GREENHOUSE GAS FLUXES FROM BOREAL FOREST SOIL

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INTRODUCTION

- Canada contains over 1/3rd of the total global boreal forest resources

- Our understandings of greenhouse gas (GHG) emissions and its controlling factors in boreal forest soils are fragmentary

- GHG fluxes from these forests can have substantial influence on atmospheric concentrations of CO_2, CH_4 and N_2O

Our Project on GHG Fluxes in Eastmain

- Determine *in-situ* rates of N_2O and CH_4 production and/or consumptions from representative forests type soils in Eastmain

- Identify controlling factors and develop indices of N_2O and CH_4 fluxes from these forests

- Model flux patterns from these forests by feeding the data into the DNDC and CENTURY models

Experimental Design

- Selected 3 major forest types:

1. Black Spruce
   - A Mature black spruce (tower site) and a burned site (burned in 2005)
2. Alnus Stand (tower site)
3. Jack Pine
   - A mature jack pine and a regenerating site (burned in 1989)
4. Aspen Stand

Experimental Design

- At each site, four GHG measurement collars will be inserted into soil this month (upto 10 cm depth)
- GHG fluxes would be measured biweekly or monthly using static-chambers over the collars
- Gas samples collected will be analyzed on a GC at Eastmain and at McGill, initially. This would allow us to compare the two GCs in terms of sensitivity and replicability

Ancillary Environmental Variables

- Soil moisture and temperatures (during gas sampling)
- N mineralization and nitrification rates (monthly)
- Soil dissolved organic C, dissolved N, NO_3 and NH_4 contents (monthly)
- Ground water table depth, soil bulk density, porosity, pH and litter fall (one in 2007)

Expected Outputs

- Summer exchanges of N_2O, CH_4 and CO_2
- Key controlling factors of GHG fluxes
- Modeling of GHG fluxes from these forests using DNDC and CENTURY models (Drs. C. Peng and X. Chen, UQAM)
- Sharing the data with Dr. Ian Strachan (Tower site), and with Dr. Michele Garneau and her student- Jessica Banville on dynamic forms of C and N
- Comparison of GHG fluxes from Eastmain to those from boreal forest soils at Chibougamau (FLUXNET site)

