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Potential Impact of Fire Management on Carbon Emissions in Yosemite National Park

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Talk Outline

- GHG emissions, air quality, and fire-related policies
- Case study in S. Fork of the Merced River (Yosemite NP)
- Modeled and actual impacts on landscape carbon stocks
- Stock protection vs. emissions reduction
- Conclusions

The Regulatory "Fire Environment"

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- Our changing mandates:
  - California's AB32: return to 1990 levels by 2020
  - NPS Pacific West region: carbon neutral by 2016
  - Federal fire policy (above my pay grade to explain)
  - National Ambient Air Quality Standards
- Laws and policies have ECOLOGICAL consequences

Yosemite as Case Study

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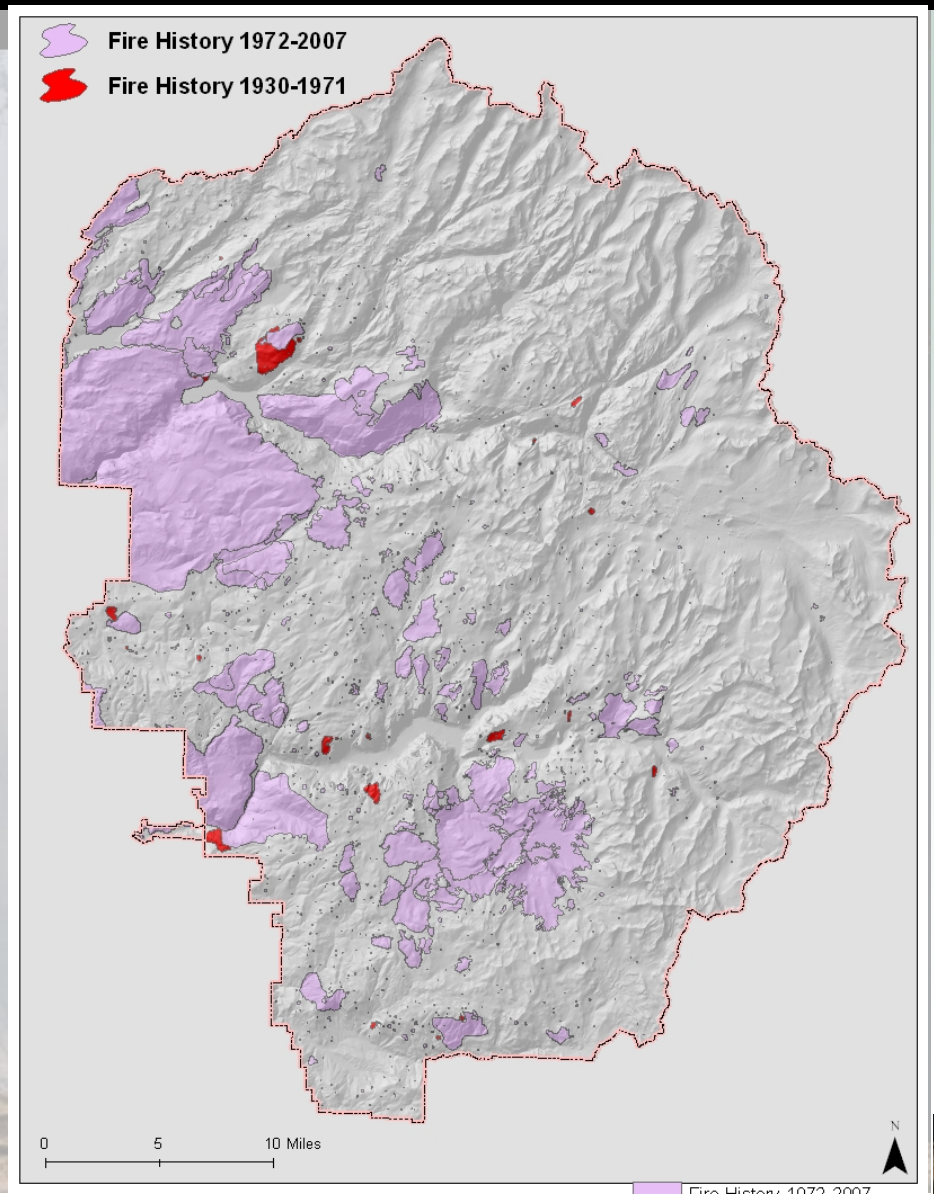
- Fire policy, and climate, have altered the Yosemite landscape
- Has it changed our carbon budgets?



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Biomass and Carbon in Yosemite

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- Fuel and Vegetation Layers
  - Coarse Wood Debris
  - Duff
  - Canopy
  - Stemwood Biomass
- Fire Scenarios
  - Actual Fires (from Yosemite Fire History Database)
  - Modeled Fires (Lightning database--all ignitions grow unchecked)
  - Max Severity (Veg mapping--all fire-accessible fuels)
- Satellite-derived severity classification scheme 1, 2, 3
  - modifies amount burned/lost in each fuel layer based on fire severity
- Succession modeling to account for post-fire regrowth
  - Time step = 1 year, for ten years:1994-2004

Yosemite Biomass Map
Bottom Up vs. Top Down

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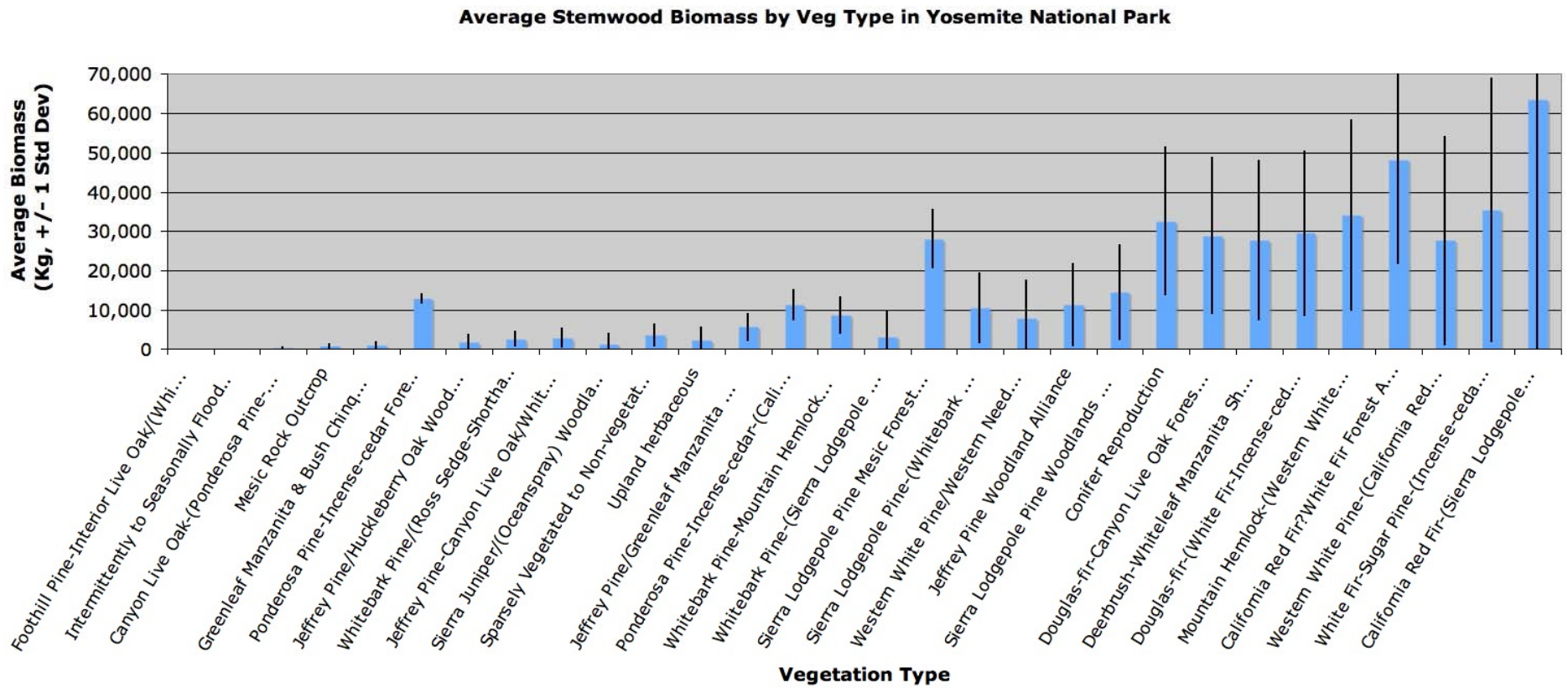

