

## Points of Interest

RICHARD WHEELER, MFA

**KEYWORDS** *Big data, geographic information systems (GIS), geospatial analysis, landscape, photography*

**PROJECT DATE** 2009–2014

**URL** [www.richardwheeler.com/points-of-interest/](http://www.richardwheeler.com/points-of-interest/)

**ABSTRACT** *Points of Interest* is an ongoing data-driven landscape photography project that explores how technology—specifically satellite imagery, computer mapping systems, and spatial analysis tools and techniques—can be used to define and explore our sense of place. By layering the geographic footprints of years of satellite imagery I create “interest surfaces” that show areas that have been photographed frequently from space, areas that have been photographed infrequently from space, and all the areas in between. I then travel to the areas of high and low collection or interest and photograph the landscapes that I find there. This work examines how technology creates new views of the landscape that expose tensions between our increasing fixation on location and our dwindling sense of place. Images and documentation in this article include new work in this project commissioned for the 20th International Symposium on Electronic Art being held in Dubai in October and November (<http://www.isea2014.org>).



FIGURE 1: Points of Interest in the United Arab Emirates As Defined by Commercial Satellite Imagery Collection, 1986–2013: Point of highest collection, Dubai

### INTRODUCTION

*Points of Interest* began out of a simple interest and desire to try to make the complex and obscure world of satellite imagery visible. This statement already raises questions: why is it necessary to make pictures “visible”? Aren’t they simply understood by looking at them? After all, satellite imagery is incorporated into GoogleMaps and other online mapping technologies that require—or at least provide—minimal training or orientation. If Google assesses that this imagery can be used without any instruction or context, mustn’t this be true?

My experience as an imagery analyst, as a consultant in spatial analytical software development, and as an artist, tells me that the answer to this question is a firm “no.” Satellite imagery and the systems that produce and distribute it are complex, and, as with many complex systems, are difficult for the layperson to understand. I believe this situation presents an opportunity for artists. I believe that the practice of art is about investigating how we experience the world, following from this, that the practice of visual art is about investigating the way that we see the world. *Points of Interest* is an effort along this line of inquiry.

I have now created work in this project within the United States—in Southern California and Nevada—and the United Arab Emirates. In all I have visited twenty-six sites, travelling thousands of miles on land, and thousands more in the air. Only in doing so have I been able to identify opportunities to refine and improve data analysis techniques, to create smarter mission plans, and at the end of the day, to create better images. I recently captured the last image in the series from Southern California contemplating that this might be the last image



FIGURE 2: Points of Interest in the United Arab Emirates As Defined by Commercial Satellite Imagery Collection, 1986–2013: Point of lowest collection, Dubai



FIGURE 3: Points of Interest in Southern California As Defined by Commercial Satellite Imagery Collection, 1986–2013: Point of highest collection, Los Angeles County

in the project as a whole. However, in reviewing the work, I now consider the last five years as only the first phase of a larger, and hopefully long-lasting, effort.

#### PROCESS SUMMARY

The end goal of the project is to create data-driven landscape photographs, where analysis of commercial satellite imagery is used to define points of interest through the identification of areas that have been photographed the most, and the least, from space using commercial satellite imagery.

The first step in this process is data acquisition, this involves downloading catalogs from commercial satellite imagery provided by entities such as Airbus (SPOT and Pleiades), Blackbridge, Digital Globe (now including GeoEye), and others. These catalogs are then uploaded into a geographic information system (GIS), which in this case was Esri's ArcGIS 10.0 and 10.1. Once loaded, the “footprints”—the bounding boxes on the earth's surface that show the geographic extent of where images have been photographed—of individual images can be viewed (see FIGURE 1, which shows, as do the following figures, documentation from analysis of commercial satellite imagery over the Emirate of Dubai in the United Arab Emirates), as well as footprints of the entire imagery output from a given satellite system (FIGURE 6) or of all satellite systems in use during the study period (in this case 1986–2013 FIGURE 7).

