Atypical Events Analysis and Application Using 2023 and 2024 Monitoring Data

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Issue Discussion

Interstate transport, State Implementation Plan (SIP) modeling, Prevention of Significant Deterioration (PSD) permitting, and regional haze calculations of baseline, current, and natural visibility conditions, uniform rate of progress, and determination of reasonable progress goal analyses involving ozone and particulate matter depend on the assumption that observed pollutant concentrations primarily reflect regional emissions and atmospheric transport rather than episodic, non-representative disturbances. Wildfire smoke fundamentally violates this assumption. Smoke introduces large, spatially extensive, and chemically complex perturbations that act as statistical noise when the objective is to isolate transport driven by anthropogenic sources. Without explicitly filtering out this noise, these analyses become unreliable and potentially misleading.

Wildfire and prescribed fire smoke affect both PM and ozone through multiple, competing mechanisms. It directly elevates PM concentrations through primary emissions while simultaneously altering ozone via the release of precursors and through radiative effects that can either enhance or suppress photochemical production. These competing processes create highly nonlinear and location-specific responses that are not governed by the same dynamics as routine interstate transport of pollutants and pollutant precursors. As a result, smoke-impacted observations do not represent background conditions but instead reflect exceptional atmospheric chemistry. Including them in certain modeling analyses confounds source attribution because elevated concentrations may be incorrectly interpreted as evidence of upwind anthropogenic influence rather than episodic fire intrusion.

Recent research[1] demonstrates that when statistical models are trained using only non-smoke conditions, they reproduce ozone behavior with substantially higher consistency than when smoke-affected days are included. Smoke days exhibit systematic residuals relative to the non-smoke baseline, indicating that wildfire influence constitutes a distinct signal rather than part of normal variability. This distinction is critical for photochemical transport modeling, which relies on separating routine transported pollution from locally generated or anomalous contributions. If fire smoke is not filtered, the residual structure of the data no longer reflects transport processes alone but instead embeds an uncontrolled external forcing.

Spatial scale further amplifies this problem. Wildfire plumes can traverse thousands of kilometers, simultaneously affecting multiple states. In an interstate transport framework, for example, such widespread enhancements could be misattributed to coordinated emissions from upwind jurisdictions. This creates a false appearance of persistent transport patterns when the signal is driven by transient natural events. Because smoke frequency and intensity vary markedly in space and time, their inclusion introduces artificial trends and gradients that bias regulatory conclusions about cross-state responsibility.

Furthermore, transport analyses assume quasi-stationary relationships between meteorology and pollutant concentrations. Wildfire smoke disrupts these relationships by modifying radiation, boundary-layer structure, and cloud properties. These feedbacks violate the assumptions underlying most transport models and statistical attribution methods. The publication shows that even sophisticated modeling frameworks require separate treatment of smoke and non-smoke conditions to maintain predictive skill. This implies that unfiltered datasets cannot satisfy the methodological requirements of robust interstate transport assessment.

[1] https://doi.org/10.1029/2025JD044088

From a policy perspective, failing to remove wildfire attributed concentrations risks penalizing upwind states for pollution that is neither controllable nor representative of their emissions. It also obscures genuine transport signals by overwhelming them with episodic extremes. Filtering smoke-affected data does not discard meaningful information; rather, it restores analytical clarity by isolating the regime in which interstate transport processes operate consistently.

The evidence indicates that wildfire smoke constitutes a dominant, structurally different source of variability in ozone and PM observations. Interstate transport analyses conducted without first filtering this noise conflate natural episodic disturbances with anthropogenic transport, undermining both scientific interpretation and regulatory fairness. Effective transport assessment therefore requires explicit separation of smoke-impacted conditions before meaningful conclusions about interstate pollution linkages can be drawn.

Project Objective

The objective of this project was to develop technical supporting materials with ozone-enhancing 2023 and 2024 atypical events data at monitors within the continental United States in using a multi-phase, multi-geographic approach. While the primary focus of the work was related to atypical event identification and application, similar procedures and processes could be applied to exceptional event date determination and demonstration preparation.

In an EPA memorandum[2] dated April 4, 2019, from EPA Air Quality Assessment Division Director Richard Wayland to the Regional Air Division Directors, EPA acknowledges that some determinations and analyses rely on ambient air quality monitoring data yet fall outside the scope of the Exceptional Events Rule (i.e., they are not included in the list of covered regulatory actions therein). These determinations may also be affected by atypical, extreme, or unrepresentative events. This memorandum identifies the most common determinations and analyses not covered by the Exceptional Events Rule and clarifies, for each, whether a separate existing mechanism—other than the Exceptional Events Rule—may be used to appropriately exclude, select, or adjust air quality monitoring data.

