Spatial and Seasonal Emissions of Road Dust in the Lake Tahoe Basin

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The clarity of water in Lake Tahoe has declined substantially over the past 40 years. Causes of the degradation include nitrogen and phosphorous fertilization of the lake waters and increasing amounts of inorganic fine sediment that can scatter light. Atmospheric deposition is a major source of fine sediment. A year-round monitoring study of road dust emissions around the lake was completed in 2007 using the Testing Re-entrained Aerosol Kinetic Emissions from Roads (TRAKER) system developed at the Desert Research Institute (DRI). Results of this study found that, compared with the summer season, road dust emissions increased by a factor of 5 in winter, on average, and about a factor of 10 when traction control material was applied to the roads after snow events. For winter and summer, road dust emission factors (grams coarse particulate matter [PM10] per vehicle kilometer traveled [g/vkt]) showed a decreasing trend with the travel speed of the road. The highest emission factors were observed on very low traffic volume roads on the west side of the lake. These roads were composed of either a 3/8-in. gravel material or had degraded asphalt. The principle factors influencing road dust emissions in the basin are season, vehicle speed (or road type), road condition, road grade, and proximity to other high-emitting roads. Combined with a traffic volume model, an analysis of the total emissions from the road sections surveyed indicated that urban areas (in particular South Lake Tahoe) had the highest emitting roads in the basin.

The results of this study were published in the October issue of the Journal of Air and Waste Management:

Zhu, D., H.D. Kuhns, S. Brown, J. A. Gillies, V. Etyemezian, A. W. Gertler. (2009) Fugitive Dust Emissions from Paved Road Travel in the Lake Tahoe Basin. Journal of the Air & Waste Management Association. 59, 1219-1929.

Highlights of this paper compare summertime to wintertime emission factors measured around the lake (Figure 1) showing higher concentrations around urban areas and on the west side of the lake.

Figure 2 shows a year round time series of road dust concentrations compared with nearby precipitation records from a Snotel station. Emission increase with snow precipitation and dissipate within approximately one month of the last snowfall.

Emission factors were averaged by road section and season to form the basis for a spatially resolved emission inventory (Table 1).

Recommendations from this study were to:

- Dirty roads with no traffic may not be worth sweeping. Evaluate the cost effectiveness of emission control strategies using the total emission rate from a road (grams per day) rather than the emission factor (grams per vehicle kilometer traveled).
- Establish road sweeping standards for the Tahoe basin including the use of PM_{10}-compliant vacuum sweepers at regular intervals during the summer and after snow storms in winter.
- Seek alternatives to applying gravel chip to community and neighborhood roads. Roads with loose gravel have the highest summertime and wintertime emission factors.
- Maintain roads to a consistent standard. Roads with degrading asphalt have high emission factors.
- Expand the use of anti-icing pretreatment before storms to reduce the amount of traction control material needed to maintain safe travel.

