Toxics Emissions Inventory: Comparison with Ambient Measurements

David Fairley, Ph.D.
Bay Area Air Quality Management District
CARE Task Force Meeting
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Goals

Determine the extent that inventory emissions match ambient measurements:

- For a given site:
  - ➔ Do the percentages of different compounds match?
  - ➔ Do the percentages of risk match?
- For a given toxic compound – Do the sites with the highest inventory estimates match the highest ambient measurements?

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Ambient Measurements

- BAAQMD lab measurements: 15 sites
- CARB lab measurements: 5 sites
- Measurements made on a 1-in-12 day schedule
- Data for 1999-2001 used
- Quarterly averaged annual averages

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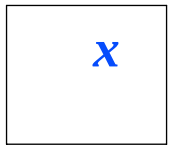
Toxics Emission Inventory Comparison

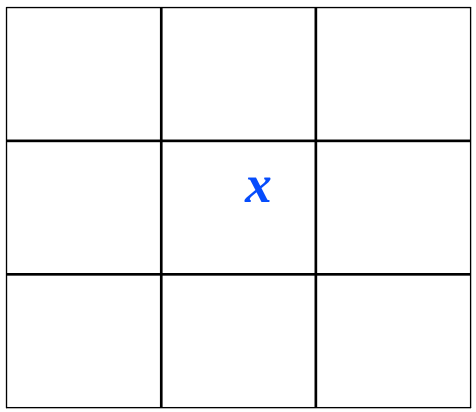
- **Total emissions =**

  on-road + area + point source

- **Compared with 2x2 km grid square containing monitoring station:**



- **Also compared with the 3x3 square of grids centered on the monitoring station:**



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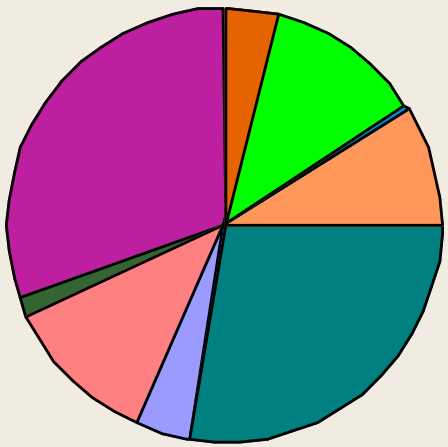
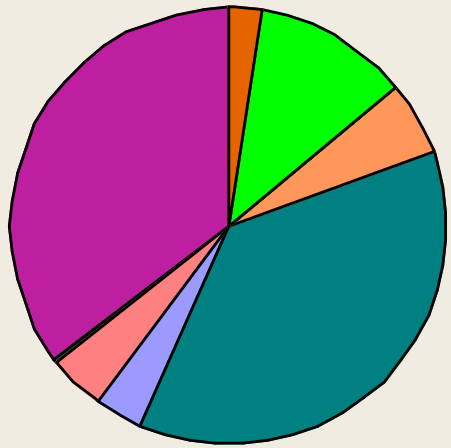
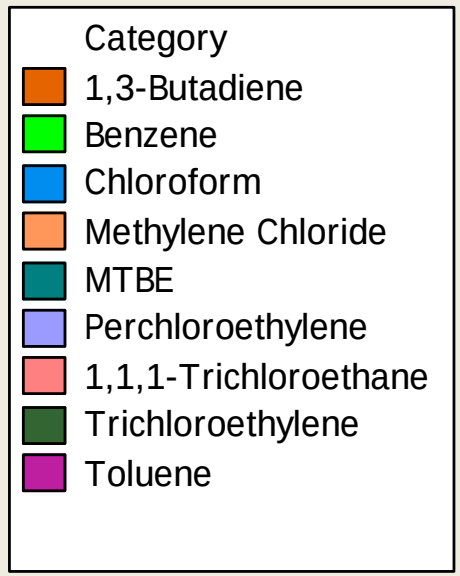
Ambient VOC Toxic Concentrations vs. 3x3 Emissions: Livermore

Ambient Concentrations



Total Emissions





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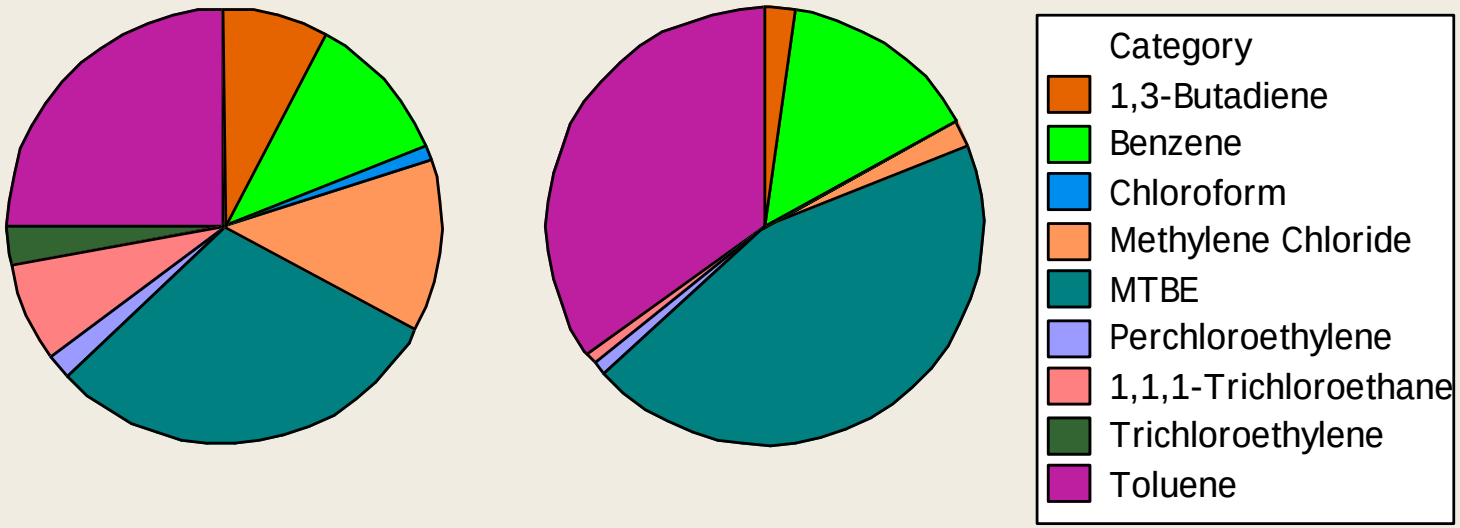
Ambient VOC Toxic Concentrations vs. Emissions: Crockett

Ambient Concentrations

Total Emissions



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How well do the emissions inventory and ambient measurements compare?

Overlap:

➔ The percent of the pie that's common to both pies.

