The Impact of Bark Beetle Outbreaks on Carbon Cycling in the Western US

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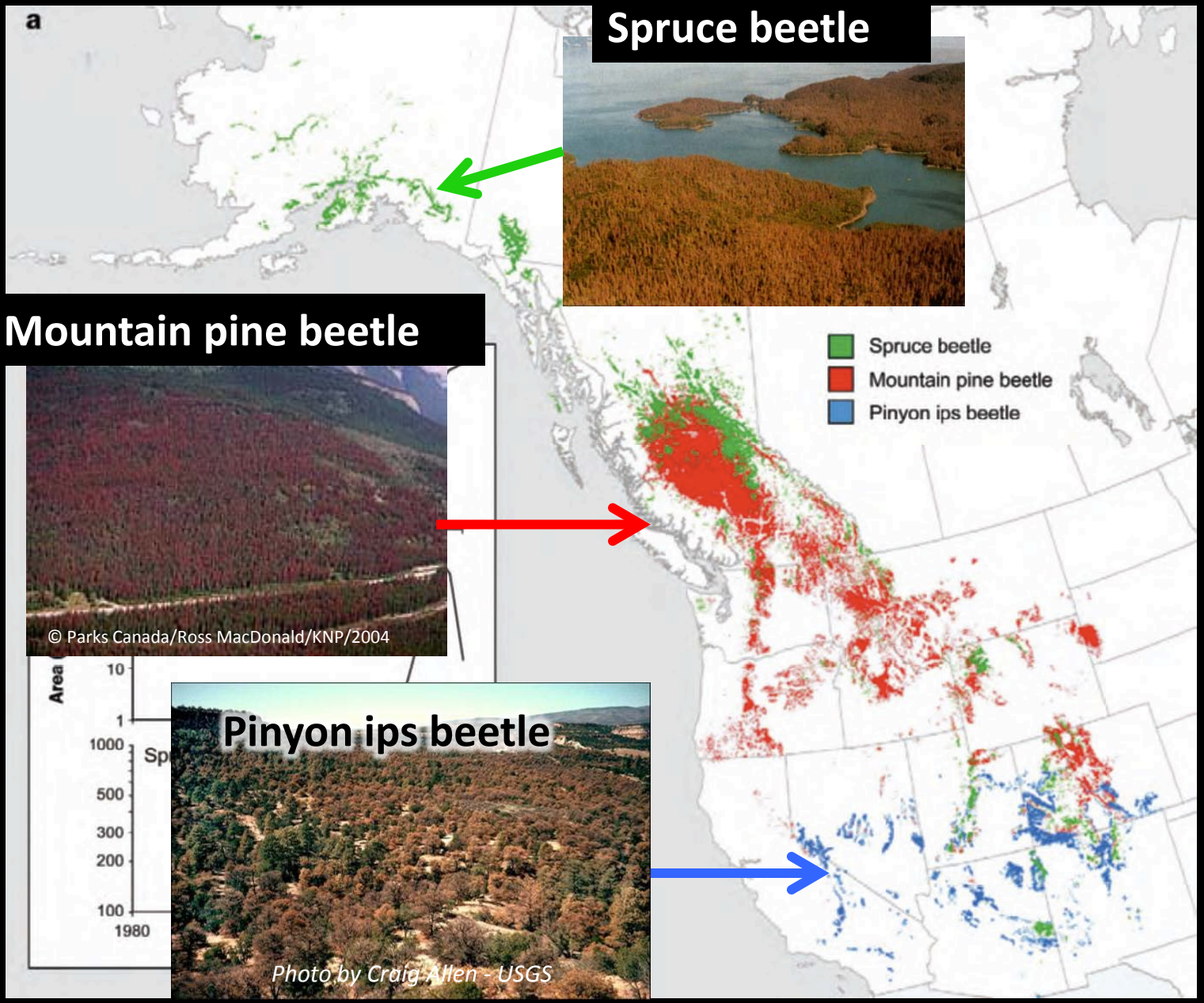
Outline

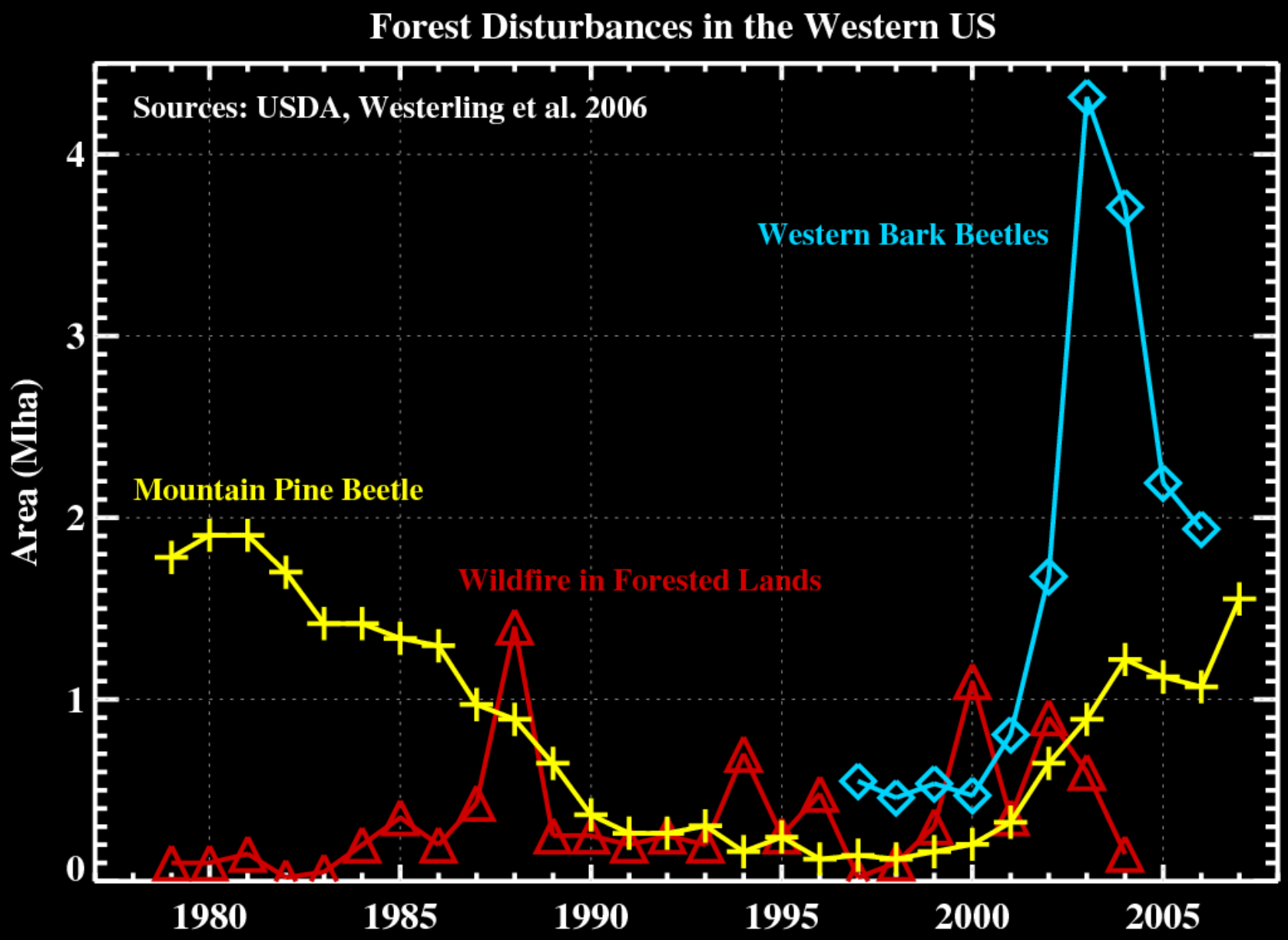
1. Background
2. Reduction of vegetative C bias in the western US
3. Insect forcing dataset
4. Results from paired simulations
5. Future work