Once all footprint data has been loaded into the GIS, it is converted from its native vector format to raster format. A Python script working with ArcGIS that iterates through each vector polygon, converts it to a raster, and adds it to the base raster. The resulting raster imager (FIGURE 8)



FIGURE 4: Points of Interest in Southern California As Defined by Commercial Satellite Imagery Collection, 1986–2013: Point of lowest collection, Los Angeles County

can be read as an “interest surface” that shows high and low areas of collection.

This raster was then brought back into ArcGIS desktop and converted to a vector based topographic surface—similar to a topographic map—where contour lines represented areas of equal interest (FIGURE 9).

This process was repeated for each area under consideration. Within the United States I have looked at counties, as these are areas (at least in the western United States) that are large enough to have some variation, yet small enough to traverse in a relatively manageable amount of time. In short, they are areas that are knowable to us in the way that an area the size of a state is not. When I created a version of this project in the United Arab Emirates I looked at individual emirates, as these are roughly equivalent in size to many of the counties that I had looked at in the United States.

For each area of study, contour lines representing the areas of highest and lowest collection were identified, and the point centroids of these areas were identified as the points of interest for the study area (FIGURE 10). Once these points were identified, I loaded them into multiple GPS units, jumped into a car, drove as far as I could, walked as far as I could, and photographed what was there.

#### PROJECT BACKGROUND

*Points of Interest* grew out of a personal desire to renew my dormant creative practice. I had worked professionally as a designer for over a decade, then, between 2003 and 2011 I worked as an intelligence analysts in the United States Army, and as a defense contractor supporting United States Department of Defense projects. Almost all of my work in this time was in imagery and spatial analy-

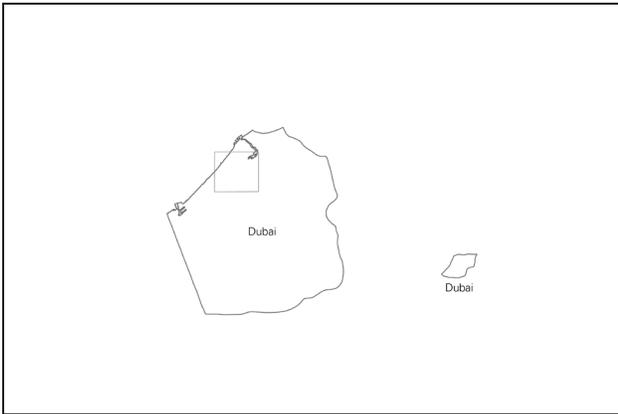


FIGURE 5: *The Emirate of Dubai, overlaid with the outline of a single Digital Globe image.*

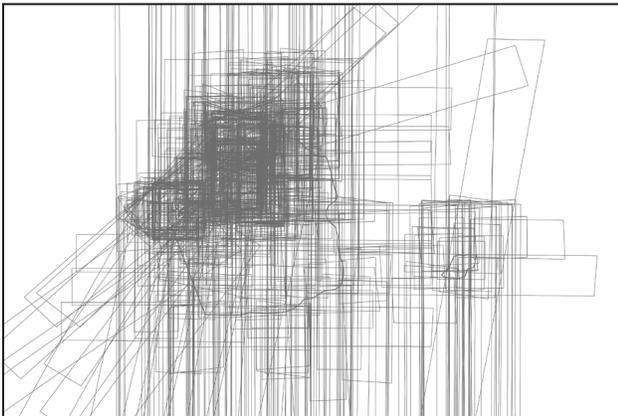


FIGURE 6: *Outlines of all Digital Globe images taken of Dubai between 1986 and 2013.*

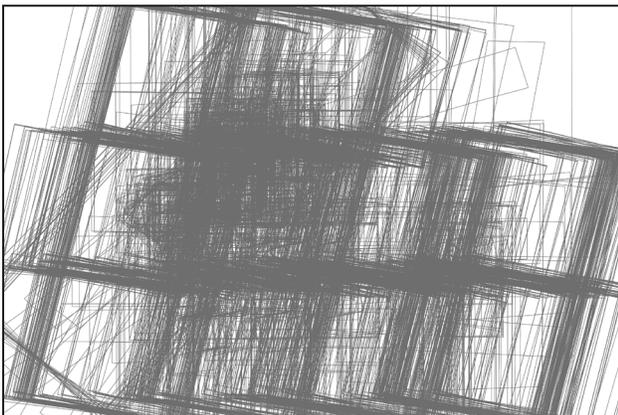


FIGURE 7: *Outlines of all commercial satellite images from all platforms taken of Dubai between 1986 and 2013.*

