Fire Ecology

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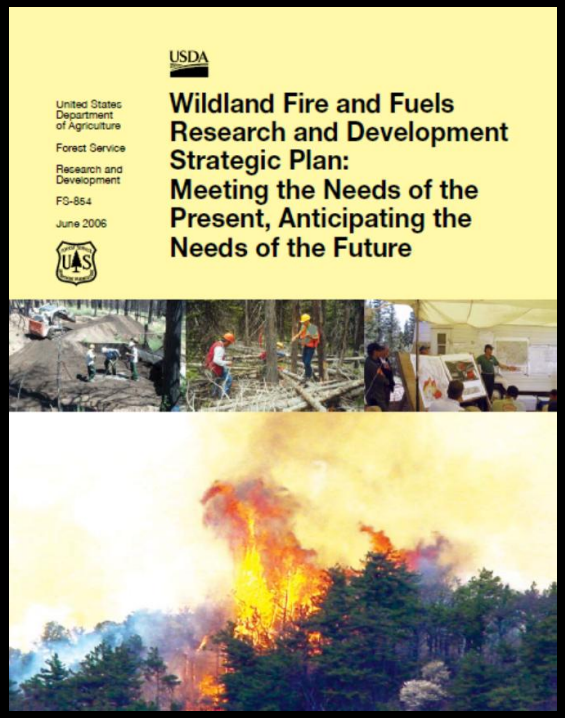
Strategic Plan Definitions

- *Interactions among fire, other natural disturbance processes, and the physical biological components of ecosystems and the environment*

- *Better understand **the relationships among** varying **fire behavior** characteristics (e.g., energy release, residence time, flame length, and depth of burn) and **fire regimes** (e.g., fire size, distribution, severity, and return interval) and **fire's effects** on vegetation, soils, watersheds, insects and disease, fish and wildlife, and carbon and nutrient cycling.*

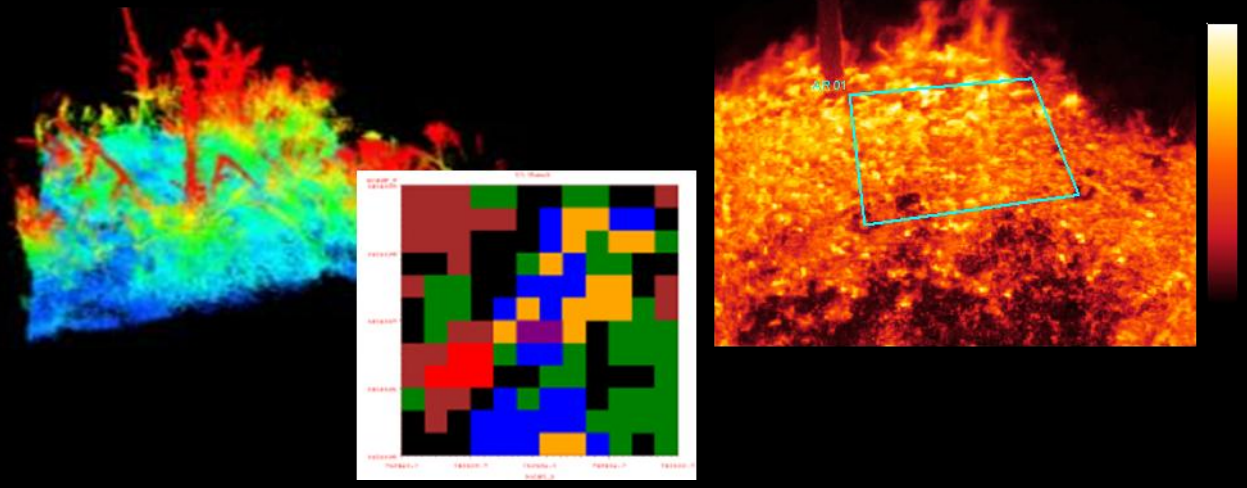


Relevance of Ecology

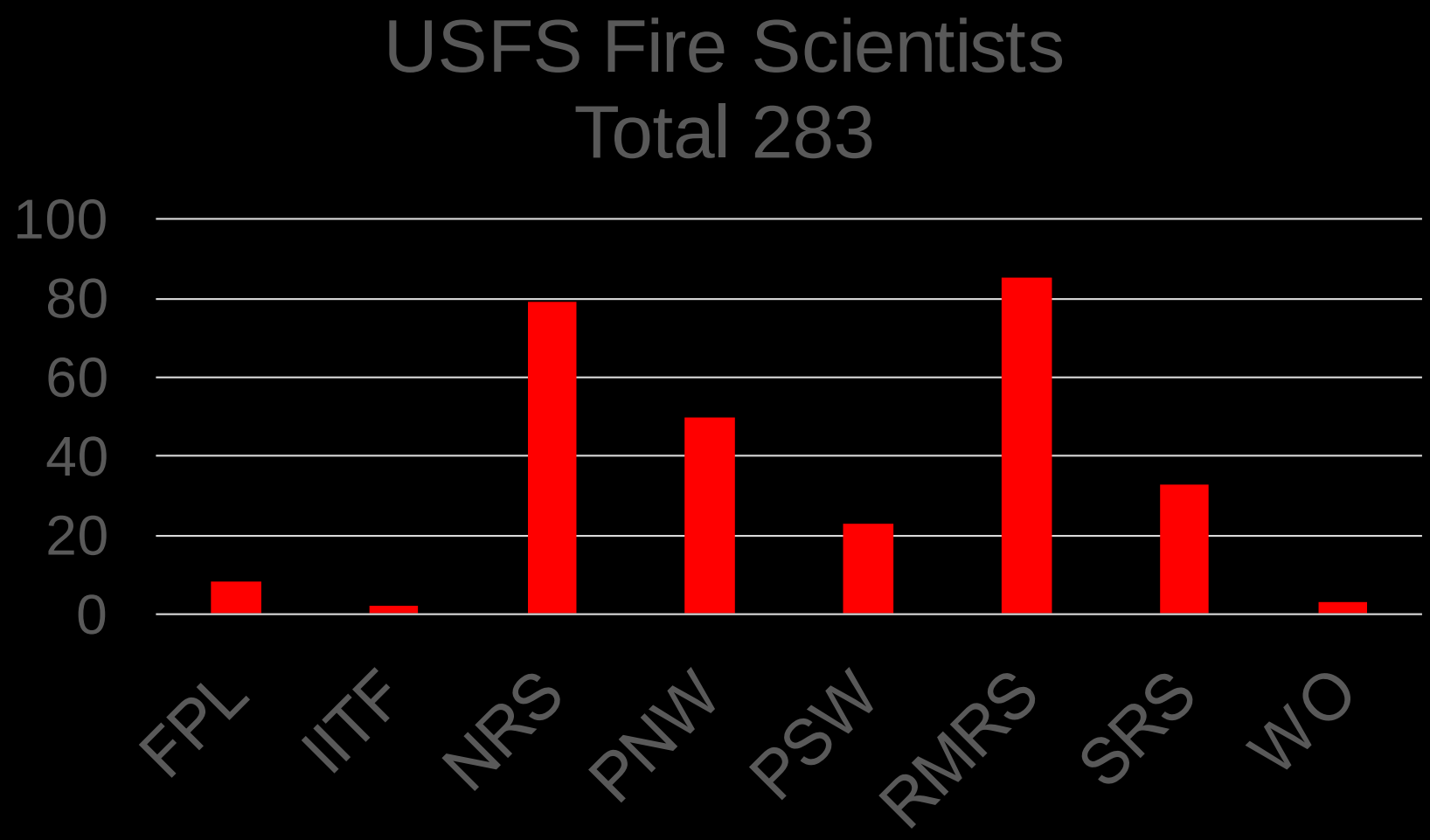
- Before the fire
  - ID Areas of potential opportunity/risk
- During the fire
  - Understand how fuels treatments impact fire behavior
    - How vegetation patterns drive fire behavior
- After the fire
  - Remediation treatment effectiveness/appropriateness

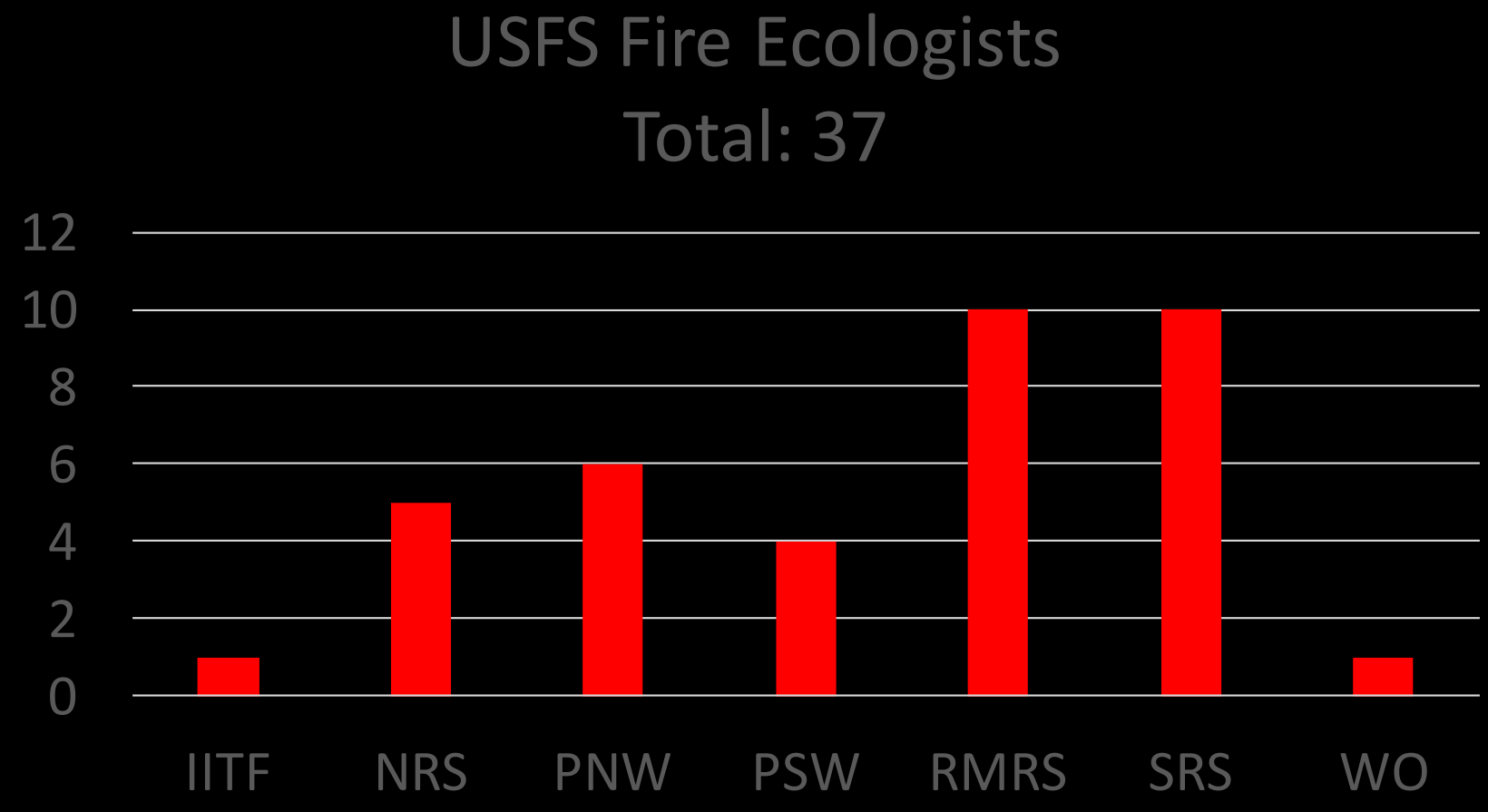
Capacity

- Personnel
- Technological



Personnel


USFS Fire Scientists
Total 283
100
80
60
40
20
0
FPL
IITF
NRS
PNW
PSW
RMRS
SRS
WO


