**Supplemental Information**

**Uncertainty Associated with Ambient Ozone Metrics in Epidemiologic Studies and Risk Assessments**

Benjamin Wells[1], Heather Simon*[1], Thomas J. Luben[2], Zachary Pekar[1], Scott M. Jenkins[1]
[1]Office of Air Quality Planning and Standards, US Environmental Protection Agency, RTP, NC
[2]National Center for Environmental Assessment, US Environmental Protection Agency, RTP, NC

*Address correspondence to Heather Simon, 109 T.W. Alexander Dr., Research Triangle Park, NC 27711 USA. Telephone: (919) 541-1803. E-mail: Simon.Heather@epa.gov.

**Table S1.** Number of days above threshold values for each city in the base dataset

| Urban Area | Total number of days | Number of days above | | | | |
|---|---|---|---|---|---|---|
| | | 40 ppb | 50 ppb | 60 ppb | 70 ppb | 80 ppb |
| Bakersfield, CA | 1070 | 1062 | 986 | 859 | 687 | 494 |
| Birmingham, AL | 1070 | 832 | 624 | 417 | 239 | 105 |
| Chicago, IL | 1070 | 746 | 477 | 238 | 113 | 48 |
| Dallas, TX | 1070 | 918 | 714 | 514 | 340 | 204 |
| Fresno, CA | 1070 | 1055 | 990 | 824 | 649 | 458 |
| Houston, TX | 1070 | 801 | 620 | 468 | 337 | 242 |
| Los Angeles, CA | 1070 | 1004 | 815 | 609 | 413 | 255 |
| Phoenix, AZ | 1070 | 1045 | 923 | 662 | 324 | 110 |
| San Bernardino, CA | 1070 | 1067 | 1032 | 893 | 712 | 550 |
| San Diego, CA | 1070 | 1030 | 906 | 645 | 363 | 165 |
| Tucson, AZ | 1070 | 1005 | 774 | 393 | 105 | 8 |

**Table S2.** Statistics from the analysis of variance in individual monitors as a function of the composite monitor for the base dataset (Smith Study Areas, April – October, 1996 – 2000)

| Urban Area | Number of monitors | Coefficient of Determination ($R^2$)[1] | Slope of EVF Regression Line[2] | P-value for EVF Regression Line Slope ≠ 0 | P-value for Breusch-Pagan Test |
|---|---|---|---|---|---|
| Bakersfield, CA | 7 | 0.804 | 0.090 | <0.0001 | <0.0001 |
| Birmingham, AL | 5 | 0.921 | 0.065 | <0.0001 | <0.0001 |
| Chicago, IL | 12 | 0.773 | 0.087 | <0.0001 | <0.0001 |
| Dallas, TX | 5 | 0.896 | 0.064 | <0.0001 | <0.0001 |
| Fresno, CA | 5 | 0.893 | 0.017 | 0.0012 | <0.0001 |
| Houston, TX | 9 | 0.850 | 0.139 | <0.0001 | <0.0001 |
| Los Angeles, CA | 12 | 0.610 | 0.278 | <0.0001 | <0.0001 |
| Phoenix, AZ | 5 | 0.812 | 0.009 | 0.3717 | 0.3940 |
| San Bernardino, CA | 8 | 0.698 | 0.217 | <0.0001 | <0.0001 |
| San Diego, CA | 8 | 0.545 | 0.139 | <0.0001 | <0.0001 |
| Tucson, AZ | 5 | 0.743 | -0.011 | 0.0845 | 0.0987 |

[1]Based on a regression between the individual monitor values and the composite monitor
[2]Slope of the regression line between the empirical variance function (EVF) and concentration

