DRAFT Guidance on the Preparation of Clean Air Act Section 179B Demonstrations for Nonattainment Areas Affected by International Transport of Emissions

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DRAFT Guidance on the Preparation of Clean Air Act Section 179B Demonstrations for Nonattainment Areas Affected by International Transport of Emissions

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Acronyms

AQS	Air Quality System
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	Carbon monoxide
CTM	Chemical Transport Model
ENSO	El Nino / Southern Oscillation
EPA	Environmental Protection Agency
FR	Federal Register
FT	Free troposphere
HTAP	Hemispheric Transport of Air Pollutants
HYSPLIT	HYbrid Single-Particle Lagrangian Integrated Trajectory
K	Kelvin
km	Kilometer
LRTAP	Long-Range Transport of Air Pollutants
mb	Millibar
NAAQS	National ambient air quality standard or standards
NASA	National Aeronautics and Space Administration
NNSR	Nonattainment New Source Review
NOAA	National Oceanic and Atmospheric Administration
NO	Nitric oxide
NOx	Nitrogen oxides
NPES	Normalized Potential Emissions Sensitivity
NPSC	Normalized Potential Source Contribution
O_3	Ozone
PA	Policy Assessment
PBL	Planetary boundary layer
PES	Potential Emissions Sensitivity
PM	Particulate matter
ppb	Parts per billion
PSC	Potential Source Contribution
PT	Potential temperature
RACM	Reasonably Available Control Measures
RACT	Reasonably Available Control Technology
RFP	Reasonable Further Progress
SIP	State Implementation Plan
WAQS	Western Air Quality Study
UN	United Nations

1. INTRODUCTION

1.1. Purpose

The purpose of this guidance document[1] is to assist air agencies[2] that are considering the development of a demonstration, under section 179B of the Clean Air Act (CAA), that a nonattainment area would be able to attain, or would have attained, the relevant National Ambient Air Quality Standard (NAAQS) but for emissions emanating from outside the U.S. To help air agencies better understand how to satisfy the requirements of section 179B, the guidance describes and provides examples of the kinds of information and analyses that the U.S. Environmental Protection Agency (EPA) recommends air agencies consider including in a section 179B demonstration. The guidance also describes a weight-of-evidence approach that EPA intends to use when evaluating section 179B demonstrations. This non-binding guidance is intended to assist in the preparation of demonstrations but does not limit the types of information and analysis that could be used to develop such demonstrations under the CAA.

An air agency has the authority under section 179B to develop and submit to EPA a demonstration that its state implementation plan (SIP) would be adequate to attain the NAAQS, or the area would have attained the NAAQS, but for emissions emanating from outside the U.S.

EPA has the authority under section 179B to assess such an international transport demonstration when evaluating a SIP submitted in response to a nonattainment designation or reclassification of an area, or when EPA determines whether a nonattainment area has failed to attain the standard by the attainment date and thus becomes subject to additional CAA requirements. If upon such assessment, the demonstration is to the Administrator's satisfaction, EPA will provide specified regulatory relief as laid out in section 179B.

In addition to describing the kinds of information and analyses that may be helpful to include in a section 179B demonstration, this guidance provides:

- A review of the existing regulatory framework for considering section 179B demonstrations;

[1] None of the recommendations in this guidance are binding or enforceable against any person, and neither any part of the guidance nor the guidance as a whole constitutes final agency action that could injure or otherwise affect the rights and obligations of any person or represent the consummation of agency decision making. Only final actions taken to approve or disapprove SIP submissions or final findings by the Administrator under section 179B(b)-(d) that implement any of the recommendations in this guidance would be final actions for purposes of CAA section 307(b). Therefore, this guidance is not judicially reviewable. This document is not a rule or regulation, and the guidance it contains may not apply to a particular situation based upon the individual facts and circumstances. This guidance does not change or substitute for any law, regulation, or other legally binding requirement and is not legally enforceable. The use of non-mandatory language such as "guidance," "recommend," "may," "should," and "can" is intended to describe EPA's policies and recommendations. The use of mandatory terminology such as "must" and "required" is intended to describe controlling legal requirements under the terms of the CAA and of EPA regulations. Neither such language nor anything else in this document is intended to or does establish legally binding requirements in and of itself. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

[2] References to "air agencies" include state, local, and tribal air agencies.

- A review of other existing regulatory mechanisms that may be more appropriate alternatives to section 179B in certain situations;
- Recommended timeframes for the section 179B demonstration development process; and
- Background on the nature of intracontinental and intercontinental transport of air pollution.

1.2. Statutory and Regulatory Framework

After EPA promulgates a new or revised NAAQS, the CAA requires EPA to designate all areas of the country as either Nonattainment, Attainment, or Unclassifiable, with respect to that NAAQS. The process for these initial area designations is outlined in CAA section 107(d)(1).

Under the CAA, air agencies are required to develop and submit SIPs to EPA that provide for the implementation, attainment, maintenance, and enforcement of the NAAQS through control programs directed at various sources of emissions. When designated as nonattainment, areas for the ozone (O_3), particulate matter equal to or less than 2.5 microns in diameter ($PM_{2.5}$), particulate matter equal to or less than 10 microns in diameter (PM_{10}), and carbon monoxide (CO) NAAQS are each assigned a classification which identifies the latest allowable attainment date and associated requirements to be addressed in the SIP. The core statutory requirements[3] to be addressed in the SIP may include the following: an accurate inventory of current emissions for all sources within the nonattainment area; a Nonattainment New Source Review (NNSR) permit program; regulations providing for implementation of Reasonably Available Control Measures (RACM), including Reasonably Available Control Technology (RACT); a demonstration that the plan provides for Reasonable Further Progress (RFP) toward attainment; a demonstration of attainment by the attainment date; and contingency measures to be implemented in certain circumstances should the area fail to attain by the attainment date.[4] These obligations are detailed in various CAA sections, including sections 110 and 171 through 193.

After the attainment date has passed, the air agency and EPA evaluate ambient air quality data for the nonattainment area to determine whether each area has attained by the attainment date. Once EPA has determined that an O_3, $PM_{2.5}$, PM_{10}, or CO nonattainment area has failed to attain the NAAQS by the attainment date, that area must, by operation of law, be reclassified to a higher classification, which will trigger additional planning obligations for the area, potentially resulting in further emissions control requirements.[5]

[3] Specific statutory SIP due dates and requirements for SIPs vary depending on the specific NAAQS and an area's classification. Related implementation requirements and deadlines associated with these statutory requirements may be established by EPA regulations. The requirements listed here only include the core statutory requirements generally applicable to most nonattainment areas.

[4] Note that O_3 nonattainment areas classified as Marginal are not subject to most of the requirements that apply to higher classifications. *Compare* CAA section 182(a) *with* sections 182(b)-(e).

[5] Reclassification to a higher classification for failure to attain the NAAQS by the attainment date do not apply to areas that are already classified at the highest classification and, in the case of ozone, a classification of Severe (which is the second-highest level of classification for ozone). Although failure to attain the SO_2, NO_2, or Pb NAAQS does not result in reclassification, it does also result in additional planning and attainment demonstration requirements.

Section 179B provides EPA with authority to consider whether state demonstrations of the impacts from international emissions are satisfactory in two contexts: (1) at the implementation plan review stage, when EPA determines prospectively whether a SIP adequately demonstrates that the area will attain by its future attainment date (*see* Section 179B(a)); and (2) after each applicable attainment date, when EPA determines retrospectively whether an area has attained the NAAQS by that attainment date (*see* 179B(b)-(d)).

In the first context, section 179B(a) provides that, "[N]otwithstanding any other provision of law, an implementation plan or plan revision required under this chapter shall be approved by the Administrator if (1) such plan or revision meets all the requirements applicable to it…other than a requirement that such plan or revision demonstrate attainment and maintenance of the relevant national ambient air quality standards by the attainment date specified under the applicable provision of this chapter, or in a regulation promulgated under such provision, and (2) the submitting state establishes to the satisfaction of the Administrator that the implementation plan of such state *would be adequate to attain* and maintain the relevant national ambient air quality standards by the attainment date … but for emissions emanating from outside of the United States." (Emphasis added). For the purpose of this guidance, we refer to such section 179B demonstrations as section 179B(a) or "prospective" demonstrations because they typically involve modeling future air quality. Thus, an EPA-approved prospective demonstration may provide relief from demonstrating future attainment and from the resulting imposition of additional (*i.e.*, beyond RACM/RACT*, et al.)* controls on domestic emission sources.

In the second context, sections 179B(b), (c), and (d) provide that, for O_3, CO, and PM, respectively, "[n]otwithstanding any other provision of law, any State that establishes to the satisfaction of the Administrator that … such State *would have attained* the national ambient air quality standard … by the applicable attainment date but for emissions emanating from outside of the United States" shall not be subject to reclassification to a higher classification category by operation of law, as otherwise required in CAA sections 181(b)(2), 186(b)(2), and 188(b)(2), respectively.[6] (Emphasis added.) For the purpose of this guidance, we refer to such section 179B demonstrations as section 179B(b)-(d) or "retrospective" demonstrations because they involve analysis of past air quality. Thus, an EPA-approved retrospective demonstration may provide relief from reclassification that would have resulted from EPA determining that the area failed to attain the NAAQS by the relevant attainment date.

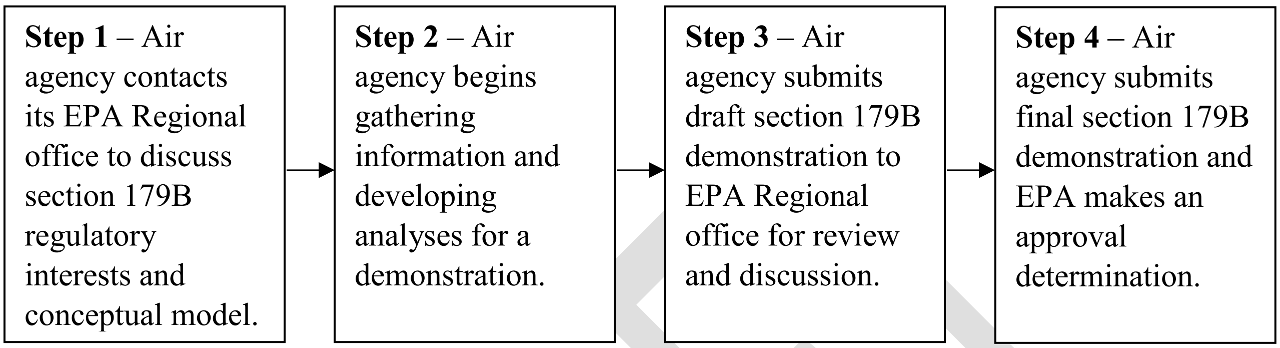
While section 179B can be an important tool for providing specified regulatory relief[7] for air agencies, EPA's approval of a 179B demonstration does not relieve air agencies with nonattainment areas of having to meet the remaining applicable planning or emission reduction requirements in the CAA. It also does not provide a basis for either excluding air monitoring data

[6] EPA's longstanding view is that CAA section 179B(b) contains an erroneous reference to section 181(a)(2), and that Congress actually intended to refer here to section 181(b)(2). *See* "State Implementation Plans; General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990," 57 FR 13498, 13569 n.41 (April 16, 1992).

[7] That "specified regulatory relief," gained if a state's 179B demonstration is to the satisfaction of the Administrator, is what is discussed above: in 179B(a), the ability for a state to submit a potentially approvable attainment plan that does not include a demonstration of attainment and maintenance of the relevant NAAQS, and in 179B(b)-(d), the ability for an area that has not attained by the attainment date to avoid reclassification.

influenced by international transport from regulatory determinations related to attainment and nonattainment, or redesignating an area to attainment.

If an air agency is contemplating a section 179B demonstration in either the section 179B(a) context or the section 179B(b)-(d) context, EPA encourages early consultation and communication throughout the demonstration development and submission process, along the lines of these basic steps:



More detailed, context-specific recommended process diagrams can be found in Sections 4.2.3 and 4.3.4 of this guidance.

1.3. Scope and Definition of International Emissions

This guidance provides examples of recommended technical analyses that an air agency can consider demonstrating either that:

1) its SIP would be adequate to show attainment but for international emissions; or
2) the area would have attained the NAAQS by the area's attainment date but for international emissions.

EPA expects section 179B demonstrations to be developed in a manner consistent with the CAA principles and practices used in attainment plans. The overall plan requirements for nonattainment areas, as identified in Subpart D of the Act, call for plans to include provisions that: (i) provide for implementation of reasonably available control measures, (ii) require reasonable further progress, (iii) include a comprehensive inventory of actual emissions from all sources, (iv) identify and quantify the allowable emissions from major new or modified stationary sources, (v) require permits for new of modified major stationary sources, and (vi) include emission limitations and such other control measures as may be necessary or appropriate to provide for attainment. Each one of these mandatory planning requirements is linked to anthropogenic emissions. To promote consistency between the nonattainment planning requirements and the corresponding section 179B provisions for relief from certain elements of those requirements, EPA recommends that section 179B demonstrations focus on the contribution to ambient concentrations attributable to international *anthropogenic* emissions. Specifically, states are required to evaluate and adopt controls on domestic anthropogenic sources as necessary to fulfill their nonattainment planning requirements. To be consistent, 179B demonstrations should focus on contributions from non-U.S. anthropogenic sources as opposed to nonanthropogenic sources on either side of the border.[8]

For purposes of this guidance, the terms "international sources" and "international emissions" therefore mean, respectively, anthropogenic sources located outside of the U.S, and anthropogenic emissions emanating from sources located outside of the U.S. Emissions from offshore areas (extending 200 nautical miles from U.S. shores) where U.S. federal laws govern emission sources are not considered to be international emissions for purposes of this guidance.[9]

1.4. Analytical Considerations

Despite the title of section 179B ("International Border Areas"), EPA has twice affirmed in recent years its interpretation that this provision is not restricted to areas adjoining international borders.[10] As explained in these instances, and as further detailed later in this document, domestic ozone air quality can be affected by sources of emissions located across United States borders in Canada and Mexico, and under certain circumstances, from sources in other continents. Additionally, in his April 12, 2018, Memorandum for the Administrator of the Environmental Protection Agency ("Promoting Domestic Manufacturing and Job Creation – Policies and Procedures Relating to Implementation of Air Quality Standards"), the President directed EPA to "not limit its consideration of demonstrations or petitions to those submitted by States located on the borders of the United States with Mexico or Canada, but rather consider[] section 179B demonstrations or petitions submitted by any State, including but not limited to those located in the Western United States." Nevertheless, EPA recognizes that technical demonstrations for non-border areas may necessitate additional technical rigor and resources, as explained below.

This guidance provides examples of information and analyses that are recommended for inclusion in section 179B demonstrations. Air agencies may also use other well-documented, appropriately applied, and technically sound information and analyses not identified in this guidance. EPA recommends that the air agency consult with its EPA Regional office as early as possible to reach a common understanding of the types of information and analyses that would be most appropriate for a section 179B demonstration for a particular area. EPA is hopeful that early consultation will help air agencies develop high-quality technical analyses and enable EPA to conduct expeditious reviews of section 179B demonstrations.

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[8] EPA believes anthropogenic emissions should be the focus of section 179B demonstrations for the reasons stated here. References to nonanthropogenic emissions may be included as part of the weight-of-evidence in a section 179B demonstration.

[9] As defined by Part V, Article 57 of the UN Convention on the Law of the Sea, *available at* https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

[10] Although section 179B is titled "International Border Areas," EPA indicated in the preambles to the implementation rules for both the 2015 and 2008 O_3 NAAQS that the statutory language of section 179B does not prohibit air agencies from submitting such demonstrations for nonattainment areas not located on the border with another country. 83 FR 63010 (December 6, 2018); *see also* 80 FR 12294 (March 6, 2015). To date, EPA has not received a section 179B demonstration for any nonattainment area not located on the Mexican border.

