Identifying Impacted Communities: Draft Revised Mapping Method Progress Update

Phil Martien, Ph.D.
Bay Area Air Quality Management District
CARE Task Force Meeting
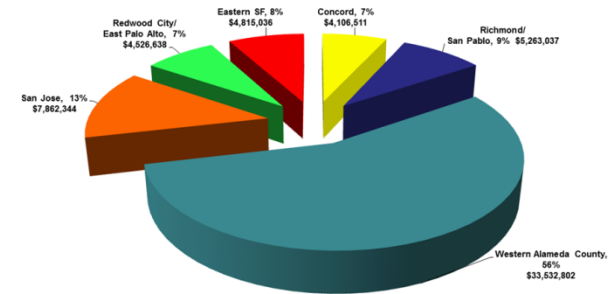**February 27, 2013**

Overview

- Background and Review

  - CARE program overview and next steps
  - June, October meetings comments/questions

- Draft Updated Mapping Method

- Preliminary Maps and Discussion

- Questions

- Next Steps

CARE Program: What have we learned?

Funding Allocated to Impacted Communities in FYE 12 - $60 million

- CARE program underway in 2005

- Developed regional maps of toxic air contaminants (TAC)

- Identified areas with high TAC exposures and vulnerable communities to help prioritize Air District activities (Impacted areas mapping)

  – Diesel particulate matter (diesel PM) affects public health

  – Non-diesel PM also very important

- Health impacts often confined to near-source (West Oakland Monitoring Study, S.F. Comm. Risk Red. Plan)

  – Neighborhoods within impacted areas may be suitable for residential development

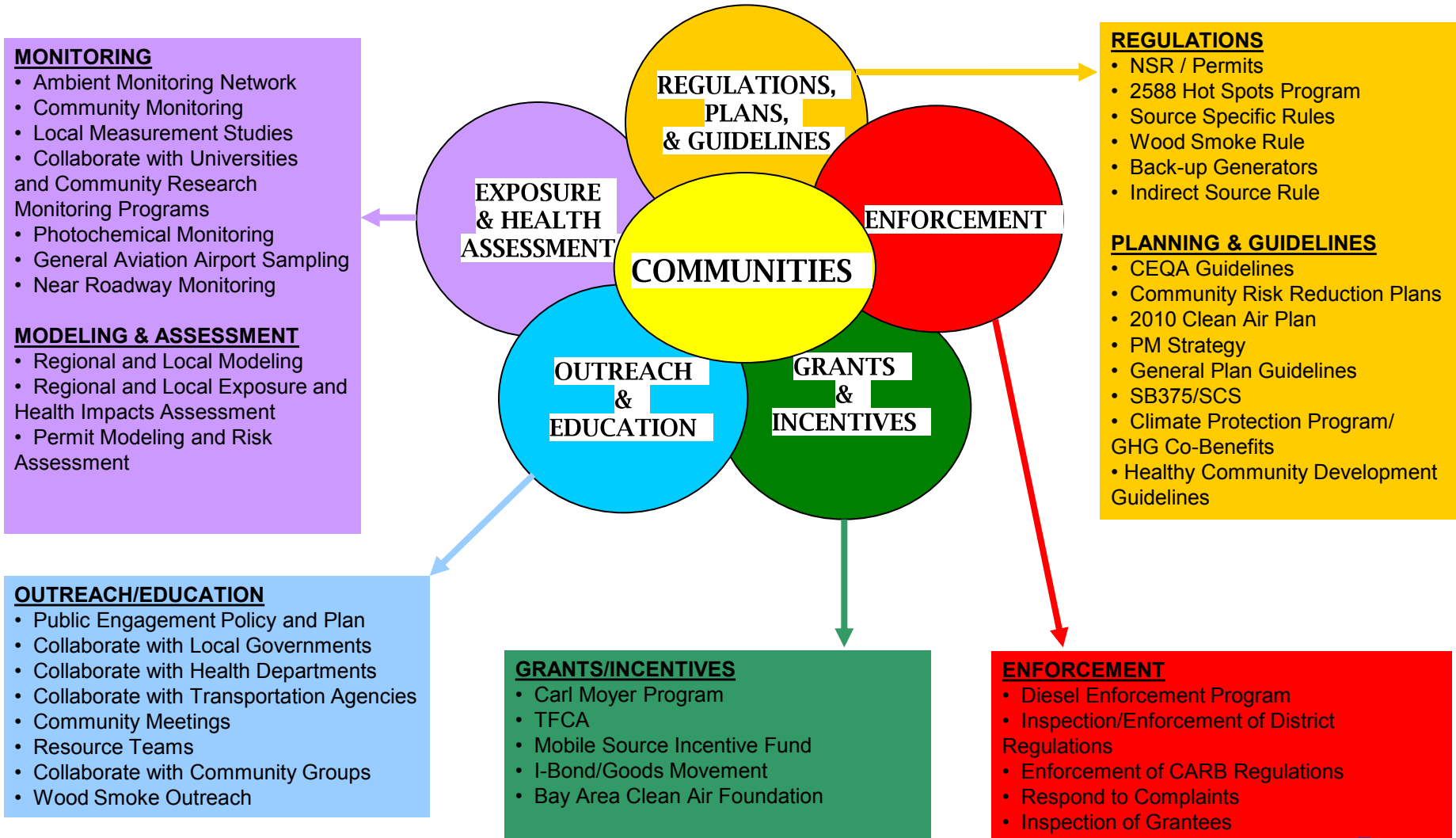 – Neighborhoods outside may not be, proximity to busy roads is important

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CARE Program: Next Steps

- CARE program established methods and helped direct mitigations that contributed to significant improvements in impacted areas

- There are still areas with high local exposures
  - Especially near busy roadways

- Local modeling and monitoring studies to help identify impacts will continue (Planning tools, Near-roadway monitoring)

- Mitigation measures to reduce impacts for new and existing residents will continue (S.F. Near-road Housing Mitigations Study)

- Interactions with city planners and health professionals will continue

- New framework for local engagement will develop

Clean Air Communities Initiative

MONITORING
- Ambient Monitoring Network
- Community Monitoring
- Local Measurement Studies
- Collaborate with Universities and Community Research Monitoring Programs
- Photochemical Monitoring
- General Aviation Airport Sampling
- Near Roadway Monitoring

MODELING & ASSESSMENT
- Regional and Local Modeling
- Regional and Local Exposure and Health Impacts Assessment
- Permit Modeling and Risk Assessment

REGULATIONS
- NSR / Permits
- 2588 Hot Spots Program
- Source Specific Rules
- Wood Smoke Rule
- Back-up Generators
- Indirect Source Rule

PLANNING & GUIDELINES
- CEQA Guidelines
- Community Risk Reduction Plans
- 2010 Clean Air Plan
- PM Strategy
- General Plan Guidelines
- SB375/SCS
- Climate Protection Program/ GHG Co-Benefits
- Healthy Community Development Guidelines

OUTREACH/EDUCATION
- Public Engagement Policy and Plan
- Collaborate with Local Governments
- Collaborate with Health Departments
- Collaborate with Transportation Agencies
- Community Meetings
- Resource Teams
- Collaborate with Community Groups
- Wood Smoke Outreach

GRANTS/INCENTIVES
- Carl Moyer Program
- TFCA
- Mobile Source Incentive Fund
- I-Bond/Goods Movement
- Bay Area Clean Air Foundation

ENFORCEMENT
- Diesel Enforcement Program
- Inspection/Enforcement of District Regulations
- Enforcement of CARB Regulations
- Respond to Complaints
- Inspection of Grantees

Central diagram labels: REGULATIONS, PLANS, & GUIDELINES; EXPOSURE & HEALTH ASSESSMENT; ENFORCEMENT; COMMUNITIES; OUTREACH & EDUCATION; GRANTS & INCENTIVES

June, October Meetings: Comments & Questions

Framing context:

- What will the impacted communities maps be used for?

- Air District current method and EJSM identified similar areas.

