Climate Change Increases Population Exposure to Airborne Particulate Matter During Extreme Events In California

Abdullah Mahmud[1], Mark Hixson[1], and Michael J. Kleeman[1]*

[1]Department of Civil and Environmental Engineering, University of California at Davis, One Shields Ave, Davis CA 95616.

*Corresponding author contact information: Department of Civil and Environmental Engineering, University of California, Davis, One Shields Avenue, Davis, CA 95616: e-mail: mjkleeman@ucdavis.edu, telephone: (530) 752-8386, fax: (530) 752-7872

Supporting Information

Figure S1 shows the future change (%) in population-weighted annual average concentrations of $PM_{0.1}$ in the future (2047-53) compared to the present-day (2000-06) for California and the three air basins of interest. The population-weighted annual average concentration of $PM_{0.1}$ total mass was predicted to decrease by ~9% in California during future years (2047-53) relative to present years (2000-06) with the majority of this change occurring in the SoCAB (Fig. S1). Primary $PM_{0.1}$ source contributions to EC and OC concentrations decreased in the SV but increased in the SJV and SoCAB. Secondary

$PM_{0.1}$ component concentrations decreased in the SoCAB with mixed results in the SV and SJV.

Figure S2 shows the future change (%) in population-weighted annual average concentrations of PM_{10} in the future (2047-53) compared to the present-day (2000-06) for California and the three air basins of interest. Patterns for PM_{10} total mass, component species, trace metals, and contributions from different sources were similar to $PM_{2.5}$ patterns. PM_{10} total mass was predicted to decrease by ~3% in California in the future. Concentrations of EC, OC, S(VI), and N(-III) were predicted to decrease in the range between ~1-4%. Population-weighted concentrations of trace metals, and contributions from different sources were also predicted to decrease in the future by as much as ~3-6%.

Figure S3 shows the distribution of population-weighted daily average $PM_{2.5}$ total mass concentrations for 1008 days of present climate (panel a) and 1008 days of future climate (panel b). The 24-hr average concentrations in both analysis periods are approximately normally distributed with a slightly lower mean value in the future compared to present-day. Extreme values (99^{th} percentile) range from 16.5-19.2 $\mu g\ m^{-3}$ in the present climate and 16.6-24.7 $\mu g\ m^{-3}$ in the future climate.

Figure S4 displays the population-weighted average $PM_{0.1}$ concentrations during extreme events. No statistically significant climate-induced changes in $PM_{0.1}$ concentrations were detected for any species or source contribution (as the 90% confidence interval spans zero). Figure S5 displays the climate effects on population-weighted PM_{10}

concentrations during extreme events. Population-weighted concentrations of PM_{10} total mass, chemical species, trace metals and primary source contributions are predicted to increase in the future for the SV and SJV, with smaller changes in the SoCAB. The total mass concentration of PM_{10} was predicted to increase by 9% in California, 39% in the SV, 47% in the SJV and only -7% in the SoCAB. Once again, the 90% confidence interval spans zero for the majority of these results relative to the inter-annual variability. The only statistically significant trends displayed in Fig. S5 are an increase in population-weighted concentrations of primary diesel PM (SJV) and a decrease in primary shipping PM (statewide).

