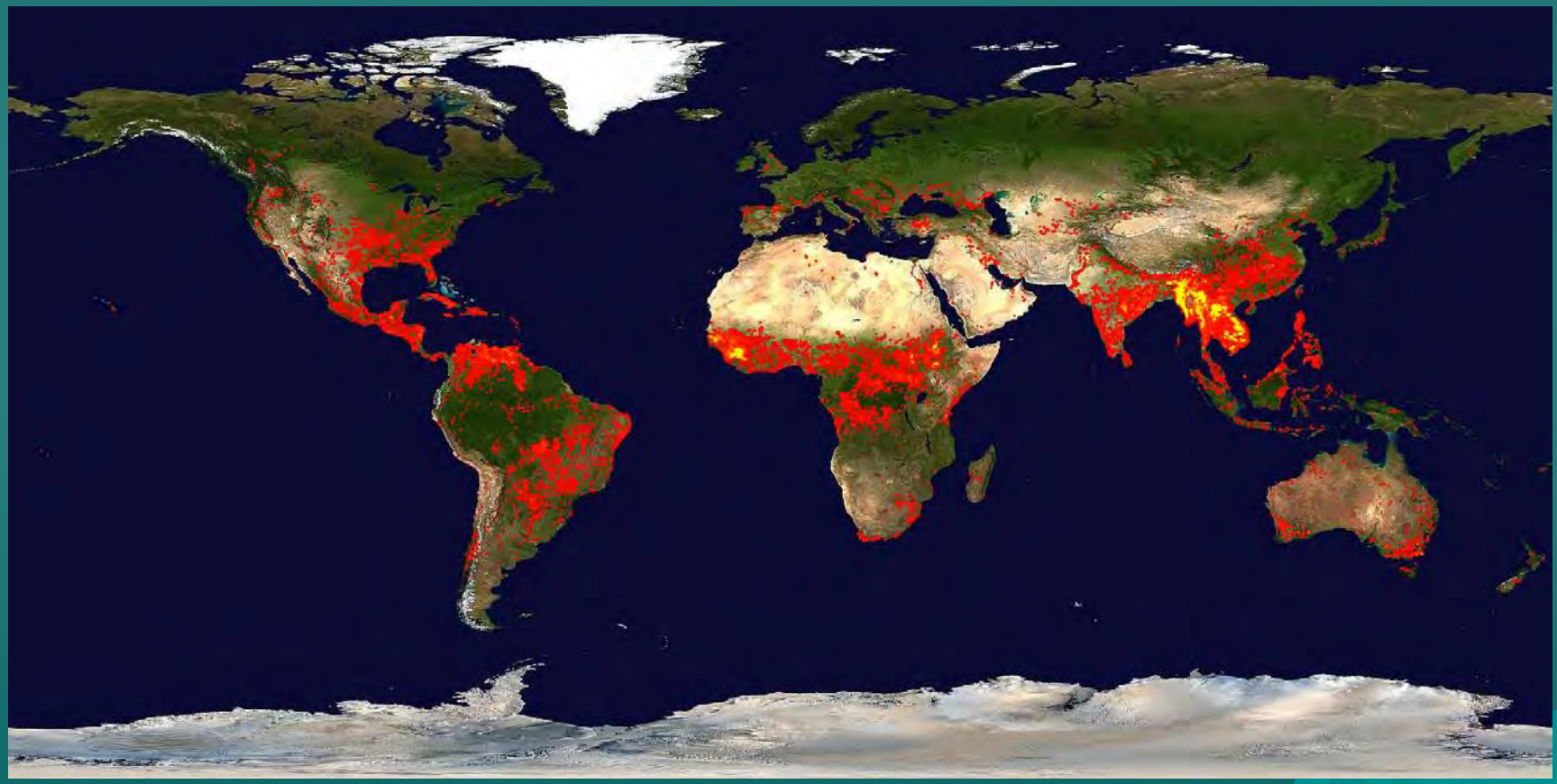
USFS National Science Forum
Landscape Level Planning / Drivers of Ecosystems

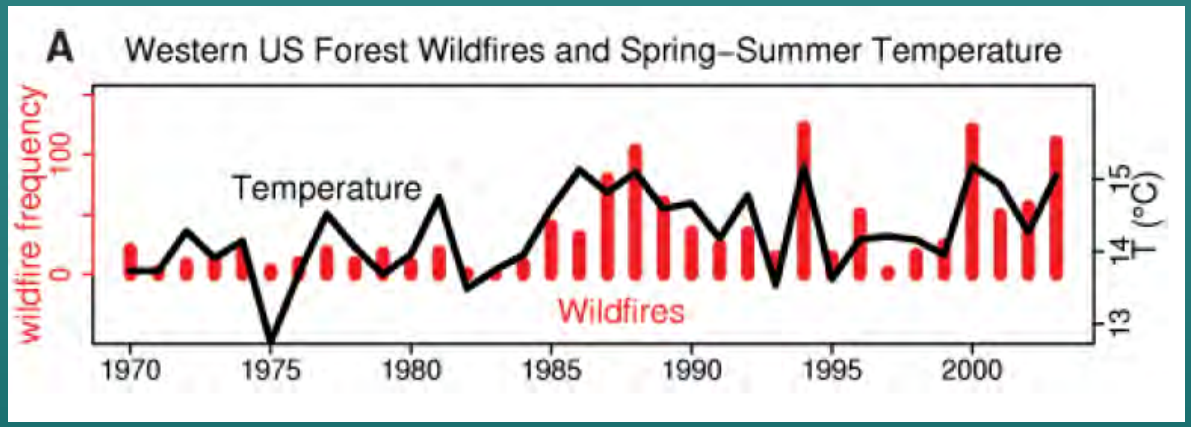


Max A. Moritz, UC Berkeley

Conventional Wisdom: Climate Change = ?

