Critical GIS as a tool for social transformation

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Key Messages

- Critical GIS opens a pragmatic plane of action by fusing progressive geographic imaginations with concrete and tangible maps.
- GIS can produce new cartographies of spaces of possibility from which geographies of hope and care can expand.
- Critical GIS scholarship can contribute to social transformation by, for example, creating cartographies of solidarity economy and being part of critical pedagogy.

When Critical GIS emerged in the 1990s and gained momentum in the 2000s, its potential for enabling progressive social change generated considerable excitement. By combining the powers of mapping, information technologies, and critical social theory, it promised new possibilities for acting upon the growing social contradictions of the neoliberal era. Critical GIS seemed to open a pragmatic plane of action by fusing progressive geographic imaginations with concrete and tangible maps. As I reflect on the state of critical GIS in the middle of the second decade of the 21st century, new configurations of class power, patriarchy, and racism are rapidly reshaping our social and geopolitical worlds and are precipitating environmental destruction. Yet, I attempt to develop the idea that GIS is a tool for social transformation because it can produce new cartographies and spaces of possibility and build and expand geographies of hope and care that change social imaginaries in favour of non-hierarchical class, gender, and race relations. In short, critical GIS scholarship both engages ongoing progressive politics and can create new possibilities for change. In particular, I examine two interventions of critical GIS: creating cartographies of solidarity and teaching.

Keywords: Critical GIS, solidarity economy, teaching, diverse economies, post-capitalist politics

La science de l'information géographique critique comme outil de transformation sociale

Lorsque la science de l'information géographique critique est apparue durant les années 1990 et a gagné en popularité au cours des années 2000, son potentiel pour un changement social progressif a suscité un enthousiasme considérable. En combinant les potentiels de la cartographie, des technologies de l'information et de la théorie sociale critique, elle a ouvert de nouvelles possibilités de tirer parti des contradictions sociales croissantes de l'ère néolibérale. Elle a semblé ouvrir un plan d'action pragmatique en fusionnant des vues géographiques progressives avec des cartes concrètes et tangibles. Alors que je réfléchis à l'état de la science de l'information géographique critique au milieu de la deuxième décennie du 21^{e} siècle, de nouvelles configurations du pouvoir des classes, du patriarcat et du racisme redéfinissent rapidement notre monde géopolitique et social et précipitent le déclin environnemental. Pourtant, je tente de développer l'idée que les SIG sont un outil de transformation sociale parce qu'il peut produire de nouvelles cartographies et de nouveaux espaces de possibilités et bâtir et étendre des géographies de l'espoir et de la bienveillance qui changent l'imaginaire social au profit de relations de classes, de genres et de races non hiérarchiques. Bref, le cursus d'études en science de l'information géographique critique implique des politiques progressistes et

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peut également créer de nouvelles possibilités pour le changement. J'ai examiné plus particulièrement deux interventions : la création de cartographies de solidarité et pédagogiques.

Mots clés : SIG critique, économie solidaire, enseignement, économies diversifiées, politiques postcapitalistes

Introduction

When critical GIS emerged in the 1990s and gained momentum in the 2000s, its potential for enabling progressive social change generated considerable excitement. By combining the powers of mapping, information technologies, and critical social theory, it promised new possibilities for acting upon the growing social contradictions of the neoliberal era. Critical GIS seemed to open a pragmatic plane of action by fusing progressive geographic imaginations with concrete and tangible maps.

Critical GIS has produced a vibrant body of scholarship, as exemplified by many journal articles and several books on the topic (e.g., Pickles 1995; Schuurman 2004; Cope and Elwood 2009; Crampton 2010). Topics in GIS and society are now taught as academic subjects at several universities and gather growing attention from graduate and undergraduate students. Mapping projects inspired by critical GIS scholarship take place across the globe where they assist communities engaged in struggles over their resources, territories, and place as well as over representation in social imaginaries.

As I reflect on the state of critical GIS in the middle of the second decade of the 21st century, new configurations of class power, patriarchy, and racism are rapidly reshaping our social and geopolitical worlds and are precipitating environmental destruction. Old struggles and alliances are falling apart and new alliances and struggles are emerging. What can critical GIS contribute to progressive social transformation when the world is being reconfigured by deepening economic inequality and a diminishing stability of livelihoods? How can it intervene in the new geographies that are taking shape within the context of terrorism and the war on terror, refugee and migrant crises, increased state violence, blind environmental destruction, violence against women and children, insecurity amidst mass surveillance, police brutality, assaults on racial minorities and indigenous people's rights? What can critical GIS do when powerful elected officials appear to only represent, and even celebrate, the power of the 1% while positioning sexism, racism, homophobia, and ignorance as values to admire? The rise of the political right after the 2016 presidential election in the United States (US) puts progressive projects on the brink and reconfigures politics from furthering the change to defending current boundaries. Yet, the projects that build geographies of hope still take place and continue to change the world under the direst of circumstances.

In this essay, I attempt to develop the idea that GIS is a tool for social transformation. Geographic Information Science today is not only an important domain of knowledge, technology, and cartographic practice with complex and contradictory social effects, it also actively produces new cartographies and spaces of possibility. Indeed, it can work to build and expand geographies of hope and care (Lawson 2007a, 2007b, 2009; Healy 2008; Raghuram 2012; Raghuram et al. 2009; Peck et al. 2014) that change social imaginaries in favour of non-hierarchical class, gender, and race relations. In short, critical GIS scholarship engages ongoing progressive politics and can create new possibilities for change. In the remainder of the paper, I will examine the potential of critical GIS to advance social transformation as it pertains to technological innovation, social critique, and production and enactment of progressive social imaginaries. I will then discuss two interventions from my own work: creating cartographies of solidarity and teaching. While they speak to various aspects of the transformative potential of critical GIS, I will primarily relate them to the urgent and the least researched task of creating social imaginaries necessary for preventing the unfolding conservative social contexts from eclipsing hope.

In which ways is Critical GIS critical?

It would be useful to first reflect on what it means to practice Critical GIS as opposed to other types of GIS-based research. Since its origins in the 1990, critical GIS scholars keep redefining their agendas in response to the fast-changing field of GIS, evolving neoliberal economy and governance, and new ways in which geospatial technologies are deployed to

resist the new frontiers of marginalization, exploitation, and exclusion (see Wilson 2015; Thatcher, Bergmann, Ricker, et al. 2016; Pavlovskaya 2017b). Previously, I suggested that critical GIS could question the status quo in three ways (Pavlovskaya 2009): by challenging the status quo of technology, by challenging the status quo of social power, and by creating spaces of possibility. It is exciting to see that critical GIS research has made strides in all three of these directions.