Specifically, in the memorandum, monitoring data exclusion, selection, or adjustment may be considered for the following types of determinations and analyses:

1. Certain Modeling Analyses under EPA's Guideline on Air Quality Models ("Guideline"; see 40 CFR Part 51, Appendix W)
    a. Preparing required air quality analyses for demonstrating compliance under PSD permitting program.
    b. Estimating base and future year design values (DVs) for ozone and PM2.5 SIP attainment demonstrations.
    c. Determining whether a SIP satisfies CAA section 110(a)(2)(D)(i)(I) regarding interstate transport.
    d. Preparing any required particulate matter "hot-spot" analysis for a transportation conformity determination for certain projects under 40 CFR Part 93 and relevant guidance.
2. Selecting data for tracking visibility on the 20 percent clearest and 20 percent most (anthropogenically) impaired days, as required by EPA's Regional Haze Rule. In particular, this

[2] https://www.epa.gov/sites/default/files/2019-04/documents/clarification_memo_on_data_modification_methods.pdf

pertains to calculations of baseline, current, and natural visibility conditions; progress to date; the uniform rate of progress; and determination of reasonable progress goals (RPGs).

3. Conducting analyses in support of a NAAQS Limited Maintenance Plan (LMP) SIP submission and implementation.

Of these types of determinations and analyses, the proposed focus is on 1.b. (base and future year design values) and 1.c. (determining whether a SIP satisfies CAA section 110(a)(2)(D)(i)(I) regarding interstate transport).

Technical Application

Using tools and data already publicly available, monitor-dates in selected regions were identified where indication of smoke impact on ozone concentrations is present. The focus was on the exclusion of atypical concentrations from modeling, believing that atypical events data should be excluded from the calculations of design values, projected design values, and associated transport linkages and significant contribution calculations. The intention being to demonstrate that these atypical events impact the modeling design values which are the basis of these regulatory calculations and that exclusion of these monitor-dates could alter the governing circumstances of these monitors and the states in which they are located.

Monitor-dates selected within analyzed states could be expanded to other monitors in the region which may have also been impacted by the smoke enhancements on those days. Instead of only focusing on monitors which demonstrate a "nonattainment to attainment" change consistent with many exceptional events demonstrations, the calculations were expanded to monitors already below the level of the NAAQS and to those where exclusion of the dates still results in nonattainment. Since the objective was to exclude monitoring data from multiple modeling applications, there is not a constraint to the binary threshold of attainment/nonattainment of the NAAQS.

This analysis did not go so far as to generate complete packages of many of the data requirements that would be consistent with Tier 1 and Tier 2 supporting information in the development of an exceptional events demonstration and therefore does not result in actual changes to the design values in AQS. Instead, the project was designed to provide the basis for considering these atypical data to directly support regulatory action or at a minimum, prompting more detailed investigation into the use of these data for those purposes.

After identifying atypical monitor dates, these dates were removed from the monitor's highest observational values until a 4th high, non-atypical value was reached. That value was then used to estimate updated 2021-2023 and 2022-2024 ozone design values which could be used in the noted determinations and analyses identified above.

Selected States

The first application of this atypical concentration application occurred across states[3] (excluding California) which have been shown to have projected average or maximum ozone concentrations that exceed the level of the 70 ppb ozone NAAQS[4]. Because the exclusion of atypical dates from monitors in these states would generate lower base year design values in the modeling, it is safe to presume that lower projection year design values and state-to-state transport linkages and significant contribution

[3] Arizona, Colorado, Connecticut, Illinois, New Mexico, Texas, Utah, Washington, and Wisconsin

[4] https://www.epa.gov/system/files/documents/2023-03/AQ%20Modeling%20Final%20Rule%20TSD.pdf

metrics would also follow. Selection of these states and monitors were used as proof of concept for the application of these data in the proposed manner and be used in near term discussions with air quality agencies.

Data Source

All observations of 8-hour averaged ozone and 24-hour PM2.5 concentration data were obtained from the EPA AQS website[5] for calendar years 2020 through 2024.