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Bottom Up vs. Top Down

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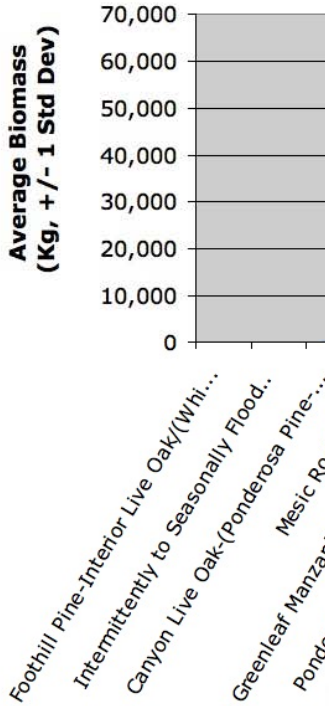

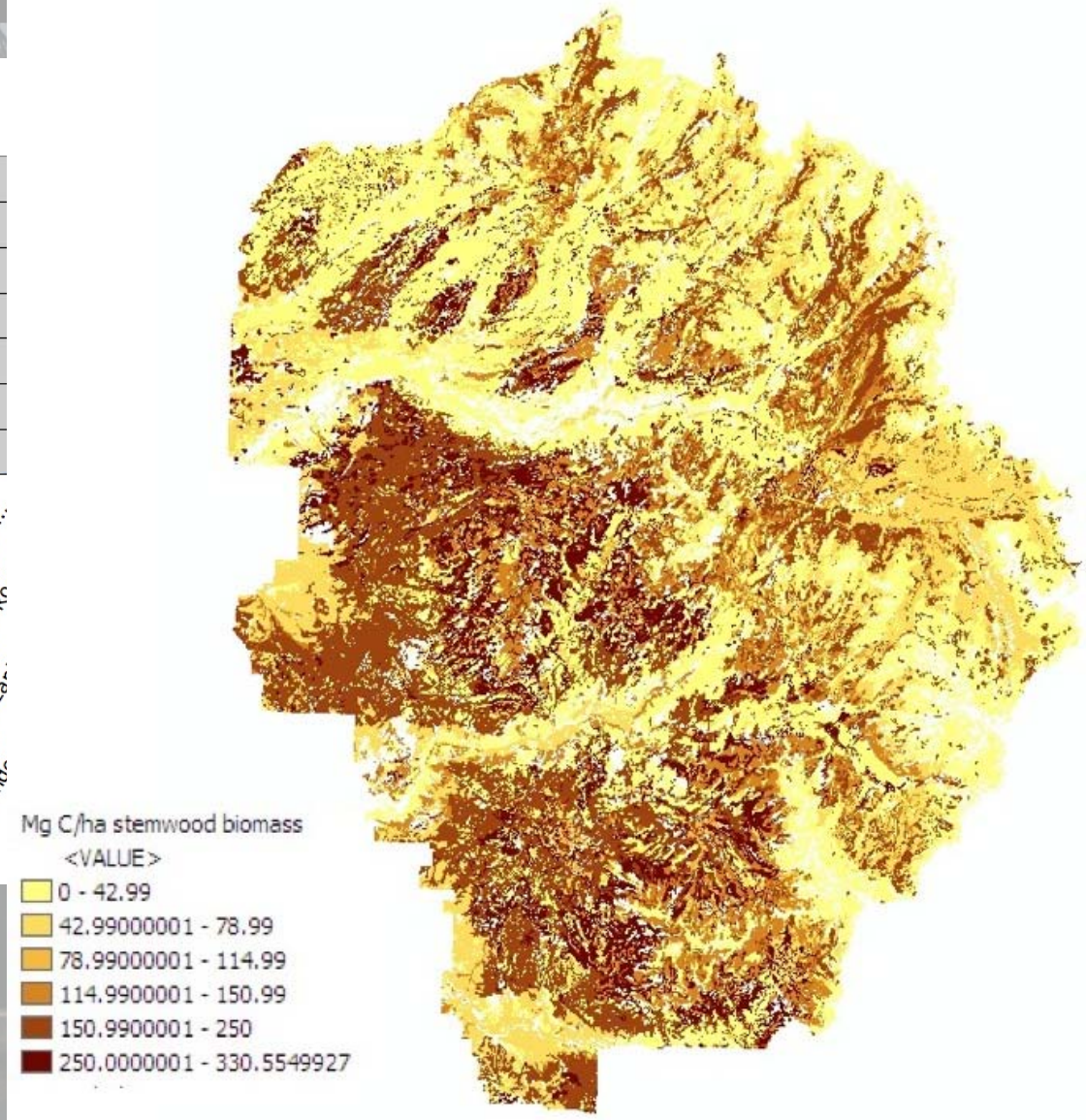

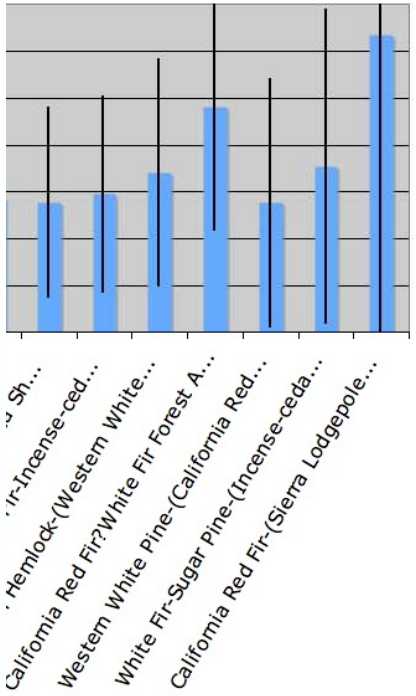

Yosemite Biomass Map
Bottom Up vs. Top Down

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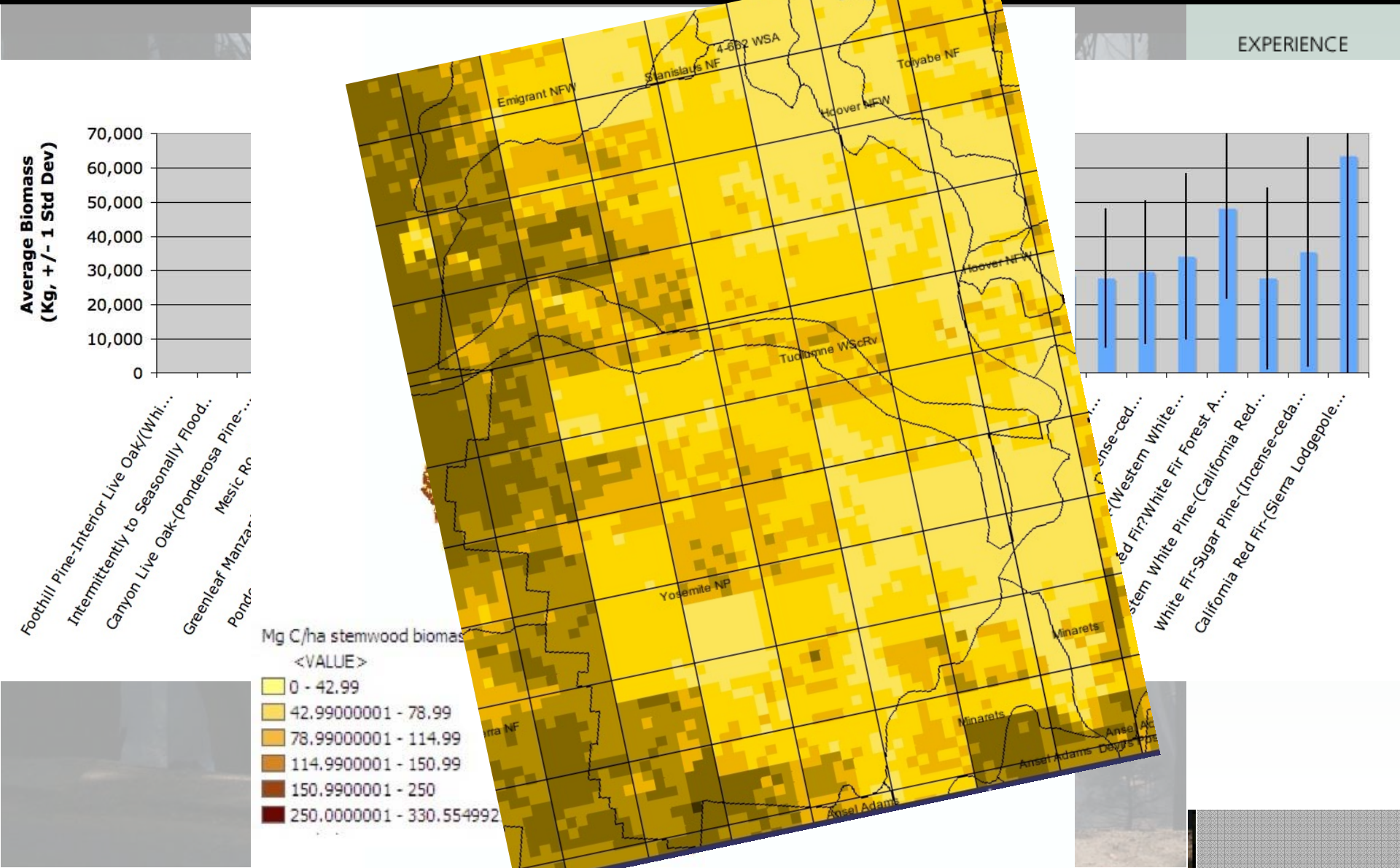

