Teaching "Boring" Topics in Geography in an Engaging Way

Joseph Kerski, Ph.D., GISP

Education Manager and Geographer, Esri

Instructor, University of Denver

jkerski@esri.com

twitter.com/josephkerski

www.youtube.com/geographyuberalles

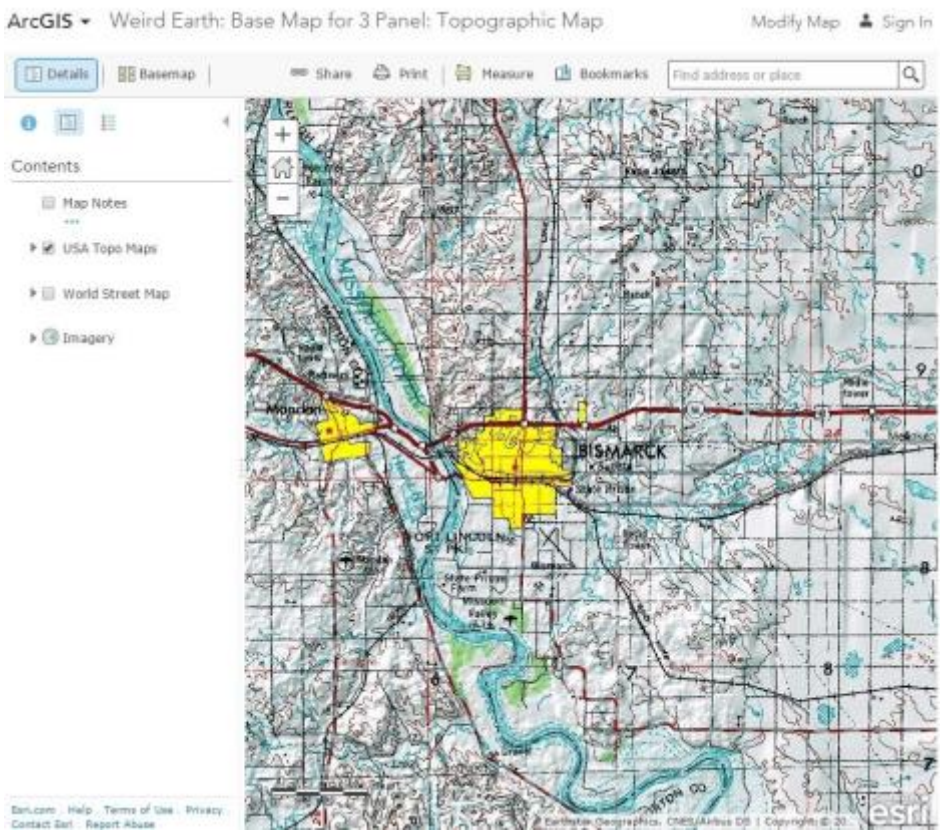
edcommunity.esri.com/blog

spatialreserves.wordpress.com

Active, hands-on instruction using web mapping tools can help engage students in grasping fundamental geographic concepts of scale, resolution, spatial representation, data quality, data collection, map updates,

1. Scale

Use USGS topographic maps in ArcGIS Online at 1:250,000, 1:100,000, and 1:24,000 for the same location.



1 - USGS topographic maps in ArcGIS Online.

