On the criticality of mapping practices: geodesign as critical GIS?

Forthcoming in a special issue of *Landscape & Urban Planning*

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Abstract:
In recent years, geospatial design (or geodesign) has emerged as an area of technological development, GIScience research, and design practice. With Esri leading the branding of this emerging area, geospatial technology developers, design consultancies, and academic units are recognizing the affordances of applying geovisualization and geoanalytical techniques to more conventional practices within design and planning fields. Additionally, the GISciences are being called to rearticulate their research agendas in the face of 'big data' and neogeography. This paper examines these developments with regard to criticality, or the ways in which mapping practices are applied in critical research -- both research that seeks to situate the emergence of geospatial technologies and enrolls these technologies more directly as method. What is the criticality of mapping practices amid these developments? More specifically to the design and planning fields, how might geodesign align with critical GIS? I take up these questions by tracing three presuppositions of criticality in mapping while examining the conditions of geodesign's emergence: representation and futurity, neutrality and efficacy, and relationality and complexity. I conclude by outlining a research agenda for further advancement of a critical geodesign.

Key words:
geodesign, critical GIS, mapping, design, geography, landscape, planning

1. Introduction

> Can we design a better future? (Esri, 2013)
>
> I am not an historian. I am a landscape planner who looks to the future. (Steinitz, 2008)
>
> If there is a common "foundation" or a unity of forces that all the arts share with each other (along with science and philosophy, which are equally oriented, in very different ways, to the ordering of chaotic forces), this is not in the unity of what has been, but only in the unity of a common future: the "power of the future" is that most urgent of forces and the most imponderable. (Grosz, 2008, p. 86-87)

Geospatial corporations are turning toward the future, which is to say that time, long identified as a limitation in geospatial software, should be instead considered as an opportunity. Esri's above

question manifests in a push to capture the design profession, just as a proliferation of web-enabled spatial media are altering the essence of data, visualization, and map interaction, and more fundamentally, the relationship between production and consumption, experts and amateurs. The academic disciplines of design, planning, and geography are also being reconfigured as technoscience, as geospatial infrastructure and tools change alongside the necessary curricula to train new workforces thereby enabling a fusing of technology and science (Pinch, 1993, as cited in Hinchliffe, 1996). Furthermore, what is meant by the "we" invoked by Esri is not to be taken lightly. This 'we' on the one hand signals a rapid increase in 'prosumers' (Ritzer and Jurgenson, 2010), while on the other calls attention to inclusion in that 'we', especially as Steinitz "looks to the future". Therefore, amid continual innovation and permutation within the GISciences, with geodesign among the 'new' efforts to attract design professionals, what does the doing of critical geodesign mean?

The notion of criticality is multiple, as what comes to matter most is considered critical, as in Grosz's words "that most urgent of forces", read in one sense as that which is vitally needed but in another as that which is indefatigably curious and questioning. Indeed, there are diverse investments in the word 'critical', even within a single discipline like geography (Blomley, 2006). I understand criticality in this dual sense: of an urgent call to action (to do, not make do) and a style of persistent defamiliarization (to make the familiar strange).

Geodesign is also an investment in criticality, as it seeks to understand and create the future, seeing the weightiness of the future as a horizon with great potential. However, my use of the word 'investment' is an intentionally slippery choice, as geodesign is both a conceptual deployment and a genre of software marketed toward design professionals.

In this article, I attempt to ask 'what can be?' of the relationship between geodesign and criticality, by reflecting upon geodesign as it rubs against critical GIS practices. In exploring this

relationship then, I begin with three presuppositions for criticality in mapping (for a brief overview, see Crampton and Krygier, 2005). *First,* 'we' map. That is to say, following Denis Wood (2011), that part of our being human entails some level of spatial awareness. While many may not have training in the cartographic sciences, Wood argues that 'we' express spatial awareness through diverse oral, visual, and performance traditions. *Second,* maps only appear neutral. Maps are not only vehicles for representation, but are practices that result in artifacts saturated with significance and meaning (see Harley, 1989). The recognition of this aspect of mapmaking greatly impacts the ways in which maps are used and interpreted. *Third,* maps and mapmaking are not outside of power, but can work to reconfigure power relationships. Along these lines, it is important to not lean on the crutch of empowerment, which assumes a fixed power geometry, but imagine a more dynamic field of power (see Pickles, 2004). The fields of critical cartography and critical GIS have developed these presuppositions for the better part of two decades, providing the precedents from which to investigate the recent energies that surround geodesign.

