# Dispatch Radio Mapping

Grant Wilson, J. Hall, Gabriel Perez Prieto

# Agenda

- Problem Statement
- Data Collection and Processing
- Audio Analysis
- Mapping
- Conclusion
- Next Steps

# Problem Statement

- Currently, FEMA identifies areas that require immediate attention (for search and rescue efforts) either by responding to reports and requests put directly by the public or, recently, using social media posts.
- This tool will utilize live police radio reports to identify:
  - Hot spots representing locations of people who need immediate attention
  - Flag neighborhoods or specific streets where the police and first-respondents were called to provide assistance related to the event

# Data Collection and Processing

DOWNLOAD AUDIO

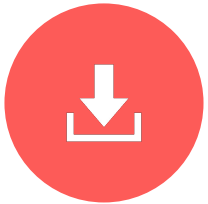
PARSE AUDIO

SPEECH TO TEXT

EXTRACT STREET NAMES

# Download Audio Files

- **BroadCastify - San Francisco City Police Dispatch Feed**
  - ”The world’s largest source of Public Safety, Aircraft, Rail and Marine Radio Live Audio Streams”
  - BART - BroadCastify Archive Tool
    - Selenium Library for Scraping
    - Feed id
    - Dates
  - Save MP3 audio files



# Audio

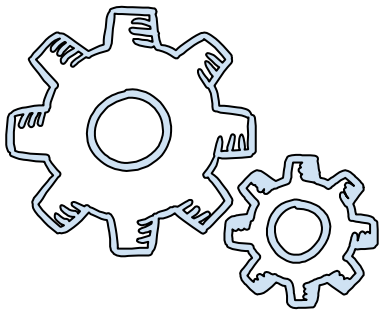
- Converting the audio to text for NLP was a challenge, given the quality of the source audio.
- Police are typically active when radioing dispatch, at varying distance from the microphone, with significant noise from
  - movement,
  - Environment,
  - static,
  - Interference
- Many of the transmissions were difficult for a human to interpret without domain expertise in police coding and terminology.
- Posed a significant challenge for the speech to text

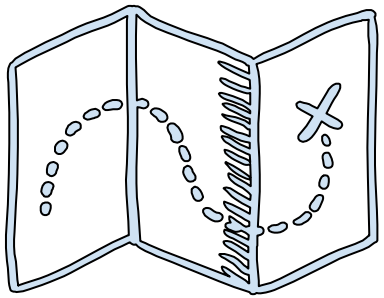
# Audio

- Noise
  - fix audio recorded in noisy environments or with poor equipment to create consistency across your recordings.
- Sibilance
  - This is a characteristic of harsh consonant sounds like "s", "sh", "x", "ch", "t", and "th".
- Tone
  - Police radio transmits audio on a very thin range of sound, sounding tinny
  - Help with equalization to shape the audio from your recorded files to match a listener profile and audio that the text-to-speech model was trained on.

# Audio

- Live Audio
  - Disaster mapping in Real Time
- Input can be microphone or direct line in from a radio





# Parse and Segment Saved Audio Files

- Break Audio into Chunks
  - Pydub Library
  - Detect Audio - Average File Loudness
  - Break if Silence > 4s
  - Convert to WAV
    - 6 s < File > 60 s

# Speech To Text

- Google Speech to Text API
  - Transcribe Audio Chunks
  - All streets of San Francisco as a Parameter
    - Give context to Google's API to search for

- Average Confidence on Transcripts
  - 79%

# Extract Street Names

- Spacy Library
  - Get Street Names from Transcript
  - All streets of San Francisco as a Parameter
    - Give context to search for
- USAdress Library
  - Get Address Numbers
- Google Maps Geocoding API
  - Join Address Number and Street Name
  - Get Latitude and Longitude

# Example 1

- ‘David once again for the night **1910** we 1404 15th Street treat everyone sits out of can I just want to play for yeah but go back to the temporary place and the Seven Roberts Roberts zebra **211** should come back to black Infinity first like I was like a regular California place it's a paper plate but I have several Robert Roberts it was fabulous party Wright place we try it was he that does go back to a **2004** is that the entity that correct yeah okay’