Tree mortality is wide spread throughout the West



Raffa et al., BioScience, 2008

Area affected by insects is similar to area affected by fires



Stages of Attack

Year following attack

Photo by Arjan Meddens

Dead tree, needles on

“ Red Attack”

After 3-5 years

Photo by Arjan Meddens

Needles off

“Gray Attack”

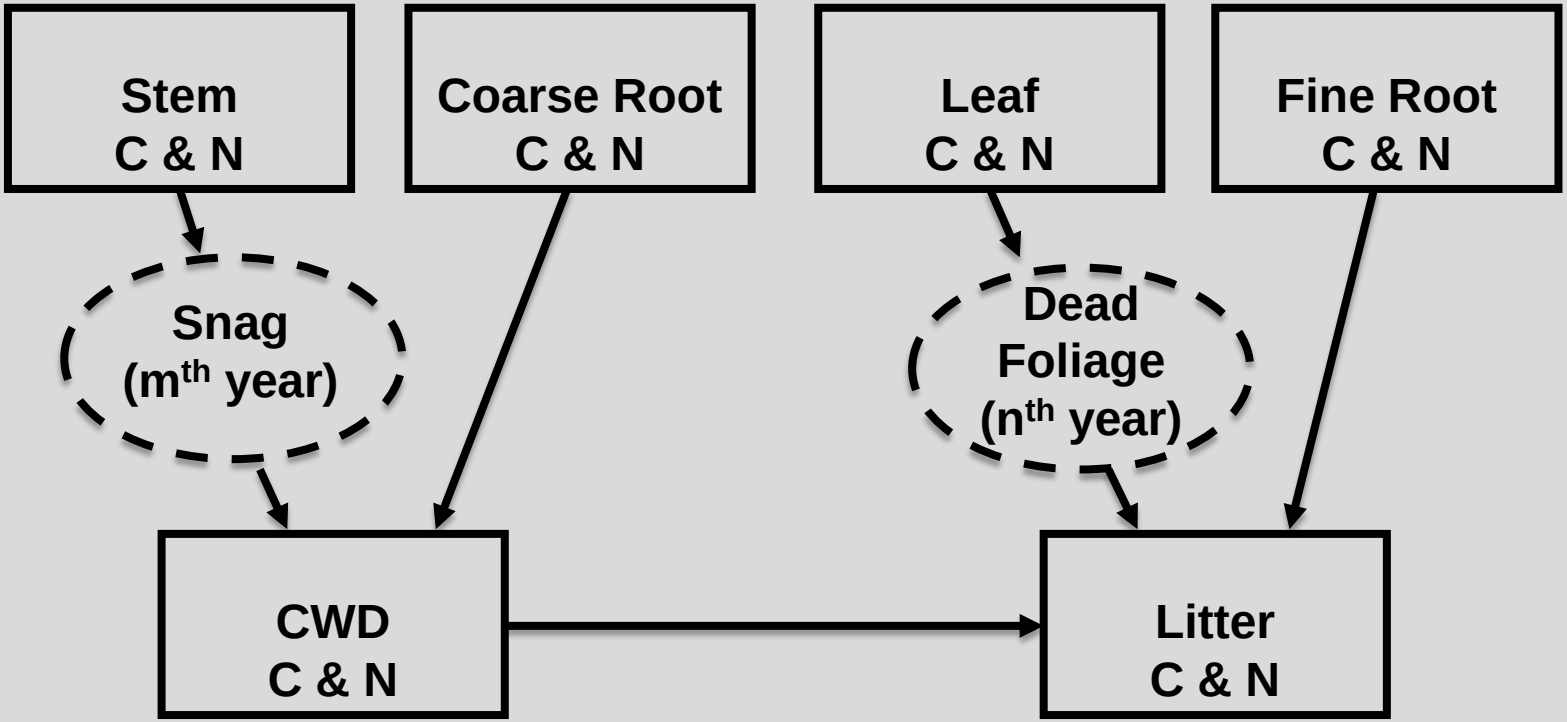
After several decades

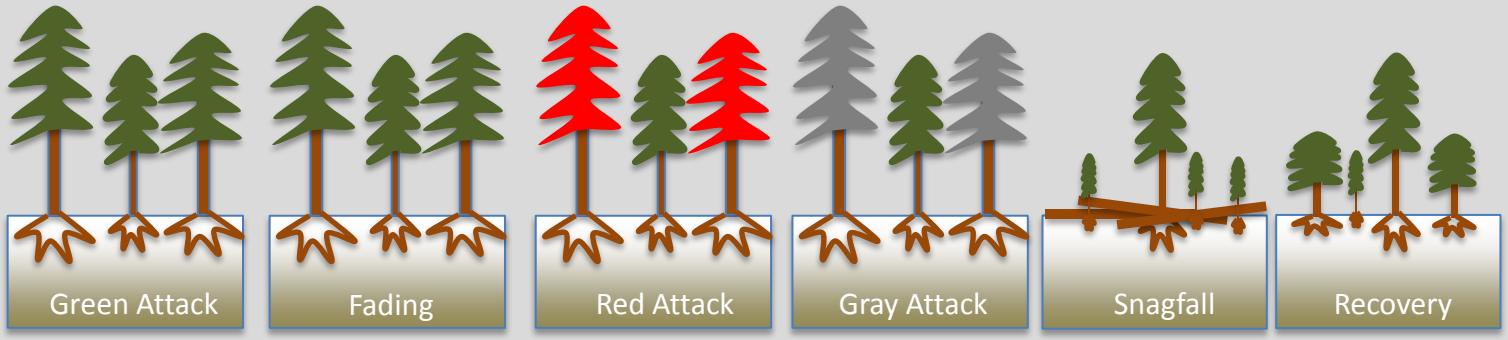
Photo by C. Schnepf, forestryimages.org

Snag fall/understory growth

“Recovery”

