Forest fuels evaluation and fuel treatment planning

for USDA Forest Service and DOI bureaus in 2007

Keith Reynolds, USDA Forest Service, PNW Research Station
Paul Hessburg, USDA Forest Service, PNW Research Station
Bob Keane, USDA Forest Service, RM Research Station
Richard Lasko, USDA Forest Service, Fire and Aviation Mgmt
Erik Christiansen, US Fish & Wildlife Service, Fire Mgmt Branch

Outline

- The context
- Overview of Ecosystem Mgmt Decision Support system
  - ✓ A short history
  - ✓ Basic concepts
- Applications in forest and rangeland fuels for 2007
  - ✓ USDA Forest Service, national and regional analyses
  - ✓ DOI bureaus
  - ✓ Experiences thus far
- The future

The context

- Dissatisfaction (both internally and externally) with process used by federal resource agencies for allocating budgets for hazardous fuels reduction.
  - ✓ Common perception that the agency does not prioritize and allocate funding according to the most critical needs.
- OIG Draft Report - Healthy Forests Initiative Audit No. 08601-6-At. Key criticisms include:
  - ✓ Lack of a transparent and repeatable process for budget allocation.
  - ✓ Lack of a standardized system for characterizing fire danger and socio-economic values at risk.

Version history of EMDS

- Version 1
  - 1997, USFS Research, Northwest Forest Plan
- Version 2
  - 1998, USFS Research, EPA OR&D, USFS EM (WO)
- Version 3
  - 2002, v3.02, Natural Resource Information System (WO)
  - 2004, v3.1, EMDS consortium (Redlands Institute)
  - 2007, v3.2, EMDS consortium (Redlands Institute)
- Version 4
  - 2008, v4.0, EMDS consortium (Redlands Institute)

EMDS development consortium

- PNW Station
  - ✓ System design & project oversight
- Redlands Institute (University of Redlands)
  - ✓ EMDS stewards and ArcGIS implementation
- Rules of Thumb, Inc.
  - ✓ NetWeaver logic engine
- InfoHarvest, Inc.
  - ✓ Priority Analyst engine

Design objectives

1. Improve the efficiency with which landscape evaluation is conducted
   a) Optimize use of information
2. Improve the quality of evaluation products
   a) More comprehensive analysis
   b) Better integration of diverse topics
3. Integrated support for planning

Integrated evaluation and planning

- Evaluation within scale
  - ✓ Concurrent evaluation of possibly numerous states and processes within a single analysis
- Across scale
  - ✓ Explicit linkage of evaluations across spatial scales
  - ✓ Comparing evaluations over time
- Across phases of adaptive management
  - ✓ Going from landscape evaluation to planning

Version 4.0 implementation

- EMDS 4.0 is an ArcMap extension (ArcGIS 9.2+)
- Microsoft Windows XP
  - Microsoft .Net
- Major components
  - **Logic engine** for logic-based evaluation of landscape condition
  - **Priority Analyst** for priority setting in planning

Logic models

- A form of meta database
- A formal logical representation of how to evaluate information
- Networks of interrelated topics
  - Mental map

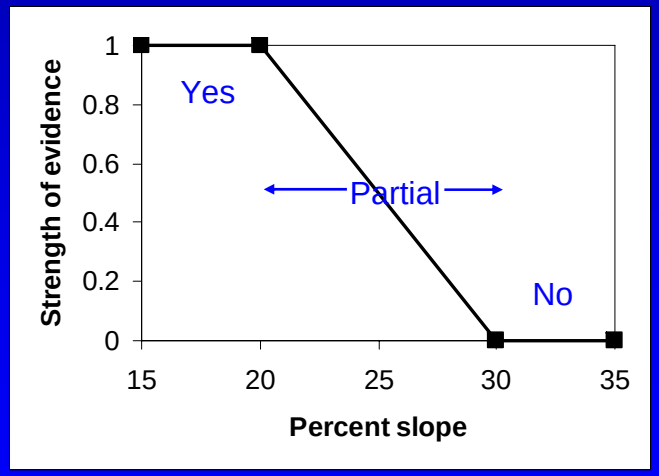
Logic models: forms of uncertainty

- Probabilistic uncertainty
  - ✓ Uncertainty of events
- Linguistic uncertainty
  - ✓ Uncertainty about the definition of events
    - Vagueness or imprecision
  - ✓ A proposition is the smallest unit of thought to which one can assign a measure of truth (strength of evidence)
  - ✓ SE: a measure that quantifies the degree of support for a proposition provided by its premises