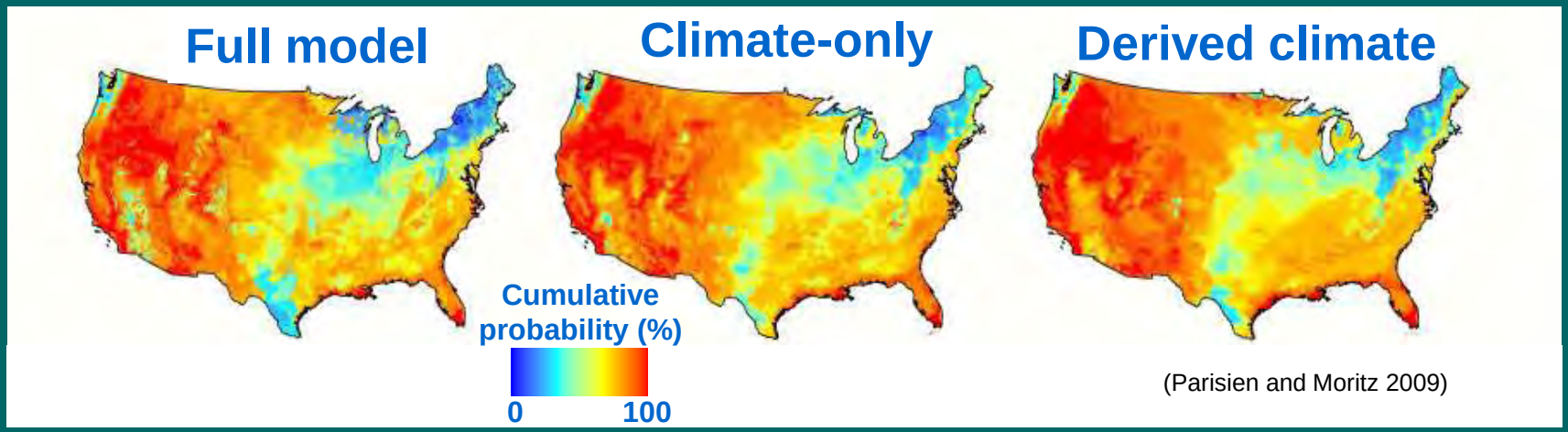
Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity

A. L. Westerling,[1,2*] H. G. Hidalgo,[1] D. R. Cayan,[1,3] T. W. Swetnam[4]



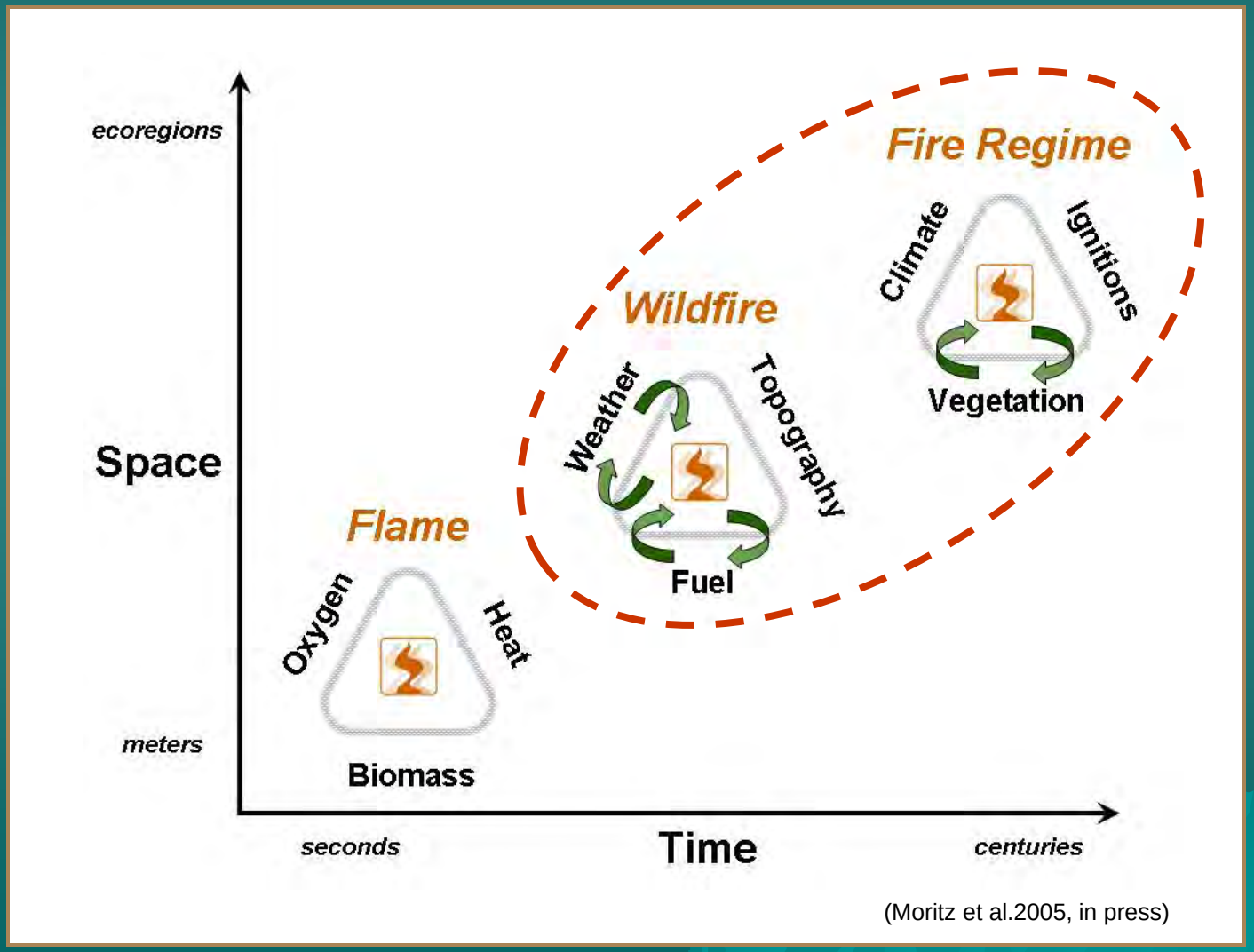
Fire regimes respond to changes in timing and amount of both Precip and Temp…