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Panel: Topographic Map"
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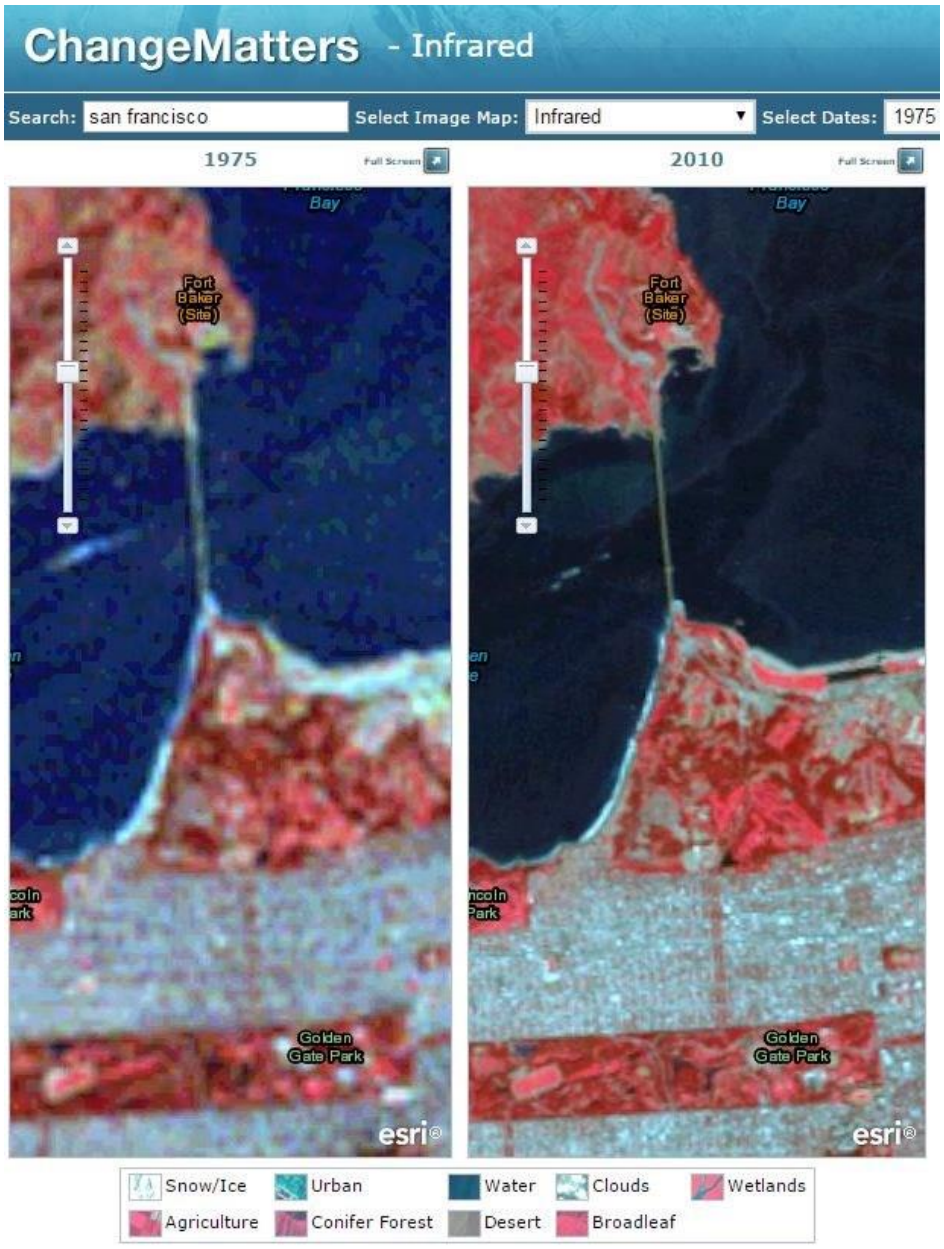
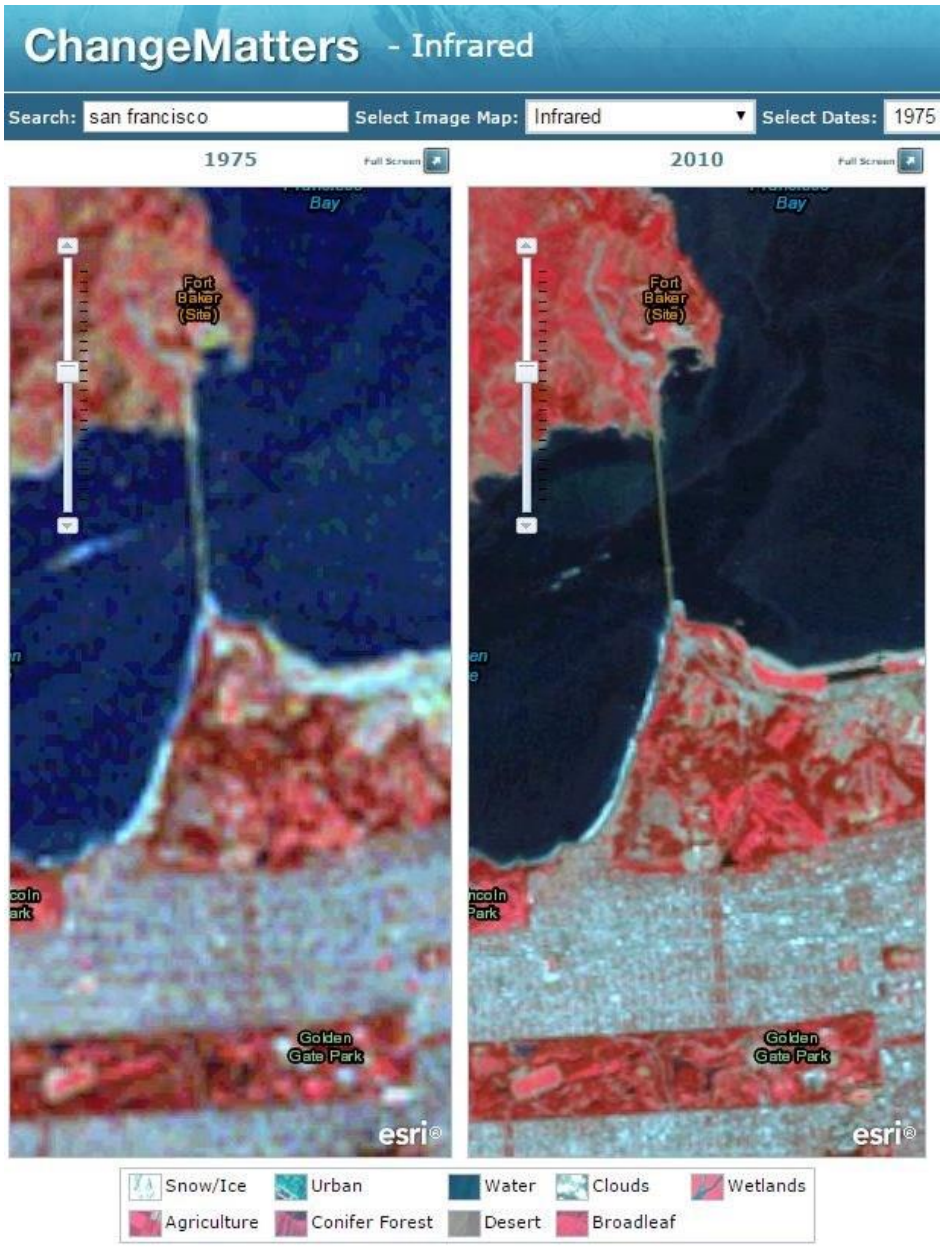
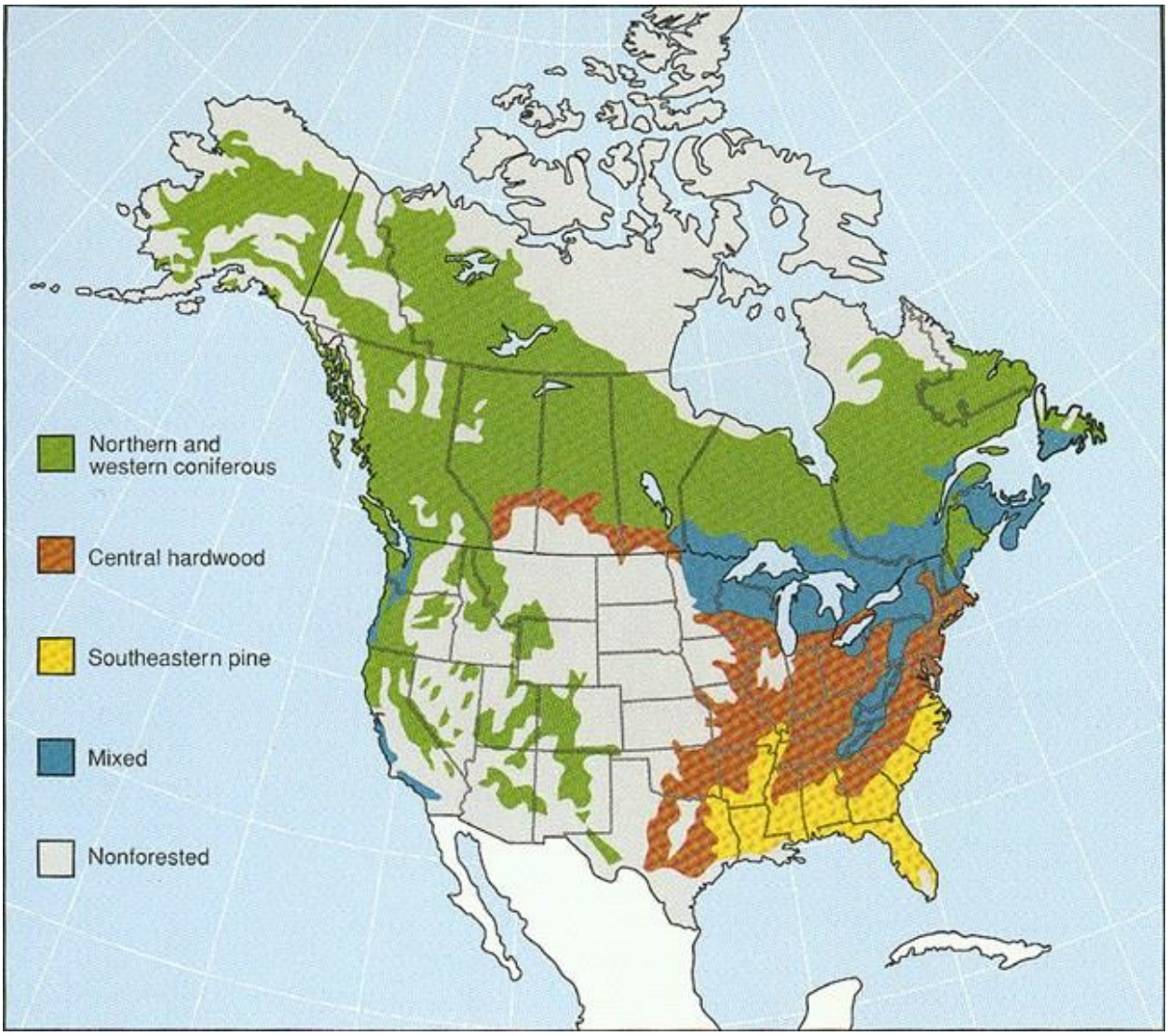
2. Resolution.

