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May 13, 2011

Mark R. Vickery  
Executive Director  
Texas Commission on Environmental Quality  
P.O.Box 13087  
Austin, Texas 78711-3087



Re: Petition for Rulemaking

Dear Mr. Vickery:

Attached please find a Petition for Rulemaking pursuant to 30 Tex. Admin. Code Ch. 20 seeking to revise the Texas State Implementation Plan ("SIP") to reflect the growing impacts of foreign pollutant transport on ozone nonattainment areas throughout the State of Texas.

I appreciate your consideration. If you have any questions or I might be of assistance please let me know. Thank you.

Sincerely,

Handwritten signature of Jed Anderson in cursive.

Jed Anderson  
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Kingwood, TX 77345  
Phone: (281) 852-8064  
Email: [jedanderson@jedlaw.net](mailto:jedanderson@jedlaw.net)

Attachments

<b>PETITION FOR RULEMAKING</b>	§	
	§	
<b>BY JED ANDERSON</b>	§	<b>BEFORE THE TEXAS COMMISSION</b>
	§	
<b>TO REVISE THE TEXAS SIP TO</b>	§	<b>ON ENVIRONMENTAL QUALITY</b>
<b>REFLECT THE IMPACTS OF</b>	§	
<b>FOREIGN POLLUTANT</b>	§	
<b>TRANSPORT</b>	§	

**ORIGINAL PETITION FOR RULEMAKING**

**TO THE HONORABLE COMMISSIONERS:**

Now comes Jed Anderson (“Petitioner”), and pursuant to the provisions of 30 Texas Administrative Code (“TAC”) Chapter 20 hereby presents this Petition for Rulemaking to the Texas Commission on Environmental Quality (“Commission”) seeking to revise the Texas State Implementation Plan (“SIP”) to reflect the growing impacts of foreign pollutant transport on ozone nonattainment areas throughout the State of Texas. Specifically Petitioner requests that the Commission submit a Section 179B petition(s) to the U.S. Environmental Protection Agency (“EPA”) and, if approved, commence a rulemaking to reduce compliance burdens in impacted nonattainment areas for the purpose of rectifying the offsetting of foreign pollutant transport by Texas citizens. Petitioner respectfully requests that the Commission consider this Petition as set out herein and initiate proceedings necessary to effectuate the Section 179B petition(s) and corresponding SIP revision(s). Pursuant to the provisions of 30 TAC § 20.15, Petitioner would respectfully show the following:

**I. Public Policy Benefits**

This Petition is submitted in the interest of ensuring that the State of Texas and its citizens are no longer held responsible for paying for the growing cost of offsetting foreign pollutant transport in order to achieve the ozone National Ambient Air Quality Standard (NAAQS).

Under the Federal Clean Air Act, States are responsible for demonstrating attainment with the NAAQS (42 U.S.C. § 7407(a)). States cannot generally control foreign pollution (U.S. Const. Art. I, Sec.10). Since States must demonstrate attainment and cannot generally control foreign pollution, States are essentially being forced to further control local emission sources in order to offset the growing impacts of foreign pollution and achieve attainment. The Clean Air Act provides the following:

**“Each State shall have the primary responsibility for assuring air quality within the entire geographic area comprising such state by submitting an implementation plan for such State which will specify the manner in which national primary and secondary ambient air quality standards will be achieved and maintained . . .” (42 U.S.C. § 7407(a)).**

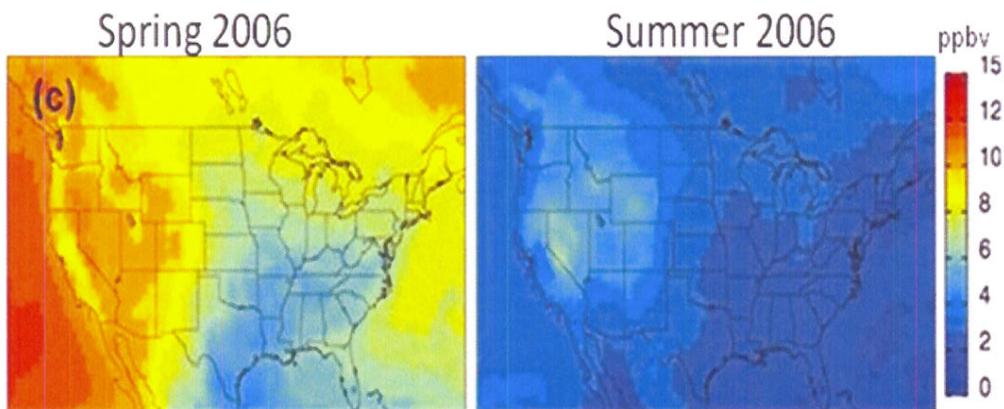
The potential exception to States offsetting foreign pollution is if a State successfully pursues a Section 179B petition. Section 179B provides the following:

