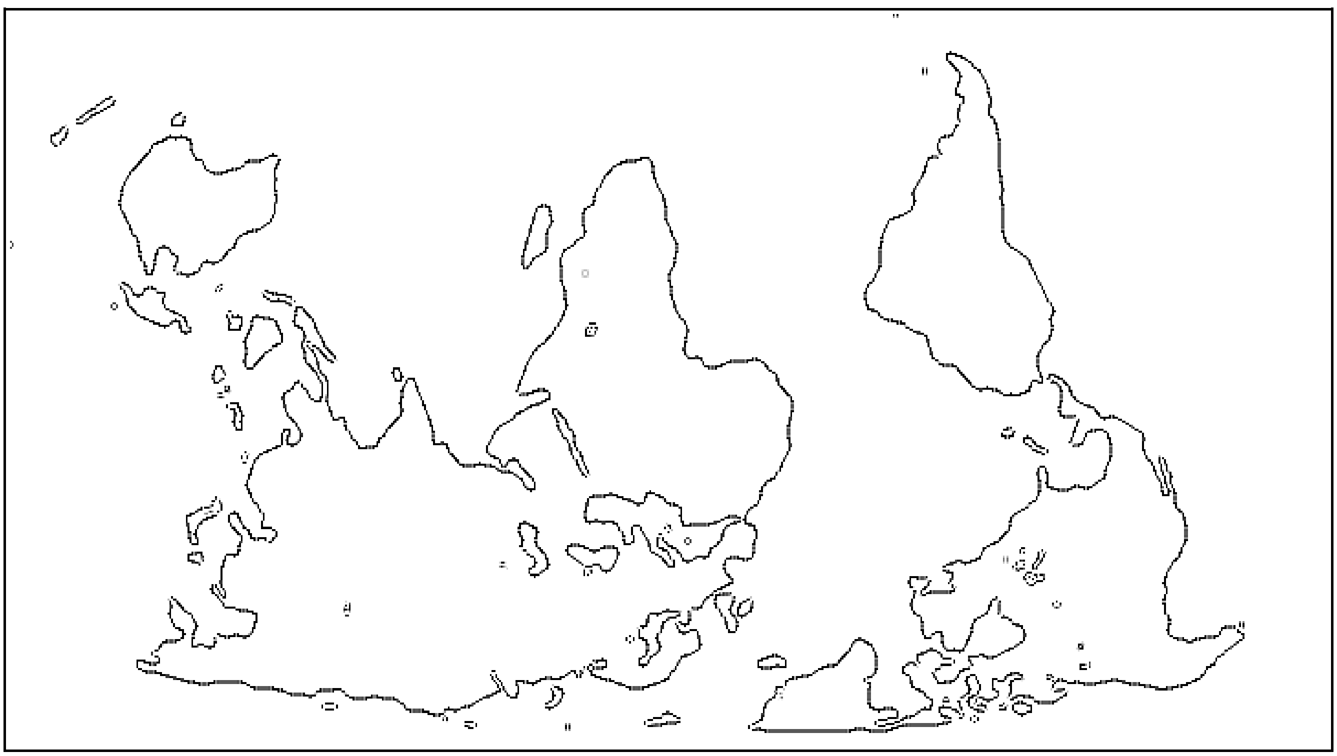
The Illustrated Guide to Nonprofit GIS* and Online Mapping

Version 0.99 :: 23 February 2010

"Maps Can Turn Our World Upside Down"



*** "GIS" stands for "Geographic Information System." See, you're learning already!**

maptogether.org

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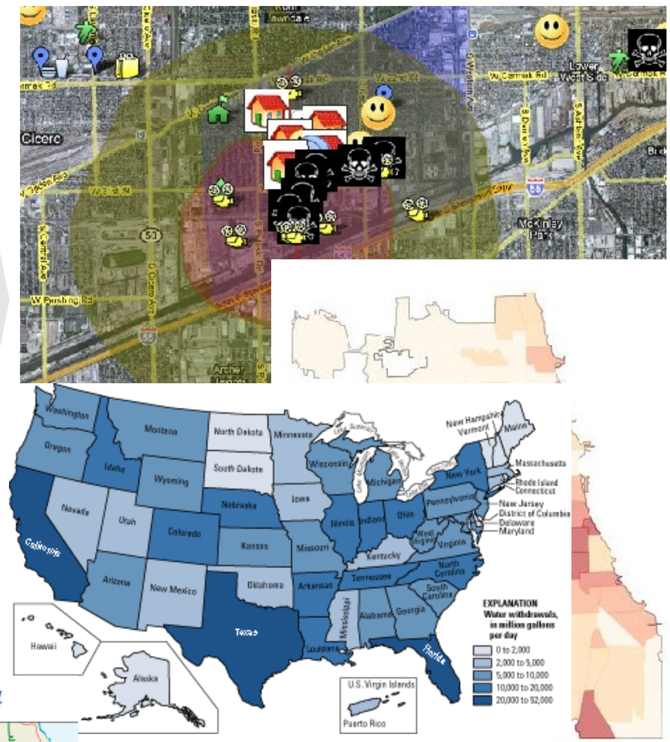
(Consider it a map of this guide! :)

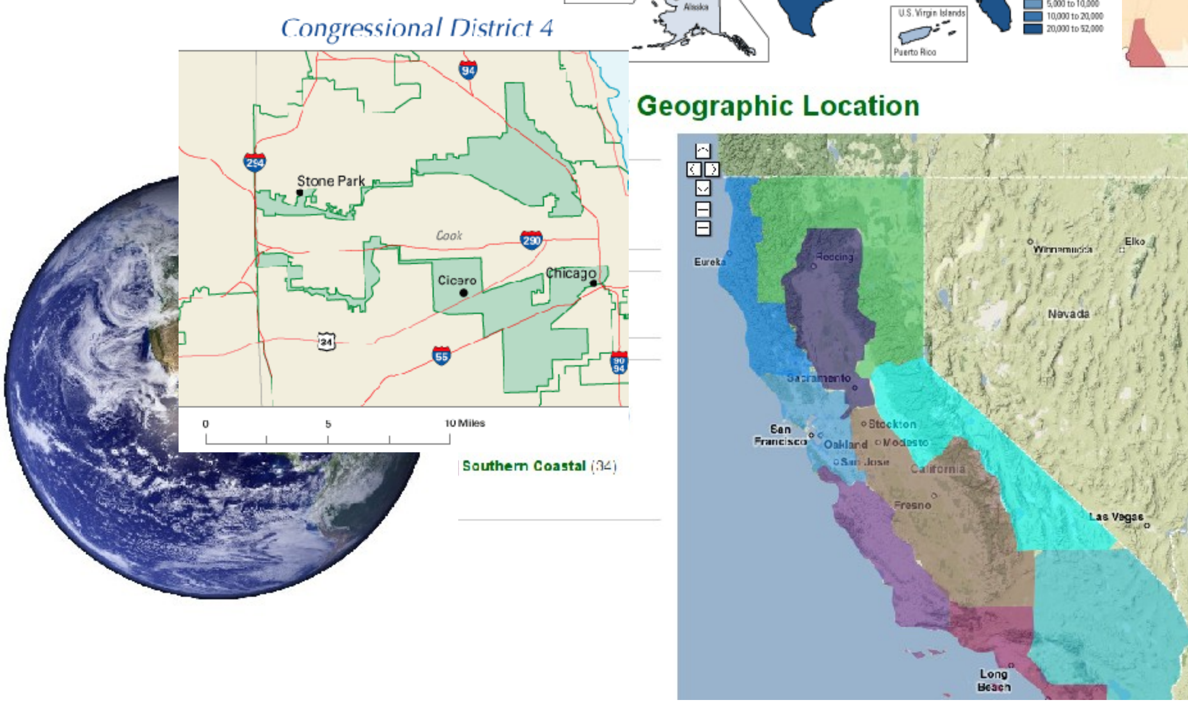
About MapTogether:

The MapTogether project provides free map-related training and tools for community and nonprofit groups around the world. Our resources include software, data sets, online mapping services, documentation, and training resources.

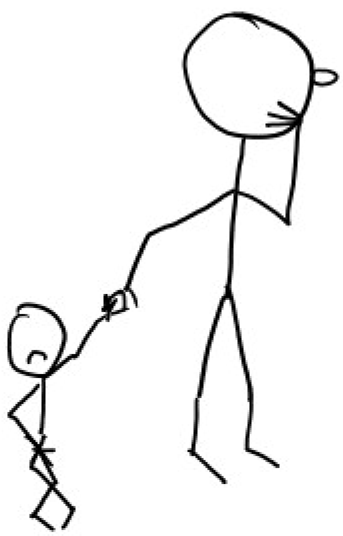
What is GIS and why should nonprofits care?

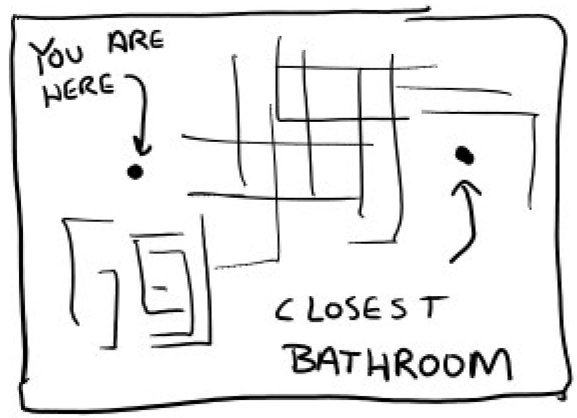
“Maps tell powerful stories about the communities and the world in which we live. Maps are a visualization tool, a way to help us transform columns of data into useful knowledge about the people and places around us.”



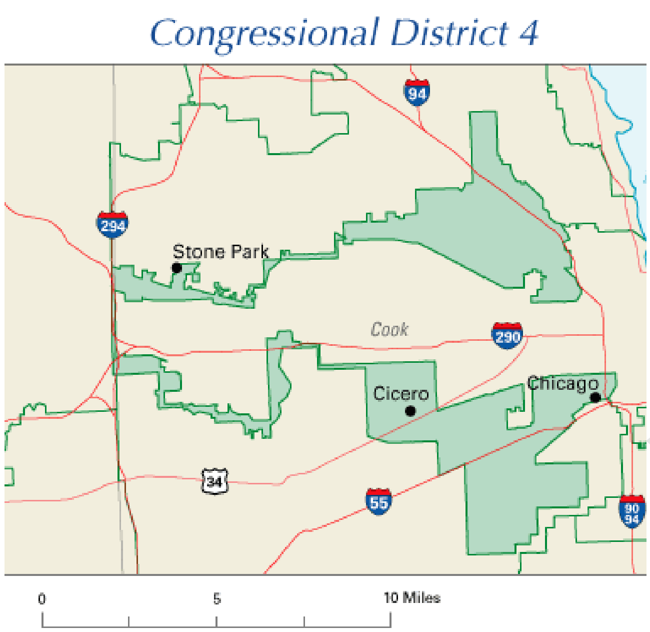


Maps can be incredibly useful...





