Welcome

Bulkley Morice Wildfire Resilience Project – Workshop 2

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Why you're here

- Representative of governments and interests in the area
- Land managers
- Project success relies on your input

"Identify the range of wildfire problems and opportunities that land managers are concerned about…"

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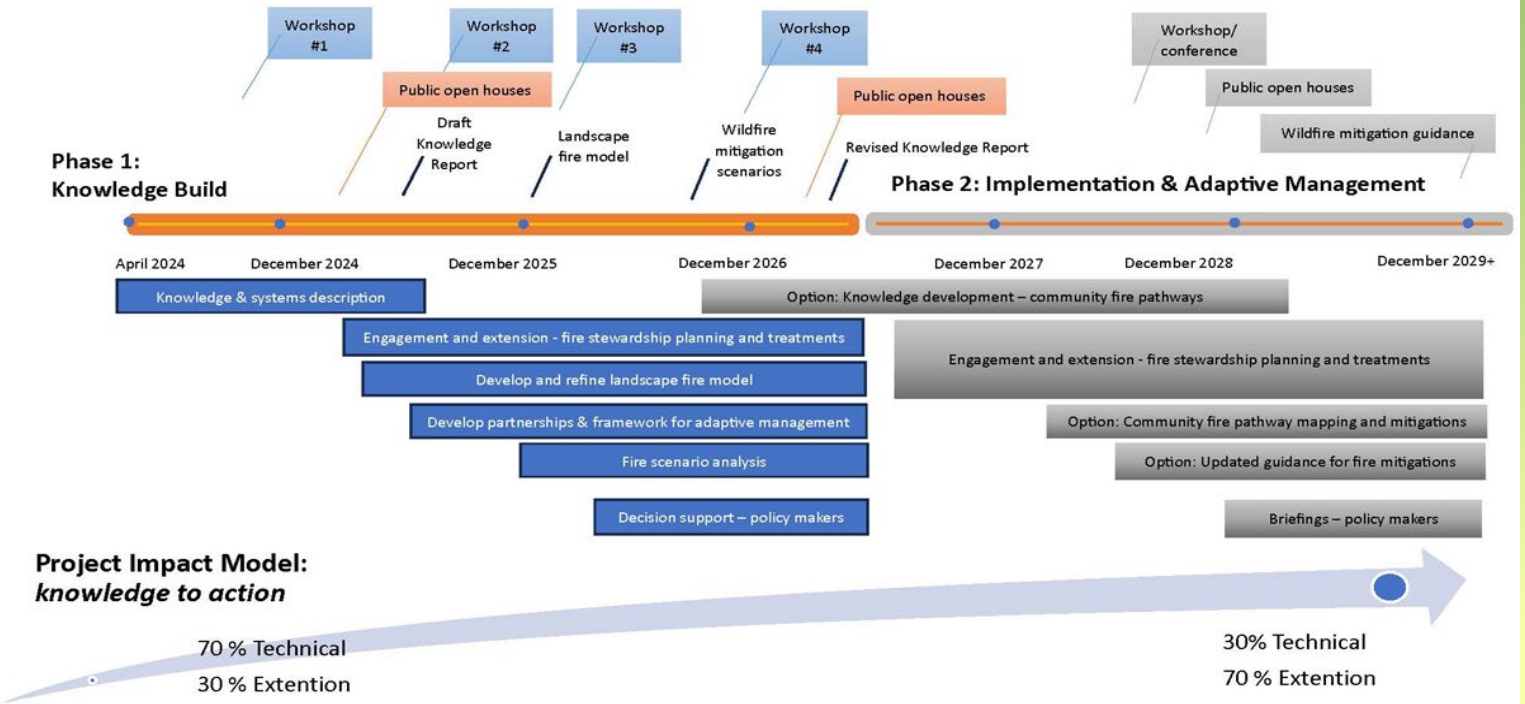
Project timeline and phases 2024 – 2030



Agenda

8:30-8:50 am	Welcome and introductions
8:50-10:15 am	Knowledge foundation – *Presentation and group discussion*
10:15-10:35 am	Break
10:35-11:15 am	Group discussion in response to the presentation
11:15-12:00 am	Explore solutions – *Model presentation* a. How models can help decision makers.
12:00-1:00 pm	Lunch
1:00-2:40 pm	Explore solutions - *Presentations and small group discussion* a. Assessing wildfire hazard at the landscape scale b. Assessing resilience
2:40-3:30 pm	Break
3:00-4:00 pm	Building blocks for the BuMo model - *Presentation and group discussion* a. What the modelling team needs b. What questions need to be answered?
4:00-4:30 pm	Steering committee direction a. Round table to hear from each participant
4:30-4:40 pm	Wrap up, next steps, fall workshop

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Introductions

- Name
- Who you represent
- The top thing on your mind about the wildfire problem

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Knowledge Foundation

Based on the project knowledge, a summary of what we understand about the fire regime and the key issues that arise

Part 1 – fire regime
Part 2 – risk and mitgation

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The Wildfire Problem

- What is wildfire resilience?
- Building our knowledge base
- Understanding wildfire
  - Wildfire risk to communities
  - Wildfire risk to ecosystems
  - Mitigations
- Management questions

Wildfire Resilience - what is it?

Ability of a system (ecosystems + communities) to react to perturbations, internal failures, and environmental events by absorbing the disturbance and/or reorganizing to maintain its functions……..

Simpler definition (from ChatGPT): Wildfire resilience is the ability of communities, ecosystems, and individuals to prepare for, withstand, and recover from wildfires.

It means minimizing damage, staying safe during a fire, and bouncing back quickly afterward. This includes actions like creating defensible space around homes, planning evacuation routes, and restoring damaged environments.

Resilience: Two dimensions

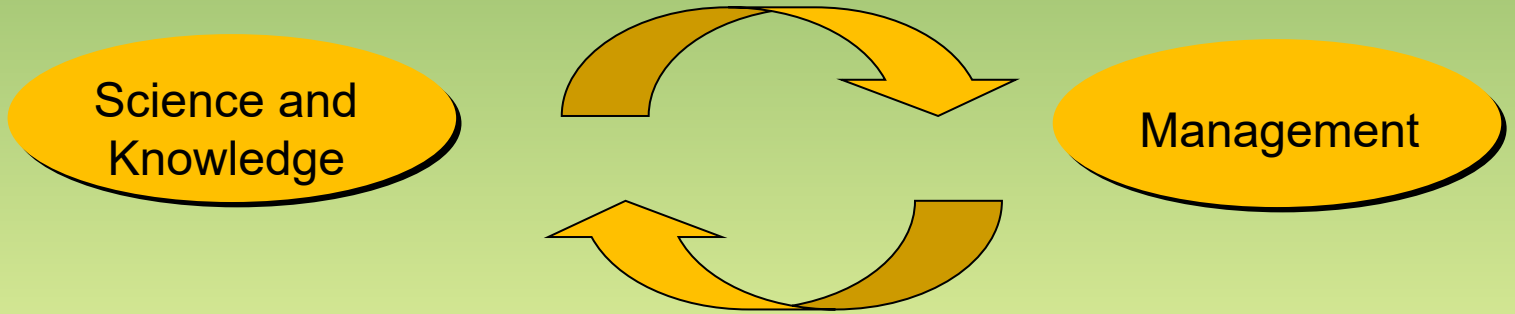
Community dimension

- Minimizing damage from wildfires to safety, property, and important ecosystem services such as water or timber.

Ecological dimension

- Maintaining the ability of the ecosystem to recover from wildfire or to transition to a new acceptable state..

