**Quantifying Sources of Precursor Emissions (NOX and VOC) to Elevated O3 in the Great Lakes Region**

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ABSTRACT

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**INTRODUCTION**

Many areas in the Great Lakes region of the United States are not currently compliant with U.S. EPA’s ozone(O3) National Ambient Air Quality Standard (NAAQS). Areas that have historically exceeded the level of the O3 NAAQS include monitors along both the eastern and western shores of Lake Michigan and also in the Detroit area. A multitude of modeling and measurement studies have been done in both of these areas over the past decades (Dye, Roberts et al. 1995, Sills, Brook et al. 2011, Stanier, Pierce et al. 2021, Olaguer, Su et al. 2023). The conceptual understanding of elevated O3 in the Great Lakes has been well characterized but the complex nature of high emissions and complex land-water meteorology make effect emission control strategies for all monitors in the region difficult.

The complex meteorological conditions that are associated with elevated O3 in the Lake Michigan have been documented and well replicated by multiple configurations of prognostic meteorological models at multiple grid scales (Abdi‐Oskouei, Carmichael et al. 2020, Baker, Liljegren et al. 2023, Pierce, Harkey et al. 2023).

Peak observed O3 in the Lake Michigan region tends to be underestimated (Baker, Liljegren et al. 2023, Pierce, Harkey et al. 2023), which may be due to local sources contributing to local O3 production in the Chicago area, more regional to continental scale sources of O3 to the Great Lakes region, or some combination of both.

Recent studies based on modeling, ambient measurements, and satellite products suggest the O3 in the Lake Michigan region is typically limited by NOX emissions although can sometimes be limited by VOC emissions or fall into a “transition” regime where both NOX and VOC emissions can result in O3 reductions (Vermeuel, Novak et al. 2019, Acdan, Pierce et al. 2023, Baker, Liljegren et al. 2023). These studies are usually focused on local O3 production and do not have a robust assignment of NOX or VOC limited O3 regime for O3 that is produced at the regional scale and transported into the Great Lakes region.

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