Can We Quantify Drivers?



	Full model	Climate-only	Derived climate
AUC	0.859	0.849	0.832
Top variables	Pot. vegetation July radiation June tot. precipitation	July radiation June tot. precipitation May abs. humidity	Max. monthly humidity Max. monthly radiation Max. monthly tot. precipitation

Linking Landscapes, Climate Change, Long-term Conservation… Broad Scales



(Moritz et al.2005, in press)

Current Science

- Fire crosses administrative boundaries, links public goods and natural resources;
- Different ecosystems may be adapted to very different fire regimes;

(only “forests and grasslands”?)

Current Science

- "Ecosystem services" has emerged as a framework for valuing benefits:
  - Common terms and currencies;
  - How to value indirect contributions?

- Common definitions & understandings of both beneficial & detrimental roles of fire are essential.

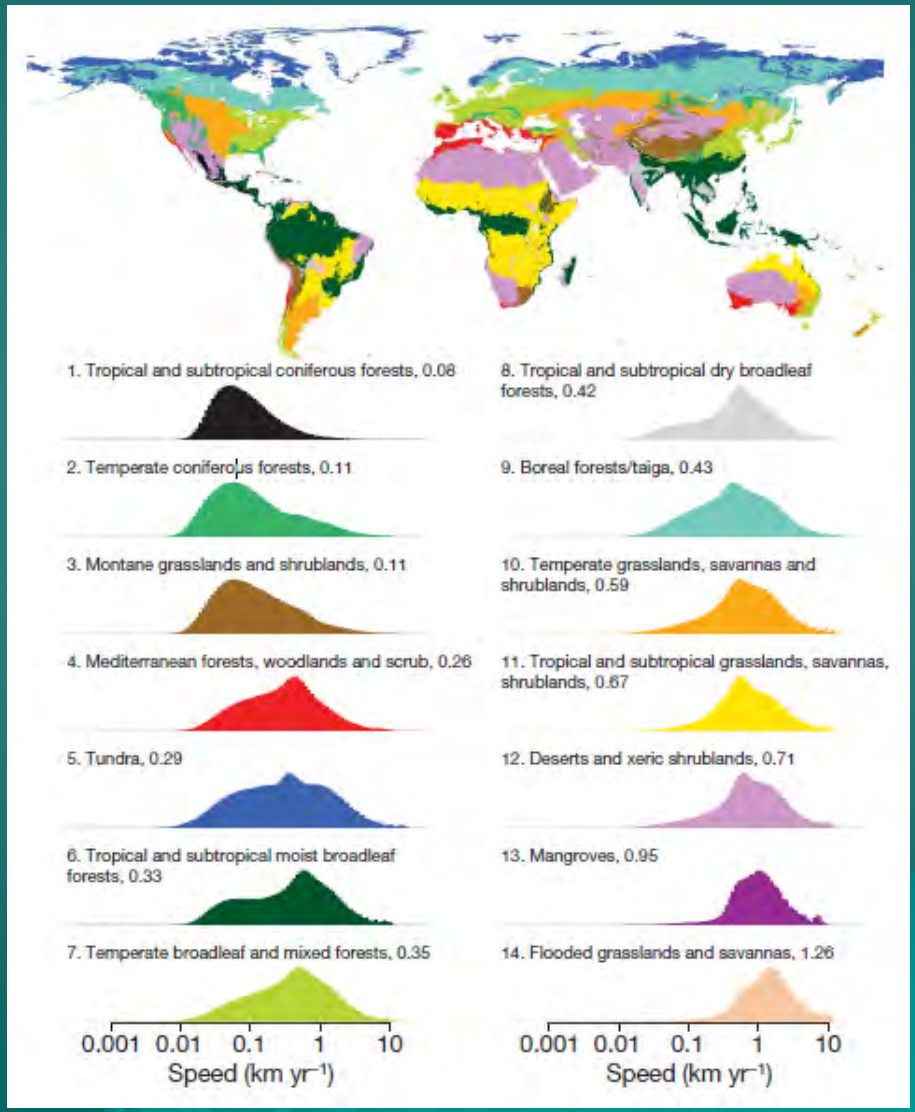
("healthy"..."restoration"..."resilient")

Complex Roles of Fire: Climate Change & Range Shifts

- Rate & intensity of climate change;
- Plasticity & dispersal ability of spp.

