GIS, Location Data, Imagery and Machine Learning

Applications and Opportunities using Geospatial Information in Local Government

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GIS, Location Data, Imagery and Machine Learning:
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ACM Orange County - 21 July 2021

Consolidated list of links from presentation:

• Countywide Addressing: https://cams-lacounty.hub.arcgis.com/
• COVID-19 Public Applications: https://covid19.lacounty.gov/dashboards
• Public WiFi Locator: findwifi.lacounty.gov
• LARIAC: https://lariac-lacounty.hub.arcgis.com/
• Open Data Portal: https://data.lacounty.gov/
• GIS Data Portal and Apps: http://gis.lacounty.gov/
• Homeless Initiative StoryMap: https://storymaps.arcgis.com/stories/400d7b75f18747c4ae1ad22d662781a3
• Delete the Divide: https://www.deletethedivide.org

• Books:
  • GIS Research Methods (2015)
  • Resilient Communities across Geographies (2021)
You’ve heard about me, what about you?

What sector do you work in?

- Private Industry - Software
- Private Industry - Hardware
- Academia
- Government
- Non-Profit
- Other
Presentation Overview

• Los Angeles County Background

• Why and how local government uses spatial information

• Geospatial data and use cases
  • Ground-based data
  • Aerial imagery

• Leveraging and supporting government use of spatial data
  • Sharing data (Open Data Portals)
  • Where we need help (in partnerships, and/or from industry/academia, or on your own)
Los Angeles County Snapshot

• Population of over ~10 million residents.
  • Largest county, by population.
  • If it were a state, would be one of the 10 largest.

• Land area of over 4000 square miles.
  • Over 65% of this area is unincorporated.

• County is responsible for all government services in unincorporated areas.
  • County provides contract services to more than 50 cities.
The county is **big** and complex!

- **37** County Departments; **~200** committees & commissions; over 500 school, sanitation and water districts.
- **~110,000** employees.
- **> 4,000** public buildings.
- **~63,000 acres** of parks, natural areas, and gardens.
- **2021-2022 operating budget > $36 Billion.**
A GIO is different than a CIO

- Serve as an advocate for geospatial methods, applications, and tools.
  - Direct the county-wide geospatial strategy and vision.
  - Guide innovation around geospatial applications and opportunities.
  - Coordinate geospatial needs of county departments.
LA County Enterprise GIS

• Provides for centralized, efficient service provision
  • Common/shared infrastructure, software, workflows, and data
• Many functions have migrated from the field to the desktop (esp. during COVID-19).
• Those that must be field based can be better optimized.
Why does government care about maps?

- Service provision (parks, clinics, schools, grants and funding, etc.)
- Public Participation (e.g., voting, census, community meetings...)
- Tax and fee assessments
- And much more...
The business of government is location-based.

• This includes location-based information from a variety of sources.
  • Databases, imagery, etc.

• Some of these data are collected explicitly with mapping and spatial analysis in mind.

• Many of these data are not, but still include location in some form
  • APN, address, jurisdictional area, service area, facility name, census block, etc...
Addressing (CAMS)

What is the Countywide Address Management System (CAMS)?

Los Angeles County established the Countywide Address Management System (CAMS) as a centralized repository of authoritative physical (plot) addresses. The Internal Services Department (ISD) Enterprise GIS Program (eGIS) manages and maintains the infrastructure behind the successful program. CAMS is critical for effectively providing services used by many departments in Los Angeles County. When used in tandem with other essential County data systems, CAMS helps support the health, safety and welfare of those who live and work in the County of Los Angeles.

CAMS includes three component parts: Data, Applications, and GeoSearch functionality.

CAMS Data

CAMS Applications

CAMS GeoSearch

https://cams-lacounty.hub.arcgis.com/
Bobcat Fire Evacuation/Repopulation Zones
COVID-19 Public Applications

https://covid19.lacounty.gov/dashboards

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Deleting the Digital Divide

Percent of Households with No Internet Access

- >25
- 14.4
- <3.8
15-minute walk time from parks/libraries with public WiFi (green and blue polygons) to communities with low internet connectivity (darker purple = less connected)
Location Analytics

Intersection of 15-minute walk time from parks/libraries with public WiFi (blue polygons) with Metro stations (grey polygons)
And many, many more uses...

BUT...

...where do these data come from?

Geospatial applications and the answers they provide are only as good as the data behind them!
Some data we collect directly

- Data ingested through regular county business processes
  - Taxation and property records
  - Building permits
  - Business licenses
  - (New) parcel/street name assignments
  - County services (Health clinics, Social Services, etc.)
  - Internal planning/infrastructure data
  - Field surveys and mapping (e.g., public works, parks, agriculture)
  - And many more...
UAS mapping

~30 min and 200 of these images give a 3D model.