Knowledge informs management



- *Knowledge: about the system*
- *Management: identifies values, risk tolerance, and preferred solutions*

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Building our Knowledge Base

Knowledge Report

- The fire regime
- Fire behaviour
- Fire effects
- Climate change

Understanding wildfire

- Proactive fire
- Stand-level fuel management
- Landscape-level fuel management
- Forest Practices

Understanding mitigations and management

Knowledge report

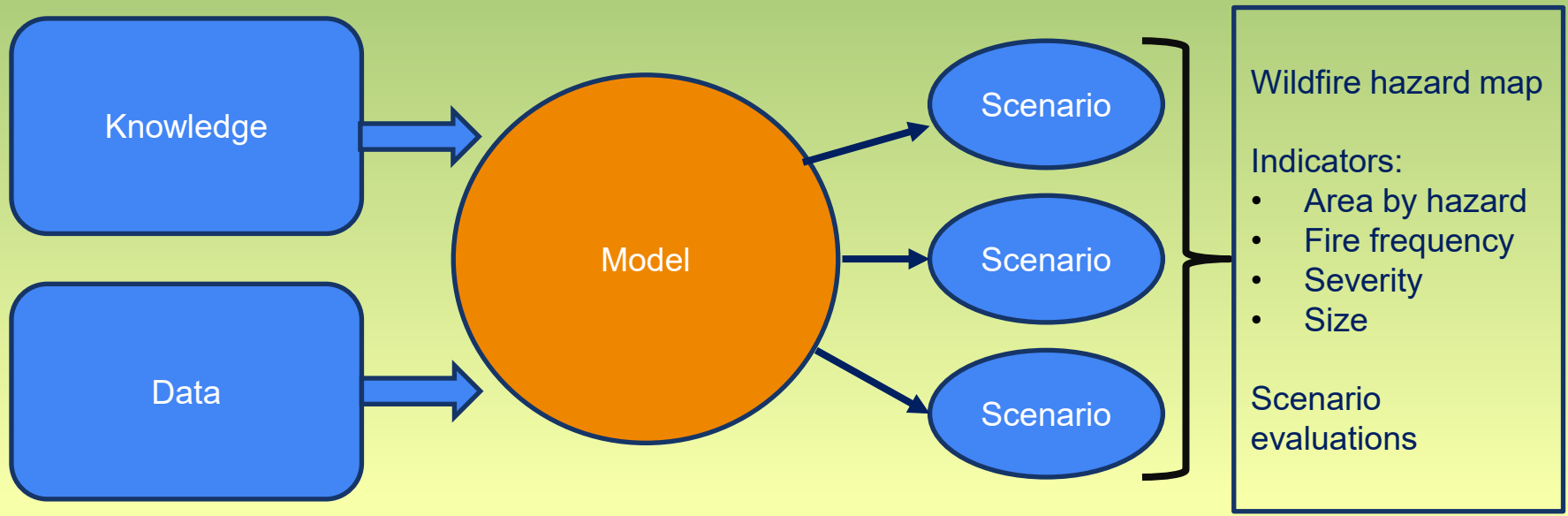
Each chapter will include:

- What is generally known and how it applies to our ecosystems
- Major uncertainties and knowledge gaps

The knowledge report is the basis for the landscape fire model

- V1: partially complete
- Peer review required
- V2: 2027

Linking knowledge and management through scenarios



Understanding wildfire

Summary:

Fire regime: We have a first approximation of the historical fire regime

- Three distinct fire regimes: dry, moist and wet
- Even with recent wildfires, we are in a fire deficit (in most areas?)
  - Absence of Indigenous -driven fires
  - Suppression effects
- Major gaps: Indigenous fire stewardship and measures of historical regimes
- TBD: future fire regime

Fire behaviour : It's very messy due to the complexity of the system. Don't expect perfection, learn to live with noise

- Unique contribution of the mountain pine beetle.

Understanding wildfire

Fire effects: Good information at the level of **principles**

- **Fire severity** drives fire effects

Climate change: A significant increase in fire is expected

- But…It's difficult to downscale climate models,
- Uncertainty around elements like precipitation
  - Will some ecosystems become wetter or drier?
- How will fire weather change with a changing climate?
- Uncertainty means we have to examine scenarios.

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Key issue: climate versus fuel -driven

Climate -driven; the type of climate limits the amount of fire weather, which drives wildfire.

- The amount of fuel on the landscape would support wildfire, but it only burns in rare weather events.
- Infrequent climate patterns create conditions for large, high -severity wildfires
  - Pacific decadal oscillation?
- Boreal forests are more climate -driven

Fuel-driven; the weather frequently supports burning , but the amount and distribution of fuel limit wildfires.

- Dry forests are more fuel -driven.

Understanding wildfire

Why does this matter?

- If a fire regime is more climate-driven, then fuel treatments will be less effective compared to fuel-driven systems.
- Periodic climate events swamp the system.

The fire regime in the Bulkley Morice appears to be somewhat climate-driven, but there are likely fuel controls as well.

If it's a mix of both, **then fuel treatments can exert some influence over fire behaviour,** but not as strongly as in fuel-driven systems.

Extreme Fire Weather

Extreme fire weather drives larger fires and more intense fires

Factors:

- Drought
- Low humidity
- Strong winds

Climate change increases how often extreme fire weather will occur, e.g., the 2021 heat dome

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Fast fire

Fire speed drives catastrophic losses

- Fast fires are more dangerous and destructive than mega -fires
- Little time to evacuate
- Suppression is overwhelmed

Factors:

- Strong winds

Balch et al (2024):*"These fires accounted for 78% of structures destroyed and 61% of suppression costs ($18.9 billion). From 2001 to 2020, the average peak daily growth rate for these fires more than doubled (+249% relative to 2001) in the Western US".*

"Understanding fast fires is crucial for improving firefighting strategies and community preparedness."

The future of wildfire?

- More fire?
  - Most areas are still in a fire deficit, but will that change?
- More large fires?
  - Large fires are part of the ecosystem, but are they getting more common or larger?
- More severe fire?
  - Stand replacing, high severity fire is part of the ecosystem; is it becoming more common?
  - Is it a problem?
- Faster fire?
  - Are fires moving faster due to weather and fuels?

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Fire regime themes:

Climate vs fuel -driven
Climate change and wildfire
Extreme fire weather
Fast fire
The future of wildfire

Questions

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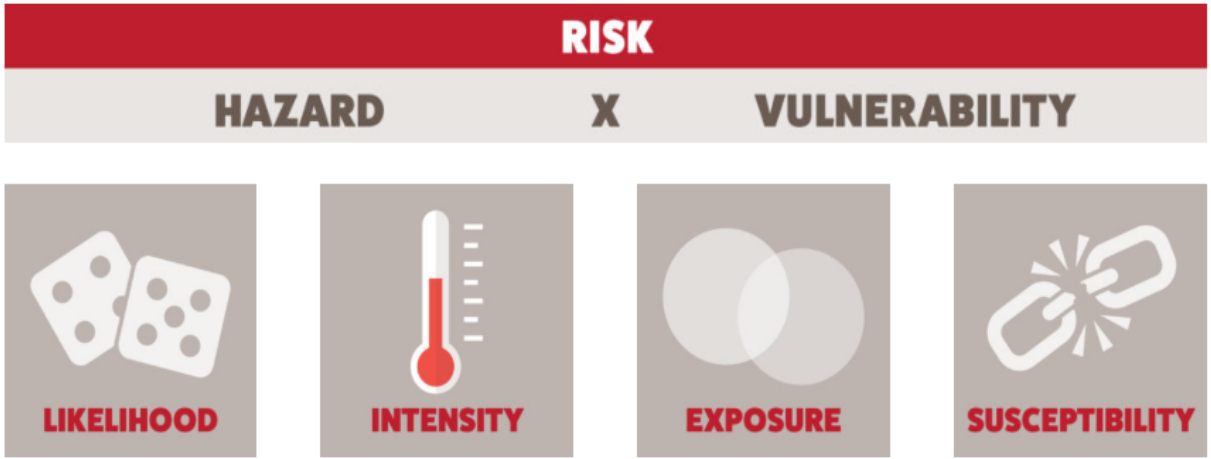
What is wildfire risk?

A community's wildfire risk is the combination of likelihood and intensity (together called "hazard") and exposure and susceptibility (together called "vulnerability").



