

Impact of particulate matter (PM) emissions from ships, locomotives, and freeways in the communities near the Ports of Los Angeles (POLA) and Long Beach (POLB) on the air quality in the Los Angeles County

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Introduction

- Particulate matter (PM) emissions from combustion sources related to goods movement, including ships, diesel trucks, and locomotives, contribute significantly to air pollution all around the globe.
- Ship and locomotive emissions and their increasingly widespread use worldwide has raised concerns on their overall contribution to air quality deterioration and health impacts, especially in areas adjacent to these sources.
- The Ports of Los Angeles (POLA) and Long Beach (POLB), together known as the San Pedro Bay Ports, represent the biggest seaway cargo movement/handling facility in the U.S. in terms of both cargo value and container traffic with a complex sources of PM emissions (Ships, Locomotives, etc.) and are located adjacent to the Long Beach community, which has a population density of nearly 9191 persons/square.

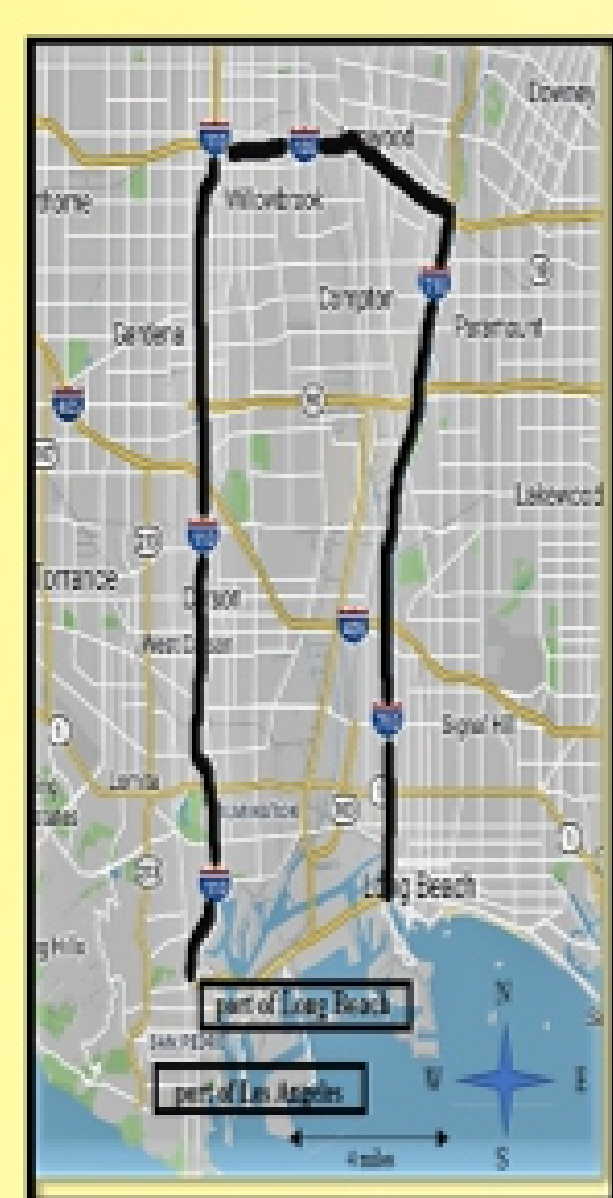
Objectives

- To evaluate the emission rates of PM_{2.5} mass, particle number (PN), and black carbon (BC) from different mobile sources near the San Pedro bay ports and nearby freeways.
- To assess the impact of these emissions on air quality within the "impact zone" of POLA and POLB, and on the air quality in the Los Angeles County.

