

# Evolution of Mapping

Kumar Navulur, PhD



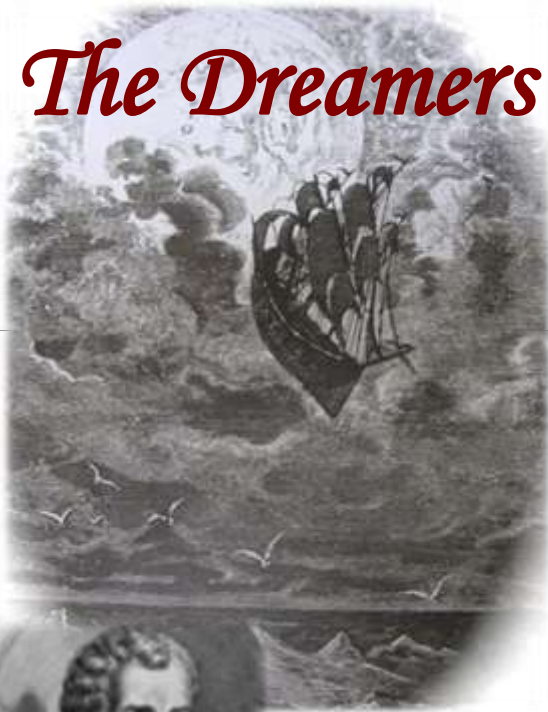
*“Man must rise above the Earth—to the top of the atmosphere and beyond—for only thus will he fully understand the world in which he lives”.*

**Socrates**  
**(470-399 BC)**



# The Dreamers

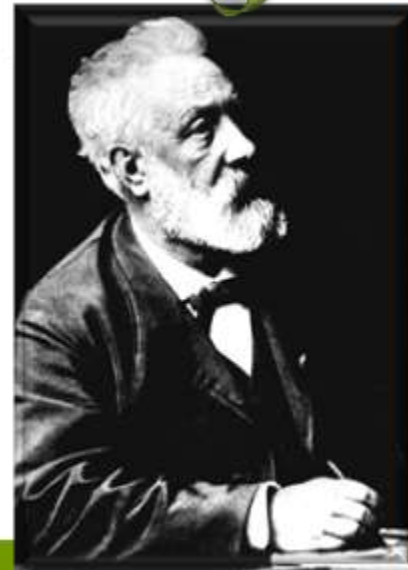
"From the Earth  
To the Moon"



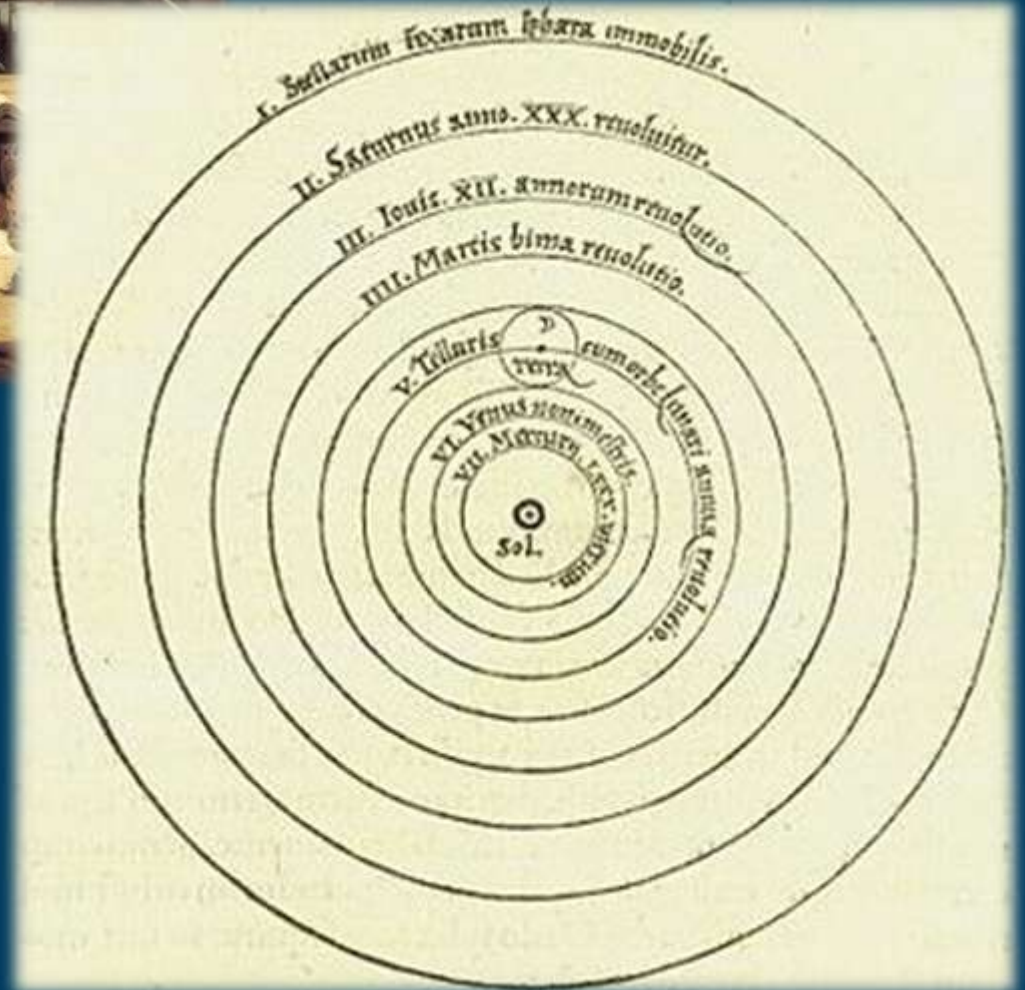
*Lucian of Samosata*  
150 AD



*Johannes Kepler*  
1611



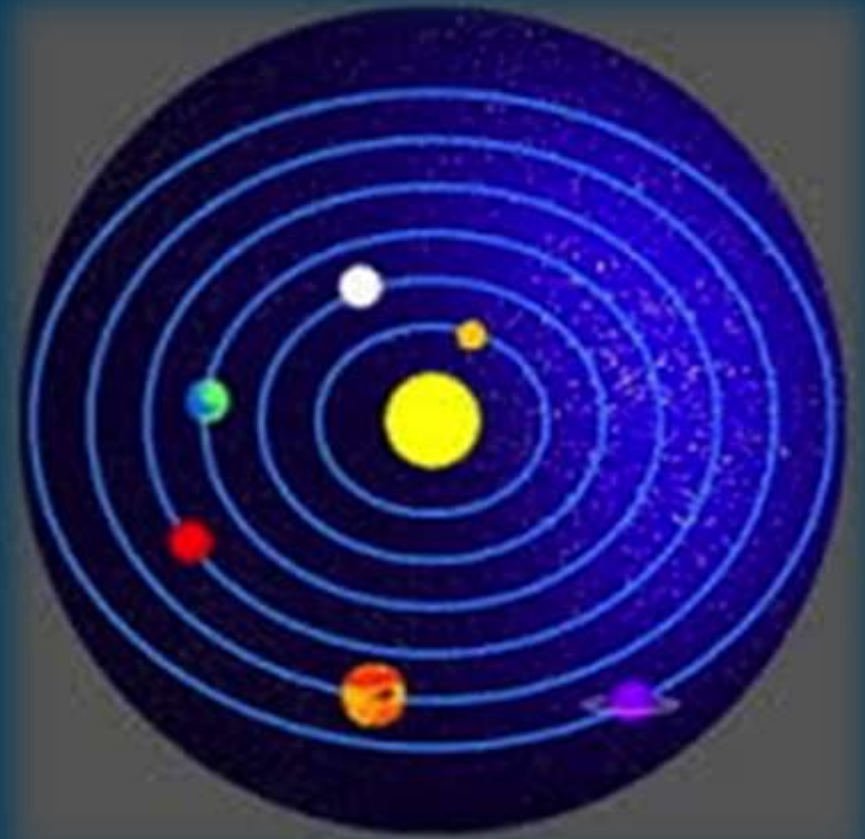
*Jules Verne*  
1865



Nicolaus Copernicus  
1473-1543



**Johannes Kepler**  
**1571-1630**



# Mercator projection (1569)

80°



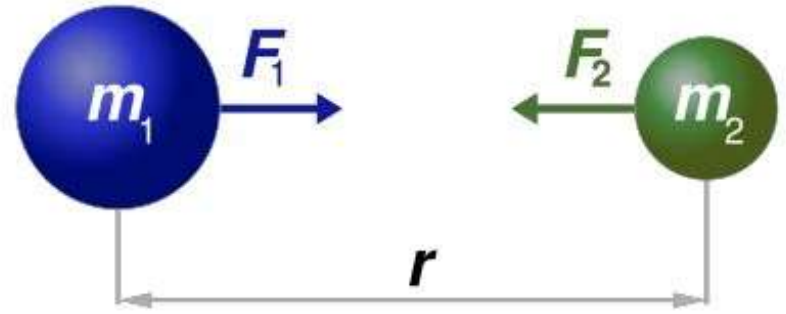
80°

180° 165° 150° 135° 120° 105° 90° 75° 60° 45° 30° 15° 0° 15° 30° 45° 60° 75° 90° 105° 120° 135° 150° 165° 180°