**Table S3.** Statistics from the analysis of variance in individual monitors as a function of the composite monitor for the first alternative dataset (CBSA, April – October, 1996-2000)

| Urban Area | Number of monitors | Coefficient of Determination ($R^2$)[1] | Slope of EVF Regression Line[2] | P-value for EVF Regression Line Slope ≠ 0 | P-value for Breusch-Pagan Test |
|---|---|---|---|---|---|
| Albuquerque, NM | 5 | 0.814 | -0.010 | 0.3170 | 0.1917 |
| Atlanta, GA | 6 | 0.817 | 0.146 | <0.0001 | <0.0001 |
| Bakersfield, CA | 7 | 0.804 | 0.090 | <0.0001 | <0.0001 |
| Baltimore, MD | 6 | 0.907 | 0.059 | <0.0001 | <0.0001 |
| Baton Rouge, LA | 9 | 0.849 | 0.080 | <0.0001 | <0.0001 |
| Birmingham, AL | 6 | 0.906 | 0.069 | <0.0001 | <0.0001 |
| Charlotte, NC | 5 | 0.863 | 0.086 | <0.0001 | <0.0001 |
| Chicago, IL | 23 | 0.766 | 0.072 | <0.0001 | <0.0001 |
| Cincinnati, OH | 8 | 0.890 | 0.020 | 0.0001 | <0.0001 |
| Cleveland, OH | 6 | 0.867 | 0.051 | <0.0001 | <0.0001 |
| Dallas, TX | 5 | 0.896 | 0.064 | <0.0001 | <0.0001 |
| Fresno, CA | 5 | 0.893 | 0.017 | 0.0012 | <0.0001 |
| Houston, TX | 11 | 0.788 | 0.160 | <0.0001 | <0.0001 |
| Los Angeles, CA | 13 | 0.614 | 0.271 | <0.0001 | <0.0001 |
| Louisville, KY | 5 | 0.897 | 0.032 | <0.0001 | <0.0001 |
| Miami, FL | 5 | 0.860 | 0.059 | <0.0001 | <0.0001 |
| Milwaukee, WI | 5 | 0.907 | 0.063 | <0.0001 | <0.0001 |
| Nashville, TN | 6 | 0.827 | 0.077 | <0.0001 | <0.0001 |
| New Orleans, LA | 6 | 0.894 | 0.069 | <0.0001 | <0.0001 |
| New York, NY | 11 | 0.808 | 0.086 | <0.0001 | <0.0001 |
| Philadelphia, PA | 10 | 0.878 | 0.055 | <0.0001 | <0.0001 |
| Phoenix, AZ | 5 | 0.812 | 0.009 | 0.3717 | 0.3940 |
| Pittsburgh, PA | 11 | 0.880 | 0.048 | <0.0001 | <0.0001 |
| Riverside, CA | 10 | 0.681 | 0.219 | <0.0001 | <0.0001 |
| Sacramento, CA | 8 | 0.702 | 0.123 | <0.0001 | <0.0001 |
| Saint Louis, MO | 16 | 0.845 | 0.079 | <0.0001 | <0.0001 |
| San Diego, CA | 8 | 0.545 | 0.139 | <0.0001 | <0.0001 |
| San Francisco, CA | 9 | 0.486 | 0.368 | <0.0001 | <0.0001 |
| San Jose, CA | 6 | 0.538 | 0.072 | <0.0001 | <0.0001 |
| Tampa, FL | 7 | 0.894 | 0.034 | <0.0001 | <0.0001 |
| Tucson, AZ | 5 | 0.743 | -0.011 | 0.0845 | 0.0987 |
| Washington, DC | 11 | 0.881 | 0.038 | <0.0001 | <0.0001 |

[1]Based on a regression between the individual monitor values and the composite monitor
[2]Slope of the regression line between the empirical variance function (EVF) and concentration