My objective is not to evaluate (and certainly not be a proponent of) geodesign as specific software or techniques of analysis and representation, but to move more slowly, to understand how geodesign *comes to be*. In this sense, while I recognize that some readers may expect to learn the benefits of a geodesign approach, I suggest stepping back from this expectation in order to first examine the discursive-material conditions that produce geodesign as a method/technique. In what follows, I trace an emerging field of scholarship, innovation, and profit, by examining key actors that are forging new academic-industrial relations. I argue for the importance of remaining attentive to the criticality of mapping as geodesign draws in new practitioners, academics, and investors. In the next section, *Following geodesign*, I establish a research approach to the study of technoscientific objects. I then take up this approach, to explore the various assemblages that produce a contemporary notion of geodesign, in *Geospatial design alignments*. In *Critical geodesign?*, I discuss the

potential for realigning geodesign around the perspectives of critical GIS and the GIS & Society research agenda (here, readers may benefit from reviewing Wilson *etal.*, 2009). I then conclude with a series of considerations for a renewed agenda of engagement and representation with geospatial technologies.

2. Following geodesign

Geodesign has become a key marketing buzzword at Esri: conferences, publications, software, and symposia. In addition to marking a specific form of geographic inquiry and representation, Esri has reorganized scholarly and industrial efforts under a renewed commitment to mapping as a vehicle for change (as both interventions in space and the making anew of space). Geodesign is therefore both matter and meaning, both material and discursive. To practice geodesign is to draw upon both of these forces, as a concretization of various ideas and affects. As such, I treat geodesign as part of a broader technoscientific endeavor that draws together investment with development and fashions a problem space in the process of providing specific solutions. In order to trace the intersecting events that give rise to geodesign, I suggest modeling critique of geodesign on critical engagements with GIS, by establishing three conceptual hinges that are central to the critical GIS research agenda.

As Harley (1989, p. 1) has argued previously, "It is better for us to begin from the premise that cartography is seldom what cartographers say it is." However, this is not to say that what GIScientists think about GIS or geodesign is irrelevant; rather, that there is always something more to discourse. To instruct as to the best practices of a technique is not necessarily to situate those same practices, and as such, to begin to understand the emergence of geodesign is to first fashion it as an object of study (in excess of geodesign as the study of objects).

2.1 GIS as an object of study

The emergence of GIS as an object of study is well-fabled. Nick Chrisman (2006) provides a nearly auto-biographical account of the development of geospatial technologies at the Harvard Graduate School of Design (GSD) in the wake of a perilous history of geographic scholarship at Harvard (see also McHaffie, 2000; Smith, 1987). What Chrisman activates is a reading of the social and interpersonal dynamics of technological development, by not reducing the advancement of techniques to only a progression of faster and more sophisticated software and hardware, but to also demonstrate how this progression is saturated with social and cultural meaning (see also Chrisman, 2005). In the 1990s, this approach to the social implications of GIS was largely categorized as part of the GIS & Society research agenda -- a (tempestuous, at times) collective of technicians and practitioners with critical human geographers (Pickles, 1995; Schuurman, 2000; Sheppard, 1995). Alongside the fostering of this area of scholarship, GIS continued to be developed for a range of social and natural scientific work (among these developments, spatial decision-support systems and analytical mapping, see Densham and Goodchild, 1994; Nyerges, 1991). Indeed, the emergence of GIScience (Wright, Goodchild, Proctor, 1997) in the late-1990s seems to further a chasm between the research agenda of GIS & Society and GIScience, over the ontological status and epistemological potential of geospatial technologies (O'Sullivan, 2006; Pickles, 1997; Sheppard, 2005).

2.2 GIS as practice (not just a method)

The recognition that GIS is a practice, and thus could be practiced differently, informed the configuration of a more critically-engaged GIS. Rob Kitchin (2008) highlights those practices of mapping that are beyond the method of mapmaking, that maps not only represent the world, but produce it and make things happen (also Kitchin, Perkins, Dodge, 2009). The criticality of mapping

is thought to reside not necessarily within the map artifact itself, but through the creation and utilization of the map. Mapmaking is thus a relational process. This rethinking of maps inherits from a critical GIS tradition (Schuurman, 1999) which attempts to wage critique in technological terms from a technopositional perspective (Wilson, 2009a). The practice of a critical GIS is an integration of critical human geography and geospatial techniques and describes both the critical *use* of (Pavlovskaya, 2006) and the *critique* of the use of geospatial technologies (Leszczynski, 2009). Amid the critical turn in GIS alongside the rise of the digital, spatial humanities (Bodenhamer, Corrigan, Harris, 2010; Dear, Ketchum, Luria, Richardson, 2011), the emergence of 'big data' impacts these mapping practices (Wilson, forthcoming).