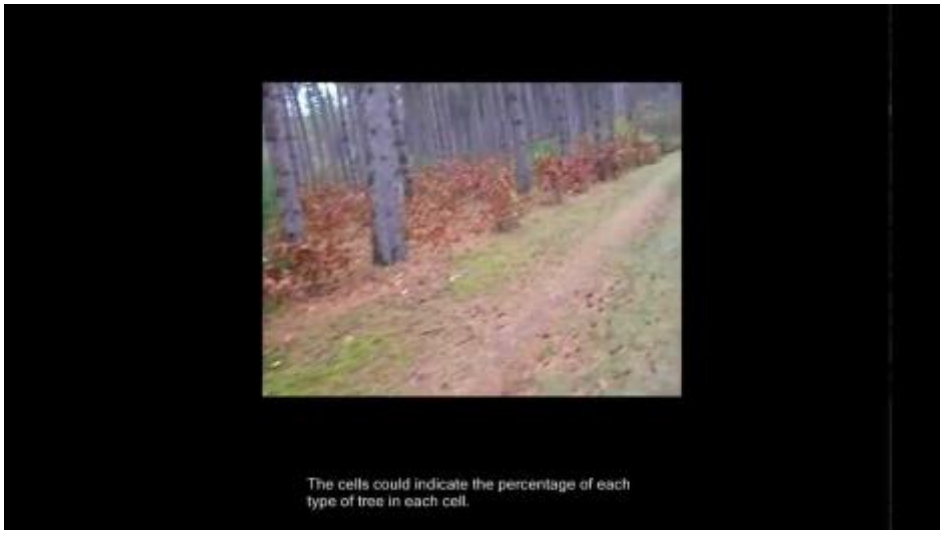




*2 - **Use the [Change Matters Viewer] to show imagery at 60 meters resolution, 30 meters, and 15 meters.***