Here's an example:

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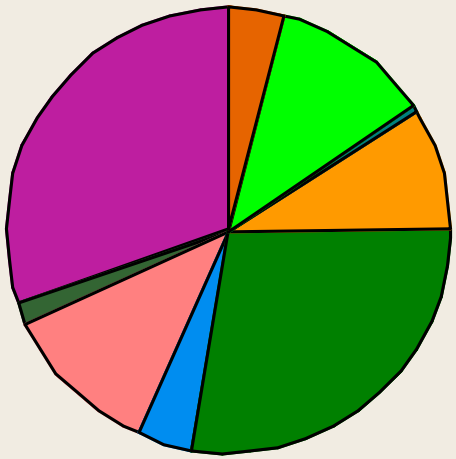
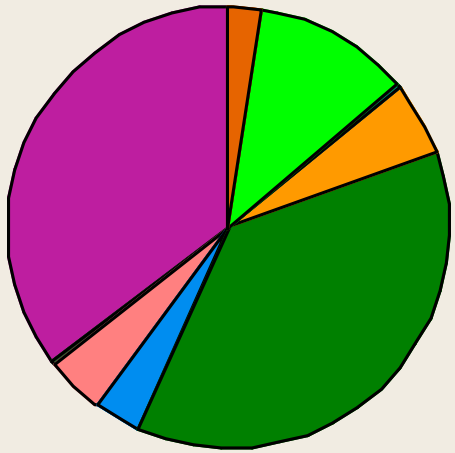
Overlap Example

Livermore (85% overlap)

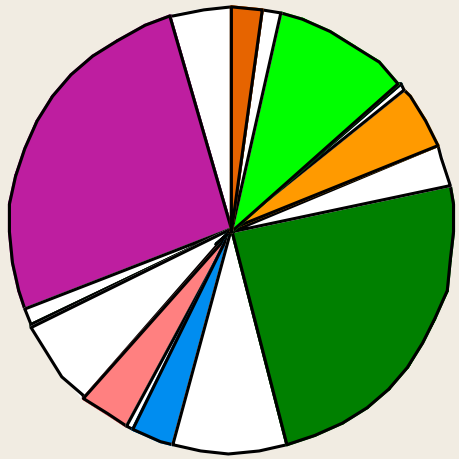
Ambient Concentrations



Total Emissions



Overlap



1,3-Butadiene
Benzene
Chloroform
Methylene Chloride
MTBE
Perchloroethylene
1,1,1-Trichloroethane
Trichloroethylene
Toluene

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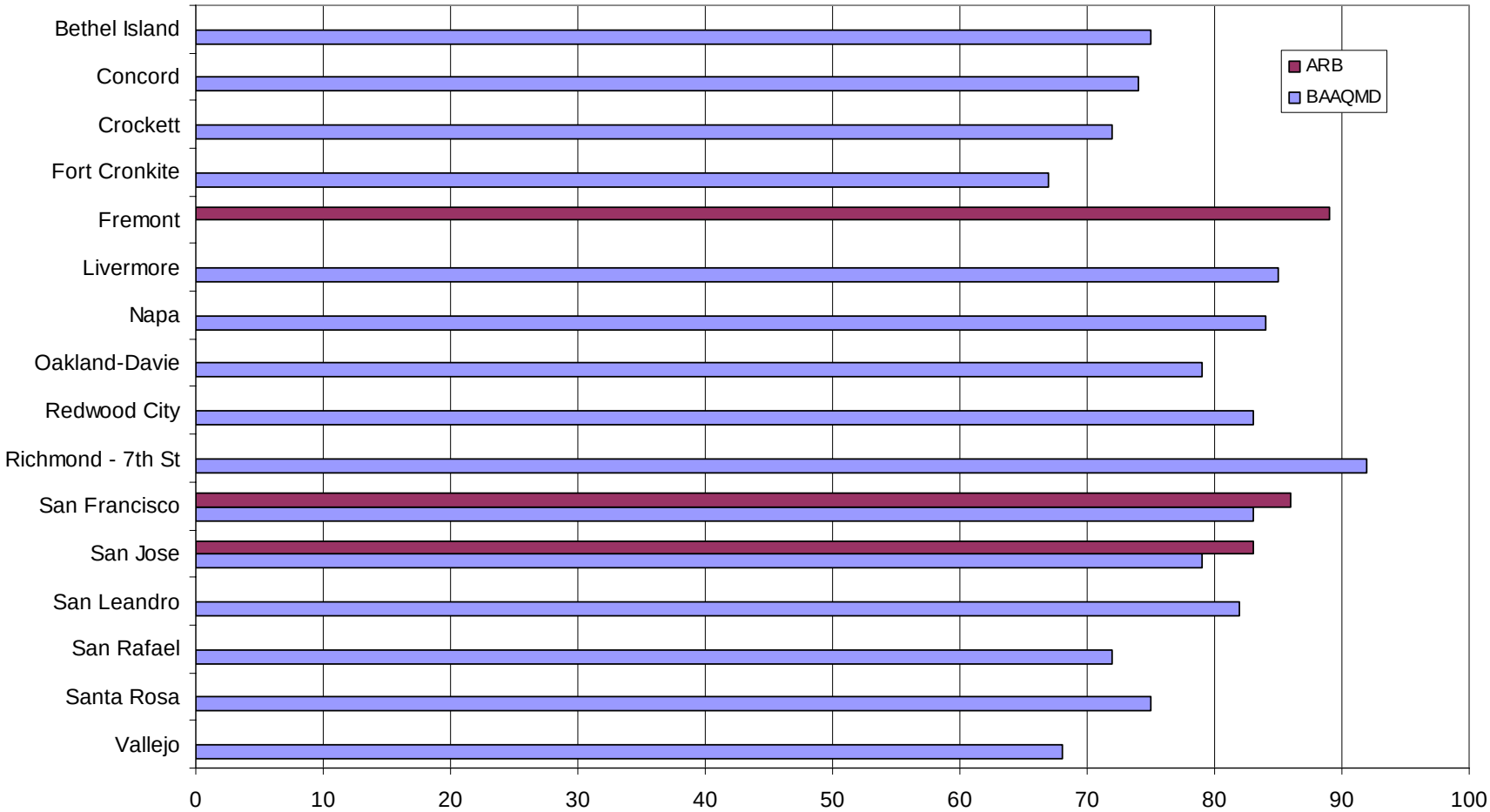
Percent Overlap Between Ambient Concentrations and Emissions

VOCs, excluding EDB, EDC and VC



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Cancer Risk Comparison

- **Comparing fractions of lifetime cancer risk from various toxics**
- **VOCs, chromium VI, diesel PM**

  ➔need to estimate diesel concentrations
- **ARB measurements used**

  ➔they include formaldehyde, acetaldehyde, and chromium VI

  ➔1,3-butadiene better estimated

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Estimating Diesel PM Concentrations

- **No direct way to measure diesel PM**
- **Elemental carbon concentrations* are a good first approximation (Fujita)**
- **Coefficient of Haze (COH) reasonably well correlated with EC. (Used regression equation of EC on COH with San Francisco data.)**