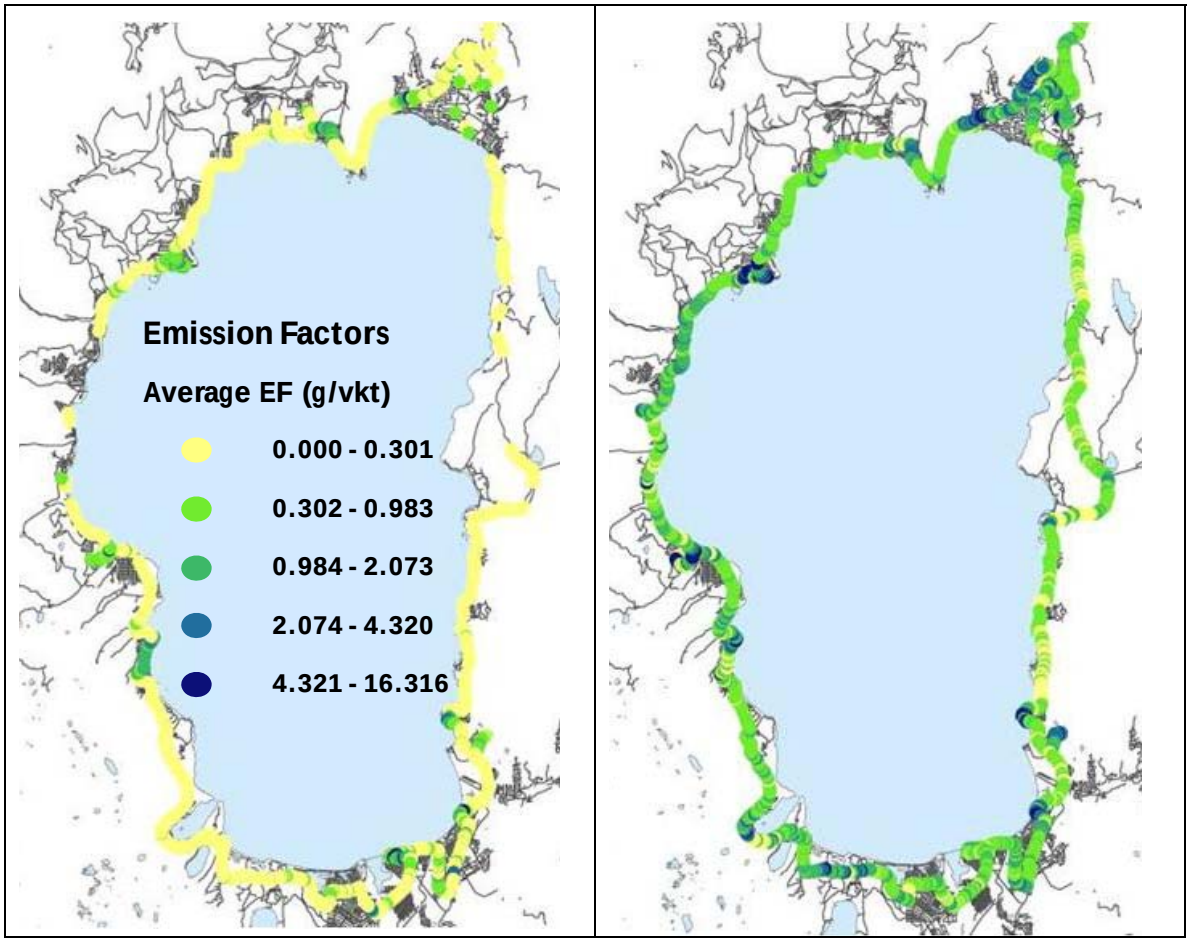

Figure 1 Comparison of summertime (left) and winter time (right) road dust emission factors measured with the TRAKER vehicle. Emission factors are presented in grams of PM_{10} per vehicle kilometer traveled (VKT).

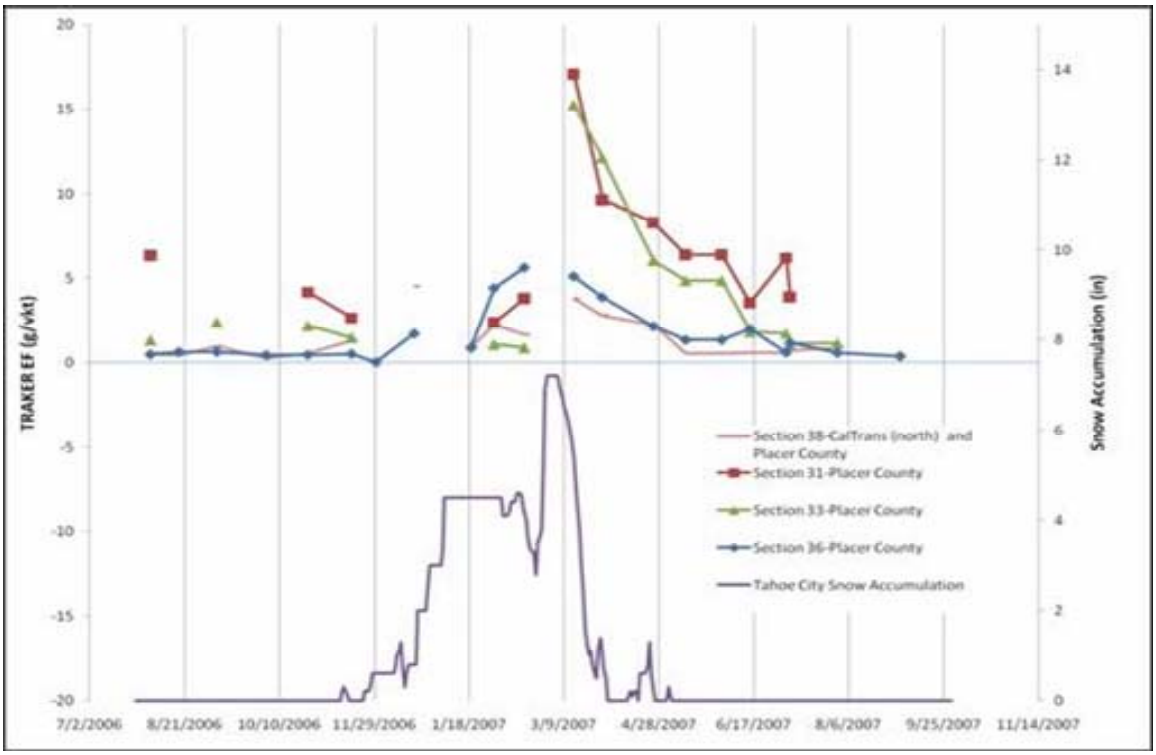

Figure 2 Time series of road dust emission factors from sections on the west side of the lake.

Table 1 Seasonal PM10 Road Dust Emission Factors. Results have been used to generate an emissions inventory modeling for the basin – ~1/3 previous estimate derived using EPA's road dust estimation protocol: AP-42.

Road Type	Maintenance Group	Summer EF (g/vkt)	Winter EF (g/vkt)
Primary	Caltrans N	0.13	0.68
Primary	Caltrans S	0.11	0.57
Primary	NDOT	0.05	0.26
Primary	SLT	0.24	1.05
Primary	Washoe	0.06	0.40
Secondary	Placer	0.66	2.35
Secondary	Washoe	0.15	0.63
Tertiary	El Dorado	2.56	3.46
Tertiary	NV GID	0.61	2.14
Tertiary	Placer	2.15	5.96
Tertiary	SLT	0.66	1.18
Tertiary	Washoe	0.62	1.91