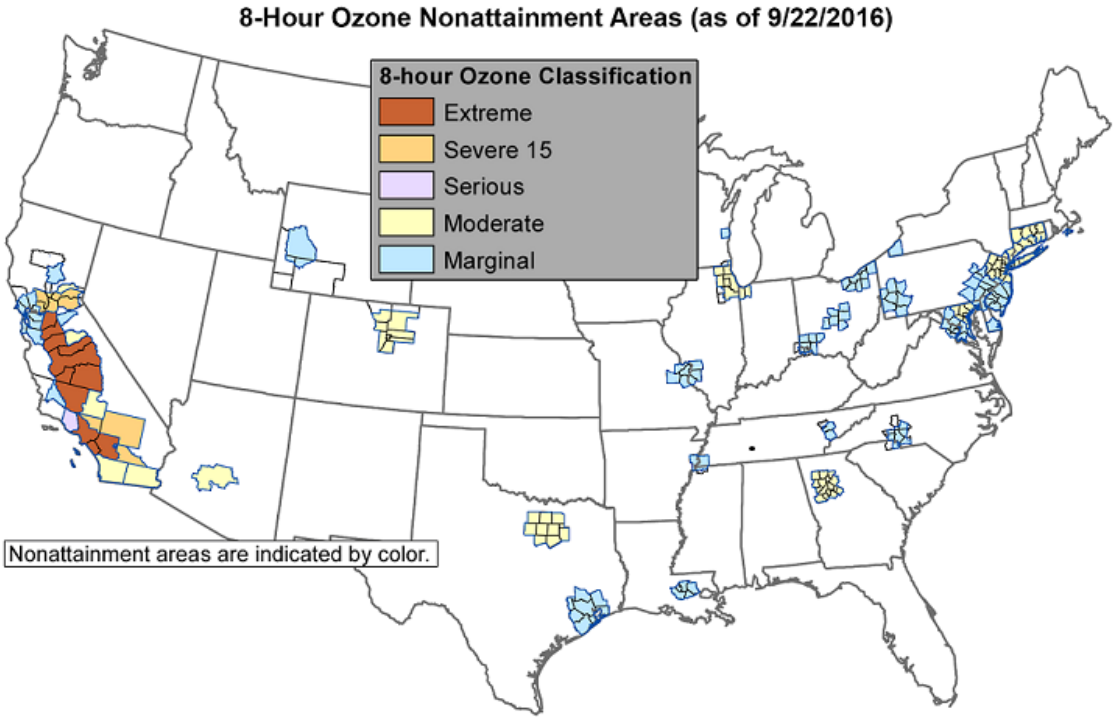
U.S. ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF INSPECTOR GENERAL

Air Quality

Management Alert:
Certain State, Local and Tribal Data Processing Practices Could Impact Suitability of Data for 8-Hour Ozone Air Quality Determinations

Report No. 17-P-0106 **February 6, 2017**



Report Contributors:

James Hatfield
Andrew Lavenburg
Jasprit Matta
Renee McGhee-Lenart
Anita Mooney
Geoffrey Pierce
Wendy Wierzbicki

Abbreviations

AQS	Air Quality System
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
Georgia DNR	Georgia Department of Natural Resources
NAAQS	National Ambient Air Quality Standards
OAQPS	Office of Air Quality Planning and Standards
OIG	Office of Inspector General
ppb	parts per billion
QAPP	Quality Assurance Project Plan
South Carolina DHEC	South Carolina Department of Health and Environmental Control

Cover photo: National map of the 8-hour ozone nonattainment areas (2008 standard), as of September 22, 2016. (Source: EPA website)

EPA Office of Inspector General
1200 Pennsylvania Avenue, NW (2410T)
Washington, DC 20460
(202) 566-2391
www.epa.gov/oig

U.S. Environmental Protection Agency
Office of Inspector General

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At a Glance

Why We Did This Review

In the process of evaluating whether selected ozone air monitoring data meet the criteria established by the U.S. Environmental Protection Agency (EPA), we found two state monitoring agencies that do not use EPA-recommended data processing practices. We are issuing this report to alert the EPA about these issues before the agency starts using the data to determine whether air quality meets the National Ambient Air Quality Standard (NAAQS) for ozone.