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Wildfire Hazard

Hazard is about the fire itself:

- What is the chance that a wildfire will occur here?
- How intense will a fire be?
- Intensity formula. $FI = H \times w \times r$
  - FI = Fire Intensity
  - H = heat of combustion
  - w = fuel consumed
  - r = rate of spread

Vulnerability

- Vulnerability is about the values of concern
- Vulnerability = Exposure x Susceptibility
  - Exposure: Will the value encounter a fire?
    - Wildland Urban Interface is a way to determine if fires are likely to approach a community.
  - Susceptibility: How likely is the value to be damaged?
- Example: Earthquakes

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Provincial Strategic Threat Assessment

- Combines hazard with exposure.
- *Does not* look at susceptibility.
- FireSmart is designed to reduce susceptibility.
  - "values out".
- Home hardening and defensible space are more effective at reducing property losses than other treatments.
- However, you can still reduce risk by reducing hazards.
- Use a "multi-barrier approach".

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Assessing wildfire risk to ecosystems

Departure from the historic disturbance regime

- Assumption: The further the fire regime is from the historical regime, the greater the risk to ecosystem resilience.
- Indicator: Fire return interval
- Indicator: Proportion of high severity fire

The historical regime is only one reference point

The project will also bring in future climate analogues

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What are effective mitigations?

- Mitigations in the forest:
  - Fuel treatment
    - Stand level
    - Landscape level
  - Beneficial Fire
  - Forest Practices
  - Land Use
- Much research is from the US dry forests.
  - Principles may apply
  - Uncertainty about how effective dry forest practices will be in the sub -boreal forest
    - E.g., stocking standards based on low density may not be appropriate.
- Stand-level fuel management chapter will identify principles, emerging best practices, and gaps

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What are effective mitigations?

- High level of uncertainty because:
  - We don’t have many examples of fire encountering treatments.
  - The system is complex
  - Climate change
- **We will have to manage with uncertainty:**
  - Identify practices most likely to work (no guarantees)
    - Based on best available information, modelling, and expert judgement
  - Try different things. Active adaptive management
  - Monitor and adjust

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Fuel Treatment Effectiveness

Fuel treatments have different objectives

- Reduce crown fires and spotting
- Reduce surface fire intensity
- Support suppression

Fuel treatments don't "stop" fires

Lots of evidence of fuel treatment changing fire behaviour and effects

However less effective under certain conditions

Beverly et al:

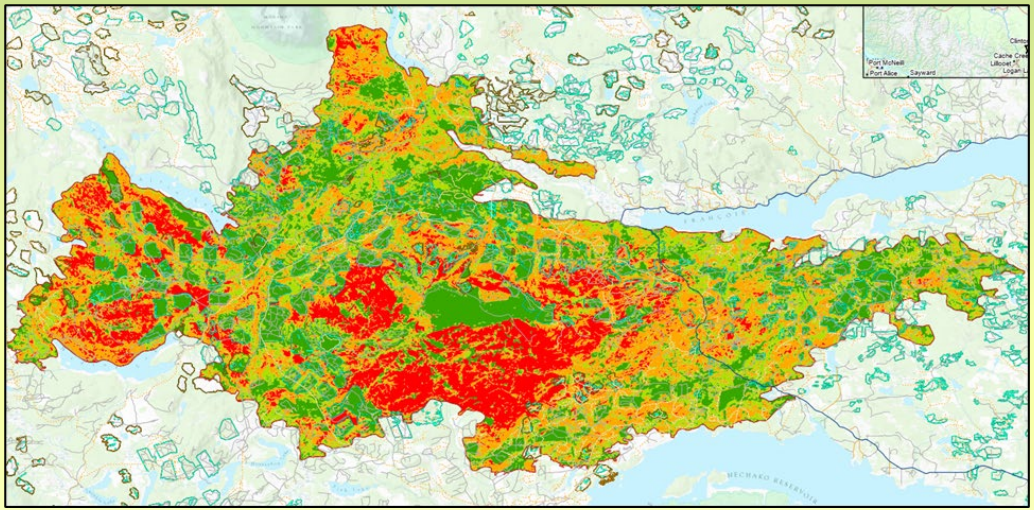
"Fuel treatments in black spruce, jack pine and lodgepole pine stands were generally effective at reducing modelled and observed fire behaviour and inhibiting crown fire development and spread under low to moderate fire weather conditions. Evidence suggests that fuel treatments in these fuel types will be ineffective when rates of spread and wind speeds are very high or extreme."

Key lesson: don't expect perfection!

Emerging themes…..

Some stands are effective at resisting recent wildfires

- Dense stands between 20 and 40 years old had much lower fire severity and often did not burn.
- May be related to stand structure and wind penetration.
- More work on understanding why



And….

Size matters

- Treatments have to be large enough.
- Wide enough to reduce the effect of spotting.
- Large enough to improve suppression response.

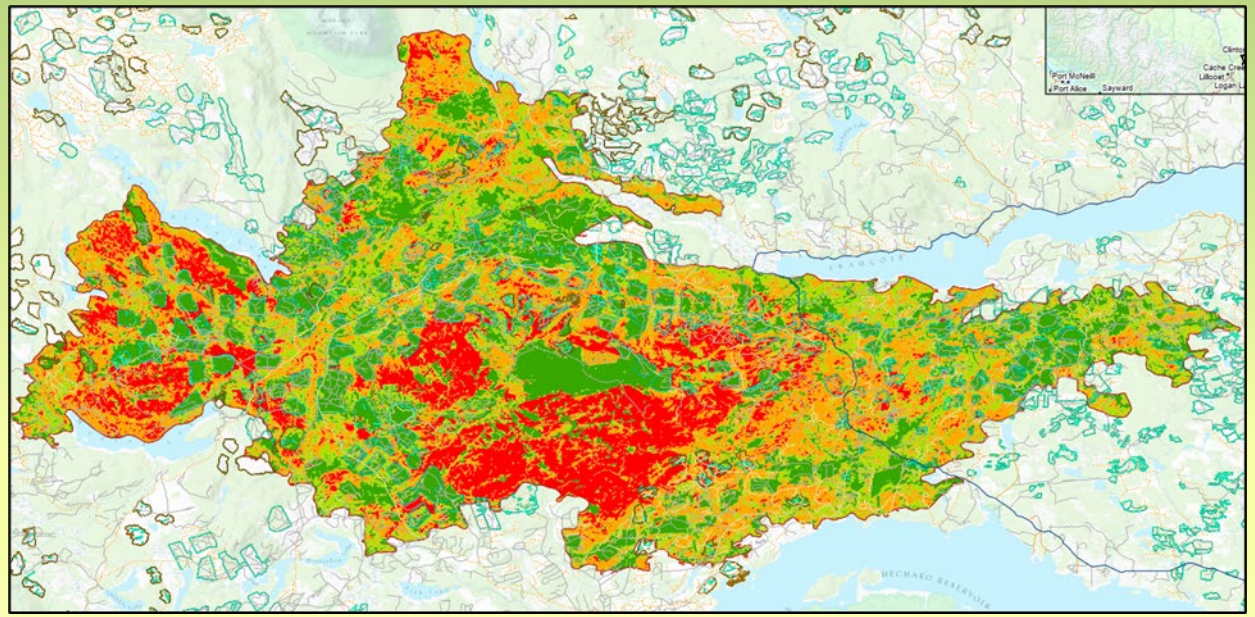
Design matters

- Placed where they have the best chance of working.
- Anchored to water, alpine, etc.

Heterogeneity reduces risk.

So…..

Did stands that resisted wildfire have a landscape effect?



