Trick or Treat?: Good and Bad Interactions Between Climate Change and Other Forest Stressors

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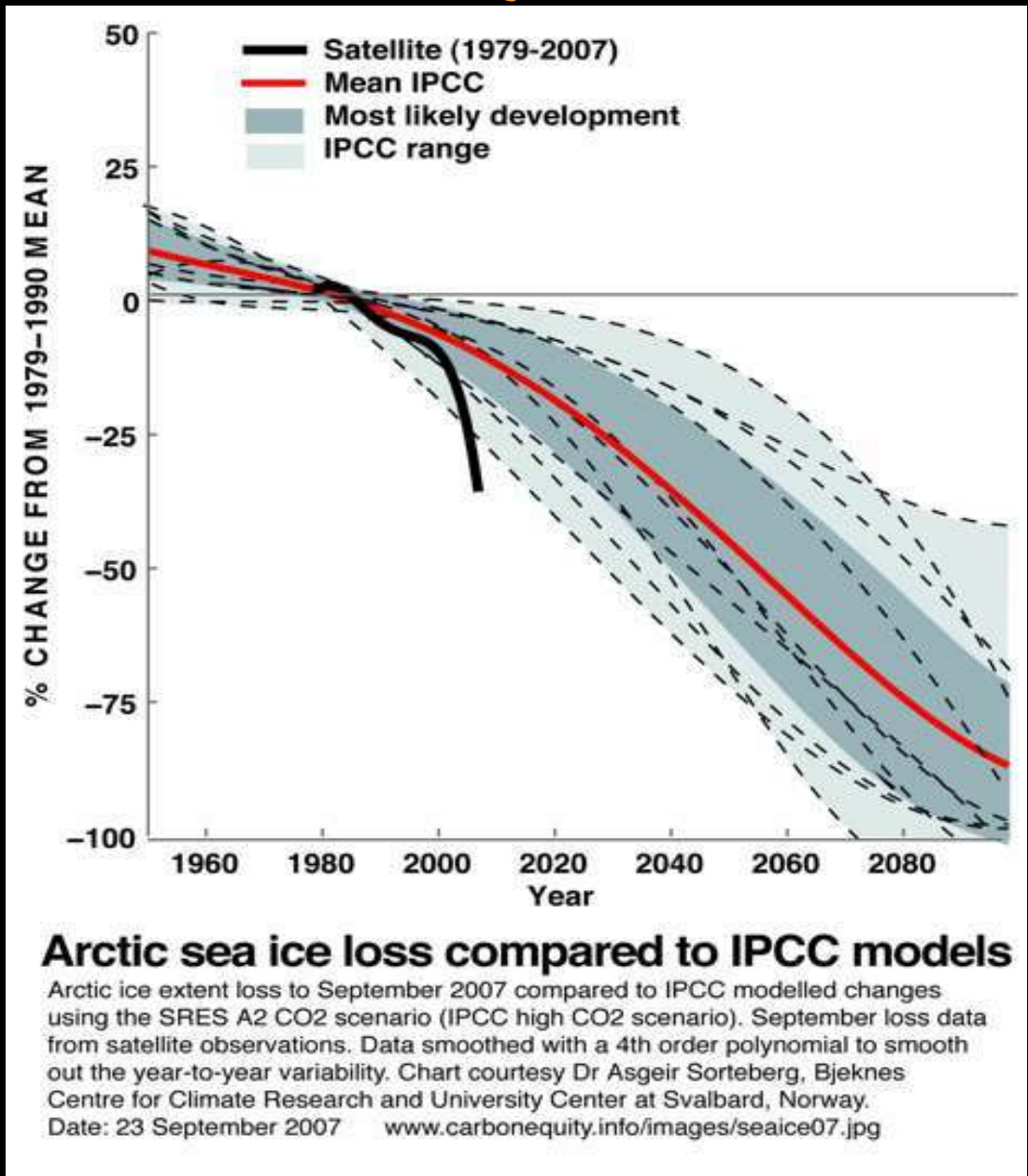
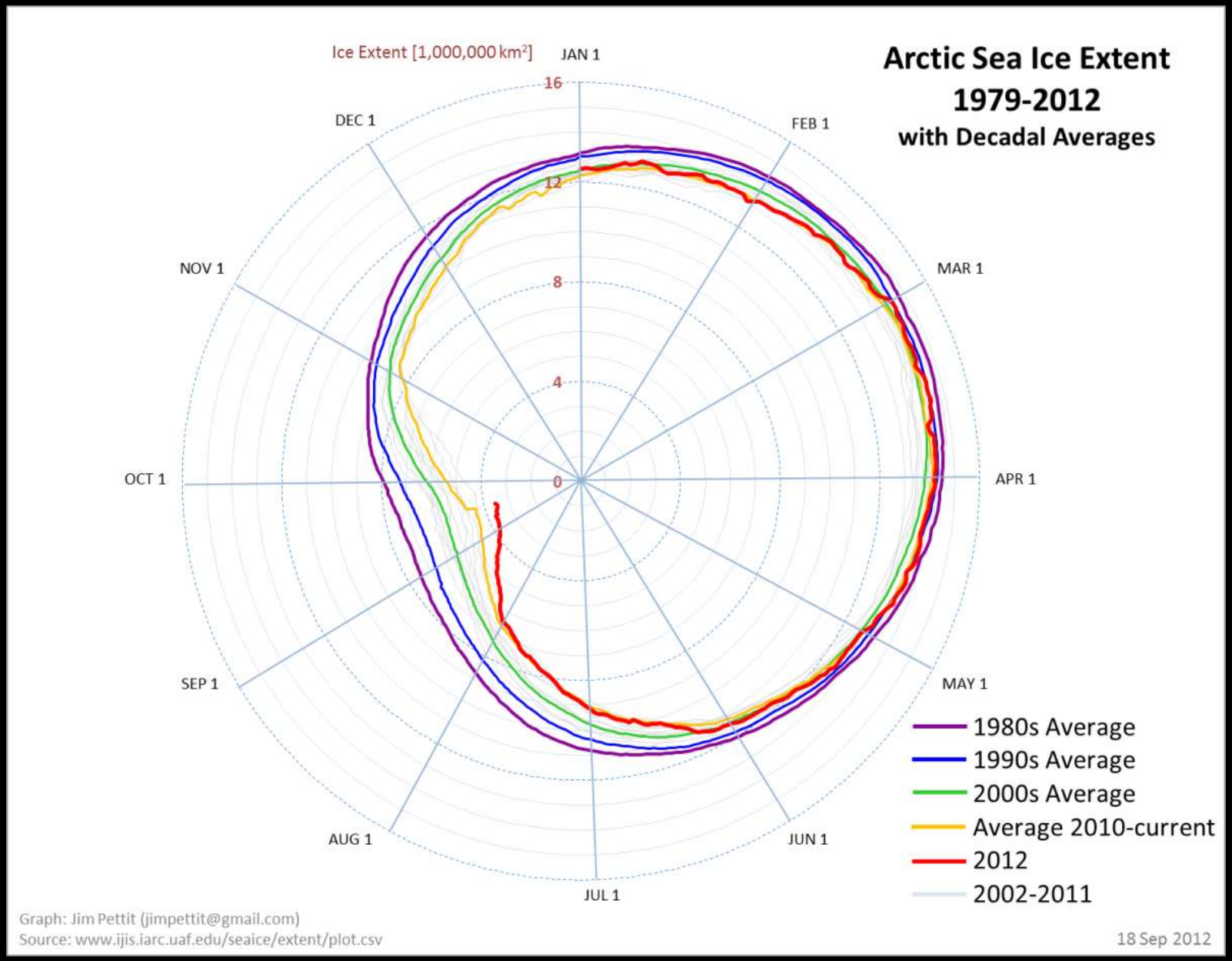
A Halloween Treat! 75 years until ice free Artic