The EPA uses Air Quality System (AQS) data to determine whether an area's air quality meets the NAAQS. A nonattainment designation means that an area's air contains unhealthy levels of pollution, and the state must develop a plan to identify enforceable measures to improve air quality in that area. The EPA plans to designate areas for the new ozone NAAQS in 2017.

This report addresses the following EPA goal or cross-agency strategy:

- *Addressing climate change and improving air quality*.

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Management Alert: *Certain State, Local and Tribal Data Processing Practices Could Impact Suitability of Data for 8-Hour Ozone Air Quality Determinations*

What We Found

There is a risk that multiple air-monitoring agencies are not always implementing the EPA's recommended quality assurance practices for ozone data. This could lessen the quality of data the agency uses to determine and inform the public as to whether the air is healthy to breathe.

Air monitoring data the EPA received from Georgia and South Carolina were not always processed according to recommended practices in the EPA's 2013 *Quality Assurance Handbook for Air Pollution Measurement Systems* (Quality Assurance Handbook). Georgia and South Carolina adjusted ozone data based on the results of quality control checks known as "zero checks" before reporting the data to the AQS. According to the Quality Assurance Handbook, zero check adjustments, although an accepted practice under certain conditions, should not be necessary and may lead to more data quality uncertainty. While Georgia stopped adjusting its data in 2015, South Carolina continued the practice.

Georgia and South Carolina were not implementing critical criteria as recommended in Appendix D of the Quality Assurance Handbook. In Appendix D, the EPA establishes three critical quality control checks ("zero," "one-point quality control," and "span checks") to validate data. Georgia uses the three quality control checks to validate its data, but the acceptance criteria that the state uses for these checks are less stringent than what the EPA recommends. South Carolina does not use zero checks to validate ozone data. South Carolina applies the one-point quality control check to validate ozone data, but its acceptance criteria are less stringent than the EPA's recommended critical criteria. South Carolina conducts span checks, but does not follow EPA-recommended practices. Variation in the use of acceptance criteria and critical quality control checks can impact the integrity of data the EPA uses to make designation decisions.

We analyzed 2012–2014 ozone data across the country and determined that about 26 percent of the hourly data reported in real time were different than corresponding data reported to the AQS. While not all of the differences are indicative of data adjustment practices, there is a risk that other air-monitoring agencies are improperly adjusting their data before reporting it to the AQS. These adjustments could impact the quality of data the EPA plans to use to determine whether ozone levels present an adverse health risk to the public (i.e., the designation process). Designation determinations can have significant implications for public health and an area's economy. Therefore, it is important that the EPA has assurance that its designation decisions are based on data that has undergone a known, consistent and accepted quality control process.

Pending completion of our ongoing work, we are making no recommendations. We are alerting the EPA to a potential risk in the use of ozone data for its designations in 2017, so that the agency can take steps to further assess and mitigate risks as needed. The agency has initiated actions to assess these risks.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE INSPECTOR GENERAL

February 6, 2017

MEMORANDUM

SUBJECT: Management Alert: Certain State, Local and Tribal Data Processing Practices Could Impact Suitability of Data for 8-Hour Ozone Air Quality Determinations
Report No. 17-P-0106

FROM: Arthur A. Elkins Jr.

TO: Sarah Dunham, Acting Assistant Administrator
Office of Air and Radiation

During our evaluation of the U.S. Environmental Protection Agency's (EPA's) ambient air monitoring data changes and gaps, we found that two states were not processing ozone data in accordance with the EPA's recommended practices. We are issuing this management alert to inform the EPA about these issues, and the potential impact the issues could have on data the agency uses to make National Ambient Air Quality Standards' ozone designation decisions in 2017. The project number for this evaluation was OPE-FY16-0035.

