Comparison of Satellite Observations of Nitrogen Dioxide to Surface Monitor Nitrogen Dioxide Concentration

Mary M. Kleb, Margaret R. Pippin, R. Bradley Pierce, Doreen O. Neil
Langley Research Center, Hampton, Virginia

Gretchen Lingenfelser
Science Applications International Corporation, Hampton, Virginia

James J. Szykman
United States Environmental Protection Agency, Research Triangle Park, North Carolina

December 2006
Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA’s scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA’s institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- **TECHNICAL PUBLICATION.** Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA counterpart of peer-reviewed formal professional papers, but having less stringent limitations on manuscript length and extent of graphic presentations.

- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.

- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.

- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.

- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.

- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA’s mission.

Specialized services that complement the STI Program Office’s diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results ... even providing videos.

For more information about the NASA STI Program Office, see the following:

- E-mail your question via the Internet to help@sti.nasa.gov
- Fax your question to the NASA STI Help Desk at (301) 621–0134
- Phone the NASA STI Help Desk at (301) 621–0390
- Write to: NASA STI Help Desk NASA Center for AeroSpace Information 7121 Standard Drive Hanover, MD 21076–1320
Comparison of Satellite Observations of Nitrogen Dioxide to Surface Monitor Nitrogen Dioxide Concentration

Mary M. Kleb, Margaret R. Pippin, R. Bradley Pierce, Doreen O. Neil
Langley Research Center, Hampton, Virginia

Gretchen Lingenfelser
Science Applications International Corporation, Hampton, Virginia

James J. Szykman
United States Environmental Protection Agency, Research Triangle Park, North Carolina

National Aeronautics and Space Administration
Langley Research Center
Hampton, Virginia 23681-2199

December 2006
Acknowledgments

This work was sponsored by NASA’s Science Mission Directorate, Applied Sciences Program. The authors wish to gratefully acknowledge the GOME and AIRNow teams for making their data available for analysis. We also acknowledge the professional assistance of William Kleb, for providing the LaTeX template and technical assistance with LaTeX document preparation.

The use of trademarks or names of manufacturers in this report is for accurate reporting and does not constitute an official endorsement, either expressed or implied, of such products or manufacturers by the National Aeronautics and Space Administration.

Available from:

NASA Center for AeroSpace Information (CASI)
7121 Standard Drive
Hanover, MD 21076–1320
(301) 621–0390

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161–2171
(703) 605–6000
Abstract

Nitrogen dioxide is one of the U. S. EPA’s criteria pollutants, and one of the main ingredients needed for the production of ground-level ozone. Both ozone and nitrogen dioxide cause severe public health problems. Existing satellites have begun to produce observational data sets for nitrogen dioxide. Under NASA’s Earth Science Applications Program, we examined the relationship between satellite observations and surface monitor observations of this air pollutant to examine if the satellite data can be used to facilitate a more capable and integrated observing network. This report provides a comparison of satellite tropospheric column nitrogen dioxide to surface monitor nitrogen dioxide concentration for the period from September 1996 through August 1997 at more than 300 individual locations in the continental US. We found that the spatial resolution and observation time of the satellite did not capture the variability of this pollutant as measured at ground level.

The tools and processes developed to conduct this study will be applied to the analysis of advanced satellite observations. One advanced instrument has significantly better spatial resolution than the measurements studied here and operates with an afternoon overpass time, providing a more representative distribution for once-per-day sampling of this photochemically active atmospheric constituent.
# Table of Contents

1 Executive Summary ............................................................... 3

2 Introduction ........................................................................... 4
   2.1 Criteria Pollutant and Scientific Rationale .......................... 4
   2.2 Ground-based Measurement Characteristics ........................ 4
   2.3 Satellite-based Measurement Characteristics ..................... 5
   2.4 Objective of Comparison .................................................. 5

3 Site-by-site Satellite/In-Situ Comparison .................................. 6
   3.1 Background on Time Period .............................................. 6
   3.2 Coincidence Criteria ..................................................... 6
   3.3 Time Series Analysis ..................................................... 6
   3.4 Site-by-site Correlation Analysis ..................................... 7

4 National Satellite and In-Situ Comparisons ............................... 11
   4.1 Maps of 80 km Binned Mean GOME Nitrogen Dioxide Statistics 11
   4.2 Site-by-site Mean Statistics .......................................... 11
   4.3 Regional Spatial Statistics ............................................. 27

5 Effect of Satellite Footprint Size on Correlation ......................... 34

6 Conclusion ............................................................................. 36

Appendix A Site-by-Site Satellite and EPA In-Situ Time Series .......... 39

Appendix B Regional Mean Satellite and In-Situ Comparisons .......... 263
1 Executive Summary

We compared NO$_2$ observations from the space-based Global Ozone Monitoring Experiment (GOME) instrument on the Second European Remote Sensing (ERS-2) satellite to United States Environmental Protection Agency (EPA) surface network measurements of NO$_2$. This work was performed to prepare for similar comparisons of NASA’s Ozone Monitoring Instrument (OMI) NO$_2$ observations when they become available. The satellite-surface comparisons indicate that GOME’s large footprint (320 x 40 km$^2$) poorly represents the spatial variability of NO$_2$ as determined by the surface network observations. OMI will have significantly better spatial resolution (24 x 13 km$^2$ at nadir). In addition, GOME measurements are performed from an orbit with a 10:30 local overpass time. At this time of day, large and rapid changes in the NO$_2$ concentration occur. The OMI overpass occurs at 13:30 local, with less rapidly changing NO$_2$ concentration.

This work was funded by NASA’s Earth Science Applications Program within the Applied Sciences Program of NASA’s Science Mission Directorate. Applied Sciences supports prototyping and benchmarking the use of NASA-sponsored observations from remote sensing systems, and predictions from scientific research and modeling, to expand and accelerate the use of knowledge, science, and technologies to serve society.
2 Introduction

The Earth System responds to both naturally occurring and human-induced change. NASA's Science Mission Directorate (SMD) seeks to understand the forcings and response of the Earth System via long-term observations from ground networks, sub-orbital platforms, and space-based assets. The role of the Earth Science Applications Program within the Science Mission Directorate is to incorporate these observations into decision support tools employed by partner Agencies and to assess the performance of these measurements in decision support tools. The approach is to enable the use of Earth Science mission outputs (i.e., models and remote sensing data products) to serve as inputs to decision support systems. Ultimately, the desired outcome is an enhanced decision support tool that results in significant socio-economic benefits.

2.1 Criteria Pollutant and Scientific Rationale

Under the Clean Air Act of 1990 (http://www.epa.gov/oar/CAA/), the EPA is required to set standards for concentrations of air quality pollutants, ensure these standards are met through monitoring, and establish a consistent means of reporting air quality to the public, which, currently, is the Air Quality Index (AQI). The EPA is currently setting air quality standards related to the concentration levels of six main air pollutants: ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. Nitrogen oxides ($NO_x$) include NO and NO$_2$, both highly reactive gases. NO is colorless and odorless, however NO$_2$ can many times be seen as a red-brown layer over urban areas. NO$_x$ is a byproduct of combustion with 95% of NO$_x$ emissions from combustion in the form of NO [1]. Exhaust from motor vehicles accounts for 49% of NO$_x$ emissions. Other sources are electric utilities, and industrial, commercial and residential burning of fossil fuels [2]. Between 1980 and 1999 NO$_2$ emissions have increased by 4% while emissions of all other criteria pollutants have decreased (between 1998 and 1999 carbon monoxide and lead emissions have increased slightly while NO$_2$ emissions have decreased slightly) [1].

There are many health and environmental impacts of NO$_x$. NO$_x$ is one of the main ingredients needed for the production of ground-level ozone [3], [4], [5], [6]. Both NO$_2$ and ozone can cause serious respiratory problems [7], [8] and references cited therein. NO$_2$ reacts to form nitrate particles and acid aerosols which contribute to acid deposition and nutrient overload in water [7], [9]. Excesses of NO$_x$ also decrease visibility [10]. In addition, when sequestered in a reservoir species, NO$_x$ can be transported long distances by prevailing winds and affect air quality in regions many miles from the source [11], [12], [13], [14].

The EPA has a ground network of monitoring stations around the US that are currently being used to monitor NO$_2$ concentration in well populated areas. Quantitative satellite data can be validated against the surface network in urban areas. Once validated, the satellite data can provide NO$_2$ distributions in remote continental areas, far from the surface network stations, extending the integrated observing network. NASA satellite data may serve as a top-down constraint on emissions inventories for NO$_2$, and could also provide evidence of longrange transport between regions.

2.2 Ground-based Measurement Characteristics

The EPA ground network consists of in-situ NO$_2$ monitoring stations located throughout the country, with higher concentrations of monitors in more densely populated regions.

These monitors are operated by the State and Local Air Monitoring Stations (SLAMS) and National Air Monitoring Stations (NAMS) networks. NO$_2$ concentrations are measured using the chemiluminescence method. This method first converts NO$_2$ to NO in a heated catalytic converter (typically molybdenum) followed by reaction of NO with ozone. This
reaction forms an excited state of NO\textsubscript{2} which releases a photon as it returns to a lower energy state. The photons are measured with a PMT (photomultiplier tube). The PMT signal is proportional to the amount of NO in the sample. The detection limit of the EPA monitors is 5 ppbv. Since the catalytic conversion is not specific to NO\textsubscript{2}, the chemiluminescence technique has been reported to overestimate NO\textsubscript{2}. Interferences by other chemical species are considered small in urban areas where emissions are fresh. However, in rural and remote regions where air mass aging can be a factor, this method can over predict NO\textsubscript{2} levels [1]. Information on the list of designated reference and equivalent methods for NO\textsubscript{2} can be found at http://www.epa.gov/ttn/antim/files/ambient/criteria/ref905.pdf (last updated Sept. 2005).

2.3 Satellite-based Measurement Characteristics

The Global Ozone Monitoring Experiment (GOME), aboard the European Space Agency’s Second European Remote Sensing (ERS-2) satellite has a 10:30am local equatorial overpass time along a sun-synchronous polar orbit. GOME has a full swath width of 960 km which is divided into three ground pixels (east, central or nadir, and west) relative to viewing straight down, for a 40 km x 320 km spatial resolution [15]. GOME has a 100 minute orbit which results in 14 orbits per day achieving global coverage in three days. For additional information regarding GOME, see [15].

The GOME data product utilized in this study is nitrogen dioxide tropospheric column. A detailed discussion of the method used to derive the tropospheric nitrogen dioxide column is given in [16]. In general, the stratospheric column is subtracted from the total column to yield the tropospheric column. The stratospheric NO\textsubscript{2} column is approximated by using the total NO\textsubscript{2} column over the central pacific where tropospheric NO\textsubscript{2} is relatively low. Note that GOME was not designed to measure tropospheric nitrogen dioxide; this product was developed after launch to support emerging scientific interest in tropospheric composition. The NO\textsubscript{2} column is sensitive to clouds, aerosols, and surface albedo, which increase the error in tropospheric NO\textsubscript{2} column. In addition, the GOME morning overpass occurs at a time of rapid change in tropospheric NO\textsubscript{2} as NO\textsubscript{x} begins to repartition into NO and NO\textsubscript{2}.

2.4 Objective of Comparison

The objective of this work is to determine the quantitative relationship between tropospheric column NO\textsubscript{2} as measured from space by GOME and the surface distribution of NO\textsubscript{2} as measured by the EPA regulatory network.
3 Site-by-site Satellite/In-Situ Comparison

3.1 Background on Time Period

The time period chosen for this analysis is September 1, 1996 through August 31, 1997. The specific dates were chosen based on availability of data. The length of time chosen allows for an analysis of the robustness of this comparison on a seasonal basis.

3.2 Coincidence Criteria

For the correlation analysis presented in Section 3.3, the data pairs of satellite tropospheric NO$_2$ column and ground-based NO$_2$ concentration must be collocated in space and time. For every ground station, the $40 \times 320$ km$^2$ GOME observations that include the longitude and latitude of the site are accumulated. The hourly surface NO$_2$ data are then linearly interpolated to the time of each GOME observation. Only surface observations within plus or minus one hour are considered for possible temporal coincidences.

3.3 Time Series Analysis

In Figure 1, an example of the GOME tropospheric column NO$_2$ and surface NO$_2$ concentration time series for summer 1997 is presented. The time series plots for all the stations for fall 1996, winter 1996-97, spring 1997, and summer 1997 are provided in Appendix A on page 39. In this analysis, we used the following seasonal definitions: September 1 through
November 30, fall; December 1 through February 28, winter; March 1 through May 31, spring; and June 1 through August 31, summer. The state and county, Metropolitan Statistical Area (MSA) description, and station ID are reported in the figures. If the site is rural, the MSA description is listed as “Not in an MSA”.

Figure 1 shows the hourly surface NO\textsubscript{2} concentration during summer 1997. The left vertical axis is surface NO\textsubscript{2} concentration given in parts per billion by volume (ppbv) and the right vertical axis is GOME tropospheric column NO\textsubscript{2}, given in molecules per cm\textsuperscript{2}. Correlations are derived from coincident GOME tropospheric column NO\textsubscript{2} and surface NO\textsubscript{2} pairs as described in Section 3.2 on the facing page. \(N_{\text{pos}}\) is the total number of GOME viewing opportunities over the site and \(N_{\text{GOME}}\) corresponds to the number of passes that NO\textsubscript{2} tropospheric columns could be determined (limited by surface albedo, cloud cover, and aerosols). The number of coincident data pairs used to determine the correlation is reported as \(N_{\text{corr}}\). At least ten coincident data pairs are required to calculate a correlation.

### 3.4 Site-by-site Correlation Analysis

Figure 2 on the next page summarizes the GOME tropospheric column NO\textsubscript{2} density and surface NO\textsubscript{2} correlations derived from the time series for each ground station across the United States (see Appendix A on page 39). A summary is shown for fall (a), winter (b), spring (c), and summer (d). The size of the point plotted indicates the number of coincident data pairs at a particular location for each season shown. The color indicates the value of the correlation coefficient. This correlation summary provides a site specific and geographical perspective on how well the GOME tropospheric column NO\textsubscript{2} density retrievals depict the variability in surface NO\textsubscript{2} concentration. The value of the correlation varies widely from season to season and station to station. There are several reasons for this (which are also site specific) including the size of the GOME footprint. As an example, in the summer two stations located in northern Kentucky (Davies KY, station ID 210590005 and Henderson KY, station ID 211010013) are close geographically yet yield very different correlations. These stations both fall within the same GOME footprint, however it is possible the stations are sampling different air masses. On July 12, at the time of the GOME overpass, Davies reports 33 ppbv of NO\textsubscript{2} while Henderson reports 8 ppbv. GOME cannot resolve the smaller scale variability.

Figure 3 on page 10 shows histograms of the site-by-site correlations for fall (top left), winter (top right), spring (bottom left), and summer (bottom right). The histograms show correlations for a total of 242 ground stations (fall), 82 (winter), 216 (spring), and 245 (summer). The histogram bin with the maximum number of stations is 0.3 to 0.4 for fall and 0.2 to 0.3 for the remaining seasons. Between 49% and 56% of the stations have correlations within the 0.1 to 0.5 range. Less than 5% of the stations have correlations above 0.7.
Figure 2: National summary plot of correlations between GOME tropospheric column NO$_2$ and EPA hourly NO$_2$ concentration for September 1996 through August 1997.
19970301-19970531 Correlation between EPA 1-hr surface NO\textsubscript{2} and GOME column NO\textsubscript{2}

#Coincidences
>20
15-20
10-15
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0

Correlation

(c) Spring.

19970601-19970831 Correlation between EPA 1-hr surface NO\textsubscript{2} and GOME column NO\textsubscript{2}

#Coincidences
>20
15-20
10-15
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0

Correlation

(d) Summer.