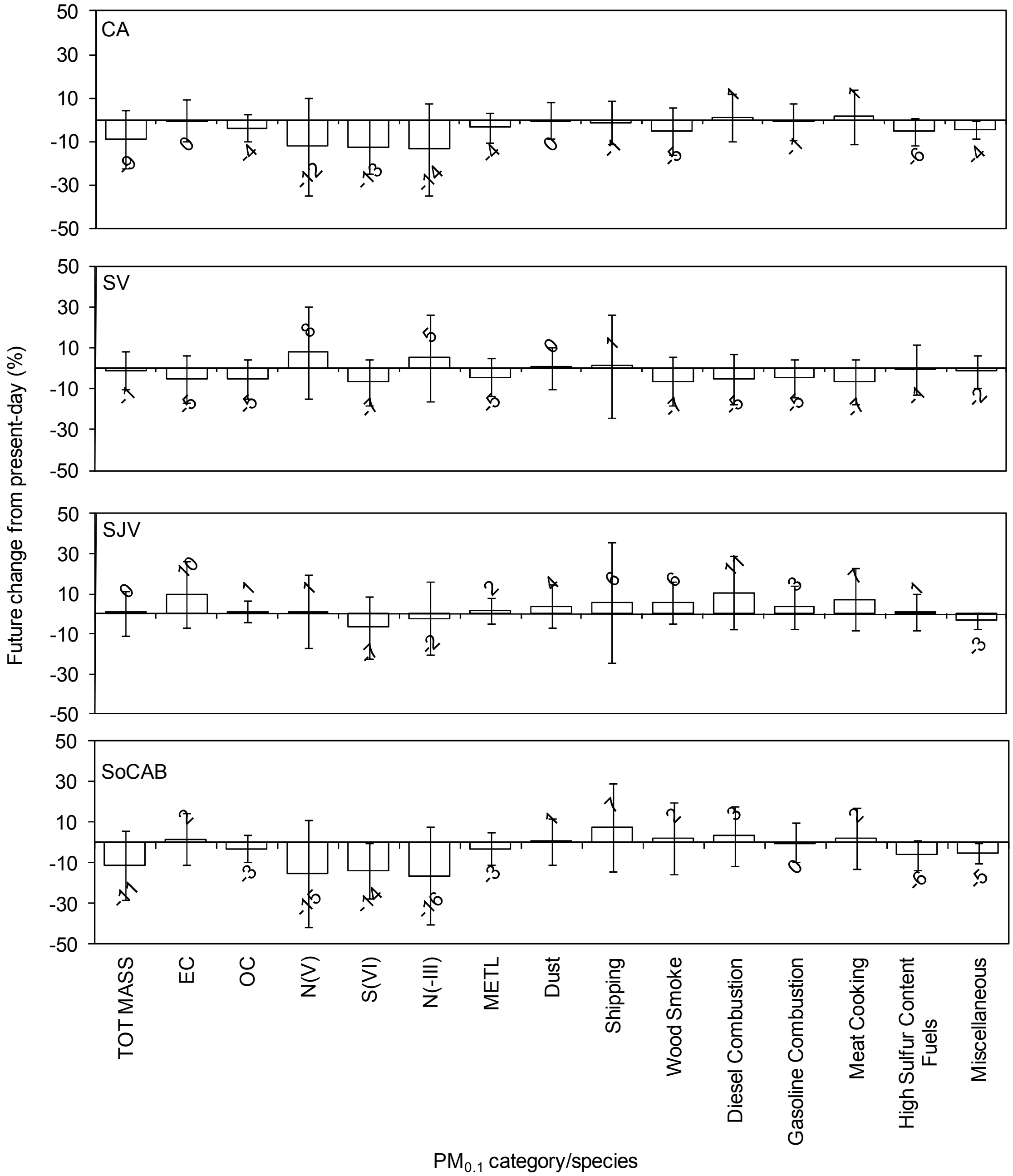

Fig. S1. Future (2047-53) change in population-weighted annual-average concentrations of $PM_{0.1}$ total mass, primary and secondary components, trace metal and source categories contributing to the total mass from present-day (2000-06). Panels (top-down) show California state-wide, Sacramento Valley (SV) air basin, San Joaquin Valley (SJV) air basin, and South Coast Air Basin (SoCAB) average results. The error bars represent the lower and upper limits of the 90% CI.