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Landscape fuel management

- Stand Level Fuel Management:
  - By treating a stand, you reduce the risk to that stand.
  - The more stands you treat, the fewer stands are at risk.
- Landscape Fuel Management:
  - By treating the right stand in the right place, you reduce risk to that stand **plus nearby forests.**

Stand Level Treatments

1 + 1 = 2

Landscape Level Management

1 + 1 > 2

Landscape fuel management

- Principles of landscape fuel management are well documented and defensible
  - Effective landscape fuel management is based on effective stand -level treatments
  - Manage for heterogeneity
  - “Cool down the landscape”
  - Prioritize treatments near critical values

- Specific evidence is lacking in our ecosystems
  - Room to test hypotheses in the model
  - Adaptive management will be required to test landscape fuel management on the ground

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Increasing beneficial fire

- Most of the area is in a fire deficit, which implies we have had recent fuel accumulations:
  - Absence of Indigenous fire
  - Fire suppression effect
- Increasing beneficial fire increases landscape heterogeneity and reduces fuels.
- Supports a landscape that can “absorb” fire.
- Opportunities:
  - Increase Indigenous fire.
  - Increase prescribed fire: as a forest practice.
  - Increase prescribed fire: as a fuel management or ecosystem restoration tool.
  - Increase managed wildfire.
- ***How much of each is wanted?***

PODS as a mitigation tool

- PODs are Potential Operational Delineations
- A map and tool that help define fuel breaks where fire suppression can be most effective.
  - Pre-defined fuel breaks are designed through a fire suppression lens.
- Some lines are stronger and others are weaker.
  - A two-lane highway with agricultural land next to it is strong.
  - An ATV trail in a dead pine stand is weak.
  - Natural features and man-made features both contribute.
- Where existing lines are weak, fuel treatments can improve them.
  - FLP can use PODs to prioritize fuel treatment as part of logging
  - Road locations
  - Harvesting, site preparation, and reforestation

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PODS in the Northwest US

PODs_Line
Part of National Potential Operational Delineations (PODs) Public

Authoritative

Private Member
National Interagency Fire Center

Summary

The National PODs Feature Service is the official depiction of PODs approved by agency administrators. Features are visible when Feature Access = Public. This service is based on the attributes from the PODs Poly and PODs Line NWCG Data Standards.

View Full Details

Download

Details

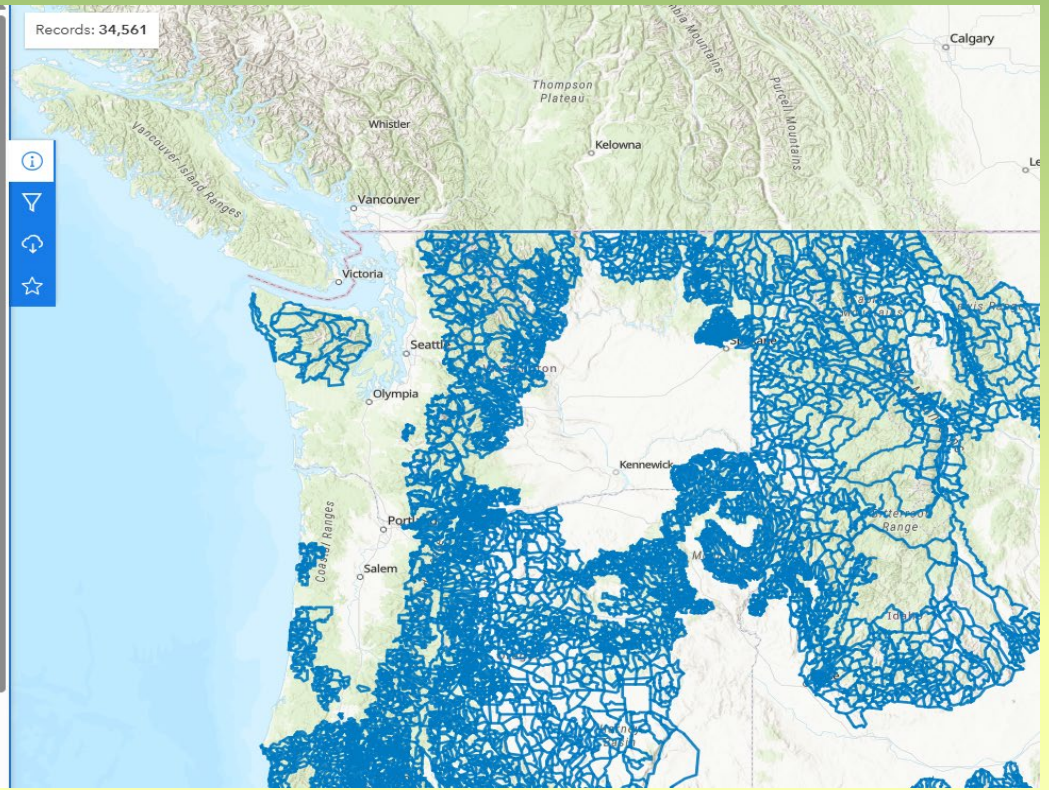
Dataset
Feature Layer

July 19, 2023
Info Updated

May 15, 2025
Data Updated

February 17, 2023
Published Date

Records: 34,561



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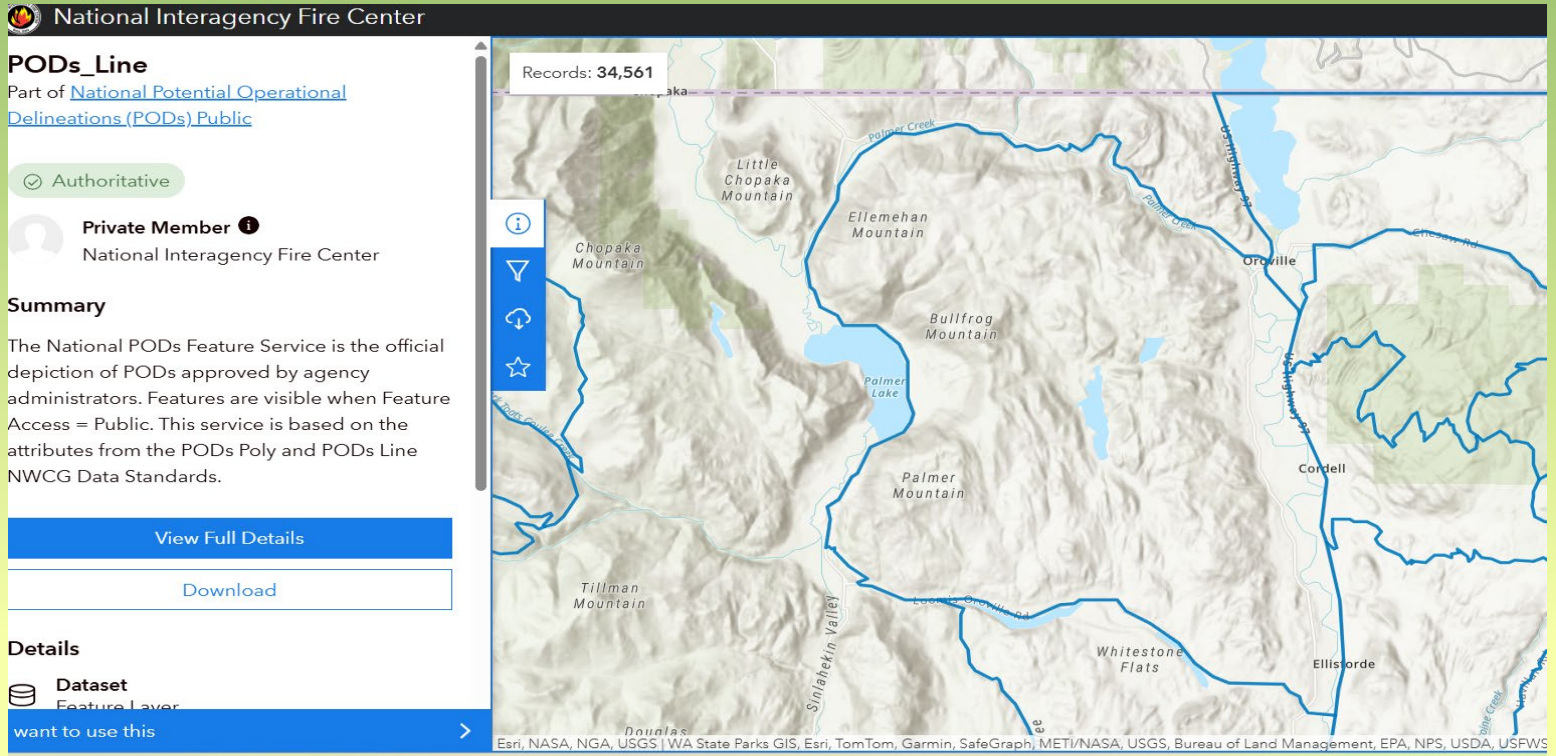
Example POD



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Developing PODs

- Conversations matter
- Make it local
- Talk across disciplines
- Get out the “crayons.”

