Hendrix and Glaser 2007; Nordås and Gleditsch 2007; Raleigh and Urdal 2007; Reuveny 2007), local circumstances and nuanced accounts indicate a causal relationship (Meier, Bond, and Bond 2007).

While a long-standing focus of geographic study of conflicts has been on the diffusion of wars, especially across international borders (O'Loughlin 1986, 2004; O'Loughlin and Anselin 1991; Gleditsch 2002; Ward and Gleditsch 2002; O'Loughlin and Raleigh 2008), civil war study has not yet taken up a close examination of this phenomenon at the local level. Preliminary accounts are intriguing (O'Loughlin 2005; Raleigh 2007; O'Loughlin and Raleigh 2008) and the mechanisms of conflict diffusion through the actions of refugees, diasporas, and allied regimes in adjoining states are now being elaborated (Salehyan and Gleditsch 2006).

The Context of the North Caucasus Conflicts, 1999–2007

In many respects, the North Caucasus conflicts resemble a classic separatist movement in Chechnya, with knock-on consequences into adjoining districts. As noted by Trenin, Malashenko, and Lieven (2004), three types of conflicts have occurred on Russia's frontier (the North Caucasus) since the end of the Soviet Union in 1991. The first, best-known, and by far the bloodiest are the Chechen wars of 1994 to 1996 and 1999 to the present (Dunlop 1998; Politkovskaya 2003; Zärcher, Baev, and Koehler 2005). A ramping-up of separatist claims in Chechnya, one of eighty-nine subjects of the Russian Federation, developed at a time of confused political authority at the federal center and uncertainty regarding the unity of the state in the aftermath of the 1991 independence of the fifteen republics of the Soviet Union. War broke out in August 1994 after President Boris Yeltsin ordered the end of the secession that had emerged under the leadership of the All-National Congress of the Chechen People (NCChP) party, headed by former Soviet general Dzhokhar Dudayev. This war was marked by major battles for control of Grozny (the capital) and ended with the Khasavyurt Agreement of August 1996 that effectively granted Chechnya autonomy within the Russian Federation. More than half the population fled the republic, including most ethnic Russians, and up to 100,000 military personnel and civilians died (Lieven 1998; Tishkov 2004).

The interwar period from 1996 to 1999 in Chechnya saw a power struggle between Aslan Maskhadov, a former Soviet officer elected as republic president, and Shamil Basayev, a guerrilla leader active in hostage-taking beyond the war zone, who advocated a more Islamist position from the leadership and who envisioned a caliphate across the entire Muslim region of the North Caucasus. As part of this wider strategy, Basayev and his followers invaded the bordering republic of Dagestan in August 1999, thereby triggering the second Chechen war. The new Russian leadership of Vladimir Putin, determined to end separatism, developed the "Chechenization" strategy of placing local allies of the Kremlin into power positions while isolating and destroying implacable oppositionists. After deciding on a local rebel clan as the best option to keep Chechnya within the Russian Federation, the Putin administration backed the former rebel, Ramzan Kadyrov, who succeeded his assassinated father, Mufti Akhmad Kadyrov, as Chechen president in 2007. Since 2001, the rebels have gradually been pushed out of the cities and towns of the steppe and piedmont in the north and center of Chechnya into the high mountains of the south and the war has devolved into a partisan-style conflict, with frequent attacks on Russian forces and their local allies (Derlugian 2003; Slider 2008).

A second type of conflict in the North Caucasus involves local ethnic groups disputing traditional territories. The most violent of these, in October 1992, was between Ingush and Ossetian militias contesting the Prigorodnyy *rayon* near Vladikavkaz (Figure 1), which had been shifted by Stalin to North Ossetia in 1944 after he deported all Ingush (and Chechens) to central Asia as punishment for their supposed support of the Nazi invaders. The district remains under the control of Ossetians but the dispute remains unsettled as thousands of Ingush remain as refugees in the adjoining republic of Ingushetia. The terrorist attack on the school in the North Ossetian town of Beslan in September 2004 was connected to this territorial dispute by both the attackers and the families of the students killed and injured (Ó Tuathail 2009). Less violent, but similar, territorial disputes resulting from Stalin's mass deportations remain unresolved in Dagestan (O'Loughlin, Kolossov, and Radvanyi 2007).

A third type of conflict is more amorphous and reflects the growing radicalization in the region, frequently taking on a religious form. Often, this militancy is a backlash against the rough and ineffective provocations of Russian military and police forces as they attempt to identify and arrest oppositionists in this most militarized region in the world (estimate from Dimitry Kozak, the former federal plenipotentiary in the region, quoted in Dunlop and Menon 2006; see also Evangelista 2005; Kramer 2005; Hahn 2008; Hassel 2008). This third type of conflict tends to have strongly local elements because the impact of religious radicalism is quite scattered in Dagestan, Kabardino–Balkaria, and Karachaevo–Cherkessia and more widespread in Ingushetia as a result of the intense connections of that republic to events in Chechnya. Lyall (2006) counted seventeen militant groups in the region, with many leaderships and aims unclear

Figure 1. Location map of the North Caucasus of Russia, with boundaries of the republics, their capitals, and key locations mentioned in the text.

but inspired by a combination of religious and ethnic goals. Individual communities such as Buinaksk and Gimry (Dagestan), Nal'chik (Kabardino–Balkaria), and Nazran (Ingushetia) have become known for frequent violent clashes between local militants and police and military detachments; this type of conflict is characterized mainly by assassinations and other attacks on political targets. It is difficult to parse political from criminal acts because, as is usual in war zones (Collier 2000), criminality and corruption flourish and what appears to be a political assassination might be motivated by a struggle for control of criminal assets (Moore 2008). The state has responded by supporting local interests who advocate regional, cultural, and religious traditions, including renewed emphasis on Sufist rituals (Malashenko 2008).

In an environment of great uncertainty about its political future and of widespread concern about economic prospects, especially among young men (Mendelson and Gerber 2006), the categorization of violent acts is often an uncertain enterprise. The overall situation in the North Caucasus was summarized by plenipotentiary Dimitry Kozak in 2005 as a systemic crisis caused by powerful clans monopolizing the economic and political power in the region. Kozak wrote that "In all North Caucasus republics, the leading positions in the organs of power and the largest economic entities are occupied by people who are related to one another" (quoted in Dunlop and Menon 2006, 106). Although interethnic violence has been rare, the fine balance of distribution of resources among the dozens of ethnicities in the region remains an ongoing concern, especially in Dagestan, the most diverse republic. Whereas the Putin administration makes frequent recourse to the moniker of Wahhabite fundamentalism to explain the causes of violence in the North Caucasus (Kynsh 2004), public opinion locally is more likely to attribute it to poor federal government actions and criminal activities (Kolossov and Ó Tuathail 2007).

The North Caucasus Violent Event Database, 1999–2007

Following in the tradition of disaggregating civil conflicts through the accumulation of information on individual incidents, we coded 14,177 violent events between 1 August 1999 and 31 August 2007 in the six ethnic republics (Chechnya, Ingushetia, Karachaevo–Cherkessia, Kabardino–Balkaria, Dagestan, and North Ossetia) and the adjoining large territory, Stavropol' *kray*, populated mostly by ethnic Russians. (Locations are identified in Figure 1.)

Unlike Lyall (2006), who collected information on 1,667 rebel attacks between 1999 and 2005, we coded all events that could be construed to be of a political character, using Lexis-Nexis as our primary source, with rebel Internet sites, Russian and foreign newspapers, and wire services consulted for specific details. Erring on the side of caution, we did not code killings or injuries that could conceivably be the result of common criminality; either the target or attacker had to have a clear political character, often identified through claims of responsibility—whether the victim was a political officeholder or location (e.g., police barracks). It is preferable to view the war as a collection of loosely connected insurgencies that unfold according to different republican-level logics (Lyall 2006). It is increasingly difficult to produce a completely binary classification of political and nonpolitical events, their admixture being a characteristic of new wars (Kaldor 1999). Like Lyall, we coded the target (federal, state, or local police; the varied types of Russian military forces; political figures; civilians; rebels or purported rebels; nongovernmental organizations; media outlets; infrastructures such as bridges, railway lines, and communications installations; border posts; governmental offices); actors (the claimants, or in many cases, those attributed as the attackers by the media source or the official press release and coded as police, military, or rebels); date; location—village, town/city, or specific point such as a crossroad that was geo-coded using place name or coordinate Web sites, Falling Rain's Directory of Towns and Cities in Russia (http://www.fallingrain.com/world/RS) and the Geonames database (http://geonames.nga.mil/ggmagaz/geonames4.asp) from the National Geospatial Agency; casualties (killed and injured—civilians, federal, local, or rebel forces); newspaper or other wire service source; and confirmation by other media reports. Although we geo-coded events as precisely as possible, locations could not be pinpointed for 3,560 events and these were allocated to the centroid of the *rayon* or cities in which they occurred.