- Don't over-analyze. Focus on mitigations!
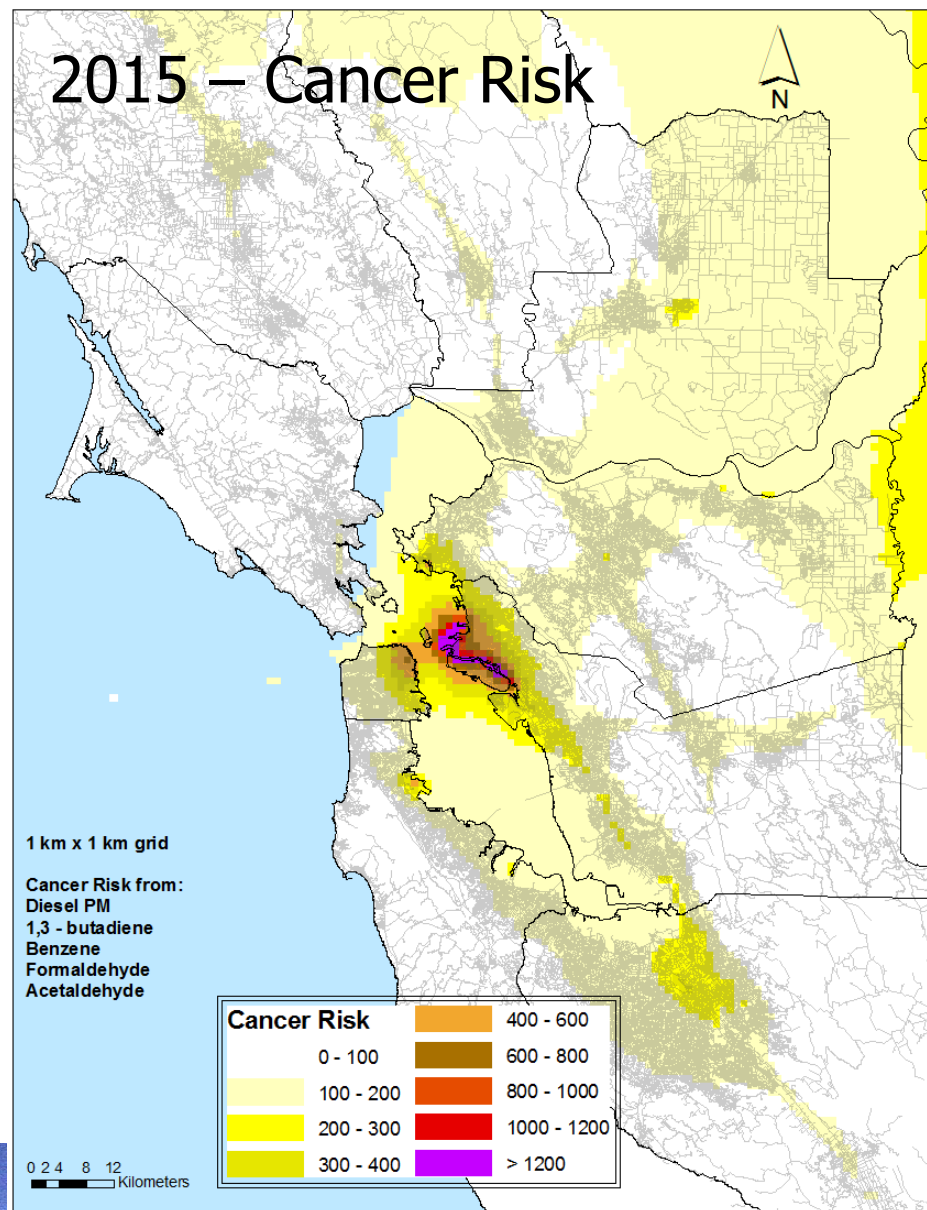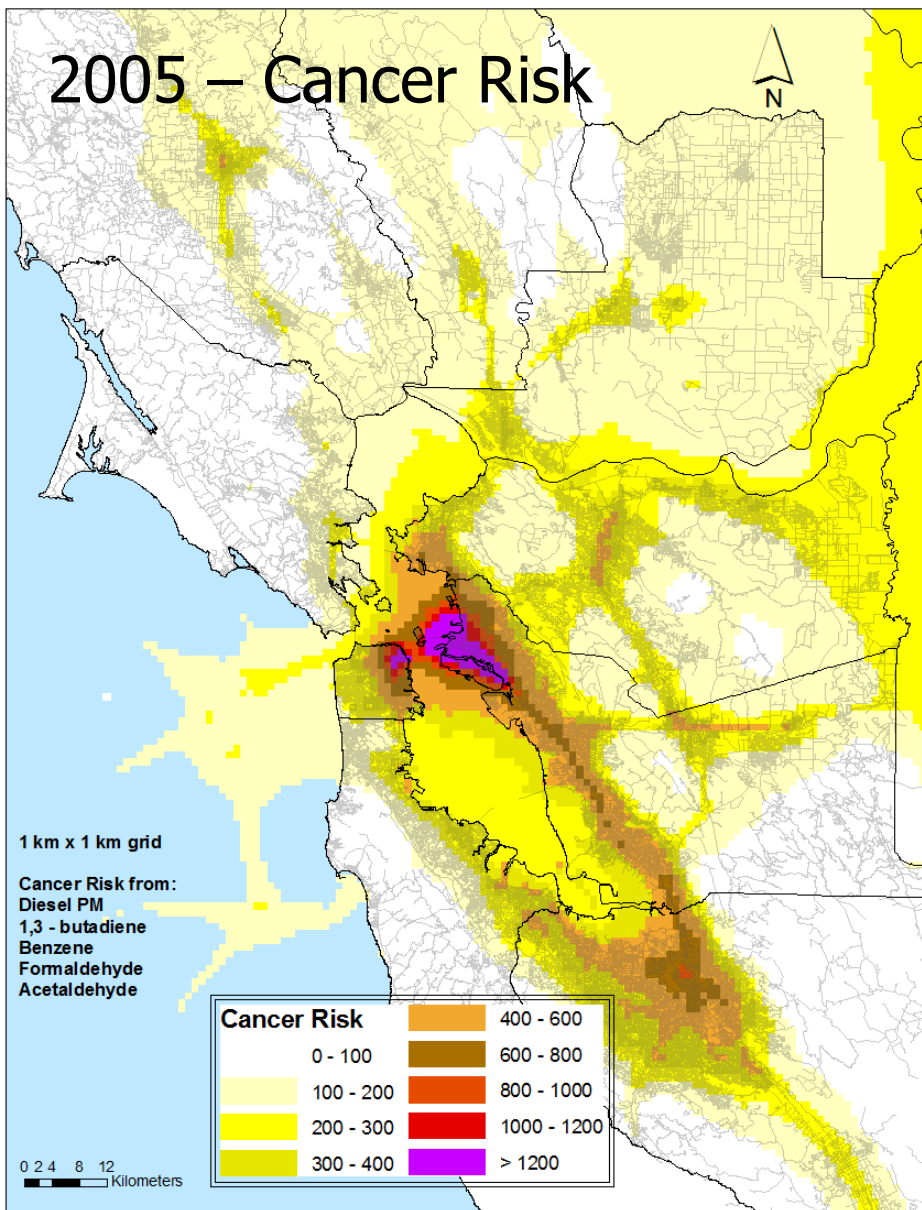
Previous Meetings: Comments & Questions

Discussing methodology:

- Document method, display components, and seek review. Compare to other methods.

- Use race/ethnicity to identify social vulnerabilities. Explore demographics of areas identified.

- Avoid metrics of *potential* exposure, e.g. proximity to industrial source, vs. *actual* exposure.

- Be cautious when monetizing impacts.

- Are health data for proposed method available?

Why Update Current Maps?

- Use latest data

- Add additional air pollutants
  - In addition to toxic compounds: fine particles and ozone

- Use new methods
  - Use health outcomes estimated from air pollution levels to identify pollution impacts
  - Use health outcome records (deaths, emergency room visits, and hospital admissions) to identify vulnerable communities

Example: Estimated Toxic Air Contaminants Decreasing

2005 – Cancer Risk

1 km x 1 km grid

Cancer Risk from:
Diesel PM
1,3 - butadiene
Benzene
Formaldehyde
Acetaldehyde

Cancer Risk

0 - 100	400 - 600
100 - 200	600 - 800
200 - 300	800 - 1000
300 - 400	1000 - 1200
	> 1200

0 2 4   8   12
Kilometers

2015 – Cancer Risk

1 km x 1 km grid

Cancer Risk from:
Diesel PM
1,3 - butadiene
Benzene
Formaldehyde
Acetaldehyde

Cancer Risk

0 - 100	400 - 600
100 - 200	600 - 800
200 - 300	800 - 1000
300 - 400	1000 - 1200
	> 1200

0 2 4   8   12
Kilometers

Goals of Proposed Method

- Focus actions where most needed
  - High pollution impacts, vulnerable populations

  - Target emissions causing high exposures

- Consider examples of similar analyses
  - Cal/EPA (CalEnviroScreen)

  - UC Berkeley researchers (EJSM)

Draft Proposed Method Outline

- Identify where air pollution is causing health impacts
- Identify vulnerable populations
- Identify where emissions are high
- Bound identified areas using major roadways

Identify where air pollution is causing health impacts

- Use recent, regional air quality modeling and measurements to map pollutant concentrations: toxic air contaminants (TAC), fine PM (PM2.5), and ozone

- Use "BenMAP approach" to link PM2.5 and ozone to increased heath impacts

- Use cancer unit risk factors to link TAC to increased cancer risk

- Aggregate and map estimated health impacts, to identify areas with greatest impacts

