

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

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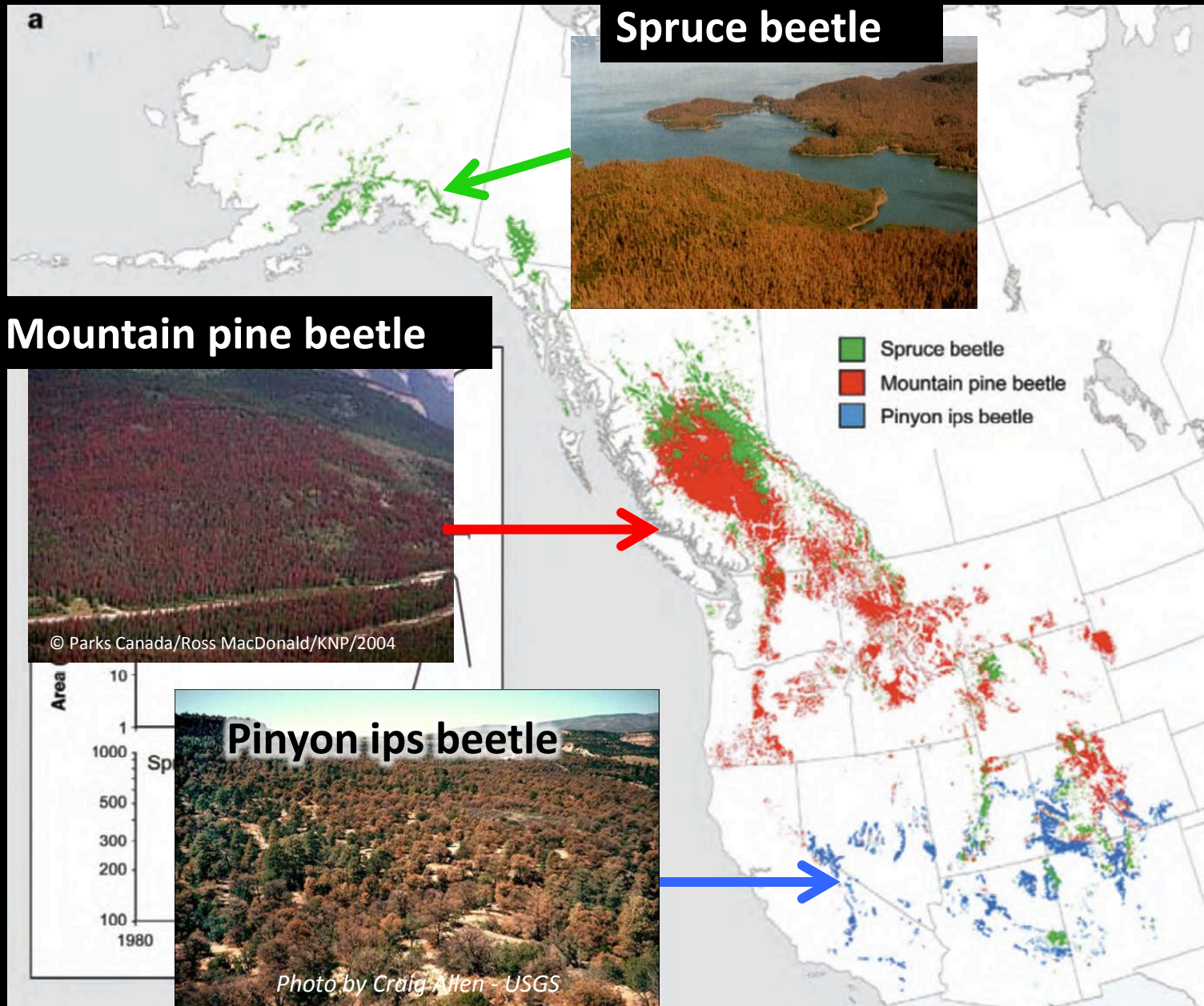