Figure 2: Concluded.
Figure 3: Histograms of the site-by-site correlations between coincident GOME tropospheric column NO$_2$ and EPA surface NO$_2$ concentration for fall 1996, winter 1996-97, spring 1997, and summer 1997.
4 National Satellite and In-Situ Comparisons

4.1 Maps of 80 km Binned Mean GOME Nitrogen Dioxide Statistics

Figure 4 on the following page shows maps of the mean GOME tropospheric column NO$_2$ density for fall 1996 (a), winter 1996-97 (b), spring 1997 (c) and summer 1997 (d). To construct these maps, all the GOME column NO$_2$ granules (40 km $\times$ 320 km spatial resolution) obtained for each season are mapped onto the Eta Data Assimilation System (EDAS) 80 km grid. The mean, the standard deviation, and the counts of GOME column NO$_2$ at each grid point are derived from the re-gridded GOME tropospheric column NO$_2$ density. The areas in black are where no GOME column NO$_2$ is retrieved over a 80 $\times$ 80 km$^2$ grid for the entire season.

In general the highest GOME NO$_2$ tropospheric column density occurs where there is more urban activity (over the eastern region of the United States and southern California) for all seasons. A seasonal variability is observed in the eastern US with a maximum occurring in the winter and minimum in the summer. This is consistent with slower photochemical activity during the winter.

Figure 5 on page 14 shows the seasonal maps of the standard deviation of the 80 km binned GOME tropospheric column NO$_2$ density for fall 1996 (a), winter 1996-97 (b), spring 1997 (c) and summer 1997 (d). Figure 6 on page 16 shows the seasonal maps of the number of GOME tropospheric column NO$_2$ retrievals used to obtain the 80 km binned statistics for fall 1996 (a), winter 1996-97 (b), spring 1997 (c) and summer 1997 (d). The standard deviation is greatest in the winter with highest values occurring in the northeastern US. Regions of higher standard deviations also occur in the central Midwest and southern California in the winter. During the winter across the northern United States the number of retrievals is typically lower than five. This is a result of GOME’s sensitivity to surface albedo. Localized regions of higher standard deviations such as in southern California reflect real variations in NO$_2$ associated with major urban areas. During the summer GOME has fewer retrievals in the eastern US than in the western US, with a minimum over Kentucky, due to the greater frequency of cloud cover in the summer [17], [18].

4.2 Site-by-site Mean Statistics

The amount of information that GOME tropospheric column NO$_2$ density could potentially contribute to characterization of the mean spatial distribution of EPA surface NO$_2$ concentration is quantified by comparing the site-by-site mean and standard deviations of the EPA ground stations and GOME tropospheric column NO$_2$ density. Figure 7 on page 18 shows the site-by-site distribution of mean EPA surface NO$_2$ concentration (top) and mean GOME tropospheric column NO$_2$ density (bottom) for fall 1996. Winter, spring, and summer maps are shown in Figure 8 on page 19, Figure 9 on page 20, and Figure 10 on page 21, respectively.

In general the GOME tropospheric column NO$_2$ density values show the same trends as EPA surface NO$_2$ concentration. One notable exception is southern Pennsylvania and the northeast corridor from Washington DC to New York City. In this region during fall, winter, and spring, the GOME tropospheric column NO$_2$ density is elevated relative to the GOME values at other sites while the EPA surface NO$_2$ concentration is not as elevated. This difference is likely due to NO$_2$ transport above the boundary layer and therefore not sampled by the EPA surface network.

Figure 11 on page 22 shows the site-by-site distribution of the standard deviation of the coincident EPA ground station NO$_2$ concentration (top) and mean GOME tropospheric column NO$_2$ density (bottom) for fall 1996. Winter, spring, and summer maps of the
Figure 4: Map of the mean 80 km GOME NO$_2$ for September 1996 through August 1997.
Figure 4: Concluded.
Figure 5: Map of the standard deviation of the 80 km binned GOME NO$_2$ for September 1996 through August 1997.
(c) Spring.

(d) Summer.

Figure 5: Concluded.
Figure 6: Map of the number of GOME NO₂ retrievals within each 80 km bin for September 1996 through August 1997.
(c) Spring.

(d) Summer.

Figure 6: Concluded.
Figure 7: Site-by-site distribution of mean EPA surface NO\textsubscript{2} concentration (top) and GOME tropospheric column NO\textsubscript{2} (bottom) for fall 1996.
Figure 8: Site-by-site distribution of mean EPA surface NO$_2$ concentration (top) and GOME tropospheric column NO$_2$ (bottom) for winter 1996-97.
Figure 9: Site-by-site distribution of mean EPA surface NO$_2$ concentration (top) and GOME tropospheric column NO$_2$ (bottom) for spring 1997.
Figure 10: Site-by-site distribution of mean EPA surface NO$_2$ concentration (top) and GOME tropospheric column NO$_2$ (bottom) for summer 1997.
Figure 11: Site-by-site distribution of EPA surface NO$_2$ concentration (top) and GOME tropospheric column NO$_2$ (bottom) standard deviations for fall 1996.
EPA and GOME standard deviations are shown in Figures 12 on the following page, 13 on page 25, and 14 on page 26, respectively. Both EPA and GOME show an elevated standard deviation in southern California consistent with an elevated standard deviation in the 80 km binned GOME NO₂ (Figure 5 on page 14).
Figure 12: Site-by-site distribution of EPA surface NO$_2$ concentration (top) and GOME tropospheric column NO$_2$ (bottom) standard deviations for winter 1996-97.
Figure 13: Site-by-site distribution of EPA surface NO$_2$ concentration (top) and GOME tropospheric column NO$_2$ (bottom) standard deviations for spring 1997.
Figure 14: Site-by-site distribution of EPA surface NO$_2$ concentration (top) and GOME tropospheric column NO$_2$ (bottom) standard deviations for summer 1997.
4.3 Regional Spatial Statistics

The comparison of maps of EPA surface NO\textsubscript{2} concentration and GOME tropospheric column NO\textsubscript{2} density site-by-site mean and standard deviations show that GOME tropospheric column NO\textsubscript{2} density may provide useful qualitative information about the spatial distribution of mean surface NO\textsubscript{2} concentration from fall 1996 through summer 1997. However, there is significant site-to-site variation in the agreement between the mean EPA surface and GOME measurements. To quantify the spatial information content in the mean GOME measurements the correlations between the site-by-site means and standard deviations within each of the EPA regions are considered. Figure 15 shows a map of the EPA regions. Only continental US regions were considered in this analysis.

Figure 15: Map of EPA regions 1 through 10.

Figure 16 on the next page is an example of the spatial correlations between GOME tropospheric column NO\textsubscript{2} density and EPA surface NO\textsubscript{2} concentration and the means and standard deviations of GOME tropospheric column NO\textsubscript{2} density and EPA surface NO\textsubscript{2} concentration for each ground station within EPA region 2 during summer 1997. The data in the top panel depicts all the EPA/GOME coincident data pairs at every ground station in region 2 that had at least 10 coincidences and the correlation computed from those coincident pairs. The middle panel depicts coincident data averaged at each ground station (the number of crosses corresponds to the number of stations with at least 10 coincidences in that region) and the associated correlation. The bottom panel depicts the standard deviation at each ground station (with at least 10 coincidences) and the associated correlation. Appendix B on page 263 presents these spatial correlations for each EPA region for fall 1996.
Figure 16: Spatial correlations between measurements, means, and standard deviations of GOME tropospheric column NO\textsubscript{2} and EPA surface NO\textsubscript{2} concentration for EPA region 2 during summer 1997.
winter 1996-97, spring 1997, and summer 1997 (provided sufficient data exists to compute
the correlations). The spatial correlation between the GOME tropospheric column NO$_2$
density and the EPA surface NO$_2$ concentration within region 2 in the summer (top panel
of Figure 16 on the preceding page is low (.34)). This value is consistent with the trend
shown in summer histogram in Figure 3 on page 10. The spatial correlation between the
site-by-site means (center panel of Figure 16 on the preceding page is higher (.56)). Site-by-
site averaging within a region does not always result in an improved correlation, but every
time the correlation does improve it is in a region with high urban activity. Site-by-site
averaging improved the correlation in region 9 for every season.

Figure 17 on the following page through Figure 20 on page 33 are similar to Figure 16
on the facing page except that they contain the seasonal correlations for all the data in
the contiguous United States. Grouping the data nationally increases the correlations,
however the highest seasonal correlation of the coincident pairs (top panels) is still less
than 0.5 (0.45). Averaging the coincident pairs at each station (center panels) increases
the correlations further to a range of 0.47 to 0.64. When grouped this way, more data
can be included in the calculations of correlations. For example, when segregated into
regions during winter, only region 9 contained enough stations with sufficient winter data to
calculate the correlations. Regions 7 and 10 did not have sufficient data during any season
for a regional analysis, however, when grouped nationally, this data could be included.
Figure 17: Spatial correlations between measurements, means, and standard deviations of GOME tropospheric column NO$_2$ and EPA surface NO$_2$ concentration for EPA the entire US during fall 1996.
Figure 18: Spatial correlations between measurements, means, and standard deviations of GOME tropospheric column NO$_2$ and EPA surface NO$_2$ concentration for EPA the entire US during winter 1996-97.
Figure 19: Spatial correlations between measurements, means, and standard deviations of GOME tropospheric column NO\textsubscript{2} and EPA surface NO\textsubscript{2} concentration for EPA the entire US during spring 1997.
Figure 20: Spatial correlations between measurements, means, and standard deviations of GOME tropospheric column NO₂ and EPA surface NO₂ concentration for EPA the entire US during summer 1997.
5 Effect of Satellite Footprint Size on Correlation

Additional analysis was performed to investigate the effect the size of the GOME footprint has on the correlation between the EPA surface NO$_2$ concentration and the GOME tropospheric column NO$_2$ density. Hourly values of NO$_2$ emissions on a 20 × 20 km grid over the continental United States were obtained from the 1999 EPA emissions inventory. Two synthetic databases were created by using the EPA inventory as a proxy for the EPA surface measurements and the GOME retrievals for June, July, and August. To create the synthetic EPA data record, the emission value associated with the grid box the station is located inside is assigned to that station. This method was used to define hourly values for every station in the contiguous US. To determine the synthetic GOME value, emission values for all emission grid center points within a 1997 GOME footprint boundary were averaged. Due to the unavailability of emission data for the entire three month period, July data was repeated for each month. Neither the mismatch in year between the emission data and the GOME footprints or the use of only July emission data to define synthetic values for the entire summer impact the correlations calculated.

Figure 21 shows the correlations calculated at each ground station site for summer. This figure is analogous to Figure 2 on page 8 (summer). Since there were no data gaps in the synthetic ground station data or the synthetic GOME retrievals, a coincidence occurred for every GOME overpass for each ground station in the contiguous US. However, the correlations tend to be higher in Figure 2 on page 8 than in Figure 21 likely due to a bias introduced by not using a weighted average to calculate the synthetic GOME retrievals (for example, see California, Texas, the Chicago area, and the Northeast). After artificially reducing the size of the GOME footprint to 0.1° × 0.1° about the center point, five coincidences resulted. The coincident synthetic EPA and GOME values were within 0.5% for three of the stations.
and within 4.3% and 5.3% for the remaining two stations. In general, this analysis indicates the GOME footprint is too large to get meaningful comparisons with the ground station data. Other studies have shown that in some instances the GOME resolution can be increased in certain ways to compensate for the large footprint and better correlations with in-situ measurements can be achieved [19], [20].
6 Conclusion

This technical evaluation of the relationship between EPA surface NO\textsubscript{2} concentration and satellite-observed tropospheric NO\textsubscript{2} column density during the period from September 1996 through August 1997 indicates that the GOME data do not represent the distribution of surface NO\textsubscript{2} as observed by the EPA regulatory network. GOME resolution is insufficient to resolve the variability (spatially and temporally) indicated in the ground station data and illustrated in this analysis using synthetic EPA and GOME values. In addition, the GOME (10:30 local) overpass occurs during a time of rapid change in tropospheric NO\textsubscript{2} as NO\textsubscript{x} begins to repartition into NO and NO\textsubscript{2}. The coarse spatial resolution of GOME, the GOME morning overpass design, and GOME’s insufficient sampling frequency for a photochemically active constituent, do not contribute meaningful data for the distribution of NO\textsubscript{2} in the lower atmosphere.

The tools and processes developed to conduct this study will be applied to the analysis of OMI NO\textsubscript{2} observations in the near future. OMI has significantly better spatial resolution than GOME; 39 OMI data points exist within one GOME footprint. OMI also operates with an afternoon (13:30 local) overpass time, providing a more representative NO\textsubscript{2} distribution for once-per-day sampling. We expect substantially better correlation between OMI NO\textsubscript{2} and surface observations of NO\textsubscript{2}. 

References


A Site-by-Site Satellite and EPA In-Situ Time Series

This appendix contains Table 1, which begins on the next page, and the site-by-site satellite and in-situ time series plots for all of the ground stations used in this analysis, which begin on page 49.

Table 1 lists the pertinent information (EPA region, station ID, state, county, longitude, latitude, fall, winter, spring, summer, MSA number, and MSA description) for the ground station sites, organized by EPA region. For each station a check in a season column indicates the presence of a time series plot for that season. The absence of a check indicates that there were not at least ten coincidences for that season and thus no time series plot was produced (indicated with the “Insufficient Coincident Data” panel). The time series plots are listed in the same order as the stations in Table 1. From left to right, the panels show fall and winter in the first row and spring and summer in the second row.
Table 1: United States EPA Ground Station Sites, Averaged by MSA.