- Transcript Confidence = 0.8180
- Model Results:
  - 1404 California Ave, 1404 15th Ave, 1404 Treat Ave, 1404 Black Pl

# Example 2

- ‘case manager Michelle is **97** 121 Leland a client is experiencing events induced psychosis getting increasingly activated and aggressive and as much customers are impossibly self-induced you doing it for back to the your doesn't get out of here with that license plates some of that about which car are you referring to the **1030** at **1141** of our courts I copy’

- Transcript Confidence = 0.8699
- Model Results:
  - 1141 Lealand Ave

# Example 3

- ‘this verse **29** that teacher Elementary is cold report of a **311** occurred last Friday on the Hudson Street side they have pictures not online with these are the secretary okay I'll **98** had a **71** for the **600**’

- Transcript Confidence = 0.8534
- Model Results:
  - 98 Hudson Ct

# Mapping

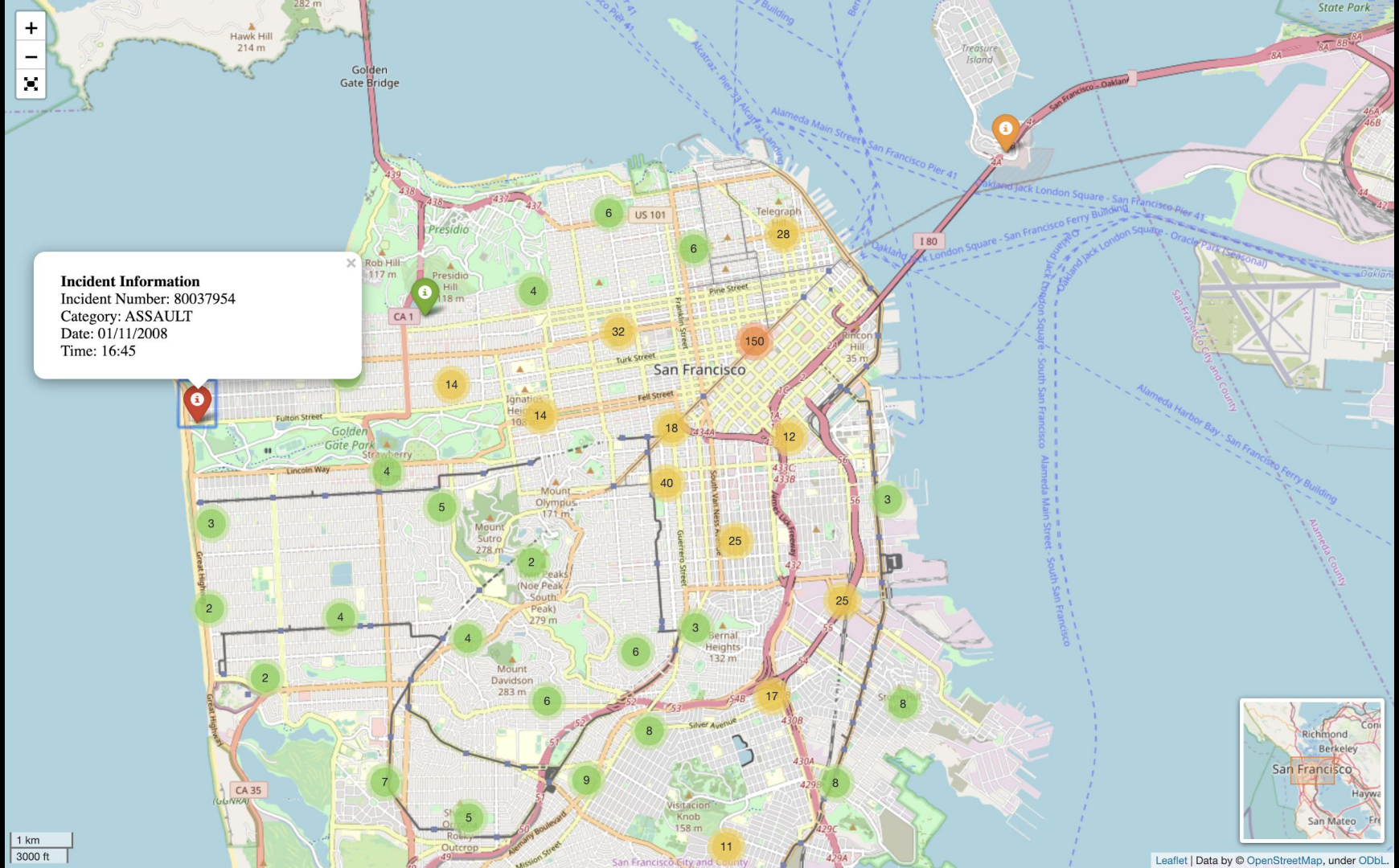
- Folium vs. Google Maps API
  - More creativity in mapping
  - Better represented the data as it relates to key interests of disaster response agencies
    - Surrounding businesses, parks, and bus stops
- Historic San Francisco Crime Data
  - Similar to disaster reporting
    - Time/Date/Location
    - Type of dispatch
      - EMS
      - Police
      - Fire

