**Abstract**

In this article we attend to an emergent practice of visualising GIS data in physical geography using the graphics engine of a videogame, Crysis. We suggest these modes of image-making aid the possibility of imagining and disseminating complex geographical data differently by re-contextualising seemingly abstract mathematical information within a human horizon of embodied meaning. Furthermore we argue these ways of imagining are closely linked to the technology and phenomenology of screens which make the presentation of these images possible. We close by reflecting on the possibility that these technologies are shifting the grounds of vision and the geographical imagination of users.

**Key Words**

videogames, visuality, screens, existential spatiality, scale, dissemination of geographical knowledge

This paper deals with an emergent practice of visualisation and model simulation and its role in the construction, practice and dissemination of physical geographical knowledge. Our case study revolves around the doctoral research of Mark Trigg at the University of Bristol[1]. His research concerns the hydraulic flood modelling of the Amazon river and floodplain. Rather than focusing on the specific scientific results of his simulation, we discuss how Mark utilises the graphics engine of a video game; Crysis, to visualise his numerical data. Using a graphical, avatar based interface allows Mark to present his data as a navigable three dimensional space, as opposed to a two dimensional large scale map view that has long been associated with traditional spatial science.

The paper has two aims. The first is to complicate a simple distinction between lived space as natural and real and digital model space as disembodied and unreal, a critique that is often made of GIS techniques as being less authentic than physically experiencing space 'up close and personal' (see Gregory 1994, Olsson 2004, Rose 1996). In the paper we develop the argument that digital models rely upon embodied forms of knowledge to be coherent and navigable for the user, a point that is easy to miss when dichotomies between model space and real space are often predicated on purely visual differences, such as photo realism for example.

The second aim is to move away from concentrating on the meaning and symbolic content of images that has dominated cultural geographers writing on the visual. In Gillian Rose's 'visual methodologies' (2007) for example, the importance of technology as a modality of the image is acknowledged, but is taken as secondary to the social contexts that gives images their meaning. In this paper we concentrate on the technologies of image presentation to make a claim that the mediums through which images are presented alter *how* we experience images *as well as what* this experience may mean (also see Ash, forthcoming). We attend to the material processes and technologies that act as the conditions of possibility for an images appearance and how phenomenologically, we make sense of images through these technologies. Indeed, as Rose herself notes, 'particular visualities structure certain kinds of geographical knowledges' (2003, 213). Thus, the screen – its nature, capacities and effectivities – is argued to take on an increasingly constitutive role not only in the practice of model building, the communication and dissemination of knowledge, but also in shaping the possibilities for geographic imaginaries. We thus seek to extend geography's long and ongoing debates around vision and visuality to the videogame and its 'screen-hood' (Berger 1972; Cosgrove 1985; Clarke & Doel 2005; Rose 2007).

As Longley (2004) notes, modelling has long been a ubiquitous practice, and the techniques of GIS have corresponded to an increased capacity for the creation and dissemination of geographical knowledge across the geographic spectrum. Marks use of a video game graphics engine to model geographical data can be read as part of larger developments in visualisation techniques within the field of GIS. Paar (2006) argues that the use of three dimensional images is linked to the desire to create photo-realistic forms of landscape representation that apparently reflect natural modes of visual perception. As Sheppard suggests: "there seems among both young and old to be a general hunger for (and gratification received from) more realistic landscape imagery, as though this was automatically better than the imagery from less high-tech media" (2001 p185). Three dimensional representations are considered useful for planning and analysis purposes as they create a sense of 'tele-presence'; an extended spatiality within the screen that gives the user a sense of the field that is not possible when looking at the field from an overhead view. Draper et al define this telepresence as a 'situation awareness'; "According to Endsley (1988), situation awareness (SA) is 'the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future' (p97)" (Draper et al 1988).