Isaac Newton  
1643-1727

$V \approx 17,500 \text{ m/h}$

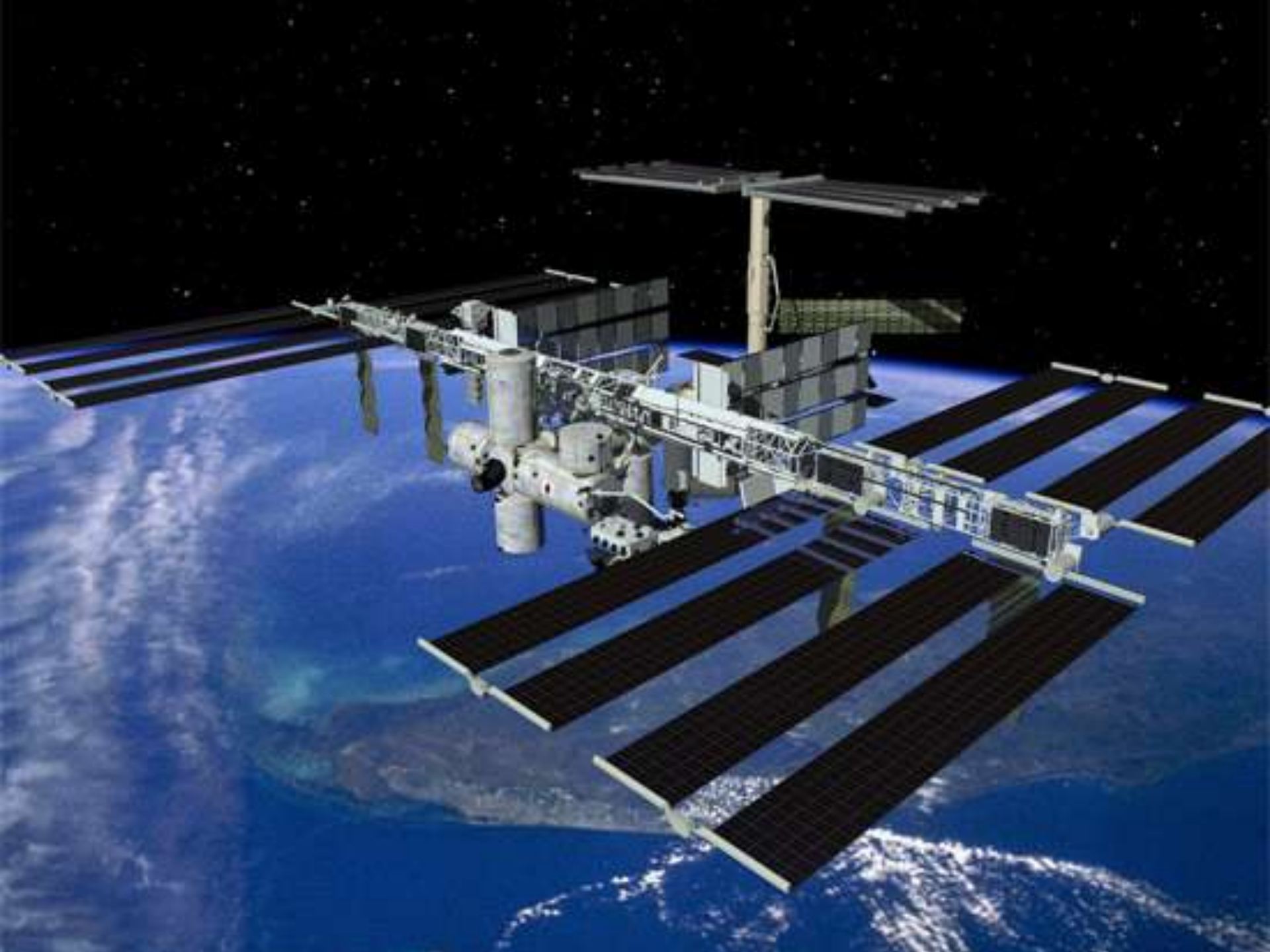


$$F_1 = F_2 = G \frac{m_1 \times m_2}{r^2}$$

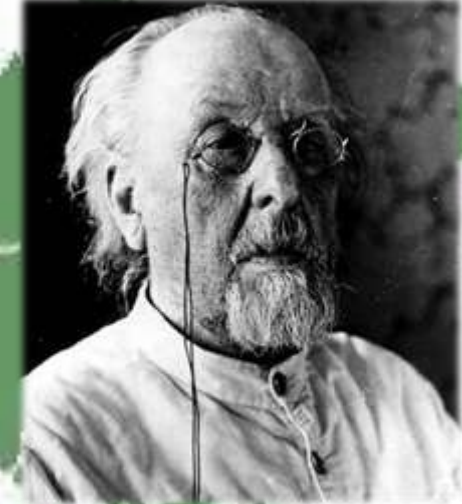
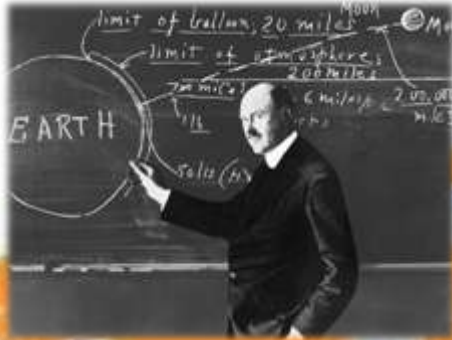








Konstantin  
Tsiolkovsky  
(1903)



Hermann  
Oberth  
(1922)

Robert  
Goddard  
(1919)



# Space Pioneers

# First photograph from space (1946)



# Space today ....

EVERY SINGLE SATELLITE ORBITING THE EARTH



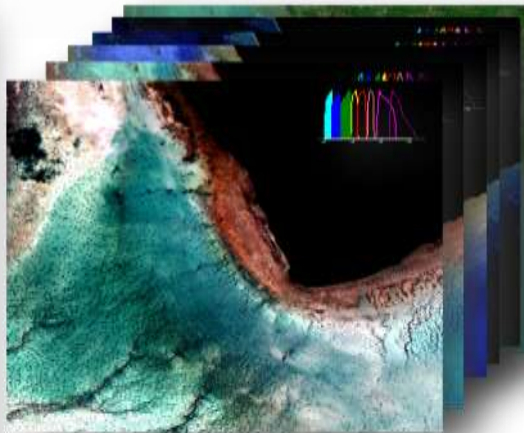
A movie poster for the film 'Gravity'. The background is a dark, deep blue space. On the right side, a curved portion of the Earth is visible, showing blue oceans and white clouds. A bright sun or star is positioned in the upper right, creating a lens flare effect. In the center-left, an astronaut in a white space suit is floating in space, with a coiled tether trailing behind. In the lower right foreground, a blurred, metallic part of a spacecraft is visible, suggesting motion. The overall mood is one of isolation and high-stakes drama.

SANDRA BULLOCK  
GEORGE CLOONEY

FROM DIRECTOR ALFONSO CUARÓN

# GRAVITY

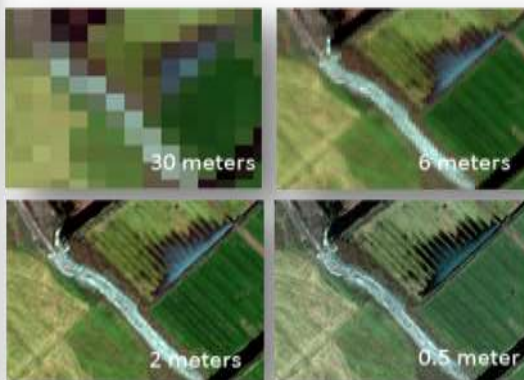
# Earth is being captured at multiple scales and in multiple dimensions ...



Increasing number of Bands That Help with Vegetation Inventory and Health Mapping



Global Collection Capacity and Frequent Refresh For Agriculture Monitoring



Increasing Spatial Resolution To Help Small Holder Farmers



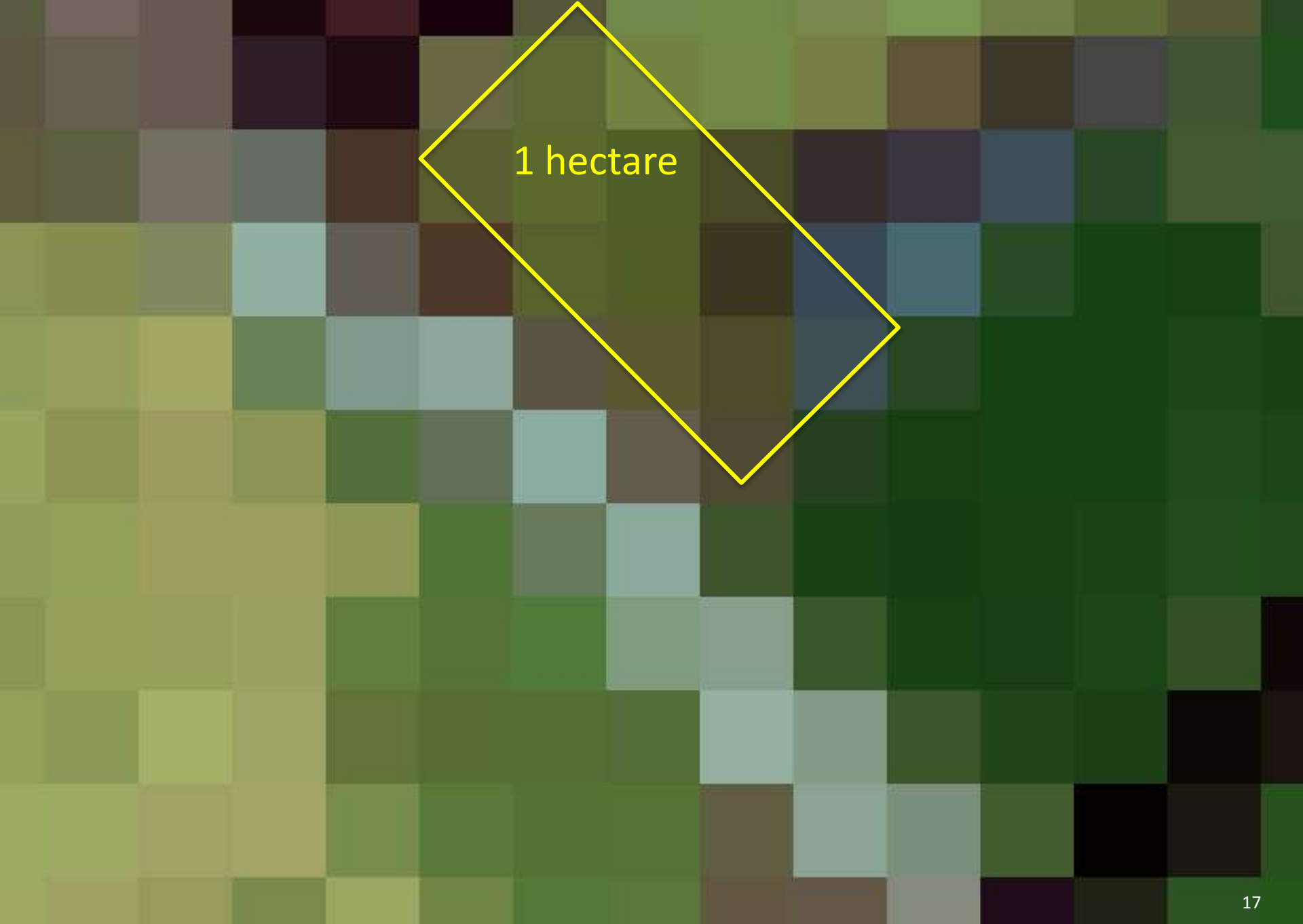
Large Scale Computing and Global Infrastructure to Process Imagery and Provide Timely Information for Farmers