The South Fork Merced Study Area

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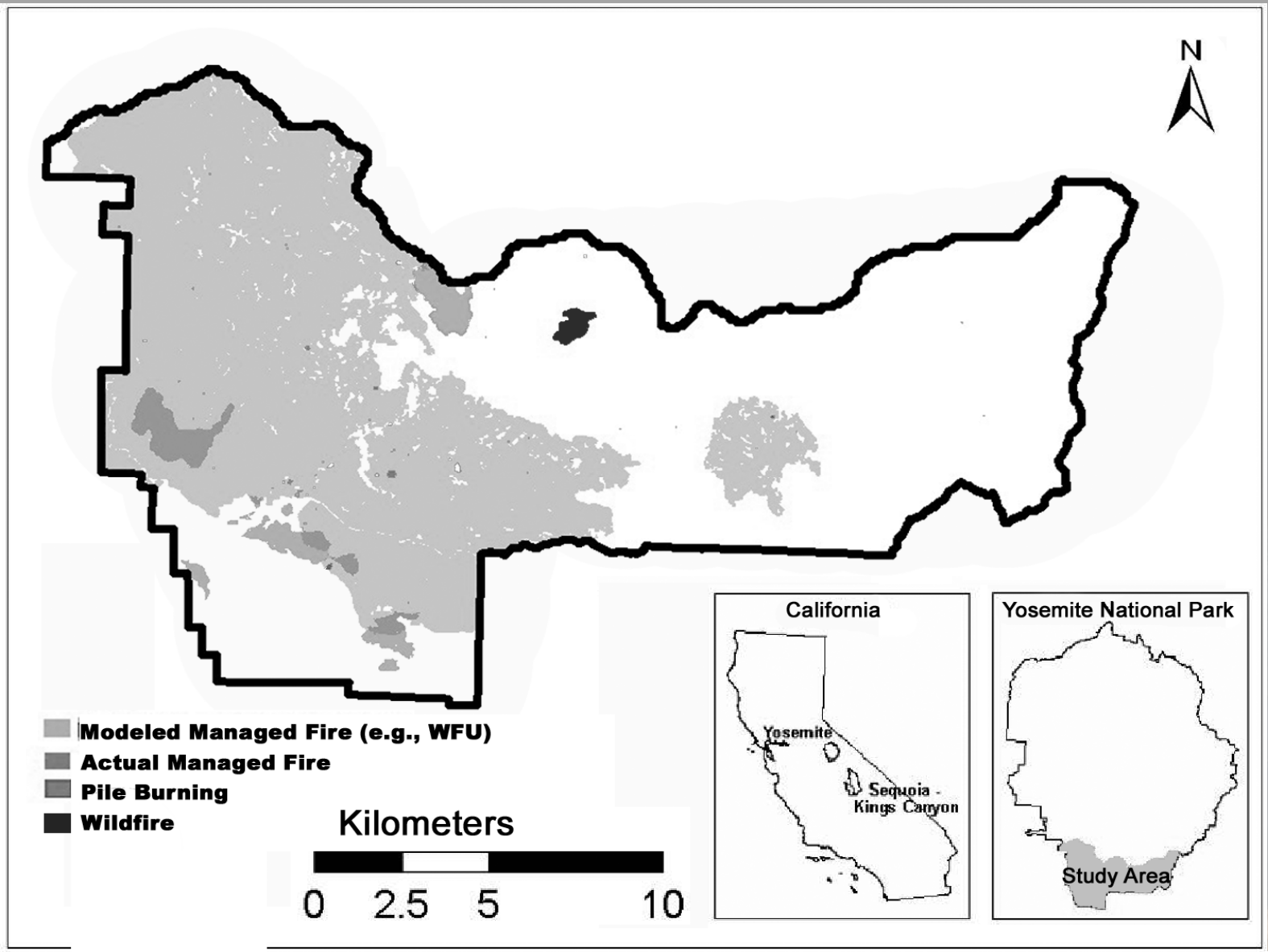

Other Assumptions and Methods

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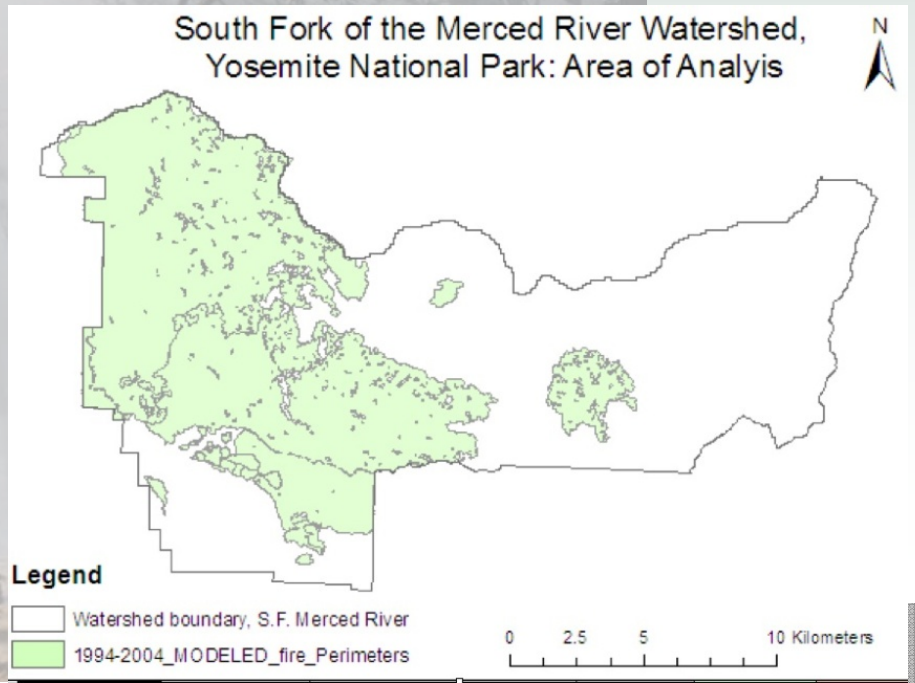
- Sums of biomass only taken over areas that modeled burning covered
- No accounting for accumulation of stemwood, canopy, cwd, or duff after max post fire—
  - surface fuels do accumulate according to standard values in Bret's succession model…
  - This is an underestimate of fuel accumulation