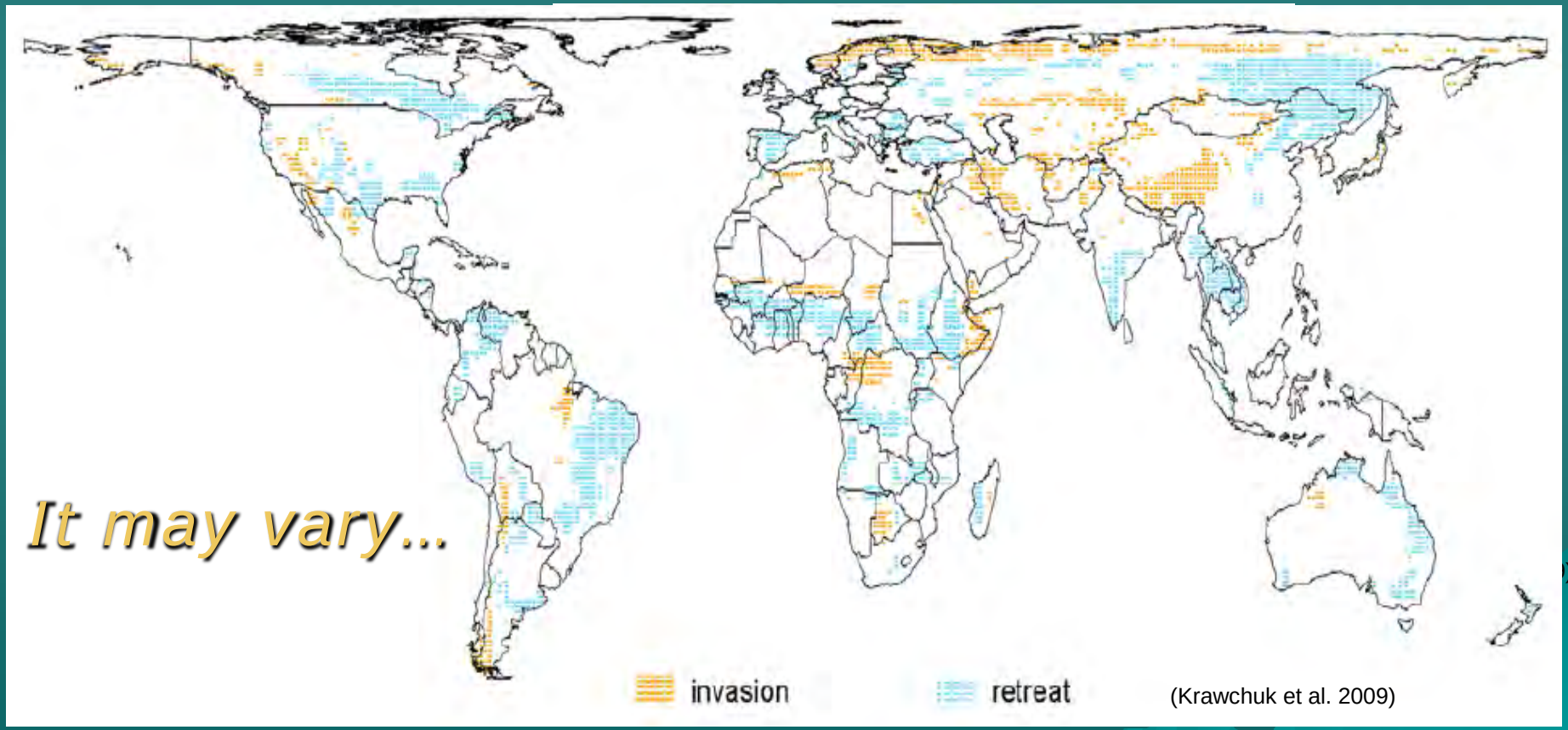
What about fire???

(Loarie et al. 2009)



Conventional Wisdom: Climate Change = ?

- More fires, larger fires, higher severities…



It may vary…

(Krawchuk et al. 2009)