2.3 Data take the wheel

The rise of 'big data' and new spatial media have placed new pressures while providing new opportunities for GIScientific as well as critical GIS scholarship. Jeremy Crampton (2009) marks these shifts as "maps 2.0" and notes a persistent tension that surrounds these mapping practices: the role of professionalization and expertise. As the vehicles for geospatial data proliferate, the evaluation and curation of data become paramount. The conventional guards for positional and attributal accuracy are being rethought to better accommodate neogeographic activities like volunteered geographic information (Goodchild, 2007; Elwood, 2010; Wilson and Graham, 2013). Data, already a significant agent in landscape change (Wilson, 2011), take on new importance as academic and for-profit enterprises scramble to capture and make sense of the massive volumes and speeds represented by 'big data' (Crampton, *etal.,* 2013). Careful not to treat 'big data' as a panacea for resolving spatial problems, critical perspectives on geospatial technologies seek to understand the political economies of the geoweb (Leszczynski, 2012), the implications for urban experience

(Wilson, 2012), and the general metaphors that we use to understand our relationship with digital technologies more generally (Graham, 2013).

To follow geodesign is to recognize it as not appearing from nowhere, but alongside longstanding endeavors to embed geospatial techniques into the social sciences, the humanities, as well as nonprofit and for-profit enterprises. In what follows, I trace the various activities that condition geodesign, as part of an evaluation of the potential for bridging geodesign with critical mapping perspectives.

3. Geospatial design alignments

> A new age of geography is dawning: the age of geodesign. (Esri, 2013)
>
> Today, geospatial technology, or GIS, is very valuable. (Dangermond, 2010)
>
> We basically came at this from the point of view of: why aren't more landscape architects, why aren't more designers, why aren't more architects using GIS to inform their design decisions? (Flaxman, 2010)

Geodesign emerges from a specific opportunity -- to better accommodate landscape architects, urban and regional planners, and architects with geospatial technologies. However, the needs that give rise to this opportunity have been accommodated precisely using more-or-less digital and automated techniques. A cursory review of the bulk of spatial decision-support systems articulates a similar opportunity: the need to support decision-making with the visualization of alternative spatial resolutions. In other words, there are a number of origin stories that work to narrate the emergence of geodesign. Here, I trace a number of these developments to better understand their prominence. This section is not meant to be comprehensive, but attempts to capture a diversity of practices that have nurtured and constituted 'geodesign' as an object of investment and development.

To narrate the emergence of geodesign, I have selected four entities to highlight as those that have conditioned or continue to constitute geodesign. There are undoubtedly many other nodes

in this assemblage, but I believe these four are important as they highlight three aspects: 1.) the continual reconfiguring of spatio-temporal problems, 2.) the machinations between academe, the military, and private corporations, and 3.) the significance of media for thought as well as creative and critical action. To fully narrate these alignments is beyond this scope of this article; however, I attempt to trace these contours in order that 'we' might think and perhaps enact a more critical geodesign.

3.1 Spatial Decision Support Consortium

The Spatial Decision Support Consortium sponsors the SDS Knowledge Portal partially funded by the US Army Research Office and hosted at the Redlands Institute at the University of Redlands, a private university located just 2.5 miles from Esri headquarters. This website provides information and scholarly materials that support the development of spatial decision-support systems (SDSS), understood "to provide decision makers with a problem solving environment within which they can explore, structure and solve complex spatial problems" (Densham, 1991). The top-right corner of the webpage allows a user to toggle their view between the SDS Knowledge Portal (http://spatial.redlands.edu/sds) and the GeoDesign Knowledge Portal (http://spatial.redlands.edu/geodesign), which, aside from some front page material, have nearly identical content (see Figure 1 on 'workflows'). As this website indicates, geodesign is the latest moniker in a multi-decade history of SDSS development and scholarship.

As this website illustrates, the move from SDSS to geodesign seems to be more about packaging or branding (a kind of 'find-and-replace' function across a range of technoscientific activities). Goodchild (2010, p. 16) views SDSS as a subset of geodesign that is conventionally situated within a scientific community. Nyerges (2011) similarly views geodesign as a broadening of an SDSS perspective, to more specifically incorporate design professionals. Indeed, Carl Steinitz's

(1990a, b) landscape change model is a touchstone for both SDSS and geodesign professionals, and describes a process by which geographic representations and models inform decisions for alterations in the landscape.