Technological innovation and the shift to digital mapping

Pushing the limits of technology expands the knowledge domains of GIS and the ways we can represent people and places. Critical GIS also engages social theoretical critiques of representation and space with regard to new spatial technologies. In particular, critical GIS is attentive to the problematic of an "epistemology of the grid" (Dixon and Jones 1998), and seeks new, non-Cartesian, ways to represent space in order to embrace processes, phenomena, experiences, events, and ideas that absolute space fails to account for. Pushing the technological bounds of GIS invites its fusion with different kinds of communication and internet-based and mobile technologies, and also opens GIS to those forms of geographic knowledge that do not fit well with the epistemologies of spatial science. As a result, new ways to visualize and analyze spatial information become possible. The contributors to this issue, among others, have done groundbreaking work in this direction. It includes, for example, the "new spatialities" proposed by Luke Bergmann (2017), ways to "queer" GIScience offered by Jack Gieseking (2015), as well as framing the advent of code as a component of flexible GIS by Renee Sieber (2016). This work is continuous with the feminist and qualitative GIS that earlier sought to incorporate non-quantifiable human experiences and ways of thinking into GIS (Kwan 2002, 2007; McLafferty 2002; Schuurman and Pratt 2002; Cope and Elwood 2009; Pavlovskaya 2017b).

The political economy and social practice of geospatial technology have profoundly changed in the last two decades. In the 1990s and 2000s, GIS was solidly in the hands of corporations and the state and, to a large degree, served their interests (e.g., marketing, urban planning, census, industry, military, and similar applications). The state of GIS was, perhaps, epitomized by a desktop GIS, a corporate software package with comprehensive spatial analytical functionality that ran on personal computers and required considerable levels of technical expertise. Making the technology available to the public and communities has been a serious challenge (Lake 1993; Elwood 2008; Haklay 2013). In addition to corporate training sessions, universities across the US began providing technical expertise as part of their academic programs. Teaching GIS soon evolved into teaching particular software products and the spatial logics built into this software (St. Martin and Wing 2007).

In the last decade, however, the field of GIS took a surprising turn. GIS functionality has quickly decentralized and is represented today by many kinds of geospatial technologies and applications, many of which rely on Geoweb, mobile computing, and advanced visualization. New tools for geographic visualization and analysis are often open source and free or easily affordable. Desktop GIS no longer solely dominates research or applications. In comparison, the new geospatial tools now more often exist as programs with a smaller scope of discrete functions or routines tailored to specific mapping and analytical needs, such as the internet-based Carto (until recently CartoDB) or different plugins for QGIS, itself a desktop but free and open source package. The freely available geospatial tools (like components of the code in R or parts of Google Earth, for example) can be embedded in customized scripts that might then drive a web-based application, and so on. While using these tools still requires geographic thinking and knowledge of techniques in spatial analysis, advanced learning of a particular software or even data structure is no longer the only option to become an expert mapper. The rapid movement away from desktop GIS and toward internet-based and open source digital mapping is opening new virtual territories to be mapped, is creating new spatial imaginations, and is generating new types of geographic information. Furthermore, new, non-expert communities have been forming around grass-roots mapping projects and such decentralization has contributed, although not without considerable contradictions, to the democratization of spatial knowledge production (Crampton and Krygier 2005).

For example, "596acres" project in New York City aims "to build more just and equitable cities" through "resident stewardship of land" (596acres

2016). It began in 2011 as an online mapping project that visualized the vacant lots (the number refers to their combined area) in order to encourage nearby residents to convert them to community gardens. A cutting-edge innovation at the time, the dynamic map reflects the different stages of conversion of each community garden and provides information about how to start the process and where to get logistical and legal help. As the project became well-known, the content of the website has expanded from Brooklyn to all of New York City and now includes other resources. Using the latest geospatial tools and being inextricably linked to the internet, 596acres exemplifies how new technologies for mapping and visualization can become tools for organizing and change.

Revealing spatial configurations of power

The second way in which GIS can do critical work is by participating in human geography projects that interrogate geographies of class, race, gender and state oppression, post-colonial power differentials, and environmental injustice and destruction. Here, critical GIS can advance the explanation of how spatial inequalities are produced and maintained (Pavlovskaya 2006). Such practices emerged from and were inspired by early critiques of GIS which go back to the 1995 book *Ground truth*, edited by John Pickles (1995). Chapters in this seminal volume compellingly exposed the role of GIS in furthering corporate and state control over society, and military intervention. Critical GIS continues this tradition of critique by drawing on emancipatory epistemologies of feminism, post-structuralism, Marxism, and critical race theory. For example, critical GIS reveals newly emerging spatial configurations of power manifested in big data, military intelligence, drone wars, and spatial surveillance (Gregory 2010; Kitchin 2014; Crampton et al. 2014). It examines how geospatial information and tools change domains of political governance (Wilson 2011), as well as traces digital practices of resi stance including advocacy for indigenous resource use rights (Palmer 2009; Dalton et al. 2016).

Moreover, because of the wide use of geospatial technologies by new generations of activists resisting the conservative realignments of power, mapping projects have become a vehicle for organizing against the assault of the neoliberal economy, neoliberal urbanism, and neoliberal policy. The first "Resistance GIS" conference held in Portland State University in May 2017 (https://resistancegis.wordpress.com/) featured such projects—for example, the Anti-Eviction Mapping Project (AEMP; https://www.antievictionmap.com/). AEMP has a multi-media story-telling website that documents the resistance to displacement caused by gentrification in the San Francisco Bay area. In particular, "through digital maps, oral history work, film, murals, and community events, the project renders connections between the nodes and effects of new entanglements of global capital, real estate, high tech, and political economy" (AEMP, n.d.). The project directly traces its epistemologies to "anti-racist and feminist analyses as well as decolonial methodology" and through the broadly understood process of digital mapping and narration creates tools and disseminates data that contribute to "collective resistance and movement building" (AEMP, n.d.). In the critical GIS spirit, the project uses new geospatial technologies to combine visualization of displacement and struggles against it with critical analysis of the new rounds of political economy, neoliberal urban restructuring, and racial capitalism. It is clear that the blending of mapping with geospatial tools on the internet and in social media opens new opportunities for social movements and mobilization. Critical GIS scholars should continue to highlight such progressive struggles, but also to critically examine how geospatial technologies may facilitate the ongoing conservative consolidation and mobilization (e.g., the alt-right movement).

It is important to note that conservative GIS practices have also evolved in relation to the reconfigured social relations of the neoliberal era. In particular, the instrumentalist leanings of technological innovation, the ongoing commercialization of GIS, and the growing identification of geospatial technologies with the entirety of geographic knowledge, all pose challenges to progressive GIS practices. I will briefly discuss these developments below.

Instrumentalist bent. While moving beyond the technical bounds of GIS makes room for new forms of digital spatial knowledge, the uncritical valuation of GIS and related geospatial tools also grows. As the scope of spatial data and opportunities for its analysis increase, so does a faith in GIS to solve social and environmental issues. Our fascination with new digital frontiers, big data, new forms of

spatial information, and practices for its creation (e.g., neogeography, crowdsourcing, mobile computing, movement tracking, social media, and so on) leads us to treat technological possibilities as an end in itself. For example, should the visualization of crowd-sourced data (e.g. FourSquare, Twitter, or Uber), as interesting as it is, be a substitute for a critical analysis of the same data and its spatial distribution? In other words, the attractive instrumentality of GIS enables a situation where algorithms and enticing visualizations overshadow the nature of the knowledge they produce. Critical GIS must continue to interrogate the consequences of the instrumentalist bent for geographic knowledge production, especially within the new domain of "big data analytics."