Results: Adding it up

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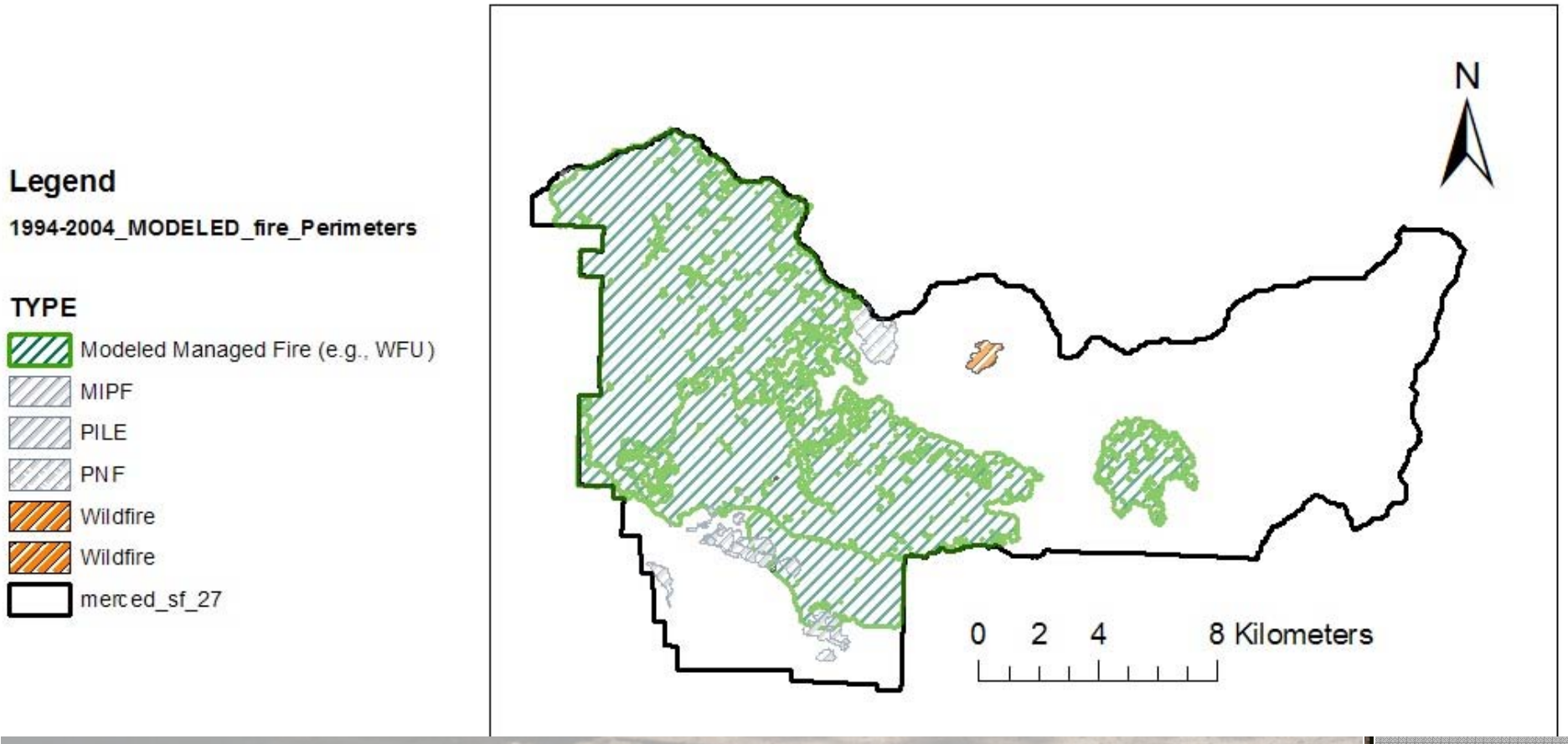
South Fork of the Merced River Watershed, Yosemite National Park: Modeled and Actual Fire Perimeters



Results: Adding it up

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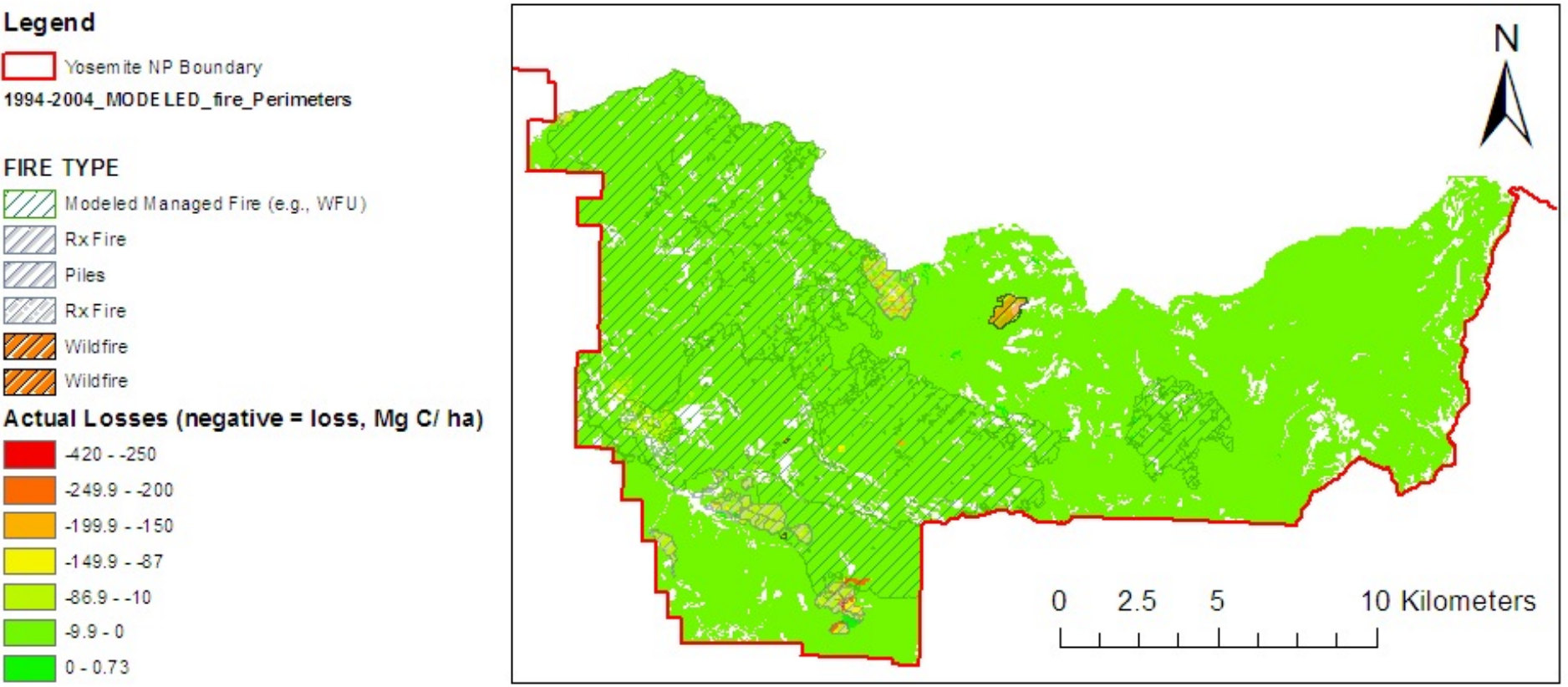
South Fork of the Merced River Watershed, Yosemite National Park: Biomass Losses from Actual Fires



