Written Testimony

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Mr. Chairman and Members of the Committee, thank you for giving me the opportunity to testify today regarding information related to the estimation and usage of background ozone concentrations in regulatory modeling. I especially would like to thank Representative Biggs for the invitation to appear before you.

INTRODUCTION

As air quality scientists, one of our main objectives is to reduce and understand the uncertainty involved with modeling ozone concentrations in past, current, or future timelines. Each data input, calculation, model, or method that supports our analyses have their own uncertainties that need to be studied in order to understand the impact of these elements on policy decisions.

To this end, there are a number of categories of pollutant concentrations that have inherent uncertainty in a regulatory sense. One of those categories is background ozone.

Background ozone has historically been defined as amounts of pollutant concentrations that are produced by sources other than people. Because amounts of ozone measured at ambient air quality monitors cannot be separated into background or anthropogenic origin, this amount needs to be determined using photochemical modeling and source apportionment tools. We know that many sources of background ozone are global in origin, and the fact that ozone is not emitted directly, rather, it is formed by reaction of hydrocarbon and nitrogen species in the presence of sunlight complicates the linkage of particular emissions to downwind ozone concentrations.

As is shown in Figure 1, the last decade has seen significant improvement in ozone air quality over most of the U.S., based on the 4^{th} highest observed regulatory value (design value); however some parts of the country have seen flatter trends or even elevated levels of ozone largely thought to be the increased contribution of background ozone (Figure 2).

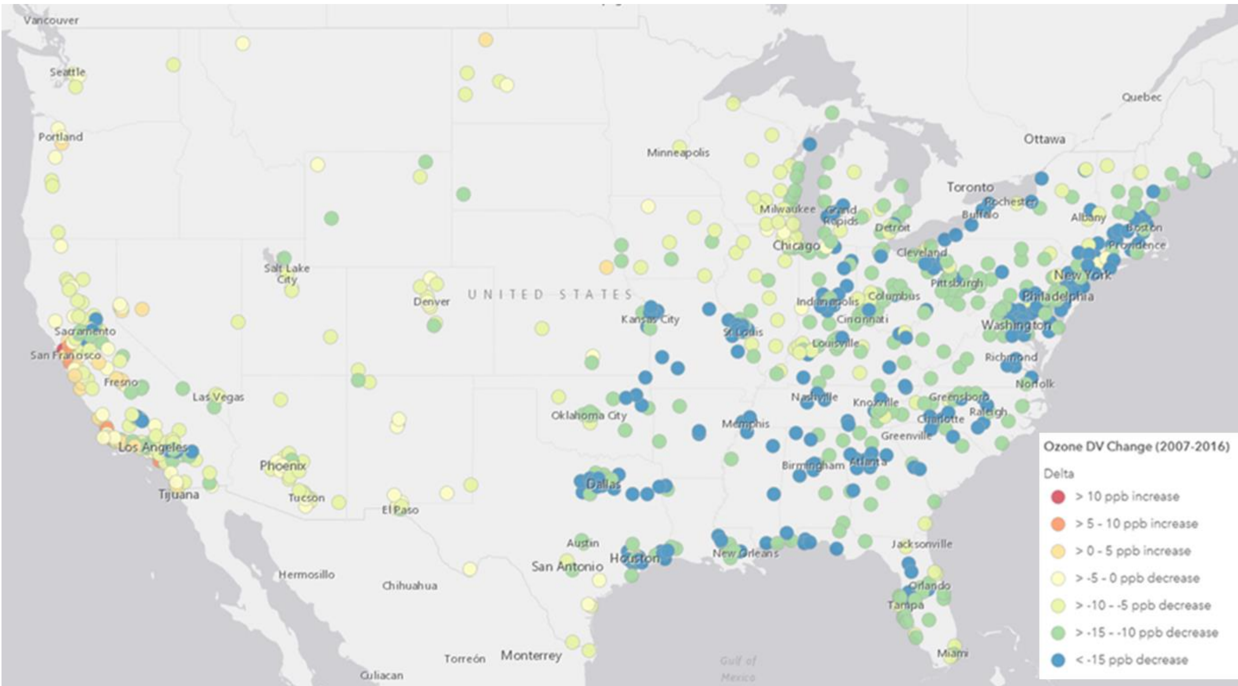

Figure 1. Trends in 2007 to 2016 MDA8 3-year ozone design values (parts per billion by volume; ppb) at AQS sites with a complete data record. Data Source: https://www.epa.gov/air-trends/air-quality-design-values