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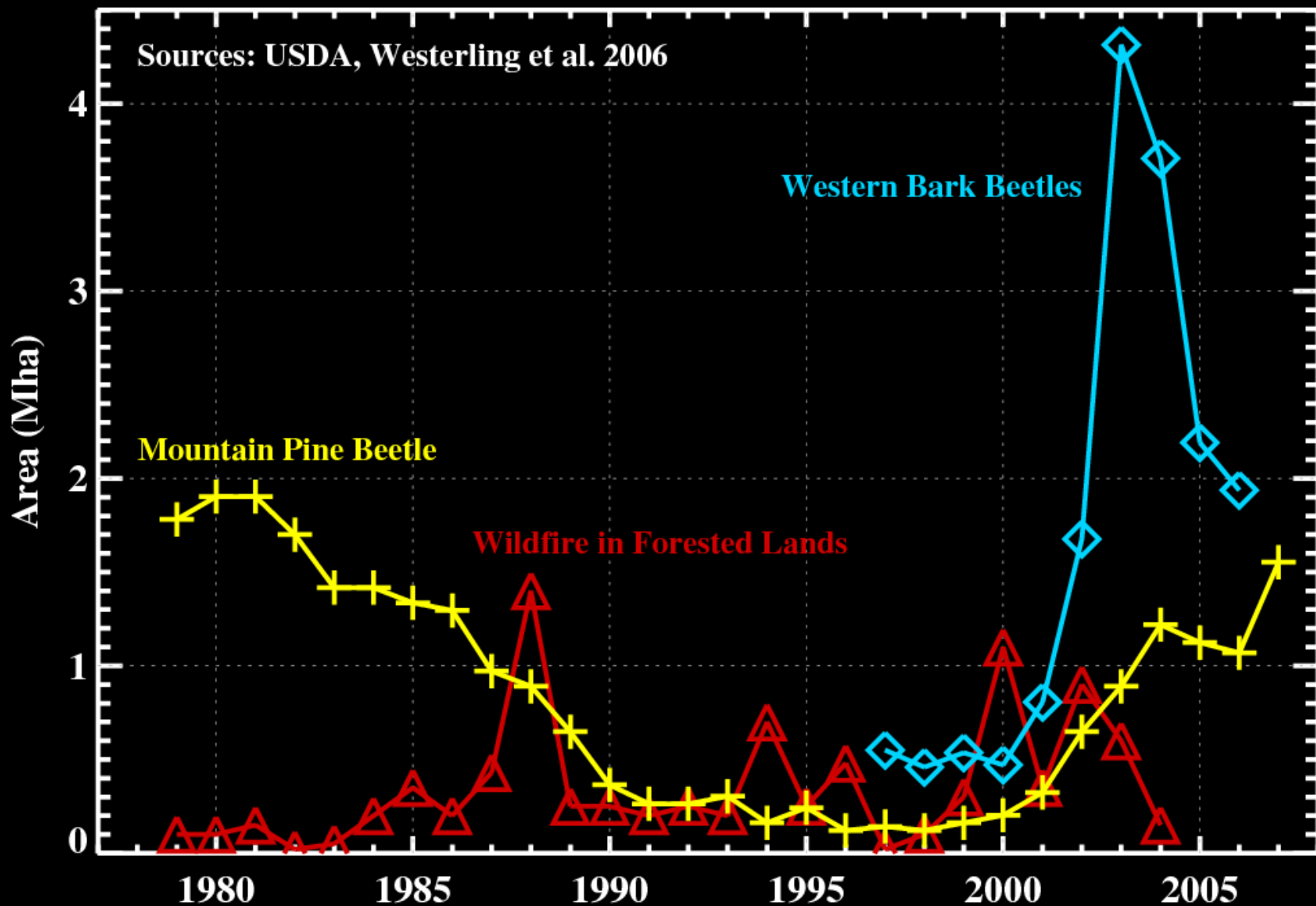
**Computing Resources:** Climate & Global Dynamics Division of NCAR