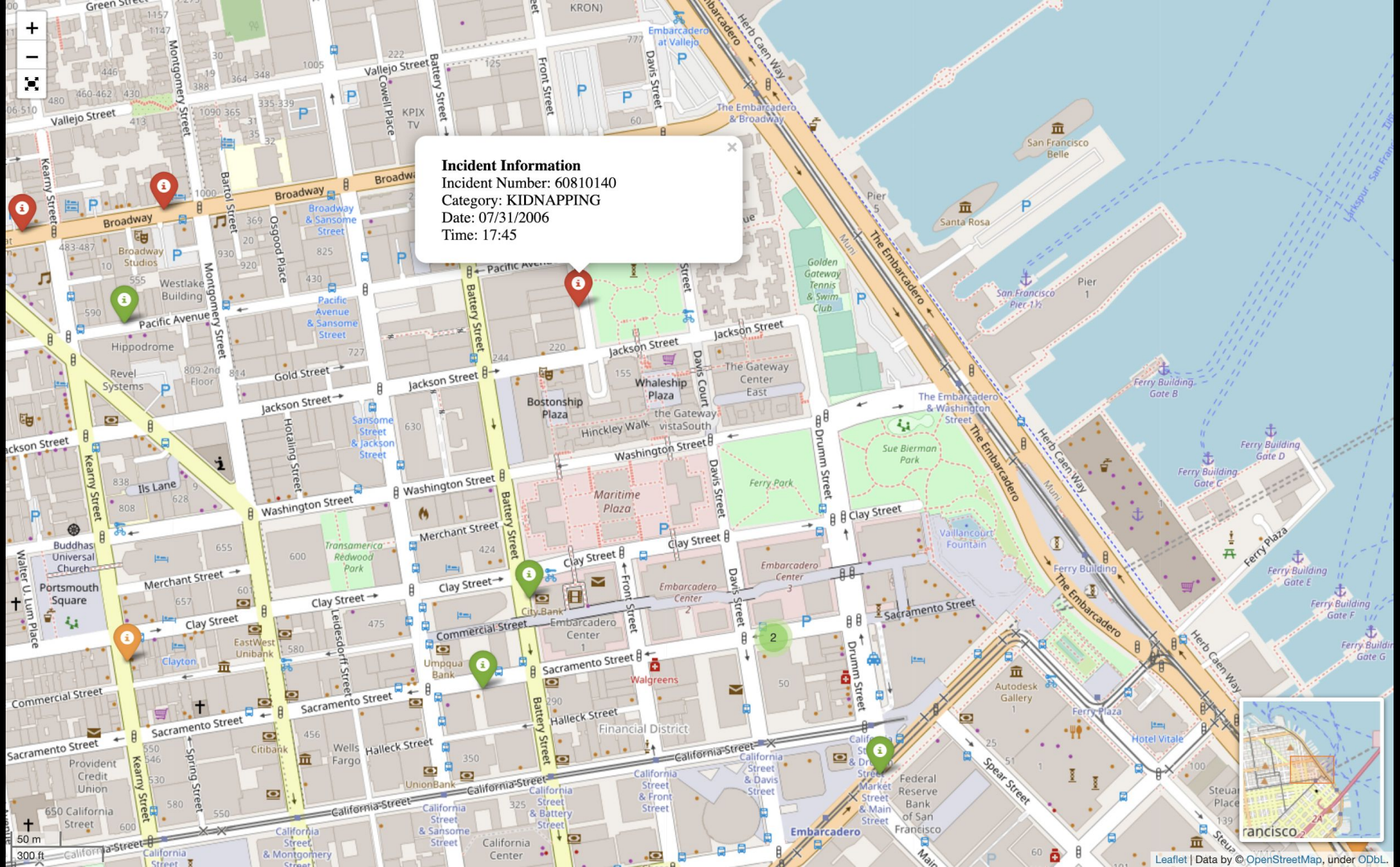
# Mapping

- Two maps
  - Individual Detail
    - Point Mapping
  - Neighborhood-area reporting
    - Frequency Mapping

# Point Mapping

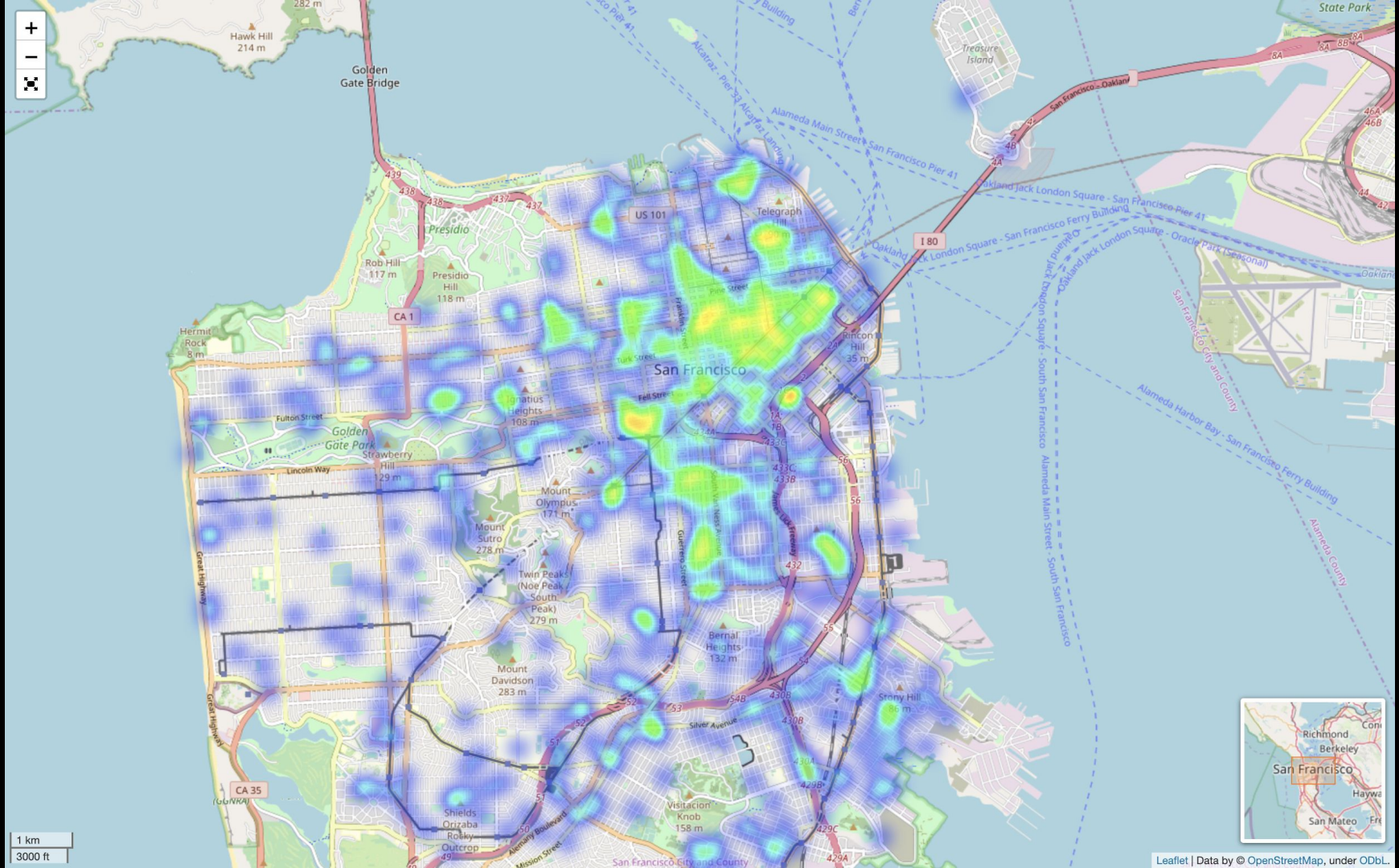
- Drops “pins” for each reported incident
  - Incident Number
  - Incident Time/Date
  - Response Category
    - Police
    - Fire
    - EMS
  - Incident Category
    - Assault
    - Downed Power Line
    - Fire