Geoweb as a capitalist and surveillance space. Another growing concern is that the Geoweb (including social media and mobile technologies), which has been largely perceived as a space of democratic interaction and emancipatory mapping, is rapidly being turned into a space of capitalist production. It has been taken over by, and acts as a tool for, primarily commercial interests; as it facilitates the delivery of commodities, it also works to gather information, market and advertise, and, indeed, manufacture "big data" (Kitchin 2014). It appropriates free labour from website users and turns knowledge into commercial products (Leszczynski 2012; Thatcher, O'Sullivan, and Mahmoudi 2016). It has also become a space of political and commercially driven surveillance (Haklay 2013; Leszczynski and Elwood 2015). In fact, corporations and the state are only expanding their use of digital geospatial information, thus enhancing and reconfiguring their power.

Cannibalization of geography by "GIS imperialism." Finally, geography as a discipline is increasingly equated with GIS by some geographers, students, and the public. In this sense, the dream of Stan Openshaw (1991) for GIS to put back together the broken fragmented discipline of geography has come true to a large extent. The attraction of geospatial technologies often overshadows the significance of academic geography in university education. GIS is no longer seen as an intellectual product of geography and cartography; it is perceived as a thing in itself and autonomous from geographic thought. The geospatial industry prizes technical expertise above geographic thinking and this undermines the need for geographic education, per se. GIS indeed stands in for the discipline of geography in many (although not all) university settings, and in some cases, it is GIS that keeps geography departments on the university map. Seeing their majors decline and resources being taken away, geography departments are enlarging their GIS programs and adding fee-based ones, hoping for larger enrollments and greater self-sufficiency. Kevin St. Martin and John Wing (2007) described this process as "GIS imperialism" and warned us of consequences of the "disciplining" of geography by GIS.

In short, the growth of GIS in general is certainly a welcome development, yet there is a danger that the uncritical support for the instrumental capabilities of geospatial technologies may turn a blind eye to the importance of geographic knowledge more generally. The focus on technology itself also disregards the configurations of social power that shape the technology and its mapping practices. Considering GIS outside this context of power may strengthen its role in conservative social projects and stifle the construction of progressive geographies. Thus, critical GIS scholarship should maintain its sharp focus on the ongoing neoliberal social and economic change and its alignments with the newest developments within geospatial technologies.

Constructing geographies of care and hope

In addition to pushing the technological bounds and continuing critique of spatial configurations of power, the third way in which GIS contributes to critical human geography is by seeking to map geographies of hope and care (Lawson 2007a, 2007b; Healy 2008). In fact, the critique of geographies of exploitation and violence must occur side by side the engagement with progressive geographies that are also being made. The feminist practice of "reading for difference" (Gibson-Graham 1996, 2006) and "mapping for difference" (Pavlovskaya and Bier 2012) calls for putting progressive alternatives on the map as a strategy to afford them ontological and political significance. Mapping spaces of possibility can keep social alternatives alive, nurtured, and cared for even while conservative neoliberal ideologies strengthen. In other words, mapping geographies of hope helps

to incorporate them into forward looking social imaginaries.

It is this aspiration to construct geographies of hope and care that constitutes GIS as a tool for social transformation. For example, feminist and qualitative GIS scholars work to change mapping so it includes the experiences of women, people of colour, and other marginalized groups (Cope and Elwood 2009). In many contexts, geospatial technologies act as advocacy and counter-mapping tools, supporting and enhancing the work of community organizations and activists (Hodgson and Schroeder 2002; Elwood 2008; Palmer 2009; Wainwright and Bryan 2009; St. Martin 2009; Snyder and St. Martin 2015). More recently, a "critical quantitative" turn has reclaimed spatial data and quantitative methods for use within critical human geography agendas (Wyly and DeFilippis 2010; Barnes 2009; St. Martin 2009). Such developments have kept critical GIS engaged with dynamic social change, both as a tool of critique and, as I will discuss below in greater detail using examples from my work, as a tool of social change.

Mapping the ontologies of the future here and now

The discussion above has shown that critical GIS practices have made strides in many directions. In particular, the technology itself has become more flexible and has incorporated new types of knowledge (e.g., qualitative, movement, and knowledge tied to new spatial ontologies); access to geospatial technology has widened while the authorship of spatial information has expanded; and GIS theory and practice have fused with critical epistemologies. The evidence of social change promoted by critical GIS is, however, harder to identify.

For the most part, critical GIS scholars focus on revealing, diagnosing, and analyzing the spatial configurations of power. Recently, it has been important, as discussed above, to expose how proliferating mapping projects get saturated with neoliberal logics and, as a result, strengthen surveillance, privatize information, dilute community power, and cultivate neoliberal subjectivities instead of community ethics. Yet, it is equally vital that we examine the progressive social change that happens with the assistance of GIS. The most obvious examples are, perhaps, counter-mapping projects by indigenous peoples and Public Participation GIS community initiatives (although important limitations and dangers of co-optation exist here as well). The two projects that I already mentioned, 596acres and the AEMP, exemplify the ongoing grass-roots efforts. There are, however, two other directions in which critical GIS enables social transformation: research that aims to create ontologies of non-exploitative economies and teaching.

The first example comes from my own research on "Mapping the Solidarity Economy in the United States," which is an NSF-funded collaboration among university professors, undergraduate and graduate student researchers, and community-based organizations that advocate for solidarity economy practices. The other example is teaching critical GIS in the university classroom, as I have done for many years in my "GIS applications in social geography" class which most recently included mapping aspects of the solidarity economy.

Both examples share important characteristics. First, they envision social transformation as an ongoing process as opposed to an all-encompassing and singular event. Second, they strategically use the ontological power of maps (Pavlovskaya 2009) which, through map-based visualization, transforms the already-existing but invisible alternative livelihoods into visible and "real" practices within socio-economic landscapes. Third, by affirming through mapping the presence of progressive livelihoods that people are already engaged in, want to learn about more, and seek to share, both projects attempt to activate new social imaginaries. This evokes a prefigurative politics that actualize possibility by fostering and engaging with desired social practices. Fourth, map authors (our research team and teams of students working on class projects) and mapped subjects (solidarity economy participants) are collective actors. Mapping here works to encourage cooperation among those who are mapping on behalf of and together with those who are being mapped. Community organizations participate in research design and data collection, students work as research assistants and also learn about and analyze geographic patterns of solidarity economy in the GIS class, while these and other analytical results are shared not only in academic venues, but also with community participants and in public forums. The ongoing fusion of research and teaching conducted as non-hierarchically as possible, has enriched the quality of both projects. The resulting mapping practices often generate social

transformations which are yet to be understood (Snyder and St. Martin 2015; St. Martin and Olson 2017). I will now discuss the two projects in greater detail and then turn to their synergies.

Mapping the solidarity economy

Solidarity economy can be broadly defined as economic practices that do not pursue profit-maximization or wealth per se, but rather support livelihoods. They prioritize an ethics of cooperation and mutual support such that people and planet are valued above profits. Solidarity economy practitioners advocate for collective ownership, workplace democracy, inclusion along all dimensions of difference, and social justice. Solidarity economy is also an international movement with strong participation in South America (e.g., Brazil and Argentina) and Europe (e.g., France, Spain, Italy) (see Miller 2010; Borowiak 2015; Borowiak et al. 2017; Safri et al.,forthcoming).