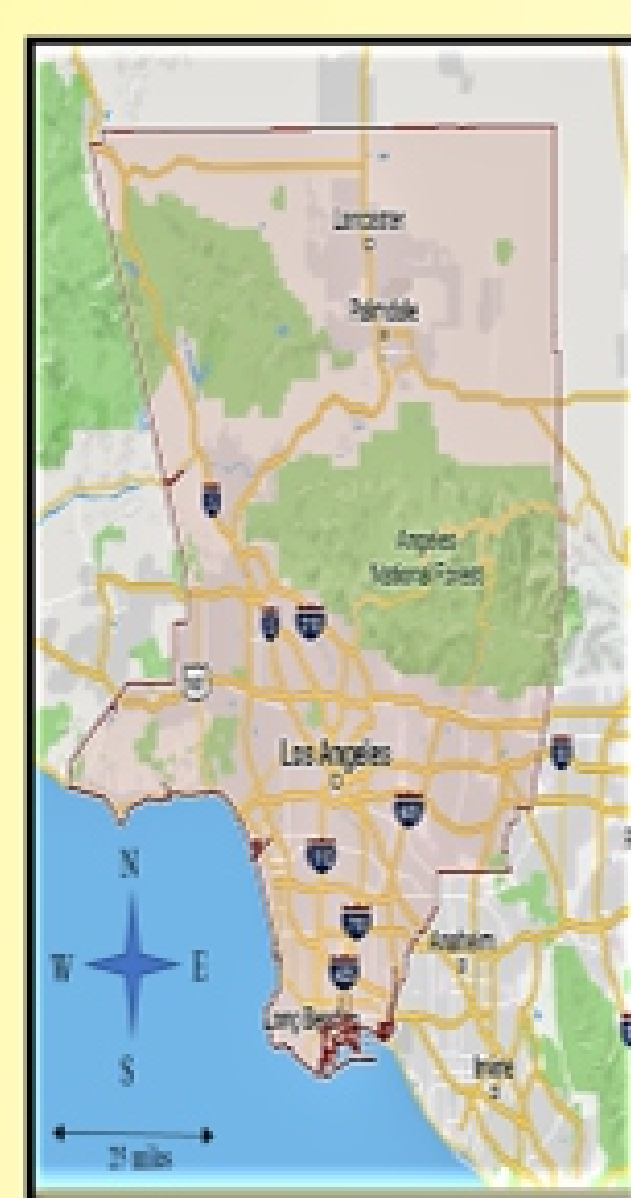
Methodology

Study area:

At the local scale, emissions from POLA and POLB and adjacent freeways were compared in an area limited to the impact zone of the ports, which is defined as the area surrounded by I-105, I-110, I-710, and the ports (Fig.1a). At the regional scale, emissions from ships, locomotives, heavy duty vehicles (HDVs), cargo handling equipment (CHE), and the sum of all freeways in the Los Angeles County (Fig.1b) were evaluated.



(Fig.1a)



(Fig. 2b)

Sampling Period

- Oct.-Nov.2015 for ship emission measurement
- May-Jun. 2017 for on-road (freeway emissions)
- Jun.-July 2014 for locomotives

Instrumentation

On-road and locomotives:

- PN:** Diffusion size classifier (DiSCmini, Testo)
- BC:** MicroAethalometer (AethLabs)
- PM:** DustTrak (TSI)
- CO₂:** Non-dispersive infrared (NDIR) analyzer (Licor)

Ships:

- PN:** Water-based condensation particle counter (TSI)
- BC:** Dual-spot Aethalometer (Magee Scientific)
- PM:** Estimated from the PN concentrations

***Emission factors and emission rates for each source are calculated using values and formulas from the literature (POLB, 2015), (POLA, 2015), (CARB, 2008).**

Results

Fig 2. Relative contributions of major sources at the Ports of Los Angeles (POLA) and Long Beach (POLB) to PM_{2.5}, particle number (PN), and black carbon (BC) emissions:

a) at the local scale; and b) at the regional scale.