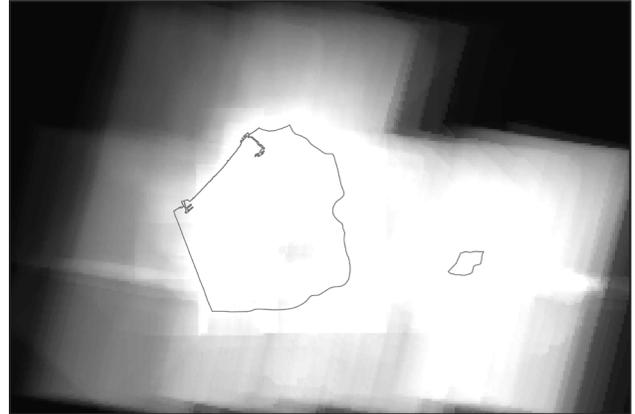


FIGURE 8: *A raster image showing the “interest surface” created by the overlapping of all commercial satellite images taken of Dubai between 1986 and 2013. Lighter pixels show areas of high collection, darker pixels show areas of low collection.*

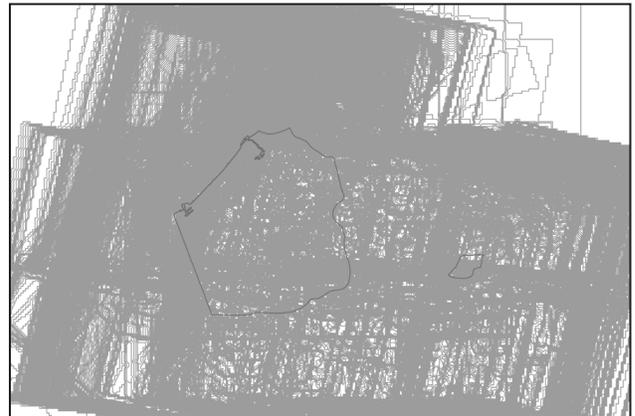


FIGURE 9: *A topographic surface created from the raster image in FIGURE 4.*

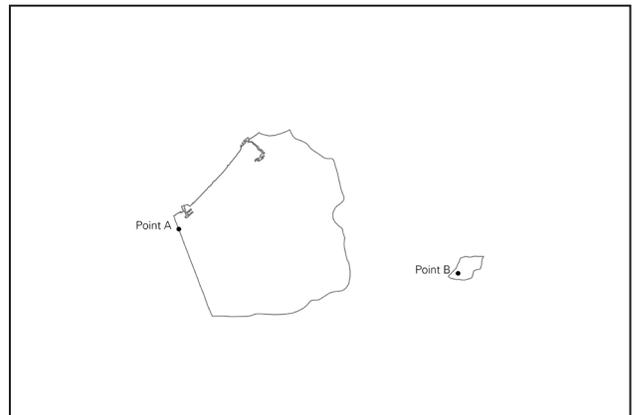


FIGURE 10: *Points of interest in Dubai as defined by commercial satellite imagery collection between 1986 and 2013. Point A: Point least seen from space. Point B: Point most seen from space.*

sis. And while I found this work interesting and rewarding, I always felt an urge to use these skills I had developed as part of creative work that lay outside the scope of my professional endeavors. Eventually this desire led me to leave full-time work in defense and to pursue an MFA from UCLA's Department of Design Media Arts, where I conducted the bulk of the substantive work that forms this project.

I was explicitly inspired by the work of artists like Trevor Paglen ([www.paglen.com](http://www.paglen.com)) and Owen Mundy ([owenmundy.com](http://owenmundy.com)), each of whose work, in part, explores military infrastructures.<sup>1</sup> But, I was also inspired by works like Edward Ruscha's *Every Building on the Sunset Strip* and photographer Matthew Jensen's *Nowhere in Manhattan*. For me, both represent projects that confront traditional ideas of landscape and landscape photography through creating programmatic systems that drive collection.