**Table S4.** Statistics from the analysis of variance in individual monitors as a function of the composite monitor for the second alternative dataset (Smith, January – December, 1996-2000)

| Urban Area | Number of monitors | Coefficient of Determination ($R^2$)[1] | Slope of EVF Regression Line[2] | P-value for EVF Regression Line Slope ≠ 0 | P-value for Breusch-Pagan Test |
|---|---|---|---|---|---|
| Bakersfield, CA | 6 | 0.918 | 0.011 | 0.1937 | 0.0063 |
| Fresno, CA | 5 | 0.935 | 0.009 | 0.0071 | 0.0004 |
| Los Angeles, CA | 11 | 0.805 | 0.142 | <0.0001 | <0.0001 |
| San Bernardino, CA | 8 | 0.795 | 0.129 | <0.0001 | <0.0001 |
| San Diego, CA | 6 | 0.817 | 0.056 | <0.0001 | <0.0001 |
| Tucson, AZ | 5 | 0.740 | -0.067 | <0.0001 | <0.0001 |

[1]Based on a regression between the individual monitor values and the composite monitor
[2]Slope of the regression line between the empirical variance function (EVF) and concentration

**Table S5.** Statistics from the analysis of variance in individual monitors as a function of the composite monitor for the third alternative dataset (Smith, April - October, 2011-2015)

| Urban Area | Number of monitors | Coefficient of Determination ($R^2$)[1] | Slope of EVF Regression Line[2] | P-value for EVF Regression Line Slope ≠ 0 | P-value for Breusch-Pagan Test |
|---|---|---|---|---|---|
| Birmingham, AL | 5 | 0.910 | 0.064 | <0.0001 | <0.0001 |
| Chicago, IL | 8 | 0.895 | 0.037 | <0.0001 | <0.0001 |
| Dallas, TX | 8 | 0.887 | 0.075 | <0.0001 | <0.0001 |
| El Paso, TX | 5 | 0.855 | 0.044 | <0.0001 | <0.0001 |
| Fresno, CA | 5 | 0.853 | 0.118 | <0.0001 | <0.0001 |
| Houston, TX | 12 | 0.902 | 0.086 | <0.0001 | <0.0001 |
| Las Vegas, NV | 8 | 0.892 | 0.015 | 0.0227 | 0.0001 |
| Los Angeles, CA | 9 | 0.480 | 0.229 | <0.0001 | <0.0001 |
| New York, NY | 5 | 0.904 | 0.034 | <0.0001 | <0.0001 |
| Phoenix, AZ | 18 | 0.782 | 0.044 | <0.0001 | <0.0001 |
| Riverside, CA | 7 | 0.471 | 0.208 | <0.0001 | <0.0001 |
| Sacramento, CA | 7 | 0.844 | 0.110 | <0.0001 | <0.0001 |
| San Bernardino, CA | 8 | 0.694 | 0.130 | <0.0001 | <0.0001 |
| San Diego, CA | 7 | 0.479 | 0.035 | 0.0170 | 0.0041 |
| Tucson, AZ | 8 | 0.893 | 0.020 | <0.0001 | <0.0001 |

[1]Based on a regression between the individual monitor values and the composite monitor
[2]Slope of the regression line between the empirical variance function (EVF) and concentration

