



Bill's Excellent Adventures with GeoData

Presented to DAMA-NYCR
September 2, 2015

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NYS Office of Information Technology Services



First, a confession...

I'm not a Data Management Professional

I'm just a "Mapping Guy"

So I'm a bit out of my league speaking to a room full of data management professionals

You: study/mastery of the DMBoK



- Data Management Body of Knowledge
- Certified Data Management Professional (CDMP)
- Data Governance and Stewardship Professional (DGSP)

Me: learned via the HOBok*

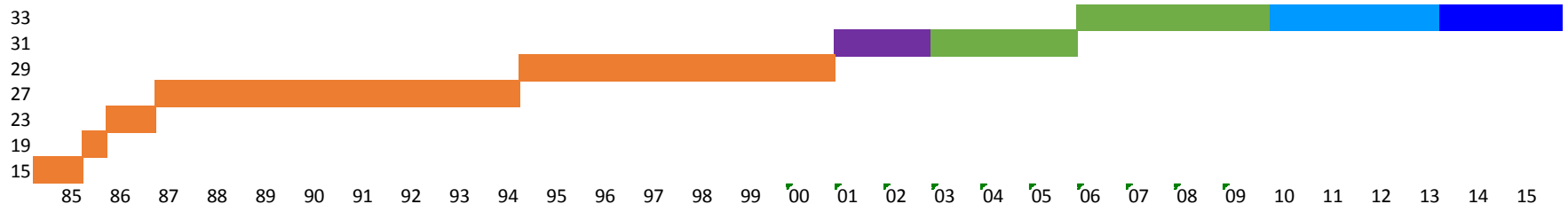


*Hands-On Body of Knowledge

That said,

I've been working with data for 30+ years to solve problems in NYS government:

- Initially at the **Dept of Transportation (DOT)**
- Then the **Office For Technology (OFT)**
- Then **Cyber Security and Critical Infrastructure Coordination (CSCIC)**
- Then **Homeland Security & Emergency Svcs (DHSES)**
- And now **Information Technology Services (ITS)**



What I'll Cover

- 4 examples of map-based data and analytics I've been involved with over my career
- I'll weave in lessons learned along the way
- My thoughts on data issues and “big data”
- Q/A

My first “real” job; DOT







Linear Referencing Systems (LRSs)

NYSDOT had 2 major systems for tracking data about the highway system:

- Milepoint system – precision odometer readings
 - used for highway inventory data (pavement condition, traffic counts, shoulder width, etc)
- Reference Markers – field-posted signs every 1/10th mile
 - used for maintenance and accident data

LRSs for GIS

We had to model both LRSs in GIS in order to join business data to the map:

- Year-long effort to create those LRSs, which then enabled us to do analytics of DOT business data in GIS
- Major leap forward, and also enabled, for the first time, an easy way to cross-walk between milepoints and reference markers

But...

- DOT is an engineering agency with a very strong engineering culture. PE's rule the agency
- Engineers questioned accuracy of map (2d vs 3d)
- This had the effect of calling into question the validity of our efforts to model DOT data in GIS

Trivia Time!

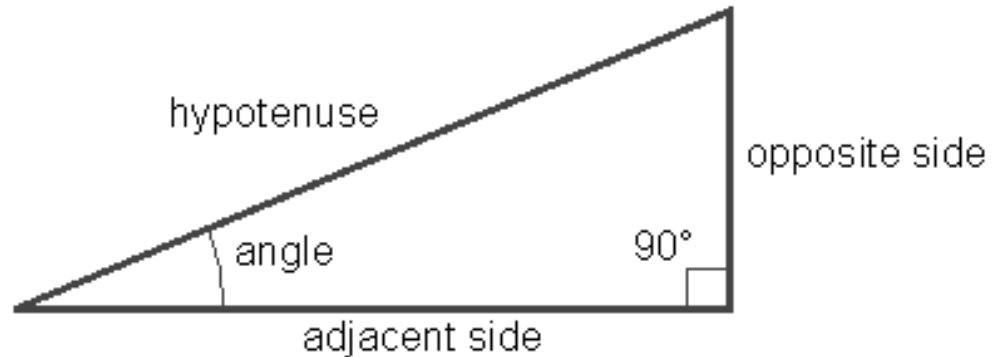
- Slope of roads expressed as “% Grade”:
rise/run,
 - so a road that rises 528 feet in 1 mile (5280 ft) =
1/10 or 0.1 or 10% grade
- Max grade of a NYS Highway?
- Max grade of an Interstate highway?
- Max grade of a RR?

Time to Do the Math

$$\sin(\text{angle}) = \frac{\text{opposite side}}{\text{hypotenuse}}$$

$$\cos(\text{angle}) = \frac{\text{adjacent side}}{\text{hypotenuse}}$$

$$\tan(\text{angle}) = \frac{\text{opposite side}}{\text{adjacent side}}$$



- Let's assume 1 mile of a 10% grade (hypotenuse = true length of 5280', rising 528')
 - Convert 10% slope to angle: $\arctan(.1) = 5.71$ degrees
- Map Length (adjacent side) is $\cos(a) * h$
 - $\cos(5.71) = 0.9950 * 5280 = 5253.8$ ft
- Map Length is short by **26 ft or 0.5%**
- **SO, if all highways were 10% grade, statewide map error is 0.5%. Conclusion: grade is not a significant error source**

Elevation Reality Check

Check 1: LRS distance total for entire NYS state highway network (i.e. total of all precision odometer readings) compared with total segment length of all NYS state highways in GIS (map length of highways). **Resulting difference (*all* errors) was less than 0.2%**

Check 2: Height of Mt Marcy (5344') on a 6" line representing total width of NYS?

0.014" 

Lesson #1:

