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Field Work in the age of Digital Reproduction: A Review of the Potentials and Limitations of Google Earth for Archaeologists

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FIELDWORK IN THE AGE OF DIGITAL REPRODUCTION

A REVIEW OF THE POTENTIALS AND LIMITATIONS OF GOOGLE EARTH FOR ARCHAEOLOGISTS

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The "virtual globe" computer application Google Earth (GE) released in 2005 is now widely used by the general public and planners, as well as by researchers and teachers in the social sciences (Sheppard and Cizek 2008:2105) (Figure 1). Using images taken from GE in PowerPoint presentations or connecting directly to GE for overhead demonstrations in the classroom are both now both commonplace. The ease of access, the striking 3D visualization, and the price (free) are a seemingly perfect combination that contributed to widespread adoption (for a general introduction to using GE, see Crowder [2007]; for an introduction to GE for archaeologists see Parcak [2009a:43–51]). All of this is made possible though the powerful backing of Google, which is, for better or worse, arguably the most influential company in existence (Schneider et al. 2004; Stross 2008; Vise and Malseed 2005).

Though archaeologists' use of satellite imagery is not new, and is certainly not necessarily tied to the proprietary application GE (e.g., Fowler 1997; Fowler and Fowler 2005), the possibilities that GE has brought to the satellite remote sensor's table are significant. GE has proven uses for visualization and presentation. But what about potential for research—is GE suited for more intensive, research question-driven applications?

Early Uses: Visualization and Pedagogy

An article in *Geology Today* (Lisle 2006) appearing soon after the release of GE praised it as a "new geological resource," specifically for its potential for aiding classroom instruction of geology. Lisle (2006:32) suggests that it "will be particularly useful for teaching geomorphology, structural geology and geological map interpretation," and ultimately, "will do to the atlas and globe businesses what the Internet has done for encyclopedia salesmen." A more recent article in the *Journal of Human Evolution* (Conroy et al. 2008) laments the lagging adoption of Geographic Information Systems (GIS) by paleontologists, and proposes that GE might remedy the situation. The article is centrally focused on GE as a tool for visualization and communication; the authors demonstrate just how easy it is to share 3D visual information about the location of fossil finds, via email.

Shortly after the release of GE in June 2005, news services began to pick up on stories of avocational, arm-chair archaeologists discovering previously unknown archaeological sites sitting at their desks using only GE (e.g., BBC News 2005; Handwerk 2006). Perhaps related to this media coverage, in 2006 several short articles appeared in newsletters and journals directed at archaeologists, each touting GE as an intriguing and worthwhile new resource for the discipline.

Ullmann and Gorokhovich (2006) provide an introduction to the software aimed at archaeologists, including a tutorial. They give step-by-step instructions on basic functions, including how to fly to a location based on a known latitude and longitude, and how to overlay an image. In an article appearing in *The SAA Archaeological Record*, Ur (2006) provides a generally enthusiastic introduction to GE for archaeologists, but also warns of potential negative repercussions. The article emphasizes the potential of GE for visualization and collaboration, but most important to Ur is GE's usefulness in the classroom—he states that this is its most promising aspect (Ur 2006:36). Ur also raises an interesting issue in suggesting that GE could lead to an increase in looting, and he is particularly concerned about the ease with which links (known as "placemarks") to specific archaeological sites can be published on the Internet. Ultimately for Ur (2006:38), GE is a "fantastic tool for archaeology," and its significance centrally "lies at the interface with students and the interested public." Ur (2006:38) also rightly suggests that "remote sensing specialists are not going to abandon ArcGIS."