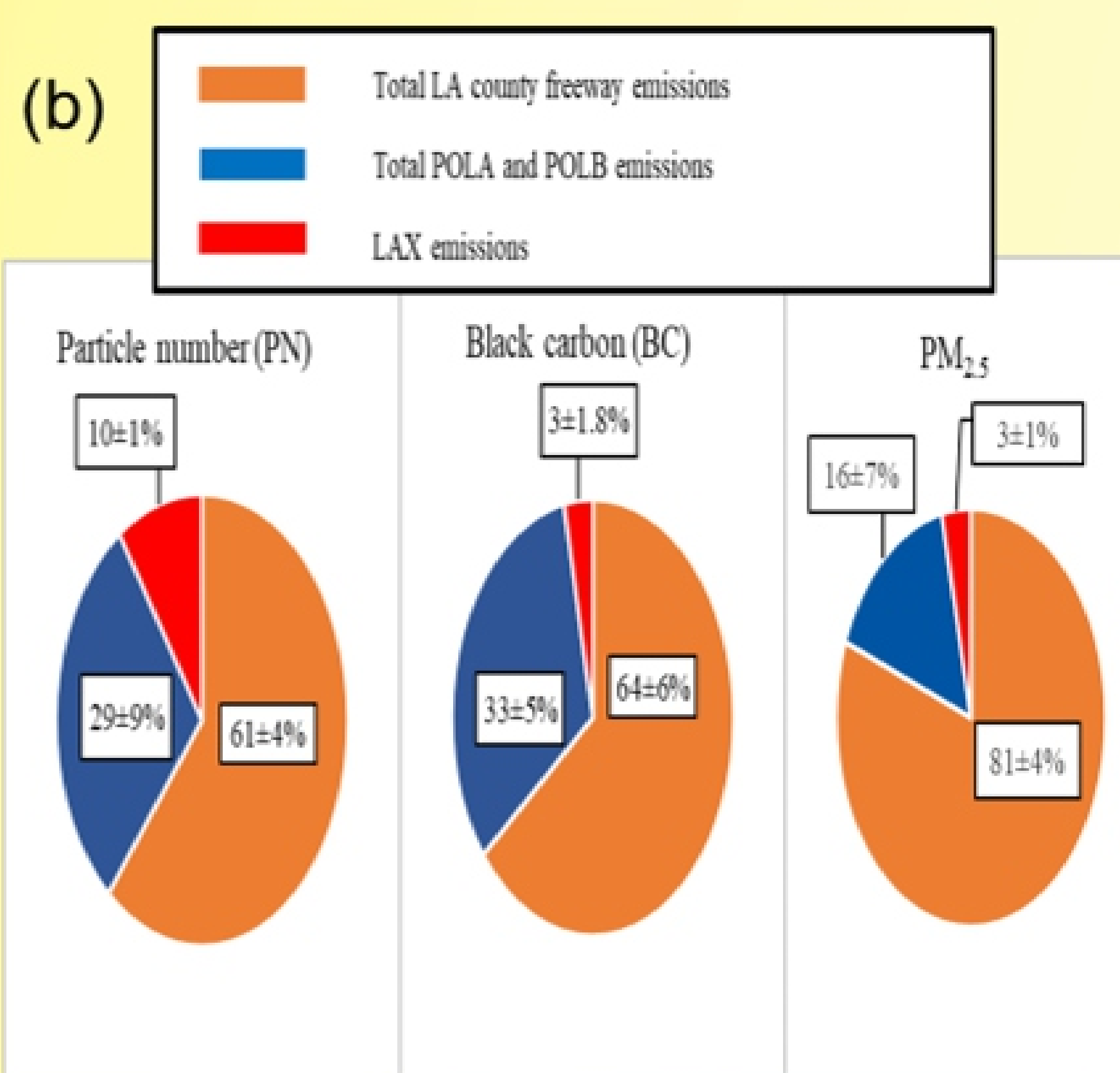
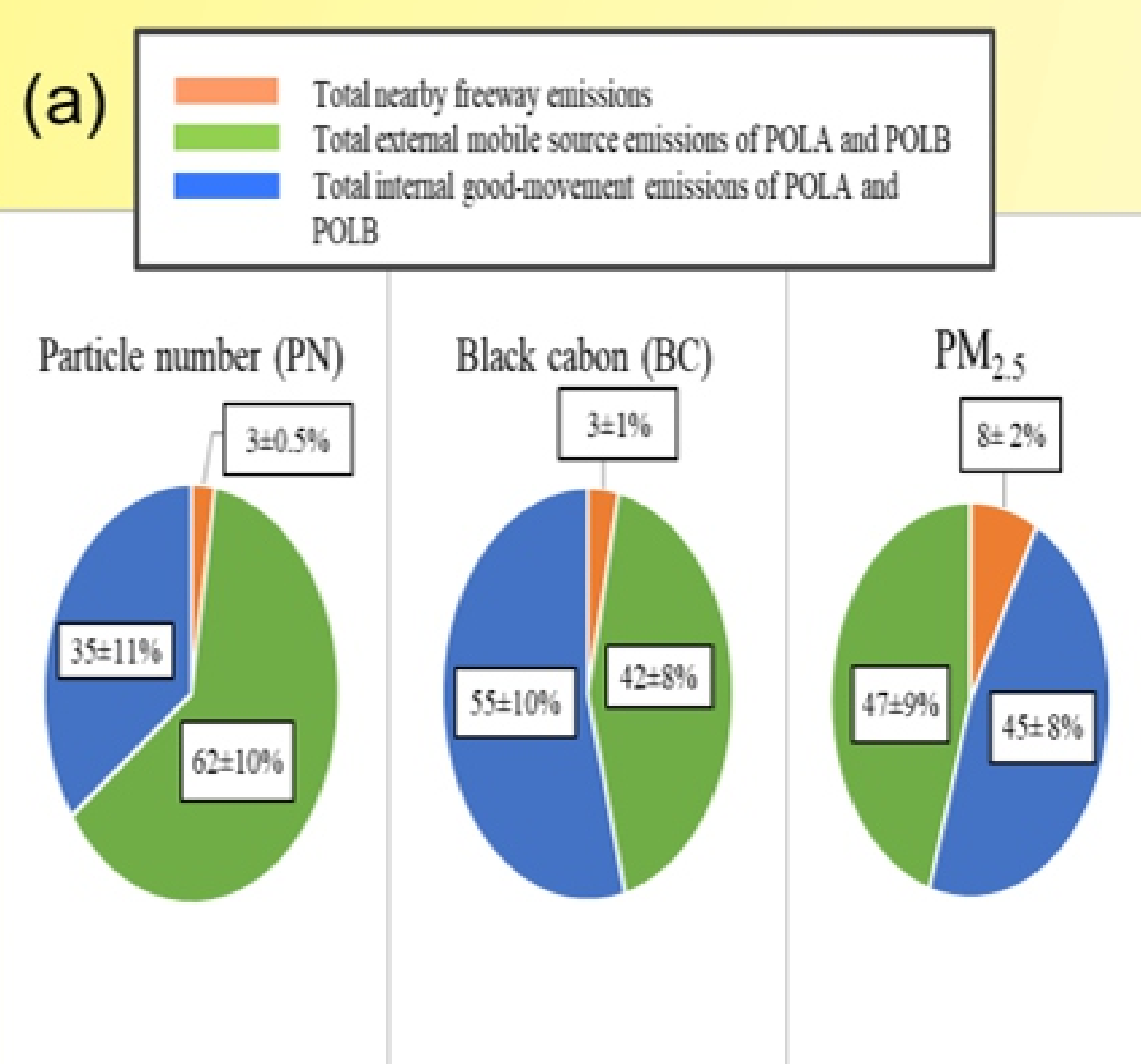