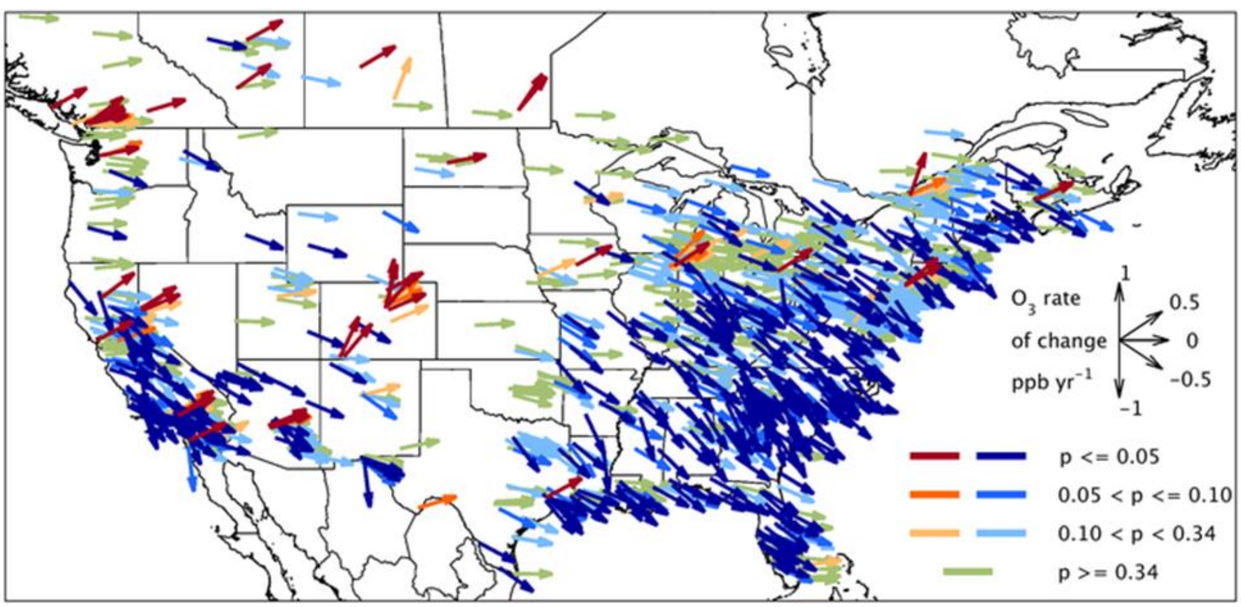

Figure 2. Trends in summer daytime average ozone, 2000 to 2014, 4th high maximum daily 8-hour ozone across all sites. Source: Tropospheric Ozone Assessment Report (Schultz et al., 2017)

BACKGROUND OZONE MODELS

As an air quality community, we use global chemistry models like Goddard Earth Observing System – Chemistry model (GEOS-CHEM), Model for OZone And Related chemical Tracers (MOZART), or Geophysical Fluid Dynamics Laboratory – Atmospheric Component 3 (GFDL-AM3) to derive boundary conditions, which include background emissions, to inform our regional models. What this means is that we generate global concentrations of ozone at very coarse scale and mesh them with our own regional and local modeling platforms which are of a much finer granularity.