Complex Roles of Fire: Climate Change & Range Shifts

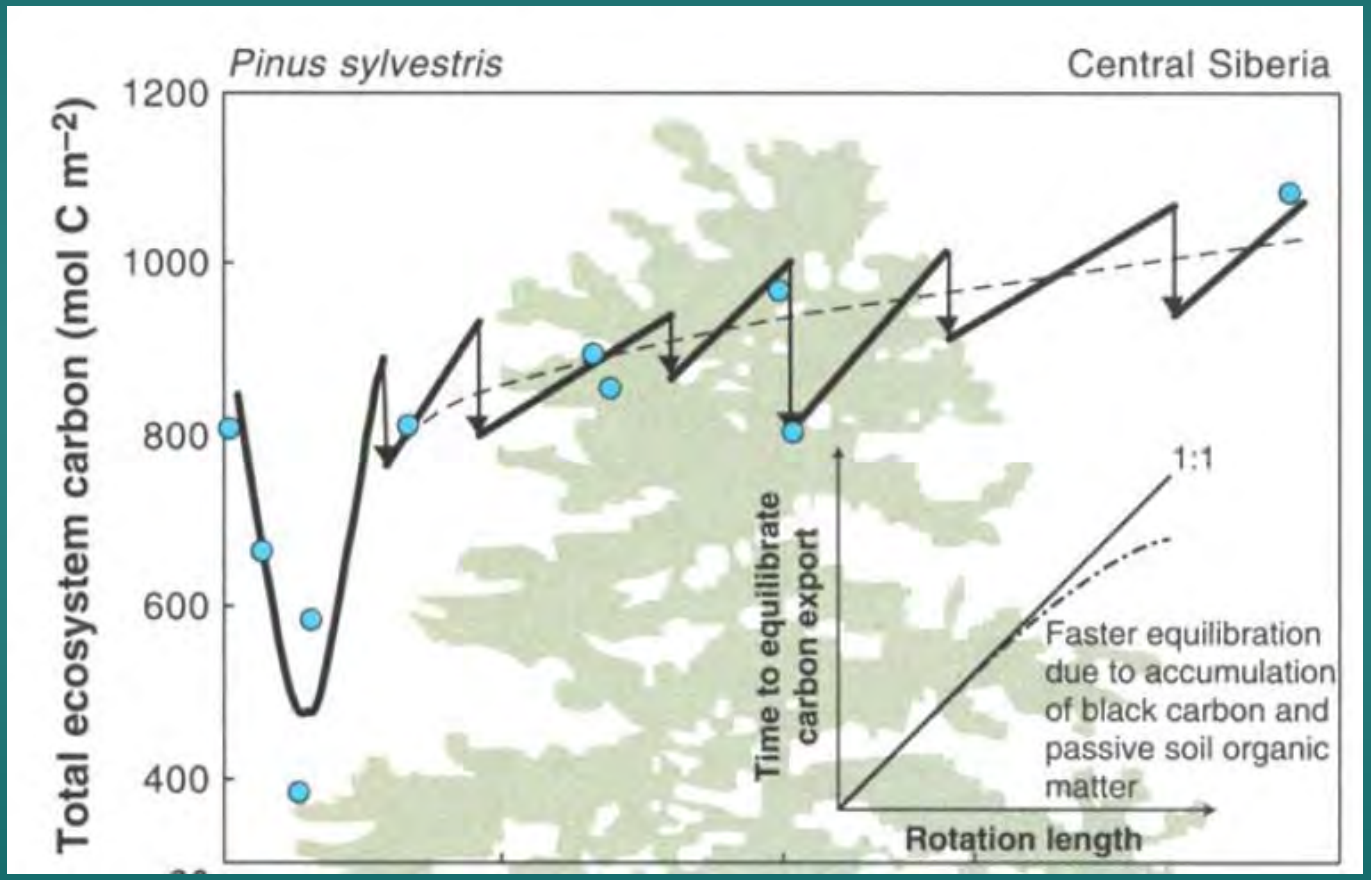
- Fire breaks inertia: hasten movement (losses) of “trailing edge” & facilitate movement (gains) of “leading edge” habitats.

Complex Roles of Fire: Carbon and GHG Emissions

- Fires release C held in biomass;
- Emphasis tends to be on stocks, instead of fluxes.

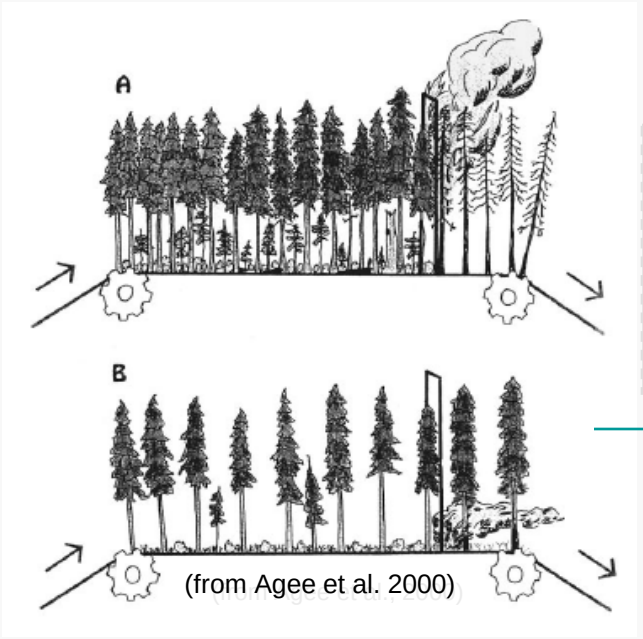
(Schulze et al. 2000)

Complex Roles of Fire: Carbon and GHG Emissions

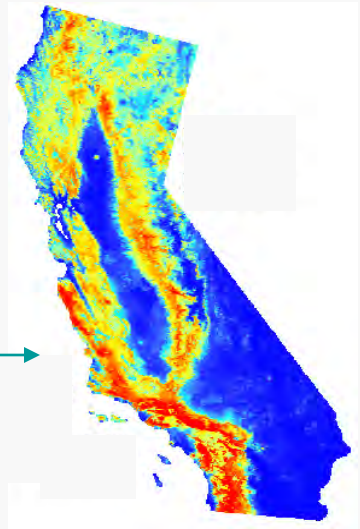


(Schulze et al. 2000)