...maps can also be incredibly powerful!



Gerrymandering: the process of re-drawing political boundaries or districts to give one class of people an unfair advantage or disadvantage over others during elections.

The 4th Congressional District of Illinois – two communities connected by a highway. Cited by *The Economist* as one of the most gerrymandered districts in the United States.

“A geographic information system (GIS) captures, stores, analyzes, manages, and presents data that is linked to location.”

wikipedia

Computers

+ Maps

= GIS

oversimplified definition

GIS isn't just about maps, though. Any information system or database using physical locations can be considered GIS, even if it doesn't create a graphical map. For example, many nonprofit organizations with an advocacy mission allow visitors to their website to enter their physical address and find out their elected representatives. This is done using a database of locations and the geographical boundaries of political districts.

As we progress through this guide, we'll be examining some of the “behind the scenes” tools and data used to create geographic applications that support nonprofit missions.

DON'T PANIC! USER-FRIENDLY INFORMATION FOLLOWS!

This guide is aimed at nonprofit professionals and volunteers without a background in GIS, geography, computer science, website development, graphic design, or any other specialty. We also try to reference **free** tools, data sources, and services wherever possible!

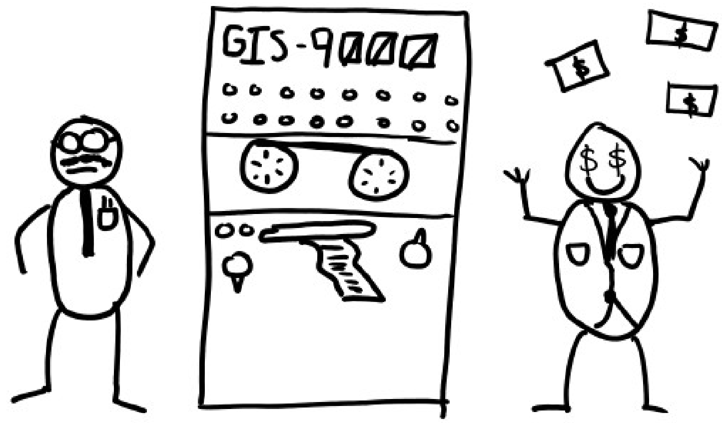
People have been making maps of the world around them for thousands of years and for many purposes: navigation, military campaigns, astronomy, exploration, and many others. The activities of both individual humans and whole societies are inherently place-based.

One of the earliest known uses of maps for public health was created by Dr. John Snow, a British physician studying a cholera outbreak in London in 1854. Now considered the father of public health and epidemiology, Snow created one of the first “spot maps” illustrating the incidence of disease in a neighborhood (at right). This allowed him to trace the cause of the cholera outbreak to a specific water source.

Fast forward one hundred years and scientists started using newfangled technology to create maps. This was quite a breakthrough: imagine mapping an area with the immensity and varied terrain of the American West using a horse, pen and paper, and a compass. Then compare that with the modern geographer's array of satellites, aerial photography, computers, remote sensing devices, graphics programs, and GPS.

Acronym Alert! “GPS” stands for “Global Positioning System”
GPS is a US-funded satellite system that provides precise location and navigation data to satellite receivers on the surface. The GPS system itself does not “track” people – it merely sends signals down to the Earth allowing the GPS unit to actually calculate your location and display it on a map, route you to the nearest highway, or direct you out of the woods.

In the “old days” – meaning the 1990s and even earlier! - GIS belonged almost exclusively to the *government*, *academia*, and large *corporations*.



Only those institutions had the resources, both financial and technical, to properly gather and analyze geographic data. Many communities had and still have valid concerns about allowing large institutions to dominate the powerful field of *geographic information science* (which is the formal study and application of geographic information systems).

Over the past several years, recent advances in computing and Internet technologies have brought many powerful and versatile mapping tools and data sources to the masses! Individuals, groups, and communities all over the planet are using maps and geographic tools to explore our world, collect and share data, and tell their stories.

"Yes, we CAN use maps and GIS to make the world a better place..."

As noted by Penn State's new aptly-named Geospatial Revolution Project public media series, “***the location of anything is becoming everything***.”

So what does all this mean today in the nonprofit/voluntary sector?

We've identified five primary areas of focus that nonprofit organizations are successfully augmenting or improving with online maps and/or related GIS technologies:

- *program and service delivery*
- *research and analysis*
- *fundraising and development*
- *"maptivism" - advocacy, activism, and storytelling*
- *community resource mapping*

Nonprofit Focus #1: Program and Service Delivery

Organizations that provide services can use GIS and mapping software for practical purposes, such as planning program or project site locations, creating maps of constituents, creating logical route maps for deliveries or mobile service programs, or coordinating events.

Hypothetical Example:

Kari Coordinator manages a small "meals on wheels" program for elderly residents of her community. Each morning she generates a list of residents and their addresses, excluding any that are known to be in the hospital or away from home. She uses a simple and free online mapping service to display the addresses as points on a map. Finally, she divides the addresses up so that she and her assistant can most efficiently deliver the meals, saving time and fuel costs.

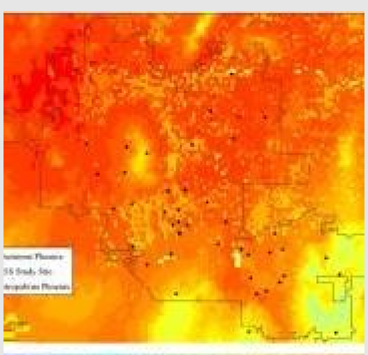
Nonprofit Focus #2: Research and Analysis

For organizations actively trying to learn more about the communities they serve, maps and geographic analysis tools can be invaluable for collecting and visualizing geographic data. In addition, projects related to the concepts of "participatory GIS" and "bottom-up community mapping" are providing new ways for constituents to share information about their community in a geographic context.

Real World Example: Correlating Urban Heat Waves & Poverty

Many people remember the Great Chicago Heat Wave of 1995, which killed over 700 people according to some estimates (twice as many as the Great Chicago Fire of 1871). Author Eric Klinenberg performed a "social autopsy" of the event in his book "Heat Wave," trying to determine why the elderly and people in low-income neighborhoods were most vulnerable. Klinenberg's book included a map (at right) showing the correlation between heat deaths and high-poverty areas.

Investigators have found that residents of low-income neighborhoods are less likely than their high-income counterparts to have air conditioning sufficient to counteract a major heat wave. In addition, some people had air conditioning but wouldn't use it because of the additional cost. Also, many elderly residents in low-income areas, who made up the majority of victims, were less likely to leave their windows open due to concern about crime.



In 2009, researchers at Arizona State University released a study demonstrating that low-income areas are likely to be hotter than their higher-income counterparts, exacerbating the problems outlined above. Heat maps, like the one shown at the left, were used to analyze heat in various communities around the Phoenix metropolitan area. This effect can be attributed to several factors, especially in the desert of Phoenix, but one of the main environmental factors is that low-income neighborhoods tend to have more pavement and less substantial vegetation. Both of these issues contribute to the so-called "heat island" effect where cities become giant heat sinks and radiators during the summer. Understanding the causes and effects of heat wave deaths is the first step to preventing more in the future.

Nonprofit Focus #3: Fundraising and Development

Organizations are striving to gather and to effectively use more information about their donors, as well as trying to forge closer ties with individual and institutional members of their community; mapping and geographic tools can provide ways to analyze this information during the development planning process. In addition, mapping and GIS tools can supplement the existing information and visualization presentation in grant proposals, fundraising appeals, and other development materials.

Hypothetical Example:

Wally Watershed is submitting a grant application to a federal funding source for environmental monitoring of his local creek system. He uses a variety of GIS tools and data to create maps that determine his organization's ideal testing regimen as well as illustrate their supporting documentation.

Another Hypothetical Example:

Polly Politician is running as a progressive candidate for her local city council. Her tech-savvy volunteer campaign staff is using GIS and mapping tools to assist with several crucial campaign tasks:

- Draft policies and program plans based on community data
- Combine voter registration records with census, ZIP code, and other political district information to create a constituent/voter database
- Use geographic information to solicit donations from target populations/segments
- Create efficient door-to-door canvassing lists for neighborhood volunteers

Nonprofit Focus #4: Advocacy, Activism, and Storytelling

Nonprofit organizations can use GIS and mapping tools for many functions under the “advocacy” and “activism” umbrella. Some of these are similar to the functions listed above: for example, gathering data from community members on a website form can be considered a vehicle for advocacy/activism as well as data collection for research and publications.

Communities can use GIS tools to create detailed maps of resources and features in their region. Grassroots movements can organize tightly-focused groups of concerned citizens near each other. In addition, maps make an excellent platform for digital storytelling projects, allowing the stories of people and groups to be associated with a geographical area.

Real World Example: Environmental Advocacy Mapping All-Stars

iLoveMountains.org is an advocacy site created by the Appalachian Voices environmental organization to protest the practice of mountaintop removal mining. In addition to containing news, multimedia, and social media tools, the site has been recognized by Google Earth Outreach and many other organizations as a pioneering implementer of GIS for advocacy and activism purposes.

The GIS tools at iLM allow users to view before and after satellite photos of areas affected by mountaintop removal mining, demonstrating the extreme destruction caused by this practice.

The “What's Your Connection” application displays the geographical and energy connections between a visitor's local power company and companies and sites where this mining occurs.

To learn more about iLM, visit http://ilovemountains.org

Nonprofit Focus #5: Community Resource Mapping

Community resource mapping can be a valuable part of the other four focus areas of nonprofit mapping.

Community resource mapping, also referred to as community asset mapping, can refer to a process where stakeholders document the assets/resources, deficits, and connections in their community – **regardless** of whether GIS and mapping tools are used. Before the boom in accessible mapping/GIS tools, community resource mapping frequently diagrammed resources in an abstract "flow chart" presentation, with no geographical component.