Modifications to CLM





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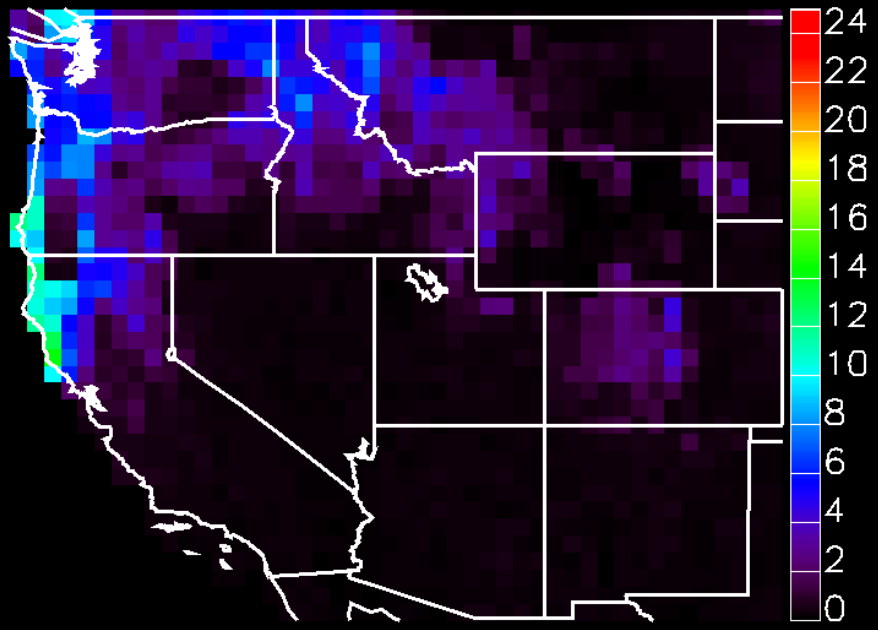
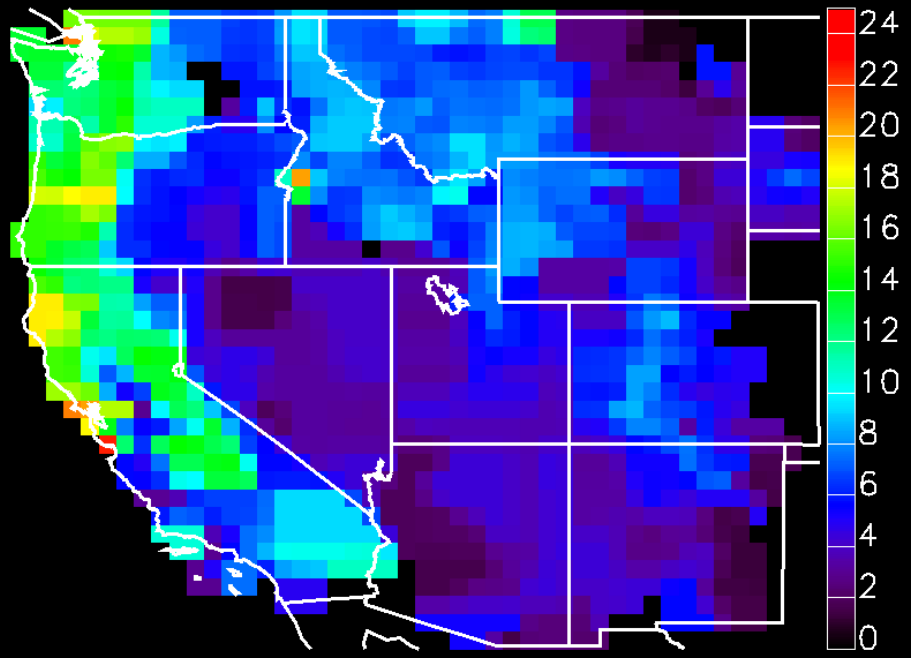
Vegetative C (kg C m^{-2})