Following Ur's assessment, it is appropriate that The Global Heritage Fund (www.globalheritagefund.org), a California based

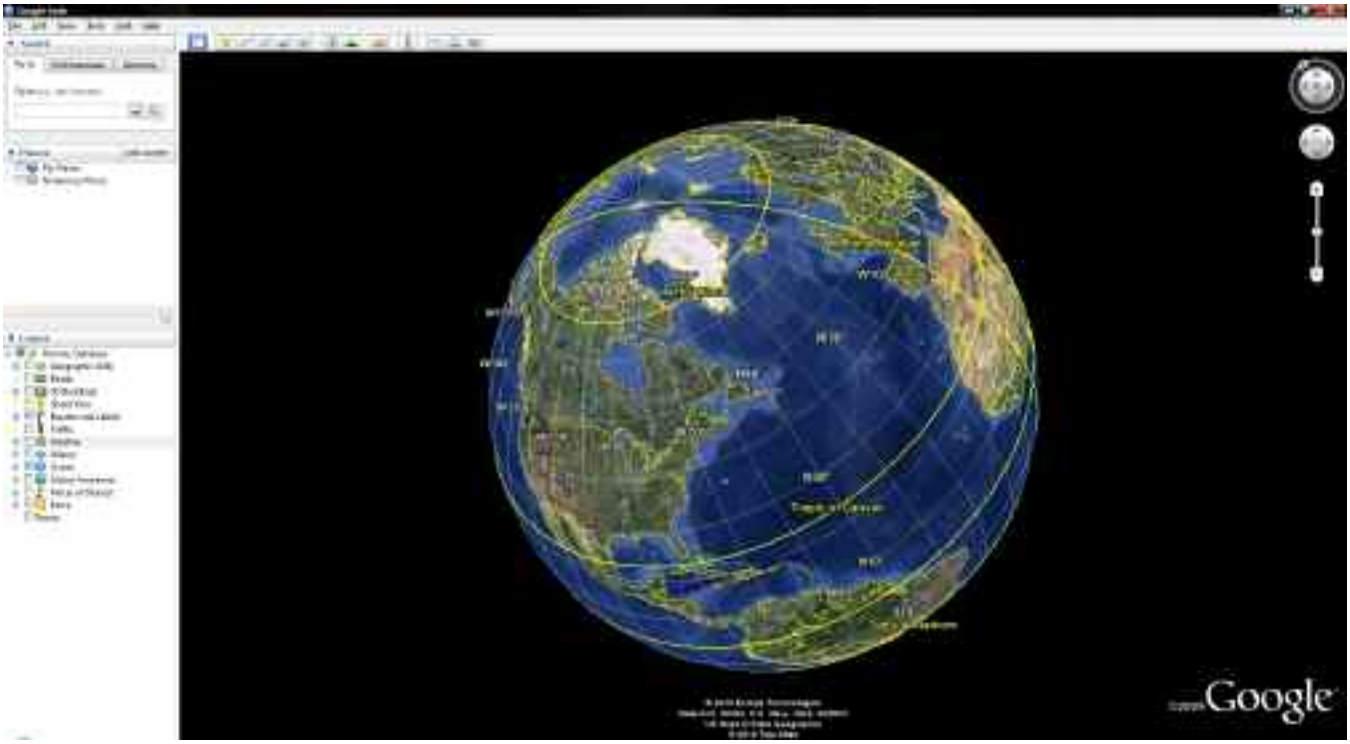

Figure 1. Google Earth.

nonprofit working to protect endangered cultural heritage sites in developing countries, has partnered with GE Outreach (www.earth.google.com/outreach) to create virtual interactive tours of endangered sites. The content is accessed in the "Global Awareness" layer tab in GE. Click on the layer, and Global Heritage Fund placemarks will pop up, each marking the location of an endangered site. Click on a placemark, and a pop-up window appears with text, images, and video content about the site. GE proves to be an innovative and flexible medium for communicating information and awareness about archaeological sites.

Beck's (2006) overview of GE is cautiously optimistic. He sees GE as a significant resource for visualizing and interpreting landscapes and archaeological sites, especially by contributing to an appreciation of the wider geographical contexts of specific sites. He highlights as positive GE's potential for education to mass audiences, as well as its help to archaeologists studying areas where other remotely sensed data is not available. Beck is, however, skeptical of the compression of the images (leading to reduced resolution), the fact that users do not have access to the raw data behind the images, and the uncertainty about "how the data can be accessed, who owns the copyright and how the data should be archived" (Beck 2006).

