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Commentary

Ground Truth 1995–2005

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In the mid-1990s, Los Alamos had a vision to develop a truly cognizant surveillance system that is adaptive and capable of learning normal behaviors based upon past experiences integrated with human expert knowledge and current scenarios to determine the state of the surveillance area. They would build predictive capabilities for future scenarios and trend analysis.
DOE NN-20 sponsored the research necessary to develop such capabilities as adaptive reasoning, image processing (providing image differencing and feature extraction), an integrated facility status system (providing the overall state of a facility), advanced biometrics, pattern recognition, anomaly detection, real-time communications, and data fusion.

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http://nis-www.lanl.gov/nis-projects/amiss/

1 Background

Ground Truth was conceived during a conversation with Brian Harley at the Annual Meeting of the Association of American Geographers in Miami in 1991. It had its roots in our respective earlier work on deconstructive and genealogical readings of what Brian saw as the hidden and embedded assumptions of maps and what I saw as the discursive and disciplinary *dispotifs* of GIS (and what I have subsequently characterized in broader terms as the social lives of maps (Pickles 2004b)). It was published in 1995 after Brian's death. At that conference, Brian and I both felt – as the various authors in this collection reflect – that GIS was becoming a powerful mediator of spatial knowledge and a powerful social actor, having emerged rapidly in conjunction with a broad series of institutions (ranging from the apparently iconoclastic Harvard Graphics Lab to the then rising Redlands 'empire' to strategic interests in terrain modeling and surveillance of various kinds among many others: see the History of GIS Project – http://www.ncgia.buffalo.edu/gishist/ for additional details).

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One issue of central concern to us was the way in which disciplinary practices were changing as Geography departments rushed to invest in GIS. This created significant new challenges for departments of Geography, sometimes placing inordinate demands on budgets, personnel, and space and rapidly changing both their content and cultures, creating new centers of dynamism and deepening old antagonisms among faculty and in some cases creating new ones. Should foreign languages still be required of doctoral students? Couldn't computer languages count as a foreign language? Why do GIS students need to take the History and Philosophy of Geography required courses? And in the early 1990s, doctoral students looking for academic positions found that few did not require expertise in GIS. Such concerns may seem quaint today, but at the time they were stretching the patience if not civility of departments and sub-fields. For those involved, GIS clearly offered new opportunities for integration, transcending the earlier lines of demarcation between human-physical geography and repositioning geographical analysis in the broader academy and beyond. For others, GIS was seen as a kind of threat. The immediate loser was professional cartography with its long history and deep commitments to craft production and a specific kind of map aesthetic (academic positions for cartographers were few and far between in those years, and perhaps since). But, as several of the authors have indicated, a more significant element of the debate that ensued was a kind of 'Science Wars' between the inheritors of spatial analysis who had worked with GIS in order to resolve some of the limitations of spatial data, computational power, and ecological and interactional effects of earlier modeling and those who had struggled against its earlier positivist, reductionist, and policy oriented logics (see Dobson 1993a; Pickles 1993, 1997; Sheppard 1993; Wright et al. 1997). GIS thus entered Geography as both slayer of cartography and champion of a reborn quantitative revolution and applied geography. And it entered with a swagger of the well-healed freshman with social connections.

GIS also entered the field at the very height of critical human geography's powers, following a decade of epistemological and methodological rethinking by Marxist, feminist, and humanistic scholars. As GIS emerged as a vibrant intellectual and institutional force, it did so just as critical geographies had reworked their older commitments to 'science' narratives of explanation, re-positioned the role of theory away from hypothetic-deductive models to complex and diverse social theoretic and historical accounts of process-pattern relations, the socio-spatial dialectic, the production of space, uneven development, contextual explanation, standpoint theory, and contingent and necessary relations. These engagements also involved serious questioning of the relationships between knowledge production and the interests it served: knowledge by whom, for whom, and to what ends? Post-positivism was, in this sense, also an opening of critical geography to a renewed commitment to projects of counter-power and the weapons of the weak.[1]