USFS Fire Ecologists
Total: 37
12
10
8
6
4
2
0
IITF
NRS
PNW
PSW
RMRS
SRS
WO

Productivity

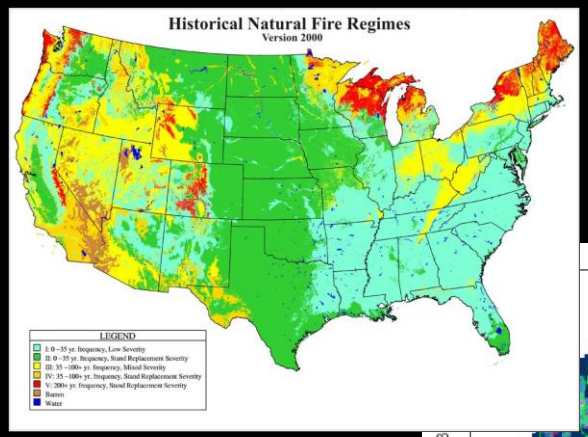
Keyword: Fire Ecology

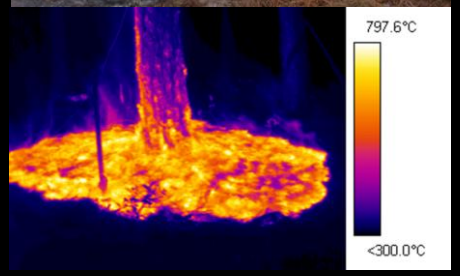
Station Specific	*Total Publications*
Forest Products Laboratory	43
International Institute of Tropical Forestry	21
Northern Research Station	203
Pacific Northwest Research Station	643
Pacific Southwest Research Station	412
Rocky Mountain Research Station	1390
Southern Research Station	283
Washington Office	63
Total Publications in Google Scholar 2009-2014	3058