Atypical Event Identification

A monitor-date was considered atypical if in addition to smoke presence overhead, using National Oceanic and Atmospheric Administration's Hazard Mapping System Fire and Smoke Product (NOAA HMS), any two or more of the following conditions were met on dates in 2023 or 2024:

- Daily observation met or exceeded the 99th percentile of 2020-2024 observations at that monitor,
- Delta in daily observation was equal to or greater than 15 ppb from 5-year monthly average at that monitor,
- Delta in daily observation was equal to or greater than 1.5 times the 5-year standard deviation calculated at that monitor,
- The log normal calculation of the daily observation was equal to or greater than 1.5, or
- The CBSA averaged PM2.5 log normal value was equal to or greater than 1.5

The monitor-specific standardized log-transformed calculations were created by averaging the standardized time series across all monitors within each ozone nonattainment area. Standardization (i.e., normalization) was done using the monthly mean and standard deviation of the log-transformed observed values at each site over the 2020-2024 period. The log normal PM2.5 value was averaged across the monitor's CBSA as not every ozone monitor was co-located with a PM2.5 monitor.

Atypical Days Selected and Used

Once all conditions were calculated and identified at the monitor level[6], an annual accounting of the total number of days within each calendar year was made and an additional count of the actual number of days excluded from the updated 4th high estimate was made. These annual counts are represented in Table 1 below.

[5] https://aqs.epa.gov/aqsweb/airdata/download_files.html

[6] Data file containing monitor-date atypical condition calculations can be found here: https://www.midwestozonegroup.com/_files/ugd/7ec07f_3a88546d6e894f5390329af42f38a7df.xlsx?dn=master_atypical_ozone.xlsx

Table 1. State level count of atypical dates identified and used for calendar years 2023 and 2024.

State	Year	Identified	Used
Arizona	2023	24	13
Arizona	2024	30	12
Colorado	2023	19	14
Colorado	2024	35	23
Connecticut	2023	37	24
Connecticut	2024	41	29
Illinois	2023	96	36
Illinois	2024	74	38
New Mexico	2023	34	27
New Mexico	2024	32	23
Texas	2023	134	100
Texas	2024	122	79
Utah	2023	14	9
Utah	2024	33	24
Washington	2023	30	21
Washington	2024	26	19
Wisconsin	2023	77	42
Wisconsin	2024	42	26

Example Calculation

Using Connecticut as an example, Table 2 below presents the unadjusted and atypical adjusted 4th high values at the monitor level. Table 3 presents the unadjusted and recalculated 3-year ozone design values at those monitors.

Additional Results Presentation

Table 4 through Table 11 present recalculated 3-year DVs for 2021-2023 and 2022-2024 absent atypical event day concentrations for the remaining states in this analysis.

Table 2. Annual 4th high ozone observation (ppb) unadjusted and adjusted for atypical event application in calendar years 2023 and 2024.

					Annual 4th High Ozone Observation (ppb)							
Monitor	**State**	**County**	**Local Name**		**2020**	**2021**	**2022**	**2023**	**2024**		**2023 Atyp**	**2024 Atyp**
090010017	CT	Fairfield	Greenwich Point Park		77	78	77	82	79		65	66
090011123	CT	Fairfield	Western Conn State Univ		67	71	75	75	78		59	62
090013007	CT	Fairfield	Usgs Lighthouse		76	86	81	81	78		68	65
090019003	CT	Fairfield	Sherwood Island Connector		73	86	81	79	82		66	68
090031003	CT	Hartford	Mcauliffe Park		64	66	74	70	74		58	59
090050005	CT	Litchfield	Mohawk Mt-Cornwall		63	68	70	67	72		58	61
090079007	CT	Middlesex	Cvh		69	78	73	75	74		61	59
090090027	CT	New Haven	Criscuolo Park-New Haven		68	71	72	69	77		60	59
090099002	CT	New Haven	Hammonasset State Park		80	83	76	78	74		64	62
090110124	CT	New London	Fort Griswold Park		71	75	71	71	73		60	59
090131001	CT	Tolland	Shenipsit State Forest		63	67	68	70	72		59	59
090159991	CT	Windham	Abington		62	68	64	63	65		56	57

Table 3. 3-year ozone design values (ppb) unadjusted and adjusted for atypical event application at monitors in Connecticut.

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
090010017	Fairfield	Greenwich Point Park	77	79	79		73	69
090011123	Fairfield	Western Conn State Univ	71	73	76		68	65
090013007	Fairfield	Usgs Lighthouse	81	82	80		78	71
090019003	Fairfield	Sherwood Island Connector	80	82	80		77	71
090031003	Hartford	Mcauliffe Park	68	70	72		66	63
090050005	Litchfield	Mohawk Mt-Cornwall	67	68	69		65	63
090079007	Middlesex	Cvh	73	75	74		70	64
090090027	New Haven	Criscuolo Park-New Haven	70	70	72		67	63
090099002	New Haven	Hammonasset State Park	79	79	76		74	67
090110124	New London	Fort Griswold Park	72	72	71		68	63
090131001	Tolland	Shenipsit State Forest	66	68	70		64	62
090159991	Windham	Abington	64	65	64		62	59

Table 4. 3-year ozone design values (ppb) unadjusted and adjusted for atypical event application at monitors in Arizona.

