The role of climate in regulating postfire nitrogen cycling and export in chaparral

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INTRODUCTION

Models predict that interannual rainfall variability will increase in CA over the next several decades. Following fire, winter rains can leach N into streams. But the long-term impacts of changing rainfall patterns remain unknown.

QUESTIONS

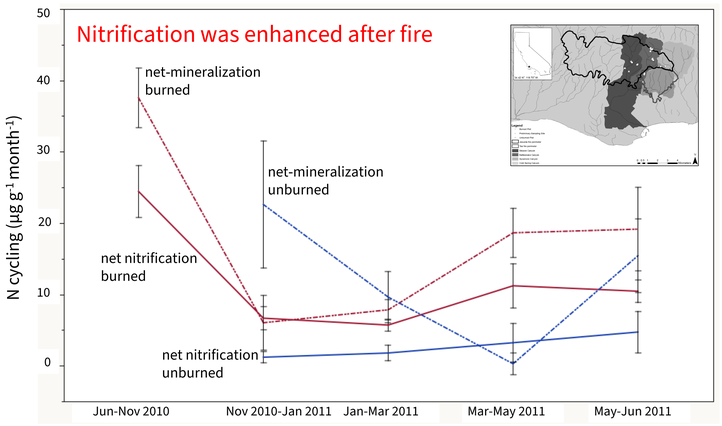
1. How does interannual rainfall variability affect postfire N export?
2. Do the effects of precipitation patterns in the years before or after fire extend over time to influence decadal scale recovery?

MEASUREMENT-MODELING APPROACH

- Field and lab analyses to evaluate controls over N cycling after fire
- Modeling to project the effects of fire timing on N dynamics & ecosystem recovery.

FIELD

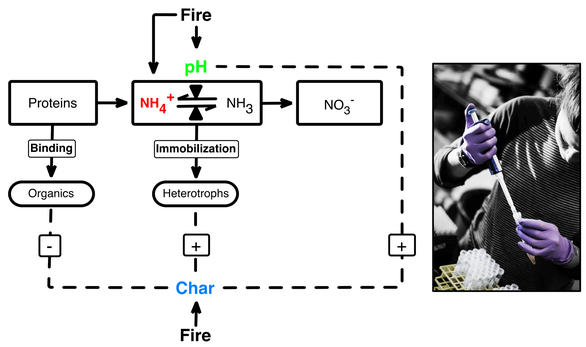
Evaluated soil C and N dynamics after fire for two years



Enhanced nitrification coincided with increased NH4+ supply, elevated pH and suppressed microbial biomass

LABORATORY INCUBATION

To evaluate controls over N cycling and microbial dynamics along a wildfire-structured age graident



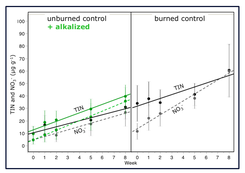
4 age classes:

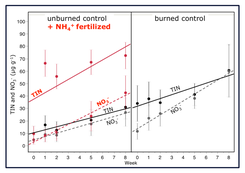
- Unburned (23 and 49-year-old)
- Burned (1.5 and 4-year-old)
- 3 plots per age

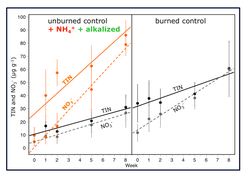
Incubated 8 weeks

- 4 levels of pH
- w/wo NH4+
- w/wo char

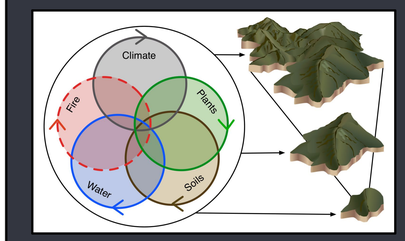
Substrate supply and pH interact to activate nitrifier populations, then trade off (or amplify one another) to sustain nitrification







MODELING



Ecohydrologic model RHESSys

15 SIMULATIONS
45 years
Fire in one of middle 15 years
Classified fire years as dry, intermediate, or wet, based on ET

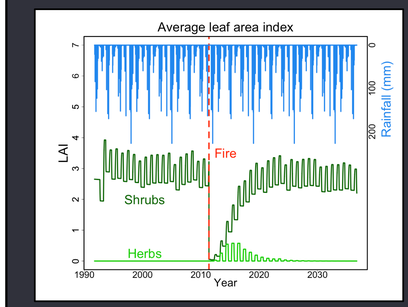
MODELING EXPERIMENT

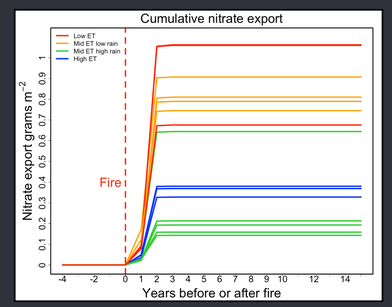
Evaluate how climate conditions before & after fire influence N cycling

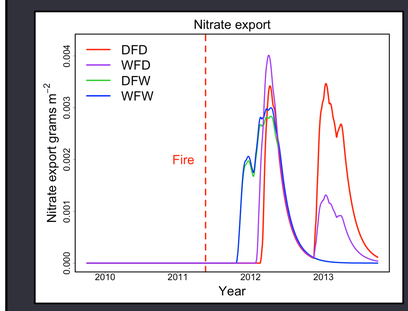
1. DFD: dry – fire – dry
2. WFD: wet – fire – dry
3. DFW: dry – fire – wet
4. WFW: wet – fire – wet

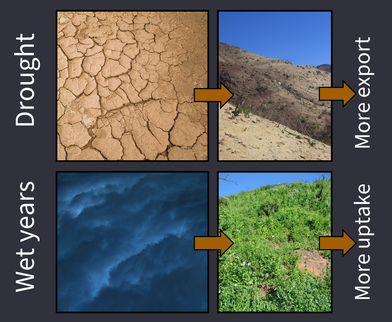
MODELING RESULTS

Export was up to an order of magnitude higher during drought









CONCLUSIONS

Nitrification ⇧ after fire

- Stimulated by ⇧ NH_4^+ supply & pH, sustained by low microbial biomass

Plants immobilized N quickly
Most export occurs in the early stages of recovery

- During this time, N export increases when fire is followed by drought due to the effects of drought on plant recovery

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