Climate effects on the retention of dissolved organic carbon in soils

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Objective

To examine the effects of incubation temperature and time on DOM adsorption and mineralization by soils collected from a California grassland, an oak woodland and a conifer forest.

Background

- Leaching of dissolved organic matter (DOM) is an important flux of carbon through ecosystems
- Dissolved organic carbon (DOC) in the soil solution affects nutrient cycling and carbon sequestration
- These processes are likely to be affected by future climate conditions

Background contd.

- DOC can be retained in the soil through sorption processes; it is lost through leaching and mineralization
  - Adsorption is positively correlated to aromaticity
  - Mineralization is a microbially mediated process

3 California ecosystems

Previous Experiments

- DOM solutions were made by incubating leaf litter from each ecosystem under different conditions
  - 5, 15, and 96 hours
  - 4, 20, and 30 ^{o}C

Previous Results

- Increased T, time of incubation→
  - Increased DOC concentration
  - Increased aromaticity of DOC
- Aromaticity is positively correlated with adsorption

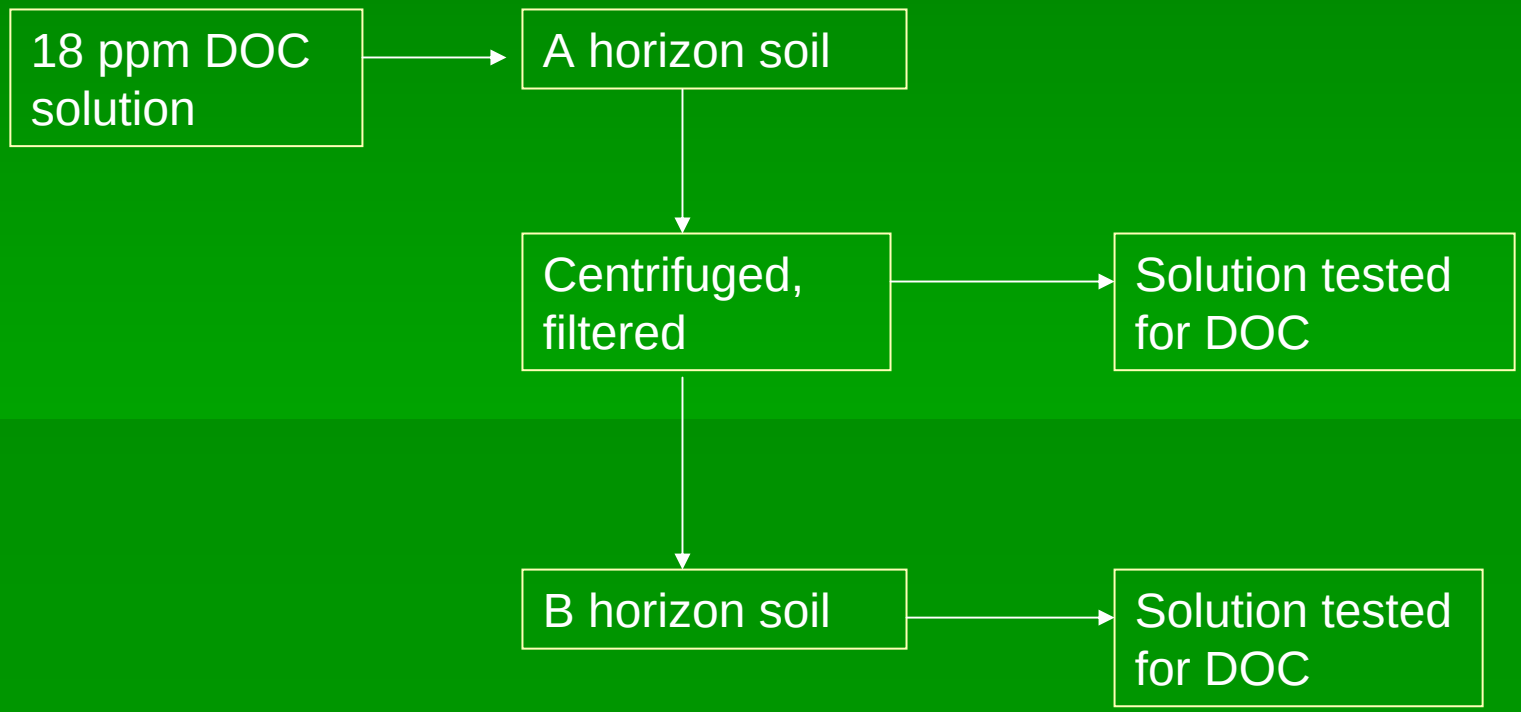
Hypothesis 1

- Increased incubation temperature and time will result in lower adsorption of DOC due to lower aromaticity