The tension between these two strains of influence is that the former frequently attempt to create narrative structures, while the latter are decidedly non-narrative, and it is in this tension that I hope to draw in the viewer. *Interest*, after all, is a value judgment, and we frequently base such judgments on stories or narratives we tell about the world. Labeling a spot a point of interest—labeling anything a [noun] of interest—implies that there is a coherent narrative that explains and justifies such a label. Quite frequently today, however, the reality is that there is no narrative behind the label, only analysis and its products.

#### PROJECT DEVELOPMENT

My initial goal in working with satellite imagery was to try to use commercial satellite imagery systems to take pictures that can only be taken from space. This goal remains elusive owing to the cost of acquiring commercial satellite imagery (it can cost upwards of a quarter of a million dollars to shoot an image). However, the initial thinking about this goal laid the foundation for the work in *Points of Interest*.

Many, if not most, of the discussions that I have had, with laypeople and professional alike, about satellite imagery—or drone imagery, or balloon imagery, or aerial imagery in general—focus on the ability of these systems to see into what has traditionally been called *denied space*. Since the first balloon was used in battle, seeing into enemy areas to gain information about what lay hidden there has been a primary goal of putting eyes in the sky. This kind of looking tends to be about seeing and identifying individual elements of interest: A mass of troops.

A tank covering a bridge. An anti-aircraft missile system.

But what is lost in this focus is the fact that looking from the sky also affords the observer a much *wider* field of view than is usually possible from the ground, even if they are looking from the very tallest peaks. From this vantage point in the sky, when using the right camera equipment, it is possible to collect images with a field of view that is beyond that capable for the human eye and mind to take in a single glance. I am not merely referring to the ability of systems to quickly traverse a large area and collect swaths of images as they go. The film reels loaded in an aircraft like the U-2 can capture photographs hundreds of miles of earth as the aircraft flies high overhead. While this capability is indeed impressive, the images so collected are still not taken in an instant—in a single decisive moment—so to speak. However, flying higher than the U-2, flying in earth's orbit, imagery satellites can capture a photograph of the same size with a single click of the shutter. As an artist, satellite imagery's ability to expand the field of photography was what originally drew me to the effort to interact with satellite systems. As I looked deeper into the way that these systems worked, I began to wonder more about how they functioned and interacted, and how they could show us something interesting about the world around us.

While the first military and intelligence satellite imagery collection began in 1959, commercial satellite imagery collection began in 1986 with the first images taken by SPOT. (from French, *Satellite Pour l'Observation de la Terre*) Since then, a number of companies have entered the market, some private, some public-private enterprises selling their products on the commercial market. The environment has not remained static. Last year saw the acquisition of GeoEye by Digital Globe and this year saw the rise of Skybox. The advent of GoogleMaps nearly ten years ago created a growing demand, and with it a growing marketplace, for commercial satellite imagery. So nearly thirty years after the first image was taken, we find ourselves only at the end of the beginning of this new era. And as it is still a young field our knowledge and understanding of its potential and its effects remains limited.

These were my primary areas of research until work on *Points of Interest* earnestly began in mid 2010. Like much exploratory work, it wasn't clear in which direction I was heading. I started out by simply collecting data. Even though I had been working with satellite imagery for nearly six years at that point, most of my experience was working in government and military systems, and the process of data discovery and acquisition in the world

of commercial satellite imagery was unknown to me. So I began looking through the catalogs of the major commercial satellite imagery systems—at that time, SPOT, GeoEye, and Digital Globe—and downloading metadata in the form of shapefiles, which I could view in a variety of geographic information systems. My goal was to understand collection patterns to see if it was possible to predict when a satellite would shoot an image of a given location.

As I loaded more and more data into my geographic information system for analysis, I saw that the spaces on the map unseen by the eyes in the sky was growing smaller and smaller, and I began to wonder if there was anywhere on earth that still hadn't been seen. This marked a major conceptual shift in my approach. Previously, my goal was to try interacting directly with commercial satellite imagery systems. The analysis of the metadata about the satellites' missions was only a task to understand these systems. But now I began to see interest in the metadata analysis in and of itself.