By contrast, GIS emerged with particularly strong commitments to modernist and progressivist notions of science and a renewed sense of the power of the universality of hypothetico-deductive methods. As Schuurman and Leszczynski (2006; this issue) point out, such renewal depended on a reworking of basic ontological categories and required that attention be given to the ways in which metadata is constructed and used. In 1992, Michael Watts and I (Pickles and Watts 1992) had argued that the absence of this kind of ontological and methodological discussion rested all too easily on defensive claims that different approaches to 'science' had generated separate spheres (or paradigms) of knowledge production and that, since there was a fundamental paradigmatic

incommensurabilty, too many geographers had taken the view that there simply was no need to take seriously the decade of critical geographic work on hypothetico-deductive approaches to science (that it was inherently conservative of the status quo (Olsson), that it was too readily appropriated to specific societal interests (Harvey), that it reduced 'life' (or the complexities of place) to location (Relph), and that it failed to account for gendered and raced differences that constitute actual spatial decision-making (Hanson)). It was, instead, science as usual.

It was particularly difficult in those early days to see in GIS and Geography much room for debate and dialogue that was not a form of partisan argument (Pickles 1998, 2006). Students and training suffered on both sides. GIS students were rarely introduced to the prevalent debates about philosophies of science, social theory, and cultural studies, they were largely unable to unleash whatever critical and hacking impulses that may have brought them to computational science and computer graphics in the first place, and they found that their graduate lives were often spent in siloed 'programs' separated into physical 'labs' and away from the disciplinary churning at work in other sub-fields of their departments. In parallel, the technical possibilities for larger data-sharing and analysis were not taken up by most Marxist, feminist, and humanistic geographers, and perhaps this also had longer-term consequences for the kinds of interventions and the claims on funding agencies their research has been able to make as neo-liberal social and economic policies increasingly restructured public services and everyday life at home and abroad. In the 1980s and 1990s, Mr. Moneybags and his newly re-energized global monopolies and financiers re-asserted their claims on the re-allocation of social surplus, and it remains for me an open question whether critical human geography might not have been more effectively engaged in disciplinary and social transformation if it had worked in and through the emerging spatial data handling technologies. Certainly, it does now seem that GIS has been more successful at participating in shaping the agendas around the bigger issues of climate change, energy politics, poverty alleviation, community development, security and risk. The work of Gahegan and Pike (2006; this issue) and Gilbert and Masucci (2006; this issue) illustrates some of the interesting possibilities of this kind of engagement and brings the discussion of GIS much more closely into line with the ways in which social movement activists are currently voraciously adapting the visual, analytical, and political possibilities of spatial data technologies to their own ends.

As some of the authors in this collection have indicated, the stakes were indeed high. I well remember my first real encounter with the political power of GIS in the mid-1980s. It was in an open citizen meeting around the siting, construction and operation of Morgantown Energy Associate's waste coal and cogeneration power plant facility in Morgantown, West Virginia. The facility, which cost approximately $174 million, was constructed to produce steam for West Virginia University and electricity for Monongahela Power Company and was located on the banks of the river next to the town center.[2] Public opposition to the plant was strong and citizen meetings were held regularly to oppose the plant. At one such meeting, MEA lawyers and specialists presented their case for the safety of the plant, despite its location next to the town, in a deeply entrenched river valley, with a smokestack projected at over 100 m. At the heart of the public meeting was a crude GIS mapping of the plant, its site, and the projected meteorological and health impacts. I don't think anything about the GIS analysis or the maps that were presented at the meeting was convincing to any of those present, but it was also clear that was not the point. The presentation was only an element, and an essential

one, in the preparation for the court case to come. The GIS analysis and the maps presented were the legitimizing tools of a longer and larger strategy of 'citizen participation' for the courts. It was particularly shocking to see the cavalier deployment of GIS by this group, but equally surprising to see the speed with which the community group fashioned their own mapping tools to present a counter claim in the case.