Arctic sea ice loss compared to IPCC models

Arctic ice extent loss to September 2007 compared to IPCC modelled changes using the SRES A2 CO2 scenario (IPCC high CO2 scenario). September loss data from satellite observations. Data smoothed with a 4th order polynomial to smooth out the year-to-year variability. Chart courtesy Dr Asgeir Sorteberg, Bjeknes Centre for Climate Research and University Center at Svalbard, Norway.
Date: 23 September 2007 www.carbonequity.info/images/seaice07.jpg

Or is it a Trick?! 5 years to a ice free Artic



Unexpected Changes!!!

- Reduced albedo as (white) ice melts and exposes more (dark) ocean
- Creates a positive feedback loop with more warming, melting more ice (the reason for the trick!)
- Once all the ice is gone, increasingly warm water will cause unprecedented atmospheric instability, leading to more extreme climate

Frightful Implications!!!

- Extremes will become more extreme
  - Drought, flood, heat waves, seasonality, wildfire, insect Disease, ozone, acid rain, species shifts
- New impact assessments will be needed

Traditional Climate Change Impact Assessment

Drought  Water shortage

Dry/hot  Wild fires

Warming  Species shift

Advantage with this method

Simple to conduct

Fewer inputs, more likely to have information

Simple to Assess

Direct relationship between cause and affect

Problems with this method

- Termed "stove piping" because no other inputs

Can lead to incomplete risk assessment

For Example: drought causes water shortages. True, but other factors also important (stand stocking, species type)

Can also fail to consider unintended consequences

For Example: To reduce water shortage risk, cut down trees. True, but could also increase soil erosion and reduce stream water quality