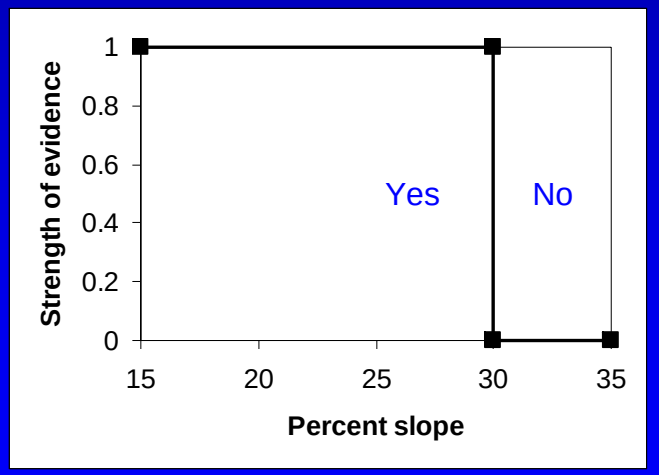
Logic models: strength of evidence

An example: strength of evidence for suitable slope for tractor logging.

Degrees of support



Bivalent reasoning



Decision models

- Summary of logic-based evaluation of wildfire potential is carried into decision model
- This model considers additional factors
  - Logistical, economic, consequences, opportunities, etc.
- EMDS uses
  - the analytic hierarchy process to help users develop weights for decision criteria
  - the simple multi-attribute rating technique to evaluate attributes of alternatives (e.g., landscape elements)

Fuels evaluation and budget priorities for USDA FS Regions and Forests and DOI bureaus

- USDA Forest Service
  - ✓ Data to evaluate wildfire potential was summarized to each National Forest
  - ✓ Forest evaluations were summarized to Regions
  - ✓ Decision models prioritize Regions and Forests for budget allocation
- DOI
  - ✓ Data for evaluating wildfire potential is summarized to each Bureau
  - ✓ Decision model prioritizes bureaus for budget allocation

Data to evaluate wildfire potential

Topic	Datum	Source
Fire behavior	Crown fire potential	Missoula FSL
	Surface fire intensity	Missoula FSL
	Fuels and weather	Missoula FSL
Probability	Length of fire season	Missoula FSL
	Number of large fires	BLM, Boise
	Problem fire days	Missoula FSL
	Total fire starts	BLM, Boise

All data obtained as, or converted to, 1-km grids.