**A SIP shall be approved if “the submitting State establishes to the satisfaction of [EPA] that the implementation plan of such State would be adequate to attain [the NAAQS] . . . but for emissions emanating from outside the United States.” (42 USC § 7509a).**

A section 179B petition was successfully obtained by the Commission for the El Paso region (see 68 FR 39457 and 59 FR 2532). Other SIPs in Texas however do not provide for or include such a Section 179B petition.

Growing evidence developed over the last several years now supports a finding that foreign pollution is impacting nonattainment areas throughout Texas (see below). Based on this growing body of evidence from such contributors as the United Nations, the EPA, Harvard, NOAA, and the University of California—it appears that the State of Texas has been requiring its citizens and businesses to offset perhaps 2 to 11 ppb’s worth of foreign ozone based on 2006 data (see below).

### Pollution Influence from Sources Outside the United States



(See Dr. Lin Zhang, “Domestic and foreign source attribution of nitrogen deposition and surface ozone pollution over the United States”, Attached).

A potential 2 to 11 ppb’s worth of ozone impacts from foreign sources translates into potentially billions of dollars in additional local controls and other nonattainment consequences to the State of Texas, its citizens, and its businesses. Of even greater potential import is the fact that foreign pollutant transport is expected to grow even more over the next 20 to 40 years (see below).

The Texas SIP(s) should be revised so that all nonattainment areas throughout Texas include a Section 179B petition to reflect the growing impacts of foreign pollution on the ability of the State to achieve attainment. Although Texas cannot use foreign pollution as an excuse, it is

unfair and unjust for the State of Texas to require its citizens and businesses to further reduce their own emissions in order to offset and make-up for the growing impacts of foreign pollutant transport. It is also unfair and unjust for the State of Texas to essentially show favoritism toward foreign pollution by further requiring domestic emission reductions in order to allow for more foreign emissions growth in future SIP planning.

Below are several examples of studies from the growing body of evidence demonstrating the impacts of foreign pollutant transport on the Texas SIP. Because of the length of these studies, full copies of these studies are hereby incorporated by reference in this Petition for Rulemaking and are available online at the weblinks listed below for the Commission's review as part of this Petition for Rulemaking.

► **2011 Harvard University Study entitled, "Domestic and foreign source attribution of nitrogen deposition and surface ozone pollution over the United States"**

- Pollution influence from sources outside the United States is increasing domestic ozone levels up to 11 ppbv or more based on an analysis of 2006 data.

-----L. Zhang, Harvard University, "*Domestic and foreign source attribution of nitrogen deposition and surface ozone pollution over the United States*", March 2011 (see Attached).

► **2010 Hemispheric Transport of Air Pollutant (HTAP Report) for the United Nations Convention on Long-Range Transboundary Air Pollution**

- "The sum of the health impacts of transported pollution in downwind foreign regions can be larger than the health impacts of emissions in the source region itself."

-----2010 Report of the Task Force on Hemispheric Transport of Air Pollution Report under the United Nations Convention on Long Range Transboundary Air Pollution, Executive Body, 28<sup>th</sup> Session ("2010 HTAP Report")(see <http://www.htap.org/>).

- "As public health-based air quality standards continue to be tightened based on new health effects research, the contribution of intercontinental transport to exceedances of such standards will continue to increase."

-----2010 HTAP Report

- "For North America ground-level O<sub>3</sub> concentrations, the RAIR [Relative Annual Intercontinental Response] is estimated to increase to around 50% under both the high and low emissions scenarios, suggesting that, in the future, changes in emissions of O<sub>3</sub> precursors outside the region may be as important as changes within the region."