Multi-stress Climate Change Impact Assessment

Drought

Stocking

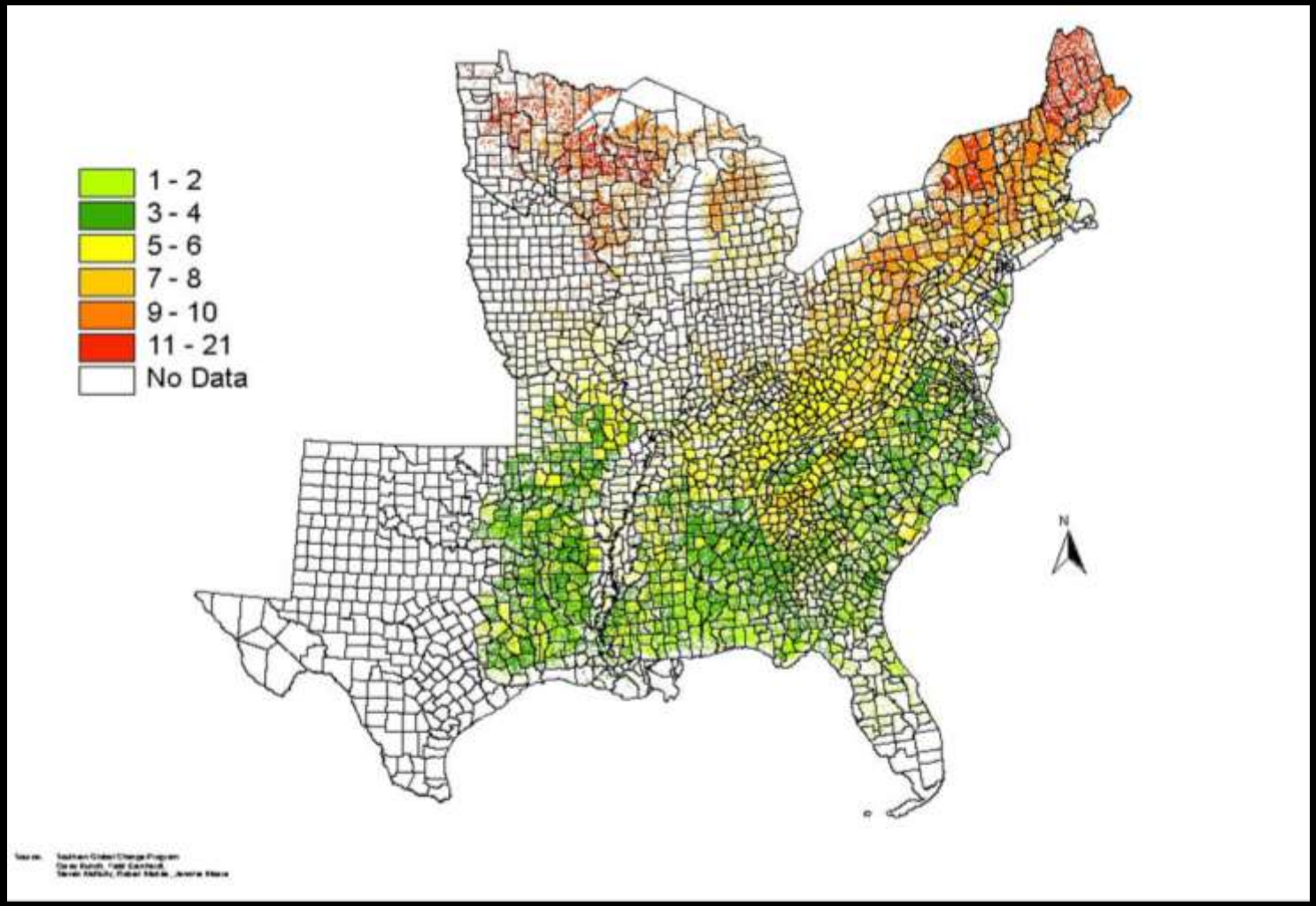