While a few individual systems still had small gaps in geographic coverage, looking at all the systems together showed that there was no area that remained unseen. Once I realized that this binary seen/unseen question was no longer relevant, I began to further wonder about the different areas that had been viewed. Which areas had been photographed the least, what areas had been photographed the most?

## TECHNOLOGIES

### PART I: TRAINING

Geospatial analysis is, at least traditionally, not a skill that is easy to pick up quickly (whether or not this will change with the advent of new spatial analysis technologies remains to be seen). In my experience, even a basic level of proficiency can take at least semester of college level instruction and, even then, most learners report that this only provides an awareness level of understanding. Once acquired, the skills are also quite perishable, even without the effects of constant changes in technology. I think that these aspects of working with spatial data in an art context—or really in any context that is outside of the mainstream of working in spatial analysis—make a discussion of the training I have received an essential part of describing the technology involved in creating the project.

### IMAGERY ANALYSIS

Although this project doesn't directly involve analysis of satellite imagery, it required knowledge of satellite imagery. I gained this mostly through training in

the US Army as an imagery analyst, which began in 2003. While this work primarily utilized classified systems, the principle is the same: there is a camera in space, looking down. Some of the same knowledge could be acquired in a university level geography course, or perhaps in an aeronautical engineering course on space systems, but these courses would probably not be open to the casual learner. Then again, enlisting in the United States Army for an eight-year term isn't a casual option either.

### SPATIAL ANALYSIS

My background in geography and geographic information science goes back to the mid 1990s, but I only undertook serious training nearly ten years later in 2003. I took geographic information systems courses at Hunter College, CUNY, and workshops through the National Geospatial Intelligence Agency. In 2008 I began working at Esri, makers of ArcGIS, and took numerous workshops through Esri and the National Security Agency, in addition to working with GIS in both my work at Esri and in the military. My skills were focused primarily on performing geospatial analysis in desktop GIS systems, and within these mostly in ArcGIS. As with imagery analysis above, these are not easily acquired capabilities, although they are becoming more available. Free GIS systems like QGIS, GIS analysis in Python with GDAL and OGR, and homebrew solution are all more robust, and lower-priced, home use editions of ArcGIS, all of which makes it easier for users to tinker with GIS and learn through doing. Still, I do not assess that this learning is easy.

### PROGRAMMING

In order to perform the kind of big data analysis that I needed to conduct for this project and similar efforts, I needed to acquire programming skills. And while in general it is becoming easier for non-programmers to learn to code, in 2009 I was still challenged to find the right entry point into programming. Additionally, while today Python is the default programming language used to automate tasks within many programs, including ArcGIS, this transition had still not occurred in 2009.

I began trying to learn Processing ([www.processing.org](http://www.processing.org)) using a book written by one of its co-creators, Ben Fry ([benfry.com](http://benfry.com)). But it proved difficult for me to bootstrap into a programming practice this way. A few years later, in the summer of 2011, I tried again, this time using a basic O'Reilly and a set of data from the United States Naval Observatory Astronomical Applications Department ([aa.usno.navy.mil](http://aa.usno.navy.mil)), and this time I managed to get make a little headway. In the fall of 2011, I transitioned

to studying programming at the University of California, Los Angeles (UCLA) under Casey Reas (reas.com), the other co-creator of *Processing*, and as part of a community of experienced creative coders. This experience of successful self-instruction—even at a small level—followed by immersion in a focused program with real programmers, created the critical mass that finally enabled me to start coding. After only a few months of processing, I felt confident enough to try to learn Python with the assistance of Nic Hanna, a colleague at UCLA (www.nicholas-hanna.net). After fewer than ten weeks at UCLA I was able to code the initial program that would analyze more than 45,000 shapefiles in ArcGIS.

The effort to create the program in Python was not effortless, however. While the documentation for using Python in ArcGIS is adequate, using it effectively required a deeper understanding of how spatial data is conceptualized and stored within ArcGIS, in particular, and within shapefiles in general. Similarly, while shapefiles themselves are a de facto standard for sharing spatial data, various implementations of shapefiles that I encountered within the datasets were not always built along the standard standard, so to speak. For the novice programmer—perhaps even for the experienced programmer—these issues can create long periods of confusion where it is unclear where a problem lies. Nevertheless, working through these kinds of problems is a part of the “on-the-job training,” part of learning to program, and is as important as formal education. There is no class that I have seen in using Stack Overflow (stackoverflow.com), but you need to learn how to use it all the same.