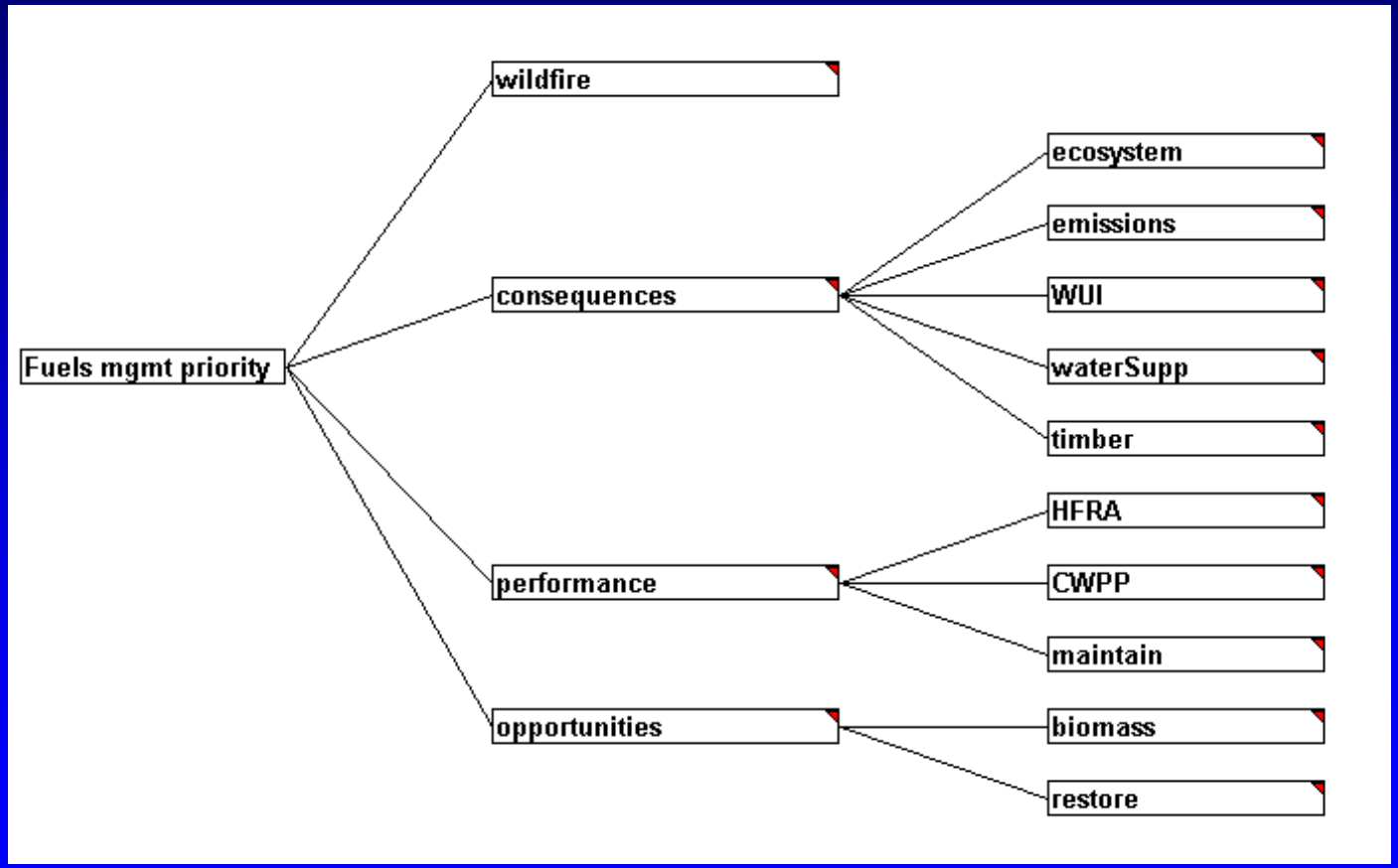
Data sources for decision model

Datum	Source
Biomass opportunity	RSAC
Ecosystem health	Missoula
Emissions	Missoula
CWPP	WO
HFRA	WO