However as Sheppard (2001 p188) notes, there is a danger in equating photo-realistic tele-presence, produced through computer software, as being equal to the space that the images represent, when in practice, on a phenomenological, scientific and methodological level they are very different. Looking at a screen for example encourages a 'foveal' or focused attention that does not utilize humans broader peripheral vision, which as Danahy (2001) argues is central to our everyday perception of the environment. As Bishop et al put it; "[w]e do not see the world through a 21in. window. We have a field of view of approximately 200 degrees (lateral) and 125 degrees (vertical) even without turning our heads" (2001 p122). Within the modeling community this limitation has lead to the development of panoramic screens that extend into the viewer's peripheral vision, in an attempt to correct the perceptual limits of regular rectangular screens and produce a more natural mode of vision (Danahy 2001). At the same time however, there is a contradictory recognition that a 'sense' of the visual field is not reducible to a visual fidelity or photo-realistic quality (Lange 2001 p165).

In the paper we attend to this contradiction, unpacking how three dimensional graphical images 'communicate' geographical knowledge to the user. Suggesting that a mimetic photo realistic production is not necessary for this communication, we argue that images work *affectively* to produce a sense of field under study, and that this communication is not simply visual or textual but

relies on the embodied knowledge of the user. In examining this example of a videogame we hope to respond to Longley's (2004) reflection that the development and rise of varied *multimedia* provide geographers with resources for thinking, imagining and communicating differently.

The paper forms three parts. The first introduces Crysis the game, and its use in Marks research. It argues that the three dimensional subject orientated perspective Crysis generates was a useful tool to Mark as it helped produce a spatially orientated sense that was absent when values such as water height remained as a numerical value. In the second section we argue that the visualisations effectivity for knowledge lies in its capacity to experientially embody the researcher within a 'human' horizon and perspective of the field that is under study. This is not to say that the researcher is disembodied prior to the Crysis visualisation. The user still engages their human capacities and knowledges to view a map of the Amazon on a computer screen. However, as an overhead view, the scale of the basin is harder to ascertain; an area which is thousands of kilometres long can fit into the space of one twenty inch LCD screen. The Crysis visualisation on the other hand produces a simulated view from the ground; a form of real time interaction (Danahy 2001) or human form of duration, where abstract numbers and units become seconds and minutes of moving a representation of a human avatar across banks and waterways. In the third section we argue that the Crysis visualisation is a hybrid object, constructed from variously assembled forms of knowledge and information from temporally and spatially dislocated points (from remote satellite mapping, to copyrighted physics algorithms, to the saved model on a platter of magnetic disks). Through this assemblage, the image produces a mechanical duration, which is the condition of possibility for sensing the spatiality of the model. It is this duration, alongside the pre-exisiting embodied knowledge of the user that gives the simulation its affectivity, its capacity for communication, that is not present when the data remains in tables of numbers and code and thus a *disseminative power.* The paper concludes with reflections on the study of visualizations and the construction of spatial imaginaries.

**Crysis, the Amazon, Imagination and Sense**

Crysis was published by Electronic Arts in 2007 for Windows format personal computers. It is a science-fiction 'first-person shooter' action game in which the player moves through a military narrative of exploration, capture and destruction that unfolds on an island whose representational quality and complexity is currently recognised to lead the videogame field[2]. It is not the concern of this paper to analyse the cultural logics of this videogame's production and consumption: its

complex relations to military anticipations and visions, or the particular genders, identities and cultural normalisations it may reproduce[3]. Rather, we focus on how its editing features allow physical geographic knowledge to be simulated as a videogame; we thus asks questions as to its status as a visualisation, its use-value for geographical sense and dissemination, and the questions and reflections it throws up for thinking about geographical knowledge.

Although Mark first became interested in Crysis purely for entertainment purposes, he quickly discovered the possibility and potential of the game's 'sandbox' or 'level' editor. The level editor was put in by developers to let gamers create their own fictional maps and landscapes to play on. However, in a spirit of experimentation, Mark produced complex and novel visualisations of his own work, in which he was able to interact with his data on an immersive and visually realistic level. In Mark's words, because the framework of the game was open this 'gave it the ability to read in real world data' – specifically, the kind of data required for a Digital Elevation Model (DEM). Thus, actual Amazonian elevation data, remotely sensed from the space shuttle Endeavour (captured in February 2000), normally processed by Mark through hydraulic models, could be represented through the graphics engine of a PC videogame.