It's absolutely critical that users trust your data







Digital Orthoimagery

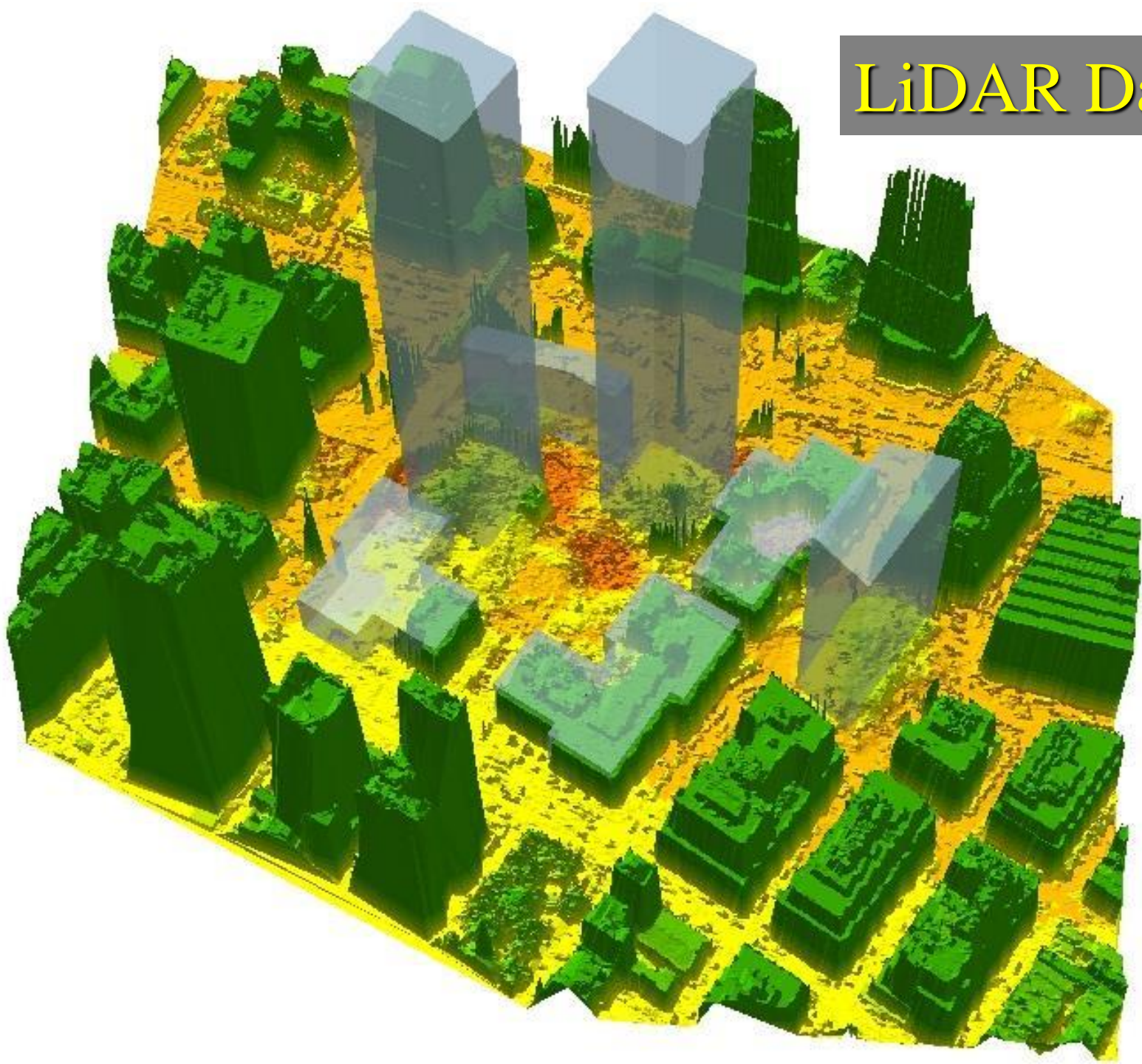
9-13-01



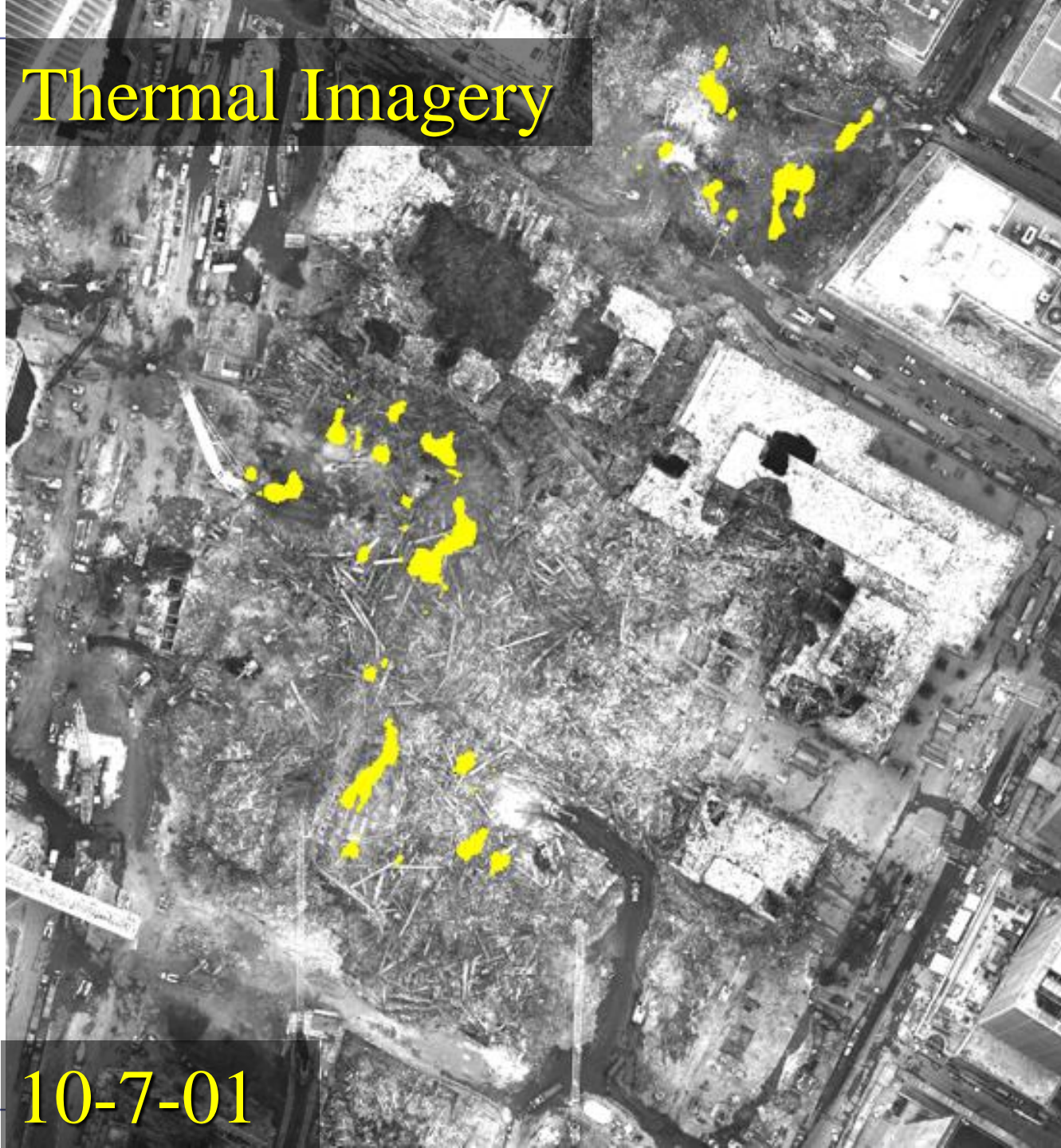
Digital Orthoimagery

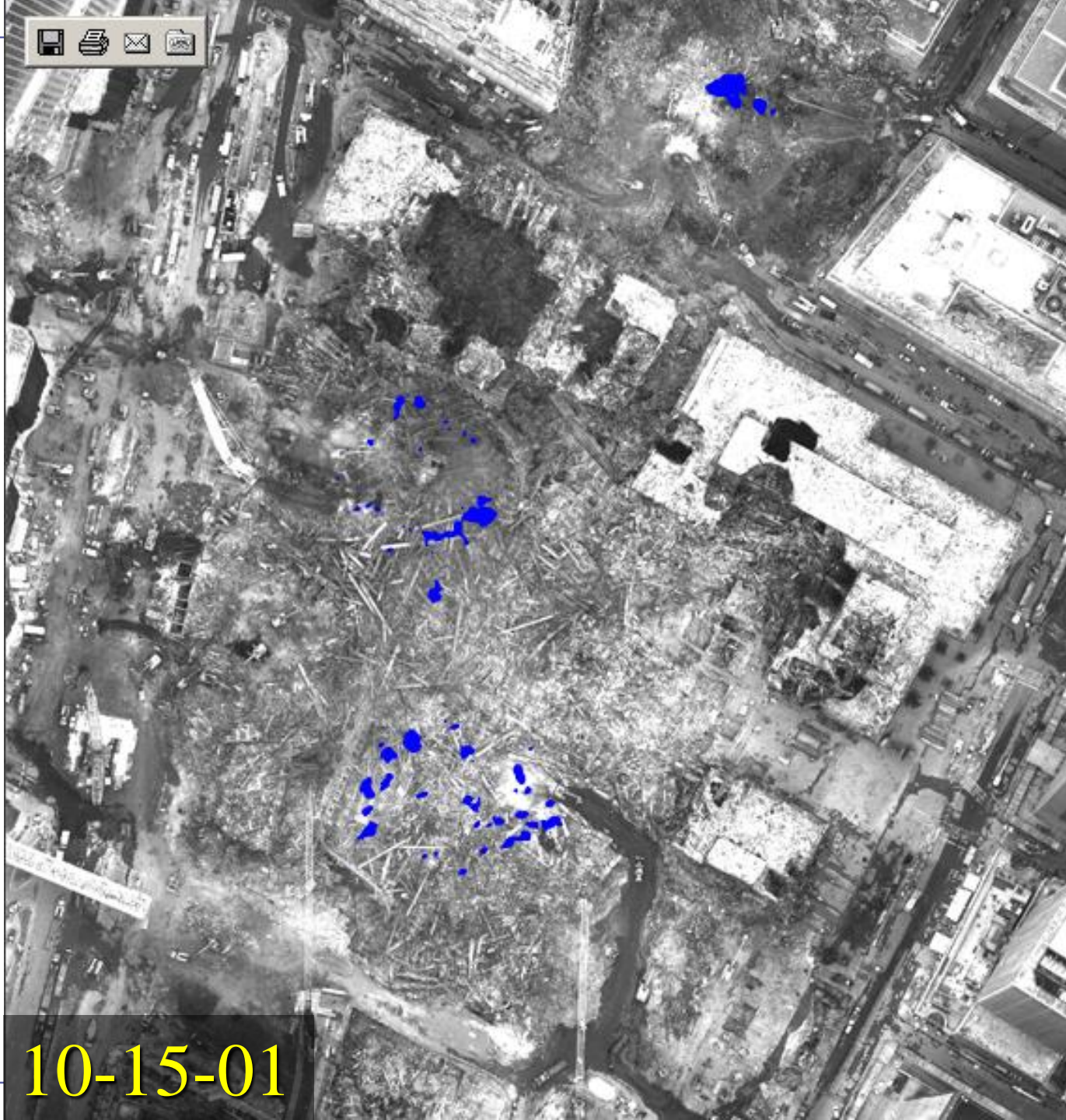
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LiDAR Data



Thermal Imagery







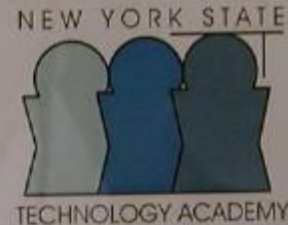
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EarthData temporary production lab in Albany

WORLD TRADE CENTER
EMERGENCY RESPONSE
TEAM
IMAGERY CENTER



Classroom A



NYC Emergency Operations Center



Emergency Mapping and Data Center

Cells







New York City



Ground Zero Conditions- 09/30/01



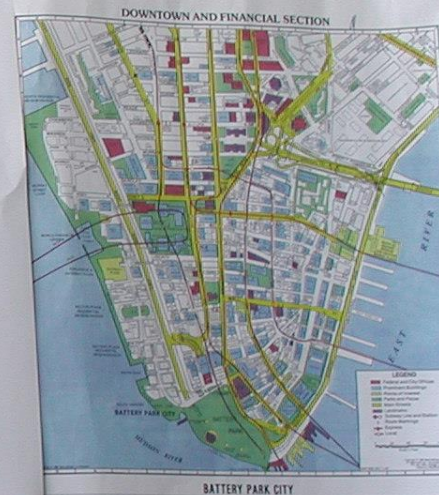
City of New York
Emergency Mapping Center
Rudolph W. Giuliani, Mayor



Disaster
the air
map of
shown

46

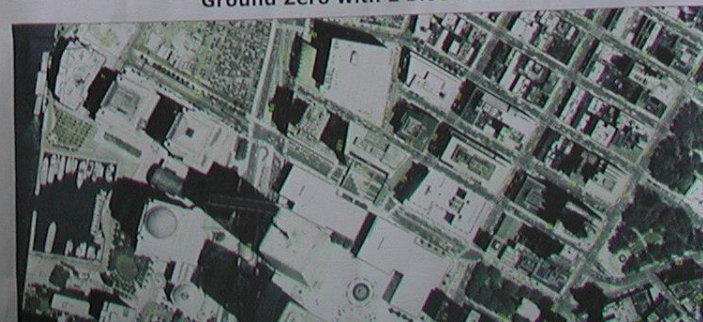
11



BATTERY PARK CITY



Ground Zero with 2 Block Radius



27

Lesson #2:

Don't assume someone else
knows what to do – take what you
know and run with it
(Carpe Diem)

The background of the slide is a faded, historical map of New York City from 1766. The map shows the city's layout, including the Hudson River, the East River, and the city's boundaries. Overlaid on the map is a document from the same period, which is a letter from Sir Henry Moore, Bart., to the Captain General and Governor in Chief of New York. The document is written in cursive and mentions the city's boundaries and the city's name. The title of the slide, "The New York Shoreline", is written in a blue, cursive font across the middle of the map.

The New York Shoreline

What do four centuries
in the historic record show?

Bill

~~William F.~~ Johnson

NYS Division of Homeland Security and Emergency Services

NYS Office for Information Technology Services

December 18, 2012

NYS 2100 COMMISSION

Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure



New York State | State Agencies | Search all of NY.gov

Governor Andrew M. Cuomo

Performance • Integrity • Pride

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NYS 2100 Commission

NYS 2100 COMMISSION

The NYS 2100 Commission is tasked with finding ways to improve the resilience and strength of the state's infrastructure in the face of natural disasters and other emergencies. The Commission will be co-chaired by Judith Rodin, President of the Rockefeller Foundation, and Felix G. Rohatyn, former Chairman of the Municipal Assistance Corporation. In addition to President Rodin's leadership and expertise, the Rockefeller Foundation will provide both staff expertise and other assistance in developing the Commission's report and recommendations. The Commission's preliminary recommendations are due January 3, 2013.