Imaging at incredible detail of even the remote areas and small settlements ...



# Context and Fit For Purpose





1 hectare

# 6m GSD of Rakaia River, New Zealand (a la RapidEye)

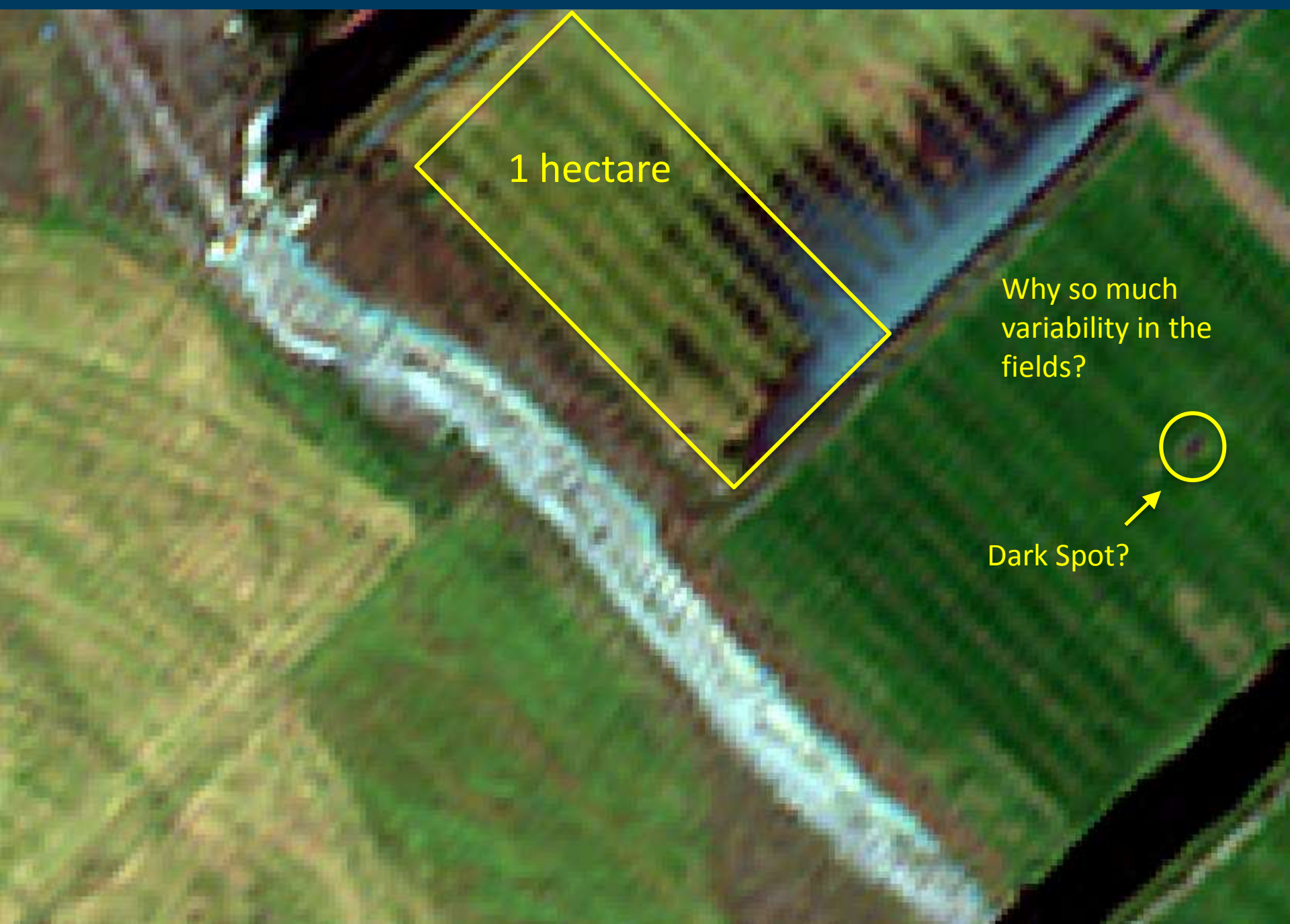


1 hectare

Why so much  
variability in the  
fields?

Dark Spot?

# 2m GSD of Rakaia River, New Zealand (a la VHR MS)



1 hectare

Why so much variability in the fields?

Dark Spot?

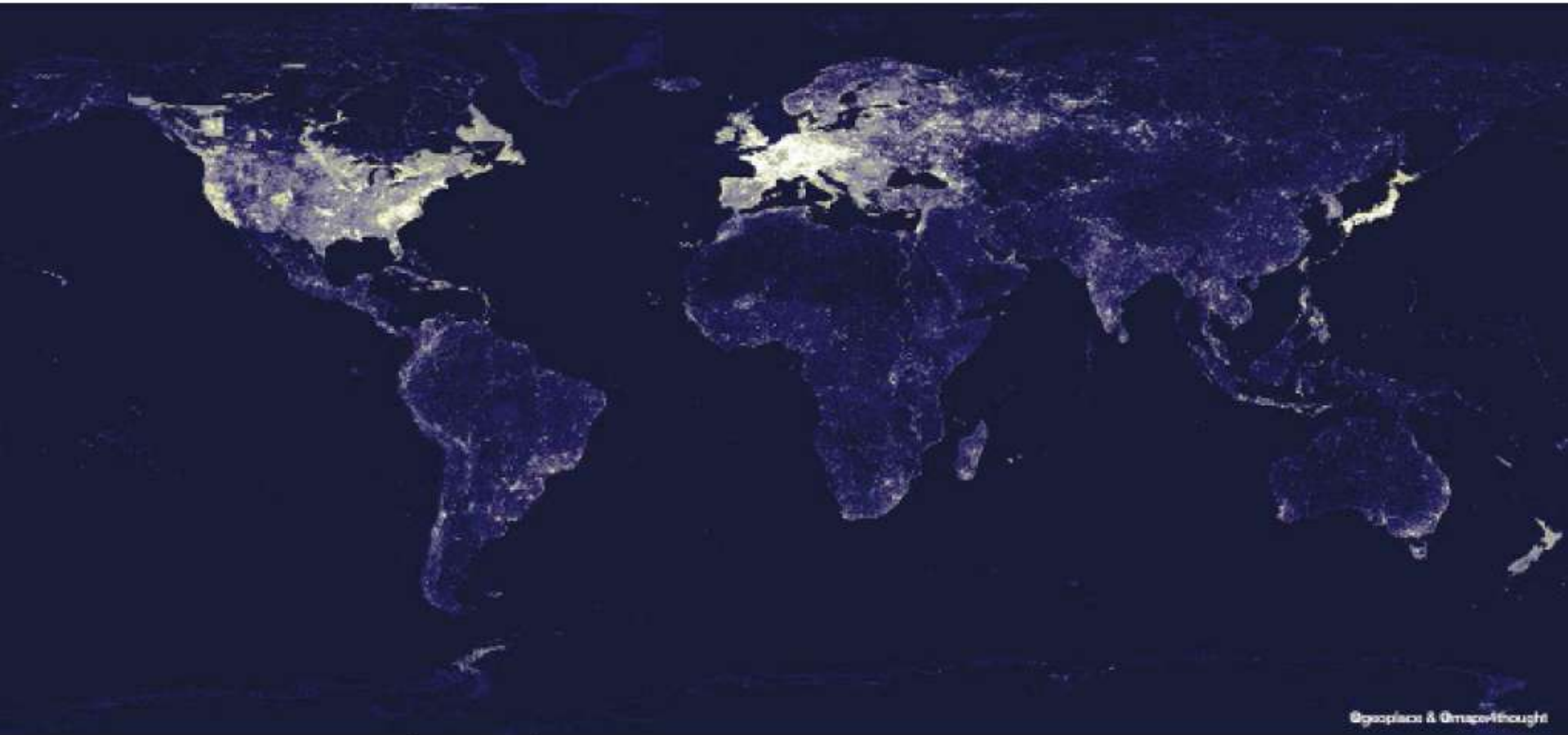


1 hectare

Crops have been harvested.

