# Ozone Health Risk Assessment for Selected Urban Areas: Draft Appendices

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# Appendix A: Air Quality

**Table A-1. Monitor-Specific $O_3$ Air Quality Information: Atlanta, GA**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 1305700011 | 0.089 | | | |
| 1306700031 | 0.100 | 0.084 | 0.073 | 0.085 |
| 1307700021 | 0.099 | 0.077 | 0.083 | 0.086 |
| 1308500012 | 0.088 | 0.077 | 0.068 | 0.077 |
| 1308900021 | 0.095 | 0.080 | 0.084 | 0.086 |
| 1308930011 | 0.090 | 0.091 | 0.088 | 0.089 |
| 1309700041 | 0.098 | 0.085 | 0.080 | 0.087 |
| 1311300011 | 0.088 | 0.077 | 0.084 | 0.083 |
| 1312100551 | 0.100 | 0.091 | 0.089 | 0.093 |
| 1313500021 | 0.089 | 0.088 | 0.092 | 0.089 |
| 1315100021 | 0.099 | 0.082 | 0.085 | 0.088 |
| 1322300031 | 0.099 | 0.083 | 0.073 | 0.085 |
| 1324700011 | 0.099 | 0.078 | 0.087 | 0.088 |
| Average: | 0.095 | 0.083 | 0.082 | |
| | | | **Design Value*:** | 0.093 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-2. Monitor-Specific $O_3$ Air Quality Information: Boston, MA**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 2500900051 | 0.088 | | | |
| 2500920061 | 0.100 | 0.079 | 0.081 | 0.086 |
| 2500940041 | 0.094 | 0.080 | 0.077 | 0.083 |
| 2501711021 | 0.096 | 0.073 | 0.070 | 0.079 |
| 2502130031 | 0.107 | 0.088 | 0.078 | 0.091 |
| 2502500411 | 0.102 | 0.078 | 0.079 | 0.086 |
| 2502500421 | 0.074 | 0.074 | 0.064 | 0.07 |
| 2502700151 | 0.091 | 0.080 | 0.074 | 0.081 |
| Average: | 0.094 | 0.079 | 0.075 | |
| | | | **Design Value*:** | 0.091 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-3. Monitor-Specific $O_3$ Air Quality Information: Chicago, IL**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 1703100011 | 0.094 | 0.077 | 0.065 | 0.078 |
| 1703100321 | 0.096 | 0.080 | 0.067 | 0.081 |
| 1703100422 | 0.103 | | | |
| 1703100501 | 0.084 | 0.069 | | |
| 1703100641 | 0.085 | 0.067 | 0.054 | 0.068 |
| 1703100721 | 0.085 | 0.075 | 0.060 | 0.073 |
| 1703100761 | | | 0.068 | |
| 1703110032 | 0.092 | 0.071 | 0.067 | 0.076 |
| 1703116011 | 0.081 | 0.075 | 0.067 | 0.074 |
| 1703140021 | 0.084 | 0.070 | 0.059 | 0.071 |
| 1703140071 | 0.093 | 0.073 | 0.064 | 0.076 |
| 1703142011 | 0.087 | 0.080 | 0.067 | 0.078 |
| 1703142012 | 0.067 | | 0.051 | |
| 1703170021 | 0.091 | 0.082 | 0.071 | 0.081 |
| 1703180031 | 0.074 | | | |
| 1704360011 | 0.084 | 0.066 | 0.065 | 0.071 |
| 1708900051 | 0.082 | 0.076 | 0.069 | 0.075 |
| 1709710021 | 0.090 | 0.074 | 0.068 | 0.077 |
| 1709710071 | 0.100 | 0.078 | 0.071 | 0.083 |
| 1709730011 | 0.087 | | | |
| 1711100011 | 0.090 | 0.079 | 0.068 | 0.079 |
| 1719710081 | 0.086 | 0.077 | 0.063 | 0.075 |
| 1719710111 | 0.087 | 0.073 | 0.068 | 0.076 |
| 1808900221 | 0.094 | 0.076 | 0.064 | 0.078 |
| 1808900241 | 0.086 | 0.081 | | |
| 1808900301 | | | 0.064 | |
| 1808920081 | 0.101 | 0.081 | 0.067 | 0.083 |
| 1809100051 | 0.107 | 0.082 | 0.070 | 0.086 |
| 1809100101 | 0.100 | 0.084 | | |
| 1812700202 | 0.097 | 0.079 | | |
| 1812700241 | 0.101 | 0.077 | 0.069 | 0.082 |
| 1812700261 | 0.100 | 0.082 | 0.072 | 0.084 |
| 5505900021 | 0.110 | 0.085 | | |
| 5505900191 | 0.116 | 0.088 | 0.078 | 0.094 |
| 5505900221 | 0.096 | 0.088 | | |
| Average: | 0.092 | 0.077 | 0.066 | |
| | | | **Design Value*:** | 0.094 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-4. Monitor-Specific $O_3$ Air Quality Information: Cleveland, OH**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 3900710011 | 0.103 | 0.099 | 0.081 | 0.094 |
| 3903500341 | 0.090 | 0.076 | 0.057 | 0.074 |
| 3903500641 | 0.090 | 0.079 | 0.063 | 0.077 |
| 3903550021 | 0.098 | 0.089 | 0.077 | 0.088 |
| 3905500041 | 0.115 | 0.097 | 0.075 | 0.095 |
| 3908500031 | 0.104 | 0.092 | 0.079 | 0.091 |
| 3908530021 | 0.088 | 0.080 | 0.076 | 0.081 |
| 3909300171 | 0.099 | 0.085 | 0.074 | 0.086 |
| 3910300031 | 0.091 | 0.086 | 0.077 | 0.084 |
| 3913310011 | 0.097 | 0.091 | 0.081 | 0.089 |
| 3915300201 | 0.103 | 0.089 | 0.077 | 0.089 |
| Average: | 0.098 | 0.088 | 0.074 | |
| | | | **Design Value*:** | 0.095 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-5. Monitor-Specific $O_3$ Air Quality Information: Detroit, MI**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 2604900211 | 0.088 | 0.087 | 0.075 | 0.083 |
| 2604920011 | 0.089 | 0.091 | 0.077 | 0.085 |
| 2609900091 | 0.095 | 0.102 | 0.081 | 0.092 |
| 2609910031 | 0.092 | 0.101 | 0.071 | 0.088 |
| 2612500012 | 0.093 | 0.090 | 0.075 | 0.086 |
| 2614700051 | 0.100 | 0.086 | 0.074 | 0.086 |
| 2616100081 | 0.091 | 0.091 | 0.071 | 0.084 |
| 2616300012 | 0.088 | 0.085 | 0.065 | 0.079 |
| 2616300161 | 0.092 | 0.084 | 0.066 | 0.08 |
| 2616300192 | 0.083 | 0.098 | 0.066 | 0.082 |
| Average: | 0.091 | 0.092 | 0.072 | |
| | | | **Design Value*:** | 0.092 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-6. Monitor-Specific $O_3$ Air Quality Information: Houston, TX**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 4803910032 | 0.095 | | | |
| 4803910041 | 0.092 | 0.097 | 0.103 | 0.097 |
| 4803910161 | | | 0.081 | |
| 4816700141 | 0.093 | 0.092 | 0.088 | 0.091 |
| 4816710022 | 0.083 | 0.082 | | |
| 4820100242 | 0.096 | 0.095 | 0.096 | 0.095 |
| 4820100263 | 0.088 | 0.098 | 0.085 | 0.09 |
| 4820100292 | 0.098 | 0.096 | 0.090 | 0.094 |
| 4820100461 | 0.078 | 0.093 | 0.084 | 0.085 |
| 4820100472 | 0.072 | 0.082 | 0.083 | 0.079 |
| 4820100512 | 0.101 | 0.103 | 0.095 | 0.099 |
| 4820100551 | 0.094 | 0.107 | 0.104 | 0.101 |
| 4820100621 | 0.095 | 0.094 | 0.097 | 0.095 |
| 4820100661 | 0.084 | 0.081 | 0.097 | 0.087 |
| 4820100701 | 0.088 | 0.100 | 0.078 | 0.088 |
| 4820100751 | 0.078 | 0.096 | 0.093 | 0.089 |
| 4820110151 | | 0.108 | 0.093 | |
| 4820110342 | 0.093 | 0.102 | 0.091 | 0.095 |
| 4820110353 | 0.092 | 0.105 | 0.092 | 0.096 |
| 4820110391 | 0.095 | 0.113 | 0.097 | 0.101 |
| 4820110411 | 0.090 | | | |
| 4820110501 | 0.094 | 0.092 | 0.097 | 0.094 |
| 4833900781 | 0.082 | 0.094 | 0.080 | 0.085 |
| Average: | 0.090 | 0.097 | 0.091 | |