The report represents the opinion of the Office of Inspector General (OIG) and does not necessarily represent the final EPA position. Final determinations on matters in this report will be made by EPA managers in accordance with established audit resolution procedures.

Action Required

Because this report contains no recommendations, you are not required to respond to this report. However, if you submit a response, it will be posted on the OIG's public website, along with our memorandum commenting on your response. Your response should be provided as an Adobe PDF file that complies with the accessibility requirements of Section 508 of the Rehabilitation Act of 1973, as amended. The final response should not contain data you do not want released to the public; if your response contains such data, you should identify the data for redaction or removal along with corresponding justification.

The report will be available at www.epa.gov/oig.

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Purpose

The U.S. Environmental Protection Agency's (EPA's) Office of Inspector General (OIG) has an ongoing review to determine whether selected ozone air monitoring data in the EPA's Air Quality System (AQS) meet the criteria established by the agency. The purpose of this report is to alert the EPA that state, local and tribal agencies may not be processing ozone ambient air monitoring data in accordance with the EPA's recommended practices, based on findings from two states we reviewed. When our work is complete, the OIG plans to issue a final report.

Background

Air monitoring networks operated by state, local and tribal agencies provide the data that the EPA uses to determine whether an area's air quality meets National Ambient Air Quality Standards (NAAQS) set by the EPA. These standards are set at a level to protect public health, including sensitive populations such as the elderly, children and asthmatics, from the effects of air pollution. Table 1 identifies some of the health effects associated with ozone.

Table 1: Health effects of ozone

Short-term health effects	Long-term health effects
• Shortness of breath and pain when taking a deep breath. • Coughing and sore or scratchy throat. • Inflamed and damaged airways. • Increased frequency of asthma attacks. • Increased susceptibility to lung infection.	• Aggravation of asthma, and is likely to be one of many causes of asthma development. • May be linked to permanent lung damage, such as abnormal lung development in children. • May increase the risk of death from respiratory causes.

Source: OIG analysis of EPA websites describing the health effects of ozone.

In 2016, the EPA started the designation process to determine whether areas in the nation meet the current 70 parts per billion (ppb) air quality standard. The EPA will then make its designations in 2017. An EPA determination that an area's air quality does not meet national standards can have significant consequences for that area and the state. A "nonattainment" designation means that the state, local agency or tribe must develop a plan that identifies enforceable measures for reducing emissions to improve air quality in that area. These measures can include more stringent permits, and additional emission controls for industry and other sources within the nonattainment area.

Air Monitoring Databases

The EPA maintains ambient air monitoring data in two databases—the AQS and AirNow. Raw or real-time data is reported to AirNow on an hourly basis for use in calculating air quality indexes that inform the public of current air quality conditions. After the monitoring agency reviews and validates the data, the hourly averages are submitted electronically to the AQS on a quarterly basis.

AirNow

- Collects hourly, real-time and forecasted air quality information to inform the public.
- Communicates air quality to the public via the air quality index.
- Data are considered preliminary and unofficial, and are not used for regulatory decisions.
- For more information, visit About AirNow.

Monitoring agencies certify annually that ambient air monitoring data are accurate and are entered into the AQS as required by the Code of Federal Regulations (CFR) through 40 CFR Part 58.15. The EPA uses air monitoring data from the AQS to compute design values each year for monitors meeting EPA completeness requirements. The ozone design value is the annual fourth-highest daily maximum 8-hour average concentration for a monitor, and is averaged over 3 years. These design values are used to make designation determinations and to classify nonattainment areas based on the highest-reading monitor in an area.

Uses for AQS Data

- Assess air quality.
- Assist in attainment and nonattainment designations.
- Evaluate state implementation plans for nonattainment areas.
- Perform modeling for permit review analysis and other air quality management functions.