The third major stimulus for *Ground Truth*, as the authors in these essays correctly point out, was the growing concern among increasing numbers of scholars and activists in the 1980s over surveillance and the role that digital data and remotely sensed imagery was beginning to play. In 1982, the United States' Department of Defense had launched and began operating the Navstar Global Positioning System (GPS), a network of 24 georotational satellites that orbited the Earth at a distance of 12,660 miles. Not only were the broader surveillance implications of the system apparent, but so too were the ways in which such technologies were rapidly contributing to fundamental issues of data and information access; these digital divides were playing themselves out geopolitically in the greatly expanded integration of digital information and surveillance technology in the US military and in the growing gap among those with and without the means to invest in hardware and software needs for their use. In the case of GPS, the divide had been designed in from the beginning, producing two flows of information: a 'robust' one (nearly instantaneous and accurate within 30 m) and designed exclusively for US military use and a 'degraded' one (time-delayed and accurate within 100 m) designed for other users, including researchers studying on research grants from NASA and other US agencies.

The launch of Navstar was one of a whole panolpy of surveillance technologies emerging in the shadow of '1984' and the late Cold War, and each had enormous potential to increase efficiencies, manage risk, and redefine individual identities and rights and the balance between the public, private, and corporate. Remotely sensed earth satellites were paralleled by the development of more direct and individualized public surveillance technologies such as CCTV Surveillance, face recognition software, biometrics, and motion sensors (see http://www.spy.org.uk/techno.htm for additional details). By the early 1990s, it was clear that geographical information systems had been fully integrated into remote sensing and that enormous efforts were then being directed to a more seamless integration of such distanced surveillance systems with biometrics (see quotation with which this commentary begins). Secret military research was integrating complex terrain modeling with manned and unmanned pilot studies, including everything from drone surveillance to unmanned missile guidance systems to biometric pilot controls. At the time, these were being tested in prototype stage as older guidance systems were being deployed in military operations in Panama, Somalia, Iraq, and Belgrade (see Clarke 1992).

Here the ontology of visibility and transparency was at its strongest and most seductive (Doel 2006, Pickles 2006). My very first paper on GIS was on surveillance (Pickles 1991) and I have continued since to try to articulate ways of thinking about the broader social and ideological contexts of digital data and spatial information futures (Pickles 2004a). These contexts range from the small technical, scientific, and practical determinations of typologies and standards to the large-scale 'moonshot' commitments and investments made by states and corporations in next generation information and mapping technologies (Pickles 2006). I have always seen them to be as much about the shaping of social policy (bio-politics) as they are about science.[3]

I am particularly interested in the logics of transparency that are being built into information systems and their social consequences, particularly the ways in which the

desire for transparency and 'complete' knowledge shapes public policy. This is a kind of socio-economic political geography of *Dossier Society* (Laudon 1986) meets *Mirror Worlds* (Gelerntner 1992), nearly always aimed at rendering humans and resources visible.[4] These are technically fascinating productions and have enormous potential commercial and policy value. But, in broader politico-epistemological terms, I wonder about the ways in which, as Elwood (2006, this issue) writes, they also reinscribe the desire for (and myth of) total vision and the God-trick at the heart of the new digital data initiatives (see Pickles 2004b, 2006). It is a fascinating puzzle of modern science that its key impulses to illuminate the workings of the world in new and useful ways are so readily aligned with the logistical and geopolitical goals of a militarized state, where a belief in transparency can lead so easily to adventurism (and to the hubris that regime change comes from overwhelming technical superiority and its deployment in 'shock and awe'), where concern for ecological sustainability leads to a broader social calculus that renders nature as value or risk (with attendant management policies of carbon sequestration and credit trading), or where the consequences of global economic policies of open capital markets, free trade, and institutional transparency can so readily produce a social regime of homeland security that enables policies to emerge like "the transition to America's Shield Initiative" along the 3,142 km (1,951 mile) U.S.-Mexico border (see http://www.dhs.gov/interweb/assetlibrary/OIG_06-15_Dec05.pdf for additional details). And it is precisely these kinds of questions that critical human geography seeks to address.