| | | | **Design Value*:** | 0.101 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-7. Monitor-Specific $O_3$ Air Quality Information: Los Angeles, CA**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 0603700021 | 0.097 | 0.104 | 0.092 | 0.097 |
| 0603700161 | 0.111 | 0.123 | 0.095 | 0.109 |
| 0603701131 | 0.073 | 0.083 | 0.076 | 0.077 |
| 0603710021 | 0.091 | 0.096 | 0.089 | 0.092 |
| 0603711031 | 0.077 | 0.082 | 0.078 | 0.079 |
| 0603712011 | 0.111 | 0.119 | 0.101 | 0.11 |
| 0603713011 | 0.049 | 0.057 | 0.065 | 0.057 |
| 0603716011 | 0.074 | 0.082 | 0.079 | 0.078 |
| 0603717011 | 0.099 | 0.109 | 0.095 | 0.101 |
| 0603720051 | 0.095 | 0.101 | 0.093 | 0.096 |
| 0603740021 | 0.059 | 0.063 | 0.070 | 0.064 |
| 0603750011 | 0.064 | 0.070 | | |
| 0603750051 | | | 0.085 | |
| 0603760121 | 0.131 | 0.137 | 0.107 | 0.125 |
| 0603790331 | 0.102 | 0.103 | 0.095 | 0.1 |
| 0605900071 | 0.069 | 0.080 | 0.088 | 0.079 |
| 0605910031 | 0.066 | 0.079 | 0.076 | 0.073 |
| 0605920221 | 0.081 | 0.095 | 0.085 | 0.087 |
| 0605950011 | 0.071 | 0.080 | 0.075 | 0.075 |
| 0606500121 | 0.113 | 0.127 | 0.112 | 0.117 |
| 0606520021 | 0.097 | 0.100 | 0.094 | 0.097 |
| 0606550011 | 0.109 | 0.105 | 0.099 | 0.104 |
| 0606560011 | 0.107 | 0.116 | 0.095 | 0.106 |
| 0606580011 | 0.109 | 0.120 | 0.111 | 0.113 |
| 0606590011 | 0.104 | 0.112 | 0.100 | 0.105 |
| 0606590031 | | | 0.060 | |
| 0607100011 | 0.092 | 0.088 | 0.082 | 0.087 |
| 0607100051 | 0.131 | 0.130 | 0.122 | 0.127 |
| 0607100121 | 0.115 | 0.103 | 0.097 | 0.105 |
| 0607100171 | 0.087 | 0.084 | 0.087 | 0.086 |
| 0607103061 | 0.106 | 0.104 | 0.085 | 0.098 |
| 0607110042 | 0.105 | 0.114 | 0.102 | 0.107 |
| 0607112341 | 0.089 | 0.087 | 0.082 | 0.086 |
| 0607120021 | 0.114 | 0.132 | 0.111 | 0.119 |
| 0607140011 | 0.113 | 0.110 | 0.099 | 0.107 |
| 0607140031 | 0.117 | 0.137 | 0.119 | 0.124 |
| 0607190021 | 0.101 | 0.111 | 0.102 | 0.104 |
| 0607190041 | 0.105 | 0.123 | 0.112 | 0.113 |
| 0611100051 | 0.076 | | | |
| 0611100071 | 0.080 | 0.087 | 0.086 | 0.084 |
| 0611100091 | 0.087 | 0.093 | 0.086 | 0.088 |
| 0611110041 | 0.097 | 0.093 | 0.092 | 0.094 |
| 0611120021 | 0.092 | 0.093 | 0.092 | 0.092 |
| 0611120031 | 0.064 | 0.074 | 0.069 | 0.069 |
| 0611130011 | 0.064 | 0.069 | 0.065 | 0.066 |
| Average: | 0.093 | 0.099 | 0.091 | |
| | | | **Design Value*:** | 0.127 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-8. Monitor-Specific $O_3$ Air Quality Information: New York, NY**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 3600500831 | 0.096 | 0.079 | 0.074 | 0.083 |
| 3600501101 | 0.089 | 0.082 | 0.069 | 0.08 |
| 3602700071 | 0.111 | 0.081 | 0.076 | 0.089 |
| 3607150011 | 0.082 | 0.087 | 0.078 | 0.082 |
| 3607900051 | 0.102 | 0.082 | 0.082 | 0.088 |
| 3608100981 | 0.082 | 0.072 | 0.064 | 0.072 |
| 3608101241 | 0.089 | 0.086 | 0.075 | 0.083 |
| 3608500671 | 0.099 | 0.086 | 0.083 | 0.089 |
| 3610300021 | 0.108 | 0.094 | 0.081 | 0.094 |
| 3610300041 | 0.090 | 0.082 | | |
| 3610300092 | 0.103 | 0.102 | 0.079 | 0.094 |
| 3611110051 | 0.084 | 0.082 | 0.076 | 0.08 |
| 3611920041 | 0.102 | 0.091 | 0.078 | 0.09 |
| Average: | 0.095 | 0.085 | 0.076 | |
| | | | **Design Value*:** | 0.094 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-9. Monitor-Specific $O_3$ Air Quality Information: Philadelphia, PA**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 4201700121 | 0.111 | 0.087 | 0.082 | 0.093 |
| 4202900501 | 0.104 | 0.085 | | |
| 4202901001 | 0.112 | 0.085 | 0.085 | 0.094 |
| 4204500021 | 0.106 | 0.080 | 0.081 | 0.089 |
| 4209100131 | 0.101 | 0.085 | 0.083 | 0.089 |
| 4210100041 | 0.082 | 0.069 | 0.054 | 0.068 |
| 4210100141 | 0.098 | 0.083 | 0.077 | 0.086 |
| 4210100241 | 0.110 | 0.082 | 0.091 | 0.094 |
| 4210101361 | 0.094 | 0.070 | 0.073 | 0.079 |
| Average: | 0.102 | 0.081 | 0.078 | |
| | | | **Design Value*:** | 0.094 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-10. Monitor-Specific $O_3$ Air Quality Information: Sacramento, CA**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 0601700101 | 0.098 | 0.096 | 0.089 | 0.094 |
| 0601700111 | 0.067 | 0.065 | | |
| 0601700121 | 0.077 | 0.075 | 0.073 | 0.075 |
| 0601700201 | 0.111 | 0.106 | 0.089 | 0.102 |
| 0605700051 | 0.099 | 0.098 | 0.093 | 0.096 |
| 0605700071 | 0.093 | 0.090 | 0.085 | 0.089 |
| 0605710011 | 0.065 | | | |
| 0606100021 | 0.101 | 0.094 | 0.092 | 0.095 |
| 0606100041 | 0.101 | 0.089 | 0.087 | 0.092 |
| 0606100061 | 0.095 | 0.085 | 0.082 | 0.087 |
| 0606100071 | | 0.068 | | |
| 0606130011 | 0.097 | | | |
| 0606700021 | 0.095 | 0.086 | 0.076 | 0.085 |
| 0606700061 | 0.105 | 0.097 | 0.083 | 0.095 |
| 0606700101 | 0.083 | 0.076 | 0.067 | 0.075 |
| 0606700111 | 0.069 | 0.087 | 0.077 | 0.077 |
| 0606700121 | 0.104 | 0.098 | 0.087 | 0.096 |
| 0606700131 | 0.079 | 0.075 | 0.067 | 0.073 |
| 0606750031 | 0.097 | 0.097 | 0.089 | 0.094 |
| 0611300041 | 0.076 | 0.077 | 0.071 | 0.074 |
| 0611310031 | 0.088 | 0.082 | 0.069 | 0.079 |
| Average: | 0.090 | 0.086 | 0.081 | |
| | | | **Design Value*:** | 0.102 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-11. Monitor-Specific $O_3$ Air Quality Information: St. Louis, MO**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 1708310011 | 0.100 | 0.083 | 0.073 | 0.085 |
| 1711700021 | 0.085 | 0.077 | 0.068 | 0.076 |
| 1711900081 | 0.094 | 0.089 | 0.074 | 0.085 |
| 1711910091 | 0.090 | 0.088 | 0.078 | 0.085 |
| 1711920072 | 0.090 | 0.082 | 0.068 | 0.08 |
| 1711930071 | 0.084 | 0.083 | 0.073 | 0.08 |
| 1716300102 | 0.093 | 0.079 | 0.073 | 0.081 |
| 2909900121 | 0.093 | 0.082 | 0.070 | 0.081 |
| 2918310021 | 0.099 | 0.091 | 0.077 | 0.089 |
| 2918310041 | 0.098 | 0.090 | 0.076 | 0.088 |
| 2918900041 | 0.098 | 0.088 | 0.070 | 0.085 |
| 2918900061 | 0.094 | 0.086 | 0.067 | 0.082 |
| 2918930011 | 0.094 | 0.082 | 0.067 | 0.081 |
| 2918950011 | 0.095 | 0.088 | 0.068 | 0.083 |
| 2918970031 | 0.093 | 0.088 | 0.069 | 0.083 |
| 2951000071 | 0.090 | 0.084 | | |
| 2951000721 | 0.081 | 0.071 | 0.058 | 0.07 |
| 2951000861 | 0.098 | 0.090 | 0.072 | 0.086 |
| Average: | 0.093 | 0.085 | 0.071 | |
| | | | **Design Value*:** | 0.089 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-12. Monitor-Specific $O_3$ Air Quality Information: Washington, D.C.**