3. Spatial Representation. Maps are representations of reality.





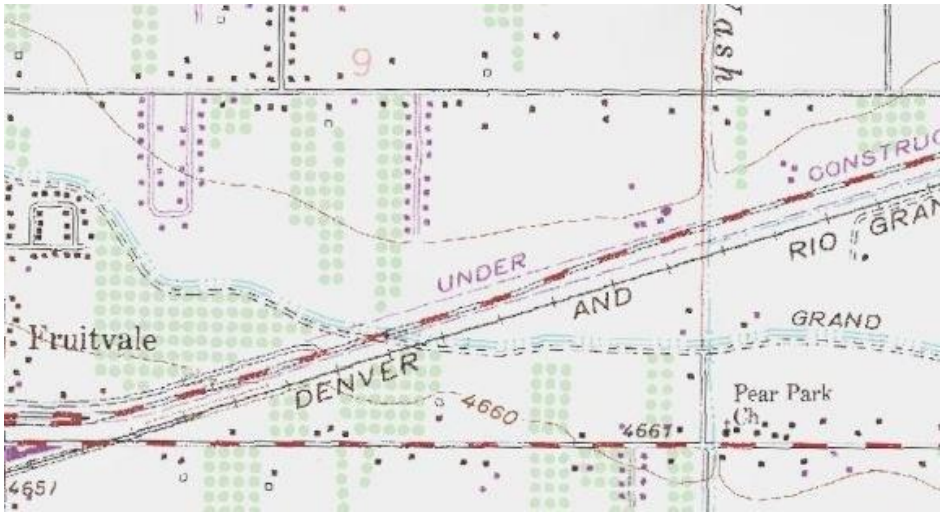
One of the themes running through our book The GIS Guide to Public Domain Data is that maps are **representations** of reality. While almost everyone is likely to agree with this statement, in the fast-paced world that GIS analysis and creating maps has become, it is easy to lose sight of this fact when staring at tables, maps, and imagery. In this video, observe my surroundings as I stand near the traditional "line" that divides the deciduous forest to the south from the coniferous forest to the north in North America.

Is the "**line**" really a line at all, or is it better described as a gradual change from deciduous to coniferous as one travels north? Is that vector line then better symbolized as a "zone", or is vegetation better mapped as a raster data set, with each cell representing the percentage of deciduous and coniferous trees?

How many other data sets do we tend to see as having firm boundaries, when the boundaries are not really firm at all in reality? How does that affect the decisions we make with them?

Even the boundary between wetlands and open water were originally interpreted based on land cover data or a satellite or aerial image. Even contour lines were often interpreted originally from aerial stereo pairs. And each data set was collected at a specific scale, with certain equipment and software, at a specific date, and within certain margins of error that the organization established.

Maps are **representations** of reality. They are incredibly useful representations to be sure, but care needs to be taken when using this or any abstracted data.



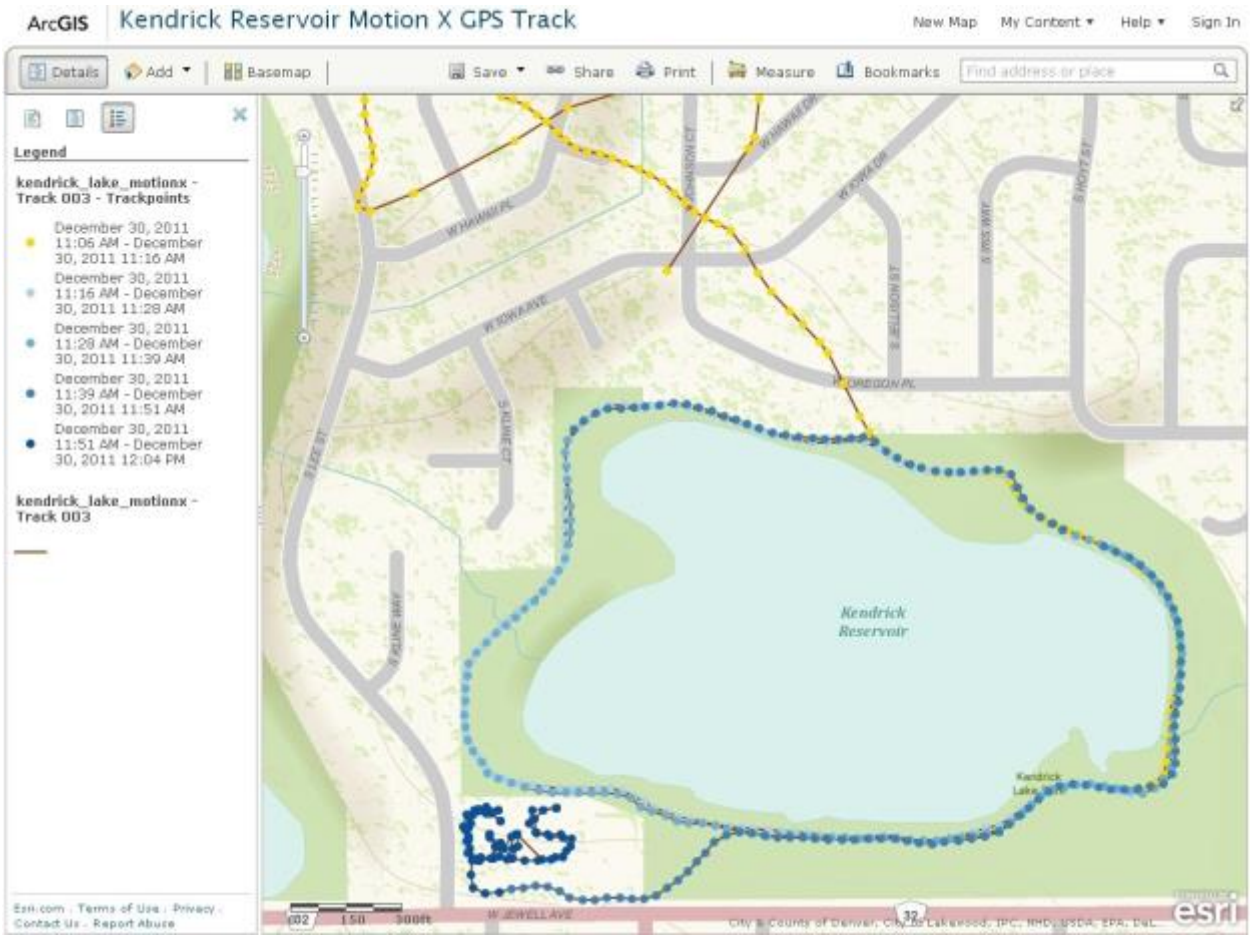
*3 - **Cartographic offset.***

Today, while GIS tools allow us to instantly zoom to a very **large** scale, the data that you are examining might have been collected at a much **smaller** scale. Remember, if you are making decisions at 1:10,000 scale and your base data was collected at 1:50,000 scale, you're treading on dangerous ground, or, one could say, you are "walking on water"!

