Impacts of wildfire and climate patterns on vegetation dynamics in the grasslands of the Southwest

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Overview of presentation

→The significance of wildfire, climate and society in the Southwest

- Introduction to vegetation models
- Research questions
- Bringing information to decision-makers, stakeholders and educators

Significance of wildfire, climate and society in the Southwest

- Woody encroachment into grasslands
- Human-caused ignition at urban-wildland interface
- Costs
- Damages
- Land/Fire management
- Climate change/variability

Example : Aspen Fire

Aspen Fire, 2003
Photo from Arizona Daily Star

Factors involved

Climate

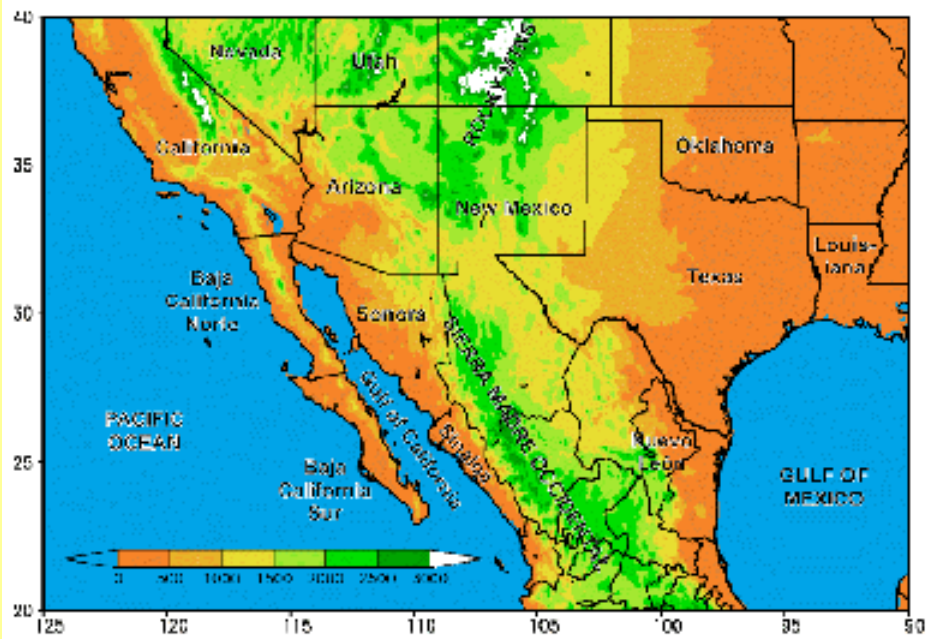
Fire

Society

Aspen Fire, 2003
Photo from Arizona Daily Star

Climate of the Southwest

- Subtropical high-pressure ridge
  - Low precip, clear skies, warm weather
- Proximity to moist air mass sources
  - Pacific Ocean, Gulf of California and Gulf of Mexico
- Seasons: wet & dry
  - Wet = summer and winter
  - Dry = fall and spring
- Climate Forcings
  - El Nino/La Nina shifts
  - Pacific Decadal Oscillation
- Topography
  - Induces spatial variation