Mark's belief in the value of experimenting with different forms of visualization derives from his earlier experience in the professional field of modelling. In interview, Mark reflected on the pedagogical use-value of getting researchers who had run a model to mentally put themselves on the river bank, to see if it 'made sense' (the phenomenological activity of constructing and maintaining our embodied orientation in the world). Mark gave the example of excessive flood levels in small river channels. Whilst a model's results might be 'accurate' according to the internal language of the model, the model itself does not judge, interpret and value that result – a result which might defy the logics of the space itself. Mark suggested these problems occurred if one uncritically accepted the models results as accurate reflections of reality, instead of questioning the results as the calculation of a human constructed mathematical model. Thus, one of the easiest ways to initially question these kinds of discrepancies was to imagine oneself situated on the riverbank under the conditions the model was suggesting, whilst thinking about the contexts of the channel, its scale, and the size of the processes that fed into it. As he noted, '…they will imagine themselves standing on the river bank, with ten metres of water above their head in a little urban river and they will say: 'No, that doesn't make sense, there shouldn't be that much water there." For Mark, his Crysis simulation fulfilled this reflexive-imaginative value of visualizing a model. What this points to is that the process whereby something comes to be registered as 'making sense' is not in itself

something abstract. Rather, it corresponds to a visceral, worldly quality of revelation of sense whereby something 'might not feel right.' Pointing to the *practice* that underwrites the production of knowledge, a given visualization either does, or does not, 'make sense' on account of its alignment with a prior series of worldly relational configurations, assumptions, expectations and tacit understandings that are not consciously present. In turn, these foreground and condition the frames of reference and judgement that go into the production of geographical knowledges.

In the process of articulating a sense of the model, Mark pointed to how the Crysis visualization could serve as a kind of iterative practice, whereby the construction of the model could be checked for its 'sense'. It formed an important function within the 'post-processing' stage where one takes and analyses the results of a model simulation to try to understand and interpret what the data is actually telling the researcher, or, indeed, if the model has worked at all.

In relation to previous work in the UK this proved unproblematic; there being generally little difficulty in accessing and travelling to the site itself. Whereas he could visualize the river size and banks in the UK, in the case of the Amazon this was a problem, precisely because a direct embodied sense of 'the field' was lacking.

> The problem I have with the Amazon is that I have never been there and it's so big it's very hard to get a sense of scale – particularly when looking at it on GIS. I don't know if you have looked at data in GIS. It's very colourful, it's very pretty and you can do all sorts of things with it; but you lose a personal connection with it, from a human point of view.

Having briefly outlined the potential use-value and importance of embodiment in the construction of Mark's geographical knowledge and the role of the image in shaping that data, we now want to further explore aspects of *how* the Crysis visualization of Mark's DEM data facilitates and produces an embodied sense of scale through an embodied, yet differently constructed perspective on the modelling data.

**Existential spatiality: perspective, embodied senses of scale, orientation and worldly concern**

Whilst it is perfectly possible for Mark to view his data from an abstract level or 'God-perspective', both within and outside of the Crysis visualisation (through the satellite images or other maps at his disposal for example) he nevertheless sees the benefits of *not* doing so – of actually producing a

'perspective', *limiting* his 'vision' in order to better sense the field site itself[4]. Not being able to run his eye over the represented space of the simulation as one would over a paper map altered the embodied knowledge he used to make sense of the space of the model; in plan form, the representation of hundreds of miles could be passed over in less than a second, whereas using the avatar such a journey would take several hours.

Navigating through the Crysis visualisation is based around coordinates that are bodily in nature; the distinctions between up(stream), down(stream), left and right, being determined in relation to the presence of the avatar on the screen and the movement of the avatar. These grounding forms of orientation are interpolated by more complex, relational spatialities regarding what is sensed and registered as 'near' or 'far'. This form of bodily sense is what Heidegger refers to as the existential spatiality of human beings, which he suggests conditions the way we come to register the world as such. Rather than moving through and judging space from a Cartesian perspective, in terms of distance between points and abstract measurements of this distance, Heidegger suggests these kinds of spatial awareness are secondary reflections of a primary spatiality (or 'worldhood') which is determined in relation to potential activity, concern and circumspection. Thus, the space of the 'world' is not arrived at as an object with a given presence available for mathematical reflection. Rather, this is *secondary* to the way in which we are intimately bounded and knotted with and through the world, the way in which its spacings always already make 'sense' (on the image of the 'knot', see Nancy 1997, 93-114).