EPA Data Processing Requirements and Guidance

Title 40 CFR Part 58 requires each monitoring agency to establish a quality system that includes data quality performance requirements for precision, bias and completeness. The regulation specifically references the EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems* (Quality Assurance Handbook)[1] as guidance for developing a quality system for ambient air monitoring programs.

The Quality Assurance Handbook states that "based upon validation criteria, the data is either reported as initially measured or invalidated." The handbook allows

[1] *Quality Assurance Handbook for Air Pollution Measurement Systems. Volume II: Ambient Air Quality Monitoring Program.* EPA-454/B-13-003 (May 2013).

daily adjustments to monitors based on automated zero checks[2], but these adjustments are allowed only under certain circumstances. Adjustments based on automated zero checks are not intended to correct data previously collected at the monitor, which would be considered post-processing the data.

The Quality Assurance Handbook has established three critical quality control checks: "zero," "one-point quality control," and "span." The three checks are critical to maintaining the integrity of the data collected by a monitor. The checks involve comparing the response of the monitor to known and certified ozone concentrations. Differences between the known ozone concentration and the monitor response are compared to the monitoring agency's acceptance criteria.

EPA's Critical Quality Control Checks

- The zero check measures the analyzer's response to zero ozone (0 ppb ozone).
- The one-point quality control check measures the analyzer's response to a typical ozone concentration at the site (10–100 ppb).
- The span check measures the analyzer's response to a concentration at the upper range of the analyzer's measurement capability (e.g., 500+ ppb).

According to the Quality Assurance Handbook, the data should be invalidated to the last acceptable check if acceptance criteria are exceeded. When data are invalidated, they are not reported to the AQS by the monitoring agency. Instead, null codes are reported to the AQS that provide an explanation as to why the data are missing. Data that are invalidated are not used to calculate ambient air averages or design values.

Scope and Methodology

We began our evaluation in January 2016, and our work is ongoing. We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform our work to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for the findings and conclusions in this report based on our audit objectives.

We obtained historical AirNow data from the EPA's Office of Air Quality Planning and Standards (OAQPS) for 2012, 2013 and 2014, as an indicator of the initial values recorded by the ozone monitors. Those years were chosen because, at the time we initiated our evaluation, they represented the most recent data in the AQS that were certified as valid by monitoring agencies and the EPA. We obtained AQS data for the same years from the EPA's public Air Data website.

[2] According to the Quality Assurance Handbook, some air monitoring analyzers are capable of conducting regularly scheduled zero and span calibrations, and automatically adjusting the monitor readings based on the results of those calibrations.

Using CaseWare IDEA software, we compared hourly data from the AQS and the AirNow to identify any values that did not match in the two databases. We then compared the top 8-hour daily maximum averages from the AQS database to those in AirNow at each site for 2012–2014. We wanted to identify where hourly differences in the data could have impacted the design values. The results of this comparison were used to identify states for review.

We selected two EPA Region 4 states—Georgia and South Carolina— for review. We conducted site visits at the Georgia Department of Natural Resources (DNR) and the South Carolina Department of Health and Environmental Control (DHEC). We obtained raw monitoring data, quality assurance and control data, and supporting documentation to explain data differences and gaps in a sample of 28 monitoring sites and 70 dates.[3] We reviewed Georgia DNR's and South Carolina DHEC's quality assurance project plans (QAPPs), standard operating procedures, and AQS summary reports. We also reviewed Region 4's Technical System Audit reports.

We interviewed Georgia DNR, South Carolina DHEC, the EPA's OAQPS, and management and/or staff from EPA Regions 3, 4 and 9. The work of the OIG is ongoing, and we plan to issue a report that fully addresses our assignment objectives.

