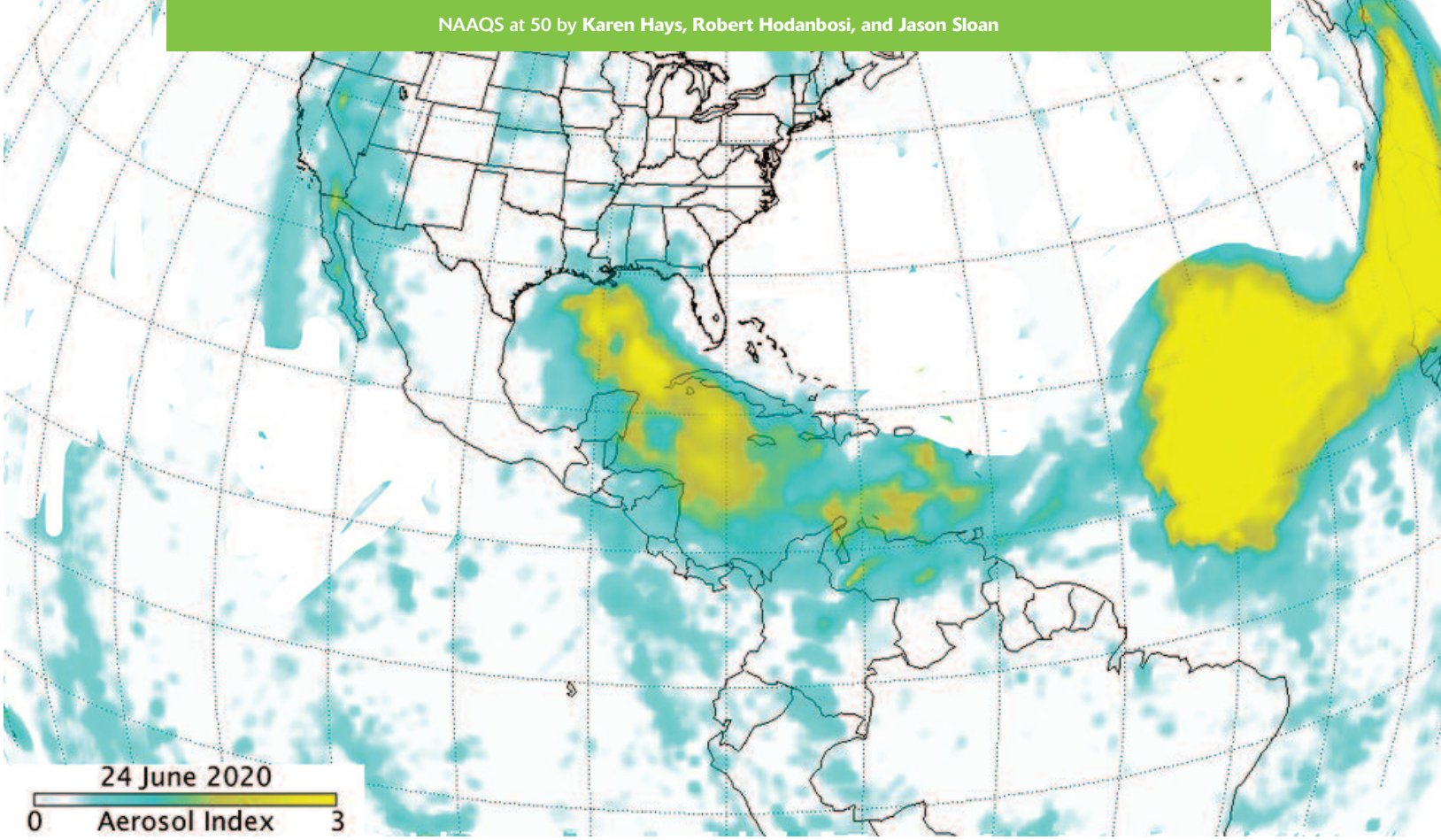

Saharan Dust Plume.
Source: National Aeronautics and Space Administration (NASA) Earth Observatory: "A Dust Plume to Remember," June 27, 2020; https://earthobservatory.nasa.gov/images/146913/a-dust-plume-to-remember.

The National Ambient Air Quality Standards at *50*

by Karen Hays, Robert Hodanbosi, and Jason Sloan

Recognizing the air quality improvements made under the U.S. National Ambient Air Quality Standards program over the past 50 years.