CLM



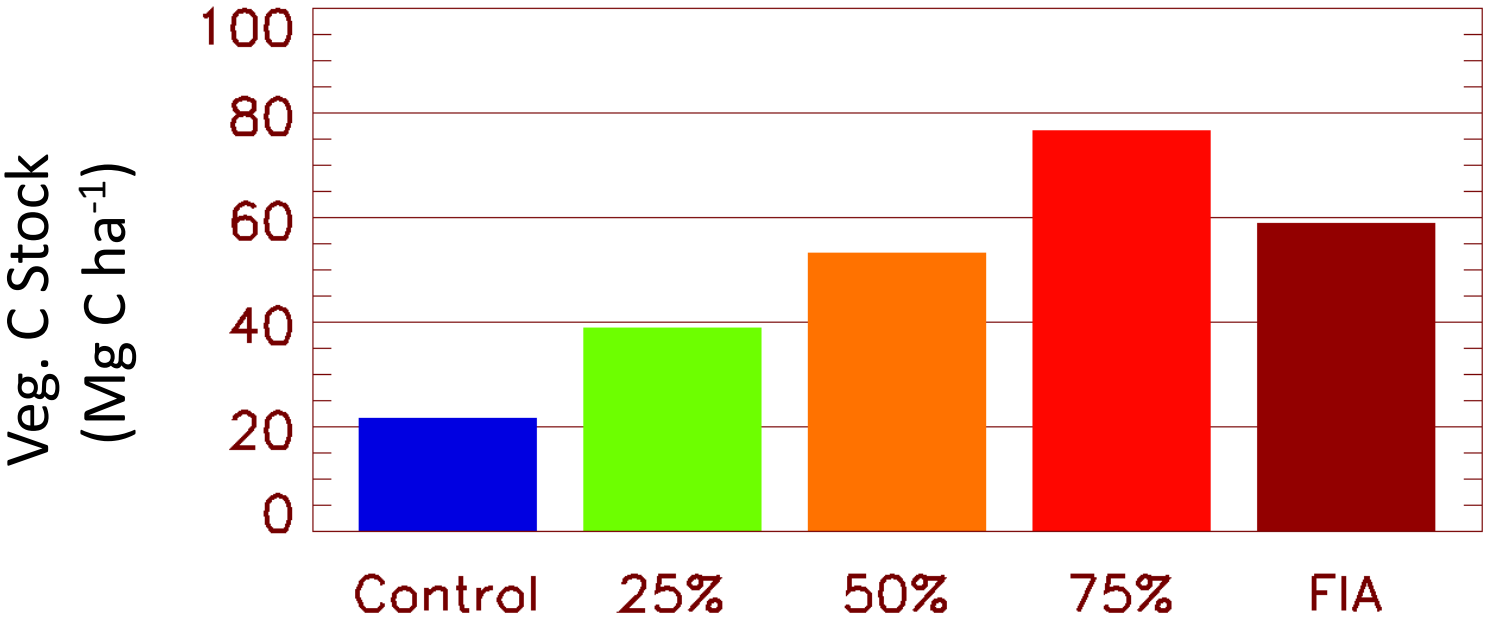
FIA



Hicke et al., 2007, *Ecological Applications*

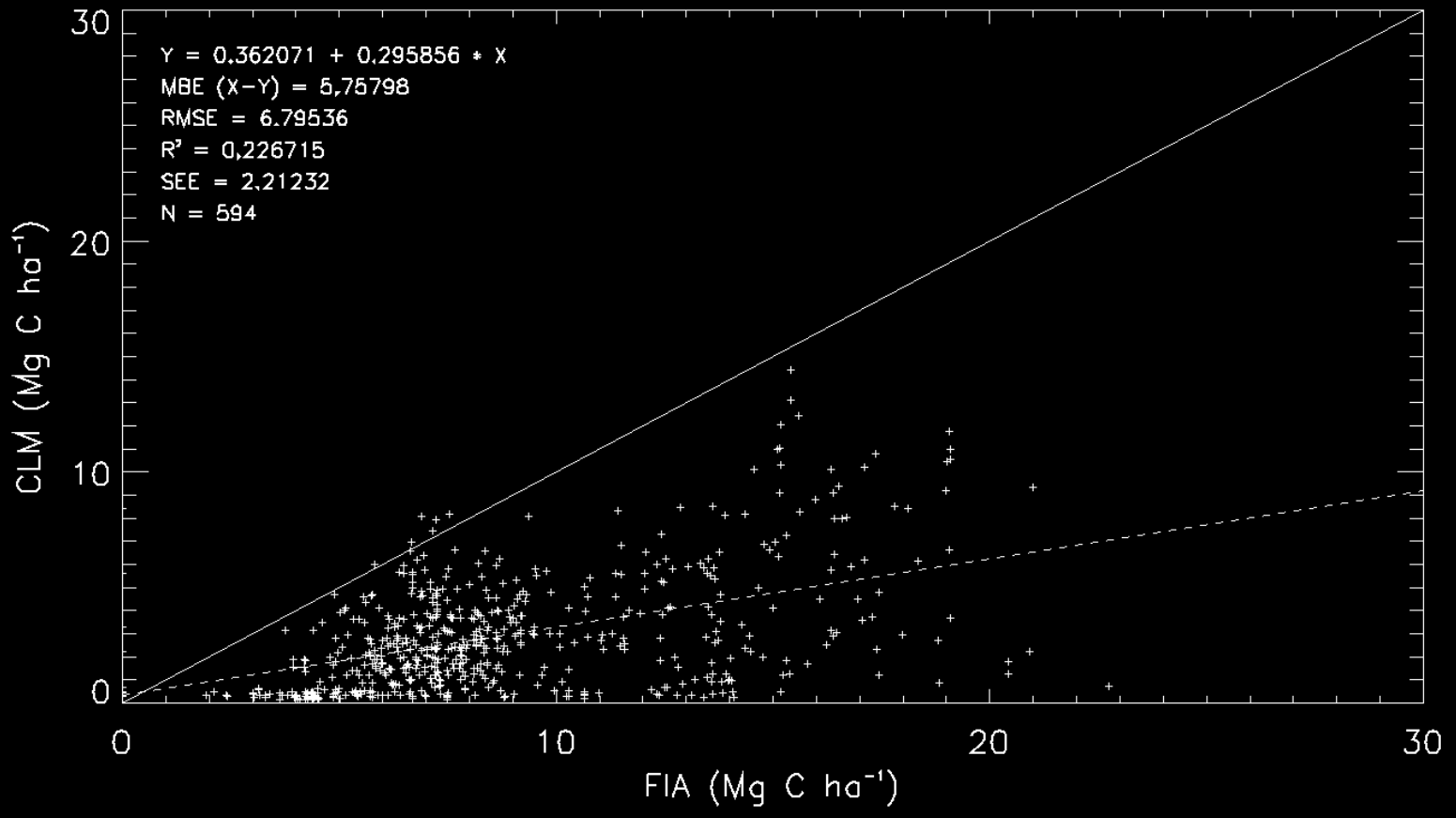
Point run in Colorado

Background Mortality = 0.5%

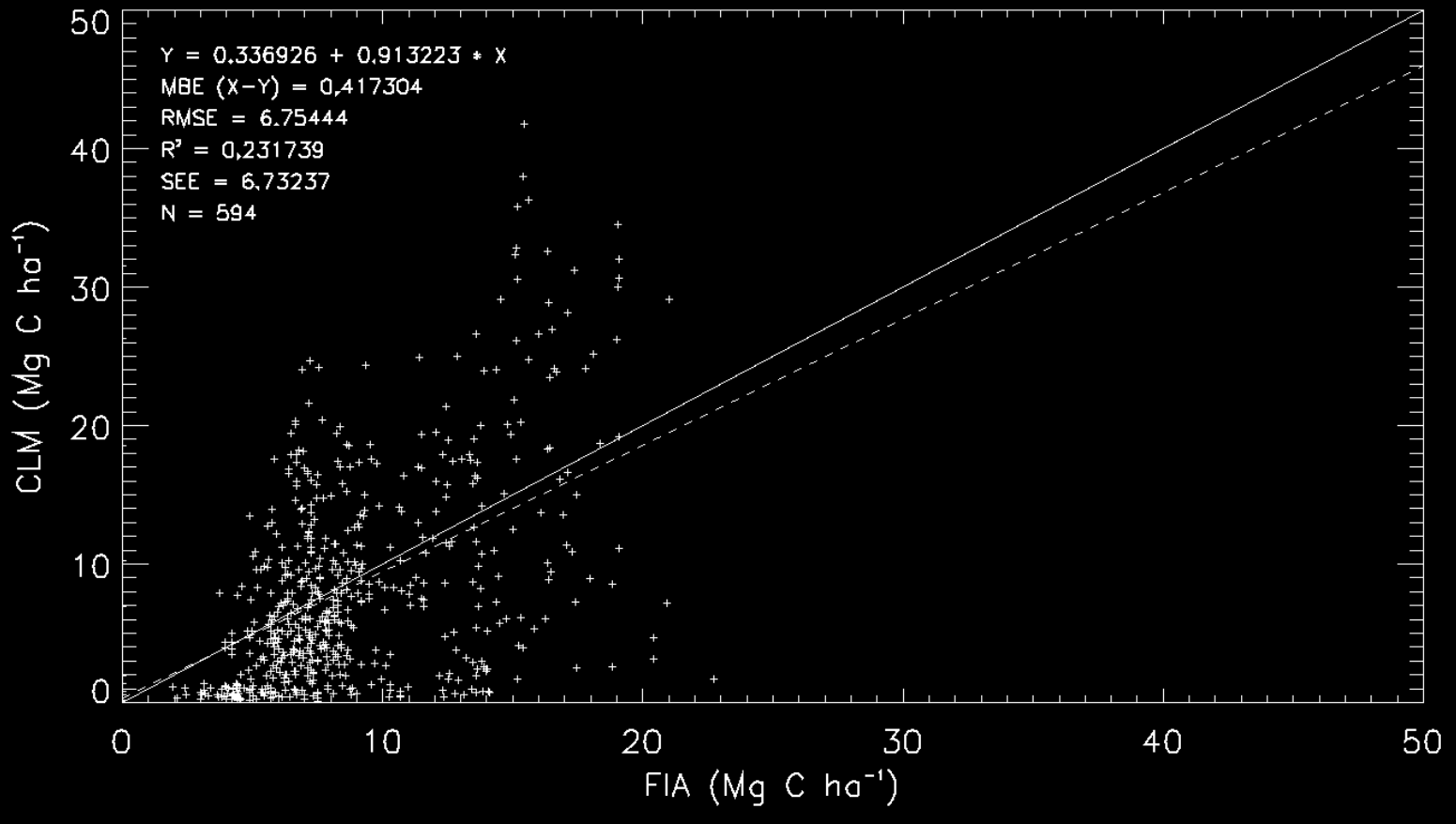


