

# Critical GIS Twenty Years After Friday Harbor Meeting: Critical Intervention to Epistemology, Ontology, Methodology, and the Social Implication of GIS

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## 프라이데이 하버 모임 20년 이후 비판 GIS: GIS의 인식론, 존재론, 방법론, 그리고 사회적 영향에 관한 비판적 개입

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**Abstract :** Critical GIS is a research framework in geography that stands at the border of GIScience and human geography, and has been revolved around the epistemological ground, ontology, and methodology of GIS, and its social impacts. Since Friday Harbor Meeting in 1993 when human geographers and GIScientists began engaging in dialogue and growing climate of discussion, the past twenty years have shown a tremendous growth in efforts to understand GIS and the theory behind it, and an array of creative ways of conducting critical GIS such as GIS and Society, participatory GIS, qualitative GIS, and feminist GIS. These are all, what I consider, evolutions of critical GIS, innovative researches ‘with’ and ‘for’ critical GIS. This paper reviews primary debates and reactions vis-à-vis critical GIS by focusing on its social history and key discussions. I particularly demonstrate that the value and discussions of critical GIS still remain relevant, and seem as important as ever, with new questions and unprecedented digital and spatial technologies such as geographic web, spatial media, spatial humanity, and Big Data.

Key Words : Critical GIS, GIS and Society, Social theory, Social history of GIS

**요약 :** 비판GIS는 지리학에서 지리정보과학과 인문지리학 사이에 존재하는 연구 영역으로서, GIS의 인식론, 존재론, 그리고 방법론적인 부분과 사회에 미치는 영향에 관하여 다루어 왔다. 인문 지리학자와 GIS 학자들이 대화를 시작, 발전시킨 1993년 프라이데이 하버 모임 후 20년 동안은 GIS와 그에 대한 이론, GIS와 사회, 참여GIS(PGIS), 질적GIS, 페미니스트GIS 등과 같은 여러 비판GIS가 창조적으로 수행되는 방법들이 제시되고 있다. 본 연구는 이러한 연구들은 모두 비판GIS를 이용하고, 또한 이를 위한 비판GIS의 진화된 형태로 간주한다. 또한 본 연구는 사회사와 주요 논의를 중심으로, 비판GIS에 관련한 주요 논쟁과 그 대응을 고찰하고자 한다. 나아가 비판GIS의 가치와 논의들은 여전히 적절하며, 지리웹, 공간 미디어, 공간 인문학, 그리고 빅데이터와 같은 전례없는 디지털 공간 기술과 연관지어 새롭게 생겨나는 질문들과 함께 계속 중요하게 인식될 것으로 예상된다.

주요어 : 비판 GIS, GIS와 사회, 사회 이론, GIS의 사회사

### I. Introduction

Analysis (NCGIA) Initiative-19 workshop, “The Social Implications of How People, Space, and Environment are Represented in GIS,” was held at the University of

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Washington's research facility at Friday Harbor, Washington State, in November 1993 (Schuurman, 1999a; Sheppard, 1995a). This meeting was considered as a turning point and the beginning of critical GIS discussions when debates between the advocates and critics of GIS changed from the somewhat hostile and an emotional state to initiating and a more conciliatory period. A larger conceptual framework of critical GIS discussions has been revolved around the epistemology, ontology, and methodology of GIS, and its social impacts. The past two decades, in particular, has seen a tremendous growth in efforts to understand the roles of position of GIS and the theory behind it in both research and everyday life (e.g. socially-relevant GIS, critical quantitative research), as well as a commitment to the community level GIS practices (e.g. Public Participation GIS, Participatory GIS). These are all part of many emerging ways of conducting critical research *with* GIS that I define as diverse evolutions of critical GIS. Critical GIS scholarship emerged in response to a series of concerns raised 'about' GIS by human geographers and GIScientists (Elwood, *forthcoming*; Lake, 1993; Pickles, 1995), and has extended the discussions and conceptualization of GIS, geospatial technologies, and related social, political and cultural practices to do with the use of GIS as a way of making knowledge. Critical GIS researchers have also increasingly challenged the use of GIS in non-conventional ways (e.g. feminist GIS), tried to find a way to reflect their various epistemologies, and unfolded the mutual relationship between GIS and society. Lately, edited journals which are focused on special issues of 'Qualitative Research and GIS,' 'Critical GIS,' 'GIS and Society,' 'GIScience After Ground Truth,' and 'Critical Cartographies' in the flagship journals demonstrate the emerging interest in critical GIS in the discipline of geography (see, respectively, *Environment and Planning A* 2006 Vol. 38, Issue 11, *Cartographica* 2005 Vol. 40, Num.4, *Transactions in GIS* Vol.10, Issue 5, *ACME: An International E-Journal for Critical Geographies* 2006 Vol.4, Issue 1 and *Cartographic Perspective* 2006 Vol.53). The efforts are continued, and we see continuous conversations about critical GIS until now with new

questions and unprecedented digital and spatial technologies (see, the most recent special editions in the respected geography journals and edited books on 'GIS and Society,' 'Crowdsourcing Geographic Knowledge: VGI in Theory and Practice,' 'Theorizing the geoweb,' and 'Critical GIS and Geoweb' in, respectively, Nyerges *et al.* (2011), Sui *et al.* (2013), *GeoJournal* 2013 Vol.78, and *Progress in Human Geography* 2014 Special Issue). The value and influence of critical GIS seem as important as ever, and this paper is intended to be another effort along this line to shed a light on the value and meanings of critical GIS.