Today, with the advent of these tools and accessible data, individuals and communities are creating geographically accurate maps of the people, places, and institutions that make up their neighborhoods, cities, and regions.

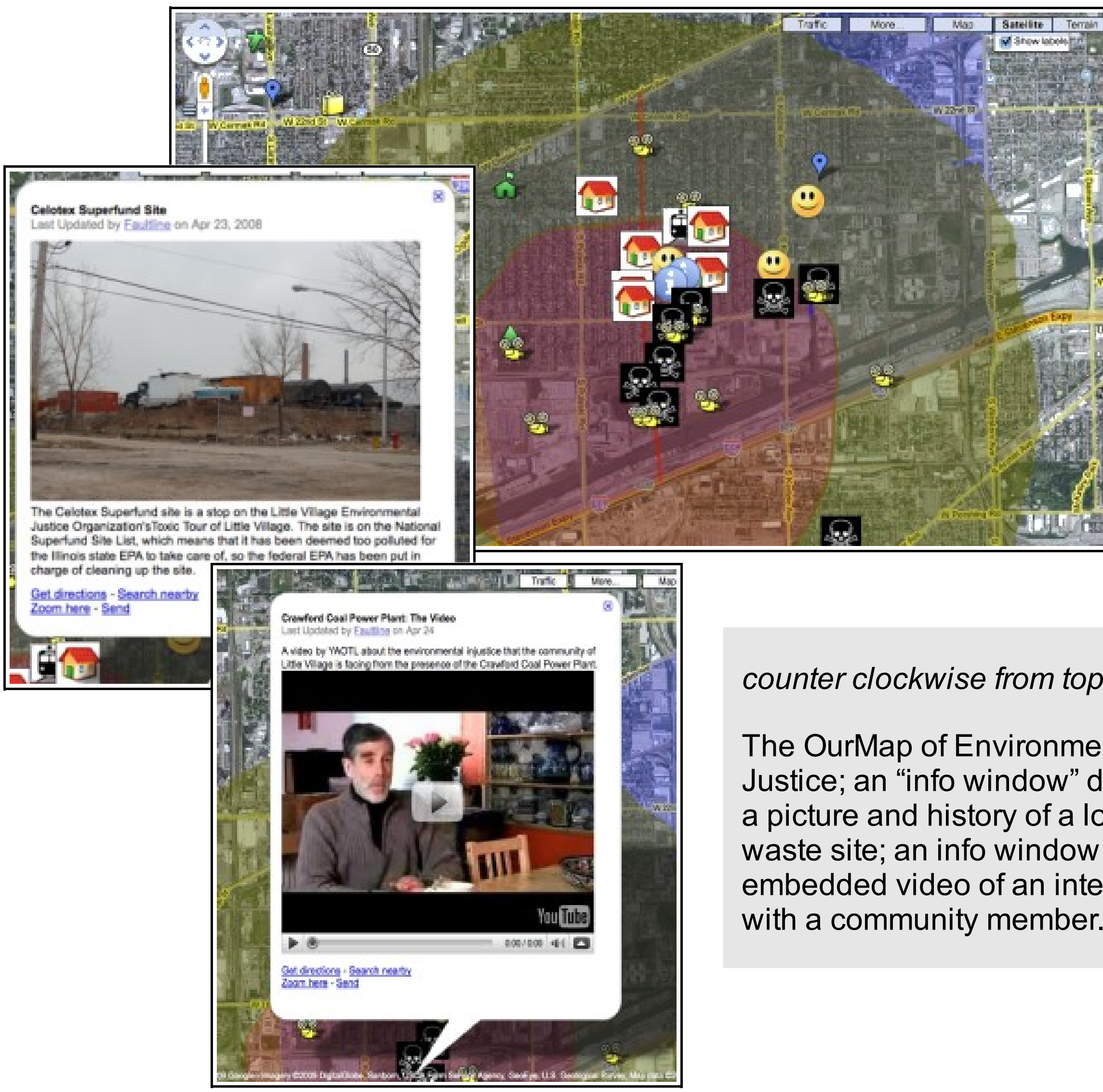
Community resource mapping that includes a geographic component and seeks input from a variety of community residents or stakeholders can be viewed as a form of what academic GIS professionals have long referred to as "public participation GIS" (abbreviated "PPGIS"). PPGIS projects might include a rural village in a developing country working with an aid organization to map floodplains and agricultural boundaries – or it could refer to a neighborhood cycling club using free online mapping services to measure and share favorite local bike routes.

As more mapping/GIS tools and data sources take advantage of Internet-enabled sharing and social media practices, it will be easier for the everyday user (such as nonprofit professionals) to create effective GIS materials and applications. Already, sites like OpenStreetMap (http://openstreetmap.org) are allowing for hyperlocal sharing of geographic data at the neighborhood level, populated by community members across the world.

Real World Example: A Youth-Created Community Environmental Map

The Little Village Environmental Justice Organization (LVEJO) has been working toward environmental and social justice in Chicago's Little Village and Pilsen neighborhoods since the mid-1990s. The organization has been using GIS and community mapping techniques for over ten years, making them community GIS pioneers by most organizations' standards.

One of the neatest LVEJO community mapping efforts is “OurMap of Environmental Justice,” a community-generated map displaying community assets, threats and dangers such as gang territory and toxic waste sites, and multimedia content from neighborhood residents. The map was created by youth from LVEJO in collaboration with the Open Youth Network of Chicago, and the result is impressive! Check out http://www.lvejo.org for more details!



counter clockwise from top:

The OurMap of Environmental Justice; an “info window” displaying a picture and history of a local toxic waste site; an info window with an embedded video of an interview with a community member.

Ethical Concerns of Nonprofit Mapping/GIS Projects

As we noted earlier, maps are powerful! Because of the nature of geographic data and the significance of physical locations, there are several ethical issues that must be considered when working with GIS and mapping technologies.

- **Privacy** – many nonprofit organizations collect address or other relevant data about their constituents, clients, donors, partners, and other community members. It's crucial to safeguard any data that has an expectation of privacy.

- **Community representation –** it's critical that all stakeholders are considered during mapping/GIS projects, especially those projects that will influence decisions made concerning the community in question.

- **Discrimination issues –** maps and GIS have been used to promote diversity, fair housing, and fair election practices, but they've also historically been used for discriminatory purposes against certain races or groups.

- **Intellectual property issues** – in addition to software licensing issues concerning mapping/GIS software, many sources and types of data are embargoed by various intellectual property protections, such as copyrights and license agreements.

The Story of the Burakumin and Google Maps

Centuries ago, in feudal Japan, the lowest caste of citizens were known as *burakumin*. Even today, the descendants of burakumin are still sometimes discriminated against in the workplace and society. In early 2009, Google added ancient historical maps of Japan to their Google Earth mapping system – these maps included notations of certain neighborhoods where burakumin lived. Since Japan has a long history of detailed genealogical and geographic records, there was fear that the maps could be used for discrimination. After a public outcry, Google removed notations on the maps referring to the burakumin.

GIS 101: Getting the Lay of the Land

Let's go over some definitions just to make sure we're on the same page. First, let's review the Wikipedia definition of a geographic information system:

"A geographic information system (GIS) captures, stores, analyzes, manages, and presents data that is linked to location."

Have you ever used Google Maps, Yahoo! Maps, MapQuest, or a similar online mapping service? Then you have used a geographic information system – congratulations! :-)

We're going to use "GIS" to refer to generic "geographic information system" technology through the rest of this guide. Note that "GIS" can also refer to "geographic information *science*" which is the formal academic study and application of these systems.

Geographic and *geospatial* are two terms that – for the purposes of this guide and basic nonprofit GIS – are interchangeable. Both of these words, in our context, essentially mean "about a physical location."

Cartography means "mapmaking." When we create maps of our community, country, or world, we're cartographers! Again, congratulations :)

Neogeography – this word literally means "new geography" and isn't rigidly defined yet, but it refers to many aspects of the new mapping "revolution" enabled by mapping technologies and the Internet. We'll look at some features of neogeography on the next page.

Neogeography is sort of an umbrella term applied to projects, tools, practices, or features that utilize modern collaborative or social technologies and/or modern mapping/GIS technologies.

When thinking about neogeography with respect to GIS, it's helpful to envision it as a spectrum, with different traits being attributed to either neogeography or "traditional GIS."

- **more formal**
- **used by academia, government, and business**
- **analytical, quantitative**
- **data-driven**
- **costly, complex, and expensive tools**

- **less formal**
- **used by people, groups, and communities**
- **interactivity, qualitative**
- **people-driven / social**
- **affordable and accessible tools**

If you need to precisely analyze soil chemistry data from thousands of sample sites to generate a map and lots of statistics and reports for an environmental project, you're probably going to need the practices and tools involved with traditional GIS.

If you need to quickly create a way to let neighborhood residents submit the location of graffiti or combine a map of cycling routes with a list of nearby public schools, then your project would be considered "neogeography."

This isn't really a black-or-white issue: there are so many types of GIS/mapping projects of various levels of complexity that it's not easy to just classify them into neat little boxes!

Hypothetical Example:

Tommy Teacher wants to demonstrate to his students that bicycling can be a safe and healthy way to explore their neighborhoods while getting exercise. He'd like to lead after-school bicycle rides on safe streets between his school and several nearby parks.

While searching online, Tommy discovers a set of online bike maps of his community created by Sarah Cyclist. Since Sarah used a free online mapping service to create and share her bike maps, Tommy is able to combine them with the addresses of his school and nearby parks. The resulting “mashup” allows Tommy to quickly and easily print out safe cycling route maps for his students and their families.

A *mashup* is the combination of two or more data sources, tools, and/or services. If you combine a “news feed” of addresses from your partner organization's website with an online map of community resources on your own website, you've created a mashup.

Real World Example: An Interactive Interface to EPA Data

The GreenSpace Map project is an excellent example of a mashup that combines data from a variety of sources on an interactive map depending on the user's query. Visitors to the GreenSpace Map enter an address and a ZIP code and specify which environmental features they'd like to search for in their area: brownfields, pollutant discharge sites, toxic inventory facilities, Superfund sites, etc. A map displays the resulting features, including a link from each feature to the EPA reports concerning it. You can see what environmental hazards lurk in your neighborhood by visiting http://www.greenspacemap.com.