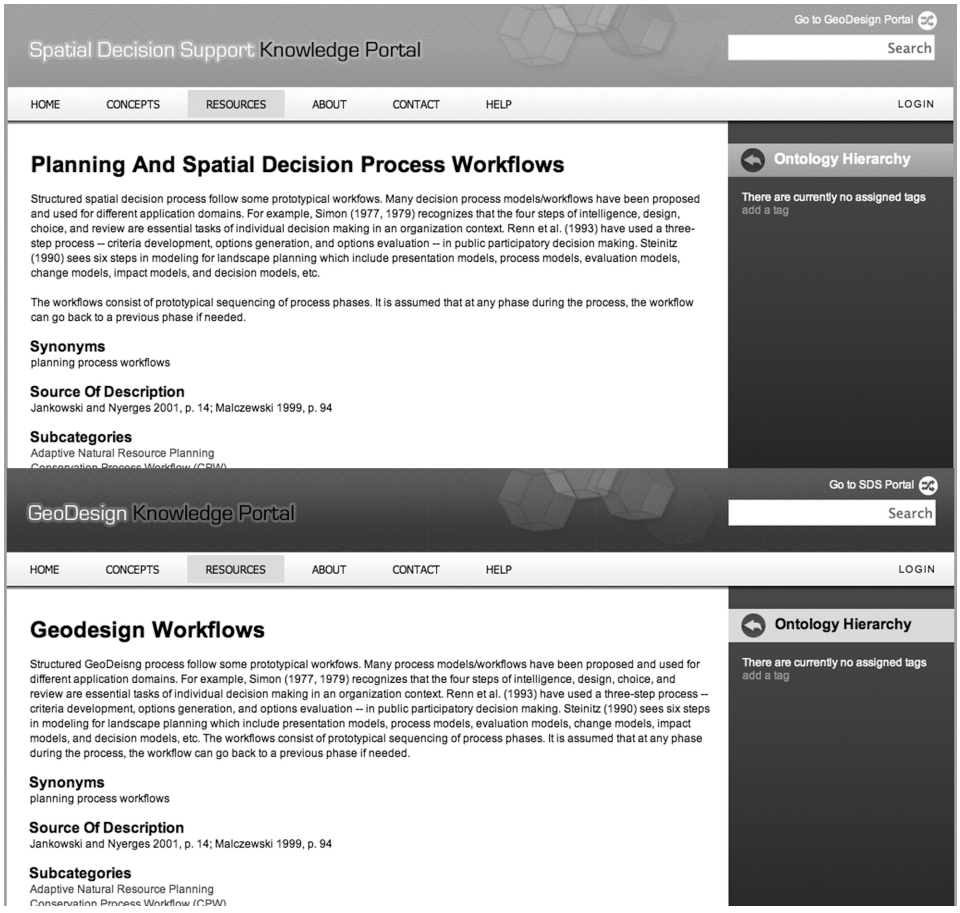

Figure 1. The 'knowledge portals' hosted by the Redlands Institute for SDSS and GeoDesign have effectively the same content.

3.2 NCGIA: The Upham Hotel

To both study change and better support the manipulation of landscapes, specialist meetings and workshops have been hosted by the National Center for Geographic Information and Analysis (NCGIA) with funding from Esri and NSF. The NCGIA, a site for basic geospatial research since

1988, has been a major actor in many of the academic and industrial developments in GIS, including support for the emergence of the GIS & Society research agenda at the Friday Harbor meetings 20 years ago in 1993 (Poiker, 1995). The three member institutions of the consortium, University of California Santa Barbara (UCSB), University at Buffalo, and University of Maine, have actively developed GIScience, with UCSB being an active organizer of conferences, workshops, and specialist meetings. Attendees will likely remember The Upham Hotel (Figure 2) as a space where these conversations were catalyzed. Goodchild (2010) specifically points to two such gatherings where geodesign begins to emerge, where the topic of bridging the design professions with the GISciences was central: the workshop on landscape change in 2001 and the specialist meeting on spatial concepts in GIS and design in 2008.

The workshop on landscape change in 2001 sought to concretize a research community and agenda around four themes, "information technologies, decision making, landscape perception and assessment, and environmental and social sciences", drawing together both architects and geographers (NCGIA, 2001). The steering committee co-chaired by Goodchild and Fritz Steiner, then president-elect of the Landscape Architecture Foundation (LAF), included faculty from Harvard, Arizona State, Michigan and Georgia, as well as individuals from LAF and the American Society of Landscape Architects and Jack Dangermond, president of Esri. Over 50 participants contributed or presented position papers, including Carl Steinitz, Stephen Ervin, and Bill Miller, well-cited figures in the academic and industrial fashioning of geodesign.