Some data uncertainties limit the analysis. Estimates of casualties are often highly variable, with rebels claiming high numbers for their success in killing federal and allied troops, whereas government sources give much lower figures for the same event. Because these claims are often so contradictory, we do not use casualty figures in this article. We only divided battle events if there was a significant shift in the location or scale of the violence during the course of the fighting. Thus, the Beslan (North Ossetia) killings of September 2004 that resulted in the deaths of 336 civilians and rescuers and thirty-two terrorist hostage-takers was coded as one event, even though it stretched over three days. In our analyses, we used both recorded point data and areal data after aggregation to the respective *rayoni* and cities. Finally, all events were categorized as military actions, police actions, rebel actions, or arrests. These latter operations, called *zachistki* ("mopping-up" operations featuring mass arrests), often result from the sweeping of a village of young men by combined military and police forces after a nearby rebel action (Kramer 2005).

To understand the distribution of violence across the 143 *rayoni* and cities of the North Caucasus, we collected aggregate information from the 2002 Russian census, supplemented by population estimates for the geographic units of Chechnya and Ingushetia by the Danish Refugee council (Trier and Deniev 2000). (In the fog of war, the reliability of the census figures for these republics is highly questionable.) Ethnic figures and urban–rural populations are generally reliable, but we dispensed with measures of wealth due to reliability concerns. Land use/land cover data for the *rayoni* are derived from the University of Maryland's Global Land Cover Facility (http://glcf.umiacs.umd.edu/index.shtml). This land cover data set was created using Advanced Very High Resolution Radiometer (AVHRR) satellite data acquired between 1981 and 1994 using a decision tree classifier and finer resolution Landsat imagery (Hansen et al. 2000). For our aggregate analyses, the satellite data were downloaded and geo-referenced to the boundary files from ESRI (country borders) and the University of Washington Central Eurasian Atlas (oblasts and rayons; http://geo.lib.washington.edu/website/ceir/). To simplify the presentation of the land cover data, the original fourteen categories were reclassified and forest cover defined as evergreen needleleaf/broadleaf, deciduous needleleaf/broadleaf, mixed forest, and woodland where each has more than 40 percent canopy cover with trees exceeding 5 m in height (Hansen et al. 2000). The mean elevation data for *rayoni* and cities were calculated from the Shuttle Radar Topography Mission (SRTM) elevation data (nominal 90 m pixel resolution), available from http://seamless.usgs.gov/.

Descriptive Longitudinal and Geographic Distribution of Violence

Violence in the North Caucasus peaked in April 2001, about eighteen months after the second war began. Although there has been a reduction in overall violence, and in each of the four types of events (police, military, rebel, and arrest), a detectable seasonal

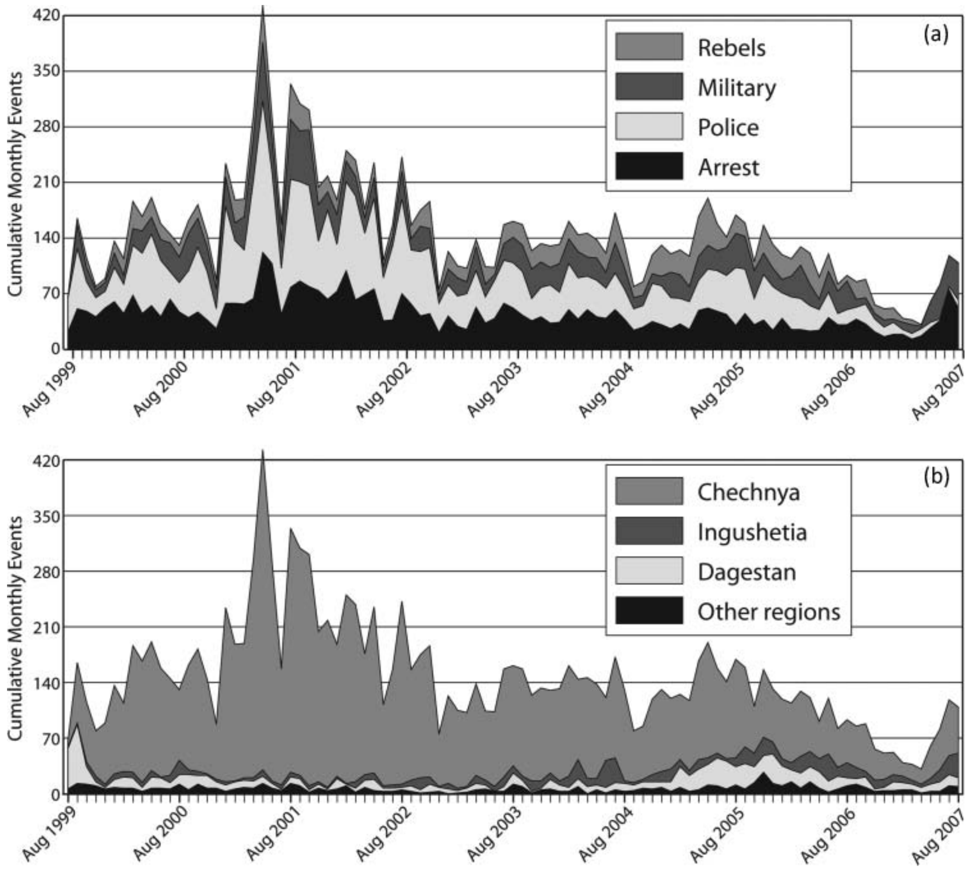

Figure 2. Monthly distribution of violent events in the North Caucasus, August 1999–August 2007, by (A) type of violence and (B) republic.

pattern of violence, with an upsurge in spring followed by a decline in late autumn, is evident in Figure 2A. After a fairly steady period of moderate violence between 2002 and 2006, the last eighteen months of the data series confirm a significant decline to spring 2007, followed by an upsurge in the last four months of the series. Much of the explanation for these trends relates to the Chechenization of the war and the switch of the former rebel Akhmad Kadyrov (and later his son, Ramzan) to the government side in 1999. Well-armed and well-financed, hundreds of rebels are estimated to have switched their support to the republican leadership (Kramer 2006; Ouvaroff 2008). Furthermore, the leadership of the Chechen rebels was devastated in 2005 and 2006, with the killing of key leaders including Aslan Maskhadov and Shamil Basayev. Although the active rebels are estimated to number no more than 1,000, they can still launch daily attacks despite Kremlin claims of stability (Smirnov 2007; Abdullaev 2008; "Interior Troops Commander Reports a Surge in Militant Activity" 2008).

By classifying the violent events by republic location in Figure 2B, we can clearly see the dominance of Chechnya (81 percent of all events) and the growing importance of Ingushetia toward the end of the series. Dagestan was more prominent early in the second Caucasus war because it started there in August 1999, and this republic suffered an upsurge in violence in 2005; Dagestan has been the site of 8 percent (1,151) of all events. Ingushetia accounts for 6.6 percent of all violence, a ratio that increased in the last few years of the data series as militant groups became more active in this small republic bordering Chechnya. Beyond these three republics, the other four regions (Stavropol' *kray*, North Ossetia, Kabardino–Balkaria, and Karachayevo–Cherkessia) collectively only accounted for 4 percent of events, but two of these were very violent, with hundreds of lives lost in a hostage-taking at a school (Beslan, September 2004) and attacks on military and police installations (Nal'chik, October 2005). Whereas violence dropped in the core region, it has proportionately grown in neighboring republics. Since 2004, violence in Chechnya has decreased from over 90 percent to nearly 50 percent of the total in the North Caucasus.

The event map of violence shows a concentration in Chechnya and bordering regions of the adjoining

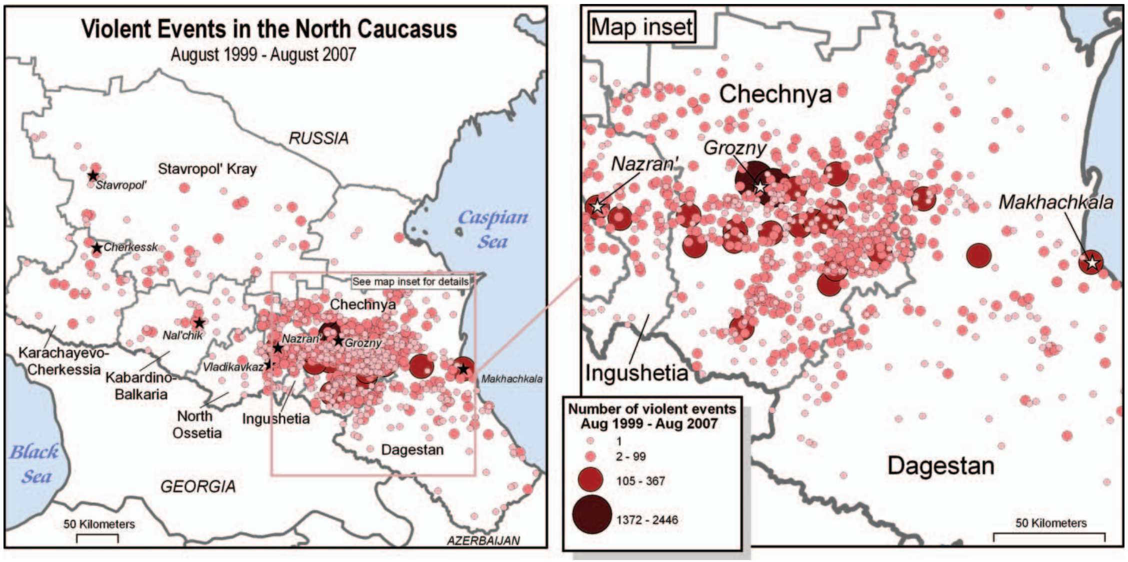

Figure 3. Geographic distribution of violent events in the North Caucasus, August 1999–August 2007. Circle size is proportional to number of events at each location.

republics, but also clearly indicates incidences of violence located hundreds of kilometers from Chechnya (Figure 3).