Regional Air Pollution Mapped to ZIP code areas

PM$_{2.5}$
Modeled annual average
(2010)
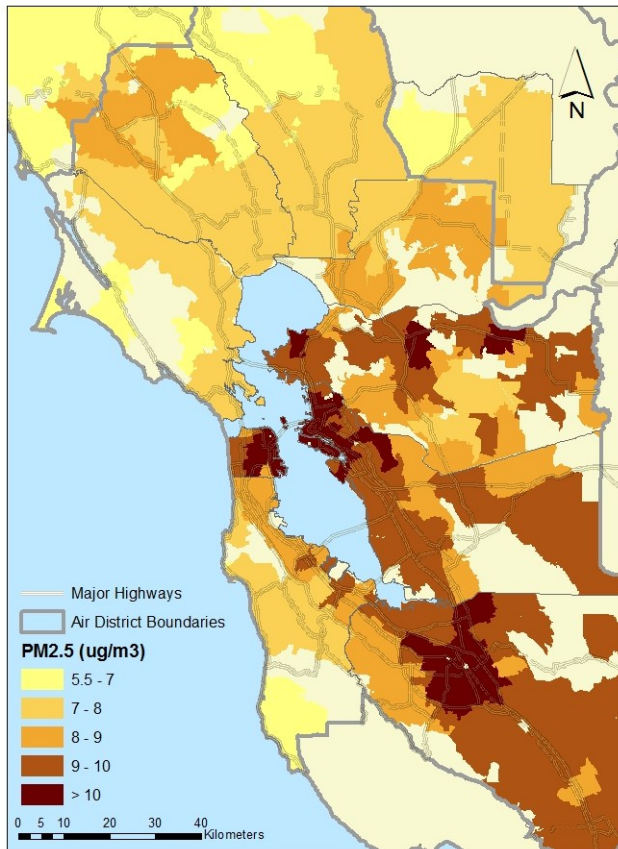
Ozone
Interpolated measurements
Mean 8-hour daily max. above 40 ppb
(2010-2011)
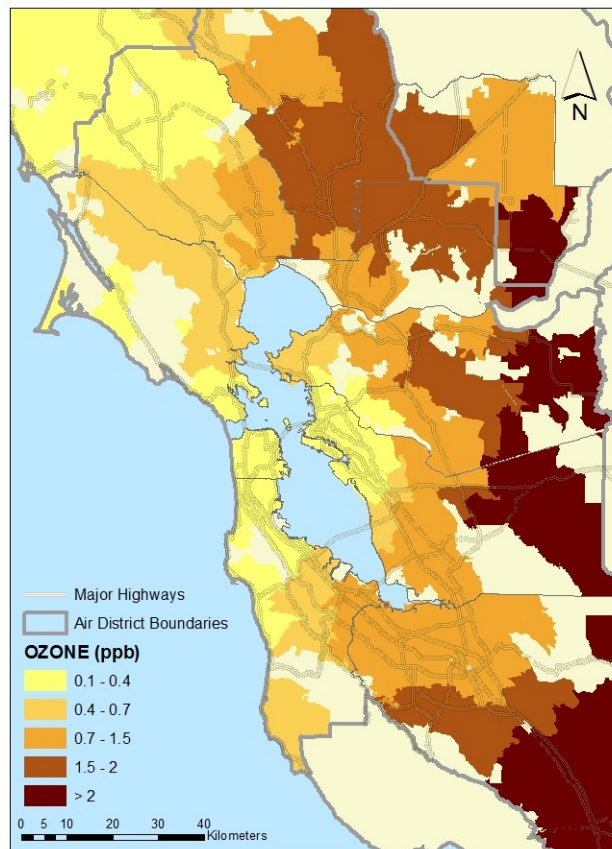
Cancer Risk
Modeled annual average
(2015)
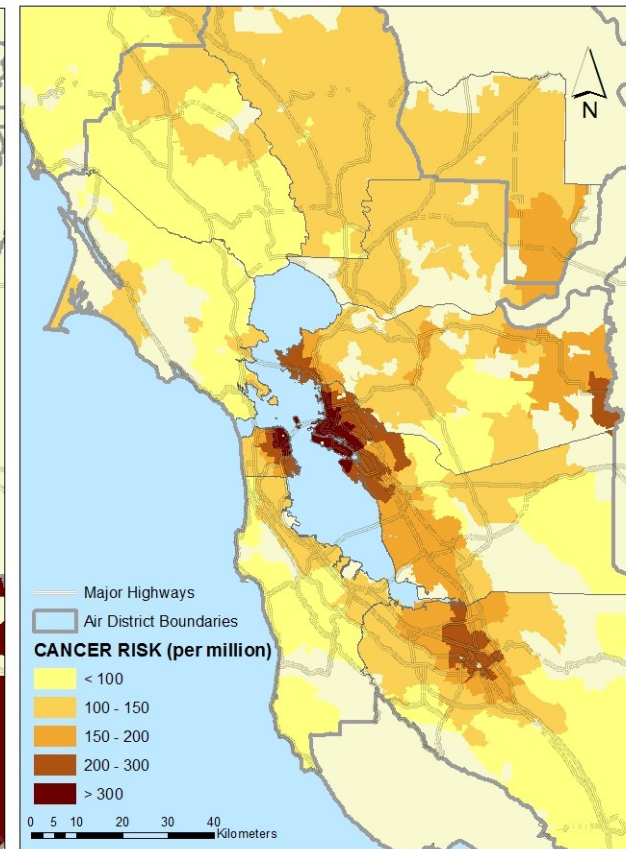
Use BenMAP approach to estimate health impacts from $PM_{2.5}$ and ozone

BenMAP is a US EPA model used to estimate the health impacts, and costs, associated with changes in air pollution. Air District used a BenMAP approach for the 2010 Clean Air Plan.

Rate Increase = Air Pollution Level **X**

Effect Estimate **X**

Baseline Rate

- **Air Pollution Level**. Above background.
- **Effect Estimate**. Percentage change in health outcome due to a unit change in ambient air pollution. Based on epidemiological studies.
- **Baseline Rate**. For example, for mortality, the baseline rate is the probability that a person will die in a given year.

Pollution to Health Outcomes

Pollutant		Method		Result
PM$_{2.5}$ Ozone	→	BenMAP	→	• Increased mortality rate • Increased costs for ER visits, hospitalization
TAC	→	Risk Factors	→	• Increased cancer risk
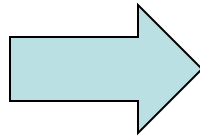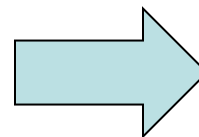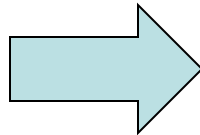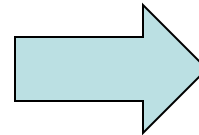
Pollution Stress Index
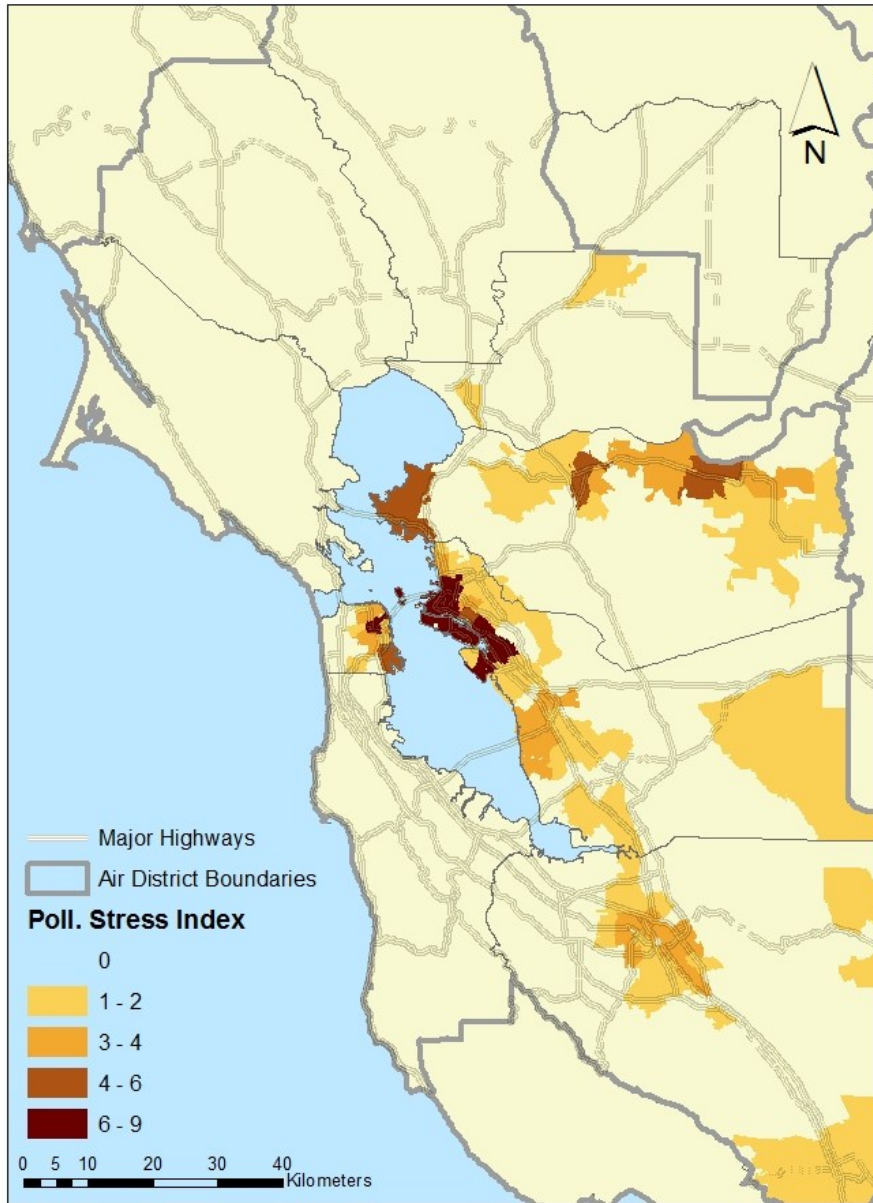
Metric to combine health impacts from air pollution

- **Increased mortality rate**
- **Increased health costs**
- **Increased cancer risk**

- Each result is ranked:
  - Top 5% = 3
  - Next 5% = 2
  - Next 10% = 1
  - < 20% = 0

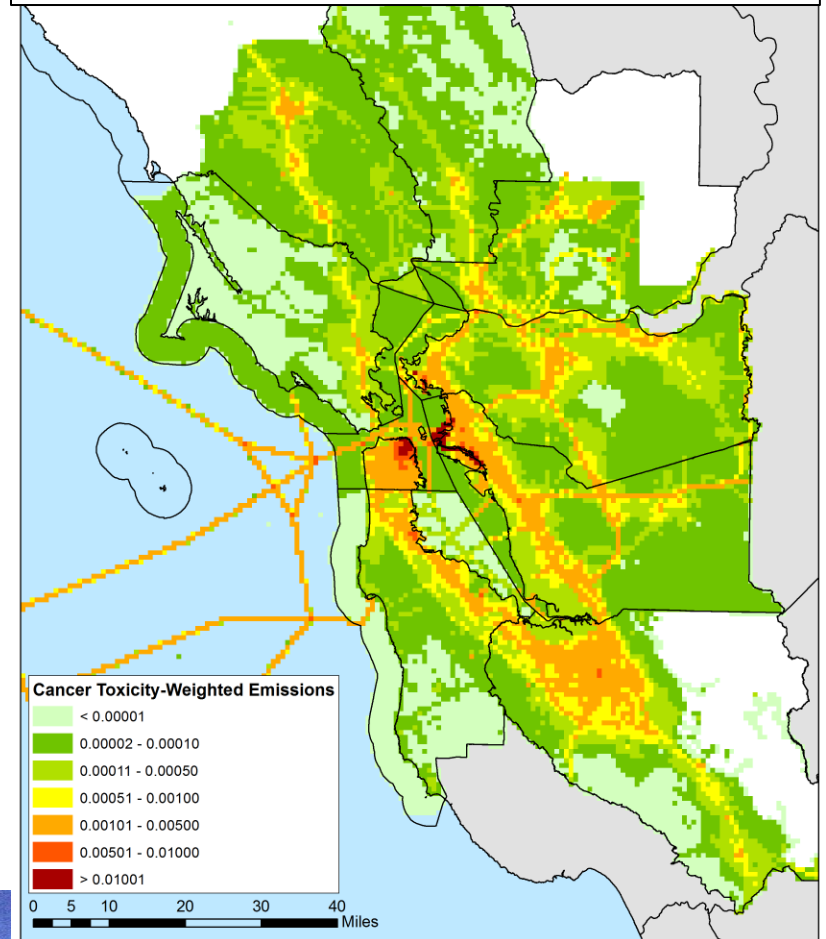- Rankings are summed for a maximum index of 9