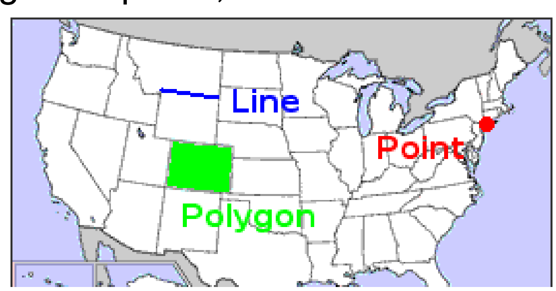
“Location, location, location! It's all about *where*.”

So all of this GIS stuff could be boiled down to understanding where something or someone is/was/will be. Your GIS or mapping project might include information about **who** (a map of your organization's constituents), **what** (a map of local schools and parks), or **when** (historical community maps) -- maybe even **how** (a map showing streets, subway, and bus routes, for instance). But the entire point of GIS is to present all of those other types of information in a "**where** context."

One way to simplify GIS is to look at it as a way to get answers to our “where” questions. Let's examine some nonprofit-relevant examples of “where” questions that GIS can answer. In fancy-pants geographer-speak, these are referred to as "spatial queries," but we're going to just keep using "where questions" because seeing phrases like "spatial queries" tends to freak non-geographers out. :-)

First, we need to understand what GIS is actually symbolizing – what features can we put on a map? While most of us are familiar with the “pushpins on a map” interface of the online mapping services, most GIS systems store three kinds of “geographic features.”

- **point** - a single location, like a dot on a map. When most people think of storing geographic data, they think of latitude and longitude coordinates referring to a point, like on a GPS unit.
- **line** - When we connect two points, we have a line.
- **polygon** - When we connect the endpoints of three or more lines, we have a polygon. Polygons can be simple (a square) or incredibly complex (a map of an electoral district).



Most GIS applications will use points and polygons – as you'll see!

An interesting note about scale: on a map of the world, New York City looks like a single point. However, on a New York City subway map, you can see that New York City isn't just a single point but an area (actually, a VERY complicated polygon). A true point has no dimensions: it's as if we had a camera with an "infinite zoom in" feature aimed at a tiny point on the ground, zooming in forever. For pragmatic purposes, like in our world map vs. subway map example above, we depict points as dots depending on the scale of the map.

Similarly, roads are frequently depicted on maps as being lines but no road in the real world is ever an exact straight no-width line: just like our example above, as we zoom in on a road from above, we can see that it gains width and curves around. A better example of a line in this context would be a straight-line border between neighboring states, such as Wyoming/Colorado: no matter how thin you drew the border line, you could always zoom in more and make it even thinner.

A note about "real" GIS vs. querying place-related data:

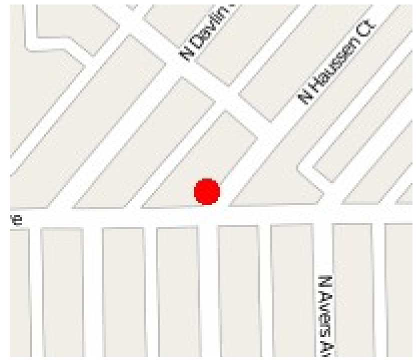
Consider a spreadsheet containing addresses of your board members. If you have a column for "ZIP codes" in the spreadsheet, and you use a filter to only show rows matching a certain ZIP code, does that make your spreadsheet a geographic information system? Not really: your spreadsheet might display all records with "90210" in that column but to the computer, it might as well be "blue" or "octopus" or "chocolate."

Some crude systems mimic actual GIS by using techniques such as this. A "true" GIS system allows users to perform "spatial queries" on their data, as described on the next page.

Spatial Queries: the “Where?” Questions

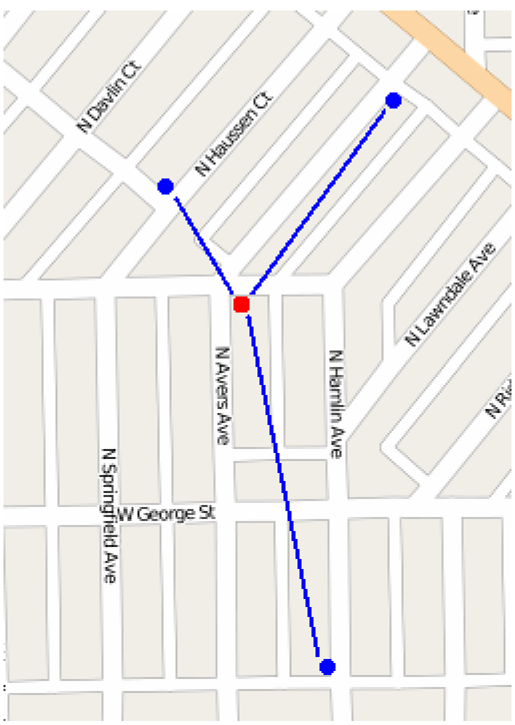
So what are these “spatial queries” we keep referring to? Let's look at some types of queries as well as examples of how nonprofit mapping projects might use these queries.

Where is Point A?



This is the absolute most basic "where" question and the most helpful answer is the most common: the GIS system draws a map and marks the point with a dot or star or other symbol. After all, a picture is worth a thousand words :-) If you've ever typed an address into Google Maps, you've performed this type of spatial query.

How far is Point A from Point B?



This is another very common “where question” answered by most online mapping providers. When calculating directions, GIS systems usually provide the route distance, i.e., the distance actually traveled on the road, as opposed to the true distance, “as the crow flies.”

Where is the closest X to me?

Whenever a website offers directions to the nearest store, post office, etc., a GIS system behind the scenes is actually comparing distances between the “starting point” and various possible destinations, then selecting the destination with the shortest distance.

Where is Point A with respect to other locations?

This can be a very broad query, and it assumes we're trying to relate a location (Point A) to another location (such as a point or polygon). GIS systems can recognize several spatial concepts, such as:

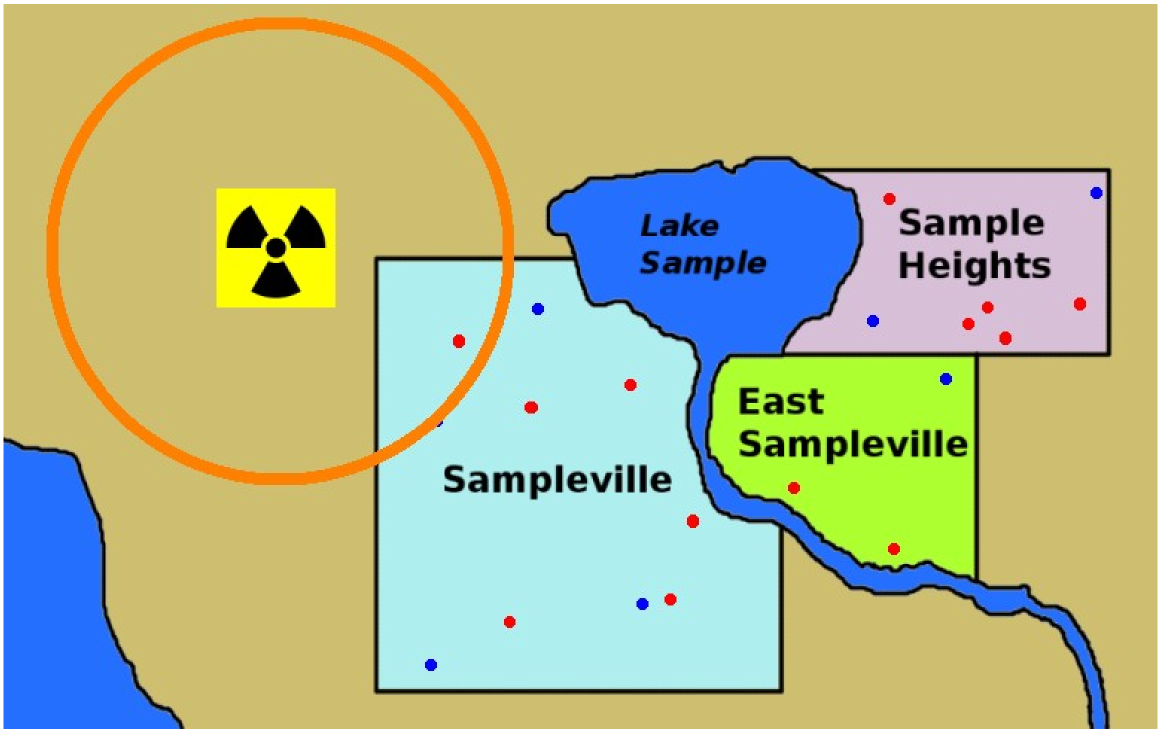
- *Adjacency: Do Polygon A and Polygon B share a border?*
- *Within/Contains: Is Point A within Polygon X?*
- *Overlap/Intersection: Does Polygon A share area with Polygon B? Does Line A ever intersect Line B?*

For example, we might use a GIS system to create a list of all of the community centers within a certain congressional district: if we define the district as a polygon shape, and we have a list of points representing community centers, then it's easy for a GIS system to determine if each point is within the district and display a list or a map of those that are.

We can search in the other "direction" as well – we can pick a particular community center and determine which polygons it belongs to, e.g., community district #3, the 10th state congressional district, and the 4th US congressional district.

Taking it a step further, we can use our GIS system to analyze more and more data so that we're answering more sophisticated queries: "show all ZIP codes where the local juvenile asthma rate is above the state average AND are also in a congressional district where the senator voted No on our juvenile asthma legislation."

Note: when any street addresses are entered into a GIS system, they must be **geocoded:** that's where the GIS system converts a human-readable address ("123 Main Street in Happytown") into a specific geographic location suitable for marking on a map ("40.271 degrees north, 87.68 degrees west"). Computers handle degrees and coordinates much better than they handle human street numbering systems.



● Community center

● Elementary school

Looking at this map of Sample County, we can see a few things:

1. East Sampleville and Sample Heights share a border; they are *adjacent*.

2. There is one community center *within* East Sampleville.

Of course one big obvious thing we notice is the giant radioactive trefoil symbol in the upper left corner, along with a circle that *intersects* Sampleville.

"But wait!" some of you are thinking. “We've defined points and lines and polygons - but it's all straight edges and jagged angles! But what about circles? What if we need to know where all the hospitals are within a 50-mile radius of a certain point as opposed to a predefined square or polygon containing that point?” Or in this case, how many community centers or schools are within the radioactive waste dump's pollution zone?