-----2010 HTAP Report

- “With changing global future emissions, it is likely that over the next 20 to 40 years it will become even more difficult for nations to meet their own environmental policy objectives without international cooperation to address transboundary and intercontinental flows of air pollution.”

-----2010 HTAP Report

- “Measurements at some locations on the western coasts of Europe and North America clearly show that trans-oceanic air flows can carry O<sub>3</sub> concentrations that approach or exceed some air quality standards or objectives.”

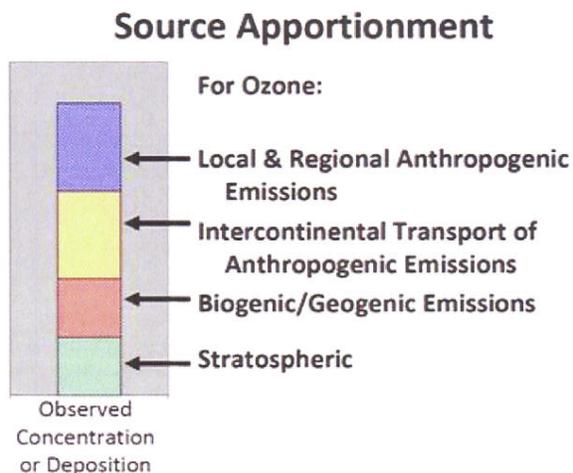
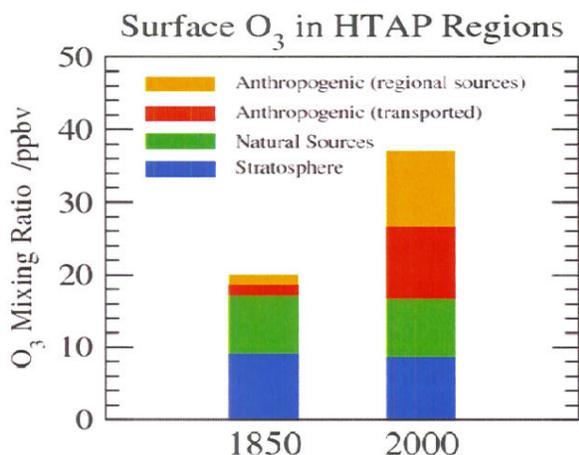
-----2010 HTAP Report

- “In these regions [North America, Europe, and East Asia] in winter, intercontinental transport of O<sub>3</sub> may exceed local and regional production.”

-----2010 HTAP Report

- “There is now a growing recognition of the importance of the transport of air pollutants over much longer distances than hitherto had been recognized. Hemispheric and intercontinental transport of air pollutants, especially ozone and PM, has been established as an important factor in air quality management.”

-----Report of the United Nations Executive Body for the Convention on Long-range Transboundary Air Pollution, February 2011, (see <http://www.unece.org/env/documents/2010/eb/eb/ece.eb.air.106.add.1.pdf>)



-----See 2010 HTAP Study and United Nations LRTAP report: [http://www.neaspec.org/documents/tap\\_jan\\_2011/2.%20Recent%20Developments%20on%20black%20carbon%20and%20further%20actions%20on%20some%20pollutants%20within%20CLRTAP\\_Mr.OLENDRZYNSKI%20BC%20final.pdf](http://www.neaspec.org/documents/tap_jan_2011/2.%20Recent%20Developments%20on%20black%20carbon%20and%20further%20actions%20on%20some%20pollutants%20within%20CLRTAP_Mr.OLENDRZYNSKI%20BC%20final.pdf)

► **EPA/Harvard/NOAA Study entitled, “Linking ozone pollution and climate change: The case for controlling methane”**

- “Although fossil fuel emissions in the U.S. for NO<sub>x</sub>, CO, and VOC decline in the IPCC A1 2030 scenario relative to 1995 by 27%, 45%, and 30%, respectively, we find that the number of grid-square summer days over the U.S. with O<sub>3</sub> > 70 ppbv increases relative to 1995. **Efforts to improve U.S. air quality are thus thwarted by the rise in global background O<sub>3</sub> levels due to increased emissions outside U.S. borders.**”