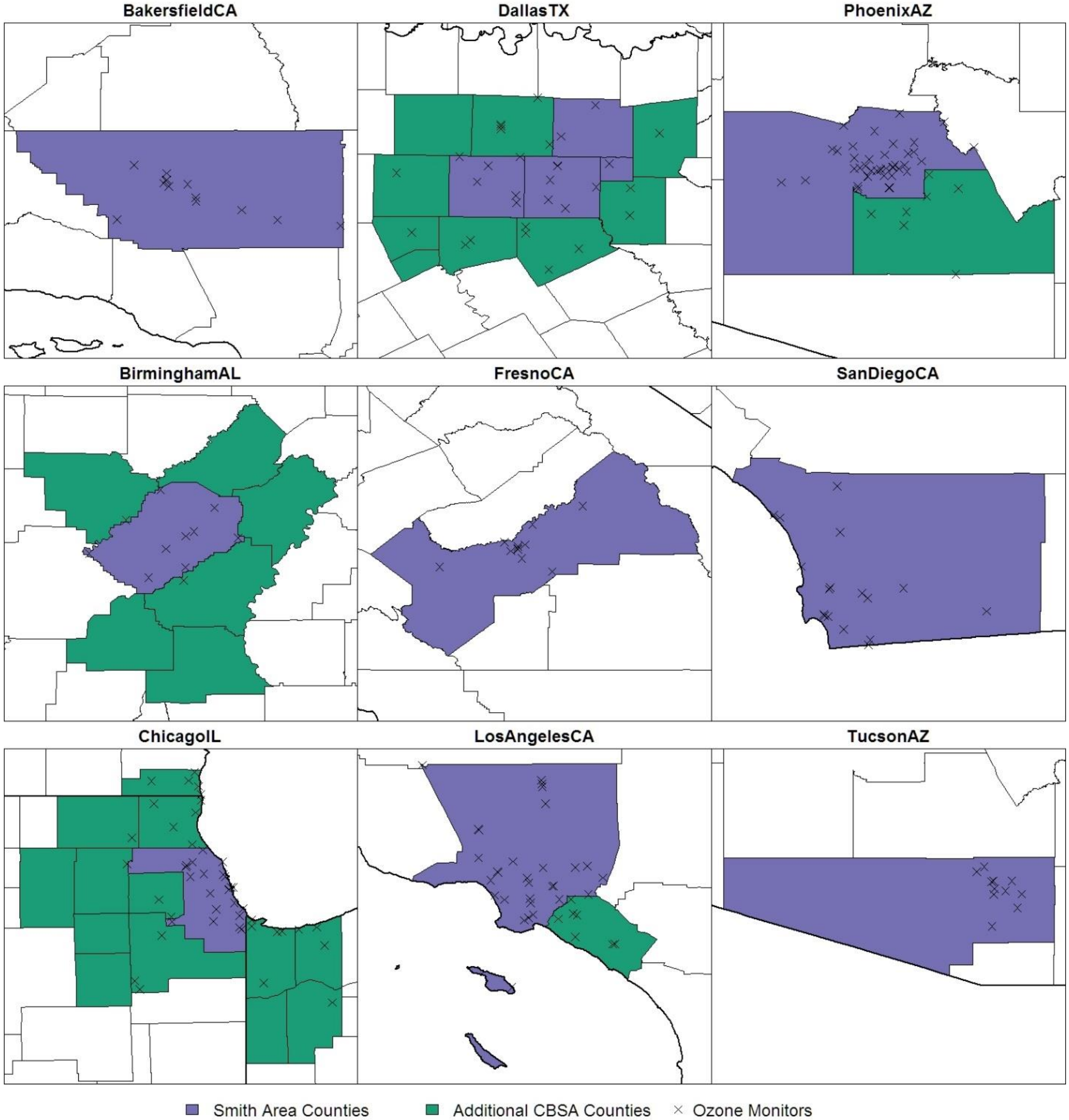


**Figure S1.** Maps of the counties included in 9 of the 11 urban areas in the base dataset. Counties shaded in purple represent areas included in the Smith et al. (2009) study, counties shaded in green represent additional counties included in the Core-Based Statistical Area (CBSA), and X's represent locations of ambient ozone monitors.