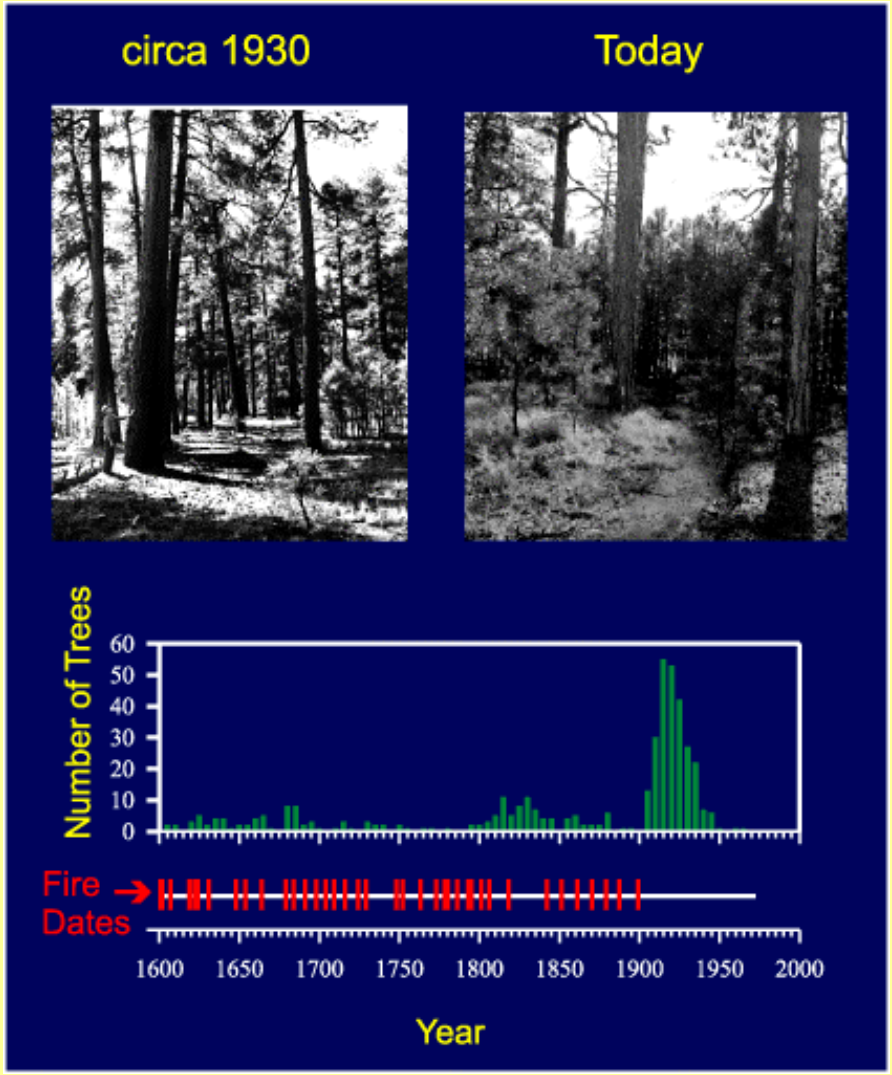


CLIMAS, University of Arizona

Fire History

- 1600-1910:
  - Frequent fires often killed encroaching plants
  - Fire naturally enhanced growth of some perennial grasses
  - Late 1800s: overgrazing-induced suppression of surface fires.

- Abrupt fire regime change:
  - After 1910: active fire suppression, increased fuel loads and fire potential
  - Roads and trails continue to encroach into wilderness; dangerous to homes and wildlands



Tree Ring Laboratory, University of Arizona

Society

- **Wildland-urban interface**
  - Structures and roads
  - Fragmentation of natural ecosystems
- **Management**
  - Fire
  - Agriculture
- **Policy**
  - Fire prevention/fighting
  - Land-use restrictions
  - Wilderness protection

www.colostate.edu/Depts/CSFS/fire/interface

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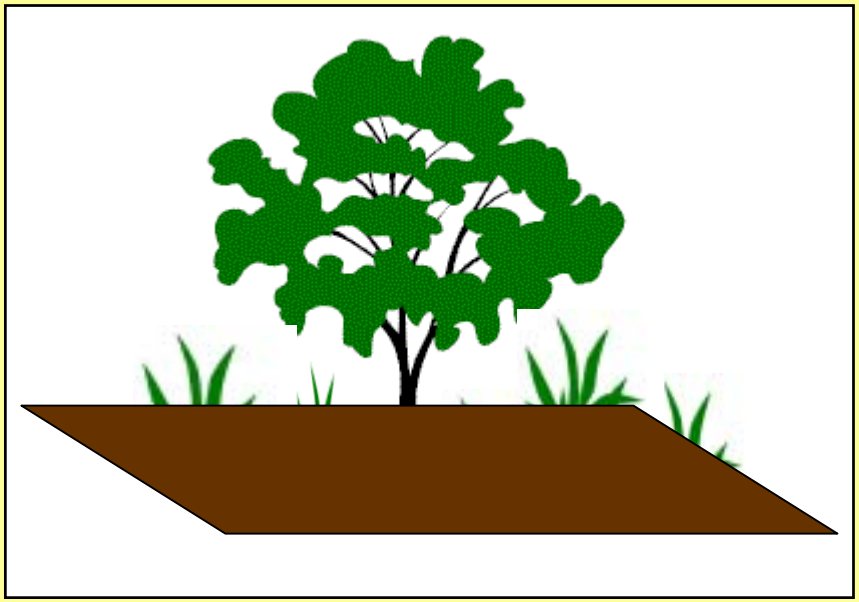
What is a Gap Dynamics Vegetation Model?