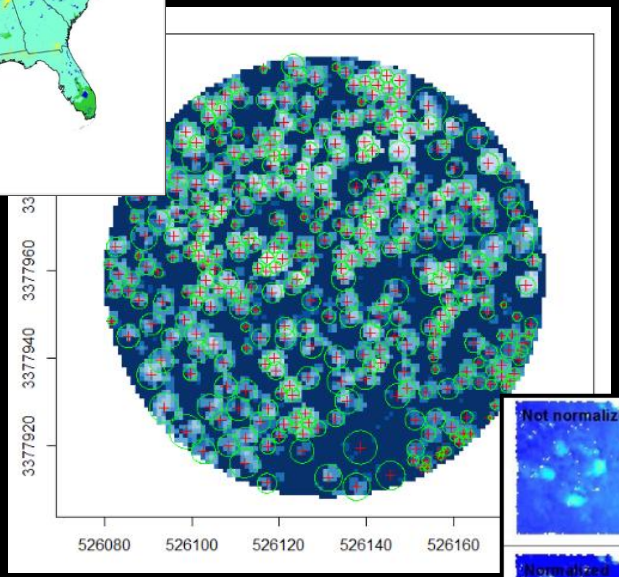
CSIRO: 822
CFS: 289
IBAMA: 89

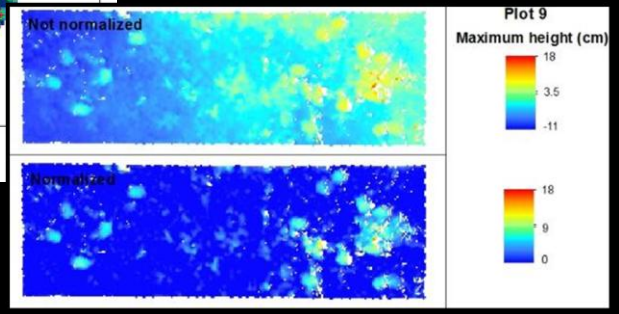
Cross Scale Expertise

- Landscape – physiology

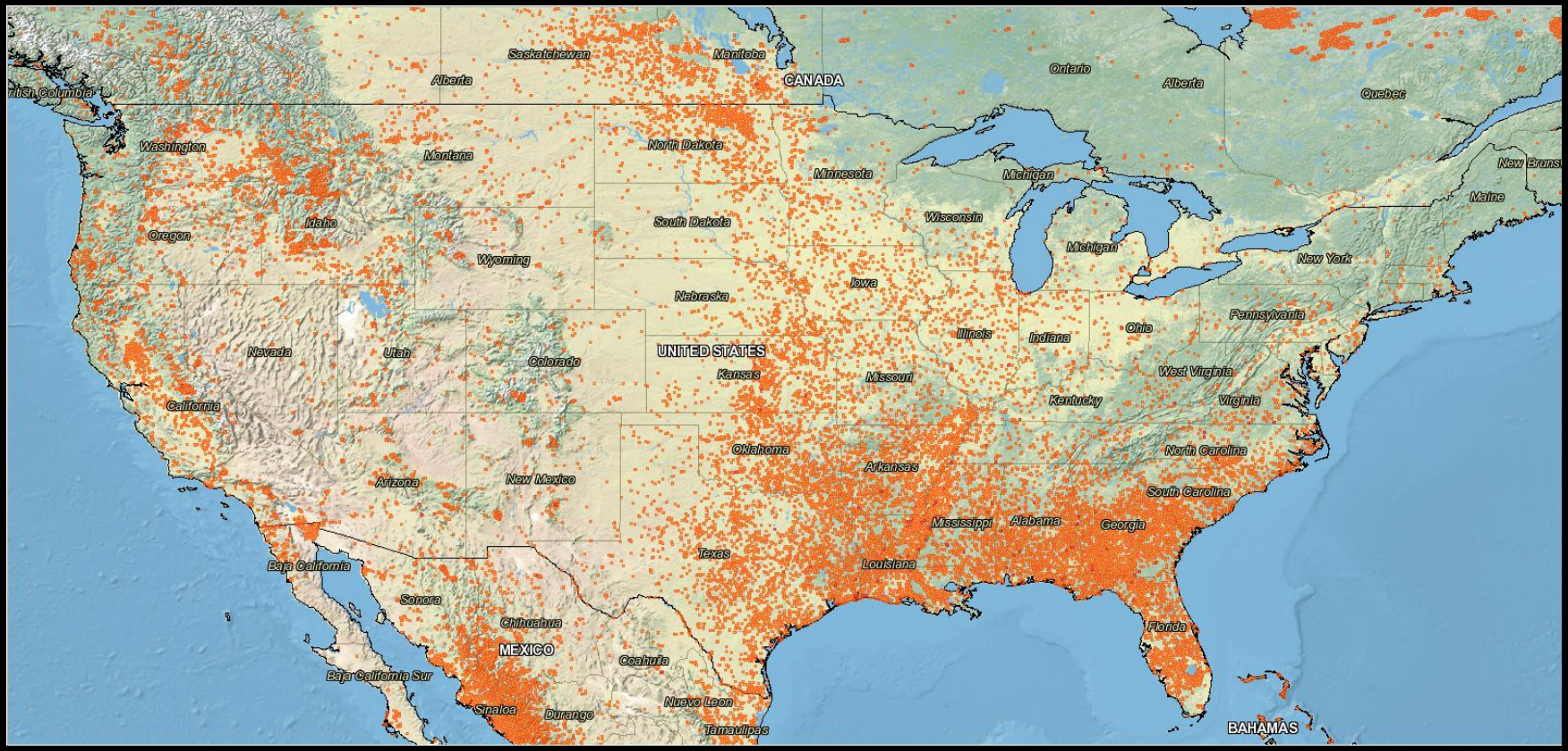




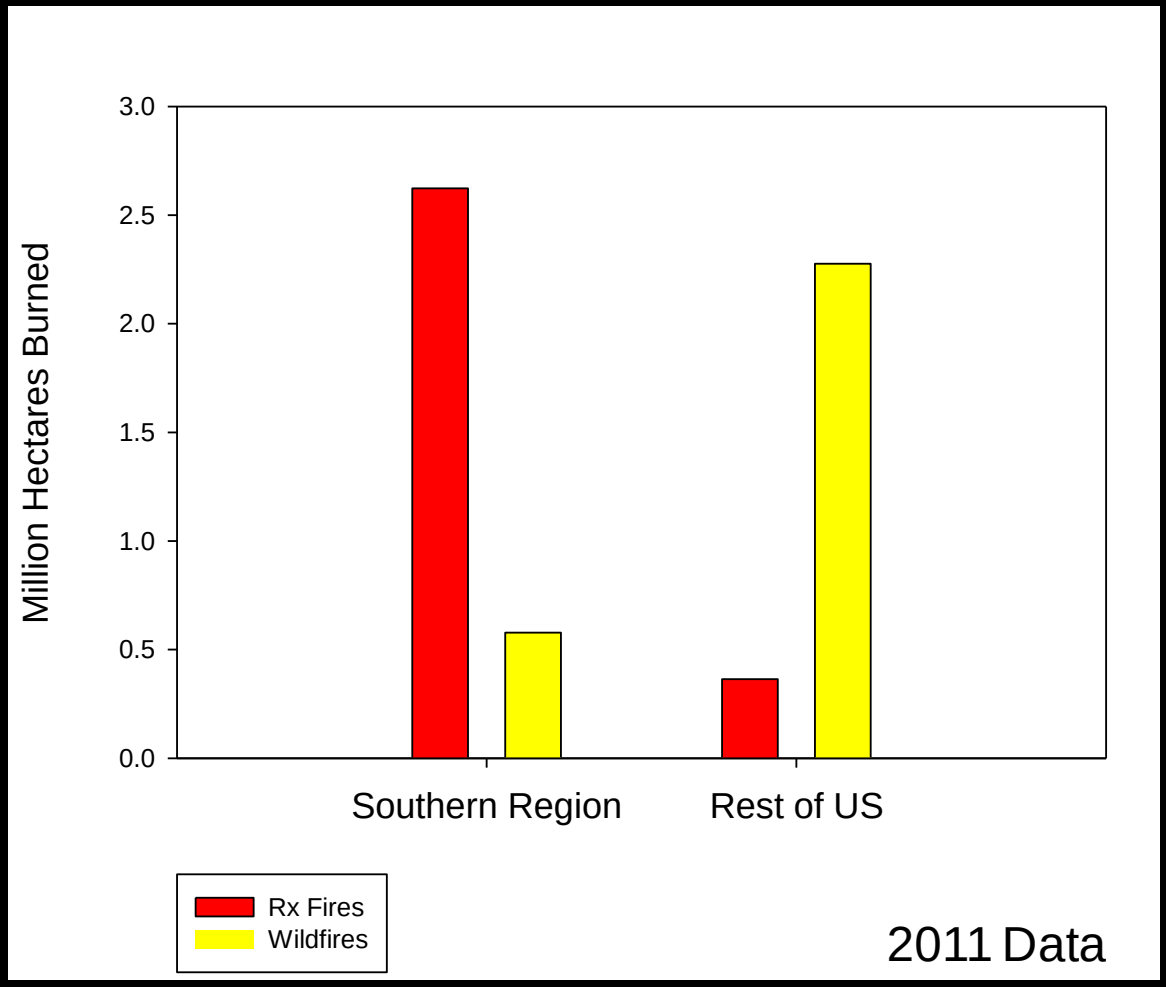




Cumulative MODIS Fire Detections 9/4/12-9/4/13



Tale of Two Fires



Citizen Fire Management

Technological Capacity

- Remote Sensing
  - Piloted – remote controlled aircraft
  - LiDAR, IR imagery, photogrammetry, NDVI
- Ecosystem Measures
  - Eddy Flux, xylem sap flux, photosynthesis
  - Soils, respiration, carbon sinks
  - Watersheds, ecohydrology
- Models
  - Forest growth, carbon fluxes, insect population dynamics, stem heating, FOFEM, TBA

Key Research Needs

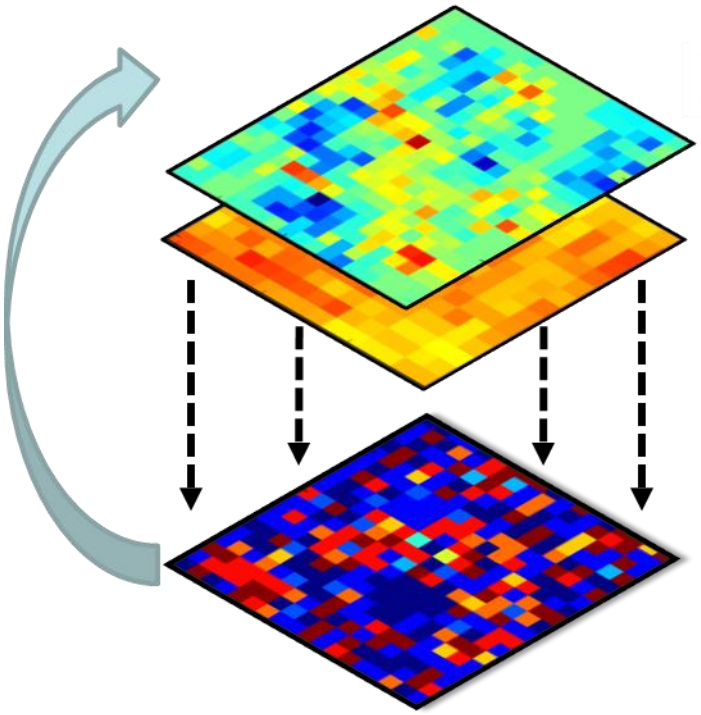
- Biophysical processes
- Vegetation responses
- Watershed Effects
- Insects and Disease
- Carbon Balance

Biophysical processes

Describe and model the linkages between fire behavior and fire effects on flora, fauna, and soils. Whenever possible, use this basic knowledge as a means of understanding and predicting ecosystem responses to fire.

How are fire and diversity linked?

- SERDP, SRS, RMRS, UNR, Air Force



Plant community (pre-fire)

Fuels ← Tree canopy driven

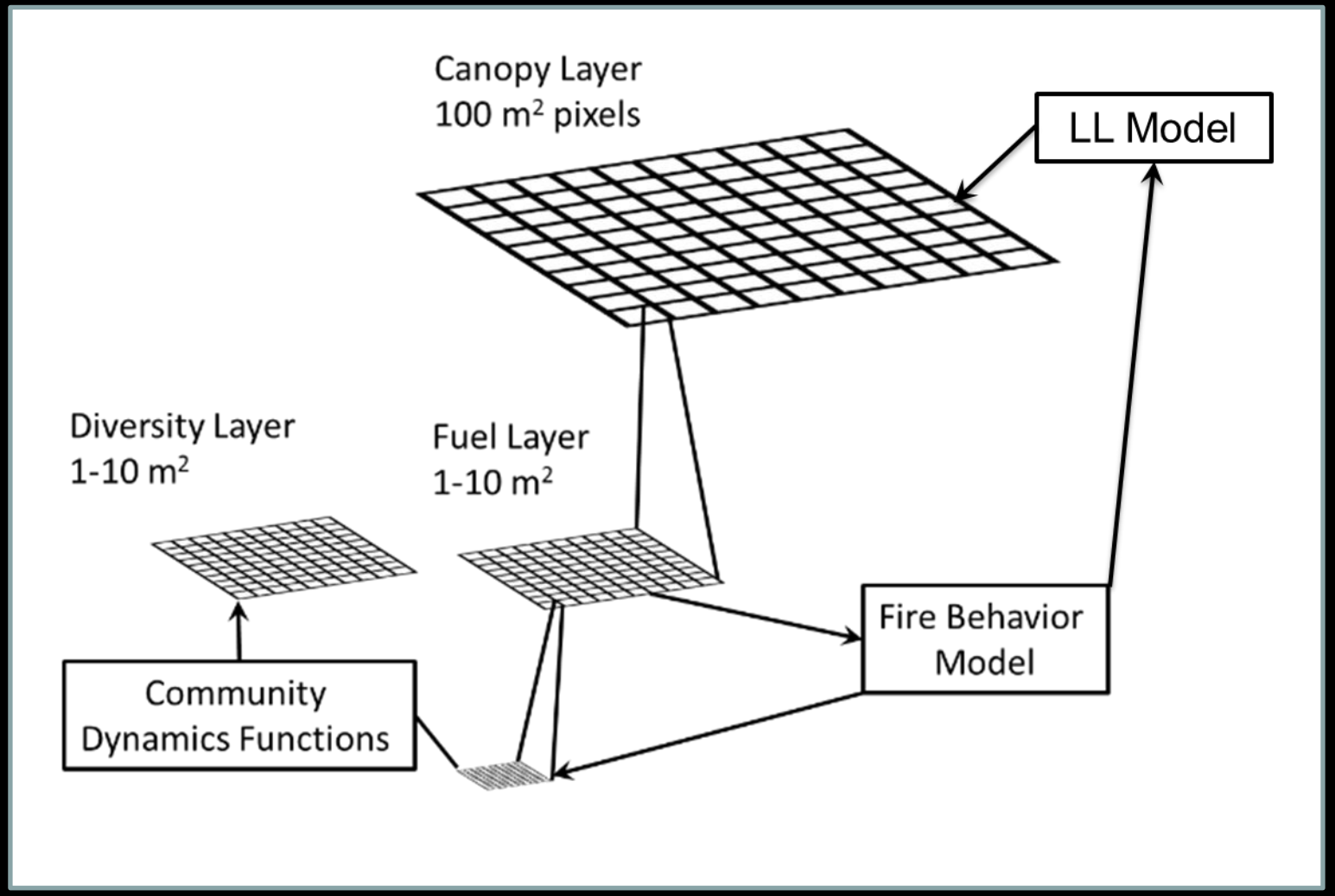
Fire intensity

Plant community (post-fire)

Test for Neutral Processes within CA model:

- **Plant mortality ~ fire intensity (fuels)**
- **Plant recruitment ~ random within recent mortality sites**