<table>
<thead>
<tr>
<th>Region</th>
<th>Station ID</th>
<th>State</th>
<th>County</th>
<th>Lon</th>
<th>Lat</th>
<th>F</th>
<th>W</th>
<th>Sp</th>
<th>Su</th>
<th>MSA</th>
<th>MSA Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>090010113-1</td>
<td>CT</td>
<td>Fairfield</td>
<td>-73.19</td>
<td>41.18</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1160</td>
<td>Bridgeport, CT</td>
</tr>
<tr>
<td>1</td>
<td>090019003-1</td>
<td>CT</td>
<td>Fairfield</td>
<td>-73.34</td>
<td>41.12</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1160</td>
<td>Bridgeport, CT</td>
</tr>
<tr>
<td>1</td>
<td>090031003-1</td>
<td>CT</td>
<td>Hartford</td>
<td>-72.63</td>
<td>41.78</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>3280</td>
<td>Hartford, CT</td>
</tr>
<tr>
<td>1</td>
<td>090091123-1</td>
<td>CT</td>
<td>New Haven</td>
<td>-72.92</td>
<td>41.31</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1160</td>
<td>Bridgeport, CT</td>
</tr>
<tr>
<td>1</td>
<td>250051005-1</td>
<td>MA</td>
<td>Bristol</td>
<td>-71.15</td>
<td>42.06</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>6480</td>
<td>Providence-Fall River-Warwick, RI-MA</td>
</tr>
<tr>
<td>1</td>
<td>250092006-1</td>
<td>MA</td>
<td>Essex</td>
<td>-70.97</td>
<td>42.47</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>8000</td>
<td>Springfield, MA</td>
</tr>
<tr>
<td>1</td>
<td>250130008-1</td>
<td>MA</td>
<td>Hampden</td>
<td>-72.56</td>
<td>42.19</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>8000</td>
<td>Springfield, MA</td>
</tr>
<tr>
<td>1</td>
<td>250250002-1</td>
<td>MA</td>
<td>Suffolk</td>
<td>-71.03</td>
<td>42.35</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>8000</td>
<td>Springfield, MA</td>
</tr>
<tr>
<td>1</td>
<td>250250021-1</td>
<td>MA</td>
<td>Suffolk</td>
<td>-71.04</td>
<td>42.35</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>8000</td>
<td>Springfield, MA</td>
</tr>
<tr>
<td>1</td>
<td>250250040-1</td>
<td>MA</td>
<td>Suffolk</td>
<td>-71.03</td>
<td>42.40</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>8000</td>
<td>Springfield, MA</td>
</tr>
<tr>
<td>1</td>
<td>250270020-1</td>
<td>MA</td>
<td>Worcester</td>
<td>-71.80</td>
<td>42.27</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>-</td>
<td>(not in an MSA)</td>
</tr>
<tr>
<td>1</td>
<td>230310006-1</td>
<td>ME</td>
<td>York</td>
<td>-70.75</td>
<td>43.08</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>-</td>
<td>(not in an MSA)</td>
</tr>
<tr>
<td>1</td>
<td>330110016-1</td>
<td>NH</td>
<td>Hillsborough</td>
<td>-71.46</td>
<td>42.99</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5350</td>
<td>Nashua, NH</td>
</tr>
<tr>
<td>1</td>
<td>330150009-1</td>
<td>NH</td>
<td>Rockingham</td>
<td>-70.76</td>
<td>43.08</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>6450</td>
<td>Portsmouth-Rochester, NH-ME</td>
</tr>
<tr>
<td>1</td>
<td>440070012-2</td>
<td>RI</td>
<td>Providence</td>
<td>-71.41</td>
<td>41.83</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>6480</td>
<td>Providence-Fall River-Warwick, RI-MA</td>
</tr>
<tr>
<td>1</td>
<td>440071010-1</td>
<td>RI</td>
<td>Providence</td>
<td>-71.36</td>
<td>41.84</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>6480</td>
<td>Providence-Fall River-Warwick, RI-MA</td>
</tr>
<tr>
<td>1</td>
<td>500070003-1</td>
<td>VT</td>
<td>Chittenden</td>
<td>-73.21</td>
<td>44.48</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>1305</td>
<td>Burlington, VT</td>
</tr>
<tr>
<td>2</td>
<td>340030001-1</td>
<td>NJ</td>
<td>Bergen</td>
<td>-73.99</td>
<td>40.81</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0875</td>
<td>Bergen-Passaic, NJ</td>
</tr>
<tr>
<td>2</td>
<td>340070003-2</td>
<td>NJ</td>
<td>Camden</td>
<td>-75.10</td>
<td>39.92</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>6160</td>
<td>Philadelphia, PA-NJ</td>
</tr>
<tr>
<td>2</td>
<td>340130011-1</td>
<td>NJ</td>
<td>Essex</td>
<td>-74.14</td>
<td>40.73</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5640</td>
<td>Newark, NJ</td>
</tr>
<tr>
<td>2</td>
<td>340131003-1</td>
<td>NJ</td>
<td>Essex</td>
<td>-74.20</td>
<td>40.76</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5640</td>
<td>Newark, NJ</td>
</tr>
<tr>
<td>2</td>
<td>340170006-1</td>
<td>NJ</td>
<td>Hudson</td>
<td>-74.13</td>
<td>40.67</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>3640</td>
<td>Jersey City, NJ</td>
</tr>
<tr>
<td>2</td>
<td>340210005-1</td>
<td>NJ</td>
<td>Mercer</td>
<td>-74.75</td>
<td>40.28</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>8480</td>
<td>Trenton, NJ</td>
</tr>
<tr>
<td>2</td>
<td>340230011-1</td>
<td>NJ</td>
<td>Middlesex</td>
<td>-74.43</td>
<td>40.47</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5015</td>
<td>Middlesex-Somerset-Hunterdon, NJ</td>
</tr>
<tr>
<td>2</td>
<td>340390004-2</td>
<td>NJ</td>
<td>Union</td>
<td>-74.21</td>
<td>40.64</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5640</td>
<td>Newark, NJ</td>
</tr>
<tr>
<td>2</td>
<td>340390008-1</td>
<td>NJ</td>
<td>Union</td>
<td>-74.44</td>
<td>40.60</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5640</td>
<td>Newark, NJ</td>
</tr>
<tr>
<td>2</td>
<td>360010012-1</td>
<td>NY</td>
<td>Albany</td>
<td>-73.76</td>
<td>42.68</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0160</td>
<td>Albany-Schenectady-Troy, NY</td>
</tr>
<tr>
<td>2</td>
<td>360050080-1</td>
<td>NY</td>
<td>Bronx</td>
<td>-73.92</td>
<td>40.84</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5000</td>
<td>New York, NY</td>
</tr>
<tr>
<td>2</td>
<td>360050083-1</td>
<td>NY</td>
<td>Bronx</td>
<td>-73.88</td>
<td>40.87</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5000</td>
<td>New York, NY</td>
</tr>
</tbody>
</table>
41

Station ID

360290005-3
360590005-2
360610010-1
360610056-1
110010025-1
110010041-1
110010043-1
100031003-1
240030019-3
240053001-2
245100040-1
245100050-1
245100051-1
420030008-1
420030031-1
420110009-1
420170012-1
420210011-1
420430401-1
420450002-1
420490003-1
420710007-1
420730015-1
420770004-1
420910013-1
420990301-1
421010004-3
421010029-2
421010047-1
421250005-1
421250200-1
421330008-1

Region

2
2
2
2
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3

NY
NY
NY
NY
DC
DC
DC
DE
MD
MD
MD
MD
MD
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA
PA

State
Erie
Nassau
New York
New York
District of Col
District of Col
District of Col
New Castle
Anne Arundel
Baltimore
Baltimore City
Baltimore City
Baltimore City
Allegheny
Allegheny
Berks
Bucks
Cambria
Dauphin
Delaware
Erie
Lancaster
Lawrence
Lehigh
Montgomery
Perry
Philadelphia
Philadelphia
Philadelphia
Washington
Washington
York

County
-78.81
-73.59
-73.99
-73.97
-77.02
-76.95
-77.01
-75.49
-76.73
-76.47
-76.60
-76.58
-76.60
-79.96
-79.99
-75.93
-74.88
-78.92
-76.84
-75.37
-80.04
-76.28
-80.35
-75.43
-75.31
-77.17
-75.10
-75.17
-75.17
-79.90
-80.26
-76.70

Lon
42.88
40.74
40.74
40.76
38.98
38.90
38.92
39.76
39.10
39.31
39.30
39.32
39.28
40.47
40.44
40.32
40.11
40.31
40.25
39.84
42.14
40.05
41.00
40.61
40.11
40.46
40.01
39.96
39.94
40.15
40.17
39.97

Lat

X

X
X
X
X
X
X
X

X

X

X
X
X
X

X
X

X
X
X
X
X
X

F

X

X
X

W

X
X
X
X
X
X

X

X

X
X
X
X
X
X
X
X

X

X

X
X
X
X
X

Sp

Table 1: Continued.

X
X
X
X
X
X

X
X
X
X

X
X

X
X
X
X
X

X
X
X
X
X
X
X
X

X
X

Su
1280
5380
5600
5600
8840
8840
8840
9160
0720
0720
0720
0720
0720
6280
6280
6680
6160
3680
3240
6160
2360
4000
0240
6160
3240
6160
6160
6160
6280
6280
9280

MSA
Buffalo-Niagara Falls, NY
Nassau-Suffolk, NY
New York, NY
New York, NY
Washington, DC-MD-VA-WV
Washington, DC-MD-VA-WV
Washington, DC-MD-VA-WV
Wilmington-Newark, DE-MD
Baltimore, MD
Baltimore, MD
Baltimore, MD
Baltimore, MD
Baltimore, MD
Pittsburgh, PA
Pittsburgh, PA
Reading, PA
Philadelphia, PA-NJ
Johnstown, PA
Harrisburg-Lebanon-Carlisle, PA
Philadelphia, PA-NJ
Erie, PA
Lancaster, PA
(not in an MSA)
Allentown-Bethlehem-Easton, PA
Philadelphia, PA-NJ
Harrisburg-Lebanon-Carlisle, PA
Philadelphia, PA-NJ
Philadelphia, PA-NJ
Philadelphia, PA-NJ
Pittsburgh, PA
Pittsburgh, PA
York, PA