Hypothesis 2

- An increase in temperature will increase microbial activity and mineralization of DOC

Methods: Adsorption



Methods: Mineralization

- A horizon inoculum was added to 18 ppm DOC solutions
- B horizon inoculum was added to A horizon supernatant from the adsorption experiment
- After a 7 day incubation, DOC was measured

Results

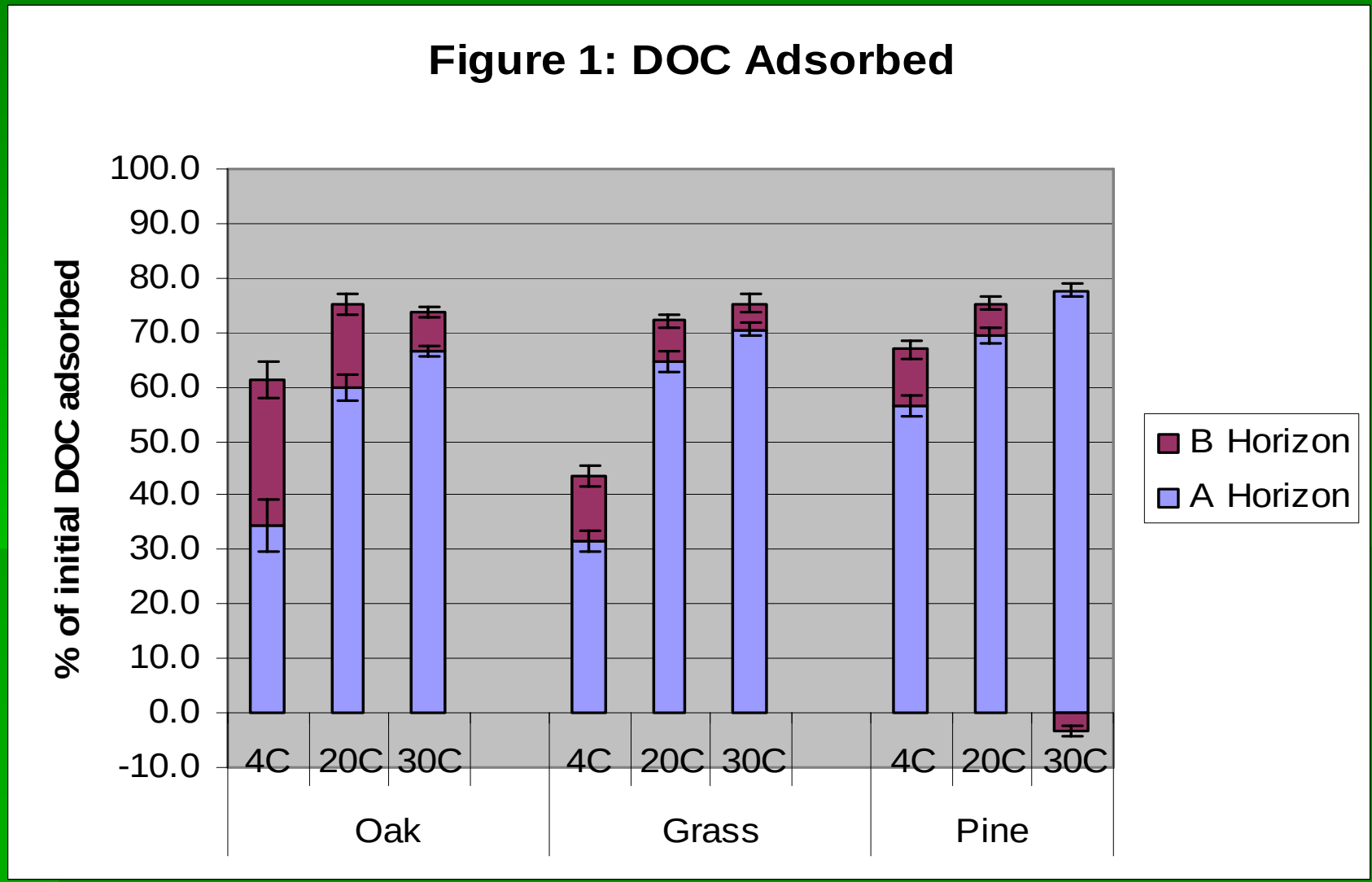
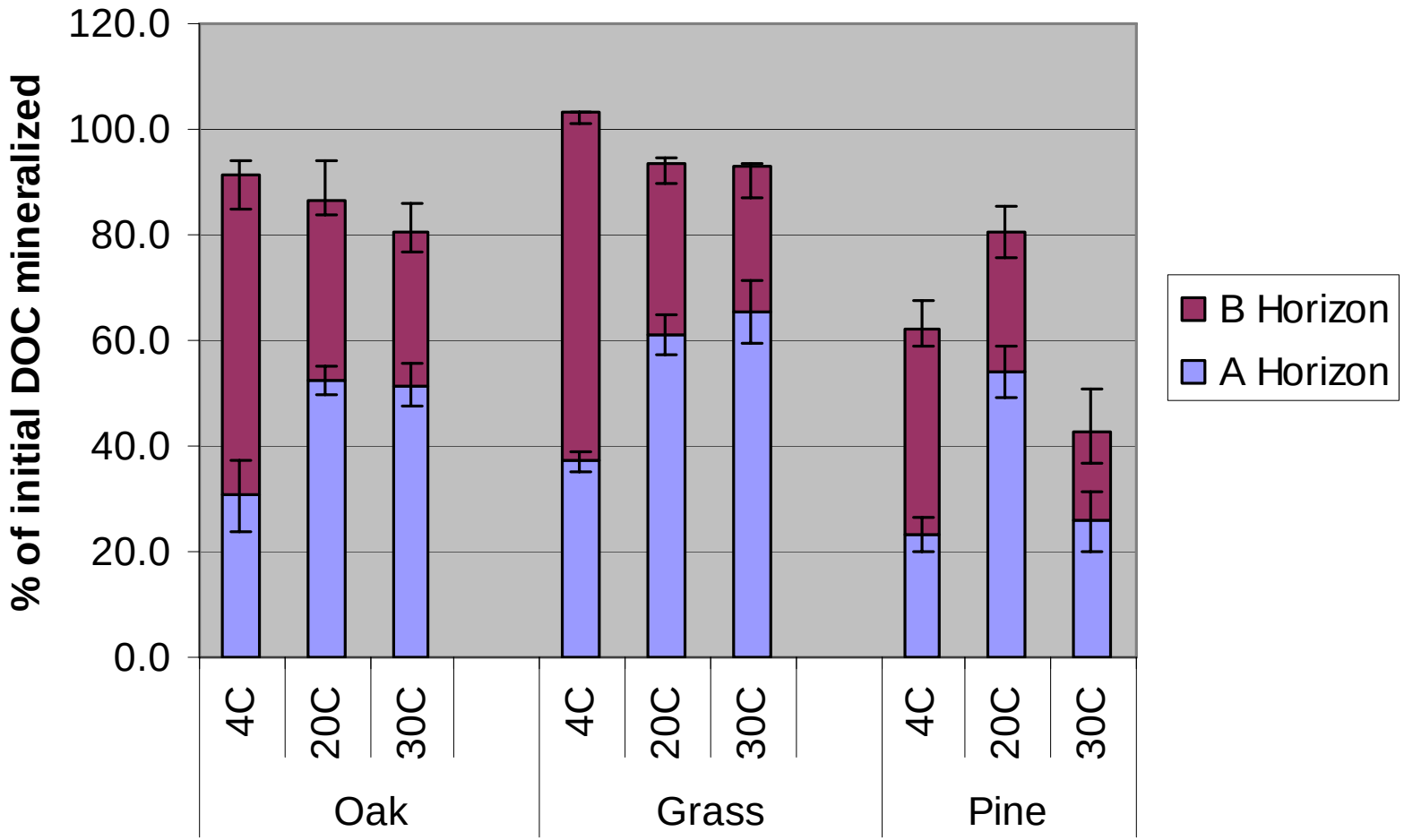


Figure 1: DOC Adsorbed
% of initial DOC adsorbed
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
4C
20C
30C
4C
20C
30C
4C
20C
30C
Oak
Grass
Pine
B Horizon
A Horizon

Adsorption results

- Increased temperature→
  - Decreased B horizon adsorption
  - Increased A horizon and total adsorption
- Incubation time was not a factor

Figure 2: DOC Mineralized



Mineralization results

- Increased temperature→
  - Increase in A horizon mineralization
  - Decrease in B horizon, total mineralization (in oak and grassland)
- Pine soil showed a peak in mineralization at 20^0C

Adsorption discussion

- These results do not support the hypothesis that aromaticity affects adsorption
- The decrease in B horizon adsorption could be a result of A horizon reactions and the lower initial concentrations
  - adsorption isotherms could test this relationship

Mineralization discussion

- These results do not support the hypothesis that microbial biodegradation will increase with higher temperatures
- However, mineralization results in high absolute loss of DOC
  - it is impossible to tell from this experiment how much mineralization and adsorption contribute to a decrease in DOC in solution

Conclusions

- Increased temperatures result in increased adsorption and mineralization in the A horizon
- Further work should explore adsorption isotherms, and the relative importance of adsorption and mineralization to DOC retention in the soil