-----Harvard, EPA, et. al., “*Linking Ozone Pollution and Climate Change: the Case for Controlling Methane*”, October 8, 2002 (see [http://www.gfdl.noaa.gov/bibliography/related\\_files/amf0201.pdf](http://www.gfdl.noaa.gov/bibliography/related_files/amf0201.pdf))

► **Harvard 2008 Study entitled, “Transpacific transport of ozone pollution and the effect of recent Asian emission increases on air quality in North America**

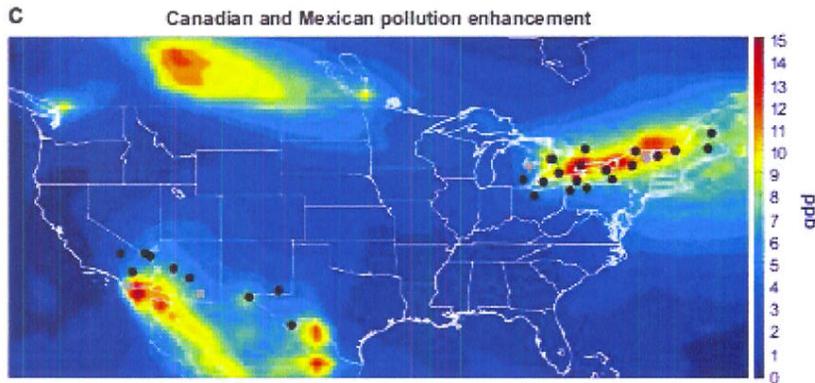
- “Asian pollution enhanced surface ozone concentrations by 5-7 ppbv over western North America in the Spring of 2006.”

-----Zhang et. al., “*Transpacific transport of ozone pollution and the effect of recent Asian emission increases on air quality in North America: an integrated analysis using satellite, aircraft, ozone, and surface observations*”, *Atmos. Chem. Phys.*, 8, 6117-6136 (2008), see <http://www.atmos-chem-phys.org/8/6117/2008/acp-8-6117-2008.pdf>.

► **2009 Harvard Study entitled, “Surface ozone background in the United States: Canadian and Mexican pollution influences”**

- Researchers concluded that pollution from Mexico and Canada enhances ozone concentrations in the United states by an average of 3-4 ppb in the summer and can increase ozone concentrations “much higher in downwind regions of the northeast and southwest.”

-----H. Wang et. al., “*Surface ozone background in the United States Canadian and Mexican Pollution Influences*”, *Atmos. Env.* 43, 1310-1319(2009) (see [https://www.cfa.harvard.edu/~hwang/publication/Wang08\\_O3\\_CANMEX.pdf](https://www.cfa.harvard.edu/~hwang/publication/Wang08_O3_CANMEX.pdf))



-----H. Wang et. al., “*Surface ozone background in the United States Canadian and Mexican Pollution Influences*”, Atmos. Env. 43, 1310-1319(2009) (see [https://www.cfa.harvard.edu/~hwang/publication/Wang08\\_O3\\_CANMEX.pdf](https://www.cfa.harvard.edu/~hwang/publication/Wang08_O3_CANMEX.pdf))

► **2010 NOAA Study entitled, “Increasing springtime ozone mixing ratios in the free troposphere over western North America”**

- Study showed that international emissions, particularly from south and east Asia, accounted for an overall increase in the median ozone rate in western North America of more than 0.6 ppb per year between 1995 and 2008.

-----O.R. Cooper et al., “*Increasing springtime ozone mixing ratios in the free troposphere over western North America*”, Nature 463, 344-348 (Jan. 21, 2010), (see <http://www.nature.com/nature/journal/v463/n7279/full/nature08708.html>).

- “Our result agrees with previous modeling studies, which indicate that **global ozone concentrations should be increasing during the early part of the twenty-first century** as a result of increasing precursor emissions, especially at northern mid-latitudes, with western North America being particularly sensitive to rising Asian emissions. We suggest that the observed increase in springtime background ozone mixing ratio **may hinder the USA’s compliance with its ozone air quality standard.**”

-----O.R. Cooper et al., “*Increasing springtime ozone mixing ratios in the free troposphere over western North America*”, Nature 463, 344-348 (Jan. 21, 2010), (see <http://www.nature.com/nature/journal/v463/n7279/full/nature08708.html>).

