Preliminary Comments from Dr. James Boylan on
EPA's *Integrated Science Assessment for Ozone and Related Photochemical Oxidants*
(External Review Draft – September 2019)

Executive Summary

Figure ES-2 on page ES-6 should change the asterisks (*) to up or down arrows to show upgraded and downgraded classifications.

Integrated Synthesis

Figure IS-6 on page IS-84 should change the asterisks (*) to up or down arrows to show upgraded and downgraded classifications.

Appendix 1 – Atmospheric Source, Chemistry, Meteorology, Trends, and Background

To what extent is the information presented in Appendix 1 regarding sources, precursor emissions, and measurement and modeling of ambient concentrations, as well as modeled estimates of background concentrations of ozone, clearly and accurately conveyed and appropriately characterized? Please comment on the extent to which available information on the spatial and temporal trends of ozone concentrations at various scales has been adequately and accurately described.

Sources of U.S. Ozone and its Precursors (Section 1.3)

This section presents estimated national values for 2014/2017 NEI emissions. However, there is no detailed discussion on the uncertainty associated with each pollutant or source sector. Some pollutants and sectors will be much more uncertain than others. For example, NOx emissions from electric generating units (EGUs) have low uncertainty since they are typically captured by hourly CEMs. On the other hand, other source sectors and pollutants may be highly uncertain. The uncertainties in the emissions inventory (magnitude, spatial allocation, and temporal allocation) should be discussed for each pollutant and source sector. In addition, it would be helpful to add national maps containing county-level emissions for NOx, VOCs, CO, and CH_4 to show the variability across the country.

It is not clear if CH_4 is included in the VOC emissions or not. The text should clearly state if CH_4 is included or excluded from the VOC emissions discussed in this Appendix. Due to the importance of biogenic VOCs, this section should discuss the differences between the BEIS and MEGAN models that are typically used to estimate biogenic VOC emissions. In addition, biogenic VOC trends should be included to see the variability from year-to-year and season-to-season.

Ozone Photochemistry (Section 1.4)

This section should start with a discussion of why the precursor emissions discussed in Section 1.3 (NOx, VOCs, CO, and CH_4) are important for ozone formation. An overview of the chemical

mechanism should be presented and important chemical reactions should be highlighted. The relative importance of each precursor should be discussed relative to urban ozone formation vs. USB ozone formation.

Inter-Annual Variability and Longer Term Trends in Meteorological Effects on Anthropogenic and U.S. Background Ozone (Section 1.5)

This section should discuss the impact of inter-annual variability and longer term trends in meteorological effects on ozone design values.

Measurements and Modeling (Section 1.6)

Ground-based ozone lidar instruments measure the vertical structure of ozone and quantify the mixing of plumes aloft. A review of these instruments and their capability should be added to this section. The section on "Satellite-Based Remote Sensing Methods" should include a discussion of the new TROPOMI satellite data that includes high resolution measurements of NO2 and formaldehyde. The section on "Advances in Regional Chemical Transport Modeling" should discuss the importance of performing a comprehensive model performance evaluation when using regional chemical transport models. This evaluation should include an evaluation of precursor pollutants to help ensure the model does not have compensating biases.

EPA's 2016 Exceptional Events Rule allows certain ozone measurements due to natural events to be excluded from the official design values when compared to the NAAQS. In some cases, identical exceptional events can be treated differently in one location vs. another based on how close the area is to the standard. In both locations, people are impacted by adverse health effects, but the data is removed in one location and not the other. The ISA should discuss how exceptional events are accounted for in health studies and risk analyses.

Ambient Air Concentrations and Trends (Section 1.7)

This section should discuss the shifting of ozone peak concentrations from summer to spring and fall that is occurring in many parts of the country (Blanchard and Hidy, 2018; Blanchard et al., 2019). In addition, this section should include a discussion on ozone precursor trends in addition to ozone trends. Specifically, trends in NOx, VOCs, and CO measurements form national monitoring networks (AQS, NCore, and PAMS) should be included and discussed.

U.S. Background Ozone Concentrations (Section 1.8)

Section 1.8.1 begins with the statement "As described in Section 1.2.2.1, USB ozone cannot be reliably estimated using ambient monitoring data because monitors can be influenced by U.S. emissions, including both relatively nearby emissions and interstate and hemispheric transport of ozone produced from U.S. emissions." Parrish et al. (2017) and Parrish and Ennis (2019) have shown that USB ozone can be reliably estimated using ambient monitoring data. Although monitors can be influenced by U.S. emissions, it is possible to account for these influences. Estimates from measurement-based approaches

and from modeling-based approaches can be compared to understand differences and minimize the uncertainty in USB ozone estimates.