Locating and Mapping Sites

The use of GE in the social sciences is shifting relatively slowly from visualization and pedagogic applications to research applications. Some archaeologists are beginning to move from simple visualization of known sites to locating previously unknown sites. Thomas et al. (2008; Thomas and Zipfel 2008) use GE in a virtual survey of large areas of Afghanistan, a country in which on the ground archaeology has been nearly impossible since the late 1970s (due to wars, occupations, and uncooperative regimes). The project has three complementary goals: (1) to update and check the plans of previously known sites, (2) to create plans for unplanned previously known sites, and (3) to analyze imagery to locate possible previously unknown sites.

They virtually revisited the known medieval Islamic site of Bust and found that an existing site plan from the 1970s missed significant detail and did not cover the entire site—partly because many of the features were likely not even visible from ground level. Using the satellite imagery from GE provided a macro perspective that made visible large features, and they thus created a revised site plan. They also compared the point locations of known sites in Afghanistan from a gazeteer with the areas where GE provides high resolution imagery, and found that 250

(19 percent) of all known sites in Afghanistan are covered by high resolution imagery. Significantly, 217 (87 percent) of these sites so far lack plans of any kind.

The researchers also developed a methodology for systematic virtual survey of large areas to locate potential archaeological sites, on average spending about 10 hours scanning each block of 275 km^2. Potential sites were initially marked using the GE Placemark tool, and were then cross-checked by a second surveyor to minimize error and to inspect in more detail. The test project resulted in the identification of 451 potential archaeological sites (Thomas et al. 2008:24).

As this work in Afghanistan demonstrates, GE can be a valuable tool for investigating expansive areas, and perhaps particularly for areas that are dangerous, or normally off-limits to the archaeologist. Since the coverage of GE over the Earth's surface does not take into account who owns the land being photographed, or any wishes for secrecy that that person, institution, or government might have, there is now the possibility of virtual archaeology not only in war zones, but also in top-secret areas. In this vein, Myers (2010) uses satellite imagery from GE to record and interpret the Camp Delta prison camp complex at Guantánamo Bay, Cuba.

Quantifying Looting

Conventional satellite imagery has been used to investigate the looting of archaeological sites. The process involves visually scanning aerial or satellite images and noting areas where looters pits have been dug; the pits appear as pock-marked areas on and around archaeological sites. But the central published reports on the topic rely on purchased commercial satellite data, which is a significant financial burden if large areas are to be assessed (Hritz 2008; Stone 2008a, 2008b). As reported in a recent issue of *The SAA Archaeological Record*, in an ongoing research project quantifying the looting at archaeological sites in Jordan, Contreras and Brodie (2010a, 2010b) demonstrate that using the free imagery provided by GE allows for expansive study areas at almost no cost. Purchasing the commercial data that covered their test study area would have added up to approximately USD $.9–2.5 million. Thus they conclude that their cost-effective methodology for quantifying looting has much to contribute to the heritage management policy-making process.

Monitoring Change over Time

One potentially useful application of GE to heritage and site management is the possibility of assessing change over time at sites. The recently released GE 5.0 is loaded with new features, including a dataset of historical imagery accessed through the "historical time slider" control. This function is as easy to use as any other aspect of GE: the user simply navigates to an area of interest then uses the mouse to drag the time slider left or right. When dragged to the left, the most current satellite image (which is displayed by default) changes to the next oldest image, and will do so continually for as many images as are available. As with all the imagery on GE, just what historical images are available depends entirely on GE's database of images (what they are able and have chosen to purchase and collate). A test of the feature while viewing the Stanford University campus revealed imagery going as far back as 1948, but another test while viewing the city of Vancouver, Canada, showed that 1991 was the oldest image available.

Considering the uneven coverage of historical imagery in GE, where necessary a combination of GE and other remotely sensed imagery, such as CORONA or SPOT for example, could be used to track change over time (though this would quickly add to the cost). This use of GE and other data could make major contributions to how we assess and intervene at threatened archaeological sites. Erosion, encroaching development, looting, and other taphonomic processes could be tracked and quantified. Layering the successive historical and recent images in a GIS would create an analyzable digital archive of the site's change over time.