Ozone Data Were Not Always Processed According to EPA-Recommended Practices

The air-monitoring agencies for Georgia and South Carolina did not always process ozone data according to recommended practices in the EPA's Quality Assurance Handbook. We found the following occurred:

- Monitoring agencies in both Georgia and South Carolina adjusted their raw ozone data based on the results of quality control checks known as "zero checks."

- Georgia and South Carolina were not validating data in accordance with recommended critical criteria found in Appendix D of the Quality Assurance Handbook.

[3] We reviewed 12 sites for 26 dates in Georgia, and 16 sites for 44 dates in South Carolina.

Data Adjustments

The Quality Assurance Handbook does not recommend adjustments of monitoring data. The handbook states that frequent adjustments or calibrations[4] to monitors should not be necessary and may lead to more data quality uncertainty. Although the handbook allows for automated adjustments to an ozone monitor based on the results of daily zero checks, the handbook does not recommend adjustments to the data after it has been recorded by the monitor (i.e., post-processing of data). However, an OAQPS quality assurance expert stated that a daily zero-check adjustment to data already recorded by the monitor could be acceptable if the data are not adjusted retrospectively. A daily zero-check adjustment to data already recorded by the monitor has essentially the same assessment value as an automated adjustment to the monitor, which is considered reasonable under EPA guidance according to an OAQPS quality assurance expert.

Georgia and South Carolina applied zero-check adjustments to the hourly averages we sampled.[5] The adjustments to the hourly data we sampled resulted in different 8-hour daily maximum averages than would have been calculated without the adjustments. Since the ozone standard is based on an 8-hour average, these adjustments could impact the EPA's design value calculations, which are used to determine compliance with the ozone NAAQS. A manager from OAQPS stated that the EPA would need to review the Georgia and South Carolina adjustments in more detail to determine whether the states' practices meet the intent of the guidance.

From 2012 through June 2015, Georgia applied a manual adjustment to its monitoring data using results of weekly zero checks before reporting the data to the AQS. Georgia stopped the practice in June 2015, based on Region 4's recommendation that the state reconsider the practice.

South Carolina adjusted its ozone data based upon results of daily zero-check procedures. Even if OAQPS was to interpret this adjustment as meeting the intent of its guidance, EPA Region 4 had questioned whether South Carolina's monitors were set up in a manner to provide reliable zero checks. In its 2015 Technical Systems Audit, Region 4 identified that South Carolina's ozone monitors were not configured according to manufacturer's operating instructions to provide zero ozone concentrations for use during zero checks. However, Region 4 was not aware that South Carolina was using daily zero checks to adjust data. The Quality Assurance Handbook states that air monitors should be assembled and set up according to instructions in the manufacturer's manual to generate quality data.

[4] The EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II*, May 2013, defines calibration as "…the comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by **adjustment**." Therefore, zero checks, and any subsequent adjustments made in response to a zero check, meet the definition of calibration.

[5] Not all adjusted ozone measurements were different than the unadjusted measurement data, because some zero checks resulted in an "adjustment" of less than 1 ppb, or 0 ppb.

South Carolina disagreed with Region 4's finding and a recommendation to reconfigure the monitors. South Carolina continues to adjust all of its hourly ozone data based upon daily zero checks.

Data Validations

Georgia and South Carolina were not implementing critical criteria as recommended in Appendix D of the Quality Assurance Handbook. In Appendix D, the EPA provides measurement quality objectives and validation criteria for each criteria pollutant, including critical validation criteria. According to the EPA, critical criteria are vital for ensuring the integrity of the data. The handbook provides acceptance criteria for each of the three critical quality control checks for ozone monitoring (zero, one-point quality control, and span). The handbook also states that observations that do not meet each and every critical criterion should be invalidated, unless there are compelling justifications for not doing so.

Georgia applies the three quality control checks recommended in Appendix D of the Quality Assurance Handbook to validate the state's data, but uses acceptance criteria for the three checks that were less stringent than recommended by the EPA. Staff at Georgia's air-monitoring agency stated that they interpreted language in a prior section of the handbook to allow for zero and span drift acceptance levels beyond what is recommended in the critical criteria table provided in Appendix D of the handbook.