Risk management topics:

What is risk management?
Assessing risk to ecosystems
What are effective mitigations?
Beneficial fire
PODs

Questions

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BREAK– 20 minutes

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Group Discussion

Small group discussion and then report out, reflecting on the presentation

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Table Discussion – 25 minutes

Questions to get you started

- *What stands out to you from the presentation?*
- *What strikes you as most important?*
- *What does this mean to you as a land manager?*
- *What impacts and benefits of wildfire are you or your government most concerned about today? In the future?*
- *Rank your top 3 concerns.*

What worries you about the wildfire problem?

Your community burning

Loss of timber resources

Loss of wildlife habitat

Smoke

Impact on water quality

Impact on cultural values

Impact on cultural/wild foods

Impact on hydrological integrity

Impact on recreation resources

Invasive species

Loss of property

Your livelihood

Change in ecosystem resilience

Cost of suppression

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Small Group Report Out

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Explore Solutions

Decision Support Tools &
Presentation of the TEF model followed by Q&A

Understanding the utility of models in examining the wildfire problem

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Bulkley Morice Wildfire Resilience Pilot: Decision-Support

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Technical Team

- Core Team:
  - Lead – Don Morgan
  - Disturbance Ecology – Phil Burton
  - Simulation Modelling – Andrew Fall
  - Fire Ecology – Kara Hoffman
  - Biodiversity – Dave Daust
  - Data Management – Brett Tripp
  - Ecological Modelling & Visualization – Gen Perkins
- Specialists:
  - FLP – Doug Lewis
  - Climate Change & Refugia - Diana Stralberg , Christine Kuntzemann , Jessica Stohlar
  - Fire Specialists
    - Ecology
    - Behaviour
    - Management
  - Carbon
  - Planning

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Common Approaches

- *develop a research model*
- *propose application in a management context*

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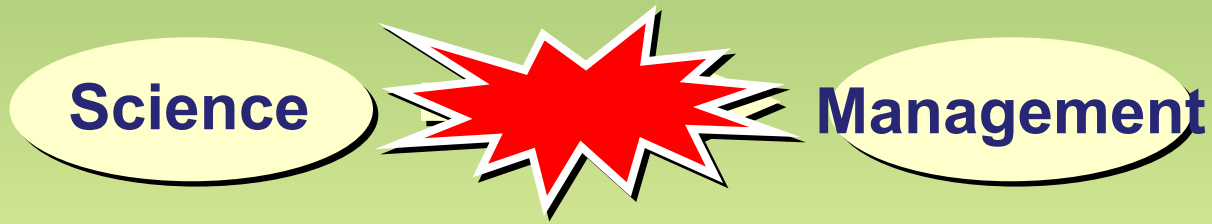
Common Approaches



- ***Assumes management decisions are based primarily on improved knowledge of system***
- ***Ignores social/economic/political objectives***

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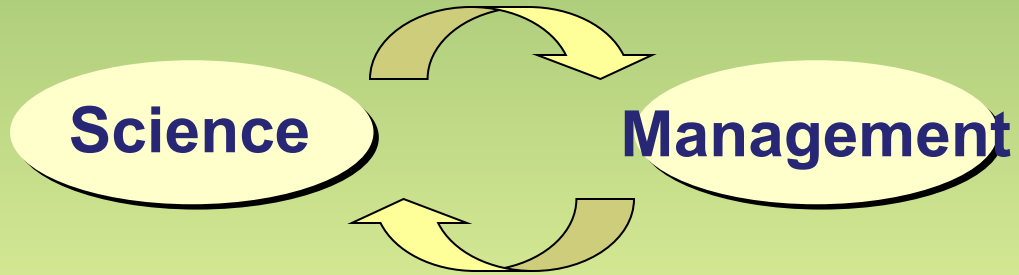
A Collaborative Approach



- Goal:
  - increased understanding by decision-makers
  - provide information in the relevant time frame
  - involve and inform stakeholders
  - document rationale for decisions

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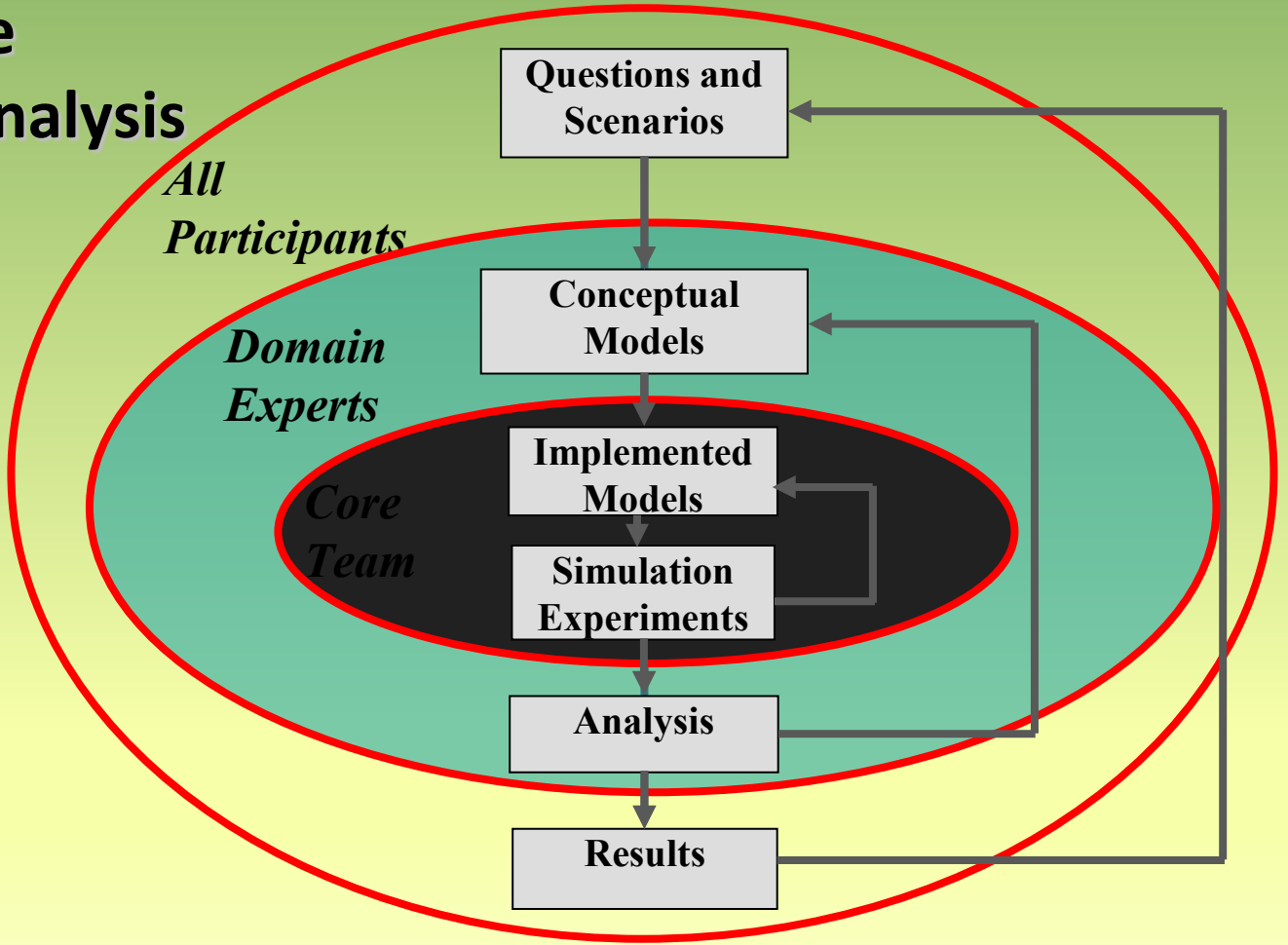
Collaborative Landscape Analysis