Technical Issues

A widely mentioned critique of GE is that it does not provide universal high resolution coverage. Though some archaeological reconnaissance might still be possible at lower resolutions (very large earthworks might be discernable, for example), for the most part, archaeologists' use of GE is dependent on the availability of high resolution imagery. The problem of low resolution coverage, however, is gradually becoming less of an issue. GE continually updates coverage, and there has been a noticeable improvement since its release in 2005. Additionally, GE is a sponsor of a recently launched satellite, GeoEye-1, that is beginning to transmit .5 m resolution images that will be loaded into GE (www.earth.google.com/geoeye).

The fast-changing nature of software and electronics in general is highlighted by the fact that in a recent article Parcak (2009b:362) criticizes GE for not providing the date that images were taken—an issue that was resolved by the April 2009 release of GE 5.0. This last point links to another possible problem: the fact that GE is a proprietary software package developed by a private company. Thus, just as archaeologists' use of hand-held global positioning systems (GPS) is, for the moment at least, dependent on the whim of the United States Department of Defense, archaeologists' use of GE is dependent on the for-profit company Google. Similarly, GE uses a proprietary file format (.KMZ). As open-source software advocates are quick to remind us, proprietary file formats have become obsolete and even unusable when their creators close up shop. Though it could be argued that Google does not appear to be going anywhere soon,

these do remain valid critiques.

Ethical Issues

Ur (2006) is concerned that GE might aid looters as much as it helps archaeologists. He notes that in print publications, archaeological sites can be plotted on a 1:250,000 map, a scale small enough that the precise location of the site would still be difficult to find without additional information. Conversely, the location of GE's placemarks, the primary tool for marking locations in GE, cannot be abstracted. Since placemarks are easily shared online (on project websites or blogs for example), and with relative ease loaded onto a handheld GPS, Ur rightly urges caution with how we use and digitally distribute them.

Moshenska (2009:50) rightly reminds us to be wary of the impersonal "bombardier's-eye view" provided by aerial and satellite perspectives—an overreliance might lead to research that dehumanizes our subjects. We must always remember that a satellite image is at the same time both a generalizing abstraction and a very particular representation. GE then is clearly not a straightforward substitute for fieldwork. Ideally, it would only be used in conjunction with the standard on-the-ground and personal methods known to all archaeologists. Where this is not possible, we must exercise caution when putting forward interpretations of sites and features.

Along with the concern about dehumanization of research subjects is the simple fact that the people captured by Google's satellites have no say in the recording of their persons and property, and no say in their online representation. As I have discussed at greater length elsewhere (Myers 2010), GE might even be seen as a sort of panoptic viewing technology that has the potential to do violence upon those being viewed. This perspective of GE as panopticon surfaces a complex, provoking, and perhaps irresolvable tension. Any use of GE by archaeologists should be accompanied by thoughtful discussion on this tension; over time, this discussion might result in resolution.

Conclusion

There are both benefits and drawbacks to the increasing integration of GE with the work of archaeologists. Problems raised by archaeologists and others include concerns over data ownership and permanence, GE's reliance on proprietary software and file formats, the irregular availability of high resolution imagery, the possible use of GE by looters, and the ethical issues of dehumanization and representation. The benefits of GE integrated with archaeology include: the possibility of locating previously unknown sites and reassessing known sites (perhaps particularly in war zones and in other areas that are difficult or impossible to access in person); economical monitoring and assessments of looting; and the potential to assess change over time at archaeological sites. Ultimately, though our use of GE should be considered and thoughtful, and though we must continue to reflect on the possible ethical repercussions of its use, the application is clearly a useful and relevant addition to the archaeologist's toolkit.

References Cited

Beck, Anthony
2006 Google Earth and Whirlwind: Remote Sensing for the Masses? *Antiquity* 80(308). Electronic document, http://www.antiquity.ac.uk/projgall/beck308/, accessed August 13, 2010.

BBC News
2005 Internet maps reveal Roman villa. *BBC News*, September 21, 2005. Electronic document, http://news.bbc.co.uk/2/hi/europe/4267238.stm, accessed March 6, 2010.