Manmade Object

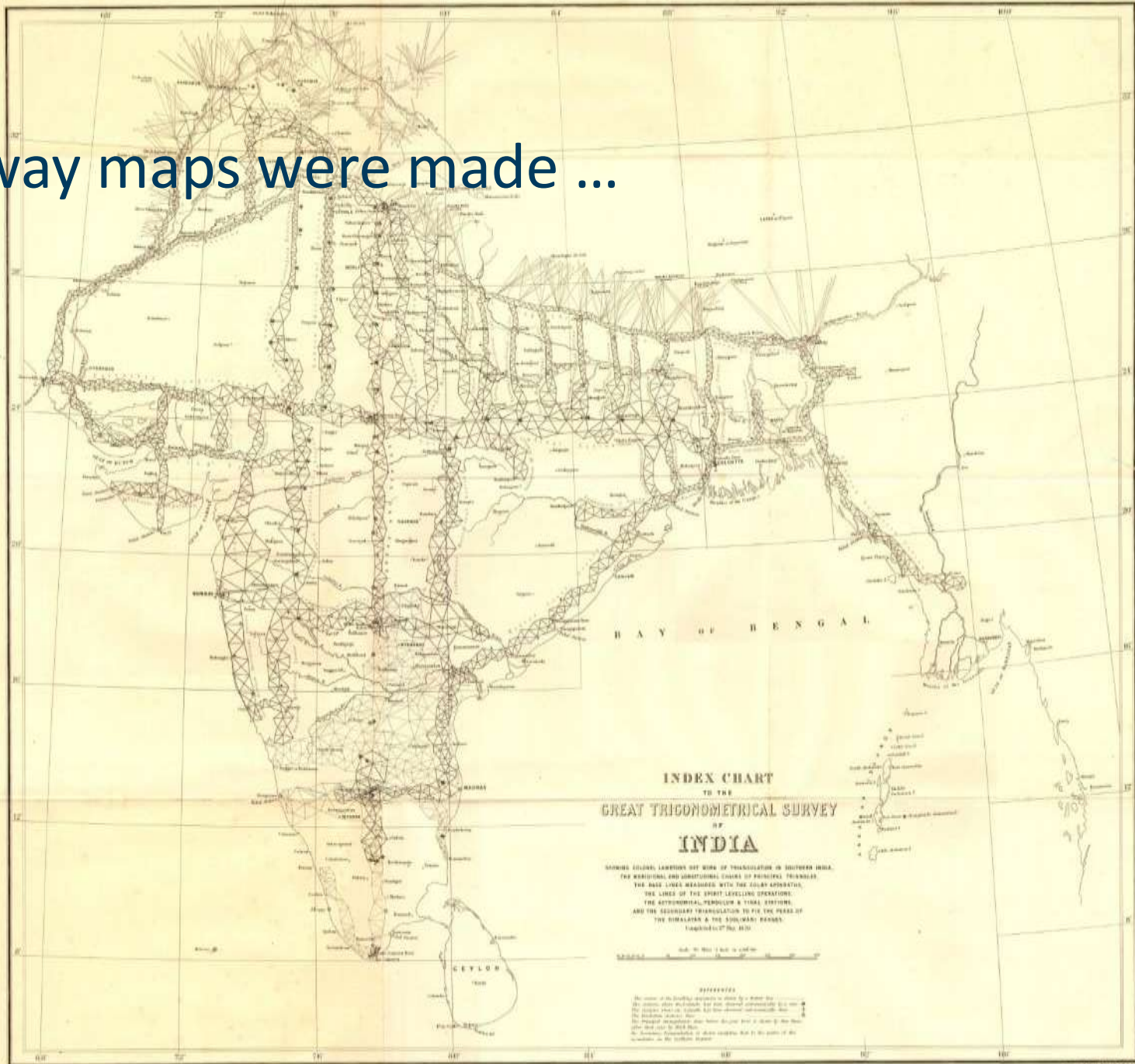
But detailed maps are still sparse in most of the world ....



©geoplaces & @mapwiththought

*Heat map showing the edits (in yellow) entered into OpenStreetMap as of 2014. Although detailed maps now exist for the US, Western Europe and Indonesia, most places in the world remain dark and largely unmapped.*

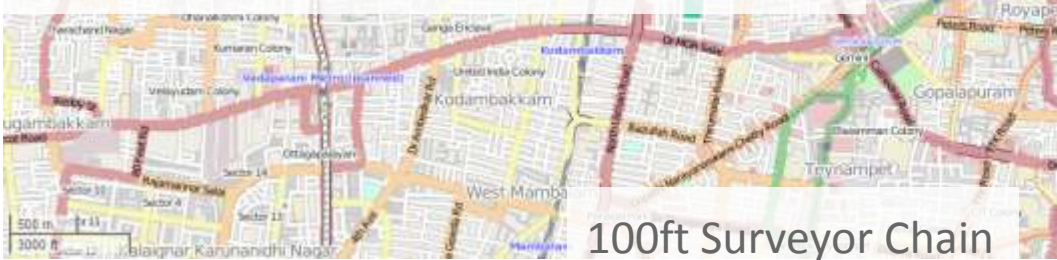
# The way maps were made ...



# The ways maps were made, on foot, time and resource consuming ...



It took 60 years and 600 people died of malaria



100ft Surveyor Chain  
 $\Delta 1^{\circ}\text{F} = \Delta 0.007\text{in}$



# Looking under the hood of map making ...





**100m CE90**

**50m CE90**

**12m CE90**

**5m CE90**

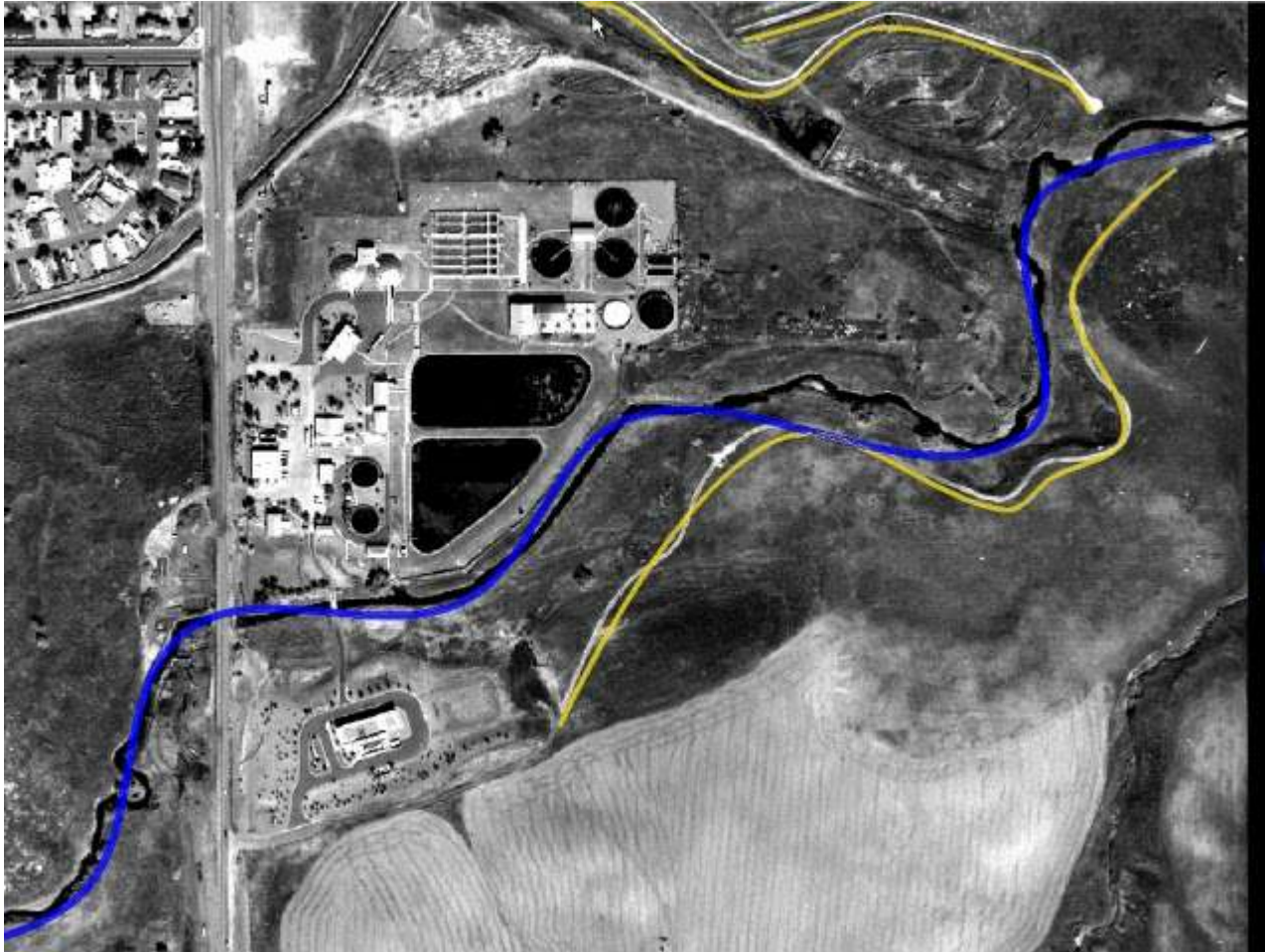
Accuracies vary by sources, creating consistency issues for creation and maintenance of maps

Resulting in gross inconsistencies overtime ...