| AIRS Monitor ID | Fourth Daily Maximum 8-Hour Average (ppm) | | | Average of the 3 Year-Specific Values (ppm) |
|---|---|---|---|---|
| | 2002 | 2003 | 2004 | |
| 1100100251 | 0.097 | 0.079 | 0.080 | 0.085 |
| 1100100411 | 0.102 | 0.082 | 0.070 | 0.084 |
| 1100100431 | 0.106 | 0.081 | 0.081 | 0.089 |
| Average: | 0.102 | 0.081 | 0.077 | |
| | | | **Design Value*:** | 0.089 |

*The design value is the maximum of the monitor-specific averages of the annual fourth daily maximum 8-hour average over the 3 year period.

**Table A-13. Composite Monitor Statistics**

| Urban Area | 24-Hour Average (ppm) | | | 1-Hour Maximum (ppm) | | | 8-Hour Maximum (ppm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Minimum | Mean | Maximum | Minimum | Mean | Maximum | Minimum | Mean | Maximum |
| Atlanta | 0.0091 | 0.0279 | 0.0504 | 0.0170 | 0.0578 | 0.1267 | 0.0146 | 0.0499 | 0.1103 |
| Boston | 0.0060 | 0.0276 | 0.0571 | 0.0185 | 0.0433 | 0.1060 | 0.0128 | 0.0379 | 0.0904 |
| Chicago | 0.0110 | 0.0270 | 0.0453 | 0.0152 | 0.0432 | 0.0758 | 0.0119 | 0.0389 | 0.0679 |
| Cleveland | 0.0080 | 0.0257 | 0.0445 | 0.0123 | 0.0404 | 0.0743 | 0.0090 | 0.0360 | 0.0676 |
| Detroit | 0.0074 | 0.0239 | 0.0459 | 0.0140 | 0.0430 | 0.0793 | 0.0094 | 0.0375 | 0.0730 |
| Houston | 0.0075 | 0.0262 | 0.0572 | 0.0155 | 0.0510 | 0.1243 | 0.0137 | 0.0443 | 0.1082 |
| Los Angeles 1* | 0.0204 | 0.0338 | 0.0491 | 0.0351 | 0.0634 | 0.1005 | 0.0319 | 0.0555 | 0.0867 |
| Los Angeles 2* | 0.0249 | 0.0398 | 0.0568 | 0.0410 | 0.0656 | 0.0992 | 0.0387 | 0.0597 | 0.0888 |
| New York 1** | 0.0055 | 0.0242 | 0.0494 | 0.0128 | 0.0449 | 0.0920 | 0.0085 | 0.0378 | 0.0811 |
| New York 2** | 0.0052 | 0.0241 | 0.0491 | 0.0115 | 0.0447 | 0.0883 | 0.0076 | 0.0378 | 0.0806 |
| Philadelphia | 0.0037 | 0.0272 | 0.0486 | 0.0090 | 0.0492 | 0.0915 | 0.0057 | 0.0426 | 0.0775 |
| Sacramento | 0.0164 | 0.0323 | 0.0462 | 0.0307 | 0.0593 | 0.0953 | 0.0241 | 0.0520 | 0.0806 |
| St. Louis | 0.0078 | 0.0248 | 0.0425 | 0.0175 | 0.0468 | 0.0890 | 0.0114 | 0.0409 | 0.0688 |
| Washington, D.C. | 0.0055 | 0.0283 | 0.0526 | 0.0140 | 0.0521 | 0.1020 | 0.0103 | 0.0450 | 0.0916 |

*"Los Angeles 1" denotes Los Angeles County; "Los Angeles 2" denotes Los Angeles, Riverside, San Bernardino, and Orange Counties.

**"New York 1" denotes the 5 boroughs of New York City -- Brooklyn, Queens, Manhattan, Bronx, and Staten Island. "New York 2" denotes the 5 boroughs plus Westchester County.

# Appendix B: Information on Concentration-Response Functions

## B.1 Tables of Study-Specific Information

### Table B-1. Study-Specific Information for $O_3$ Studies in Atlanta, GA

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | 0 | 71 | 0.00020 | -0.00084 | 0.00123 |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |
| Huang et al. (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | 0 | 71 | 0.00120 | -0.00039 | 0.00279 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00124 | 0.00047 | 0.00201 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | PM10 | NA | NA | 0.00074 | -0.00033 | 0.00171 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | NO2 | NA | NA | 0.00060 | 0.00011 | 0.00109 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | SO2 | NA | NA | 0.00051 | 0.00001 | 0.00102 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | CO | NA | NA | 0.00069 | 0.00020 | 0.00117 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

NA denotes "not available."

**Table B-2. Study-Specific Information for $O_3$ Studies in Boston, MA**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | -3 | 86 | 0.00028 | -0.00079 | 0.00136 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

**Table B-3. Study-Specific Information for $O_3$ Studies in Chicago, IL**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |
| Schwartz (2004) | Mortality, non-accidental | < 800 | all | 0-day lag | 1 hr max. | logistic | none | NA | NA | 0.00099 | 0.00031 | 0.00166 |
| Schwartz -- 14 US Cities (2004) | Mortality, non-accidental | < 800 | all | 0-day lag | 1 hr max. | logistic | none | NA | NA | 0.00037 | 0.00012 | 0.00062 |
| Huang et al. (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | 0 | 65 | 0.00075 | -0.00067 | 0.00218 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00124 | 0.00047 | 0.00201 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | PM10 | NA | NA | 0.00074 | -0.00033 | 0.00171 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | NO2 | NA | NA | 0.00060 | 0.00011 | 0.00109 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | SO2 | NA | NA | 0.00051 | 0.00001 | 0.00102 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | CO | NA | NA | 0.00069 | 0.00020 | 0.00117 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

NA denotes "not available."

**Table B-4. Study-Specific Information for $O_3$ Studies in Cleveland, OH**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | 2 | 75 | 0.00061 | -0.00038 | 0.00161 |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |
| Huang et al. (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | 2 | 75 | 0.00148 | -0.00004 | 0.00299 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00124 | 0.00047 | 0.00201 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | PM10 | NA | NA | 0.00074 | -0.00033 | 0.00171 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | NO2 | NA | NA | 0.00060 | 0.00011 | 0.00109 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | SO2 | NA | NA | 0.00051 | 0.00001 | 0.00102 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | CO | NA | NA | 0.00069 | 0.00020 | 0.00117 |
| Schwartz et al. (1996) | Hospital admissions, respiratory illness | 460-519 | 65+ | avg of 1-day and 2-day lags | 1 hr max. | log-linear | none | NA | NA | 0.00086 | 0.00020 | 0.00148 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

NA denotes "not available."

**Table B-5. Study-Specific Information for $O_3$ Studies in Detroit, MI**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | 2 | 75 | 0.00076 | -0.00024 | 0.00177 |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |
| Schwartz (2004) | Mortality, non-accidental | < 800 | all | 0-day lag | 1 hr max. | logistic | none | NA | NA | 0.00068 | -0.00011 | 0.00148 |
| Schwartz -- 14 US Cities (2004) | Mortality, non-accidental | < 800 | all | 0-day lag | 1 hr max. | logistic | none | NA | NA | 0.00037 | 0.00012 | 0.00062 |
| Ito (2003) | Mortality, non-accidental | < 800 | all | 0-day lag | 24 hr avg. | log-linear | none | NA | NA | 0.00093 | -0.00085 | 0.00271 |
| Ito (2003) | Mortality, respiratory | 460-519 | all | 0-day lag | 24 hr avg. | log-linear | none | NA | 55 | 0.00359 | -0.00276 | 0.00993 |
| Ito (2003) | Mortality, circulatory | 390-459 | all | 0-day lag | 24 hr avg. | log-linear | none | NA | 55 | 0.00089 | -0.00172 | 0.00349 |
| Huang et al. (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | 2 | 75 | 0.00135 | -0.00015 | 0.00286 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00124 | 0.00047 | 0.00201 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | PM10 | NA | NA | 0.00074 | -0.00033 | 0.00171 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | NO2 | NA | NA | 0.00060 | 0.00011 | 0.00109 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | SO2 | NA | NA | 0.00051 | 0.00001 | 0.00102 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | CO | NA | NA | 0.00069 | 0.00020 | 0.00117 |
| Ito (2003) | Hospital admissions (unscheduled), pneumonia | 480-486 | 65+ | 0-day lag | 24 hr avg. | log-linear (GAM str. estimation)*** | none | NA | 55 | -0.00218 | -0.00621 | 0.00186 |
| Ito (2003) | Hospital admissions (unscheduled), pneumonia | 480-486 | 65+ | 1-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | -0.00054 | -0.00459 | 0.00352 |
| Ito (2003) | Hospital admissions (unscheduled), pneumonia | 480-486 | 65+ | 2-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | 0.00066 | -0.00342 | 0.00473 |
| Ito (2003) | Hospital admissions (unscheduled), pneumonia | 480-486 | 65+ | 3-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | 0.00190 | -0.00216 | 0.00595 |
| Ito (2003) | Hospital admissions (unscheduled), ischemic heart disease | 410-414 | 65+ | 0-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | 0.00054 | -0.00221 | 0.00328 |
| Ito (2003) | Hospital admissions (unscheduled), ischemic heart disease | 410-414 | 65+ | 1-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | -0.00047 | -0.00325 | 0.00231 |
| Ito (2003) | Hospital admissions (unscheduled), ischemic heart disease | 410-414 | 65+ | 2-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | 0.00071 | -0.00211 | 0.00354 |
| Ito (2003) | Hospital admissions (unscheduled), ischemic heart disease | 410-414 | 65+ | 3-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | 0.00140 | -0.00139 | 0.00418 |
| Ito (2003) | Hospital admissions (unscheduled), heart failure | 428 | 65+ | 0-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | 0.00065 | -0.00252 | 0.00383 |

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Ito (2003) | Hospital admissions (unscheduled), heart failure | 428 | 65+ | 1-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | 0.00323 | 0.00002 | 0.00645 |
| Ito (2003) | Hospital admissions (unscheduled), heart failure | 428 | 65+ | 2-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | 0.00223 | -0.00104 | 0.00550 |
| Ito (2003) | Hospital admissions (unscheduled), heart failure | 428 | 65+ | 3-day lag | 24 hr avg. | log-linear (GAM str. estimation) | none | NA | 55 | 0.00178 | -0.00145 | 0.00501 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

***"GAM str. estimation" denotes that estimation of the log-linear C-R function used a generalized additive model with a stringent convergence criterion. This study also estimated log-linear C-R functions using generalized linear models (GLM).
NA denotes "not available."

**Table B-6. Study-Specific Information for $O_3$ Studies in Houston, TX**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | 1 | 76 | 0.00079 | 0.00005 | 0.00154 |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |
| Schwartz (2004) | Mortality, non-accidental | < 800 | all | 0-day lag | 1 hr max. | logistic | none | NA | NA | 0.00044 | 0.00004 | 0.00084 |
| Schwartz -- 14 US Cities (2004) | Mortality, non-accidental | < 800 | all | 0-day lag | 1 hr max. | logistic | none | NA | NA | 0.00037 | 0.00012 | 0.00062 |
| Huang et al. (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | 1 | 76 | 0.00122 | -0.00016 | 0.00261 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00124 | 0.00047 | 0.00201 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | PM10 | NA | NA | 0.00074 | -0.00033 | 0.00171 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | NO2 | NA | NA | 0.00060 | 0.00011 | 0.00109 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | SO2 | NA | NA | 0.00051 | 0.00001 | 0.00102 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | CO | NA | NA | 0.00069 | 0.00020 | 0.00117 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

NA denotes "not available."