*** Using the IMPROVE methodology**

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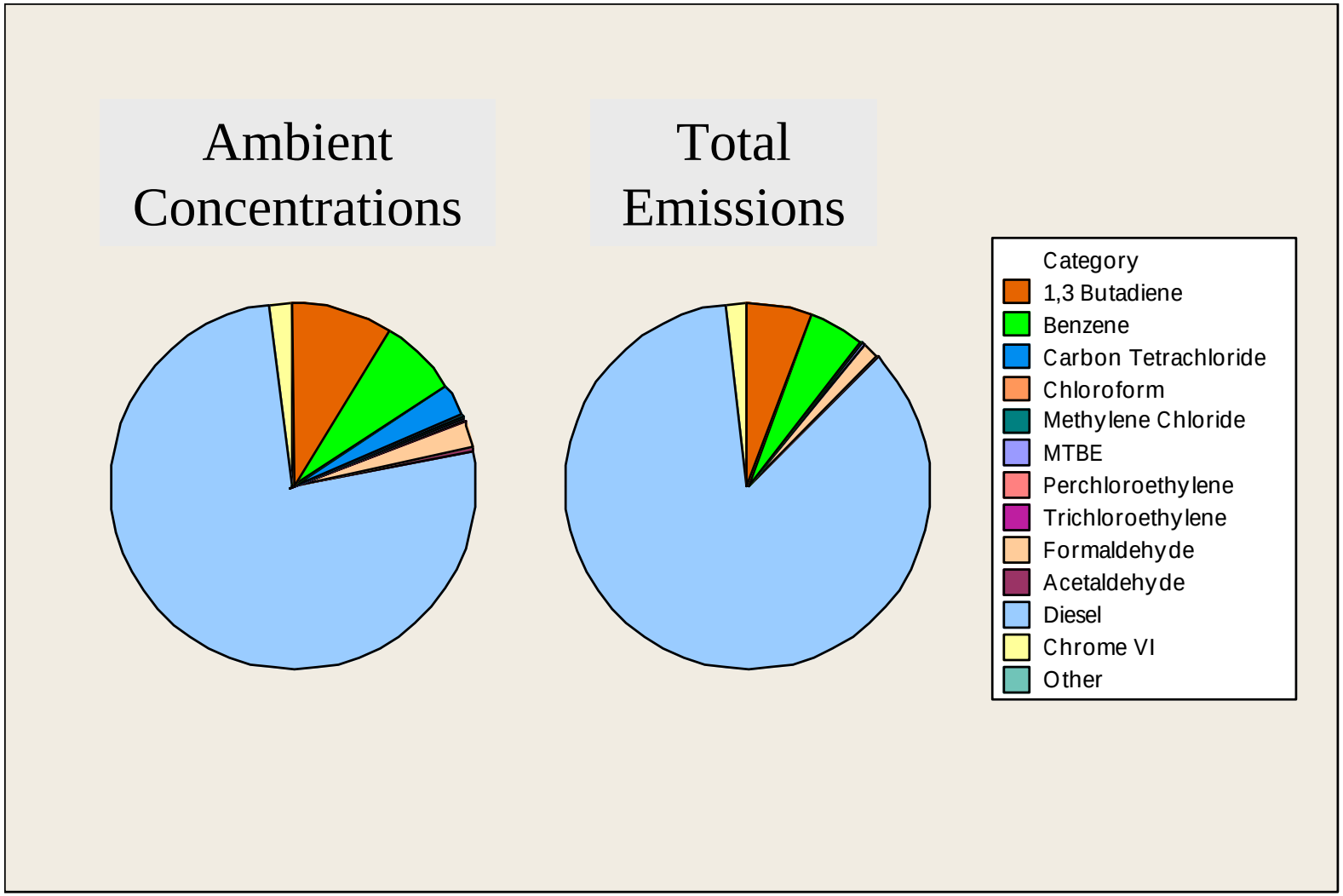
Cancer Risk: Emissions vs. Ambient San Jose



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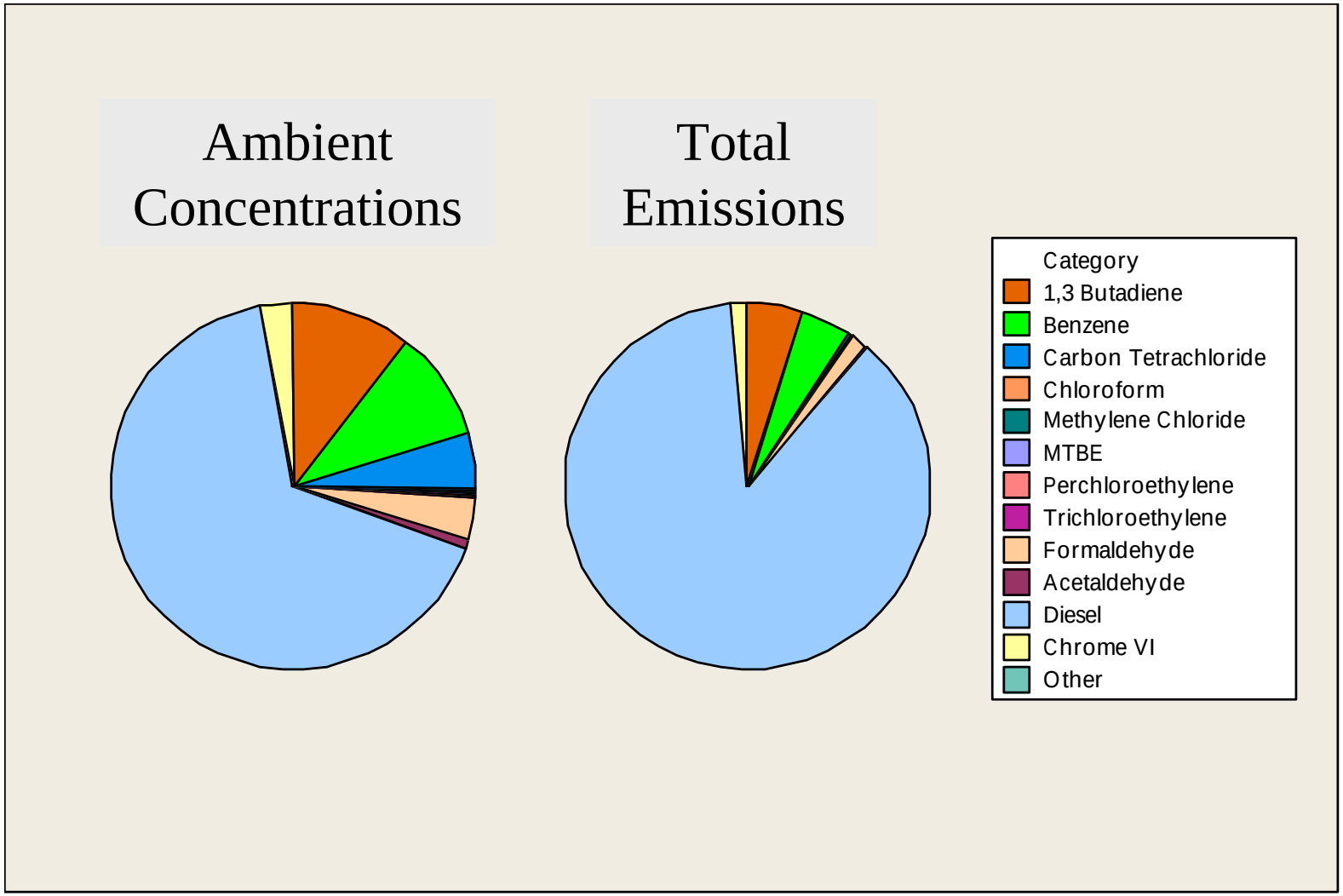
Cancer Risk: Emissions vs. Ambient Concord