MSA Description


<table>
<thead>
<tr>
<th>Region</th>
<th>Station ID</th>
<th>State</th>
<th>County</th>
<th>Lon</th>
<th>Lat</th>
<th>F</th>
<th>W</th>
<th>Sp</th>
<th>Su</th>
<th>MSA</th>
<th>MSA Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>510130020-1</td>
<td>VA</td>
<td>Arlington</td>
<td>-77</td>
<td>38.86</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8840</td>
<td>Washington, DC-MD-VA-WV</td>
</tr>
<tr>
<td>3</td>
<td>510360002-1</td>
<td>VA</td>
<td>Charles City</td>
<td>-77</td>
<td>37.34</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6760</td>
<td>Richmond-Petersburg, VA</td>
</tr>
<tr>
<td>3</td>
<td>510590005-1</td>
<td>VA</td>
<td>Fairfax</td>
<td>-77</td>
<td>38.89</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8840</td>
<td>Washington, DC-MD-VA-WV</td>
</tr>
<tr>
<td>3</td>
<td>510590018-1</td>
<td>VA</td>
<td>Fairfax</td>
<td>-77</td>
<td>38.74</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8840</td>
<td>Washington, DC-MD-VA-WV</td>
</tr>
<tr>
<td>3</td>
<td>510591004-3</td>
<td>VA</td>
<td>Fairfax</td>
<td>-77</td>
<td>38.87</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8840</td>
<td>Washington, DC-MD-VA-WV</td>
</tr>
<tr>
<td>3</td>
<td>510595001-1</td>
<td>VA</td>
<td>Fairfax</td>
<td>-77</td>
<td>38.93</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8840</td>
<td>Washington, DC-MD-VA-WV</td>
</tr>
<tr>
<td>3</td>
<td>511530009-1</td>
<td>VA</td>
<td>Prince William</td>
<td>-77</td>
<td>38.86</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8840</td>
<td>Washington, DC-MD-VA-WV</td>
</tr>
<tr>
<td>3</td>
<td>515100009-1</td>
<td>VA</td>
<td>Alexandria</td>
<td>-77</td>
<td>38.81</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8840</td>
<td>Washington, DC-MD-VA-WV</td>
</tr>
<tr>
<td>3</td>
<td>517100023-1</td>
<td>VA</td>
<td>Norfolk City</td>
<td>-76</td>
<td>36.85</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5720</td>
<td>Norfolk-Virginia Beach-Newport News, VA-NC</td>
</tr>
<tr>
<td>3</td>
<td>517600021-1</td>
<td>VA</td>
<td>Richmond City</td>
<td>-77</td>
<td>37.56</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6760</td>
<td>Richmond-Petersburg, VA</td>
</tr>
<tr>
<td>3</td>
<td>540291004-1</td>
<td>WV</td>
<td>Hancock</td>
<td>-80</td>
<td>40.42</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8080</td>
<td>Steubenville-Weirton, OH-WV</td>
</tr>
<tr>
<td>4</td>
<td>011011002-1</td>
<td>AL</td>
<td>Montgomery</td>
<td>-86</td>
<td>32.41</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5240</td>
<td>Montgomery, AL</td>
</tr>
<tr>
<td>4</td>
<td>011170004-1</td>
<td>AL</td>
<td>Shelby</td>
<td>-86</td>
<td>33.32</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1000</td>
<td>Birmingham, AL</td>
</tr>
<tr>
<td>4</td>
<td>120250027-1</td>
<td>FL</td>
<td>Dade</td>
<td>-80</td>
<td>25.74</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5000</td>
<td>Miami, FL</td>
</tr>
<tr>
<td>4</td>
<td>120254002-1</td>
<td>FL</td>
<td>Dade</td>
<td>-80</td>
<td>25.80</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5000</td>
<td>Miami, FL</td>
</tr>
<tr>
<td>4</td>
<td>120310032-2</td>
<td>FL</td>
<td>Duval</td>
<td>-81</td>
<td>30.36</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>3600</td>
<td>Jacksonville, FL</td>
</tr>
<tr>
<td>4</td>
<td>120952002-1</td>
<td>FL</td>
<td>Orange</td>
<td>-81</td>
<td>28.60</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5960</td>
<td>Orlando, FL</td>
</tr>
<tr>
<td>4</td>
<td>120991004-1</td>
<td>FL</td>
<td>Palm Beach</td>
<td>-80</td>
<td>26.69</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8960</td>
<td>West Palm Beach-Boca Raton, FL</td>
</tr>
<tr>
<td>4</td>
<td>121030018-1</td>
<td>FL</td>
<td>Pinellas</td>
<td>-82</td>
<td>27.79</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8280</td>
<td>Tampa-St. Petersburg-Clearwater, FL</td>
</tr>
<tr>
<td>4</td>
<td>130890002-1</td>
<td>GA</td>
<td>DeKalb</td>
<td>-84</td>
<td>33.69</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0520</td>
<td>Atlanta, GA</td>
</tr>
<tr>
<td>4</td>
<td>130893001-1</td>
<td>GA</td>
<td>DeKalb</td>
<td>-84</td>
<td>33.85</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0520</td>
<td>Atlanta, GA</td>
</tr>
<tr>
<td>4</td>
<td>131210048-1</td>
<td>GA</td>
<td>Fulton</td>
<td>-84</td>
<td>33.78</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0520</td>
<td>Atlanta, GA</td>
</tr>
<tr>
<td>4</td>
<td>210190015-1</td>
<td>KY</td>
<td>Boyd</td>
<td>-82</td>
<td>38.47</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>3400</td>
<td>Huntington-Ashland, WV-KY-OH</td>
</tr>
<tr>
<td>4</td>
<td>210290006-1</td>
<td>KY</td>
<td>Bullitt</td>
<td>-85</td>
<td>37.99</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4520</td>
<td>Louisville, KY-IN</td>
</tr>
<tr>
<td>4</td>
<td>210371001-1</td>
<td>KY</td>
<td>Campbell</td>
<td>-84</td>
<td>39.11</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1640</td>
<td>Cincinnati, OH-KY-IN</td>
</tr>
<tr>
<td>4</td>
<td>210590005-1</td>
<td>KY</td>
<td>Davies</td>
<td>-87</td>
<td>37.78</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5990</td>
<td>Owensboro, KY</td>
</tr>
<tr>
<td>4</td>
<td>210670012-1</td>
<td>KY</td>
<td>Fayette</td>
<td>-84</td>
<td>38.07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4280</td>
<td>Lexington, KY</td>
</tr>
<tr>
<td>4</td>
<td>211010013-1</td>
<td>KY</td>
<td>Henderson</td>
<td>-87</td>
<td>38.86</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2440</td>
<td>Evansville-Henderson, IN-KY</td>
</tr>
<tr>
<td>4</td>
<td>211110051-1</td>
<td>KY</td>
<td>Jefferson</td>
<td>-85</td>
<td>38.06</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4520</td>
<td>Louisville, KY-IN</td>
</tr>
<tr>
<td>4</td>
<td>211111021-2</td>
<td>KY</td>
<td>Jefferson</td>
<td>-85</td>
<td>38.26</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4520</td>
<td>Louisville, KY-IN</td>
</tr>
<tr>
<td>4</td>
<td>211170007-2</td>
<td>KY</td>
<td>Kenton</td>
<td>-84</td>
<td>39.07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1640</td>
<td>Cincinnati, OH-KY-IN</td>
</tr>
<tr>
<td>4</td>
<td>211451024-1</td>
<td>KY</td>
<td>McCracken</td>
<td>-88</td>
<td>37.06</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>(not in an MSA)</td>
<td></td>
</tr>
<tr>
<td>Region</td>
<td>Station ID</td>
<td>State</td>
<td>County</td>
<td>Lon</td>
<td>Lat</td>
<td>F</td>
<td>W</td>
<td>Sp</td>
<td>Su</td>
<td>MSA</td>
<td>MSA Description</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>-------</td>
<td>--------</td>
<td>-----</td>
<td>-----</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>-----</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>4</td>
<td>370670022-1</td>
<td>NC</td>
<td>Forsyth</td>
<td>-80.23</td>
<td>36.11</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>3120</td>
<td>Greensboro-Winston-Salem-High Point, NC</td>
</tr>
<tr>
<td>4</td>
<td>371190034-1</td>
<td>NC</td>
<td>Mecklenburg</td>
<td>-80.77</td>
<td>35.25</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1520</td>
<td>Charlotte-Gastonia-Rock Hill, NC-SC</td>
</tr>
<tr>
<td>4</td>
<td>450450008-1</td>
<td>SC</td>
<td>Greenville</td>
<td>-82.40</td>
<td>34.84</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>3160</td>
<td>Greenville-Spartanburg-Anderson, SC</td>
</tr>
<tr>
<td>4</td>
<td>470110102-1</td>
<td>TN</td>
<td>Bradley</td>
<td>-84.76</td>
<td>35.28</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>-</td>
<td>(not in an MSA)</td>
</tr>
<tr>
<td>4</td>
<td>470370011-1</td>
<td>TN</td>
<td>Davidson</td>
<td>-86.74</td>
<td>36.21</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>5360</td>
<td>Nashville, TN</td>
</tr>
<tr>
<td>4</td>
<td>471050003-1</td>
<td>TN</td>
<td>Loudon</td>
<td>-84.30</td>
<td>35.79</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>3840</td>
<td>Knoxville, TN</td>
</tr>
<tr>
<td>4</td>
<td>471070101-1</td>
<td>TN</td>
<td>McMinn</td>
<td>-84.75</td>
<td>35.30</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>(not in an MSA)</td>
</tr>
<tr>
<td>4</td>
<td>471570024-1</td>
<td>TN</td>
<td>Shelby</td>
<td>-90.04</td>
<td>35.15</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>4920</td>
<td>Memphis, TN-AR-MS</td>
</tr>
<tr>
<td>4</td>
<td>471630007-1</td>
<td>TN</td>
<td>Sullivan</td>
<td>-82.52</td>
<td>36.53</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>3660</td>
<td>Johnson City-Kingsport-Bristol, TN-VA</td>
</tr>
<tr>
<td>5</td>
<td>1703100063-1</td>
<td>IL</td>
<td>Cook</td>
<td>-87.63</td>
<td>41.88</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1600</td>
<td>Chicago, IL</td>
</tr>
<tr>
<td>5</td>
<td>1703100064-1</td>
<td>IL</td>
<td>Cook</td>
<td>-87.60</td>
<td>41.79</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1600</td>
<td>Chicago, IL</td>
</tr>
<tr>
<td>5</td>
<td>1703100072-1</td>
<td>IL</td>
<td>Cook</td>
<td>-87.61</td>
<td>41.90</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>1600</td>
<td>Chicago, IL</td>
</tr>
<tr>
<td>5</td>
<td>170313101-1</td>
<td>IL</td>
<td>Cook</td>
<td>-87.89</td>
<td>41.96</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1600</td>
<td>Chicago, IL</td>
</tr>
<tr>
<td>5</td>
<td>170314002-1</td>
<td>IL</td>
<td>Cook</td>
<td>-87.75</td>
<td>41.86</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1600</td>
<td>Chicago, IL</td>
</tr>
<tr>
<td>5</td>
<td>170314201-1</td>
<td>IL</td>
<td>Cook</td>
<td>-87.80</td>
<td>42.14</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>1600</td>
<td>Chicago, IL</td>
</tr>
<tr>
<td>5</td>
<td>170318003-1</td>
<td>IL</td>
<td>Cook</td>
<td>-87.57</td>
<td>41.63</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1600</td>
<td>Chicago, IL</td>
</tr>
<tr>
<td>5</td>
<td>170971007-1</td>
<td>IL</td>
<td>Lake</td>
<td>-87.81</td>
<td>42.47</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>1600</td>
<td>Chicago, IL</td>
</tr>
<tr>
<td>5</td>
<td>171630010-2</td>
<td>IL</td>
<td>St Clair</td>
<td>-90.16</td>
<td>38.61</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>7040</td>
<td>St. Louis, MO-IL</td>
</tr>
<tr>
<td>5</td>
<td>180890022-1</td>
<td>IN</td>
<td>Lake</td>
<td>-87.30</td>
<td>41.61</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>2960</td>
<td>Gary, IN</td>
</tr>
<tr>
<td>5</td>
<td>180891016-2</td>
<td>IN</td>
<td>Lake</td>
<td>-87.33</td>
<td>41.60</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>2960</td>
<td>Gary, IN</td>
</tr>
<tr>
<td>5</td>
<td>181410012-1</td>
<td>IN</td>
<td>St Joseph</td>
<td>-86.46</td>
<td>41.70</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>7800</td>
<td>South Bend, IN</td>
</tr>
<tr>
<td>5</td>
<td>181411008-1</td>
<td>IN</td>
<td>St Joseph</td>
<td>-86.24</td>
<td>41.69</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>7800</td>
<td>South Bend, IN</td>
</tr>
<tr>
<td>5</td>
<td>260990009-1</td>
<td>MI</td>
<td>Macomb</td>
<td>-82.79</td>
<td>42.73</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>2160</td>
<td>Detroit, MI</td>
</tr>
<tr>
<td>5</td>
<td>261630016-1</td>
<td>MI</td>
<td>Wayne</td>
<td>-83.10</td>
<td>42.36</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>2160</td>
<td>Detroit, MI</td>
</tr>
<tr>
<td>5</td>
<td>261630019-2</td>
<td>MI</td>
<td>Wayne</td>
<td>-83.00</td>
<td>42.43</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>2160</td>
<td>Detroit, MI</td>
</tr>
<tr>
<td>5</td>
<td>270370020-1</td>
<td>MN</td>
<td>Dakota</td>
<td>-93.03</td>
<td>44.76</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>5120</td>
<td>Minneapolis-St. Paul, MN-WI</td>
</tr>
<tr>
<td>5</td>
<td>270370423-1</td>
<td>MN</td>
<td>Dakota</td>
<td>-93.06</td>
<td>44.78</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>5120</td>
<td>Minneapolis-St. Paul, MN-WI</td>
</tr>
<tr>
<td>5</td>
<td>271230864-1</td>
<td>MN</td>
<td>Ramsey</td>
<td>-93.18</td>
<td>44.99</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>5120</td>
<td>Minneapolis-St. Paul, MN-WI</td>
</tr>
<tr>
<td>5</td>
<td>390350060-1</td>
<td>OH</td>
<td>Cuyahoga</td>
<td>-81.68</td>
<td>41.49</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>1680</td>
<td>Cleveland-Lorain-Elyria, OH</td>
</tr>
<tr>
<td>5</td>
<td>390350066-1</td>
<td>OH</td>
<td>Cuyahoga</td>
<td>-81.58</td>
<td>41.46</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>1680</td>
<td>Cleveland-Lorain-Elyria, OH</td>
</tr>
<tr>
<td>5</td>
<td>390610037-1</td>
<td>OH</td>
<td>Hamilton</td>
<td>-84.52</td>
<td>39.11</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>1640</td>
<td>Cincinnati, OH-KY-IN</td>
</tr>
<tr>
<td>5</td>
<td>390614002-1</td>
<td>OH</td>
<td>Hamilton</td>
<td>-84.44</td>
<td>39.16</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>1640</td>
<td>Cincinnati, OH-KY-IN</td>
</tr>
<tr>
<td>Region</td>
<td>Station ID</td>
<td>State</td>
<td>County</td>
<td>Lon</td>
<td>Lat</td>
<td>F</td>
<td>W</td>
<td>Sp</td>
<td>Su</td>
<td>MSA</td>
<td>MSA Description</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------</td>
<td>-------</td>
<td>---------</td>
<td>------</td>
<td>------</td>
<td>---</td>
<td>---</td>
<td>----</td>
<td>----</td>
<td>----------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>390811012-2</td>
<td>OH</td>
<td>Jefferson</td>
<td>-80.62</td>
<td>40.36</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>8080</td>
<td>Steubenville-Weirton, OH-WV</td>
</tr>
<tr>
<td>5</td>
<td>550790007-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.92</td>
<td>43.05</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5080</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>5</td>
<td>550790041-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.88</td>
<td>43.08</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>5080</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>6</td>
<td>051191002-1</td>
<td>AR</td>
<td>Pulaski</td>
<td>-92.26</td>
<td>34.83</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>4400</td>
<td>Little Rock-North Little Rock, AR</td>
</tr>
<tr>
<td>6</td>
<td>550790007-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.92</td>
<td>43.05</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0760</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>6</td>
<td>550790041-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.88</td>
<td>43.08</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0760</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>5</td>
<td>550790007-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.92</td>
<td>43.05</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0760</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>5</td>
<td>550790041-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.88</td>
<td>43.08</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0760</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>6</td>
<td>550790007-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.92</td>
<td>43.05</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0760</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>6</td>
<td>550790041-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.88</td>
<td>43.08</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0760</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>5</td>
<td>550790007-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.92</td>
<td>43.05</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0760</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>6</td>
<td>550790041-1</td>
<td>WI</td>
<td>Milwaukee</td>
<td>-87.88</td>
<td>43.08</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>0760</td>
<td>Milwaukee-Waukesha, WI</td>
</tr>
<tr>
<td>Region</td>
<td>Station ID</td>
<td>State</td>
<td>County</td>
<td>Lon</td>
<td>Lat</td>
<td>F</td>
<td>W</td>
<td>Sp</td>
<td>Su</td>
<td>MSA</td>
<td>MSA Description</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>-------</td>
<td>---------</td>
<td>------</td>
<td>------</td>
<td>---</td>
<td>---</td>
<td>----</td>
<td>----</td>
<td>------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>6</td>
<td>482011037-1</td>
<td>TX</td>
<td>Harris</td>
<td>-95.36</td>
<td>29.75</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>3360</td>
<td>Houston, TX</td>
</tr>
<tr>
<td>6</td>
<td>484391002-1</td>
<td>TX</td>
<td>Tarrant</td>
<td>-97.36</td>
<td>32.81</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2800</td>
<td>Fort Worth-Arlington, TX</td>
</tr>
<tr>
<td>6</td>
<td>484530017-1</td>
<td>TX</td>
<td>Travis</td>
<td>-97.75</td>
<td>30.26</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0640</td>
<td>Austin-San Marcos, TX</td>
</tr>
<tr>
<td>7</td>
<td>202090020-1</td>
<td>KS</td>
<td>Wyandotte</td>
<td>-94.62</td>
<td>39.15</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>3760</td>
<td>Kansas City, MO-KS</td>
</tr>
<tr>
<td>7</td>
<td>291831002-1</td>
<td>MO</td>
<td>Platte</td>
<td>-90.23</td>
<td>38.87</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7040</td>
<td>St. Louis, MO-IL</td>
</tr>
<tr>
<td>7</td>
<td>291890001-2</td>
<td>MO</td>
<td>St Louis</td>
<td>-90.34</td>
<td>38.52</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7040</td>
<td>St. Louis, MO-IL</td>
</tr>
<tr>
<td>7</td>
<td>291893001-2</td>
<td>MO</td>
<td>St Louis</td>
<td>-90.35</td>
<td>38.64</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7040</td>
<td>St. Louis, MO-IL</td>
</tr>
<tr>
<td>7</td>
<td>291895001-1</td>
<td>MO</td>
<td>St Louis</td>
<td>-90.29</td>
<td>38.77</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7040</td>
<td>St. Louis, MO-IL</td>
</tr>
<tr>
<td>7</td>
<td>295100072-2</td>
<td>MO</td>
<td>St Louis City</td>
<td>-90.20</td>
<td>38.62</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7040</td>
<td>St. Louis, MO-IL</td>
</tr>
<tr>
<td>7</td>
<td>295100080-1</td>
<td>MO</td>
<td>St Louis City</td>
<td>-90.25</td>
<td>38.68</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7040</td>
<td>St. Louis, MO-IL</td>
</tr>
<tr>
<td>7</td>
<td>080130001-1</td>
<td>CO</td>
<td>Adams</td>
<td>-104.95</td>
<td>39.84</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2080</td>
<td>Denver, CO</td>
</tr>
<tr>
<td>7</td>
<td>080310002-1</td>
<td>CO</td>
<td>Denver</td>
<td>-104.99</td>
<td>39.75</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2080</td>
<td>Denver, CO</td>
</tr>
<tr>
<td>7</td>
<td>080416001-1</td>
<td>CO</td>
<td>El Paso</td>
<td>-104.72</td>
<td>38.63</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1720</td>
<td>Colorado Springs, CO</td>
</tr>
<tr>
<td>7</td>
<td>080416004-1</td>
<td>CO</td>
<td>El Paso</td>
<td>-104.81</td>
<td>38.92</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1720</td>
<td>Colorado Springs, CO</td>
</tr>
<tr>
<td>7</td>
<td>080416011-1</td>
<td>CO</td>
<td>El Paso</td>
<td>-104.83</td>
<td>38.85</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1720</td>
<td>Colorado Springs, CO</td>
</tr>
<tr>
<td>7</td>
<td>080416018-1</td>
<td>CO</td>
<td>El Paso</td>
<td>-104.75</td>
<td>38.81</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1720</td>
<td>Colorado Springs, CO</td>
</tr>
<tr>
<td>7</td>
<td>080590006-1</td>
<td>CO</td>
<td>Jefferson</td>
<td>-105.19</td>
<td>39.91</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2080</td>
<td>Denver, CO</td>
</tr>
<tr>
<td>7</td>
<td>080590008-1</td>
<td>CO</td>
<td>Jefferson</td>
<td>-105.17</td>
<td>39.88</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2080</td>
<td>Denver, CO</td>
</tr>
<tr>
<td>7</td>
<td>080590009-1</td>
<td>CO</td>
<td>Jefferson</td>
<td>-105.20</td>
<td>39.86</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2080</td>
<td>Denver, CO</td>
</tr>
<tr>
<td>8</td>
<td>380570124-1</td>
<td>ND</td>
<td>Mercer</td>
<td>-101.93</td>
<td>47.40</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8520</td>
<td>Tuscon, AZ</td>
</tr>
<tr>
<td>8</td>
<td>490110001-1</td>
<td>UT</td>
<td>Davis</td>
<td>-111.88</td>
<td>40.89</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6520</td>
<td>Provo-Orem, UT</td>
</tr>
<tr>
<td>8</td>
<td>490350003-1</td>
<td>UT</td>
<td>Salt Lake</td>
<td>-111.85</td>
<td>40.65</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7160</td>
<td>Salt Lake City-Ogden, UT</td>
</tr>
<tr>
<td>8</td>
<td>490353006-1</td>
<td>UT</td>
<td>Salt Lake</td>
<td>-111.87</td>
<td>40.74</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7160</td>
<td>Salt Lake City-Ogden, UT</td>
</tr>
<tr>
<td>8</td>
<td>490490002-1</td>
<td>UT</td>
<td>Utah</td>
<td>-111.66</td>
<td>40.25</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6520</td>
<td>Provo-Orem, UT</td>
</tr>
<tr>
<td>8</td>
<td>490570001-2</td>
<td>UT</td>
<td>Weber</td>
<td>-111.97</td>
<td>41.22</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7160</td>
<td>Salt Lake City-Ogden, UT</td>
</tr>
<tr>
<td>9</td>
<td>040130019-1</td>
<td>AZ</td>
<td>Maricopa</td>
<td>-112.14</td>
<td>33.48</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6200</td>
<td>Phoenix-Mesa, AZ</td>
</tr>
<tr>
<td>9</td>
<td>040133002-6</td>
<td>AZ</td>
<td>Maricopa</td>
<td>-112.04</td>
<td>33.46</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6200</td>
<td>Phoenix-Mesa, AZ</td>
</tr>
<tr>
<td>9</td>
<td>040133003-1</td>
<td>AZ</td>
<td>Maricopa</td>
<td>-111.92</td>
<td>33.48</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6200</td>
<td>Phoenix-Mesa, AZ</td>
</tr>
<tr>
<td>9</td>
<td>040133010-1</td>
<td>AZ</td>
<td>Maricopa</td>
<td>-112.12</td>
<td>33.46</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6200</td>
<td>Phoenix-Mesa, AZ</td>
</tr>
<tr>
<td>9</td>
<td>040191011-1</td>
<td>AZ</td>
<td>Pima</td>
<td>-110.87</td>
<td>32.21</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8520</td>
<td>Tuscon, AZ</td>
</tr>
<tr>
<td>Region</td>
<td>Station ID</td>
<td>State</td>
<td>County</td>
<td>Lon</td>
<td>Lat</td>
<td>F</td>
<td>W</td>
<td>Sp</td>
<td>Su</td>
<td>MSA</td>
<td>MSA Description</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>-------</td>
<td>--------------</td>
<td>------</td>
<td>------</td>
<td>---</td>
<td>---</td>
<td>----</td>
<td>----</td>
<td>-----</td>
<td>------------------</td>
</tr>
<tr>
<td>9</td>
<td>060010003-1</td>
<td>CA</td>
<td>Alameda</td>
<td>-121.77</td>
<td>37.69</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5775</td>
<td>Oakland, CA</td>
</tr>
<tr>
<td>9</td>
<td>060011001-1</td>
<td>CA</td>
<td>Alameda</td>
<td>-121.96</td>
<td>37.54</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5775</td>
<td>Oakland, CA</td>
</tr>
<tr>
<td>9</td>
<td>060070002-1</td>
<td>CA</td>
<td>Butte</td>
<td>-121.84</td>
<td>39.76</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1620</td>
<td>Chico-Paradise, CA</td>
</tr>
<tr>
<td>9</td>
<td>060130002-1</td>
<td>CA</td>
<td>Contra Costa</td>
<td>-122.02</td>
<td>37.94</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5775</td>
<td>Oakland, CA</td>
</tr>
<tr>
<td>9</td>
<td>060130003-1</td>
<td>CA</td>
<td>Contra Costa</td>
<td>-122.36</td>
<td>37.95</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5775</td>
<td>Oakland, CA</td>
</tr>
<tr>
<td>9</td>
<td>060131002-1</td>
<td>CA</td>
<td>Contra Costa</td>
<td>-121.64</td>
<td>38.01</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5775</td>
<td>Oakland, CA</td>
</tr>
<tr>
<td>9</td>
<td>060131003-1</td>
<td>CA</td>
<td>Contra Costa</td>
<td>-122.34</td>
<td>37.96</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5775</td>
<td>Oakland, CA</td>
</tr>
<tr>
<td>9</td>
<td>060133001-1</td>
<td>CA</td>
<td>Contra Costa</td>
<td>-121.90</td>
<td>38.03</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5775</td>
<td>Oakland, CA</td>
</tr>
<tr>
<td>9</td>
<td>060170011-1</td>
<td>CA</td>
<td>El Dorado</td>
<td>-119.97</td>
<td>38.95</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6920</td>
<td>Sacramento, CA</td>
</tr>
<tr>
<td>9</td>
<td>060190007-1</td>
<td>CA</td>
<td>Fresno</td>
<td>-119.74</td>
<td>36.71</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2840</td>
<td>Fresno, CA</td>
</tr>
<tr>
<td>9</td>
<td>060190008-1</td>
<td>CA</td>
<td>Fresno</td>
<td>-119.77</td>
<td>36.78</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2840</td>
<td>Fresno, CA</td>
</tr>
<tr>
<td>9</td>
<td>060190242-1</td>
<td>CA</td>
<td>Fresno</td>
<td>-119.87</td>
<td>36.84</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2840</td>
<td>Fresno, CA</td>
</tr>
<tr>
<td>9</td>
<td>060194001-1</td>
<td>CA</td>
<td>Fresno</td>
<td>-119.50</td>
<td>36.60</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2840</td>
<td>Fresno, CA</td>
</tr>
<tr>
<td>9</td>
<td>060195001-1</td>
<td>CA</td>
<td>Fresno</td>
<td>-119.72</td>
<td>36.82</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2840</td>
<td>Fresno, CA</td>
</tr>
<tr>
<td>9</td>
<td>060250005-1</td>
<td>CA</td>
<td>Imperial</td>
<td>-115.48</td>
<td>32.68</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>(not in an MSA)</td>
</tr>
<tr>
<td>9</td>
<td>060250006-1</td>
<td>CA</td>
<td>Imperial</td>
<td>-115.39</td>
<td>32.68</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>(not in an MSA)</td>
</tr>
<tr>
<td>9</td>
<td>060290007-1</td>
<td>CA</td>
<td>Kern</td>
<td>-118.85</td>
<td>35.35</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0680</td>
<td>Bakersfield, CA</td>
</tr>
<tr>
<td>9</td>
<td>060290010-1</td>
<td>CA</td>
<td>Kern</td>
<td>-119.01</td>
<td>35.39</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0680</td>
<td>Bakersfield, CA</td>
</tr>
<tr>
<td>9</td>
<td>060290011-1</td>
<td>CA</td>
<td>Kern</td>
<td>-118.15</td>
<td>35.05</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0680</td>
<td>Bakersfield, CA</td>
</tr>
<tr>
<td>9</td>
<td>060290014-1</td>
<td>CA</td>
<td>Kern</td>
<td>-119.04</td>
<td>35.36</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0680</td>
<td>Bakersfield, CA</td>
</tr>
<tr>
<td>9</td>
<td>060290232-1</td>
<td>CA</td>
<td>Kern</td>
<td>-119.02</td>
<td>35.44</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0680</td>
<td>Bakersfield, CA</td>
</tr>
<tr>
<td>9</td>
<td>060295001-1</td>
<td>CA</td>
<td>Kern</td>
<td>-118.78</td>
<td>35.21</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0680</td>
<td>Bakersfield, CA</td>
</tr>
<tr>
<td>9</td>
<td>060296001-1</td>
<td>CA</td>
<td>Kern</td>
<td>-119.27</td>
<td>35.50</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0680</td>
<td>Bakersfield, CA</td>
</tr>
<tr>
<td>9</td>
<td>060311004-1</td>
<td>CA</td>
<td>Kings</td>
<td>-119.64</td>
<td>36.31</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>(not in an MSA)</td>
</tr>
<tr>
<td>9</td>
<td>060370002-2</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-117.92</td>
<td>34.14</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060370016-1</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-117.85</td>
<td>34.14</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060370113-1</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.46</td>
<td>34.05</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060371002-2</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.32</td>
<td>34.18</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060371103-1</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.24</td>
<td>34.07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060371201-2</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.53</td>
<td>34.20</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060371301-2</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.21</td>
<td>33.93</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060371601-2</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.06</td>
<td>34.01</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>Region</td>
<td>Station ID</td>
<td>State</td>
<td>County</td>
<td>Lon</td>
<td>Lat</td>
<td>F</td>
<td>W</td>
<td>Sp</td>
<td>Su</td>
<td>MSA</td>
<td>MSA Description</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>-------</td>
<td>----------</td>
<td>------</td>
<td>-------</td>
<td>---</td>
<td>---</td>
<td>----</td>
<td>----</td>
<td>-----</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>9</td>
<td>060371701-2</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-117.75</td>
<td>34.07</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060372005-1</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.11</td>
<td>34.08</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060374002-2</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.19</td>
<td>33.82</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060375001-1</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.37</td>
<td>33.93</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060379002-1</td>
<td>CA</td>
<td>Los Angeles</td>
<td>-118.13</td>
<td>34.69</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4480</td>
<td>Los Angeles-Long Beach, CA</td>
</tr>
<tr>
<td>9</td>
<td>060410001-1</td>
<td>CA</td>
<td>Marin</td>
<td>-122.52</td>
<td>37.97</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7360</td>
<td>San Francisco, CA</td>
</tr>
<tr>
<td>9</td>
<td>060450008-1</td>
<td>CA</td>
<td>Mendocino</td>
<td>-123.20</td>
<td>39.15</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>(not in an MSA)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>060450009-1</td>
<td>CA</td>
<td>Mendocino</td>
<td>-123.35</td>
<td>39.40</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>(not in an MSA)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>060470003-1</td>
<td>CA</td>
<td>Merced</td>
<td>-120.43</td>
<td>37.28</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4940</td>
<td>Merced, CA</td>
</tr>
<tr>
<td>9</td>
<td>060531002-2</td>
<td>CA</td>
<td>Monterey</td>
<td>-121.63</td>
<td>36.70</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7120</td>
<td>Salinas, CA</td>
</tr>
<tr>
<td>9</td>
<td>060550003-1</td>
<td>CA</td>
<td>Napa</td>
<td>-122.29</td>
<td>38.31</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8720</td>
<td>Vallejo-Fairfield-Napa, CA</td>
</tr>
<tr>
<td>9</td>
<td>060590001-5</td>
<td>CA</td>
<td>Orange</td>
<td>-117.91</td>
<td>33.82</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5945</td>
<td>Orange County, CA</td>
</tr>
<tr>
<td>9</td>
<td>060591003-1</td>
<td>CA</td>
<td>Orange</td>
<td>-117.93</td>
<td>33.67</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5945</td>
<td>Orange County, CA</td>
</tr>
<tr>
<td>9</td>
<td>060595001-2</td>
<td>CA</td>
<td>Orange</td>
<td>-117.95</td>
<td>33.93</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5945</td>
<td>Orange County, CA</td>
</tr>
<tr>
<td>9</td>
<td>060610006-1</td>
<td>CA</td>
<td>Placer</td>
<td>-121.27</td>
<td>38.75</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6920</td>
<td>Sacramento, CA</td>
</tr>
<tr>
<td>9</td>
<td>060655001-2</td>
<td>CA</td>
<td>Riverside</td>
<td>-116.54</td>
<td>33.86</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060658001-2</td>
<td>CA</td>
<td>Riverside</td>
<td>-117.43</td>
<td>34.01</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060659001-1</td>
<td>CA</td>
<td>Riverside</td>
<td>-117.34</td>
<td>33.68</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060670002-1</td>
<td>CA</td>
<td>Sacramento</td>
<td>-121.38</td>
<td>38.71</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6920</td>
<td>Sacramento, CA</td>
</tr>
<tr>
<td>9</td>
<td>060670006-1</td>
<td>CA</td>
<td>Sacramento</td>
<td>-121.37</td>
<td>38.61</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6920</td>
<td>Sacramento, CA</td>
</tr>
<tr>
<td>9</td>
<td>060670010-1</td>
<td>CA</td>
<td>Sacramento</td>
<td>-121.49</td>
<td>38.56</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6920</td>
<td>Sacramento, CA</td>
</tr>
<tr>
<td>9</td>
<td>060670011-1</td>
<td>CA</td>
<td>Sacramento</td>
<td>-121.42</td>
<td>38.30</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6920</td>
<td>Sacramento, CA</td>
</tr>
<tr>
<td>9</td>
<td>060670012-1</td>
<td>CA</td>
<td>Sacramento</td>
<td>-121.16</td>
<td>38.68</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6920</td>
<td>Sacramento, CA</td>
</tr>
<tr>
<td>9</td>
<td>060670002-1</td>
<td>CA</td>
<td>Sacramento</td>
<td>-121.59</td>
<td>38.72</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6920</td>
<td>Sacramento, CA</td>
</tr>
<tr>
<td>9</td>
<td>060710001-1</td>
<td>CA</td>
<td>San Bernardino</td>
<td>-117.02</td>
<td>34.90</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060710012-1</td>
<td>CA</td>
<td>San Bernardino</td>
<td>-117.56</td>
<td>34.43</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060710014-1</td>
<td>CA</td>
<td>San Bernardino</td>
<td>-117.33</td>
<td>34.51</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060710015-1</td>
<td>CA</td>
<td>San Bernardino</td>
<td>-117.37</td>
<td>35.78</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060710017-1</td>
<td>CA</td>
<td>San Bernardino</td>
<td>-116.06</td>
<td>34.14</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060711004-2</td>
<td>CA</td>
<td>San Bernardino</td>
<td>-117.67</td>
<td>34.10</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060712002-1</td>
<td>CA</td>
<td>San Bernardino</td>
<td>-117.51</td>
<td>34.10</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060714001-1</td>
<td>CA</td>
<td>San Bernardino</td>
<td>-117.28</td>
<td>34.42</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
</tbody>
</table>
Table 1: Continued.