**Table B-7. Study-Specific Information for $O_3$ Studies in Los Angeles, CA**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. (2004)*** | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | 0 | 68 | 0.00018 | -0.00043 | 0.00079 |
| Bell et al. -- 95 US Cities (2004)*** | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |
| Huang et al. (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | 0 | 68 | 0.00107 | 0.00001 | 0.00213 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00124 | 0.00047 | 0.00201 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | PM10 | NA | NA | 0.00074 | -0.00033 | 0.00171 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | NO2 | NA | NA | 0.00060 | 0.00011 | 0.00109 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | SO2 | NA | NA | 0.00051 | 0.00001 | 0.00102 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | CO | NA | NA | 0.00069 | 0.00020 | 0.00117 |
| Linn et al. (2000)**** | Hospital admissions (unscheduled), pulmonary illness -- spring | 75-101***** | 30+ | 0-day lag | 24 hr avg. | log-linear | none | 1 | 70 | 0.00110 | -0.00047 | 0.00267 |
| Linn et al. (2000)**** | Hospital admissions (unscheduled), pulmonary illness -- summer | 75-101***** | 30+ | 0-day lag | 24 hr avg. | log-linear | none | 1 | 70 | 0.00060 | -0.00077 | 0.00197 |
| Linn et al. (2000)**** | Hospital admissions (unscheduled), cardiovascular illness -- spring | 103-144***** | 30+ | 0-day lag | 24 hr avg. | log-linear | none | 1 | 70 | 0.00030 | -0.00068 | 0.00128 |
| Linn et al. (2000)**** | Hospital admissions (unscheduled), cardiovascular illness -- summer | 103-144***** | 30+ | 0-day lag | 24 hr avg. | log-linear | none | 1 | 70 | 0.00010 | -0.00088 | 0.00108 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

***Los Angeles is defined in this study as Los Angeles County.

****Los Angeles is defined in this study as Los Angeles, Riverside, San Bernardino, and Orange Counties.

*****Linn et al. (2000) used DRG codes instead of ICD codes.

**Table B-8. Study-Specific Information for $O_3$ Studies in New York, NY**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. -- 95 US Cities (2004)*** | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |
| Huang et al. (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | -2 | 81 | 0.00170 | 0.00054 | 0.00286 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00124 | 0.00047 | 0.00201 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | PM10 | NA | NA | 0.00074 | -0.00033 | 0.00171 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | NO2 | NA | NA | 0.00060 | 0.00011 | 0.00109 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | SO2 | NA | NA | 0.00051 | 0.00001 | 0.00102 |
| Huang et al. -- 19 US Cities (2004)*** | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | CO | NA | NA | 0.00069 | 0.00020 | 0.00117 |
| Thurston et al. (1992)**** | Hospital admissions (unscheduled), respiratory | 466, 480-486, 490, 491, 492, 493 | all | 3-day lag | 1 hr max. | linear | none | NA | 206 | 1.370E-08 | 3.312E-09 | 2.409E-08 |
| Thurston et al. (1992)**** | Hospital admissions (unscheduled), asthma | 493 | all | 1-day lag | 1 hr max. | linear | none | NA | 206 | 1.170E-08 | 2.488E-09 | 2.091E-08 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

***New York in this study is defined as the five boroughs of New York City plus Westchester County.

****New York in this study is defined as the five boroughs of New York City.

NA denotes "not available."

**Table B-9. Study-Specific Information for $O_3$ Studies in Philadelphia, PA**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |
| Moolgavkar et al. (1995) | Mortality, non-accidental | < 800 | all | 1-day lag | 24 hr avg. | log-linear | none | 1 | 159 | 0.00140 | 0.00086 | 0.00191 |
| Moolgavkar et al. (1995) | Mortality, non-accidental | < 800 | all | 1-day lag | 24 hr avg. | log-linear | TSP, SO2 | 1 | 159 | 0.00139 | 0.00066 | 0.00212 |
| Huang et al. (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | -3 | 84 | 0.00151 | 0.00007 | 0.00296 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00124 | 0.00047 | 0.00201 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | PM10 | NA | NA | 0.00074 | -0.00033 | 0.00171 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | NO2 | NA | NA | 0.00060 | 0.00011 | 0.00109 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | SO2 | NA | NA | 0.00051 | 0.00001 | 0.00102 |
| Huang et al. -- 19 US Cities (2004) | Mortality, cardiovascular and respiratory | 390-448; 490-496; 487; 480-486; 507. | all | distributed lag | 24 hr avg. | log-linear | CO | NA | NA | 0.00069 | 0.00020 | 0.00117 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.
NA denotes "not available."

**Table B-10. Study-Specific Information for $O_3$ Studies in Sacramento, CA**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | 0 | 71 | 0.00026 | -0.00079 | 0.00131 |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

NA denotes "not available."

**Table B-11. Study-Specific Information for $O_3$ Studies in St. Louis, MO**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | 0 | 118 | 0.00044 | -0.00072 | 0.00159 |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

NA denotes "not available."

**Table B-12. Study-Specific Information for $O_3$ Studies in Washington, D.C.**

| Study | Health Effects* | ICD-9 Codes | Ages | Lag | Exposure Metric | Model | Other Pollutants in Model | Observed Concentrations** (ppb) | | $O_3$ Coefficient | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | min. | max. | | | |
| Bell et al. -- 95 US Cities (2004) | Mortality, non-accidental | < 800 | all | distributed lag | 24 hr avg. | log-linear | none | NA | NA | 0.00039 | 0.00013 | 0.00065 |

*Health effects are associated with short-term exposures to $O_3$.

**Rounded to the nearest ppb.

NA denotes "not available."

## B.2 Concentration-Response Functions and Health Impact Functions

Notation:

$y_0 = Incidence\ under\ baseline\ conditions$
$y_c = Incidence\ under\ control\ conditions$
$\Delta y = y_0 - y_c$
$x_0 = O_3\ levels\ under\ baseline\ conditions$
$x_c = O_3\ levels\ under\ control\ conditions$
$\Delta x = x_0 - x_c$

### B.2.1 Log-linear

The log-linear concentration-response function is: $y = Be^{\beta x}$

The derivation of the corresponding health impact function is as follows:

$$y = Be^{\beta x}$$

$$y_0 = Be^{\beta x_0}$$

$$y_c = Be^{\beta x_c}$$

$$\Delta y = Be^{\beta x_0} - Be^{\beta x_c}$$

$$\Delta y = Be^{\beta x_0} \cdot \left(1 - \frac{Be^{\beta x_c}}{Be^{\beta x_0}}\right)$$

$$\Delta y = Be^{\beta x_0} \cdot \left(1 - e^{\beta \cdot (x_c - x_0)}\right)$$

$$\Delta y = Be^{\beta x_0} \cdot \left(1 - e^{-\beta \Delta x}\right)$$

$$\Delta y = y_0 \cdot \left(1 - e^{-\beta \Delta x}\right)$$

### B.2.2 Linear

The linear concentration-response function is: $y = \alpha + \beta x$

The derivation of the corresponding health impact function is as follows:

$$y = \alpha + \beta x$$
$$y_0 = \alpha + \beta x_0$$
$$y_c = \alpha + \beta x_c$$
$$\Delta y = y_0 - y_c = \beta x_0 - \beta x_c$$
$$\Delta y = \beta(x_0 - x_c) = \beta \Delta x$$

### B.2.3 Logistic

The logistic concentration-response function is: $y = \left( \frac{e^{\beta x}}{1 + e^{\beta x}} \right) = \frac{1}{1 + e^{-\beta x}}$

The derivation of the corresponding health impact function is as follows:

$$y = \frac{1}{1 + e^{-\beta x}}$$
$$odds = \frac{y}{1 - y} = \frac{\left( \frac{1}{1 + e^{-\beta x}} \right)}{1 - \left( \frac{1}{1 + e^{-\beta x}} \right)}$$
$$odds = \frac{\left( \frac{1}{1 + e^{-\beta x}} \right)}{\left( \frac{e^{-\beta x}}{1 + e^{-\beta x}} \right)} = \frac{1}{e^{-\beta x}} = e^{\beta x}$$
$$odds\ ratio = \frac{e^{\beta x_0}}{e^{\beta x_c}} = e^{\beta \Delta x}$$
$$\frac{\left( \frac{y_c}{1 - y_c} \right)}{\left( \frac{y_0}{1 - y_0} \right)} = e^{-\beta \Delta x}$$
$$\frac{y_c}{1 - y_c} = \left( \frac{y_0}{1 - y_0} \right) \cdot e^{-\beta \Delta x}$$
$$y_c = (1 - y_c) \cdot \left( \frac{y_0}{1 - y_0} \right) \cdot e^{-\beta \Delta x}$$

$$y_c + y_c \cdot \left( \frac{y_0}{1-y_0} \right) \cdot e^{-\beta \Delta x} = \left( \frac{y_0}{1-y_0} \right) \cdot e^{-\beta \Delta x}$$

$$y_c \cdot \left[ 1 + \left( \frac{y_0}{1-y_0} \right) \cdot e^{-\beta \Delta x} \right] = \left( \frac{y_0}{1-y_0} \right) \cdot e^{-\beta \Delta x}$$

$$y_c = \frac{\left( \frac{y_0}{1-y_0} \right) \cdot e^{-\beta \Delta x}}{1 + \left( \frac{y_0}{1-y_0} \right) \cdot e^{-\beta \Delta x}}$$

$$y_c = \frac{y_0 \cdot e^{-\beta \Delta x}}{1 - y_0 + y_0 \cdot e^{-\beta \Delta x}}$$

$$y_c = \frac{y_0}{(1-y_0) \cdot e^{\beta \Delta x} + y_0}$$

$$y_0 - y_c = y_0 - \frac{y_0}{(1-y_0) \cdot e^{\beta \Delta x} + y_0}$$

$$\Delta y = y_0 \cdot \left( 1 - \frac{1}{(1-y_0) \cdot e^{\beta \Delta x} + y_0} \right)$$

## B.3 The Calculation of "Shrinkage" Estimates from the Location-Specific Estimates Reported in Huang et al. (2004)

"Shrinkage" estimates were calculated from the location-specific estimates reported in Table 1 of Huang et al. (2004), using the method described in DuMouchel (1994). Both Huang et al. (2004) and DuMouchel (1994) consider a Bayesian hierarchical model. Although they use different notation, the models are the same. The notation comparison is given in Table B-13 below.