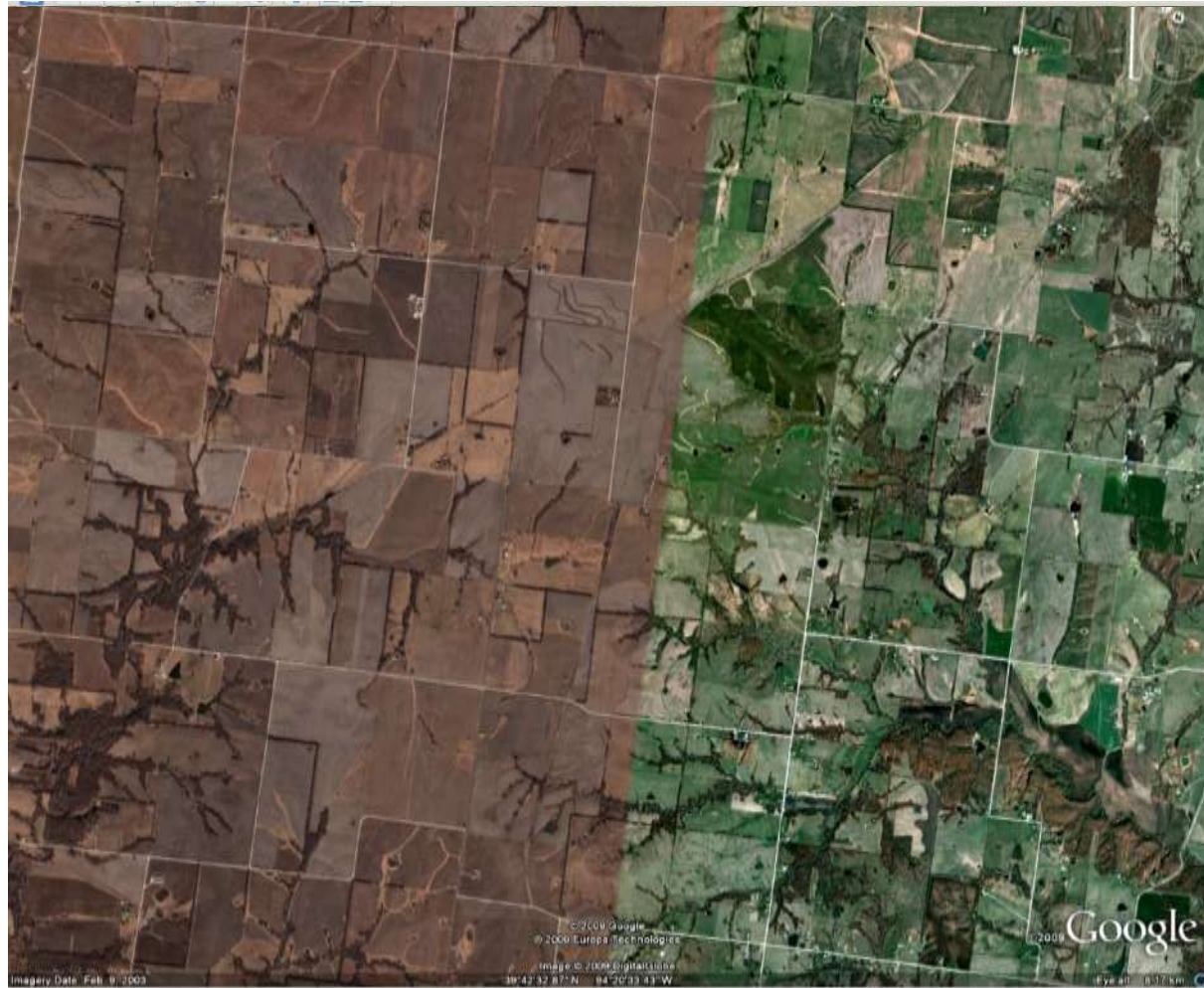
Conflation



# How do you integrate legacy maps ...



# Underlying imagery is often not consistent ...



# The Geospatial Paradigm ...

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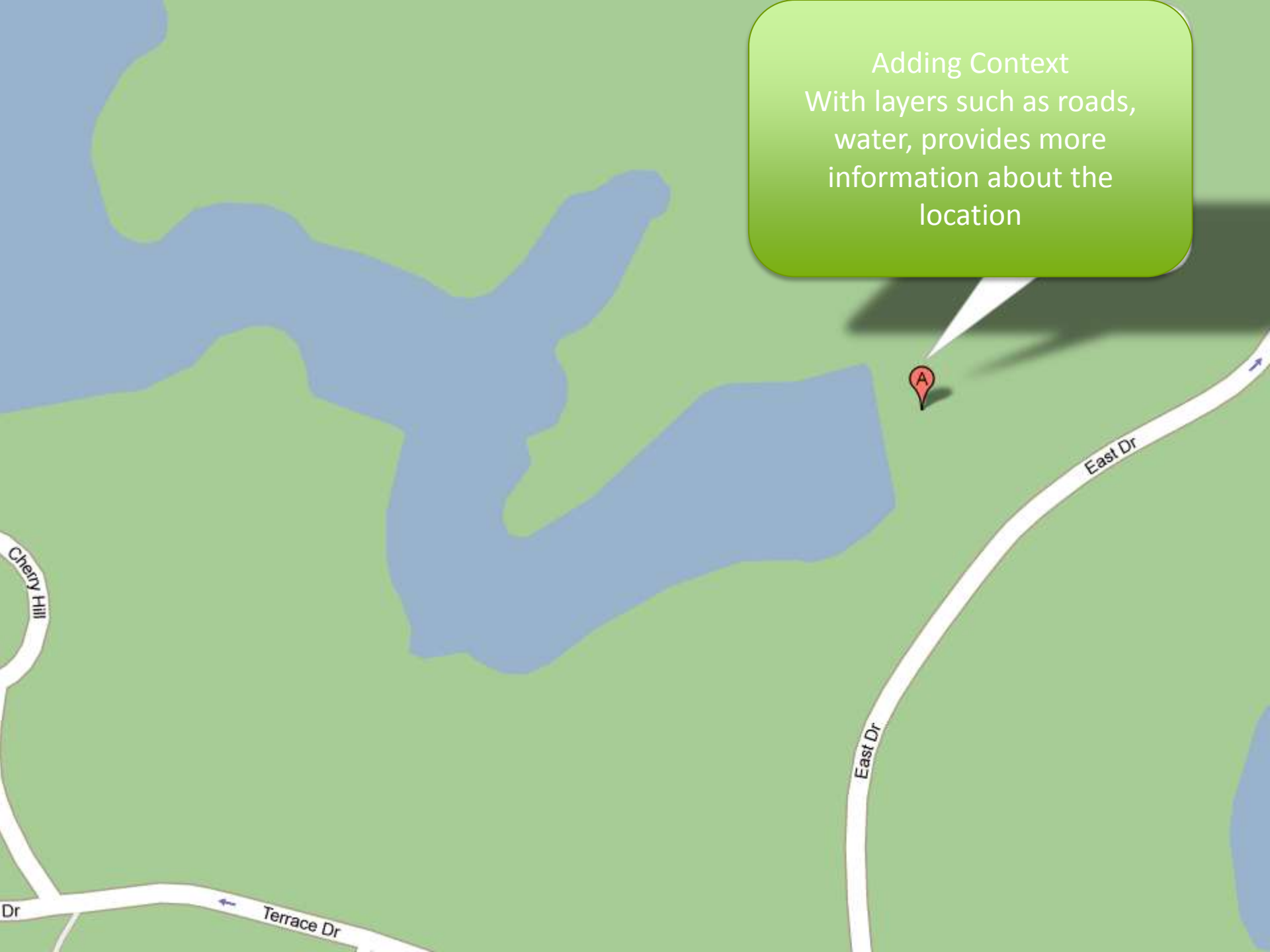
Location, Time, and Context as the Organization Principles

Location such as coordinates,  
place names, etc. can orient  
you to the position on the  
earth



Lat: 40°46'31.93"N  
Lon: 73°58'7.70"W

Adding Context  
With layers such as roads,  
water, provides more  
information about the  
location



Adding Context  
Information such as address  
and ground photos add to  
context