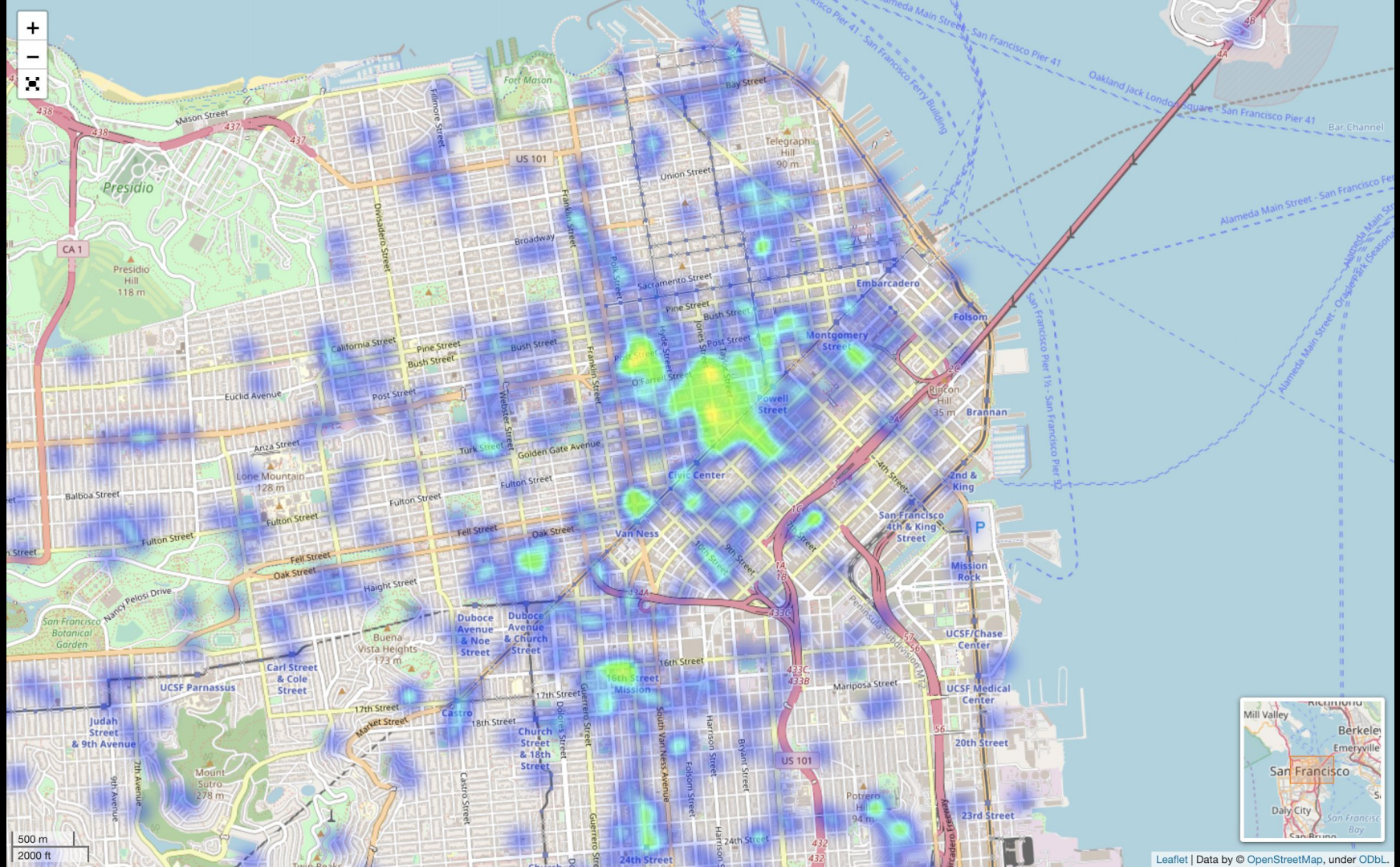

Incident Information
Incident Number: 80037954
Category: ASSAULT
Date: 01/11/2008
Time: 16:45
San Francisco
Golden Gate Bridge
Golden Gate Park
Presidio
Telegraph Hill
Rincon Hill
Mount Olympus
Mount Sutro
Mount Davidson
Bernal Heights
Visitacion Knob
Treasure Island
Alameda Harbor Bay - San Francisco Ferry Building
Alameda Main Street - San Francisco Pier 41
Oakland Jack London Square - San Francisco Ferry Building
Oakland Jack London Square - Oracle Park (Seasonal)
San Francisco - Oakland
US 101
I 80
CA 1
CA 35
Fulton Street
Lincoln Way
Fell Street
Turk Street
Pine Street
Silver Avenue
Alemany Boulevard
Mission Street
Great Highway
Richmond
Berkeley
San Mateo
1 km
3000 ft
Leaflet | Data by © OpenStreetMap, under ODbL.


Incident Information
Incident Number: 60810140
Category: KIDNAPPING
Date: 07/31/2006
Time: 17:45
Broadway
Vallejo Street
Pacific Avenue
Jackson Street
Washington Street
Clay Street
Sacramento Street
California Street
Commercial Street
Merchant Street
Gold Street
Broadway & Sansome Street
Pacific Avenue & Sansome Street
Sansome Street & Jackson Street
Battery Street
Montgomery Street
Kearny Street
Front Street
Davis Street