These estimates are informed by global emission inventories of varying quality depending on the state-of-science in each source county. Here in the U.S., we support the global models with our EPA-generated National Emission Inventories (NEI), arguably of the highest quality in the world that uses continuous emission monitors, regular stack testing, and model generated quantification oftentimes corroborated with on-ground measurements. For other counties without regulatory agencies or support in inventorying its emitting sources, these data may be developed in a top-down manner using methods like population-based emission factors. To this we add regional background concentrations from models that estimate biogenic or wildfire emissions and complete the platform with our national inventories of anthropogenic sources.

One of the greatest challenges we face in using these global models is the scaling of the coarse information to match the configuration of our regional models. Each model may have a different temporal, spatial, or chemical composition compared to the regional configurations and yet provide information of great importance to our regional and local-scale policy-informing science.

For the background categories that are generated within the U.S. boundaries, we also use models to derive biogenic emissions or NOx from soil, either natural or fertilized. Models like the Biogenic Emission Inventory System (BEIS) or Model of Emissions of Gases and Aerosols from Nature (MEGAN) estimate the emission of gases and aerosols from terrestrial ecosystems into the atmosphere. Driving variables include landcover, weather, and atmospheric chemical composition. However, even with the higher quality data available to us to support these models, different versions of our biogenic models can have widely ranging results for speciated components of ozone precursor emissions leading to increased uncertainty in our background calculations.

Wildfire emissions can be based on models, like the SMARTFIRE2 system, to estimate wild land fire emission estimates augmented with local activity data (acres burned, types of fuels, fuel consumption values, etc.) obtained from ground-level surveys to make emission estimates for both wild and prescribed fires more accurate. Other options include the Fire INventory from the National Center for Atmospheric Research (NCAR) (FINN) that uses satellite observations of active fires and land cover, together with emission factors and estimated fuel loadings to provide daily, highly-resolved (1 km) open burning emissions estimates for use in regional and global chemical transport models.

CONTRIBUTION OF BACKGROUND TO MODELED OZONE CONCENTRATIONS

When we look at all these factors and run our source apportionment tools on the resulting modeling platforms, we, EPA, and others have found that background ozone can range from 10 percent of the modeled contribution to close to 90 percent on any single modeled day. Over an entire year, this can average to greater than 50 ppb of total modeled ozone depending on location; with higher background contribution seen in the western, high elevation monitor locations. This is a large fraction of the current 70 ppb ozone standard and can make it very difficult, if not impossible, for many regions of the country to attain the NAAQS. Figure 3 represents the source apportioned contribution of U.S. anthropogenic emissions compared to the regulatory design value (4th highest observed day) for a 2011 modeling episode. In this example from EPA, as much as 85 percent of modeled ozone in the western Rockies region comes from categories other than U.S. anthropogenic sources with a minimum of no less than 18 percent contribution across the rest of the country.