Resources

- Emergency Preparedness Home
- NYS Ready Commission
- NYS Respond Commission

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Contact Webmaster

<http://www.governor.ny.gov/assets/documents/NYS2100.pdf>

or just Google "NYS 2100"

DAMA-NYCR presentation, 2-September-2015



**Lower
Manhattan**



New York

Bronx

Queens

Kings

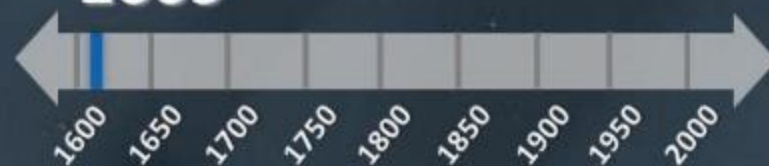
Richmond

Nassau

Suffolk



1609



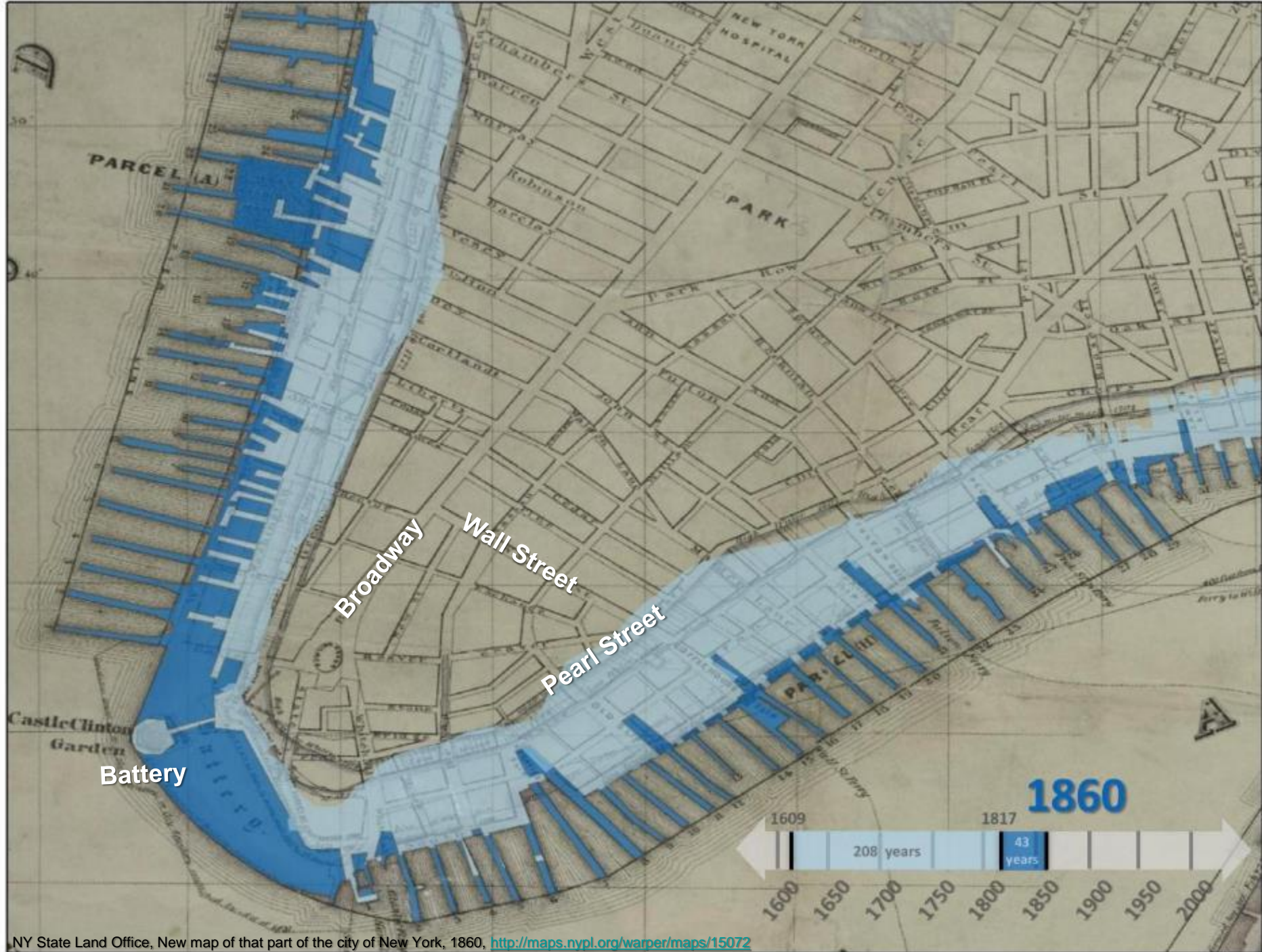


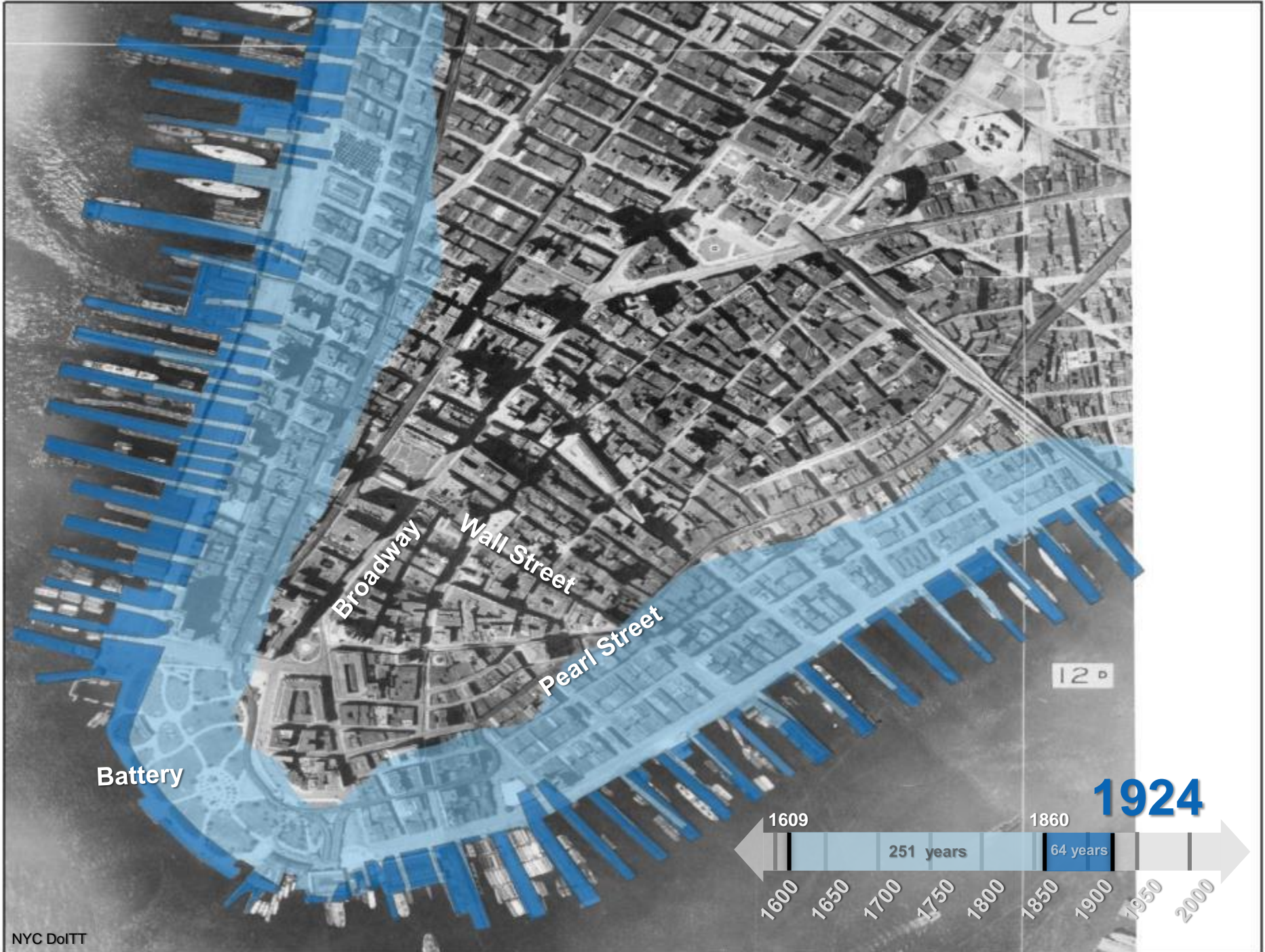
Map visualization from the Mannahatta Project: <http://welikia.org/> and <http://www.oasisnyc.net/>;
Cortelyou, *Castello plan*, 1660, New York Public Library, <http://maps.nypl.org/warper/maps/13913>