Drumm Street
Embarcadero
The Embarcadero
Herb Caen Way
Bostonship Plaza
Whaleship Plaza
Hinckley Walk
The Gateway vistaSouth
The Gateway Center East
Maritime Plaza
Ferry Park
Sue Bierman Park
Vaillancourt Fountain
Ferry Plaza
Ferry Building
Ferry Building Gate B
Ferry Building Gate C
Ferry Building Gate D
Ferry Building Gate E
Ferry Building Gate F
Ferry Building Gate G
Embarcadero Center 1
Embarcadero Center 2
Embarcadero Center 3
Financial District
Federal Reserve Bank of San Francisco
Transamerica Redwood Park
Portsmouth Square
Buddhist Universal Church
Walter U. Lum Place
Ils Lane
Hotaling Street
Leidesdorff Street
Spring Street
Halleck Street
Spear Street
Steuart Street
Main Street
Market Street & Main Street
Golden Gateway Tennis & Swim Club
Pier 1
Pier 5
San Francisco Belle
Santa Rosa
San Francisco Pier 1½
Hotel Vitale
Autodesk Gallery
Walgreens
Citibank
Wells Fargo
UnionBank
Umpqua Bank
City Bank
Clayton
EastWest Unibank
Provident Credit Union
650 California Street
Broadway Studios
Westlake Building
Hippodrome
Revel Systems
KPIX TV
KRON)
Embarcadero at Vallejo
The Embarcadero & Broadway
The Embarcadero & Washington Street
50 m
300 ft
Leaflet | Data by © OpenStreetMap, under ODbL.