For example, whilst 'the distance to the top of a hill' may be geometrically shorter than a metrically longer distance 'through to the end of the valley' beneath it, the 'top of the hill' is nevertheless sensed and registered as 'further away' than the end of the valley, because of the effort needed to reach it. As Heidegger puts it: "a pathway which is long 'Objectively' can be much shorter than one which is 'Objectively' shorter still but which is perhaps 'hard going' and comes before us as interminably long." (1962, 140-141)[5] Thus spatial distance between two points becomes a matter of where one wants to go and how one goes about getting there, rather than the simple physical extension of distance to that point. Or as David Harvey puts it, reflecting on the complexities of 'social space', '[d]istance, it seems, can be measured only in terms of process and activity. There is no independent metric to which all activity can be referred.' (Harvey 1969, 210)

The Crysis engine provides a human centered perspective on the data by introducing an interactive sense of real time temporal scale to the model. Rather than moving across the model, from a

sovereign 'God-perspective' at rapid speed (Haraway 1988), the user encounters this representation of 'the field' under simulated modalities of walking, swimming, flying or sailing. It is this which facilitates the communication of scale: the distance between two locational points on the model is traversed through longer durations of temporal activity, immersion and navigation; rather than a simple shift in focus, or movement of the retina, over a metrical plan.

Arguably a sense of scale emerges therefore through these durational, processual projections in which 'distance' is always already interpolated through a socio-spatiality; not from the mere application of a metric. As Mark reflects on the Crysis visualisation:

> You are not God where you can see all the data at once from one simple perspective… you have to actively go around the model and explore it with different vehicles and whatever you have in the game. That means sensing it in a different way…for example…once I constructed a simulation of my section of the Amazon, putting a water level in that matched the model, I tried to cross the river. Six kilometers. It sounds a lot, but when you try and swim across it; or take a boat, or a helicopter across, you start to realize it's quite big. It's kind of obvious, but it really is big. It takes a realistic amount of time to cross this and then you start to realize you are not dealing with just any river, or even some big river. It is huge…

Thus the 'objects' of the environment are in fact not at all addressed as 'objects' in a static sense, but are rather taken up in varying levels of concern and action – a familiarity or, 'worldhood' which is precisely what is absent from standard models. The boat Mark uses to move around his model, emerges not as a specific categorical object, but a '*for the sake of which*', it is indissociable from an embodied, worldly-durational practice or project (one gets in a boat, for the sake of crossing the river, in order to…). What the videogame achieves is a presentation of an environment in which this background ontological grounding is familiar; a familiarity which alters how one thinks and reflects upon the model as a scientific object. As such, it can grasp the sense of a specific contextual environment, through giving the model a human duration, that is not possible by merely using overhead plan views or tables of numbers that are central to other frameworks of modeling.

These perspectival limitations, produced through the videogame, were important in deepening Mark's imagining and appreciation of the size of his area of study. They also provided him another perspective on the enormity of the impacts that flooding has in the area: there is then a creativity to this visualisation that can spur different lines of thought. Thus, the videogame facilitated conceptual reflection on important global climate issues, for example, the levels of methane discharge from biological ('natural') sources in the Amazon basin – levels which are currently only rough

approximations within climate change models, and that have been arrived at through particular metrical algorithms.

Although we do not have space to go into it, we want then to point to how this experience of embodied navigation and movement, framed through the limited human perspective on the model, can fold back into the questions and awarnesses that formulate mathematical perceptions and understandings of wider 'systems'. In passing, we can further highlight the difficulty of trying to pick apart distinct aspects, or 'forms', of knowledge and assemble them within a linear narrative of how geographical knowledge is produced (theoretical stage, mathematical description, interpretation of results, imagination). As Mark outlines:

> It is huge, and that really starts to make you think about the mathematics of what you are doing, the water loss from the channel into the flood plain. It also helps you to realize that the data you have got in there is not real data, in the sense that Crysis is obviously not the real world either, it's just a representation. Also, the DEM that I have got is limited in its resolution, so it does blur things out a bit; but you start to actually *see* those limits of model resolution when it is physically represented and that helps you understand how your mathematical model of the hydrology might be operating, because that's essentially what it sees – the cell by cell basis of the water level. So when you put yourself in that position you start to visualize it better I suppose. It's almost a visualization tool for understanding, seeing and experiencing. Perhaps that's better, an experience tool.