Unified Model for Rx Fire

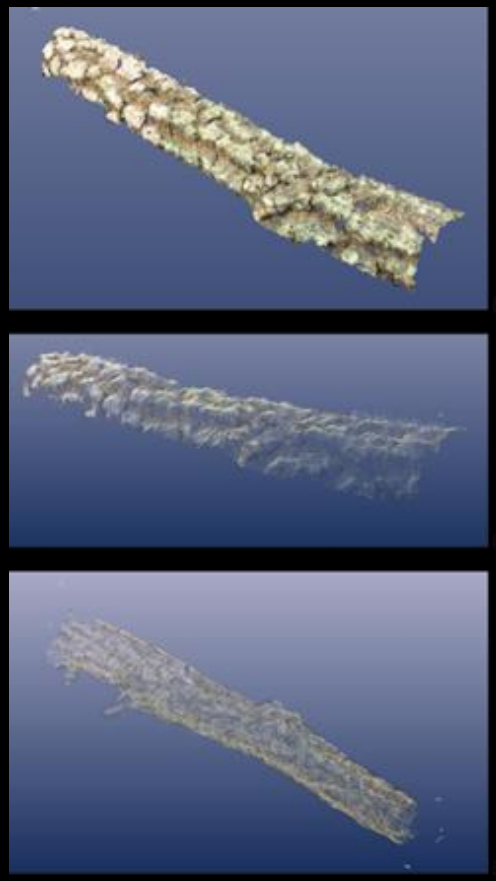


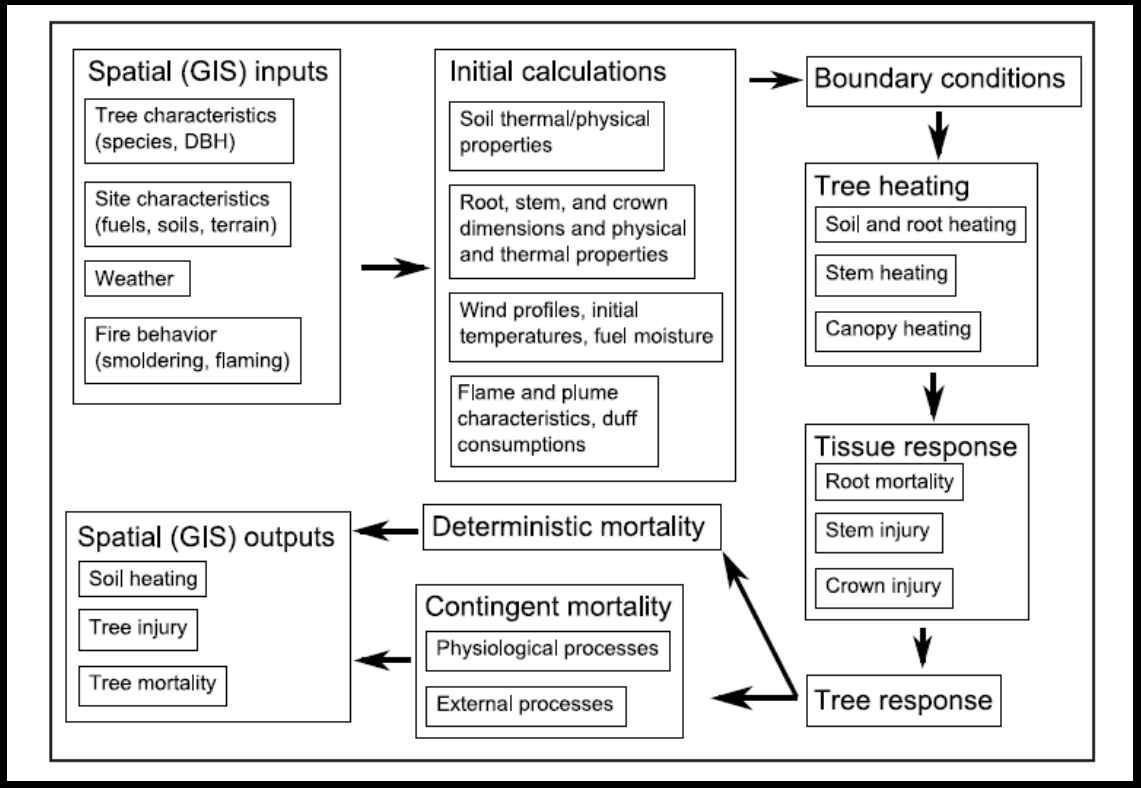
Fire-vegetation interactions

- Enhance basic knowledge of fire interaction with vegetation, including injury and mortality, recovery of vegetation and fuels, factors affecting postfire productivity and wildlife habitat, and the role of invasive species.

Stem Heating

- NRS, RMRS, SRS





Watershed Function

- Evaluate the effects of changing fire regimes on short- and long-term watershed processes, including water yield, water quality, erosion, fish habitat, and site quality or productivity.

Hayman Fire

- RMRS

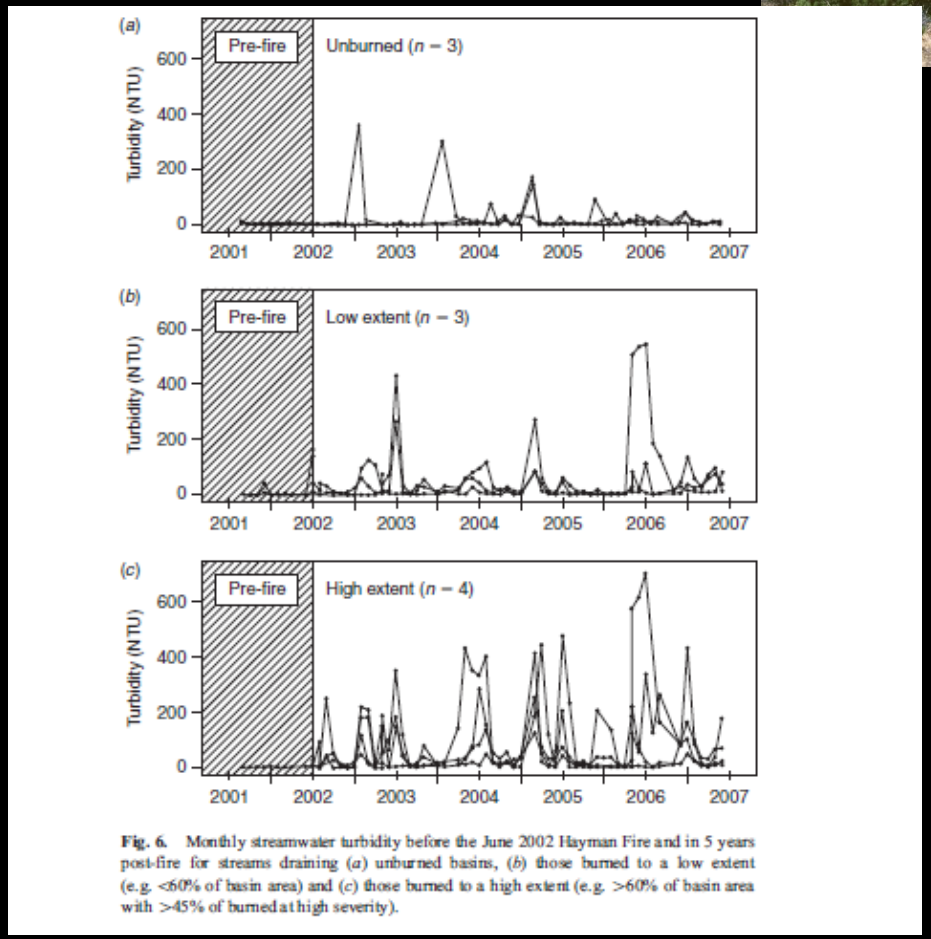


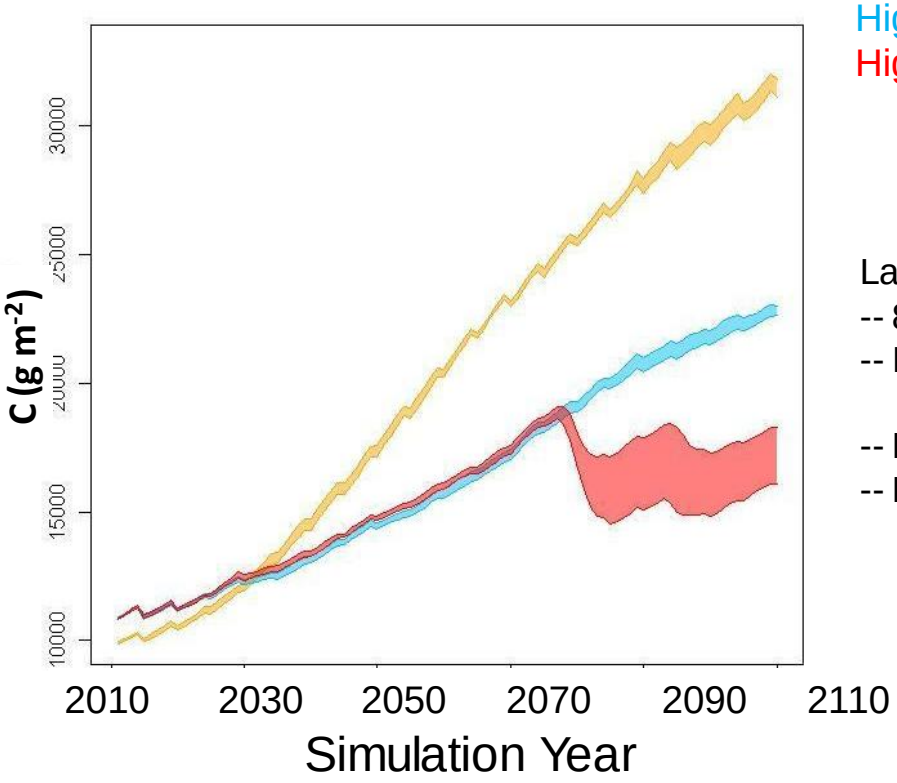
Fig. 6. Monthly streamwater turbidity before the June 2002 Hayman Fire and in 5 years post-fire for streams draining (*a*) unburned basins, (*b*) those burned to a low extent (e.g. <60% of basin area) and (*c*) those burned to a high extent (e.g. >60% of basin area with >45% of burned at high severity).

Insects and Disease

- Quantify the relationships between insects and disease and fire disturbance, including the effects of insect and disease damage on fire regimes and effects of fire on insect and disease levels.

PSW, PNW

Management: Fire, Bark Beetles, and Climate



Baseline Climate, Fire, and Mgmt
High Emissions, Fire, and Mgmt
High Emissions, Fire, Mgmt, and Bark Beetles

Lake Tahoe Basin (CA, NV):
-- 80% Federal Lands (USFS)
-- Intensively managed (Thinning)

-- High future C storage potential (2nd growth forests)
-- Dependent on climate-fire-insects and future mgt.

Louise Loudermilk (Portland State), Carl Skinner (PSW), Alec Kretchun (PNW)

Carbon Balance

- Predict changes in carbon sequestration, storage, and release in relationship to changing climate, management, and fire regimes

Carbon

- PSW
- Promoting a more sophisticated understanding of how fire and carbon interact…