Figure 2. The Upham Hotel, in Santa Barbara, California,
has served as the site for numerous NCGIA workshops and specialist meetings
including the 2001 workshop on landscape change (NCGIA, 2001).

Seven years later, in advance of the first Esri Geodesign Summit, the specialist meeting on spatial concepts in GIS and design intended to more squarely understand "the potential of integrating design more fully into GIS" (NCGIA, 2008). Of the nearly 40 participants and contributors (see Figure 3), seven were also members of the 2001 workshop, Helen Couclelis, Dangermond, Ervin, Goodchild, Steiner, Steinitz, and Miller, with new participants representing important work across GIScience and Design, perhaps tilting more toward Geography than the 2001 workshop. Participants explored the conceptual (in)compatibilities that form the foundation of GIScience and design disciplines, while forming specific breakout sessions to explore the possibilities for a unified curricula in spatial thinking (NCGIA, 2008).

These NCGIA workshops and meetings have undoubtedly catalyzed a relationship between industry professionals in the development of design and geospatial technologies and academic professionals in the development of curricula, training, and research that enrolls GIS to engage in design. And as storytelling around the histories of geospatial design indicate, these two major groups are co-constitutive.

Figure 3. The Upham Hotel again in 2008 became the site for discussing the integration of design work into GIS (NCGIA, 2008).

3.3 Harvard

Dangermond, a 1969 Harvard Design alumnus, spoke at the opening of the Center for Geographical Analysis (CGA) at Harvard in 2006, recorded as a major event in the return of Geography to Harvard. He stated that CGA "will make a difference in advancing the science of many fields. What happens with this center and what starts today will set off shockwaves in the academic world" (as quoted in Gehrman, 2006). While it is impossible here to capture the importance of Harvard both to the development of GIScience (see Chrisman, 2006 and McHaffie, 2000) as well as to the specter of Geography within the Ivies (see Smith, 1987), there are key figures connected to the Harvard Graduate School of Design (GSD) in the geodesign conversation (see Steinitz 2012), including Dangermond, Steinitz, and Ervin, as well as Michael Flaxman a former PhD student of Steinitz at the GSD, credited with one of the most widely-cited definitions of geodesign:

> And the notion that if you look at what separates designers, using the term loosely from other types of analytic tasks, the notion of generating many ideas and then being ruthless about filtering them out is one of the operating creative characteristics of design. And we felt that GIS at the time was not supporting that well, and we came up with a notion of geospatial design or now GeoDesign, that I would define basically as *a design and planning method which tightly couples the creation of design proposals*

with impact simulations informed by geographic context. (Flaxman, 2010, emphasis added)

Flaxman, who has also worked at MIT and at Esri, is a continued touchstone for thinking about the integration of sketching and analysis in geospatial technologies.

In 2011, the GSD hosted a colloquium called *Geographic Representation NOW*, drawing together Flaxman, Sarah Williams (then director of Columbia University's Spatial Information Design Lab), Lize Mogel (a renowned map artist from NYC), Jon Reades (from University College London's Centre for Advanced Spatial Analysis), Maria Arquero de Alarcon (from University of Michigan) and myself (representing the work of The New Mappings Collaboratory at the University of Kentucky). Here, Harvard's new hire in critical geography, Neil Brenner, and Charles Waldheim, articulated a vision for the return of critical spatial thinking and geographic representation to the design traditions fostered at the GSD (Arbona, 2011).

3.4 Esri

Esri is an important common connector across these three previous entities. The work of the SDS Consortium is centralized at the Redlands Institute just a few miles from Esri headquarters. Santa Barbara, California, the location of The Upham Hotel and numerous NCGIA initiatives at UCSB (where Goodchild was the Jack and Laura Dangermond Professor of Geography, after a $2 million donation by Dangermond to UCSB, see Forbes, 2012), is located just over a 3-hours drive from Esri campus. In addition to having the president of Esri as an alumnus, the faculty and students of the Harvard CGA (and GSD, although less so) are frequently connected to Esri work. However, the bulk of the involvement of Esri in the fashioning of geodesign can be witnessed through their annual summits and their media production in both academic and popular literature.