What we want to point to is the way in which different visualizations of geographical data can feedback into ways of imagining and thinking space and provide a *creativity* to the knowledge building process in modelling, because new methods of visualizing data, such as the Crysis level editor provides a translation of this 'data' into different forms and expressions of geographical imagination. The power of these tools is that these forms of imagining do not remain in a separate realm from mathematical modelling, but can and do trigger different thoughts, perspectives and realizations, which actively feedback into the scientific process of modelling. Processes of cognition are bound up with the way in which an object of knowledge is framed and addressed as such. An awareness of this is therefore open to experimenting with different ways of mediating knowledge, for it is generous to the possibility of thinking and constructing geographical knowledge otherwise.

**Dissemination: communication, visualisation and screens**

Clarity and directness of communication is a key aspect to geographical address and dissemination. The varying means and mediums of communication mean that, as Harvey notes, '[i]n pursuing his [sic.] objectives the geographer must necessarily resort to an appropriate language.' (1969, 191)

Labouring within the modelling process, the researcher can be hard-put to achieve an objective of communication when it is simply not possible to cover and explain complex mathematical procedures before certain audiences (the public, private clients etc.). A desire to transform mathematical data "into a form that many non expert users can immediately understand" as Longley (2004, 113) argues, is a key aim in the dissemination of academic and specialist knowledge. We want to unpack here how various visualizations speak to this desire for 'immediacy', and in particular, that in the case of Crysis there is a visual language at work which can address certain objectives of sharing and experiencing geographical sense.

In interview, Mark moved from the example of Crysis to notions of visuality more broadly. He stressed the high pedagogical value in the presentation of results visually, in both academic and commercial spheres.

> Usually things are done from the point of view of trying to get something across – a message – about some research or work people have been doing. Before I started this Amazonian research, quite a lot of the work I had done in the past concerned taking quite technical results and presenting them as flood risk assessments for an engineering consultancy to clients…Sometimes if you present a picture people can understand what the flooding means to them. Then they get it. The questions stop about the detail and they say: 'now I understand where you are coming from'. Then they start to ask sensible questions which work, rather than trying to understand the model.[6]

However what this leaves un-thought is just *why* and *how* this mediating visualisation lends itself to immediate sensory understanding without the need for complex mathematical interpretation. It is to this issue that we now turn.

The visual language employed in the simulations Mark created provided users and viewers with a different kind of sensory experience of the model; an experience that was constituted through real time navigation and duration, rather than an imagination of scale imposed onto a flat cartographic projection. In his own words the simulation acted as an 'experience tool' which produces a greater capacity for sharing what would otherwise be primarily addressed in a specifically learnt symbolic and schematic language. This (visual) language was effective we argue, because of the medium of the screen, which acts as the conditions of possibility upon which the simulation and its sense could be rendered visible. The 'immediacy' that Longley foregrounds as a feature of certain media requires an interpretation that places it alongside wider issues in the history of visuality which has reflected on the mechanisms and particular mediations by which attention, captivation and receptivity have become possible, and through which, something might effect and affect viewers 'immediately'[7]

(Rose 2003, 2007; Crary 1992, 1999). Returning to the example at hand, we can point to how Mark himself registered these senses of immediacy, attention and captivation whilst presenting his simulation to various colleagues. In moving across the river, what is scientifically named as 'density', 'volume', 'power', 'flow' and so on are sensed, all at once, from the third person perspective of the avatar. Mark related that even colleagues who had visited the Amazon, and who were skeptical of his use of a 'videogame', nevertheless were captivated by the visualization. Thus, if the previous section outlined how scale is embodied, and that this embodiment produces a 'sense', here we can note that there is also an *affectivity* that is communicable in this visual presentation of scale, through the screen. Thrift defines affect as a "sense of push in the world" (2004 p64), a pre-personal field of intensity that gives humans a sense of being alive; which is made manifest through emotions and feelings as we encounter and are affected by objects and forces in the world. The screen, image and visualization contributed to the production of this affect.