Ground Truth emerged in this context of growing awareness of the *surveillant society* and the emergence of a new kind of bio-politics focused on populations, markets (geodemographics and 'Enterprise GIS'), aggregate flows and desires (political gerrymandering, electoral planning, or business marketing decisions), and – of course – ways of measuring, mapping, and evaluating value (be it base resource stocks, carbon sequestration, or wetland credits). Not surprisingly, these projects attracted bright people interested in pushing the knowledge frontiers, seeing what could be done, and trying out new applications and uses. Also not surprisingly, these applications generated equally strong interests in thinking about the social implications of their use, the possibility of new forms of regulation, and the opportunities for entirely new uses. As Elwood (2006, this issue) describes, with the tendency for GIS, remote sensing and a wide range of other technologies to be integrated, efforts emerged to rationalize data standards and systems (such as the National Data Standards Initiative and the Digital Earth Initiative) and to create regulations governing appropriate uses (e.g. the UK based Local Government Information Unit recommendations for a proper code of practice governing CCTV use). As one of the authors in the collection writes, in all of these contexts – disciplinary focus, student training, public policy, and the emergence of ever more sophisticated geodemographic and bio-political surveillance and control systems – the stakes were very high.[5]

2 Reflections Post-1995

So, what was achieved and how far have we come? The authors in this collection point to the interesting and often exciting work that is now being carried out in the field. If *Ground Truth* contributed anything to this it was probably only to lend some legitimacy to these kinds of issues, concerns, and questions, and – as was its explicit intent – to provide a wide range of linguistic and conceptual tools to do that. It is important to

remember that *Ground Truth* was not the only stimulus to even this limited set of goals. Jerome Dobson's (1993a, c) papers on 'Automated Geography' and the responses to it had already prefigured some of the epistemological discussions in *Ground Truth* (see, especially Sheppard (1993) and Pickles (1993)). Eric Sheppard's key 1995 essay 'GIS and Society: Towards a Research Agenda' (Sheppard 1995a) was not in the volume because it was about to be published in the special issue of *Cartography and Geographic Information Systems*, and it too had been prefigured by Eric's careful review and critique of National Science Foundation supported GIS research programs at the National Center for Geographical Information Analysis, in which he had made a very strong call for a broadening of NSF support and NCGIA research activities on issues relating to GIS and Society.

Together, these overlapping initiatives spawned an interest in 'heading off' whatever negative impacts a social critique of GIS might generate, and this led to a meeting between 'GISers' and what were then referred to as 'the social theorists'.[6] This was the Friday Harbor Meeting, Washington, in November 1993, out of which – at least for Geography – came so much (see http://www.geo.wvu.edu/i19/ for additional details). NCGIA at Santa Barbara, Buffalo, and Maine supported the Friday Harbor conference and this, in turn, generated not only Initiative-19 on 'GIS and Society: The Social Implications of How People, Space, and Environment are Represented in GIS' (began February 1996), but also longstanding relations of collaborations and friendships, with follow-up meetings in Minnesota, Maine, and Santa Barbara, among others.[7] In the words of the executive summary of the Friday Harbor meeting:

> "The workshop brought together researchers and graduate students from the US and Europe and represented a spectrum of the Geography discipline. Deliberations began in an opening plenary session where the steering committee identified three core I-19 conceptual issues: (1) epistemologies of GIS; (2) GIS, spatial data institutions, and access to information; and (3) developing alternative GISs. Subsequent small group and plenary discussions generated the following seven research focus areas: (1) GIS 2 and virtual geographies; (2) GIS social practice and intellectual history; (3) environmental justice and political ecology; (4) GIS in the community – local knowledge and multiple realities; (5) data access, privacy and geo-demographics; (6) gender and representation; and (7) geographic information (and systems) and the human dimensions of global environmental change" (see http://www.geo.wvu.edu/i19/origins/proposal.html for additional details).

Thus, a central goal of both *Ground Truth* and these meetings was to make certain kinds of conversation possible and certain kinds of questions legitimate ones for students to ask. In the early 1990s, the excitement over GIS had not led to very much broader questioning of the politics of funding and technology development, of the consequences of an emerging digital divide, or of the social possibilities for GIS to be other than a tool of advanced technical science (but see Pickles 1991; Yapa 1991; Brandt and Craig 1994; Chrisman 1987; Dansby 1991; Clark 1992; Clarke 1992; Miller 1992; Onsrud 1992a, b; Dobson 1993b; Lake 1993; Onsrud et al. 1994; Crampton 1995). In the decade since, we have seen a flourishing of conferences, workshops, and publications in which divergent perspectives have fleshed out key common concerns. GIScience has emerged to challenge the GIS community to develop rigorous traditions of reflection, critique, and theory development around GIS. Individuals like Jerome

Dobson, Mike Goodchild, and David Mark have pushed for institutional broadening and deepening (see Dobson 1993d), and others like Eric Sheppard, Michael Curry, Trevor Harris, and Dan Weiner have been willing to engage in those institutional initiatives (e.g. Sheppard 1995b, Mark et al. 1998). As a consequence, GIScience and critical approaches to GIS have together articulated broader theoretical goals and a different institutional role for GIS in Geography and the broader academy, in turn transforming the role GIS now plays in research and education through a much more diverse set of approaches, theoretical concerns, and applied contexts.