Identify vulnerable populations

- Use health outcome records (2009 – 2011) for health effects aggravated by air pollution:

- Death rates

- Emergency room visits, hospital admission rates
  - COPD Hospital Admissions
  - Pneumonia Hospital Admissions
  - Myocardial Infarction (MI, heart attack) Hospital Admissions
  - Cardiovascular Hospital Admissions (without MI)
  - Asthma Emergency Room Visits
  - Hospital Admissions for Respiratory Diseases
  - Lung Cancer Hospital Admissions
  - All Cancer Hospital Admissions
  - Non-Trauma Hospital Admissions

  - Use tabulated costs for each type of ER visit/hospital admission to combine all types to a total cost

Vulnerability Index
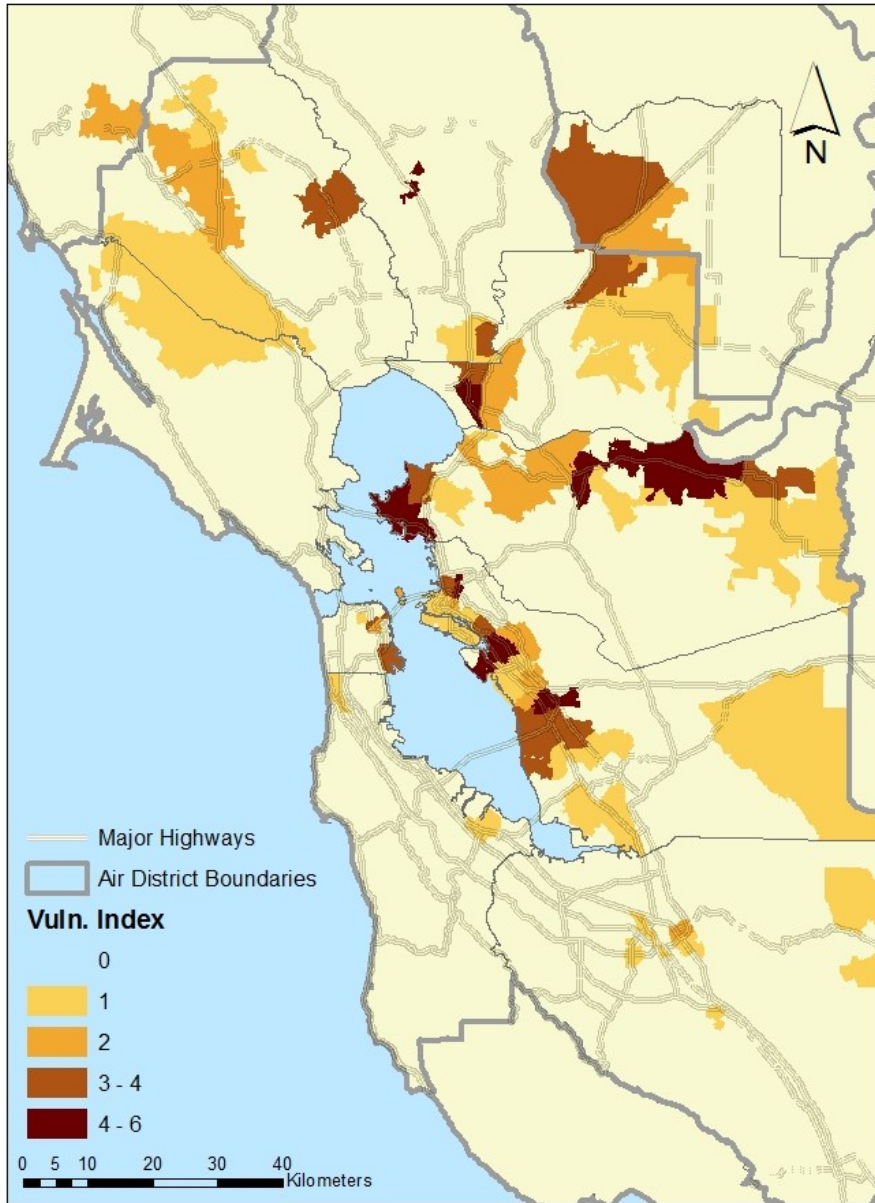
Metric to combine adverse health outcomes, based on health records

- **Mortality rate**

- **Health costs**

- Each result is ranked:
  - Top   5%   = 3
  - Next 5%   = 2
  - Next 10%   = 1
  - < 20%   = 0

- Rankings are summed for a maximum index of 6

Identify where emissions are high

- Emission estimates from regional modeling

- $PM_{2.5}$ direct emissions

- TAC direct emissions weighted by cancer risk

- Precursor emissions: oxides of nitrogen (NOx), volatile organic compounds (VOC), and sulfur dioxide (SO2)

Direct Emissions

PM$_{2.5}$
Direct Emissions
(2010)
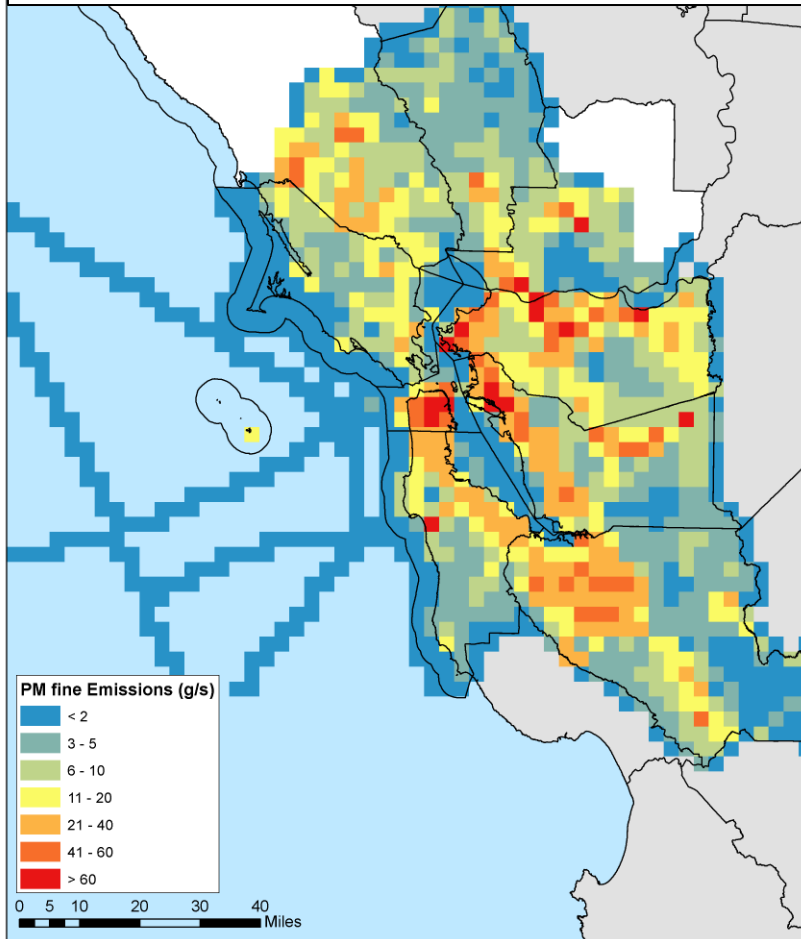
Toxic Air Contaminants
Direct Emissions
with Cancer-risk Weighting
(2015)

PM fine Emissions (g/s)

	< 2
	3 - 5
	6 - 10
	11 - 20
	21 - 40
	41 - 60
	> 60

0 5 10   20   30   40
Miles

Cancer Toxicity-Weighted Emissions

	< 0.00001
	0.00002 - 0.00010
	0.00011 - 0.00050
	0.00051 - 0.00100
	0.00101 - 0.00500
	0.00501 - 0.01000
	> 0.01001