EPA recommends that section 179B demonstrations include a conceptual model that describes the conditions causing the exceedance(s)[11] at the ambient monitor(s), discusses how emissions from international anthropogenic sources led to the exceedances at the affected monitor(s), and identifies the specific EPA regulatory decision (SIP approval or determination of attainment) that is intended to be addressed by the demonstration. The conceptual model would generally appear at or near the beginning of a demonstration to help readers and the reviewing EPA staff understand the role of international transport before more detailed technical evidence is presented. It would include much of the information that the air agency provided or discussed with EPA during initial consultations regarding a possible demonstration. Section 4 of this guidance describes the recommended scope of a conceptual model in more detail.

As described in Section 1.2 of this guidance, section 179B contemplates two different types of demonstrations that could be developed by an air agency at different points in the air quality management process. If the air agency intends to submit a section 179B(a) prospective demonstration (*i.e.*, one intended to support approval of a SIP submission by showing that the plan would be adequate to *attain and maintain the standard by the attainment date* but for international emissions), it should submit the demonstration prior to or as part of the overall SIP submission. A retrospective demonstration pursuant to sections 179B(b)-(d) (*i.e.*, one intended to avoid a reclassification by showing that an area *would have attained the standard* but for international emissions) should illustrate that air quality was impacted by international emissions on specific days during the years that contribute to the design value calculation for the area. Typically, this retrospective demonstration would be submitted after air quality data collected pursuant to federal reference or equivalent monitoring methods are available indicating that the area failed to attain by the attainment date (and as noted in Section 4.3, such indication and associated submittal, could occur before the attainment date).

Given the extensive number of technical factors and meteorological conditions that can affect international transport of air pollution, EPA believes that section 179B demonstrations should be evaluated based on the weight of evidence of all information and analyses provided by the air agency. The appropriate level of supporting documentation will vary on a case-by-case basis depending on the nature and severity of international influence. EPA will consider and qualitatively weigh all evidence based on its relevance to section 179B and the nature of international contributions as described in the demonstration's conceptual model. Every demonstration should include fact-specific analyses tailored to the nonattainment area in question.

The demonstration should also consider and examine any contradictory evidence that may indicate that influences other than international emissions caused or contributed to the subject NAAQS exceedances or violations. Such evidence, for example, may include data indicating that NAAQS exceedances or violations could be predominantly attributed to local, intrastate, or interstate U.S. sources. EPA will weigh the body of available evidence to determine whether it collectively indicates that the SIP would be adequate to attain the NAAQS, or the area would have attained the NAAQS, but for emissions emanating from outside of the U.S.

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[11] For purposes of this guidance, unless otherwise specified, the term "exceedance" also includes non-exceedance-level concentrations that contribute to a violation due to the way design values are calculated for certain NAAQS (*e.g.*, 3-year design value for the O_3 NAAQS).

2. INTERNATIONAL TRANSPORT OF POLLUTION

The inclusion of section 179B in the 1990 CAA Amendments was an acknowledgement of the long-standing recognition of international transport of pollution to the U.S. In the legislative history to the 1990 Amendments (US Senate, 1993), the Senate committee on Environment and Public Works recognized that EPA and air agencies would need to develop technical analyses that attempted to quantify the impact of international transport of pollution (US Senate, 1993, p. 5742 and 10110). EPA has actively engaged in various efforts since that time to quantify and understand the impacts to the U.S. of both nearby and more distant international emissions from around the world. This section provides an overview of the type of transport that occurs at intracontinental and intercontinental scales.

2.1. Near-border Transport

Near-border transport to the U.S. from Canada and Mexico is more easily observed and documented than intercontinental transport. Pollutants from near-border international emissions sources, such as industrial facilities and motor vehicles, are transported on a scale comparable to the distance extending across large metropolitan areas. For example, international near-border emissions from Juarez, Mexico, have been demonstrated to impact El Paso, Texas, located directly across the border (TNRCC, 1994; EPA, 2009). Conceptually, analyses for near-border areas can be similar to analyses performed for interstate transport programs. In addition, North American intracontinental transport can also occur over greater distances, and it can potentially affect interior locations in the U.S. to a lesser degree than border areas.

EPA has previously estimated the level of O_3 and haze pollution contributed to U.S. air quality monitors from near-border Canadian sources, Mexican sources, and international shipping emissions from outside the 200-nautical-mile boundary. For example, air quality modeling for the 2015 O_3 NAAQS Policy Assessment (PA) estimated Canadian and Mexican contributions to U.S. pollution for the calendar year 2007 (EPA, 2014). In addition, modeling to support the Cross-State Air Pollution Rule and the Regional Haze Rule quantified projected 2017 O_3 contributions and 2028 particulate matter contributions from an approximately 300,000 square mile region of northern Mexico and an approximately 600,000 square mile region of southern Canada, respectively (EPA, 2016a; EPA, 2018b). These two studies use two techniques (*i.e.*: (1) “zero-out”; and (2) source apportionment, both discussed in more detail in Section 6.3.3.1 of this guidance) that provide quantitative estimates of international transport.

2.2. Long-range Transport

Long-range international transport of air pollution has been recognized for decades, as illustrated by Byrne (2015). Particularly with O_3, modeling analyses have always included boundary conditions that implicitly included “background” O_3. “Background” is a generic term that has in the past been used to refer to O_3 formed from any non-local or regional source, but recent publications have refined the term to focus on uncontrollable sources (Jaffe et al., 2018). Uncontrollable sources as used in discussion of domestic air pollution include global contribution of natural and international anthropogenic sources. EPA has been aware of global natural and international anthropogenic contributions while setting prior O_3 NAAQS, as illustrated by the use of boundary conditions in modeling.[12]

The characterization of international transport of pollution has significantly advanced in the last decade with the development of improved international emissions inventories and global-scale chemical transport models (CTMs). While global scale CTM simulations alone have been used to estimate international transport to the U.S., global-scale models typically have coarse spatial resolution and perform poorly for estimating concentrations in U.S. urban areas (Jaffe, et al., 2018). To better estimate impacts of international transport of emissions to U.S. urban areas, recent modeling studies have used higher spatial resolution models of the North American "region" with boundary conditions derived from global-scale CTMs.

EPA has also endeavored to characterize and quantify contributions from more distant international sources. EPA has been actively engaged in the task force on Hemispheric Transport of Air Pollutants (HTAP) as part of the United Nations (UN) Convention on Long-Range Transport of Air Pollutants (LRTAP). The HTAP effort has included two phases that focused on characterizing transported air pollution for the years 2000 (Dentener, Keating, & Akimoto, 2010) and 2010. These studies quantify the sensitivity of air pollution levels in the U.S. to anthropogenic emissions from other regions, with an emphasis on long-range transport from Europe, Russia, and Asia. EPA also supported the National Research Council's 2010 report "Global Sources of Local Pollution: An Assessment of Long-Range Transport of Key Air Pollutants to and from the United States." (NRC, 2010)

Synthesis of the literature, including citations above and other studies, show that contributions from international emissions to U.S. O_3 concentrations come from a combination of diffuse background and identifiable plumes from intercontinental transport. Intercontinental transport plumes occur more efficiently between certain locations on the globe than others (Dentener, Keating, & Akimoto, 2010; NRC, 2010). For example, semi-permanent pressure systems can set up an atmospheric "conveyor belt" between the Asian east coast and the U.S. west coast. Off the coast of China, a semi-permanent low-pressure system lofts air and associated pollutants to the middle and upper free troposphere. In this region of the atmosphere, fast winds can move pollution eastward toward the U.S. Pacific coast over the course of days to weeks. During transport in the upper troposphere, O_3 has a long chemical lifetime because the low temperatures in that part of the atmosphere are not conducive to O_3 destruction.

The U.S. Pacific coast has a semi-permanent high-pressure system that draws down air from the upper troposphere. During vertical mixing of air from the upper troposphere with air closer to the surface, O_3 transported in the upper troposphere is diluted and chemically destroyed (NRC, 2010). The amount of international O_3 that is mixed down from the upper troposphere with air near the surface depends on location and local meteorology. The further a location is from an international source, in general, the less O_3 will be available to mix down. Local meteorology, however, creates exceptions to this rule due to planetary boundary layer (PBL), the lowest layer of the troposphere, dynamics and topography. Areas with exceptionally deep PBLs can more rapidly transport free tropospheric air to the surface. Complex topography can include mountain peaks that are routinely exposed to free tropospheric air. The peaks can also create winds that

[12] Boundary conditions accounted for all sources that were not explicitly accounted for within the modeling domain.

enhance O_3 mixing down mountain slopes (Zaveri, Saylor, Peters, McNider, & Song, 1995). As a result, high-altitude locations with complex topography may experience greater impacts from intercontinental transport of O_3 as compared to locations at lower elevations.

There is a large body of research exploring the role of international transport and its evolution. For example, it is well known that Asian NOx emissions increased quickly in the 1990s and 2000s (van der A, et al., 2017) and that transport of O_3 also increased (Lin, Horowitz, Payton, Fiore, & Tonnesen, 2017; Verstraeten, et al., 2015). Several recent studies (Huang, et al., 2017; Nopmongcol, Liu, Stoeckenius, & Yarwood, 2017) have quantified interhemispheric transport in 2008 or 2010 near the peak contribution (circa 2011). There is broad consistency in the literature that transpacific transport increased and has since either flattened or decreased (Jaffe, et al., 2018).

3. EVALUATING THE SECTION 179B RELATIONSHIP TO OTHER RELATED PROVISIONS

As discussed in this document, section 179B addresses sources of emissions originating outside of the U.S. and provides qualifying nonattainment areas with specified regulatory relief from otherwise-applicable additional planning requirements. This section discusses limitations to section 179B applicability and identifies related regulatory mechanisms that air agencies may also find useful for addressing their obligations.

Section 179B relief is limited to nonattainment area requirements, and only speaks to relief from (1) the attainment demonstration requirement and (2) the requirement that EPA determine whether an area failed to attain by the attainment date (and reclassify as appropriate). It does not specifically address EPA authority to do any of the following:

- Exclude monitoring data influenced by international transport from regulatory determinations related to an area’s designation as attainment or nonattainment (however, if an exceedance or violation is event-related, it may be able to qualify as an exceptional event, as described in Section 3.2 of this guidance).

- Classify an area with a lower classification than indicated by actual air quality;

- Relax any mandatory control measures associated with the area’s classification;

- Redesignate a nonattainment area to attainment without meeting the other attainment plan requirements of CAA section 107(d)(3); or

- Address interstate transport SIP obligations under CAA section 110(a)(2)(D)(i), the “good neighbor” provision.

Where section 179B is not the most appropriate mechanism, air agencies should consider the regulatory mechanisms discussed below.

3.1. Extension of Attainment Date

In certain circumstances, a nonattainment area that fails to attain the NAAQS by its attainment date but has achieved a threshold level of air quality and has met all requirements and commitments pertaining to the area in the applicable implementation plan may be eligible for a 1-year extension of the attainment date. For example, an area that fails to attain the 2015 O_3 NAAQS by its attainment date may be eligible to request a 1-year extension if it has complied with all requirements in its SIP and if, for the attainment year, the area's fourth highest daily maximum 8-hour average is at or below the level of the standard.[13] A 1-year extension is also possible for nonattainment areas for CO, $PM_{2.5}$, and PM_{10}.[14] In addition, up to 5-year extensions are also possible under certain conditions for $PM_{2.5}$ and PM_{10} areas classified as Serious.[15]

Air agencies considering whether to develop a section 179B demonstration may also be eligible for an attainment date extension. In such situations, the attainment date extension pathway may offer different advantages relative to the 179B pathway. Air agencies with questions regarding these mechanisms are encouraged to consult their EPA Regional office.

3.2. Exceptional Events

Section 319(b) of the CAA recognizes that, when making certain NAAQS-related regulatory determinations, it may be appropriate to exclude ambient monitoring data that are influenced by exceptional events. The 2016 Exceptional Events Rule provides the regulatory mechanism for this purpose.[16]

When exceptional events influence monitoring data and cause exceedances or violations of the NAAQS, air agencies can develop and submit a technical demonstration to request the exclusion of certain event-influenced data, and, if the demonstration satisfies the Exceptional Events Rule criteria, EPA can exclude these data from the data set used for certain regulatory decisions. Specifically, transported pollution must be event-related and be either natural or caused by a human activity unlikely to recur at a particular location (*see* 40 CFR 50.14(c)(3)(iv)(E)).

Exceptional events from natural causes may include wildfires, stratospheric O_3 intrusions, high wind dust events, and volcanic activity. Exceptional events that are human activities unlikely to recur at a particular location may include prescribed fires on wildland, chemical spills, industrial accidents, or terrorist activities. In accordance with the CAA, routine emissions generated by and transported from anthropogenic sources are not exceptional events.[17]

3.3. Section 110(a)(2)(D) – Interstate Transport

[13] *See* CAA section 181(a)(5). More information regarding extending attainment dates for the O_3 NAAQS is available in Implementation of the 2015 National Ambient Air Quality Standards for Ozone: Nonattainment Area State Implementation Plan Requirements, 83 FR 62998 (December 6, 2018).
[14] *See* CAA section 186(a)(4) for CO, and CAA section 188(d) for Moderate $PM_{2.5}$ and PM_{10} areas.
[15] *See* CAA section 188(e).
[16] 81 FR 68216 (October 3, 2016).
[17] An example of routine emissions generated by and transported from anthropogenic sources might include emissions of O_3 precursors or directly emitted particulate matter (or PM precursors) from one state or foreign country's power plants transported into another state or the U.S.

CAA sections 110(a)(1) and 110(a)(2)(D)(i)(I) require all states, within 3 years of promulgation of a new or revised NAAQS, to submit SIPs that contain adequate provisions prohibiting any source or other type of emissions activity within the state from emitting any air pollutant in amounts that will contribute significantly to nonattainment in, or interfere with maintenance by, any other state with respect to that NAAQS. Section 179B does not relieve a state of its obligations to prohibit significant contribution under CAA section 110(a)(2)(D)(i) (aka the "good neighbor" provision). Thus, this guidance does not address any policy governing whether an air agency can take into account emissions emanating from outside the U.S. in developing a plan to meet its interstate transport obligation[18] for any NAAQS.

4. THE DEMONSTRATION DEVELOPMENT PROCESS UNDER SECTION 179B

This section describes the recommended section 179B demonstration development and submission process. It also provides additional details about prospective and retrospective demonstrations under section 179B. The Clean Air Act timelines for nonattainment areas give rise to different submission schedules for each type of demonstration.

4.1. Early Engagement with EPA Regional Offices

EPA recommends that an air agency engage with its EPA Regional office as early as possible when considering development of a demonstration under section 179B. The air agency and EPA should discuss the conceptual model for characterizing the international impacts, identify the types of analyses that would be most appropriate for the demonstration, and establish expectations for timing and other considerations.

4.2. Prospective Demonstrations under Section 179B(a).

As discussed in Section 1.2 of this document, section 179B(a) states that an implementation plan or plan revision shall be approved by the Administrator if such plan or revision meets all the requirements applicable to it, other than a requirement that such plan or revision demonstrate attainment and maintenance of the relevant NAAQS by the attainment date, if the air agency establishes to the satisfaction of the Administrator that the SIP *would be adequate to attain and maintain* the relevant NAAQS by the applicable attainment date, but for emissions emanating from outside of the U.S. The wording in paragraph (a) of section 179B (the air agency must show that the SIP "would be" adequate to attain and maintain the NAAQS but for international emissions) indicates that this demonstration is to be forward-looking or prospective in nature. For this reason, we refer to such demonstrations as "prospective demonstrations" under section 179B.