South Carolina does not use zero checks to validate ozone data. South Carolina applies the one-point quality control check to validate ozone data, but its acceptance criteria for this check is less stringent than the EPA's recommended critical criteria. South Carolina also conducts span checks, but averages the result with the result of the one-point quality control check to validate the state's ozone data. Region 4 noted in its 2015 Technical Systems Audit of South Carolina that the state's ozone validation criteria did not conform to the Quality Assurance Handbook. However, South Carolina continues to use critical criteria for data validation that are less stringent than the EPA's recommended critical criteria.

Variation in the use of acceptance criteria and critical quality control checks by monitoring agencies to validate data reported to the EPA can impact the integrity of the data used to make decisions regarding compliance with NAAQS.

Risk That Other Air-Monitoring Agencies Are Not Following EPA-Recommended Practices

During our review, we found data indicating a risk that other monitoring agencies are not implementing EPA-recommended data processing practices. We found differences between data reported to the AQS and real-time data reported to AirNow and identified QAPPs, which had not been approved since the 2013 version of the Quality Assurance Handbook.

Based on our analysis, about 26 percent of the AQS hourly ozone data differed from the corresponding real-time data reported in AirNow. There are a number of reasons for such differences. For example, monitoring agencies can find certain data reported in real time to AirNow to be invalid and, therefore, not report the data to the AQS. Further, monitoring agencies could apply different conventions for rounding or truncating raw data before reporting to either database. However, because we confirmed that at least some of these differences were due to data adjustment practices, there is a risk that other monitoring agencies may have made adjustments to the raw monitoring data before they were reported to the AQS. These adjustments can impact the EPA's ability to assess data quality, and determine whether the data are sufficient and comparable for making designation decisions.

Air-monitoring agencies develop QAPPs that should identify their quality control procedures and data-validation criteria. The EPA's critical criteria for zero checks changed significantly in 2013. Thus, there is a risk that QAPPs that have not been approved in the last 5 years have not been updated to include the EPA's revised criteria. Based on data in the AQS, about 38 percent of monitoring agencies do not have ozone monitoring QAPPs that have been approved within the last 5 years.

Agency Actions Prompted by OIG Work

In November 2016, OAQPS began conducting a review of hourly ozone data in AirNow and the AQS from 2012–2015, to determine the risk of any data adjustments potentially impacting data that could be used in the EPA's upcoming designation determinations. Preliminary results from the OAQPS analysis identified some differences between data in the AQS and AirNow for monitoring locations in some states. OAQPS intends to expand its analysis to look at design values and potential impacts on designation determinations. OAQPS is also in the process of polling its regional offices to develop a list of monitoring agencies that perform zero adjustments to ozone-monitoring data.

Conclusion

Ozone data in Georgia and South Carolina were not always processed according to EPA-recommended practices, and there is a risk that other monitoring agencies do not always process data in accordance with EPA-recommended practices. As a result, ozone data that the EPA plans to use in determining whether ozone levels present a health risk to the public (i.e., designation decisions) could have been processed in a manner that does not achieve the data quality expected by the EPA, or in a manner that was not comparable across different monitoring agencies. Designation determinations can have significant implications for public health and an area's economy. It is important that the EPA has assurance that its designation decisions are based on data that has been processed using comparable

quality control procedures that meet the criteria in the Quality Assurance Handbook.

Pending completion of our ongoing work, we are making no recommendations. We are alerting the EPA to a potential risk in the use of ozone data for its 2017 designation process, so that the agency can take appropriate steps to further assess and mitigate risks. Based on the discussion of our initial results with the EPA, the agency has started to take actions to assess the risk that any ozone data adjustments could pose to the designation process.

Appendix A

Distribution

The Administrator
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Agency Follow-Up Official (the CFO)
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