0 5 10   20   30   40
Miles

Precursor Emissions
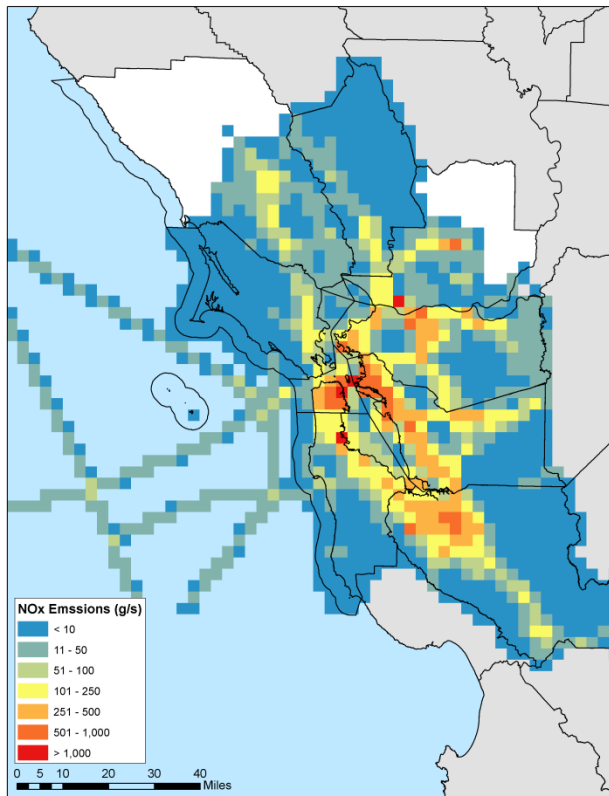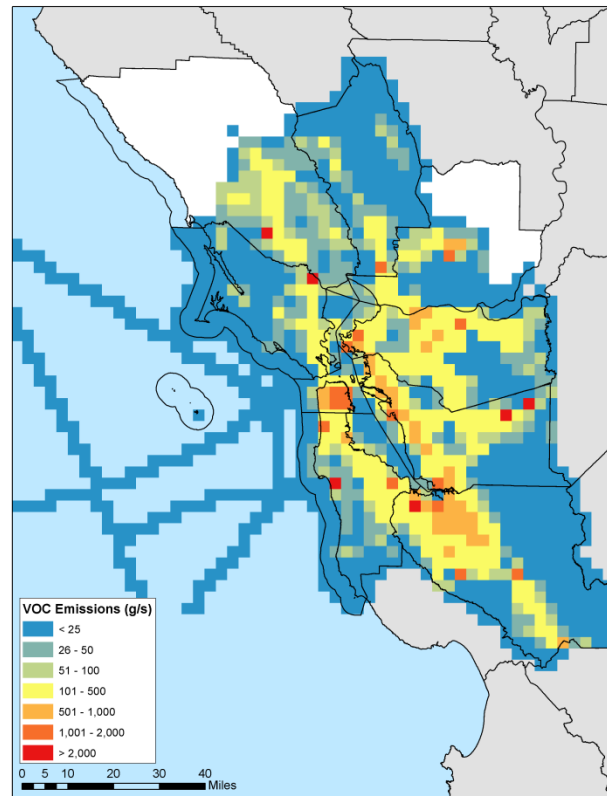
NOx (2010)   VOC (2010)   SO2 (2010)

Emissions Index

Emissions Index

	0
	1 - 2
	2 - 4
	4 - 8
	9
	Major Highways
	Air District Boundaries

0 5 10   20   30   40
Kilometers
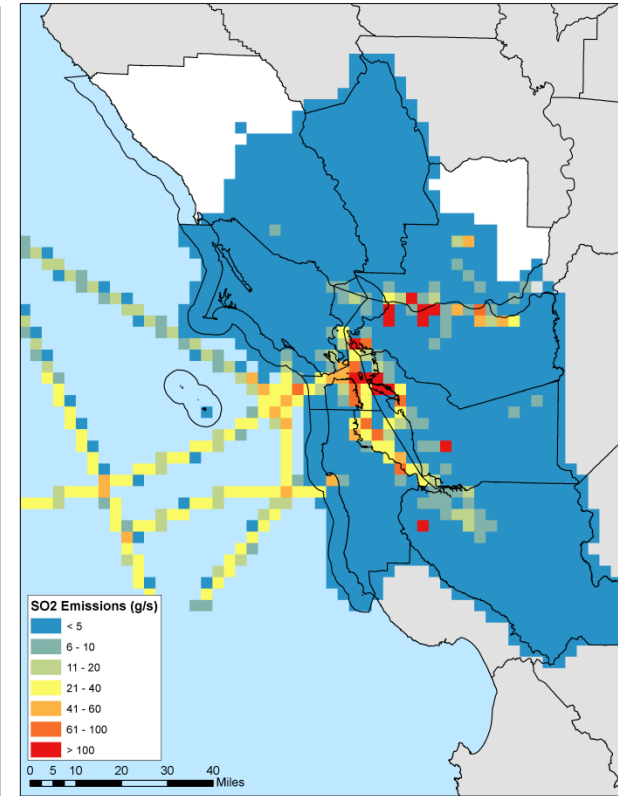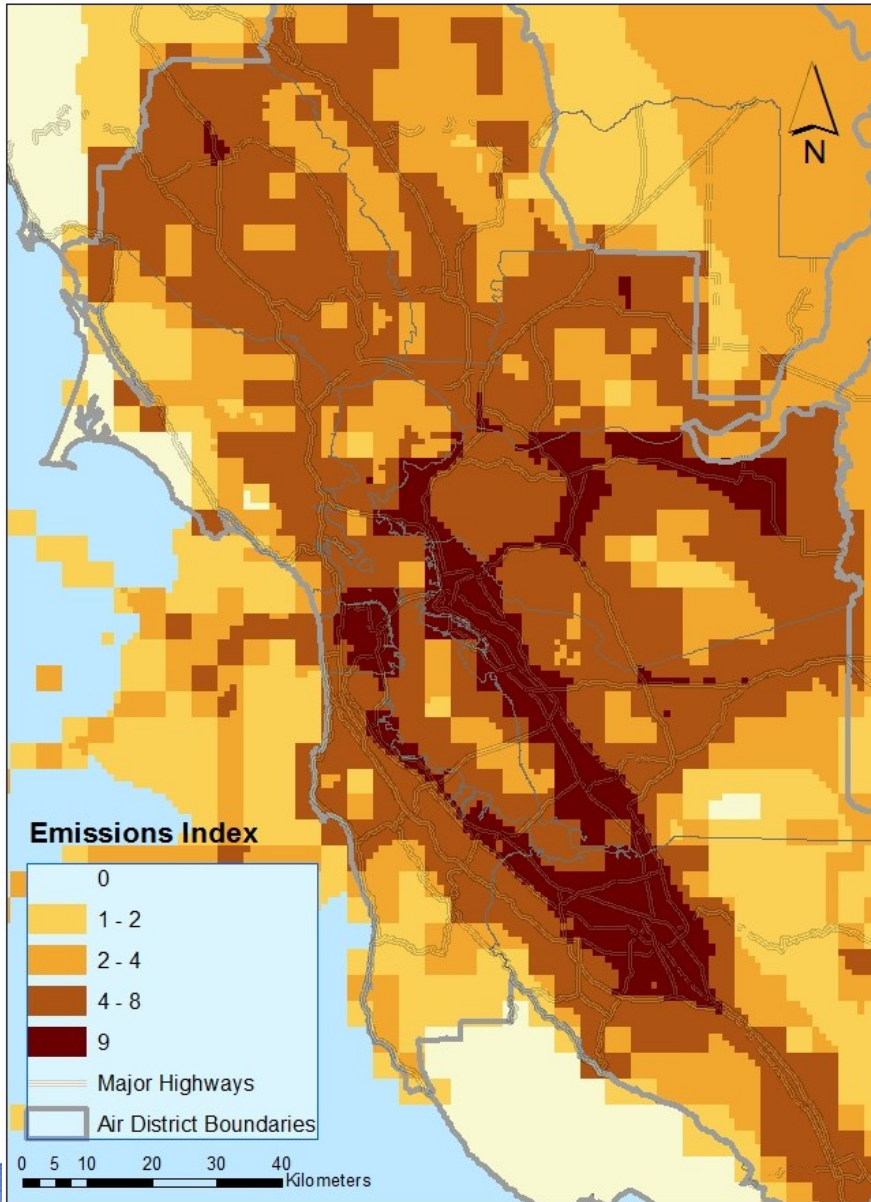
Metric to combine emissions of different pollutants

- **PM2.5 direct emissions**

- **TAC direct emissions (cancer weights)**

- **Combined precursor emissions**

- Each result is ranked:
  - Top 25% = 3
  - Next 25% = 2
  - Next 25% = 1
  - < 75%   = 0

- Rankings are summed for a maximum score of 9

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How best to combine elements?