Gap model - conceptual model of a forest stand

- "**gap**" - canopy gap created by death of dominant plant
- **Gap-phase regeneration** - continual growth cycle of a forest stand



Plot characteristics:

- size =gap dominant plant makes when it dies
- Horizontally homogeneous
- Vertically heterogeneous

Simulate:

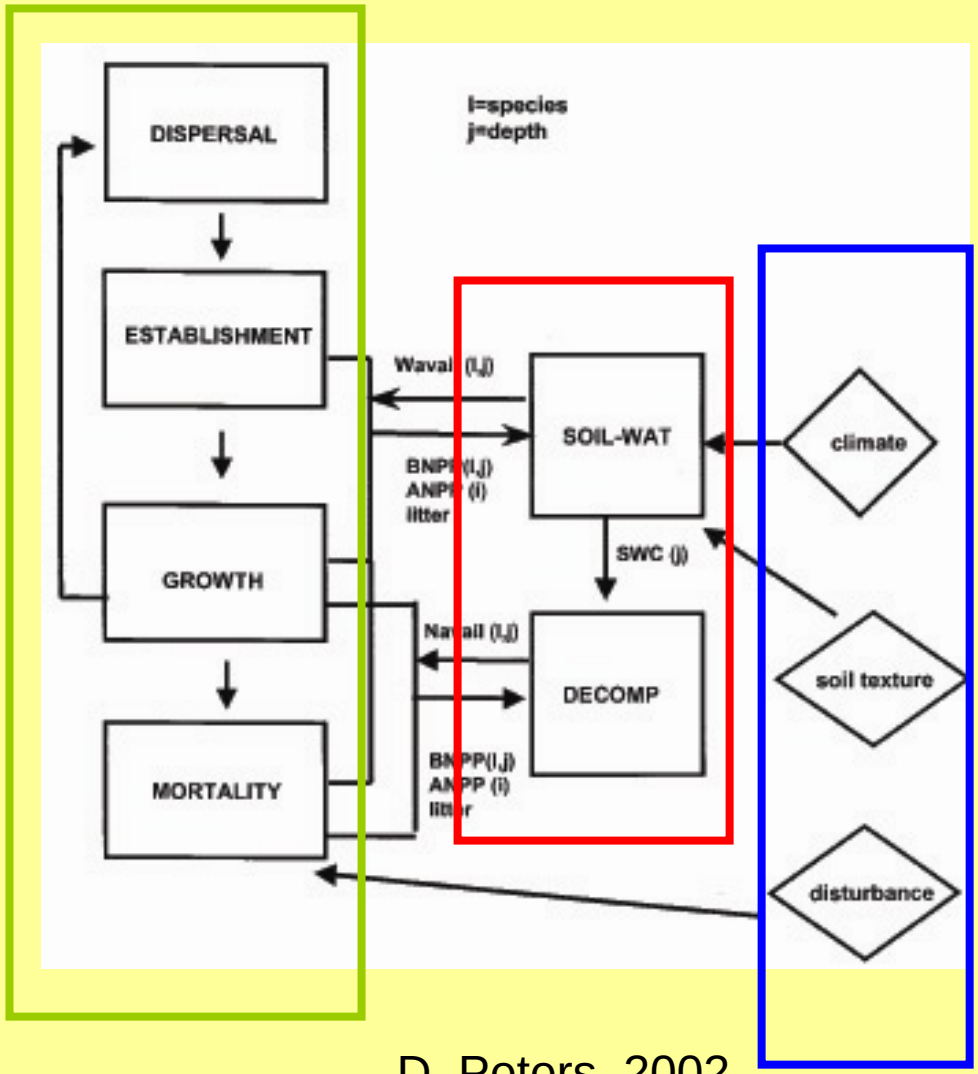
- Seedling establishment
- Annual diameter growth
- Mortality (over multiple generations of tree replacement)

Controls of environment:

- Available light
- Soil moisture and fertility
- Temperature

How does ECOTONE work?