Our research demonstrates that, in the US, the solidarity economy also exists and makes a positive impact on workers' lives and communities. However, it is invisible within dominant economic statistics and models. Solidarity-based practices are not considered because they are not measured; they have no place in the US economic landscapes or within the country's social imaginary dominated by capitalism. The American public is unaware that any proximate solidarity economy exists. Mainstream economic education and public discourse focus almost exclusively on private enterprise and market economy, and they assume that all economic actors (individuals, enterprises, and corporations) share or aspire to a profit maximizing behaviour. Compared to the scale and size of a presumably all-encompassing capitalist economy, other alternative economic practices are treated as either insignificant, complementary to capitalism, or a deviation from the norm with no future. It is in this context that my colleagues and I began working on the project "Mapping the Solidarity Economy in the United States." Our major goal is to address the discursive silencing and resulting ontological absence of progressive non-capitalist economic forms. We aim to produce solidarity economy, together with interested actors outside the academia, as an ontological entity that would become a subject of theory, policy, and action (Safri et al., forthcoming; Borowiak et al. 2017). Importantly, we foreground the spatiality of the solidarity economy; making visible geographies of alternative economic practices within the social landscapes of the US works to produce a public discourse on the solidarity economy where none had previously existed. While the final product is a map, we understand mapping broadly, as including the entire process, interactions, and negotiations that produce the maps and their future digital and social lives (c.f. Del Casino and Hanna 2006).

Over the course of several years, we have worked as a research collective that includes four project PIs (political scientist Dr. Craig Borowiak from Haverford College; geographer Dr. Stephen Healy, a Research Fellow at the Institute for Culture and Society at Western Sydney University; economist Dr. Maliha Safri at Drew University; and myself, a geographer at Hunter College and CUNY Graduate center); one professional activist/organizer Dr. Emily Kawano, economist and a Coordinator of the United States Solidarity Economy Network; a dozen undergraduate and graduate student researchers funded at various stages of the project; and several community-based organizations that support worker co-ops, housing co-ops, credit unions, artist collectives, Community Supported Agriculture (CSA) networks, community gardens, and others. This collective effort is working to map the collective subject of solidarity economy at the national level, as well as at finer scales in New York City, Philadelphia, and Western Massachusetts, our case study sites.

The theoretical entry into the project is a diverse economies framework (Gibson-Graham 1996, 2006; Gibson-Graham et al. 2013) that starts with the ontological assumption that the economy (like gender, identity, sexuality) is always heterogeneous, despite the hegemony that particular forms gain. Even the US, always assumed to be a singularly capitalist society, includes class processes that exemplify non-capitalist forms of exploitation (e.g., unpaid housework in a patriarchal household) and those that are based on an ethics of solidarity (e.g., worker cooperatives). The hegemonic position of theories of capitalism in research and policy, called by Gibson-Graham "capitalocentrism," draws our attention always toward capitalist logics and institutions while simultaneously making invisible any alternative class processes or economic forms—despite their ubiquity and significant contribution

to livelihoods not just in developing or not-yet-fully capitalist countries, but also in the US. While not all forms of economic diversity are progressive (e.g., slavery), we can identify, assess the role of, and theorize the current and future significance of those non-exploitative economies that foreground the wellbeing of local, national, and global communities (what Gibson-Graham calls "community economies").

We have discovered that putting together the data on solidarity economy at the national scale, and mapping such data in meaningful ways, is indeed a formidable undertaking. Given the hegemony of an understanding of "the" economy as singularly capitalist, the realm of solidarity economy is largely invisible and informal; few statistics exist even about its widely spread formal components (e.g., worker cooperatives), which are lumped together with capitalist enterprises. Our research had to start from scratch and faced epistemological and methodological challenges at all stages. The first big step included organizing our conceptual thinking in the form of a typology of the US solidarity economy. Although some of its components were to some degree studied in the past, they have always been understood separately and we sought to bring them together into an evolving and expanding entity.

Table 1 presents our typology of solidarity economy. This typology is by no means exhaustive because our project also seeks to stimulate social imagination and creativity rather than provide a final blueprint and conceptual closure. We used our typology as a guide for researching sources of data that would provide us with the spatial information needed for mapping.

Table 1 makes it clear, however, that solidarity economy comes in many forms. Some of these forms, such as worker cooperatives and credit unions, can be mapped once the data are acquired, while other forms are hard or impossible to map using available cartographic tools. This is the juncture where new digital mapping and geovisualization technologies could make a contribution by finding new ways to visualize these phenomena. For example, household labour which, depending on context, can express solidarity instead of patriarchal exploitation cannot be easily and directly mapped to household location because it is not measured by statistics. Its non-monetized and informal nature requires special research while, for example, household income that expresses wage relation is part of the standard census dataset. Yet other forms of solidarity economy do not have a location, such as community lending networks, time banks, or even Mexican hometown associations, formal organizations that often operate via social media (Smyth 2015, 2017). As a result, the database of solidarity economy that we have built is largely partial and biased toward the formal institutions with a precise geographic location because this is what gets counted and mapped with available technologies. Nevertheless, it allowed us to analyze selected geographies of solidarity economy and create a public internet-based platform that incorporates the segment of the solidarity economy for which we found the data (Figure 1).

The resulting interactive and searchable map with over 25,000 entries is located at www.solidarityeconomy.us. Being present in this Geoweb space makes the solidarity economy visible to

Table 1
Typology of solidarity economy in the United States.

Consumption	Production	Finance	Exchange	Governance
• Consumer cooperatives • Buying clubs • Co-housing • Intentional communities • Affordable housing cooperatives • Community land trusts	• Worker cooperatives • Producer cooperatives • Volunteer collectives • Community gardens • Collectives of self-employed • Unpaid care work • Babysitting/childcare clubs	• Credit unions • Community development credit unions • Peer lending	• Fair trade networks • Community supported agriculture/fisheries • Complementary currencies • Barter networks • Free-cycle networks • Time banks	• Participatory budgeting • Collective management of community resources • Solidarity economy support organizations/networks

SOURCE: Adapted from Safri et al. (forthcoming).

researchers, participants, and the general public. As participants can now become aware of each other using this map, one potential effect of this project might be that they, then, support each other through the development of supply chains within the solidarity economy. For example, a worker cooperative in the cleaning industry might order supplies from manufacturers that are also worker cooperatives and food from a pizza worker co-op or a CSA farm. The public platform also has the capability for solidarity economy participants to add themselves to the map. Thus, it being only a front-end for the evolving realms of solidarity economy, we hope that the map will continue to evolve long after our research project ends. We also hope that the map will invigorate imaginations about economic possibility and continue to expand ontologies of solidarity economy.