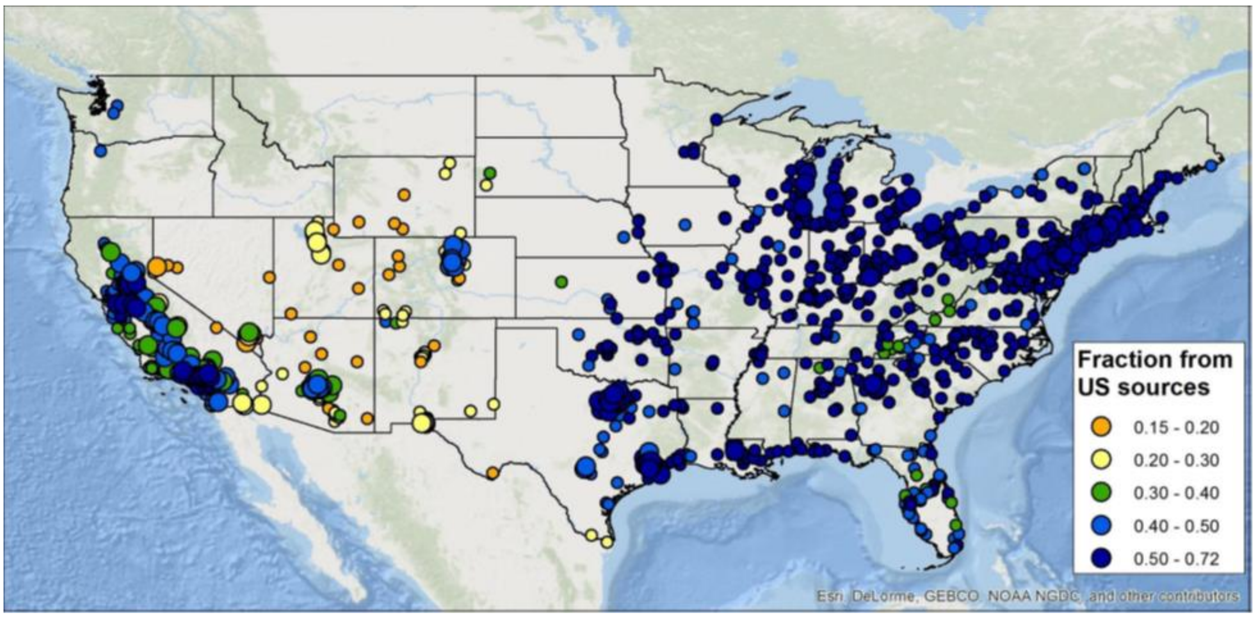

Figure 3. Map of estimated anthopogenic U.S. contribution to ozone design values based on CAMx source apportionment modeling (2011). Larger circles represent sites with 2015 DV2 > 70 ppb. Source: Dolwick, P. Mid-Atlantic States Section Annual Workshop, "Ozone: Challenges, Trends, Strategies, and New Developments." New Brunswick, NJ, October 12th, 2017.

An overall impact assessment of the influence of background ozone with respect to boundary condition modeling is extremely important as the level of the ozone NAAQS decreases and the relative contribution of boundary condition emissions increases. In many parts of the country, the contribution of controllable U.S. sources is a small portion of the overall ozone concentration which includes both background and local contribution. As the incremental cost of every ton of emissions increases, a diminishing rate of return on U.S. control programs impacting air quality, nationally, regionally, or locally is being observed with historically comparable levels of emission reductions.

REGULATORY IMPACT OF BACKGROUND OZONE

The importance of transported pollution has long been understood. The Clean Air Act has provisions to account for it. Section 179B of the Clean Air Act states, with respect to ozone, that "*any State that establishes to the satisfaction of the Administrator that, with respect to an ozone nonattainment area in such State, such State* *would have attained the national ambient air quality standard for ozone by the applicable attainment date, but for emissions emanating from outside of the United States*".

In the 2008 ozone SIP Requirements Rule, the EPA stated that a Section 179B demonstration could include consideration of any emissions from North American or intercontinental sources. (80 FR 12293). The EPA also stated at that time that it did not believe use of section 179B was limited to nonattainment areas adjoining international borders.

More recently, however, in the *Proposed Implementation of the 2015 National Ambient Air Quality Standards for Ozone: Nonattainment Area Classifications and State Implementation Plan Requirements* (81 FR 81276), EPA requested comment on narrowing the scope of the Section to just international border states based on its anticipation that section 179B will most often be used by states with areas along the border with Mexico and Canada and the Agency's historic use of its CAA section 179B authority to approve attainment plans in the immediate vicinity of the Mexican border, including El Paso, Texas, Imperial Valley, California, and Nogales, Arizona.

So when that leap is made from science to policy, the various definitions of uncontrollable ozone sources become important to consider. For example, baseline ozone, or U.S. background, or global background, or global anthropogenic background, or international exceptional events have all been cited as applicable to 179B petitions and potential regulatory relief under the "but for" clause of this section of the Act.

This is also similar to what is seen in the application of the exceptional events rule (Section 319 of the Clean Air Act), another regulatory definition, that allows a state to request elimination of a high concentration day from its design value calculation when influence is proven from contribution from a non-recurring, uncontrollable event like a wildfire, dust storm, stratospheric intrusion, or other internationally influenced event. EPA has recently made the process easier for states to make an exceptional event exclusion request in addition to other improvements underway at the Agency and elsewhere to address these issues.