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
040058001	Coconino	Grand Canyon Np - The Abyss	63	63	65		63	65
040070010	Gila	Tonto Nm	76	75	77		73	74
040128000	La Paz	Alamo Lake	65	67	68		67	68
040130019	Maricopa	West Phoenix	77	77	78		75	73
040131003	Maricopa	Mesa	80	80	79		78	74
040131004	Maricopa	North Phoenix	81	78	77		76	73
040131010	Maricopa	Falcon Field	80	79	79		77	75
040132001	Maricopa	Glendale	78	79	80		78	75
040132005	Maricopa	Pinnacle Peak	79	77	77		76	74
040133002	Maricopa	Central Phoenix	75	77	75		74	70
040133003	Maricopa	South Scottsdale	77	74	74		73	71
040134003	Maricopa	South Phoenix	72	73	71		69	67
040134004	Maricopa	West Chandler	73	71	71		70	68
040134005	Maricopa	Tempe	75	77	76		74	71
040134008	Maricopa	Cave Creek	74	73	73		72	70
040134010	Maricopa	Dysart	76	75	77		74	71
040134011	Maricopa	Buckeye	70	69	69		69	67
040137003	Maricopa	St Johns Air Monitoring Site	70	69	71		68	69
040137021	Maricopa	Red Mountain Air Monitoring Station	77	77	79		76	75
040137022	Maricopa	Lehi Air Monitoring Station	78	79	80		77	77
040137024	Maricopa	High School Air Monitoring Station	76	75	76		74	73
040139508	Maricopa	Humboldt Mountain	70	70	73		69	70
040139702	Maricopa	Blue Point-Sheriff Station-Tonto Nf-Salt River Recreation Area	77	76	79		73	74
040139704	Maricopa	Fountain Hills	77	74	75		73	72
040139997	Maricopa	Jlg Supersite	79	80	79		79	78
040190021	Pima	Saguaro Np	69	68	70		68	69
040191011	Pima	22nd & Craycroft	70	69	70		68	68
040191018	Pima	Tangerine	68	67	68		67	66
040191020	Pima	Fairgrounds	68	68	71		67	68
040191028	Pima	Children'S Park Ncore	70	69	70		68	68
040191030	Pima	Green Valley -Replaces Site 0007 245 W Esperanza	66	67	69		67	67

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
040191032	Pima	Rose Elementary	64	64	65		63	64
040191034	Pima	Coachline	67	65	65		65	65
040213001	Pinal	A J Maintenance Yard	74	72	72		72	71
040213003	Pinal	Casa Grande Airport	72	70	70		70	69
040213007	Pinal	Pinal Air Park	69	69	67		68	66
040217001	Pinal	Sacaton Air Monitoring Site	68	69	71		68	68
040218001	Pinal	Queen Valley	76	75	76		73	74
040258034	Yavapai	Prescott Pioneer Park	62	61	65		61	64
040278011	Yuma	Yuma Supersite	68	70	69		70	69

Table 5. 3-year ozone design values (ppb) unadjusted and adjusted for atypical event application at monitors in Colorado.

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
080013001	Adams	Welby	77	74	76		74	72
080050002	Arapahoe	Highland Reservoir	80	77	73		76	71
080050006	Arapahoe	Aurora East	74	73	74		71	69
080077004	Archuleta		64	60	57		60	57
080130014	Boulder	Boulder Reservoir	76	75	75		74	70
080310002	Denver	Denver - Camp	74	72	73		72	70
080310026	Denver	La Casa	77	75	75		75	72
080350004	Douglas	Chatfield State Park	83	81	80		81	77
080410013	El Paso	U.S. Air Force Academy	74	69	70		69	67
080410016	El Paso	Manitou Springs	74	71	73		71	69
080450012	Garfield	Rifle-Health Dept	62	59	59		59	58
080470003	Gilpin	Black Hawk	76	75	74		73	69
080519991	Gunnison	Gothic	65	65	66		64	65
080590006	Jefferson	Rocky Flats-N	83	80	81		79	75
080590011	Jefferson	National Renewable Energy Labs - Nrel	84	80	79		80	75
080590014	Jefferson	Evergreen	67	75	77		74	73
080671004	La Plata	Shamrock Mine	64	64	63		63	63
080677001	La Plata	Ute 1	66	66	67		66	66
080677003	La Plata	Ute 3	66	67	65		67	65
080690007	Larimer	Rocky Mountain Np	72	70	71		70	67
080690011	Larimer	Fort Collins - West	77	76	75		75	71
080691004	Larimer	Fort Collins - Csu - S. Mason	71	71	73		70	68
080770020	Mesa	Palisade-Water Treatment	65	63	63		63	62
080830006	Montezuma	Cortez - Health Dept	63	62	62		62	61
080830101	Montezuma	Mesa Verde Np	66	64	64		64	63
080838001	Montezuma	Towaocumu2	62	61	61		60	60
081030006	Rio Blanco	Rangely, Golf Course	65	67	44		67	66
081230009	Weld	Greeley - Weld County Tower	72	71	73		71	69
081230013	Weld	Platteville Atmospheric Observatory	77	74	61		74	61