Poppleton, Plan of the city of New-York, 1817, New York Public Library, <http://maps.nypl.org/warper/maps/15128>





Battery

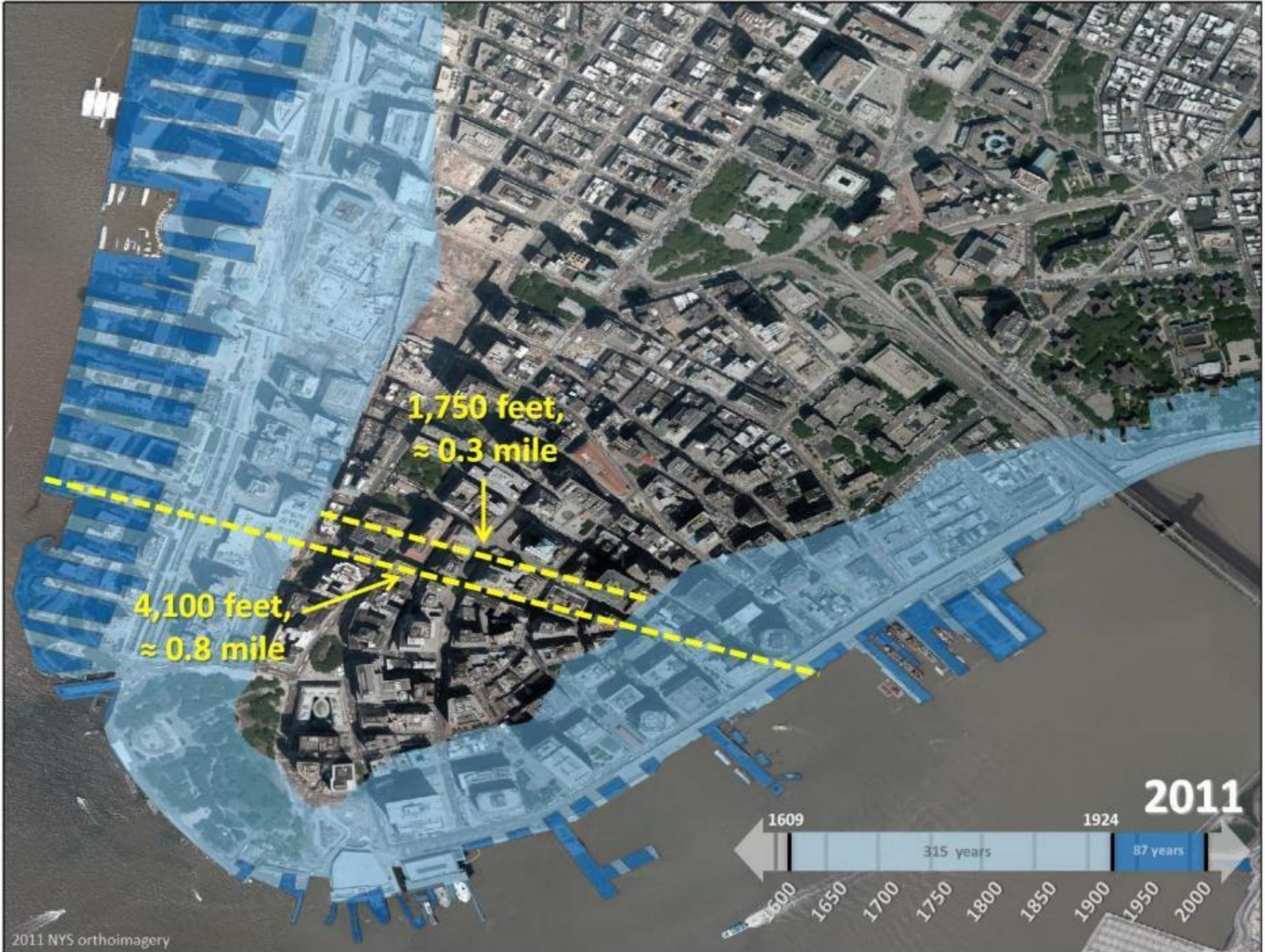
Broadway

Wall Street

Pearl Street

1924









Lesson #3:

Data has lasting value (quite unlike the systems we used to manage it or even the people that know the systems or data)