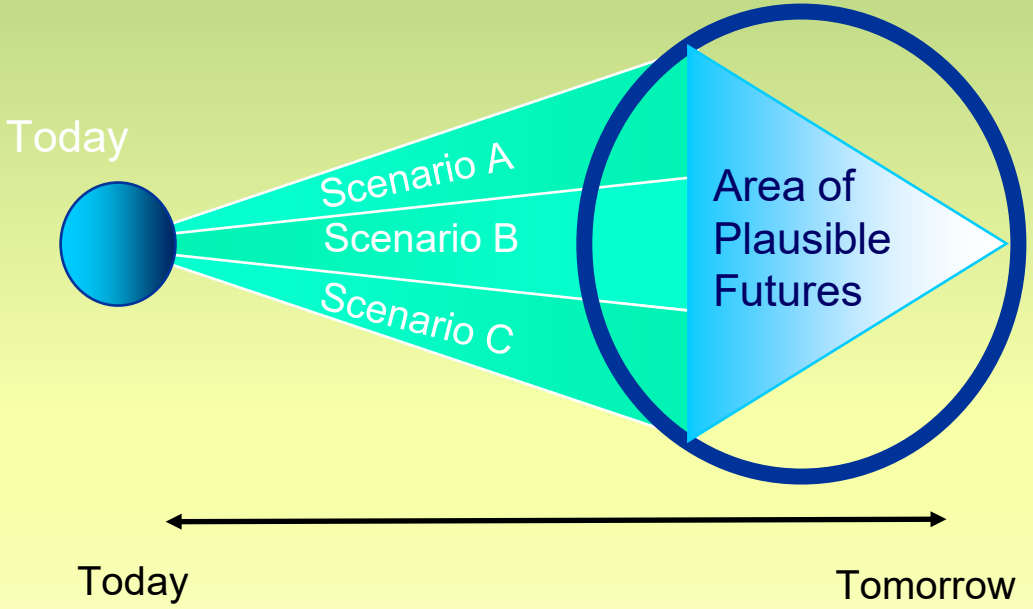


Assessment Approach

- Requirements:
- Defined *management alternatives*
  - Scenarios
- A set of *values* (ecological, social, economic)
  - Indicators
- A *method* of projecting the values through time given the management alternatives
  - Models

Managing for Resilience: Scenarios

- System Testing:
  - Model Validation
  - System Space Exploration
- Management Experiments:
  - What strategies ensure future ecosystem services?
  - Identification of decisions that limit future options.



Time-based Empirical Fire (TEF) Model for assessing landscape fire hazard in the BC Central Interior

Andrew Fall, PhD
Landscape Systems Analyst
Gowlland Technologies Ltd. (and FAIB)

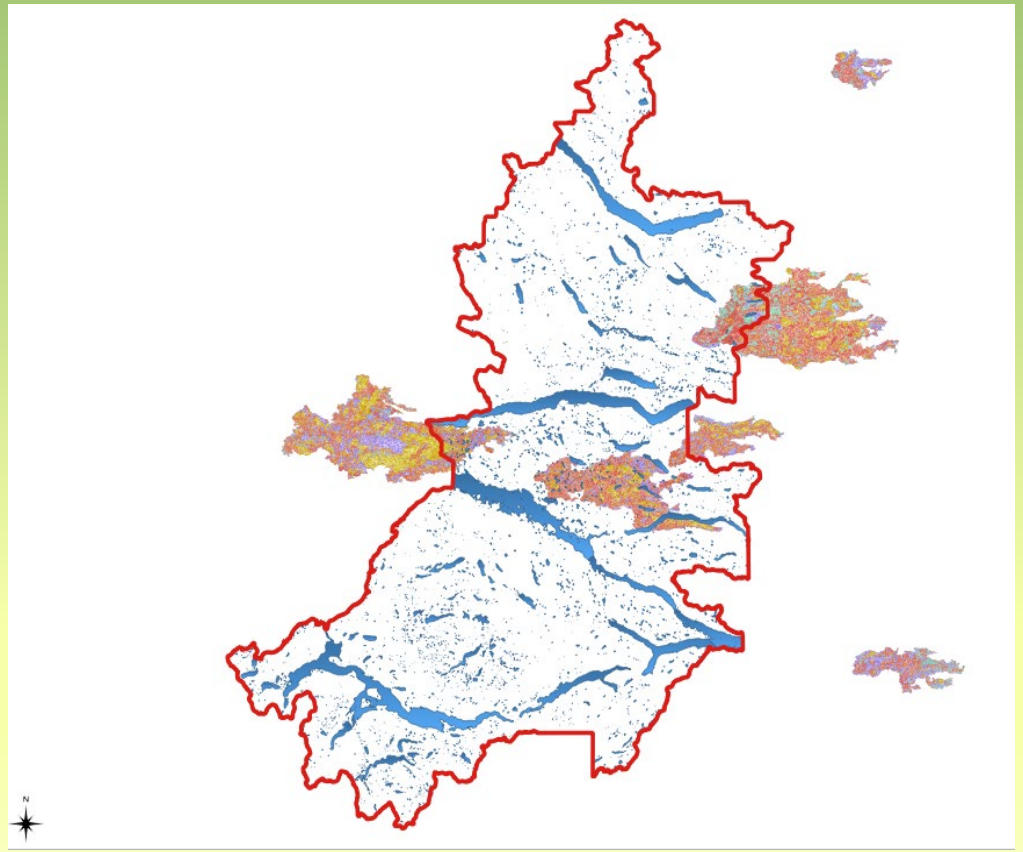
Don Morgan, MSc

Dr. Phil Burton, PhD
Emeritus professor UNBC

Kevin Kriese, MRM
Emeritus Chair of Forest Practices Board

Why model Wildfire?

- Climate change is expected to result in more wildfire
- Fire models can be used to assess:
  - fire risk to communities
  - potential for hazard reduction
  - impacts on values – old growth, wildlife habitat, water quality, economy, etc.
  - potential *macro refugia* under climate change (fire refugia)



Fire Model Types

Operational fire models

- To predict fire behaviour for suppression efforts and short-term planning
- Mechanistic/physical (bottom-up)

Tactical fire models (e.g. wildfire hazard models)

- To evaluate the burn probability (relative fire likelihood) and wildfire resilience
- Semi-mechanistic/process

Strategic fire models (forest projection)

- To assess impacts of long-term feedback between fire and other processes for strategic planning
- Process/pattern (empirical, top-down)