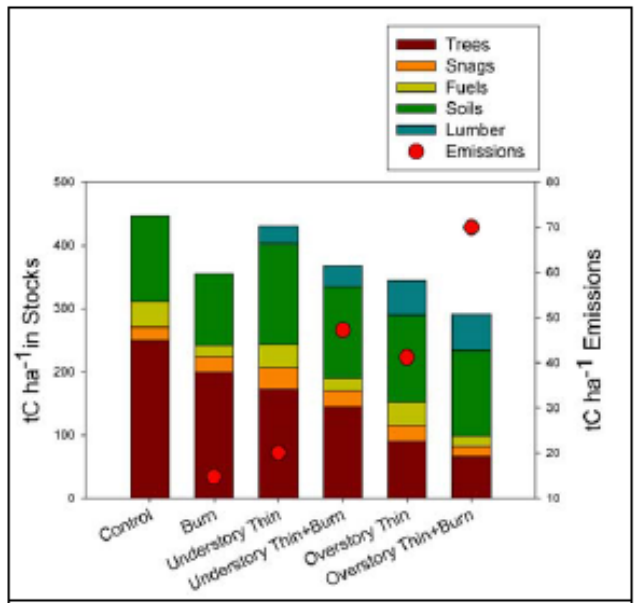
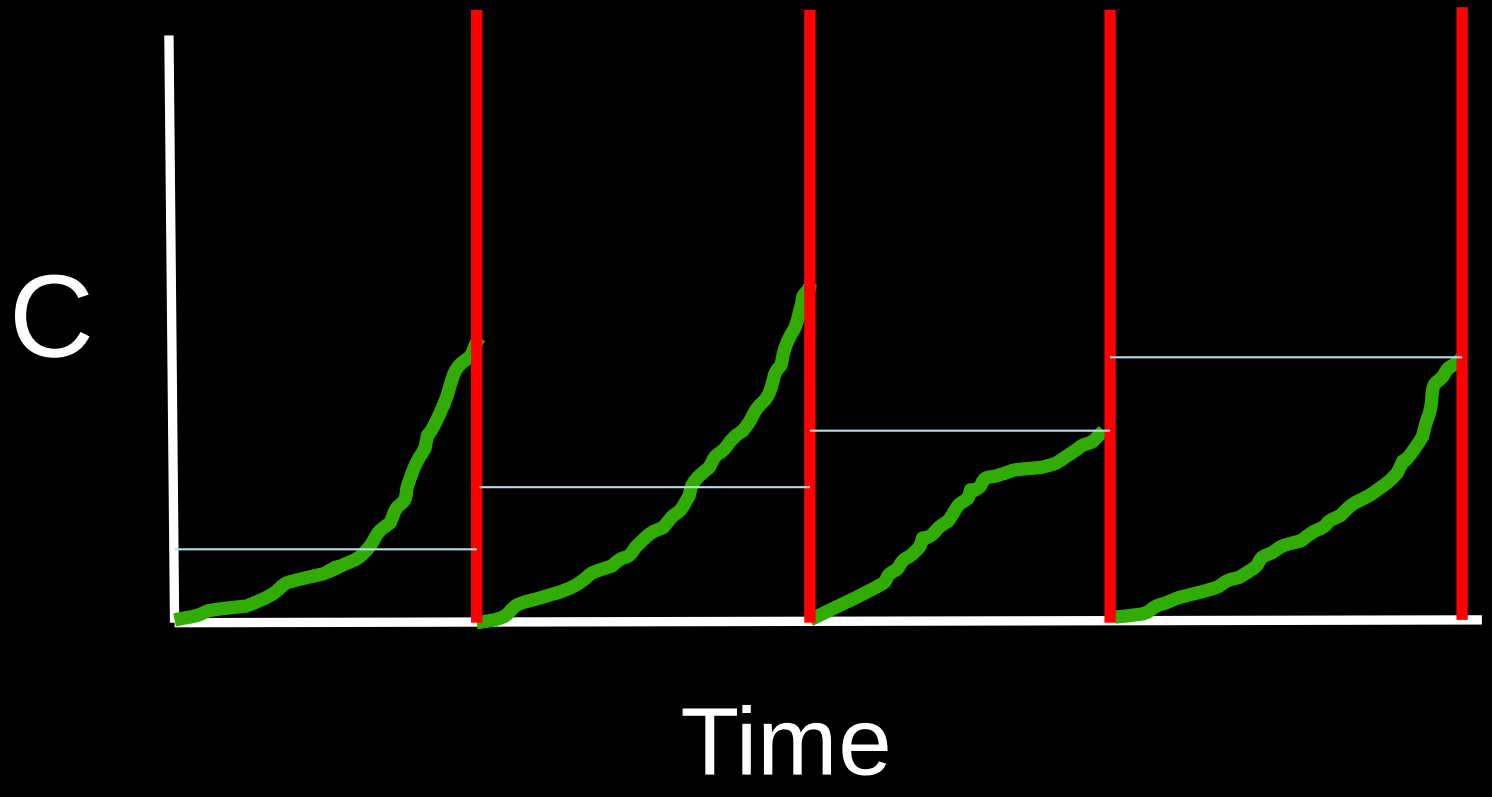
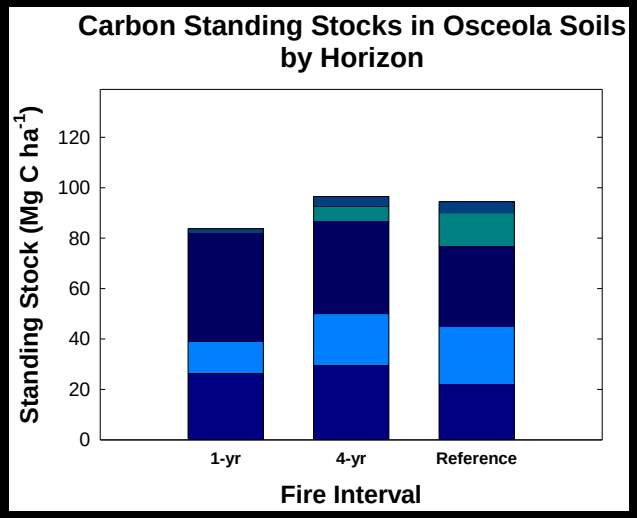


Figure 1: Carbon stocks and treatment emissions by treatment type. Figure adapted from North et al. (2009).

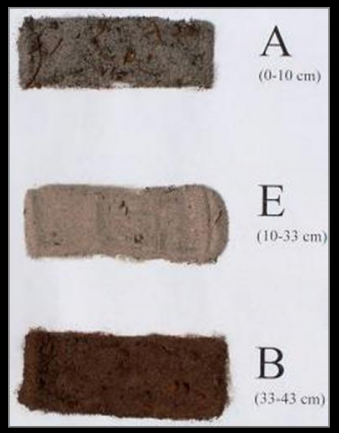
Productivity, Black Carbon



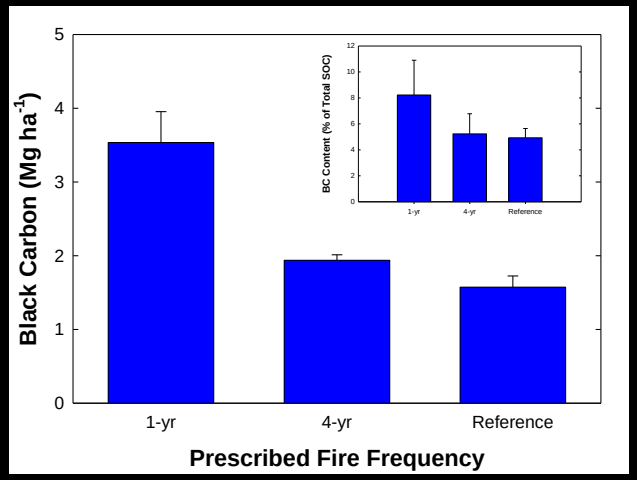
Soil Carbon



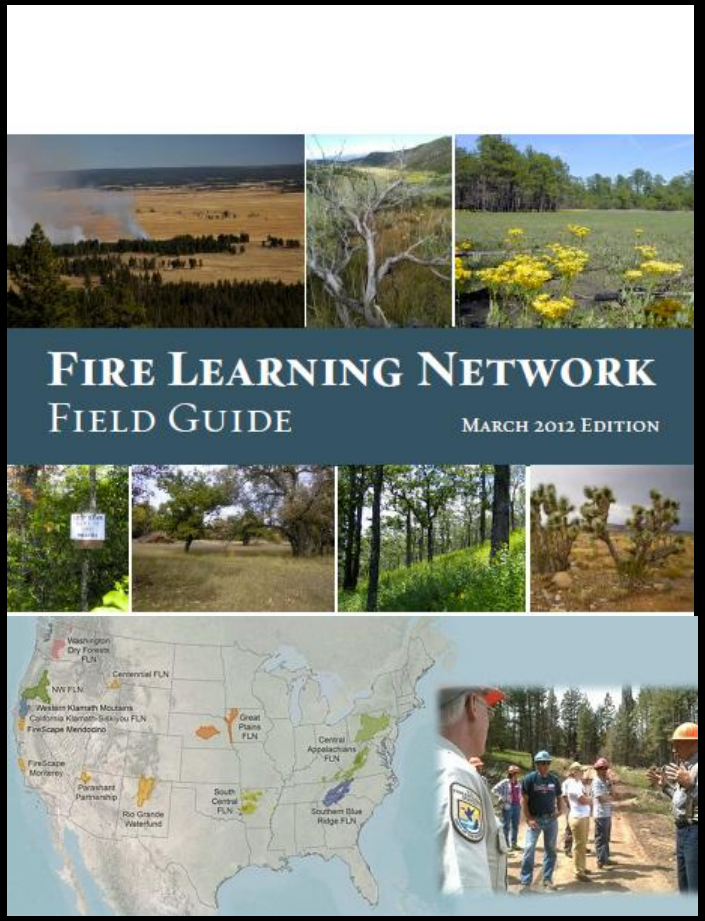
Protected



At Risk

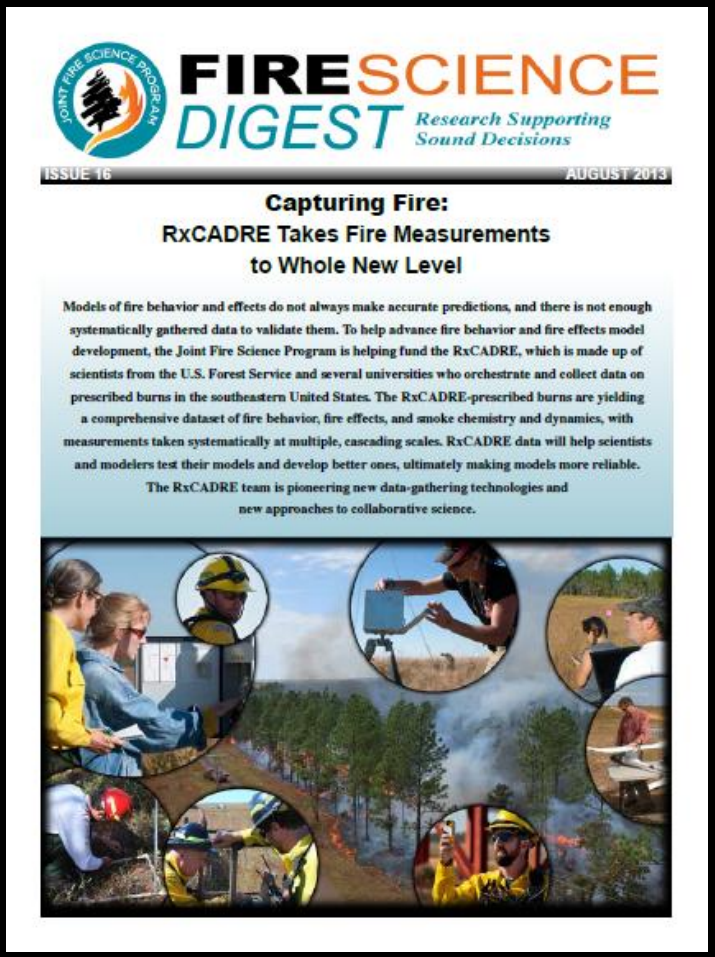


Tech Transfer



Knowledge Transfer

- RxCADRE
- Firefighter Science



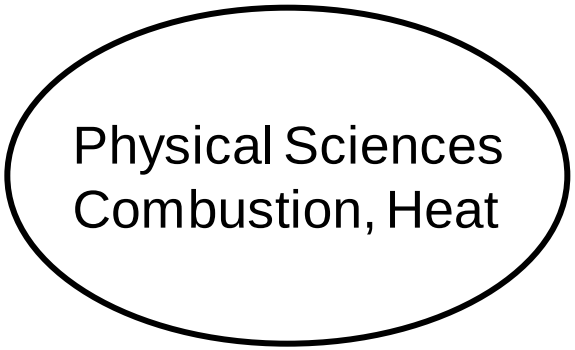
FIRE SCIENCE DIGEST
Research Supporting Sound Decisions