The main highway of the region, the Caucasian Federal Highway, can be generally picked out in Figure 3. Linking Makhachkala to Grozny and then west to Nazran, Nal'chik, and Mineral'nyy Vody before turning northwest toward Rostov-na-Donu (see Figure 1), its course is visible by the clusters of violence at its major towns and cities. A border effect is also evident for Chechnya due to rebel attacks on border posts. For the first eight years of the war, the federal authorities imposed a "ring of steel" on Chechnya to try to contain the violence; road, rail, transport, and oil links were diverted around the republic. The posts that marked this "ring of steel" thus became the targets of intense violence. Key places can also be picked out in the region of greatest violence: Grozny city with 2,446 events, Grozny *rayon* (county) around the city with 1,372 events, Makhachkala (Dagestan's capital) with 272 events, and cities in Chechnya (Vedeno, 173 events; Gudermes, 285 events; Shali, 238 events; Urus-Martan, 191 events). An animation by season of the violence (thirty-two map frames for eight years) is available for download from our Web site at http://www.colorado.edu/ibs/waroutcomes/maps/allEventsAnimation.avi.

The mountains in the south of the Chechen republic, with up to 63.3 events per 1,000 people over the eight years of the data, show the highest ratio of violence (Figure 4). The Buinaksky *rayon* in Dagestan and two in Ingushetia have higher intensities than two of the Chechen *rayoni*; only twenty-one of the 143 geographic units in the study area experienced no violent event. The sparsely populated steppes of northern Stavropol'-*kray* and the mountains of southern Dagestan are most peaceful.

Comparison of our statistics to other accounts of the Caucasian wars after 1999 suggests that our data are more comprehensive than those heretofore published. For the same time period as Lyall's (2006) study, we counted 3,735 rebel actions compared to his 1,667 for the same areal coverage. Although our data for casualties are not used in this article because the range is large due to rival claims, they are certainly much higher than the approximate 3,000 deaths for federal and local police and military given by Russian government sources (Kavkazskiy Uzel 2007; Mukhin 2007). "Memorial," a Russian human rights organization, counts more than 75,000 civilians killed in the two wars since 1994 (Kavkazskiy Uzel 2007).

Geo-Statistical Analysis of North Caucasus Violent Events

Using the geo-coordinates of the individual events, we examined the distribution for geographic–temporal trends and evidence of clusters of violence, checking the accuracy of the frequent claims by commentators (e.g., Peuch 2005; Kramer 2006; Smirnov 2007) that violence is diffusing from Chechnya. Most of the analyses of the point data were conducted in the Splancs

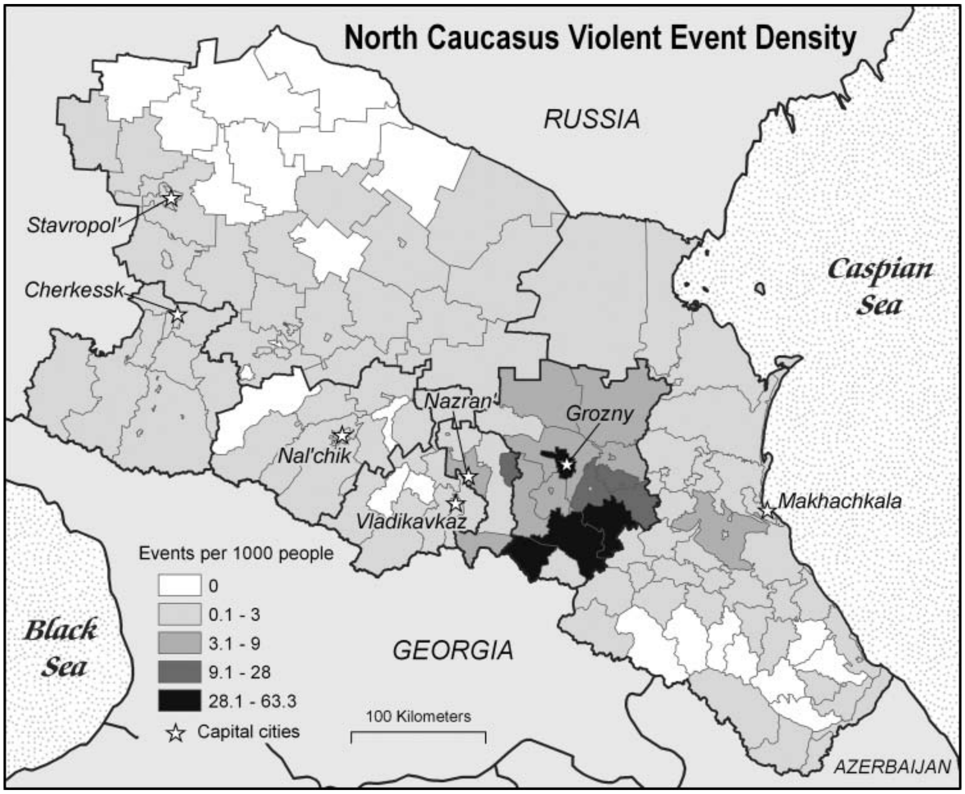

Figure 4. Geographic distribution of violent events per 1,000 people in the North Caucasus rayoni and cities, August 1999–August 2007.

package written for R (Rowlingson et al. 2007). A kernel density that effectively converts the point data on a grid so that intensity can be visualized is particularly effective.

Figure 5 shows the three-dimensional plot for space–time interactions in the conflict event data and indicates the basis for the cutoff of 5 km in our geostatistical analysis. The values are calculated from the equation

$$\hat{D}(h,t) = \hat{K}(h,t) - \hat{K}_S(h)\hat{K}_T(t)$$

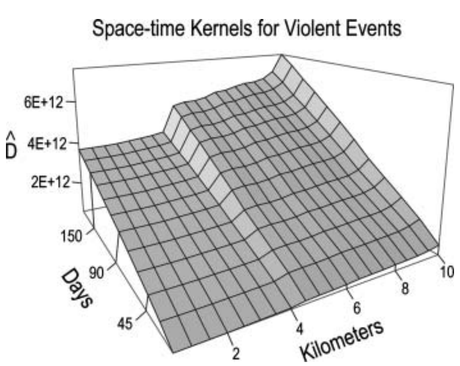

Figure 5. Time–space plot of violent events in the North Caucasus, August 1999–August 2007 (geo-located 14,177 events).

where $\hat{K}(h,t)$ is the estimate for the bivariate space–time K function defined as the expected number of events within distance h and time t of an arbitrary event (Bailey and Gattrell 1995; Diggle et al. 1995).

To assess whether there is any space–time interaction in the data, the estimates for the spatial K function, $\hat{K}_S(h)$, and temporal K function, $\hat{K}_T(t)$, are multiplied and subtracted from the combined space–time function. Raised values in the resulting plot indicate evidence of space–time interaction. Figure 5 shows little variation in the temporal dimension as $\hat{D}$ rises gradually, but a significant spike between 4 and 5 km indicates increased spatial dependence of the events at this distance. There is also a smaller rise at 10 km, beyond which (not shown) the plot resumes its steady rise. The extreme value of the observed statistic on the plot of the distribution of ninety-nine Monte Carlo simulations (not shown) provides further evidence of strong space–time interaction in the data. The low spatial threshold of 5 km points to the localized nature of violence in the region and the graph indicates that spatial autocorrelation has a more significant effect than the time dimension.