I first propose to review ongoing debates and reactions *vis-à-vis* 'critical GIS' discussions by focusing on central themes in the following two sections. I primarily focus on exploring the key themes that have arisen in these debates such as GIS's putative positivist epistemological ground, GIS's biased ontology, GIS's methodological reliance on secondary quantitative data sources for deductive empirical analysis, unequal power relation in the access and use of GIS, socially constructed maps, and concern for the social implication of GIS. In this process, the chronology of these discussions is important in order to allow us to sense the changing atmosphere between the two groups, thus it also provides a rough timeline of the sea changes of key discussions. Then, in section four, I focus on central issues and roots of critical GIS that allowed to generate an array of creative intervention and permutations of critical GIS, such as feminist GIS, participatory GIS and qualitative GIS. Finally, I discuss about the future of critical GIS scholarship and its potential applications in critical researches in related to new developments in digital geospatial techniques, spatially-mediated environment, geographic web (geoweb), and Big Data study.

## II. Early Debates between Advocates and Critics of GIS

There were obvious gaps between the advocates and

critics of GIS in the early reactions and conversation in critical GIS and "GIS and Society" in general. One of the main concerns of critics was, epistemologically, the perception of GIS as rooted in putative positivism, and associated with the epistemological ground in deductive logic, and its tendency to rely on secondary quantitative data source for empirical analysis. Another key issue that critics pointed out, in relation to GIS's positivist epistemology claim, was that GIS is biased toward a particular ontology from at the very beginning because GIS's generally understood positivistic epistemological assumptions and its characteristics might be embedded in the ontology of GIS as well. Moreover, unequal power relation, which is closely related to the issues like the access and use of GIS, an increasing surveillance and privacy, and the increasing dominant military involvement, was an important topic in debates. The atmosphere between two groups were, at times, quite intensive and hostile back and forth regardless of the contents of their arguments, which is most noticeable by the strong words and attacks between Taylor (1990) and Openshaw (1991, 1992). Based on the gravity of this situation, both sides refused to cooperate with each other and communication had been lost.

The benefits from the increasing automation of geographic practices were well summarized by Dobson (1983) in the early 1980s. Dobson (1983: 142) believed that such increasing automation and computerization of geographic practice would lead to the automated study of spatial phenomena, permitting storage integrated systems approach and reconfigure the discipline through his notion of "Automated Geography." This notion was later considered to be the predecessor of GIS, and GIS surely acquired a strong position as Dobson predicted. It is even enough to be considered synonymous with the use of computing in geographical research (Gilbert 1995).

Taylor (1990) made the bold inference that GIS was considered a direct descendent of the quantitative revolution. Differentiating Geographic Knowledge Systems (GKS) from GIS, he dismissed GIS as a "trivial pursuit" geography based on facts rather than knowledge, and a "Return of

the worst sort of positivism and a naïve empiricism," (Taylor, 1990: 212) By placing GKS an ideal well-suited system for (political) geography, he comparatively found no need of placing GIS in this equation. Openshaw (1991) strongly disagreed with Taylor by asserting that GIS is truly geographic, and it offers the basis for a long-overdue reconciliation between the 'soft' social science and the 'hard' spatial science, of which GIS is a part. It ignited their fierce fights against each other's view. After Taylor responded to Openshaw's initial reaction to him, Openshaw criticized him again, and stated, "It is particularly important that those who comment on GIS should be properly informed and base their comments and criticism on some knowledge and experience of what GIS can and cannot do" (Openshaw, 1992: 465). Openshaw's (1991: 624) harsh words like, "previously most of the technical cripples in geography," summarize equally intense criticism between the critics of GIS, especially human geographers, and the practitioner and advocates of GIS.

Sheppard (1993) critiqued GIS a little different way that GIS has the potential to favor uses of (only) secondary datasets that focus empirical research efforts on data collected for other purposes, restricting theoretical issues. He considered GIS to be the same as "Automated Geography," the term Dobson (1983) originally coined, and was uneasy, in particular, about the algorithmic nature of GIS models "as a means of privileging Boolean logic and reductionist problem-solving at the expense of theoretical knowledge such as historical-hermeneutics and critical emancipatory knowledge." (Sheppard, 1993: 459) In other words, Sheppard's concern was epistemological that post-positivist epistemology such as social theory might be sidelined in favor of empirical positivistic study. What Dobson and other GIS practitioners saw from GIS, as a new technology that could bring about more comprehensive understandings of society, was seen as far more problematic in practical, conceptual, and epistemological ways by Shepard and many human geographers. Fortunately, this somewhat hostile atmosphere evolved into a more conciliatory period in the middle

of 1990s, and the intensity was slightly mediated by the negotiating efforts from both sides<sup>1)</sup>.

