Near-Roadway Risk Screening
Tools for Urban Planners

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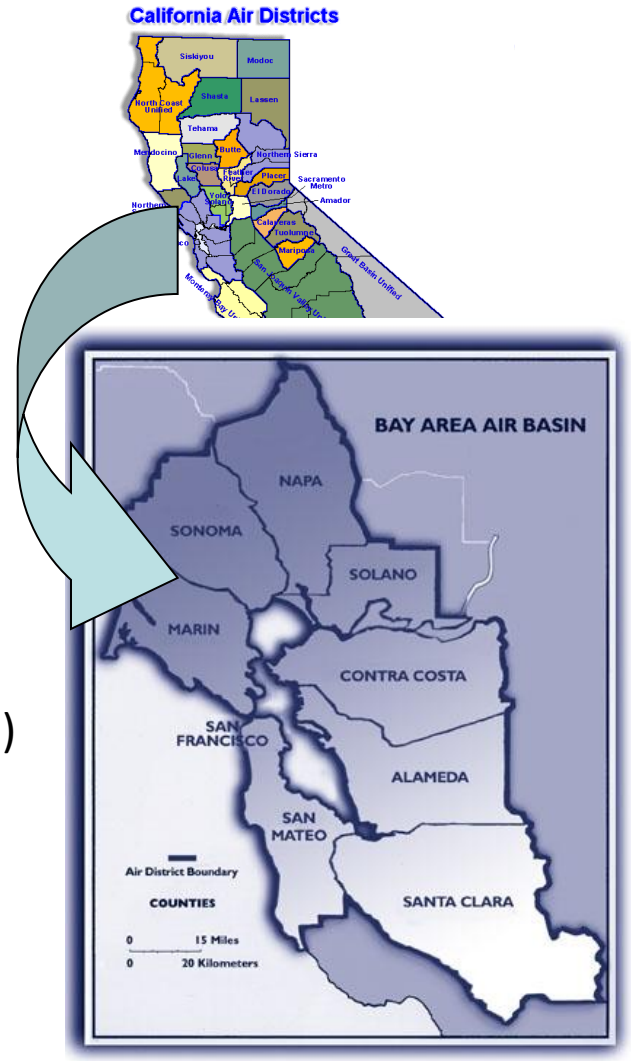
BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Regional Air Pollution Control Agency

- Jurisdiction over air quality in San Francisco Bay Area
- 9 counties, 101 cities, population > 7 million
- 170+ million vehicle-miles per day
- 22 member Board of Directors

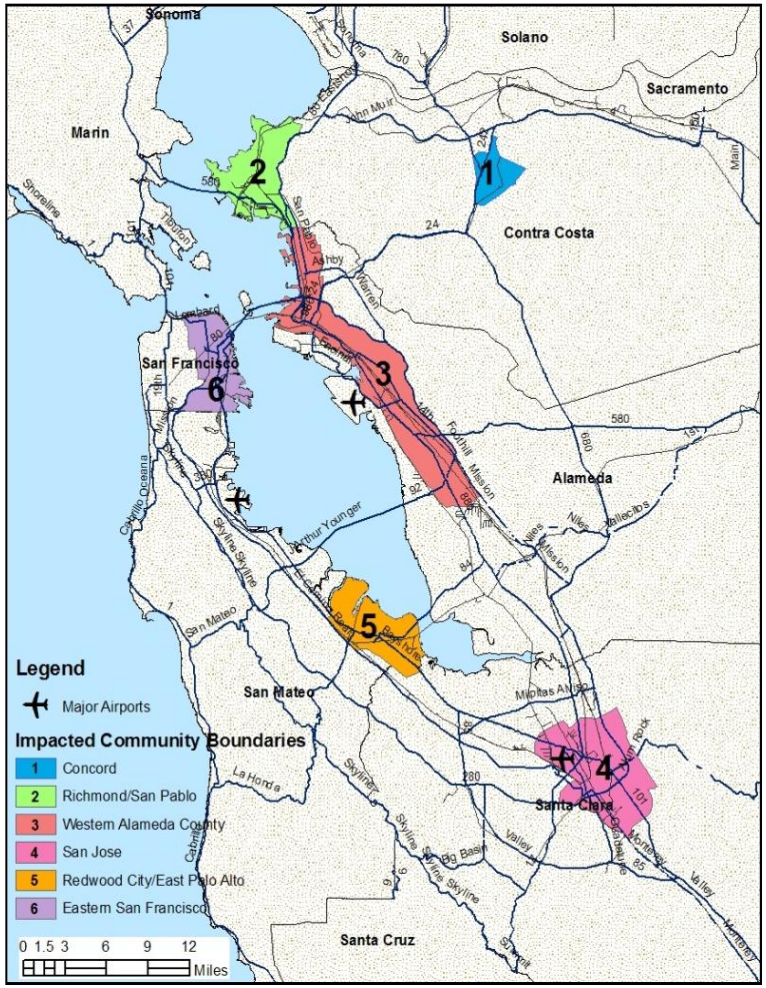
Responsibilities

- Stationary source regulations & permits
- Compliance assistance/enforcement
- Air quality monitoring
- Plans for attaining/maintaining air quality standards
- Incentive programs (reduce emissions from motor vehicles)
- Coordinate with regional agencies, cities and counties on transportation and land use programs to reduce motor vehicle emissions