This year is the 50th anniversary of the U.S. Environmental Protection Agency (EPA), which is officially marked by the swearing in of William Ruckelshaus on December 2, 1970, as the agency's first administrator. Also passing the 50-year mark in 2020 is the U.S. National Ambient Air Quality Standards (NAAQS) program, established under the U.S. Clean Air Act Amendments of 1970. These half-century milestones provide an opportunity to reflect on environmental achievements accomplished due to cooperation between EPA and state, local, and tribal entities, as well as the regulated community. As a recent report from the Association of Air Pollution Control Agencies (AAPCA) highlights, the air quality improvements made under the NAAQS program exemplify the environmental progress made in the past 50 years and underscores the primacy role of state and local leadership under the Clean Air Act.[1]

The U.S. NAAQS program protects public health by establishing standards for six criteria air pollutants—carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), ground-level ozone (O_3), lead (Pb), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)—which are to be reviewed every five years.[2] State and local environmental agencies with delegated permitting, planning, enforcement, and regulatory authority work in coordination with EPA to develop state implementation plans (SIPs) to meet and maintain NAAQS while accommodating their own unique social, geographic, and economic factors. Public transparency for air quality progress is critical, and important information about long-term air quality and criteria pollutant trends are available through several reports and data analyses from EPA, including:

- An analysis (https://www.epa.gov/air-trends) of the ambient air pollution data provided to the national air quality system from thousands of monitors across the United States, collected by EPA, state, local, and tribal air pollution control agencies;
- Air Pollutant Emissions Trends Data (https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data) that provide nationwide estimates of emissions of criteria air pollutants based on the National Emissions Inventory (NEI);[3] and
- Design values (https://www.epa.gov/air-trends/air-quality-design-values), defined by EPA as "a statistic that describes the air quality status of a given location relative to the level of the NAAQS … typically used to designate and classify nonattainment areas, as well as to assess progress toward meeting the NAAQS."[4]

In May of this year, AAPCA published the 2020 edition of *State Air Trends & Successes: The StATS Report*, which lists key metrics and trends for the NAAQS program, as well as toxic air releases, visibility information for national parks and wilderness areas, greenhouse gases, and social and economic indicators that may impact air quality.[5] *The StATS Report* is published annually using data from EPA and other federal agencies, and includes trends for AAPCA's state members, as well as at the national level. The AAPCA 2020 report illustrates marked and improving national trends for the emissions and ambient concentrations of the six criteria air pollutants.

The success of the Clean Air Act in improving air quality has been cited regularly in reports and articles. A 2017 article, "The Clean Air Act: Substantial Success and the Challenges Ahead," in the *Annals of the American Thoracic Society* notes that, "Actions to control emissions from vehicles, factories, electric power plants, and more have reduced emissions of the most prominent pollutants […] by 73%, even while the U.S. gross domestic product has grown by more than 250%."[6] These actions include complex air pollution control efforts and technologies, such as scrubbers installed at power plants burning fossil fuels, which can remove more than 90% of SO_2 from emissions and also reduce emissions of other pollutants.[7] These emissions reductions contribute

Table 1. Percent change in ambient air pollution levels.

Pollutant	1980 vs 2019 (% change)	1990 vs 2019 (% change)	2000 vs 2019 (% change)	2010 vs 2019 (% change)
Carbon Monoxide (CO)	-85	-78	-65	-23
Lead (Pb)	-98	-98	-93	-85
Nitrogen Dioxide (NO_2; annual)	-65	-59	-51	-25
Nitrogen Dioxide (NO_2; 1-hr)	-62	-51	-36	-17
Ozone (O_3; 8-hr)	-35	-25	-21	-10
Coarse Particulate Matter (PM_{10}; 24-hr)	---	-46	-46	-17
Fine Particulate Matter ($PM_{2.5}$; annual)	---	---	-43	-23
Fine Particulate Matter ($PM_{2.5}$; 24-hr	---	---	-44	-21
Sulfur Dioxide (SO_2; 1-hr)	-92	-90	-82	-71

Table 2. Percent change in criteria pollutant and precursor emissions.