% reduction of CLM predicted area burned

100% Fire and 2% Mortality



50% fire and 0.5% Mortality



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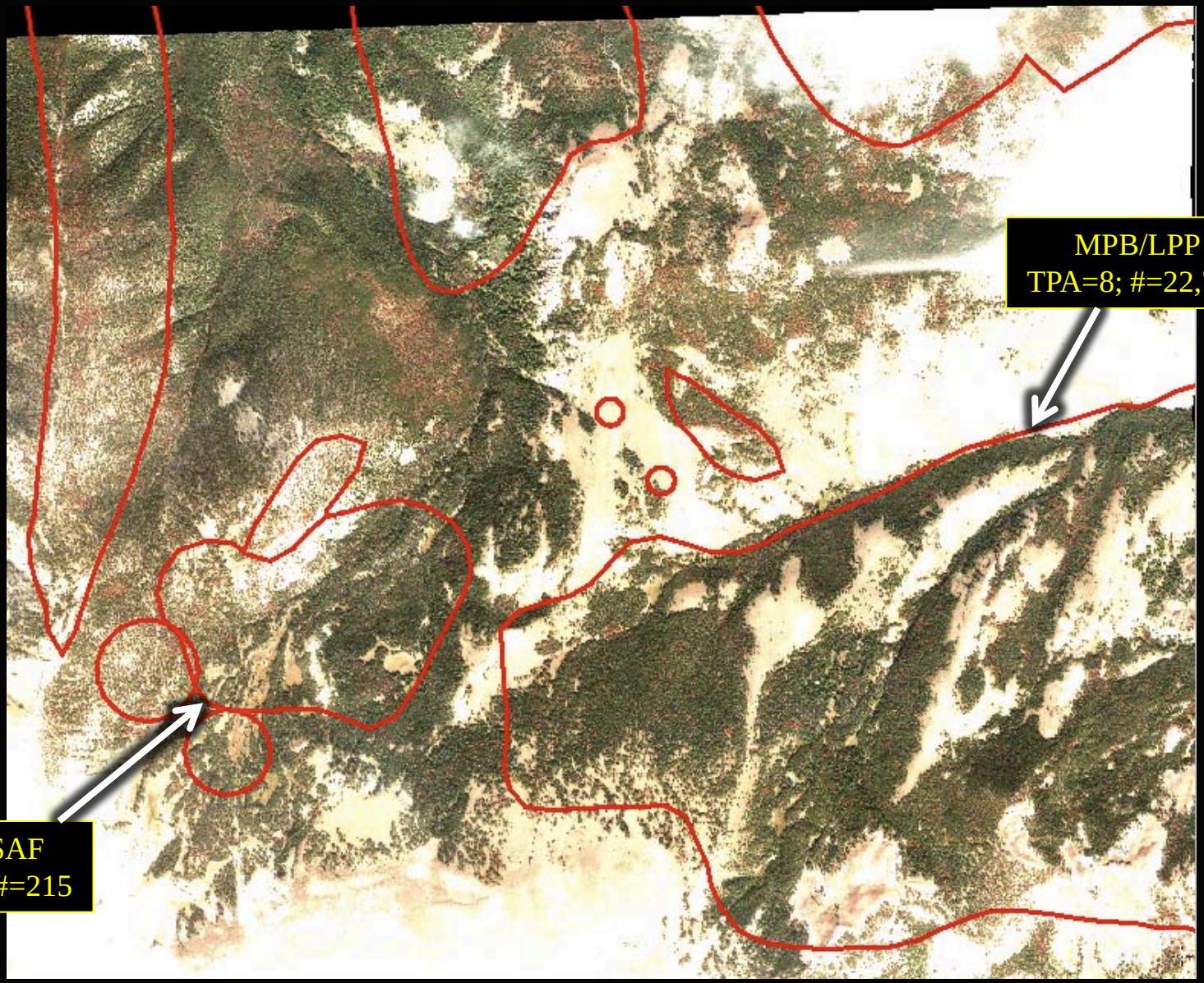
USFS Aerial Detection Surveys (ADS)