As already mentioned, the map is currently biased toward formal institutions because of the absence of metrics for the solidarity economy in US statistics. Gaps in data collection, as well as the informal, non-monetized, and non-locational nature of many solidarity economy practices, also contribute to gaps in representation. It would take years of research and creative visualization to map all types of solidarity economies. Although mapping stands for the host of activities comprising research, social interaction, technology, and teaching, it provides an invigorating, but not the only, way to create space for solidarity economy within the public discourse. In fact, we think of this mapping initiative as the beginning of and impetus for conversations and future research projects concerning the solidarity economy. It certainly cannot be disentangled but is different from other research methods used by our team to shed light on the meaning of solidarity economy and its role in supporting livelihoods, such as participant observation, surveys, and in-depth interviews with its participants. It is also connected to the other modes by which we disseminated information about our research, including analytical briefs for worker co-op organizations, presentations at the academic conferences and to the members of the community, and incorporation of ideas about solidarity economy into teaching.

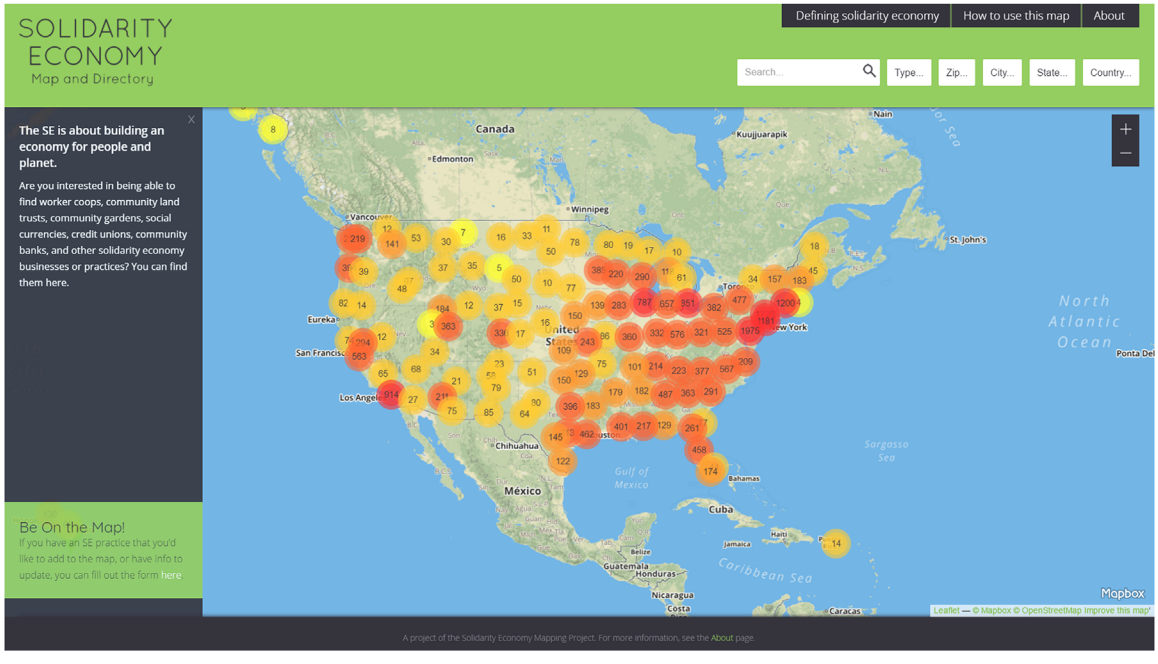

Figure 1
Screen shot of the solidarity economy website map and directory.
SOURCE: www.solidarityeconomy.us. Reproduced with permission of Emily Kawano, Craig Borowiak, and Maliha Safri.

Teaching

Teaching is a powerful transformative practice. Teaching students to see and map the world as a diverse economic landscape presents itself as another opportunity to engage in social transformation with GIS. While I raise the topic of solidarity economy in many classes, it is in the course "GIS applications in social geography" where students can most clearly see the link between spatial knowledge production and social transformation; indeed, the case of the solidarity economy combined with a critical GIS perspective makes them acutely aware of the progressive and social justice potentials of mapping projects.

In a recent class, as part of their final projects, students worked with our solidarity economy datasets. They worked in teams and had to collectively participate in all stages of the mapping process and learn to take advantage of their mutual strengths. Each team consisted of undergraduate and graduate students with different levels of expertise in social theory and GIS. These differences necessitated and generated productive discussions among the students about the phenomena they were mapping and about what and how to represent them on the map. The final posters and submitted reports had to examine the phenomenon itself, including its history and geography; explain the nature of data and how well they do or do not represent particular qualities of solidarity economy; and find creative ways to analyze the available data as well as visualize and explain its spatial patterns at national and local scales.

Four student teams mapped different aspects of solidarity economy: the national geography of worker cooperatives; the national geography of credit unions; the geography of worker cooperatives in New York City; and the geography of solidarity economy in Philadelphia (New York and Philadelphia being two of our research sites). The posters that students produced then became part of a poster session on the last day of class (see Figure 2 for a poster example). These posters have, for the students, reinforced the visual power of mapping and, importantly, made students feel their own role in the creation of an ontology of solidarity economy. During the poster session, they engaged each other in conversations with great care and insight because they all now shared a technical and critical knowledge of GIS, were versed in its potential social impact, and understood the politics of mapping. They could all talk about their struggles with datasets, categorization of data, the emerging patterns, and other key issues, and they all knew what it took to create their maps and posters as part of a cooperative and supportive team. Importantly, however, students also became quite knowledgeable about the subjects of solidarity economy; for example, although they had no idea what worker cooperatives and credit unions were at the beginning of the class, by the end of the course they knew much more about their geographies than the location alone.

Spatial patterns of solidarity economy generated in class corroborated some of the most surprising findings from the larger research project. One unexpected conclusion was that the professional and middle classes use and thus benefit more from certain types of the solidarity economy than more marginalized groups (Pavlovskaya 2017a). Examples of this include employment-based credit unions and worker cooperatives, albeit with some notable exceptions. As we did ourselves, my students initially expected to find solidarity economy primarily in low-income and minority areas. In the case of Philadelphia, however, the students discovered that it was concentrated in middle-class neighbourhoods (see Borowiak et al. 2017) which made them critical of solidarity economy outcomes. The students interpreted the absence of solidarity economy in the neighbourhoods where it was most needed as evidence of a compromised commitment to social justice.

This counter-intuitive finding pushed me to think more about the nature of solidarity economy and recognize that it is not a monolithic construct, but rather a set of diverse economies. Solidarity economy practices pursue similar ethical goals but originate in different settings and spaces, and include people with different histories, objectives, and imaginations. In most cases, they are grassroots initiatives that emerge where people have a need but also where there are sufficient resources and capacities to organize economic lives in a new way. In the US, building alternative economies is particularly hard because the capitalocentrism of the mainstream economy plays down the current role and potential of solidarity economy and makes it hard to take it off the ground.