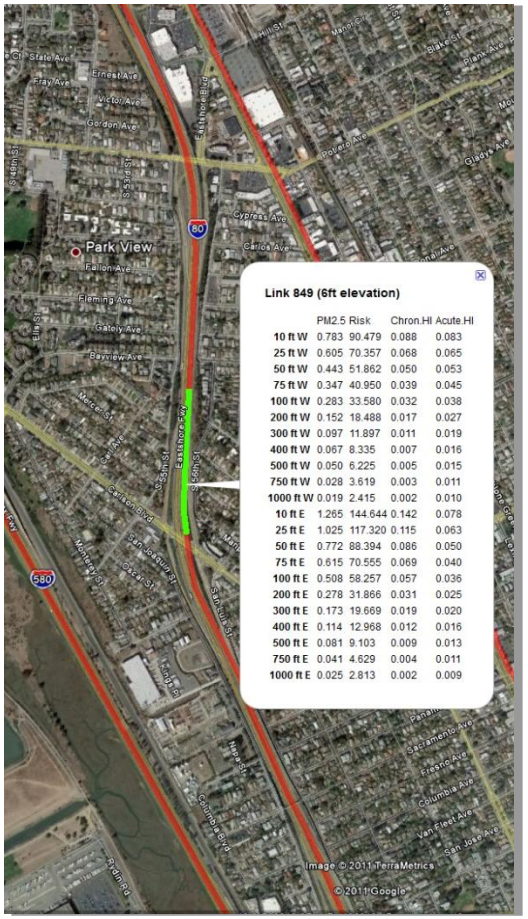
Community Air Risk Evaluation (CARE)

- CARE program identifies 6 priority communities in Bay Area (2009)
  - Exposure of vulnerable populations (youth, seniors, low income) to air toxics
  - High emissions of air toxics
  - Roadways as primary boundaries
- Focus comprehensive emission reduction strategies through Clean Air Communities Initiative
- Seek to reduce impacts from land use and transportation decisions
- Promote infill, while protecting residents
- Impacted communities currently being updated to include PM, other factors



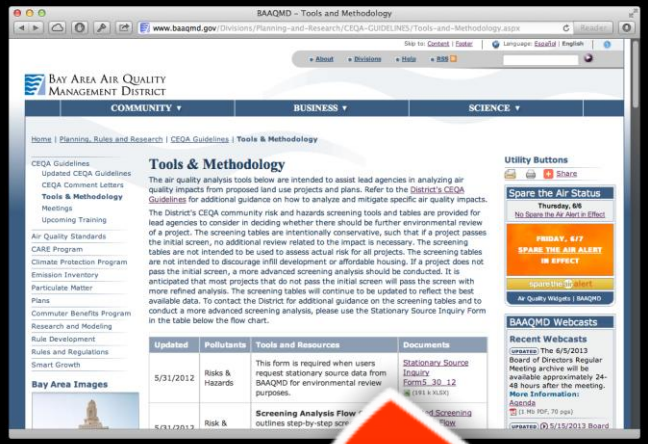
Technical Assistance for Planners

- **Guidance for environmental review processes**
  - Estimating and mitigation AQ impacts
- **State Highways Screening Tables**
  - PM and risk values for all links along every state highway, at varying distances from roadway
  - Local traffic volumes and meteorology
  - Google Earth application
- **Surface Street Screening Tables**
  - County specific meteorology and truck percentages
- **Stationary Source Screening Tables**
  - PM and risk values for permitted stationary sources
- **Planning Guidance**
  - How to address healthy infill in local plans & programs
  - Recommend best practices - air filtration, setbacks, site design, project phasing, etc.



Highway Screening Analysis Tool

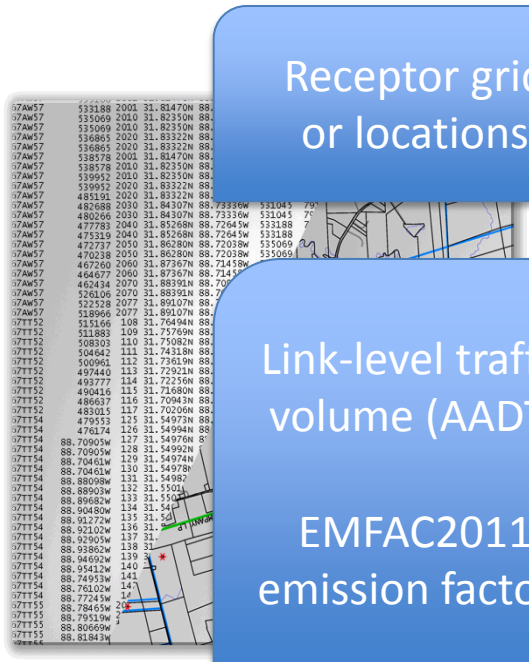
http://tinyurl.com/**BAAQMD-HSAT**



Link 467 (6ft elevation)