Results: Adding it up

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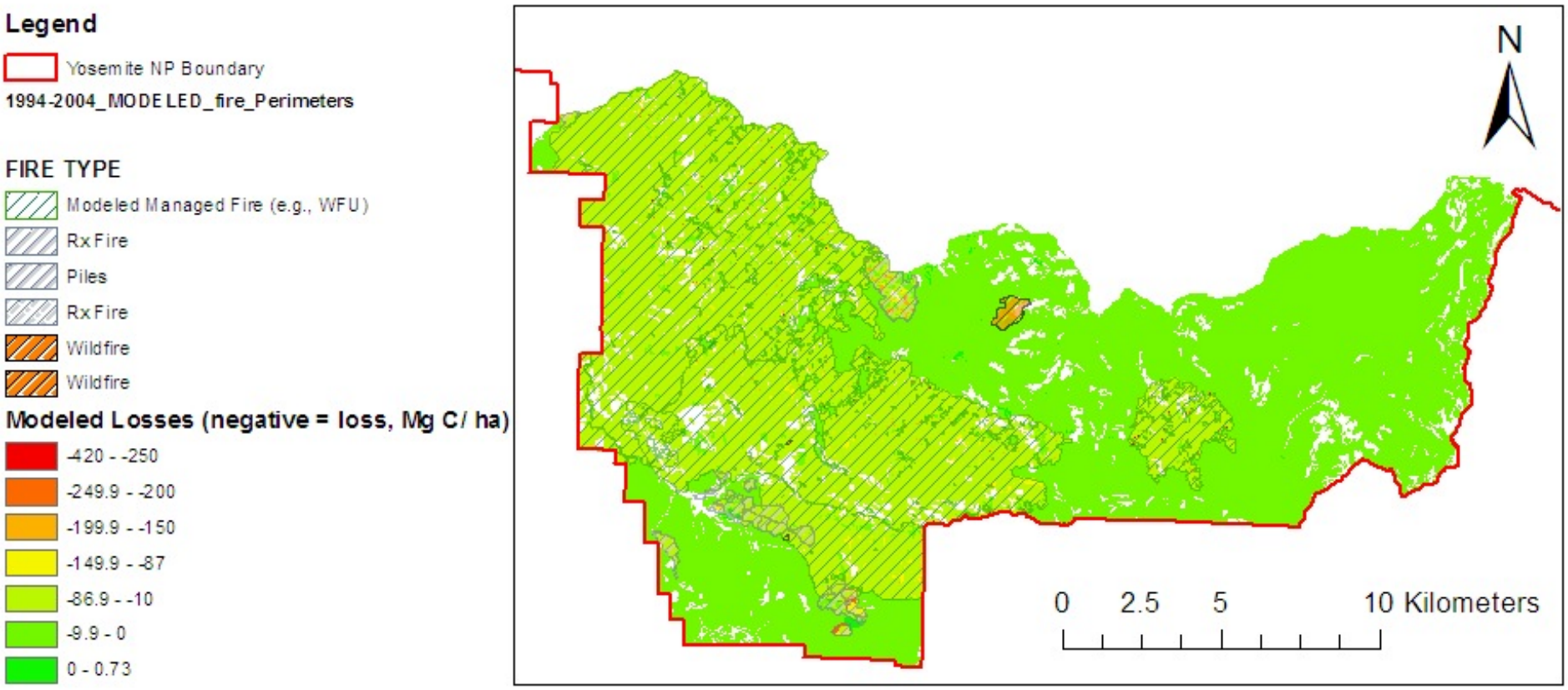
South Fork of the Merced River Watershed, Yosemite National Park: Biomass Losses from Modeled Natural Fires



Results: Adding it up

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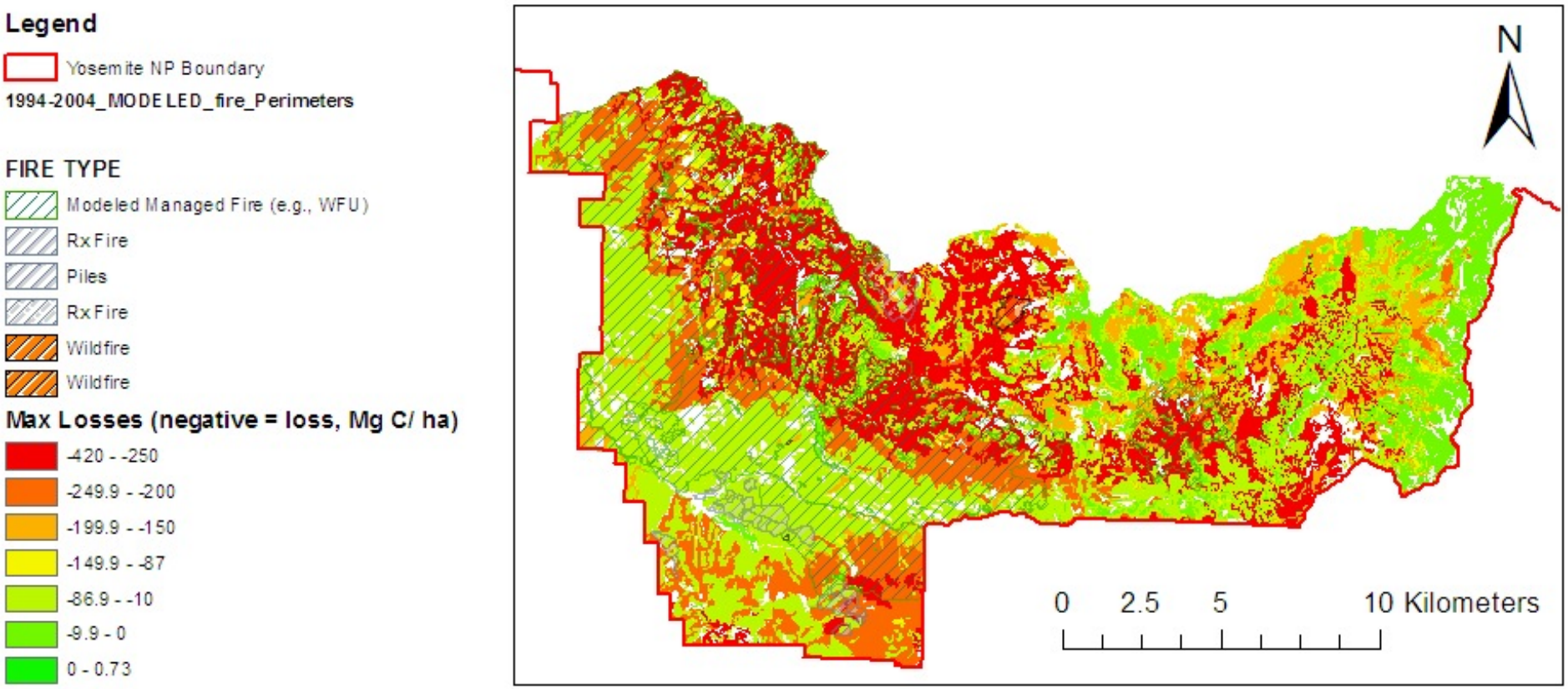
South Fork of the Merced River Watershed, Yosemite National Park: Biomass Losses from Max Severity Fires



Results: Adding it up

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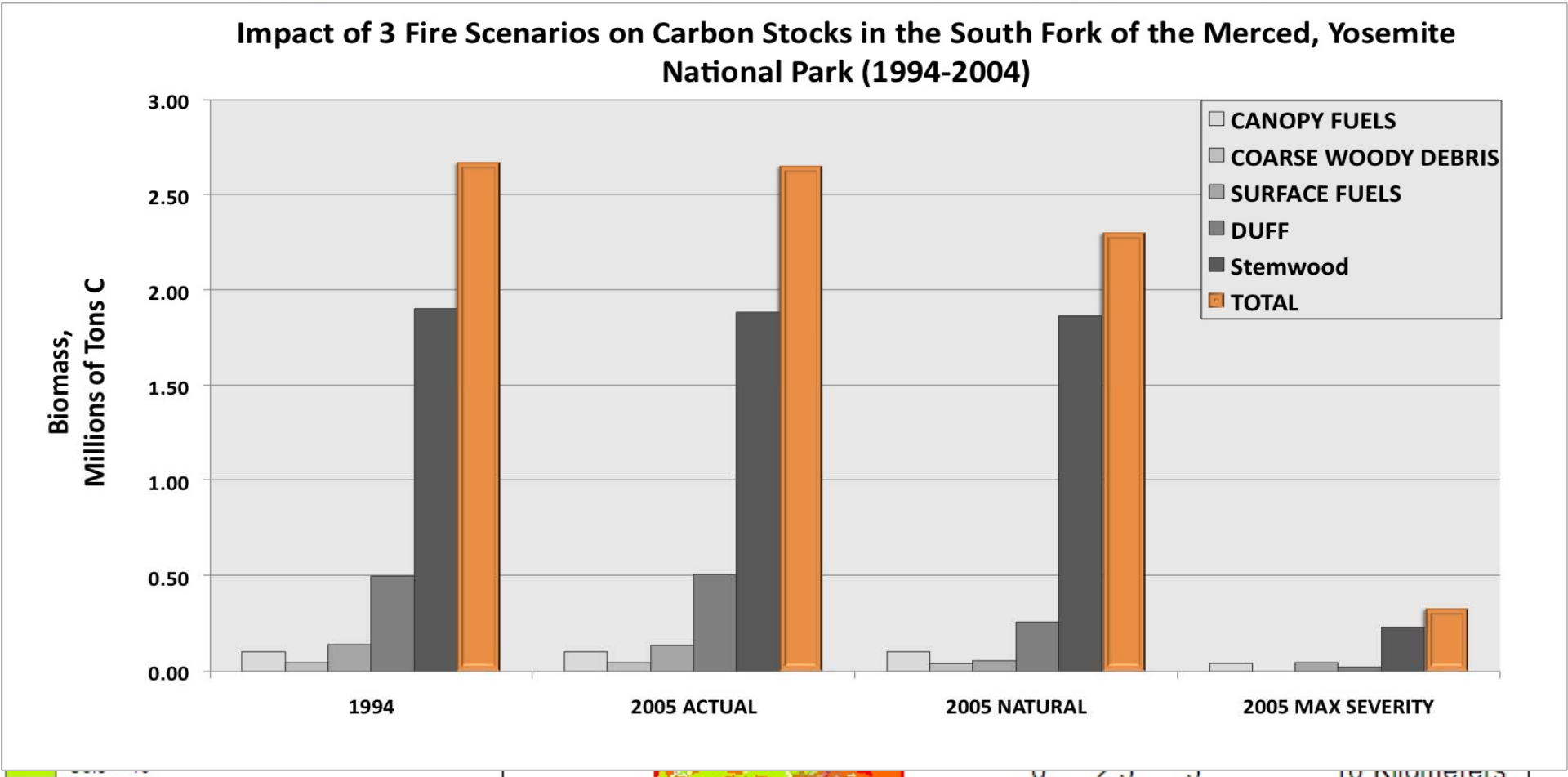