# Frequency Mapping

- Neighborhood-wide incidents
- Quick read on areas requiring assistance
- Balances with detail-oriented Point Mapping
  - Demonstrates call-concentration
  - Neighborhoods needing disaster-assistance


Hawk Hill
214 m
Golden
Gate Bridge
Presidio
Rob Hill
117 m
Presidio
Hill
118 m
Hermit
Rock
8 m
CA 1
US 101
Telegraph
Hill
I 80
Rincon
Hill
35 m
San Francisco
Ignatius
Heights
108 m
Fulton Street
Golden
Gate Park
Strawberry
Hill
129 m
Lincoln Way
Mount
Olympus
171 m
Mount
Sutro
278 m
Twin Peaks
(Noe Peak
South
Peak)
279 m
Great Highway
Bernal
Heights
132 m
Mount
Davidson
283 m
Silver Avenue
Stony Hill
86 m
CA 35
Shields
Orizaba
Rocky
Outcrop
Visitacion
Knob
158 m
Alemany Boulevard
Mission Street
San Francisco City and County
Treasure
Island
State Park
San Francisco – Oakland
Alameda Main Street - San Francisco Pier 41
Oakland Jack London Square - San Francisco Pier 41
Oakland Jack London Square - San Francisco Ferry Building
Oakland Jack London Square - Oracle Park (Seasonal)
Jack London Square - South San Francisco
Alameda Main Street - South San Francisco
San Francisco City and County
Alameda Harbor Bay - San Francisco Ferry Building
Alameda County
Richmond
Berkeley
San Francisco
San Mateo
1 km
3000 ft
Leaflet | Data by © OpenStreetMap, under ODbL.


Presidio
Fort Mason
Telegraph Hill 90 m
Presidio Hill 118 m
Lone Mountain 128 m
Buena Vista Heights 173 m
Mount Sutro 278 m
Rincon Hill 35 m
Potrero Hill 94 m
Civic Center
Van Ness
Powell Street
Montgomery Street
Embarcadero
Folsom
Brannan
2nd & King
San Francisco 4th & King Street
Mission Rock
UCSF/Chase Center
UCSF Medical Center
UCSF Parnassus
Carl Street & Cole Street
Judah Street & 9th Avenue
Duboce Avenue & Noe Street
Duboce Avenue & Church Street
Church Street & 18th Street
16th Street Mission
Castro
US 101
CA 1
Mason Street
Bay Street
Union Street
Broadway
Sacramento Street
Pine Street
Bush Street
California Street
Post Street
Geary Street
O'Farrell Street
Market Street
Mariposa Street
20th Street
23rd Street
24th Street
Oakland Jack London Square - San Francisco Pier 41
Alameda Main Street - San Francisco Pier 41
Bar Channel
Mill Valley
Berkeley
Emeryville
San Francisco
Daly City
500 m
2000 ft
Leaflet | Data by © OpenStreetMap, under ODbL.

# Conclusion

- Improvements
  - Audio Analysis
  - Live Audio
  - Point Mapping
  - Frequency Mapping
- Utility
  - Identify key neighborhoods
  - Facilitate native integrating with dispatch radio
  - Cleaner address analysis
  - Isolate Critical Infrastructure weaknesses
    - Neighborhood analysis of incidents

# Next Steps

- Clean audio before processing
  - Dolby
- Improve NLP
  - Sentiment/Urgency Analysis
- Address Extraction
- New avenues for speech to text
- Include damage assessment