Section 179B(a) does not include language specific to only certain NAAQS, and thus an air agency theoretically could develop such a demonstration for any NAAQS. If an air agency is required to submit a plan demonstrating attainment of the NAAQS by the relevant attainment

[18] *See* CAA section 110(a)(2)(D)(i) (aka the "good neighbor" provision) for information on addressing interstate transport SIP obligations.

date and is seeking to submit a SIP that shows that the area would attain but for international emissions, then the air agency should submit a demonstration under the process and schedule described in this section. The air agency is not required to develop an attainment demonstration for an O_3 nonattainment area classified as Marginal, and therefore EPA does not expect to receive section 179B(a) prospective demonstrations for such areas.

4.2.1. Section 179B(a) Process and Key Questions

A SIP that includes a prospective demonstration under section 179B(a) must meet all applicable requirements of the CAA other than a demonstration that the area will attain the NAAQS by the attainment date.[19] In general, the applicable requirements for any O_3 nonattainment area include an emissions inventory requirement, the conformity requirements, and the requirement for a nonattainment new source review program. Additional applicable requirements for a nonattainment area other than a Marginal O_3 nonattainment area include RACM (including RACT) measures to show the area is making reasonable further progress toward attainment and contingency measures. Section 179B(a)(2) defines the demonstration in terms of attainment "but for" international emissions. If the plan, in meeting all the otherwise applicable requirements of the CAA, results in attainment, it would be attaining "despite" international emissions rather than "but for" international emissions. Thus, to support the 179B(a) demonstration, an air agency should show that even after fulfilling other relevant obligations, such as imposition of required controls, the area is still projected not to attain the NAAQS. The air agency should therefore first evaluate whether the area can attain the standard by the attainment date based on required domestic emission reductions only.

An air agency should follow the steps below when considering and developing a demonstration under CAA section 179B(a). Step 1 is a required exercise as part of the attainment SIP development process. Step 2 is conditional upon the outcome of the analyses for Step 1.

Step 1. **SIP Attainment Modeling for Potential Domestic Reductions:** For the subject nonattainment area in the relevant SIP, the air agency should first model projected air quality concentrations for the attainment year based on on-the-books domestic net emission reductions and growth by the outermost attainment date (*e.g.*, including mobile source standards, interstate transport programs, rules already adopted by the state for other nonattainment plans, *etc.*), and potential reductions associated with required controls that can be implemented by the attainment date.[20, 21]

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[19] *See* CAA section 179B(a).

[20] For further information on how to conduct these analyses, see Modeling Guidance for Demonstrating Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze, November 29, 2018. Available at: https://www3.epa.gov/ttn/scram/guidance/guide/O3-PM-RH-Modeling_Guidance-2018.pdf.

[21] Note that details on the RACM/RACT analytical process for a particular NAAQS can be found in other implementation rules and guidance. *See, e.g.*, $PM_{2.5}$ NAAQS implementation rule at 81 FR 58129-58132; O_3 NAAQS implementation rules at 70 FR 71659, 80 FR 12264, and 83 FR 62998; General Preamble for Implementation of Title I of the Clean Air Act Amendments of 1990 at 57 FR 13498.

Go to Step 2 *only if* the Step 1 modeling shows the area could not attain with on-the-books measures and RACM/RACT that can be implemented by the attainment date.

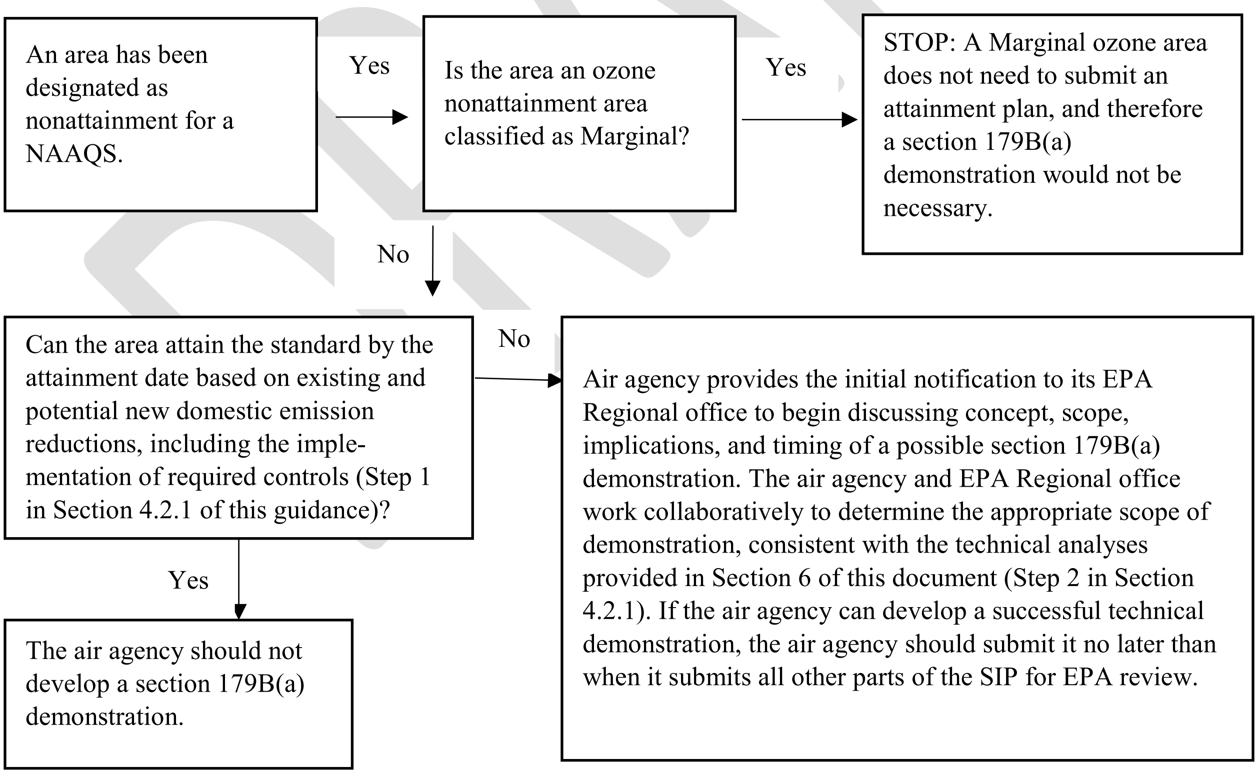
Step 2. **179B(a) Analyses for International Anthropogenic Emissions:** The air agency may consider developing a demonstration of the impact of international emissions pursuant to the analyses identified in Section 6 of this document.

An air agency should include documentation of completing the analyses for Step 1 as part of its section 179B(a) demonstration.

4.2.2. Section 179B(a) Demonstration Submission Schedule

EPA considers a section 179B(a) demonstration as part of an attainment SIP. Therefore, the demonstration should be submitted to EPA no later than the date when all other SIP elements are submitted. An air agency may also elect to submit a section 179B(a) demonstration before the bulk of the attainment SIP is completed. The air agency should consult with its EPA Regional office to determine a mutually agreeable timeline for the development and submission of a section 179B(a) demonstration to avoid potentially missing CAA deadlines.

4.2.3. Flow Chart for Section 179B(a) Prospective Demonstrations (SIP approval)



4.3. Retrospective Demonstrations under Sections 179B(b)-(d)

As discussed in Section 1 of this guidance, sections 179B(b) – (d) (relating to nonattainment areas for O_3, CO, and PM, respectively) provide that "any State that establishes to the satisfaction of the Administrator that such State *would have attained* the national ambient air quality standard by the applicable attainment date, but for emissions emanating from outside of the United States, shall not be subject to a mandatory reclassification to the next highest classification by operation of law."[22] Because the wording in each of these section 179B paragraphs is presented in the past tense, EPA believes that such demonstrations should be retrospective in nature. In other words, the demonstration should include analyses showing that the air quality data on specific days in the past were impacted by international emissions to an extent that prevented the area from attaining the standard by the attainment date.

A nonattainment area that may be eligible to submit a section 179B(b) – (d) retrospective demonstration already would have been required under the CAA to submit a SIP. The CAA requires an air agency to meet all SIP requirements applicable to the area during the SIP development, submission, and implementation process. Section 179B does not relieve an air agency of its planning or control obligations.

EPA recommends that the air agency communicate with the EPA Regional office as soon as possible after determining that they would like to explore the possibility of submitting a section 179B(b) – (d) retrospective demonstration. Much of the relevant air quality data and other information for a retrospective demonstration may be available to the air agency in advance of the attainment date. However, to ensure the integrity of air quality data used in demonstrations, EPA recommends that the air agency submit a retrospective demonstration only after all air quality data used to calculate the attainment year design value are certified, but before the date by which EPA is required to make determinations of whether areas attained by the attainment date (*i.e.*, 6 months after the attainment date). As further described in Section 4.3.2 of this guidance, an air agency may optionally pursue early certification of ambient data to have more time to develop a demonstration prior to the date by which EPA must make its determinations of attainment. Moreover, EPA does not believe a state is precluded from submitting its demonstration prior to the attainment date if the appropriate attainment year data are certified.

As noted above, if EPA approves a section 179B(b) – (d) retrospective demonstration, EPA will not be required to issue a determination of attainment by the attainment date pursuant to sections 181(b)(2), 186(b)(2), or 188(b)(2) of the CAA. Additionally, EPA does not intend to take action on any retrospective section 179B demonstrations until after all air quality data used to calculate the attainment year design value as of the attainment date are certified.

4.3.1. Marginal Nonattainment Areas for the O_3 NAAQS

As discussed in Section 4.2 of this guidance, O_3 nonattainment areas classified as Marginal are only subject to new source review permitting, conformity, and emission inventory and source emission statement requirements. As described in the 2015 O_3 NAAQS Implementation Rule,

[22] *See* CAA section 179B(b), (c), and (d). Any such state (or area) would also not be subject to a determination of failure to attain by the attainment date.

section 182(a) of the CAA does not require states to implement RACM/RACT in Marginal O_3 nonattainment areas, and nothing in section 179B alters the statutory requirements with respect to RACM/RACT obligations in subpart 2.[23]

However, an air agency with a Marginal O_3 nonattainment area that is affected by international emissions may wish to evaluate whether implementing emission reduction measures on domestic sources in the nonattainment area can bring the area into attainment prior to the attainment date. If the area instead submits a section 179B(b) demonstration that is approved, it will likely remain designated nonattainment and retain its current classification, in general, until such time as the area attains the standard and the air agency submits, and EPA approves, a request for redesignation. The area will continue to be subject to NNSR and the other requirements noted above until the area meets and EPA approves an air agency submission addressing the redesignation criteria of CAA section 107(d)(3)(E).

4.3.2. Schedule for Retrospective Demonstrations for O_3 Nonattainment Areas

Although EPA encourages an air agency to consult with its EPA Regional office regarding a possible section 179B retrospective demonstration as soon as practicable, a complete section 179B retrospective demonstration should rely on certified air quality data for the entire period evaluated. EPA recommends that the air agency submit such a demonstration for O_3 as soon as possible after the data from the most recent year are certified.

Air agencies are required to certify O_3 air quality data for a given calendar year by May 1 of the following year.[24] An air agency may also elect to pursue early certification of the preceding year's air quality data, which could provide the air agency with more time to complete a section 179B retrospective demonstration in advance of the area's attainment date. Attainment dates for Marginal through Extreme O_3 NAAQS nonattainment areas extend from 3 to 20 years from the effective date of area designations by EPA. For the nonattainment areas for the 1997, 2008, and 2015 O_3 NAAQS, attainment dates fall on June 15, July 20, and August 3 (respectively) of various years, depending on an area's classification. EPA is obligated to make determinations of attainment within 6 months of each attainment date based on the area's design value (CAA section 181(b)(2)(A)). An area's design value is based on air quality data for the 3 calendar years preceding the attainment date. Therefore, EPA recommends that an air agency submit its section 179B retrospective demonstration as soon as practicable, and well ahead of EPA's deadline to make a determination of attainment, because EPA approval of such a demonstration would relieve the area from being subject to EPA's determination of whether the area attained by its attainment date.

4.3.3. Schedule for Retrospective Demonstrations for PM_{10}, $PM_{2.5}$, and CO Nonattainment Areas

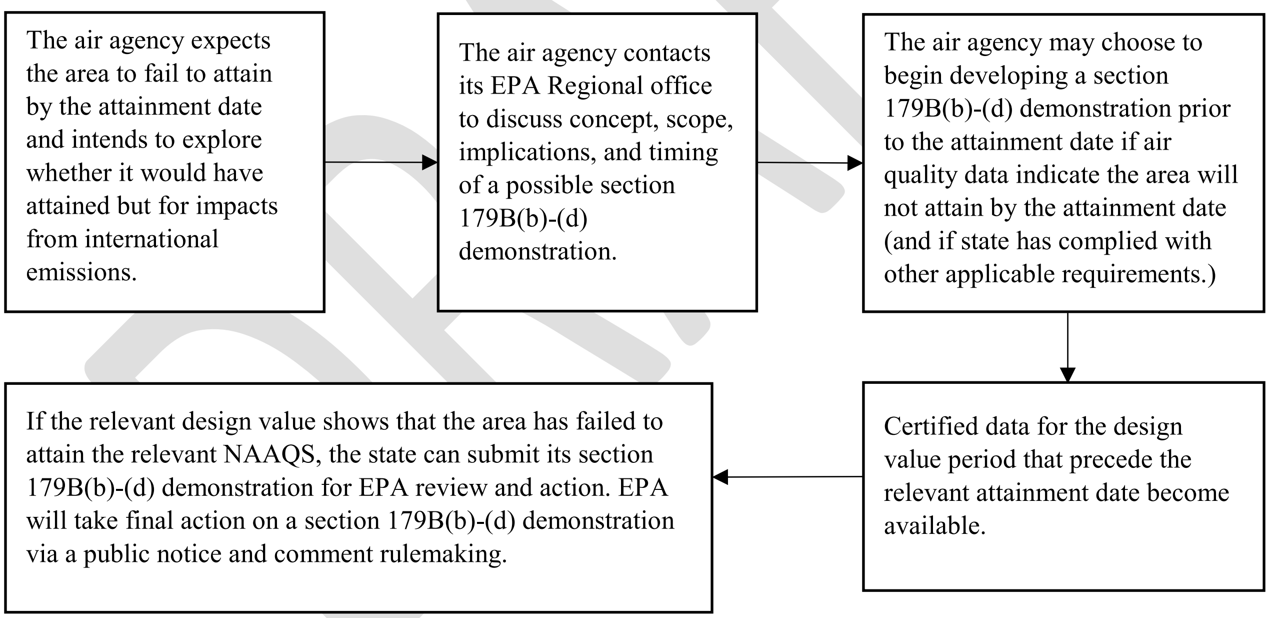
Although EPA encourages the air agency to consult with its EPA Regional office regarding a possible section 179B retrospective demonstration as soon as practicable, a complete section 179B retrospective demonstration should rely on certified air quality data for the entire period

[23] 83 FR 63010 (December 6, 2018).
[24] 40 CFR § 58.15 - Annual air monitoring data certification.

evaluated. Thus, like the recommendation for O_3, EPA recommends that the state submit such a demonstration for PM_{10}, $PM_{2.5}$, and CO as soon as possible after the data from the most recent year are certified.