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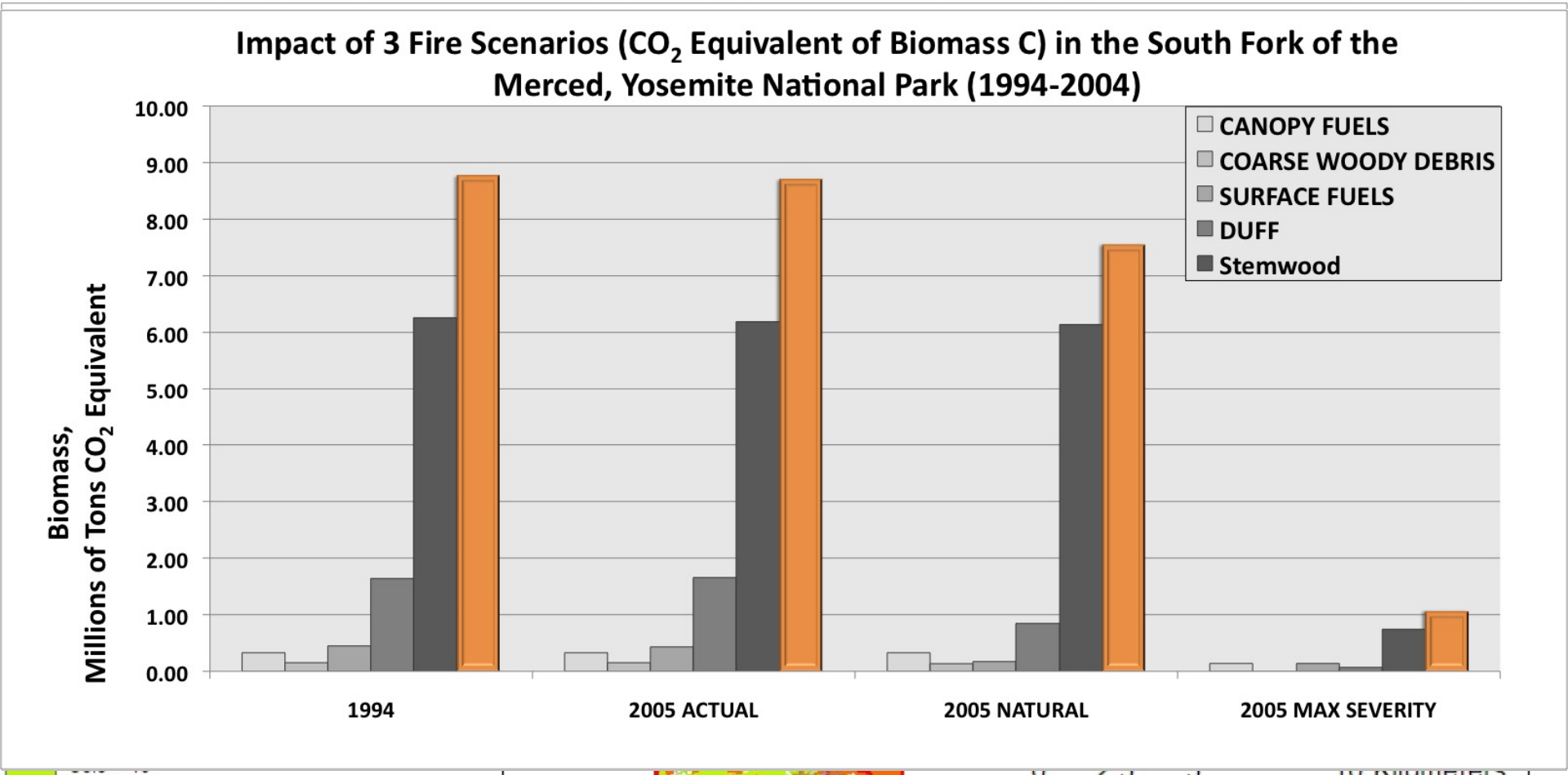

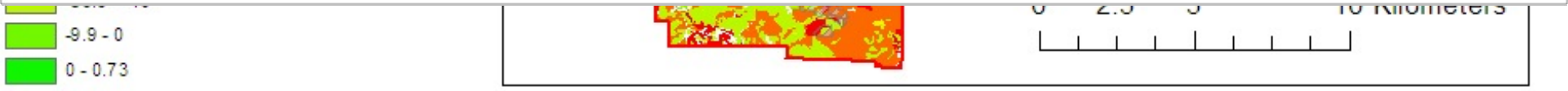

Summary

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- Most of the carbon in these fuels layers (mostly stemwood) appears “resistant” to historically modeled, unchecked fires
- The other part “vacations” in the atmosphere before coming back as biomass regrows
- These natural severity fires hardly touched the stemwood biomass; high severity did.
- Based on $400/acre fire use management costs, this translates to about to about $2 per ton CO2EQ to maintain the resistant biomass in place, assuming:
  - Fire is unplanned fire (i.e., no active ignition)
  - Biomass C converts completely to CO2