	PM2.5	Risk	Chron.HI	Acute.HI
10 ft W	3.516	337.327	0.276	0.077
25 ft W	2.900	281.593	0.230	0.065
50 ft W	2.295	225.574	0.183	0.053
75 ft W	1.926	190.858	0.155	0.045
100 ft W	1.667	166.336	0.135	0.040
200 ft W	1.106	112.528	0.091	0.026
300 ft W	0.836	86.277	0.069	0.020
400 ft W	0.668	69.727	0.056	0.017
500 ft W	0.557	58.709	0.047	0.014
750 ft W	0.396	42.663	0.034	0.010
1000 ft W	0.304	33.187	0.026	0.008
10 ft E	3.798	338.487	0.282	0.075
25 ft E	3.136	280.647	0.233	0.064
50 ft E	2.439	219.260	0.182	0.053
75 ft E	2.006	180.748	0.150	0.045
100 ft E	1.708	154.190	0.128	0.039
200 ft E	1.072	97.462	0.080	0.024
300 ft E	0.773	70.605	0.058	0.018
400 ft E	0.594	54.513	0.045	0.015
500 ft E	0.476	43.863	0.036	0.014
750 ft E	0.307	28.487	0.023	0.011
1000 ft E	0.216	20.138	0.016	0.008

HSAT: Under the Hood



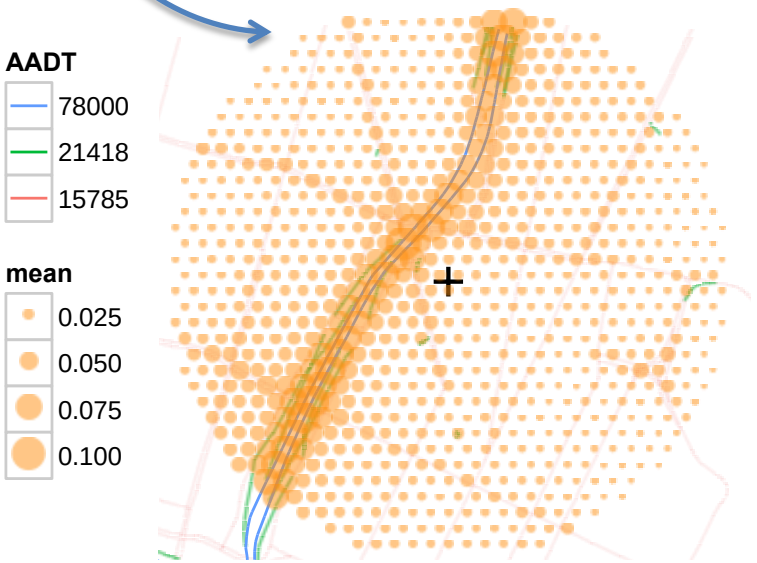
Receptor grid or locations

Link-level traffic volume (AADT)

EMFAC2011 emission factors

ISC-format meteorology

```
> library(Rcaline)
> ... # do stuff
> PM25 <- predict(my_model)
> plot(PM25)
> write.kml(PM25)
```