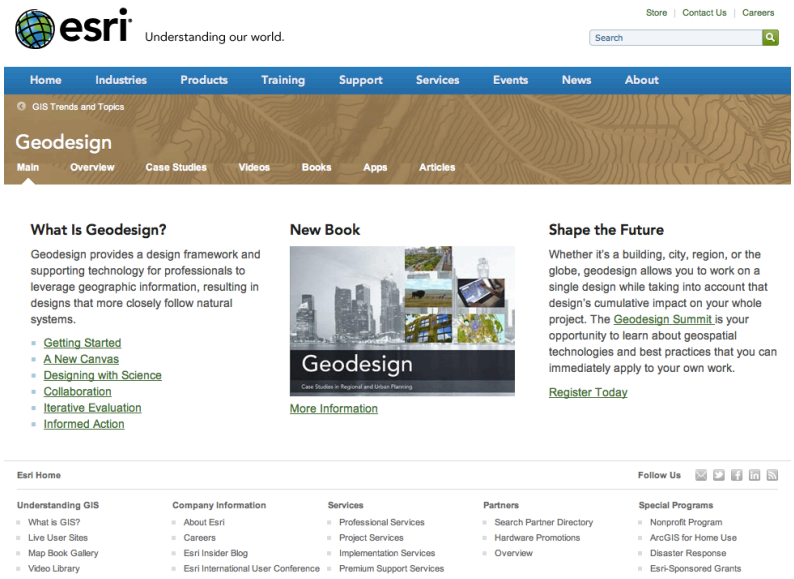

Figure 4. Esri cross-promotes the Geodesign Summit on their geodesign technology webpage (Esri, 2013).

Held annually since 2010, Esri's Geodesign Summit is a gathering of professional architects and landscape architects, urban and regional planners and civil engineers, developers and academics. Their marketing materials note that this is pitched at anyone interested in or working at "the intersection of geography and design" (Esri, 2013). To learn more about geodesign, the Summit website points a user to Esri's technology topic page, where users can find books produced by Esri Press (see Figure 4) and numerous other content curated by the company.

Esri produces three technology news publications -- ArcNews, ArcUser, and ArcWatch -- in addition to books produced by Esri Press and numerous audience-specific newsletters. The company is a major producer of available literature and digital resources that support the term 'geodesign'. In a bibliography on the topic maintained by Matt Artz (2013) since 2009, Esri is explicitly a host of nearly half of the publications (131 out of 279) referenced. Many of those publications not published by Esri are either authored by Esri employees or are directly reporting on Esri developments in the field of geodesign.

Were it not for these summits and the media production that surrounded them, the academic scholarship that elevated decision-making about and spatial simulations of landscape change would perhaps still be captured by literature under the heading of SDSS. Without tracing in the connecting lines too boldly (or conjecture any nefarious relationships, of course), it is possible to begin to "reassemble" the conditions that surround the emergence of geodesign (Latour, 2005). The opportunity presented by explicitly folding practices from the design disciplines into GIS demanded a 'new' geospatial technoscience and, accordingly, 'new' geospatial scholarship to support such investments and ideas.

4. Critical geodesign?

> Maybe twenty-five years ago, it would have been easier to draw a distinction between 'GIS proper', let's call it, and the emergence of a couple of other discourses: on the one hand, the emergence of what has been called critical GIS, and various attendant subdisciplines, and [...] the beginnings of a discourse around mapping [...] and the reception of cultural geography in schools of architecture and design. [...] But at the same moment, ten years ago, at least from my own perspective, those discourses were largely discrete from one another and I think what I've been learning is the inscrutability and overlap these days and the [...] productive engagement between techniques of production and equally critical understandings of reception and audience, leavened by the emergence of art and design practices [...] It is a really timely question for us here in the School. (Waldheim, 2011)

The alignments around geospatial design briefly outlined in the previous section provide the connecting tissues upon which one can begin to assess the appropriateness of critical mapping perspectives. An overview of the SDSS literature reveals that SDSS scholarship and development does not readily overlap with the critical GIS literature (nor with the broader GIS & Society literature, see Figure 5 for a crude representation of this). Furthermore, as Charles Waldheim, chair of landscape architecture at the GSD notes above in his opening remarks at *Geographic Representation NOW*, there is certainly a "timely question" to be addressed: that of the relationship between critical GIS and design practices. In what follows, I examine three geographic concerns from a critical GIS

perspective as they rub against the notion of geodesign as fashioned by the entities previously introduced: representation and futurity, neutrality and efficacy, and relationality and complexity.