My own interest in GIS was always less focused on GIS as a tool of analysis – as GIScience as an institutional nexus – and more on its role as a social actor. While other contributors to *Ground Truth* wrote about GIS in its present form, my interest was always in the social and technical assemblages that were coming into being, of which GIS was one focal point but not the only one. Stan Openshaw captured this interest in one of the workshop discussions at Friday Harbor when he suggested (paraphrasing) that "what you all want is GIS2"; "If what we have now is GIS1 – a binary logic Turing machine, produced with specific kinds of ontologies and uses in mind, what you want is GIS2, a different geographical information system, with different logical operators, different ontologies, and for different uses. Now that is an interesting proposition."

The extent to which GIScience and Critical GIScience or participatory GIScience have been able to produce GIS2 remains, I think, an open question (Barndt 1998). Denis Wood (2005) remains skeptical. He has recently asked of *P*ublic *P*articipation *G*eographical *I*nformation *S*ystems, where is the public, where is the participation, where is the geographical, where is the information, and where is the system? In part, he is responding to the immense possibilities for a broadening engagement of communities and publics in debates about local and regional resource allocation decisions, and the ways in which current information and mapping technologies make this possible (see Craig and Elwood 1998). Changes in the scale, power, and cost of GIS have certainly corresponded to a boom in the number and types of users and the diversification of products available to users. Hardware and software costs have declined and accessibility, power, and ease of use have improved. At the same time, dominant actors like ESRI have emerged in the market creating added funds and direction for innovation and simultaneous standardization.[8]

Together these have generated a shift in the ways in which geo-spatial technologies are being used and by whom. Elwood (2006, this issue), Schuurman and Leszezynski (2006, this issue), Gahegan and Pike (2006, this issue), and Gilbert and Masucci (2006, this issue) provide fascinating insights into the ways in which conceptual and critical approaches to GIS are integrating the lessons from participatory GIS, GIScience, information science and conceptual mapping, and community activism into new and exciting forms of GIS practice. It is hard to imagine 'standardization' emerging from these endeavors, and surely that is, in part, the point. A strong committed politics of participatory GIS and the appropriation of spatial data technologies and critical cartographies by community activists and social movements have changed entirely the specific places and communities in which GIS use is occurring, and along with it will continue to pose questions about the nature and meaning of what GIS means in the lives of communities, including communities of 'expertise'.

The criticisms in *Ground Truth* about the ways in which these technologies and analytics were being conceived and used in the service of state, business, and political organizations remain largely true today. But as the authors in this collection have shown

so nicely, the actors in this game are changing, new uses and logics are being developed, and the possibility for a participatory and democratized GIS is now very real. The essays in this collection provide important insights into why and how engaged and concerned GIS can speak to these kinds of geographical information futures and who will design and map them. I want to thank Sarah Elwood and Nadine Schuurman for organizing the sessions at the Annual Meeting of the Association of American Geographers and for bringing together these papers and commentaries. The kinds of ontological and conceptual remapping that the essays represent may well see not just an expanded use for GIS1, but the emergence of a real set of GIS2, GIS3, . . . as the struggles to democratrize technologies and change the instrumentality of their logics and uses continues to gain ground among new communities of users. Among social activists in many parts of the world, the use of GIS and other mapping practices as a form of counter-power and counter-mapping has been fundamental to social mobilization and concrete political struggles. What they might do in the next decade with these practices, geospatial technologies, and the kinds of innovations these papers address is anyone's guess.