► **2010 University of California Berkeley Study entitled, “Pb Isotopes as an indicator of the Asian Contribution to Particulate Air Pollution in Urban California”**

- Study found as much as 80% of the lead in an air sample from the San Francisco area originated in Asia.

-----Stephanie A. Ewing et. al., “*Pb Isotopes as an Indicator of the Asian Contribution to Particulate Air Pollution in Urban California*”, *Environ. Sci. Technol.*, 2010, 44 (23), pp 8911–8916, October 29, 2010, see <http://pubs.acs.org/doi/abs/10.1021/es101450t>.

► **2009 National Research Council Report, “Global Sources of Local Pollution: An Assessment of Long-Range Transport of Key Air Pollutants to and from the United States”**

- "The relative importance of long-range pollutant contributions from foreign sources is likely to increase as nations institute stricter air-quality standards that result in tougher emission controls on domestic sources"

-----National Research Council Report, “*Global Sources of Local Pollution: An Assessment of Long-Range Transport of Key Air Pollutants to and from the United States RC Report*” (“NRC Report”), 2009 (see [http://www.nap.edu/openbook.php?record\\_id=12743](http://www.nap.edu/openbook.php?record_id=12743)).

- "It is possible that emissions from emerging economies like China, with relatively limited emissions controls, are outpacing reductions in the developing countries"

-----NRC Report

- “The Committee thus concludes that long-range transport of pollutants from foreign sources can under some conditions have a significant impact on U.S ambient concentrations and deposition rates for each of the four pollutant classes considered and that U.S. environmental goals are affected to varying degrees by nondomestic sources of these pollutants.”

-----NRC Report

## II. Petitioner’s Name and Address

Petitioner’s name is Jed Anderson and his address is 6118 Soaring Pine Court, Kingwood, TX 77345.

### **III. Brief Explanation of the Proposed Rule**

The proposed rule would be to revise the Texas SIP(s) to include Section 179B petition(s) for all of the ozone nonattainment regions throughout Texas. The purpose would be to recognize the growing impact of foreign pollution on the ability of Texas to achieve attainment and to rectify the situation where Texas citizens and businesses are paying for the cost of offsetting foreign emissions by further reducing emissions from their own sources in order to make-up for the impact of foreign emissions on NAAQS attainment.

### **IV. Text of the Proposed Rule**

The proposed rule change would be made to the Texas SIP(s) as a SIP revision(s) to the attainment demonstration plan(s). Examples of SIP revisions are provided at the following TCEQ weblink: <http://www.tceq.texas.gov/airquality/sip/siplans.html>. A suggested text for inclusion in the SIP narrative, once the underlying Section 179B petition is approved, would be the following:

#### **Foreign Pollutant Transport**

*Based on the Commission's review of the role of international pollutant transport on domestic pollution levels in Texas, it appears that foreign pollution is impacting ozone nonattainment areas throughout the State of Texas. Such foreign pollutant influence appears to be growing and is projected to continue growing over the next 20 to 40 years.*

*The Federal Clean Air Act provides that the State of Texas SIP shall be approved if "the submitting State establishes to the satisfaction of [EPA] that the implementation plan of such State would be adequate to attain [the NAAQS] . . . but for emissions emanating from outside the United States." (42 USC § 7509a). In order to properly reflect the impacts of foreign pollution on the ability of the State of Texas to achieve attainment, and to rectify any situation where Texas citizens and businesses are paying for the cost of offsetting foreign pollution in order to attain the NAAQS, the Commission has submitted and received approval for a Section 179B petition from EPA. The modeling and control strategies in the SIP have therefore been adjusted to properly reflect the contribution from foreign pollution to the States ability to achieve the ozone NAAQS in Texas.*

### **V. Statement of the Statutory Authority for the Rule Petition**

Below is the statutory authority allowing the Commission to pursue a Section 179B petition and revise its State Implementation Plan accordingly:

#### **Statutory Authority to Pursue a Section 179B Petition**

Section 179B of the Federal Clean Air Act provides the following:

**A SIP shall be approved if “the submitting State establishes to the satisfaction of [EPA] that the implementation plan of such State would be adequate to attain [the NAAQS] . . . but for emissions emanating from outside the United States.” (42 USC § 7509a).**

The State of Texas has already successfully pursued a Section 179B petition for the El Paso nonattainment area (*see* 68 FR 39457 and 59 FR 2532).