Stage 1
Building Rooftops
Centroids of Vacant Parcels



Current Geocoding in NYS agencies

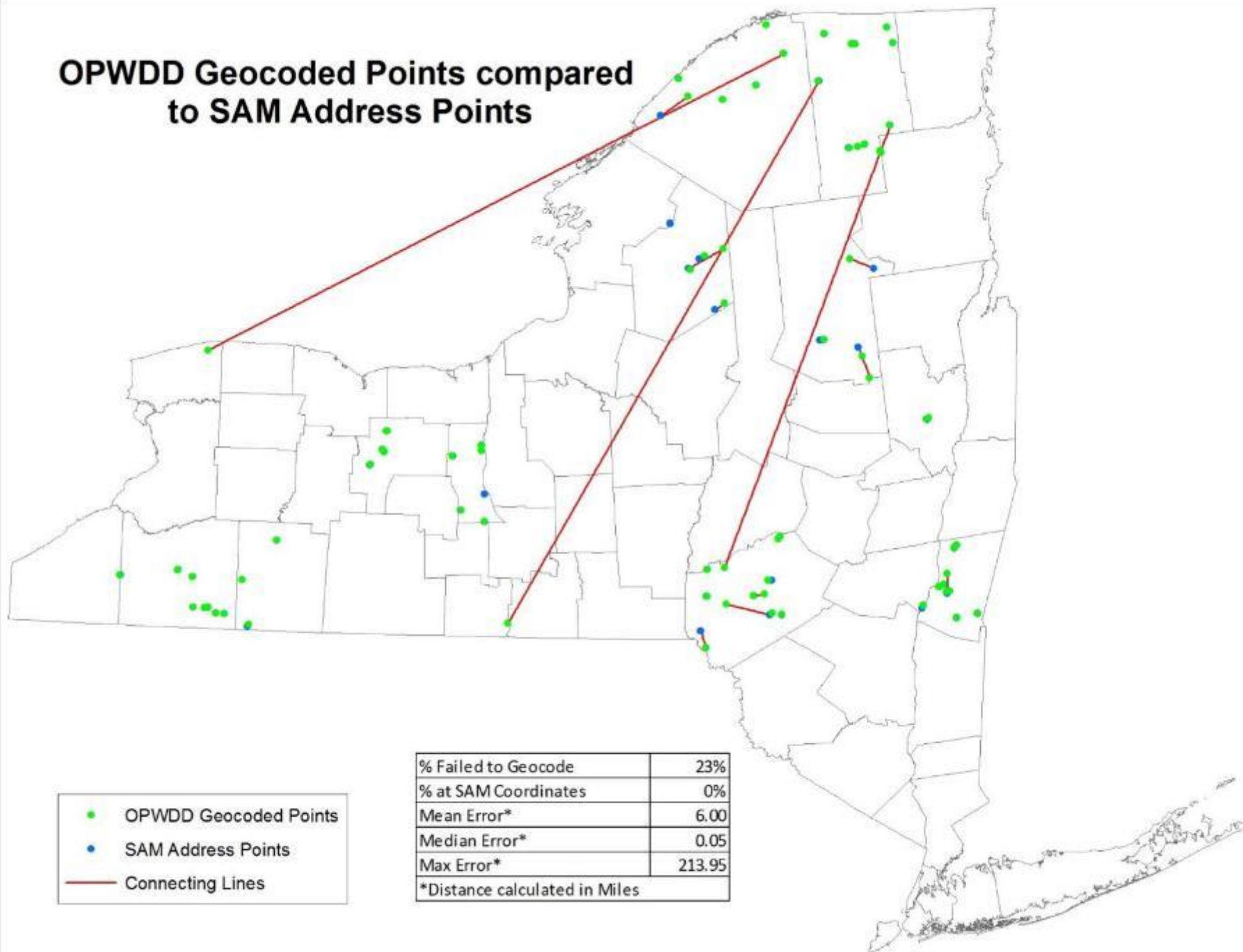
	A	B	C	D	E	F	G	H	I
	Cluster	Agency	Program Area	Software	Version	Ref Data	Maint?	Cost/yr	geocode Transactions/yr
5	Public Safety	GPO	all	ArcGIS Server	10.1	SAM Here, NYS Streets	yes		50,000
6		GPO	Data Improvement	Map Marker	14	Map Marker	N	\$2,000	20,000
7		DCJS	Crime Analysis Centers	GIS Program Office	N/A	GIS Program Office GIS Web Service	N/A	N/A	12,000
8		DCJS	NYDEX	Map Marker	14	Map Marker		\$14,767	8,000,000
9	Transp & Econ Dev	NYSDDOT	various	ArcGIS	9.3 V10.1	NYS Geocoding Service and NYS Streets	0	\$0	50,000
10		DHCR	Storm Recovery	ArcGIS	10.1	NYS Geocoding Service	0	\$0	500,000
11		MPOs		ArcGIS	10.1	NYS Geocoding Service and NYS Streets	0	\$0	10,000
12		ESDC							
13	Energy & Environ	State Parks	Website	Google			none	none	N/A
14		State Parks	SHPD	ESRI	nationwide geocoder		none	none	N/A
15		State Parks	SHPD	Custom built					
16		Ag & Mkts	Ag Development	Public-facing web page	N/A	Google Maps	No	Free	5,000
17		Ag & Mkts	Dairy Services	ArcMap	10.1	AUS Streets circa 2011	No	Free	1,000
18		Public Service		ArcGIS Server/ArcMap		ESRI Service	No	Free	
19		APA		N/A		N/A	N/A	N/A	N/A
20		DEC		ArcMap	10	AUS Streets circa 2011	No	Free	
21	Fin, Reg, Gaming	Tax	Common Services	ESRI - ArcGIS server	10.1	NYS points & segments	Y	\$21,355	20,000,000
22		Tax	e-Channel	ESRI - ArcGIS server	10.1	NYS points & segments	Y	county	10,000,000
23		Tax	Rowes	ESRI - ArcGIS server	10.1	NYS points & segments	Y	county	10,000,000
24		DFS	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25		Budget	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26		Gaming/Lottery	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	General Gov	DMV				AUS			
28		SLA	ITA/Licensing/Couns	ArcGIS	10.0 (10.2 soon)	AUS	Yes	\$11,228	20,000
29		DOS	Office of Planning & Development	ArcGIS	10.1	NYS_Points_Streets web service from http://gis-services.dhses.ny.gov/arcgis/rest/services/NYS_Points_Streets/GeocodeService/FindAddressCandidates	Maintained by DHSES	\$0	500,000
30		DOS	Land Management	MapInfo Pro/ESRI Arc G	MI 12/ArcGIS 9	Ortho Photosat data			50
31	Health	DMH	Forensics	ArcGIS	10.1	ArcGIS Online North America and US Streets, NYS_Points_Streets (developed by N gis-services.dhses.ny.gov/arcgis/rest/services/NYS_Points_Streets/GeocodeService/FindAddressCandidates	none	none	25,000
32		DMH	NY SAFE Act			gis-services.dhses.ny.gov/arcgis/rest/services/MuniBoundaries/MapServer/Query	Maintained by DHSES	\$0	20,000
33		DCH	Informatics	MapMarker	USA 26	2013-07	Yes	\$22,307	150,000,000
34	Behavioral Health	OPWDD		MapMarker	v13				
35	Human Svcs	OCFS	Applications	Piney Bowes Envisia	4.4	12-Dec	Y	\$130,000	3,000,000
36		OTDA	Applications	Piney Bowes Envisia	4.4	12-Dec			500,000
37		Labor	Unemployment	IBM InfoSphere			Y	\$75,000	2,000,000
38	Other	NYSTA	Real Property/Permit	Google Maps	-	Google Streets/Geocoding	(By Google)		
39		NYSTA	Real Property/Permit	ArcGIS	10	Esri's North America Geocode Service	(By Esri)		
40		NYSTA	Real Property/Permit	ArcGIS Server	10	Bing Maps	(By Microsoft)		
41		NYSTA	E-ZPass Operations	ArcGIS	10	National Zip code polygons	No		
42		NYSTA	E-ZPass Operations	ArcGIS	10	Esri's North America Geocode Service	(By Esri)		

At least 35 different geocoding solutions!

Ground Truth

- Geocoding results are normally evaluated on “hit rate” or percentage geocoded. This is a **poor measure**, as it depends on tolerances to accept weaker matches.
- Now that NYS has high-accuracy SAM data (9-1-1 address points matched to rooftop coordinates using imagery), we can finally assess **ground truth** of geocoding results.