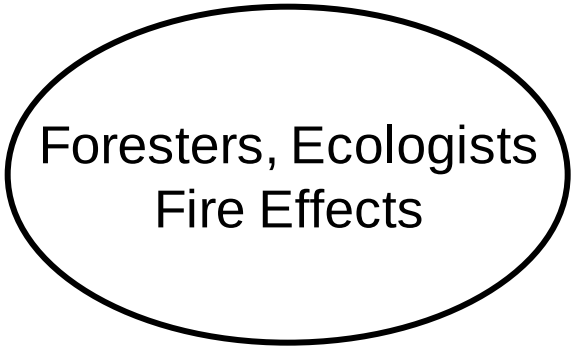
ISSUE 16 AUGUST 2013

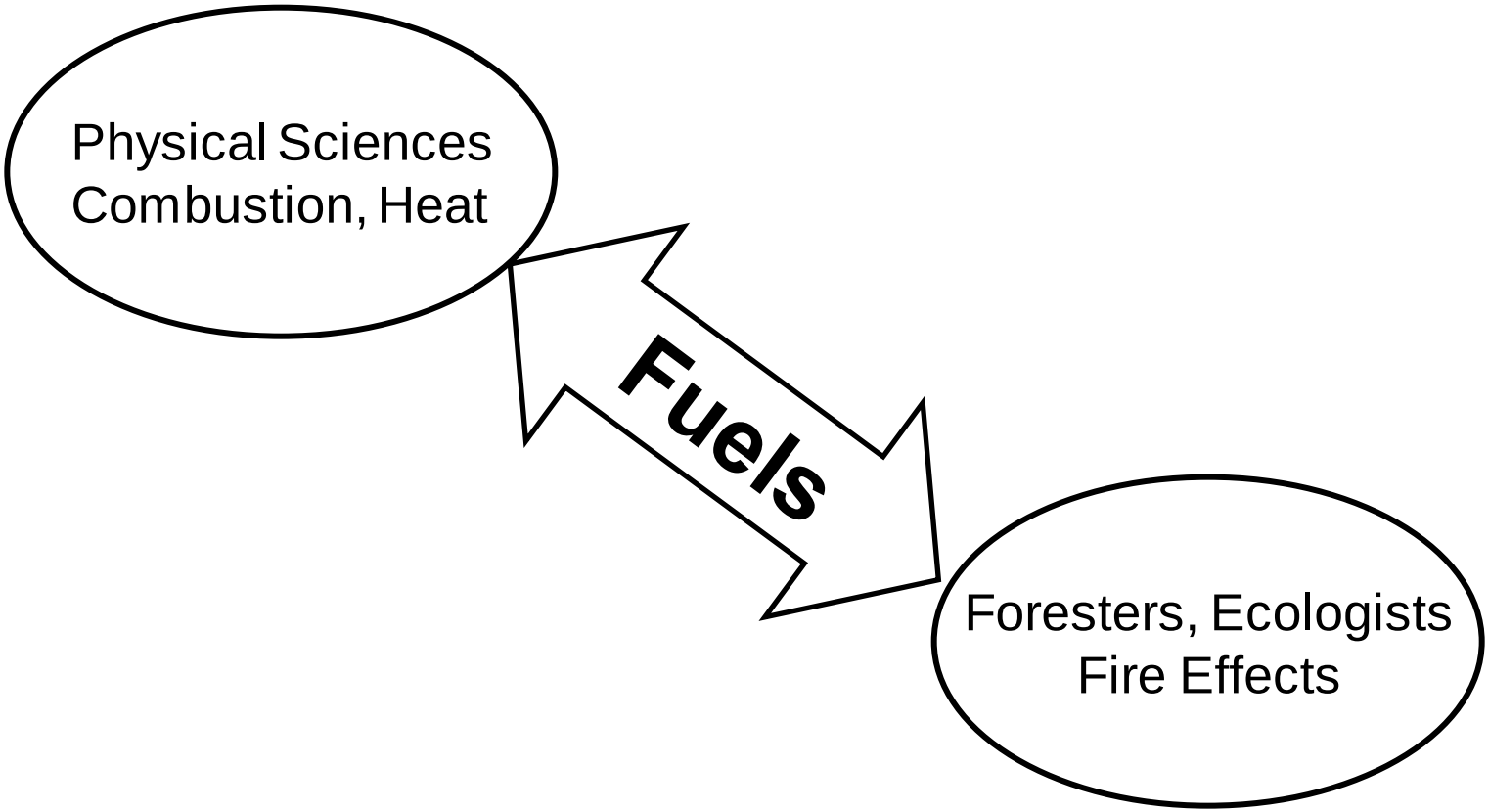
Capturing Fire:
RxCADRE Takes Fire Measurements to Whole New Level

Models of fire behavior and effects do not always make accurate predictions, and there is not enough systematically gathered data to validate them. To help advance fire behavior and fire effects model development, the Joint Fire Science Program is helping fund the RxCADRE, which is made up of scientists from the U.S. Forest Service and several universities who orchestrate and collect data on prescribed burns in the southeastern United States. The RxCADRE-prescribed burns are yielding a comprehensive dataset of fire behavior, fire effects, and smoke chemistry and dynamics, with measurements taken systematically at multiple, cascading scales. RxCADRE data will help scientists and modelers test their models and develop better ones, ultimately making models more reliable. The RxCADRE team is pioneering new data-gathering technologies and new approaches to collaborative science.