# Tree mortality is wide spread throughout the West



# Area affected by insects is similar to area affected by fires

## Forest Disturbances in the Western US



# 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



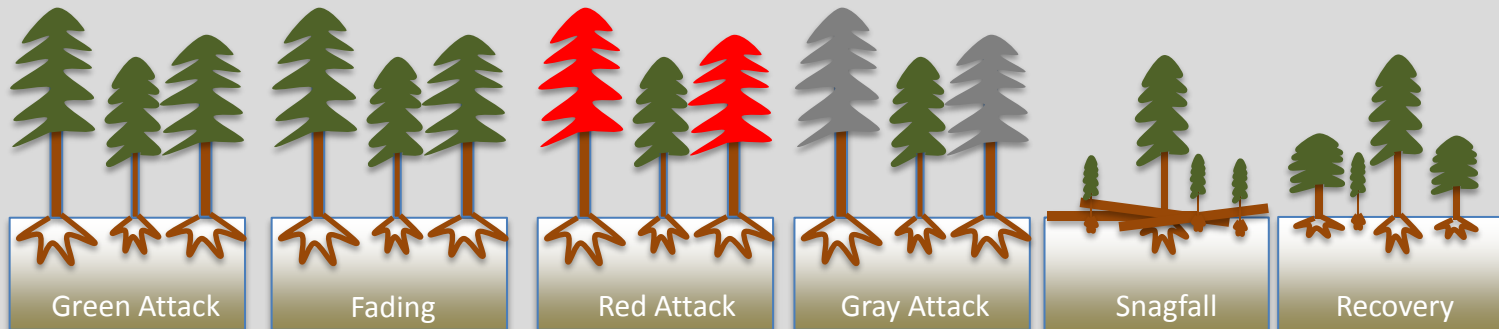
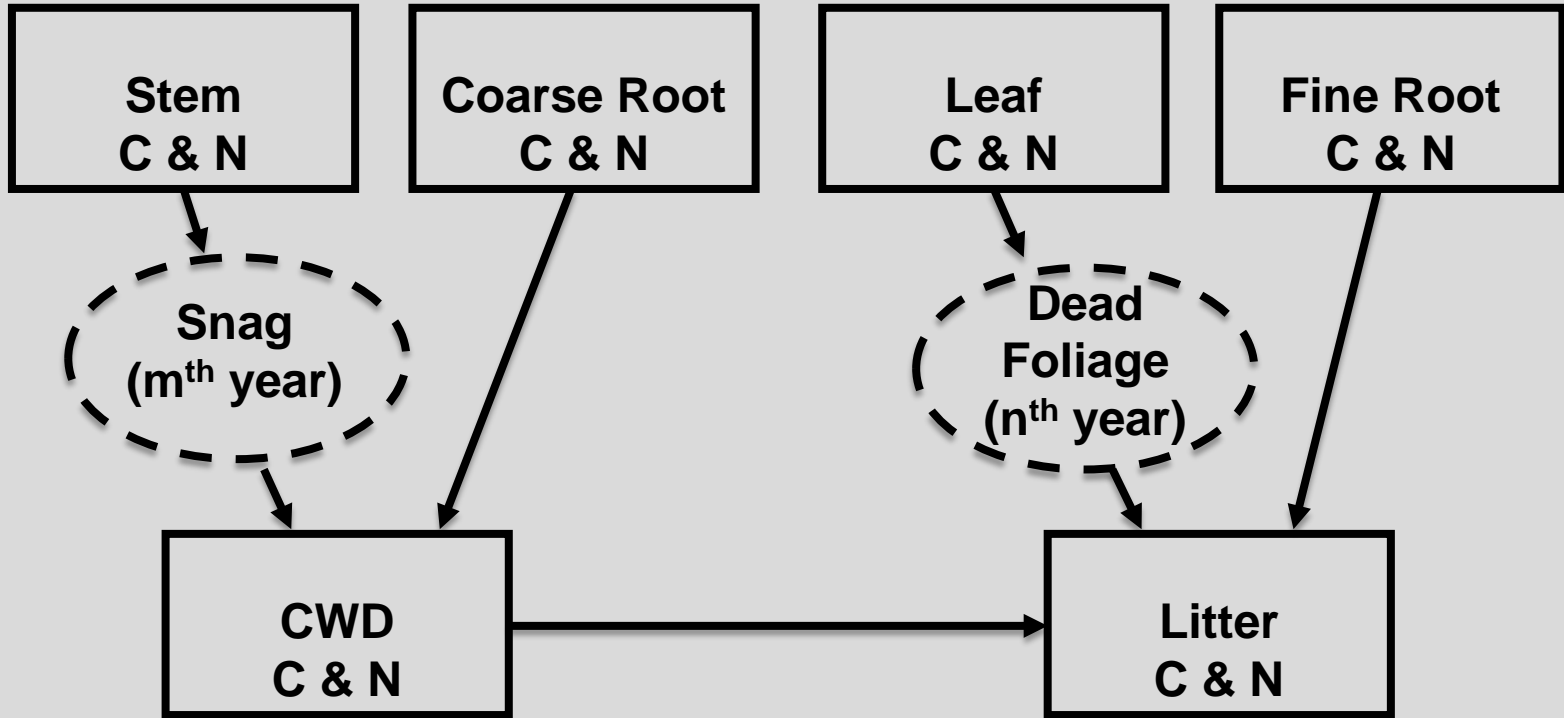
Photo by C. Schnepf, forestryimages.org