To be clear, screen, visualisation and image mean different things, but all contribute to the distinct affects the Crysis simulation can produce. By screen we mean a material frame that structures the spatial and temporal limits of what an image can show (Freidberg 2006, Hansen 2006). The screen is an affective object because it can mechanically create a physiological sense of movement for the viewer, through the alternate refreshing of pixels on its surface. The image is the content of these lines, a world of light constituted by pixels, but as Bergson (1991) argues the image is also a movement in time that emerges from between distinct frames or refreshes. Even images that appear still to the human observer have to be continually refreshed to appear as still. For Bergson time is not constituted by the distinct frames of the image, but through the gaps between distinct frames or pixels, which he terms the images 'duration'. The Crysis visualisation utilises the technological capacity of the screen and image (its refreshing of pixels and creation of duration) together to produce an experience of world that corresponds with a specific history of landscape representation. The visualisation is then the product of a specific scopic regime; in this case a fixed isotropic perspective, that has become the dominant mode of artistic spatial representation in the twenty first century (Jay 1999).

The model, and the sense the image of the model on screen discloses, is therefore not simply a natural representation of either the DEM data or the territory of the Amazon itself. Rather it is a complex assemblage of information and knowledge drawn from a variety of associated technologies and objects. The phenomenological experience or sense derived from the image is an achievement constructed from spatially and temporally distanced locations, objects, knowledges and events, such

as the launch of the space shuttle Endeavor in February 2000 which carried the remote sensing equipment which collected the DEM data, the communication networks necessary to return this data to earth and computer programs that render this numerical data in graphical form and so on  The model itself, as an object of experience, is what Latour terms a 'circulating reference' (1999 p24).

Referring to scientific field trips into the Amazon Latour suggests: “[f]or the world to become knowable, it must become a laboratory. If virgin forest is to be transformed into a laboratory, the forest must be prepared to be rendered as a diagram” (ibid p43). Marks Crysis visualisation expands and complicates the creation and rendering of a diagram. Whereas the forest floor  samples collected by the soil scientists in Latour's account are transported and translated into forms that allow them to be compared with one another in the same time and space (the laboratory), the Crysis Visualisation  reverses this process; it is predicated on the accuracy by which it corresponds to the geometrical structure of the DEM data, but at the same time produces a profoundly finite and limited take on the DEM data, from a subject oriented perspective in which the scientific variables of the forest can only be experienced holistically rather than in isolation. Furthermore, this holism is complicated by a mixture of variables derived from both the computer graphics engine (such as the vegetation that populates the model, which is randomly generated by a computer algorithm) and the referential geometric values concerning the morphology of the landscape and water level that is directly imported from the satellite DEM data. The visualisation is therefore a circulating referent inasmuch as it does not simply refer to a pre-existing reality in a mimetic way, but rather translates and transports information from disparate times and spaces into a hybrid assemblage; an assemblage that acts as the conditions of possibility for sensing the image of the visualisation on screen.

As a hybrid object, or circulating reference the screen, image and visualisation presented through them, produces a different affective sense of scale from other cartographic objects such as paper maps or plastic globes. Whereas maps and globes produce an affective sense of scale through representing time spatially as a distance between points and lines, the screen, image and visualisation produce a sense of duration for the viewer; a time that is not spatially represented, but emerges from between the distinct states of pixels and images that make up the representational content of the image. The effect of this duration is to create an immediate sense of familiarity for the user or viewer, because this form of time corresponds with their own experience of time as subjective and flowing rather than representing time as static and a distance between points. Mark recognised that the model created an immediate affective response from viewers, where scale was

sensed qualitatively and intuitively, without the need for text or language.

> 'Oh, I see what you mean about the scale'. It's almost what people don't say, but their reactions, when they view it, that gives you a sense that there is some value in it.