### III. Reconciliation and Deeper Conversation on Epistemology, Ontology, and Power

As previously stated, the Friday Harbor meeting<sup>2)</sup> became a new turning point, and the attitudes between the advocates and critics of GIS softened as both sides started to have a better recognition and appreciation of the main issues from the opposing critique. As a result, new proposals were created for an Initiative by NCGIA to further study social consequences of GIS and how particular logics and visualization techniques, value systems, and ways of representation have been used in different levels of information (Mark *et al.*, 1997). There still continued to be a considerable gap in perspective, and the language used did little to build alliances with each group frequently claimed that they could barely decipher the other's languages and terminologies (Schuurman, 2000); however, the key difference, compared to the early debates, was the willingness to engage in dialogue and a growing climate of discussion. This was exactly what Harvey (1997) highlighted, the importance of integration through the history of geography, and the establishment of 'Boundary Objects' in geography, the concept that he further developed (Harvey, 1998). Harvey (1998) encouraged the advocates of GIS to join the critics' discussion in examining more social dimensions of GIS for better integration.

Positivist epistemological origin and the social and theoretical implications of GIS ontology have been further discussed. As we witnessed in the previous section, one of the main critiques associated with the spread of GIS was its epistemological framework grounded in deductive positivist logic and its tendency to rely on secondary quantitative data sources for empirical analysis (Harris and Weiner, 1998; Miller, 1995; Sheppard, 1993). Epistemology is a way of knowing, and positivism,

which is often referred to logical positivism, was developed by the Vienna Circle in the 1920s and 1930s (Kitchin, 2006). Positivists pursue the truth about reality in the form of absolute law, and their positions are grounded on the following assumptions such as the verifiable events, universally objective criteria, precise quantitative measurement of fact, value-free observer, and deductive empirical approach (Kitchin, 2006; Lake, 1993). In other words, positivism is often characterized by its philosophy that social behavior can be measured, modeled and explained through the development of scientific absolute laws in the same way that natural phenomena are examined (Fotheringham, 2006). I consider the main reason for the criticism by the critics was not because the grounding of GIS is positivistic *per se*, but the epistemological inflexibility in GIS. Sui (1994: 265) strongly criticized this epistemological inflexibility of GIS that "GIS not only have restricted our pursuit of knowledge (of positivism) but also inadvertently have marginalized other insightful epistemologies." However, there are also diverse perspectives regarding GIS's epistemological root among the advocates of GIS as well. Some scholars did not agree with the idea that the epistemology of GIS is a deductive nature of positivism (Goodchild, 1992; Schuurman, 2000). Schuurman (1999a; 2000), in particular, argued that the critics ironically failed to present adequate evidence of positivism in GIS, and added that rendering geographic space in GIS fits more closely with 'pragmatism' rather than any other epistemological approach including positivism. Likewise, through a conversation with Schuurman, David Mark (in Schuurman 2000) stated "computation is not necessarily positivism even though computation still requires empirical data." Mark differentiated the research method, quantitative research method, from the epistemology, positivism.

By reviewing these issues of positivist roots of GIS, we can see there was the preconceived notion that "GIS is a positive tool," and I believe it is one of the misunderstood assumptions of GIS, and, it consequently limit our practice of using GIS.

The social and theoretical implications of GIS ontology

were re-examined. In philosophy, ontology refers to the theory of existence and it asks the fundamental question of what exists. Its inquiry of 'existence' is transferred to the question of 'representation.' In regard to GIS, ontology has a slightly different meaning. It is often considered to be what GIS researchers believe exists and how to represent this existence inside a digital computer (Mark *et al.*, 1995; Mark, 1999; Schuurman, 2004). Especially, in relation to GIS's generally understood positivistic epistemological assumption, it is also assumed that positivism's characteristics, such as its insistence on the nomothetic laws about reality, might be embedded in the ontology of GIS as well. For instance, Sui (1994: 265) pointed out that to most GIS critics, positivists' insistence on the nomothetic laws about reality is "at best naïve, and at worst, an arrogant fantasy." As a way to represent the object in the real world, GIS has implemented certain logics and models, and it has been coincidentally related with its generally understood epistemology of positivism. GIS's embedded ontology might be limited in deductive and instrumental logic; however, that is not always the case any more, and it is more obvious when I re-visit this discussion now. Ontologically, the biggest limitation in current GIS is its inclination to the models and computations as many critics of GIS argued. Whether the based model is vector or raster, in our general understanding of GIS, all data have to be "quantified" in order to be included in GIS. However, we have seen that GIS, ontologically, is not merely based on a deductive or mathematical logic, and epistemologically, only for a positivist. For example, there are researchers who used raster-based GIS models in non-positivistic ways (Heasley, 2003; Jiang, 2003) as we will see more examples next section, and these are cases of non-traditional forms of GIS have broken the generally misunderstood or misconceived epistemology and ontology of GIS.