#### WAYFINDING AND TRAVEL

Identifying points of interest was only one half of this project. Journeying to these points—or trying to—was the other. And these journeys drew on every piece of knowledge and every experience that I have with wayfinding.

This training came from many places. Summer camp. The military. Mapping sidewalk hazards in New York City. A surveying class one summer in Maine. Tinkering with GPS units. Driving across America. I don't think that there is any one piece of training that I could point to that could address all that I used or all that I needed. The skill—the outlook—needed to find unknown places is something that can only be found through getting lost a little.

#### PHOTOGRAPHY

Isn't everyone a photographer nowadays? Is photographic “training” relevant? These questions are beyond the scope of this article, but I will mention my background

in the interest of completeness. I studied traditional silver-nitrate, non-silver, and chromogenic color photography in the early 1990s through the early 2000s and worked in museum and magazine publications as a photo researcher and designer during the same period.

#### PART II: WORK

##### DATA ACQUISITION

All data used in this project came from the public facing websites of commercial satellite imagery system operators. In each case, the operator provided access to their catalogs to enable researchers and other potential consumers to locate imagery of interest.

The usability of these sites varied—and still varies—considerably. SPOT imagery can be downloaded for an entire continent for an entire year. But for other systems there are: limits on the spatial extent of a search, limits of the temporal extent of a search, limits of the number of features that can be downloaded at a time, or some combination of all of these. Within search itself, there are also different philosophies on how to search for spatial data. Some systems enable users to enter coordinates for a bounding box. Some enable search using a center point and radius. Some enable users to upload shapefiles that define the search area. However, no two systems are the same, so some effort must be made to create a search plan that describes the same overall search areas using the individual search methodologies unique to each system.

Dealing with the kind of “federated system” can be frustrating, yet this is essential to combining disparate data sets in order to produce new analysis. I now wish that I had kept track of the amount of time that I devoted to working through this problem in order to better estimate for similar kinds of challenges in the future.

##### DATA STRUCTURE

The satellite footprints that I have worked with have been stored as shapefiles, one of the most common standard formats for storing spatial data. A full discussion of shapefiles is beyond the scope of this paper. What is relevant here is that the shapefiles I used stored polygons.

Because each system is different, metadata and its structure within each file was different as well. Luckily, since I was only focusing on spatial metadata, these differences did not pose much of a problem. However I do wonder if, in future iterations, it would be better to strip out this non-essential metadata before conducting spatial analysis in order to decrease file size and potentially increase performance?

#### DATA CLEANUP

Like any dataset, this one was messy. But no messier than most.

Some field renaming was necessary to conform each dataset to the same naming conventions used in the processing program. In some files, the shape geometries were stored in formats unreadable by ArcGIS through ArcPy, and in these cases the shape geometries were written out to text files using standard geoprocesses, and then recreated in new, clean shapefiles using the textfiles. In some rare cases, I had to construct shapefiles from scratch using only coordinates of bounding boxes.

While the tasks themselves were not time consuming, understanding that I had to perform them often took a great deal of time. The shapefile rewriting process described above came out of puzzling over many cryptic error statements and through much debugging through brute force trial and error.

#### DATA PROCESSING

Like much big data analysis—like any data analysis—data processing decisions that I make are constrained by available resources. Time, money, data structure, computing power, and programming skills are all factors to consider. Limits to all of these have influenced my decisions to date and point the way towards how addressing limitations could influence future work.

One of the biggest challenges in this kind of spatial analysis is addressing the computational complexity of combining so many polygons. Ideally, one would simply take all the polygons in the area of interest during the time period of interest and analyze them such that a new polygon was created for every area where a given polygon intersected with every other polygon that both overlapped it and overlapped each other. This not only sounds complicated, but is complicated if using a dataset that has more than even a few shapes. In Southern California, between 1986 and 2011, with nearly 45,000 polygons, it quickly became apparent that there was no way I was going to be able to perform this operation on a desktop system.