Some data, such as USGS Digital Line Graphs, originally came from cartographic products. Cartographic products were sometimes created according to national map accuracy standards but in the case of the USGS topographic maps, roads were offset from railroads if they appeared too closely on the final

topographic product so that the map reader could distinguish between these features. As a result, the position of the road is inaccurate on the resulting DLG. Scale matters and again, the data source maters.

4. Data Quality. Be critical of your data--even when it is your **own**!



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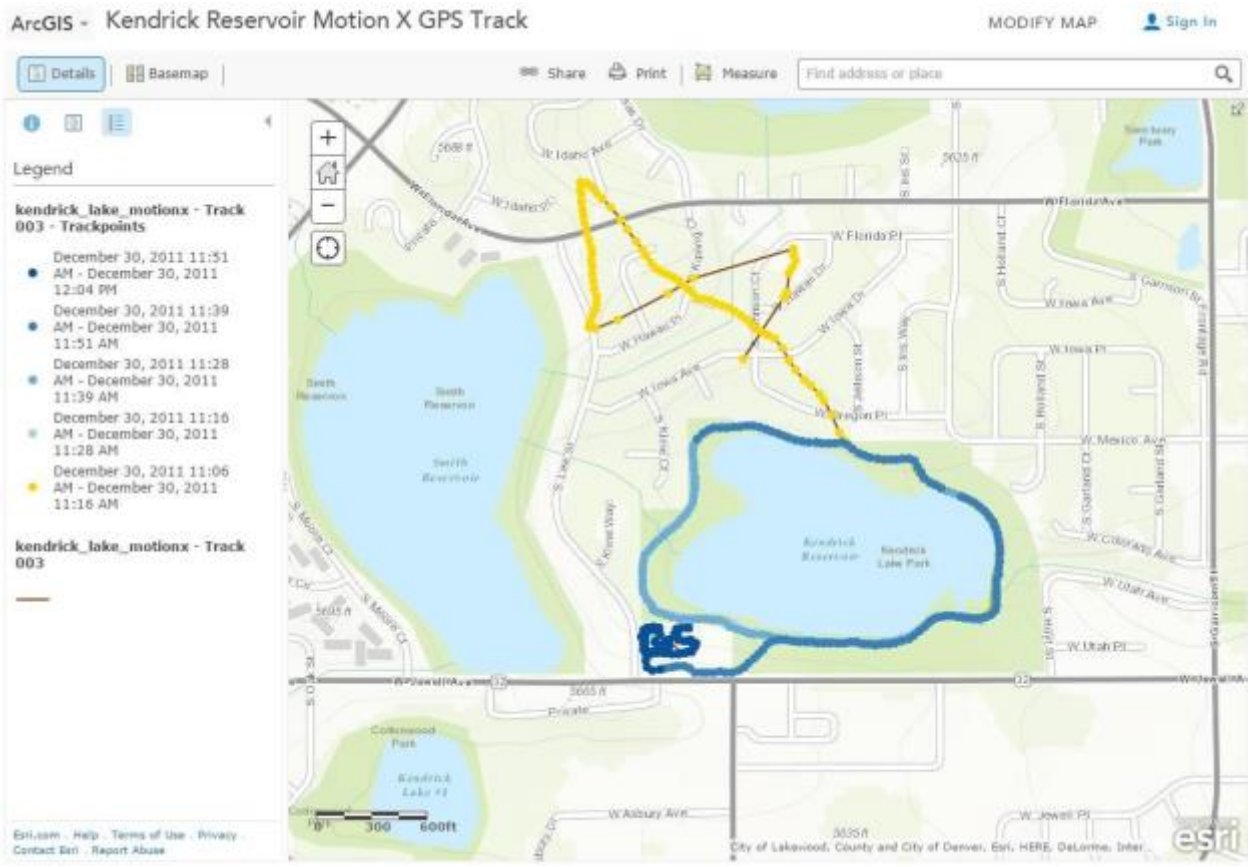
Thanks to mobile technologies, anyone can create spatial data, even from a smartphone, and upload it into the GIS cloud for anyone to use. This has led to incredibly useful collaborations such as

OpenStreetMap, but this ease of data creation means that caution must be employed more than ever before.

For example, examine this map that I created using MotionX-GPS on an iPhone and mapped using ArcGIS Online, that follows my track around Kendrick Reservoir in Colorado. This map was symbolized at the time of GPS collection, from yellow to gradually darker blue dots as time passed.



5. Data Quality: Be critical of the devices and apps you are using.

Comparing the Spatial Accuracy of Two Location Apps on a Smartphone in the Field

Building on past field investigations where I studied the spatial accuracy of GPS receivers and smartphone location apps, I recently compared the spatial accuracy of two location apps on a smartphone. My goals were twofold: (1) To determine which of two location apps was more spatially accurate in varied terrain and conditions; and (2) To model a field activity that integrates geography, science, and mathematics that students can engage in easily and effectively.