Pollutant	1980 vs 2019 (% change)	1990 vs 2019 (% change)	2000 vs 2019 (% change)	2010 vs 2019 (% change)
Carbon Monoxide (CO)	-75	-69	-56	-27
Lead (Pb)	-99	-87	-76	-30
Nitrogen Oxide (NO_X)	-68	-65	-61	-41
Volatile Organic Compounds (VOCs)	-59	-47	-27	-18
Direct Coarse Particulate Matter (PM_{10})	-63	-30	-27	-17
Direct Fine Particulate Matter ($PM_{2.5}$)	---	-36	-43	-20
Sulfur Dioxide (SO_2)	-92	-91	-88	-73

significantly to improved ambient pollution levels, though "complex chemical reactions result in [pollutants] not being a direct one to one relationship in reduced emissions and corresponding reduction in the particular air pollutant."[8]

Ambient Air Quality Trends

EPA's national-level analysis of 2019 monitoring data shows substantial reductions in the ambient concentrations of all criteria pollutants over the past several decades, resulting in improved air quality.[9] Compared to 1980, data for 2019 show at least a 35% decline in the ambient levels of CO, Pb, NO_2, O_3, and SO_2. Fine and coarse particulate matter ($PM_{2.5}$ and PM_{10}) levels have declined more than 40% since 2000. Further, more recent data point to a sustained trend of meaningful improvements, with monitored concentrations of all criteria pollutants down at least 10% from 2010 to 2019 (see Table 1).

Emissions Trends

When evaluating the emissions trends for criteria pollutants and criteria pollutant precursors, similar progress can be seen. Published in June of this year, EPA's 2020 air trends report, *Our Nation's Air – EPA Celebrates 50 Years!*, details the nation's substantial air quality progress through 2019, highlighted by a 77% reduction in the combined emissions of criteria pollutants and precursors since 1970.[10]

In coordination with state and local air agencies, EPA develops nationwide estimates of emissions annually for the NEI, which are "based on actual monitored readings or engineering calculations of the amounts and types of pollutants emitted by vehicles, factories, and other sources."[11] These data provide the basis for several analyses and reports, including EPA's yearly air trends report. As Table 2 shows, criteria pollutant and

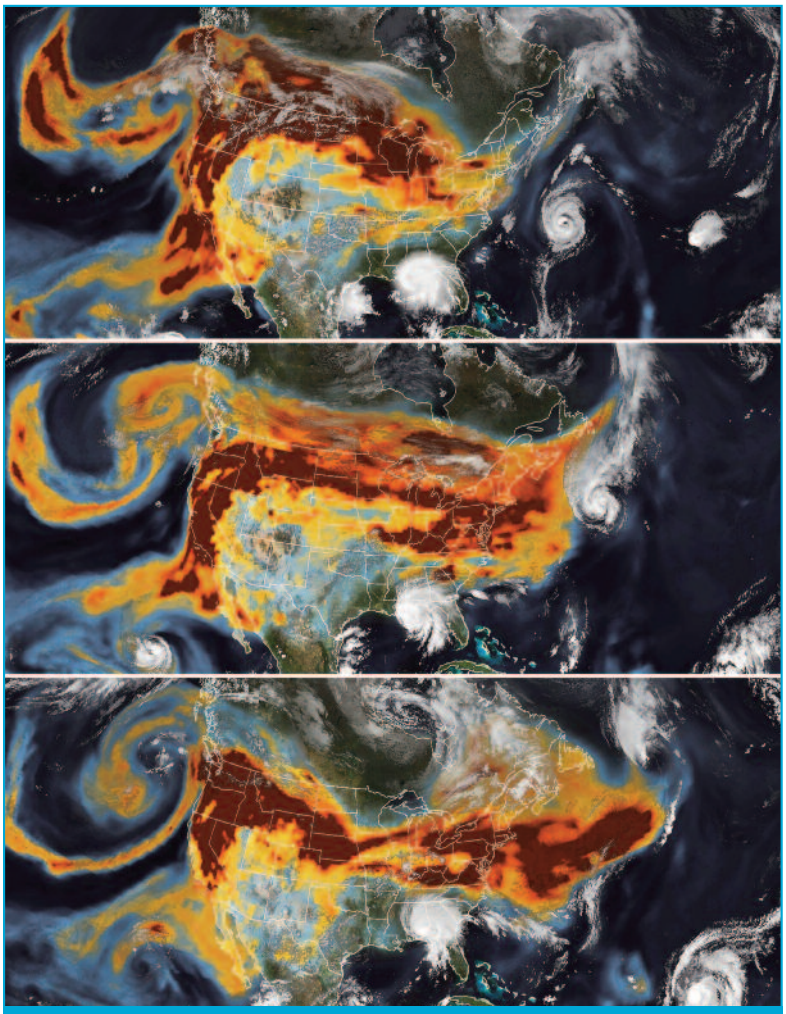

Figure 1. Wildfire Impacts.
Sources: National Aeronautics and Space Administration (NASA) Earth Observatory: "A Meeting of Smoke and Storms," September 19, 2020; https://earthobservatory.nasa.gov/images/147293/a-meeting-of-smoke-and-storms?src=eoa-iotd.

precursor emissions have declined substantially, with at least a 27% reduction in all emissions from 2000 to 2019.