Air agencies are required to certify air quality data for a given calendar year by May 1 of the following year. An air agency may also elect to pursue early certification of the preceding year's air quality data, which could provide the state with more time to complete a section 179B retrospective demonstration in advance of the area's attainment date. The attainment date for the PM_{10}, $PM_{2.5}$, and CO NAAQS nonattainment areas falls on December 31 of a given year. EPA is required to make determinations of attainment within 6 months of the December 31 attainment date (i.e., by June 30th of the year following the attainment date). *See* CAA section 186(b)(2)(A) for carbon monoxide; CAA section 188(b)(2) for $PM_{2.5}$ and PM_{10}. Therefore, EPA recommends that the air agency submit its section 179B retrospective demonstration as soon as practicable, and well ahead of EPA's deadline to make a determination of attainment, because EPA approval of such a demonstration would relieve the area from being subject to EPA's determination of whether the area attained by its attainment date.

4.3.4. Flow Chart for Section 179B(b)-(d) Retrospective Demonstrations (potential reclassification)



5. CONCEPTUAL MODEL OF INTERNATIONAL INFLUENCE

Section 179B demonstrations should include a conceptual model that is intended to frame the "state of the knowledge" for air quality in the nonattainment area. The conceptual model includes information regarding the influence of emissions, meteorology, transport, and/or other relevant atmospheric processes on air quality in given nonattainment area (EPA, 2018c). A well-constructed conceptual model of pollutant formation and transport for the area can assist in the determination of international transport impacts by highlighting the contrast between locally formed pollutant days and the internationally influenced days in question. The conceptual model should provide the context for reviewing the more detailed analyses provided by the state, described in Section 3 of this guidance.

The conceptual model should clearly identify which type of transport and international sources/source regions directly affect the nonattainment area and whether that transport type is distinct from typical conditions. Clearly identifying the conceptual distinction between local and international contributions forms the basis for which analyses should be included in the demonstration. The conceptual model should also identify which regions and sources meaningfully contribute to the international portion of emissions that influence ambient concentrations in the area of interest.

The information included in a conceptual model should help establish the context for the overall analysis and should be consistent with more detailed evidence and analyses provided in the overall demonstration. To promote a shared understanding and interpretation of this information, the list below provides examples of the kinds of information that would typically be useful to include in a conceptual model.

- A summary of the affected area's NAAQS attainment and classification information.
- A description of the regulatory determination the state believes is influenced by the international emissions.
- A map of the existing ambient monitors in the area, and a description of the sites (*e.g.*, site ID, current measured design value, elevation, recent pollutant trends), and any other relevant information.
- A list of the monitor(s) and days that the air agency has identified as influenced by international anthropogenic emissions.
- A description of the key differences between the measured exceedances influenced by international emissions concentrations and typical exceedances influenced by local, non-international emissions. It would be helpful to include a table of the relevant monitor data (*e.g.*, date, hours, monitor values, and design value calculations with and without the international emissions).
- A summary of the meteorological and atmospheric conditions that lead to high concentrations at the monitor on days influenced by international anthropogenic emissions and days not influenced by international anthropogenic emissions. The contents of this summary will vary by area, but could include:
    - the months in which high concentration days usually occur
    - the diurnal evolution of a typical exceedance in the area
    - the source sector(s) that contribute to the local and regional contribution
    - the source sector(s) that contribute to the international contribution (if known)
    - for PM, the pollutant species that contribute to typical exceedances in the area
    - typical spatial patterns of exceedance days
    - the meteorological conditions associated with high concentration days influenced by international emissions, including a description of the route traveled by transported pollution, such as distance and altitude

    - the meteorological conditions associated with high concentration days not influenced by international emissions.
- Identification of specific international anthropogenic emissions sources (*e.g.*, an international emitting facility) or source regions (*e.g.*, an international metropolitan area) that predominantly impact the monitor location on internationally influenced days
- Where available, a description of how controls on the upwind international anthropogenic sources differ from those required within the U.S. and how that difference could have affected the regulatory determination.

The California Air Resources Board's 2013 SIP for Imperial County for the 2006 24-Hour $PM_{2.5}$ standard (CARB, 2014)[25] contains useful examples for several components of a conceptual model for a section 179B demonstration.

Figure 1 below, taken from the referenced Imperial County SIP, shows one example of an overview map where the border with Mexico is clearly visible, as are major topographical features, major roads, and cities. In addition, the lower left-hand inset presents the broader context of the nonattainment area location within California. This type of graphic should also show where area monitors are located relative to key international anthropogenic sources and provide context for other geographical considerations.

[25] The citation of specific sections of a plan or demonstration as useful examples is not intended as an endorsement of the entire document.

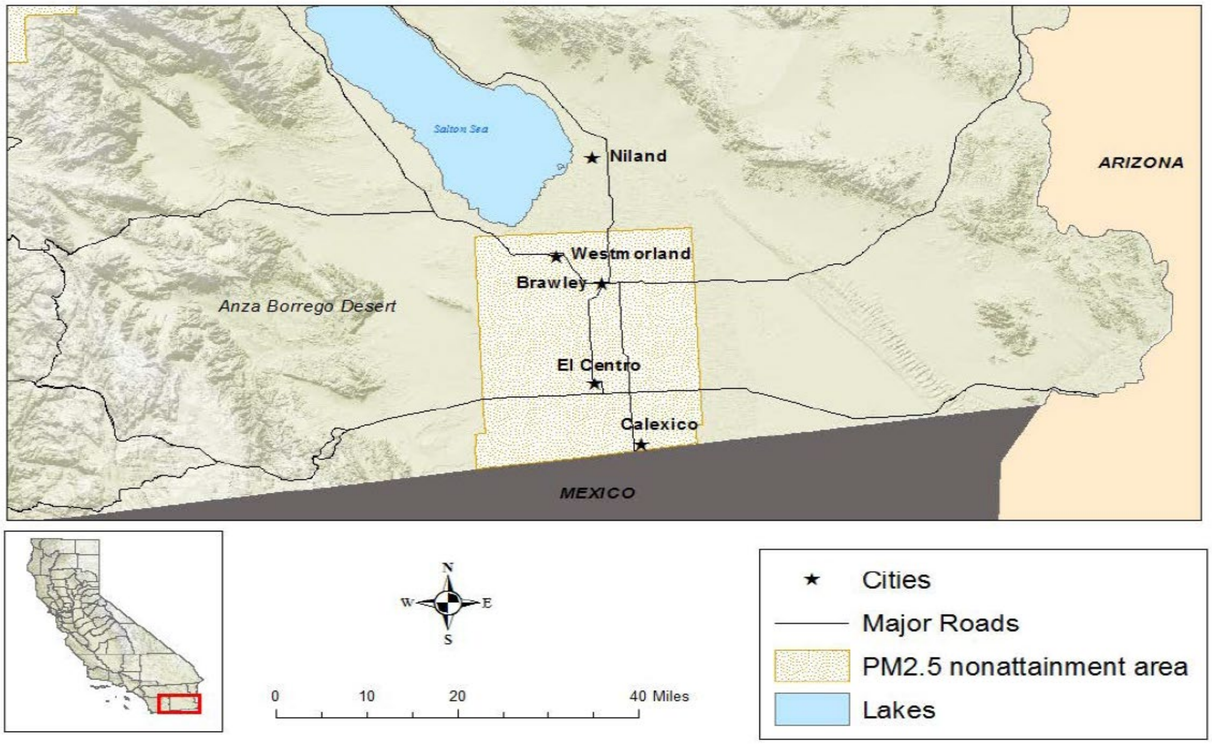


Figure 1. Example overview map, Imperial County $PM_{2.5}$ nonattainment area overview map (CARB, 2014)[26]

That same SIP also included a graphic that connected time and space trends for $PM_{2.5}$ concentrations. Figure 2 below, also taken from the referenced Imperial County SIP shows both that substantial air quality improvements have been made in the region and that the southern-most monitor (Calexico) has the highest design values with the smallest reduction between 2001 and 2012. This result would need to be corroborated with discussion of emissions in a later section to establish that domestic emissions affecting Calexico have been reduced commensurate with domestic emissions affecting El Centro and Brawley.

Other components of the conceptual model will be case-specific. In addition to the Imperial County demonstration for the 2006 $PM_{2.5}$ NAAQS referenced in Figures 1 and 2, components of other section 179B demonstrations referenced in this document may provide helpful examples for how elements can be addressed. Each situation regarding international contributions is unique and every section 179B demonstration will necessitate information and analyses to be tailored accordingly.

[26] The citation of specific sections of a plan or demonstration as useful examples is not intended as an endorsement of the entire document.

Figure 2. 2001 and 2012 24-hour Design Values for Brawley, El Centro and Calexico

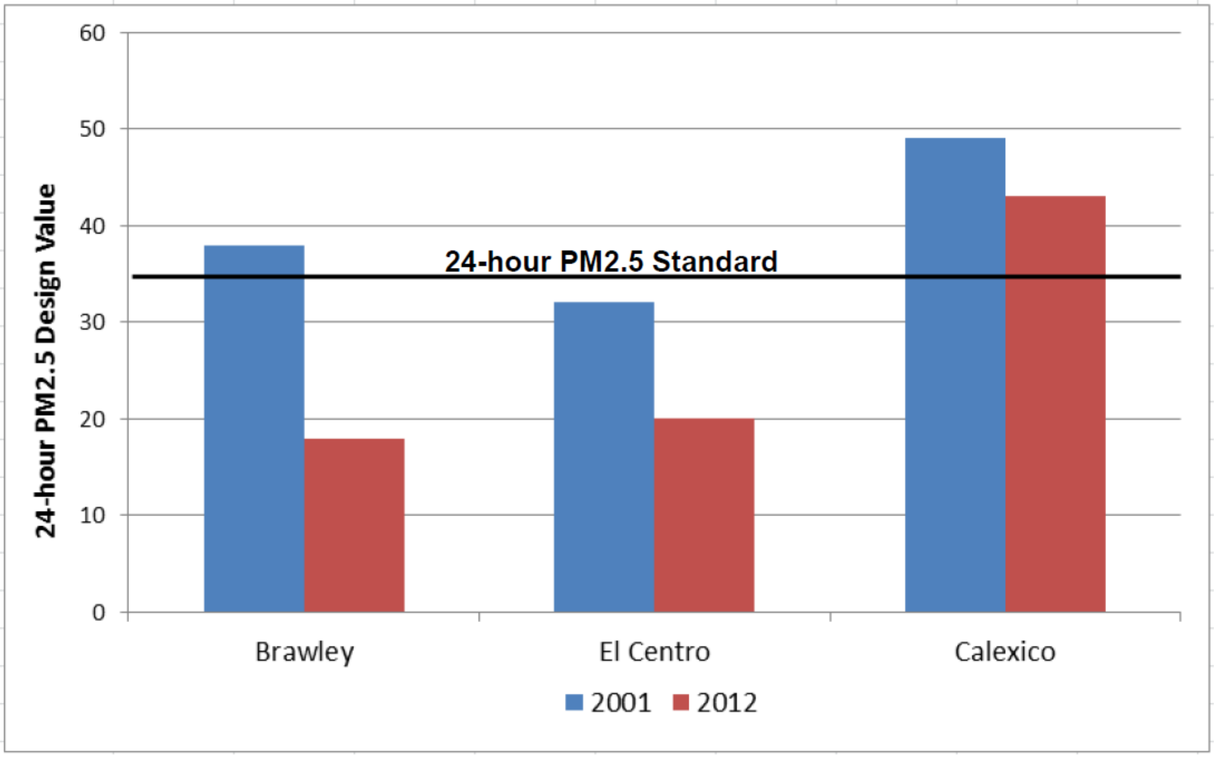


Figure 2. 2001 and 2012 24-hour $PM_{2.5}$ Design Values for three Monitoring Sites in Imperial County, California (CARB, 2014, pp. 15, Figure 2.5)[27]

6. TECHNICAL ANALYSES IN SUPPORT OF THE SECTION 179B DEMONSTRATION

6.1. Determining the Appropriate Analytic Approach for the Section 179B Demonstration

As noted in Section 1.3 of this guidance, EPA recognizes that the relationship between certain NAAQS exceedances and associated international transport is clearer in some cases than in others.

While each section 179B demonstration will involve a unique set of conditions, EPA believes that the general characteristics listed below would suggest the need for a demonstration with fewer lines of evidence to be appropriate:

- Affected monitors located near an international border.
- Large international emission sources located across the border near the affected monitors.
- Meteorology and international transport patterns connect emissions from identified international sources to monitors on days with monitored exceedances.

[27] The citation of specific sections of a plan or demonstration as useful examples is not intended as an endorsement of the entire document.

- Exceedances do not occur on days with similar conditions when transport to monitors is domestic in origin.

Conversely, the following characteristics would suggest the need for a more detailed demonstration with additional lines of evidence:

- Affected monitors not located near an international border.
- Specific international sources and/or their contributing emissions are not identified or are difficult to identify.
- Exceedances on internationally influenced days are in the range of typical exceedances attributable to local sources.
- Exceedances occurred in association with other processes and sources of pollutants, or on days where meteorological conditions were conducive to local pollutant formation (*e.g.*, for O_3, clear skies and elevated temperatures).

Proximity to borders and coasts have clear and strong relationships with nearby international anthropogenic sources. Figure 3 shows the combined O_3 contributions (the fourth highest 8-hour daily maximum value within the U.S.) from anthropogenic emissions in Canada and Mexico based on source apportionment modeling results for 2023 (EPA, 2018b). This modeling estimates future aggregate international contributions of emissions from Canada and Mexico and is not necessarily representative of the international contributions that occur on specific days (*e.g.*, specific exceedances that may influence a SIP determination and be critical for section 179B purposes) in a given area. Therefore, this type of analysis, by itself, would not be sufficient to demonstrate international contributions for the purposes of section 179B, but it may be helpful as part of a broader set of analyses used to support the weight of evidence in a section 179B demonstration.

In the 2023 modeling results discussed above, 24 of the 26 monitors with contributions greater than 5 ppb were located within 30 miles of the Canada or Mexico international border, and all 26 were within 40 miles of the border. Additionally, the influence of international sources on near-border U.S. monitors appears to be substantially larger in locations with a large industrial source or urban center directly on the international side of the border.