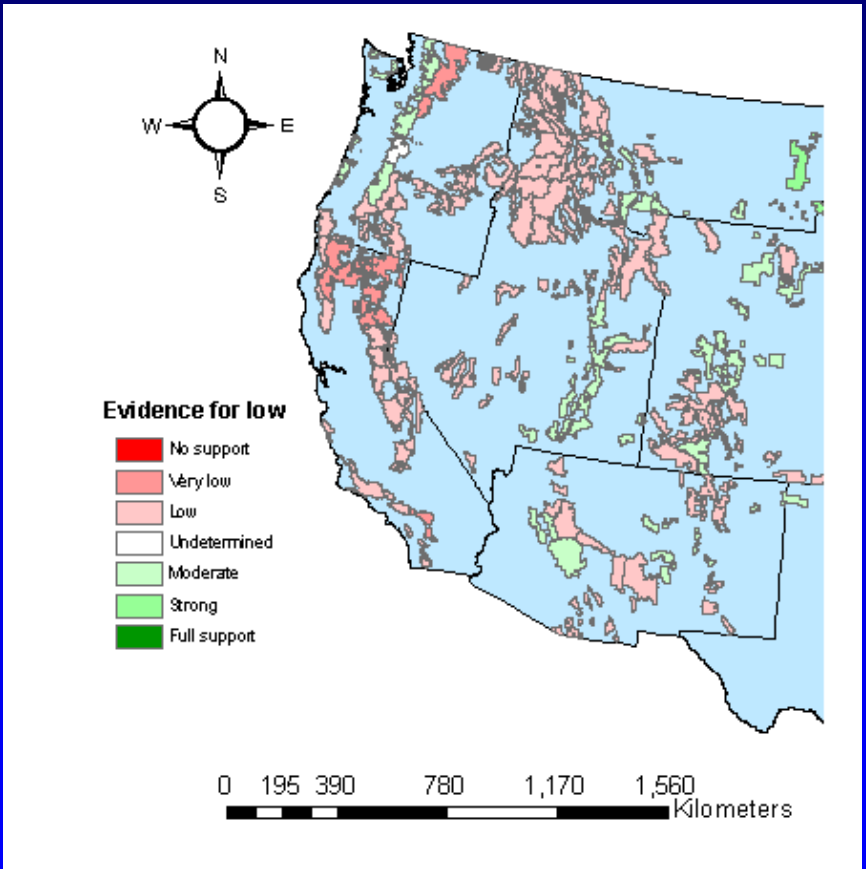
Datum	Source
Timber values	WO
Vegetation maintenance	Missoula
Vegetation restoration	Missoula
Water supply	EPA
WUI	UW

Most data obtained as, or converted to, 1-km grids.