Water shortage

Species

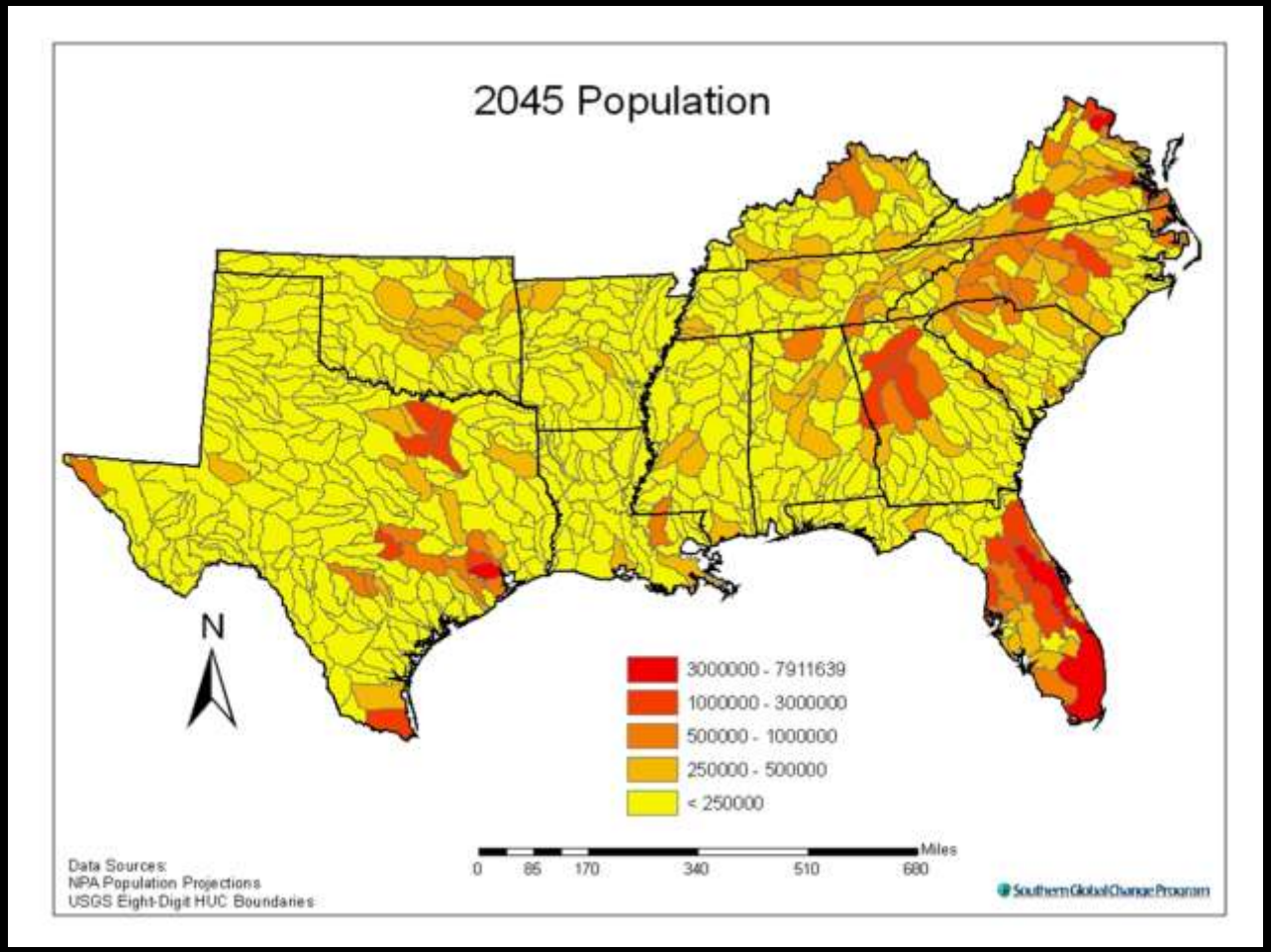
A Multi-stress Trick!