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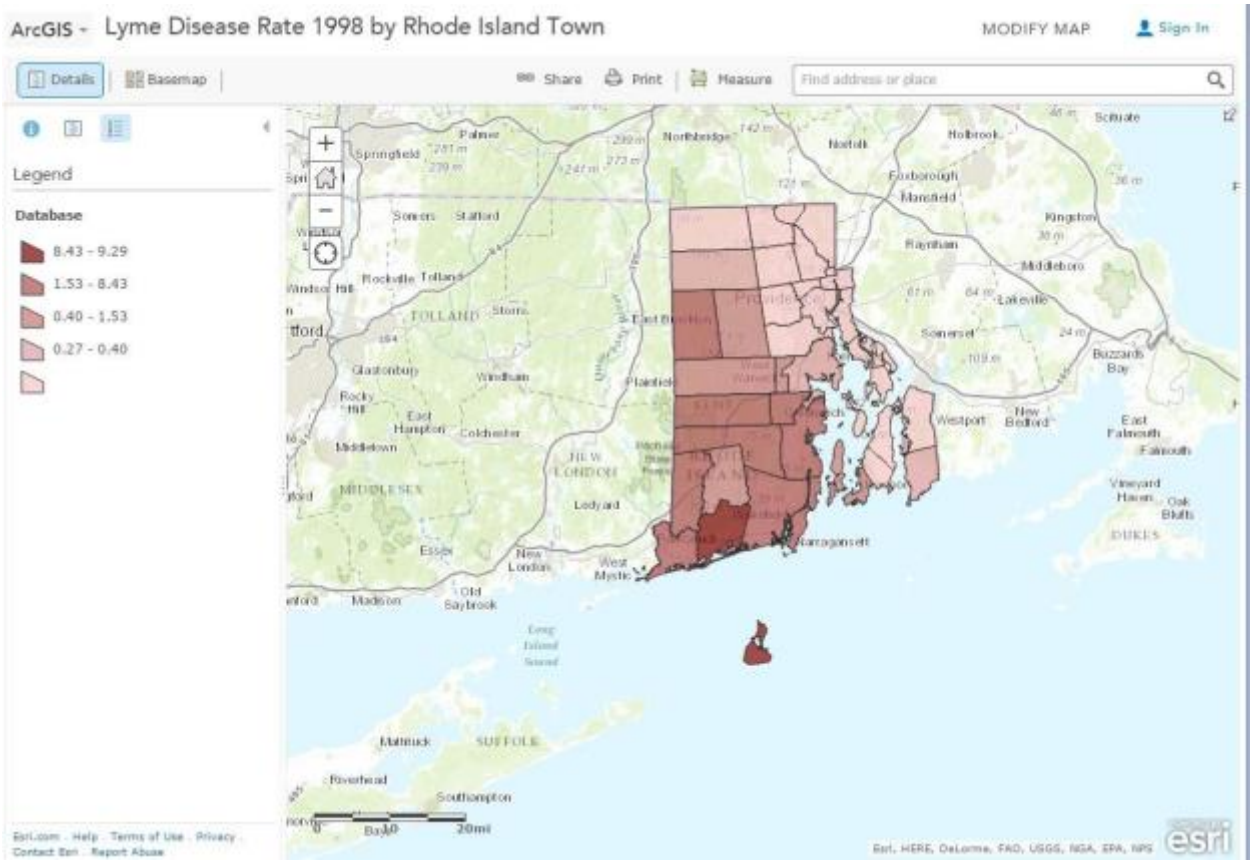
These simple examples point to the serious consequences that could result from using data without being critical of its source, spatial accuracy, precision, lineage, date, collection scale, methods of collection and other considerations. Therefore, be critical of the data — even when it's your own!

6. Be critical of the Data Collection Methods

My colleague Lyn Malone and I have taught workshops using Lyme disease case counts from 1992 to 1998 by town in the state of Rhode Island. Most recently, we started with an Excel spreadsheet and used Esri Maps for Office to map and publish the data to ArcGIS Online. The results are here.

Rhode Island Towns Lyme Disease Rate – 1998.



After one of the workshops, we sought to update the data with information from 1999 to the present, so we contacted the Rhode Island Department of Health. They not only provide d the data, they also provided valuable information about the data. The Public Health staff told us that Lyme disease surveillance is time and resource intensive.

During the 1980s and 1990s, as funding and human resource capacity allowed, the state ramped up surveillance activities — including robust outreach to healthcare providers.

Prioritizing Lyme surveillance allowed the state to obtain detailed clinical information for a large number of cases and classify them appropriately. The decrease observed in the 2004-2005 case counts was due to personnel changes and a shift in strategy for Lyme surveillance. Resource and priority changes reduced their active provider follow up.

As a result, in the years since 2004, the state has been reporting fewer cases than in the past. They believe this decrease in cases is a result of changes to surveillance activities and not to a change in the incidence of disease in Rhode Island.

If this isn't the perfect example of "**know your data**", I don't know what is. If one didn't know that surveillance activities had changed, an erroneous conclusion about the spatial and temporal patterns of Lyme disease would surely have occurred — and often, this kind of information doesn't make it into standard metadata forms.

This is also a reminder that contacting the data provider is often the most helpful way of obtaining the inside scoop on how the data was gathered, even though it sounds "so 20th century".

And you can bet that we made sure this information was included in the metadata when we served this updated information.

7. Maps Change, or ...

… walking on the water!