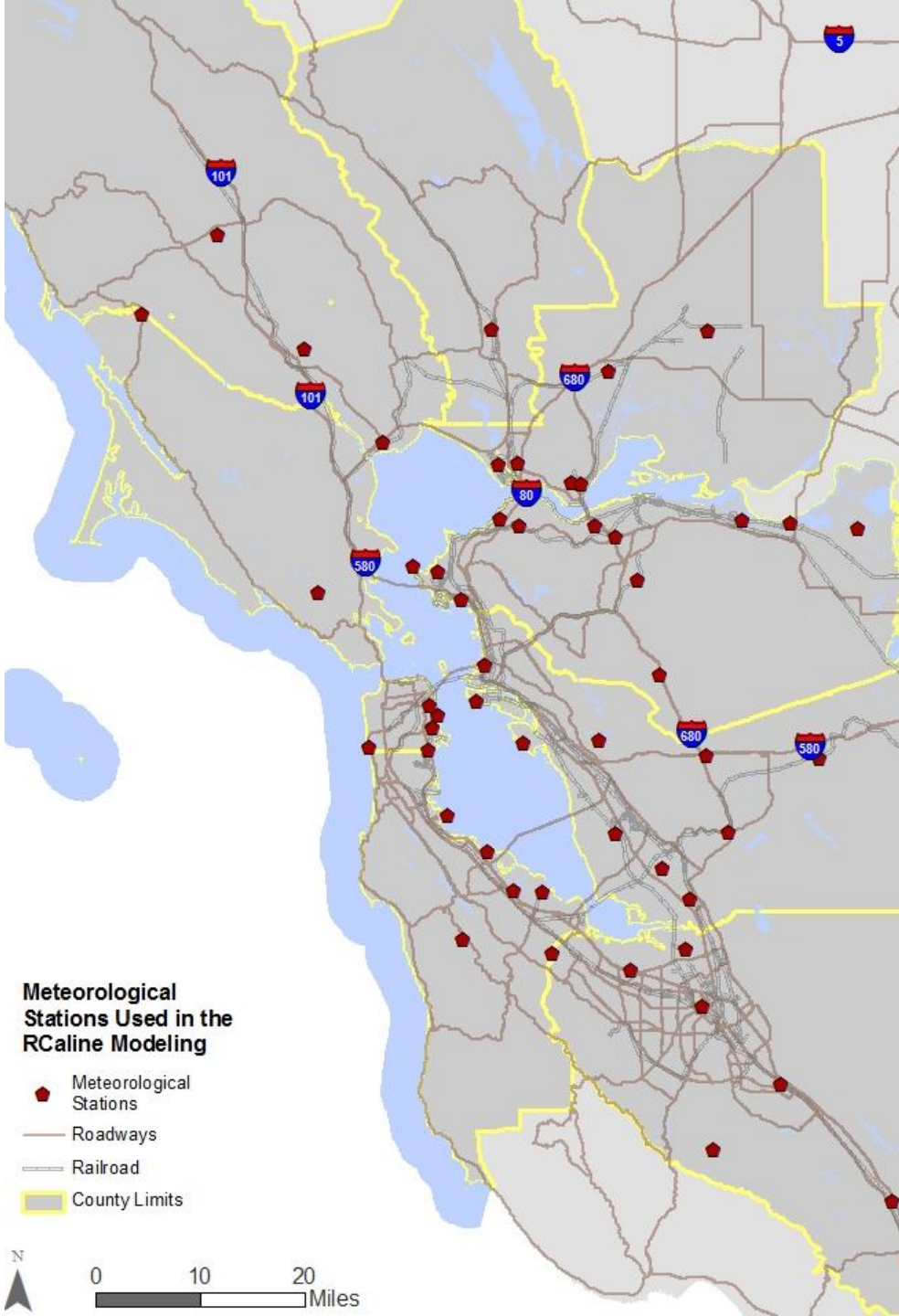


CALINE3 + R = Rcaline

HSAT Inputs

Meteorology

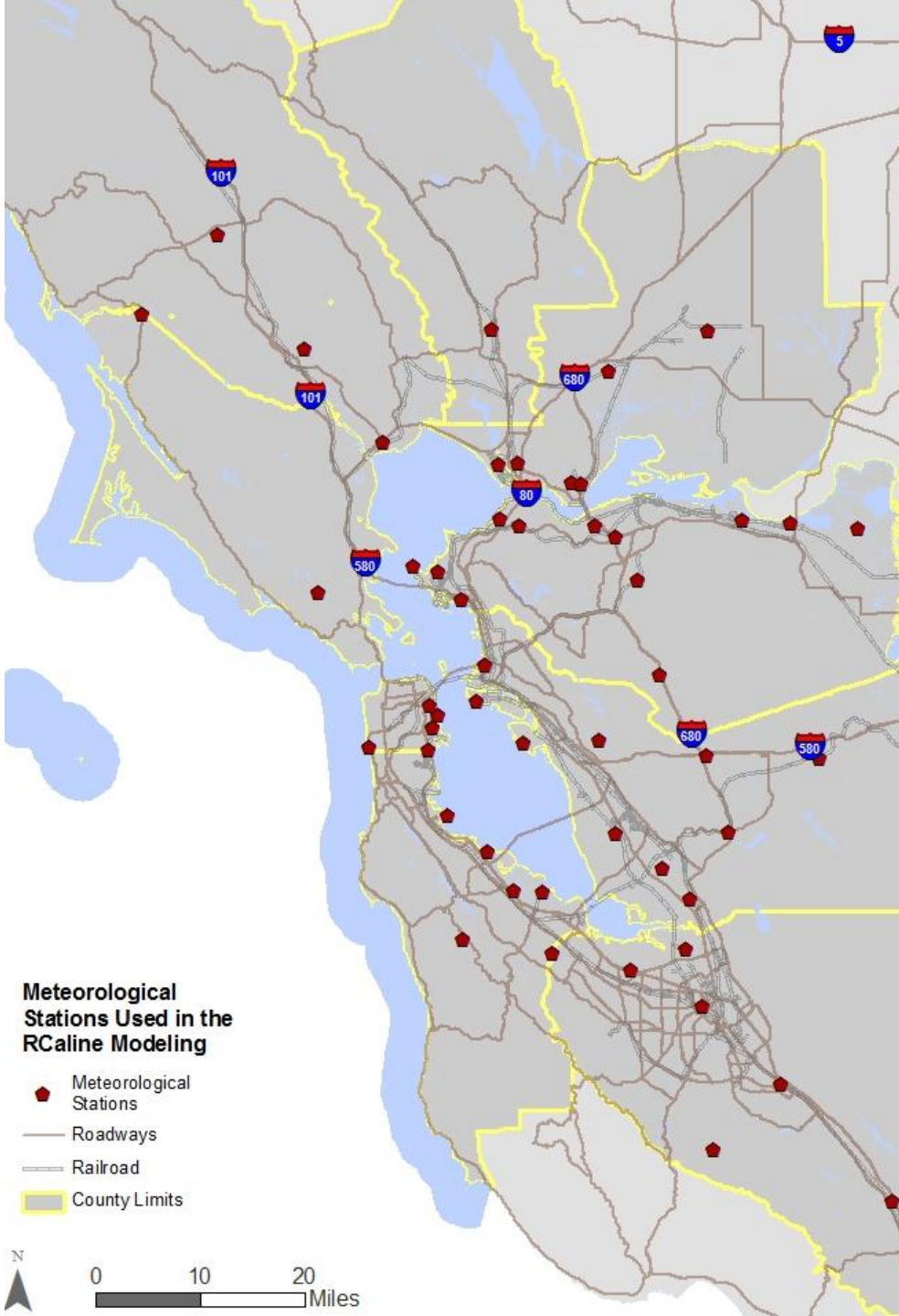
- BAAQMD-operated network of stations
- Used in support of many air quality programs
- Matched to highway links based on local knowledge
- Most recent year available was used