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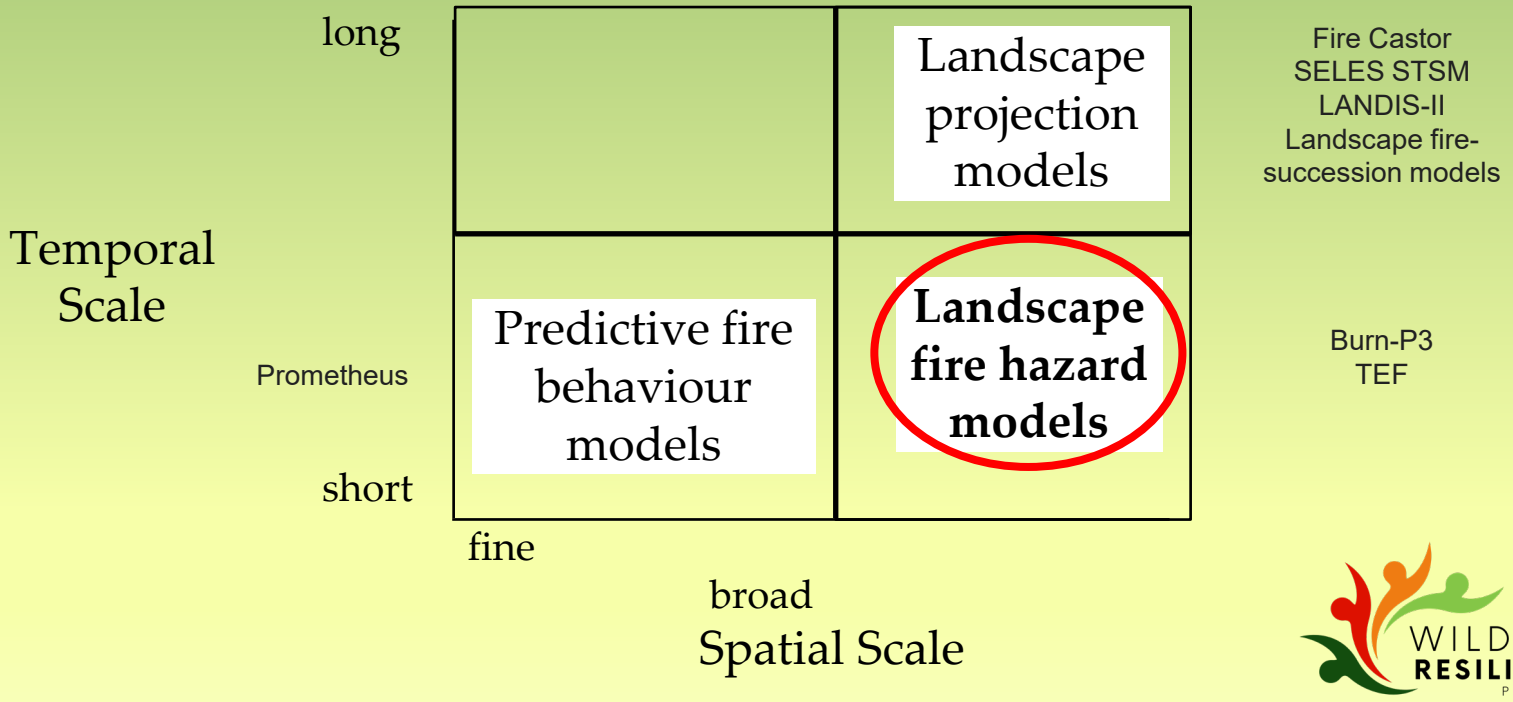
Model Scale


long
Landscape projection models
Fire Castor
SELES STSM
LANDIS-II
Landscape fire-succession models
Temporal Scale
Prometheus
Predictive fire behaviour models
Landscape fire hazard models
Burn-P3
TEF
short
fine
broad
Spatial Scale

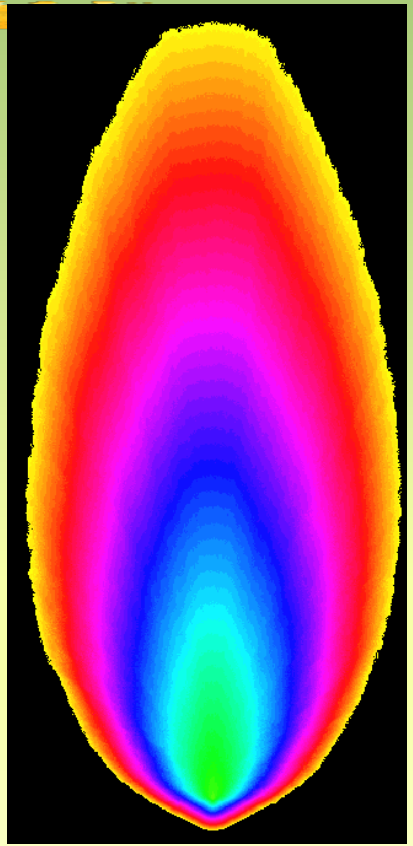
Fire Spread: Wind Effect

Wind speed and direction

- Increase/decrease spread rate
  (consistent with Canadian Forest Service Fire Behaviour Prediction System)

Input as a daily spatial sequence

Elliptical shape with near-constant wind speed & direction (with small variability in wind)



Day burned
(ignition near south)

Fire Spread: Slope Effect

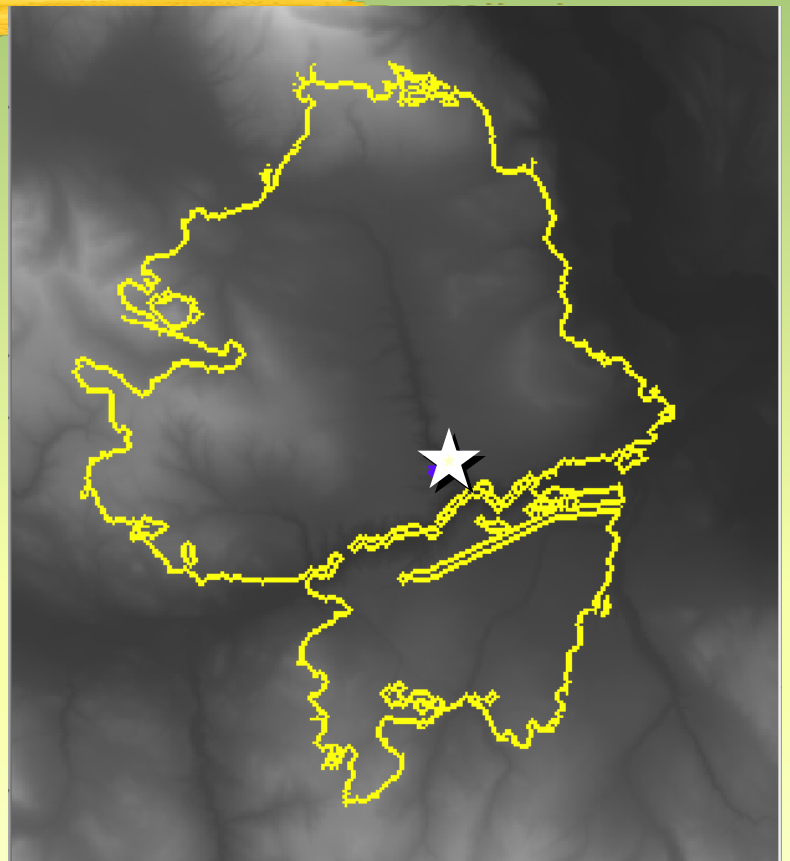
Slope effect => effective wind speed
(consistent with CFS FBP System)

Uphill ≈ down wind

Downhill ≈ up wind

Example:

- Shading: elevation
- Star: ignition point
- Yellow: fire perimeter



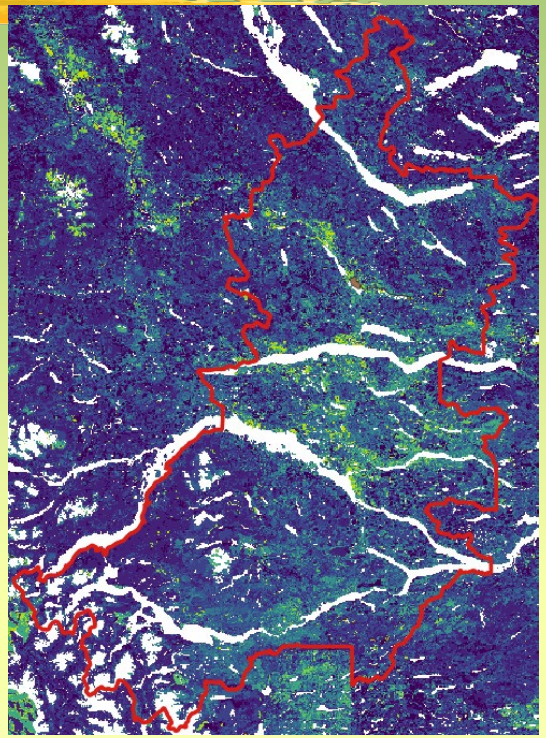
Fire Spread: Forest Cover Effect

Local Burn Probability (FireSusc)