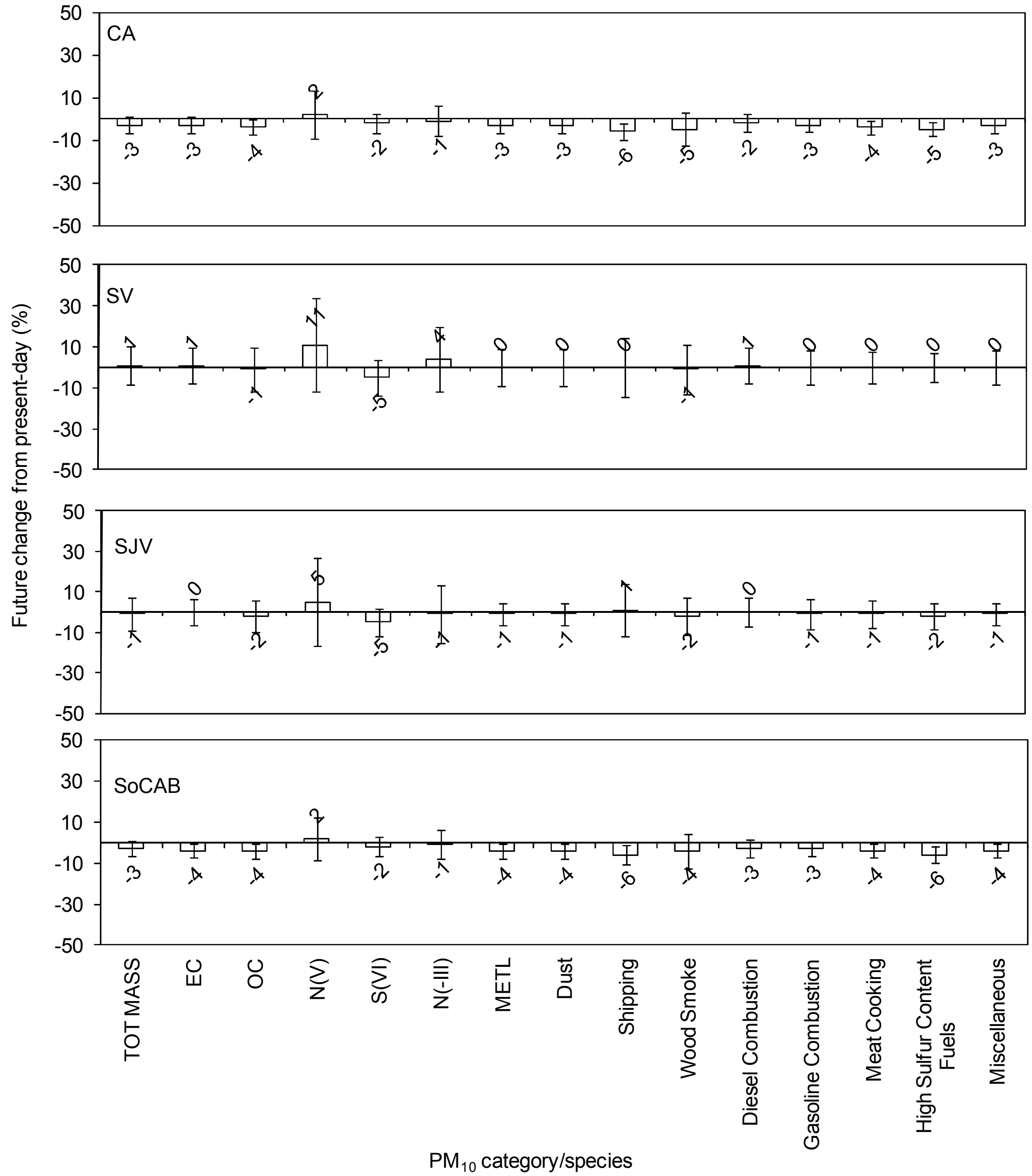

Fig. S2. Future (2047-53) change in population-weighted annual-average concentrations of PM_{10} total mass, primary and secondary components, trace metal and source categories contributing to the total mass from present-day (2000-06). Panels (top-down) show California state-wide average, Sacramento Valley (SV) air basin average, San Joaquin Valley (SJV) air basin average, and South Coast Air Basin (SoCAB) average results. The error bars represent the lower and upper limits of the 90% CI.

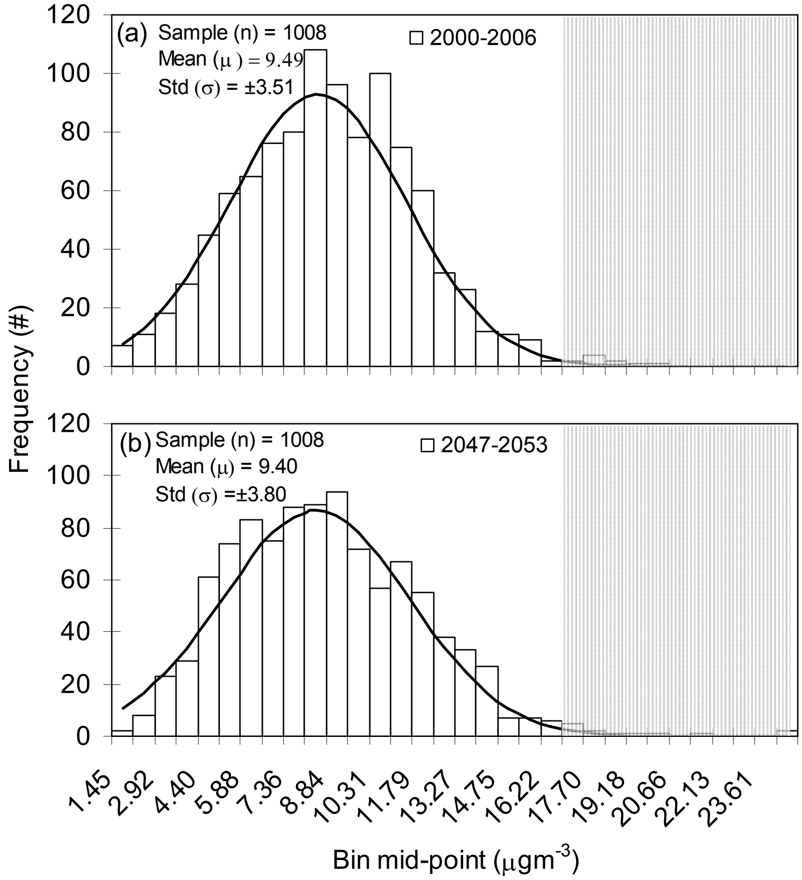

Fig. S3. Frequency distribution of 24-hr average population-weighted $PM_{2.5}$ total mass concentrations for California under the (a) present-day (2000-2006) and (b) future (2047-2053) climate conditions. The shaded regions encompass values higher than the 99th percentile value of each distribution.