Emission controls have reduced ozone in the U.S. to the extent that background ozone contributes the majority of urban ozone concentrations, even on many days when ozone exceeds the NAAQS. Figures 1 and 2 show estimates of the ozone design values that would be present in the absence of U.S. or North American anthropogenic emissions. Figure 1 is from a model calculation using the "zero-out sensitivity approach" (Jaffe et al., 2018). Figure 2 is developed from an observational-based approach (Parrish et al., 2017; Parrish and Ennis, 2019) applied to the entire country. These two maps show that in the southwestern U.S., background ozone makes such a large contribution that it will be extremely difficult to reach the 70 ppb NAAQS unless the background contribution decreases. Section 1.8.2.1 discusses new USB and North American Background estimates, but all of these estimates are for seasonal means. It is critical to evaluate the ozone design values that can result from USB.

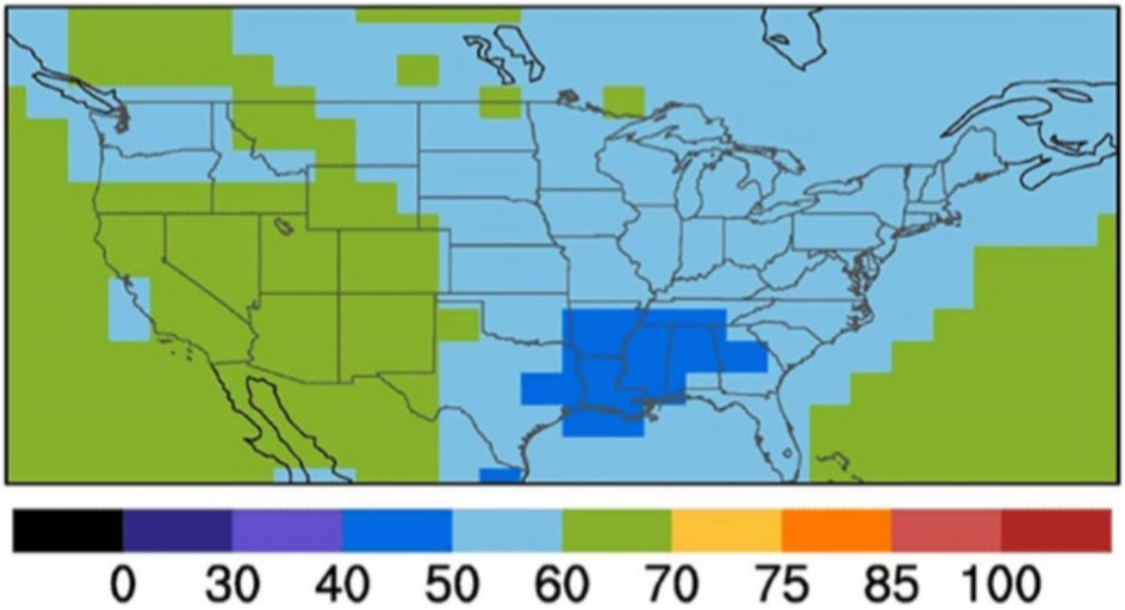

Figure 1. Annual 4th highest MDA8 O3 in ppb from North American background (i.e., with North American anthropogenic precursor emissions set to zero) averaged over 2010–2014 from a GFDL-AM3 model simulation (Jaffe et al., 2018).