Two years after the Friday Harbor meeting, John Pickles (1995) published an edited book, *Ground Truth*, which focused on GIS and its impacts on society. It touched many important issues such as 'power' and

'socially constructed maps,' which emerged into the central themes in Critical GIS discussions. Pickles (1995) pointed out that GIS is not only made a new way to see the world by its visualization and spatialization capability, but also produced a spill-over effect such as 'unequal power relationship.' Power relations in GIS are also closely related to the following issues: surveillance and privacy (Crampton, 1995; Esnard, 1998), increasing domination of military and corporations in GIS industry (Schuurman, 1999b), underrepresentation of marginalized people (Sheppard 1995b) and the concept of socially constructed maps (Harley, 1992). For instance, Neil Smith (1992) examined issues of the social repercussions of GIS, especially the negative side effects of GIS through the example of usage of GIS in the first Gulf War. There are many issues we can relate to Smith's work, such as militarization and industrialization of GIS technology; however, the issue of 'power' is the most deeply embedded, in this case, the unequal power hegemony between dominant GIS users and marginalized GIS victims. Besides the effects of GIS in the processes of exploitation and unequal power relations through the military uses, Pickles (1995) considered side effects of GIS within the discipline whereas GIS has become a powerful tool by its visualization and spatialization capability to protect disciplinary power and access to funding.

In this reconciliation period, the gaps between the advocates and critics of GIS have been lessened and mitigated; however, as Clark (1998) saw, the unequal power problems and uneasiness remained. However, central themes in GIS and Society discussions have been continuously brought up and challenged in a more theoretical framework of critical GIS. Critical GIS, as the "trajectory of the path of knowledge production" (Sheppard, 2005: 6), begins standing at the interface between GIS and social theories, and makes users of GIS to be more conscious and to be critical of what their philosophical and epistemological grounds are, especially when they work 'with' GIS.

## IV. Creative Intervention and Permutation

The concept of critical GIS questions not only the social implications of GIS on society which has been the main issue in the early debate on GIS & Society discussions, but also the impact of society to GIS. Critical GIS also treats technology non-deterministically (Crampton, 2001), and concern with the intellectual and political issues of what we represent, and the limitations that how we represent people and space in GIS (Crampton, 2001; Crampton, and Krygier, 2006; Harvey *et al.*, 2005). However, the most influential aspects of critical GIS is a new *research paradigm* that allows the contrasting points of view, either epistemological or ontological, in geography, tackles on a particular problem using well-defined ideas (Sheppard, 2005: 6). Critical GIS has opened up the possibility of GIS in various researches rooted in different epistemologies, ontologies, and methodologies, and has evolved to the diverse and creative permutations such as feminist GIS, participatory GIS, approaching to technology, and qualitative GIS. Innovative researchers from both the critics and advocates of GIS pulled apart some already obsolete assumptions of GIS, and have shown different practices of critical GIS.

### 1. Engagement with Diverse Epistemologies

One of creative examples of critical GIS is to utilize GIS beyond its positivistic means. Some scholars demonstrated that GIS practice need not marginalize other epistemologies besides positivism, and have demonstrated what non-positivist aspects of GIS would look like by combining GIS with their own diverse epistemologies such as feminism, realism, social constructivism, and post-structuralism (Couclelis, 2004; Dixon and Jones III, 1998; Gibson-Graham, 2000; Harvey, 2006; Knigge and Cope, 2006; Kwan, 2002; Pavlovskaya, 2006; Poore and Christman, 2006). Among these efforts of intersecting GIS and social theories, post-structuralism has had an influential impact on

critical researchers having a non-positivistic perspective, for instance, post-positivist view. Post-structuralism, which is sometimes equated with 'post-modernism,' is a theoretical approach to knowledge and society that embrace the ultimate undecidability of meaning, the constitutive power of discourse, and the political effectivity of theory and research (Brennan-Horley and Gibson, 2009; Gibson-Graham, 2000). By explaining three important concepts in post-structuralism: deconstruction, discourse analysis and performativity, Gibson-Graham (2000) argued that post-structuralism, (1) helps particularly feminist geographers to (re)value the absence or subordinated term within a binary hierarchy are easily undermined, (2) challenges the universality by understanding certain knowledge become normalized and accepted as truth, and (3) emphasizes the uncertainties and discontinuities, respectively.