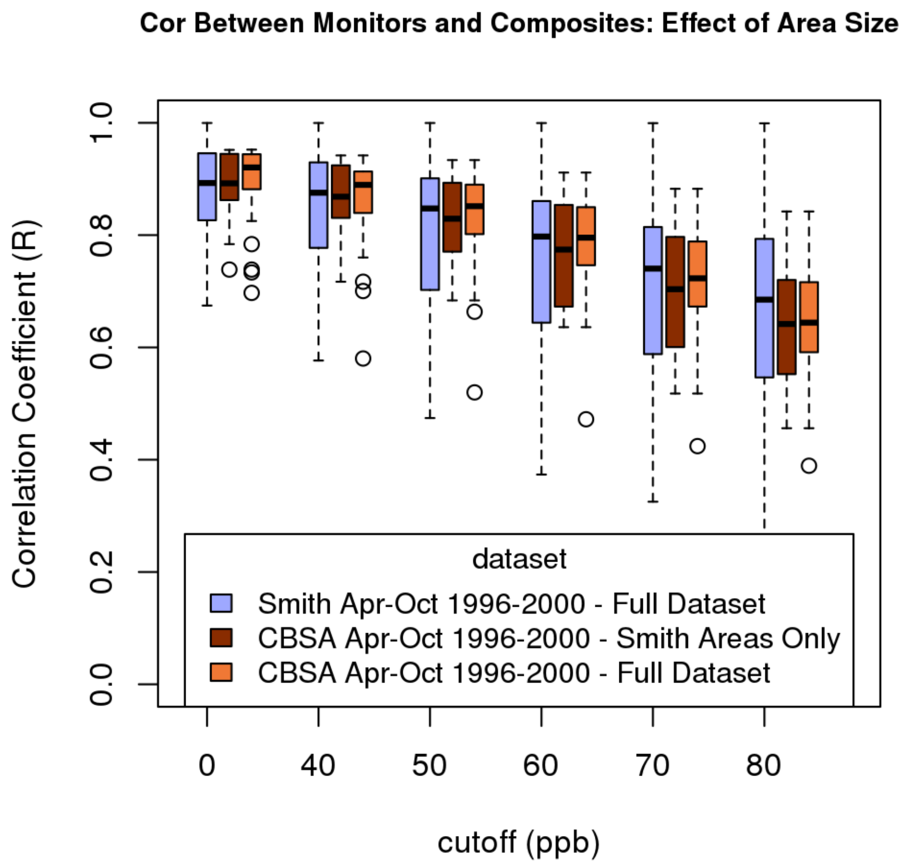


**Figure S2.** Boxplots showing correlation between individual monitor ozone values and the composite monitor values across urban areas in the base dataset and the first alternative dataset to explore the impact of spatial selection criteria used in the core analysis. The boxes represent the interquartile range across cities with the median value shown as the horizontal line. The whiskers extend to 1.5 times the interquartile range. Outliers are shown as circles.