### **Statutory Authority to Revise the SIP**

- The Federal Clean Air Act (FCAA), 42 USC, §7410, et. seq., requires states to submit SIP revisions that specify the manner in which the NAAQS will be achieved and maintained within each air quality control region of the state;
- Tex. Health & Safety Code § 382.002, which provides that the policy and purpose of the TCAA is to safeguard the state's air resources from pollution;
- Tex. Health & Safety Code §382.011, which authorizes the commission to control the quality of the state's air;
- Tex. Health & Safety Code §382.012, which authorizes the commission to prepare and develop a general, comprehensive plan for the control of the state's air;
- Tex. Health & Safety Code §382.0172, which delineates the Section 179B petition process;
- Texas Water Code §5.102, General Powers; and
- Texas Water Code §5.013, General Jurisdiction of Commission

### **VI. Injury or Inequity Resulting from Failure to Adopt the Proposed Rule**

The injury and inequity resulting from the failure of the State of Texas to acknowledge the current and growing impacts of foreign pollutant transport on the ability of Texas citizens and businesses to achieve the ozone NAAQS would be significant. It is both unfair and unjust to require Texas citizens and businesses to further reduce their own emissions in order to offset foreign pollution impacts. It is also unfair and unjust to prejudice foreign sources over Texas sources in terms of requiring Texas sources to further reduce their own emissions to allow for more future expected growth from foreign emissions in the SIP planning process.

Based on the above studies it appears that the State of Texas may currently be requiring its own citizens and businesses to offset perhaps 2 to 11 ppb's worth of foreign ozone based on 2006 data. This impact from foreign pollutant transport is expected to grow even more over the next

20 to 40 years. A 2 to 11 ppb's worth of ozone adjustment translates into potentially billions of dollars in controls and other nonattainment consequences for the State of Texas, its citizens, and its businesses. A difference between 2 to 11 ppb for example might mean the difference between attainment and nonattainment for an entire metropolitan area.

It must again be emphasized that Texas cannot use foreign emissions as an excuse, but it simply is unfair and unjust to require Texas citizens and businesses to further reduce their own emissions in order to offset foreign emissions impacts and achieve attainment.

It is difficult to foresee how much credit EPA will give the State of Texas in the requested Section 179B petition(s) for international pollution transport, but it appears that EPA will have to give the State of Texas something. It would appear difficult for EPA to argue that there are no emissions coming into Houston, Dallas, Austin, San Antonio, Waco, and other Texas cities from other countries—especially since EPA's own studies and other studies now show evidence quite to the contrary (*see* above studies from NOAA, the EPA, the United Nations, Harvard, the National Research Council, and the University of California).

For the above reasons it appears incumbent upon the Commission to pursue this Petition for Rulemaking in order to ensure justice and fairness to Texas citizens—and to acknowledge the growing impacts of foreign pollutant transport on the Texas SIP.

## VII. Prayer

WHEREFORE, premises considered, Petitioner respectfully requests that the Commission submit a Section 179B petition(s) to EPA in order to address the growing impacts of foreign pollutant transport on ozone nonattainment areas throughout the State of Texas and to revise the Texas SIP accordingly. The Petitioner further prays for any and all other relief to which Petitioner may be entitled.

Respectfully submitted,



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**ATTACHMENT**



# Domestic and foreign source attribution of nitrogen deposition and surface ozone pollution over the United States

Lin Zhang<sup>1</sup> (linzhang@fas.harvard.edu), Daniel J. Jacob<sup>1</sup>, Claire C. Carouge<sup>1</sup>, Eladio Knipping<sup>2</sup>, Naresh Kumar<sup>2</sup>, Yuxuan Wang<sup>3</sup>, Dan Chen<sup>4</sup>, and Aaron van Donkelaar<sup>5</sup>

<sup>1</sup> Harvard University, <sup>2</sup> Electric Power Research Institute, Los Angeles, Los Angeles, <sup>3</sup> Dalhousie University

## 1. Introduction

Atmospheric input of reactive nitrogen to ecosystems has increased by more than a factor of 3 globally due to human activity [Galloway et al., 2004]. Consequences include soil acidification, eutrophication, and a reduction in plant biodiversity. The US Environmental Protection Agency (EPA) is presently developing secondary air quality standards for protection of ecosystems against the detrimental effects of nitrogen deposition [US EPA, 2010]. This requires a better understanding of nitrogen deposition over the U.S. in its various forms and including contributions from a range of sources both natural and anthropogenic, foreign and domestic.