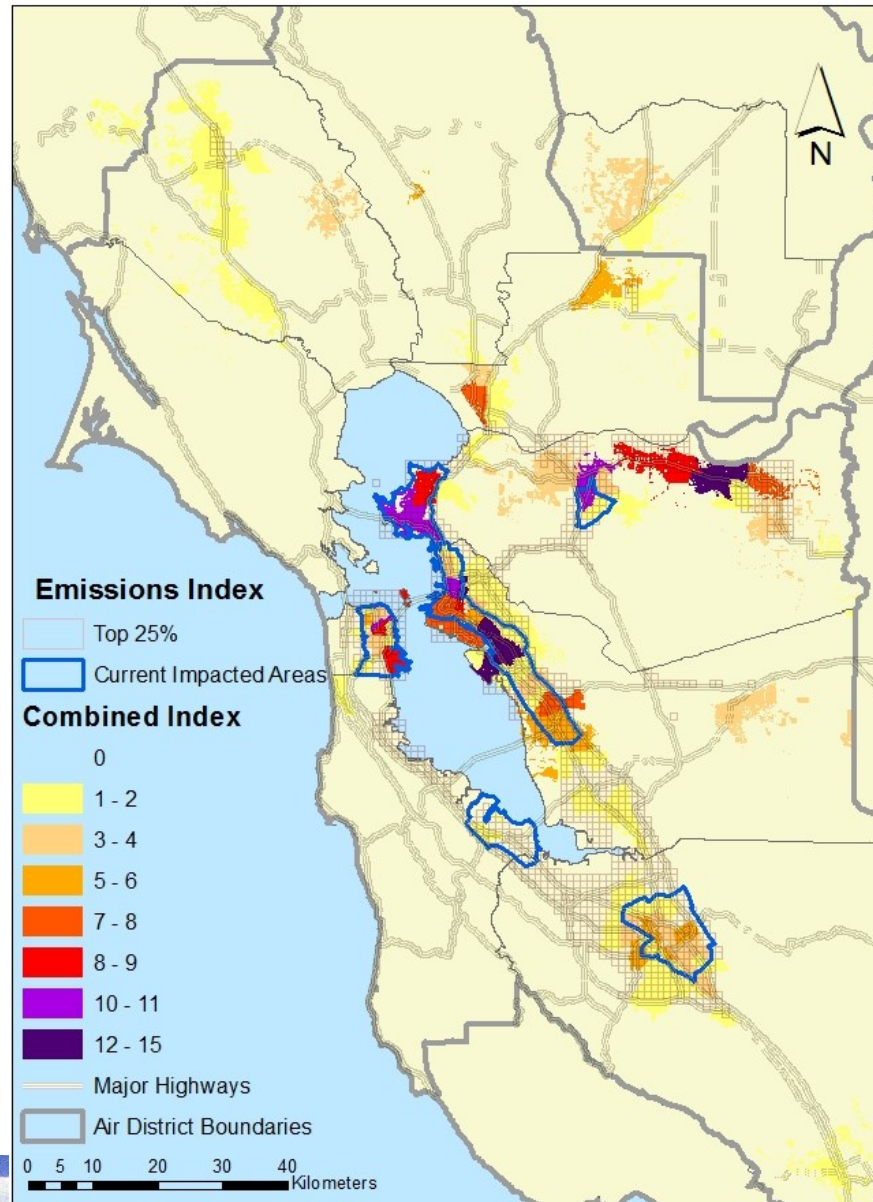Pollution Stress Index
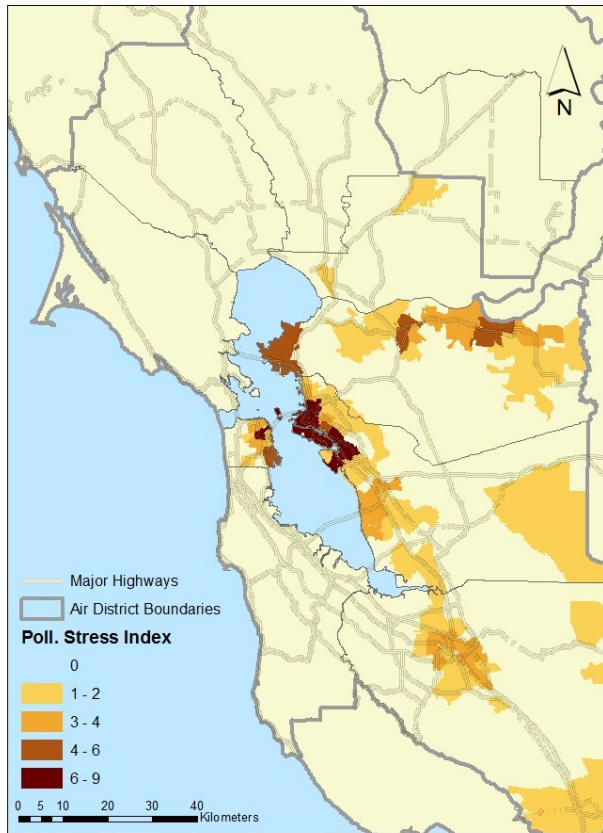
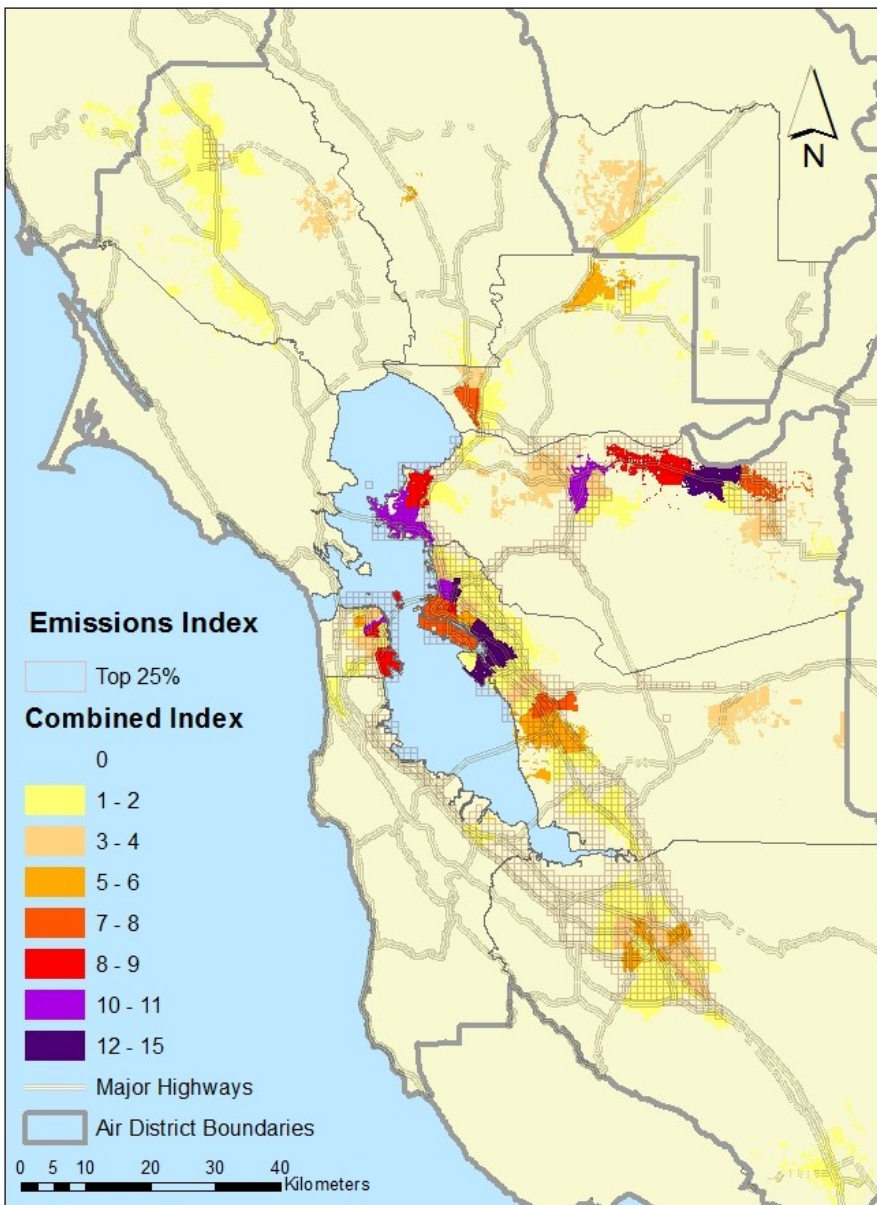Vulnerability Index
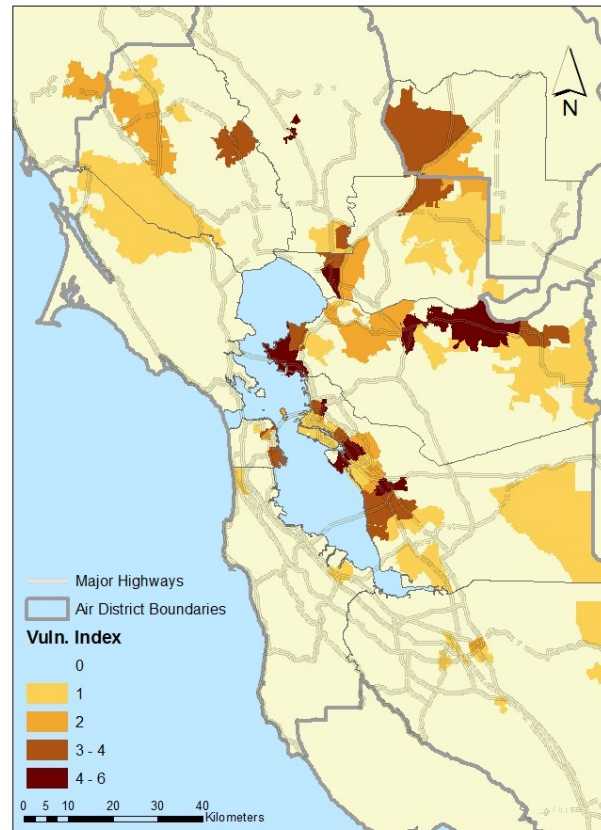
Emissions Index
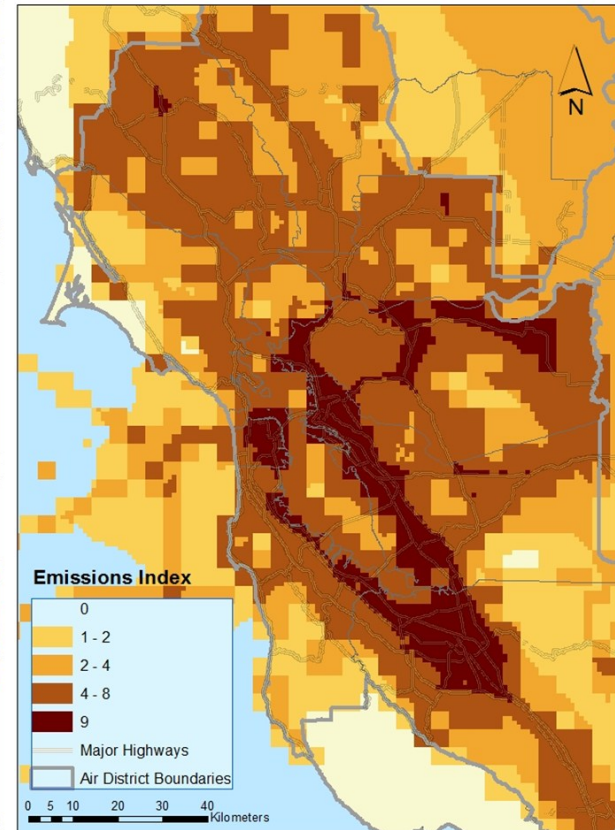
One option: A combined index

Emissions Index
- ☐ Top 25%

Combined Index
- 0
- 🟨 1 - 2
- 🟧 3 - 4
- 🟧 5 - 6
- 🟧 7 - 8
- 🟥 8 - 9
- 🟪 10 - 11
- 🟪 12 - 15
- —— Major Highways
- ☐ Air District Boundaries

