Negative carbonyl sulfide fluxes measured from bryophyte samples

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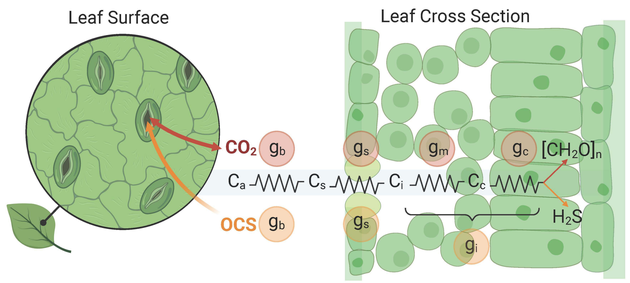
Background



Carbonyl sulfide (OCS) is taken up by plants during photosynthesis along similar pathways to carbon dioxide. Because OCS is not respired, it is a potential tracer gas for terrestrial carbon uptake. The OCS fluxes of other ecosystem components must be known for OCS to be used to estimate gross primary production.

The OCS fluxes of bryophytes such as mosses and liverworts are relatively understudied. They may vary with environmental conditions such as moisture, temperature, and UV light exposure. This work aims to address the uncertainty in bryophyte OCS fluxes by designing an experiment to measure gas flux measurements of bryophytes under laboratory manipulations of temperature.

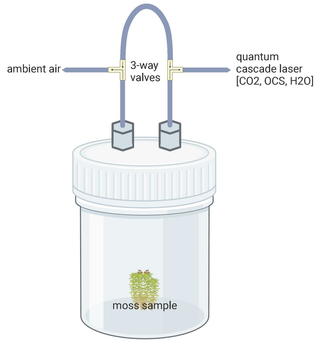
Methods

I. Sample collection

Moss samples were collected from a wetland in Harvard Forest, MA, a transition hardwood forest, in June and November 2024. The samples were rinsed with DI water to remove excess soil and detritus. Samples were stored in petri dishes in a glass-front refrigerator to provide ambient light at 10 degrees C. The moss was regularly watered with DI water to prevent it from drying out. Sphagnum moss samples, which were collected from standing water, were stored in glass jars filled with DI water instead of petri dishes.

II. Laboratory setup

Gas concentration measurements were made with a quantum cascade laser (QCL). The sample was rinsed with room-temperature DI water and placed in a PFA jar with a self-contained thermocouple and data logger to measure temperature. The jar was set in a cooler filled with water temperature-controlled with a chiller. Sphagnum moss samples also each had 100 mL DI water added to the PFA jar.



Measurements

Samples were saturated with DI water before each experiment. They were first run only at room temperature (bath chiller temperature set to 23 degrees C) while gas concentrations were measured with the QCL.

For measurements during sample temperature manipulations, the bath chiller temperature was ramped from 5 degrees C to 35 degrees C.

Sample mass was recorded before and after each experiment to track of moisture loss over the duration of the experiment.

After measurements were taken, samples (except for 002 and 010) were dried in a 60° C oven and their surface area was measured.

Sample	ID	Sample	ID
001	Bazzania trilobata	007	Hypnum imponens
002	Sphagnum recurvum	008	Dicranum scoparium
003	Hypnum imponens	009	Bazzania trilobata
004	Leucrobryum glaucum	010	Sphagnum recurvum
005	(no ID)	011	Hypnum imponens
006	Hypnum imponens	012	Thuidium delicatulum

Moss sample 008

Calculations

Fluxes were calculated using

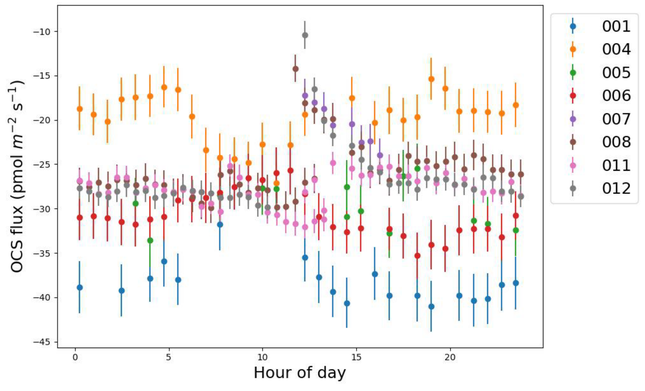
$$F = v(C_1 - C_2)$$

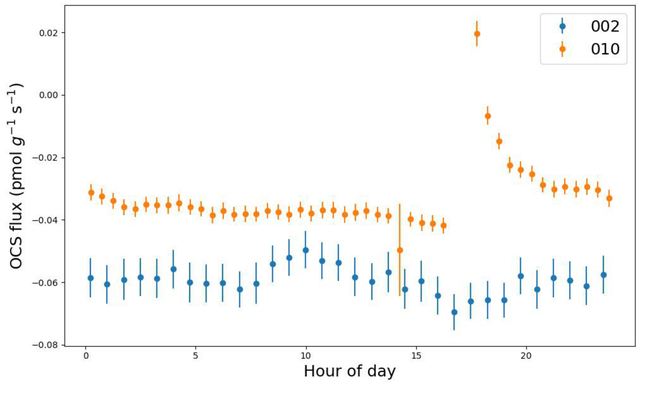
Where:

- F is the OCS or CO_2 exchange rate in pmol s^{-1}
- C_1 is the mixing ratio of the compound in ambient air
- C_2 is the mixing ratio of the compound in the sample gas
- v is the flow rate in L min^{-1} of the sample entering the QCL

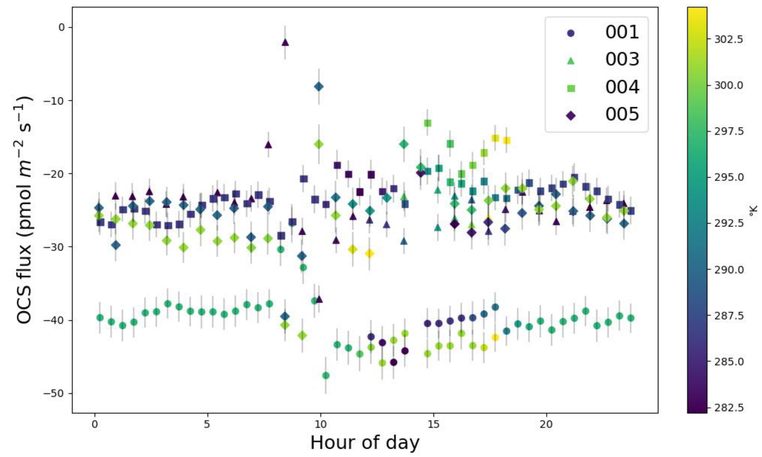
Results

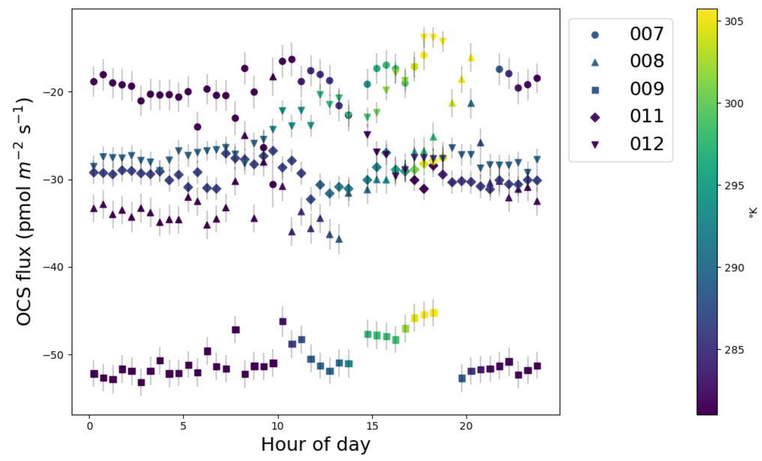
Isothermal

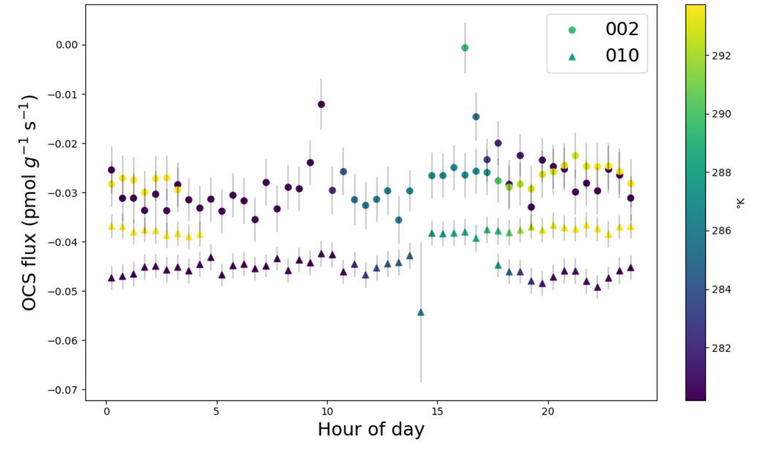




Temperature range







OCS fluxes were mostly negative, indicating uptake under these conditions.

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