Applying the concept of circles to our where questions involves the GIS concept of a "buffer," as in the phrase "buffer zone." Think of a circle as a buffer zone around a central point - the size of the circle depends on the radius, the distance from the circle's center to its edge.

Buffers are also useful because they can exclude regions around points or polygons: for instance, "show me all of the potential new playground sites that are NOT within 1 mile of a toxic waste dump."

Conclusion

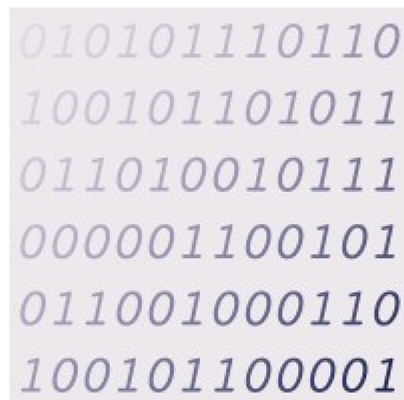
OK, so now we've gotten a pretty good look at some of the underlying concepts of GIS, and it wasn't too scary, was it? :)

Next, we'll look at where we get the data that we'll use in our mapping projects!

Data:
What Are We Mapping?

So you'd like to create a mapping project for your nonprofit organization: what are you going to map? What “where questions,” as discussed in the previous section, are you going to ask and have your application or project answer?

The source data for a mapping application can come from many sources:



- Your existing databases and spreadsheets
- Government, academic, and community institutions
- Commercial data providers
- Collecting data directly from your community and/or users

A simple mapping project could be based on a simple spreadsheet of names and addresses. On the other end of the spectrum, a complex project could require thousands of data points of many different types.

First Name	Last Name	Address	City	State	ZIP	Status
Alice	Alpha	123 Apple Way	Anytown	US	10001	Donor
Bob	Bravo	456 Birch Dr	Anytown	US	10001	Volunteer
Carol	Charles	789 Cactus Rd	Anytown	US	10002	Donor
Dave	Delta	12 Dogwood St	Anytown	US	10002	Staff

We can map this! Well, we could if Anytown, US was a real city and state. :)

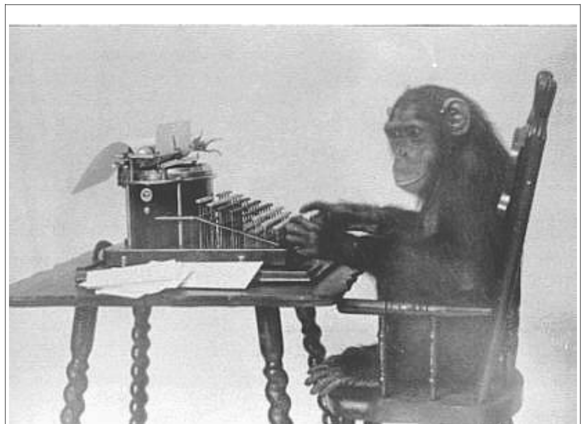
There are a number of possible challenges when acquiring and using data:

- Practical: availability, quality, scope
- Legal: licensing, copyrights, etc.
- Technical: incompatible formats, technology, etc.
- Financial: cost, both to obtain data and to format/edit it

Before we dive in looking for data, let's discuss some of these challenges and how to deal with them.

Practical Challenges Of Data Acquisition

Availability: Does the data even exist? Do you have access to it? If your organization is not collecting the data you require, where can you get it?



*Monkeys are *horrible* at data entry!*

Scope: What context does the data apply to? How granular is the data? For example, if you're hoping to map crime statistics in your city neighborhood by neighborhood, the FBI's state-by-state crime total reports won't help.

Quality: Is the data sufficiently precise and accurate? (If I tell you I'm between 10 and 100 years old, I'm being *accurate* but not *precise.* If I tell you I'm 128.53 years old, I'm being *precise* but not *accurate.*) Is the data valid?

Legal Challenges of Data Acquisition

In the United States (and many other countries), facts such as data can't be copyrighted, but “collections” of data can be. This means that some of the data you may want to map must be licensed or purchased from a data provider or data broker. Most government sources of data, especially from the US federal government, are freely available for use by all. Thanks to the Internet, an increasing number of public and free data sets are becoming available from academic institutions, corporations, and nonprofit organizations.

One type of data involved in mapping projects that frequently gets overlooked is the base map – also known as the “base layer” or “background” of the map. For instance, many of the mashups popular on the Internet involve displaying data on top of a Google Map (or Yahoo Map or Bing Map), which would be the base map layer. Technically, Google (or other map provider) is licensing the use of their maps to the application provider – and this licensing agreement is subject to dozens of pages of legalese.

For the most part, it's relatively safe to use a Google Map as the base layer for a freely-available, publicly-available mapping application, especially a noncommercial app created by a nonprofit organization. However, it's important to follow all of the rules in the map provider's terms of service to make sure that your application isn't violating any policies or legal requirements. Later in this section, we'll review some data sources that are in the public domain, which means you can basically do whatever you want with them.

A final note about data acquisition – it's **critical** that any mapping application that maps data about individuals, especially their real-time locations or residences, have a strict privacy policy in place that accounts for the concerns of those individuals.

Technical Challenges Involved with Data Acquisition

Have you ever received a file attachment via email from a friend or colleague that you couldn't open? If so, you're familiar with the concept that data can come in many different types, often called *formats*. Location-related data is no different: there are many different formats for map data, location data, GPS coordinates, regions and boundaries, etc., each with its own advantages and disadvantages. Luckily, there are also many different tools for translating and converting from one format to another. Obviously, it's crucial to have data in a format that your mapping/GIS platform will support.

Later in this section we'll examine some of the most commonly-used geo-related data formats in detail.

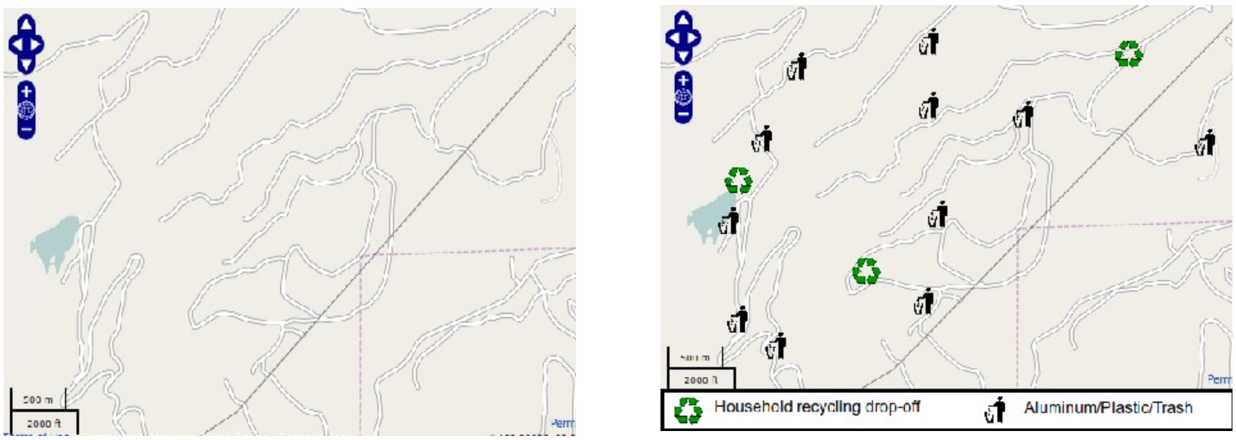
Costs Involved with Data Acquisition

Each of the challenges mentioned above can increase the costs of your project dramatically – including actual financial costs as well as extra investments in time and human resources. If the data for your project is inaccurate, you might need to have employees or volunteers spend considerable time "cleaning" it up. If the data you require for your map is only available from a commercial data provider, you'll need to purchase the data or somehow recreate it. Technical challenges, as you may have guessed, bring their own set of potential costs: sophisticated mapping projects with advanced GIS requirements usually involve significant technology budgets, even with the rapid advances in this software.

For the purposes of this guide, we'll focus on free and low-cost tools and data sources that are as accessible to as many nonprofit organizations as possible.

More About Base Map Layers

As mentioned earlier, the background or “base” of a map is an often-overlooked part of creating a mapping application. A base map is a plain map, upon which we superimpose or “layer” additional information, such as pushpin icons.



^ *Base map from OSM (left); map with overlaid recycling layer (right)*

As you may have noticed if you've ever used the Internet, the majority of mashups and maps are generated using Google Maps as the base map. There are many reasons not to use Google as a base map, such as the fact that they reserve the right to add advertisements onto their maps – imagine your farmer's market and organic grocery map sprinkled with McDonald's logos! That's unlikely, of course, but the right is spelled out in the Google Maps terms of service.

There is another, more practical reason to consider an alternative base map provider, and that is simply quality. Google's base mapping data, like virtually all commercial data providers, is geared toward businesses and consumers. In some underserved areas of the world – and even the US – the commercial map providers are somewhat lacking.

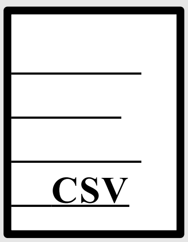
Here is a picture of Google's map of Kibera, Nairobi, Kenya – the largest slum in Africa and home to about a million people:

It's not too surprising that a commercial data provider based in North America wouldn't have detailed maps of an African slum, since they wouldn't have many customers concerned with the area. However, for the people of Kibera and the institutions attempting to serve them, knowledge about their local area is invaluable. Map Kibera, a community mapping organization, chose an increasingly popular alternative to Google's base maps: OpenStreetMap (OSM).

OSM is a free online atlas of the world, created by hundreds of thousands of volunteers working together, much like a map-specific Wikipedia. Map Kibera used the OSM tools and a team of volunteers to put their city-within-a-city "on the map," literally! Comparing the OSM version of Kibera (below) to Google's version (above) illustrates the power of community mapping!

DATA DIGRESSION!