In order to address this limitation, I considered options to increase computing power. One obvious option was to use a commercial cloud-based system like Amazon Web Services. Another was to try either the supercomputing or cloud-based academic resources at UCLA. In both cases, the cost in both time and money, and my limited programming ability, led me to believe that I would be losing ground in terms of making work, and there would be no promise of solving the challenges of increasing

computing power in a timely manner—if at all.

I decided instead to think about changing the data's structure in order to enable faster processing while still staying within my limited programming ability. I was able to do this partly because I was working on an art project whose concept was, by its nature, not necessarily about creating results with a high degree of accuracy. With this in mind, I could consider strategies that could include making the data coarser in order to speed up processing.

Based on earlier training, I hypothesized that working with raster data could potentially increase speed over working with vector data. Combining rasters is a relatively fast operation within both ArcGIS and various Python libraries, like NumPy, and so I believed that working with the data as a raster could open up a number of avenues of approach, which could prove useful in an effort to develop an effective strategy. Finally, once I made the conceptual decision to convert to rasters, I would automatically be accepting a loss in data resolution, which would free me up to experiment with the different raster sizes in an effort to find the best size to enable acceptable speed.

Once I tested the decision to convert from vector to raster, I was able to automate the process with Python in ArcGIS. In this process, the program opens a shapefile and steps through each polygon in the file. Each polygon is converted to a raster with a value in each cell of 1. This raster is then added to a base raster with a spatial extent of the entire study area. For the first polygon in a shapefile, this process results in a base raster with cell values of 0 for every area except that covered by the initial rasterized polygon. A second polygon is then converted to raster, and this raster is added to the base raster. For the sake of illustration, we will assume that this second polygon partially, but not completely, overlaps the first. For the second polygon in the shapefile, this process resulted in a base raster with cell values of 0 for every area not covered by either the first or second polygons. Further, processing allows for a cell value of 1 for every area covered by either the first or the second polygon but not by both, and a cell value of 2 for every area covered by both the first and the second polygon. This process is repeated for each polygon in each file for the entire study areas, which produces a raster file showing the areas that have been photographed the most from space, the areas that have been photographed the least from space, and every area in between.

However, for the photo projects I created I was not looking for areas, but for points. A friend of mine, in response to Sir Edmund Hillary's famous quote about why he climbed Mt. Everest, retorted: "People don't climb

mountains because they are there; they climb them because they have a top.” Creating this kind of clear goal—no matter how fuzzy the logic behind creating it might have been—was an essential conceptual piece of this project for me. It speaks to our desire for certainty, a desire that big data so often promises to fill.

In order to find such points, the resulting raster file was first converted to a topographic surface using ArcGIS desktop. Using this vector data I was then able to identify point centroids of the polygons representing the areas that had been collected the most and the least for either the study area as a whole or for subsets. The project started in Southern California and to date I have located points in areas no larger than counties in this region. That being said, since San Bernardino County is the largest in the United States, and is in fact larger than some states and some countries, these are not areas of insignificant size.

#### WAYFINDING AND TRAVEL

The issue with almost every point I visited is that it is in some way “off the grid.” You don’t realize how profoundly our experience of moving through space in the world is constrained by systems of property ownership and of transportation until you try to move outside of the design constraints of these systems, even marginally. And so strategizing how to use these systems most effectively to get to my targets became challenging.

I used traditional road maps, of course. As well as GoogleMaps. And GoogleMaps in a smartphone. But also a series of Garmin Nuvi GPS units for use in a car. Why? Because at various times different road networks would be available in each of these systems. And then I also used a handheld Garmin for terminal guidance to my point of interest. And a compass. And trail maps. And satellite imagery pulled from Google and printed out.

Even with all this when I planned out my routes and tried to get to my destinations, I inevitably discovered ground truths that were not captured in any of these systems. Gated roads. Gated trails. Fenced off property. Unclear boundaries. Inconvenient water. Often, I navigated as far as I could, and then had to turn back. Perhaps in the end, it was a fitting testament to the power of satellite imagery.

#### PHOTOGRAPHY

I mostly find little interest in the discussion of technology in the context of image making. You have a toolbox, and you put the right tools for the job in it.