Table 6. 3-year ozone design values (ppb) unadjusted and adjusted for atypical event application at monitors in Illinois.

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
170010007	Adams	John Wood Community College	61	65	64		62	60
170190007	Champaign	Thomasboro	65	67	67		64	63
170191001	Champaign	Isws Climate Station	63	68	70		65	66
170230001	Clark	416 S. State St. Hwy 1- West Union	61	66	66		62	61
170310001	Cook	Village Garage	72	74	74		69	68
170310032	Cook	South Water Filtration Plant	75	77	73		72	67
170310076	Cook	Com Ed Maintenance Bldg	70	74	72		70	67
170311003	Cook	Taft Hs	71	70	71		67	65
170311601	Cook	Cook County Trailer	73	74	73		71	68
170313103	Cook	Iepa Trailer	63	67	69		61	60
170314002	Cook	Cook County Trailer	71	71	71		66	65
170314007	Cook	Regional Office Building	70	74	74		69	67
170314201	Cook	Northbrook Water Plant	74	77	75		70	65
170317002	Cook	Water Plant	74	76	76		72	68
170436001	DuPage	Morton Arboretum	70	73	70		69	65
170491001	Effingham	Central Jr High	63	68	69		64	63
170650002	Hamilton	Ten Mile Creek Dnr Office	65	68	66		64	62
170830117	Jersey	Jerseyville Water Treatment Plant (Wtp)	66	73	74		69	67
170859991	Jo Daviess	Stockton	62	66	66		63	61
170890005	Kane	Larsen Junior High	70	74	73		69	68
170971007	Lake	Camp Logan Trailer	74	76	76		72	68
171110001	McHenry	Cary Grove Hs	71	74	73		70	67
171132003	McLean	Isu Harris Physical Plant	67	69	70		66	67
171150013	Macon	Iepa Trailer	64	69	68		65	64
171170002	Macoupin	Iepa Trailer	62	66	66		63	62
171190120	Madison	Alton Horace Mann Elementary School	71	74	74		72	70
171190122	Madison	Village Of Maryville	68	71	70		68	65
171193007	Madison	Water Plant	70	73	72		69	66
171430024	Peoria	Firestation	62	67	66		63	61

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
171431001	Peoria	Peoria Heights Hs	65	69	69		66	65
171570001	Randolph	Iepa Trailer	64	71	70		66	63
171613002	Rock Island	Rock Island Arsenal	63	68	67		65	62
171630010	Saint Clair	Iepa-Raps Trailer	66	70	69		65	63
171670014	Sangamon	Illinois Building State Fairgrounds	62	66	67		62	62
171971011	Will	Com Ed Training Center	65	69	68		66	64
172012001	Winnebago	Maple Elementary School	66	71	71		67	65

Table 7. 3-year ozone design values (ppb) unadjusted and adjusted for atypical event application at monitors in New Mexico.

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
350010023	Bernalillo	Del Norte High School	69	69	71		69	69
350010029	Bernalillo	South Valley	67	66	65		66	65
350011012	Bernalillo	Foothills	73	72	72		72	70
350012022	Bernalillo	San Jose	13	35	60		35	58
350130008	Dona Ana	6o La Union	76	76	76		75	72
350130020	Dona Ana	6zk Chaparral	71	70	70		69	67
350130021	Dona Ana	6zm Desert View	81	79	72		77	69
350130022	Dona Ana	6zn Santa Teresa	75	72	70		71	68
350130023	Dona Ana	6zq Solano	66	67	69		66	65
350150010	Eddy		77	78	80		77	76
350151005	Eddy	5zr On Blm Land Bordering Residential Area Outside Carlsbad City Lim	77	78	79		77	76
350250008	Lea	5zs Hobbs Jefferson	66	71	72		69	69
350390026	Rio Arriba	3crd Coyote Ranger District	64	63	63		63	63
350431001	Sandoval		70	67	68		67	67
350450009	San Juan	1zb Bloomfield	64	65	67		65	65
350450018	San Juan		70	70	68		69	66
350450020	San Juan	Chaco Culture Nhp - Radio Repeater	68	67	66		67	65
350451005	San Juan	1h Substation	67	67	67		67	66
350490021	Santa Fe		67	65	66		65	65
350610008	Valencia		66	63	65		63	63

Table 8. 3-year ozone design values (ppb) unadjusted and adjusted for atypical event application at monitors in Texas.