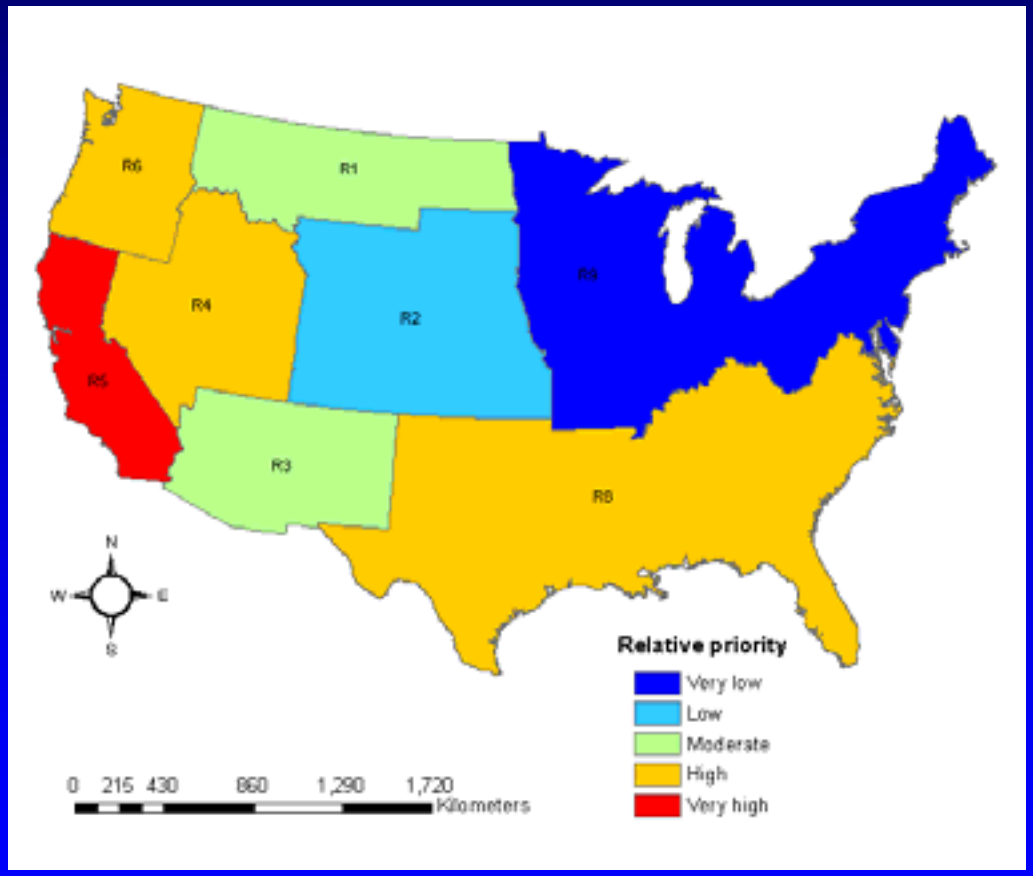
USDA Forest Service decision model



Wildfire potential in western National Forests



Priorities for USFS Regions



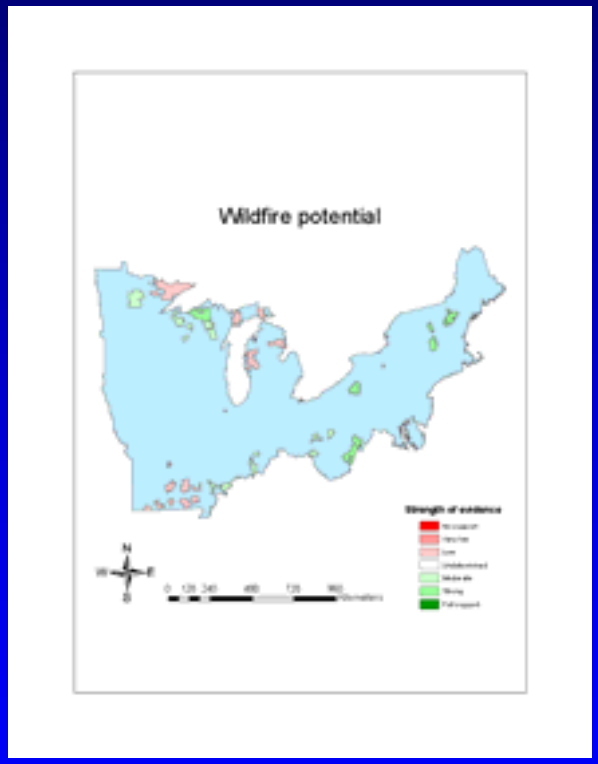
Wildfire potential vs. Regional priorities

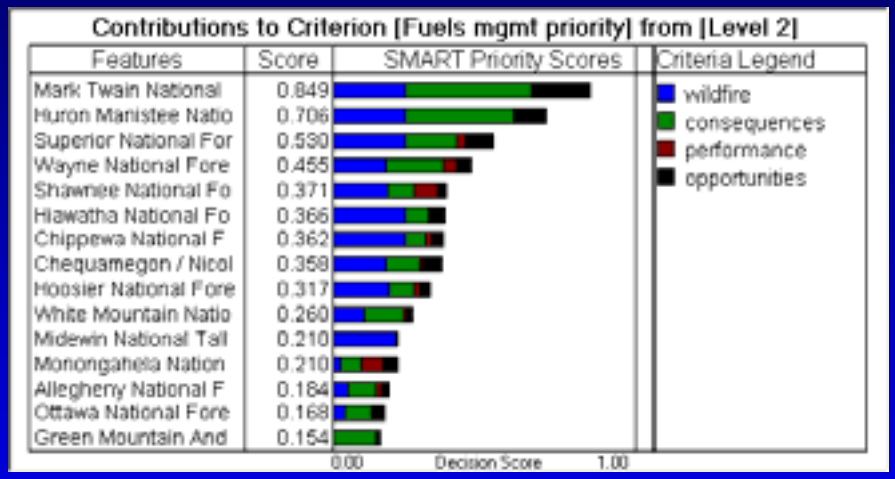
Regions with the highest wildfire potential are not necessarily the highest priority.