Woolsey fire damage assessment w/ LA County Fire
UAS for site inspections

- Useful in a variety of code enforcement applications
  - Permit Inspections
  - Illegal dumping
  - Rooftop equipment
  - Industrial properties
  - Encroachments
Local governments have a long history of using aerial imagery.

“LARIAC is multi-jurisdictional purchasing arrangement that enables participating local governments and agencies to benefit from combined economies of scale to efficiently and cost-effectively acquire high-definition aerial data.”

https://lariac-lacounty.hub.arcgis.com/
Established in 2005.
Each cycle is three years.
  • We’re in our 6th cycle (2020-2022)
Members “buy in” each cycle (typically around 40 members)
Resources are leveraged and optimized through collaboration
  • 30-40% saving vs. purchase from vendors
  • Overhead cost savings of 60-80%
  • Shared best practices/technical knowledge
  • Consistent dataset across jurisdictions
  • Derived data products
Products

- Topographic mapping (surface model) and 2ft contours
- Building footprints and change (new, modified, replaced) 3yr cycle
- Land cover (once 😞 )
Imagery is crucial in change assessment

January 2003

January 2011

March 2017

February 2006

March 2014

February 2020
Bobcat Fire Damage Assessment

Devil’s Punchbowl BEFORE fire
Bobcat Fire Damage Assessment

Devil’s Punchbowl AFTER fire
Bobcat Fire Damage

Devil's Punchbowl AFTER fire

Bobcat Fire Post-Disaster Imagery provided by Esri/USGS Imagery

Government use of Maps
Street-level imagery and LiDAR data
Feature Extractions

- Assets (signs, lights, manholes, etc.)
- ADA ramps and clearances
- Paint markings
- Pavement, curbs and sidewalks;
- Street slope and crown
- Bridge clearances
- etc...
Our Future Geospatial Data Efforts
(Machine Learning/Automation)
Emerging use case – how do we know our trees?

- Local governments know about their “public trees” (somewhat).
- Data are infrequently updated and expensive to collect.
- We know little to nothing about the rest (majority) of the trees.
- (In concept) we know trees can be mapped using remote sensing.
- Desired information: species, size, and condition.
Project Goals

• Identify individual urban tree species from remotely sensed imagery and derive canopy metrics over time across three pilot study sites
  • Using these results, determining a plant’s health status becomes a welcomed future application

• Assist stakeholders, who are often burdened with managing urban forest stock manually, to deploy their expertise more efficiently and save time.
Objectives

• Priorities for the pilot project:
  • Individual tree *species* identification
  • Canopy cover metrics
  • Health assessment

• Technology objectives:
  • Use data that is readily available and frequently updated
  • Use open-source software tools
  • Leverage/build on peer-reviewed methods
Data sources

• LARIAC Data:
  • LiDAR, collected on an eight to 10-year cycle, (10.2cm h-res, 27.7 cm v-res)
  • 4-band high resolution (3-4 in\(^2\)) orthophotos (collected ~ annually)
  • Land cover map (tree canopy) 2017
Airborne Visible / Infrared Imaging Spectrometer (AVRIS)

- NASA JPL sensor
  - Currently limited to an airborne sensor system
  - LA County imagery available since 1994
  - 224 contiguous spectral bands
  - Spatial resolution of 20 m²

- Orbital hyperspectral sensors have been tested and future missions are anticipated to provide frequent coverage.
Workflow for Tree ID

1) Hyperspectral Transforms
   • Probabilistic tree crowns in mixed pixels

2) Fused LiDAR point cloud
   • Crown segmentation
   • HSI + LiDAR

3) Faster R-CNN for species ID
   • Explore application of 1 & 2 from pixel / object-level to species level?
Observations on local govt. use of geospatial

• There are MANY opportunities to use ML/AI and other computational methods to fully leverage our investments in our imagery – this is one area where YOU can help.

• Work-from-home has significantly raised the profile of geospatial analysis and applications in local government:
  • Desktop assessments and analysis vs. field work
  • The ability to use analytics to make more effective, data driven decisions (stop our history of ÷ 5)
  • Opportunities to turn around data and decisions faster
  • Removal of human inconsistency and error
  • Plus: maps are great communication tools!
Governments have LOTS of (spatial) data! [Please use it!]

https://data.lacounty.gov/

http://gis.lacounty.gov/
Turning Data into Information
[we do, but you can too!]

https://storymaps.arcgis.com/stories/400d7b75f18747c4ae1ad22d662781a3

https://www.deletethedivide.org

http://gis.lacounty.gov
I’d be remiss not to pitch some books! 😊

S.L. Steinberg and S.J. Steinberg (2015)
*GIS Research Methods*

S.L. Steinberg and S.J. Steinberg, eds (2021)
*Resilient Communities across Geographies*
Thank you for your attention!

County of Los Angeles

Enterprise Geographic Information Systems

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