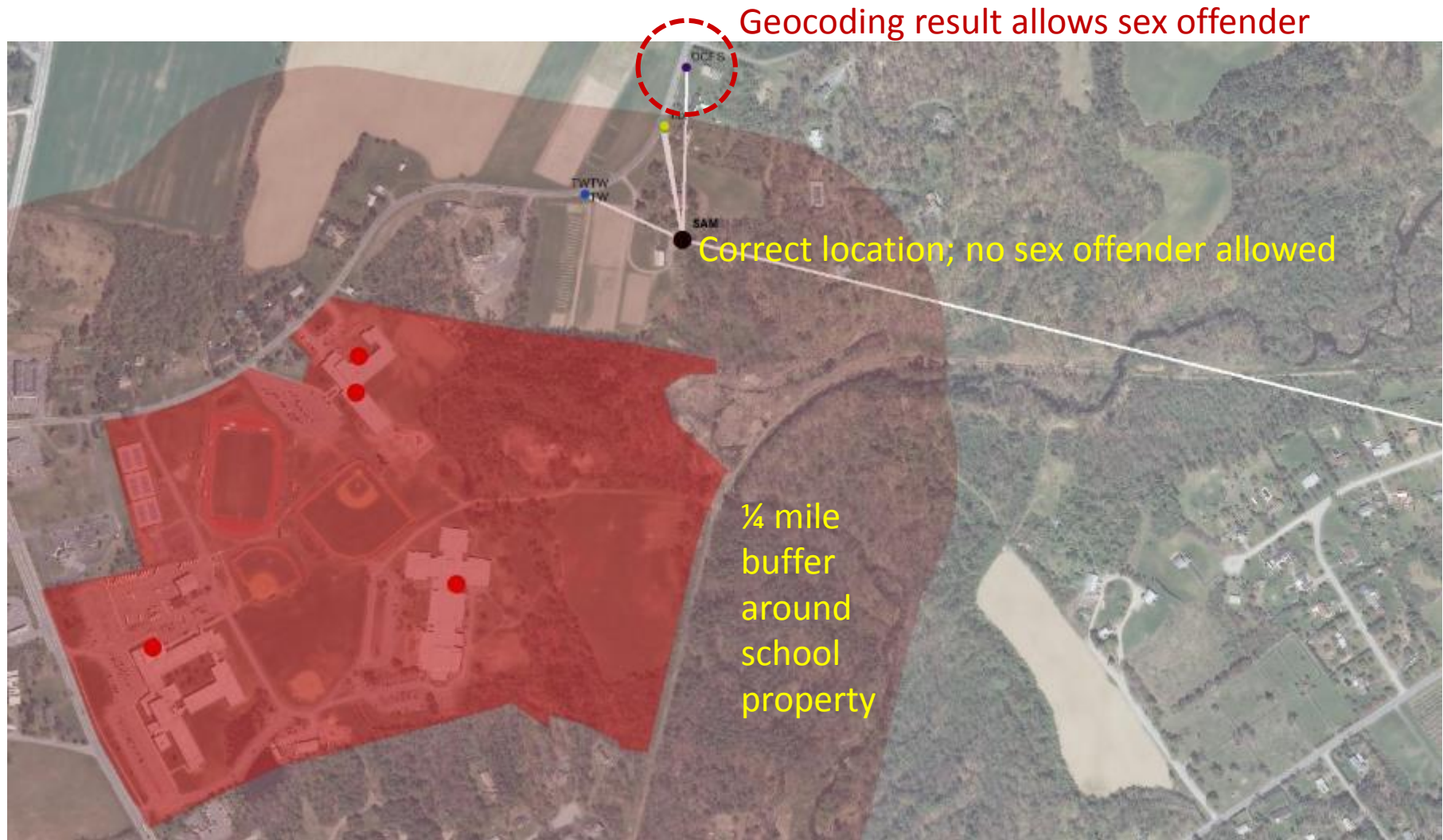
OPWDD Geocoded Points compared to SAM Address Points



Sales Tax example



Sex Offender Placement example



Ground Truth Error Analysis

NYS_ID	JoinID	Input_Address	Input_City	Input_Zip_Code	DOH_wZip_Geocoded_Address	DOH_wZip_Geocoded_City	DOH_wZip_Geocoded_Zip	DOHZip_Distance_Difference_Miles
CATT011515	11	208 South Third St	Olean	14760	208 S 3RD ST	KNAPP CREEK	14760	0.00
CATT011515	12	208 South Third St	Knapp Creek	14760	208 S 3RD ST	OLEAN	14760	0.00
STLA003660	145	119 Jefferson Ave	Massena	13662	119 JEFFERSON AVE	MASSENA	13662	0.00
COLU026705	40	32 Worth Ave	Hudson	12534	32 WORTH AVE	HUDSON	12534	0.00
CATT005082	9	15 Sno Way	Ellicottville	14731	15 C ST	ELLCOTTVILLE	14731	0.00
FRAN005003	64	210 East Main St	Chateaugay	12920	210 E MAIN ST	CHATEAUGAY	12920	0.01
CATT003786	6	5438 US Rte 62	Conewango Valley	14726	5438 ROUTE 62	CONEWANGO VALLEY	14726	0.04
CATT003786	8	5438 US Rte 62	Conewango Vly	14726	5438 ROUTE 62	CONEWANGO VLY	14726	0.04
SENE014307	142	2291 Lake Rd Spur	Canoga	13148	2291 LAKE ROAD SPUR	SENECA FALLS	13148	0.01
CATT003786	7	5438 US Rte 62	Conewango	14726	5438 ROUTE 62	CONEWANGO VALLEY	14726	0.04
SARA055717	126	11 Vichy Dr	Saratoga Springs	12866	11 VICHY DR	SARATOGA SPRINGS	12866	0.01
SARA056653	127	3 Hayes Dr	Saratoga Springs	12866	3 HAYES DR	SARATOGA SPRINGS	12866	0.00
ALLE000646	2	9952 West Hill Rd	Fillmore	14735	9952 W HILL RD	FILLMORE	14735	0.01
ALLE000646	1	9952 West Hill Rd	Allen	14735	9952 W HILL RD	FILLMORE	14735	0.01
COLU010339	27	112 Northern Blvd	Germantown	12526	112 NORTHERN BLVD	GERMANTOWN	12526	0.01
COLU010339	26	112 Northern Blvd	Cheviot	12526	112 NORTHERN BLVD	GERMANTOWN	12526	0.01
SARA070892	131	12 Vichy Dr	Milton	12866	12 VICHY DR	SARATOGA SPRINGS	12866	0.01
ONTA044875	121	6640 Rte 5 And 20	East Bloomfield	14469	6640 STATE ROUTE 5 AND 20	BLOOMFIELD	14469	0.39
ONTA044875	123	6640 Rte 5 And 20	Bloomfield	14469	6640 STATE ROUTE 5 AND 20	BLOOMFIELD	14469	0.39
CATT029871	17	5695 Bonn Way East	Great Valley	14741	5695 BONN WAY E	GREAT VALLEY	14741	0.01
CATT029871	16	5695 Bonn Way East	Great Valley	14741	5695 BONN WAY E	GREAT VALLEY	14741	0.01
SENE010102	2	7500 Lake Rd	Seneca Falls	13148	7500 LAKE ROAD	SENECA FALLS	13148	0.02
SENE010102	1	7500 Lake Rd	Canoga	13148	7500 LAKE ROAD	SENECA FALLS	13148	0.02
STLA006518	147	437 Old Potsdam Parishville Rd	Potsdam	13676	437 OLD POTSDAM PARISHVILLE RD	POTSDAM	13676	0.04
SENE011674	136	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
STLA014172	74	384 West Main St	Malone	12953	384 W MAIN ST	MALENE	12953	0.02
DELA020591	54	41 Private Drive 1	Cabinhill	13752	41 PRIVATE DR 1	DELANCEY	13752	0.02
SENE020131	141	Private Drive 1	Delancey	13752	PRIVATE DRIVE 1	SENECA FALLS	13752	0.02
SENE010506	8	190 State Route 62	Chateaugay	12920	190 STATE ROUTE 62	CHATEAUGAY	12920	0.03
STLA006518	146	437 Old Potsdam Parishville Rd	Eben	13676	437 OLD POTSDAM PARISHVILLE RD	POTSDAM	13676	0.04
DELA020591	54	41 Private Drive 1	Cabinhill	13752	41 PRIVATE DR 1	DELANCEY	13752	3.62
FRAN003154	63	6259 State Rte 374	Bellmont	12920	6259 STATE ROUTE 374	CHATEAUGAY	12920	0.03
SENE010102	136	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
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SENE010102	183	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	184	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	185	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	186	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	187	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	188	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	189	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	190	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	191	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	192	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	193	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	194	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	195	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	196	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	197	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	198	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	199	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	200	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	201	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	202	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	203	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	204	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	205	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	206	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	207	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	208	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	209	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	210	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	211	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	212	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	213	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	214	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	215	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	216	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	217	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	218	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	219	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	220	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	221	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	222	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	223	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	224	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	225	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	226	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	227	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	228	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	229	9825 Extension Rd	Trumansburg	14886	9825 EXTENSION RD	TRUMANSBURG	14886	0.02
SENE010102	230	9825 Extension Rd	Trumansburg					

Lesson #4:

Work on solving the big problems

And now for something completely different...