HSAT Inputs

Road Network & Traffic

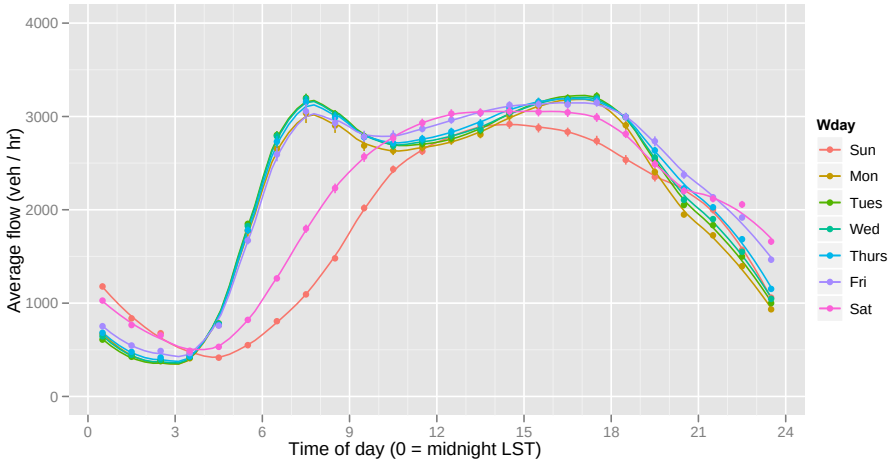
- Geometry: FHWA NHPM + 2008 TIGER
- AADTs: Caltrans (2009), joined via milepost ID
- Avg speed = weighted sum of AM/midday/PM speeds from MTC BAYCAST-90 model



HSAT Inputs

Emission Factors

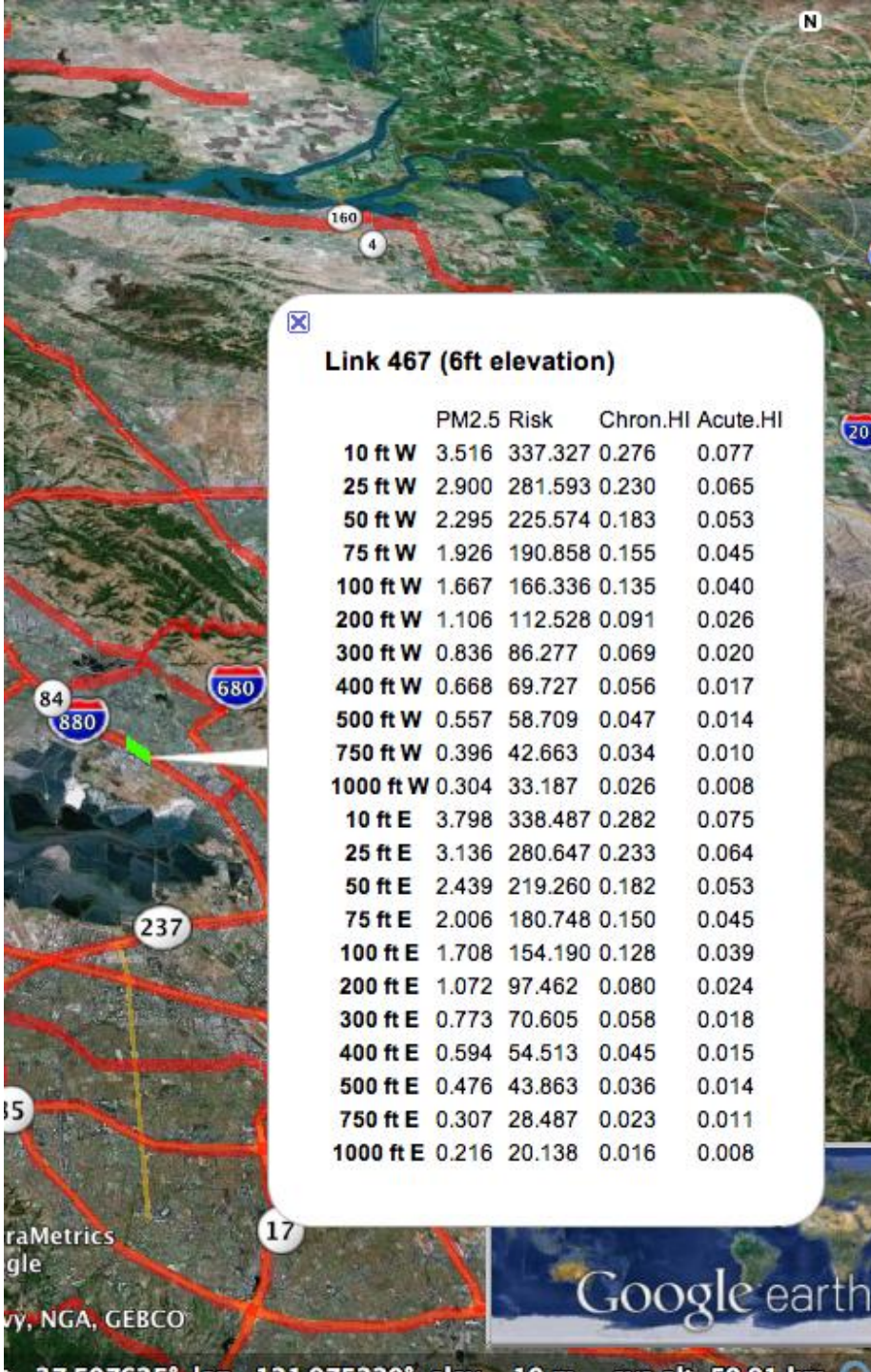
- EMFAC (CARB 2011)
- Truck/non-truck
- Scaled by diurnal profile
- Joined to ~1200 links
- Total organic gases (TOG)
- $PM_{2.5}$ (exhaust + brake/tire)
- PM_{10} (exhaust + brake/tire)
- Diesel fractions