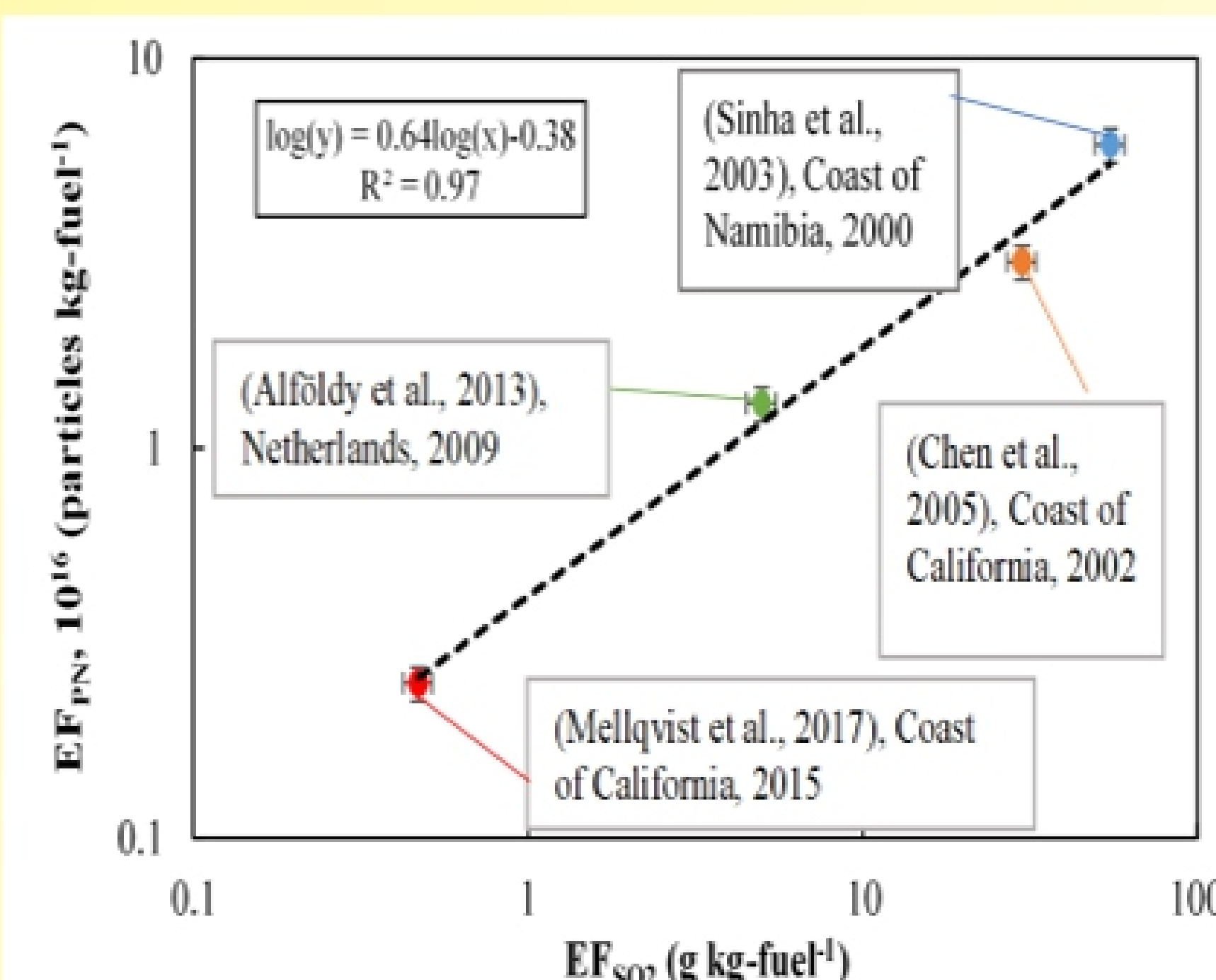


