**I. Background**

Tropospheric ozone (O₃) is a pollutant with major impacts on human health, including:
- Difficulty breathing
- Inflammation and damage of the lungs
- Aggravation of asthma and bronchitis

Salt Lake City sees frequent unhealthy summer O₃.

O₃ production depends on complex reactions involving NOₓ and VOCs.
- NOₓ is emitted from combustion, fossil fuels
- VOCs are emitted from vegetation, solvents, industry, cows, etc.

Halogens further complicate these reactions.
- Halogens are released from sea spray, industry, salts

Halogens can cause...
- Catalytic loss (O₃)
- Increased atmospheric oxidizing capacity (O₂, O₃)
- Increased NOₓ (O₃)

Salt Lake City is uniquely located near a major halogen point source.

**II. Measurements**

- Hawthorne Elementary DEQ site
- Gas concentration and meteorological data
- Data from 06/01/2021 – 08/31/2021 and 06/01/2022 – 08/31/2022
- Number weighted median hourly summer values
- TUV (Tropospheric Ultraviolet and Visible Radiation) Model
- Photolysis rates

**III. Methodology**

**Framework for 0-D Atmospheric Modeling (F0AM)**

- Explicit box model with >15,000 reactions
- MCMv331 (Master Chemical Mechanism), Riedel et al., 2014 halogen submechanism
- We ran 86 hours (4 days) of “spinups” to model unconstrained species, spinup outputs act as run inputs
- Meteorological and solar parameters are input as measured
- All constrained species are held constant throughout spinups
- On a run, NOₓ, halogens, and O₃ evolve
- Isoprene NOₓ and VOC concentrations are calculated by multiplying each gas’s fraction of the total family with the intended family concentration, meaning speciation is as measured throughout the isoplates

**IV. Results**

**VOC Speciation**

**O₃ Speciation**

**O₃ Isoplates**

**Change in Pbpb**

**Percent Change**

**IV. Future Work**

- Improve constraints on halogens and VOCs
- Our halogen concentrations are estimates, accurate concentrations and speciation of Salt Lake City halogens are not currently known
- Many VOCs are unmeasured, although we spin them up, more extensive measurements are needed to accurately represent VOC speciation

What is the role of halogens in the O₃ cycle?
Inclusion of bromine and iodine chemistry

**IV. Acknowledgements**

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**Understanding the Impact of Halogens on Summer Tropospheric Ozone**

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**V. Sensitivity Analysis**

Model runs near measured values
- VOCs at 0.5- and 2-times Salt Lake City values
- Runs with and without halogens, high halogen runs with 2-times Salt Lake City estimates
O₃ concentrations, oxidant concentrations, and halogen reaction distributions respond to changes in halogens and VOCs

**O₃ Timeseries**

**Chlorine Compound Distribution**

**Oxidant Production Rates**

**Change in Total Oxidants**

**Reactive Cl₂ Production and Loss Rates by VOC Level**

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