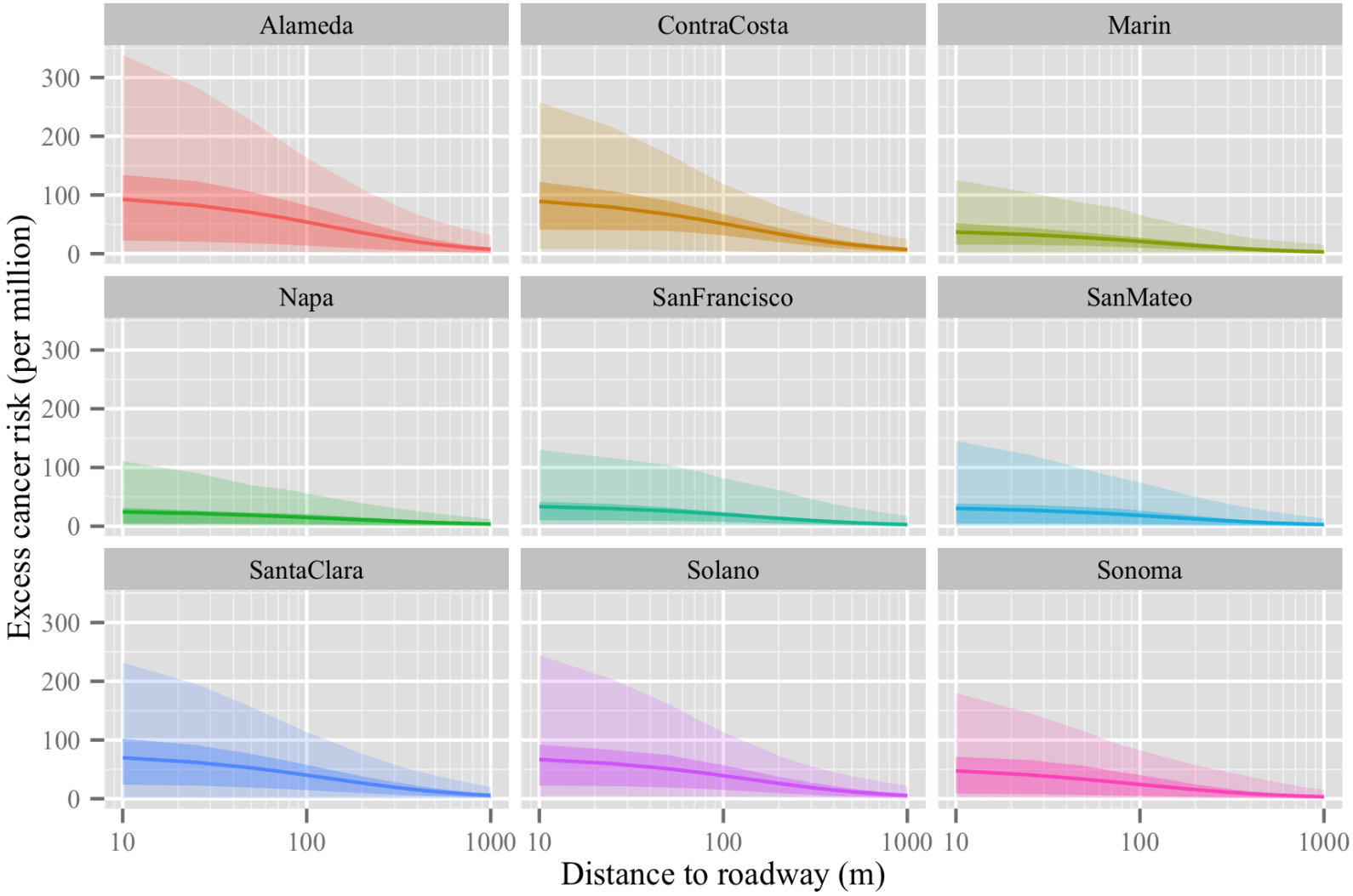
HSAT Model

Approach (pseudocode)

