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# Global Worming: A Quantitative Study about Greenhouse Gas Flux in Surface Soils Facilitated by the Anecic Earthworm, *Lumbricus terrestris*, Under Rising Global Temperature

Rachel Briden Frei
*University of Rhode Island*, qtfrei506@my.uri.edu

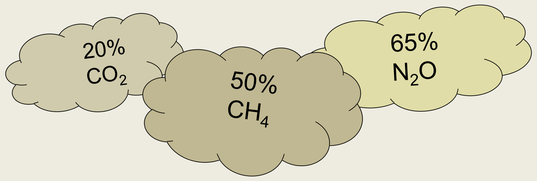
Jose A. Amador
*Univeristy of Rhode Island*, jamador@uri.edu

# *Global Worming*: A Quantitative Study About Greenhouse Gas Flux in Surface Soils Facilitated by the Anecic Earthworm, *Lumbricus terrestris*, Under Rising Global Temperature

Rachel Frei and José Amador, Laboratory of Soil Ecology and Microbiology

## Introduction

- Climate change is the long-term alteration in the Earth's average weather conditions believed to be driven by greenhouse gases (GHG) causing an increase in extreme weather events, warmer global temperature and increased precipitation
- **Soils can produce and consume GHGs**




Soil contribution to GHGs

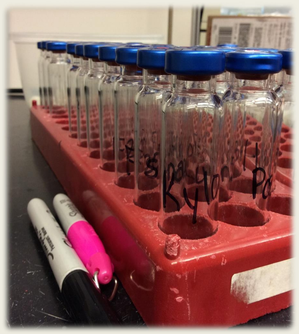
- Temperature and moisture are key factors in determining the rate of biological and biogeochemical processes
  - Decomposition
  - Permafrost Warming
  - Nutrient Cycling

## *Lumbricus terrestris*

Earthworms are part of the forest and agricultural soil biota and help improve soil structure and fertility, create habitat for other soil microbes and are essential in the regulation of soil surface litter. As an anecic earthworm, *L. terrestris* drags surface litter into the soil where decomposition is facilitated by soil microbes, promoting GHG production.

## Objective

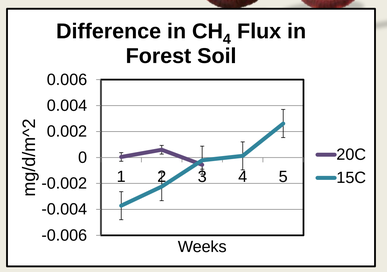
Determine the effects of rising global temperature on GHG flux in soils that are inhabited by earthworms.



## Hypothesis

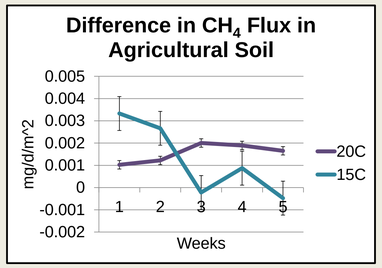
I hypothesize that the decomposition process mediated by earthworms within surface soils will speed up with an increasing temperature, and furthermore increase the rate at which GHGs are produced in soils.

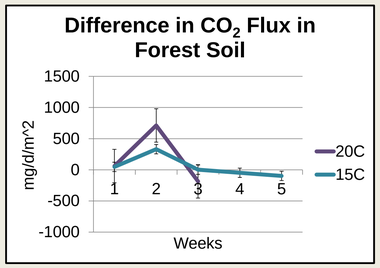
## Results




**Methane**

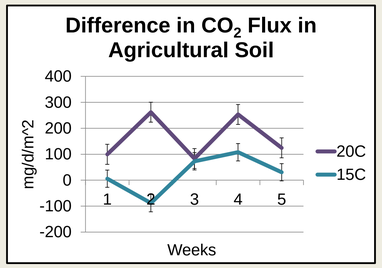
At 15ºC in forest soil, $CH_4$ production increased whereas at 15ºC in agricultural soil, $CH_4$ production decreased and some soil consumption of $CH_4$ occurred. A relativity stable production flux was seen at 20ºC in agricultural soil.