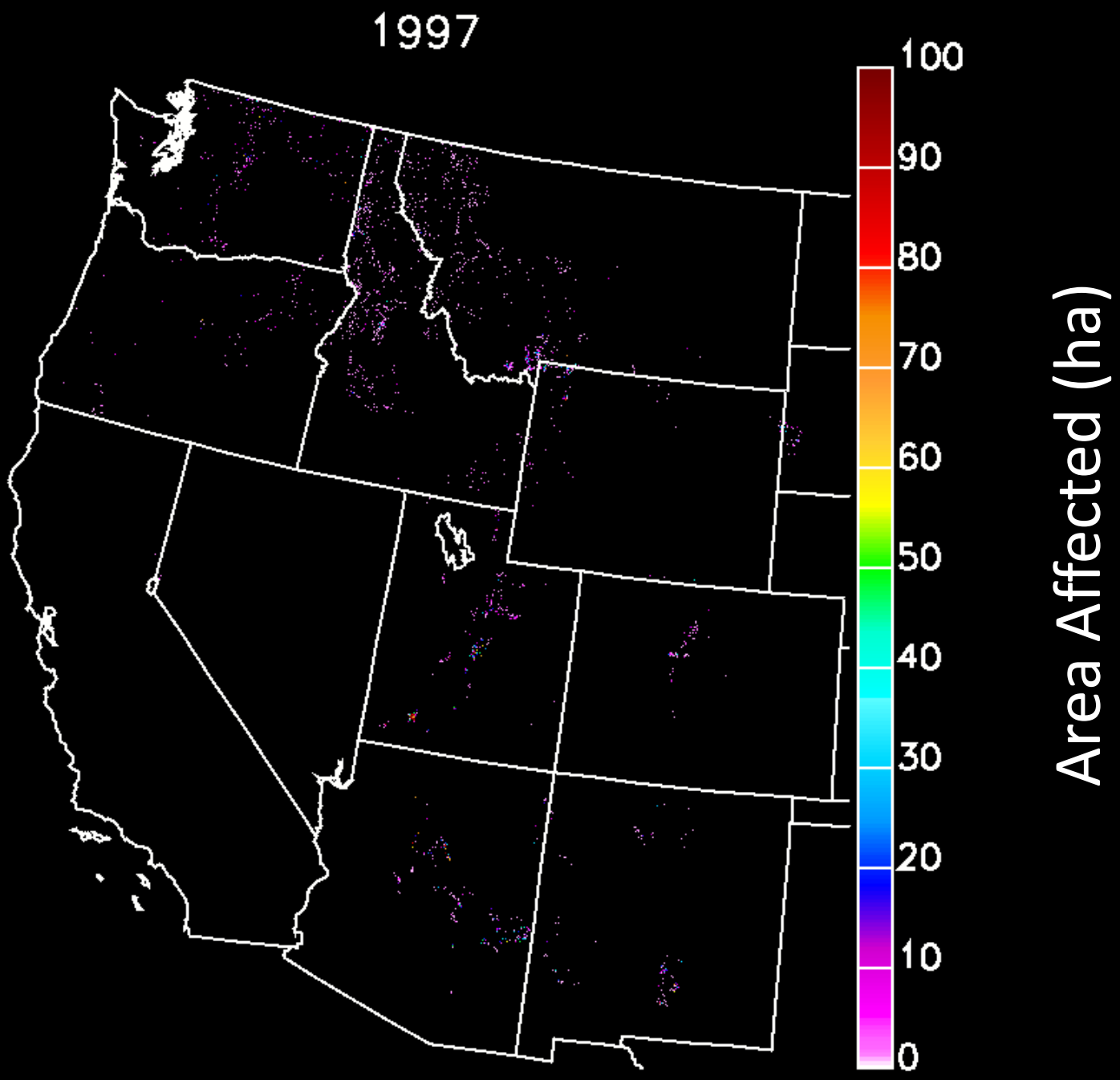
- Conducted yearly to map insect, disease, and other disturbance

- Westwide (US) data available from 1997

Photos by W. Ciesla: http://www.fs.fed.us/r2/resources/fhm/aerialsurvey/

Aerial survey polygons on 2.4-m QuickBird satellite image




1997
100
90
80
70
60
50
40
30
20
10
0
Area Affected (ha)