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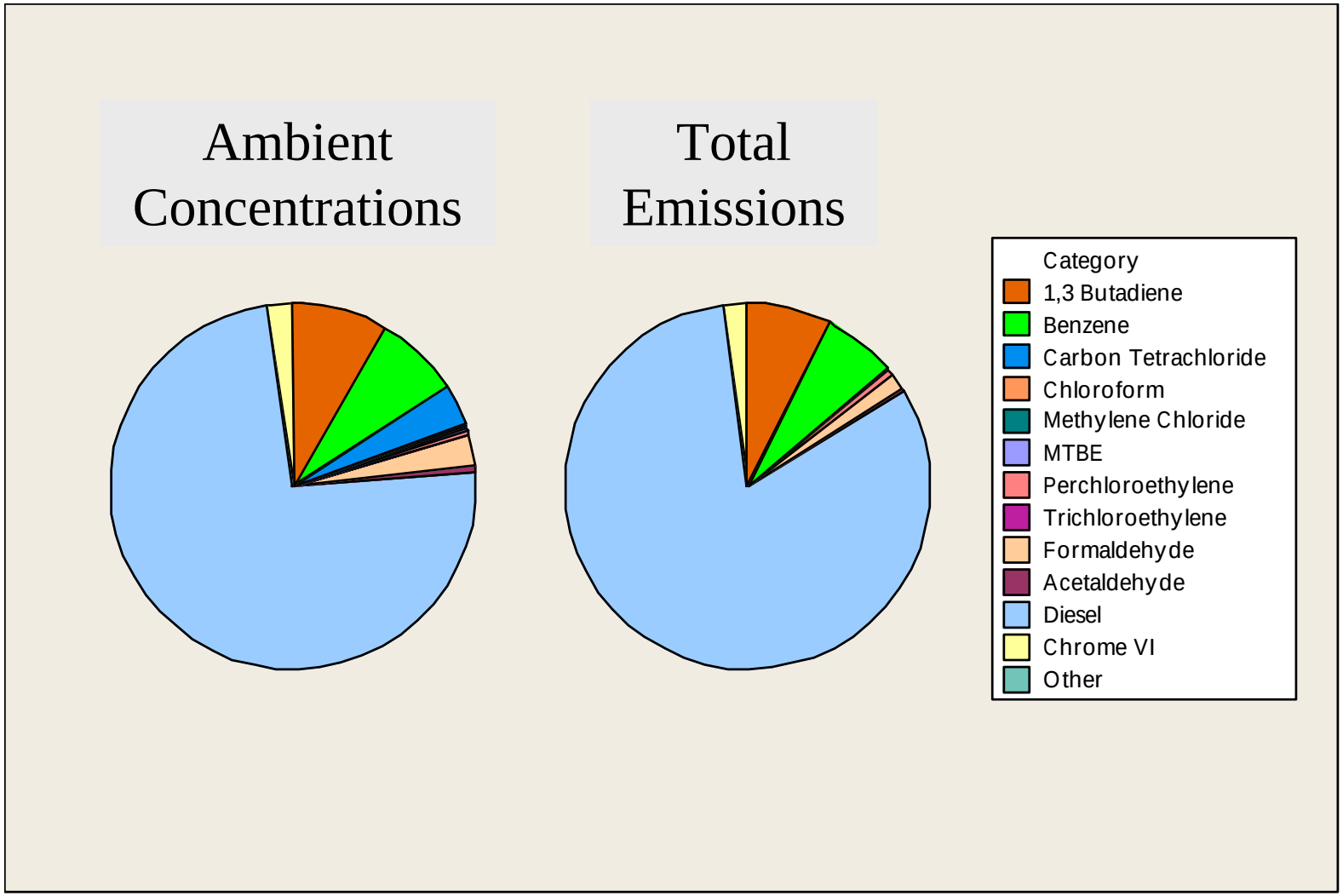
Cancer Risk: Emissions vs. Ambient Fremont



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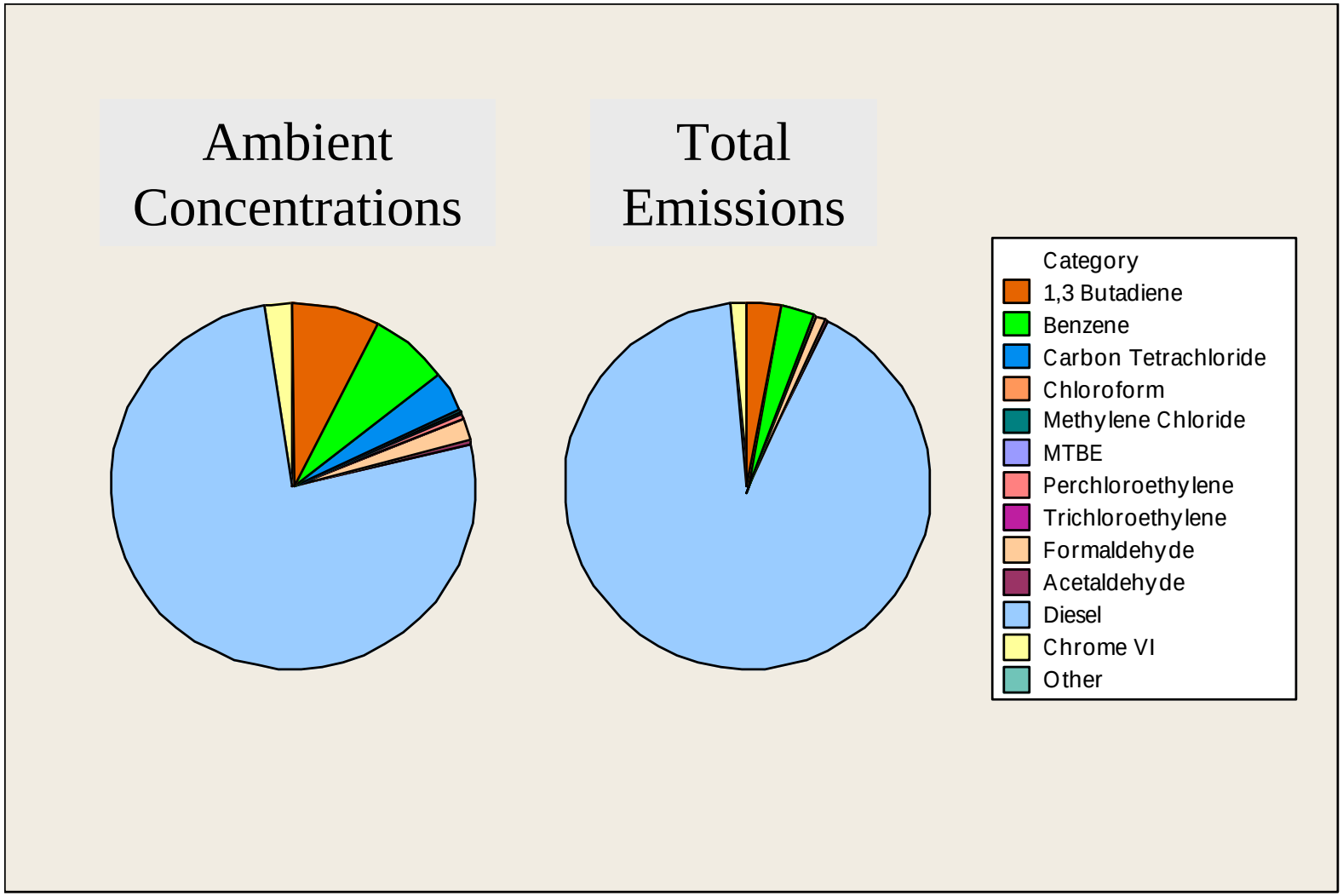
Cancer Risk: Emissions vs. Ambient San Francisco