Notes

1 The institutional history of this emergent 'big science' model of research in GIS and Geography became the focus of the GIS History Project following a 1996 National Center for Geographical Information Analysis (NCGIA) sponsored workshop in Santa Barbara (see http://www.ncgia.buffalo.edu/gishist/ for additional details).

2 See http://www.interworldtechnologies.com/MAE.pdf for a brief summary of the plant; http://www.state.wv.us/wvsca/docs%5Cspring92%5C20647.htm for the court case resulting from filings of nuisance caused by the transport of waste from the plant by road; and http://72.14.207.104/search?q=cache:zMhUS_aPh30J:www.psc.state.wv.us/orders_hist/1988/88001290.pdf+monongahela+river+cogeneration+plant+Morgantown&hl=en&gl=us&ct=clnk&cd=1 for the 1989 case before the Public Service Commission, Charleston, West Virginia.

3 I have been particularly interested in the short step from GIS and Gelerntner's (1992) *Mirror World* to the present massive investments in 3-D GIS modeling at the Los Alamos National Laboratory to the Department of Homeland Defense's 'America's Shield Initiative' (http://www.dhs.gov/interweb/assetlibrary/OIG_06-15_Dec05.pdf) and the Department of Defense program of Full Spectrum Dominance (Joint Vision 2020; http://www.defenselink.mil/news/Jun2000/n06022000_20006025.html).

4 See, for example, the Los Alamos 3-D GIS models of surface and subsurface hydrological flow, contaminant dispersal and porous flow studies, structural geology, subsurface volcanic plumbing, mining, ore body, and petroleum reservoir studies, and the relationship of geologic structure to topography, and their 3-D GIS analysis of solar insolation studies for crop and forest productivity, viticulture, and snowmelt (see http://www.gislab.lanl.gov/research_develop/3d_GIS.html for additional details).

5 My interest in GIS has always been as much an interest in trying to shape a sub-field of political economy that David Lyon (2002) has come to call "surveillance studies." See Lyon's argument for the need for surveillance studies in the inaugural volume of the online *journal Surveillance and Society* (http://www.surveillance-and-society.org/articles1/editorial.pdf).

6 Participants included Ron Abler, Stuart Aitken, Michael Barndt, Kerry Brooks, Nik Chrisman, William Craig, Helen Couclelis, Michael Curry, Susan Cutter, Catherine Dibble, Graham Dudley, Oliver Froehling, Michael Goodchild, Jon Goss, Trevor Harris, John Krygier, Helga Leitner, David Mark, Patrick McHaffie, Bob McMaster, Roger Miller, Mark Monmonier, Timothy Nierges, Nancy Obermeyer, Harlan Onsrud, Stan Openshaw, John Pickles, Paul Schroeder, Michael Scott, Eric Sheppard, Daniel Sui, Jonathon Taylor, Dalia Varenka, Howard Veregin, Dan Weiner, and Andrea Westersund (see http://www.geo.wvu.edu/i19/report/list.html for additional details).

7 These included the Public Participation GIS Project, History of GIS Project, and the Varenius Project. See, for example, the Empowerment, Marginalization, and Public Participation GIS workshop held in Santa Barbara, 15–17 October 1998 (see http://www.ncgia.ucsb.edu/Publications/Varenius_Reports/PPGIS98.pdf for additional details). It is an interesting question whether this kind of extended and vigorous conversation among colleagues and friends occurred to the same degree in the United Kingdom (see, for example, Flowerdew 1998).

8 Data released in 2002 by Daratech, Inc., a Cambridge, MA-based market research and technology assessment firm, indicated that in 2001 worldwide GIS software revenue reached $1.1 billion, representing 14.3% growth over the previous year. The largest market for GIS software was the utilities industry (21% of all software revenue), followed closely by state and local governments, the telecommunications industry, and organizations involved in earth resources management. Moreover, GIS software sales drove more than $7.7 billion in total user spending on software and related hardware and services, with services contributing $5.4 billion (Directions Magazine 2002). The leading providers (in revenue terms) were ESRI (35%), Intergraph (13%), GE (7%), Autodesk (7%), Leica (6%), Mapinfo (6%), IBM (5%), SICAD (5%), and Logica (3%) (see http://www.daratech.com/press/releases/2002/ 021114.html for additional details).

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