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
480271045	Bell	Temple Georgia	66	70	68		65	62
480271047	Bell	Killeen Skylark Field	67	71	72		67	65
480290032	Bexar	San Antonio Northwest	71	73	75		69	66
480290052	Bexar	Camp Bullis	75	76	74		72	67
480290059	Bexar	Calaveras Lake	67	69	70		66	64
480391004	Brazoria	Manvel Croix Park	73	77	75		71	66
480391016	Brazoria	Lake Jackson	67	70	70		65	63
480430101	Brewster	Big Bend Np	61	63	65		62	63
480611023	Cameron	Harlingen Teege	55	57	57		54	54
480850005	Collin	Frisco	74	78	79		73	69
481130069	Dallas	Dallas Hinton	67	72	73		66	63
481130075	Dallas	Dallas North #2	71	75	77		69	67
481130087	Dallas	Dallas Redbird Airport Executive	71	75	78		71	70
481210034	Denton	Denton Airport South	76	79	80		76	72
481211032	Denton	Pilot Point	77	81	80		78	73
481391044	Ellis	Italy	63	66	67		63	62
481410029	El Paso	Ivanhoe	65	64	64		63	63
481410044	El Paso	El Paso Chamizal	69	68	70		67	66
481410055	El Paso	Ascarate Park Se	64	64	70		61	65
481410057	El Paso	Socorro Hueco	73	70	72		70	70
481410058	El Paso	Skyline Park	70	69	72		68	68
481411021	El Paso	Ojo De Agua	50	74	76		72	73
481671034	Galveston	Galveston 99th Street	70	74	77		68	67
481830001	Gregg	Longview	61	65	66		63	61
482010024	Harris	Houston Aldine	69	72	79		67	65
482010026	Harris	Channelview	64	72	74		64	62
482010029	Harris	Northwest Harris County	71	74	78		69	68
482010046	Harris	Houston North Wayside	62	67	76		62	61
482010047	Harris	Lang	70	75	79		68	67

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
482010051	Harris	Houston Croquet	73	78	76		72	66
482010055	Harris	Houston Bayland Park	78	83	84		77	75
482010062	Harris	Houston Monroe	63	68	68		61	58
482010066	Harris	Houston Westhollow	70	73	76		69	66
482010416	Harris	Park Place	73	78	79		71	67
482010417	Harris	Houston Harvard Street	52	78	82		75	73
482011015	Harris	Lynchburg Ferry	63	70	74		63	63
482011017	Harris	Baytown Garth	69	75	77		69	66
482011034	Harris	Houston East	72	79	82		71	68
482011035	Harris	Clinton	72	76	80		70	69
482011039	Harris	Houston Deer Park #2	71	75	78		68	67
482011050	Harris	Seabrook Friendship Park	61	64	70		59	61
482030002	Harrison	Karnack	60	63	64		60	58
482150043	Hidalgo	Mission	60	58	55		58	54
482210001	Hood	Granbury	69	75	78		70	70
482311006	Hunt	Greenville	63	66	67		62	60
482450009	Jefferson	Beaumont Downtown	63	64	65		61	59
482450011	Jefferson	Port Arthur West	60	62	61		60	56
482450022	Jefferson	Hamshire	62	64	65		61	59
482450101	Jefferson	Setrpc 40 Sabine Pass	61	63	66		59	61
482450102	Jefferson	Setrpc 43 Jefferson Co Airport	63	65	66		62	59
482451035	Jefferson	Nederland 17th Street	61	66	69		62	61
482510003	Johnson	Cleburne Airport	74	77	77		74	71
482570005	Kaufman	Kaufman	66	67	70		64	65
483091037	McLennan	Waco Mazanec	64	68	69		64	63
483390078	Montgomery	Conroe Relocated	72	71	75		69	69
483491051	Navarro	Corsicana Airport	65	65	67		65	64
483550025	Nueces	Corpus Christi West	62	63	63		60	59
483550026	Nueces	Corpus Christi Tuloso	61	62	61		58	57
483611001	Orange	West Orange	61	63	65		60	57
483670081	Parker	Parker County	70	73	75		68	67