Priorities can be strongly influenced by the other factors in the decision model.

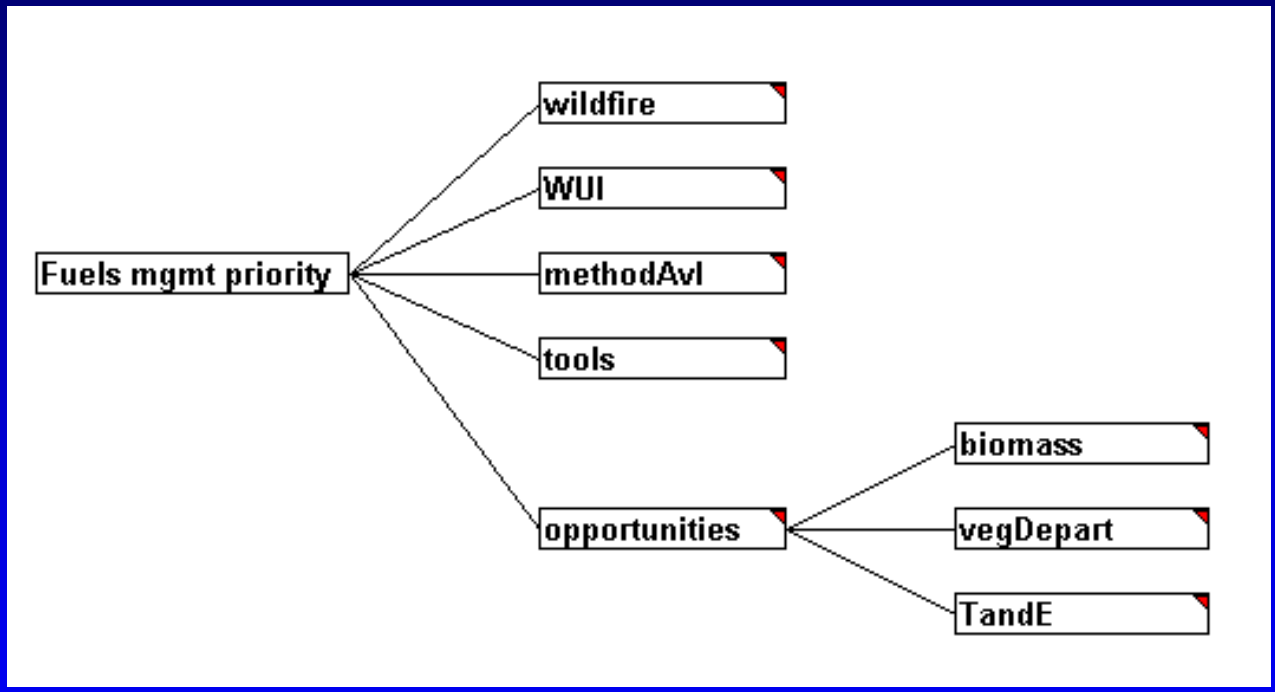
Region	WF pot	Priority
1	5	5
2	6	7
3	4	6
4	3	3
5	1	1
6	3	4
8	7	2
9	8	8