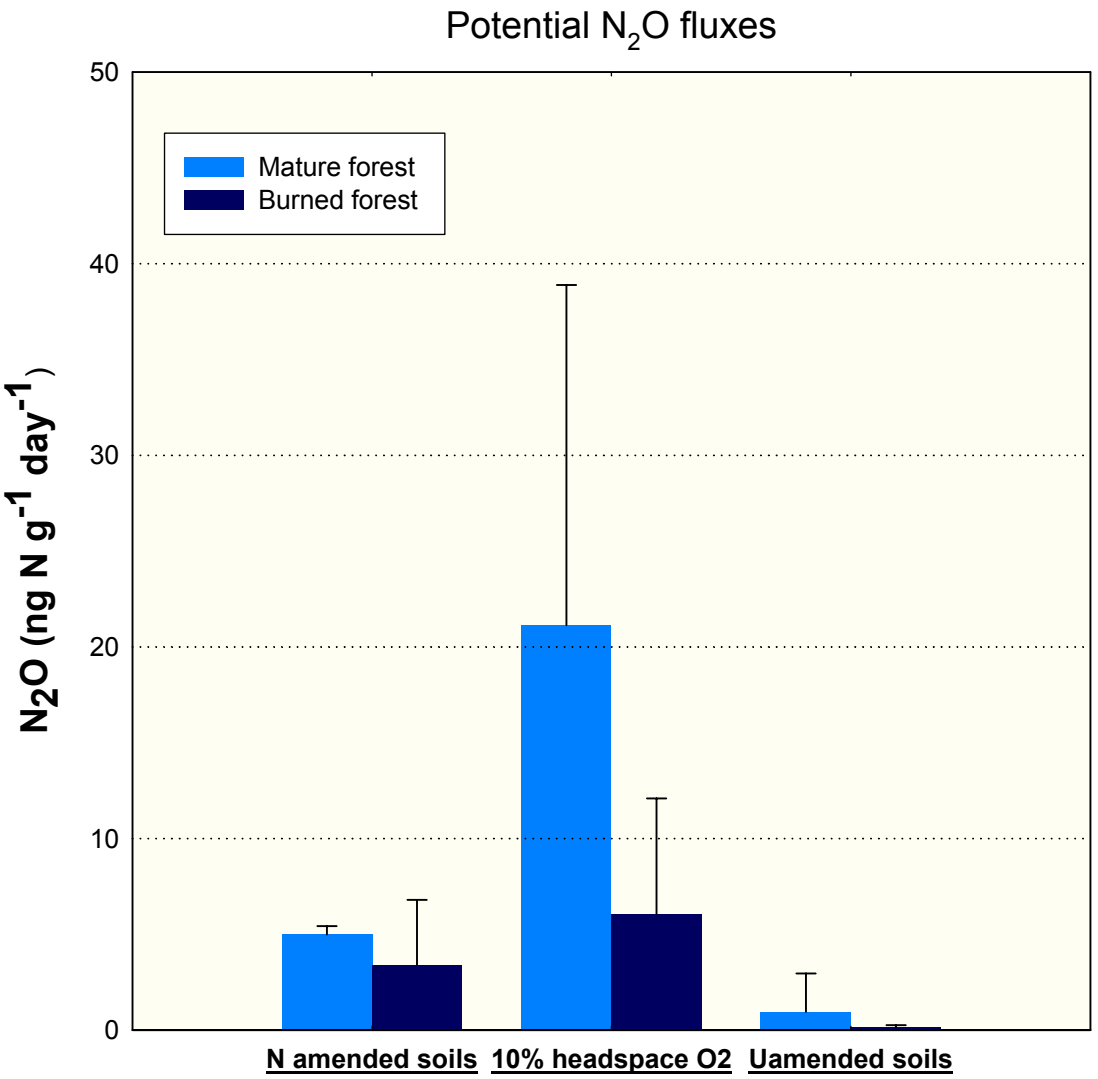
Research Work undertaken in winter 2006

- We collected organic soils (0-10 cm depth) from the mature and burned black spruce forests (October 2006)
- The soils were incubated in the laboratory for quantification of potential GHG fluxes
- In-situ N mineralization rates over winter months in all the sites at Eastmain will be completed this month