Wildland Urban Interface Wildfires

2001 Down Deadwood

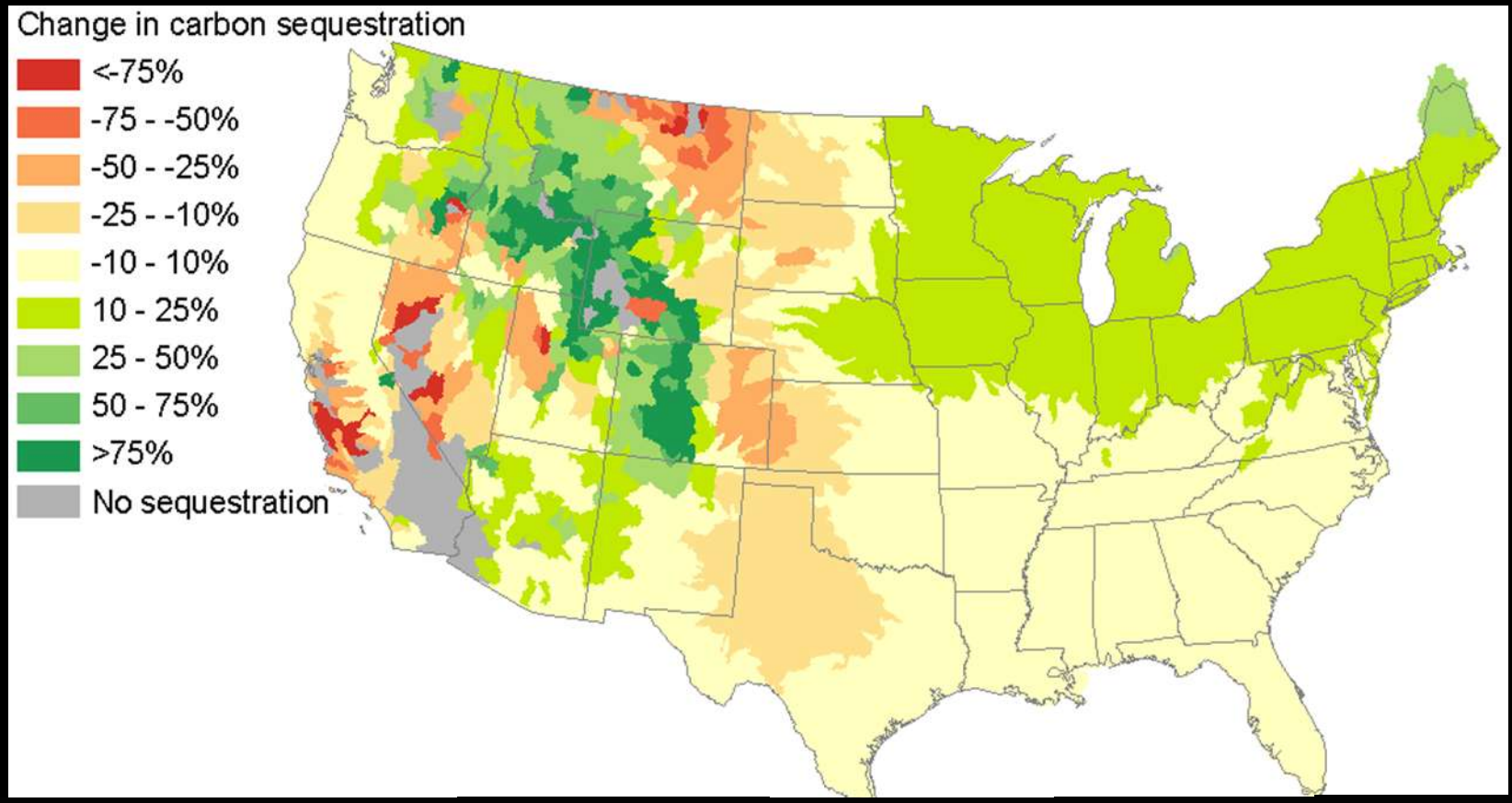


Population growth and ownership fragmentation



Note: in the case of zombies
This should not be confused
With OWNER fragmentation