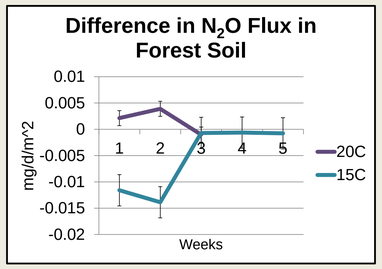

**Carbon Dioxide**

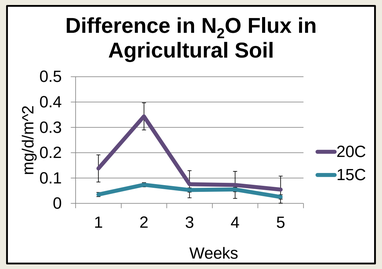
There was an increase in $CO_2$ production in agricultural soil at both temperatures, yet fluctuation varied greatly. Forest soil experienced an opposite effect as soil consumption of $CO_2$ increased after three weeks.

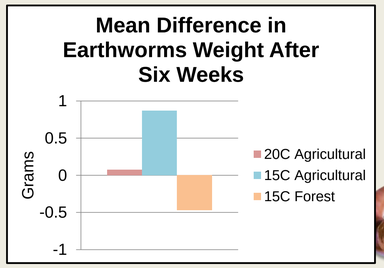



**Nitrous Oxide**

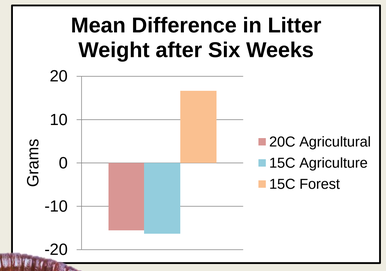
There was an increase in $N_2O$ production in agricultural soil and a decrease in $N_2O$ soil consumption. While these short-term effects seem drastic, they quickly became stable and leveled out, fluctuating little between production and consumption.



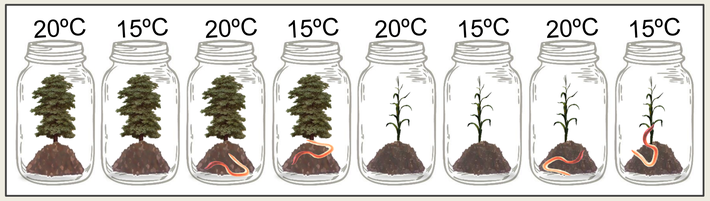

Earthworms incubated at 20°C and 15°C in agricultural soil experienced an overall weight gain after six weeks while earthworms in forest soil experience a loss in weight. It was observed that earthworms in the forest soils did not consumer much, if any, surface litter.




Both 20°C and 15°C agricultural soil experienced a loss in surface litter due to the presence of earthworms. The increase in litter weight in forest soil can be contributed by an increase in moisture content in litter and soil particles adhering to leaves.

## The Experiment

- 32 microcosms each containing 500 g of soil and 20 g of litter, with or without a single earthworm
  - Agricultural soil from the URI agronomy farm (Enfield series)
    - Corn stalk leaves for litter
  - Forest soil from the North Woods in Kingston, RI (Scio series)
    - Forest leaves for litter
- Employed eight different treatments, each having four replications
- Earthworms were given names based on characters from Harry Potter and Star Wars.
- Microcosms were sealed and incubated at 15ºC and 20ºC
- GHG flux measured weekly for six weeks and analyzed by gas chromatography
- Earthworms and litter were weighed at the beginning and end of the six weeks




## Conclusions

- My hypothesis was found to be both right and wrong depending on the gas
- $CH_4$ production was slightly increased at 20°C in agricultural soil, but increased at 15°C in forest soil
- Temperature increased $CO_2$ production at 20°C in agricultural soil, while deceasing production in forest soil
- $N_2O$ experienced a short-term increase in production at 20°C in agricultural soil, further plateauing just above the production threshold (zero)
- Greater GHG fluctuations seen in agricultural soil
- Earthworms in agricultural soil consumed the most litter, while earthworms in agricultural soil at 15°C increased most in weight
- **The presence of earthworms and increased soil temperature may increase GHG production**

**Acknowledgements**

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