For each of the eight years in the study, we generated an intensity map, creating a smoothed version of the individual events in grid form (Figure 6). Using the

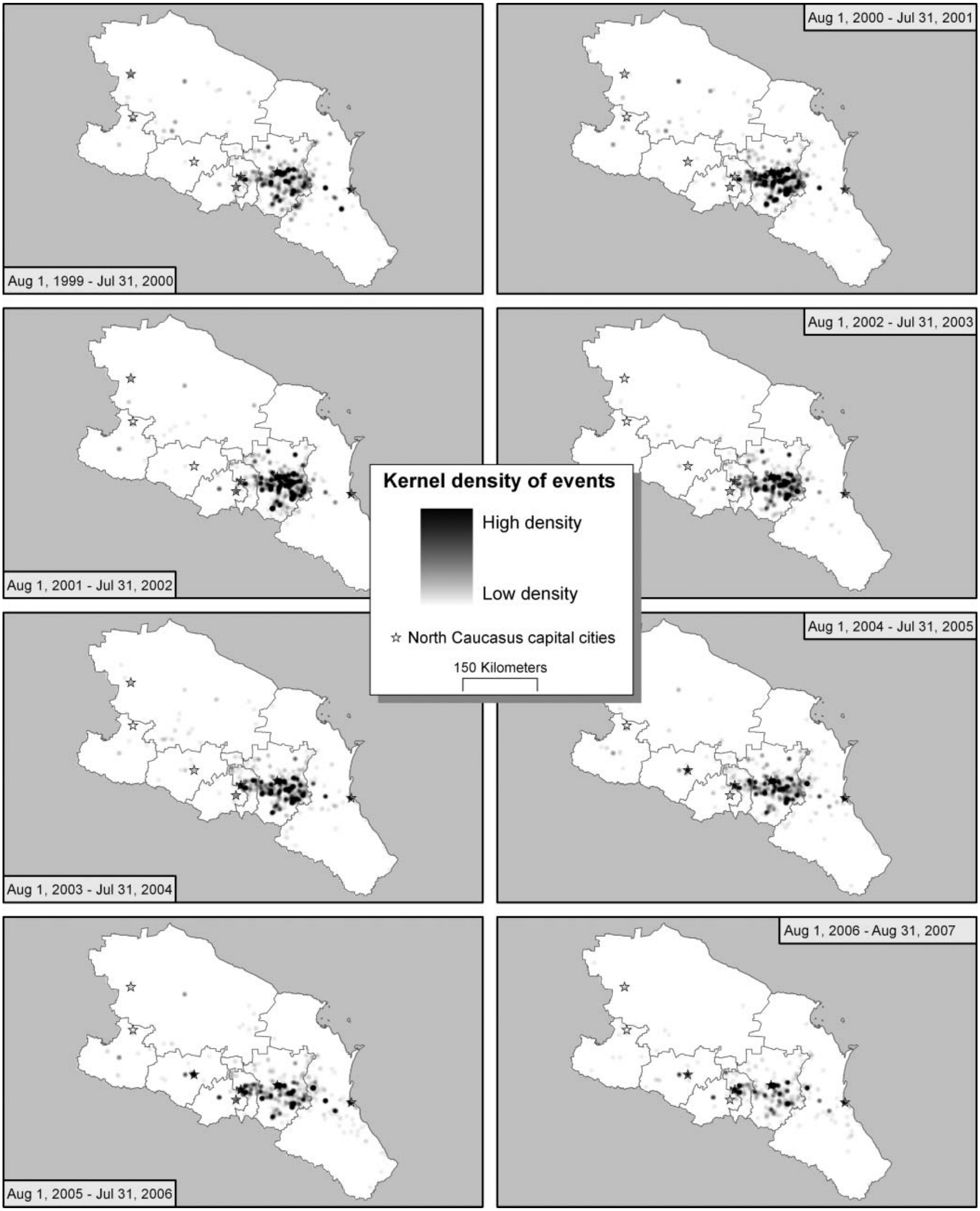

Figure 6. Kernel density of violent events in the North Caucasus, August 1999–August 2007 (geo-located 14,177 events).

spkernel2d function within Splancs, a kernel estimation is calculated for each grid cell by summing the weighted distances between the center of each grid cell and every event within a given bandwidth. For our analysis, a distance of 5 km was chosen on the basis of the K function results (see Figure 5). The weights for nearby events are determined by the quartic kernel such that events close to the grid cell center are weighted strongly and points near the edge of the bandwidth contribute little to the estimation; the larger the bandwidth, the smoother the resulting map. (For full details, see Bailey and Gattrell 1995, 84–88.)

The intensity maps for the eight years (August 1999–August 2007) show the clustering of events along the Caucasian Federal Highway in central Chechnya in all years (Figure 6). Points of higher density correspond to cities and major towns, and the same hot spots appear on multiple maps: Khasavyurt and Buinaksk in Dagestan, the major cities of Chechnya on the steppe and piedmont, and the capital cities of Nazran (Ingushetia) and Nal'chik (Kabardino–Balkaria). In the last three years of the study, a reduction in violence intensity is also noted.

The $\hat{D}$ function provides an indicator of overall space–time interaction at increasing spatio-temporal distances, but an alternate approach can be used to identify individual space–time clusters. For this, a scan statistic as implemented in the SaTScan software was calculated (Kulldorff 2007). Although geographers have frequently identified spatial clusters for specific time periods (a recent application of this methodology to identify crime clusters before and after a major bridge completion between Denmark and Sweden can be seen in Ceccato and Haining 2004), the use of both time and spatial measures is typically found in epidemiology (see the extensive bibliography in Kulldorff 2007; also see Kulldorff et al. 2005; Conley, Gahegan, and Macgill 2005). In particular, the space–time permutation scan statistic used here compares the observed number of events in a space–time cylinder to the expected number of events within specific area and time dimensions. Events are assumed to follow a Poisson distribution within a given cylinder with a base area that represents the spatial dimension and the height of which is the temporal dimension. For cylinders with observed to expected ratios greater than one, a likelihood ratio test is calculated and compared to a Monte Carlo generated distribution of test statistics to assess the significance of each potential cluster. This simulation approach has the advantage of eliminating problems associated with multiple testing and edge effects.[1]

For our analysis, we limited the search criteria to include cylinders with a maximum radius of 20 km and temporal length of three months (using a time aggregation unit of two days). Furthermore, to reduce duplicate clusters, no neighboring pairs of clusters could both have their centers within the radius of other clusters. To limit the impact of a temporal edge effect, a week's content of event data were included on either end of the twelve-month period. For example, the period from 1 August 2000 to 31 July 2001 was expanded to 24 July 2000 to 7 August 2001.

The eight yearly space–time maps in Figure 7 are focused on Chechnya because no significant clusters were found in the outer reaches of the North Caucasus study area. Most clusters are generated by the coincidence of violent events in the same place within a short period of time, although we mapped clusters up to thirty days in length. An example is the eight- to thirty-one-day cluster visible southeast of Nazran in Ingushetia for the 2002–2003 map. On 26 September 2002, a helicopter was shot down near Galashki with the loss of two lives. In the succeeding three weeks, federal forces launched attacks on rebel positions, made mass arrests, and engaged in significant battles with the rebels, with dozens killed on both sides. The database includes twenty-two events in the immediate vicinity of Galashki during this short time period.

In the first year of the war, the clusters are evident along the border between Chechnya and Dagestan, as Chechen rebels penetrated into their eastern neighbor in August 1999, triggering the war; the clusters are also evident in the cities of central Chechnya, which became sites of heavy fighting when the federal authorities attacked the rebel government in Grozny. Temporally longer but spatially reduced clusters are visible for later years on the Chechen–Ingush border, in and around Grozny, and in the mountains of southern Chechnya. As the war tended to take on a less urban character after the Russian military pushed the rebel government out of Grozny in February 2000, almost as many clusters are seen in Ingushetia as in Chechnya.

Major rebel attacks, as in Nazran in June 2004 and Nal'chik in October 2005, where the fighting was followed by *zachistki* (mass arrest) operations over many weeks, in turn generating further violence, are also visible. The last three years of the study have not seen many space–time clusters, as the overall level of violence had reduced drastically.

The descriptive account of the second Chechen war shows a decline in both the level of overall violence over time as well as a reduction in the spatial density