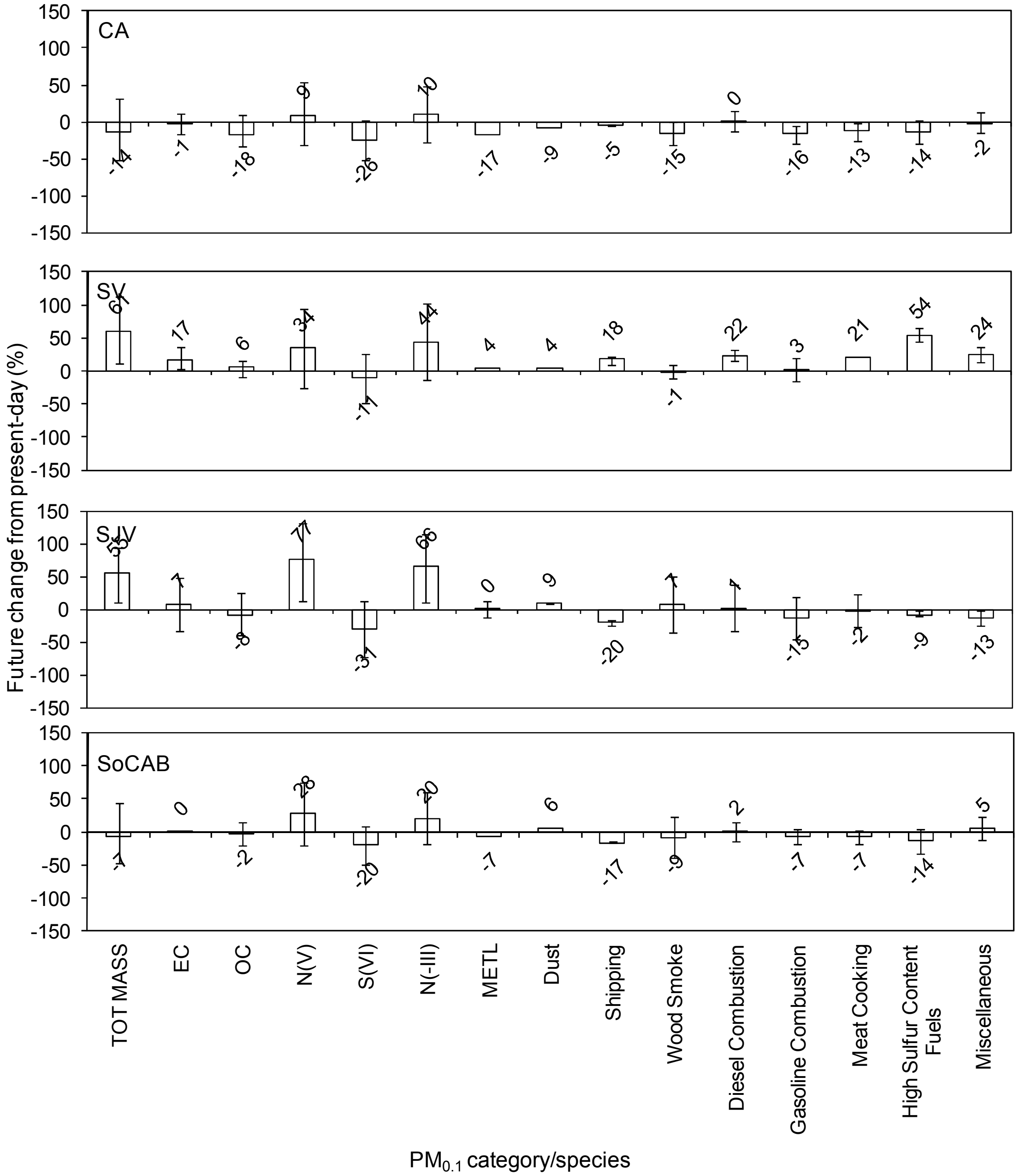

Fig. S4. Difference between the future (2047-53) and present-day (2000-2006) 10-year return level values of population-weighted $PM_{0.1}$ mass and species concentrations, and contributions to primary total mass concentrations from different sources for California (CA), Sacramento Valley (SV), San Joaquin Valley (SJV), and South Coast Air Basin (SoCAB) averages. Error bars represent the lower and upper limits of the 90% CI.