Given a posterior distribution for $\tau$, $\pi(\tau \mid y)$, a shrinkage estimate for the ith location is calculated as:

$$\theta_i^* \equiv E[\theta_i \mid y] = \int \theta_i^*(\tau)\pi(\tau \mid y)d\tau$$

where $\theta_i^*(\tau) \equiv E[\theta_i \mid y, \tau] = \mu^*(\tau) + [y_i - \mu^*(\tau)]\tau^2 / (\tau^2 + s_i^2)$,

where $\mu^*(\tau) \equiv E[\mu \mid y, \tau] = \sum_i w_i(\tau) y_i$ ,

where $w_i(\tau) = (\tau^2 + s_i^2)^{-1} / \sum_j (\tau^2 + s_j^2)^{-1}$ .

A shrinkage estimate for the ith location is thus defined to be the expected value of the ith location-specific parameter, given all the location-specific estimates (see Table 1 for notation explanations). The posterior variance of the true ith location-specific parameter, given all the location-specific estimates, is given by:

$$\theta_i^{**} \equiv V[\theta_i \mid y] = \int \{V[\theta_i \mid y, \tau] + [\theta_i^*(\tau) - \theta_i^*]^2\}\pi(\tau \mid y)\, d\tau ,$$

where $V[\theta_i \mid y, \tau] = [s_i^2 / (\tau^2 + s_i^2)]^2 / \sum_j (\tau^2 + s_j^2)^{-1} + \tau^2 s_i^2 / (\tau^2 + s_i^2)$.

A 95 percent credible interval around the ith shrinkage estimate was calculated as $\theta_i^* \pm 1.96 * (\sqrt{\theta_i^{**}})$.

**Table B-13. Notation**

| | Huang et al. (2004) | DuMouchel (1994) |
|---|---|---|
| Location indicator | c | i |
| parameter being estimated for location c (or i) | $\theta^c$ | $\theta_i$ |
| Estimate of parameter for location c (or i)* | $\hat{\theta}^c$ | $y_i$ |
| variance in the overall distribution of true θs. | $\tau^2$ | $\tau^2$ |
| variance of the estimate of $\theta^c$ or ($\theta_i$)** | $v^c$ | $s_i^2$ |
| The mean of the overall distribution of true θs | μ | μ |
| The model: | $\hat{\theta}^c \sim N(\theta^c, v^c)$ (1)<br>$\theta^c \sim N(\mu, \tau^2)$ (2)<br>$(1)\&(2) \Rightarrow \hat{\theta}^c \sim N(\mu, v^c + \tau^2)$ | $y_i = \mu + \delta_i + \varepsilon_i$ (1)<br>$\theta_i = \mu + \delta_i$ (2)<br>$\delta_i \sim N(0, \tau^2)$ (3)<br>$\varepsilon_i \sim N(0, s_i^2)$ (4)<br>$(2)\ and\ (3) \Rightarrow \theta_i \sim N(\mu, \tau^2)$<br>$(1),(2),(3)\&(4) \Rightarrow y_i \sim N(\mu, \tau^2 + s_i^2)$ |

*Given in Table 1 of Huang et al. (2004)

**Estimated by taking the square of the location-specific standard error, reported in Huang et al. (2004) for each location.

# Appendix C: Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: April – September, 2004

**Table C-1. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Atlanta, GA, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 6<br>(-26 - 38) | 0.4<br>(-1.8 - 2.6) | 0.1%<br>(-0.6% - 0.8%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 12<br>(4 - 20) | 0.8<br>(0.3 - 1.4) | 0.3%<br>(0.1% - 0.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 8<br>(-3 - 18) | 0.5<br>(-0.2 - 1.2) | 0.8%<br>(-0.3% - 1.8%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 8<br>(3 - 13) | 0.5<br>(0.2 - 0.9) | 0.8%<br>(0.3% - 1.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 5<br>(-2 - 11) | 0.3<br>(-0.1 - 0.8) | 0.5%<br>(-0.2% - 1.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 4<br>(1 - 7) | 0.3<br>(0 - 0.5) | 0.4%<br>(0.1% - 0.7%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 3<br>(0 - 7) | 0.2<br>(0 - 0.4) | 0.3%<br>(0% - 0.7%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 4<br>(1 - 8) | 0.3<br>(0.1 - 0.5) | 0.5%<br>(0.1% - 0.8%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-2. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Boston, MA, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 7<br>(2 - 12) | 1.0<br>(0.3 - 1.7) | 0.3%<br>(0.1% - 0.5%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-3. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Chicago, IL, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 49<br>(16 - 81) | 0.9<br>(0.3 - 1.5) | 0.2%<br>(0.1% - 0.4%) |
| Mortality, non-accidental | Schwartz (2004) | all | 0-day lag | 1 hr max. | none | 394<br>(125 - 658) | 7.3<br>(2.3 - 12.2) | 1.9%<br>(0.6% - 3.1%) |
| Mortality, non-accidental | Schwartz -- 14 US Cities (2004) | all | 0-day lag | 1 hr max. | none | 148<br>(46 - 250) | 2.8<br>(0.9 - 4.6) | 0.7%<br>(0.2% - 1.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 23<br>(-21 - 66) | 0.4<br>(-0.4 - 1.2) | 0.4%<br>(-0.4% - 1.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 38<br>(14 - 61) | 0.7<br>(0.3 - 1.1) | 0.7%<br>(0.3% - 1.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 22<br>(-9 - 53) | 0.4<br>(-0.2 - 1) | 0.4%<br>(-0.2% - 1%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 18<br>(3 - 33) | 0.3<br>(0.1 - 0.6) | 0.4%<br>(0.1% - 0.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 15<br>(0 - 31) | 0.3<br>(0 - 0.6) | 0.3%<br>(0% - 0.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 21<br>(6 - 36) | 0.4<br>(0.1 - 0.7) | 0.4%<br>(0.1% - 0.7%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-4. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Cleveland, OH, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 27<br>(-17 - 69) | 1.9<br>(-1.2 - 5) | 0.4%<br>(-0.2% - 0.9%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 17<br>(6 - 28) | 1.2<br>(0.4 - 2) | 0.2%<br>(0.1% - 0.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 16<br>(0 - 32) | 1.2<br>(0 - 2.3) | 0.9%<br>(0% - 1.7%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 14<br>(5 - 22) | 1.0<br>(0.4 - 1.6) | 0.7%<br>(0.3% - 1.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 8<br>(-3 - 19) | 0.6<br>(-0.2 - 1.4) | 0.4%<br>(-0.2% - 1%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 7<br>(1 - 12) | 0.5<br>(0.1 - 0.9) | 0.4%<br>(0.1% - 0.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 6<br>(0 - 11) | 0.4<br>(0 - 0.8) | 0.3%<br>(0% - 0.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 8<br>(2 - 13) | 0.5<br>(0.2 - 0.9) | 0.4%<br>(0.1% - 0.7%) |
| Hospital admissions, respiratory illness | Schwartz et al. (1996) | 65+ | avg of 1-day and 2-day lags | 1 hr max. | none | 59<br>(15 - 102) | 27.0<br>(6.9 - 46.8) | 1.5%<br>(0.4% - 2.6%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-5. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Detroit, MI, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 33<br>(-11 - 76) | 1.6<br>(-0.5 - 3.7) | 0.4%<br>(-0.1% - 0.8%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 17<br>(6 - 28) | 0.8<br>(0.3 - 1.4) | 0.2%<br>(0.1% - 0.3%) |
| Mortality, non-accidental | Schwartz (2004) | all | 0-day lag | 1 hr max. | none | 128<br>(-21 - 274) | 6.2<br>(-1 - 13.3) | 1.4%<br>(-0.2% - 2.9%) |
| Mortality, non-accidental | Schwartz -- 14 US Cities (2004) | all | 0-day lag | 1 hr max. | none | 70<br>(22 - 117) | 3.4<br>(1.1 - 5.7) | 0.7%<br>(0.2% - 1.2%) |
| Mortality, non-accidental | Ito (2003) | all | 0-day lag | 24 hr avg. | none | 40<br>(-37 - 116) | 2.0<br>(-1.8 - 5.6) | 0.4%<br>(-0.4% - 1.2%) |
| Mortality, respiratory | Ito (2003) | all | 0-day lag | 24 hr avg. | none | 13<br>(-10 - 34) | 0.6<br>(-0.5 - 1.6) | 1.6%<br>(-1.3% - 4.3%) |
| Mortality, circulatory | Ito (2003) | all | 0-day lag | 24 hr avg. | none | 6<br>(-11 - 22) | 0.3<br>(-0.5 - 1.1) | 0.4%<br>(-0.8% - 1.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 15<br>(-2 - 31) | 0.7<br>(-0.1 - 1.5) | 0.6%<br>(-0.1% - 1.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 14<br>(5 - 22) | 0.7<br>(0.3 - 1.1) | 0.6%<br>(0.2% - 0.9%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 8<br>(-3 - 19) | 0.4<br>(-0.2 - 0.9) | 0.3%<br>(-0.1% - 0.8%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 7<br>(1 - 12) | 0.3<br>(0.1 - 0.6) | 0.3%<br>(0% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 6<br>(0 - 11) | 0.3<br>(0 - 0.5) | 0.2%<br>(0% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 8<br>(2 - 13) | 0.4<br>(0.1 - 0.6) | 0.3%<br>(0.1% - 0.5%) |
| Hospital admissions (unscheduled), pneumonia | Ito (2003) | 65+ | 0-day lag | 24 hr avg. | none | -26<br>(-77 - 22) | -10.5<br>(-30.8 - 8.8) | -1%<br>(-3% - 0.9%) |
| Hospital admissions (unscheduled), pneumonia | Ito (2003) | 65+ | 1-day lag | 24 hr avg. | none | -6<br>(-56 - 41) | -2.6<br>(-22.6 - 16.5) | -0.2%<br>(-2.2% - 1.6%) |
| Hospital admissions (unscheduled), pneumonia | Ito (2003) | 65+ | 2-day lag | 24 hr avg. | none | 8<br>(-42 - 55) | 3.1<br>(-16.7 - 22.1) | 0.3%<br>(-1.6% - 2.1%) |
| Hospital admissions (unscheduled), pneumonia | Ito (2003) | 65+ | 3-day lag | 24 hr avg. | none | 22<br>(-26 - 68) | 9.0<br>(-10.5 - 27.5) | 0.9%<br>(-1% - 2.7%) |
| Hospital admissions (unscheduled), ischemic heart | Ito (2003) | 65+ | 0-day lag | 24 hr avg. | none | 12<br>(-52 - 75) | 5.0<br>(-20.9 - 30) | 0.2%<br>(-1% - 1.5%) |
| Hospital admissions (unscheduled), ischemic heart | Ito (2003) | 65+ | 1-day lag | 24 hr avg. | none | -11<br>(-77 - 53) | -4.4<br>(-30.9 - 21.3) | -0.2%<br>(-1.5% - 1.1%) |
| Hospital admissions (unscheduled), ischemic heart | Ito (2003) | 65+ | 2-day lag | 24 hr avg. | none | 17<br>(-50 - 80) | 6.6<br>(-19.9 - 32.3) | 0.3%<br>(-1% - 1.6%) |
| Hospital admissions (unscheduled), ischemic heart | Ito (2003) | 65+ | 3-day lag | 24 hr avg. | none | 32<br>(-32 - 95) | 12.9<br>(-13 - 38.1) | 0.6%<br>(-0.6% - 1.9%) |
| Hospital admissions (unscheduled), heart failure | Ito (2003) | 65+ | 0-day lag | 24 hr avg. | none | 11<br>(-42 - 61) | 4.3<br>(-16.7 - 24.5) | 0.3%<br>(-1.2% - 1.7%) |