The two “solitudes” in forest fire research…

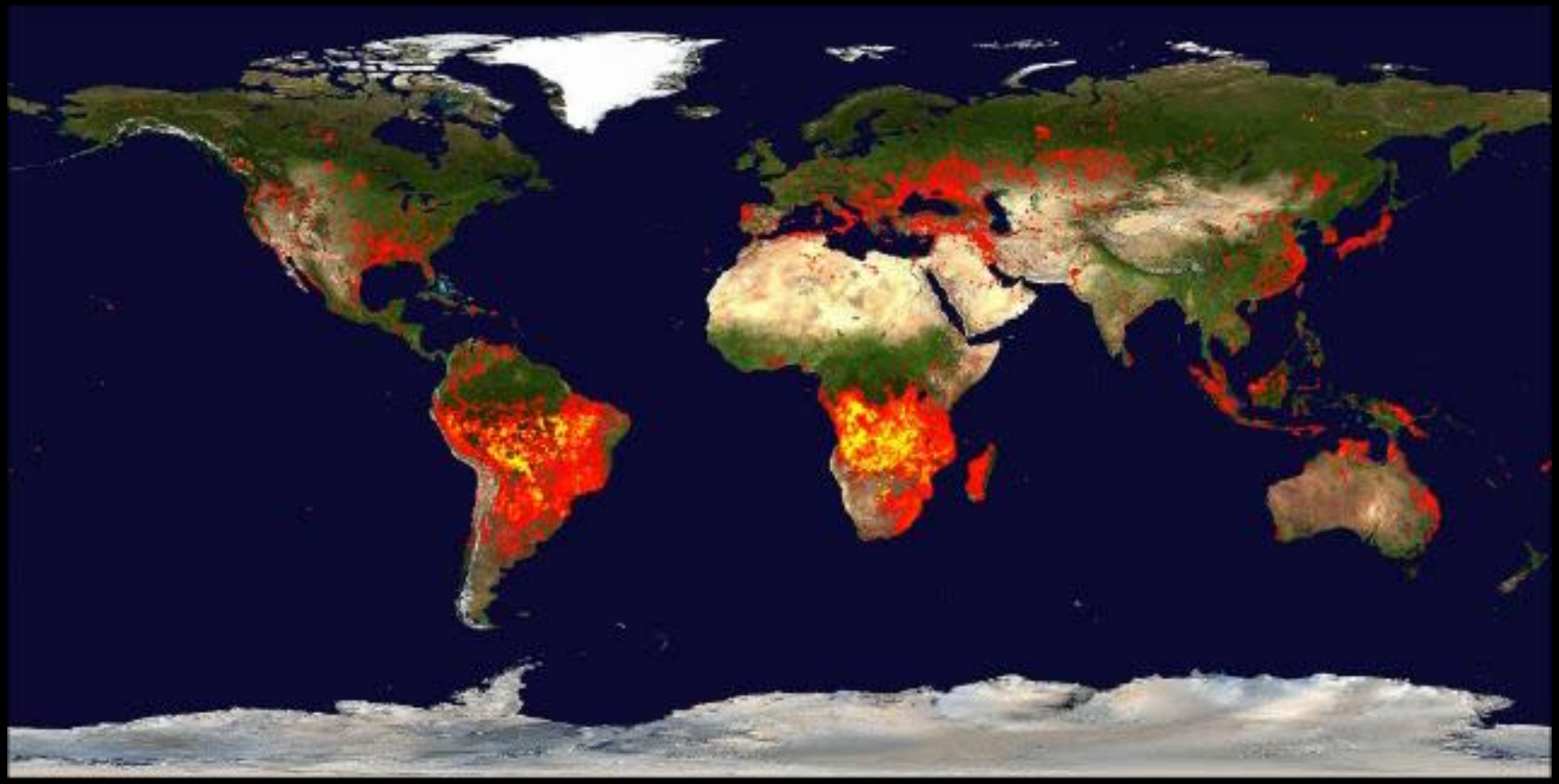




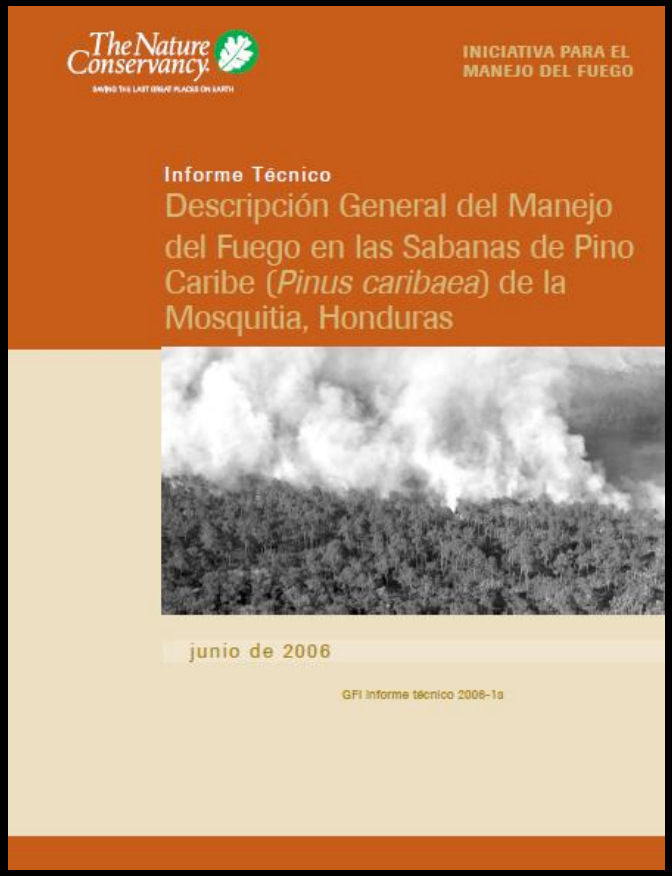

Physical Sciences
Combustion, Heat
Fuels
Foresters, Ecologists
Fire Effects

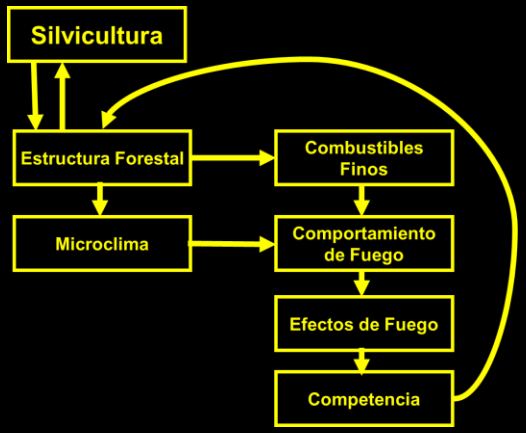
Examples of Collaborations

- Forest Service:
  - Within/Among Stations
  - Among Government Agencies
    - Funded by JFSP, SERDP, ESTCP,
  - State and Private Entities
    - State Management Agencies
    - Universities
    - Private land owners (NGO's)
  - Other Governments

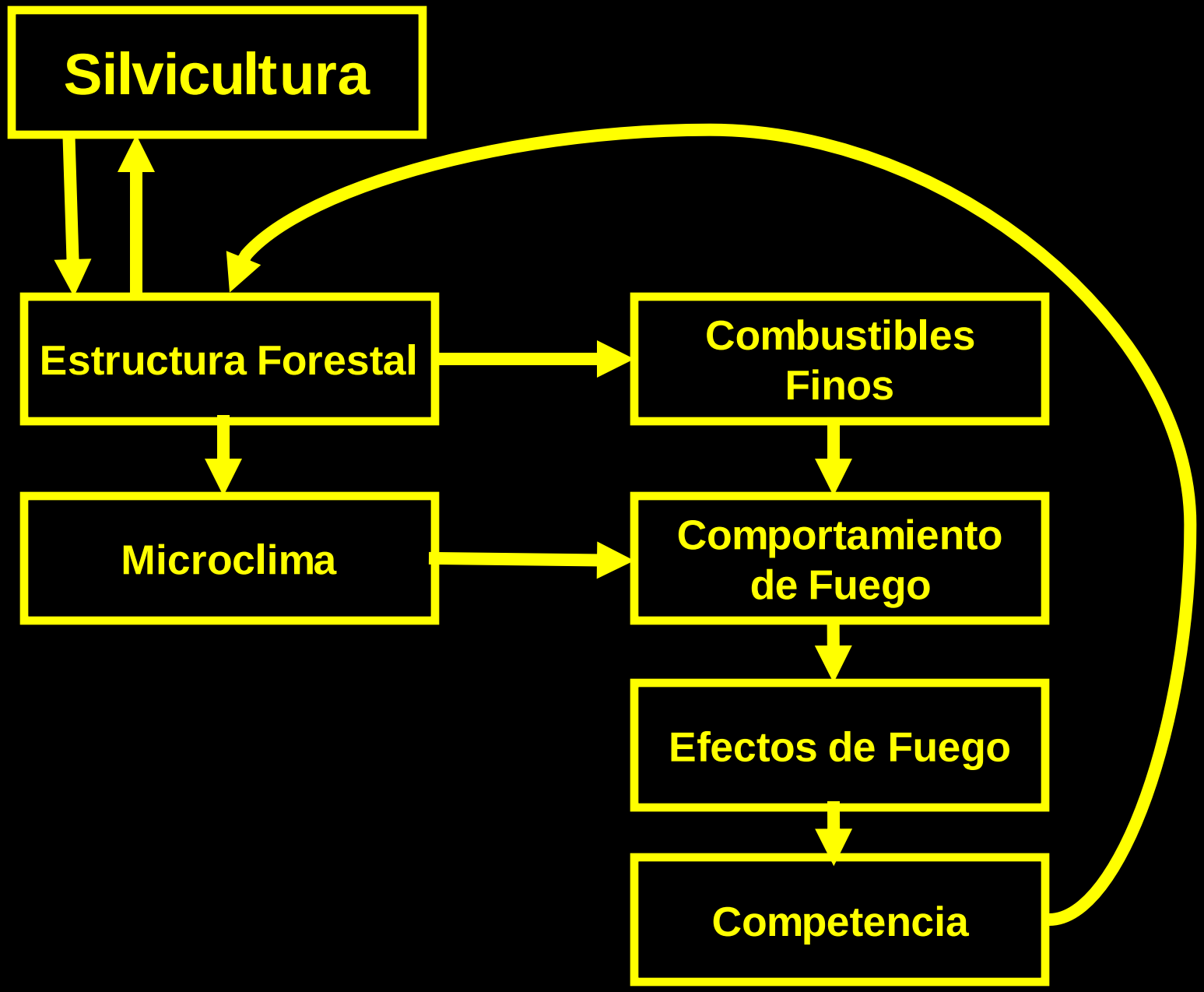


International Outreach



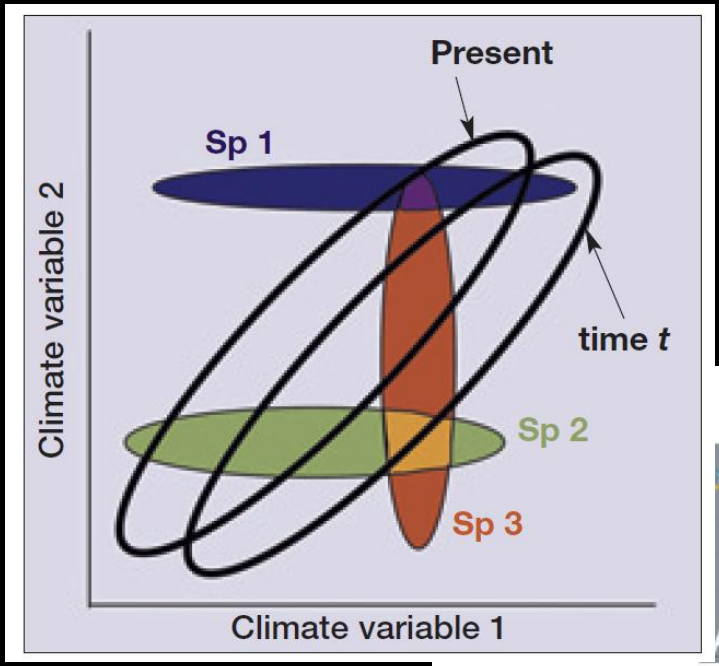


Cita: Myers, R., J. O'Brien y Steven Morrison, Descripción General del Manejo del Fuego en las Sabanas de Pino Caribe (*Pinus caribaea*) de la Mosquitia, Honduras. GFI informe técnico 2006-1a. The Nature Conservancy, Arlington, VA.


Silvicultura
Estructura Forestal
Combustibles Finos
Microclima
Comportamiento de Fuego
Efectos de Fuego
Competencia

Watch Out

No analog future



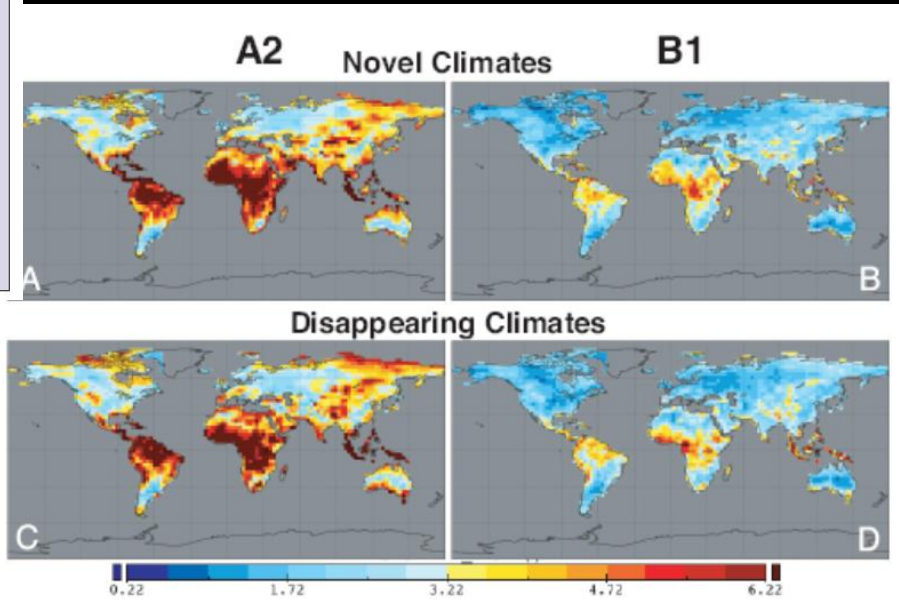


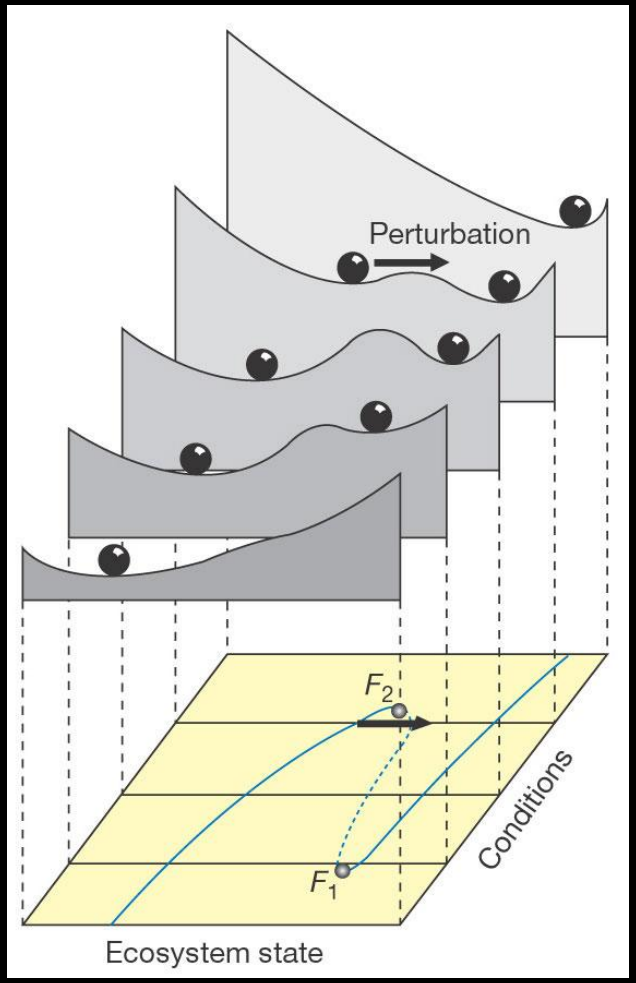
Fig. 3. *A–D* correspond to *C–F* in Fig. 1, except, here, the pool of potential analogs is restricted to gridpoints within 500 km of each target gridpoint. (*A*) SED_{min} between the 21st-century realization for each gridpoint and the set of 20th-century climate realizations (A2 scenario). High dissimilarities indicate risk of regionally novel 21st-century climates. (*B*) As in *A* but for the B1 scenario. (*C*) SED_{min} between the 20th-century realization for each gridpoint and the set of 21st-century climate realizations (A2 scenario). High dissimilarities indicate risk of regionally disappearing 20th-century climates. (*D*) As in *C* but for the B1 scenario.