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
483739991	Polk	Alabama-Coushatta	57	59	60		56	57
483819991	Randall	Palo Duro	67	69	69		68	67
483970001	Rockwall	Rockwall Heath	63	64	64		60	58
484230007	Smith	Tyler Airport Relocated	65	69	69		66	65
484390075	Tarrant	Eagle Mountain Lake	76	78	82		74	71
484391002	Tarrant	Fort Worth Northwest	77	80	83		74	72
484392003	Tarrant	Keller	72	75	80		71	69
484393009	Tarrant	Grapevine Fairway	76	79	81		73	72
484393011	Tarrant	Arlington Municipal Airport	72	74	77		70	67
484530014	Travis	Austin North Hills Drive	61	71	72		67	67
484530020	Travis	Austin Audubon Society	64	67	68		63	61
484690003	Victoria	Victoria	60	60	62		58	60
484790016	Webb	Laredo College	54	57	60		54	55

Table 9. 3-year ozone design values (ppb) unadjusted and adjusted for atypical event application at monitors in Utah.

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
490037001	Box Elder	Washakie	66	63	61		63	61
490050007	Cache	Smithfield	66	66	66		66	64
490071003	Carbon	Price #2	66	63	62		63	60
490110004	Davis	Bountiful Viewmont	79	76	75		76	74
490130002	Duchesne	Roosevelt	67	77	76		77	74
490137011	Duchesne	Station Located Near Intersection Of 6000 So & 10000 West	66	76	76		76	75
490210005	Iron	Enoch	62	62	61		62	61
490352005	Salt Lake	Copper View	78	77	75		77	73
490353006	Salt Lake	Hawthorne	76	75	73		74	71
490353010	Salt Lake	Rose Park	78	74	74		74	72
490353013	Salt Lake	Herriman #3	77	75	69		75	68
490353014	Salt Lake	Lake Park	72	75	74		74	72
490353015	Salt Lake	Utah Technical Center	76	73	71		72	69
490353016	Salt Lake	Inland Port	53	77	74		76	71
490354002	Salt Lake	Near Road	75	77	74		76	73
490370101	San Juan	Canyonlands Np	66	65	65		64	64
490450004	Tooele	Erda	71	71	70		70	68
490471002	Uintah	Dinosaur Nm - West Entrance Housing	64	76	76		76	75
490471004	Uintah	Vernal #4	64	69	69		69	68
490472002	Uintah		66	71	69		71	68
490472003	Uintah		67	75	70		75	70
490477022	Uintah	Station Near Intersection Of Whiterock Canyon Rd & Quray Canal	65	72	73		72	72
490494001	Utah	Lindon	73	72	71		72	69
490495010	Utah	Spanish Fork	70	69	67		68	66
490530007	Washington	Hurricane	65	64	64		64	63
490530130	Washington	Zion Canyon	66	65	65		65	64
490571003	Weber	Harrisville	74	72	71		72	69

Table 10. 3-year ozone design values (ppb) unadjusted and adjusted for atypical event application at monitors in Washington.

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
530050003	Benton	Kennewick_S Clodfelter Rd	64	66	66		64	60
530090013	Clallam	Cheeka Peak	52	52	49		52	49
530110011	Clark	Vancouver - Blairmont Dr	55	58	60		56	57
530139991	Columbia	Confederated Tribes Of The Umatilla Indian Reservation	50	58	59		57	55
530330010	King	Issaquah - Lake Sammamish (Wiithin Lake Sammamish State Park)	41	40	60		37	57
530330017	King	North Bend - North Bend Way	57	62	63		57	56
530330023	King	Enumclaw - Mud Mtn (Army Corp Of Engineers Site)	70	73	71		70	64
530330080	King	Seattle - Beacon Hill	50	49	48		48	47
530530012	Pierce	Mt Rainier - Jackson Visitiors Center	59	58	58		57	56
530570011	Skagit	Anacortes-202 Ave	48	48	47		47	47
530630001	Spokane	Cheney - Turnbull	59	61	58		60	57
530630046	Spokane	Spokane - Greenbluff	61	64	63		64	61
530670013	Thurston	Lacey - College St	18	36	54		35	52
530730005	Whatcom	Custer - Loomis	50	51	51		48	46

Table 11. 3-year ozone design values (ppb) unadjusted and adjusted for atypical event application at monitors in Wisconsin.