Within-Region analyses – Northeast example

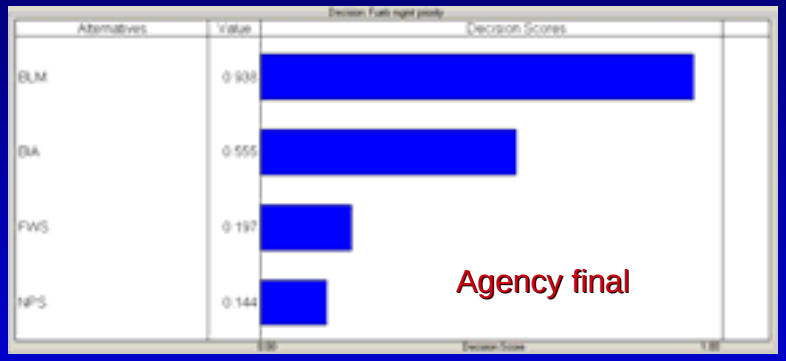


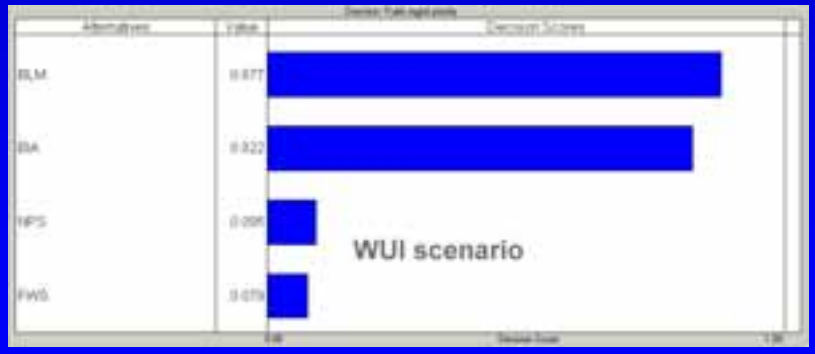


DOI 2007 decision model



DOI Alternatives





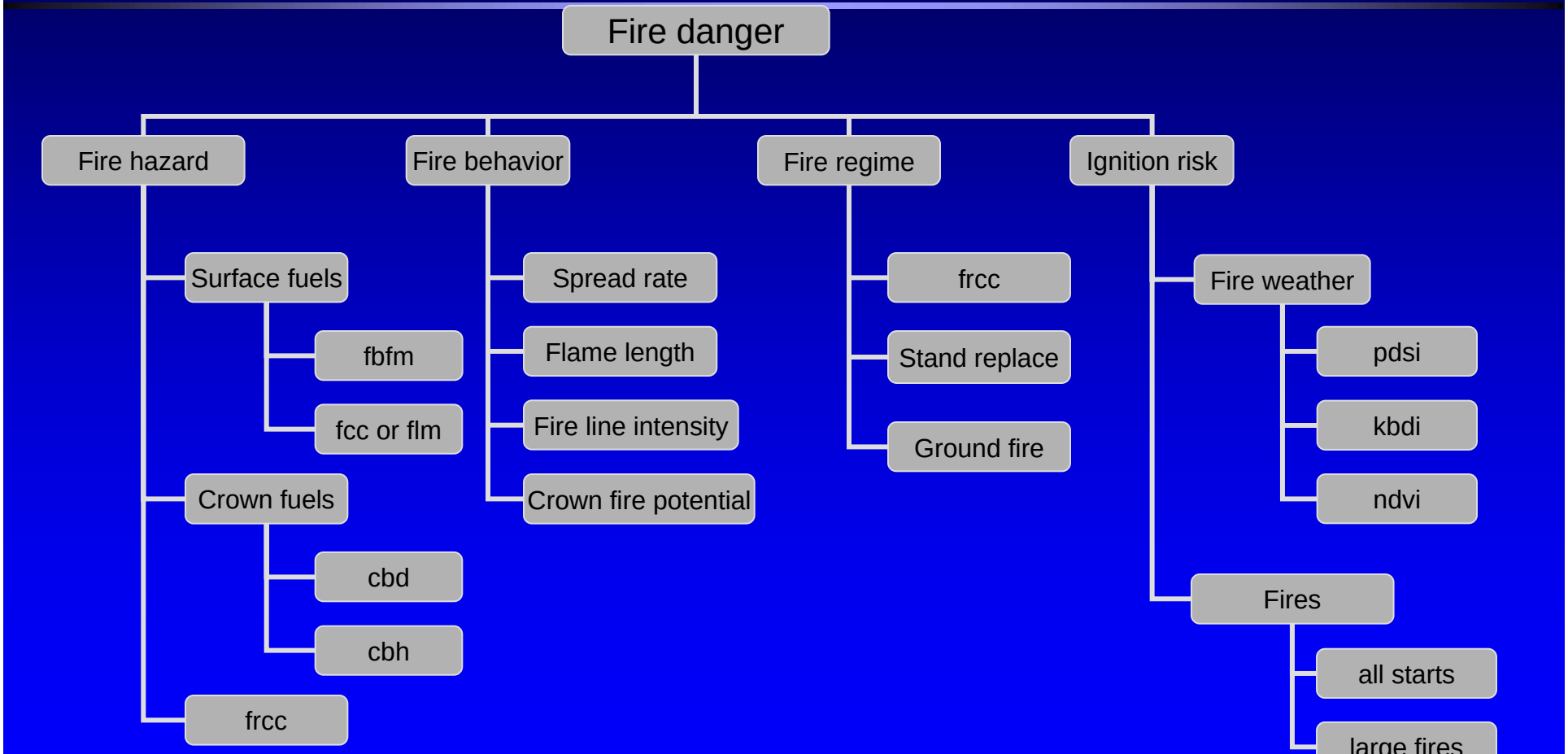
The 2007 experience

- A few bumps and warts
  - ✓ Logic had to be highly simplified for existing data
  - ✓ Questionable data layers
- But the FY07 analyses met a basic need
  - ✓ Rational and transparent models
  - ✓ Positive review from GAO, Congressional staff, and agency fuels manager at various levels
  - ✓ Common system between USDA and DOI

The future …

- More comprehensive evaluation of wildfire potential based on LANDFIRE data
- Ramping up to the continental US
  - Logistics are a major issue
- Better integration across all natural resource agencies

A more advanced logic

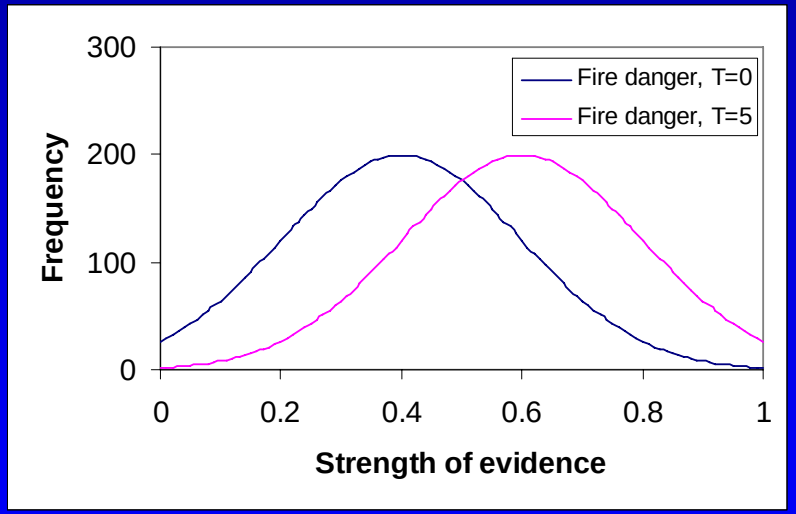


A single unified model for planning

1. Assess current condition
   - ✓ Context for planning (where are we starting from?)
2. Evaluate alternative strategies
   - ✓ A framework for synthesizing results of projections
   - ✓ Harvest scheduling, vegetation modeling, etc.
3. Priority analysis for more tactical decisions
   - ➢ Which activities to do where?
4. Evaluate plan implementation
   - ➢ How well is the plan working?

Outputs versus outcomes

- Change in performance standards of federal agencies
  - ✓ Old (outputs): acres treated per year
  - ✓ New (outcomes): acres of reduced fire danger per year
- New planning rule and EMS
- Adaptive management (ISO 14001)
  - ✓ Hypothesis testing
  - ✓ Shift in distribution of outcomes?



Contact information

- Phone: +01-541-750-7434
- Email: kreynolds@fs.fed.us
- Website: http://www.institute.redlands.edu/emds/