Snag fall/understory growth

**“Recovery”**



# Modifications to CLM

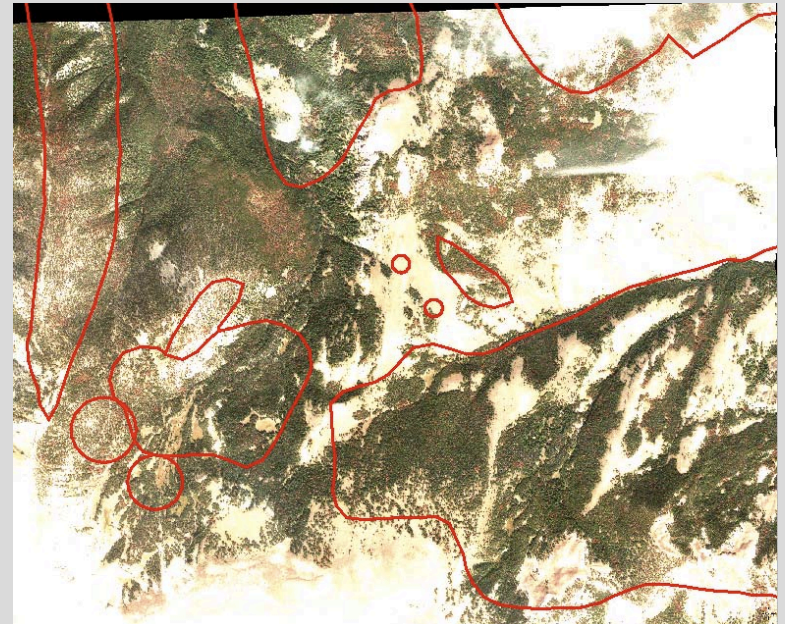


# Prescribing Historical Bark Beetle Outbreaks

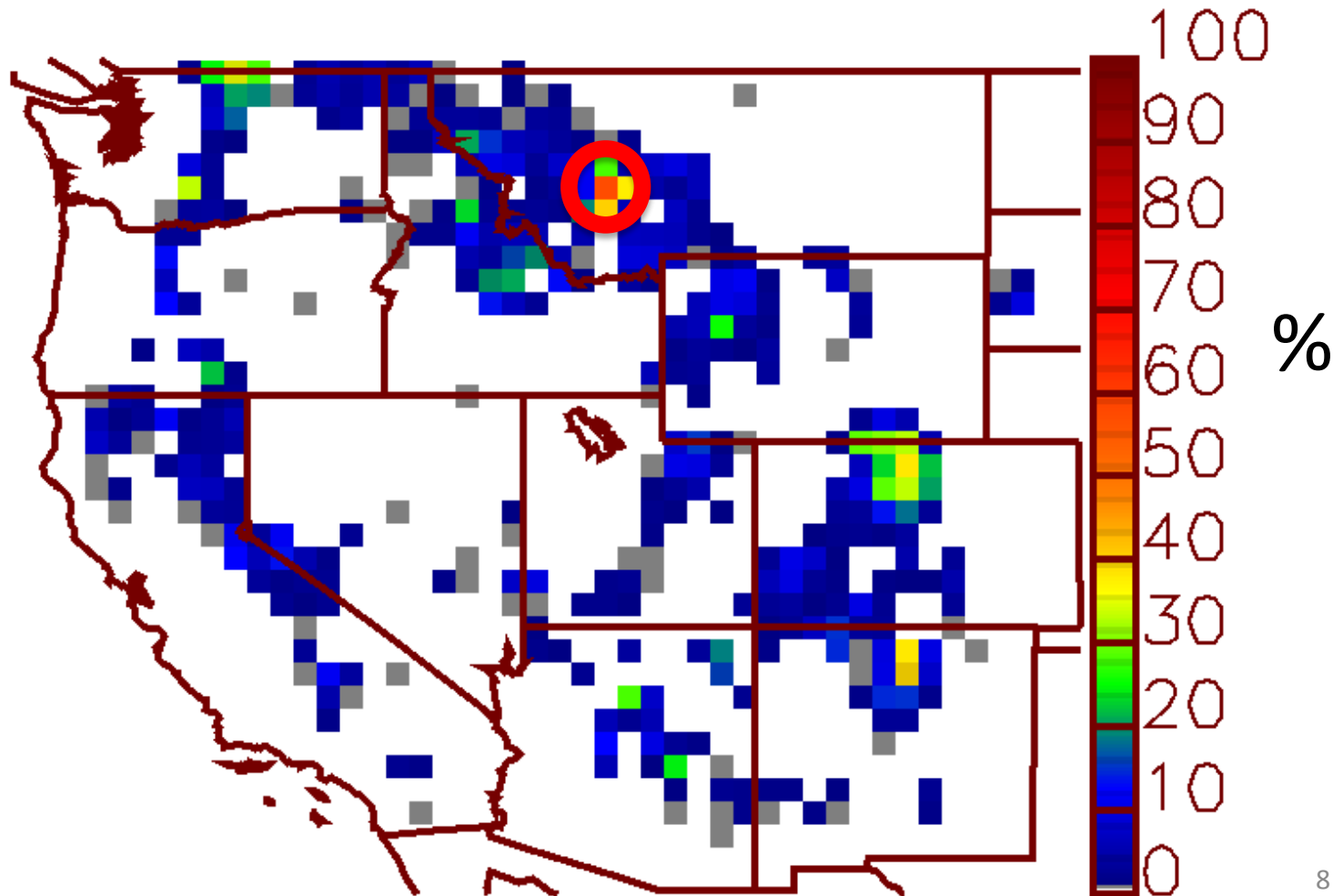
USFS Aerial Detection Surveys  
1997-2009

# USFS Aerial Detection Surveys (ADS)

- Conducted yearly to map insect, disease, and other disturbance
- Westwide (US) data available from 1997