For example, only formal profit-oriented enterprises count as the economy while many informal socially embedded and ethical economic practices that support livelihoods on a daily basis in all kinds

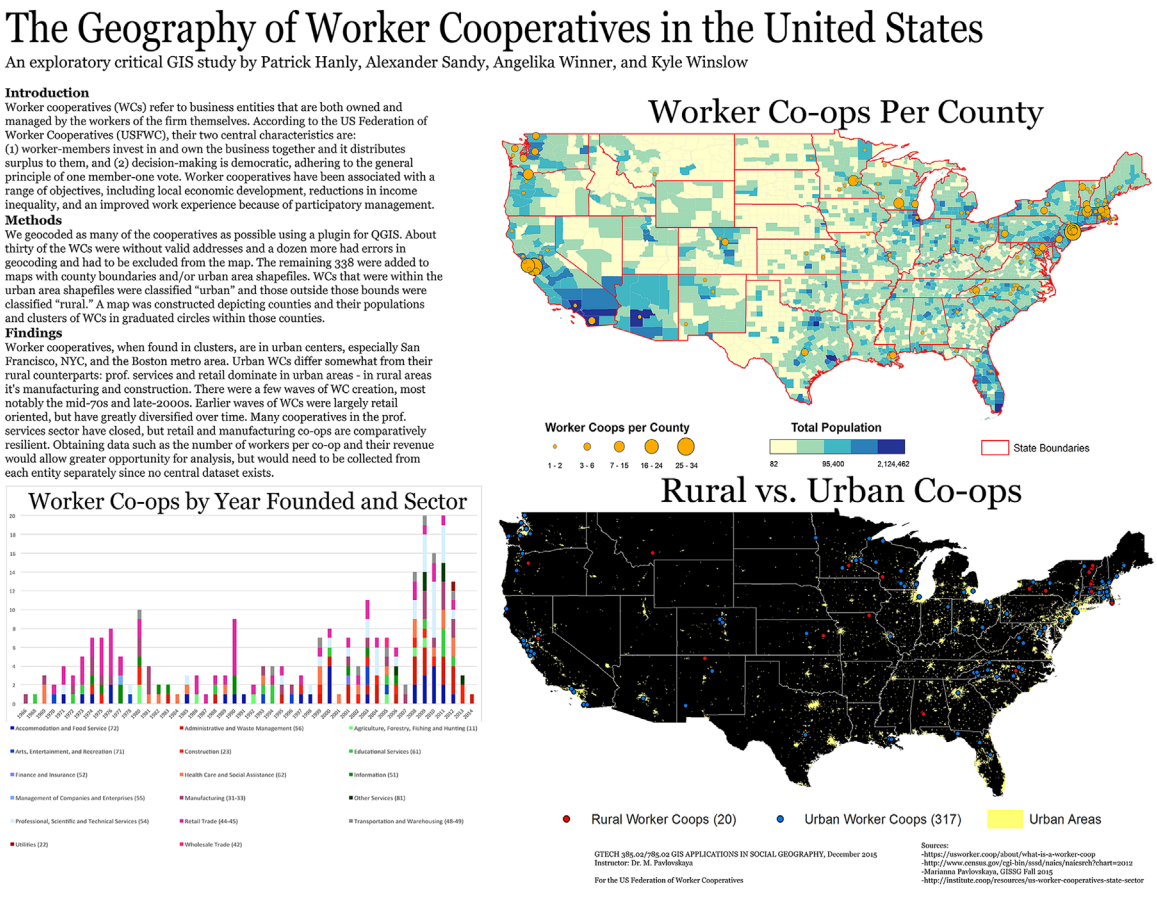

Figure 2
Example of a poster produced by the students: Geography of worker cooperatives in the United States.
SOURCE: Students in the "GIS applications in social geography" class: Patrick Hanly, Alexander Sandy, Angelika Winner, and Kyle Winslow.

of communities, and especially in the low-income ones, are not included in economic statistics (e.g., gift economies, community lending, family child-care, etc.). For the purposes of mapping and analysis they are invisible and do not lend themselves to the traditional forms of cartographic representation. In fact, one could claim (and this is to be verified by our future research) that lower-income areas depend more than other neighbourhoods on these forms of solidarity economy that cannot be easily visualized.

Legal and labour regulatory frameworks in the US also consider capitalist enterprise to be a norm. Consequently, it is logistically harder to set up a worker cooperative than a private enterprise. Formalizing solidarity economy into worker co-ops, credit unions, and community gardens requires logistical, time, and expert resources that are more accessible to professional and middle classes. That solidarity economy initiatives can successfully spread around wealth and create secure economic environments is clearly understood by the middle class, that has resources to organize itself into these economic forms (Pavlovskaya 2017a). While this is another item for future research agenda, there is a clear need, therefore, to channel greater resources into the creation of formal solidarity economy institutions in low-income communities and lend support to the informal solidarity initiatives there as well. These heterogeneous geographies

generated discussions about the meaning of spatial patterns and the need for careful research that would explain them.

Finally, the classroom projects and discussions do indeed stimulate student imagination and generate their interest in non-capitalist economic forms that can potentially result in social transformation. Several MA students wrote their theses on issues related to solidarity economy (e.g., worker cooperatives, credit unions, consumer cooperatives, food security and community gardens, and Mexican hometown associations). One PhD student has a long-term interest in studying gendered aspects and regional geographies of solidarity economy (Hudson 2017). Several undergraduate students, too, have examined its spaces and patterns as part of their capstone experience (see the list of recent topics in Table 2). Almost all students have used GIS to visualize geographic patterns of solidarity economy. Students also delivered numerous presentations, within academia and to the community, on the subject of solidarity economy (recent student presentations are also listed in Table 2). Moreover, some graduate students have already published or are about to publish their research in top geography journals (Smyth 2017). Thus, students have contributed in a variety of ways to the process of creating ontologies of solidarity economy through their class projects and research that revolved around mapping with a GIS.

In the end, students understand that the progressive non-hegemonic practices and phenomena do exist but in order to make them part of our collective imaginations, we need to be able to see and recognize them as such. They also become interested in finding out ways to participate in these practices. Similar to my students, many people in the US would consider these economic alternatives a possibility once they were able to see them—both on the map and as part of the social imaginary—as a viable and future looking practice. As the realization grows that, in contrast to the neoliberalized

Table 2
Topics of student research projects inspired by solidarity economy mapping at Hunter College.

Topic	Type	Year/venue
Struggles of narrative and space in New York City's solidarity economy	PhD student, conference presentation	The Annual Meeting of the AAG, Boston, MA, April 5–9, 2017
Evaluation of community gardens within the NYC metropolitan area	Undergraduate Honours thesis	2016
Alternative childcare and single parent households in Philadelphia	Undergraduate Capstone project	2016
Community gardens as part of NYC solidarity economy	Undergraduate Capstone project	2016
Poster #026: Credit union practices in mortgage lending: Non-capitalist alternatives up to and through the "Great Recession"	MA student, conference poster session	The Annual Meeting of the AAG, San Francisco, CA, March 29–April 2, 2016
Collectivities and the solidarity economy: Struggles over the narrative of a movement	PhD student, conference presentation	The Challenging Collectivities Conference at Goethe University, Frankfurt, 2016
New York City: Struggles over the narrative of the solidarity economy	PhD student, conference presentation	The Annual Meeting of the AAG, San Francisco, CA, March 29–April 2, 2016
Making Puebla York: Diaspora spaces of Mexican hometown associations in New York City	MA/PhD student, conference presentation	Making the City in Latin America Symposium, University of Kentucky, 2016
Tensions and solidarity in collective remittance sending: Mexican hometown associations in New York City	MA/PhD student, conference presentation	The Annual Meeting of the AAG, San Francisco, CA, March 29–April 2, 2016
Spaces of solidarity: Mexican hometown associations in New York City	MA student, invited research presentation	The Society of Women Geographers New York City Chapter at Hunter College, 2016
Mexican hometown associations in New York City: A study of transnational solidarity	MA thesis	2015
Alternative food networks in New York City	Undergraduate Honours project	2014
Geography of cooperative enterprises in the United States	MA thesis	2013
Credit unions: An alternative financial model	MA research paper	2012
Facing the food crisis: The political economy of alternative agriculture projects	MA thesis	2010