### Central Park Boathouse Cafe



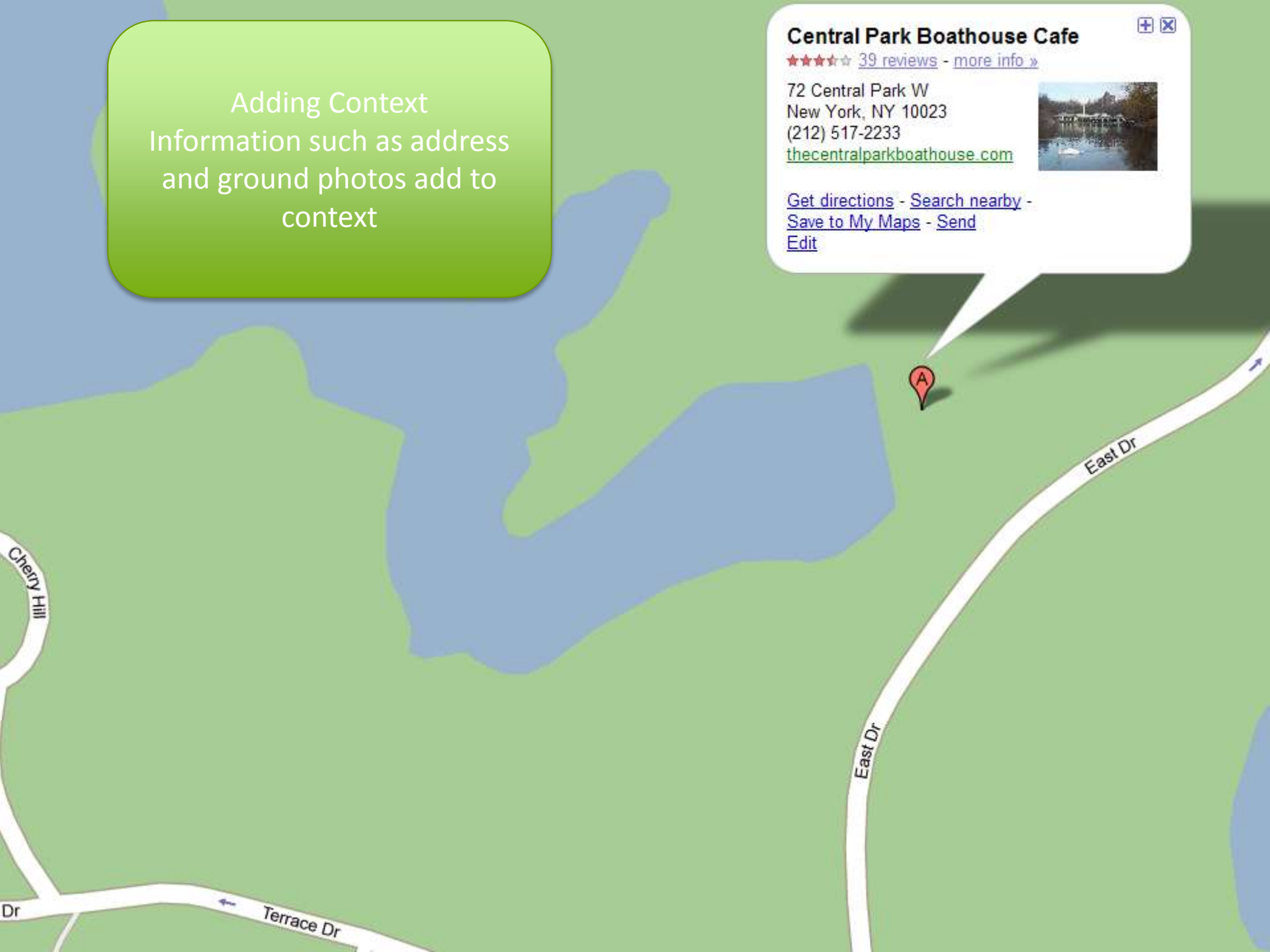
★★★★☆ 39 reviews - [more info »](#)

72 Central Park W  
New York, NY 10023  
(212) 517-2233

[thecentralparkboathouse.com](http://thecentralparkboathouse.com)

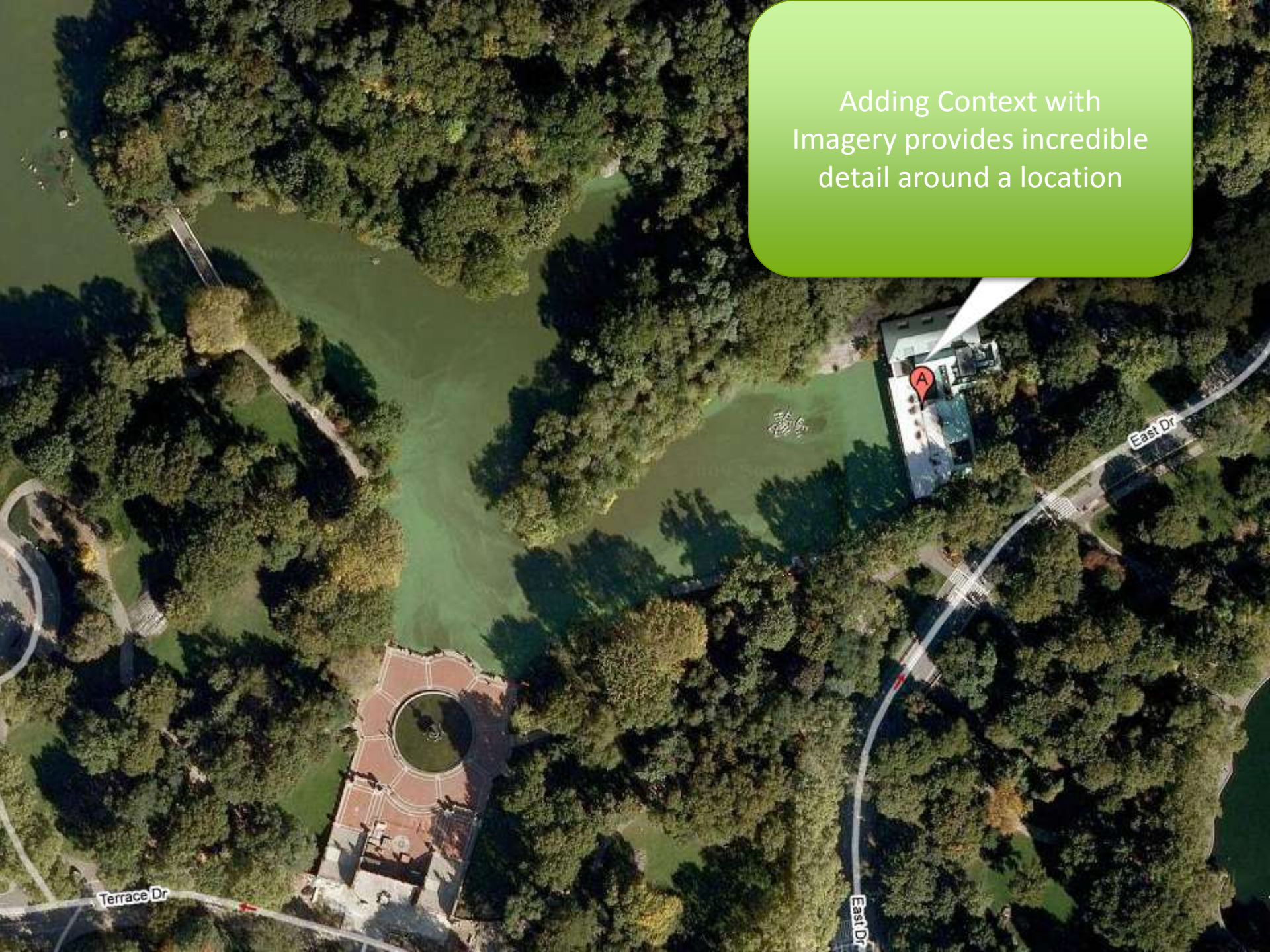


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[Save to My Maps](#) - [Send](#)  
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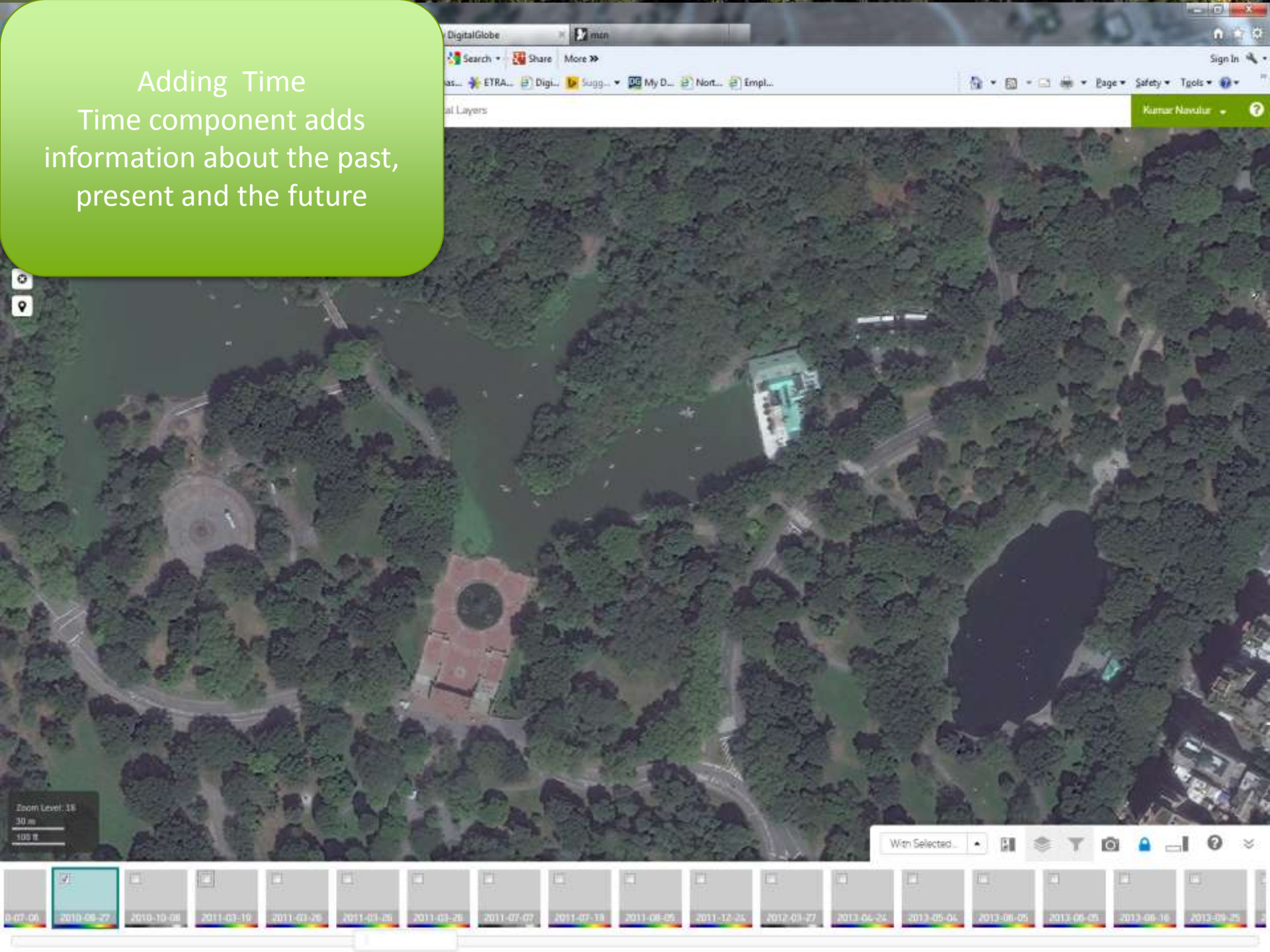