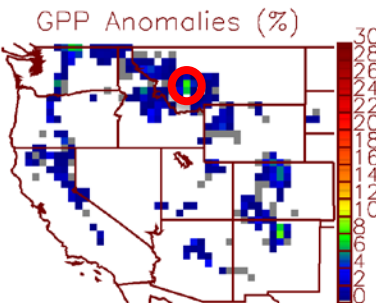
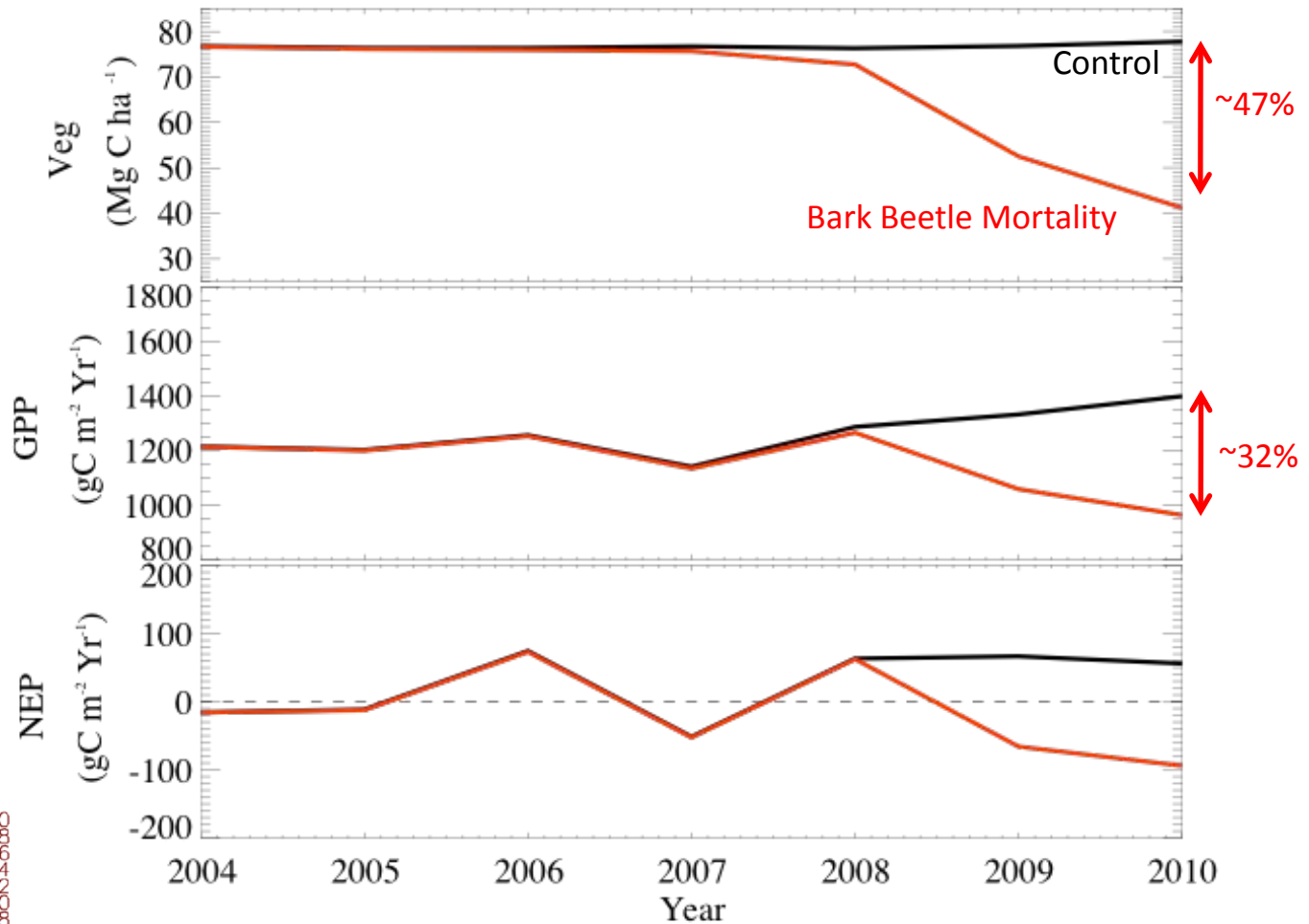