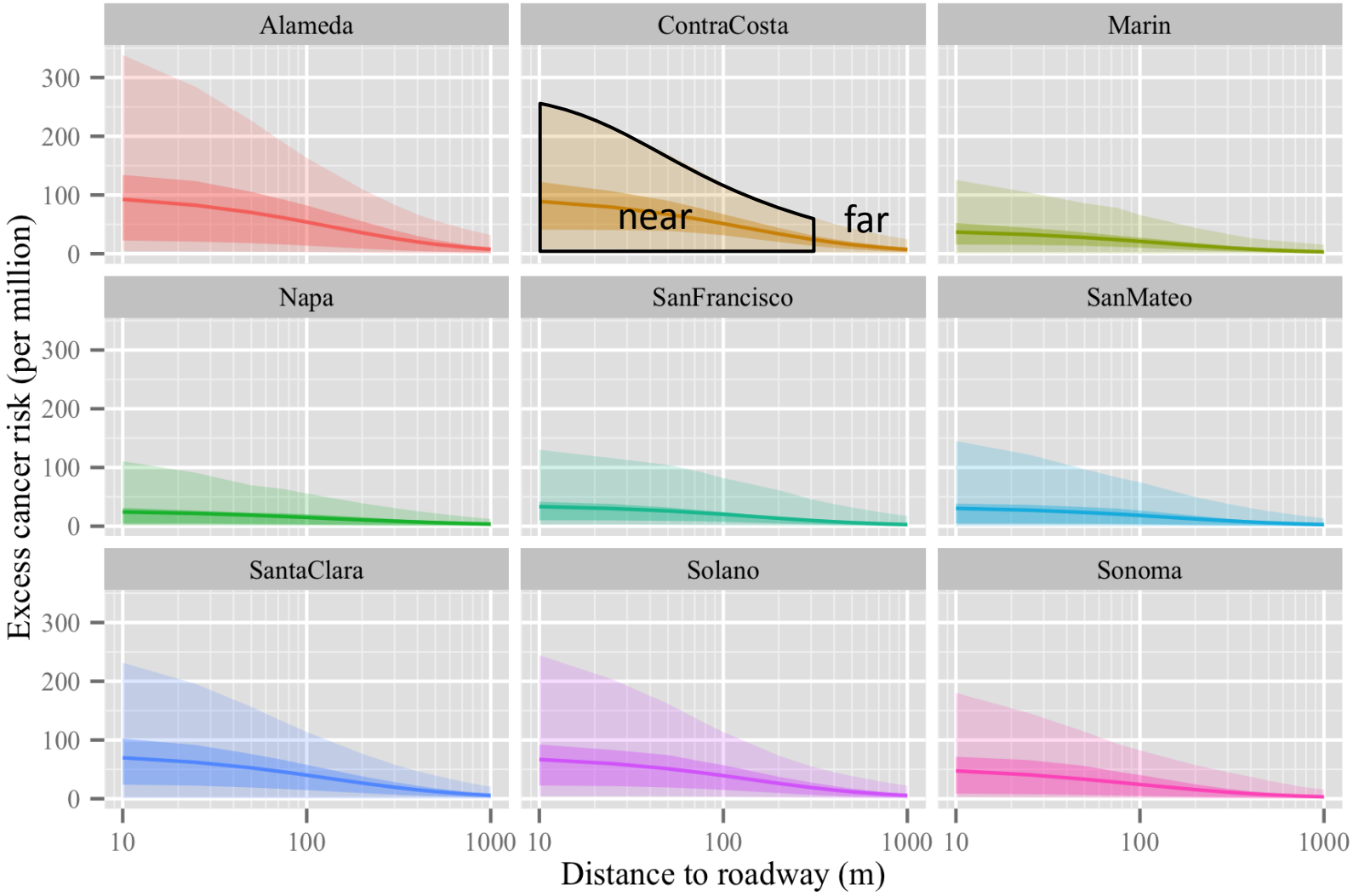
```
# For each transect location
distances = [10, 25, 50, …, 750, 1000]
for each L in highway_links:
    for each R in transect(L, distances):

        # Model annual "unit emissions" result
        for each M in nearest(meteorology, R):
            X_RLM = Rcaline(M, R, AADT_L, EF_L = 1.0)
        X_RL = apply(mean, C_RLM, M)

        # Scale by emission factors
        for each P, Y in pollutants, years:
            C_RPY = X_R x EF_L x EF_PY

        # Summarize 70-year risk profile
        Cancer_R = f(DPM_RY1, …)
```