For example, by having post-structuralist perspective, Pavlovskaya (2002, 2004) studies women's formal and informal economies in Russia, and mapped the typically invisible transformation of multiple economies of households, which contributed to creating alternative geographies of transition that are rooted in daily household experiences, acknowledging the existence of information economies. Although her attempts seem to be as simple process as getting data and making a GIS map, it demonstrates how critical researchers can raise critical questions based on their own *epistemologies*, and furthermore, use GIS in a diverse and socially-engaged ways. As another example, McLafferty (2002, 2005) shows how GIS can provide a tool for visualization beyond the scope of daily experiences by including the daily experience of women who are suffering from a breast cancer. In her case, feminist epistemology to represent the situated knowledge are combined and visualized in GIS. Dixon and Jones III (1998) also delineated contemporary divisions between post-structuralists and spatial analysts and scientific approach.

It is hard to elucidate exactly how post-structuralism and other epistemologies directly impact on the practice of (critical) GIS (Pavlovskaya, 2006), and it is also not

clear how much these diverse perspectives are constructed, especially in the socially-engaged uses of GIS. However, these engagements with various epistemologies seemed to inspire many critical geographers to re-envision a singular category or a single method.

## 2. Participatory GIS

The central issue of 'power' in the earlier discussions demonstrates that GIS can have a simultaneous potential for empowering and marginalizing people in community. The concept of PGIS is started from the criticism of traditional GIS for its inability to represent various features of the world, especially those who do not have locations or spatial information (Curry, 1998). Public Participation GIS (PPGIS) and Participatory GIS (PGIS) respond to this question of 'power' in GIS. PGIS questions the alternative use of GIS for representing local knowledge, and considers how the local residents, especially, of marginalized area, can be included in the planning or research process, and how local knowledge, needs, desires, and even hopes of people can be represented adequately in that process by the help of GIS. Therefore, in PGIS, GIS has been considered to be influential to produce local knowledge; thus GIS can be part of a communicative discourse to understand better and how communicative actions shape power relations (Aitken and Michel, 1995; Al-Kodmany, 1999; Elwood, 2011; Weiner *et al.*, 2002; Obermeyer, 1998; Sieber, 2006). As a way to include contextual local knowledge, Elwood and Leitner (1998, 2003) conceptually discussed how to modify GIS database and construct alternative knowledge for the incorporation with local knowledge through GIS.

PGIS also focuses on brining community residents in the planning process, and helping them to participate (Barndt, 1998; Elwood, 2002; Ghose, 2001; Ghose and Huxford, 2001; Ramasubramanian, 1995). This is based on the belief that GIS can thus make a positive impact on the "empowerment" of residents, especially who were previously ignored in the research or planning process (Corbett and Keller, 2005; Elwood, 2006). GIS can become

a tool for empowerment, and local residents can have the power to represent their own needs and references by collecting and building their own local knowledge systems in GIS. However, we also need to remember that GIS does not always give a positive impact on 'empowerment,' 'participation,' and 'representation.' As some scholars warn us, GIS can equally not only promote, but it also marginalizes socially-differentiated people and community at the same time. Its impacts are always contingent (Harris and Weiner 1998; Weiner *et al.*, 2002).

PGIS is intended to contribute in capturing local knowledge in GIS; however, it is also distinguished practice of GIS in that it is not primarily a technology, but is integrative and oriented towards processes and communications 'about' representation as much as toward the representation itself (Curry, 1998; Sheppard, 2001; Sieber, 2004). PGIS is integrative and oriented toward process and communication, and of system of input participants, participation, and representation (Schroeder, 1997).

## 3. Approaching Technology

One of the main criticisms from GIS practitioners to the critics of GIS was the lack of understanding of GIS technology during the early debate period (Demeritt, 1996; Schuurman, 1999a, 2000). In response to this criticism, many researchers pursued understanding both social and technical side of GIS and its relationship with society. This was an effort to 'approach' GIS technology in order to directly incorporate with GIS not shy away from it, and to smooth the communication with the experts of GIS. Openshaw (1997) was sarcastic about the language usage by the critics, social theorists in particular. He did not think that the languages of social theorists are comprehensible for the GIS community. Even though his words were also contemptuous, Openshaw made an important point that most of critics including the participants who contributed to Pickles's (1995) book of *Ground Truth* were lacking an understanding

of GIS technology itself or never used it before for their researches. He was not alone. Although the words used were not as hostile as Openshaw's, Schuurman (2000) also insists that human geographers need to make an argument relevant to technology if they are serious, and must learn more about GIS.

We can also learn the equal importance of understanding technology inside GIS and its relationship with society from 'Sociology of Scientific Knowledge (SSK)' and 'Studies of Technology and Society (STS) literatures, which are based on the social constructivist perspective. These studies contribute to critical GIS by stressing how technology is intricately interwoven with our lives and society in many fundamental ways (Harvey, 1998, 2000; Schuurman, 1999a). For example, Harvey (1998) examined how GIS technology involves social negotiation among different social groups and multiple, even opposing, perspectives in a social constructivist framework. Schuurman (2002: 77) also admitted, "GIS is a social as well as technical parameter," and tried to find her way to incorporate GIS with social aspects of reality.