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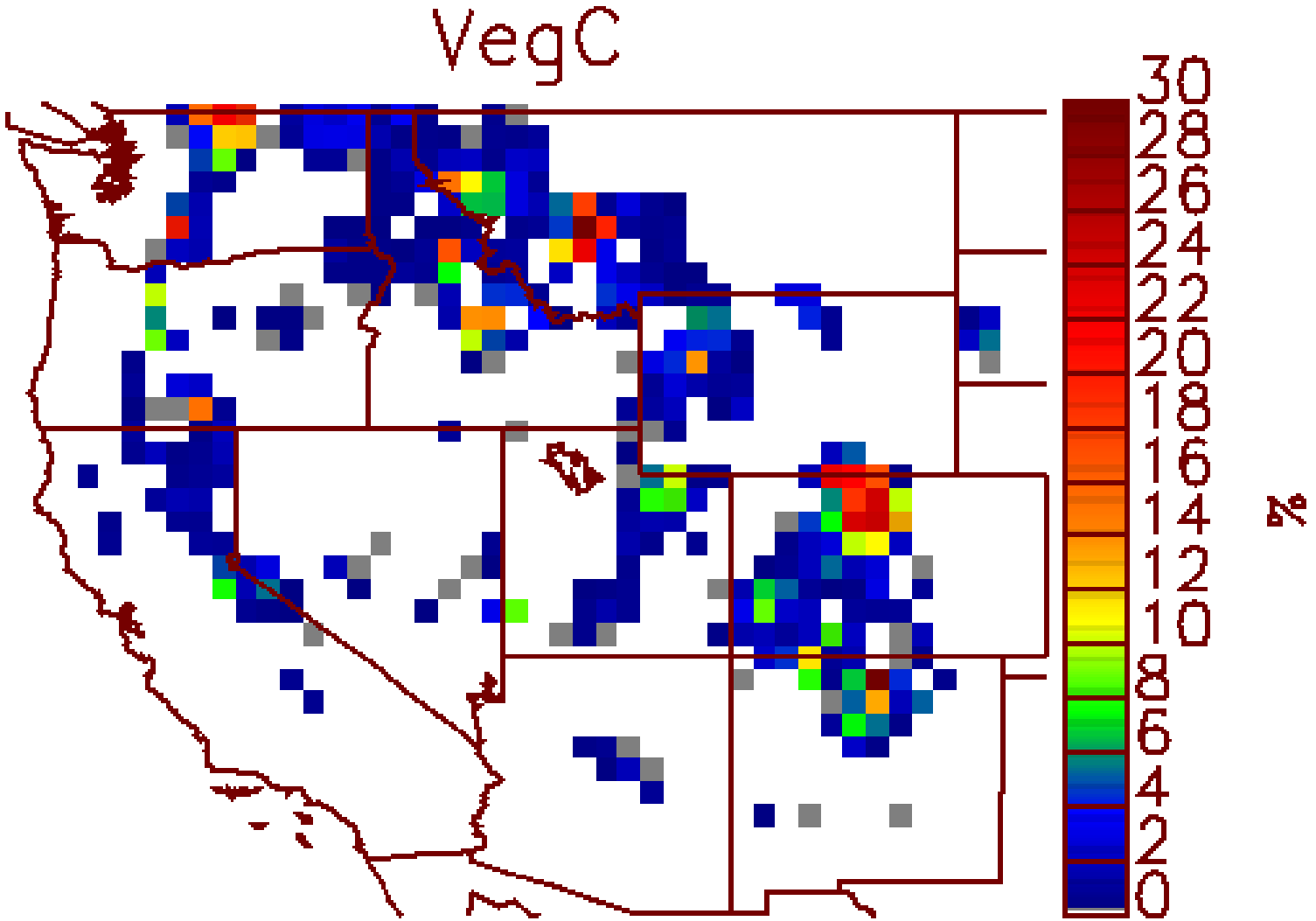
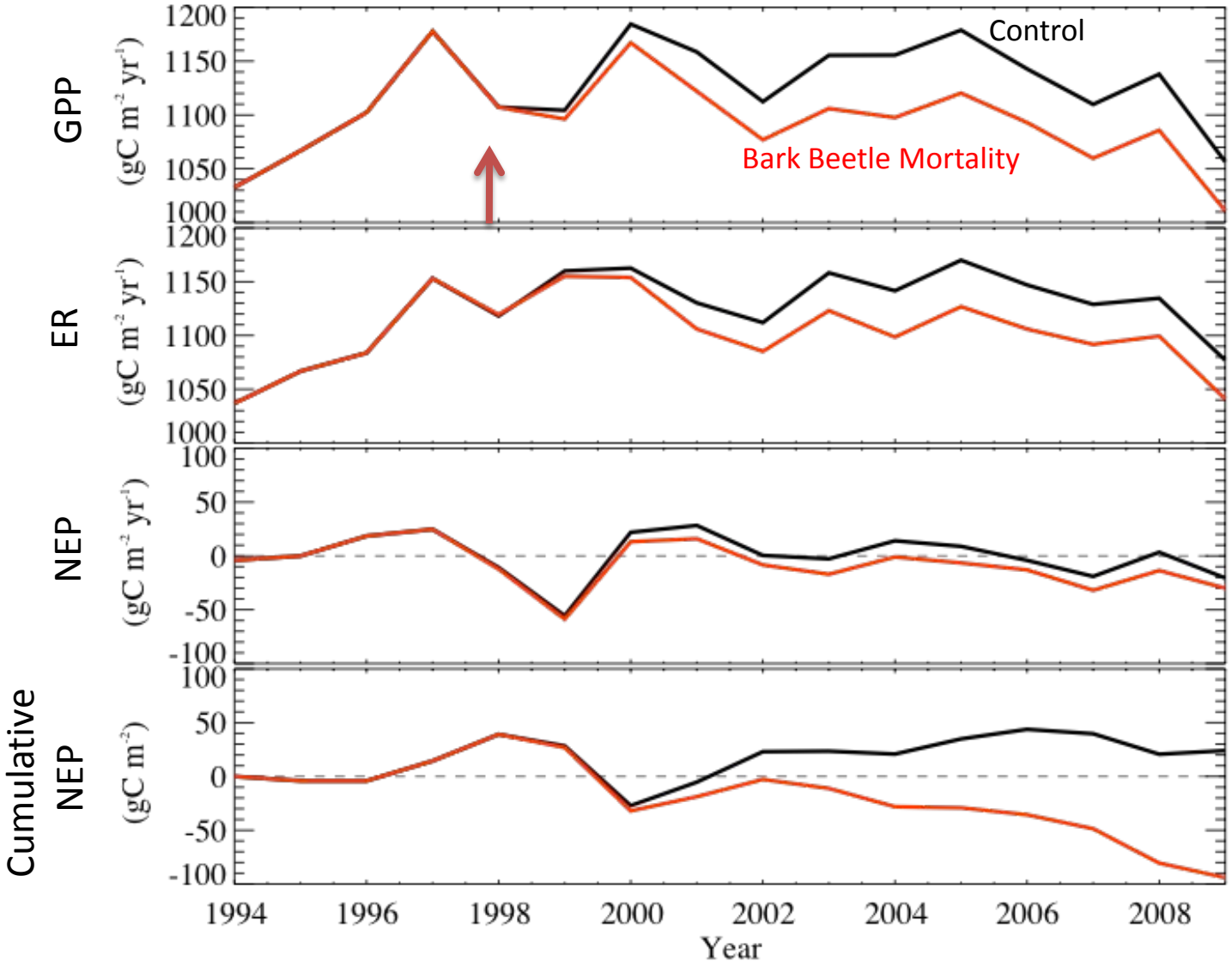
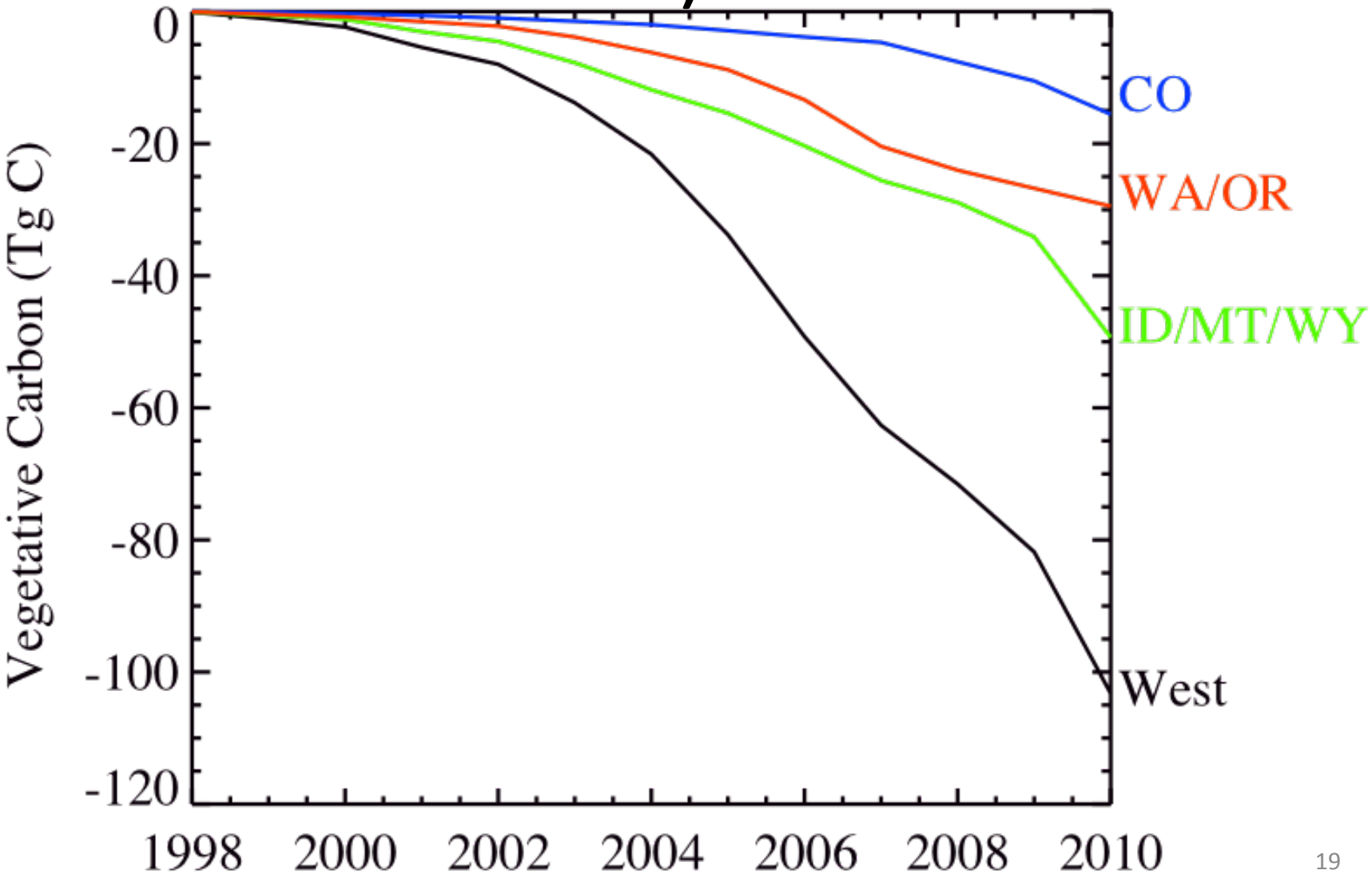
Reduction in Vegetative Carbon