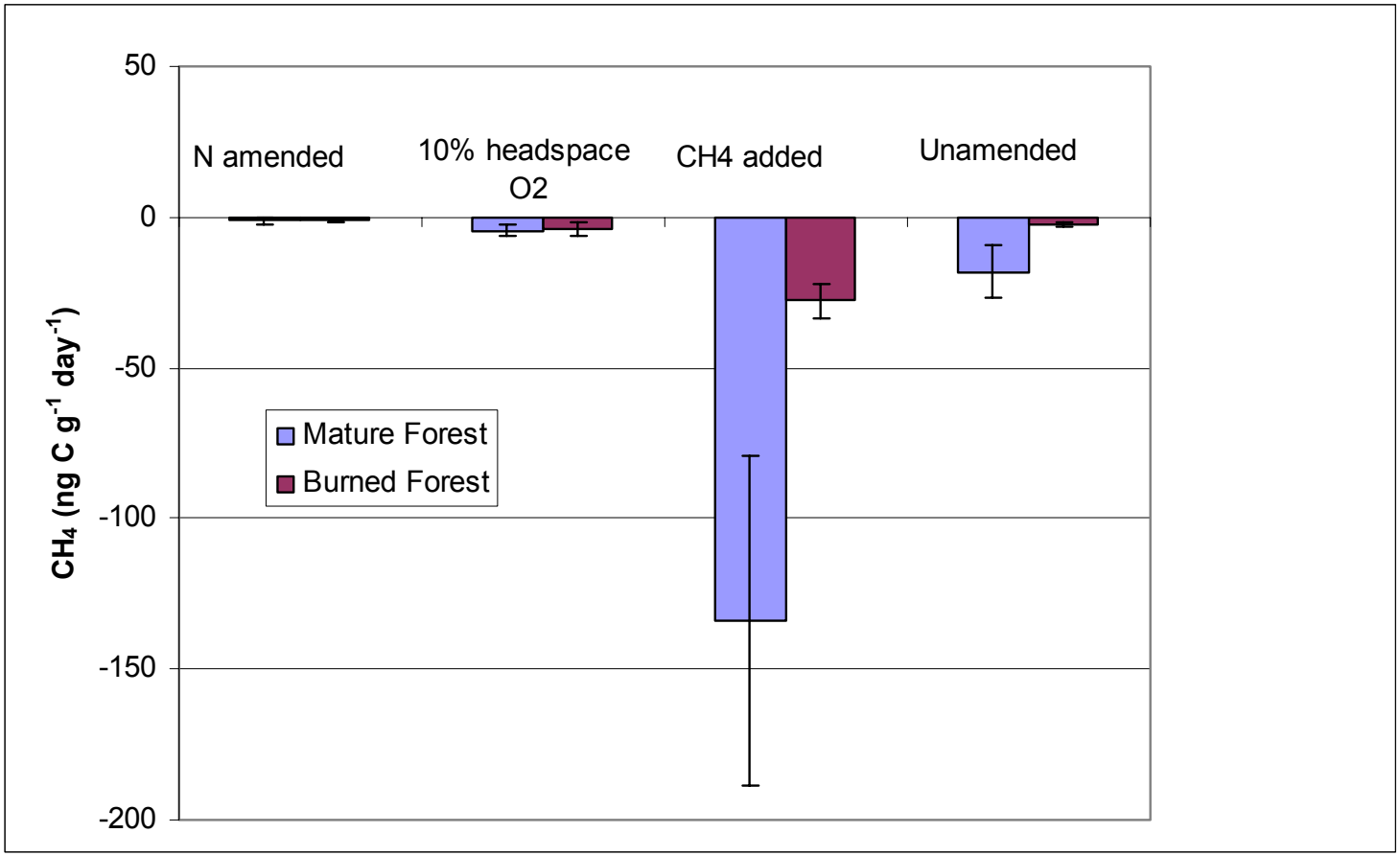
Laboratory Incubations

- Soils were incubated in Mason Jars at 70% water-filled pore spaces for potential GHG fluxes under following manipulations:
  - NH_4NO_3 additions
  - Headspace N_2O amendments
  - Headspace CH_4 amendments
  - Unamended control