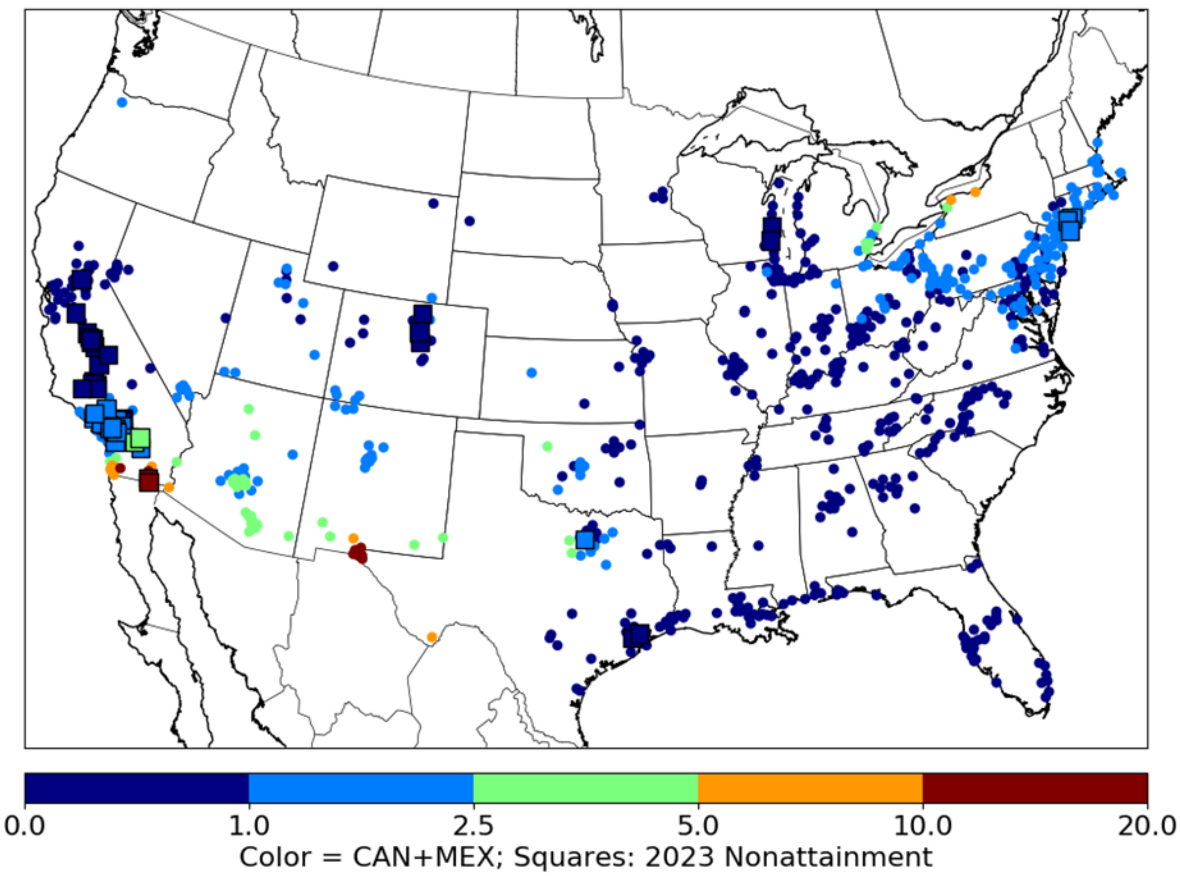


Figure 3 O_3 (fourth highest maximum daily 8-hour average) contributions from in-domain Mexican and Canadian anthropogenic emissions at AQS monitors in 2023 projections. Monitors that are projected as nonattainment in 2023 are outlined squares and all other monitors are smaller circles.

Consistent with the general pattern illustrated in Figure 3, Figure 4 shows a strong exponential decay of Mexico/Canada contribution with distance from the border. This modeling is only able to quantify emissions from within the contiguous U.S. modeling domain (aka in-domain), which extends from 23 to 52 degrees north. Outside the domain, international shipping and transpacific international contributions could not be quantified in this modeling.

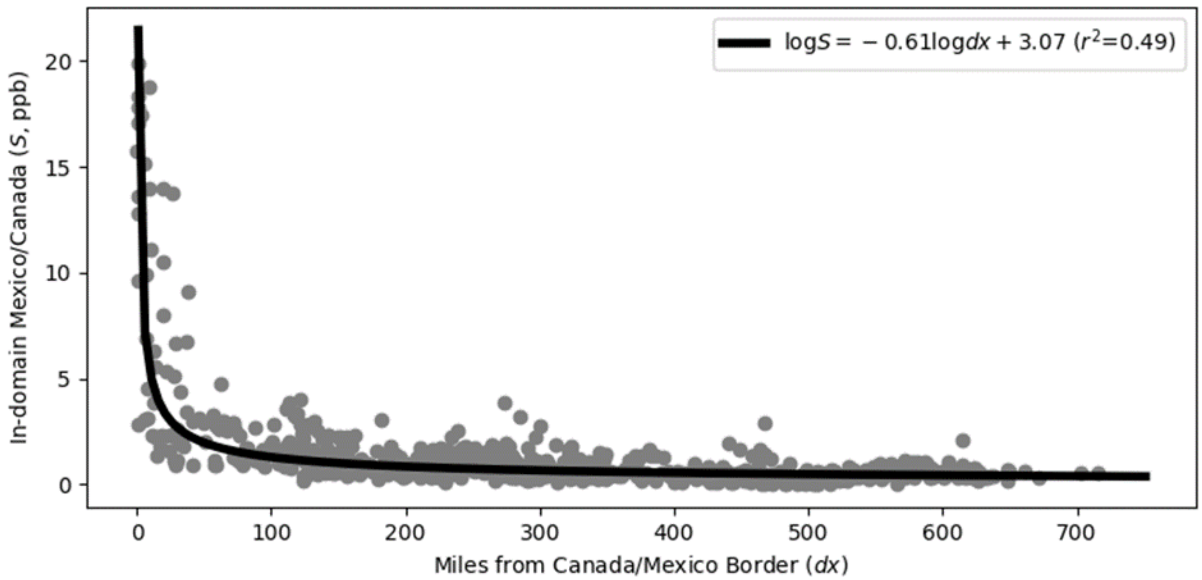


Figure 4 Mexico/Canada source contribution (S) in 2023 at monitors by distance from border (dx).

Impacts from other international sources (not from Canada, Mexico, or shipping) are related to longer-range transport efficiency, which is related to an area's elevation. Figure 5 shows the influence of $O_3$and precursors from outside the modeling domain as represented by simulation of initial and lateral boundary conditions as a function of elevation at monitors more than 100 miles from the boundary. The boundary conditions do not distinguish between international anthropogenic and natural sources, but here serve as a proxy for efficiency of transport from the boundaries to the monitor. Although the relationship is not trivial (r^2=0.55), it is driven by a cluster of low-elevation monitors and a scattering of high-elevation monitors. If the low-elevation monitors (<500 m) are excluded, the relationship significantly weakens (r^2=0.08). To contrast, removing the monitors away from the border strengthens the relationship with distance from border. Proximity to the boundary alone is not sufficient to explain the variability in international contribution between sites. Instead, there is a complex relationship between location, local topography, elevation, and season.

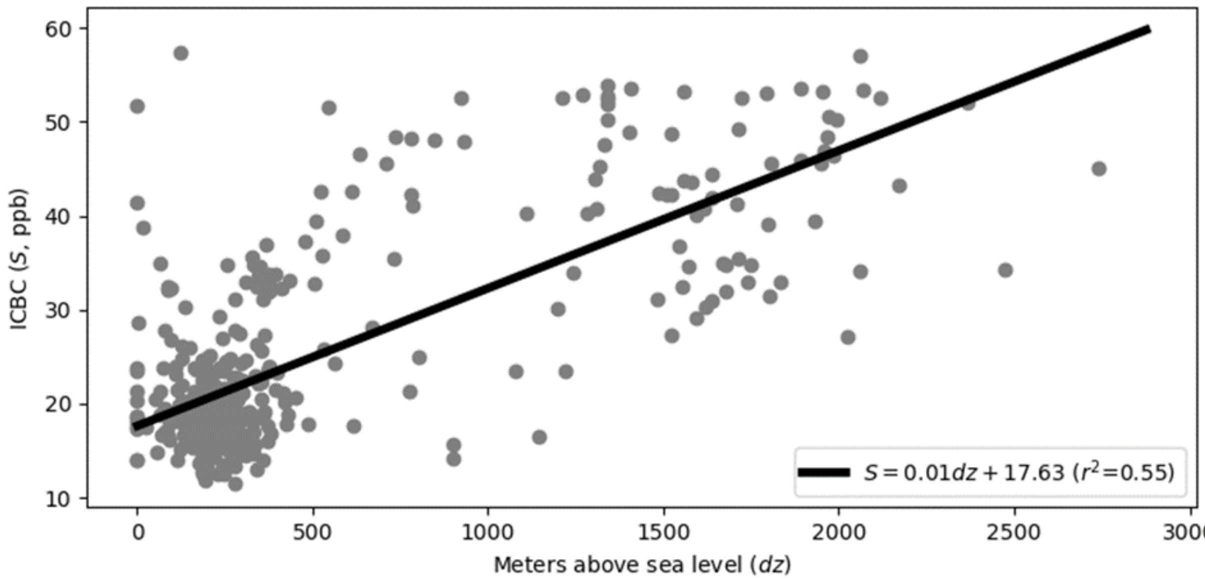


Figure 5 Initial and Boundary Conditions contribution (ICBC) to design values in 2023 as a function of elevation at AQS monitors that are farther than 100 miles from the border.

6.2. Analyses to Consider in Weight-of-Evidence Demonstrations

As with all intended section 179B demonstrations, the submitting air agency and its EPA Regional office should discuss the appropriate level of evidence before developing a demonstration. As a result of this discussion, EPA and the air agency should jointly identify the appropriate analytical approach for the section 179B demonstration.

There is no rigid set of rules regarding which specific analytical elements will demonstrate (or refute) the influence of international anthropogenic emissions. Each case is unique. Table 1 provides a checklist of possible analyses that could support the demonstration of international anthropogenic influence. Each analysis is described in more detail in Section 6.3 of this guidance. Other assessments not specifically mentioned in this guidance may also be valuable for certain areas. An approvable demonstration will generally contain a consistent analytical narrative that shows international anthropogenic emissions meaningfully contributed to an exceedance at the monitor.

Table 1. Potential analyses to demonstrate international contribution

Type of Analysis	Description of analyses
Conceptual Model	Description and basic supporting information regarding the conditions that lead to high O_3 in the area and what conditions are conducive to international-influence.

<table>
<tr><th>Type of Analysis</th><th>Description of analyses</th></tr>
<tr><td>Ambient Observational Analysis</td><td>5 years (or more) of peak concentration data with other internationally influenced days flagged.
Table with percentile ranks of days for section 179B.
Coincidence between high pollution and meteorological/air quality conditions characteristic of international transport.
Wind roses and back trajectories indicating potential influence of international sources on exceedances.
Summary narrative.
Demonstrations needing additional lines of evidence:
Historical diurnal profile comparison on local and non-local contribution days.</td></tr>
<tr><td>Comprehensive Emission Analysis</td><td>Develop a domestic emission inventory.
Obtain or develop an international emission inventory for proximate sources.
Projections of both inventories to the relevant year (in some cases it may be helpful to project prior-year inventories even for historical analyses).
Demonstrations needing additional lines of evidence:
Obtain or develop a broader international emission inventory.</td></tr>
<tr><td>Modeling to Quantify International Contribution</td><td>Optional:
If available, reference existing modeling that has been evaluated, typically for a related analysis.

Demonstrations needing additional lines of evidence (choose one in consultation with the Region):
Dispersion modeling quantifying international contribution and culpability. (inert pollutants)
Photochemical modeling quantifying contribution via sensitivity modeling or source apportionment. (chemically reactive pollutants)</td></tr>
<tr><td>Chemical Fingerprint Analysis (aka “receptor modeling” or “filter analysis”)</td><td>Where available and applicable.</td></tr>
</table>

6.3. Analyses to Demonstrate International Contribution

After determining the appropriate analytical approach for a section 179B demonstration, the next step in establishing a relationship between international emissions and a monitored exceedance is to develop the analyses that describe how international emissions were transported to the monitor in sufficient quantities to cause the exceedance. The analyses necessary to establish this relationship should be tailored to the area and pollutant of interest, and should generally include pollutant measurements, meteorological observations, emissions quantification, and air quality modeling. The 1994 Addendum to the General Preamble of the Implementation of Title I of the Clean Air Act Amendments of 1990 (59 FR 42001) suggested a set of five analyses that may help support section 179B demonstrations (a, d) for PM_{10}:

> *1. Place several ambient PM-10 monitors and a meteorological station; measuring wind speed and direction, in the U.S. nonattainment area near the international border.[28] Evaluate and quantify any changes in monitored PM-10 concentrations with a change in the predominant wind direction.*
> *2. Comprehensively inventory PM-10 emissions within the U.S. in the vicinity of the nonattainment area and demonstrate that the impact of those sources, after application of reasonably available controls, does not cause the NAAQS to be exceeded. This analysis must include an influx of background PM-10 in the area. Background PM-10 levels could be based on concentrations measured in a similar area not influenced by emissions from outside the U.S.*
> *3. Analyze ambient sample filters for specific types of particles emanating from across the border. (Although not required, characteristics of emissions from sources may be helpful).*
> *4. Inventory the sources on both sides of the border and compare the magnitude of PM-10 emissions originating within the U.S. to those emanating from outside the U.S.*
> *5. Perform air dispersion and/or receptor modeling to quantify the relative impacts on the nonattainment area of sources located within the U.S., and of foreign sources of PM_{10} emissions (this approach combines information collected from the international emission inventory and meteorological stations, ambient monitoring network, and analysis of filters).*

With the exception of item 3 above, these methods with minor modifications are also generally applicable to other criteria pollutants, including carbon monoxide and O_3 which are explicitly noted in section 179B(b)-(d). For O_3 and potentially $PM_{2.5}$, the type of modeling performed will be chemical transport and not dispersion. Again, air agencies can describe the mechanics of the international transport in a variety of ways. Although the specific analyses appropriate for a section 179B demonstration will vary on a case-by-case basis, these methods are generally aligned with the five factors considered in the present-day designations process: air quality data, emissions and emissions-related data, meteorological data, geography/topography, and jurisdictional boundaries.[29]

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[28] *See* 40 CFR part 58 for guidance on locating PM-10 monitors and "On-site Meteorological Program Guidance for Regulatory Modeling Applications" (EPA, 1987) for guidance on locating meteorological stations.
[29] Memorandum to Regional Administrators entitled "Area Designations for the 2015 Ozone National Ambient Air Quality Standards" February 2016 at: *https://www.epa.gov/sites/production/files/2016-02/documents/ozone-designations-guidance-2015.pdf*.

This guidance on analyses is structured into four types of supporting analyses. Section 6.3.1 of this guidance discusses measured air quality data analyses. Section 6.3.2 of this guidance describes comprehensive emissions analyses. Section 6.3.3 characterizes source-receptor modeling analyses. Section 6.3.4 of this guidance highlights receptor modeling analyses. The examples provided in each section focus on $PM_{2.5}$ and O_3, which EPA anticipates will be of wider interest than CO and PM_{10}. However, the examples may be applicable to other criteria pollutants.

6.3.1. Measured Air Quality Data Analysis

The first component of establishing a relationship between international anthropogenic emissions and the monitored exceedance is to prepare an analysis showing how the measured concentration compares to the distribution or time series of historical concentrations measured at the same monitor and/or at other monitors in the area. Air agencies can show the relationship between the days with internationally influenced concentration(s) and historical concentrations across all days in a variety of ways. Table 2 describes example analyses that could be completed to show whether the international-influenced exceedances were outside the bounds of generally expected pollutant levels.

Table 2: Suggested Analyses for Comparing Historical and Internationally Influenced Concentrations

Historical Concentration Evidence	**Types of Analyses/Supporting Information**
1. NAAQS concentration data	Plot the NAAQS concentration matrix at the affected monitor(s) for the most recent 5-year period[30] that includes the international transport influence(s) of regulatory significance. This can also be supplemented with a table that briefly describes percentile ranks of internationally influenced days with a comparison against historical means and maxima.
2. Identify transport influences	Distinguish any high concentrations associated with previously approved international transport demonstrations, suspected international transport, and other unusual occurrences (*e.g.*, exceptional events) from other high pollution days that are primarily due to normal domestic emissions (provide evidence to support the identification when possible).

6.3.1.1. Demonstration Days and Historical Context

[30] Section 8.4.2.e of appendix W (82 FR 5182, January 17, 2017) recommends using 5 years of adequately representative meteorology data from the National Weather Service (NWS) to ensure that worst-case meteorological conditions are represented. Similarly, for international influence purposes, EPA believes that 5 years of ambient air data better represent the range of “normal” air quality than do shorter periods.

A brief overview of the measured concentration data and the transport patterns that governed the suspected international influence should be provided near the beginning of a section 179B demonstration as part of the conceptual model. For illustrative purposes, Figure 6 shows an example time-series plot that highlights (in red) the days that are the focus of a hypothetical demonstration and puts them in the context of other O_3 days. In this case, 2015 and 2016, which are the focus of the evaluation of international sources, do not fully cover the 5-year data period. Therefore, there could be other historical days (*i.e.*, a subset of the days in blue) that also have international influence. Note that Figure 6 shows that days being evaluated for international influence are not unlike other exceedance days in the historical record. An example of tabular day identification is shown in Table 3 that could complement a figure like Figure 6.