<table>
<thead>
<tr>
<th>Region</th>
<th>Station ID</th>
<th>State</th>
<th>County</th>
<th>Lon</th>
<th>Lat</th>
<th>F</th>
<th>W</th>
<th>Sp</th>
<th>Su</th>
<th>MSA</th>
<th>MSA Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>060719004-1</td>
<td>CA</td>
<td>San Bernardino</td>
<td>-117.27</td>
<td>34.11</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6780</td>
<td>Riverside-San Bernardino, CA</td>
</tr>
<tr>
<td>9</td>
<td>060730001-1</td>
<td>CA</td>
<td>San Diego</td>
<td>-117.06</td>
<td>32.62</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7320</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>9</td>
<td>060730003-1</td>
<td>CA</td>
<td>San Diego</td>
<td>-116.94</td>
<td>32.79</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7320</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>9</td>
<td>060730005-1</td>
<td>CA</td>
<td>San Diego</td>
<td>-117.37</td>
<td>33.20</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7320</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>9</td>
<td>060730006-1</td>
<td>CA</td>
<td>San Diego</td>
<td>-117.13</td>
<td>32.83</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7320</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>9</td>
<td>060731002-1</td>
<td>CA</td>
<td>San Diego</td>
<td>-117.07</td>
<td>33.13</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7320</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>9</td>
<td>060731006-1</td>
<td>CA</td>
<td>San Diego</td>
<td>-116.75</td>
<td>32.83</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7320</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>9</td>
<td>060731007-1</td>
<td>CA</td>
<td>San Diego</td>
<td>-117.15</td>
<td>32.71</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7320</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>9</td>
<td>060731008-1</td>
<td>CA</td>
<td>San Diego</td>
<td>-117.40</td>
<td>33.22</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7320</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>9</td>
<td>060732007-1</td>
<td>CA</td>
<td>San Diego</td>
<td>-116.94</td>
<td>32.58</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7320</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>9</td>
<td>060750005-1</td>
<td>CA</td>
<td>San Francisco</td>
<td>-122.39</td>
<td>37.76</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7360</td>
<td>San Francisco, CA</td>
</tr>
<tr>
<td>9</td>
<td>060771002-2</td>
<td>CA</td>
<td>San Joaquin</td>
<td>-121.27</td>
<td>37.95</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8120</td>
<td>Stockton-Lodi, CA</td>
</tr>
<tr>
<td>9</td>
<td>060773003-1</td>
<td>CA</td>
<td>San Joaquin</td>
<td>-121.53</td>
<td>37.74</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8120</td>
<td>Stockton-Lodi, CA</td>
</tr>
<tr>
<td>9</td>
<td>060792002-1</td>
<td>CA</td>
<td>San Luis Obispo</td>
<td>-120.65</td>
<td>35.28</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7460</td>
<td>San Luis Obispo-Atascadero-Paso Robles, CA</td>
</tr>
<tr>
<td>9</td>
<td>060798001-1</td>
<td>CA</td>
<td>San Luis Obispo</td>
<td>-120.67</td>
<td>35.49</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7460</td>
<td>San Luis Obispo-Atascadero-Paso Robles, CA</td>
</tr>
<tr>
<td>9</td>
<td>060811001-1</td>
<td>CA</td>
<td>San Mateo</td>
<td>-122.20</td>
<td>37.48</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7360</td>
<td>San Francisco, CA</td>
</tr>
<tr>
<td>9</td>
<td>060830008-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-120.02</td>
<td>34.46</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060830010-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-119.70</td>
<td>34.42</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060831007-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-120.43</td>
<td>34.95</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060831015-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-120.21</td>
<td>34.48</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060831018-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-120.20</td>
<td>34.53</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060831021-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-119.46</td>
<td>34.40</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060831026-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-120.03</td>
<td>34.48</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060831027-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-120.04</td>
<td>34.47</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060832004-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-120.46</td>
<td>34.64</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060832011-1</td>
<td>CA</td>
<td>Santa Barbara</td>
<td>-119.83</td>
<td>34.45</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7480</td>
<td>Santa Barbara-Santa Maria-Lompoc, CA</td>
</tr>
<tr>
<td>9</td>
<td>060850004-1</td>
<td>CA</td>
<td>Santa Clara</td>
<td>-121.89</td>
<td>37.34</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7400</td>
<td>San Jose, CA</td>
</tr>
<tr>
<td>9</td>
<td>060950004-1</td>
<td>CA</td>
<td>Solano</td>
<td>-122.24</td>
<td>38.10</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8720</td>
<td>Vallejo-Fairfield-Napa, CA</td>
</tr>
<tr>
<td>9</td>
<td>060970003-1</td>
<td>CA</td>
<td>Sonoma</td>
<td>-122.71</td>
<td>38.45</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7500</td>
<td>Santa Rosa, CA</td>
</tr>
<tr>
<td>9</td>
<td>060990005-1</td>
<td>CA</td>
<td>Stanislaus</td>
<td>-120.99</td>
<td>37.64</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5170</td>
<td>Modesto, CA</td>
</tr>
<tr>
<td>9</td>
<td>060990006-1</td>
<td>CA</td>
<td>Stanislaus</td>
<td>-120.84</td>
<td>37.49</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>5170</td>
<td>Modesto, CA</td>
</tr>
<tr>
<td>9</td>
<td>061010003-1</td>
<td>CA</td>
<td>Sutter</td>
<td>-121.62</td>
<td>39.14</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>9340</td>
<td>Yuba City, CA</td>
</tr>
</tbody>
</table>
Table 1: Continued.