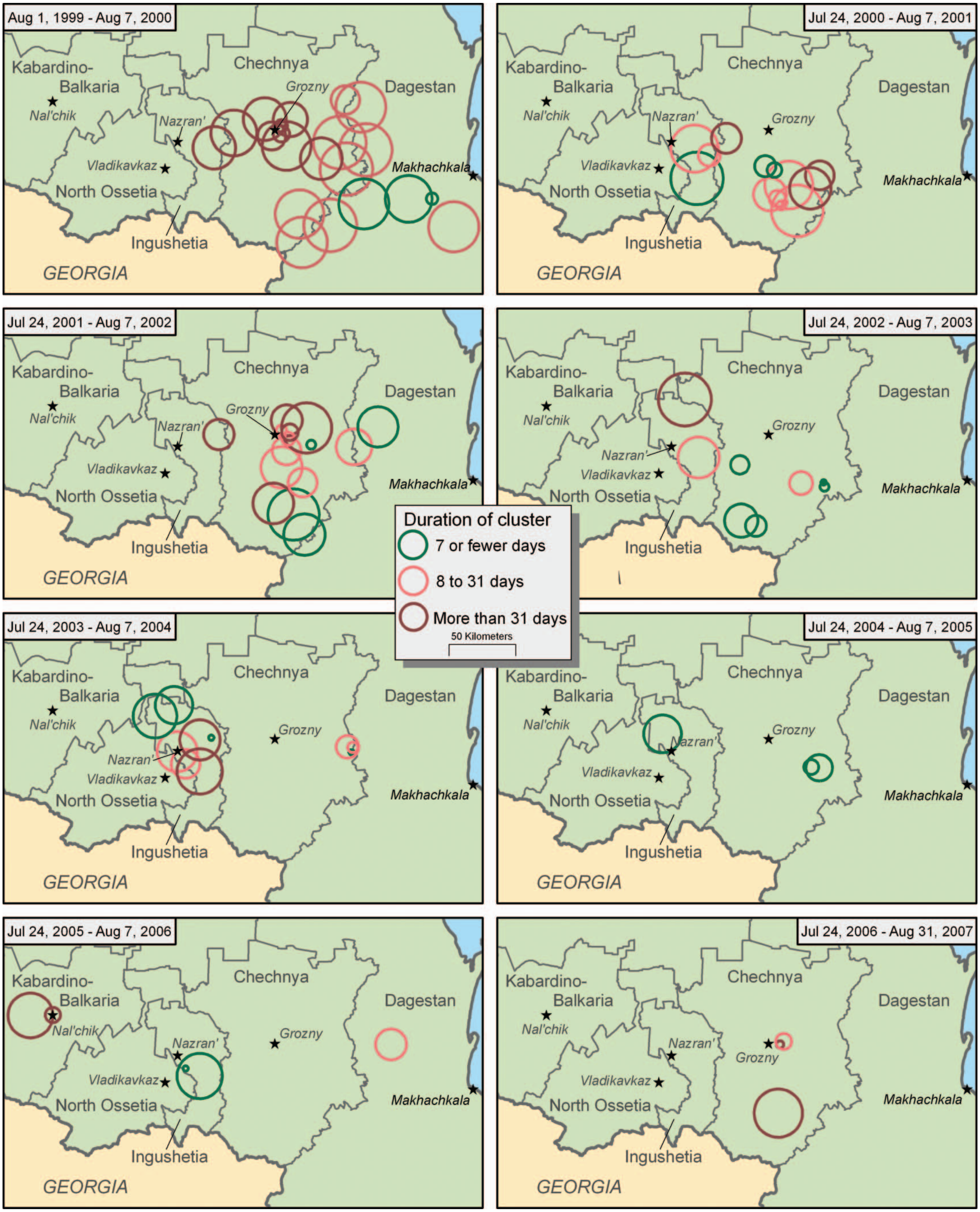

Figure 7. Significant space–time clusters of violent events in the North Caucasus by year, August 1999–August 2007.

and space–time clustering of conflict. At first blush, the arguments of Russian and Chechen government officials about the ending of significant violence in the region would seem to be supported, although the region remains highly militarized and politically unstable; however, as can be gleaned from the three maps for August 2004 through August 2007 (Figure 7), although Chechnya has experienced a dramatic drop in violence, adjoining regions have seen relatively more concentrations of conflict than in the period from 1999 to 2004. This trend suggests that the arguments of Russian and external observers that the conflict is spreading and changing its character also have credence. In the long term, a low-intensity conflict over a broader geographic area might be more destabilizing than a confined although more destructive war in one territory.

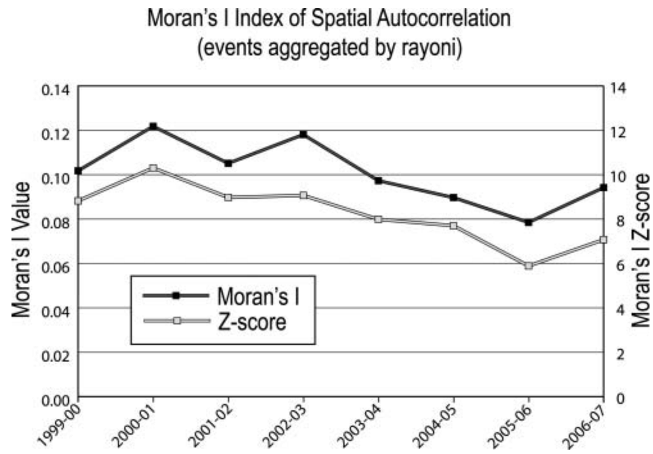

Figure 8. Spatial clustering of violent events in the North Caucasus, August 1999–August 2007, using Moran's I index by year. Z-score of 1.64 is significant at the .05 level, one-tailed test.

The Spread of Violence in the North Caucasus, 1999–2007

There have been numerous claims that a new style of conflict has emerged during the second Chechen war. As the rebels were pushed out of the more densely populated urban centers in central Chechnya and as the Russian military, with their *Kadyrovtsi* Chechen allies, have increased their control of major routes in the piedmont and steppes that constitute about two thirds of the republic, the conflict has proportionately become more manifest in the forested mountainous south and the adjoining parts of Dagestan and Ingushetia that offer protection to the rebels. An analysis of maps of rebel attacks between 1999 and 2005 claimed that "it is clear, however, that violence is spreading: war touched only eleven districts (*rayoni*) in 1999, principally in Chechnya and (briefly) Dagestan, but reached nineteen by 2003, twenty-five by 2004, and thirty-two in 2005" (Lyall 2006, 16). Other commentators (e.g., Kramer 2005; Smirnov 2007; Vatchagaev 2008) concurred with the specter of long-term hostilities in the poor North Caucasus bolstered by an increase in assassinations and politico-criminal activity. In Dagestan, violence is mostly caused by *jihadists*, not by interethnic tensions, and a tit-for-tat pattern has been produced by the special operations of the republic and federal security forces against Islamic militants (ICG 2008).

There are numerous options of geographic analytical methods used to check claims of spatio-temporal diffusion. We present two summary measures for each of the eight years of the study: (1) Moran's I index for the events aggregated to the *rayon*/city scale with the inverse of intercentroidal distances as the spatial weighting measure and (2) centrographic indicators of mean center and standard distance ellipses for the individual geo-located events. Whereas the Moran's I index has been used in studies of conflict (e.g., O'Loughlin and Anselin 1991; Raleigh 2007), centrographic methods have not been applied, possibly because of the absence of detailed geo-coded data.

The Moran's I measure and its associated Z-score plot in Figure 8 for the violence ratio (events per 1,000 inhabitants) over the eight years of the war shows significant spatial clustering in all years across the 143 *rayoni*/cities, with the peak clustering occurring in the second year as the fighting centered on control of Grozny and surrounding cities. After three years of declustering, the index shows an uptick in 2006 and 2007, as violence reconcentrated in the mountainous areas of south Chechnya (note the cluster in Figure 7 in this region). The trend in the index is consistent with a diffusion hypothesis, but because it is a global measure, more localized indicators are needed to document a diffusion of conflict process.

The maps of the standard deviational ellipses (calculated for both x and y dimensions and containing roughly 67 percent of observations) and the mean centers for the four types of conflict over eight years of the study are clearer expressions of the spatio-temporal trends for the 14,177 geo-located events in the database (Figures 9 and 10). Whereas the mean centers are grouped tightly just south of Grozny for all the distributions, the standard ellipses are more varied. Military actions against the rebels are concentrated within

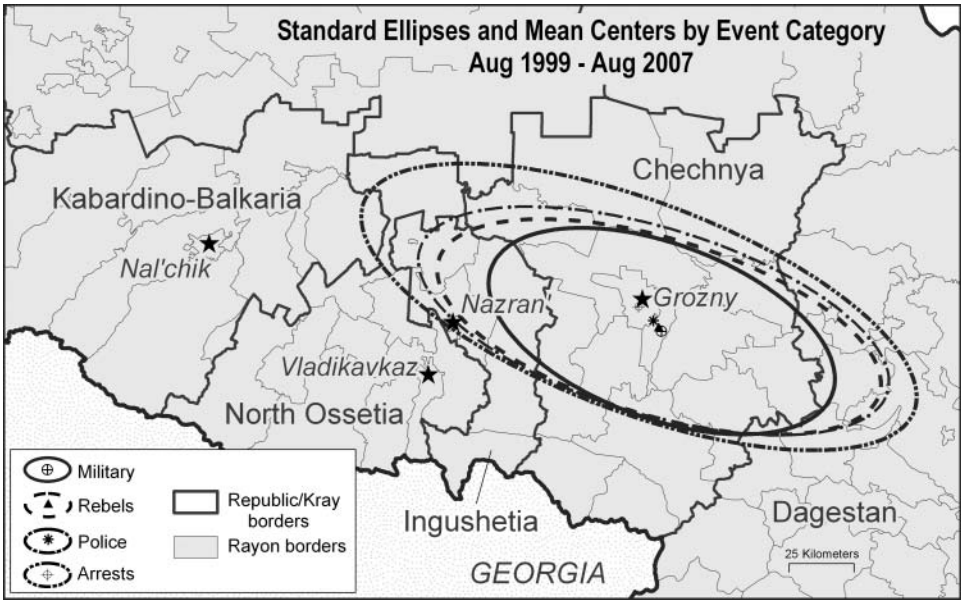

Figure 9. Mean centers and standard deviational ellipses of violent events in the North Caucasus, August 1999–August 2007, by type of event.

25–50 km of Grozny, whereas arrests (usually in *zachistki* by joint police and military units) show the greatest geographic dispersion (Figure 9). With mass arrests having a wider reach than the rebel or military actions, the ellipses provide another indicator of the broad sweep strategy of the authorities to try to capture rebels, militants, and their supporters (Human Rights Watch 2008); however, these arrests in turn generate bitter local resentment and further attacks on government officials and armed forces (Human Rights Center "Memorial" 2008). The primary orientation of the ellipses (northwest–southeast) generally follows the line of the Caucasian Federal Highway through the densest zones of violence from the mountains on the Chechen–Dagestan border through central Chechnya to northern Ingushetia.