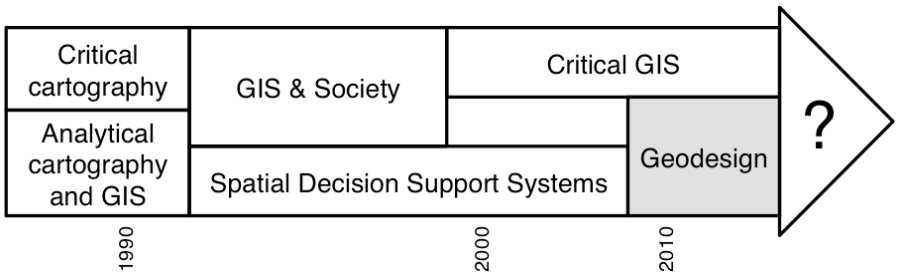

Figure 5. The relationship between geodesign and critical mapping fields like critical GIS is not readily apparent upon reviews of their supporting literature.

4.1 Representation and futurity

Sketch and simulation, design generation and design evaluation, according to Goodchild (2010) and Flaxman (2011) respectively, are the two most significant areas of development in the computational support of geodesign practices. In some sense, the decision-making research priorities of SDSS is ever-present; to address these two capacities as Densham (1991, p. 403) articulated is "first, [...] to increase the level of understanding and to refine the definition [of the problem] and second, [...] to investigate the possible trade-offs between conflicting objectives and to identify unanticipated, and potentially undesirable, characteristics of solutions." Therefore, geodesign and SDSS clamor for an approach to represent and calculate futures, to build tools to saturate the thought-process of design with visualizations of present conditions and simulations for future possibilities.

Geodesign is a thoroughly representational technique, and its tilt toward 'the future' introduces, as Ervin (2012) notes, possibility, probability, certainties, as well as randomization. Furthermore, geodesign invokes a notion of 'the preferred' as a key aspect of the work of future-

making, amid an array of designed alternatives. In this sense, geodesign connotes a technological practice invested in the project of anticipation and hope (Anderson, 2010; Kinsley, 2012), and works to both produce the framing of these designs and the particularities of their visioning, both the context or situation of a design intervention and the machinations of a specific implementation plan (such as the range of potential analytical options and metrics that are specifically coded within these systems).

4.2 Neutrality and efficacy

Aitken and Michel (1995), in the midst of the GIS & Society critiques of the 1990s, recognized the use of geospatial technologies in planning disciplines as bringing 'the real' into being, calling into question the assumed objectivity or neutrality of these tools. GIS, they argued, had been treated instrumentally by planning traditions, serving to reinforce problematic distinctions between expert and citizen, science and art, theory and implementation. In the wake of critical mapping perspectives, it is perhaps challenging to not read the bolstering of geodesign discourse as retreading similar terrain: to rely upon geospatial instruments for conjuring 'the real' and 'the future'.

> Design was clearly an early objective of GIS, but as argued earlier, it tended to lose its centrality as GIS evolved to serve more lucrative and immediate markets. Now more than ever, we sense the need for effective tools that can help us to ensure a desirable future for the planet, and GIS clearly contains the foundation for such tools. (Goodchild, 2010, p. 19)

However, what are the possibilities for disentangling efficacy from neutrality? As critical GIS scholarship has demonstrated (Elwood, 2006), effective maps can spring precisely from such situated, political perspectives. That maps only appear neutral serves as a source of power, as the legitimacy of such documentation practices connote specific significance and meaning within government and management processes.

4.3 Relationality and complexity

How we make decisions about these complex presents and the futures we prefer is diversely imagined. Steinitz (2008), for instance, points to a broadening of public participation in these decisions, which has trickle-up requirements for the configuring of these simulation geospatial systems. Goodchild (2010) delineates 'design' from 'Design', the former having to do with optimization of a spatial problem with an obvious (and perhaps inevitable) implementation and the latter the domain of planning which paramountly involves uncertainty. Further, he notes that uncertainty is fundamental to design practices (and GIScience practices more generally, given much of Goodchild's research). Nyerges (2011) additionally articulates a 'super design' process which is attuned to management across planning, program funding, and project implementation in spatial decision making. Geodesign is pitched as that which wrestles this complexity through sketching, public involvement, group decision making, and simulation and evaluation. Indeed, geospatial design is perhaps a crystallization of multiple trajectories in computing:

> So the aspect of geodesign that's interesting to me is, how do you do geodesign in the midst of complexity? Enter the digital age, the use of computers for storing information that you can't keep track of in your mind. [...] It allows you to extend your thinking using digital technology so you can handle complexity. (Miller, 2012)

For Bill Miller then, geodesign extends the capacity of human thought, where thinking is the original design problem. In this vision, geodesign is prosthesis, a more-than-human assemblage (Braun, 2005), a cyborg geography (Wilson, 2009b) that enacts hybrid ways of knowing and being in the world. To think complexity in this way, as relationality, is to gather the multiple perspectives and conditions that produce such representations (of complexity, uncertainty, and management glut).