Rapid and Catastrophic Ecological Change

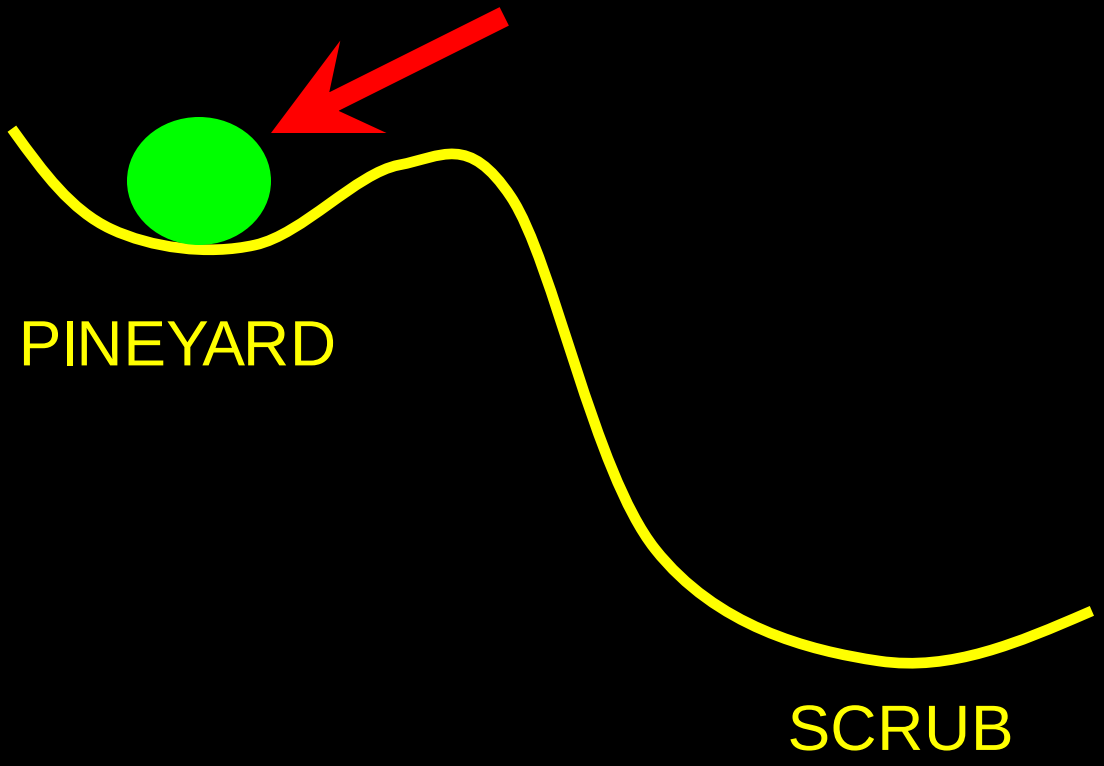
- Interactions among disturbances can have unexpected consequences…

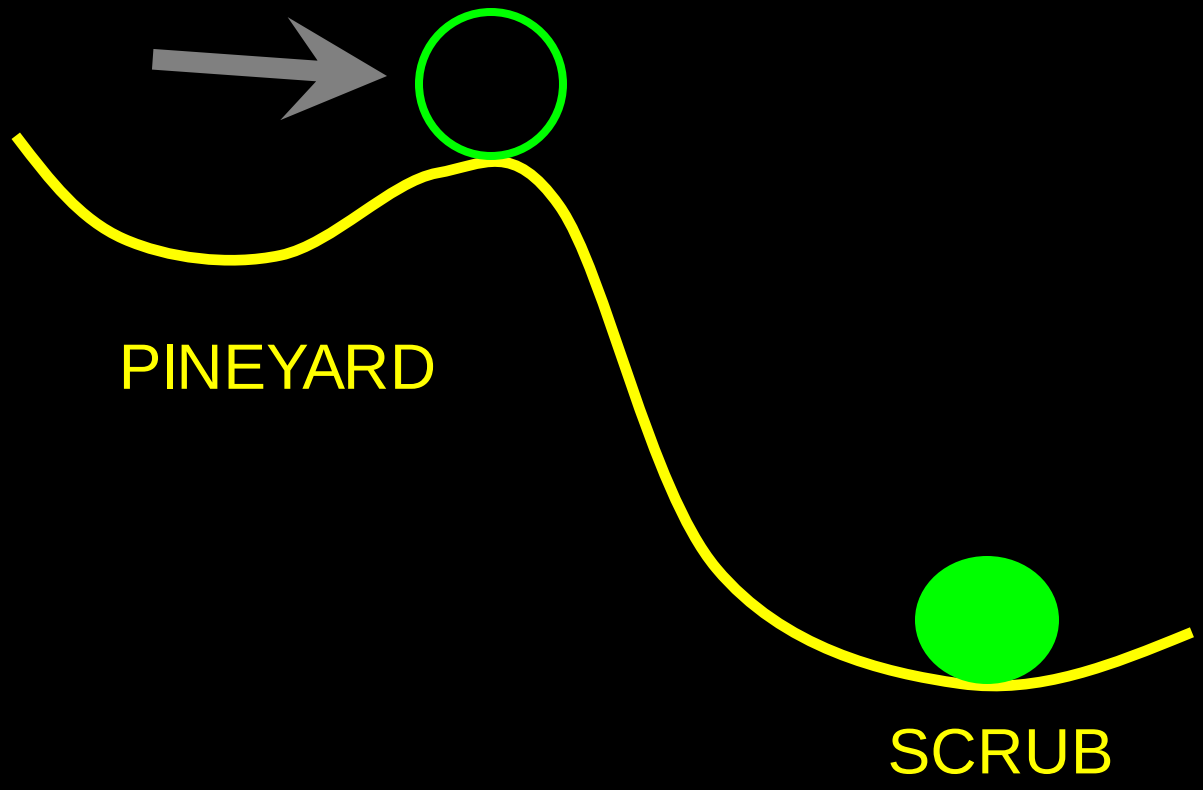
Disturbance and the rising tide: the challenge of biodiversity management on low-island ecosystems
Read More: http://www.esajournals.org/doi/abs/10.1890/070221

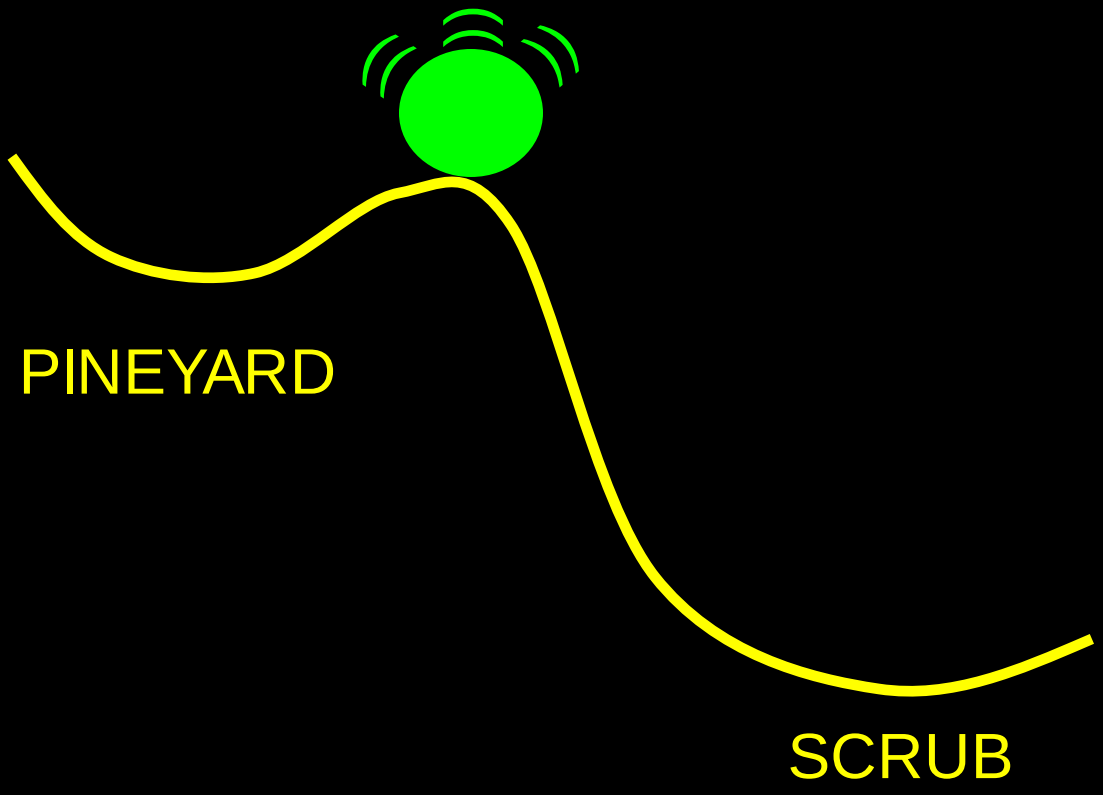
Alternative Stable States



Catastrophic shifts in ecosystems. Marten Scheffer, Steve Carpenter, Jonathan A. Foley, Carl Folke and Brian Walker. Nature 413, 591-596(11 October 2001)


PINEYARD
SCRUB


PINEYARD
SCRUB


PINEYARD
SCRUB

Facing the uncertain future

- Understanding future ranges of variation:
  - The past is no longer prologue…
- Mechanistic understanding
  - Mechanistic models
- Identifying tipping points
  - Providing rapid guidance

The No-Analog Future

- Changes will often be rapid and might require unprecedented or controversial interventions