Social and Economic Contexts

Emissions reductions and corresponding air quality improvements are the result of planning efforts undertaken by state and local air pollution control agencies in coordination with EPA, regulated industry, and other stakeholders. To better situate these remarkable improvements, both EPA's and AAPCA's 2020 reports track social and economic indicators that have the potential to impact air quality. Since EPA's inception, and the passage of the CAA amendments (and the first Earth Day) in 1970, the United States has experienced the following growth:

- An increase in Gross Domestic Product (GDP) of 285%, totaling US$21.43 trillion in 2019;[12]
- A 60% increase in population, from 203 million people in 1970 to an estimated 330 million today;[13]
- Energy consumption grew 48%, from 67.7 thousand trillion British thermal units (Btu) in 1970 to 97.6 thousand trillion Btu in 2018;[14] and
- Vehicle miles traveled were up 195%, from approximately 1.1 trillion miles in 1970 to nearly 3.26 trillion miles in 2018.[15]

Importantly, the trendlines for these social and economic indicators are not only very different from the air quality trends that characterize the NAAQS program, but they also reflect the vital work of state and local agencies as on-the-ground experts well-positioned to understand, and respond to, localized issues that may impact air quality.

Air Quality Success in the 21st Century

Earlier this year, with the NAAQS program entering a sixth decade as the cornerstone of the CAA, EPA proposed to retain the standards for ozone and PM. These proposals follow the CAA-stipulated periodic review of NAAQS to ensure the protection of public health and welfare. As EPA continues to evaluate these standards, state and local air agencies continue to improve air quality in their jurisdictions, using regulatory and planning tools to bring areas of the country that are not yet attaining a standard into attainment.

These strategies are not without challenges, some of which may be outside of the control of federal, state, and local entities. Wildfires, for example, can have widespread impacts, with smoke that can increase PM and ozone levels for numerous states (see Figure 1). 2020 provides two specific and countervailing examples, with stay-at-home orders in the first half of the year reducing air pollution levels due to reduced motor vehicle traffic and a Saharan dust cloud crossing the Atlantic Ocean in mid-June and resulting in increased particulate matter levels for at least 15 states (see satellite image on first page). An increase in air pollution outside of agency control may activate "exceptional events" provisions of the CAA for regulatory purposes, but air agencies must still communicate with an impacted public with accurate, up-to-date information.

In some instances, technological innovations have helped bridge the gap that may exist between agency expertise and public understanding. More sophisticated monitoring and modeling technology give a better understanding of air quality, while social media platforms and online dashboards provide at-the-ready communication tools. Other innovations,

such as personal air sensors, continue to improve and may serve as future tools for evaluating air quality.

EPA's *FY 2018 – 2022 Strategic Plan* states that, "The idea that environmental protection is a shared responsibility between the states, tribes, and the federal government is embedded in our environmental laws, which in many cases provide states and tribes the opportunity and responsibility for implementing environmental protection programs."[16]

While today's air pollution control agencies are more technologically equipped and better informed than in 1970, the CAA's framework of cooperative federalism remains vital entering the third decade of this century. As the 2020 edition of *The StATS Report* spotlights, state and local agencies not only develop plans for maintaining and improving air quality across the United States, but also serve as critical checkpoints for emergent issues, like the impacts of wildfires, or increased citizen concerns about local air toxics issues. These agencies also often generate and share best practices for public education, tracking air quality progress, and SIP development.[17] The collaborative efforts of federal, state, tribal, and local agencies that characterize the past 50 years of environmental protection have proven foundational to achieving success under the CAA—and remain vital to air quality efforts in the 21st century.

More information on EPA's 50th anniversary is available online at https://www.epa.gov/50. em

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AAPCA is a national, non-profit, consensus-driven organization focused on assisting state and local air quality agencies and personnel with implementation and technical issues associated with the U.S. Clean Air Act. AAPCA represents nearly 50 state and local air agencies, and senior officials from 23 state environmental agencies currently sit on the AAPCA Board of Directors. AAPCA is housed in Lexington, Kentucky as an affiliate of The Council of State Governments.

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