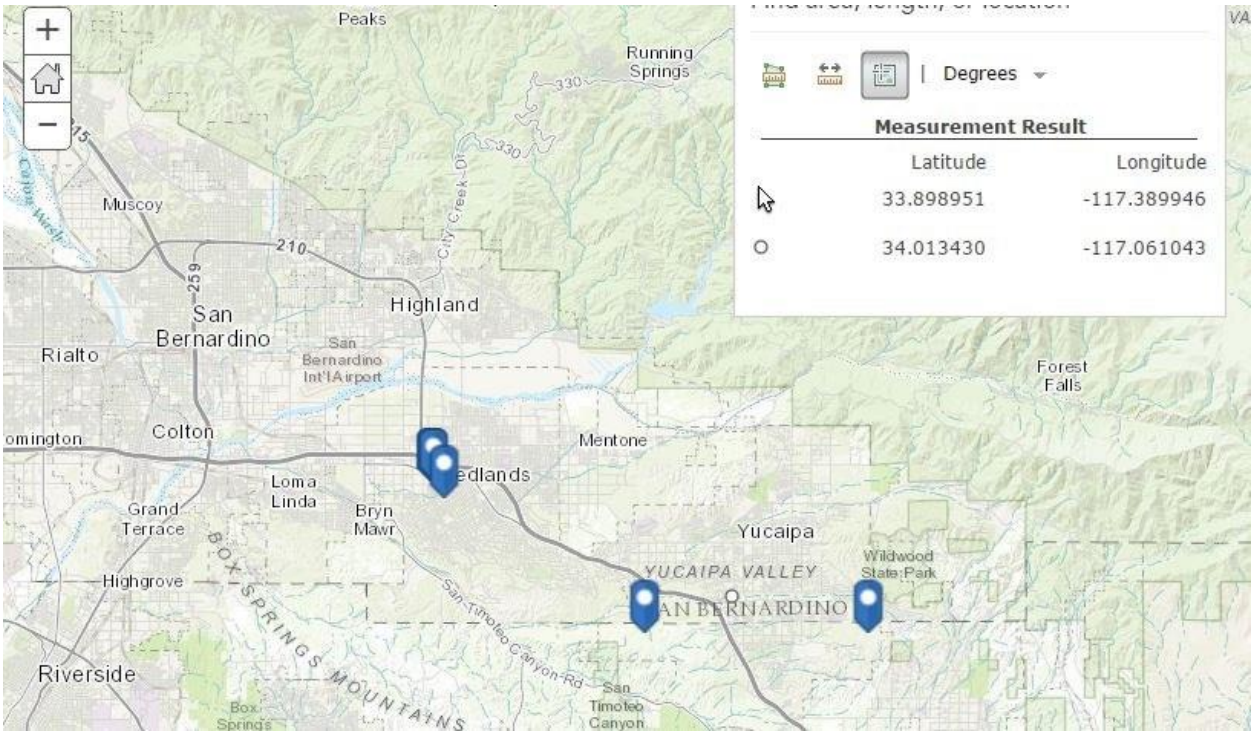
After my University of Wisconsin Milwaukee presentations for GIS Day, being a geographer, I took the opportunity to get out onto the landscape. I walked on the Lake Michigan pier at Manitowoc, enjoying a walk in the brisk wind to and from the lighthouse, recording my track on my smartphone in a fitness application called Runkeeper. When my track ended, on the resulting map it appeared as though I had been *walking on the water!*

Funny, but I don't recall even getting wet!

It all comes down to paying close attention to your data and knowing its sources, which should lead to a larger discussion on the importance of scale and resolution in any project involving maps or GIS. In my case, even if chose a larger scale, the pier did not appear on the Runkeeper application's base map in 2012. It does, now, however, and it also appears on the base map in ArcGIS Online.

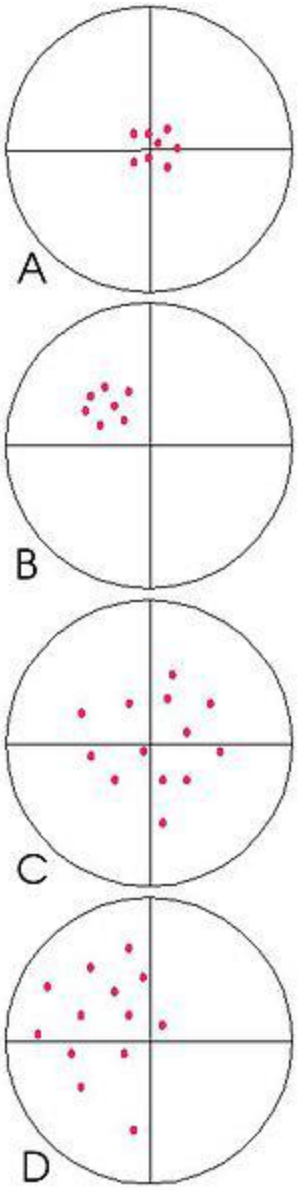
Most of the GIS literature understandably focuses on the success stories, but if you dig a bit, you can find examples where neglecting these important concepts have led not only to bad decisions, but have cost people their property and sometimes, even their lives.

8. Precision matters!



Accuracy is the *degree* or *closeness* to which the information on a map matches values in the real world. Accuracy refers to the quality of data and the number of errors contained in a certain dataset. In GIS data, accuracy can refer to a geographic position, or to an attribute, or to conceptual accuracy.

Precision refers to how exact is the description of data. Precise data may be inaccurate, because it may be exactly described but inaccurately gathered; perhaps the surveyor made a mistake, or the data was recorded wrongly into the database.



The crosshair of each image represents the true value of the entity and the red dots represent the measure values.

Image A is precise and accurate, image B is precise but not accurate, image C is accurate but imprecise, Image D is neither accurate nor precise. Understanding both accuracy and precision is important for assessing the usability of a GIS dataset. When a dataset is inaccurate but highly precise, corrective measures can be taken to adjust the dataset to make it more accurate.