Let's examine three of the most common formats that you're likely to encounter in your mapping project:

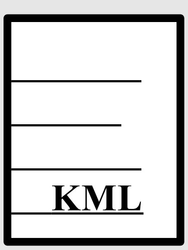


CSV: "Comma-Separated Values"

This format is essentially a table of plain text in rows, with each "column" separated by commas or another character. This is the "lowest common denominator" of data formats – most databases and applications can import and/or export CSV data. Virtually all spreadsheet applications, such as Microsoft Excel and OpenOffice.org Calc, can read and write CSV data.

```
"First","Last","Address","City","State","ZIP"
"Alice","Adams","123 Apple Blossom Drive","Happyville","CA","99900"
"Bob","Baker","456 Birch Street","Happyville","CA","99900"
```

^ *example of CSV data*

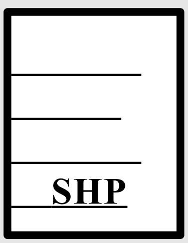


KML: "Keyhole Markup Language"

KML is a standard format for storing data about geographic features, such as points, lines, and polygons. KML was created by a company named Keyhole (hence the name) which was then purchased by Google and integrated into Google Earth. Because KML is now an open standard, many different geographic tools can import and export files in this format. If you've ever looked inside an HTML or XML file, then the internals of KML will look familiar.

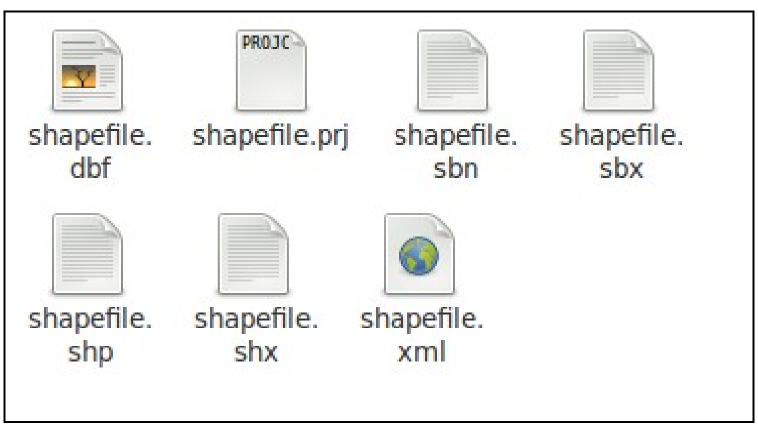
```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://earth.google.com/kml/2.1">
<Document>
        <name>startinglocation.kml</name>
        <Style id="PushPin63">
                <IconStyle>
                        <Icon>
                                <href>http://maps.google
con63.png</href>
```

^ *example of KML*



SHP: “Shapefile” or “ESRI Shapefile”

A shapefile is a detailed technical geographic format, originally created by a company called ESRI nearly twenty years ago. Throughout this time, ESRI has been the leading proprietary geographic software publisher, so the ESRI shapefile format is very popular in formal GIS – such as the academic, corporate, and government sectors we mentioned earlier in the guide. These days, free and open source software is available that can read and edit these shapefiles; expensive ESRI GIS software isn't necessary. One note: the term “shapefile” is misleading since there are at least three actual sub-files that are required to make up each shapefile.



^ *files that make up a typical “shapefile”*

Data Sources for Mapping Projects

I. Using your existing data

The easiest data to acquire is the data you already have! If your organization is already collecting the data that you hope to map, or at least some of it, then you've got a head start.

Of course, managing data can be a challenge for a nonprofit – is the data you need stored in a gigantic spreadsheet on a colleague's computer? Is it contained in a box of paper forms dating back several quarters – or years? (Gulp!) Is it already stored within a well-designed database application, easily exported to a common format?

As mentioned earlier, one of the most common formats used to manually exchange data between programs is CSV, or comma-separated values. Virtually all database applications, spreadsheets, etc. can be wrangled into exporting CSV suitable for your mapping application. The big question is how much data wrangling will be required.

> **"CSV is the de facto data format standard for one-time exports and data migration projects."**

Source: Peter S. Campbell and the awesome folks at Idealware.org:

http://www.idealware.org/articles/data_exchange_alpha_soup.php

II. Third-party Data Sources: .gov, .edu, .org, and .com

If you don't already have the data you require, perhaps someone else has already collected it – no need to reinvent the wheel!

There is an ever-expanding amount of data and information available for nonprofits to use these days, thanks to technical innovations like the Internet and cultural shifts promoting transparency and open data principles. Of course, acquiring data from another source means that we need to be aware of the challenges and costs – direct and implied – that we reviewed earlier in this chapter.

With the incredible diversity in nonprofit missions, there's obviously no way to list all the valuable resources out there, but we'll make a quick list of some of the most common sources of **free** data. As mentioned earlier, there are plenty of commercial data brokers who can sell detailed sets of the most esoteric data imaginable, but we'll focus on free sources, such as those offered by government and academic institutions.

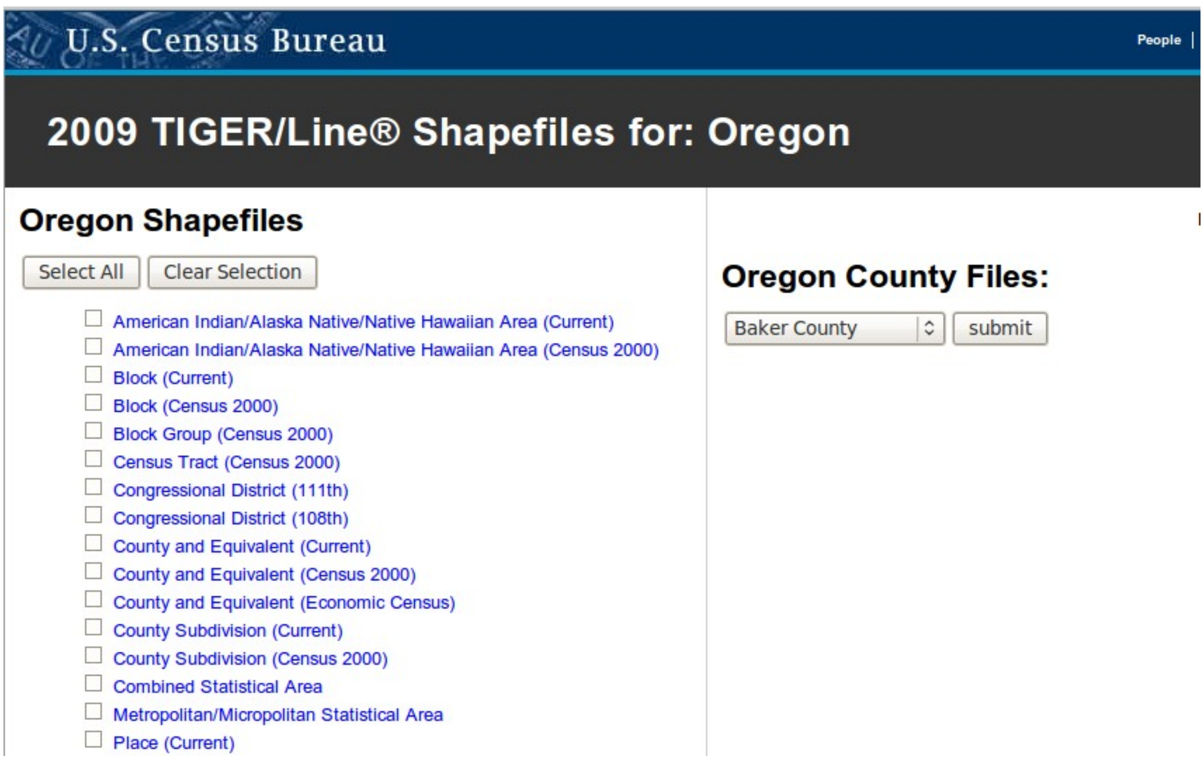
Local and state data sources:

- Local municipalities usually have some sort of GIS capabilities in-house for activities like city planning, land and title registration, zoning, etc. However, many haven't yet moved this data or the associated tools online.
- Local nonprofit organizations with focuses on community, economic, or neighborhood development frequently collect and release local data pertinent to their mission.
- Local community or private colleges – don't just check the geography department (if your local schools even have one). Identify disciplines related to your mission such as environmental biology and pollution mitigation or sociology. This may also include your state's university extension or land grant service program, if any.
- Many states are moving to offer a centralized portal of geo-related (and other data). Many state-level departments offer maps and GIS data as well as thematic data related to their function.

U.S. government data sources

Between the various agencies, departments, and divisions of the U.S. government, literal libraries full of data have been collected over the years. The federal government offers several invaluable resources that help mapping application planners find freely-available data they need for their projects. We'll look at a few of the most helpful resources in this section.

U.S. Census Bureau – http://www.census.gov



The Census Bureau's mission is to collect data about the country, and their website is one of the first stops you should make for publicly available mapping data, especially when it comes to U.S. political boundaries. On the Census Bureau site, you can download shapefiles for various states, counties, congressional districts, census tracts, metropolitan areas, and more. Again, this data is freely available and can be used by a number of different mapping and GIS programs.

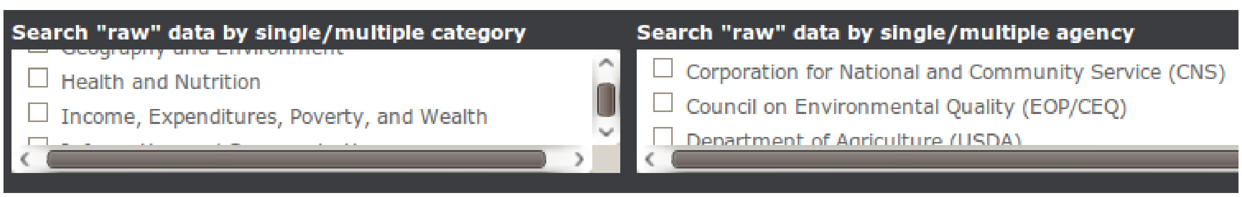
Data.gov – http://www.data.gov

Data.gov is the centralized "one-stop" source for federal data. Let's check out the mission of the site according to the front page:

> *The purpose of Data.gov is to increase public access to high value, machine readable datasets generated by the Executive Branch of the Federal Government.*

In this context, "machine readable" essentially means that software can import (or "read") the data. And, as you can see from this logo, the data on data.gov is usually available in one of the common formats that we learned about earlier in this chapter: CSV, KML, and SHP.