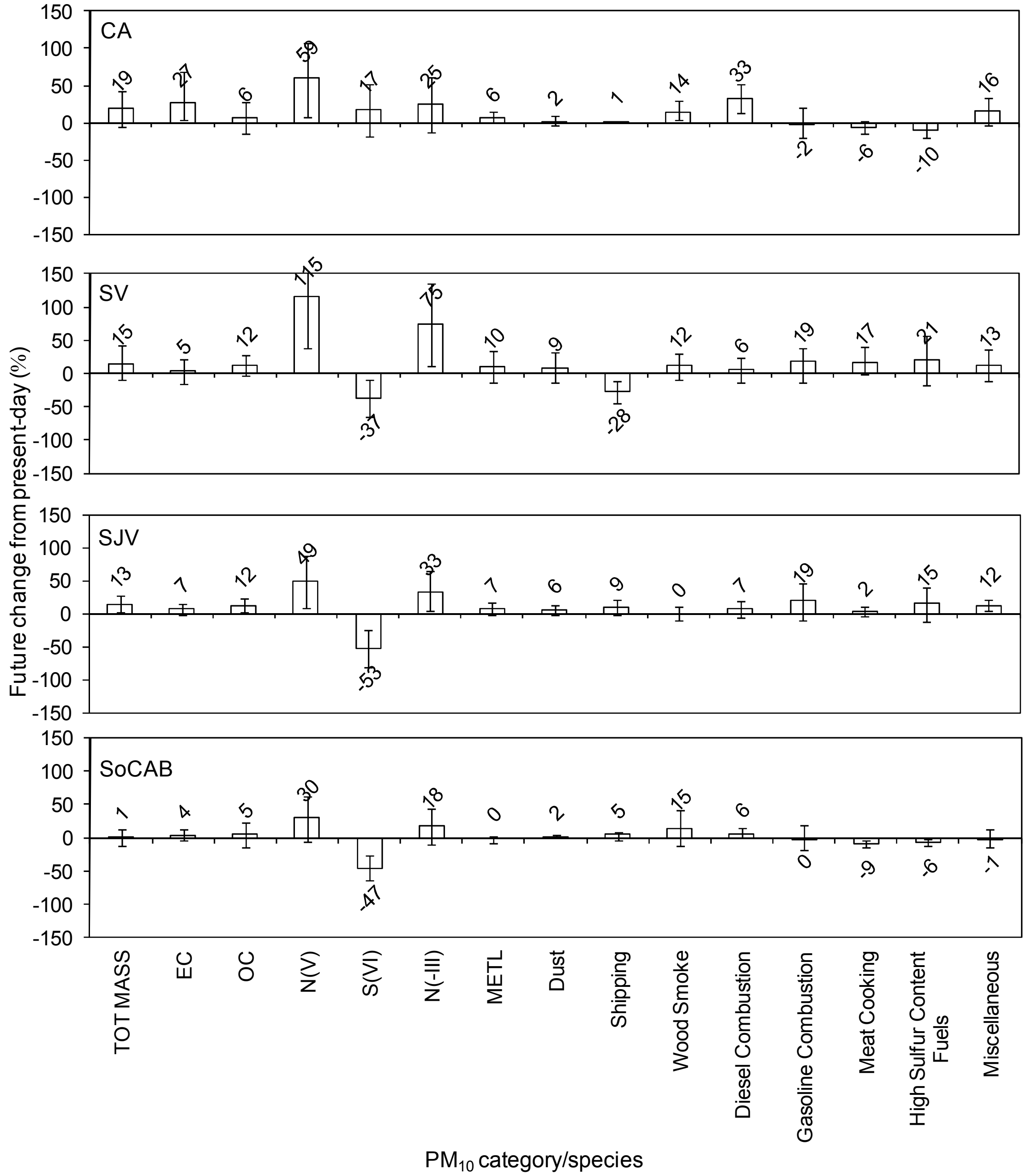

Fig. S5. Difference between the future (2047-53) and present-day (2000-2006) 10-year return level values of population-weighted PM_{10} mass and species concentrations, and contributions to primary total mass concentrations from different sources for California (CA), Sacramento Valley (SV), San Joaquin Valley (SJV), and South Coast Air Basin (SoCAB) averages. Error bars represent the lower and upper limits of the 90% CI.