capitalist enterprise, solidarity economies are capable of providing working people with secure livelihoods, the social transformation is ongoing. Mapping different alternatives to capitalism in the spirit of critical GIS means doing it as part of a larger critical inquiry and performed social practice. Doing so would continue to generate desire for post-capitalist economy, while also expanding the space of social imagination and creativity for its new and yet unknown forms.

Conclusion

I conclude this essay with the claim that critical GIS can enable social transformation in important ways. Critical GIS scholarship makes it explicit that maps are not neutral knowledge statements, but rather are powerful and empowering practices. In fact, maps possess ontological power; being part of the social process, they produce the worlds instead of simply reflecting them (Pavlovskaya 2006; Crampton and Krygier 2005). With the advent of GIS, digital and internet-based mapping has become a widely spread, socially involved, and technology-reliant practice that generates new ontologies and remakes places (Pavlovskaya 2016). These qualities turn maps and mapping practices into tools for social transformation that can shift the balance of power. In particular, they can promote economic change by visualizing spaces of the existing progressive economies that are marginalized by the dominant capitalocentric discourses. Maps, and the collaborations through which they are made, understood, and used, spur myriads of changes that are open-ended and take place in multiple sites. Making room on the map of the US economy for the existing alternatives to capitalism also enlarges the field of possibility because it invites economic and social creativity by indicating that there is always space for new imaginations. I attempted to illustrate these potentials of critical cartographic and GIS practices by drawing on examples from my research with colleagues on the solidarity economy in the US and my teaching that incorporates the insight from this research.

Over the course of the last several years, our research project has generated a database of the solidarity economy, an open and interactive public internet-based map, productive collaborations with community-based organizations and participants of the solidarity economy, and close cooperation with undergraduate and graduate students, both within and outside the classroom, around critical cartography and GIS-based mapping. These experiences indicate that mapping in the spirit of critical GIS can indeed be transformative as part of research and teaching.

First, mapping ontologies of solidarity economy at the national and local scales and making the viable and already existing alternatives to capitalism visible would hopefully help people to increase their economic security by practicing economic solidarity. Second, it would acknowledge and honour struggles of people who create non-capitalist economy on a daily basis and transfer property, land, and labour outside the realm of capitalism and into the realms of solidarity and ethical use. Third, it allowed students and myself to better understand who participates in solidarity economy and why it brings tangible benefits to those involved. Fourth, the research opened up questions about whether today's solidarity economy can provide a path towards post-capitalism and become a basis of a broad movement, one analogous to the ongoing feminist revolution which is individual in practice, yet global in scope (see Gibson-Graham 1996, 2006). Finally, we have been forced to think about how mapping can spur social imaginations beyond already existing forms of economy (e.g., capitalism) and become a way to enable a diverse and widely ranging politics of possibility.

The significance of revealing geographies of solidarity economy lies in the fact that it is an important site of class transformation today. Although the matter is complex, the relations of production and distribution are changed once property moves from private to collective ownership, and workers begin to appropriate their own surplus and/or control its distribution, make decisions collectively, and create strategies for preserving workplaces. In other words, they create viable economies that do not seek profit-maximization but instead secure livelihoods, while also radically transforming the society before our eyes. It is exciting to see that critical GIS can make a meaningful contribution to this transformation by being part of human geographic research and pedagogy. Putting geographies of hope and care on the map is a counter-mapping practice that sets limits to conservative geographies. At the same time, once on the map, the

new worlds of which geographies of hope can be part do indeed feel possible.

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References

596acres. 2016. *Championing resident stewardship to build just and equitable cities.* http://596acres.org.

AEMP (Anti-Eviction Mapping Project). n.d. *Anti–Eviction Mapping Project.* https://www.antievictionmap.com/about/.

Barnes, T. J. 2009. "Not only . . . but also": Quantitative and critical geography. *Professional Geographer* 61(3): 292–300.

Bergmann, L. 2017. Towards economic geographies beyond the nature-society divide. *Geoforum* 85: 324–335.

Borowiak, C. 2015. Mapping social and solidarity economy: The local and translocal evolution of a concept. In *Social economy in China and the world*, ed. N. Pun, B. Hok-bun Ku, H. Yan, and A. Koo. New York, NY: Routledge, 17–40.

Borowiak, C., M. Safri, S. Healy, and M. Pavlovskaya. 2017. Navigating the fault lines: Race and class in Philadelphia's solidarity economy. *Antipode.* doi: 10.1111/anti.12368.

Cope, M., and S. Elwood, eds. 2009. *Qualitative GIS: A mixed methods approach.* Los Angeles, CA: SAGE.

Crampton, J. W. 2010. *Mapping: A critical introduction to cartography and GIS.* Malden, MA: Wiley-Blackwell.

Crampton, J. W., and J. Krygier. 2005. An introduction to critical cartography. *ACME: An International Journal for Critical Geographies* 4(1): 11–33.

Crampton, J. W., S. M. Roberts, and A. Poorthuis. 2014. The new political economy of geographical intelligence. *Annals of the Association of American Geographers* 104(1): 196–214.

Dalton, C. M., L. Taylor, and J. Thatcher. 2016. Critical data studies: A dialog on data and space. SSRN Scholarly Paper ID 2761166. Rochester, NY: Social Science Research Network. https://papers.ssrn.com/abstract2761166.

Del Casino, V. J., and S. P. Hanna. 2006. Beyond the "binaries": A methodological intervention for interrogating maps as representational practices. *ACME: An International E–Journal for Critical Geographies* 4(1): 34–56.

Dixon, D. P., and J. P. Jones. 1998. My dinner with Derrida, or spatial analysis and poststructuralism do lunch. *Environment and Planning A* 30(2): 247–260.

Elwood, S. 2008. Grassroots groups as stakeholders in spatial data infrastructures: Challenges and opportunities for local data development and sharing. *International Journal of Geographical Information Science* 22(1/2): 71–90.

Gibson-Graham, J. K. 1996. *The end of capitalism (as we knew it): A feminist critique of political economy.* Oxford, UK: Blackwell.

——. 2006. *A postcapitalist politics.* Minneapolis, MN: University of Minnesota Press.

Gibson-Graham, J. K., J. Cameron, and S. Healy. 2013. *Take back the economy: An ethical guide for transforming our communities.* Minneapolis, MN: University of Minnesota Press.

Gieseking, J. 2015. Crossing over into territories of the body: Urban territories, borders, and lesbian-queer bodies in New York City. *Area* 48(3): 262–270.