What is crucial to an encounter with the simulation, we argue is the role of the screen and its specific capacities to capture and draw upon audience attention. As the screen becomes an increasingly mediatising object in the construction of geographical knowledge this in turn asks us to reflect on the kind of vision and perception screens generate. Importantly, what was telling from Mark's account of his use of Crysis is an absence of the recognition of the role of the screen. In other words, the screen in Mark's account was not foregrounded as a constitutive feature in the production of his knowledge. This absence is precisely on account of the very phenomenality of the screen: something which is not approached in itself as an object (except perhaps when broken down) and which therefore actively fosters a transparency and a taken-for-granted framework of engagement (see Thrift 2004a, 2004b)[8]. The screen therefore has its own 'screenhood' which is primarily its ability to capture the attention of users, whilst necessarily and at the same time disappearing from conscious perception. As Introna & Ilharco write:

> When we push the "on" button the screen captures our attention as it is the place, the location, the setting, the scene, in which what is supposedly relevant for us at that particular time is happening. Screen has as its necessary condition this supposed relevance. (2006, 63)

It is the screen which serves as the shifting ground of what is made visible, and the forms of perception this encourages amongst users. The use of screens therefore signals the shifting everyday practices of geographers. Indeed the image of the geographer hunched over a flat map is somewhat redundant. As Longley notes, in relation to academic practice the two-dimensional paper map is more or less 'obsolete' (2004, 109). The ubiquity and familiarity of the screen has resulted in a movement of the image, which rises up from its horizontal paper form to a verticality. This is concomitant with changing horizons of perception, and its creation of new postures of attention and engagement adequate to, and formative of, expanding capacities of geographical imagination. The work on questions of vision and visuality within the history of geography has indeed highlighted the way in which practices of visualization, from geometrical perspectives and plans (Cosgrove 1985; Harvey 1990), and the projections of cartographics (Gould & White 1974; Pickles 2004) to the affectivities of new media (Carter & McCormack 2006; Doel & Clarke 2007), act as conditions of possibility for geographical knowledge and sense. Within these studies, as Crary notes, it is not at all a question of trying to discover some essence to geographic perception or vision:

> Whether perception or vision actually change is irrelevant, for they have no autonomous history. What changes are the plural forces and rules composing the field in which perception occurs. And what determines vision at any given historical moment is not some deep structure, economic base, or world view, but rather the functioning of a collective assemblage of discrete parts on a single social surface…There never was or will be a self-present beholder to whom a world is transparently self-evident. Instead there are more or less powerful arrangements of forces out of which the capacities of an observer are possible. (Crary 1992, 6)

What practices, imaginations and knowledges can arise from the use of videogames within this complex history? This paper has tentatively outlined some thoughts on this issue, and we want to extend this open historical questioning in the following concluding section.

**Reflections**

> Computer imaging tends to flatten our magnificent, multi-sensory, simultaneous and synchronic capacities of imagination by turning the design [or research] process into a passive visual manipulation, a retinal journey. (Pallasmaa 2007, 12)

This paper in many respects challenges this (visual studies) narrative and the distinctions that are sometimes drawn between, on the one hand, an ocularcentric modernity of abstraction that denigrates the sensuous and reduces the body to an eye; and on the other, a wholesome, authentic, lost 'bodily wisdom' of haptic touch. Whilst is it important to critique the abstractions and 'disembodied' nature of certain visual methods, this critique is often overplayed, and sometimes slips into, and rearticulates, a wider narrative of metaphysical anxiety concerning 'technology' more broadly. As it does so it thereby posits, as a retinal inversion, an uncritical and supposedly 'natural' state and condition. Indeed, videogames seem to offer evidence of the ways in which the 'visual' is not necessarily solely thought as some Cartesian disembodiment, but a sensory and worldly process of relation and co-constitution (Wylie 2002; Patterson 2006; Crary 2002; for discussion of the haptic and tactile nature of images see Deleuze 2005; Nancy 2005). As this examination of a simulation undertaken through a videogame has shown, often these techniques of visualization have as their precondition an enrolment of the very embodied knowledge and experiential awareness that is supposedly absent. They work as visual methods *because* they employ these embodied relational configurations and perspectives. Thus we want to inject a level of criticality to the sense that 'our era' is one of 'the omnipresent visual image' which articulates discrete 'bodiless observer[s]' (Pallasmaa 2007, 27).