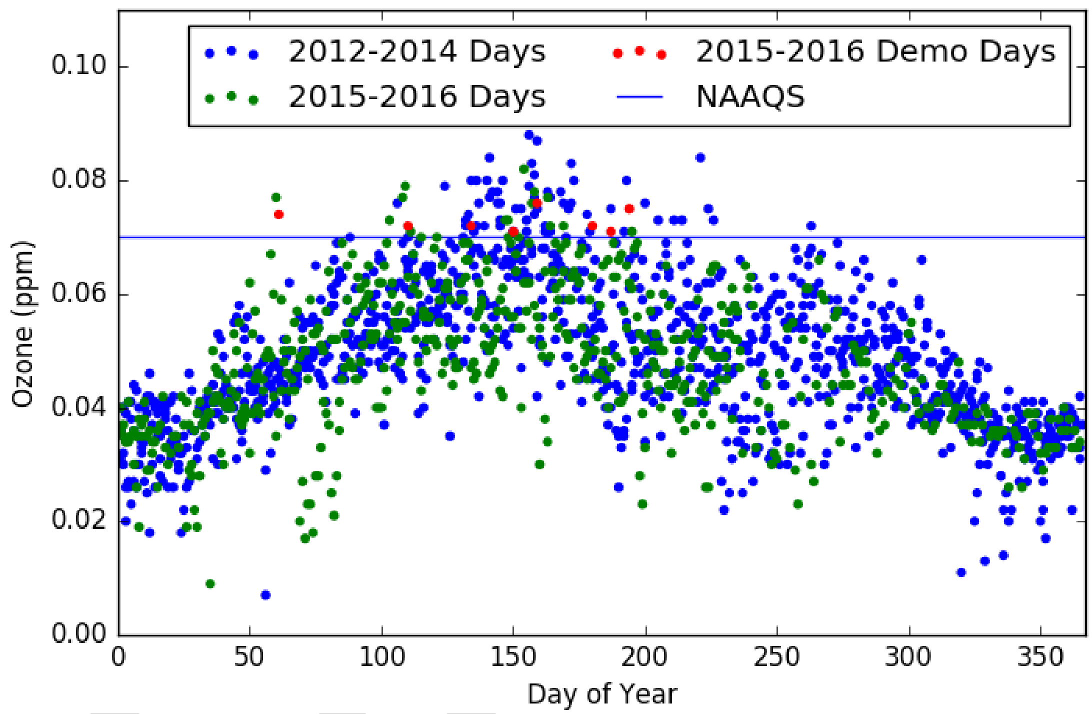


Figure 6. Measured O_3 as a function of day-of-year with example days highlighted as influenced by international sources marked in red and other days marked in green.

Table 3. Example tabular summary of exceedance days for internationally influenced O_3 data.

Transport Day	**Concentration** (ppm)
3/1/2015	0.074
4/19/2015	0.071
5/18/2016	0.071
5/30/2016	0.070
6/7/2016	0.075
6/30/2016	0.071
7/7/2016	0.070
7/12/2016	0.074

6.3.1.2. Establishing an International Source-Receptor Relationship

Measured exceedances should be connected to international source emissions by meteorological analysis. Fleming, Monks, and Manning (2012) published a particularly relevant review paper highlighting in-situ wind direction, trajectory models, particle dispersion models, and chemical transport models. The two most widely used analyses in section 179B demonstrations are in-situ wind analyses and trajectory analyses. Fleming, Monks, Manning (2012) highlight that more sophisticated methods have largely replaced local wind direction as a method of identifying air mass history. Further, they note that dispersion models provide a more useful field for composition analysis. Trajectory analyses rely on the use of meteorological models and their interpretation of observed conditions (aka reanalysis), which provides meteorological information over a broad area, but introduces biases inherent in the meteorological model. For example, previous section 179B demonstration submissions have highlighted that reanalysis may be too coarse to properly represent wind flow patterns in locations with complex topography. Despite their respective limitations, winds and trajectory analyses can provide useful information as part of the weight-of-evidence in a section 179B demonstration.

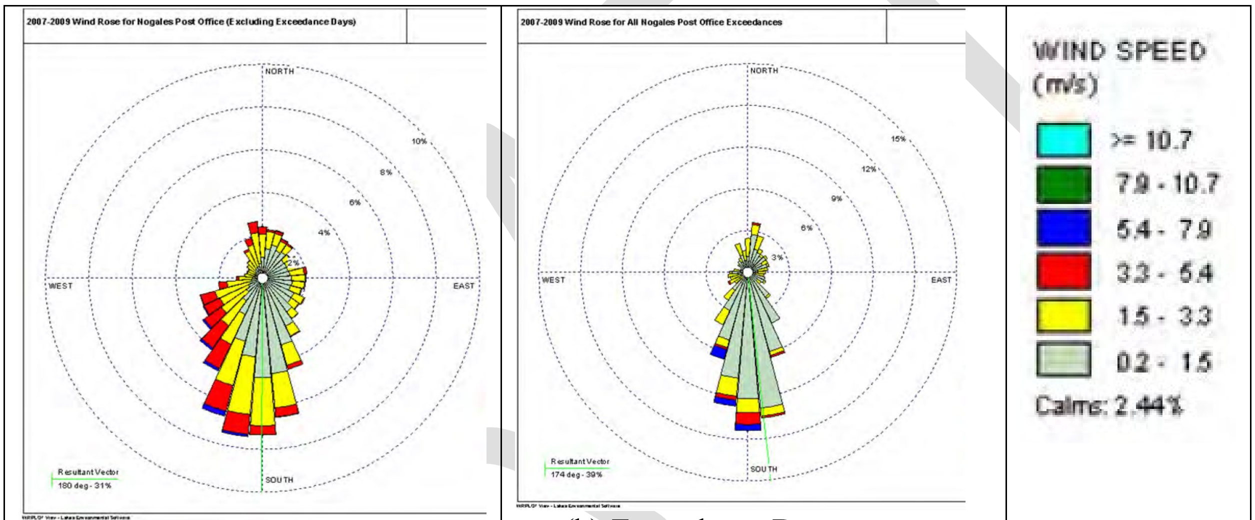
In-situ Winds Analyses: In-situ winds analyses infer sources of pollution based on the speed and direction from which the wind blows. The strength of the method is in its simplicity to perform, but the simplicity is achieved by assuming that locally measured winds are representative of wind directions between the source and monitor. One weakness of this approach is the known existence of meandering or circular wind patterns. Wind analyses should only be used when more sophisticated methods are precluded. If included in a demonstration, in-situ wind analyses will hold less weight in the evidence assessment.

In-situ wind analysis was used in the section 179B demonstration for the Nogales, Arizona, PM_{10} nonattainment area (ADEQ, 2012). That demonstration suggested that local topography limited the application of trajectory analyses. Each section 179B demonstration should review the increasingly accurate and fine-scale meteorology data available at the time. When opting out of trajectory or dispersion modeling, the air agency should still compare trajectory or dispersion modeling to its proposed technique. In the case of Nogales, the demonstration instead included analysis of measured local winds. Table 4 and Figure 7 highlight that wind direction on low concentration days was disproportionately from the north and west, and that high concentration days were disproportionately from the southerly direction with lower wind speeds. By itself, this wind vector analysis is merely suggestive. It is possible that meteorology conducive for transport from international sources is associated with southerly winds, or southerly winds may indicate a larger-scale flow pattern that connects this monitor to other domestic sources. Therefore, additional analyses are needed to help confirm conclusions from the wind vector analysis.

Table 4: Nogales, Arizona Hourly ambient PM10 concentrations sorted by concentration and wind direction, 2007 – 2009 exceedance days. (ADEQ, 2012, p. Appendix A Table 11)[31]

[31] The citation of specific sections of a plan or demonstration as useful examples is not intended as an endorsement of the entire document.

	Range of Ambient Concentration Values (microgram/m³)						
Wind Direction Quadrant	< 150	150 - 250	250 - 350	350 - 450	450 - 550	>= 550	Share of All Wind Direction Observations
Northerly NW to NNE	27%	6%	3%	3%	3%	0%	17%
Easterly NE to ESE	15%	16%	16%	11%	3%	8%	14%
Southerly SE to WSW	41%	71%	72%	84%	92%	92%	57%
Westerly SW to WNW	18%	6%	8%	3%	3%	0%	12%
Total	100%	100%	100%	100%	100%	100%	100%



(a) Non-Exceedance Days (b) Exceedance Days

Figure 7: Nogales, Arizona PM10 nonattainment area: wind roses for non-exceedance and exceedance days (ADEQ, 2012, pp. Appendix A, Figure 9)

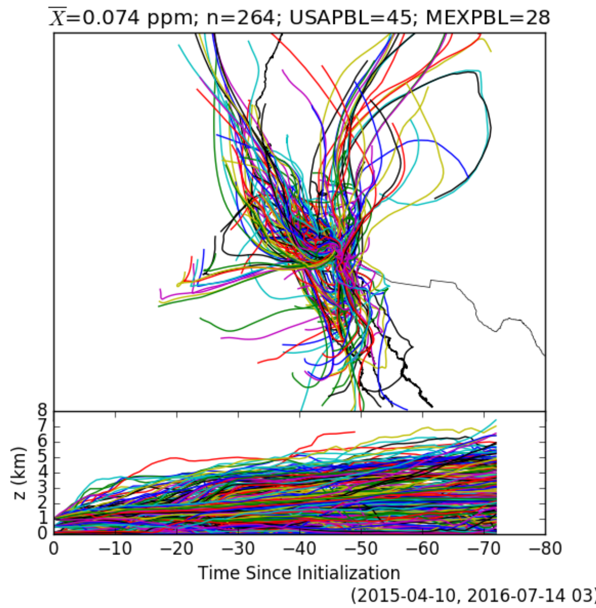
Trajectory Analyses: Backward trajectory analyses promote a fuller understanding of transport between sources and measured concentrations. A trajectory analysis follows an air mass represented by a single point as it moves through space due to atmospheric forces, and a backward trajectory retraces the path a particle would have taken to arrive at a point. The location of trajectories can be paired with additional meteorological data, geopolitical boundaries, and emission inventories to help distinguish between the influence of domestic and international emissions.

The examples shown in Figure 8 and Figure 9 present results of HYSPLIT trajectories to assess the potential international and domestic impacts in the Imperial County, California, area.[32] Trajectories were initialized every 2 hours through each 8-hour maximum O_3 daily value (from start, *d*t=0,2,4,6,8 hours) from 2015-01-01 to 2016-08-24 using North American Mesoscale

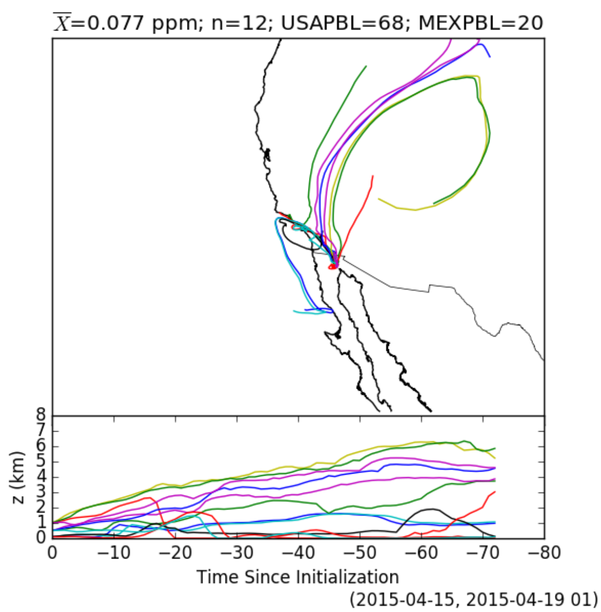
[32] Trajectories were developed to support this guidance document and have not been used in a submission.

Forecast System archived on the Sigma coordinate (NAMS) data downloaded from the HYSPLIT archive. Each initialization uses three altitudes: 100, 500, and 1000 meters. The three altitudes help to characterize air throughout the PBL. Ideally, each altitude release would be paired with hourly trajectories (8 trajectories/day for O_3, 24 trajectories/day for $PM_{2.5}$) instead of the five used here. The trajectories used in these examples were also configured to include PBL height as an output along with coordinates. The altitude of the trajectory can be compared to the PBL to identify when a trajectory is likely to interact with emissions. If the PBL is not known, using a low assumed PBL may be appropriate. The residence time of trajectories within the PBL or below a fixed level can qualitatively be considered a potential emissions sensitivity (PES, f_x). The sensitivity can then be combined with emission inventories to develop an expected potential source contribution (PSC, f_xE_x). Because PES and PSC do not account for pollutant production and loss processes, the results should not be interpreted as absolute contributions and may be most useful in section 179B demonstrations when normalized. (For example, $NPES_x = PES_x / \Sigma PES_x$; and $NPSC_x = PSC_x / \Sigma PSC_x$). The normalized values show the expected relative contributions.

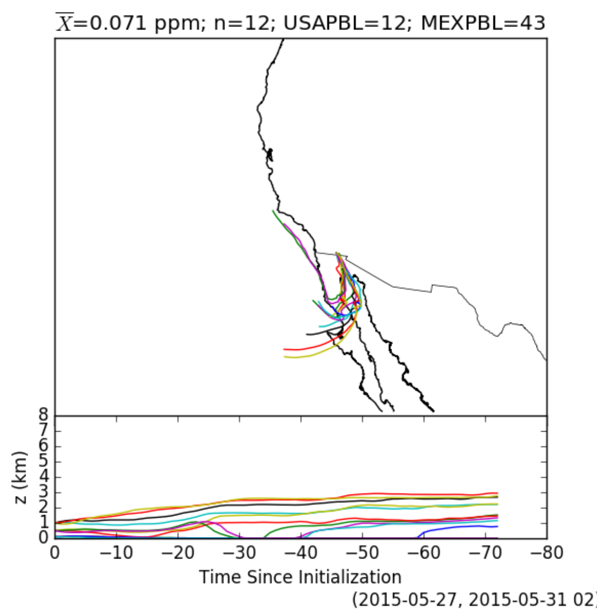
Figure 8 simply compares trajectories from (a) all exceedance day trajectories; (b) days that are primarily U.S. influenced; and (c) days that are primarily Mexican influenced. Trajectories are rarely conclusive on their own because they are individually subject to model configuration artifacts and represent probable trajectories. When a large majority (*e.g.*, 75 percent) of trajectories pass over an international source region of interest with known emissions (here Mexicali), this is part of a weight of evidence that an international contribution exists on that day. When the international contribution is more prevalent on exceedance days than other days, that reinforces the weight of evidence.



(a) All Exceedance Days



(b) Example US-related Exceedance



(c) Example Mexico-related Exceedance

Figure 8 El Centro 72-hour back trajectories for (a) all exceedance days, (b) an example primarily domestically influenced trajectory, and (c) an example more internationally influenced exceedance day.

Figure 9 shows back trajectory-based NPES (a,b) and NPSC (c,d). Comparing NPES panels (a) and (b) reveals that exceedance day trajectories spent relatively more time in the Mexican PBL than non-exceedance days (24 percent vs. 17 percent), but also show a density of PBL time along the U.S. Pacific coast. This identifies both international and domestic sources on exceedance days. Comparing NPSC panels (c,d) to NPES (a,b) shows that emissions across the border play a bigger role than suggested by just looking at trajectories. Like NPES, the NPSC attributed to Mexico is greater on exceedance days (52 percent) than all days (39 percent).