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Hospital admissions (unscheduled), heart failure | Ito (2003) | 65+ | 1-day lag | 24 hr avg. | none | 52 (0 - 101) | 20.7 (0.1 - 40.6) | 1.5% (0% - 2.9%) |
| Hospital admissions (unscheduled), heart failure | Ito (2003) | 65+ | 2-day lag | 24 hr avg. | none | 36 (-17 - 87) | 14.4 (-6.9 - 34.8) | 1% (-0.5% - 2.5%) |
| Hospital admissions (unscheduled), heart failure | Ito (2003) | 65+ | 3-day lag | 24 hr avg. | none | 29 (-24 - 79) | 11.5 (-9.6 - 31.8) | 0.8% (-0.7% - 2.3%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.
Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-6. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Houston, TX, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 35 (2 - 67) | 1.0 (0.1 - 2) | 0.4% (0% - 0.7%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 17 (6 - 28) | 0.5 (0.2 - 0.8) | 0.2% (0.1% - 0.3%) |
| Mortality, non-accidental | Schwartz (2004) | all | 0-day lag | 1 hr max. | none | 93 (9 - 176) | 2.7 (0.3 - 5.2) | 1% (0.1% - 1.9%) |
| Mortality, non-accidental | Schwartz -- 14 US Cities (2004) | all | 0-day lag | 1 hr max. | none | 78 (24 - 130) | 2.3 (0.7 - 3.8) | 0.9% (0.3% - 1.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 12 (-2 - 26) | 0.4 (0 - 0.8) | 0.6% (-0.1% - 1.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 13 (5 - 20) | 0.4 (0.1 - 0.6) | 0.6% (0.2% - 1%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 7 (-3 - 18) | 0.2 (-0.1 - 0.5) | 0.4% (-0.1% - 0.8%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 6 (1 - 11) | 0.2 (0 - 0.3) | 0.3% (0.1% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 5 (0 - 10) | 0.2 (0 - 0.3) | 0.2% (0% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 7 (2 - 12) | 0.2 (0.1 - 0.3) | 0.3% (0.1% - 0.6%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-7. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Los Angeles, CA, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004)*** | all | distributed lag | 24 hr avg. | none | 62 (-149 - 271) | 0.6 (-1.6 - 2.8) | 0.2% (-0.5% - 1%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004)*** | all | distributed lag | 24 hr avg. | none | 133 (45 - 221) | 1.4 (0.5 - 2.3) | 0.5% (0.2% - 0.8%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004)*** | all | distributed lag | 24 hr avg. | none | 99 (1 - 195) | 1.0 (0 - 2.1) | 1.3% (0% - 2.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | none | 115 (44 - 185) | 1.2 (0.5 - 1.9) | 1.6% (0.6% - 2.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | PM10 | 68 (-26 - 161) | 0.7 (-0.3 - 1.7) | 0.9% (-0.4% - 2.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | NO2 | 56 (10 - 101) | 0.6 (0.1 - 1.1) | 0.8% (0.1% - 1.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | SO2 | 47 (0 - 94) | 0.5 (0 - 1) | 0.6% (0% - 1.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | CO | 64 (19 - 108) | 0.7 (0.2 - 1.1) | 0.9% (0.3% - 1.5%) |
| Hospital admissions (unscheduled), cardiovascular illness -- spring | Linn et al. (2000)**** | 30+ | 0-day lag | 24 hr avg. | none | 43 (-98 - 181) | 0.5 (-1.2 - 2.2) | 0.5% (-1.1% - 2%) |
| Hospital admissions (unscheduled), cardiovascular illness -- summer | Linn et al. (2000)**** | 30+ | 0-day lag | 24 hr avg. | none | 19 (-165 - 198) | 0.2 (-2 - 2.4) | 0.2% (-1.9% - 2.2%) |
| Hospital admissions (unscheduled), pulmonary illness -- spring | Linn et al. (2000)**** | 30+ | 0-day lag | 24 hr avg. | none | 75 (-32 - 179) | 0.9 (-0.4 - 2.1) | 1.7% (-0.7% - 4.1%) |
| Hospital admissions (unscheduled), pulmonary illness -- summer | Linn et al. (2000)**** | 30+ | 0-day lag | 24 hr avg. | none | 46 (-60 - 148) | 0.5 (-0.7 - 1.8) | 1.2% (-1.6% - 4%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

***Los Angeles is defined in this study as Los Angeles County.

****Los Angeles is defined in this study as Los Angeles, Riverside, San Bernardino, and Orange Counties. The spring C-R function was run with April - June air quality data; the summer C-R function was run with July - Septen

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-8. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Philadelphia, PA, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 23<br>(8 - 38) | 1.5<br>(0.5 - 2.5) | 0.3%<br>(0.1% - 0.5%) |
| Mortality, non-accidental | Moolgavkar et al. (1995) | all | 1-day lag | 24 hr avg. | none | 82<br>(52 - 112) | 5.4<br>(3.4 - 7.4) | 1%<br>(0.6% - 1.4%) |
| Mortality, non-accidental | Moolgavkar et al. (1995) | all | 1-day lag | 24 hr avg. | TSP, SO2 | 82<br>(39 - 124) | 5.4<br>(2.6 - 8.2) | 1%<br>(0.5% - 1.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 20<br>(1 - 39) | 1.3<br>(0.1 - 2.6) | 1.1%<br>(0.1% - 2.1%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 17<br>(6 - 27) | 1.1<br>(0.4 - 1.8) | 0.9%<br>(0.3% - 1.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 10<br>(-4 - 24) | 0.7<br>(-0.3 - 1.6) | 0.5%<br>(-0.2% - 1.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 8<br>(1 - 15) | 0.5<br>(0.1 - 1) | 0.4%<br>(0.1% - 0.8%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 7<br>(0 - 14) | 0.5<br>(0 - 0.9) | 0.4%<br>(0% - 0.7%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 9<br>(3 - 16) | 0.6<br>(0.2 - 1) | 0.5%<br>(0.1% - 0.9%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.
Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-9. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Sacramento, CA, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 12<br>(-36 - 59) | 1.0<br>(-3 - 4.8) | 0.3%<br>(-0.9% - 1.4%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 18<br>(6 - 29) | 1.4<br>(0.5 - 2.4) | 0.4%<br>(0.1% - 0.7%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.
Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-10. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: St. Louis, MO, April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 3<br>(-6 - 13) | 1.0<br>(-1.7 - 3.6) | 0.2%<br>(-0.3% - 0.6%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 3<br>(1 - 5) | 0.9<br>(0.3 - 1.5) | 0.2%<br>(0.1% - 0.3%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table C-11. Estimated Health Risks Associated with "As Is" $O_3$ Concentrations: Washington, D.C., April - September, 2004**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Above Policy Relevant Background Levels** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 8<br>(3 - 14) | 1.5<br>(0.5 - 2.4) | 0.3%<br>(0.1% - 0.5%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

# Appendix D: Estimated Health Risks Associated with $O_3$ Concentrations That Just Meet the Current 8-Hour Daily Maximum Standard: April – September, 2004