Complex Roles of Fire: Carbon and GHG Emissions



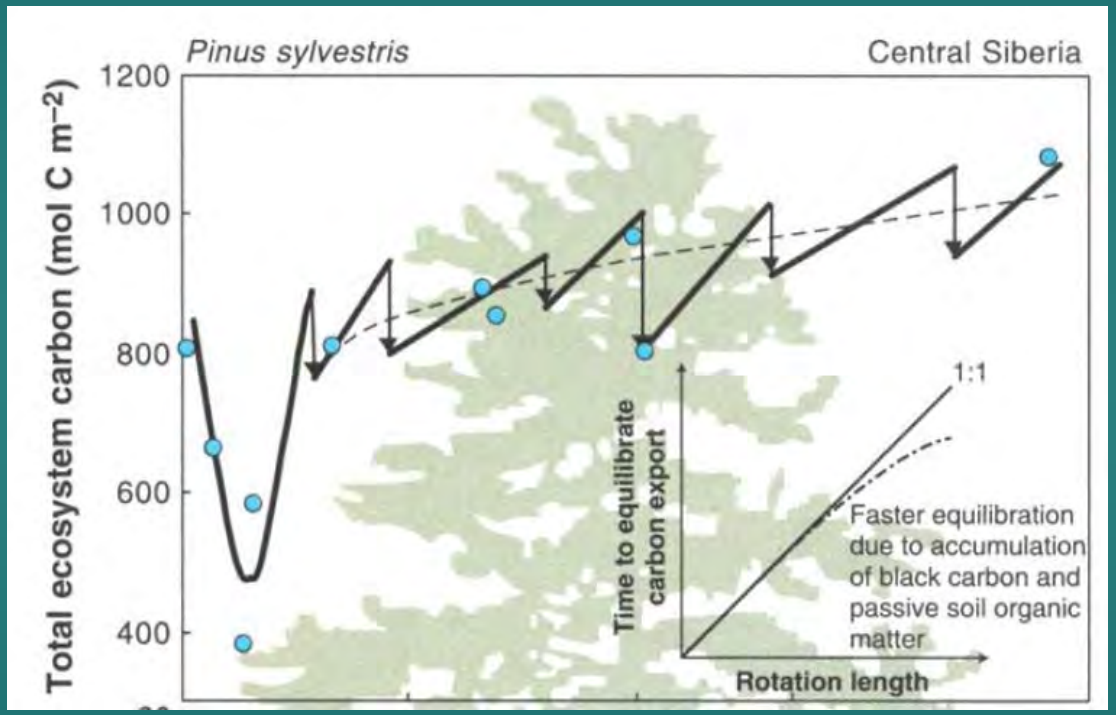
(from Agee et al. 2000)



Emissions reductions should still play a (science-based) role in supporting restoration!

Complex Roles of Fire: Carbon and GHG Emissions

- Fires release C held in biomass (*temporarily*);
- Emphasis tends to be on stocks, instead of fluxes (*temporarily*).



Black carbon or "biochar" production?...

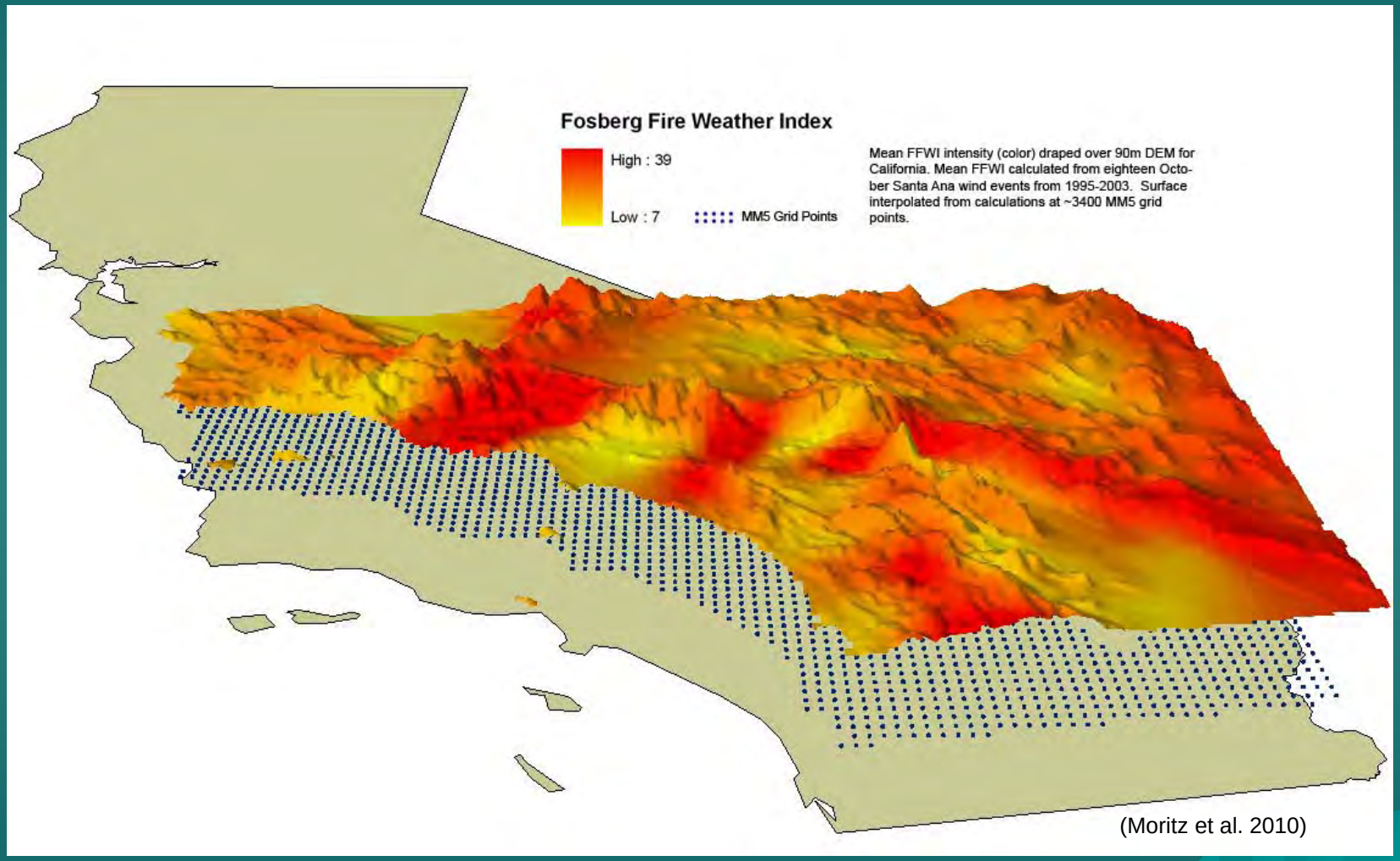
(Schulze et al. 2000)