Clearly new media forms are contributing to expanding visual methodologies and geographic imaginaries, and will continue to offer new possibilities in the future. The question of how to approach and think about different images and visualisations is no doubt a crucial one. In this paper we have addressed a certain visualisation technique, but, as with all images, there is always an excess of interpretative possibility. The images in Crysis, as well as mimicking the already existing 'familiar' world which we inhabit, also alter the technological context in which sense (the logic of this inhabitation) is made. These modes of sensing, produced by practices of modelling visualisation (which also extend out into domestic entertainment spaces of videogame play), are mediated by the screen and the modes of perceiving and being-attentive screens encourage. These actively bleed back into everyday ways of experiencing and moving through space and thus subtly shift the grounds of our geographical *being-in-the-world*.

Geographers have talked much about the intimate *relationalities* which compose the world. It is often however very difficult to express this in a non-conceptual way, one which is not burdened either with specific (mathematical) languages; or literatures and narratives of socio-spatial theorizing. Whilst we are not claiming that somehow these problems of expression can be simply and unproblematically 'captured' in any given visuality, we nevertheless want to point to how increasing capacities for visualization can help communicate intimate notions of relatedness. In the context of thinking about flooding, we can also note that, on account of their immediacy of sense and their capacity to communicate shared horizons of existential spatiality, new visualisations of complex environments (ecosystems, landmasses, rivers etc.) can help to present shifts in ecological relations under conditions of climate change; in particular, those shifts which make human dwelling an impossibility. These visualisations can therefore play a part within the development of environmental ethical sensibilities and consciousnesses; the images thus having important 'social lives' (Rose 2007). Finally, in this way we can note how certain spatialities and geographical imaginaries 'allow thought to develop particular effectivities and intensities' (Crang & Thrift 2000, 3). This is precisely what we hope to have highlighted in this examination of a visual technique conducted in a spirit of interdisciplinarity and experimentation. These effectivities and intensities are achievements within the practice of sense making through particular relational assemblages (technical objects, satellite images, tacit understandings, screens and so on). By highlighting the agency and singularity of the mediatising capacity of the screen and image we hope to have further grounded how these actors will have an increasing role in the production and dissemination of geographic sense.

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1 See Mark Trigg's website: http://www.ggy.bris.ac.uk/postgraduates/ggmat

2 The island is actually modelled photographically on Hawaii. The geometry and physics of the game-engine was specifically designed to allow the importing of GIS data in order to attain greater visual reality.

3 For example, in Crysis, the player's avatar is a member of the future US military Delta Force division (year, 2020). He is called 'Nomad', and has a specially designed 'suit' which is in fact resonant of current military plans. For a series of reflections on the often intimate relations between

the military and various media see: Crampton & Power 2005; Power 2007.

4 'Perspective' is for the most part simply not possible within the parameters of modeling and GIS. This is because the very notion of 'perspective' necessarily incorporates the fragmentary, contextual and finite limits which constitute its sense (Romanillos, forthcoming). In short, a 'God-perspective' is a contradiction in terms.

5 This is a brief and simple example of notions of 'deseverance' and 'directionality' that structure Heidegger's reflections on spatiality. See Heidegger 1962 Section III: 'The Worldhood of the World' and also, Dreyfus 1991; Elden 2001.

6 We want to point here to the work being organised by Sarah Whatmore, Stuart Lane and Neil Ward on flood science and flood risk, and the interdisciplinary ethos of this research that asks questions as to the relations of science and policy in the unfolding of 'environmental knowledge controversies'. See: http://knowledge-controversies.ouce.ox.ac.uk/

7 As Rose notes (2003), there are also wider questions here in relation to the geometries of power that structure fields of visibility, in particular, the 'authority' that images and image presentation can (re)produce.

8 In an essay in Anitopde, Gillian Rose suggests that slides, projected on screens, operate distinct power geometries and relations on account of its dazzling nature and the forms of 'attention' it produces which somehow in itself numbs normative criticality (2003)