<table>
<thead>
<tr>
<th>Region</th>
<th>Station ID</th>
<th>State</th>
<th>County</th>
<th>Lon</th>
<th>Lat</th>
<th>F</th>
<th>W</th>
<th>Sp</th>
<th>Su</th>
<th>MSA</th>
<th>MSA Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>061072002-1</td>
<td>CA</td>
<td>Tulare</td>
<td>-119.29</td>
<td>36.33</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8780</td>
<td>Visalia-Tulare-Porterville, CA</td>
</tr>
<tr>
<td>9</td>
<td>061110005-1</td>
<td>CA</td>
<td>Ventura</td>
<td>-119.42</td>
<td>34.39</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8735</td>
<td>Ventura, CA</td>
</tr>
<tr>
<td>9</td>
<td>061110007-1</td>
<td>CA</td>
<td>Ventura</td>
<td>-118.87</td>
<td>34.21</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8735</td>
<td>Ventura, CA</td>
</tr>
<tr>
<td>9</td>
<td>0611111004-1</td>
<td>CA</td>
<td>Ventura</td>
<td>-119.23</td>
<td>34.45</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8735</td>
<td>Ventura, CA</td>
</tr>
<tr>
<td>9</td>
<td>061112002-1</td>
<td>CA</td>
<td>Ventura</td>
<td>-118.68</td>
<td>34.28</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8735</td>
<td>Ventura, CA</td>
</tr>
<tr>
<td>9</td>
<td>061112003-1</td>
<td>CA</td>
<td>Ventura</td>
<td>-119.31</td>
<td>34.29</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8735</td>
<td>Ventura, CA</td>
</tr>
<tr>
<td>9</td>
<td>061113001-1</td>
<td>CA</td>
<td>Ventura</td>
<td>-119.14</td>
<td>34.25</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8735</td>
<td>Ventura, CA</td>
</tr>
<tr>
<td>9</td>
<td>061130004-1</td>
<td>CA</td>
<td>Yolo</td>
<td>-121.78</td>
<td>38.53</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>9270</td>
<td>Yolo, CA</td>
</tr>
<tr>
<td>9</td>
<td>320030557-1</td>
<td>NV</td>
<td>Clark</td>
<td>-115.11</td>
<td>36.16</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4120</td>
<td>Las Vegas, NV-AZ</td>
</tr>
<tr>
<td>9</td>
<td>320050004-1</td>
<td>NV</td>
<td>Douglas</td>
<td>-119.94</td>
<td>38.96</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>(not in an MSA)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>325100004-1</td>
<td>NV</td>
<td>Carson City</td>
<td>-119.76</td>
<td>39.17</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>(not in an MSA)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>160010016-1</td>
<td>ID</td>
<td>Ada</td>
<td>-116.21</td>
<td>43.62</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1080</td>
<td>Boise City, ID</td>
</tr>
<tr>
<td>10</td>
<td>160050015-1</td>
<td>ID</td>
<td>Bannock</td>
<td>-112.46</td>
<td>42.88</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6340</td>
<td>Pocatello, ID</td>
</tr>
<tr>
<td>10</td>
<td>410510080-1</td>
<td>OR</td>
<td>Multnomah</td>
<td>-122.60</td>
<td>45.50</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6440</td>
<td>Portland-Vancouver, OR-WA</td>
</tr>
<tr>
<td>10</td>
<td>530110011-1</td>
<td>WA</td>
<td>Clark</td>
<td>-122.52</td>
<td>45.62</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6440</td>
<td>Portland-Vancouver, OR-WA</td>
</tr>
<tr>
<td>10</td>
<td>530330080-1</td>
<td>WA</td>
<td>King</td>
<td>-122.31</td>
<td>47.57</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>7600</td>
<td>Seattle-Bellevue-Everett, WA</td>
</tr>
</tbody>
</table>
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20 1997

Jul 10 1997

Jul 30 1997

Aug 19 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

CT Fairfield BRIDGEPORT, CT id=090019003-1 (1-hr) Correlation = 0.76

N_{poss} = 14

N_{GOME} = 14

N_{corr} = 11
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

CT Hartford
HARTFORD, CT
id=090031003-1 (1-hr)
Correlation= 0.64
N_{surf}=22 \ N_{GOME}=22 \ N_{corr}= 17
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19960901-19961130

- Sep 13
- Oct 03
- Oct 23
- Nov 12

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

MA Essex
BOSTON, MA-NH
hid=250092006-1
1-hr
Correlation= 0.33
N poss=18
N GOME=18
N corr= 16

Insufficient Coincident Data

EPA Surface and GOME Column NO2 19970301-19970531

- Mar 12
- Apr 01
- Apr 21
- May 11
- May 31

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

MA Essex
BOSTON, MA-NH
hid=250092006-1
1-hr
Correlation= -0.06
N poss=16
N GOME=16
N corr= 11

EPA Surface and GOME Column NO2 19970601-19970831

- Jun 20
- Jul 10
- Jul 30
- Aug 19

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

MA Essex
BOSTON, MA-NH
hid=250092006-1
1-hr
Correlation= 0.05
N poss=21
N GOME=21
N corr= 19

56
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
In the graph, there are two main datasets being compared:

1. **Surface NO2 (ppbv)**: This dataset measures the concentration of nitrogen dioxide at the surface level, expressed in parts per billion by volume (ppbv). The data is plotted against time, with each point representing the concentration of NO2 on a specific date.

2. **GOME NO2 (1X10^15 mol/cm^2)**: This dataset provides columnar measurements of NO2, integrated over a vertical column of the atmosphere. The data is also plotted against time.

Each dataset is color-coded to distinguish between them. Red and blue lines represent the surface and GOME data, respectively.

### Time Intervals
- **1996**: The graph covers the period from September 13 to December 31, 1996. There are points indicating significant changes in NO2 concentrations.
- **1997**: The graph extends from January 1 to June 30, 1997. The data for this period shows similar patterns, with notable variations in NO2 levels.

### Correlation
- The correlation between the surface and GOME data is indicated by correlation coefficients. For instance, the coefficient for the 1996 period is 0.13, and for the 1997 period from January 1 to June 30, it is 0.65.

### Insufficient Data
- Insufficient coincident data is noted for the **Winter (12/1/96-2/28/97)** period. This indicates that there are gaps in the data for this specific time frame, possibly due to limited observations or technical issues.

### Other Notes
- The graph includes identifiers for specific locations and stations, such as MA Hampden and SPRINGFIELD, MA, with corresponding dataset codes and identifiers.
- The data points are marked with symbols to indicate the number of observations (N) for both surface and GOME data, as well as the correlation coefficient for these data points.
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
EPA Surface and GOME Column NO2 19960901-19961130

Sep 13, 1996
Oct 03, 1996
Oct 23, 1996
Nov 12, 1996

0 20 40 60 80 100 120
Surface NO2 (ppbv)

0 5 10 15
GOME NO2 (1X10^15 mol/cm^2)

NJ Essex
NEWARK, NJ
id=340131003-1 (1-hr)
Correlation= 0.26
N_{pos}= 14
N_{GOME}= 14
N_{corr}= 12

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12, 1997
Apr 01, 1997
Apr 21, 1997
May 11, 1997
May 31, 1997

0 20 40 60 80 100 120
Surface NO2 (ppbv)

0 5 10 15 20
GOME NO2 (1X10^15 mol/cm^2)

NJ Essex
NEWARK, NJ
id=340131003-1 (1-hr)
Correlation= 0.44
N_{pos}= 21
N_{GOME}= 21
N_{corr}= 20

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20, 1997
Jul 10, 1997
Jul 30, 1997
Aug 19, 1997

0 20 40 60 80 100
Surface NO2 (ppbv)

0 2 4 6 8 10 12 14
GOME NO2 (1X10^15 mol/cm^2)

NJ Essex
NEWARK, NJ
id=340131003-1 (1-hr)
Correlation= 0.32
N_{pos}= 20
N_{GOME}= 20
N_{corr}= 14

Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

NY Albany
ALBANY-SCHENECTADY-TROY, NY
id=360010012-1
Correlation= 0.66
N_{poss}=16
N_{GOME}=16
N_{corr}= 10
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
EPA Surface and GOME Column NO2 19970301-19970531

Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

NY Bronx NEW YORK, NY id=360050083-1 (1-hr)
Correlation= 0.64 Nposs=21 N_GOME=21 N_corr= 17

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

NY Bronx NEW YORK, NY id=360050083-1 (1-hr)
Correlation= 0.48 Nposs=17 N_GOME=17 N_corr= 15
Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12
1997
Apr 01
1997
Apr 21
1997
May 11
1997
May 31
1997

Surface NO2 (ppbv)
0
20
40
60
80
100

GOME NO2 (1x10^15 mol/cm^2)
0
5
10
15
20
25
30
35
40
45
50

DE New Castle
WILMINGTON-NEWARK, DE-MD
id=100031003-1 (1-hr)
Correlation=
N_{surf}=19
N_{GOME}=19
N_{corr}=12

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)
0
2
4
6
8
10
12
14

GOME NO2 (1x10^15 mol/cm^2)
0
5
10
15
20
25
30
35
40
45
50

DE New Castle
WILMINGTON-NEWARK, DE-MD
id=100031003-1 (1-hr)
Correlation=
N_{surf}=24
N_{GOME}=24
N_{corr}=19
EPA Surface and GOME Column NO2 19960901-19961130

Sep 13, 1996
Oct 03, 1996
Oct 23, 1996
Nov 12, 1996

Surface NO2 (ppbv)

0 20 40 60 80 100 120

GOME NO2 (1X10^15 mol/cm^2)

DC District of Columbia Washington, DC-MD-VA-WV
id=110010025-1 (1-hr)
Correlation= 0.18

N pos = 12
N corr = 12

EPA Surface and GOME Column NO2 19961201-19970228

Dec 02, 1996
Dec 22, 1996
Jan 11, 1997
Jan 31, 1997
Feb 20, 1997

Surface NO2 (ppbv)

0 50 100 150 200 250

GOME NO2 (1X10^15 mol/cm^2)

DC District of Columbia Washington, DC-MD-VA-WV
id=110010025-1 (1-hr)
Correlation= -0.03

N pos = 12
N corr = 10

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12, 1997
Apr 01, 1997
Apr 21, 1997
May 11, 1997
May 31, 1997

Surface NO2 (ppbv)

0 10 20 30 40 50

GOME NO2 (1X10^15 mol/cm^2)

DC District of Columbia Washington, DC-MD-VA-WV
id=110010025-1 (1-hr)
Correlation= 0.19

N pos = 16
N corr = 13

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20, 1997
Jul 10, 1997
Jul 30, 1997
Aug 19, 1997

Surface NO2 (ppbv)

0 3 6 9 12 15

GOME NO2 (1X10^15 mol/cm^2)

DC District of Columbia Washington, DC-MD-VA-WV
id=110010025-1 (1-hr)
Correlation= 0.07

N pos = 21
N corr = 19

87
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)

0 20 40 60 80 100

GOME NO2 (1X10^15 mol/cm^2)

0 2 4 6 8 10 12 14

MD Anne_Arundel BALTIMORE, MD
id=240030019-3 (1-hr)
Correlation=-0.02
N_{corr}=23 N_{GOME}=23 N_{poss}=23
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20 1997

Jul 10 1997

Jul 30 1997

Aug 19 1997

Surface NO2 (ppbv)

GOME NO2 (1X10 15 mol/cm 2)

MD Baltimore BALTIMORE, MD

Did=240053001-2 (1-hr) Correlation= 0.11

Nposs=26 N GOME=26 Ncorr= 18
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

MD Baltimore City
BALTIMORE, MD
id=245100051-1
Correlation=
N_{surf}=23N_{GOME}=23
N_{corr}=20

Surface NO2 (ppbv)

GOME NO2 (1X10^{15} mol/cm^2)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

Correlation = 0.41
N_{surf}=20 N_{GOME}=20 N_{corr}= 18

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

Correlation = 0.41
N_{surf}=24 N_{GOME}=24 N_{corr}= 22
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

PA Lawrence NOT IN AN MSA id=420730015-1 (1-hr) Correlation= 0.50 N
poss=13 N GOME=13 N corr=12

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

PA Lawrence NOT IN AN MSA id=420730015-1 (1-hr) Correlation= 0.04 N
poss=12 N GOME=12 N corr=11
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

- Winter (12/1/96-2/28/97)
- Spring (3/1/97-5/31/97)
- Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12
1997
Apr 01
1997
Apr 21
1997
May 11
1997
May 31
1997

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

PA Washington
PITTSBURGH, PA
id=421250200-1 (1-hr)
Correlation= 0.42
N
poss=15
N
GOME
=15
N
corr
= 15

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

PA Washington
PITTSBURGH, PA
id=421250200-1 (1-hr)
Correlation= 0.59
N
poss=18
N
GOME
=18
N
corr
= 17

112
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)

Insufficient Coincident Data

Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)

Insufficient Coincident Data

Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)

Insufficient Coincident Data

Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12
1997
Apr 01
1997
Apr 21
1997
May 11
1997
May 31
1997

Surface NO2 (ppbv)

0
2
4
6
8
10
12
14

GOME NO2 (1X10^15 mol/cm^2)