Some Thoughts on Data...

noise



content

*What we store
and query*

data

information

Domain of:

- *Search*
- *Discovery*
- *Awareness*

Domain of:

- *SM Experts*
- *Synthesis*
- *Insights*

knowledge

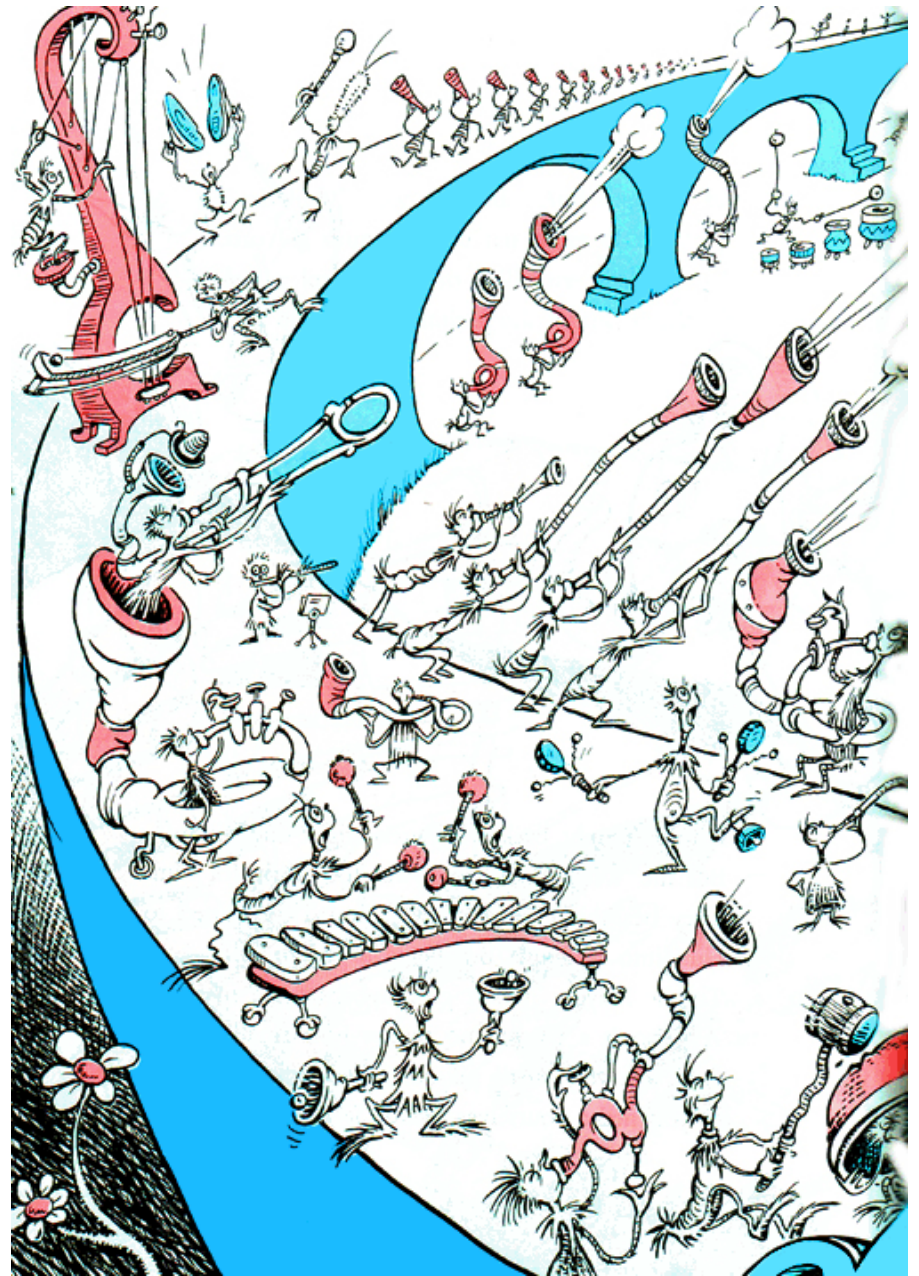
expertise

*What we need
for decisions*

wisdom

If it's not the
data you need,
it's just Noise!

The Grinch says: "If
there's one thing I
hate it's the Noise,
Noise, Noise Noise!"



Government Role

Why should government agencies produce data if it can be bought or licensed?

- Authoritative
- No market factors skewing it
- Transparency
- Build once, Use many ==> Open Data

Presentation Matters

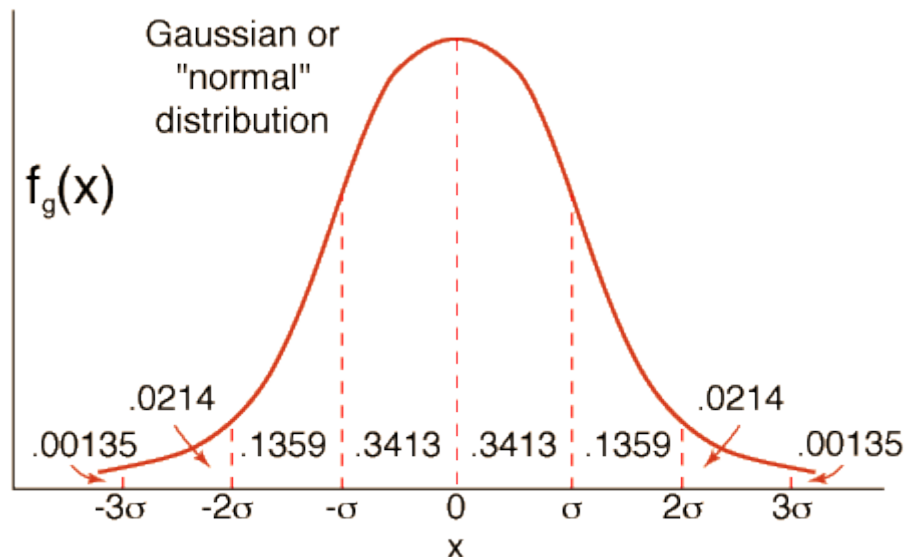
- A lot.
- Importance of info design
- Power of Comparison
- In GIS: map + output table = “Magic Combo”

Big Data – what’s the Big Deal?

- It’s really just lots and lots of small data
- Much more noise
- Yes, some new insights, but are they “needles in the haystack?”
- Are we storing/crunching all of this data because we can? (cheap compute/storage)
- Sampling may be better, more accurate, and certainly cheaper

Sampling and Understanding Errors

Remember this stuff?



It still works!

Thank You!

Any Questions?