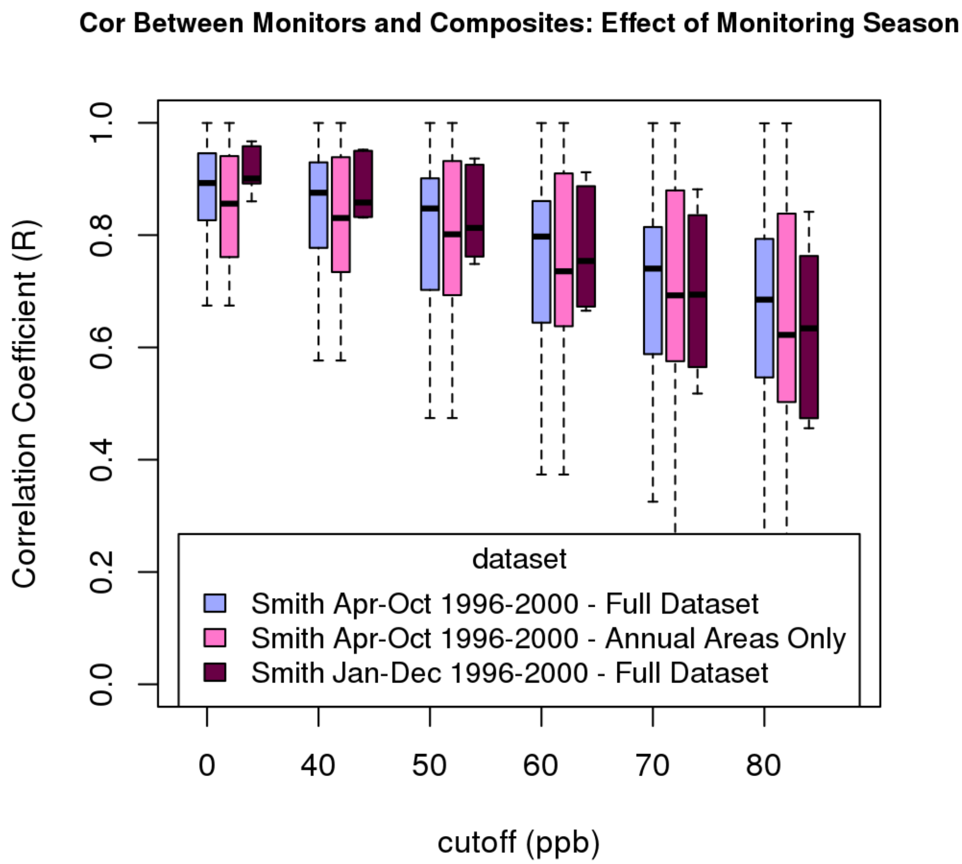


**Figure S3.** Boxplots showing correlation between individual monitor ozone values and the composite monitor values across urban areas in the base dataset and the second alternative dataset to explore the impact of temporal selection criteria (ozone season) used in the core analysis. The boxes represent the interquartile range across cities with the median value shown as the horizontal line. The whiskers extend to 1.5 times the interquartile range. Outliers are shown as circles.

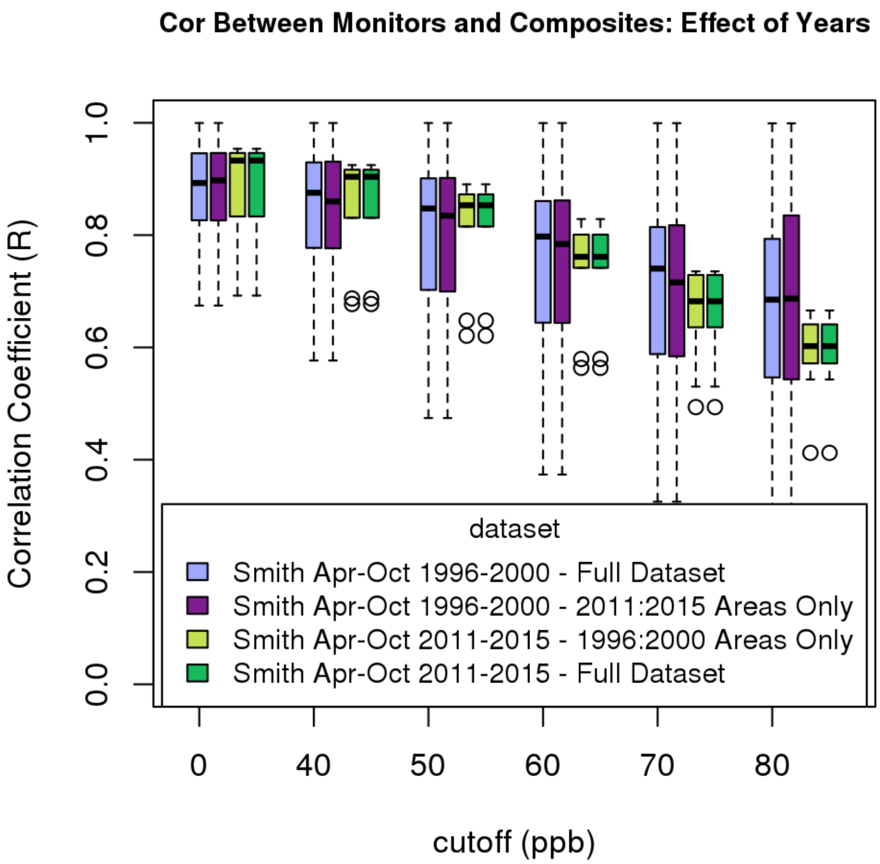


**Figure S4.** Boxplots showing correlation between individual monitor ozone values and the composite monitor values across urban areas in the base dataset and the third alternative dataset to explore the impact of temporal selection criteria (years) used in the core analysis. The boxes represent the interquartile range across cities with the median value shown as the horizontal line. The whiskers extend to 1.5 times the interquartile range. Outliers are shown as circles.