KY Daviess OWENSBORO, KY id=210590005-1 (1-hr)

Correlation = -0.01

poss = 15 N

GOME = 15 N

corr = 12

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)

0
2
4
6
8
10
12
14

GOME NO2 (1X10^15 mol/cm^2)

KY Daviess OWENSBORO, KY id=210590005-1 (1-hr)

Correlation = 0.01

poss = 14 N

GOME = 14 N

corr = 11
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Summer (6/1/97-8/31/97)

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

KY Jefferson LOUISVILLE, KY-IN
id=21110051-1 (1-hr)
Correlation= 0.34
N_{surf}=18 N_{GOME}=18 N_{corr}= 15
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)

Insufficient Coincident Data
Fall (9/1/96-11/30/96)

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12
1997

Apr 01
1997

Apr 21
1997

May 11
1997

May 31
1997

0
20
40
60
80
100

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

KY Kenton CINCINNATI, OH-KY-IN
id=211170007-2 (1-hr) Correlation= 0.20 N
poss=15 N GOME=15 N corr= 13
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19960901-19961130
Sep 13
1996
Oct 03
1996
Oct 23
1996
Nov 12
1996

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

NC Forsyth-GRENSBORO--WINSTON-SALEM--HIGH POINT, NC
id=370670022-1 (1-hr)
Correlation = 0.18
N poss = 16
N GOME = 16
N corr = 11

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12
1997
Apr 01
1997
Apr 21
1997
May 11
1997
May 31
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

NC Forsyth-GRENSBORO--WINSTON-SALEM--HIGH POINT, NC
id=370670022-1 (1-hr)
Correlation = 0.51
N poss = 19
N GOME = 19
N corr = 17

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

NC Forsyth-GRENSBORO--WINSTON-SALEM--HIGH POINT, NC
id=370670022-1 (1-hr)
Correlation = 0.21
N poss = 12
N GOME = 12
N corr = 11

138
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12
1997
Apr 01
1997
Apr 21
1997
May 11
1997
May 31
1997

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

TN Sullivan JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA
id=471630007-1 (1-hr) Correlation= 0.02
N poss=19 N GOME=19 N corr= 14

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)

TN Sullivan JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA
id=471630007-1 (1-hr) Correlation= 0.39
N poss=10 N GOME=10 N corr= 10

EPA Surface and GOME Column NO2 19970101-19970331

Jan 10
1997
Feb 10
1997
Mar 10
1997
Apr 10
1997

Surface NO2 (ppbv)

TN Sullivan JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA
id=471630007-1 (1-hr) Correlation= 0.29
N poss=19 N GOME=19 N corr= 14

EPA Surface and GOME Column NO2 19970401-19970630

Mar 10
1997
Apr 10
1997
May 10
1997
Jun 10
1997

Surface NO2 (ppbv)

TN Sullivan JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA
id=471630007-1 (1-hr) Correlation= 0.42
N poss=19 N GOME=19 N corr= 14

EPA Surface and GOME Column NO2 19970701-19970930

Jul 10
1997
Aug 10
1997
Sep 10
1997
Oct 10
1997

Surface NO2 (ppbv)

TN Sullivan JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA
id=471630007-1 (1-hr) Correlation= 0.39
N poss=19 N GOME=19 N corr= 14

EPA Surface and GOME Column NO2 19971001-19971231

Sep 10
1997
Oct 10
1997
Nov 10
1997
Dec 10
1997

Surface NO2 (ppbv)

TN Sullivan JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA
id=471630007-1 (1-hr) Correlation= 0.39
N poss=19 N GOME=19 N corr= 14
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Winter (12/1/96-2/28/97)

Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

IL Cook CHICAGO, IL id=170310072-1 (1-hr) Correlation= -0.06
poss=20 N GOME=20 N corr= 15
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19960901-19961130
Sep 13 1996
Oct 03 1996
Oct 23 1996
Nov 12 1996

Surface NO2 (ppbv)

0 20 40 60 80 100

GOME NO2 (1x10^15 mol/cm^2)

IL Cook CHICAGO, IL id=170313101-1 (1-hr)

Correlation = 0.42
N_{poss} = 15
N_{GOME} = 15
N_{corr} = 15

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

Surface NO2 (ppbv)

0 5 10 15

GOME NO2 (1x10^15 mol/cm^2)

IL Cook CHICAGO, IL id=170313101-1 (1-hr)

Correlation = -0.06
N_{poss} = 16
N_{GOME} = 16
N_{corr} = 15

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)

0 20 40 60 80 100

GOME NO2 (1x10^15 mol/cm^2)

IL Cook CHICAGO, IL id=170313101-1 (1-hr)

Correlation = 0.38
N_{poss} = 19
N_{GOME} = 19
N_{corr} = 16
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

IL Lake CHICAGO, IL
id=170971007-1 (1-hr)
Correlation= 0.37
N_surface=19 N_GOME=19 N_corr= 15
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Winter (12/1/96-2/28/97)

Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

IN LakeGARY, IN id=180890022-1 (1-hr)
Correlation = -0.03
Nposs = 14
NGOME = 14
Ncorr = 12
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Insufficient Coincident Data

Summer (6/1/97-8/31/97)

Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Insufficient Coincident Data

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

IN St Joseph SOUTH BEND, IN id=181410012-1 (1-hr) Correlation = 0.45

N poss = 16

N GOME = 16

N corr = 12

158
Insufficient Coincident Data

Fall (9/1/96-11/30/96)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Spring (3/1/97-5/31/97)
Insufficient Coincident Data

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20
Jul 10
Jul 30
Aug 19
1997
1997
1997
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

IN St_JosephSOUTH BEND, IN id=181411008-1 (1-hr) Correlation= 0.38
Poss=21 N GOME=21 N Corr= 19

159
Insufficient Coincident Data
Fall (9/1/96-11/30/96)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

MI Macomb DETROIT, MI
id=260990009-1 (1-hr)
Correlation= 0.06
N_{surf}=18 N_{GOME}=18 N_{corr}= 11

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

MI Wayne DETROIT, MI id=261630016-1 (1-hr) Correlation= 0.39

Poss = 12 N GOME corr = 10
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

MI Wayne DETROIT, MI id=261630019-2 (1-hr) Correlation= 0.53 N_GOME=16 N_corr= 12
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

Surface NO2 (ppbv)
0 20 40 60 80 100

GOME NO2 (1X10^15 mol/cm^2)
0 10 20 30

OH CuyahogaCLEVELAND-LORAIN-ELYRIA, OH id=390350060-1 (1-hr) Correlation= 0.37 N poss=12 N GOME=12 N corr= 10

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)
0 50 100 150 200

GOME NO2 (1X10^15 mol/cm^2)
0 10 20 30

OH CuyahogaCLEVELAND-LORAIN-ELYRIA, OH id=390350060-1 (1-hr) Correlation= 0.30 N poss=14 N GOME=14 N corr= 13

166
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)
Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

OH Cuyahoga
CLEVELAND-LORAIN-ELYRIA, OH
id=390350066-1 (1-hr)
Correlation= 0.61
Npossible=13
NGOME=13
Ncorr= 11
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

OH Jefferson
STEUBENVILLE-WEIRTON, OH-WV
id=390811012-2 (1-hr)
Correlation= 0.25
N_surface=15 N_GOME=15
N_corr= 14

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

OH Jefferson
STEUBENVILLE-WEIRTON, OH-WV
id=390811012-2 (1-hr)
Correlation= 0.26
N_surface=13 N_GOME=13
N_corr= 13
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19960901-19961130

AR Pulaski
LITTLE ROCK-NORTH LITTLE ROCK, AR
id=051191002-1 (1-hr)
Correlation= 0.19
N_{corr}=16 N_{GOME}=16 N_{pos}= 16

EPA Surface and GOME Column NO2 19970301-19970531

AR Pulaski
LITTLE ROCK-NORTH LITTLE ROCK, AR
id=051191002-1 (1-hr)
Correlation= 0.41
N_{corr}=10 N_{GOME}=14 N_{pos}= 14

EPA Surface and GOME Column NO2 19970601-19970831

AR Pulaski
LITTLE ROCK-NORTH LITTLE ROCK, AR
id=051191002-1 (1-hr)
Correlation= 0.28
N_{corr}=14 N_{GOME}=18 N_{pos}= 14
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19960901-19961130
LA East Baton Rouge
Baton Rouge, LA
id=220330003-1 (1-hr)
Correlation= 0.48
N_{surf}=20 N_{GOME}=20 N_{corr}= 17

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997
LA East Baton Rouge
Baton Rouge, LA
id=220330003-1 (1-hr)
Correlation= -0.19
N_{surf}=12 N_{GOME}=12 N_{corr}= 12

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997
LA East Baton Rouge
Baton Rouge, LA
id=220330003-1 (1-hr)
Correlation= 0.17
N_{surf}=19 N_{GOME}=19 N_{corr}= 12
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)

Insufficient Coincident Data

175
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Summer (6/1/97-8/31/97)

Spring (3/1/97-5/31/97)

Insufficient Coincident Data

Insufficient Coincident Data
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
EPA Surface and GOME Column NO2 19960901-19961130

Sep 13
1996
Oct 03
1996
Oct 23
1996
Nov 12
1996

Surface NO2 (ppbv)

GOME NO2 (1X10^-15 mol/cm²)

NM Dona_Ana LAS CRUCES, NMid=350130021-1 (1-hr) Correlation= 0.13
N_oss=26 N_GOME=26 N_cor= 13

EPA Surface and GOME Column NO2 19961201-19970228

Dec 02
1996
Dec 22
1996
Jan 11
1997
Jan 31
1997
Feb 20
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^-15 mol/cm²)

NM Dona_Ana LAS CRUCES, NMid=350130021-1 (1-hr) Correlation= -0.10
N_oss=15 N_GOME=15 N_cor= 10

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12
1997
Apr 01
1997
Apr 21
1997
May 11
1997
May 31
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^-15 mol/cm²)

NM Dona_Ana LAS CRUCES, NMid=350130021-1 (1-hr) Correlation= -0.05
N_oss=24 N_GOME=24 N_cor= 14

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12
1997
Apr 01
1997
Apr 21
1997
May 11
1997
May ...
Surface NO2 (ppbv)
0
2
4
6
8
10
12
GOME NO2 (1x10^15 mol/cm^2)
NM San_Juan
NOT IN AN MSA
id=350450009-1 (1-hr)
Correlation= 0.12
N_{sur}==23
N_{GOME}=23
N_{corr}= 17

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug...
Surface NO2 (ppbv)
0
2
4
6
8
10
12
GOME NO2 (1x10^15 mol/cm^2)
NM San_Juan
NOT IN AN MSA
id=350450009-1 (1-hr)
Correlation= -0.43
N_{sur}==27
N_{GOME}=27
N_{corr}= 14
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)

Insufficient Coincident Data

Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

TX Harris
HOUSTON, TX
id=482011034-1
(1-hr)
Correlation= 0.53
N_cor=15 N_GOME=15
N_poss= 13
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12
1997

Apr 01
1997

Apr 21
1997

May 11
1997

May 31
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^{15} mol/cm^2)

TX Harris HOUSTON, TX
id=482011035-1 (1-hr)
Correlation= 0.39
N_{poss}=11
N_{GOME}=11
N_{corr}= 10

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20
1997

Jul 10
1997

Jul 30
1997

Aug 19
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^{15} mol/cm^2)

TX Harris HOUSTON, TX
id=482011035-1 (1-hr)
Correlation= -0.20
N_{poss}=16
N_{GOME}=16
N_{corr}= 11
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19960901-19961130
Sep 13
1996
Oct 03
1996
Oct 23
1996
Nov 12
1996

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

MO St_Louis_CityST. LOUIS, MO-ILid=295100080-1 (1-hr)Correlation= 0.31N
poss=15 N
GOME=15 Ncorr= 15

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12
1997
Apr 01
1997
Apr 21
1997
May 11
1997
May 31
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

MO St_Louis_CityST. LOUIS, MO-ILid=295100080-1 (1-hr)Correlation= 0.01N
poss=17 N
GOME=17 Ncorr= 12

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

MO St_Louis_CityST. LOUIS, MO-ILid=295100080-1 (1-hr)Correlation= 0.25N
poss=15 N
GOME=15 Ncorr= 13

212
EPA Surface and GOME Column NO2 19960901-19961130

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970601-19970831

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

Correlation=-0.07
N=16
N_{corr}=14
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19960901-19961130

Sep 13
1996
Oct 03
1996
Oct 23
1996
Nov 12
1996

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Insufficient Coincident Data

Spring (3/1977-5/31/97)

GOME NO2 (1x10^15 mol/cm^2)
Surface NO2 (ppbv)

CO JeffersonDENVER, COid=080590006-1 (1-hr) Correlation= 0.16N
poss=17 N GOME=17 N corr= 11

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19960901-19961130

Sep 13
1996
Oct 03
1996
Oct 23
1996
Nov 12
1996

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Insufficient Coincident Data

Spring (3/1977-5/31/97)

GOME NO2 (1x10^15 mol/cm^2)
Surface NO2 (ppbv)

CO JeffersonDENVER, COid=080590006-1 (1-hr) Correlation= 0.08N
poss=23 N GOME=23 N corr= 12

Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
EPA Surface and GOME Column NO2 19960901-19961130

Surface NO2 (ppbv)

GOME NO2 (1X10$^{15}$ mol/cm$^2$)

CO Jefferson
DENVER, CO
id=080590009-1 (1-hr)
Correlation= 0.36
$N_{sur}=18$ $N_{GOME}=18$ $N_{corr}=12$

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970601-19970831

Surface NO2 (ppbv)

GOME NO2 (1X10$^{15}$ mol/cm$^2$)

CO Jefferson
DENVER, CO
id=080590009-1 (1-hr)
Correlation= -0.06
$N_{sur}=24$ $N_{GOME}=24$ $N_{corr}=17$

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Winter (12/1/96-2/28/97)

Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831

Jul 10, 1997
Jul 30, 1997
Aug 19, 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

UT Salt Lake
SALT LAKE CITY-OGDEN, UT
id=490353006-1 (1-hr)
Correlation=0.35
N_poss=22
GOME=22 N_corr=21
Insufficient Coincident Data

Winter (12/1/96-2/28/97)

Insufficient Coincident Data

Spring (3/1/97-5/31/97)
EPA Surface and GOME Column NO2 19960901-19961130

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

AZ Maricopa PHOENIX-MESA, AZ id=040133002-6 (1-hr) Correlation = 0.85 N = 24 N_{corr} = 23

EPA Surface and GOME Column NO2 19961201-19970228

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

AZ Maricopa PHOENIX-MESA, AZ id=040133002-6 (1-hr) Correlation = -0.08 N = 18 N_{corr} = 17

EPA Surface and GOME Column NO2 19970301-19970531

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

AZ Maricopa PHOENIX-MESA, AZ id=040133002-6 (1-hr) Correlation = 0.63 N = 29 N_{corr} = 26

EPA Surface and GOME Column NO2 19970601-19970831

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

AZ Maricopa PHOENIX-MESA, AZ id=040133002-6 (1-hr) Correlation = 0.51 N = 28 N_{corr} = 17
EPA Surface and GOME Column NO2 19960901-19961130

Sep 13 1996
Oct 03 1996
Oct 23 1996
Nov 12 1996

Surface NO2 (ppbv)

0
20
40
60
80
100

GOME NO2 (1X10^{15} mol/cm^2)

0
2
4
6
8
10
12
14

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data

Fall (9/1/96-11/30/96)

Insufficient Coincident Data

Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

0 20 40 60 80 100

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

AZ Maricopa PHOENIX-MESA, AZ id=040133010-1 (1-hr) Correlation = 0.25 N-pos = 27 N-GOME = 27 N-corr = 22