Carbon Balance in a Warming Climate

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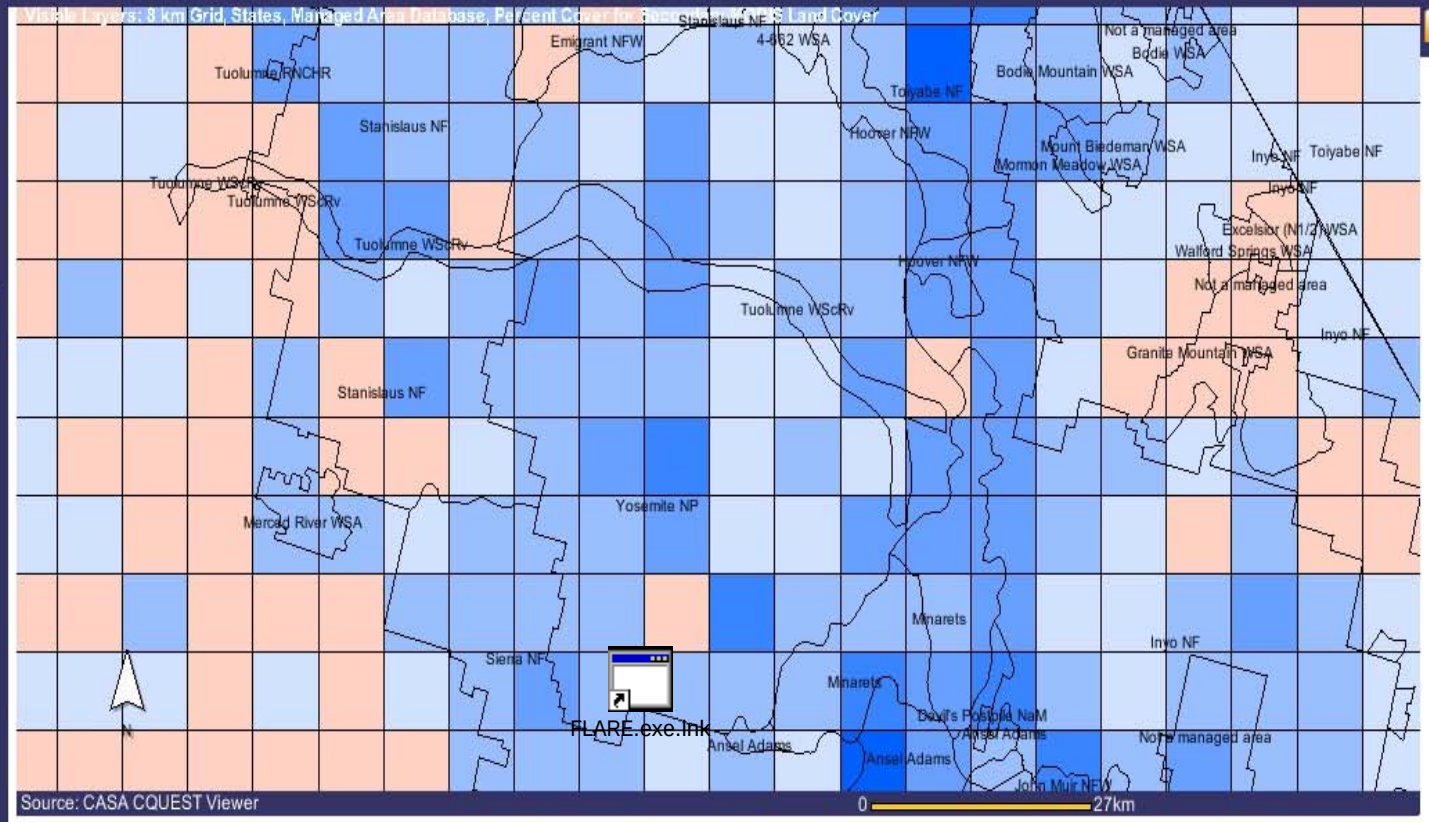
Overview | Data Set Information Guides | User Guides | Partnerships & Projects | Validation/Uncertainty Analysis | Related Sites | Contact

CASA CQUEST Viewer - Query and Evaluation Support Tools for Carbon Accounting

Reload Viewer
Help
CQUEST Home Page

Map Tools
Zoom In
Zoom Out
Zoom to Point
Full Map
Pan
Pixel/ Feature Info
Query
Measure
Buffer
Select Box
Select Line/Poly
Clear
Print Map
Download



Layers | Legend | Metadata

Legend
8 km Grid
States
Managed Area Database
NEP 2004 (g C/m^2/yr)
greater than 900
800 - 900
700 - 800
600 - 700
500 - 600
400 - 500
300 - 400
200 - 300
0.1 - 200
0
-0.1 - -100
-100 - -200
-200 - -300
-300 - -400
-400 - -500
-500 - -600
less than -600

This is the Layer / Legend Toggle Tool. This tool is used to toggle between the Layer and Legend views. Note: Only the visible (checked) layers will be displayed in the legend.

Carbon Balance in a Warming Climate

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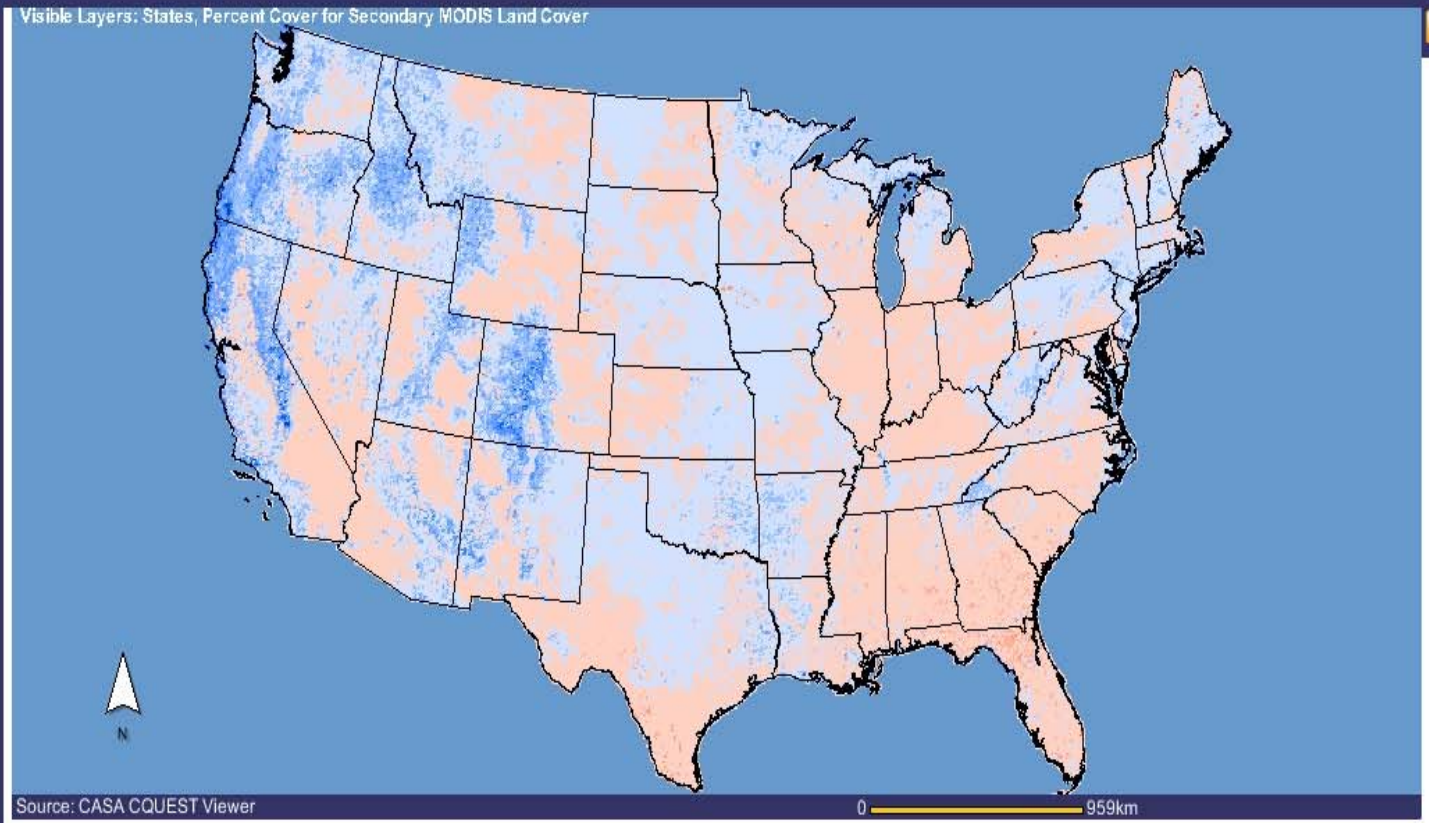
- Reload Viewer
- Help
- CQUEST Home Page

Map Tools

- Zoom In
- Zoom Out
- Zoom to Point
- Full Map
- Pan
- Pixel/ Feature Info
- Query
- Measure
- Buffer
- Select Box
- Select Line/Poly
- Clear
- Print Map
- Download



Layers | Legend | Metadata

Legend

States
NEP 2004 (g C/m^2/yr)

- greater than 900
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- 300 - 400
- 200 - 300
- 0.1 - 200
- 0
- -0.1 - -100
- -100 - -200
- -200 - -300
- -300 - -400
- -400 - -500
- -500 - -600
- less than -600

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Fire Emissions in Context

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- Yosemite lost ~42,000 Mg C from all forest fires in 2007, according to emission models
- Satellite data says Yosemite's forest emitted 310,000 Mg C over that
- Total Yosemite stemwood biomass is about 58,000,000 Mg C
- Small changes in large stocks are still large