Projected future forest productivity by 2050



Synergistic conditions

Demographic

- Forest fragmentation
- Restrictions in forest management options

Climate

- warming – increased fuels in some areas
- extremes – increased drought potential

Insects

- Increase risk of outbreak caused forest death

Means Increased Fire Severity and Frequency

There are NO Management cheap options

- More aggressive fuel reduction programs
- More aggressive removal of dead timber
- More aggressive insect outbreak control

Hearse Oil change Analogy

Changing the oil cost $25 and should be done every 3,000 miles. If it is changed until 10,000 miles, there could be some engine problems that may cost hundreds of $. If it is not changed until 50,000 miles, there will likely be major engine problems costing thousands of $. We have chosen to wait, and now we are (grim) reaping the consequences.

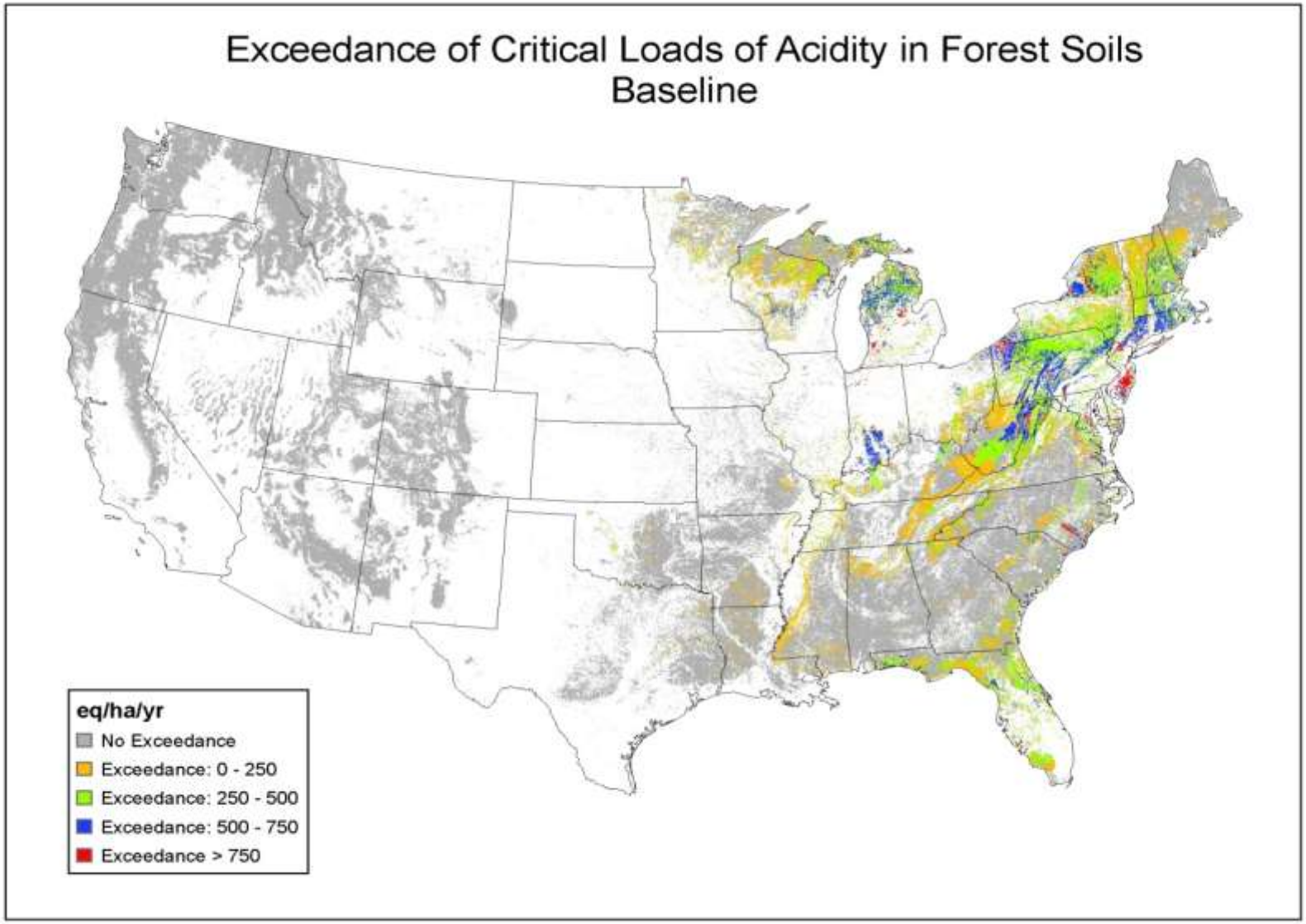
A Treat

Climate Change and Acid Rain

A critical load can be defined as a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge.