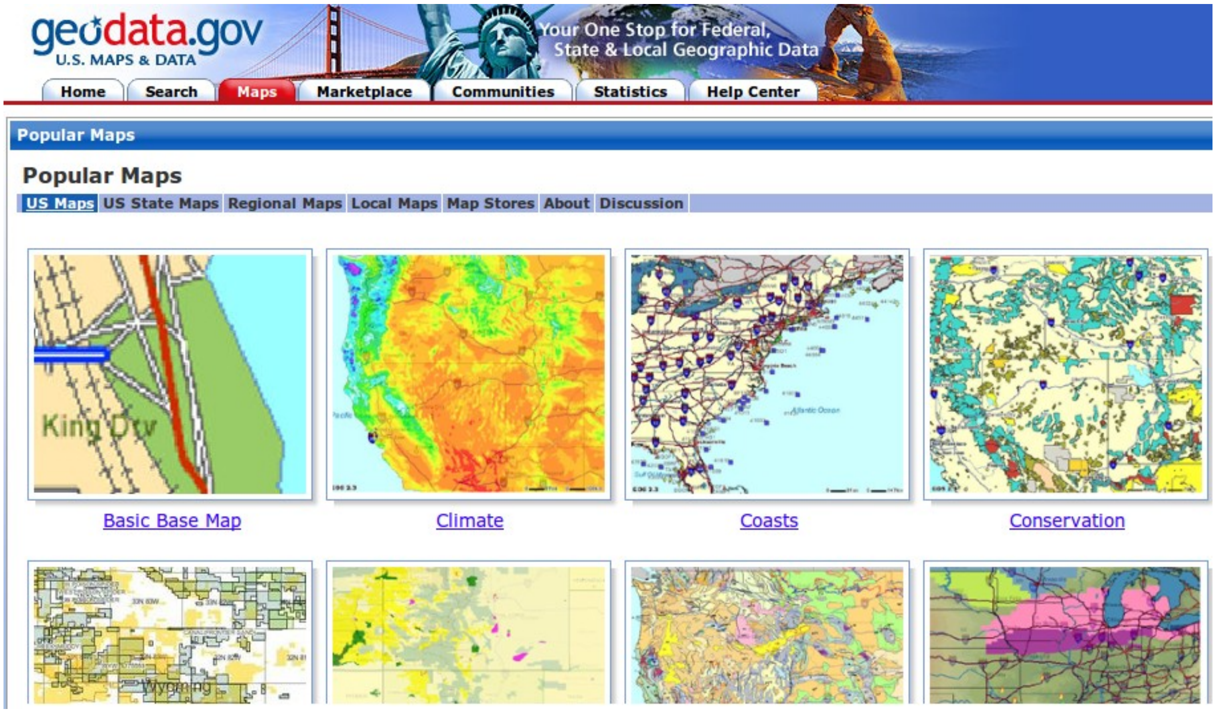
The Data.gov site offers plenty of search and filtering options, such as the ability to search data by category and/or by sponsoring department:



^ search and filter options on Data.gov portal

One thing you might notice on the Data.gov site is a link to the Geodata Catalog. "Geodata? Sounds like it might be related to 'geographic data' which could be pretty relevant!" The Data.gov site does indeed allow visitors to search for geographic-specific data within its Geodata Catalog. However, the government also offers a special site **just for** geodata, which we'll examine on the next page.

Geodata.gov – http://www.geodata.gov



^ examples of "thematic maps" - i.e., maps about a specific theme, available at www.geodata.gov

Geodata.gov is an invaluable resource for the budding cartographer! In addition to hosting the official National Atlas and the geographic names database, the website also allows you to create your own custom maps based on federal, state, and local data.

Geodata.gov also offers "communities" of interest as well as special interest topics, each with content selected by administrators as especially relevant. For instance, the "Indian Ocean Tsunami" special interest section contains a wealth of information related to that disaster and the subsequent recovery, including geological/seismological maps as well as maps of humanitarian organizations offering relief services.

One of the neatest features of Geodata.gov is the geographic search. Enter a starting point and some search terms and you can graphically see which data sets are relevant to your local area – a great way to browse through the available data sets!

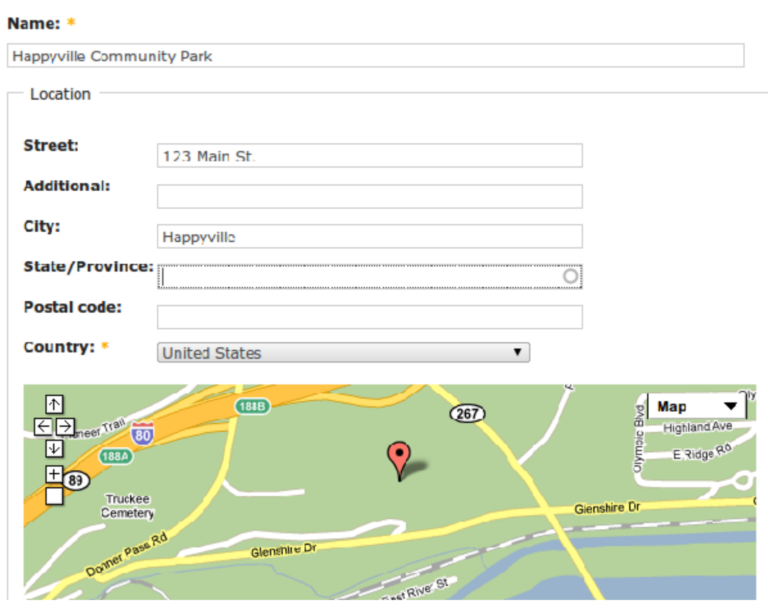
III. Collect your own data

Well, it turns out your organization doesn't have all of the data it needs to map, and neither does the local, county, state, or federal governments! You couldn't even find a commercial data provider who had already collected the info – what to do now?

Or perhaps your mapping project is **intended** to collect and map previously-uncollected data, like incidents of graffiti or potholes in your specific neighborhood. Maybe you want to get the public involved – remember the "public participation GIS" we discussed back in the first section of this guide? Perhaps your map is intended to solicit feedback from your community, such as identifying community assets and resources.

Who needs third-party data providers anyway when you can collect your own data – or even better, have your application's users collect it for you!

Below is an example of a website form that allows community members to add places to a community map, either by entering an address or by selecting a point on a visual map of the community.



Public participation GIS – or community asset mapping, depending on your context – doesn't have to involve technology for data collection. Organizations were taking surveys and polling long before Google Maps arrived on the scene! Paper forms can be used to acquire the data, and some community mapping professionals even recommend that community members start their mapping project with large paper maps before becoming concerned with digital tools.

< In this picture from the Center for International Forestry Research's Multidisciplinary Land Assessment project, women stakeholders from a community in India engage in community mapping on a paper map.

Sharing your data

We mentioned the concepts of "open data" and "transparency" earlier in this section. If at all possible, consider sharing your data back to the community. Consult with your executive management and/or legal counsel before sharing, and of course make sure you aren't sharing any personally identifiable information about your constituents or any proprietary information about your programs or funders.

A (Very Brief) Review of Mapping and GIS Tools for Nonprofits

Over the past few years, the number and variety of mapping and GIS tools available for nonprofits – and the public at large – has increased dramatically. These tools range from the simple to the complex and from free to expensive and these categories do not necessarily overlap!

The purpose of this section is to provide a **very** brief overview of some of the tools commonly used for mapping and GIS analysis in the nonprofit sector. It is *not* intended to be an exhaustive survey of what's out there. Before we dive in, let's examine some of the characteristics of different types of mapping and GIS software:

Proprietary vs. Open Source ("free" as in "freedom of speech")

With "open source" software (e.g., Mozilla Firefox), we are free to use it however we'd like to do whatever we'd like, such as adding advertising-blocker features. Proprietary software (e.g., Microsoft Internet Explorer) usually can't be modified and may have restrictions on its use.

Expensive vs. Inexpensive ("free" as in "free pizza at my party")

As mentioned above, some of the most useful software is also completely free to download and use!

Simple vs. Sophisticated

The right tool for the job: make sure the software you choose has the features your project requires. As with most software, GIS and mapping software comes in many different forms with varying degrees of user-friendliness, so do your homework!

Browser-based (web-based) vs. Desktop-based

Google Maps is an example of mapping software that you access through your web browser, from any computer. Google Earth is an example of software that is downloaded and installed to your specific computer.

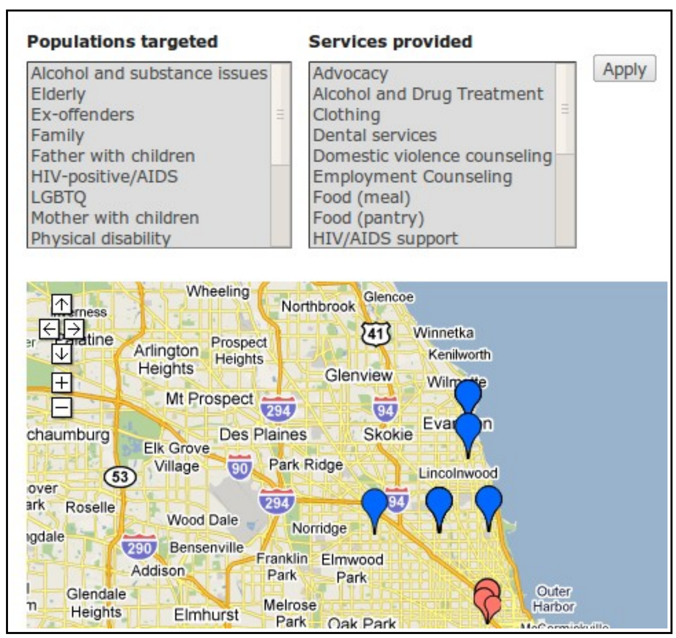
Browser/Web-based Tools

Google Maps ***http://maps.google.com***

The 800-pound gorilla of the online mapping world, and the base map for virtually every mashup you'll encounter... for now! Google Maps wasn't the first web-based mapping site, but it was and continues to be generally accepted as the best overall for most uses.

In addition to its user-friendly navigation and the “slippy map” scrolling that it popularized, Google Maps also offers a sophisticated Application Programming Interface, or API. An API allows other Internet sites and programs to interface with a website “behind the scenes.” In the case of Google Maps, the API allows programmers to add Google Maps integration to their existing databases and applications.