# Cumulative Mortality from Bark Beetle Outbreaks (1997 - 2009)

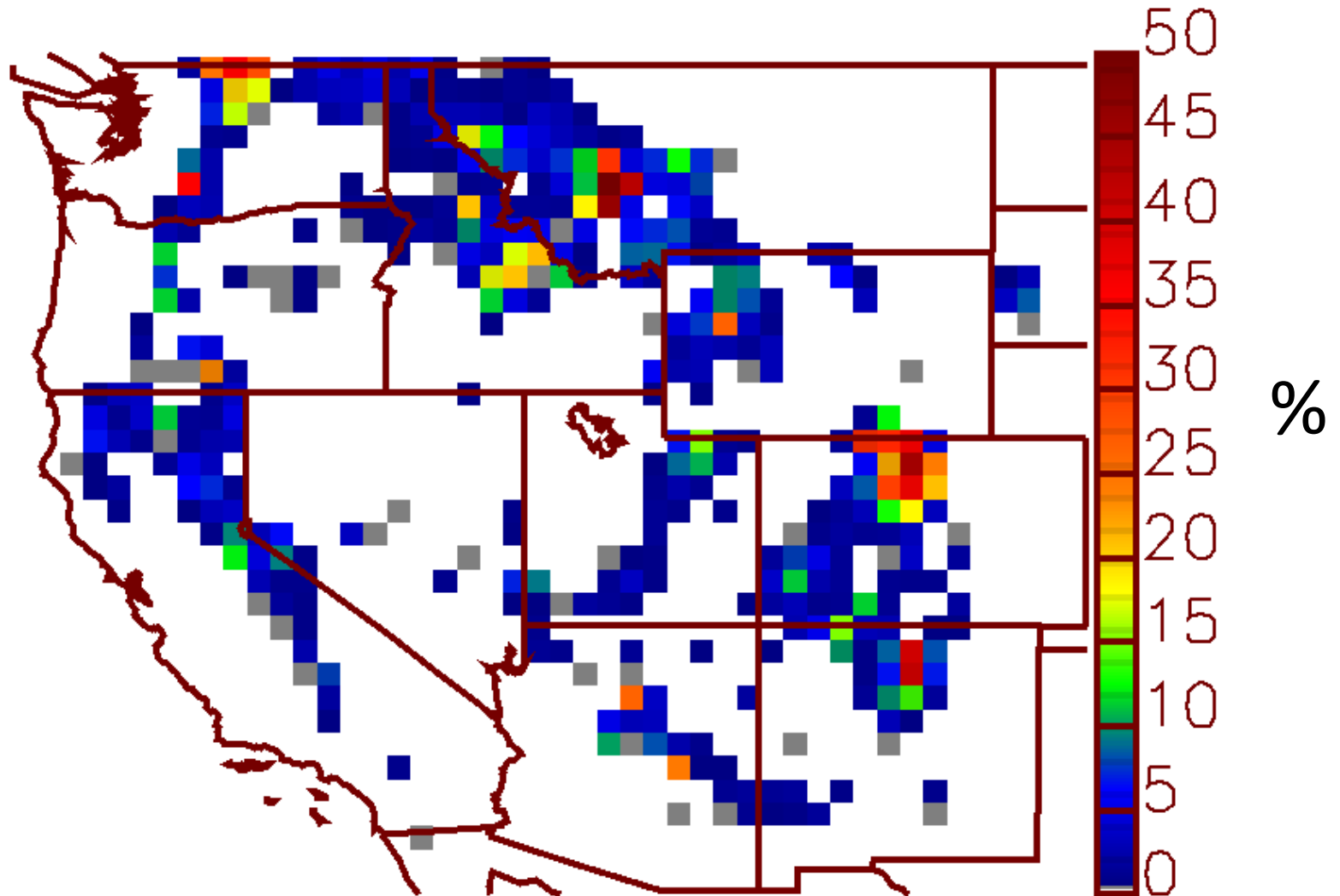




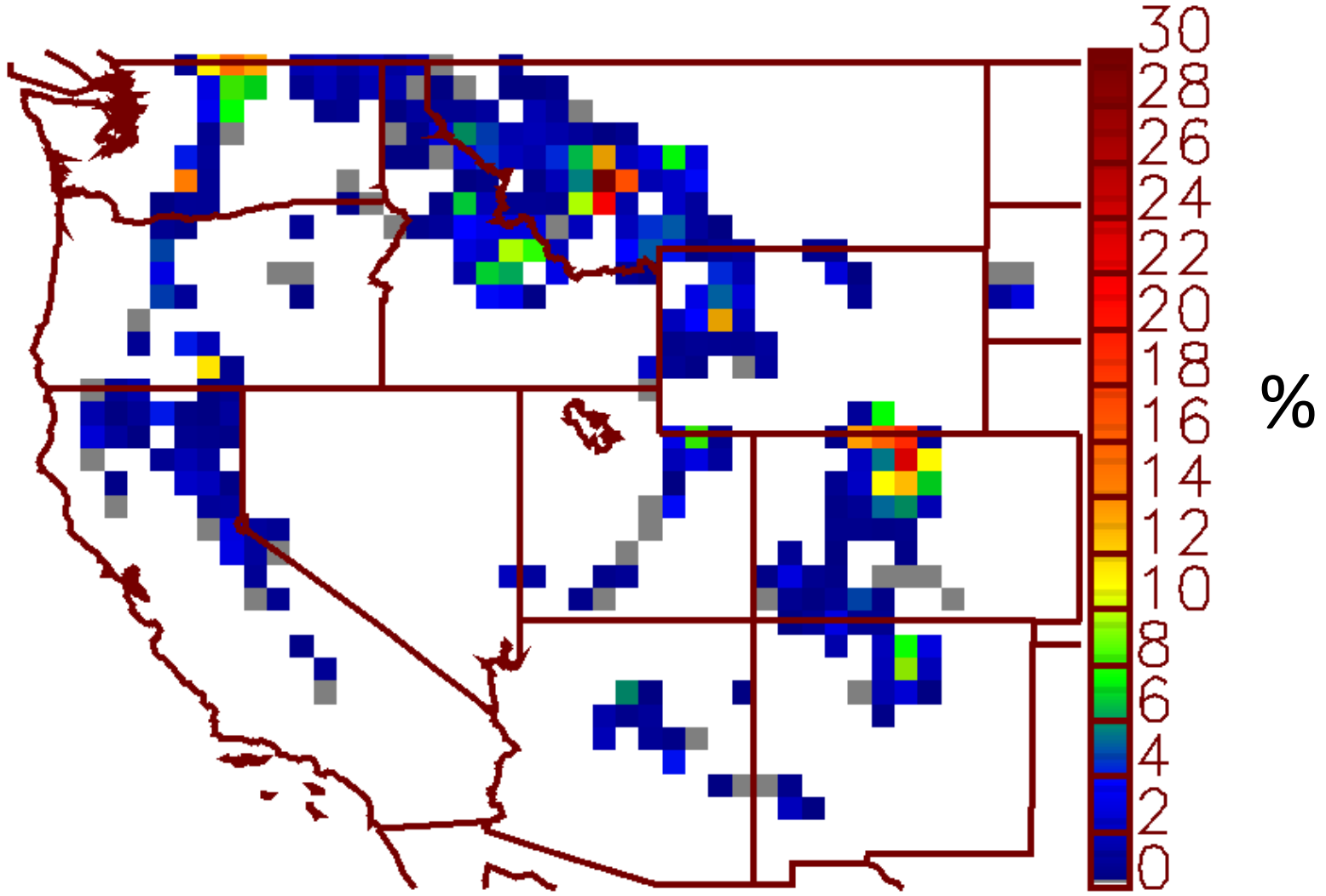
# Outbreak in Montana (2,127 km<sup>2</sup>) (57% mortality over 3 years: 2007 - 2009)



# Live Veg. C Reduction in 2009



# Annual Average GPP Reduction in 2009



# Impacts of Bark Beetle Mortality in the Western US Compared to Impacts in British Columbia

	Duration (Years)	Average NEP reduction (Tg C yr <sup>-1</sup> )	Total live veg C. reduction (Tg C)
Western US 1997 - 2009	13	6.7	157
British Columbia (Kurz et al., 2008) 2000 - 2020	20	12.9	317

# Summary and Future Work

- Added an insect mortality mechanism to CLM
- Created an insect mortality forcing data set for the western US (1997-2009)
- Insect outbreaks reduced live veg C. by 47% and GPP by 32% in one outbreak in Montana
- Future work is to compare the impact of insects to that of fire in the western US