The most dramatic evidence of spatial diffusion is visible in Figure 10, the standard deviational ellipses for each year for each type of violence. The same pattern of greater spatial extent for arrests is visible for all eight years, but an examination of the yearly plots for the arrests shows a shrinking ellipse over time. None of the other plots shows this trend; their shapes, ranges, and predominant axes show a great deal of consistency over the years. One interpretation of the arrest maps is that the authorities are becoming more spatially selective in their sweeps to concentrate on the areas of rebel activity. Excluding the ellipses for August 1999 through July 2000 and August 2000 through July 2001 from the plots would bring the ellipses for the arrests into conformity with the other distributions. In contrast to the arrest maps, the other distributions show indications of spread, especially in the last three years of the study. The ellipses now reach into North Ossetia to the west and to a point within 40 km of Makhachkala, the Dagestani capital on the Caspian Sea; the eastern and western extensions of the ellipses are about equal in length and stand in sharp contrast to the north–south elongation, which hardly changes over time.

The evidence in Figure 10 for the diffusion of the North Caucasian conflicts from the center in Chechnya is clear, although it is not as dramatic as might be gauged from the comments of military pundits and journalists. The reason for the lack of dramatic shifts on the maps is that the core of violence (rebel attacks, military, and police operations) is still in Chechnya's most densely populated region—especially the cities and military targets along the Caucasian Federal Highway. Even in the last months of the study, over half of all violent events still took place in the Chechen republic. Violence has spread, in the sense that places farther from Chechnya are now seeing violence more frequently; it is doubtful that these places will ever experience the intensity of conflict that marked the 1994–1996 war and the 1999–2002 period in the second war, as their violent events are generally guerrilla hit-and-run attacks on federal and republic installations and personnel and are followed by the inevitable arrests crackdown. Only a tiny minority of the populations of the North Caucasian republics want separation from Russia through formation

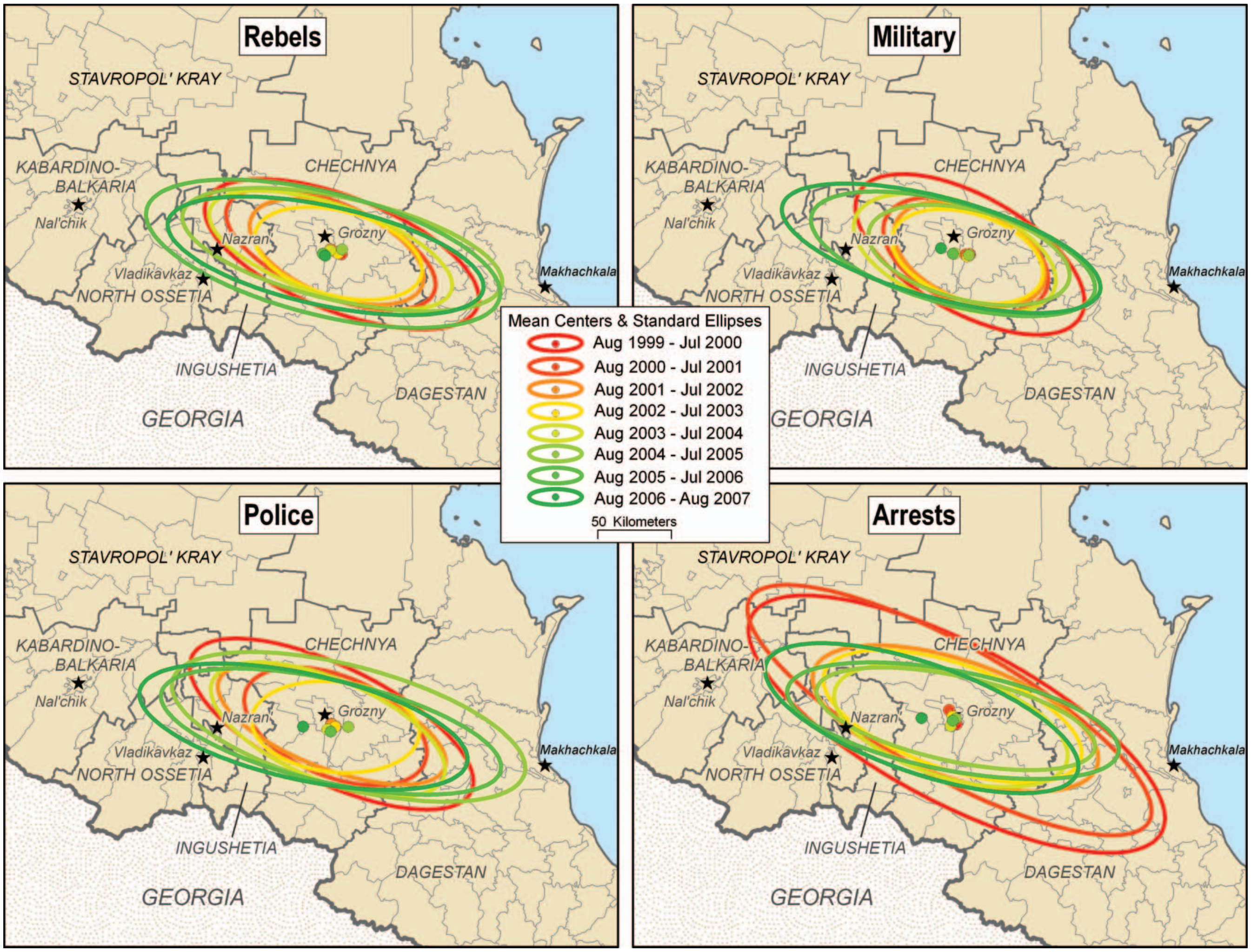

Figure 10. Mean centers and standard deviational ellipses of violent events in the North Caucasus, August 1999–August 2007, by year.

of a national homeland (O'Loughlin and Ó Tuathail 2009).

Explaining the Distribution of Violence in the North Caucasus, 1999–2007

Having presented evidence for the modest diffusion of violence from Chechnya during the course of the war that started in August 1999, we turn now to an explanation of the distribution of the violence. We summarize all violence as the rate of violent events per 1,000 persons in each *rayon* and city ($n = 143$) as mapped in Figure 3. Using GWR (Fotheringham, Brunsdon, and Charlton 2002; Charlton, Fotheringham, and Brunsdon 2003), we account for the distribution of violence using the aggregate characteristics of the *rayoni*/cities. Our choice of GWR is predicated on our interest in identifying localized correlates of violence and is in line with the advantages of a geographically disaggregated analysis promoted by Fotheringham (1997). War studies have been characterized for too long by generalized explanations of violence that emanate from the institutional lens that political scientists prefer; a complementary disaggregated geographic account examines place-to-place variations in the distributions of wars.

In his examination of the distribution of rebel attacks in the North Caucasus, Lyall (2006) introduced an explanation that combines the ethnic mix of an area with the level of popular support for rebel actions. He expected that the smaller a group's share of the conflict area population, the more restraint an insurgent organization will show while their actions are further curtailed by the number of competing organizations, the nature and type of counterinsurgency practices adopted by the Russian government and its local allies, and the intensity of popular support. Without reliable information on the size and ambition of the plethora of insurgent groups, it is very hard to examine these hypotheses and Lyall had to resort to a descriptive account for selected districts. Our study is more circumspect because, although our event data are numerous and more comprehensive, the correlates needed to understand rebel and state strategies are not available.

Although dozens of explanations have been proffered for the onset and duration of wars, the match of available information to the desiderata of predictive variables is poor for the analysis of violence distribution in the North Caucasus. We have measures of ethnicity, terrain, land cover, targets, and location in the Chechen Republic. In collecting data for analysis, we applied a natural log transformation for each of the 143 observations because of the skewed distribution of the dependent variable. The Russian census data for 2002 are not reliable for Chechnya and Ingushetia; instead, we substituted population data from the Danish Aid Agency and estimated the percentage of the population that is Russian, the majority population throughout the area (O'Loughlin, Kolossov, and Radvanyi 2007). Similarly, we have no reliable data on income distribution or inequalities that might offer a test of the grievance hypothesis, such as is available for Nepal and other states (Murshed 2002; Murshed and Gates 2005).

The targets for rebel actions are readily identified and include Grozny and the neighboring political and population centers and the vital transportation arteries, especially the Caucasian Federal Highway, known colloquially as the "highway of death" (Lyall 2006). The urban indicator was the percentage of urban land area for each *rayon*/city derived from the populated places polygons in the Digital Chart of the World. To calculate the mean distance to the Federal Caucasian Highway, we turned to the Digital Chart of the World (Danko 1992) road network (available from http:// data.geocomm.com/catalog/index.html); a distance-to-highway grid was then derived and an average distance value calculated for each district. Only the section of the highway from Makhachkala west was used for the calculation because the southern part of the highway does not serve the same military role.