These discussions of social constructivism of GIS remind us of the equal importance of being familiar with GIS technology in order to understand its social repercussion, and there is no technology outside the social (Schuurman, 2002). Many cases of critical GIS, as we will see more from qualitative GIS discussions as well, are all attempts to incorporate technology with social aspects of reality.

#### 4. Qualitative GIS

Qualitative GIS has considered ways to incorporate GIS with qualitative data and research as a mixed-methods research. It is a 'methodological' as well as 'conceptual' intervention to the critical GIS discussions (Cope and Elwood, 2009; Jung and Elwood 2010; Knigge and Cope 2006; Kwan, 2004; Pain *et al.*, 2006). The term of qualitative GIS initially evolved from interests in integrating 'the qualitative' with GIS; however, it has become more than merely the sum of qualitative research and GIS

technologies. Rather, GIS has matured enough to the level at which innovative research practices have led to new forms of data collection, analysis, and evaluation.

On the conceptual level, qualitative GIS raises questions connected to critical GIS, particularly how GIS causes researches to confront and reconcile different ways of knowing and representing the world. On the practical level, it attunes to the new techniques, tools and practices that are constantly being developed to construct and strengthen spatially referenced, qualitatively informed multi- and mixed-methods inquiries. Here, we also need to be more cautious to understand the subtle difference and relations between qualitative GIS and critical GIS. I argue that qualitative GIS is not just a subfield of critical GIS; rather, it creates a new possibility of critical GIS by denying any determined research method whether it is a quantitative or qualitative method. There are also two very different, but closely related ways of defining qualitative GIS.

The qualitative characteristic of GIS via spatial information theorists is one trajectory of understanding qualitative GIS. Spatial information theorists critique that conventional GIS is not enough for geographic concepts and provides fewer tools for complex spatial analysis, and they try to develop their own formal models with their main research of interests (Gahegan, 1999). Even though spatial information theorists do not specifically consider the interrelationship between qualitative research and GIS, it is important to acknowledge their contributions since they have concern with abstracted relationships between objects in space, as opposed to the underlying geometry defined by the raw spatial data (e.g. qualifying quantitative data logic) (Egenhofer and Mark, 1995; Gahegan, 1995; Mark *et al.*, 1995; Shariff 1998). The concept of "naïve geography" is particularly helpful to understand this logic. Naïve geography is "the field of study that deals with formal models of surrounding *common-sense* geographic world which means geography performed by people, and reasoning needs little explanation." (Egenhofer and Mark, 1995: 2) It can be shortly defined as the body of knowledge that 'people' define about



their world. For instance, in this perspective, more qualitative data such as natural language might be expected to use to describe people's surrounding environment and defining characteristics such as topology and landscape. The main strategies of spatial information theorists responding the issues of 'qualitative' in qualitative reasoning were mainly focused on the development of formalisms of geographic models and testing the formalized model of qualitative GIS<sup>3)</sup>. In the case of naïve geography, qualitative reasoning methods of both spatial and temporal data as well as the inference rules are employed in lieu of numerical quantitative approximation (Egenhofer and Mark 1995).

The other trajectory of qualitative GIS was motivated by the efforts of both GIS practitioners and human geographers who were eagerly pushing the envelop to develop unconventional ways of using GIS, and for those who critical question the interlocking relationship between GIS and society, and especially those who use GIS combining both quantitative and qualitative data and research method. The key question was what qualitative forms of knowledge might be, and what forms of knowledge could be excluded in traditional GIS. Different qualitative GIS strategies created a framework in which many diverse practices involving qualitative research and GIS could be accumulated insights and original contributions.

First, the power of visualization and (map) image has been theorized, and qualitative data have been visualized in GIS in a qualitative way (Rose 2001; Krygier 1999). Researchers in PPGIS and PGIS well testify the visualization impact of GIS to produce local knowledge and include participants in the research process. Al-Kodmany's (1999) case study of Chicago's Pilsen neighborhood and Elwood's (2006) experience in neighborhood spatial knowledge building are good examples of how GIS can visualize and represent local knowledge and spatial narratives. Secondly, not only data but also qualitative research has been visualized in GIS. In other words, GIS has been used to show the findings of critical ethnographic study or qualitative research. Kwan and Lee's (2004) study of gender and ethnic difference in terms of space/time

prism in Oregon, Portland and Pavlovskaya's (2002) work of information economy in Russia that I mentioned before clearly demonstrate this. Thirdly, qualitative data are often multi-format data such as texts, image, audio, and video, and can be contextualized by connecting with a spatially referenced data in GIS through 'hyperlinks' tools within GIS. Talen's (2000) concept of 'hypermedia,' Cieri's (2003) research of investigating lesbian social space in Philadelphia, Weiner and co-workers' (2002) GIS-Interactive Multimedia, Matthews *et al.*'s (2005) 'hot-links' are all diverse practices to use 'hyperlinks' tool in GIS in a way to integrate GIS with qualitative data and research.