0 5 10   20   30   40
Kilometers
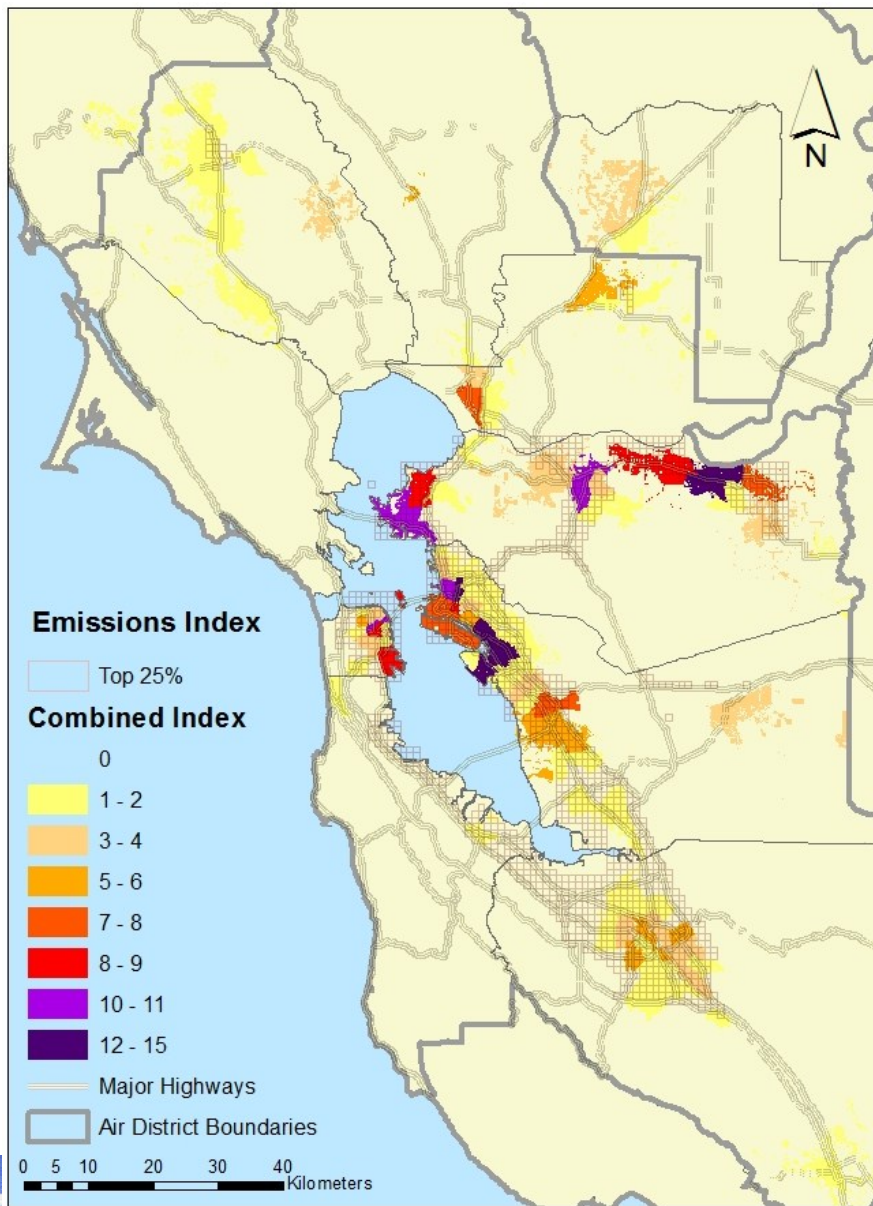
- Combined index = Pollution stress index + Vulnerability index

- Select highest emissions index values

- Impacted: areas with a combined index over 4 or 5, for example, near highest emissions
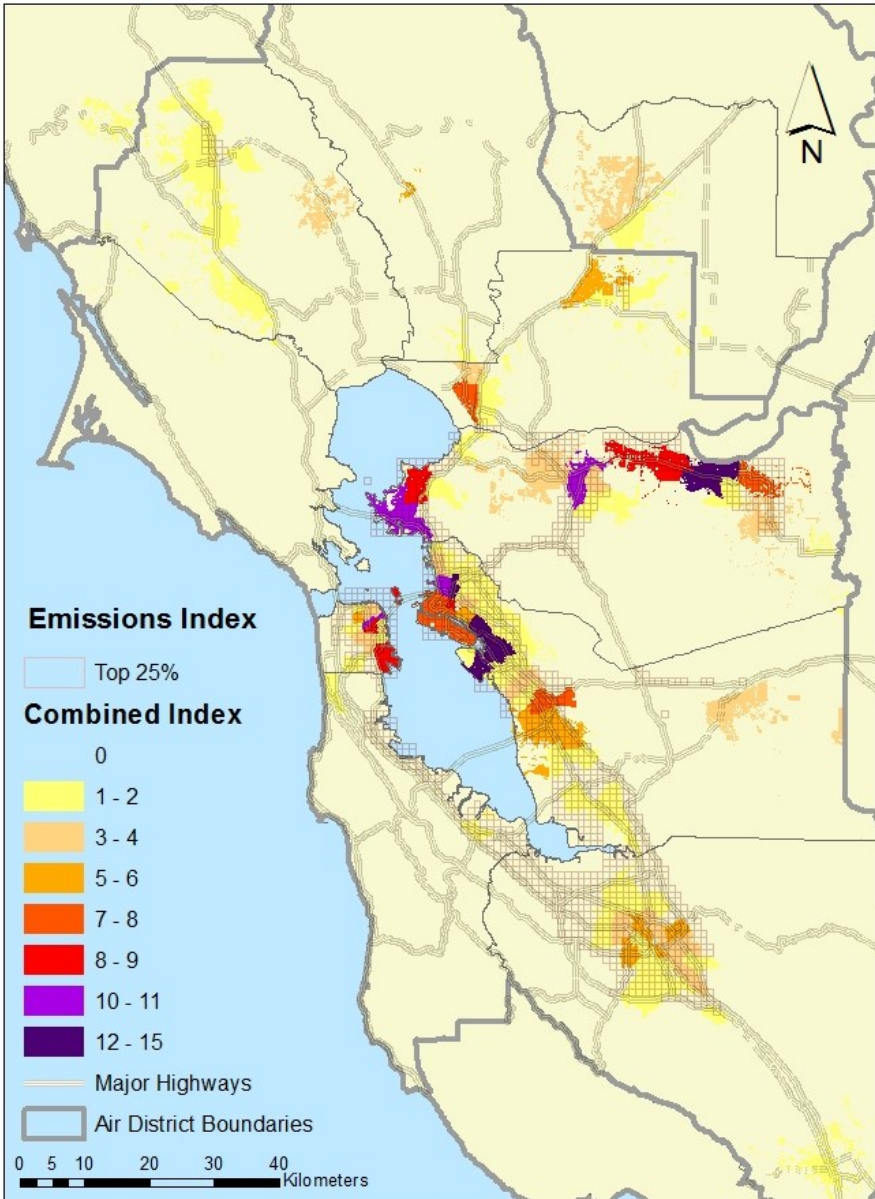
24

Comparison to Current Method
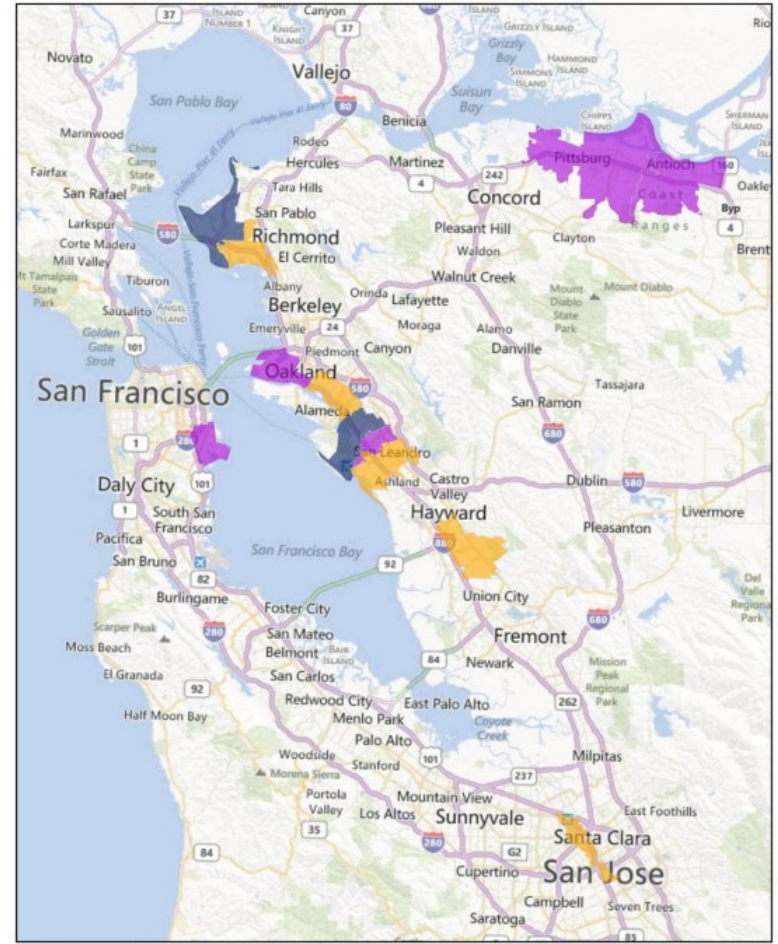
Comparison to EJ Screening Method

Emissions Index

- Top 25%

Combined Index

- 0
- 1 - 2
- 3 - 4
- 5 - 6
- 7 - 8
- 8 - 9
- 10 - 11
- 12 - 15
- Major Highways
- Air District Boundaries