While this project is about landscape, it is also about getting out into the landscape. As such, I chose to use

hand-held digital equipment rather than medium or large format equipment.

In my case I wanted to look at wide fields of view. Even though I was looking for points, I was also looking at landscape. Even though I was looking on the ground, I was referring to images captured from space. Therefore, I chose lenses with wide angles of view but not so wide as to be fisheyed; lenses that produced a view that seemed like it could be one taken in by the eye in a single glance without distortion.

I also wanted to achieve focus and large depth of field. I was not and do not look for romantic views of landscape (even if I sometimes find them). I try to avoid fuzziness or lack of sharpness. I therefore tried to shoot at the highest f-stop possible as much as possible.

I also wanted to look at instants or moments, although this was of secondary importance to field of view and depth of field. I chose to use relatively high ISO speeds in order to be able achieve these goals. In order to avoid graininess this imposes limits on final output size, but I can still show images at 20”x30” without too much grain.

#### PROJECT CONCLUSIONS

While there is sometimes a great deal of correlation at a gross level between how much an area has been photographed and some attributes of this area this does not always hold true at the more detailed level of the analysis. Frequently, population density and wealth are good predictors for the amount of photography one finds for a given area, with a direct relationship between density and wealth and the amount of photography. Sometimes, however, this does not hold true. In San Diego County, for example, the area photographed most often from space lies directly across the border between the United States and Mexico, a few miles east of the Port of Entry at San Ysidro. This is an unpopulated, rugged, mountainous area covered mostly by a wilderness park on the United States side of the border, and an area where one would typically expect very little satellite photography. The fact that it is the area most photographed in San Diego County indicates that United States Customs and Border Patrol probably purchased this imagery, and that the area is likely an illegal border crossing point.

An important outcome of this project is that it visually displays emergent effects of complex systems. Each commercial satellite provider is a business. Each business has its own business model, which drives decisions on what kinds of images should be taken: what size, what resolution, what look angle, and so on. These decisions,

in turn, drive the deployment of the overall satellite system, as well as the tasks for the individual satellites within those systems, and how each will be used to take specific pictures. But since the systems and business models are different, when the location metadata from different companies are combined in order to find areas that have been photographed the most and the least from space the areas that emerge are often created by the unintentional interactions within and between these systems and models.

Many factors come into play. An area of interest may be larger than the frame size of a satellite camera system. As such, the system may need to collect multiple images to provide coverage. However, in order to mosaic these images together effectively, each will be taken with some overlap, producing an increase in coverage in these areas. Similarly, an area of interest may be smaller than the frame size of a satellite camera system. As such, the resulting images will contain other areas not of interest that are collected anyway. Combinations of these effects alone create many areas that seem to be of interest but are simply being imaged as a result of system design.

In the analysis of almost any complex and/or federated system similar emergent effects can be seen. However, because of the number of operations used to join and analyze datasets in such systems, it can be hard to see, either literally or figuratively, where such effects are occurring, or to understand their effects. For the layperson, one effect of this obscurity is a lack of understanding about how the complexity and seemingly advanced nature of technological systems can still produce spurious results.

What I realized, and what drives the pictorial phase of this project, is that there could be no consistent pattern amongst the points of highest and lowest collection when looked at across many areas. While some cases might show a dense urban area to be the point of highest collection and a sparse rural area to be the point of lowest collection, others would not. This lack of consistent output from a rigorous analytical process using complex outputs from advanced technological systems would undoubtedly confuse, it not unsettle, the viewer. “Highest” and “lowest,” “most” and “least”—these are definitive terms to which we want to attach definitive views. We know what the tallest mountain looks like. We know what the deepest canyon looks like. But when the point most photographed from space looks different time and time again we have to ask, “why this place?”

#### NOTES

**1** A self-penned write-up of one of Mundy’s projects, Camp La Jolla, was included in Volume III, Issue 3 of PJIM (<http://piim.newschool.edu/journal/issues/2011/03/index.php>).

#### BIOGRAPHY

Richard Wheeler is an artist. He is an adjunct faculty member in *Art Center College of Design’s* Media Design Practices: Field program and a lecturer in UCLA’s Department of Design Media Arts.