Qualitative GIS has brought up growing GIS's potential for non-positivist modes of analysis including qualitative research, and attempted to break the taken-for-granted binaries of quantitative and qualitative geography in the discipline (Kwan and Knigge 2006; Schuurman and Pratt 2002). There are different types, phases, and levels of 'mixing' of qualitative research with GIS, and GIS and qualitative research are more *recursively* and *iteratively* integrated throughout the research process. By placing and discussing diverse practices of qualitative GIS allows us to see many creative, innovative, and emerging original uses of GIS with qualitative research from the perspective of critical GIS. Moving from the idea of GIS *within* mixed-methods research where there is an integration of GIS as a quantitative research tool and qualitative research, new discussion of qualitative GIS considers GIS itself *as* mixed-methods research, inherently having both quantitative and qualitative characteristics (Cope and Elwood 2009; Jung 2009). Methodologically, GIS as a mixed-methods approach is the most qualitative form it can ever have because GIS cannot be completely qualitative tool or method, either<sup>4)</sup>. Qualitative GIS has generated great interests, discussions, and refinements among researchers and practitioners seeking to break down methodological barriers and produce new knowledge, and proves that the relationship between GIS and embedded (both positive and negative) assumptions should not be necessarily deterministic.

## V. Greater Need for Critical GIS Than Ever Before: Geoweb, Big Data and Spatial Media

Twenty years after the Friday Harbor meeting in 1993, a special forum of 'Revisiting Critical GIS' is scheduled this year at the exact same location<sup>5)</sup>. The key questions are around the raising questions of rapid development and dissemination of digital geospatial technologies, datasets, and practices, and if the discussions and arguments of 'critical GIS' still remain relevant or not. It also draws attention on new possibilities and challenges for the geoweb, Big Data and digital humanities that many consider 'new lines' of critical GIS and GIS and Society discussions (Goodchild, *forthcoming*; Wilson, *forthcoming*). For instance, new scholarship on Big Data has rapidly developed out of various theoretical and analytical spectrums, and many efforts have also been made by geographers to develop new geospatial applications designed to research them (Barnes, 2013; Boyd and Crawford, 2012; Kitchin, *forthcoming*; Shin, *forthcoming*; Sui and Goodchild, 2011; Wilson, *forthcoming*). I would like to briefly share my own enthusiasm as well as concerns for these new developments in regards to critical GIS, and pitch for the greater need for critical GIS than ever before.

First, socially-relevant and socially-engaged critical GIS practices need to continue challenging the conventional use of GIS, and encourages the development of a critical literacy in the innovative use of map and cartographies to destabilize fixed social and spatial categories. New mapping technologies (e.g. location-based service, spatial media) can make it possible to visualize more complex, nuanced, layered social issues (see, Leszczynski and Elwood, *forthcoming*), for various new spatial media examples). At the same time, we need an iterative and reflexive conversation with broader social and spatial theories. For instance, visual analyses and representation in GIS are more powerful now due to the ever-growing Information and Communication Technology (ICT) and GIS technologies; however, these can only go

so far in representing the full complexity of related phenomena such as digital divide, privacy, social and spatial inequality, social reproduction, and additional processes that are not typically "represented" and that perhaps cannot ever be fully visualized in a conventional GIS. I argue, therefore, that new geovisualization techniques themselves might best be understood as powerful yet limited pieces of subjective data, which need to be always considered in conjunction with broader social and spatial theories. Social history of critical GIS clearly suggests this, and we need to keep in mind that critical GIS is closely related to the socially-relevant uses of GIS (Dorling, 1998; Fiedler *et al.*, 2006; Kanarinka, 2006). Critical GIS gives researchers to have a critical eye to see the stories hidden behind GIS including power relations, gender inequality, and social marginalization, and further more to consider the way to represent these critical social concerns and issues.

Secondly, there is (un)surprisingly a lack of discussions of implementing qualitative analyses, or of exploring synthetic approaches that invite an integration of qualitative data and analyses and geographic visualization engaging 'with' Big Data. By reviewing the significance of qualitative GIS as a critical GIS approach, I see the relevance and credibility of qualitative GIS on the geographic study of Big Data. Qualitative GIS make us consider different levels and meanings of qualitative data. Qualitative data are understood from non-numerical data and rich descriptive data, and to interpretive qualitative data, and then, qualitative analysis that is intended to reveal the contexts and meanings of qualitative data. What we often see are various forms of qualitative data in Big Data, and it is important to ask which level of qualitative data are currently included as a part of Big Data analysis, and how. Technical and practical discussions of implementing qualitative GIS approach to Big Data analysis needs to be followed as well. For example, for analyzing textual data in social media, Big Data analytics techniques as Text Analytics and Text Parsing are often used, but it certainly requires certain levels of knowledge and technical expertise in Natural

Language Process, Machine Learning, Database Management Systems, and Computer Programming Language. It calls for a new level of 'approaching technology' practice and attitude standing between technical and critical practices – what Wilson defined as a techno-positionality (Wilson 2009).