Example Outbreak in Montana



Vegetative Carbon Anomalies (Tg C)



Regional Impacts to C cycle

	NEP ($Tg\ C\ yr^{-1}$)	VEG C. (Tg C)
Lower Bound	0.37	4.8
Upper Bound	8.64	103.0
Kurz et al., 2008 BC	12.85	---

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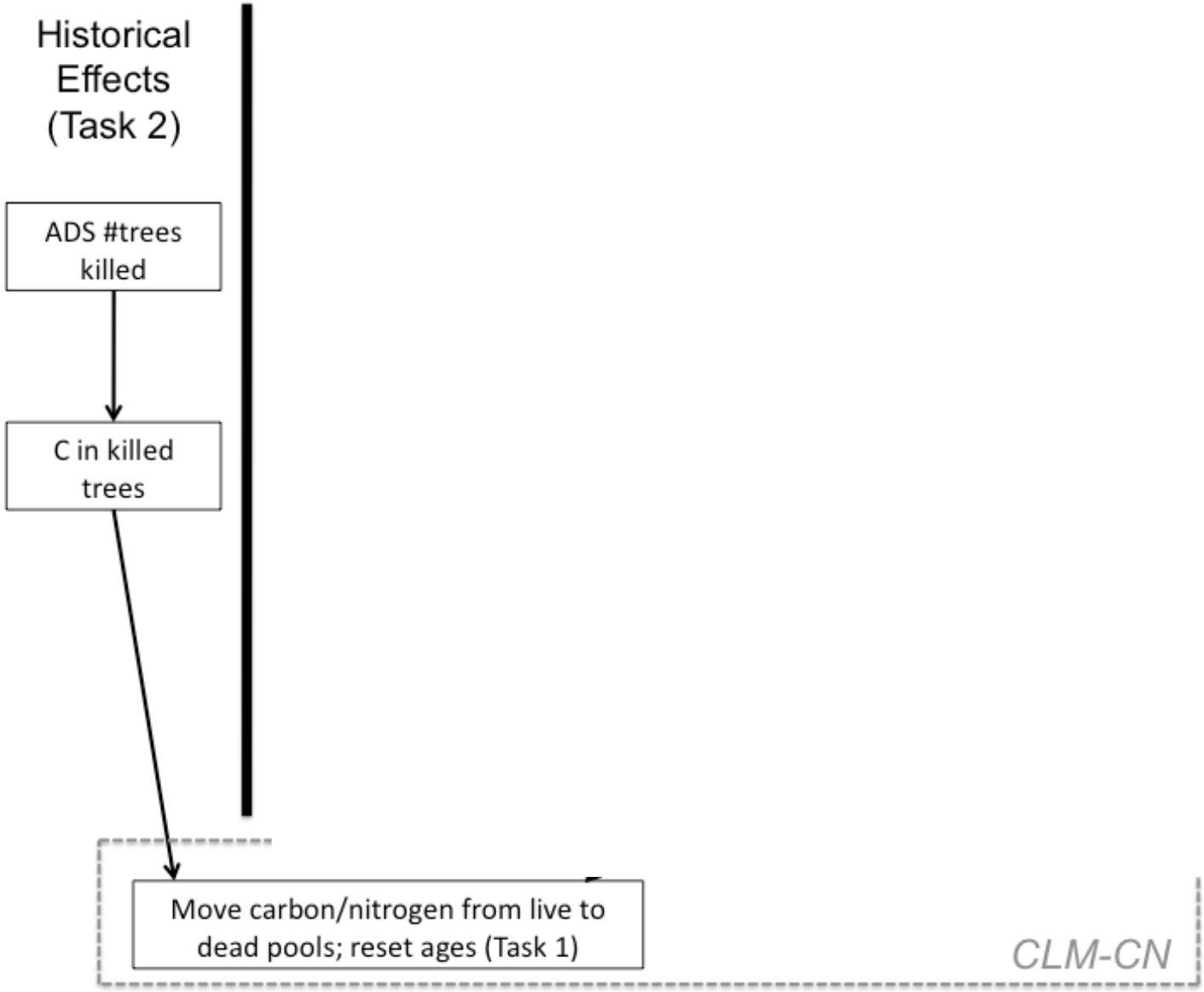
Future Work


Historical Effects (Task 2)
ADS #trees killed
C in killed trees
Move carbon/nitrogen from live to dead pools; reset ages (Task 1)
CLM-CN