When pollutant loads exceed the critical load it is considered that there is risk of harmful effects. The excess over the critical load has been termed the exceedance. A larger exceedence is often considered to pose a greater risk of damage.

Estimated Forest Soil Critical Acid Load



Simple Mass Balance Equation for Forest Soils

$$CL(S+N) =$$

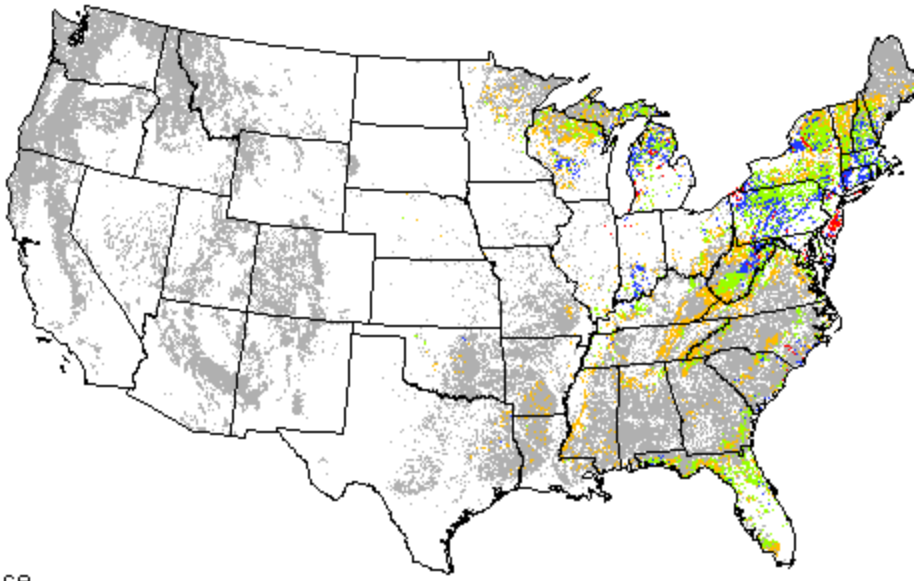
$$BC_{dep} - Cl_{dep} + BC_{w} - BC_{u} + N_{i} + N_{u} + N_{de} - ANC_{le(crit)}$$

BC_{dep} = Base Cation Deposition
Cl_{dep} = Chloride Deposition
BC_{w} = Base Cation Weathering
BC_{u} = Base Cation Uptake

N_{i} = Nitrogen Immobilization
N_{u} = Nitrogen Uptake
N_{de} = Nitrogen Denitrification
$ANC_{e(crit)}$ = Acid Neutralizing Capacity

Exceedance of Critical Loads on Forest Soils Scenario: Runoff

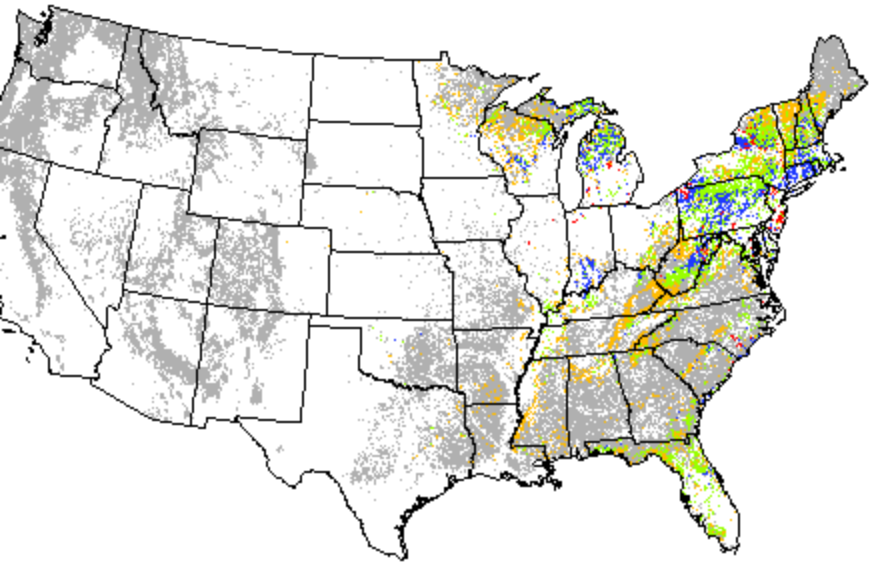
Scenario	No Exceedance	0 - 250	250 - 500	500 - 750	> 750	Total Exceeded in US
Historic	77.8%	9.0%	8.6%	3.9%	0.6%	22.2%
Hadley	77.3%	9.1%	8.8%	4.2%	0.6%	22.7%
Miroc	77.0%	9.1%	8.9%	4.3%	0.6%	22.9%

