Physiology and Isoprene Emissions of Drought-Stressed and Ozone Exposed Plants in a Laboratory Chamber

Amanda S. Harte[1], Garrett L. Haas[2], and Gunnar W. Schade[1]

Texas A&M University – [1] Department of Atmospheric Sciences, [2] Environmental Geosciences Program

ABSTRACT

Isoprene can play a pivotal role in tropospheric air chemistry. In our changing climate, isoprene is expected to significantly contribute to the feedback between climate change and biogeochemical processes; therefore, it is worthwhile to study the effect of a changing climate on the physiology and isoprene emissions of trees. In this experiment, several species of isoprene-emitting oak trees are isolated in a Teflon foil chamber and subjected to different levels of soil moisture and ozone exposure to observe and analyze their changes in physiology and emissions. Using the data from this chamber, a relationship between environmental stresses and isoprene emissions can be determined for the species used in the experiment.

OBJECTIVES

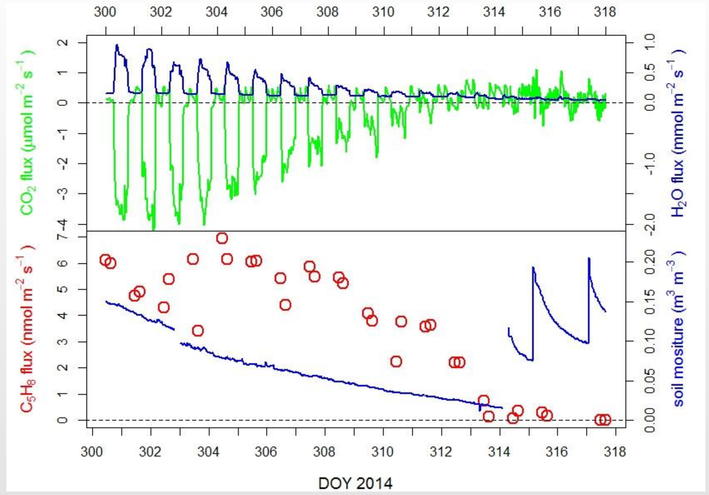
1) To create a controlled setting for live plant analysis using a Teflon foil chamber and light assembly.
2) To sample, record, and analyze gas composition and plant growth variables using a data logger
3) To manipulate the plant's growth conditions, such as soil moisture and ozone concentration in the chamber, in order to simulate environmental stresses

REFERENCES

1) Fang, C., R. Monson, and E. Cowling, 1996: Isoprene emission, photosynthesis, and growth in sweetgum (liquidambar styraciflua) seedlings exposed to short- and long-term drying cycles. *Tree Physiology*, **16,** 441-446.

2) Pegoraro, E., A. Rey, J. Greenburg, P. Harley, J. Grace, Y. Malhi, and A. Guenther, 2004: Effect of drought on isoprene emission rates from leaves of Quercus virginiana Mill. *Atmospheric Environment*, **38,** 6149-6156.

DROUGHT STRESS



	After 10 days:	After 14 days:
CO_2 Flux	75% reduction	100% reduction
H_2O Flux	75% reduction	85% reduction
C_5H_8 Flux	40% reduction	90% reduction

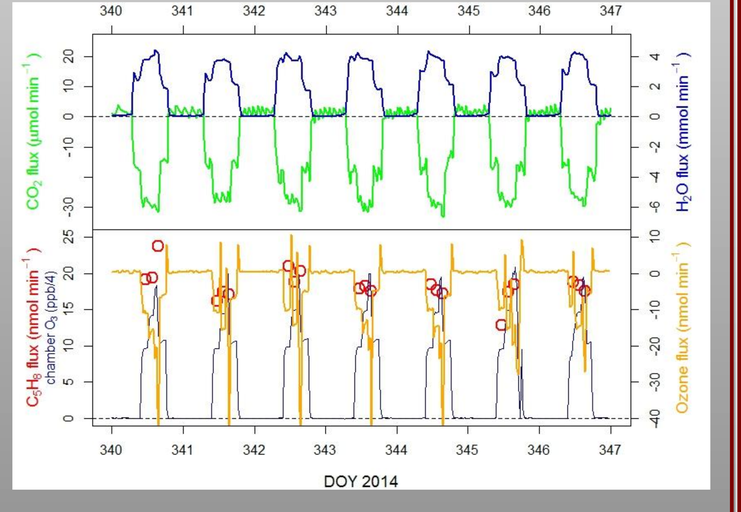
- Sample was rewatered on 14th day
- A response in CO_2, H_2O, and C_5H_8 flux was not observed after rewatering *(see Conclusions)*
- SM data is non-calibrated





OZONE EXPOSURE

- $[O_3]$ of 40, 60, and 80 ppb was established in chamber
- P_n, stomatal conductance, and isoprene flux did not change significantly during the ozone testing
- Higher $[O_3]$ exposure has not been conducted in the chamber



CHAMBER SETUP

- Experiments are conducted in a Teflon foil chamber of adjustable volume (approx. 200-250 L)
- 12 daylight LED bulbs provide adjustable illumination; filtered and humidified compressed air is used
- A CR-23X data logger records CO, CO_2, H_2O, and O_3 concentrations
- Soil moisture, chamber temperature and humidity, and leaf temperature are recorded
- Isoprene samples are taken with Tenax cartridges and analyzed using a thermal desorber and gas chromatography flame ionization detection (TD-GC-FID).

CONCLUSIONS

- Analysis of drought stress testing supports previous research of drought's effect on plant emissions [1, 2]
- Some uncertainty of drought stress results due to the plant's senescence at the end of the experiment
- Analysis of ozone exposure testing does not indicate a significant effect on fluxes at the tested O_3 exposures for this species (life oak)

ACKNOWLEDGMENTS

The research presented in this poster was funded by a grant from the National Science Foundation, NSF-ATM0955438

CONTACT

Amanda S. Harte
Meteorology, Class of 2015
aharte@email.tamu.edu

Dr. Gunnar W. Schade
gws@geos.tamu.edu