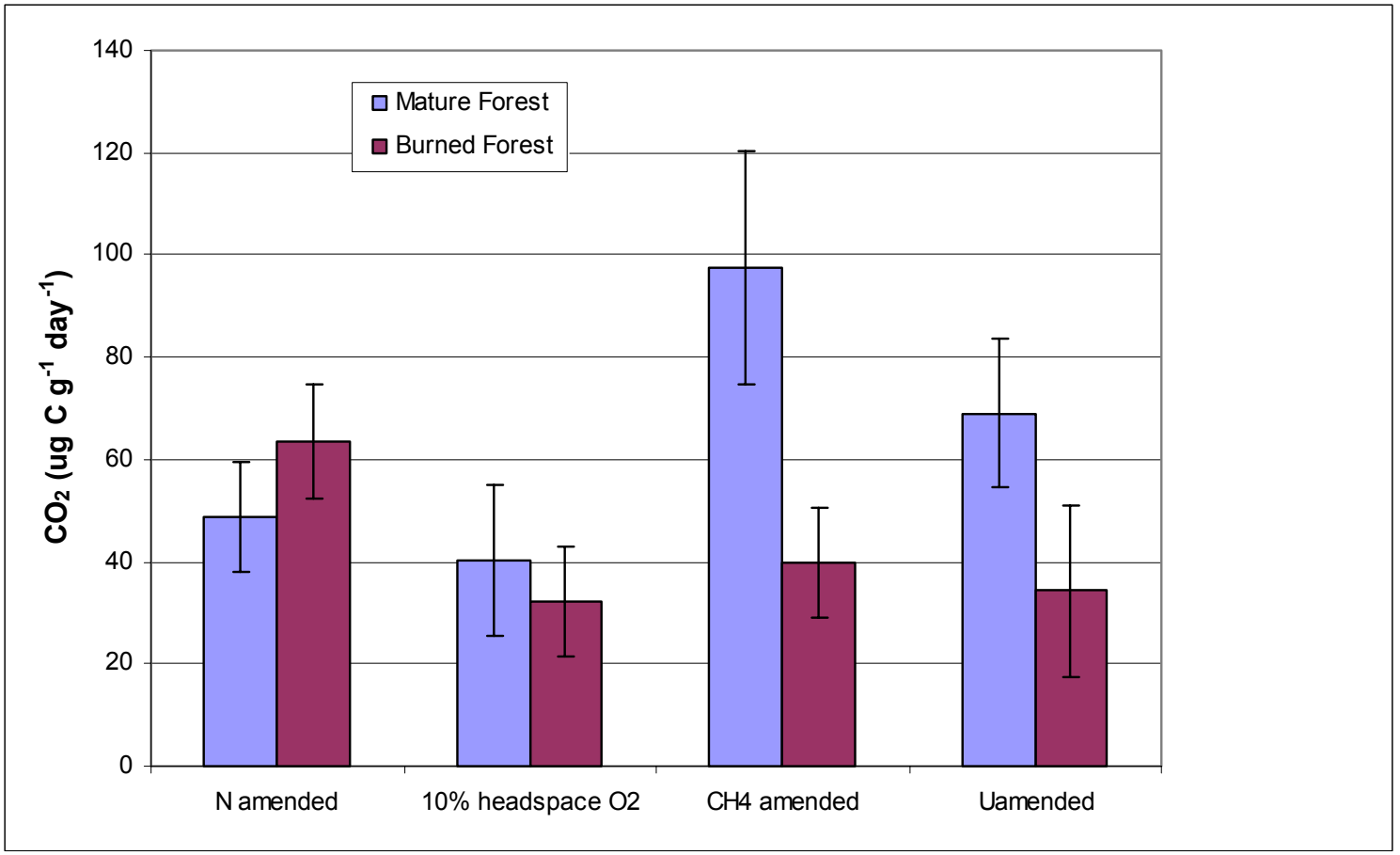
Preliminary Results



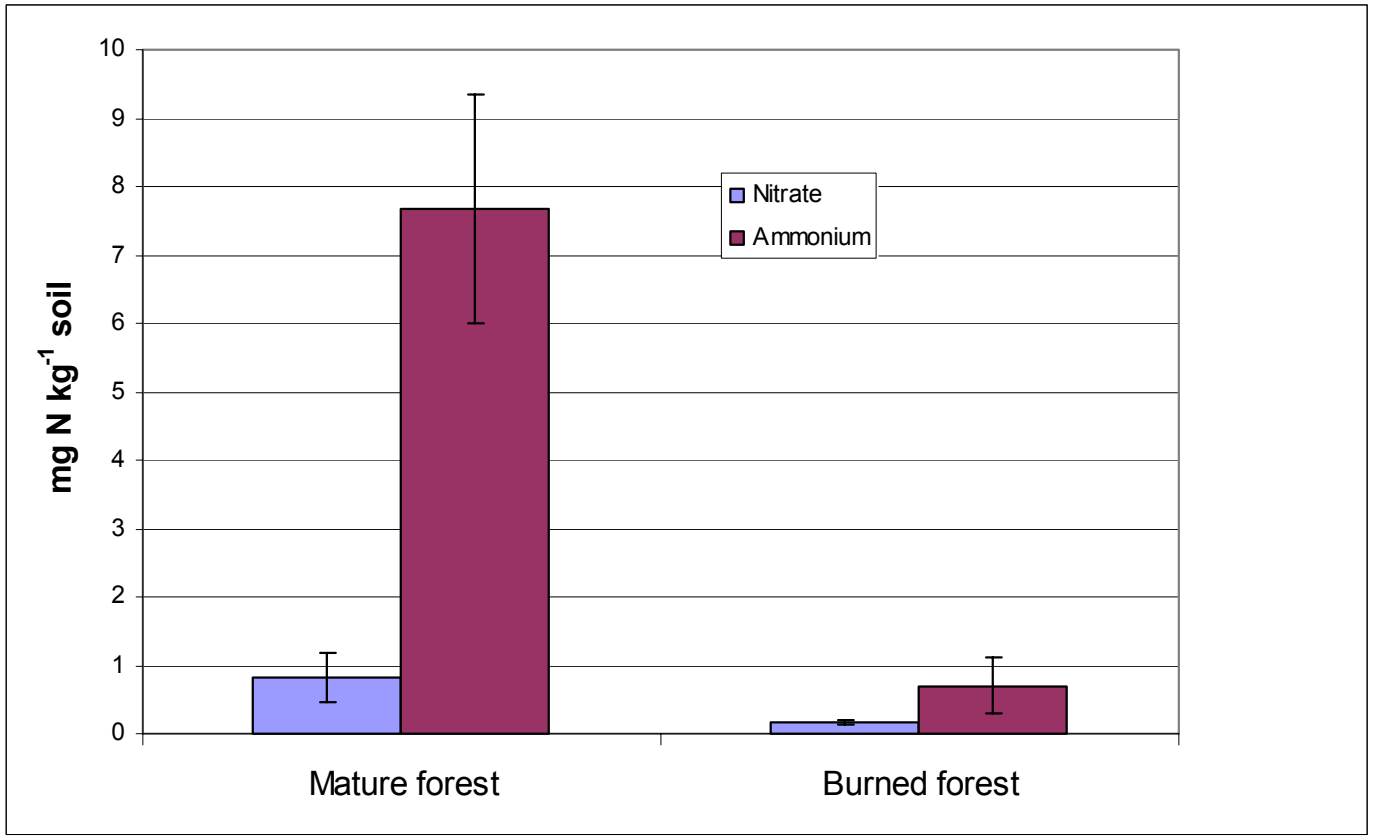
CH_4 Fluxes


50
0
-50
-100
-150
-200
N amended
10% headspace O2
CH4 added
Unamended
Mature Forest
Burned Forest
CH4 (ng C g-1 day-1)

Soil Microbial Respiration



Mineral N contents



Discussions

- Mineral N additions resulted in higher N_2O emissions.
- Mineral N additions reduced CH_4 oxidation potentials of these forests
- Future increases in reactive N input into boreal forests can substantially influence GHG fluxes
- Reduction of headspace O_2 by 50% may have induced anoxic conditions that reduced CH_4 oxidation and increased N_2O production by denitrifiers.

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