Fig 3. Particle emission factor as a function of SO₂ emission factor for ship emissions from 2000 to 2015.



Conclusions

- Results from the present study indicated that within POLA's and POLB's zone of impact, port-related sources have much larger contributions to PM_{2.5}, PN, and BC emissions; the emission rates from these sources were estimated to be 10-40 times higher than those of the nearby freeways for PM_{2.5}, PN and BC.
- However, at the regional scale, that is the whole Los Angeles County, freeway emissions are the dominant contributor source category to PM_{2.5}, PN, and BC levels, with emission rates of 2-5 times higher than those from sources at POLA and POLB.
- In addition to ship emissions, results from the present study indicated the importance of other mobile sources, such as locomotives, CHE, and HDVs operating at the ports, to the total emissions from POLA and POLB, which can negatively impact the air quality of the communities adjacent to the ports.
- Interestingly, the PM_{2.5} mass and PN emission rates from these seemingly less important sources were estimated to be 1.5-2 times higher than those coming from ships, and in case of BC, emissions from these sources were as much as those from ships and vessels

References

- POLA: air emission inventory, port of Long Beach, August 2014.
- POLB: air emission inventory, port of Long Beach, July 2015.
- CARB: Emissions Estimation Methodology for Ocean-Going Vessels, California Air Resources Board Planning and Technical Support Division, may 2008.

Acknowledgment

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