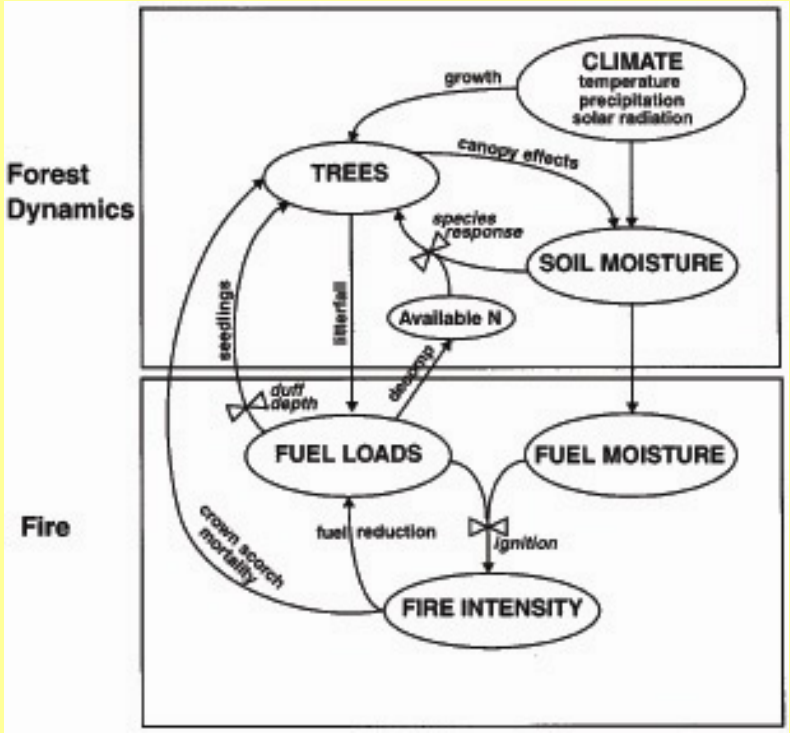
- **Driving variables**: set the base conditions for how the model will simulate different soil and plant processes.
- **Major plant processes**: represent the typical life cycle of plants, where dispersal is a function of plants once they reach a certain maturity.
- **Submodels** of soilwater and nitrogen dynamics allow feedbacks between the major plant processes and the driving variables.



D. Peters, 2002

Adding Fire

- Forest dynamics:
  - Climate
  - Establishment, growth, death, decay
  - Soil moisture
  - Nutrient exchange
- Fire model adds
  - fuel
  - Fuel moisture
  - Fire intensity



C. Miller, 1999

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Research Goals

- **Validate vegetation model for southeast Arizona**
  - Using long-term data from test site in Huachuca mountains

- **Simulate past → future vegetation changes in SW to:**
  - Test the response of vegetation to various climate, fire, grazing and policy scenarios
  - Determine which scenarios cause max/min change
  - Find thresholds of fire frequencies and management strategies that a predicted climate can support

  - Grazing > climate or fire on altering vegetation over time
  - Invasion of certain encroaching species (e.g. creosote, mesquite, black/blue grama)

This summer:

- Fuel mapping in Jemez Mountains in northern New Mexico

- Preparation work for modeling:
  - Collecting historical data for test site in Huachuca Mountains
  - Formatting data to run with the model