Extended Analyses



Extended Analyses

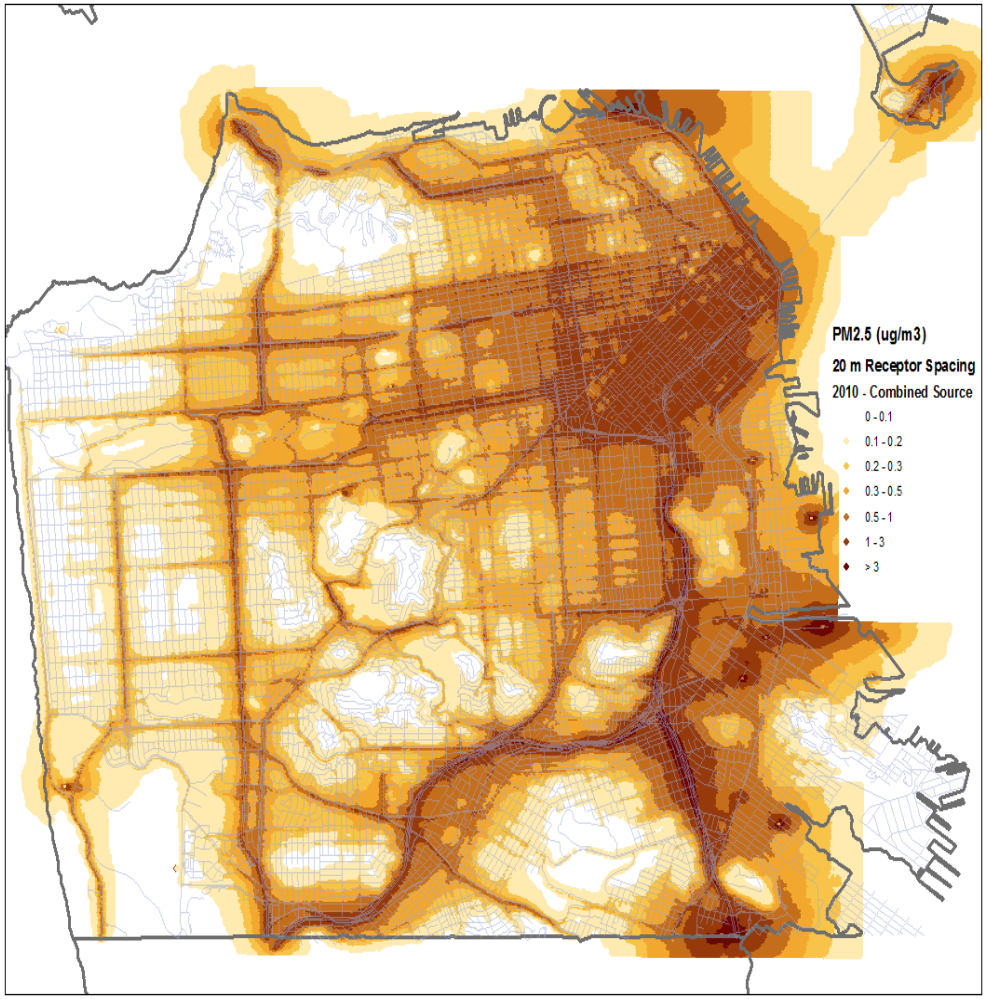


Extended Analyses

	$PM_{2.5}$, mean (sd), µg/m^3		Cancer risk, mean (sd), x10^{-6}	
County	**Near**	**Far**	**Near**	**Far**
Contra Costa	0.61 (0.36)	0.15 (0.12)	45.5 (24.7)	11.7 (8.6)
Alameda	0.57 (0.42)	0.14 (0.13)	47.8 (39.6)	12.3 (12.6)
Santa Clara	0.55 (0.35)	0.14 (0.11)	35.7 (26.2)	9.3 (8.2)
San Francisco	0.39 (0.29)	0.09 (0.10)	17.9 (19.8)	4.7 (7.6)
Solano	0.38 (0.28)	0.09 (0.08)	34.8 (25.7)	9.0 (7.9)
Marin	0.35 (0.28)	0.09 (0.10)	18.7 (14.1)	4.9 (5.0)
San Mateo	0.34 (0.33)	0.09 (0.11)	16.3 (18.4)	4.5 (5.9)
Sonoma	0.29 (0.25)	0.07 (0.07)	21.8 (21.5)	5.3 (6.2)
Napa	0.18 (0.17)	0.07 (0.06)	13.6 (15.7)	5.1 (5.9)
(All)	0.48 (0.37)	0.12 (0.11)	34.1 (30.6)	8.8 (9.5)

Near := 10–300m Far := 300–1000m

Local Plans to Address Health Risks: SF Community Risk Reduction Plan



- Address local AQ exposures and health effects in long-range community plans
- Model AQ conditions in expected growth areas, adjust development plans and mitigations as needed
- Pilot programs in San Francisco and San Jose
- District modeled 2014 and 2025 emissions and exposure, including:
  - Freeways, surface streets
  - Permitted stationary sources
  - Ships and trains
- Pollution highest near freeways, ship terminals, certain stationary sources
- Identifies strategies to reduce exposure
  - E.g., expand SF's ordinance requiring air filters in housing near freeways

Acknowledgments

- Bay Area AQMD
- UC Berkeley School of Public Health
- Sonoma Technology, Inc.

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