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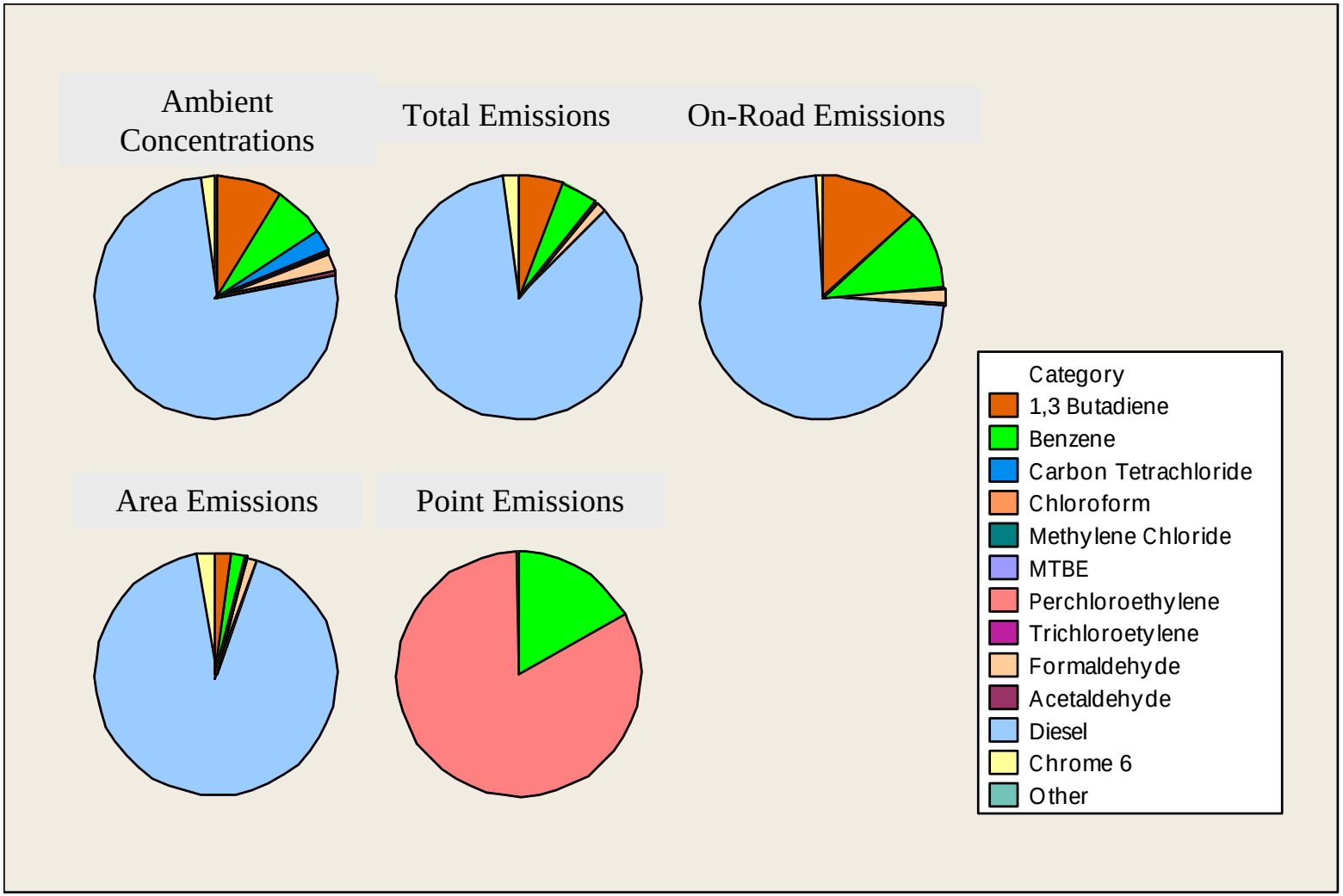
Cancer Risk: Emissions Categories vs. Ambient for San Jose



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Risk Comparison Summary

- **Good match between ambient and emissions risk estimates**

  ➔ Diesel by far the greatest risk, followed by benzene and 1,3-butadiene

  ➔ Risk overlap from 79% to 92%

- **Emissions inventory diesel risk somewhat greater than ambient**

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Risk Uncertainties

- **Risks from wood-burning, cooking, and gasoline PM emissions may also have aggregate risks greater than the sum of the individual component risks, as with diesel.**
- **There may be compounds with significant risk that are not yet recognized.**
- **There are considerable uncertainties in diesel concentrations. BAAQMD now measures EC at a number of sites.**
- **A sensitivity analysis shows that omitted compounds Ethylene Dibromide, Ethylene Dichloride and Vinyl Chloride could represent a small increase in risk (at most 5% to 7%).**

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Spatial Correlations

- **For a given toxic compound:**

  Comparison between emissions inventory at various sites with annual average measurements at those sites.

