### Evaluations of Model Simulated Ozone and Precursors in MUSICAv0 Against In-Situ and Airborne Measurements in the Continental US: A Case Study in Colorado and Michigan

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### **MUSICAv0**

#### <u>MU</u>Iti-<u>S</u>cale Infrastructure for <u>C</u>hemistry and <u>A</u>erosols, Version 0

- Configuration of CAM-Chem within CESM
- Spectral Element (SE) Dynamical Core
- Regional Refinement
- Comprehensive representation of stratospheric and tropospheric chemistry (Emmons et al., 2020)
- Emission Inventories:
  - Copernicus Atmosphere Monitoring Service (CAMS)
  - Fire INventory from NCAR (FINN) & Quick Fire Emission Dataset (QFED)
- Coupled with the Community Land Model Version 5 (CLM5) (includes MEGAN algorithms for vegetation emissions) (Guenther et al., 2012)
- Described in Pfister et al (2020)



## Campaigns - Colorado

## Front Range Air Pollution and Photochemistry Experiment (FRAPPÉ)

- Designed to identify main drivers of summertime ozone in Colorado's NFRMA (Northern Front Range Metropolitan Area).
- Included NSF/NCAR C-130 aircraft and ground site measurements.
- July 26 August 18 of 2014

#### Deriving Information on Surface Conditions from COlumn and VERtically Resolved Observations Relevant to Air Quality in Colorado (DISCOVER-AQ Colorado)

- Understand sources, transport, and chemical transformations of air pollutants, particularly those leading to surface ozone and PM formation and how they relate to satellite observations.
- Included ground sites and remote sensing, and aircrafts (NASA P-3 & B-200).
- July 14 August 12 of 2014





## Quantifying the role of biogenic volatile organic compounds (BVOCs) emissions on model simulated isoprene, monoterpene, formaldehyde and $O_3$ via observational constraints.





**Reduce BVOC Emissions** – Isoprene & Monoterpene

Mariscal et al (2022a, in prep)

### **CONTROL - SENSITIVITY**



COLORADO			
	Ozone [ppb]		
	CRL - SENS		
	75% BVOC	50% BVOC	25% BVOC
Min	-0.79	-0.94	-0.71
Max	1.321	1.323	2.54
Mean	-0.11	0.22	0.68

Reduction of BVOC Emissions leads to **non-linear change** in  $O_3$  averaged over Colorado.



Mariscal et al (2022a, in prep)

### Vertical Profiles Compared to FRAPPÉ Aircraft Observations

#### Biogenic Emission Influence on Surface Ozone and HCHO in MUSICA-V0 Against FRAPPÉ Observations



Mariscal et al (2022a, in prep)





### Michigan

- Refined Grid over Michigan (~ 7 km)
- MUSICAv0 Simulations with Refined Grid
- Compare Model Output to MOOSE Campaign Observations



### Michigan-Ontario Ozone Source Experiment (MOOSE)

- Led by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), with participants from universities, federal agencies, and Environment Climate Change Canada.
- Seeks to define potential attainment strategies in the southeast Michigan region and better understand what contributes to these ozone exceedances.
  - MOOSE Phase I: May 24 June 30, 2021
  - MOOSE Phase II: Summer 2022



### Summary

- Preliminary findings of MUSICA-V0 simulation output evaluated against the FRAPPÉ C-130 flight track determined that isoprene and monoterpenes were being overestimated in the model.
- Reduce BVOCs by 25, 50, and 75% in MUSICA-V0.
- Initial analysis with aircraft and stationary datasets from FRAPPÉ and DISCOVER-AQ-Colorado was conducted.
- Although no concrete conclusion can be made at this time, the initial model evaluation with aircraft and the Whole Air Sampler (WAS) measurements does point to the assumption that a reduction in BVOCs in the model will help reduce the discrepancies in the model.
- Further analysis is needed to better evaluate the model and determine optimal BVOC content.
  - Regridding of Vegetation Maps (?)
- Michigan Grid Continuation

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# Thank You!

Any Questions?