However, to be clear, relief using 179B or exceptional event exclusion does not give anyone cleaner air to breathe. It simply recognizes a regulatory reprieve based on the language of the law. In the air quality community these options are not be seen as a "free pass" to pollute. Rather this is seen as a reality that must enter into the regulatory discussion and be understood in order to develop control programs that maximize air quality benefit with minimal societal disruption. Unfortunately, there is vague regulatory clarity on exactly what could be considered in many of these cases and therefore we continue to pursue direction in both definition and application as it relates to transport contribution of uncontrollable and background ozone concentrations at local locations.

CURRENT WORK UNDERWAY

The current state-of-science related to global background ozone modeling indicates that these models can provide key inputs to regional modeling activities. However, at this time, what is important to the global modeling community is not what is important to the regional modeling community. It is up to us to use the data responsibly which means we first need to understand the inputs. Like our own national inventory, global emissions are not constant and therefore background contributions also vary from year to year. Understanding these changes to adequately include and project future years' background concentrations is extremely important if we are to define effective national, regional, or local control programs.

Nationally, we also need to understand how changing climate is related to increasing wildfire activity and international emissions; how changes in land use and drought conditions can impact biogenic background emissions; and how our own control programs can be limited by the increases in uncontrollable source contribution.

From a scientific perspective, improvements to understanding background ozone are being developed using collaborative model attribution studies among EPA, NOAA, NASA, states, and international organizations looking to reduce the uncertainty involved with boundary contribution and associated relative international contribution to domestic air quality problems. Several of these are long-term programs, like the Task Force on Hemispheric Transport of Air Pollution (HTAP) organized under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP) has been looking at improving the assessment of the quantification, temporal and spatial distribution, halogen chemistry at the global scale, vertical transport between the free troposphere and the boundary layer, international contribution, evaluation of concentrations aloft in elevated layers, and consistency in the coupling of global models to regional models. Research programs like these are critical and are drastically underfunded. Without substantive, direct funding of these projects, much of the work is being performed "on the side" of other projects; unacceptable for such an important issue on that critical interface of science and public policy.

Additional support for these programs will allow us to better understand the uncertainty involved in this area and provide the technical information necessary for states to develop plans for attaining national ambient air quality standards.

SUMMARY

In summary, it is absolutely clear that there is an ever increasing impact of uncontrollable emission sources on the ability of our states to achieve attainment with the current air quality standards. While much work has occurred related to the understanding of background ozone and international transport's contribution to locally observed air quality concentrations, we still have a long way to go in understanding the contribution of these sources and improving the models and methods used to quantify and qualify their use in a regulatory framework.

I thank you for your time and this opportunity to present this information before the Committee, and I am happy to answer any questions that Members may have on this topic.

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Mr. Stella is internationally recognized as a technical authority in the modeling and policy application of emission inventories for ozone and particulate matter pollutants and precursors. For over twenty-five years he has coordinated with both public and private workgroups, modeling centers, and stakeholders to develop, evaluate, and apply control measures and program designs in support of emissions and air quality policy decisions.

Prior to joining Alpine Geophysics in 2003, Mr. Stella was at on staff at EPA's Office of Air Quality Planning and Standards where he managed and prepared the emission inventories, control strategies, and associated temporal, spatial and speciation data for the Regional Transport NOx SIP Call, Section 126 rulemaking, Tier-2 tailpipe standards, 1-hour attainment demonstrations, Heavy-Duty Diesel Engine standards, Multi-Pollutant legislation, Clear Skies Analysis, and US/Canadian Air Quality Agreements. Mr. Stella is a recipient of two U.S. EPA Gold Medals for the NOx SIP Call Rulemaking (1999) and the Tier-2 Tailpipe Standard (2001); projects in which he participated while at EPA.

Mr. Stella received his Bachelors of Science degree in Chemical Engineering from the Johns Hopkins University in Baltimore, Maryland.