Fire Emissions in Context

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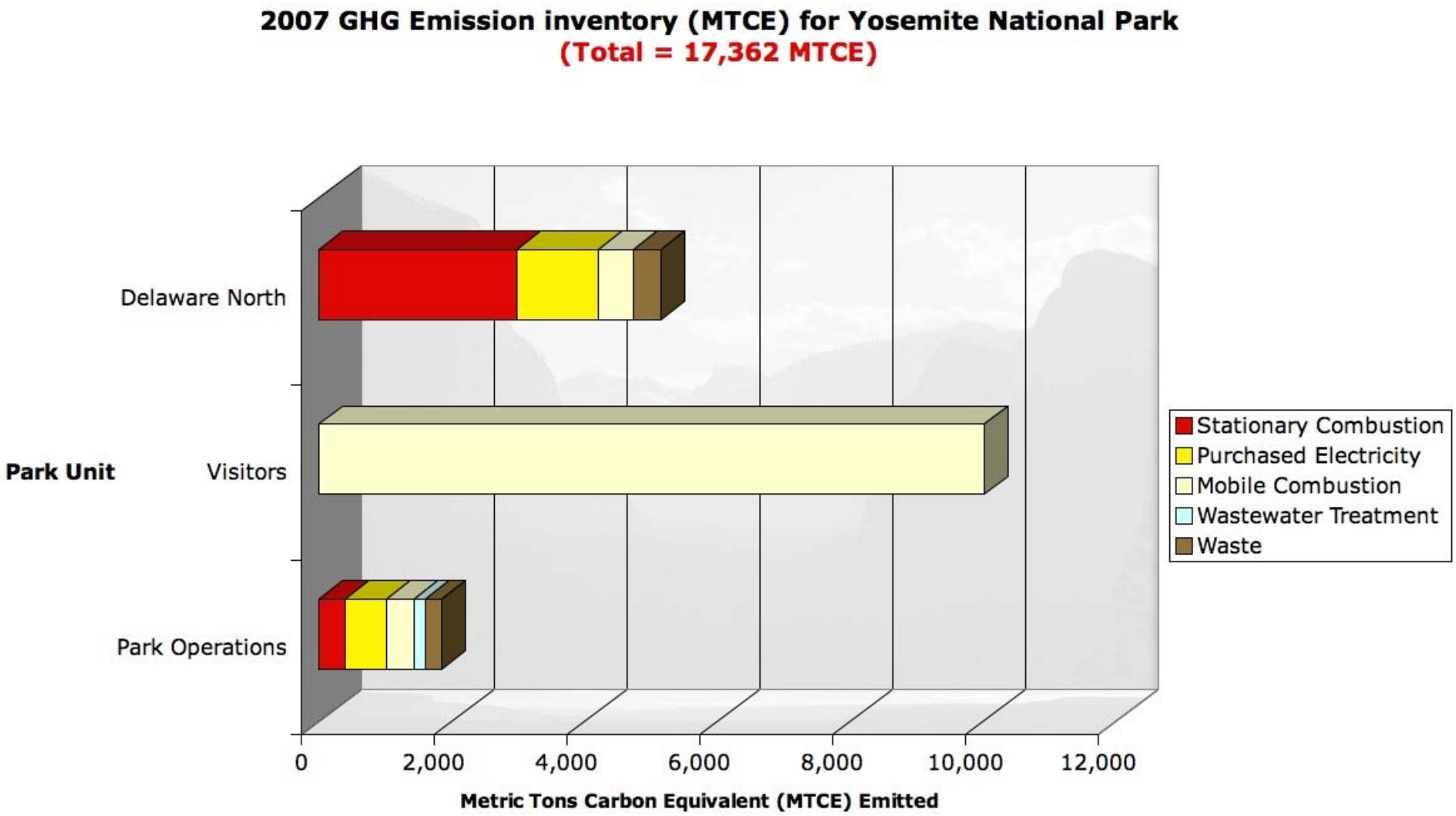

Fire Emissions in Context

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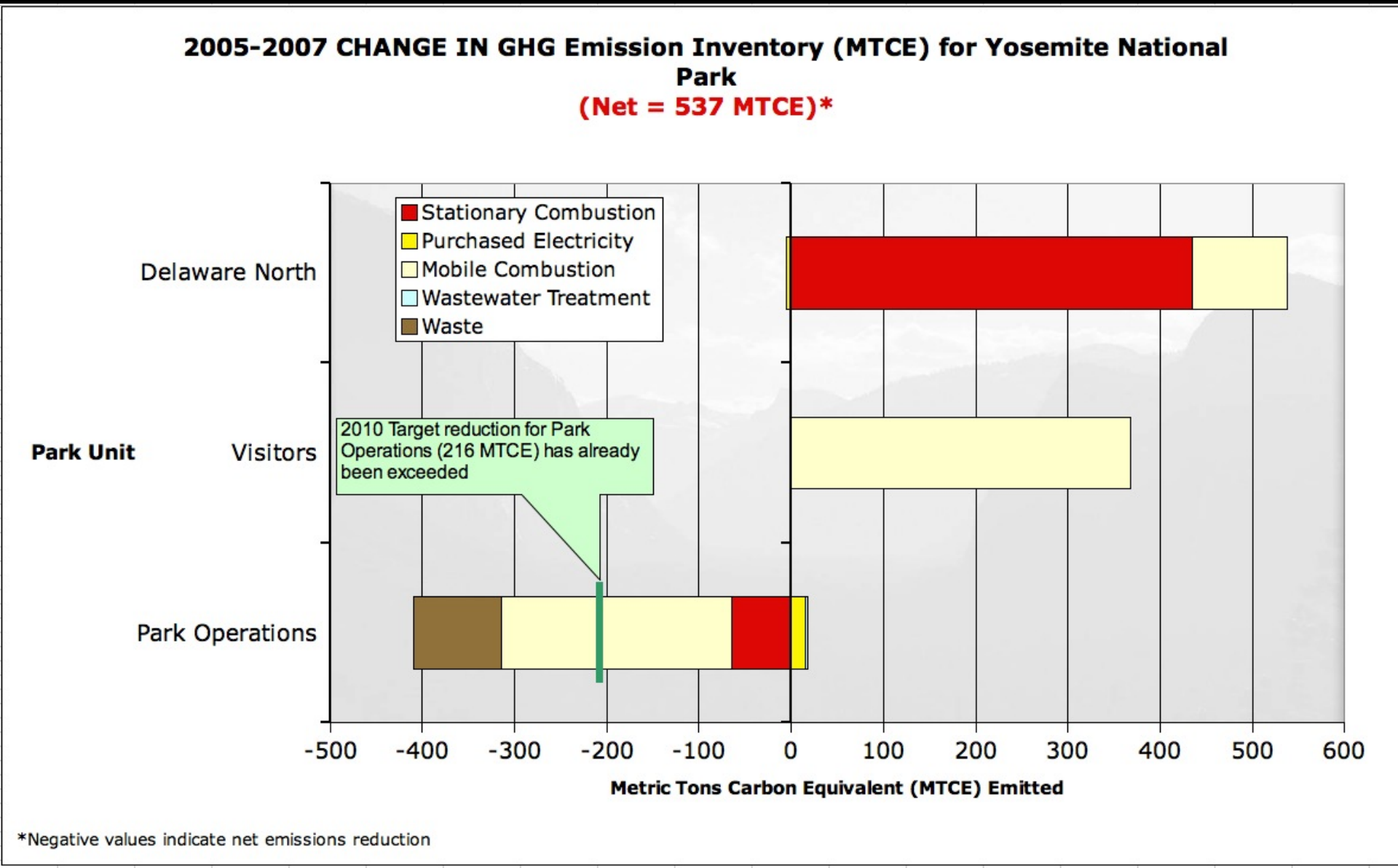

*Negative values indicate net emissions reduction

Conclusions

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- Modeling fire could be one method for determining amount of “resistant” carbon in fire-dependant forests
  - i.e., how much of fire-caused stock reductions are relatively permanent.
- Carbon stocks (and potential fire emissions) are vast compared to fluxes
- Warming landscapes tend to lose carbon; stocks in forested, fire-dependant landscapes may be especially vulnerable and unstable
- Fire emissions can swamp gains in other sectors
  - And to the extent they are preventable, should they count?
- What are the smoke tradeoffs?
  - Air pollutant emissions scale linearly with greenhouse gases

Acknowledgements

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- Brett Davis and Jan van Wagtendonk, co-authors
- Carol Miller--allometry
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- Kent van Wagtendonk—GIS, map support