For surface ozone, the US air quality standard is becoming increasingly stringent. As the standard decreases to values close to the northern mid-latitude background, one needs to assess whether it can be met solely through domestic emission reductions.

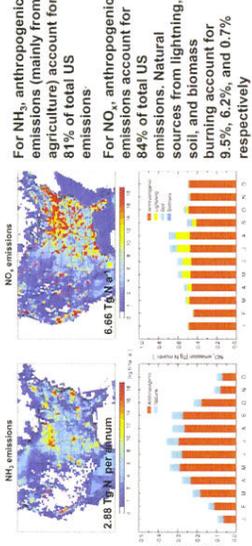
Here we use a nested version of the global GEOS-Chem chemical transport model (CTM) to address these issues.

## 2. The GEOS-Chem nested simulations

The nested version of GEOS-Chem [Wang et al., 2004; Chen et al., 2009] has 0.5° × 0.667° horizontal resolution over North America and adjacent oceans (140°–40°W, 10°–70°N), and 2° × 2.5° horizontal resolution for the rest of the world.

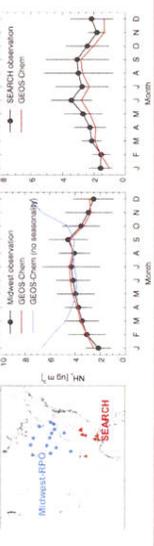
We conduct whole year model simulations for 2006–2008 and three sensitivity simulations for 2006: 1) without US anthropogenic emissions, 2) without North American anthropogenic emissions, and 3) without global anthropogenic emissions. Differences between these simulations allow us estimate the contributions from domestic and foreign emissions.

The Figure below shows the annual total NH<sub>3</sub> and NO<sub>x</sub> emissions for 2006–2008, and their monthly variations over the contiguous US.



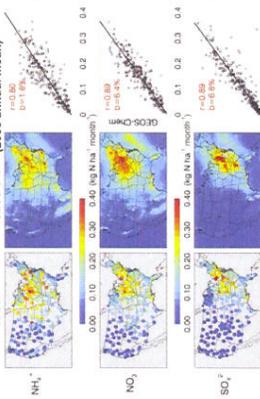
For NH<sub>3</sub>, anthropogenic emissions (mainly from agriculture) account for 81% of total US emissions. For NO<sub>x</sub>, anthropogenic emissions account for 84% of total US emissions. Natural sources from lightning, soil, and biomass burning account for 9.5%, 6.2%, and 0.7% respectively.

US anthropogenic NH<sub>3</sub> emissions are constrained with the total reduced nitrogen (NH<sub>3</sub> + NH<sub>4</sub><sup>+</sup>) air concentration data as shown in the Figure below. We derive monthly scaling factors to match the mean NH<sub>3</sub> concentrations observed at Midwest-RPO sites. These scaling factors are applied nationwide. Comparison with NH<sub>3</sub> measurements at SEARCH sites supports the derived emissions.

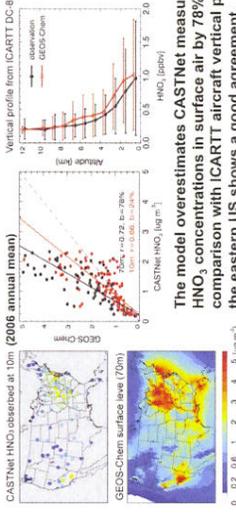


## 3. Wet deposition and surface concentration

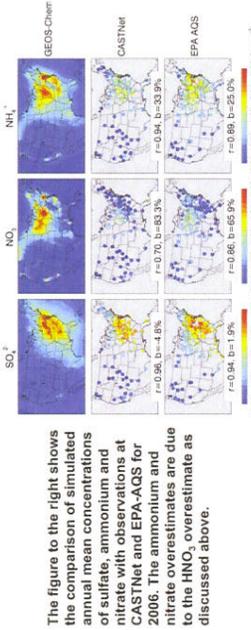
The figure on the left shows comparisons of simulated wet deposition fluxes of sulfate, ammonium, and nitrate with measurements from the National Atmospheric Deposition Program (NADP). The correlation coefficients (r) and mean biases (b) are shown inset. The model reproduces the geographical variations and the annual mean wet deposition with insignificant biases.