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Measure distances between these points on this web map: http://denverro.maps.arcgis.com/home/webmap/viewer.html?webmap=875f2496d54c4dd88a42f9600de301e9

34.056294, -117.195796

34.05629, -117.19579

34.0562, -117.1957

34.056, -117.195

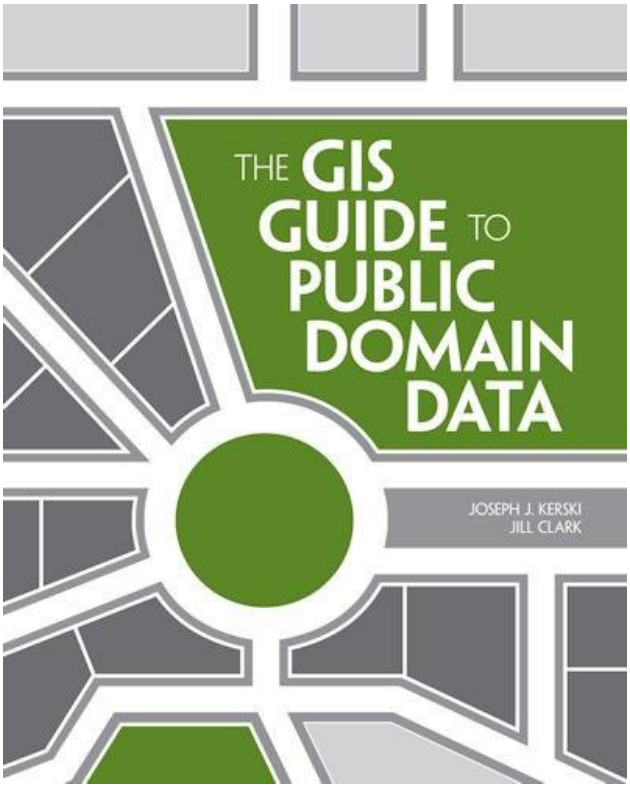
34.05, -117.19

34.0, -117.1

34 -117

Conclusion:

As cloud based geotechnologies continue to evolve, and as geoawareness increases in society, these concepts are becoming increasingly important. Active, hands-on instruction using web mapping tools can help engage students in grasping these fundamental concepts in geography.

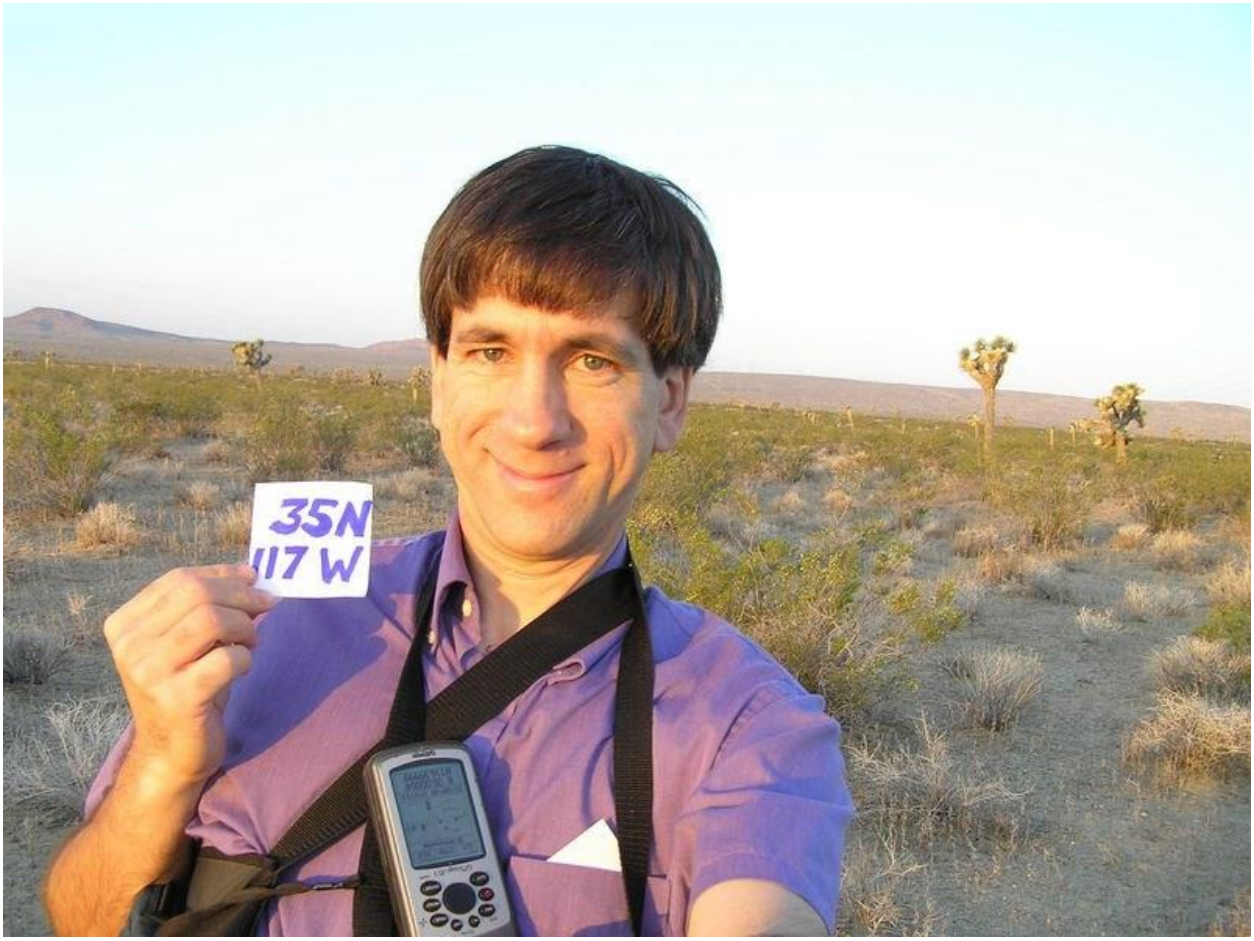


For more information:

On topics of data quality and related data issues, see the book that Jill Clark and I wrote, entitled *The GIS Guide to Public Domain Data*, and the blog that we update weekly, Spatial Reserves.

See my article in *Directions Magazine* on the topic of data quality.

Questions? Comments? jkerski@esri.com



Keep in touch!

https://www.linkedin.com/in/josephkerski = My LinkedIn pages.

http://spatialreserves.wordpress.com = Geospatial data blog and book.

http://twitter.com/josephkerski = Daily geo-related posts.

https://blogs.esri.com/esri/gisedcom/ = GIS in education blog.

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