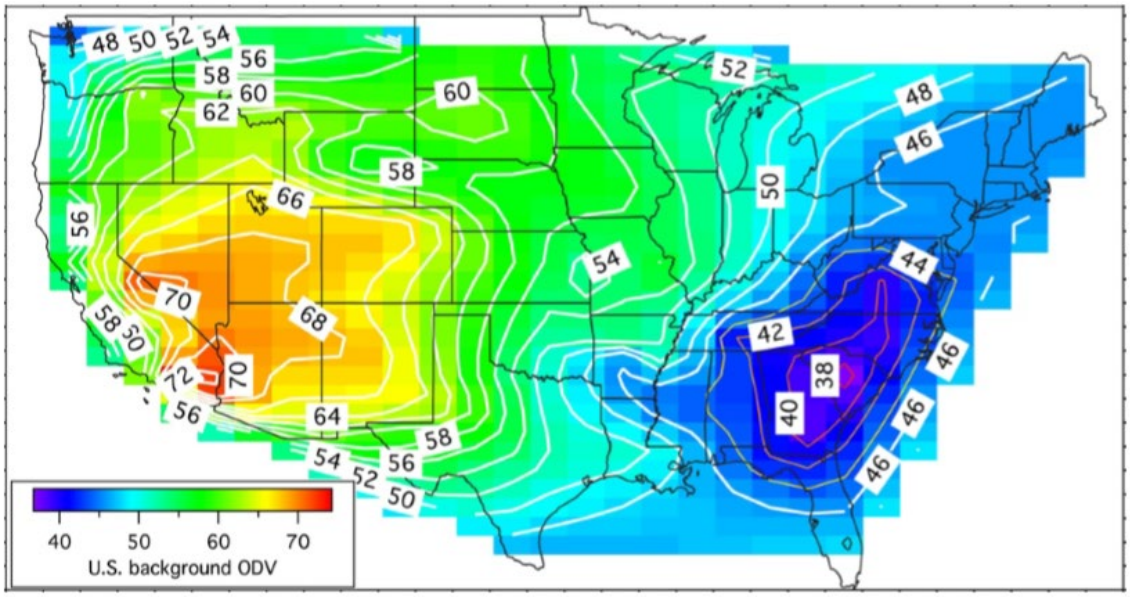

Figure 2. Ozone design values expected from U.S. background (i.e., with U.S. anthropogenic precursor emissions set to zero) in ~ 2015 derived from observations (D.D. Parrish, unpublished figure).

Appendix 2 – Exposure to Ambient Ozone

Appendix 2 describes scientific information on exposure to ozone and implications for epidemiologic studies. To what extent is the discussion on methodological considerations for exposure measurement and modeling clearly and accurately conveyed and appropriately characterized? Please comment on the extent to which the discussion regarding exposure assessment and the influence of exposure error on effect estimates in epidemiologic studies of the health effects of ozone has been adequately and accurately described.

Exposure Assessment Methods (Section 2.3)

This section gives a high-level overview of fixed-site monitors, passive and active personal samplers, spatial interpolation, land use regression and spatiotemporal modeling, chemical transport modeling, hybrid approaches, and microenvironmental modeling. The discussion on microenvironmental modeling should include additional information on APEX and SHEDS.

Personal Exposure (Section 2.4)

This section discusses updates to the Consolidated Human Activity Database (CHAD), infiltration of ambient ozone into homes and buildings (I/O ratio), and personal exposure to ambient concentration (P/A) ratios. Additional discussion should be added for ozone infiltration in vehicles since a large amount of time is spent commuting. Also, a detailed discussion of the uncertainties and variability associated with the CHAD, I/O ratios, and P/A ratios should be included.

Copollutant Correlations and Potential for Confounding (Section 2.5)

It is stated on page 2-32 "Given that the majority of the copollutant correlation data are low, confounding of the relationship between ambient ozone exposure and a health effect by exposure to CO, SO_2, NO_2, PM_{10}, or $PM_{2.5}$ is less of a concern for studies of the health effects of ambient ozone exposure compared with studies of the health effects related to exposure of other criteria air pollutants. When copollutant correlations are higher during the warm season, greater risk of copollutant confounding exists." However, the summer is the season with the highest ozone concentrations and the highest ozone exposure; therefore, a greater risk of copollutant confounding exists and should be accounted for.

Interpreting Exposure Measurement Error for Use in Epidemiology Studies (Section 2.6)

This section adequately describes the influence of exposure error on effect estimates in epidemiologic studies of the health effects of ozone.

References

Blanchard, C. L. and G. M. Hidy, "Ozone response to emission reductions in the southeastern United States," Atmos. Chem. And Phys. 18: 8183–8202 (2018).

Blanchard, C. L., et.al., "Emission influences on air pollutant concentrations in New York State: I. Ozone," Atmospheric Environment: X 3 (2019) 100033

Jaffe D. A., et al. (2018) Scientific assessment of background ozone over the U.S.: Implications for air quality management. Elem. Sci. Anth., 6 56 doi.org/10.1525/elementa.309.

Parrish, D. D., Young, L. M., Newman, M. H., Aikin, K. C., and Ryerson, T. B. (2017) Ozone Design Values in Southern California's Air Basins: Temporal Evolution and U.S. Background Contribution, J. Geophys. Res.-Atmos., 122, 11166–11182, https://doi.org/10.1002/2016JD026329.

Parrish, D. D. and C. A. Ennis (2019). Estimating background contributions and US anthropogenic enhancements to maximum ozone concentrations in the northern US, Atmos. Chem. Phys., 19, 12587–12605, https://doi.org/10.5194/acp-19-12587-2019.