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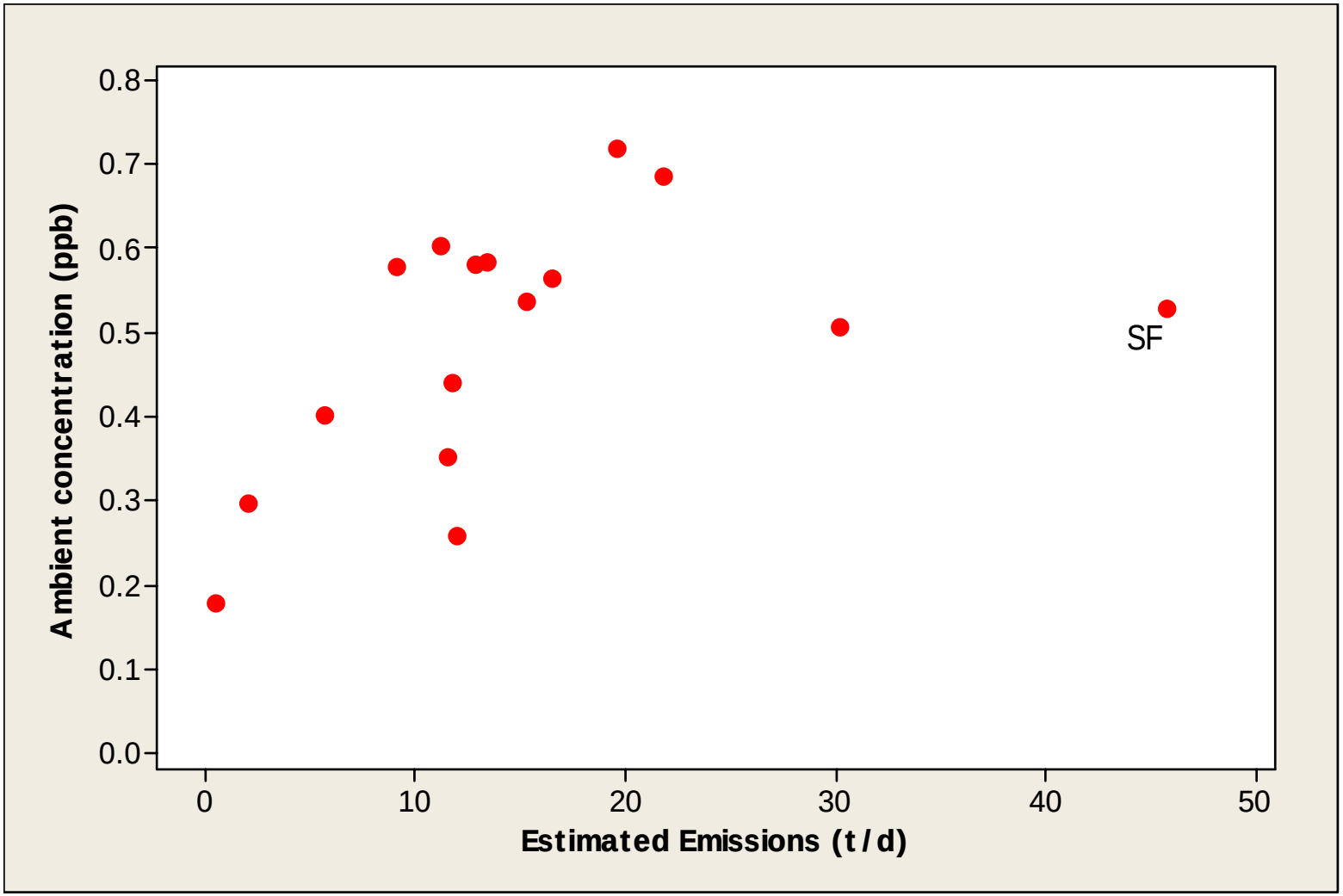
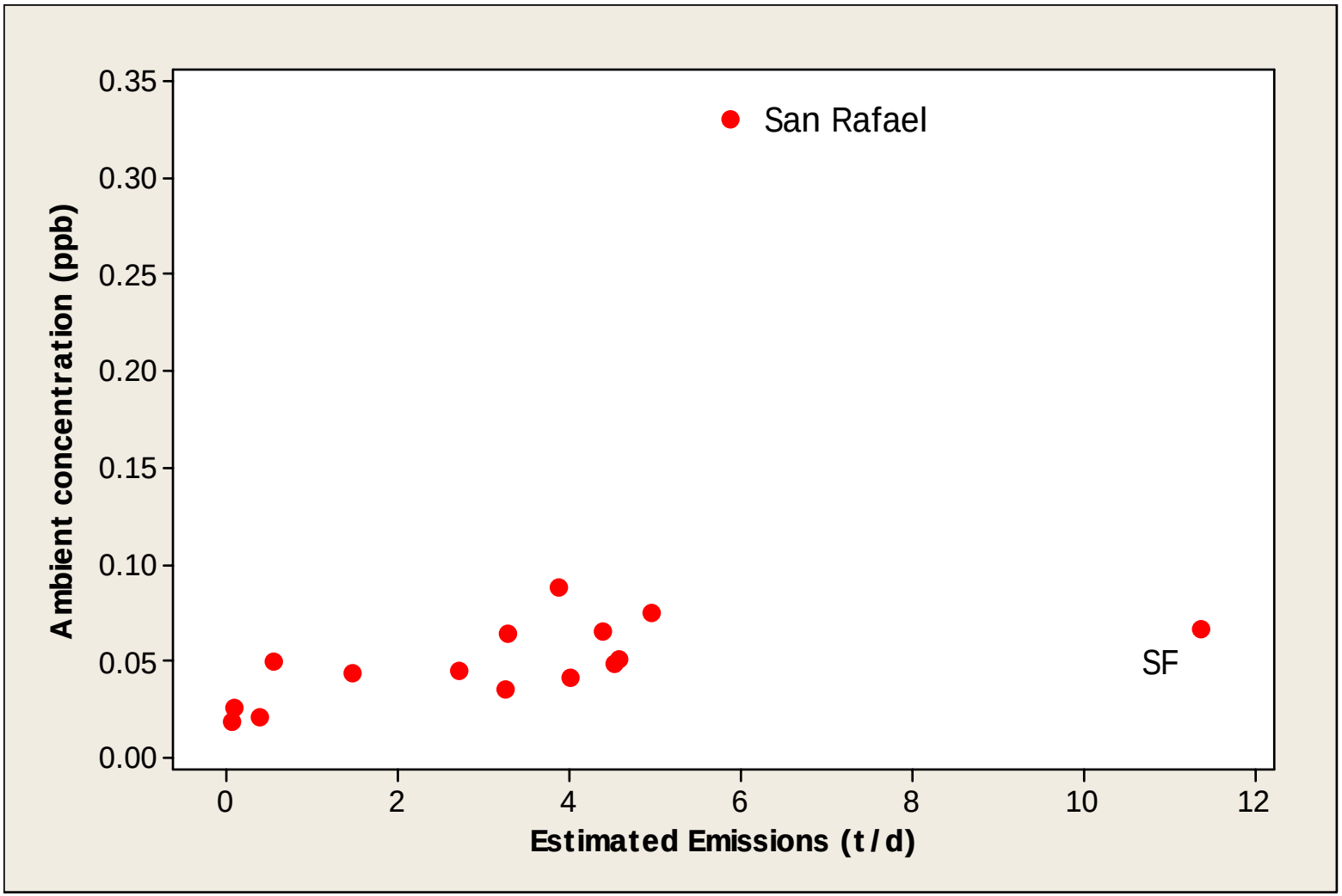
Benzene: Ambient Concentrations vs. Emissions across sites



Perchloroethylene: Ambient Concentrations vs. Emissions across sites



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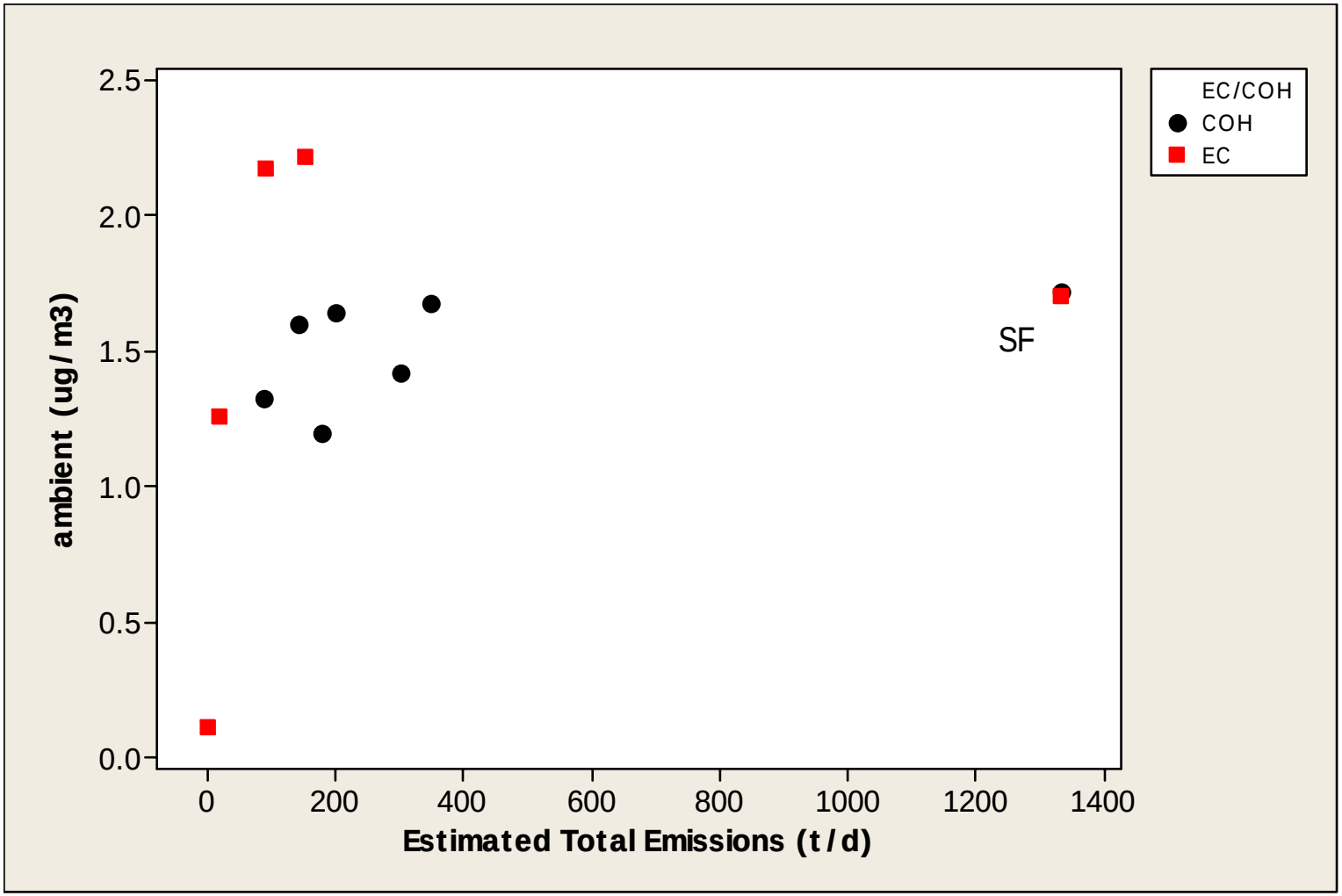
Diesel: Ambient Concentrations vs. Emissions across sites