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

0 20 40 60 80 100

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

AZ Maricopa PHOENIX-MESA, AZ id=040133010-1 (1-hr) Correlation = 0.60 N-pos = 25 N-GOME = 25 N-corr = 21

EPA Surface and GOME Column NO2 19970901-19971130

Sep 20 1997
Oct 10 1997
Oct 30 1997
Nov 19 1997

0 20 40 60 80 100

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

AZ Maricopa PHOENIX-MESA, AZ id=040133010-1 (1-hr) Correlation = 0.50 N-pos = 26 N-GOME = 26 N-corr = 21
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
EPA Surface and GOME Column NO2 19960901-19961130

Sep 13
1996
Oct 03
1996
Oct 23
1996
Nov 12
1996

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

CA Contra_Costa
OAKLAND, CA
id=060130002-1 (1-hr)
Correlation= 0.37
Npos=28
NGOME=28
Ncorr= 21

EPA Surface and GOME Column NO2 19961201-19970228

Dec 02
1996
Dec 22
1996
Jan 11
1997
Jan 31
1997
Feb 20
1997

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

CA Contra_Costa
OAKLAND, CA
id=060130002-1 (1-hr)
Correlation= 0.02
Npos=12
NGOME=12
Ncorr= 10

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12
1997
Apr 01
1997
Apr 21
1997
May 11
1997
May 31
1997

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

CA Contra_Costa
OAKLAND, CA
id=060130002-1 (1-hr)
Correlation= 0.40
Npos=23
NGOME=23
Ncorr= 19

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

CA Contra_Costa
OAKLAND, CA
id=060130002-1 (1-hr)
Correlation= 0.56
Npos=26
NGOME=26
Ncorr= 24
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20
1997
Jul 10
1997
Jul 30
1997
Aug 19
1997

Surface NO2 (ppbv)

CA Contra_Costa
OAKLAND, CA
id=060131003-1
1-hr
Correlation=
0.15
N_poss=26
N_GO=26
N_corr=13

GOME NO2 (1X10^15 mol/cm^2)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data

Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Winter (12/1/96-2/28/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

EPA Surface and GOME Column NO2 19961201-19970228
Dec 02 1996
Dec 22 1996
Jan 11 1997
Jan 31 1997
Feb 20 1997

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

CA Imperial
NOT IN AN MSA
id=060250006-1 (1-hr)
Correlation= 0.51
N_{surf}=19 N_{GOME}=19 N_{corr}= 16

Insufficient Coincident Data
Summer (6/1/97-8/31/97)

EPA Surface and GOME Column NO2 19970301-19970531
Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

Surface NO2 (ppbv)
GOME NO2 (1X10^15 mol/cm^2)

CA Imperial
NOT IN AN MSA
id=060250006-1 (1-hr)
Correlation= 0.34
N_{surf}=30 N_{GOME}=30 N_{corr}= 13
EPA Surface and GOME Column NO2 19960901-19961130

Sep 13 1996
Oct 03 1996
Oct 23 1996
Nov 12 1996

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

CA KernBAKERSFIELD, CA id=060295001-1 (1-hr) Correlation= 0.16

poss = 30
GOME = 30
corr = 30

EPA Surface and GOME Column NO2 19961201-19970228

Dec 02 1996
Dec 22 1996
Jan 11 1997
Jan 31 1997
Feb 20 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

CA KernBAKERSFIELD, CA id=060295001-1 (1-hr) Correlation= 0.52

poss = 16
GOME = 15
corr = 15

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12 1997
Apr 01 1997
Apr 21 1997
May 11 1997
May 31 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

CA KernBAKERSFIELD, CA id=060295001-1 (1-hr) Correlation= -0.10

poss = 35
GOME = 35
corr = 17

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

Surface NO2 (ppbv)

GOME NO2 (1X10^15 mol/cm^2)

CA KernBAKERSFIELD, CA id=060295001-1 (1-hr) Correlation= 0.34

poss = 33
GOME = 33
corr = 24
EPA Surface and GOME Column NO2 19960901-19961130

Sep 13, 1996
Oct 03, 1996
Oct 23, 1996
Nov 12, 1996

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

ID Ada BOISE CITY, ID
id=160010016-1 (1-hr)
Correlation=-0.06
N_{sur}=18 N_{GOME}=16 N_{corr}=15

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

EPA Surface and GOME Column NO2 19970301-19970531

Mar 12, 1997
Apr 01, 1997
Apr 21, 1997
May 11, 1997
May 31, 1997

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

ID Ada BOISE CITY, ID
id=160010016-1 (1-hr)
Correlation=-0.15
N_{sur}=21 N_{GOME}=15 N_{corr}=13

EPA Surface and GOME Column NO2 19970601-19970831

Jun 20, 1997
Jul 10, 1997
Jul 30, 1997
Aug 19, 1997

Surface NO2 (ppbv)

GOME NO2 (1x10^15 mol/cm^2)

ID Ada BOISE CITY, ID
id=160010016-1 (1-hr)
Correlation=0.25
N_{sur}=32 N_{GOME}=29 N_{corr}=27
Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

Insufficient Coincident Data
Summer (6/1/97-8/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)
Insufficient Coincident Data
Fall (9/1/96-11/30/96)

Insufficient Coincident Data
Winter (12/1/96-2/28/97)

Insufficient Coincident Data
Spring (3/1/97-5/31/97)

EPA Surface and GOME Column NO2 19970601-19970831
Jun 20 1997
Jul 10 1997
Jul 30 1997
Aug 19 1997

WA King
SEATTLE-BELLEVUE-EVERETT, WA
id=530330080-1 (1-hr)
Correlation= 0.34
N_{surf}=20 N_{GOME}=19 N_{corr}= 16

Surface NO2 (ppbv)
GOME NO2 (1x10^15 mol/cm^2)

202
B Regional Mean Satellite and In-Situ Comparisons

This appendix contains the spatial correlations between measurements, means, and standard deviations for each EPA region and season (fall 1996 through summer 1997). Only the regions where at least 10 coincidences occur for at least 10 ground stations per season are included. This ensures there will be at least 10 points in the mean and standard deviation panels from which the correlation is computed. During winter only region 9 meets this criteria. In addition, regions 7 and 10 did not meet this criteria during any season.
Correlation of EPA and GOME NO$_2$  
19960901-19961130  
Region 01  
r=0.207303  
n=223

Correlation of EPA and GOME NO$_2$ Means  
19960901-19961130  
Region 01  
r=0.0656337  
n=15

Correlation of EPA and GOME NO$_2$ Standard Deviations  
19960901-19961130  
Region 01  
r=-0.0241315  
n=15
Correlation of EPA and GOME NO$_2$

![Correlation of EPA and GOME NO$_2$](image)

**Correlation of EPA and GOME NO$_2$**

- **Means**
  - $r=0.160768$
  - $n=179$

- **Means**
  - $r=0.0348815$
  - $n=15$

- **Standard Deviations**
  - $r=0.540483$
  - $n=15$
Correlation of EPA and GOME NO₂

Correlation of EPA and GOME NO₂ Means

Correlation of EPA and GOME NO₂ Standard Deviations
Correlation of EPA and GOME NO$_2$

19960901-19961130
Region 04
$r=0.214383$
$n=300$

Correlation of EPA and GOME NO$_2$ Means

19960901-19961130
Region 04
$r=0.123214$
$n=24$

Correlation of EPA and GOME NO$_2$ Standard Deviations

19960901-19961130
Region 04
$r=0.293096$
$n=24$
Correlation of EPA and GOME NO$_2$

![Graph showing correlation between EPA NO$_2$ and GOME NO$_2$]

- **Region 05**
- **r = 0.426501**
- **n = 167**

Correlation of EPA and GOME NO$_2$ Means

![Graph showing correlation between EPA NO$_2$ and GOME NO$_2$ Means]

- **Region 05**
- **r = 0.543948**
- **n = 13**

Correlation of EPA and GOME NO$_2$ Standard Deviations

![Graph showing correlation between EPA NO$_2$ and GOME NO$_2$ Standard Deviations]

- **Region 05**
- **r = -0.00508030**
- **n = 13**
Correlation of EPA and GOME NO$_2$

- 19960901-19961130 Region 06
- $r=0.0815128$
- $n=410$

Correlation of EPA and GOME NO$_2$ Means

- 19960901-19961130 Region 06
- $r=-0.395336$
- $n=27$

Correlation of EPA and GOME NO$_2$ Standard Deviations

- 19960901-19961130 Region 06
- $r=-0.643616$
- $n=27$
Correlation of EPA and GOME NO$_2$

**Means**

- Period: 19960901-19961130
- Region: 08
- Correlation Coefficient ($r$): 0.266065
- Number of Points ($n$): 148

**Correlation of EPA and GOME NO$_2$ Means**

- Period: 19960901-19961130
- Region: 08
- Correlation Coefficient ($r$): 0.00217565
- Number of Points ($n$): 11

**Standard Deviations**

- Period: 19960901-19961130
- Region: 08
- Correlation Coefficient ($r$): 0.596882
- Number of Points ($n$): 11
Correlation of EPA and GOME NO\textsubscript{2}

19960901-19961130
Region 09
\(r = 0.456952\)
n = 2179

Correlation of EPA and GOME NO\textsubscript{2} Means

19960901-19961130
Region 09
\(r = 0.622159\)
n = 100

Correlation of EPA and GOME NO\textsubscript{2} Standard Deviations

19960901-19961130
Region 09
\(r = 0.274312\)
n = 100
Correlation of EPA and GOME NO$_2$

\[ \text{r} = 0.420386 \]
\[ n = 870 \]

Correlation of EPA and GOME NO$_2$ Means

\[ \text{r} = 0.670749 \]
\[ n = 64 \]

Correlation of EPA and GOME NO$_2$ Standard Deviations

\[ \text{r} = 0.362785 \]
\[ n = 64 \]
Correlation of EPA and GOME NO$_2$

19970301-19970531
Region 02
r=0.381621
n=252

Correlation of EPA and GOME NO$_2$ Means

19970301-19970531
Region 02
r=-0.00482121
n=14

Correlation of EPA and GOME NO$_2$ Standard Deviations

19970301-19970531
Region 02
r=0.228667
n=14
Correlation of EPA and GOME NO$_2$

19970301-19970531
Region 03
r=0.300636
n=384

Correlation of EPA and GOME NO$_2$ Means

19970301-19970531
Region 03
r=0.129371
n=28

Correlation of EPA and GOME NO$_2$ Standard Deviations

19970301-19970531
Region 03
r=0.554145
n=28
Correlation of EPA and GOME NO$_2$


g = 0.199482
n = 214

Correlation of EPA and GOME NO$_2$ Means


g = 0.385866
n = 17

Correlation of EPA and GOME NO$_2$ Standard Deviations


g = 0.329224
n = 17
Correlation of EPA and GOME NO$_2$

Correlation of EPA and GOME NO$_2$ Means

Correlation of EPA and GOME NO$_2$ Standard Deviations

19970301-19970531
Region 06
r=-0.0983724
n=265

19970301-19970531
Region 06
r=-0.0510302
n=18

19970301-19970531
Region 06
r=-0.161297
n=18
Correlation of EPA and GOME NO$_2$

19970601-19970831
Region 01
r=0.299877
n=242

Correlation of EPA and GOME NO$_2$ Means

19970601-19970831
Region 01
r=0.268488
n=17

Correlation of EPA and GOME NO$_2$ Standard Deviations

19970601-19970831
Region 01
r=0.476697
n=17
Correlation of EPA and GOME NO\textsubscript{2}

19970601-19970831
Region 02
\(r=0.342713\)
n=218

Correlation of EPA and GOME NO\textsubscript{2} Means

19970601-19970831
Region 02
\(r=0.562465\)
n=15

Correlation of EPA and GOME NO\textsubscript{2} Standard Deviations

19970601-19970831
Region 02
\(r=0.531099\)
n=15
Correlation of EPA and GOME NO$_2$

$$\text{GOME NO}_2 \text{ (1X10}^{15}\text{ mol/cm}^2)$$

$$\text{EPA NO}_2 \text{ (ppbv)}$$

19970601-19970831
Region 03
$$r=0.172038$$
n=545

Correlation of EPA and GOME NO$_2$ Means

$$\text{GOME NO}_2 \text{ (1X10}^{15}\text{ mol/cm}^2)$$

$$\text{EPA NO}_2 \text{ (ppbv)}$$

19970601-19970831
Region 03
$$r=0.0132216$$
n=34

Correlation of EPA and GOME NO$_2$ Standard Deviations

$$\text{GOME NO}_2 \text{ (1X10}^{15}\text{ mol/cm}^2)$$

$$\text{EPA NO}_2 \text{ (ppbv)}$$

19970601-19970831
Region 03
$$r=-0.218686$$
n=34
Correlation of EPA and GOME NO$_2$

19970601-19970831
Region 04
$r=0.124706$
$n=165$

Correlation of EPA and GOME NO$_2$ Means

19970601-19970831
Region 04
$r=-0.00764944$
$n=13$

Correlation of EPA and GOME NO$_2$ Standard Deviations

19970601-19970831
Region 04
$r=0.227110$
$n=13$
Correlation of EPA and GOME NO$_2$

19970601-19970831
Region 05
$r=0.333495$
$n=306$

Correlation of EPA and GOME NO$_2$ Means

19970601-19970831
Region 05
$r=0.337968$
$n=21$

Correlation of EPA and GOME NO$_2$ Standard Deviations

19970601-19970831
Region 05
$r=0.480621$
$n=21$
Correlation of EPA and GOME NO$_2$

Correlation of EPA and GOME NO$_2$ Means

Correlation of EPA and GOME NO$_2$ Standard Deviations
Correlation of EPA and GOME NO$_2$

Correlation of EPA and GOME NO$_2$ Means

Correlation of EPA and GOME NO$_2$ Standard Deviations

19970601-19970831
Region 08
$r=0.282583$
$n=224$

19970601-19970831
Region 08
$r=0.437669$
$n=14$

19970601-19970831
Region 08
$r=0.205277$
$n=14$
Correlation of EPA and GOME NO$_2$

19970601-19970831
Region 09
r=0.513140
n=2081

Correlation of EPA and GOME NO$_2$ Means

19970601-19970831
Region 09
r=0.741452
n=99

Correlation of EPA and GOME NO$_2$ Standard Deviations

19970601-19970831
Region 09
r=0.694049
n=99
Comparison of Satellite Observations of Nitrogen Dioxide to Surface Monitor Nitrogen Dioxide Concentration

Kleb, Mary M.; Pippin, Margaret R.; Pierce, R. Bradley; Neil, Doreen O.; Lingenfelser, Gretchen; and Szykman, James J.

Nitrogen dioxide is one of the U. S. EPA's criteria pollutants, and one of the main ingredients needed for the production of ground-level ozone. Both ozone and nitrogen dioxide cause severe public health problems. Existing satellites have begun to produce observational data sets for nitrogen dioxide. Under NASA’s Earth Science Applications Program, we examined the relationship between satellite observations and surface monitor observations of this air pollutant to examine if the satellite data can be used to facilitate a more capable and integrated observing network. This report provides a comparison of satellite tropospheric column nitrogen dioxide to surface monitor nitrogen dioxide concentration for the period from September 1996 through August 1997 at more than 300 individual locations in the continental US. We found that the spatial resolution and observation time of the satellite did not capture the variability of this pollutant as measured at ground level. The tools and processes developed to conduct this study will be applied to the analysis of advanced satellite observations. One advanced instrument has significantly better spatial resolution than the measurements studied here and operates with an afternoon overpass time, providing a more representative distribution for once-per-day sampling of this photochemically active atmospheric constituent.

Nitrogen dioxide, Nitrogen oxides, GOME, Air pollution, Earth Science data applications, Satellite data