We can revisit McColl's (1969) hypothesis about the importance of a secure base for rebels by calculating the mean elevation (meters) above sea level of the *rayoni*/cities. In his preliminary analysis of rebel attacks, Lyall (2006, 17) claimed that "simple visualization reveals that there is no clear relationship between difficult terrain and attack propensity." The expectation that difficult terrain can shelter rebels and invite government responses is now a standard feature of disaggregated studies of war and can be estimated in the GWR model. Similarly, forested areas are expected to offer cover for rebel actions and bases. Because Chechnya accounts for over four fifths of the cases in our data set and because the war's origins lie in the attempt of rebels in this republic to assert their independence, we added a dummy variable, location in Chechnya, to reduce the variance unexplained.

GWR analysis allows the heterogeneity of parameters in the prediction of the distribution of violence to be estimated and mapped. It relies on the assumption that locations nearer to the point where violence is estimated are more influential on the estimates than places farther removed. This method estimates a local regression model for each observation by weighting near neighbors more than far neighbors according to a spatial kernel. There are two main types of spatial kernels, adaptive and fixed. Adaptive kernels specify a set number of neighbors to include in each local regression estimate, whereas fixed kernels specify a set distance bandwidth around each observation. The drawback of the adaptive kernel method is that neighboring weights are a function of area/unit density. Since we preferred to weight neighbors uniformly based on distance, a fixed kernal was used. The distance bandwidth for the fixed kernel was chosen by minimizing the Akaike Information Criterion (AIC) using an iterative approach (Fotheringham, Brunsdon, and Charlton 2002). For our model, this step resulted in a fixed bandwidth of 78.19 km. This distance is large enough that most areal units will have enough neighbors included for estimating the model parameters. The weights for the local regression models are then calculated as

$$w_{ij} = \exp(-d_{ij}^2/78.19^2)$$

where d_{ij} is the distance between centroid i and centroid j. Given our bandwidth distance, this means that neighbors beyond about 100 km from the observation being estimated are weighted so that they add little contribution to the regression parameter estimates. The parameters for the global (not geographically weighted) and the GWR models are shown in Table 1.

Repeating the GWR analysis for each of the four types of violent events and for the cumulative total allows us to check the consistency of the predictive

Table 1. Parameter estimates for global and geographically weighted regression models of the distribution of violence in the North Caucasus, 1999–2007

	b value	*SE*	*t* value	Geographically weighted regression median value	*p* value (Monte Carlo test of spatial variation)
Rayon/city in Chechnya	3.568	0.397	8.989	3.605	0.08
Urban area percentage	0.009	0.007	1.263	0.011	0.64
Mean elevation	0.000	0.000	−1.611	0.000	0.13
Forest percentage	0.017	0.007	2.469	0.012	0.47
Mean distance to highway	−0.008	0.003	−2.623	−0.005	0.00
Russian population percentage	−0.016	0.004	−4.110	−0.009	0.00
Intercept	−1.468	0.293	−5.009	−1.826	0.02
Residual sum of squares		263.68		179.99	
Sigma		1.392		1.229	
Akaike Information Criterion		510.39		499.46	
Adjusted R^2		0.622		0.705	

factors. Only the model for arrests differed from the others. In this case, the predictive variable for forest cover was not significant, as it was in the other four models. Otherwise, the dependent variables show the same strength and direction of relationships and we report the results for the total events model in Table 1.

As is usual with GWR models, there is a significant improvement in the fit of the model compared to the global one. An improvement of 83.7 in the residual sum of squares estimates, a corresponding drop in the AIC and the adjusted R^2 value from .622 to .705 attests to the improvement. Of the six predictors, only two (distance to the Caucasian Federal Highway and Russian percentage) show significant spatial variation in its parameter estimate using a Monte Carlo test procedure. The ordinary least squares estimates for the global model generally follow the hypothesized relationship with the rate of violence. Location in Chechnya is highly significant as might be expected from the maps shown earlier, and the farther the *rayon*/city is from the Caucasian Federal Highway, the lower the rate of violence.

Similarly, the ratio of Russians in the population is negatively associated with the rate of violence. Mean elevation is not significant, nor is the urban ratio (Table 1). Contrary to Lyall (2006), the urban factor does not emerge as important when Chechen location and the distance to the main highway through the area, linking many of the major towns and cities, are taken into account. Finally, the forest cover measure is positively related to the level of violence in a *rayon*/city.

Estimates for the local parameters, as well as the estimated R^2 value, are mapped in Figure 11. Clearly, there is considerable heterogeneity on the maps, with much of the pattern related to the specific nature of the multiple conflicts that have started and developed in the past decade. The overall fit for the southwestern part of Stavropol' *kray* (the Mineral'nyy Vody tourist region), Kabardino–Balkaria, and part of Karachaevo–Cherkessia is poor (local R^2 value less than .422). This area has had a moderate level of violence and has both a strong Russian presence and a high urbanization ratio. The model shows the best fit (higher than .715) for the border area between Dagestan and Chechnya, including the capital cities (Makhachkala and Grozny, respectively) and the main towns along the Caucasian Federal Highway, and a coefficient of determination that is above the global average for other *rayoni* near Chechnya and for nearly all of Dagestan (Figure 11A). The model fit is better for high-violence locations than for regions with an absence of violence.

Interpreting the intercept value (not mapped) as an indicator of unexplained variance, the high local values for this estimate in the west of the study region (Stavropol' *kray* and the republic of Karachaevo–Cherkessia) reflect a lower overall level of violence. *Rayoni* with low levels of violence in southern Dagestan and Kabardino–Balkaria are evident on the map of the estimates of the Chechnya location predictor (Figure 11B), with the largest coefficient values found in the west of the study area and in southern Dagestan, both regions farthest from this republic. The

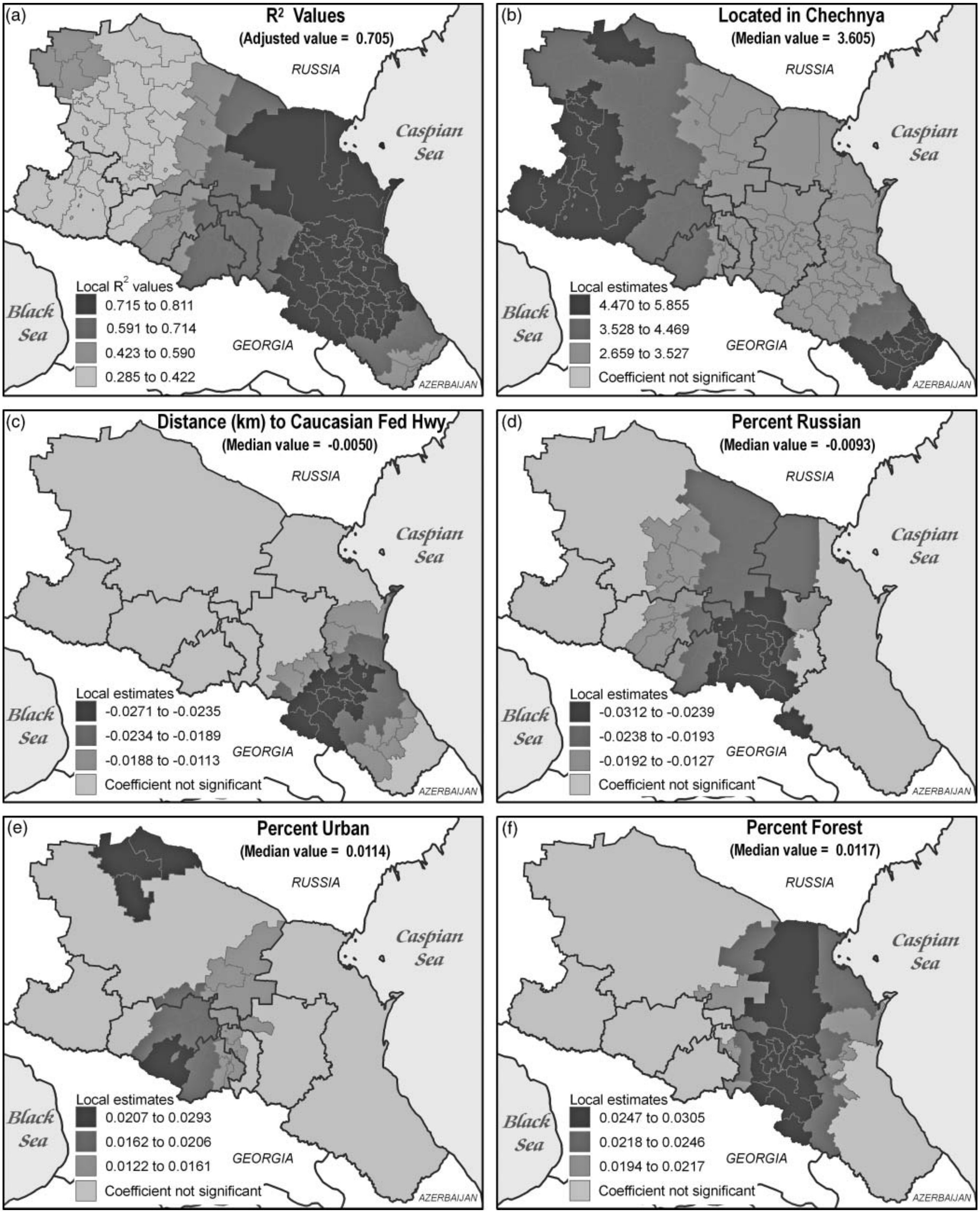

Figure 11. Distribution of coefficients for the geographically weighted regression model of violent events for the *rayoni*/cities in the North Caucasus, 1999–2007. Significance is defined as a t value of 1.68 for a one-tailed test ($df = 40$).