Gregory, D. 2010. Seeing red: Baghdad and the event-ful city. *Political Geography* 29(5): 266–279.

Haklay, M. 2013. Neogeography and the delusion of democratisation. *Environment and Planning A* 45(1): 55–69.

Healy, S. 2008. Caring for ethics and the politics of health care reform in the United States. *Gender, Place & Culture* 15(3): 267–284.

Hodgson, D. L., and R. A. Schroeder. 2002. Dilemmas of countermapping community resources in Tanzania. *Development and Change* 33(1): 79–100.

Hudson, L. T. 2017. Struggles of narrative and space in New York City's solidarity economy. Paper presented at the 2017 Annual Meeting of the American Association of Geographers, April 5–9, in Boston, MA.

Kitchin, R. 2014. Big data, new epistemologies and paradigm shifts. *Big Data & Society* 1(1). doi: 10.1177/2053951714528481.

Kwan, M.-P. 2002. Feminist visualization: Re-envisioning GIS as a method in feminist geographic research. *Annals of the Association of American Geographers* 92(4): 645–661.

——. 2007. Affecting geospatial technologies. *The Professional Geographer* 59(1): 22–34.

Lake, R. W. 1993. Planning and applied geography: Positivism, ethics and geographic information systems. *Progress in Human Geography* 17(3): 404–413.

Lawson, V. 2007a. Geographies of care and responsibility. *Annals of the Association of American Geographers* 97(1): 1–11.

——. 2007b. Introduction: Geographies of fear and hope. *Annals of the Association of American Geographers* 97(2): 335–337.

——. 2009. Instead of radical geography, how about caring geography? *Antipode* 41(1): 210–213.

Leszczynski, A. 2012. Situating the Geoweb in political economy. *Progress in Human Geography* 36(1): 72–89.

Leszczynski, A., and S. Elwood. 2015. Feminist geographies of new spatial media. *The Canadian Geographer* 59(1): 12–28.

McLafferty, S. L. 2002. Mapping women's worlds: Knowledge, power and the bounds of GIS. *Gender, Place & Culture* 9(3): 263–269.

Miller, E. 2010. Solidarity economy: Key concepts and issues. In *Solidarity economy I: Building alternatives for people and planet.* Amherst, MA: Center for Popular Economics.

Openshaw, S. 1991. A view on the GIS crisis in geography, or, using GIS to put Humpty-Dumpty back together again. *Environment and Planning A* 23(5): 621–628.

Palmer, M. H. 2009. Engaging with indigital geographic information networks. *Futures* 41(1): 33–40.

Pavlovskaya, M. 2006. Theorizing with GIS: A tool for critical geographies? *Environment and Planning A* 38(11): 2003–2020.

——. 2009. Critical GIS and its positionality. *Cartographica* 44(1): 8–10.

——. 2016. Digital place-making: Insights from critical cartography and GIS. In *The digital arts and humanities: Neogeography, social media and big data integrations and applications*, ed. C. Travis and A. von Lünen. Cham: Springer, 153–167.

——. 2017a. Place-making through ethical finance? Potential of credit unions in New York City. Paper presented at the 2017 Annual Meeting of the American Association of Geographers, April 5–9, in Boston, MA.

——. 2017b. Qualitative GIS. In *The International Encyclopedia of Geography: People, the earth, environment, and technology*, ed. D. Richardson, N. Castree, M. F. Goodchild, A. Kobayashi, W. Liu, and R. A. Marston. Hoboken, NJ: Wiley-Blackwell.

Pavlovskaya, M., and J. Bier. 2012. Mapping census data for difference: Towards the heterogeneous geographies of Arab American communities of the New York Metropolitan Area. *Geoforum* 43(3): 483–496.

Peck, J., D. Massey, K. Gibson, and V. Lawson. 2014. Symposium: The Kilburn manifesto: After neoliberalism? *Environment and Planning A* 46(9): 2033–2049.

Pickles, J., ed. 1995. *Ground truth: The social implications of geographic information systems*. New York, NY: The Guilford Press.

Raghuram, P. 2012. Global care, local configurations: Challenges to conceptualizations of care. *Global Networks* 12(2): 155–174.

Raghuram, P., C. Madge, and P. Noxolo. 2009. Rethinking responsibility and care for a postcolonial world. *Geoforum* 40(1): 5–13.

Safri, M., C. Borowiak, S. Healy, and M. Pavlovskaya. Forthcoming. Putting solidarity economy on the map. *Journal of Design Strategies*.

Schuurman, N., 2004. *GIS: A short introduction*. Malden, MA: Wiley-Blackwell.

Schuurman, N., and G. Pratt. 2002. Care of the subject: Feminism and critiques of GIS. *Gender, Place & Culture: A Journal of Feminist Geography* 9(3): 291–299.

Sieber, R. 2016. Constructively Critical GIS. Panel presentation at the 2016 Annual Meeting of the American Association of Geographers, March 29–April 2, San Francisco, CA.

Smyth, A. 2015. Mexican hometown associations in New York City: A study of transnational solidarity. MA thesis, Department of Geography, Hunter College.

——. 2017. Re-reading remittances through solidarity: Mexican hometown associations in New York City. *Geoforum* 85: 12–19.

Snyder, R., and K. St. Martin. 2015. A fishery for the future: The Midcoast Fishermen's Association and the work of economic being-in-common. In *Making other worlds possible: Performing diverse economies*, ed. G. Roelvink, K. St. Martin, and J. K. Gibson-Graham. Minneapolis, MN: University of Minnesota Press.

St. Martin, K. 2009. Toward a cartography of the commons: Constituting the political and economic possibilities of place. *Professional Geographer* 61(4): 493–507.

St. Martin, K., and J. Olson. 2017. Creating space for community in marine conservation and management: Mapping "communities at sea." In *Conservation in the Anthropocene Ocean*, ed. P. Levin and M. Poe. Cambridge, MA: Elsevier, 123–141.

St. Martin, K., and J. Wing. 2007. The discourse and discipline of GIS. *Cartographica* 42(3): 235–248.

Thatcher, J., D. O'Sullivan, and D. Mahmoudi. 2016. Data colonialism through accumulation by dispossession: New metaphors for daily data. *Environment and Planning D: Society and Space* 34(6): 990–1006.

Thatcher, J., L. Bergmann, B. Ricker, R. Rose-Redwood, D. O'Sullivan, T. J. Barnes, L. R. Barnesmoore, et al. 2016. Revisiting Critical GIS. *Environment and Planning A* 48(5): 815–824.

Wainwright, J., and J. Bryan. 2009. Cartography, territory, property: Postcolonial reflections on indigenous counter-mapping in Nicaragua and Belize. *Cultural Geographies* 16(2): 153–178.

Wilson, M. W. 2011. "Training the eye": Formation of the geocoding subject. *Social & Cultural Geography* 12(4): 357–376.

——. 2015. New lines? Enacting a social history of GIS. *The Canadian Geographer* 59(1): 29–34.

Wyly, E., and J. DeFilippis. 2010. Mapping public housing: The case of New York City. *City & Community* 9(1): 61–86.