One challenge associated with using backward trajectories is that a large number of trajectories is necessary to create a PES or PSC. The NPES and NPSC in Figure 9 are relatively sparse and currently include 23 days with three altitudes and five releases (345 trajectories). Further, the trajectory could pass near a source and the narrow nature of the trajectory would not include the source. For this reason, trajectory-based NPES and NPSC can only provide supporting evidence. When exceedance days show larger fractions of NPSC from international anthropogenic sources, this adds to the weight of evidence that international anthropogenic sources contribute to exceedances.

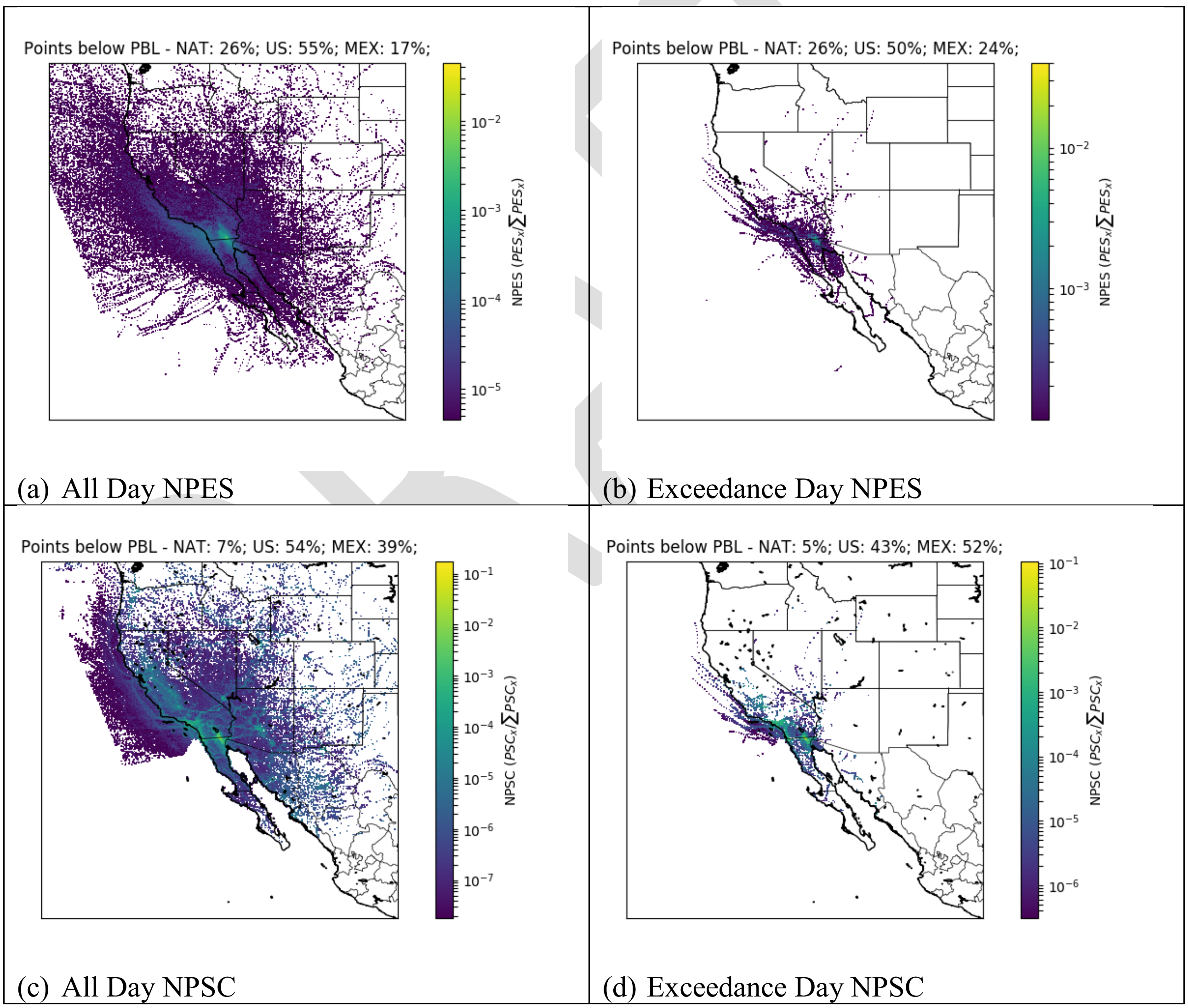


Figure 9: Imperial County, California O_3 nonattainment area: El Centro 72-hour back trajectory Normalized Potential Emission Sensitivity maps (a,b) and Normalized Potential Source Contribution maps (c,d) for all days (a,c) and exceedance days (b,d). The frequency is shown by the color and identifies the fraction of hourly locations from all trajectories that are in

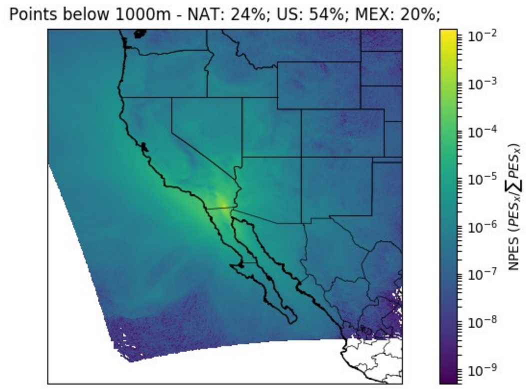
each cell. The USA, MEX, and OCN (ocean) labels identify the percentage of NPES within each region. The USA, MEX and NAT labels identify the percentage of NPSC from regional sources.

Backward Dispersion: Backward dispersion analyses follow plumes rather than single-point air masses in backward trajectories. Backward dispersion results can improve upon trajectory analyses in several ways. First, backward dispersion includes the effects of turbulent motion. Each trajectory is no longer defined by just its average pathway, but instead is described by a probability distribution of particles. Second, the backward dispersion model uses a continuous release so that the backward trajectory includes many different initial conditions. The backward dispersion creates a "retroplume" that is proportional to residence time (Seibert and Frank 2004; 10.5194/acp-4-51-2004). The retroplume does not account for all processes and is subject to certain assumptions (Lin et al. 2003; 10.1175/BAMS-D-14-00110.1). When assumptions are satisfied, the retroplume can be converted to a NPES and NPSC (similar residence time from back trajectories).

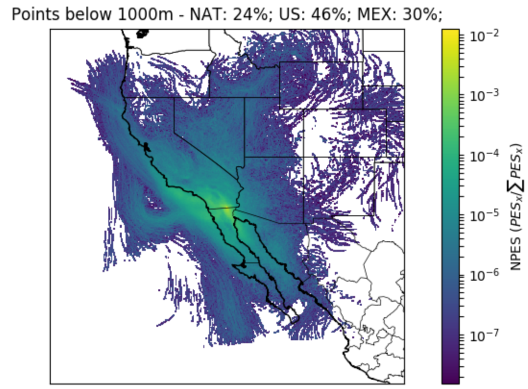
The example shown in Figure 10 is based on HYSPLIT backward dispersion simulations. Similar to the back-trajectory section (above), simulations were configured based on maximum daily 8-hour O_3 measurements on 587 days at the El Centro monitor. For backward dispersion, source locations were configured to release a vertical line-source of a generic gas tracer between 100 and 1000 m over the monitor. The release lasted for the full 8-hour period. Compared to a series of backward trajectories, the 8 hours of emissions provide a more continuous view of possible sources, the dispersion model accounts for turbulent motion, and explicitly weights closer sources more heavily. In the case of secondarily-formed O_3 and $PM_{2.5}$, the weighting toward closer sources may overestimate their influence. In an ideal case, these receptor-oriented backward dispersion results could be combined with source-oriented forward dispersion results to produce a more complete source-receptor relationship.[33]

Figure 10 shows the backward dispersion NPES and NPSC. Compared to backward trajectories (*see* Figure 9), the backward dispersion NPES and NPSC have a smoother distribution that results from turbulent dispersion. The percent attributed to various regions (NPES: U.S., Mexico, or Ocean; NPSC: U.S., Mexico, or Natural) is also similar to backward trajectories. A key difference is that the dispersion-based continuous surface lends itself to creating day-specific NPES and NPSC in a way that trajectories do not. Figure 10 also shows two days that illustrate primarily U.S.-influenced (Figure 10e) and primarily Mexico-influenced (Figure 10f) exceedances. Despite the quantitative results, there are many uncertainties and the results depend upon the configuration and choices made in the processing. When a large majority of NPSC are from a source region (here Mexico), these results could be part of a weight of evidence that these days have international influence. When the fraction of NPSC is substantially larger on exceedance days than typical days, this strengthens the weight of evidence.

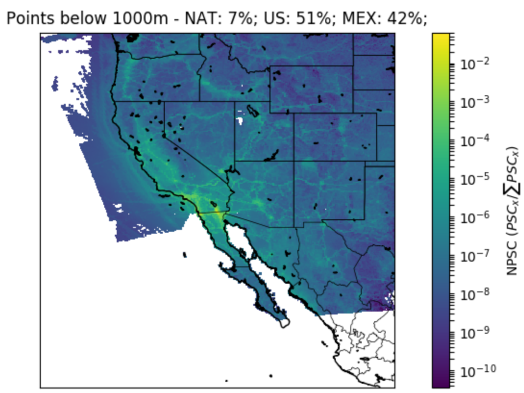
[33] *https://ready.arl.noaa.gov/documents/Tutorial/html/src_recp.html.*



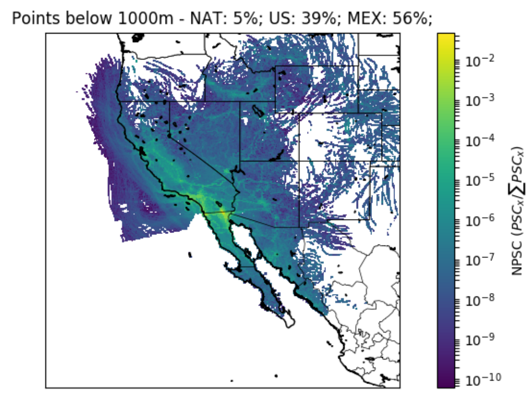
(a) *All days NPES*



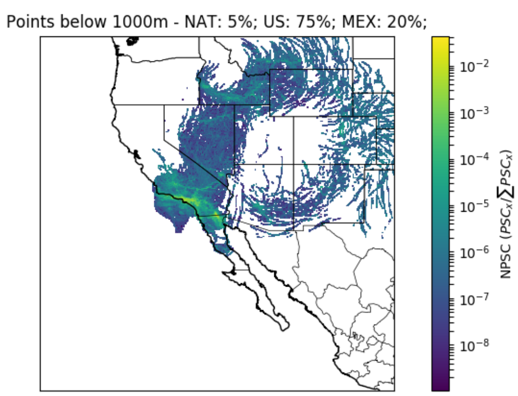
(b) Exceedance days NPES



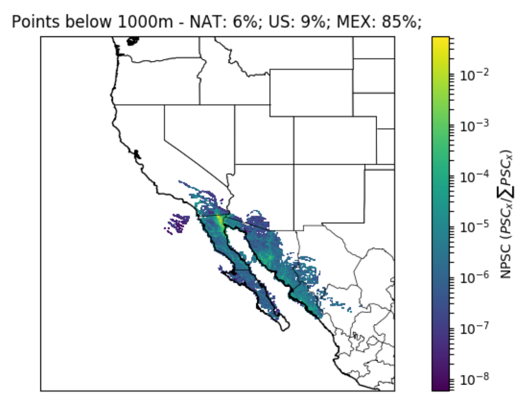
(c) All days NPSC



(d) *Exceedance days NPSC*



(e) Primarily U.S. Influenced Exceedance



(f) Primarily Mexico Influenced Exceedance

Figure 10: El Centro 72-hour back dispersion-based NPES (a,b) and NPSC (c-f) for all days (a,c), exceedance days (b,d), a primarily U.S. influenced exceedance (e) and a primarily Mexico influenced exceedance (f).

6.3.2. Comprehensive Emission Analysis

A comprehensive emissions analysis is an important component of a section 179B demonstration. The emissions analysis provides most compelling direct evidence when the international emissions are immediately abutting the nonattainment area. In this case, the emissions analysis, including domestic and international emissions, will cover a geographic region of similar size and proximity to a metropolitan area. Emissions within the region would be separated into international and domestic components. A comprehensive emissions analysis should consider:

- What emission sources currently exist, and what is the magnitude of domestic versus international emissions?
- What controls are in place currently for the international sources (where available)?
- What change in emissions is expected in the foreseeable future (where available)?
- Are there international agreements that are already addressing these emissions?

Domestic and international emissions inventories should be developed in a manner consistent with EPA's emission inventory guidance (EPA, 2017). Domestic emissions should have been developed by the state during the SIP development process and should conform to that guidance. Not all emission guidance that is relevant to the domestic emissions is practical for international sources. The international emissions database may either be developed as a part of the section 179B demonstration or leveraged from a pre-existing public database. In either case, the process for developing the database should be based on the same principles of emission inventory development as are included in the guidance for domestic emissions. When using a pre-existing database, the provenance and methodology used to build the international emissions database should be well documented. Ideally, the database should also be compared to well-established databases (*e.g.*, EDGAR, EDGAR-HTAP).

A prospective attainment demonstration is based on future emissions estimates for international and domestic sources. Thus, on-the-books emissions controls should be considered when projecting future air quality. In some cases, it may be difficult to forecast international emission changes. The section 179B demonstration should document a good faith effort to account for expected international emissions growth and emission reduction measures. If there are significant uncertainties in international emissions estimates, it may be useful to provide a range of estimates.

A Nogales, Arizona, PM_{10} section 179B demonstration (ADEQ, 2012)[34] illustrates the value of comparing domestic and international emissions for metropolitan areas. Nogales is the name of two cities (one in Arizona and one in Mexico) that share a border. The Nogales nonattainment area included only the U.S. side. The majority of the population and PM_{10} emissions, however, occur on the Mexican side of the border. Table 5 shows an example PM_{10} emissions from the Nogales nonattainment area, a range of emissions estimates from the cross-border municipality, and a range of percent contribution to the combined airshed emissions. ADEQ quantified emissions bounding the years (2008-2011) of exceedances being evaluated. The results in Table

[34] The citation of specific sections of a plan or demonstration as useful examples is not intended as an endorsement of the entire document.

5 are based on aggregated estimates for several broad source categories (not shown), including point, agricultural, residential wood combustion, waste burning, construction, onroad mobile, and nonroad sources.

Table 5: Annual Emission Inventories for Nogales, Arizona, and Nogales, Sonora, Mexico. Adapted from ADEQ (2012) Appendix A Clean Air Act Section 179B Attainment Determination for the Nogales, Arizona, PM_{10} Nonattainment Area; Tables 6-9.

	2008		**2011**	
	PM_{10}	**Percent**	**PM_{10}**	**Percent**
Nogales NAA, Arizona	1,531	18-36.1%	1,528	17.1-35.7%
Nogales Municipality, Mexico	[2,713-6,987]	[63.9-82]%	[2,757-7,420]	[64.3-82.9]%
Total	4,244-8,518	100%	4,285-8,948	100%

When the emissions inventory shows large emissions in a nearby international metropolitan area (large both in total and relative to local emissions), this supports a weight of evidence that international emissions are contributing to exceedances.

6.3.3. Modeling to Quantify International Contribution

Using air pollution modeling techniques – such as chemical transport models or dispersion models - can be a good way to estimate the contribution of international emissions to monitors exceeding the NAAQS. In some cases, sufficient modeling may be readily available from the relevant SIP or past EPA analyses. The key factors for determining which modeling technique to use include: proximity of the nonattainment area to the emissions source or source region, and whether the NAAQS exceedances at the monitor are the result of emissions that react in the atmosphere (such as O_3 or secondarily formed $PM_{2.5}$) or primary emissions (such as direct emissions of $PM_{2.5}$). Air agencies should consult with their EPA Regional office to determine the need for and applicability of modeling techniques.