mountainous area along the Chechen–Dagestan border has the highest values for the distance to the federal highway predictor, a reflection of the embedded nature of rebel activity in this inaccessible terrain. Although not bisected by the main highway, it has seen consistent violence since the first month (August 1999) of the second Chechen war (Figure 11C). The areas of greatest increase in recent violence on the borders of Ingushetia, Chechnya, and North Ossetia are marked by high estimates for the Russian population percentage, which is low in these *rayoni* (Figure 11D). For the nonsignificant factor, urban percentage, the map shows only a few *rayoni* with significant coefficients (Figure 11E). The pattern of the forest cover coefficients (Figure 11F) emphasizes again the significance of this factor in Chechnya and western Dagestan (the high values of this coefficient in northern Dagestan could be an artifact of the few neighbors within the 78.19-km kernel for this *rayon*, although in this area of steppe, little violence would be expected). Finally, the pattern of the estimates for the insignificant predictors, mean elevation and urban percentage, show the most dispersed and idiosyncratic distributions.

The limitations of data access make the modeling of violence in the North Caucasus a challenging exercise. We have shown the strong influence of the Chechen locational factor, which, despite many predictions and assertions of war diffusion, still maintains its predominance. The importance of the main transport route in the region, the Federal Caucasian Highway, as both an infrastructural asset to federal and republican forces and as a rebel target, is also evident in our analysis. Violence is also found disproportionately in non-Russian locations, but despite recent press discussions and even rebel claims, such as on the main rebel Web site (http://www.kavkaztsentr.org), that higher elevations favor their activities, elevation does not appear to be a major factor in the war to date. It is true that the pattern of rebel attacks and government responses has shifted to the south and west over recent years, but the value of the high mountains to the rebels, as a refuge and a base from which to launch attacks, is not (yet) in line with McColl's (1969) expectations. The significance of the forest cover element, however, suggests the advantages to rebels of more difficult terrain. Having lost their main bases in the cities and the heavily populated *rayoni*, the rebels have adapted a different, guerrilla strategy but refrain from trying to maintain control of specific towns (Kramer 2005). Doing so invites massive governmental retaliation.

Conclusions

Our analysis has shown modest evidence of diffusion in the North Caucasian wars that is a result of the changing nature of the conflicts that have enveloped the region in the past nine years. With its origins in a separatist conflict that was bounded by the Chechen claims to their republic, the destabilization was exacerbated by the attack on Dagestan in August 1999 by Chechen rebels and by the nature of the response of the Russian security services. Over the past five years, the federal government has increased cooperation with local allies, has installed reliable officials in key public offices, and has increasingly relied on *zachistki* (mass arrest) operations to dampen the rebellion. The end result is that these tactics have now drawn all adjoining republics into the conflicts. Endemic poverty and poor employment prospects, coupled with a trend to join religious groups by many of the disaffected, has meant that the prospects for peace are no better now than a decade ago. In some ways, despite the reduction in casualties, the security situation is worse than ever, as the region has settled into (seemingly) permanent low-level hostilities between the power ministries and a myriad of oppositionists. A recent journalistic account concluded that Dagestan, not Chechnya, was now the most dangerous republic in Russia for visitors (Vatchagaev 2008).

Although we have gathered a large amount of information on the conflict, the event data are dependent on the sources that reported the events. The claims of government and rebels are so contradictory that reliable information is a particularly scarce commodity in the North Caucasus because of Russian control of information and the dangers to journalists from all sides, reflected in the murder of prominent reporters like Anna Politkovskaya in 2006. International agencies have great difficulty in serving the refugees and other war casualties; the United Nations High Commission for Refugees and other UN agencies withdrew from Nazran, Ingushetia, in April 2007 due to a rocket attack on their offices.

To attempt to mitigate the potential inaccuracies of the reports, we resorted to different sources that noted the violent events, avoiding the use of weights to scale their severity. This approach obviously understates the importance of some events, such as the bloody end to the school hostage-taking in September 2004 in Beslan. The cumulative effect of local events of varying severity also has important repercussions for the tit-for-tat nature of the violence and the difficulty of finding solutions.

In coding and organizing the data for the spatial analysis, we chose to adopt a two-track approach, by analyzing both point and areal (density rate) events data. Each has drawbacks and advantages, but we were able to indicate the replicative nature of the analyses—both types of data demonstrate clear, although modest, evidence for diffusion of violence from the central Chechnya core area surrounding Grozny. Our GWR analysis showed the importance of the main transportation artery and the targets in Chechnya in explaining the distribution of violence. Lack of data for predictive variables (especially level of material wealth) do not allow an effective test of the "greed versus grievance" explanation that has dominated the quantitative study of civil wars.

McColl's (1967, 1969) articles at the time of the Vietnam war were filled with "counterinsurgency" language and tactics and produced a geography of rebellion that started from Mao Zedong's principles for guerrillas. Central to these tactics was the strategy of building bases, in defensive sites that were accessible to targets, and McColl showed how difficult it was to destroy the hideouts once they were established. Although the technology of war and the nature of war (fewer international conflicts) have changed in the past half century, the interest in geographically tracking the details of violence remains as prominent as ever. Modern technologies, especially GIS and associated spatial analytical techniques, allow a sophistication of analysis that descriptive accounts like McColl's could hardly imagine. Although we have confined ourselves in this article to mapping and analyzing spatial distributions of violence, our data lend themselves to use in forecasting and extrapolation models, ascertaining the precise nature of spatial diffusion (contagious, hierarchical, relocation), comparison of the geographic tactics and targeting of specific rebel groups and governmental agencies, examination of the influence of environmental factors (weather, terrain, land cover), and temporal developments in rebel and government actions as causes of, and response to, political changes. Spatial-analytical approaches have been applied to a diversity of environmental and social topics, the recently available large, disaggregated data sets on political violence now parallel data on criminal activities (location of offenses, homes of offenders, etc.), epidemiology (disease occurrences), and geological distributions (e.g., petroleum) and demand similar mapping and analysis.

Acknowledgments

The authors thank the National Science Foundation's Human and Social Dynamics program (Grant No. 0433927) for the financial support that made possible both the cooperative field work in the North Caucasus in 2005 through 2007 and the events data collection. Gearóid Ó Tuathail and Vladimir Kolossov again proved to be inestimable colleagues in the larger project on war outcomes in Bosnia and the North Caucasus and continue to offer invigorating comradeship during the field excursions. Sitora Rashidova, Yana Raycheva, Mary Robinson, and Evan O'Loughlin painstakingly coded and geo-located the events data over many long months. Nancy Thorwardson of Computing and Research Services at the Institute of Behavioral Science, University of Colorado, prepared the figures for publication with her exemplary skill, punctuality, humor, and élan and cast her editorial cold eye over earlier versions of the article. The article also benefited from the comments and questions of colleagues at the 2007 Conference of Irish Geographers in Dublin, Dartmouth College's Geography Department, Kennan Institute at the Woodrow Wilson International Center for Scholars, and the April 2008 Boston meeting of the Association of American Geographers. Thanks also to *Annals* editor Audrey Kobayashi for her editorial work. Any remaining errors are ours.

Notes

1. To assess whether the observations within each cylinder form a cluster, they are compared against the expected number of events with the given area and time period. Using the Kulldorff et al. (2005) method, for each spatial location, *s*, and each time unit, *t*, an expected number of violent events is calculated:

$$E[c_{st}] = \frac{1}{C}\left(\sum_{s} c_{st}\right)\left(\sum_{t} c_{st}\right)$$

where c_{st} is the observed number of events cases at the given spatial location during t and C is the total number of observed violent events. From these individual calculations, the expected number of events within a given cylinder, A, can be calculated by the following summation:

$$E[c_A] = \sum_{(s,t)\in A} E[c_{st}]$$

For each cylinder, the observed to expected ratio, ODE $= c_A/E[c_A]$, is calculated, and for each cylinder with an ODE > 1, the Poisson generalized likelihood ratio measure is

$$\left(\frac{c_A}{E[c_A]}\right)^{c_A}\left(\frac{C-c_A}{C-E[c_A]}\right)^{C-c_A}$$

where c_A is the observed number of events in the cylinder.

To evaluate the statistical significance of the cluster, a Monte Carlo method is used to generate 999 random permutations of the data for which the likelihood ratio statistic is calculated. A p value is then calculated by comparing the rank of the test statistic generated from the real data, R, against the 999 simulated values, $p = R/(999 + 1)$.

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