Vertical profile from ICART-DC-8



The model overestimates CASTNet measurements of HNO<sub>3</sub> concentrations in surface air by 78%, but comparison with ICART aircraft vertical profiles over the eastern US shows a good agreement.



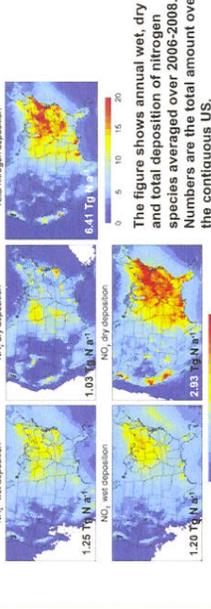
## Acknowledgements

This work has been funded by the Electrical Power Research Institute (EPRI)

## References

Galloway, J. N., et al. (2004). *Biogeochemistry*, 70. US EPA, 2004. EPA-452/P-04-009a. Wang, Y. X., et al. (2004). *J. Geophys. Res.*, doi: 10.1029/2004JD005237. Chen, D., et al. (2009). *Atmos. Chem. Phys.*, 1310-1319.

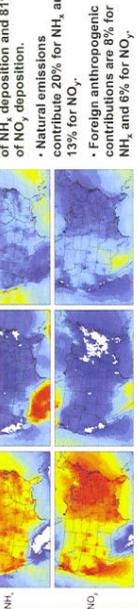
## 4. Source attribution of US nitrogen deposition



The figure shows annual wet, dry and total deposition of nitrogen species averaged over 2006–2008. Numbers are the total amount over the contiguous US.

NO<sub>x</sub> dry deposition is the dominant contributor. HNO<sub>3</sub> accounts for 65% of the dry deposition with a value of 1.92 Tg N a<sup>-1</sup>. Annually 20% of the NH<sub>3</sub> emissions are exported and not deposited over the US land, and 38% for NO<sub>x</sub> emissions.

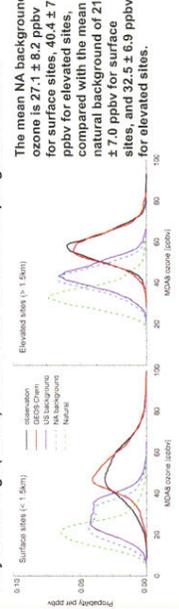
The figure below shows the percentage contributions from US domestic, foreign anthropogenic, and natural emissions for 2006



- Domestic anthropogenic emissions contribute 72% of NH<sub>3</sub> deposition and 61% of NO<sub>3</sub> deposition.
- Natural emissions contribute 20% for NH<sub>3</sub> and 13% for NO<sub>3</sub>.
- Foreign anthropogenic contributions are 8% for NH<sub>3</sub> and 6% for NO<sub>3</sub>.

## 5. Source attribution of surface ozone pollution

We evaluate the model ozone simulation by comparison to observations at CASTNet sites. The figure below shows the probability distributions of maximum daily 8-h average (MDA8) ozone concentrations for spring-summer 2006.



The mean NA background ozone is 27.1 ± 8.2 ppbv for surface sites, 40.4 ± 7.3 ppbv for elevated sites, compared with the mean natural background of 21.8 ± 7.0 ppbv for surface sites, and 32.5 ± 6.9 ppbv for elevated sites.

Simulated NA background ozone for 2006 is ~5 ppbv higher in western intermountain US and ~2 ppbv higher in the east than the previous GEOS-Chem studies of Fjore et al. [2003] and Wang et al. [2009] for 2004. This may reflect improved model representations or a real trend in the background.

a) NA background ozone

b) Canadian/Mexico influences

c) Influences from anthro. emissions outside NA