**Table D-1. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Atlanta, GA, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 4<br>(-18 - 26) | 0.3<br>(-1.2 - 1.8) | 0.1%<br>(-0.4% - 0.6%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 8<br>(3 - 14) | 0.6<br>(0.2 - 0.9) | 0.2%<br>(0.1% - 0.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 5<br>(-2 - 12) | 0.4<br>(-0.1 - 0.8) | 0.6%<br>(-0.2% - 1.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 6<br>(2 - 9) | 0.4<br>(0.1 - 0.6) | 0.6%<br>(0.2% - 0.9%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 3<br>(-1 - 8) | 0.2<br>(-0.1 - 0.5) | 0.3%<br>(-0.1% - 0.8%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 3<br>(0 - 5) | 0.2<br>(0 - 0.3) | 0.3%<br>(0% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 2<br>(0 - 5) | 0.2<br>(0 - 0.3) | 0.2%<br>(0% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 3<br>(1 - 5) | 0.2<br>(0.1 - 0.4) | 0.3%<br>(0.1% - 0.5%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-2. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Boston, MA, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 5<br>(2 - 9) | 0.8<br>(0.3 - 1.3) | 0.2%<br>(0.1% - 0.3%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-3. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Chicago, IL, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 27<br>(9 - 44) | 0.5<br>(0.2 - 0.8) | 0.1%<br>(0% - 0.2%) |
| Mortality, non-accidental | Schwartz (2004) | all | 0-day lag | 1 hr max. | none | 307<br>(98 - 512) | 5.7<br>(1.8 - 9.5) | 1.5%<br>(0.5% - 2.4%) |
| Mortality, non-accidental | Schwartz -- 14 US Cities (2004) | all | 0-day lag | 1 hr max. | none | 116<br>(36 - 195) | 2.2<br>(0.7 - 3.6) | 0.6%<br>(0.2% - 0.9%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 13<br>(-11 - 36) | 0.2<br>(-0.2 - 0.7) | 0.2%<br>(-0.2% - 0.7%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 21<br>(8 - 33) | 0.4<br>(0.1 - 0.6) | 0.4%<br>(0.2% - 0.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 12<br>(-5 - 29) | 0.2<br>(-0.1 - 0.5) | 0.2%<br>(-0.1% - 0.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 10<br>(2 - 18) | 0.2<br>(0 - 0.3) | 0.2%<br>(0% - 0.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 8<br>(0 - 17) | 0.2<br>(0 - 0.3) | 0.2%<br>(0% - 0.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 11<br>(3 - 19) | 0.2<br>(0.1 - 0.4) | 0.2%<br>(0.1% - 0.4%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.
Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-4. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Cleveland, OH, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 17<br>(-11 - 45) | 1.2<br>(-0.8 - 3.2) | 0.2%<br>(-0.1% - 0.6%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 11<br>(4 - 18) | 0.8<br>(0.3 - 1.3) | 0.1%<br>(0% - 0.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 10<br>(0 - 21) | 0.7<br>(0 - 1.5) | 0.6%<br>(0% - 1.1%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 9<br>(3 - 14) | 0.6<br>(0.2 - 1) | 0.5%<br>(0.2% - 0.8%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 5<br>(-2 - 12) | 0.4<br>(-0.1 - 0.9) | 0.3%<br>(-0.1% - 0.7%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 4<br>(1 - 8) | 0.3<br>(0.1 - 0.6) | 0.2%<br>(0% - 0.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 4<br>(0 - 7) | 0.3<br>(0 - 0.5) | 0.2%<br>(0% - 0.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 5<br>(1 - 8) | 0.4<br>(0.1 - 0.6) | 0.3%<br>(0.1% - 0.4%) |
| Hospital admissions, respiratory illness | Schwartz et al. (1996) | 65+ | avg of 1-day and 2-day lags | 1 hr max. | none | 46<br>(12 - 80) | 21.4<br>(5.5 - 37) | 1.2%<br>(0.3% - 2%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-5. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Detroit, MI, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 19 (-6 - 44) | 0.9 (-0.3 - 2.1) | 0.2% (-0.1% - 0.5%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 10 (3 - 16) | 0.5 (0.2 - 0.8) | 0.1% (0% - 0.2%) |
| Mortality, non-accidental | Schwartz (2004) | all | 0-day lag | 1 hr max. | none | 105 (-17 - 223) | 5.1 (-0.8 - 10.8) | 1.1% (-0.2% - 2.4%) |
| Mortality, non-accidental | Schwartz -- 14 US Cities (2004) | all | 0-day lag | 1 hr max. | none | 57 (18 - 96) | 2.8 (0.9 - 4.6) | 0.6% (0.2% - 1%) |
| Mortality, non-accidental | Ito (2003) | all | 0-day lag | 24 hr avg. | none | 23 (-22 - 67) | 1.1 (-1.1 - 3.3) | 0.2% (-0.2% - 0.7%) |
| Mortality, respiratory | Ito (2003) | all | 0-day lag | 24 hr avg. | none | 7 (-6 - 19) | 0.4 (-0.3 - 0.9) | 0.9% (-0.8% - 2.4%) |
| Mortality, circulatory | Ito (2003) | all | 0-day lag | 24 hr avg. | none | 3 (-7 - 13) | 0.2 (-0.3 - 0.6) | 0.2% (-0.5% - 0.9%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 9 (-1 - 18) | 0.4 (0 - 0.9) | 0.4% (0% - 0.8%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 8 (3 - 13) | 0.4 (0.1 - 0.6) | 0.3% (0.1% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 5 (-2 - 11) | 0.2 (-0.1 - 0.5) | 0.2% (-0.1% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 4 (1 - 7) | 0.2 (0 - 0.3) | 0.2% (0% - 0.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 3 (0 - 7) | 0.2 (0 - 0.3) | 0.1% (0% - 0.3%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 4 (1 - 8) | 0.2 (0.1 - 0.4) | 0.2% (0.1% - 0.3%) |
| Hospital admissions (unscheduled), pneumonia | Ito (2003) | 65+ | 0-day lag | 24 hr avg. | none | -15 (-46 - 13) | -6.2 (-18.4 - 5.1) | -0.6% (-1.8% - 0.5%) |
| Hospital admissions (unscheduled), pneumonia | Ito (2003) | 65+ | 1-day lag | 24 hr avg. | none | -4 (-33 - 24) | -1.5 (-13.4 - 9.5) | -0.1% (-1.3% - 0.9%) |
| Hospital admissions (unscheduled), pneumonia | Ito (2003) | 65+ | 2-day lag | 24 hr avg. | none | 5 (-24 - 31) | 1.8 (-9.8 - 12.7) | 0.2% (-0.9% - 1.2%) |
| Hospital admissions (unscheduled), pneumonia | Ito (2003) | 65+ | 3-day lag | 24 hr avg. | none | 13 (-15 - 39) | 5.2 (-6.2 - 15.7) | 0.5% (-0.6% - 1.5%) |
| Hospital admissions (unscheduled), ischemic heart | Ito (2003) | 65+ | 0-day lag | 24 hr avg. | none | 7 (-30 - 43) | 2.9 (-12.3 - 17.3) | 0.1% (-0.6% - 0.9%) |
| Hospital admissions (unscheduled), ischemic heart | Ito (2003) | 65+ | 1-day lag | 24 hr avg. | none | -6 (-45 - 31) | -2.6 (-18.2 - 12.3) | -0.1% (-0.9% - 0.6%) |
| Hospital admissions (unscheduled), ischemic heart | Ito (2003) | 65+ | 2-day lag | 24 hr avg. | none | 10 (-29 - 46) | 3.9 (-11.7 - 18.6) | 0.2% (-0.6% - 0.9%) |
| Hospital admissions (unscheduled), ischemic heart | Ito (2003) | 65+ | 3-day lag | 24 hr avg. | none | 19 (-19 - 54) | 7.5 (-7.6 - 21.9) | 0.4% (-0.4% - 1.1%) |
| Hospital admissions (unscheduled), heart failure | Ito (2003) | 65+ | 0-day lag | 24 hr avg. | none | 6 (-24 - 35) | 2.5 (-9.8 - 14.1) | 0.2% (-0.7% - 1%) |

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Hospital admissions (unscheduled), heart failure | Ito (2003) | 65+ | 1-day lag | 24 hr avg. | none | 30 (0 - 58) | 12 (0.1 - 23.2) | 0.8% (0% - 1.6%) |
| Hospital admissions (unscheduled), heart failure | Ito (2003) | 65+ | 2-day lag | 24 hr avg. | none | 21 (-10 - 50) | 8.3 (-4 - 19.9) | 0.6% (-0.3% - 1.4%) |
| Hospital admissions (unscheduled), heart failure | Ito (2003) | 65+ | 3-day lag | 24 hr avg. | none | 17 (-14 - 45) | 6.7 (-5.6 - 18.3) | 0.5% (-0.4% - 1.3%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-6. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Houston, TX, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 16<br>(1 - 30) | 0.5<br>(0 - 0.9) | 0.2%<br>(0% - 0.3%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 8<br>(3 - 13) | 0.2<br>(0.1 - 0.4) | 0.1%<br>(0% - 0.1%) |
| Mortality, non-accidental | Schwartz (2004) | all | 0-day lag | 1 hr max. | none | 68<br>(6 - 129) | 2<br>(0.2 - 3.8) | 0.8%<br>(0.1% - 1.4%) |
| Mortality, non-accidental | Schwartz -- 14 US Cities (2004) | all | 0-day lag | 1 hr max. | none | 57<br>(18 - 96) | 1.7<br>(0.5 - 2.8) | 0.6%<br>(0.2% - 1.1%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 6<br>(-1 - 12) | 0.2<br>(0 - 0.3) | 0.3%<br>(0% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 6<br>(2 - 9) | 0.2<br>(0.1 - 0.3) | 0.3%<br>(0.1% - 0.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 3<br>(-1 - 8) | 0.1<br>(0 - 0.2) | 0.2%<br>(-0.1% - 0.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 3<br>(0 - 5) | 0.1<br>(0 - 0.1) | 0.1%<br>(0% - 0.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 2<br>(0 - 5) | 0.1<br>(0 - 0.1) | 0.1%<br>(0% - 0.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 3<br>(1 - 5) | 0.1<br>(0 - 0.2) | 0.1%<br>(0% - 0.3%) |

*Health effects are associated with short-term exposures to $O_3$.