Current Science

- Fire will play multiple roles in spp. range shifts & C budgets;
- Ecosystem services could provide common terms & currencies;
- Resilience will involve the right kind of fire linking landscapes (but avoiding thresholds).

Challenges

- Ongoing fragmentation & decreasing interest in ecosystems for natural resources;
- Invasive plants/pathogens & interactions with other processes;
- Uncertainties:
  - Fuzzy concepts (e.g., fire regime types)
  - Climate change projections
  - Fire weather patterns



(Moritz et al. 2010)

Hope?

- Far broader scope of mission than other types of plans;
- Science can help by providing quantitative descriptions of patterns/processes/services that are being restored & conserved.

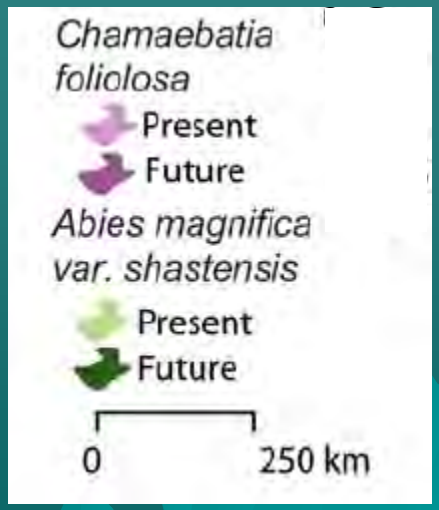
Thank you

Complex Roles of Fire: Climate Change & Range Shifts

- Rate & intensity of climate change;
- Plasticity & dispersal ability of spp.

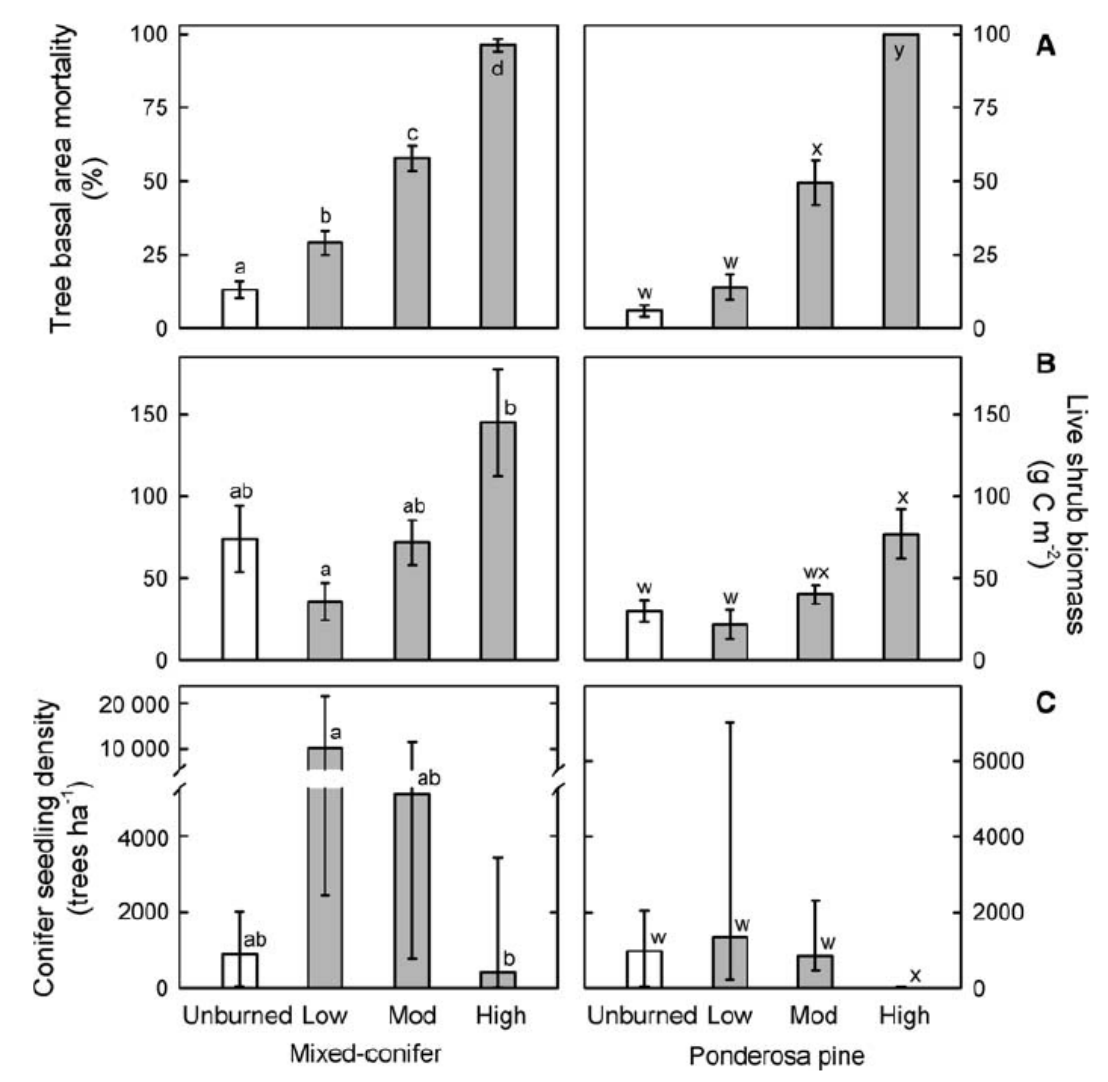
(Loarie et al. 2008)