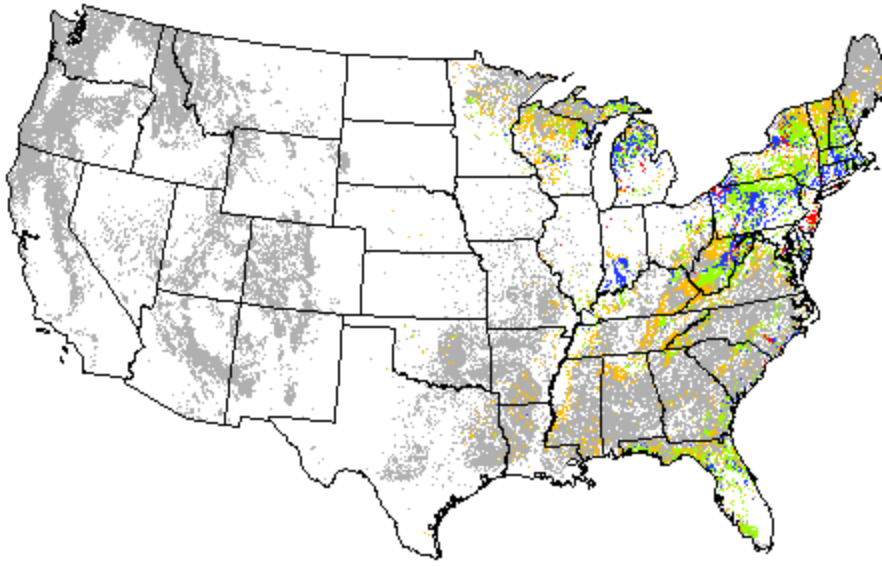


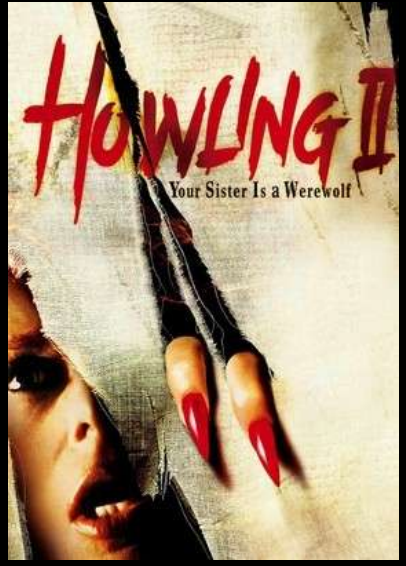
eq/ha/yr

- No Exceedance
- Exceedance: 0 - 250
- Exceedance: 250 - 500
- Exceedance: 500 - 750
- Exceedance: > 750

Historic Clima







Frightful Implications (the sequel)!!!

Changing climate could significantly impact the amount of forest soil in exceedence of the critical acid load

- total forest area in exceedence could decrease by 6%

However, most of the exceedence occurs in New England where The impacts of climate change will be felt the most.

- Therefore, the amount of area in the highest category of exceedence (i.e. 750 eq/ha/yr) could decrease by over 20%

So what have we learned (conclusions)?

- While already costing billions of $ annually, climate change impacts will likely become increasingly severe within 5-10 years.

- Synergistic impacts between climate change and other stresses are very likely.

- Most (but not all) synergies will likely be negative

- Management coping and adaptation options will likely be costly, but non-management intervention may not be an option


Happy
Halloween!