0 5 10   20   30   40 Kilometers
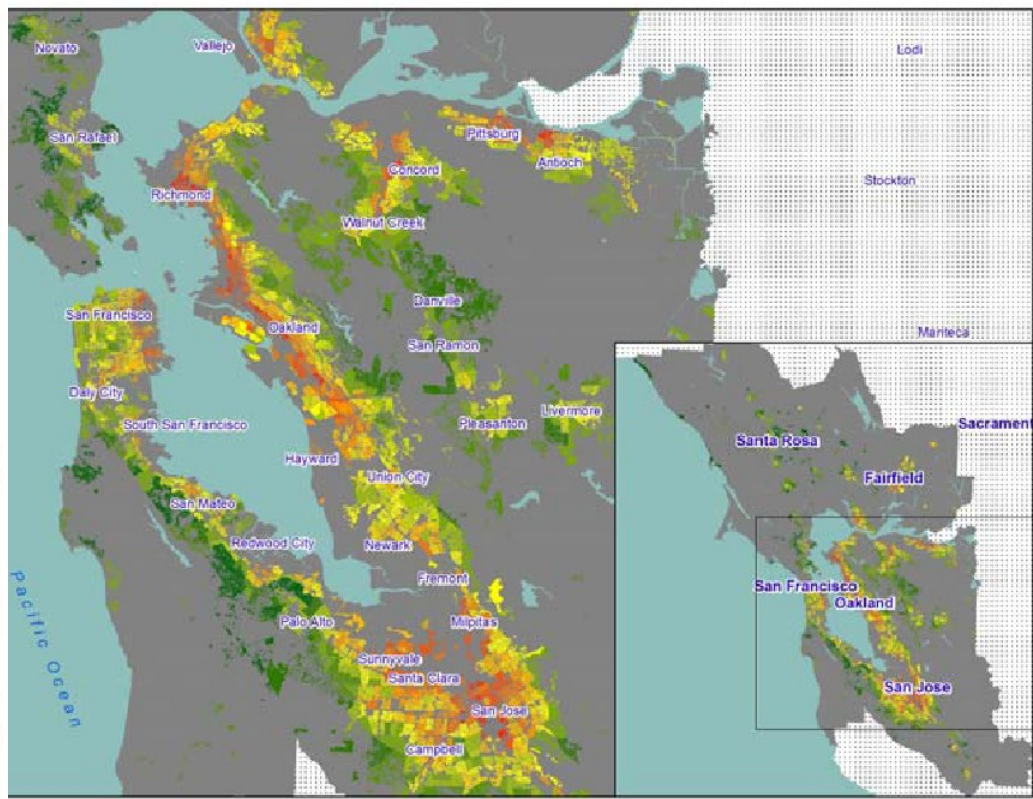
Comparison to CalEnviroScreen

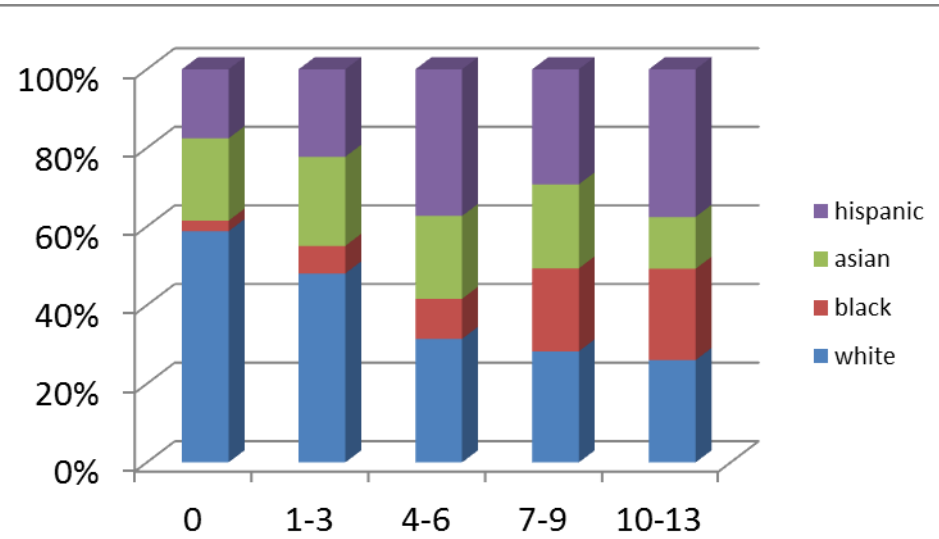CALENVIROSCREEN TOP 5, 10, 15% SCORES (JAN 23, 2013)

Socio-economic factors in combined index areas

Median Household Income
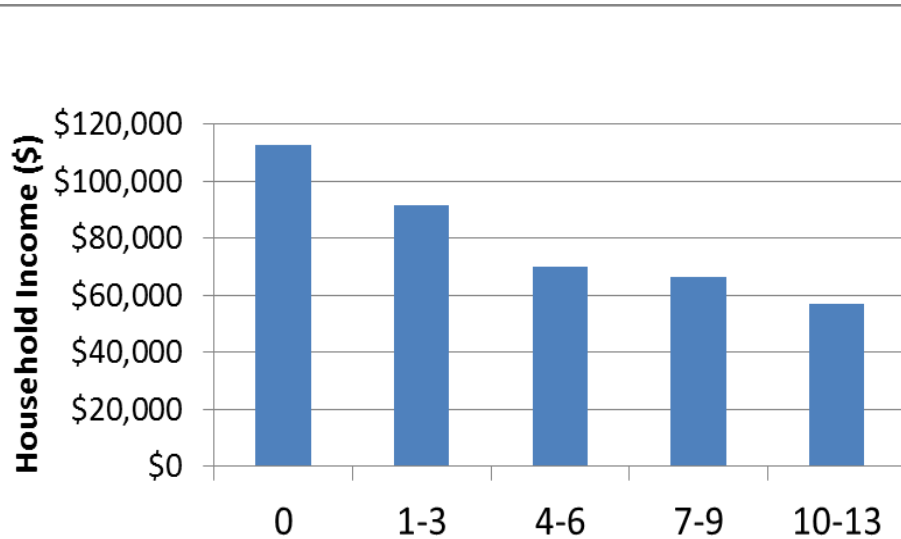
Race/Ethnicity

Combined index
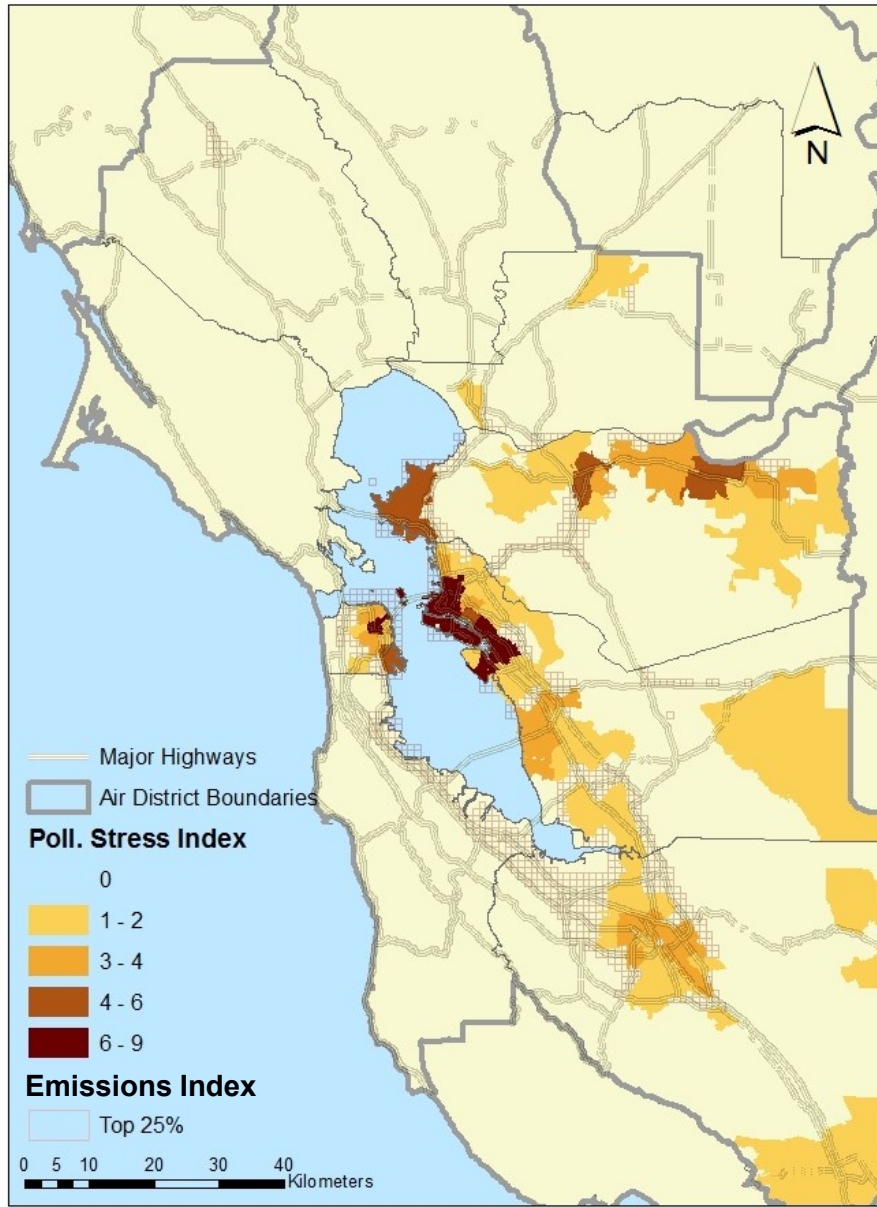
Combined index

Factors not included (income, race/ethnicity) in developing the combined index (air pollution, health outcomes) are reflected in the result.

Another option: Pollution stress index

Major Highways
Air District Boundaries

Poll. Stress Index
- 0
- 1 - 2
- 3 - 4
- 4 - 6
- 6 - 9

Emissions Index
- Top 25%

0 5 10   20   30   40
Kilometers

- Pollution stress index uses baseline incidence rates for each ZIP area

- Already includes population vulnerabilities

- Simpler and identifies similar areas

- Map with highest emissions index

Discussion/Questions

- Best way to combine elements?
  - Combined index
  - Pollution stress index
  - Other

- Include population density?
  - Investigate influence

- Other questions?

Next Steps

- Investigate questions

- Finalize proposed approach

- Develop and share maps using updated method; seek input (Mar/Apr 2013)

- Finalize updated maps (Apr/May 2013)

- Continue ongoing research
  - Asthma prevalence data, lung cancer data
  - Traffic proximity
  - Relating emission sources areas to impacted areas

- Continue ongoing mitigation activities