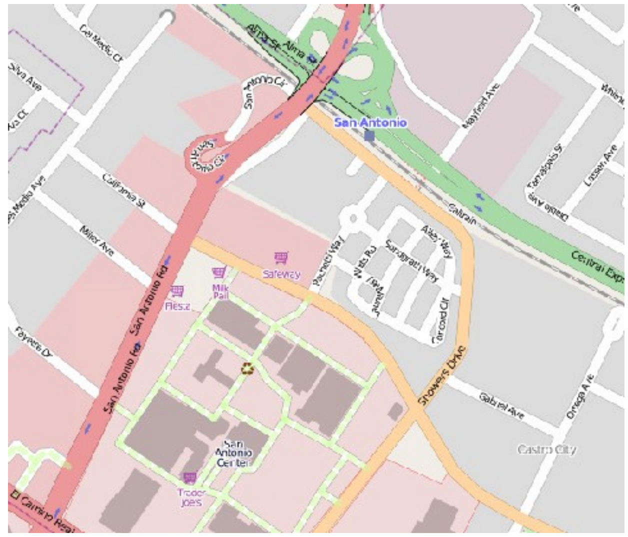
Google Maps is free for most uses, but you are limited to their data, features, and terms of service, which could change at any time.



A Google Map integrated into an existing Drupal website thanks to the Google Maps API >

OpenStreetMap ***http://openstreetmap.org***

OpenStreetMap (OSM) is a web-based map application with roads, places, etc. added by an army of volunteers around the world. Armed with GPS units and paper maps, these volunteers record information about their local communities and then enter the data into the OSM system using user-friendly tools. With so many volunteers helping, many parts of the OSM global map are more detailed and more accurate than their commercial counterparts (see the Map Kibera example in the previous chapter). In addition, since anyone can add to the OSM map with minimal training, your community can make sure that it's represented properly “on the map” and make any changes you wish.

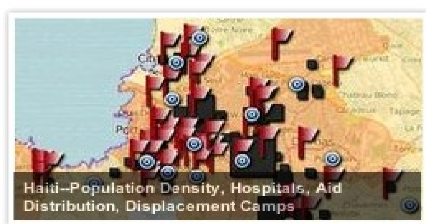


GeoCommons ***http://www.geocommons.com***

GeoCommons is a great example of the power of sharing data, not to mention some pretty cool mapmaking tools! The site offers two main features: Finder and Maker. GeoCommons Finder is a library of publicly available data sets shared by users of the site. Users can upload their data sets for use by the public or an approved list of colleagues. GeoCommons Maker is a user-friendly, web-based mapmaking tool that allows users to easily create thematic maps of various styles using data from GeoCommons Finder.

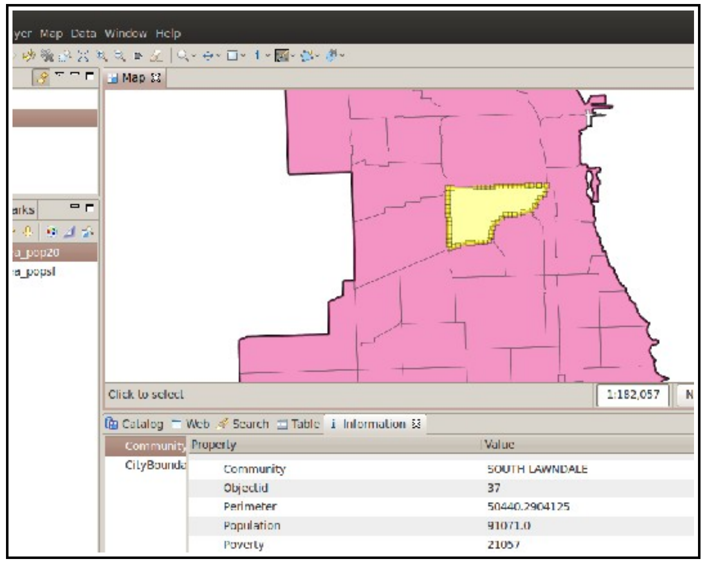
If you're looking for a potential portal to share your geodata, look no further!


Recovery Act High Speed Rail Awards & Unemployment


Haiti--Population Density, Hospitals, Aid Distribution, Displacement Camps

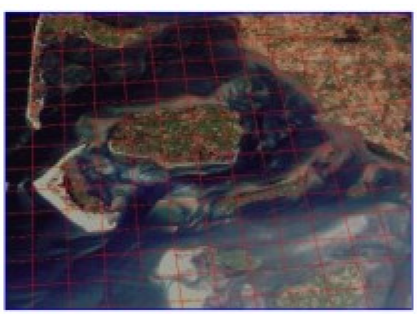

NOAA 5-day Precipitation (No Snow!) Forecast - 02/16/2010

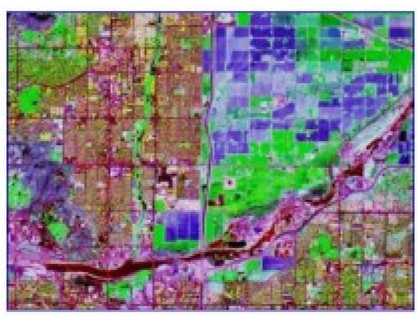
uDig *http://udig.refractions.net*

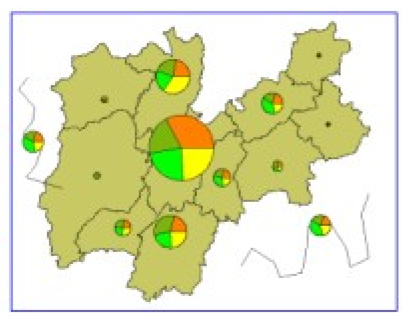


uDig is full-featured desktop GIS software that is free, open source, and available for Windows, Mac OSX, and Linux users. Users can import imagery, shapefiles, feature lists, and more, as well as connect to live Internet-based mapping resources like WMS and WFS servers. This tool is sophisticated and offers many complex GIS analytical and visualization features, so some training or serious time studying the manual is required to make the most of it.

GRASS *http://grass.osgeo.org*







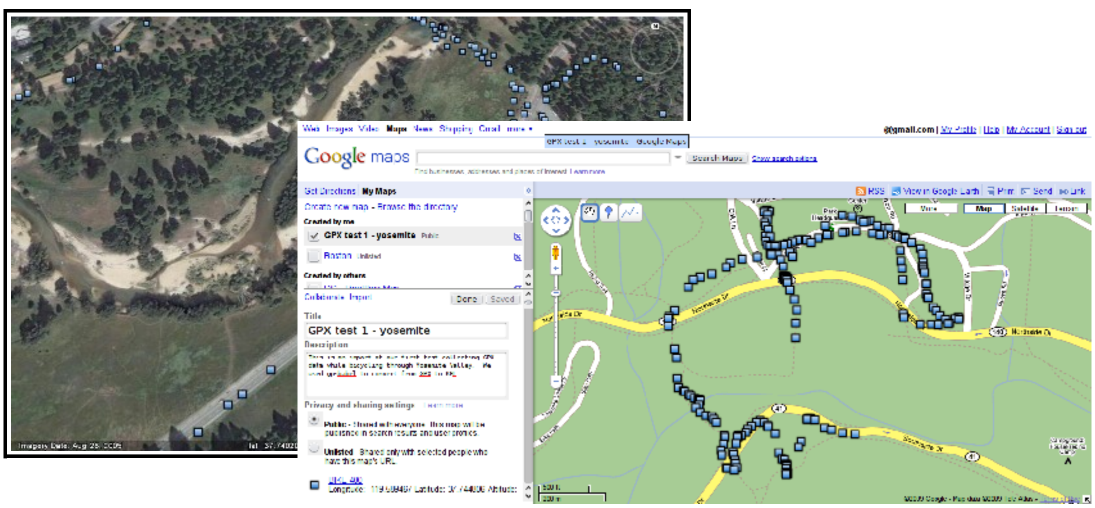
In many ways similar to uDig, GRASS is a desktop GIS tool with sophisticated capabilities. “GRASS” stands for “Geographic Resources Analysis Support System” which is, admittedly, quite a mouthful. GRASS is a project of the Open Source Geospatial Foundation, an international standards body which promotes open geodata formats and software to encourage interoperability.

Like uDig, GRASS is free, open source, and available for all three major desktop platforms: Windows, Mac OSX, and Linux.

Google Earth ***http://earth.google.com***

Google Earth is desktop-based software that presents a 3D virtual globe to the user. Users can view various satellite imagery on the globe, as well as superimpose (or "layer") various features, images, and videos. Instead of viewing a flat map on a webpage, Google Earth users can zoom in from space to look at buildings and neighborhoods, as well as "fly" from location to location around the world.

The image at right shows a Google Earth image created by Mountain Resource Group as part of an environmental advocacy campaign. Watershed resources are illustrated, along with a pop-up info window.



background: a KML file of points in Yosemite National Park, as viewed in Google Earth.
foreground: the same data set viewed in Google Maps.

ArcGIS (ArcView 9)   http://www.esri.com

ArcGIS is a suite of sophisticated – and expensive – GIS tools from software developer ESRI. The ArcGIS suite has been the predominant commercial GIS software platform for nearly twenty years and has widespread penetration in academia and government of all levels. This software is proprietary – it's not open source so users must abide by the license agreement.

A single user license of ArcView 9 starts at $1,500 – not to mention other costs such as hardware, training, etc. For smaller nonprofit organizations that require ArcView's advanced capabilities, single licenses plus training materials are available from TechSoup Stock for less than $200 – a huge savings over the retail license cost.

Important Links

- MapTogether.org – get the latest copy of this guide as well as lots of resources about nonprofit GIS, community mapmaking, and other relevant topics

  http://maptogether.org

- Social Source Commons GIS Toolbox – a user-maintained directory of tools, websites, and services useful for nonprofit organizations and community groups engaging in mapping/GIS projects

  http://socialsourcecommons.org/toolbox/show/485

- University of Oregon's listing of state-by-state dataset collections and resources

  http://libweb.uoregon.edu/map/map_section/map_Statedatasets.html

- Google Earth Outreach – GE-centric portal aimed at nonprofit and nongovernmental organizations. Includes showcase of effective Google Earth-based campaigns, tutorials for nonprofits using Google Maps and Google Earth, and grant information for nonprofits seeking free and discounted Google Earth software.

  http://earth.google.com/outreach/index.html

- Datamob.org – public data and interface repository. Datamob “highlights the connection between public data sources and the people building interfaces for them.”

  http://www.datamob.org/

- Zillow Neighborhood Boundaries Collection – free collection of neighborhood boundary shapefiles for cities across the United States

  http://www.zillow.com/howto/api/neighborhood-boundaries.htm