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
550030010	Ashland	Bad River Tribal School - Odanah	57	60	57		57	54
550090026	Brown	Green Bay - Uw	64	67	67		62	59
550210015	Columbia	Columbus	66	69	68		62	60
550250041	Dane	Madison East	65	69	68		64	62
550270001	Dodge	Horicon Wildlife Area	66	70	68		66	63
550290004	Door	Newport Park	73	72	71		70	66
550350014	Eau Claire	Eau Claire - Dot Sign Shop	62	66	63		62	58
550390006	Fond du Lac	Fond Du Lac	64	66	65		63	61
550410007	Forest	Potawatomi	59	63	63		58	57
550550009	Jefferson	Jefferson - Laatsch	66	69	69		66	63
550590019	Kenosha	Chiwaukee Prairie Stateline	75	77	78		73	69
550590025	Kenosha	Kenosha - Water Tower	73	74	74		70	67
550610002	Kewaunee	Kewaunee	67	71	71		68	65
550630012	La Crosse	Lacrosse - Dot Building	59	64	63		59	58
550710007	Manitowoc	Manitowoc - Wdlnd Dunes	73	73	73		70	67
550730012	Marathon	Lake Dubay	57	64	63		58	57
550790010	Milwaukee	Milwaukee - Sixteenth St. Health Center	63	66	64		63	59
550790068	Milwaukee	Milwaukee - Uwm Upark	72	72	70		69	66
550790085	Milwaukee	Bayside	73	74	74		71	68
550870009	Outagamie	Appleton - Aal	64	66	65		62	60
550890008	Ozaukee	Grafton	72	73	74		70	67
550890009	Ozaukee	Harrington Beach Park	71	73	74		70	66
551010020	Racine	Racine - Payne And Dolan	75	74	74		72	68
551050030	Rock	Beloit - Converse	67	71	70		65	62
551110007	Sauk	Devils Lake Park	63	67	65		62	60
551170006	Sheboygan	Sheboygan - Kohler Andrae	75	77	78		73	69
551170009	Sheboygan	Sheboygan - Haven	69	70	70		67	65
551199991	Taylor	Perkinstown	59	64	63		59	56
551250001	Vilas	Trout Lake	58	63	62		57	56

			3-Year Ozone Design Value (ppb)					
Monitor	**County**	**Local Name**	**2020-2022**	**2021-2023**	**2022-2024**		**2021-2023 Atyp**	**2022-2024 Atyp**
551270006	Walworth		71	73	72		69	67
551330027	Waukesha	Waukesha - Cleveland Ave	68	73	71		69	65

Future Applications

From these data, future-year base case design values can be recalculated after excluding atypical dates from the modeling platform's base-year design value calculations. By removing the influence of these non-representative events, the resulting design values provide a more accurate characterization of typical air quality conditions and establish a more appropriate baseline for future-year projections.

Consistent with the procedures outlined in EPA's modeling guidance for ozone attainment demonstrations, the modeled base case can then be adjusted to quantify the impacts of atypical events across all monitoring sites. This process relies on the recalculated base-year modeling design values and allows for a systematic assessment of how atypical, exceptional, or unusual events may have influenced monitored concentrations. The resulting adjusted base case provides a clearer understanding of the air quality conditions that would be expected in the absence of those atypical influences.

Additionally, once the adjusted base case has been established, source apportionment results from the analytic year can be applied to identify the relationships between emissions sources and monitored pollutant concentrations. These analyses can then be used to develop source linkage assessments and calculate significant contribution metrics, providing valuable information for regulatory evaluations, attainment demonstrations, transport analyses, prepare exceptional events demonstrations, and other air quality planning activities.

Observations

In 2023 and 2024, wildfire and prescribed fire smoke affected monitoring sites across the United States and influenced a substantial number of monitoring days during the ozone season. These smoke impacts occurred not only at individual monitors but also across broad geographic regions, affecting air quality measurements over large portions of the country.

The results of this analysis indicate that the removal of atypical event data from the base-year modeling platform can likely have a meaningful influence on projected modeled attainment outcomes. For areas with design values near the NAAQS, even relatively small adjustments to the underlying base-year conditions may alter future-year attainment projections and affect regulatory conclusions.

The methods developed through this effort provide a practical and reproducible framework for addressing atypical and exceptional events within the context of attainment demonstrations, interstate transport analyses, and other regulatory applications. The approach is particularly valuable because it can be applied consistently across large numbers of demonstrations and planning efforts, improving the treatment of wildfire and prescribed fire smoke impacts in regulatory assessments.

However, at present, no comparable modeling platform or methodology is widely available to support ozone transport SIP analyses or attainment demonstrations while accounting for atypical and exceptional events in a manner that is both regionally consistent and aligned with current regulatory conditions. As wildfire activity continues to increase in frequency and geographic extent, tools such as these provide an important means of ensuring that regulatory decisions are based on representative air quality conditions and a more accurate understanding of anthropogenic emission impacts.