Adding Context with Imagery provides incredible detail around a location

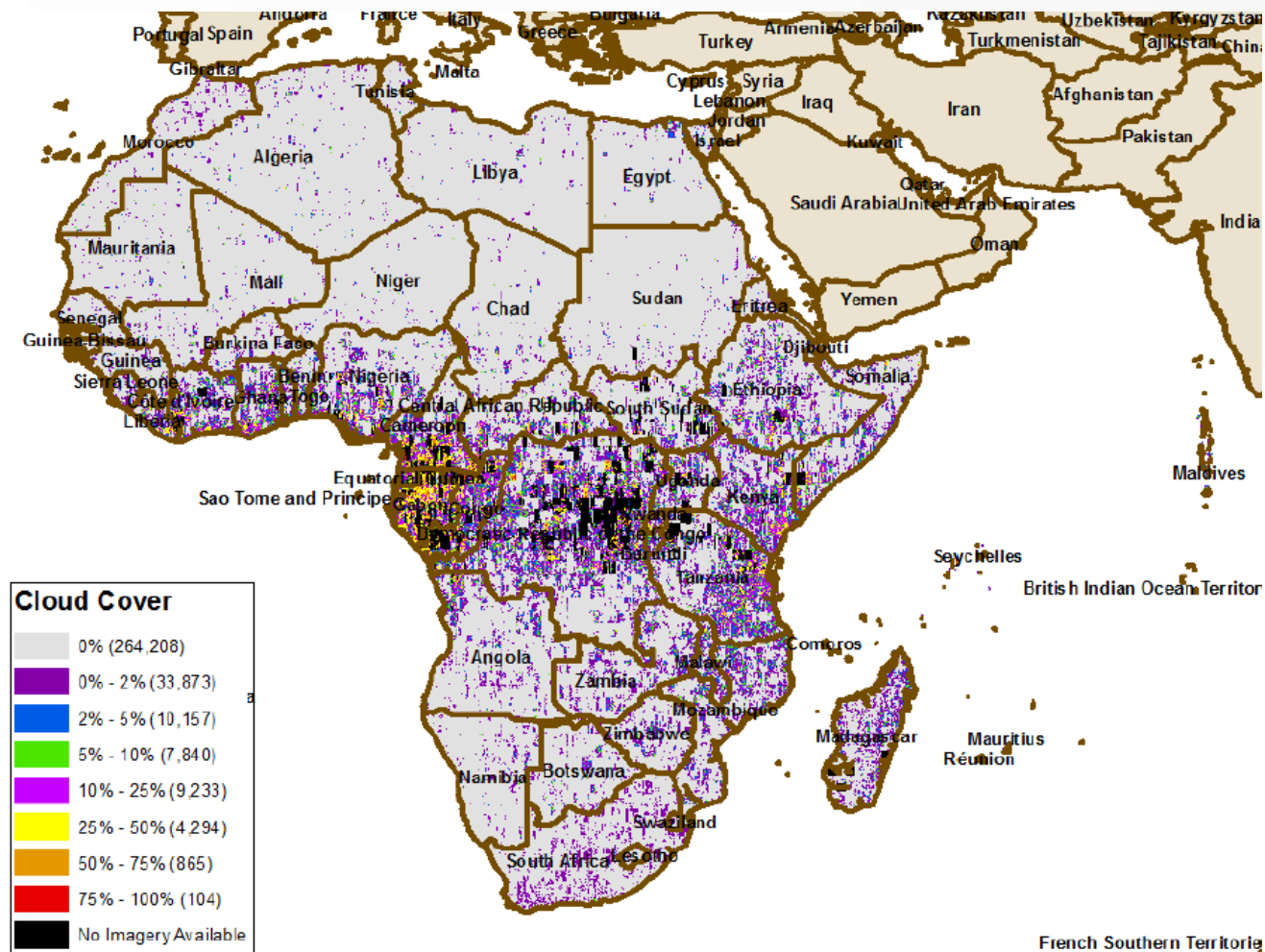


## Adding Time

Time component adds information about the past, present and the future



# Geospatial Information is being collected at unprecedented rate ...



# Starting with nation wide accurate mosaics ...



# UPDATE 3-Fifty new Ebola cases, 25 deaths in West Africa - WHO

Tue Jul 8, 2014 5:37pm EDT

0 COMMENTS |  Tweet 16 |  Share  Share this  8+1  2 |  Email  Print

RELATED TOPICS

[Healthcare »](#)

\* WHO sees "mixed picture" for disease in West Africa

\* American dies in Ghana after travel to Ebola region (Adds Ghana health ministry statement)

By [Stephanie Nebehay](#)

GENEVA, July 8 (Reuters) - Fifty new cases of Ebola and 25 deaths have been reported in Sierra Leone, Liberia and Guinea since July 3, as the deadly virus spreads in families, the World Health Organization (WHO) said on Tuesday.

In a statement, the United Nations agency said that the latest figures from health ministries in the three countries showed a total of 844 cases including 518 deaths in the epidemic that began in February.



<http://www.firstdigitalghana.com/>



Location in Guinea

Coordinates:  10°23'N 12°05'W

Country	 Guinea
Region	Mamou Region
Prefecture	Mamou Prefecture
Population (2008)	
• Total	76,269









# Using Automated extraction Software identify every village and nomadic settlements



# Crowds validated every village/settlement to ensure accuracy

**tmn.d** Nigerian Villages

Choose the best label for the highlighted area.