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Spatial Summary

- **Modest correlations across sites for a given toxic**

➔ **Doesn't imply problem with inventory – monitors measure concentrations at a point; inventory estimates are an average over 2x2 km grid. Prevailing winds or localized conditions can make the two different.**

➔ **Not a large variation across sites for most toxics.**

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Summary & Conclusions

- **Good agreement between emissions fractions and ambient concentrations at most sites.**
- **Good agreement between risk components based on emissions and those based on ambient concentrations.**
- **Diesel emissions may be overestimated. Might be a problem with the area source inventory, perhaps construction equipment.**
- **Modest correlations across sites for given toxics.**
- **Need to do more than look at emission totals in 2x2km cells to estimate community-level exposures. (Phase II)**

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Measurement Issues

- Many measurements below limits of detection (LOD)
- In forming averages, used ½ LOD for observations < LOD
- BAAQMD and ARB LODs sometimes different
- Set of toxics measured by BAAQMD and ARB labs somewhat different
- Carbon Tetrachloride – special case (mainly background)

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Summary of BAAQMD Toxics Measurements

- **Means little affected by LOD:**

  Benzene, MTBE, Perchloroethylene, 1,1,1-Trichloroethane, and Toluene
- **Means affected by LOD (but still included in comparison):**

  1,3-Butadiene, Chloroform, Methylene Chloride, and Trichloroethylene
- **Excluded because 100% below LOD:**

  Ethylene Dibromide, Ethylene Dichloride, and Vinyl Chloride
- **Excluded (except for risk calculations) because sources overwhelmingly background:**

  Carbon Tetrachloride

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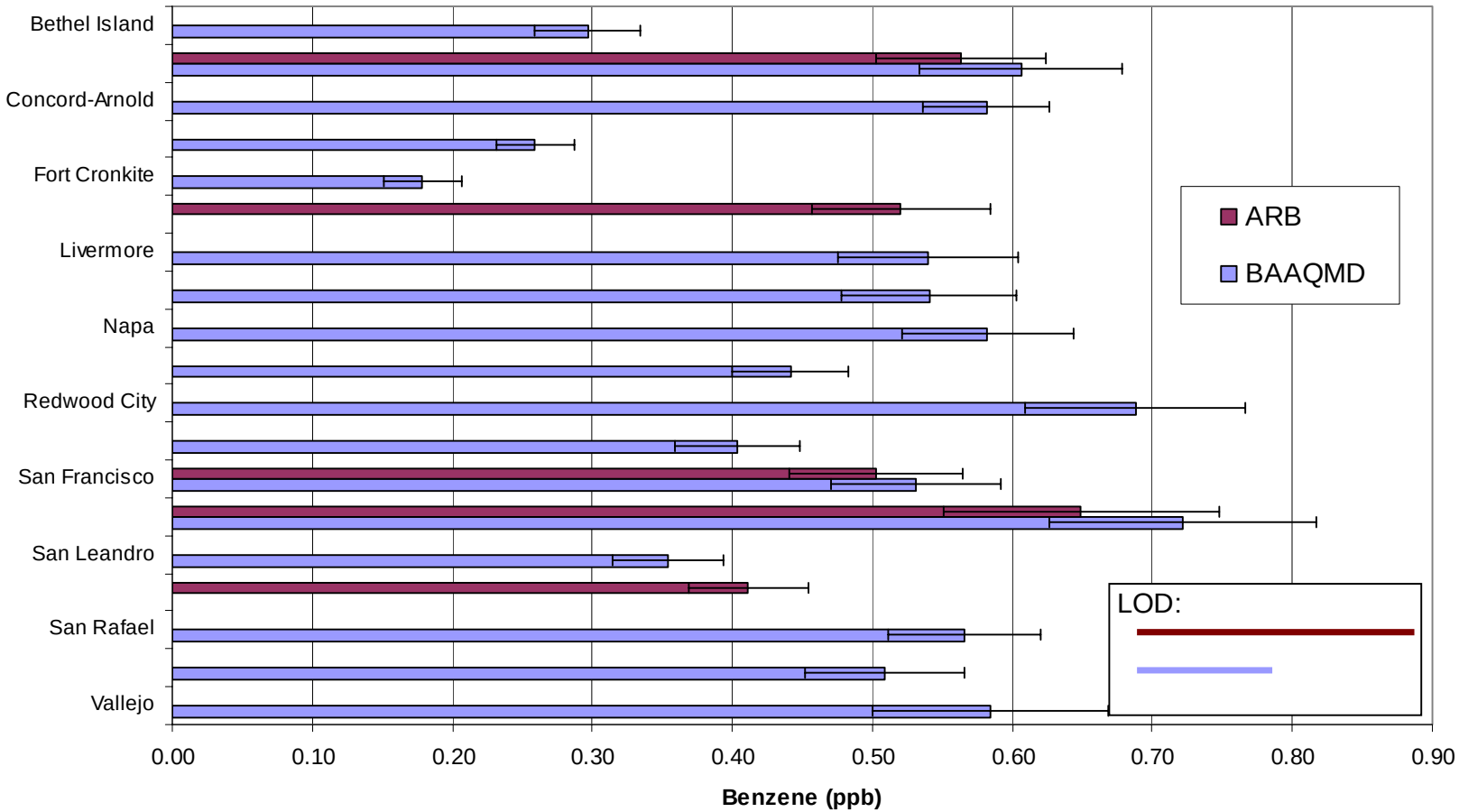
Mean Ambient Benzene Concentrations 1999-2001