As a sociotechnical system that produces and is produced by relationality, geodesign can work to reconfigure power relationships, not as a unidimensional notion of empowerment, but as a dynamic field of power (Foucault, 1990 [1978]). As such, a more critical geodesign does not target power to reduce its effects (by 'leveling the playing field' or by 'empowering') but attempts to

recognize and, further, to place at the forefront this dynamism of power: the potential to alter the speeds, volumes, and general topology/network of power relations. Understood broadly in this way, geospatial design practices are not outside of power, and can enable new discursive and material worlds.

5. Conclusions

> This may be our next major challenge -- to make more complex landscape planning more readily understandable, in order to broaden public participation, and to improve decision making in support of a more equitable and sustainable future. (Steinitz, 2008, p. 74)

> At bottom, Deleuze suggests, it may be that what all the arts share is the aim of capturing the *force of time*, of opening up sensation to the force of the future, or making time able to be sensed not in order to control or understand duration (which cannot be controlled and is that which ensures that the self-identical is always transitional, always other, never actual) but to live it as one can, even if that means becoming-different [...] It is this goal that makes art itself eternal, always seeking a way to render time sensational, to make time resonate sensibly, for no art can freeze time or transform its forces except through the invention of new techniques, new forces and energies. (Grosz, 2008, p. 86-87)

Geodesign is presented by Esri as the latest in geospatial technoscience in order to capture "the force of time", to invoke Grosz on Deleuze (2008). However, it is precisely this inability to "control or understand duration" that the conceptual deployment of geodesign is presented with both a problem and an opportunity. The future cannot be frozen, fixed, made static, but can undoubtedly be transformed: is a more critical geodesign that requisite new force and new energy? As I have outlined, geodesign is a further articulation of a SDSS agenda, although one that has been carefully crafted by a small-set of overlapping entities: NCGIA, Harvard, and Esri. Therefore, geodesign is both an idea and an investment that culminates in software. As software is ultimately conditioned by its potential markets, the central problematic for a more critical geodesign becomes how to proceed (and we must) while negotiating this conditioning.

The particular concretization of geodesign (as software) might, depending on the advocate, be a drawing together of the critical sensibilities of landscape architecture (an attention to context and contingency) with geospatial representation technologies (as in Waldheim, 2011), or might be a further entrenchment of a scientific positionality that intends to master time through space (compare Flaxman, 2010; Nyerges, 2011). Significantly then, I have argued that a full-tracing of the overlap between the GIS & Society movement (and critical GIS) and the SDSS/geodesign movement has yet to be fully taken up, but might begin with basic science and technology studies research as to the panoply of individuals, organizations, industries and institutions that are assembling and aligning their work in support of geodesign.

How might a more critical geodesign proceed? Built upon the foundation of critical GIS practices, a critical geodesign might be both a visioning or representation of futures-to-come (to strike at socio-environmental injustices) as well as a criticality that serves to perpetually question and situate the conditions that enable such techniques of visioning. But this must begin from those very early deconstructive attitudes toward mapping technologies (Harley, 1989), to engage an ethics of resolute non-neutrality, to take a stance for alternative, hopeful futures, to recognize that stance as always-already political. In this sense, a more critical perspective on geodesign recognizes that it is not only software. While indeed technological, geodesign is also more fundamentally epistemological, for how we know the present and can think the future exceeds the bits and bytes captured within the machine. As such, the practice of geodesign begins to mingle with that of a critical GIS, to simultaneously attend to the technical representation of space while also situating/contextualizing and questioning those mapping practices.

Geodesign must also continue to draw together diverse publics, to inspire new geographic literacies, and new retentional strategies for engagement, to be of and in the world. The question posed by Esri (2013), "Can we design a better future?" hinges on that "we", as an assemblage of

human and more-than-human entities. The 'we' comes with great difficulty, as the terms of involvement and engagement are not universal (witness, for instance, the debates surrounding indigenous mapping projects, Young and Gilmore, 2013; Bryan, 2010; Herlihy, 2010). Questions of access, privacy, and the mobility of spatial knowledge must continue to drive a renewed commitment to that 'we' by Esri and other geodesign proponents. The success of a more critical geodesign, and of spatial thought, representation, and action, is vital for planetary survival, and should draw together our best techniques, forces, and energies.

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