Thirdly, the use of critical visual methodologies should be further extended. The outcomes of critical GIS approaches are often (newly created) 'visuals'. In addition, the rapid proliferation and diversification of spatial media, contents in geoweb and spatial media are mainly 'visual' and they are often connected to other visual and textual representations (Elwood, 2010). However, many critical GIS discussions have been focused on the multiplicity of theory, data, and analyses of GIS, and the contingent nature of visualized representation have not received enough attentions so far. Visuals are constituted representation; however, they are also constitutive. We particularly need to understand this inherent qualitative and critical nature of 'visuals' and remember that the outcomes of geographic analysis are often visuals that we not only need to represent them, but also to understand how to interpret and process the information in visuals.

Lastly, the level and pace at which new web-based GIS and spatial media have expanded and influenced our lives are quite unprecedented. However, the problems and concerns in the early debates in critical GIS discussions, such as uneven power relations, data access, digital divide, and privacy and surveillance, are still maintained. Indeed, these issues are more intensified and produced new types of ethical and social problems that we have not seen before. The gaps between people who access to geospatial technologies and new spatial media and those who cannot have been widening (Goodchild, *forthcoming*). In addition, the adaptation of user-generated geographic information in geoweb and spatial technologies have been interpenetrated to our everyday lives differently, and resulted in an uneven distribution of geographic data and representation of different places. We see a more nuanced digital divide

based on social, economical and political orientation, and, even by age and gender (Graham and Zook, 2013; Leszczynski and Elwood, *forthcoming*; Stephens, 2013; Thatcher, 2013). New developments and emerging researches, such as the geoweb (Leszczynski and Wilson, 2013), spatial media (Elwood and Leszczynski, 2013), spatial humanities (Bodenhamer, *et al.*, 2010), Crowdsourcing GIS (Sui *et al.*, 2013), and neogeography (Turner, 2006), present a exciting possibility in critical GIS scholarship; however, they may reinforce digital divides, disadvantaging the poor and specific racial and ethnic population, and marginalizing people in under-developed and under-represented region. The discussions of critical GIS will be further realized and developed through these new emerging fields.

## VI. Conclusions

Critical GIS was introduced as a new sub-discipline, one that uniquely straddles technology and geographical theory including social and social theory, and is still standing on the border of GIScience and human geography (Elwood, *forthcoming*; Schuurman, 1999a). I began this paper with the detailed examination and critique of central discussions in critical GIS, first by chronologically, and then by key themes. We witnessed that many debates between the advocates and critics of GIS arose around the claim of GIS's narrowly understood putative positivistic epistemology, its biased ontology, its reliance on secondary quantitative data and deductive empirical analysis. Social implications of GIS, especially related to unequal power relation were often debated. By re-visiting these early as well as newly-developed arguments of critical GIS, I highlight that there were apparent misconceptions of GIS, and these limited generally embedded assumptions of GIS have restricted our understanding and uses of GIS. At the same time, fortunately, these discussions of critical GIS helped us re-conceptualize the un-seen possibilities of GIS beyond the way that people usually imagined

two decades ago. I fully support this idea by demonstrating many emerging and innovative ways of theorizing and practicing critical GIS, critical research 'with' and 'for' GIS, and these examples, I hope, provide new ways to reflect various epistemologies, ontologies, and methodologies of GIS, and to unfold interlocking relationship between GIS and society further. Critical GIS continue helping us to understand the roles and positions of GIS and the theory and social perspective behind it.

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- 1) Nadine Schuurman's (1999a; 2000) description of personal interviews with the individuals involved in this debate allows us to vividly understand the change in atmosphere between two groups
- 2) As one of steering committees, David Mark commented about this meeting: "When I and my colleagues organized this meeting, we anticipated one-third GISers, one-third social theorists, and one-third philosophers were coming. However, people who had really an opposite opinion even didn't show up at the meeting. So, we can say that people who showed up had relatively open-minded, and the atmosphere was actually more positive." (Personal Interview with David Mark, April 17, 2006)
- 3) We can clearly see the different from Egenhofer and co-researchers' (1999) suggestion of the need of geographic research that a linkage between human and thought regarding geographic space and the mechanisms of implementing these in *computational models*.
- 4) Here, I also think that qualitative GIS can be valuable for a positivist and empiricist epistemology as well.
- 5) More information about this special meeting will be available at <http://revisitingcriticalgis.github.io>.

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