What about fire???



Complex Roles of Fire: Carbon and GHG Emissions

- We probably still have a lot to learn about this…



(Meigs et al. 2009)

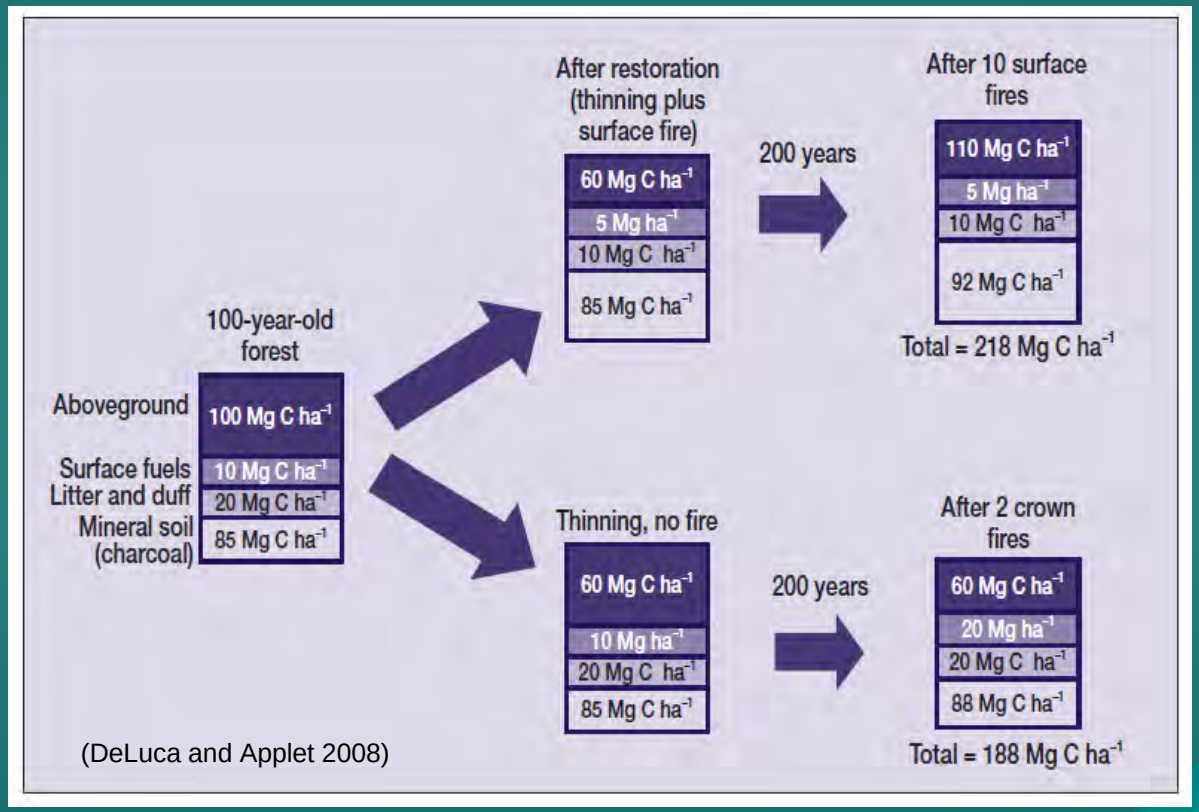
Complex Roles of Fire: Carbon and GHG Emissions

- C combustion varied from 13 to 35% of prefire aboveground C pools;
- C emissions = ~2.5% of Oregon statewide anthropogenic CO2 for 2-year period;
- Early successional veg offset declines in NPP and NEP, buffering fire impacts.

(Meigs et al. 2009)

Complex Roles of Fire: Carbon and GHG Emissions

- In addition to sequestration, BC has an integral role in nutrient cycling.



Substitution of biochar production for restoration is questionable...

Controls on Fire Vary