Building(s) 1

No Building(s) 2

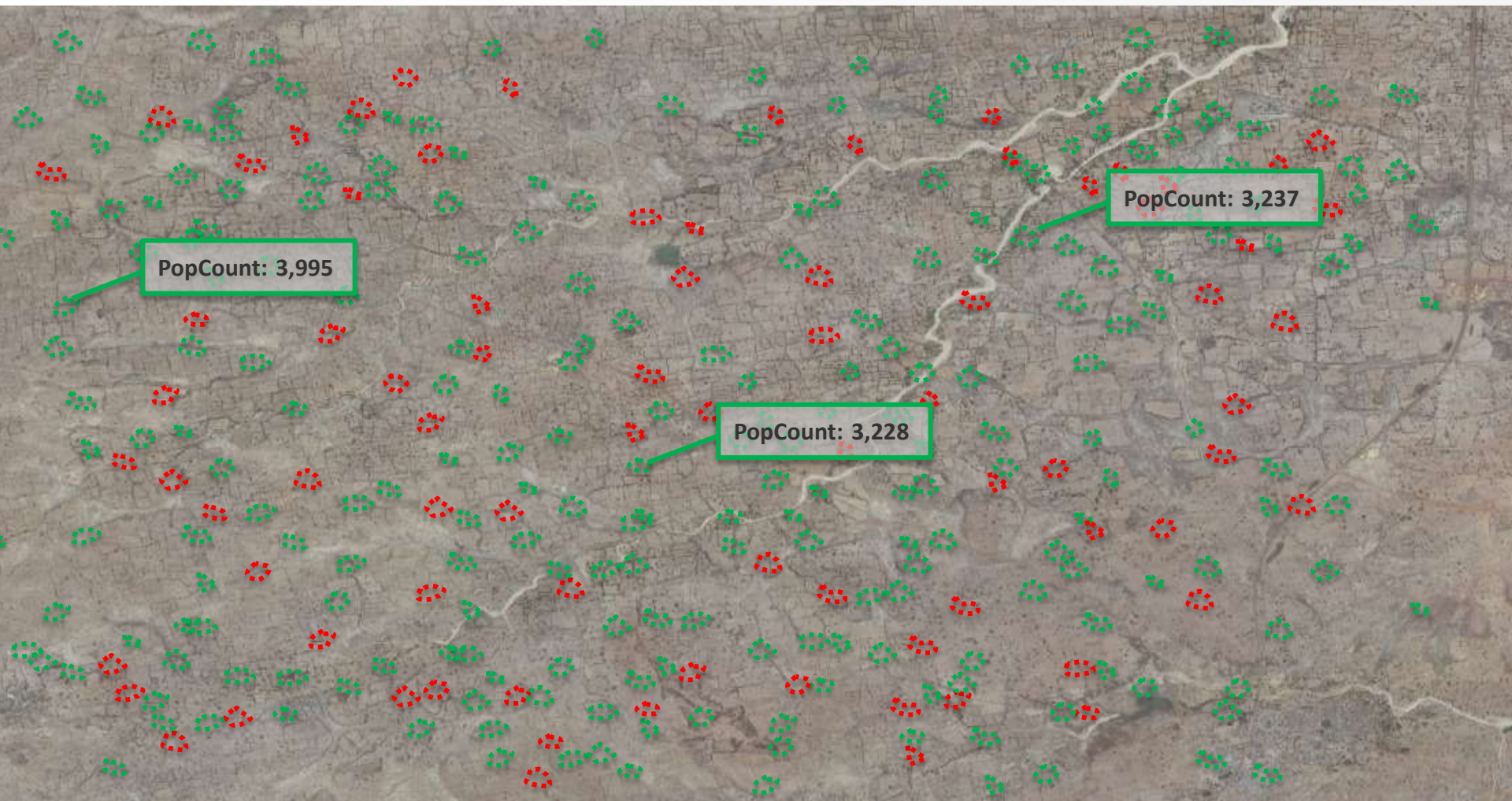
Share this Location



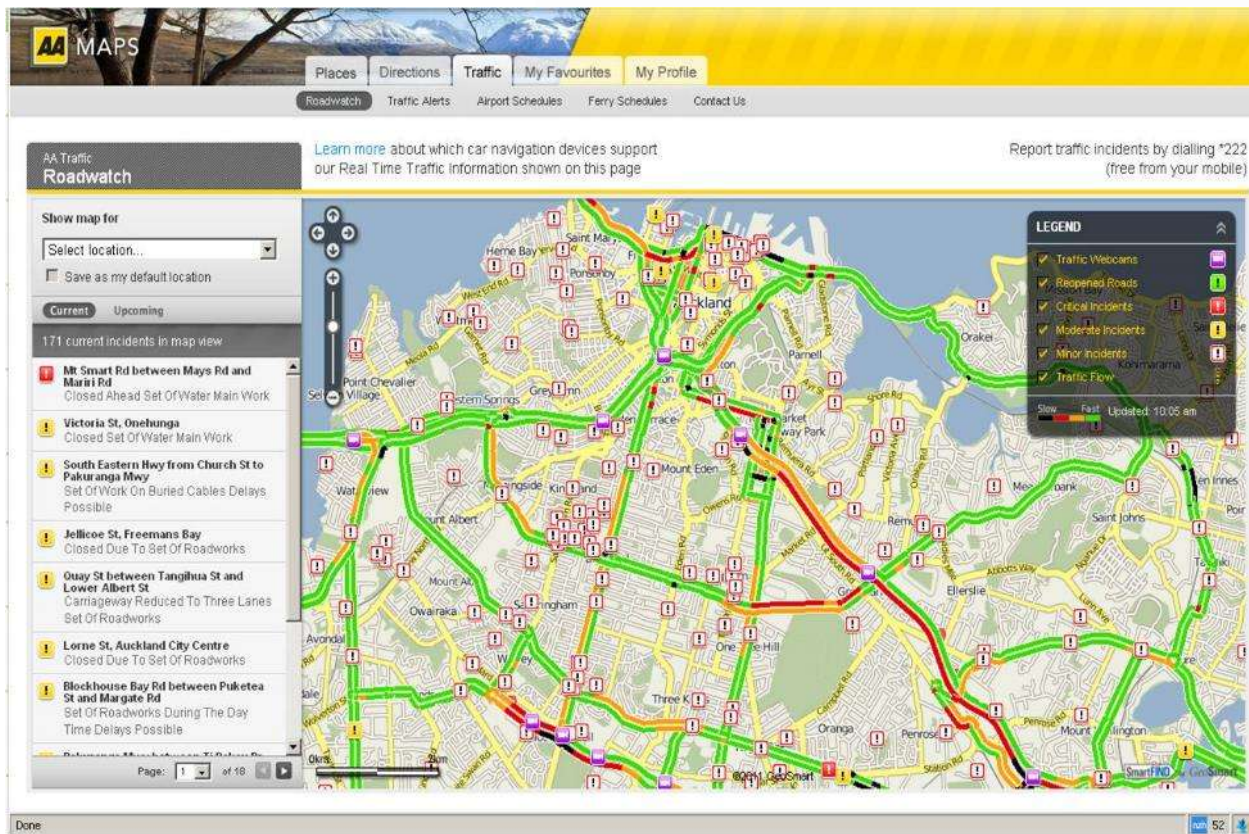
100 ft

powered by DigitalGlobe  
Sat 6/14/2014 10:23 AM UTC

# Estimated population density of various villages to optimize medical supplies and logistics ...



# What is a map in this dynamic information age?



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AA Traffic  
**Roadwatch**

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Report traffic incidents by dialling \*222 (free from your mobile)

Show map for: Select location...  
Save as my default location

Current | Upcoming

171 current incidents in map view

- 1** Mt Smart Rd between Mays Rd and Mariri Rd  
Closed Ahead Set Of Water Main Work
- 1** Victoria St, Onehunga  
Closed Set Of Water Main Work
- 1** South Eastern Hwy from Church St to Pakuranga Mwy  
Set Of Work On Buried Cables Delays Possible
- 1** Jellicoe St, Freemans Bay  
Closed Due To Set Of Roadworks
- 1** Quay St between Tangihua St and Lower Albert St  
Carnage Way Reduced To Three Lanes Set Of Roadworks
- 1** Lorne St, Auckland City Centre  
Closed Due To Set Of Roadworks
- 1** Blockhouse Bay Rd between Puketea St and Blar gate Rd  
Set Of Roadworks During The Day Time Delays Possible

**LEGEND**

- Traffic Webcams
- Reopened Roads
- Critical Incidents
- Moderate Incidents
- Minor Incidents
- Traffic Flow

Slow Fast Updated: 10:05 am

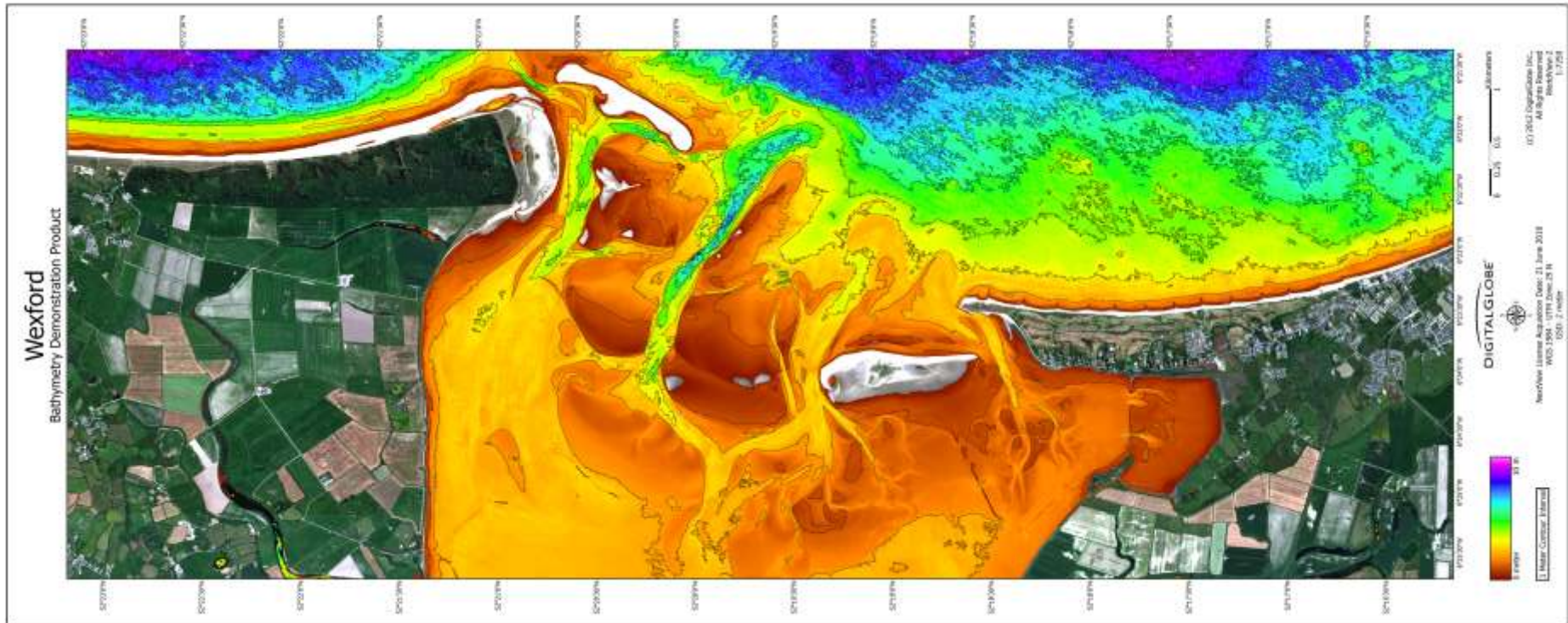
Page: 1 of 18

An aerial, 3D perspective view of the San Francisco Financial District. The buildings are rendered in shades of gray and brown, showing their true heights and shapes. The city grid is visible, and the bay is partially seen at the bottom left. A white text box is overlaid at the top, and a yellow text box is overlaid at the bottom right.

Now we have technologies to represent Globe in  
it's true 3D forum ...

**San Francisco, USA  
Financial District**

# Let us not forget Mapping Water-Land Interface



# How can we create authoritative data?



Accuracy



Completeness



Consistency



Currency

# Our Purpose

## “Seeing a Better World “

By giving our customers the power to see the Earth clearly and in new ways, we enable them to make our world a better place.

Outcomes: Saving Lives, Resources and Time







[www.digitalglobe.com](http://www.digitalglobe.com)