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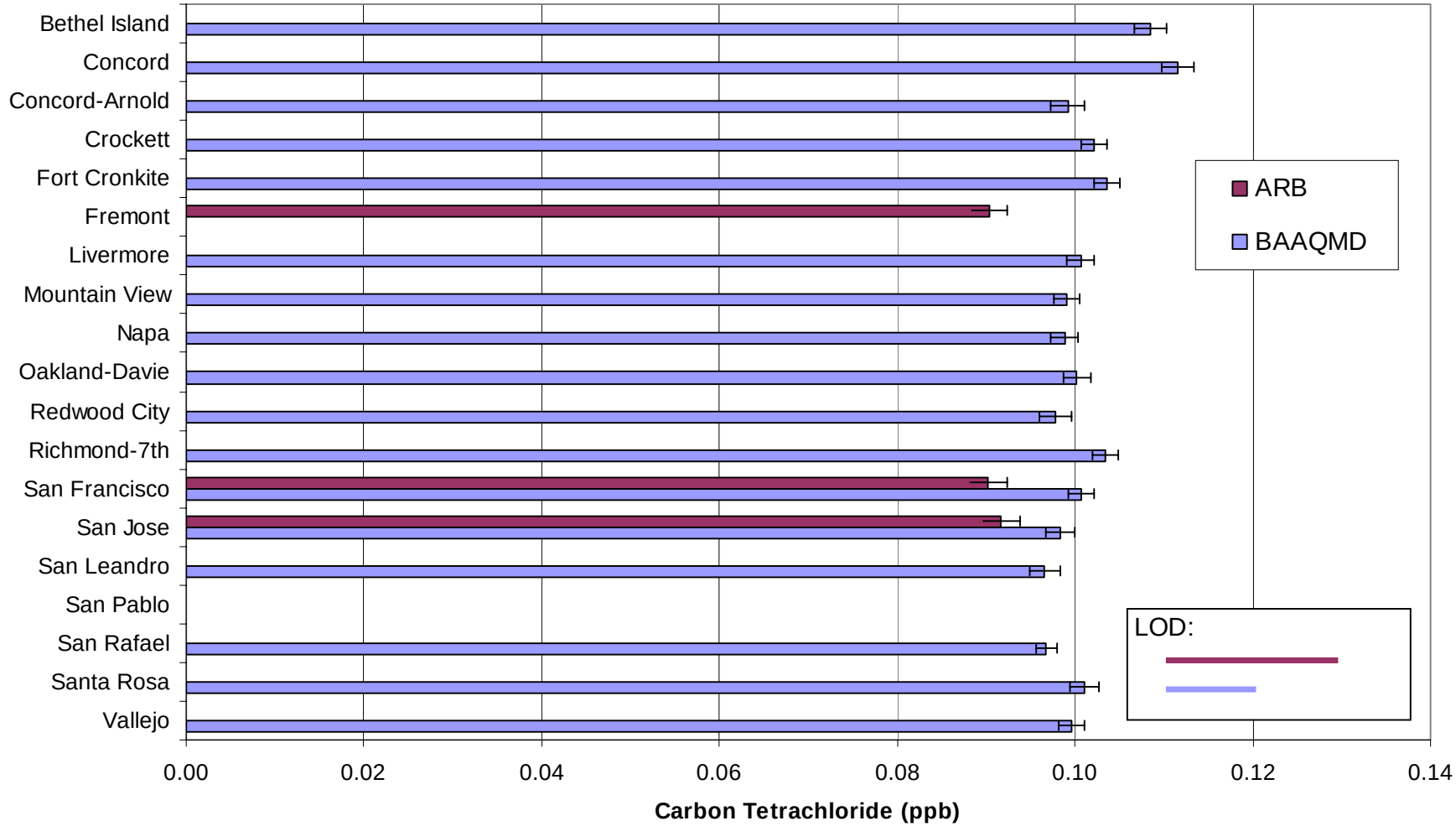
Mean Ambient Carbon Tet. Concentrations 1999-2001



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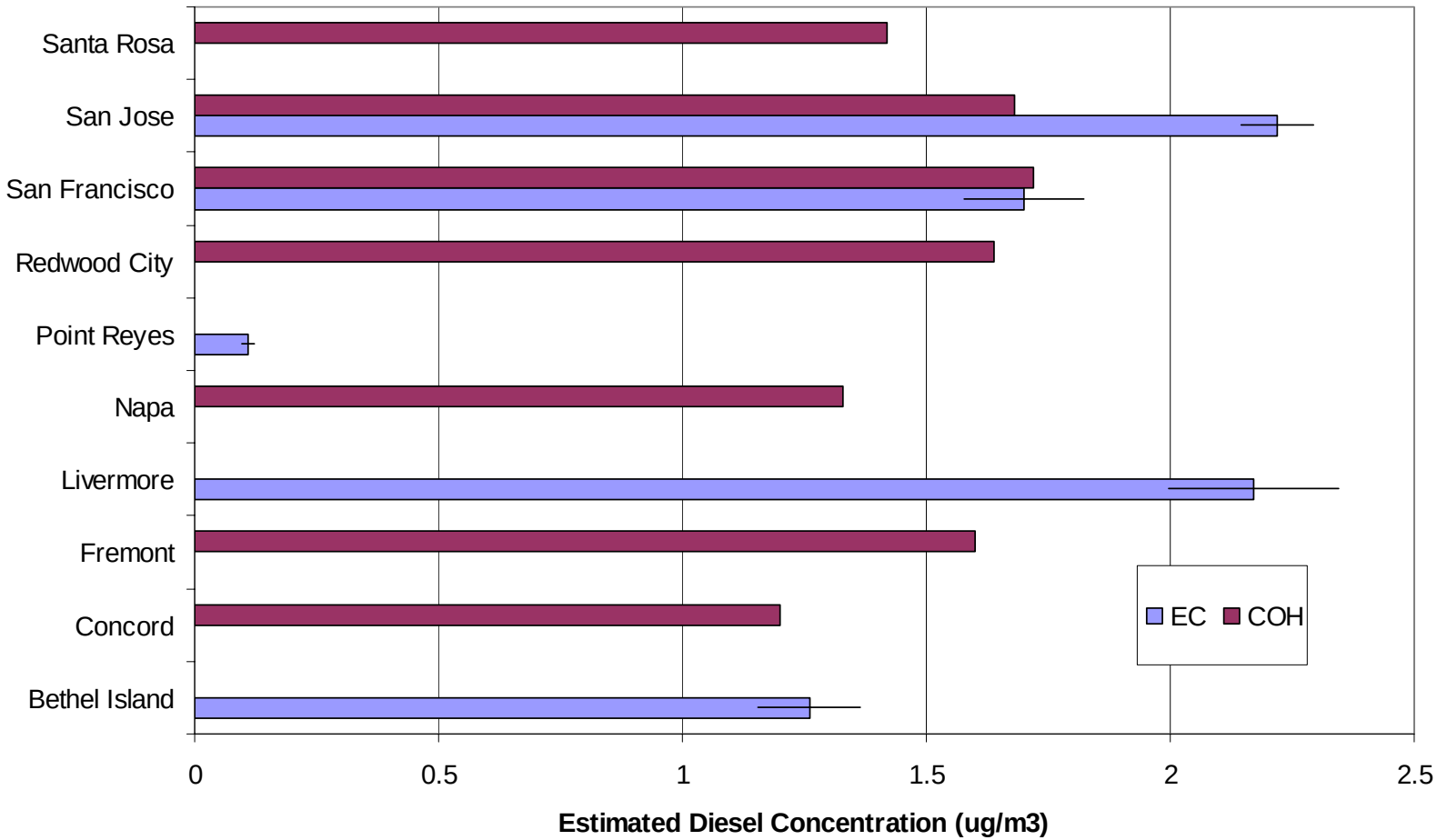
Estimated Average Diesel Concentrations 1999-2001 using EC and COH

(Error bars don't include error in converting EC to diesel)



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Diesel Risk Fraction: Emissions vs. Ambient