6.3.3.1. Chemical Transport Modeling

Chemical Transport Modeling (CTM) is the preferred approach for quantifying international contribution for pollutants with a secondary component (such as O_3 and $PM_{2.5}$, which are formed, at least in part, as a result of photochemical reactions of precursor gases in the atmosphere). CTMs are necessary for quantifying long-range and secondary pollutant international contributions, and Baker & Kelly (2014) showed that CTMs can also reliably estimate single-source impacts relatively near the source. Thus, CTM application is not limited to regional-scale or national-scale international source contribution estimates. EPA has released guidance on performing CTM simulations (EPA, 2018c), which will be referred to hereafter as the modeling guidance. The applications described in the modeling guidance focus on SIP demonstration modeling, which is most directly applicable to the 179B(a) demonstration. For a 179B(b)-(d) demonstration, the observations and modeling would be from the attainment period rather than the designation period. The attainment period is the design value period used to determine whether the area attained by the applicable attainment date, while the designation period is the design value period used to designate the area as nonattainment. For either type of demonstration, the technical approach is similar. Both benefit from day-specific evaluation and analysis but can use a representative modeling year to evaluate sensitivity to controls (either domestically or internationally). When using a surrogate year, a demonstration should examine the impact of year-specific meteorology and transport patterns. Contributions from international sources can use various techniques described in the modeling guidance. The modeling guidance document describes "brute-force" sensitivity modeling (*i.e.*, rerunning the model simulation with emissions that have either been reduced or zeroed out from sources of interest) and source apportionment modeling that can be used to identify contributions from specific types of sources or source sectors, including international emissions.

Any modeling analysis for evaluating long-range impacts of international emissions will typically include a global simulation and a regional simulation. The global component is often used to supply boundary conditions to the regional simulation. To the extent practical, the two scales should use consistent meteorology, vertical resolution, emissions and representation of chemical species. The need for consistency is particularly true for the international emissions. It is also recommended to use consistent gas-phase chemical mechanisms and aerosol physics/chemistry components when conducting analyses with both global and regional simulations. Maintaining this consistency is critical when conducting analyses that zero-out anthropogenic emissions or rely on source apportionment modeling that targets sources present in both modeling scales.

Before estimating source contributions, the base case simulation[35] should be able to reasonably reproduce historical exceedances and gradients between internationally influenced days and other days. For example, if internationally influenced days (identified by meteorology or trajectory analysis) are observed to have a higher concentration than on other days, then the base case should similarly predict higher concentrations on those days. This relationship is important because international contribution is often considered in a fractional sense. As a fraction, the denominator is total O_3. If the total O_3 on internationally influenced days is biased low, that could be due to international or local sources. Predicting the right pattern related to the international contribution does not guarantee accurate fractional prediction, but accuracy improves confidence in model results. Thus, the air agency should conduct both a model performance evaluation and diagnostic evaluation as described in the modeling guidance. These evaluations will provide confidence that variability in international contributions is reasonably well represented.

After the base case has been evaluated and shown capable of representing observations on internationally influenced days, then quantification of the international sources can commence. The choice of base case should match the application. For prospective demonstrations, the modeling should use the same base case and future year, consistent with the SIP modeling. For retrospective demonstrations, the modeling should focus on years used in the attainment evaluation. Quantifying the impact from international sources, as previously stated, may be done using a combination of sensitivity and/or source apportionment model runs. Depending on the scale of the analysis, this work may require coordinated efforts between a global and regional simulation. When this is the case, it is especially important to understand the consistency of inventories developed at the different scales. Regardless of the technique used for quantification

[35] Base case is used to denote a simulation of a historical year that represents a baseline period (*e.g.*, design value period) before emission projections and hypothetical controls are applied to project a future year air quality state.

of source contributions (*e.g.*, sensitivity or source apportionment modeling), the most important aspect is appropriate implementation, discussed next.

The appropriate implementation of both sensitivity and source apportionment simulations begins with identifying the sources to be quantified. The sources to be quantified should be consistent with those described in the conceptual model. If the conceptual model links proximate international sources (*e.g.*, for near-border receptors), then sensitivity runs would include perturbations to just these emissions and source apportionment should isolate the influence of these emissions as a separate tag. When the emissions cross scales (global to regional), the emissions should be consistent between the two scales and the sensitivity or source apportionment modeling must also cross scales. For sensitivity analyses, the boundary conditions for the regional perturbation simulation would be provided by a consistent perturbation in the global model.

In addition, the sensitivity or source apportionment modeling results should include an estimate of contribution from the U.S. for comparison. It may also be useful to separate the U.S. contribution into the nonattainment area's own state contribution and contributions from all other U.S. states. The collection of modeled results can be used to estimate the contribution of domestic and international anthropogenic sources.

Model contributions will be imperfect, and an estimate of a range should be considered and discussed in the context of the demonstration. Particularly for sensitivity modeling, the order of emission perturbations influences the result (zeroing the international source or the local source give different answers). Thus, two estimates of international source contribution should be developed and used to help characterize a range. The range of results should demonstrate that international anthropogenic sources were large contributors relative to U.S. contributions on exceedance days.

Simulation results may be available from analyses conducted for a related regulatory program in lieu of developing modeling specific for the application. For example, EPA often performs source apportionment analyses with its modeling platform. EPA 2011 modeling platform and Western Air Quality Study ("WAQS") 2011 platform have both made source apportionment modeling publicly available (EPA, 2016a).[36] These model results include an estimate of future-year contribution from "in-domain" Mexico and Canada. If the conceptual model identifies near-source Mexican or Canadian sources as key contributors to nonattainment area exceedances, results from EPA modeling analyses may provide useful information in support of a prospective demonstration. For example, EPA's source apportionment results can be used as an upper bound estimate used to constrain adjustments proposed by trajectory analysis. EPA source apportionment results could also supplement state developed estimates to help characterize the credible range. In addition, the inputs for EPA's analysis provide a foundation for additional analyses that could be developed for a demonstration.

When results show that international contributions are larger on exceedance days and meaningfully larger than domestic contributions, the weight of evidence will be more

[36] Henderson, B. H. et. al. 2019 "Global Sources of North American Ozone" 18th Annual CMAS, Chapel Hill, North Carolina.

compelling. The appropriateness of using preexisting modeling for a section 179B demonstration should be discussed with the appropriate EPA Regional office.

6.3.3.2. Dispersion Modeling

Dispersion modeling is the preferred approach for quantifying contributions of near-monitor international emission sources of primary pollutants. For situations where the international contribution is from a single or group of industrial sources in close proximity (less than 50 km) to the impacted monitor, EPA has established several preferred dispersion models that can be used (The *Guideline on Air Quality Models*, i.e. Appendix W [37]), depending on the application. In most applications, EPA's preferred near-field model, AERMOD will be used. When applied in a section 179B demonstration, a dispersion model should be applied with actual emissions from the international source(s) and modeled for the time period of the monitor design value calculation. For these applications, EPA's Appendix W offers guidance on many modeling inputs and procedures. Additionally, the SO_2 NAAQS Designations Modeling Technical Assistance Document (TAD), provides recommendations on modeling domain, receptor placement, emissions inputs, meteorological data, and other inputs (EPA, 2018d). While the TAD is for SO_2, many of the recommendations would apply to other pollutants in section 179B demonstrations.

6.3.4. Receptor Modeling Analysis

This section describes receptor modeling and chemical finger-print approaches that are only applicable to identifying contributions from sources of particulate matter (or sources of pollutants that correlate well with particulate matter). Many tools are available for receptor modeling and discussed on the Support Center for Regulatory Atmospheric Modeling website (https://www.epa.gov/scram/air-pollutant-receptor-modeling). In an ideal case, there may be a unique tracer emission from a specific source across the border that can be used to identify international contribution. In more complex conditions, a Chemical Mass Balance or Positive Matrix Factorization may be used to identify international influence. With either approach, the connection of the receptor modeling to specific international sources will be critical.

6.3.4.1. Unique Tracer Analysis

A unique tracer analysis will need to include evidence that the tracer was emitted from the identified international source and that there are no sources of the tracer on the U.S. side of the border. Further, the tracer will need to be measurable above the detection limit in measurements made at or near the exceeding monitor.

The tracer choice will be extremely specific to the specific source and geographic area, but it should have certain properties. It should have a proportional relationship to total emissions of the pollutant and precursor potential from the source of interest. It should also be either chemically inert or have a lifetime much longer than the time spent in transport from the source to the monitor. If both of these properties are met, then the measured tracer concentration on exceeding days should be proportional to the international source contribution on exceeding days.

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[37] Appendix W to 40 CFR Part 51, *Guideline on Air Quality Models*

An analysis of tracer and international source contribution should be done on both internationally influenced exceedance days and days believed to be influenced by local sources (*see* Section 3.4.4 of this guidance). The contribution should be clearly larger on international transport days to demonstrate that there are not local sources of the tracer. Then, the contribution on exceeding, internationally influenced days would be subtracted from measured total to isolate the non-international contributions. If the non-international contribution is below the NAAQS, then this analysis would support a weight of evidence that international anthropogenic emissions caused the exceedance.

6.3.4.2. Chemical Mass Balance or Positive Matrix Factorization

Chemical mass balance (CMB) (Schauer & Cass, 2000; Schauer, et al., 1996; Watson, Chow, & Mathai, 1989; Watson, et al., 2015) and positive matrix factorization (PMF) (Aiken, et al., 2009; Lanz, et al., 2007; Larsen & Baker, 2003; Ulbrich, Canagaratna, Zhang, & Worsnop, 2009) are two examples of receptor modeling methods which can be used to estimate source contributions to particulate matter. Both techniques combine ambient observations of speciated particulate matter with a set of minimization equations to produce an estimate of the source or factor (which can be associated with a type of source) contribution to PM_{10} or $PM_{2.5}$.

Using these techniques in a section 179B demonstration necessitates a careful selection of source profiles (for CMB) or interpretation of factors (for PMF) to properly attribute which sources are international. For CMB, source profiles specific to or dominated by emission sources located outside of the U.S. need to be used along with domestic source profiles for proper attribution of the international contribution. For PMF, additional measurements such as wind direction may be used as input to strengthen the confidence that one of the factors is international in origin.

Like the unique tracer analysis, CMB or PMF should be performed on both exceedance days and days believed to be influenced primarily by local emissions. If a source or factor is identified which is solely or mostly international in origin, the contribution should be clearly larger on the days identified to be dominated by international transport. The contribution on exceeding, internationally influenced days would then be subtracted from measured total to isolate the non-international contributions. If the non-international contribution is below the NAAQS, then this analysis would support a weight of evidence that international anthropogenic emissions caused the exceedance.

PMF was applied for the Calexico-Ethel monitor in a 2014 section 179B demonstration. In their analysis, they identified industrial sources, secondary nitrate/sulfate, motor vehicle sources, airborne soil, and refuse burning. Refuse burning, which was attributed exclusively to Mexico, was identified by a high organic carbon, elemental carbon and chlorine signature. Figure 11 shows the results of that analysis pooled for 2010 to 2012 and for just the days during that period with high $PM_{2.5}$ concentrations. The demonstration also showed that the individual days identified as transport-influenced had high refuse concentrations.

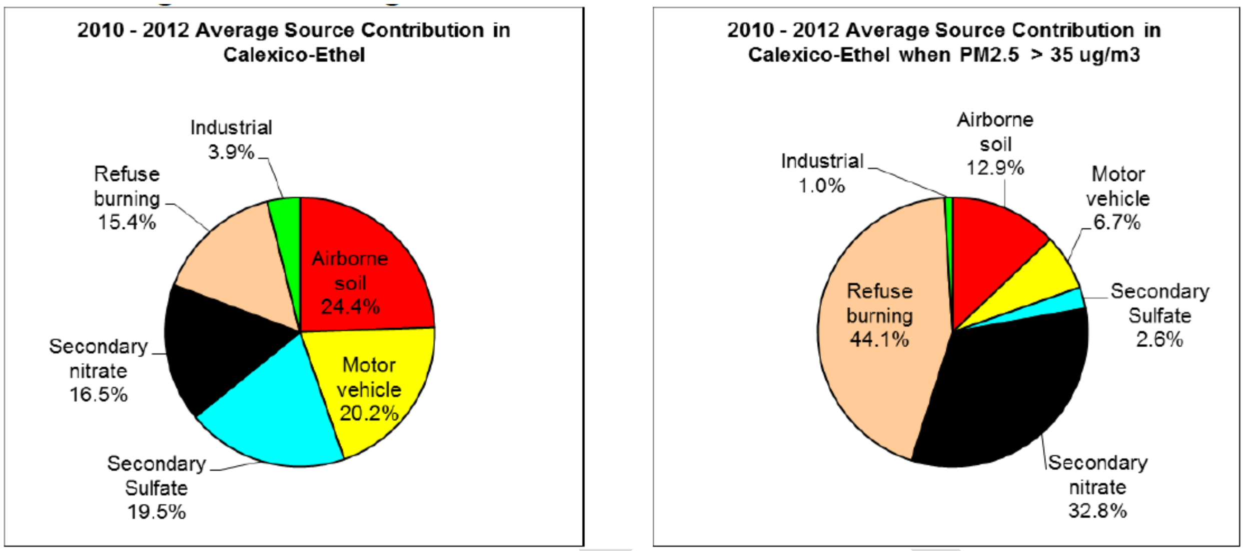

Figure 11: Average source contributions between 2010 and 2012 (CARB, 2014, p. Figure B2)[38]

Receptor modeling techniques are generally contrasted with dispersion/chemical transport models that use pollutant emissions rate estimates, meteorological transport, and chemical transformation mechanisms to estimate the contribution of each source to receptor concentrations. Receptor and dispersion/chemical transport models can be complementary in a section 179B demonstration, with each type having strengths that compensate for the weaknesses of the other.

6.4. Example Conclusion Statement in the Demonstration

A section 179B demonstration should begin with a conceptual model and follow with a demonstration that establishes a relationship between international anthropogenic emissions and the monitored exceedance(s) based on the weight of evidence. The demonstration includes multiple lines of evidence and analyses such as those identified in Section 6 of this guidance and should conclude with a statement similar to the language below:

> Based on the evidence, including comparisons and analyses, provided in section [*reference the relevant section(s)*] of this demonstration with respect to ambient air concentrations measured at the [name of monitor] on [dates], [*Air Agency Name*] has established that the [area name] area [would attain (for 179B(a) demonstrations) or would have attained for 179B(b)-(d) demonstrations) the [name of NAAQS] NAAQS by the relevant attainment date but for emissions emanating from outside the U.S.

7. Public Comment Process

In addition to providing a conceptual model and evidence of international anthropogenic emissions transport to the subject area in a demonstration, EPA encourages air agencies to conduct and document (in the demonstration) a public comment process for all section 179B

[38] The citation of specific sections of a plan or demonstration as useful examples is not intended as an endorsement of the entire document.

demonstrations prior to submitting the demonstration to EPA. In the case of a section 179B(a) "prospective" demonstration, the public comment process would be documented as part of completeness requirements in the associated SIP. In the case of a section 179B(b)-(d) "retrospective" demonstration, the air agency would likely need to conduct a demonstration-specific public comment process to include in its stand-alone submission.

Documentation of a public comment process as part of a section 179B demonstration should include information about how the public comment process was publicized, such as newspaper listings, website postings, and/or places (*e.g.*, library, agency office) where a hardcopy was available. EPA also recommends that air agencies include any comments received and the agency's responses to those public comments.

8. References

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