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Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-7. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Los Angeles, CA, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004)*** | all | distributed lag | 24 hr avg. | none | 29 (-71 - 127) | 0.3 (-0.7 - 1.3) | 0.1% (-0.3% - 0.5%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004)*** | all | distributed lag | 24 hr avg. | none | 63 (21 - 104) | 0.7 (0.2 - 1.1) | 0.2% (0.1% - 0.4%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004)*** | all | distributed lag | 24 hr avg. | none | 46 (0 - 91) | 0.5 (0 - 1) | 0.6% (0% - 1.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | none | 54 (21 - 86) | 0.6 (0.2 - 0.9) | 0.7% (0.3% - 1.2%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | PM10 | 32 (-12 - 75) | 0.3 (-0.1 - 0.8) | 0.4% (-0.2% - 1%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | NO2 | 26 (5 - 47) | 0.3 (0 - 0.5) | 0.4% (0.1% - 0.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | SO2 | 22 (0 - 44) | 0.2 (0 - 0.5) | 0.3% (0% - 0.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004)*** | all | distributed lag | 24 hr avg. | CO | 30 (9 - 51) | 0.3 (0.1 - 0.5) | 0.4% (0.1% - 0.7%) |
| HA (unscheduled), cardiovascular illness -- spring | Linn et al. (2000)**** | 30+ | 0-day lag | 24 hr avg. | none | 20 (-47 - 85) | 0.2 (-0.6 - 1) | 0.2% (-0.5% - 0.9%) |
| HA (unscheduled), cardiovascular illness -- summer | Linn et al. (2000)**** | 30+ | 0-day lag | 24 hr avg. | none | 11 (-102 - 121) | 0.1 (-1.2 - 1.4) | 0.1% (-1.1% - 1.4%) |
| HA (unscheduled), pulmonary illness -- spring | Linn et al. (2000)**** | 30+ | 0-day lag | 24 hr avg. | none | 35 (-15 - 83) | 0.4 (-0.2 - 1) | 0.8% (-0.4% - 1.9%) |
| HA (unscheduled), pulmonary illness -- summer | Linn et al. (2000)**** | 30+ | 0-day lag | 24 hr avg. | none | 28 (-37 - 90) | 0.3 (-0.4 - 1.1) | 0.8% (-1% - 2.5%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

***Los Angeles is defined in this study as Los Angeles County.

****Los Angeles is defined in this study as Los Angeles, Riverside, San Bernardino, and Orange Counties. The spring C-R function was run with April - June air quality data; the summer C-R function was run with July - Septemb

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-8. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Philadelphia, PA, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 16<br>(5 - 26) | 1.1<br>(0.4 - 1.7) | 0.2%<br>(0.1% - 0.3%) |
| Mortality, non-accidental | Moolgavkar et al. (1995) | all | 1-day lag | 24 hr avg. | none | 57<br>(36 - 78) | 3.7<br>(2.4 - 5.1) | 0.7%<br>(0.4% - 1%) |
| Mortality, non-accidental | Moolgavkar et al. (1995) | all | 1-day lag | 24 hr avg. | TSP, SO2 | 56<br>(27 - 85) | 3.7<br>(1.8 - 5.6) | 0.7%<br>(0.3% - 1.1%) |
| Mortality, cardiovascular and respiratory | Huang et al. (2004) | all | distributed lag | 24 hr avg. | none | 14<br>(1 - 27) | 0.9<br>(0 - 1.8) | 0.8%<br>(0% - 1.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 12<br>(4 - 19) | 0.8<br>(0.3 - 1.2) | 0.6%<br>(0.2% - 1%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | PM10 | 7<br>(-3 - 16) | 0.5<br>(-0.2 - 1.1) | 0.4%<br>(-0.1% - 0.9%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | NO2 | 6<br>(1 - 10) | 0.4<br>(0.1 - 0.7) | 0.3%<br>(0.1% - 0.6%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | SO2 | 5<br>(0 - 9) | 0.3<br>(0 - 0.6) | 0.3%<br>(0% - 0.5%) |
| Mortality, cardiovascular and respiratory | Huang et al. -- 19 US Cities (2004) | all | distributed lag | 24 hr avg. | CO | 6<br>(2 - 11) | 0.4<br>(0.1 - 0.7) | 0.3%<br>(0.1% - 0.6%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.
Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-9. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Sacramento, CA, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 8<br>(-24 - 39) | 0.6<br>(-1.9 - 3.2) | 0.2%<br>(-0.6% - 0.9%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 12<br>(4 - 19) | 0.9<br>(0.3 - 1.6) | 0.3%<br>(0.1% - 0.5%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-10. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: St. Louis, MO, April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. (2004) | all | distributed lag | 24 hr avg. | none | 2<br>(-4 - 8) | 0.6<br>(-1 - 2.3) | 0.1%<br>(-0.2% - 0.4%) |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 2<br>(1 - 3) | 0.6<br>(0.2 - 0.9) | 0.1%<br>(0% - 0.2%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

**Table D-11. Estimated Health Risks Associated with $O_3$ Concentrations that Just Meet the Current 8-Hour Daily Maximum Standard: Washington, D.C., April - September**

| Health Effects* | Study | Ages | Lag | Exposure Metric | Other Pollutants in Model | Health Effects Associated with $O_3$ Concentrations that Just Meet the Current $O_3$ Standard** | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Incidence | Incidence per 100,000 Relevant Population | Percent of Total Incidence |
| Mortality, non-accidental | Bell et al. -- 95 US Cities (2004) | all | distributed lag | 24 hr avg. | none | 7<br>(2 - 11) | 1.2<br>(0.4 - 2) | 0.3%<br>(0.1% - 0.4%) |

*Health effects are associated with short-term exposures to $O_3$.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest whole number; incidences per 100,000 relevant population and percents are rounded to the nearest tenth.

Note: Numbers in parentheses are 95% confidence or credible intervals based on statistical uncertainty surrounding the $O_3$ coefficient.

# Appendix E: Calculation of Risk Above Policy Relevant Background

## Appendix E: Calculation of Risk Above Policy Relevant Background

The estimated policy relevant background (PRB) ozone concentrations that we are using are derived from GEOS-CHEM model predictions, and the measured ambient ozone concentrations are sometimes lower than these PRB values. There is a question of how to best treat this in our estimation of risk above PRB.

Let $x_0$ denote the "as is" (ambient) $O_3$ level, and $y_0$ denote the corresponding baseline incidence rate. The difference in health effects incidence, $\Delta y = y_0 - y$, corresponding to a given difference in ambient $O_3$ levels, $\Delta x = (x_0 - x) > 0$ can be calculated for log-linear concentration-response functions by:

$$\Delta y = y_0[1 - e^{-\beta \Delta x}] . \quad (1)$$

If we let $\Delta x = c - b$, where c = the "as is" $O_3$ concentration and b = the PRB $O_3$ concentration, the risk above background ($\Delta y = y_0 - y_b$ = the difference in health effects incidence rates from the as-is concentration incidence rate, $y_0$, to the PRB concentration incidence rate, $y_b$) can similarly be calculated for log-linear concentration-response functions by equation 1 (where now $\Delta y = y_0 - y_b$ and $\Delta x = c - b$).

Without loss of generality we can take the baseline incidence rate $y_0$ to be 1. Then

$$\Delta y = [1 - e^{-\beta \Delta x}]. \quad (2)$$

Now we consider the implications of different ways of calculating risk above background. To simplify this analysis, we use the approximation to equation (2), valid for $\beta \approx 0$,

$$\Delta y = \beta \, \Delta x = \beta \, (c - b) . \quad (3)$$

Let $c_t$ be the measured concentrations (t=1 to N), $b_t$ the true background concentrations, and B the estimated background concentration. Then the overall bias, $\theta$, in the estimated background is given by

$$\theta = B - \frac{1}{N} \sum_t b_t \quad (4)$$

The true risk above background, R, is

$$R = \sum_t \Delta y = \beta \sum_t \Delta x = \beta \sum_t (c_t - b_t) \quad (5)$$

If the measured concentrations $c_t$ are always greater than the estimated background B, then equation 3 (approximating equation 2) gives an estimated risk above background of

$$\hat{R} = \beta \sum_t (c_t - B) = \beta \sum_t c_t - \beta B \tag{6}$$

and the error E of this estimate is

$$E = R - \hat{R} = \beta \sum_t (c_t - b_t) - \beta \sum_t (c_t - B) = \beta \sum_t (B - b_t) = \beta N \theta \tag{7}$$

However, the measured concentrations are sometimes smaller than the estimated background. In these cases we cannot use equation 6 since it is not physically realizable. The error E of our risk estimate will depend on how we calculate risk in this situation.

**Method I.** When $c_t < B$ we set the risk to zero in equation 6, with the rationale that, since ambient concentrations cannot go below background, we lower the estimated background concentrations in these cases down to the ambient concentration $c_t$.

Then the estimate of risk above background is

$$\beta \sum_{t|c_t > B} (c_t - B) \tag{8}$$

where $t|c_t > B$ indicates the summation over all times t when $c_t > B$.

The error E of this estimate is

$$E = \beta \sum_t (c_t - b_t) - \beta \sum_{t|c_t > B} (c_t - B) = \beta N \theta + \beta \sum_{t|c_t \le B} (c_t - B) \tag{9}$$

since

$$\beta \sum_t (c_t - b_t) - \beta \sum_t (c_t - B) = \beta N \theta \tag{10}$$

$$\beta \sum_t (c_t - b_t) - \beta \sum_{t|c_t > B} (c_t - B) - \beta \sum_{t|c_t \le B} (c_t - B) = \beta N \theta \tag{11}$$

$$\beta\sum_{t}(c_t - b_t) - \beta\sum_{t|c_t>B}(c_t - B) = \beta N\theta + \beta\sum_{t|c_t\le B}(c_t - B) \qquad (12)$$

**Method II.** When $c_t < B$ we set the background for that day equal to $c_t$ and increase B on other days to yield the original monthly average background concentration, or use some other method of adjusting $b_t$ to use daily varying background concentrations $B_t$ that are always less then the measured concentrations and whose average is the original monthly average background concentration B. This approach places more credence on the average estimated background than on the estimated background values for individual hours. The error of this estimate of risk above background is given by

$$E = \beta\sum_{t}(B_t - b_t) = \beta(N\,B - \sum_{t} b_t) = \beta N\theta \qquad (13)$$

**Discussion**

To recap, the error of the estimate of risk if we use method I is:

$$E_I = \beta N\theta + \beta\sum_{t|c_t\le B}(c_t - B)$$

and the error of the estimate of risk if we use method II is:

$$E_{II} = \beta N\theta\,.$$

If we have overestimated background, $\theta > 0$, and $E_{II} > 0$. Since the second term in $E_I$, $\beta\sum_{t|c_t\le B}(c_t - B)$, must be $\le 0$, $E_I \le E_{II}$. If, as is likely, $\beta\sum_{t|c_t\le B}(c_t - B)$ is smaller in absolute value than $\beta N\theta$, then $0 \le E_I \le E_{II}$.

If we have overestimated background, then, the first method would be preferable; if background is underestimated, then the second method would be more accurate. Since we believe that we have overestimated background in cases where the observed concentration is lower than the estimates background obtained from the GEOS-CHEM model, we have applied the first method in estimating risks in this draft report.