Contreras, Daniel A., and Neil Brodie
2010a Quantifying Destruction: An Evaluation of the Utility of Publicly-Available Satellite Imagery for Investigating Looting of Archaeological Sites in Jordan. *Journal of Field Archaeology* 35(1):98–111.
2010b Shining Light on Looting: Using Google Earth to Quantify Damage and Raise Public Awareness. *The SAA Archaeological Record* 10(3):30–33.

Conroy, Glenn C, Robert L Anemone, John Van Regenmorter, and Aaron Addison
2008 Google Earth, GIS, and the Great Divide: A New and Simple Method for Sharing Paleontological Data. *Journal of Human Evolution* 55:751–755.

Crowder, David
2007 *Google Earth for Dummies*. Wiley, Hoboken, NJ.

Fowler, Martin F.
1997 A Cold War Spy Satellite Image of Bury Hill near Andover, Hampshire. *Hampshire Field Club and Archaeological Society Newsletter* 27:5–7.

Fowler, Martin, and Yvonne Fowler
2005 Detection of Archaeological Crop Marks on Declassified CORONA KH-4B Intelligence Satellite Photography of Southern England. *Archaeological Prospection* 12:257–264.

Handwerk, Brian
2006 Google Earth, Satellite Maps Boost Armchair Archaeology. *National Geographic News*, November 7, 2006. Electronic document, http://news.nationalgeographic.com/news/2006/11/061107-archaeology.html, accessed March 6, 2010.

Hritz, Carrie
2008 Remote Sensing of Cultural Heritage in Iraq: A Case Study of Isin. *TAARII Newsletter* 3(1):1-8.

Lisle, Richard J.
2006 Google Earth: A New Geological Resource. *Geology Today* 22(1):29–32.

Moshenska, Gabriel
2009 Resonant Materiality and Violent Remembering: Archaeology, Memory and Bombing, *International Journal of Heritage Studies* 15(1):44–56.

Myers, Adrian
2010 Camp Delta, Google Earth and the ethics of remote sensing in archaeology. *World Archaeology* 42(3):455–467.

Parcak, Sarah
2009a *Satellite Remote Sensing for Archaeology*. Routlege, London.
2009b The Skeptical Remote Senser: Google Earth and Egyptian Archaeology. In *Beyond the Horizon: Studies in Egyptian Art, Archaeology and History in Honour of Barry J Kemp*, edited by S. Ikram and A. Dodson, pp. 361–381. American University in Cairo Press, Cairo.
Sheppard, S., and P. Cizek
2008 The Ethics of Google Earth: Crossing Thresholds from Spatial Data to Landscape Visualization. *Journal of Environmental Management* 90:2102–2117.
Schneider, Fritz, Nancy Blachman, and Eric Fredricksen
2004 *How to Do Everything With Google*. McGraw-Hill, Emeryville, California.
Stone, Elizabeth
2008a Archaeological Site Looting: The Destruction of Cultural Heritage in Southern Iraq. In *Catastrophe! The Looting and Destruction of Iraq's Past*, edited by G. Emberling and K. Hanson, pp. 65–80. The Oriental Institute Museum of the University of Chicago, Chicago.
2008b Patterns of Looting in Southern Iraq. *Antiquity* 82:125–138.
Stross, Randall
2008 *Planet Google: How One Company's All-Encompassing Vision is Transforming Our Lives*. Free Press, New York.
Thomas, David, and Claudia Zipfel
2008 A New Look at Bust: Google Earth and Archaeological Sites in Afghanistan. Poster presented at the Sixth World Archaeological Congress, Dublin, Ireland. 29 June–4 July 2008.
Thomas, David C., Fiona J. Kidd, Suzanna Nikolovski, and Claudia Zipfel
2008 The Archaeological Sites of Afghanistan in Google Earth. *AARGnews* 37:22–30.
Ullmann, Lee, and Yuri Gorokhovich
2006 Google Earth and Some Practical Applications for Archaeology. *CSA Newsletter* XVIII(3). Electronic document, http://csanet.org/newsletter/winter06/nlw0604.html, accessed March 6, 2010.
Ur, Jason
2006 Google Earth and Archaeology. *The SAA Archaeological Record* 6(3):35–38.
Vise, David A., and Mark Malseed
2005 *The Google Story*. Delacorte Press, New York.