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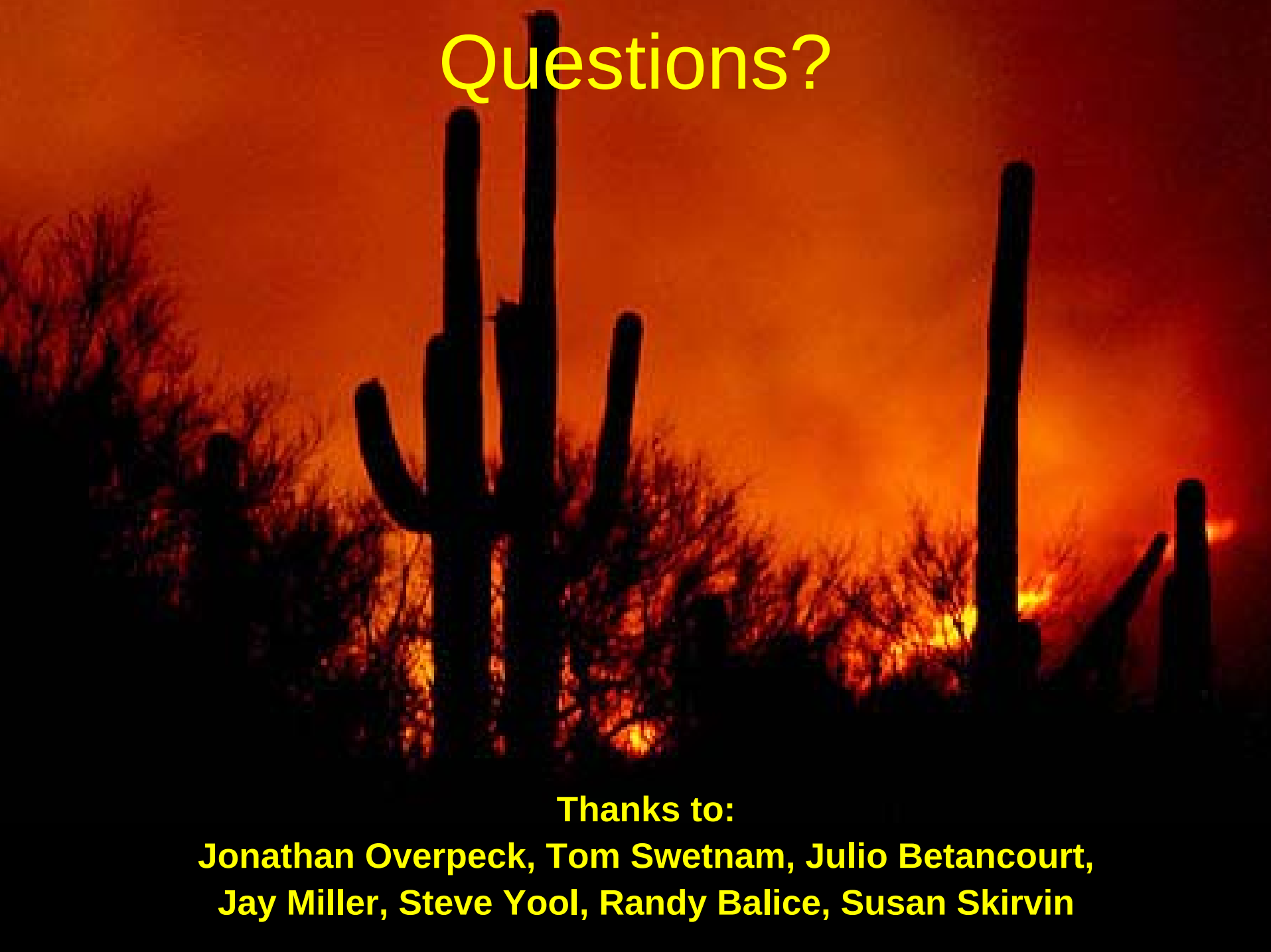
WALTER Research

- What are the **climate and human dimensions of wildfire**, and how do these interact to produce particular types and levels of wildfire and fire hazard?
- How might **climatic changes,** in combination with **changing land-use patterns**, affect forest health, biodiversity, and ecosystem functioning?
- How might **land-use choices** increase or decrease vulnerability of ecosystems to **extreme weather events**?

http://walter.arizona.edu

Exhibit on Wildfire

- Educational **multi-media** display on fire, climate and society
- To be displayed at the **Flandrau Science Center** at the University of Arizona



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