- produced by calibrating inventory attributes using field data (using "random forests" decision tree learning)

Affects potential to burn, and rate of spread

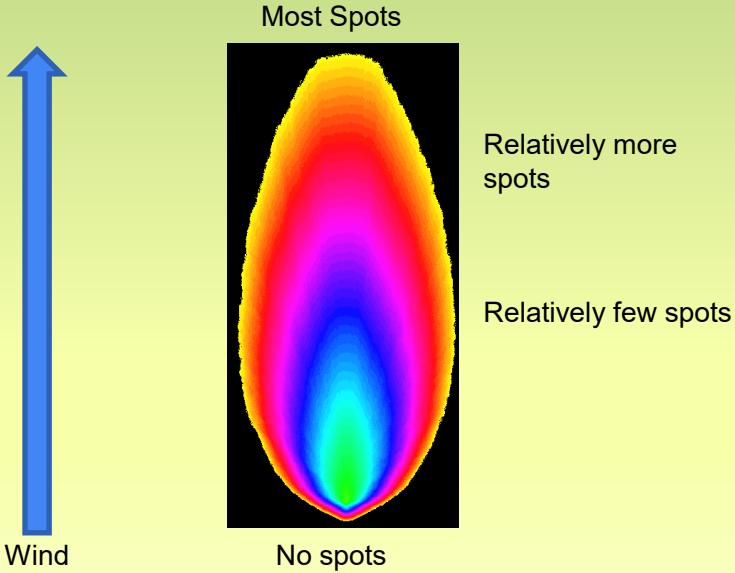
- net rate of spread ~ *f(wind, slope, FireSusc)*

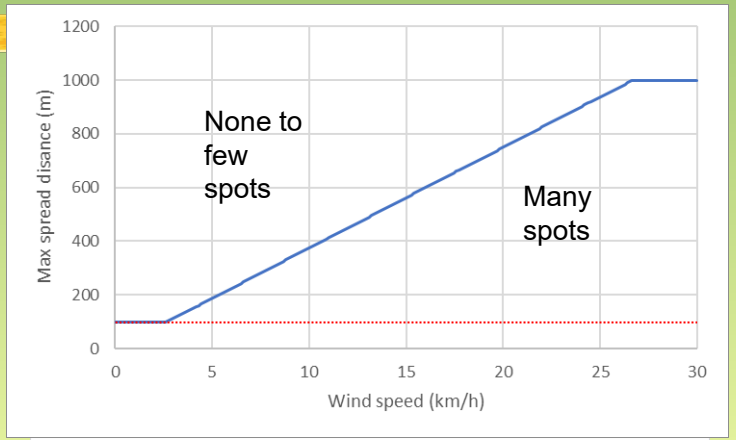


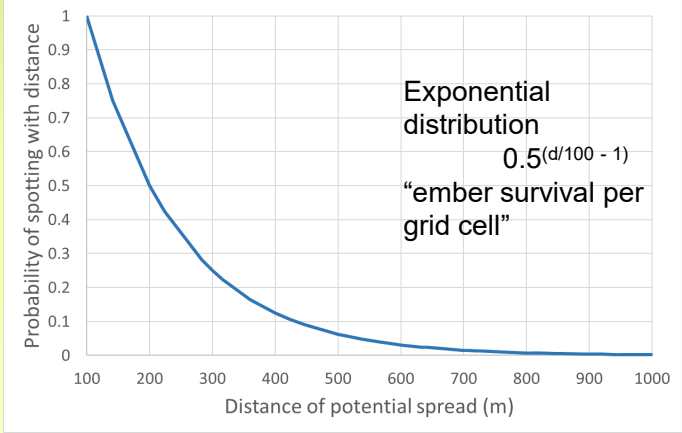
Burn probability – lighter colour higher probability

Fire Spotting

Based on burn rate of spread





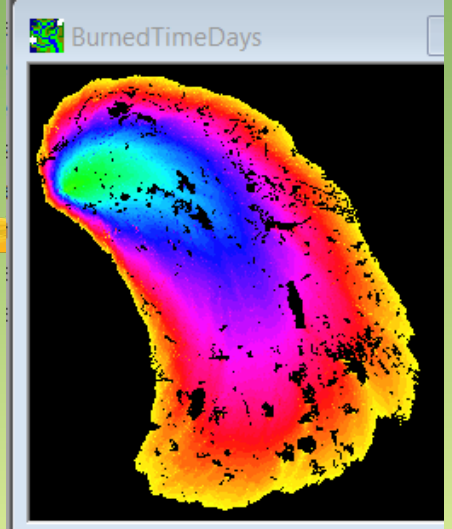


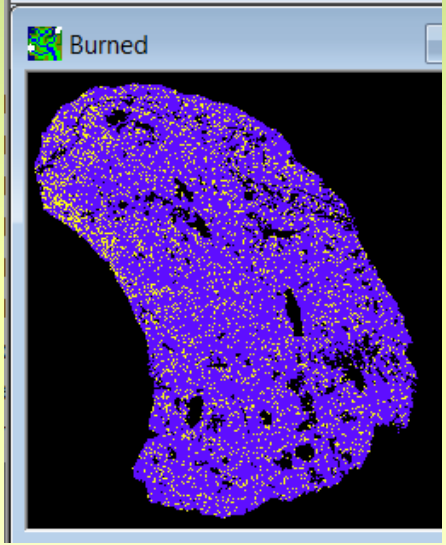
Extinguishment

(1) Fires grow for a specified “duration” (days)

(2) Fire growth may extinguish along individual cells along the active front (increasing when fire slows)

- May leave areas unburned “islands”
- Example: yellow = stopped cells





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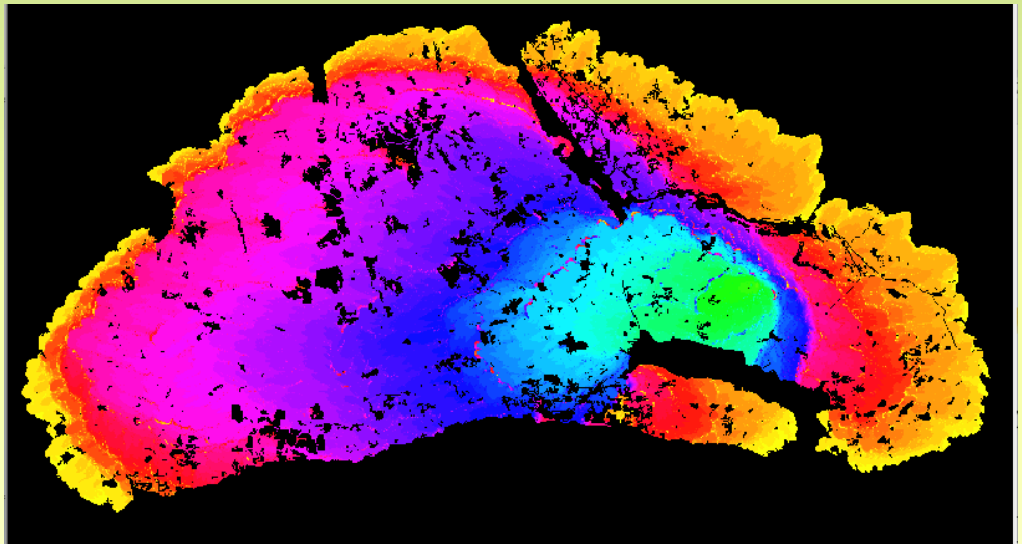
Single-fire outputs

Day Burned
(since fire start)

(ignition in green area)



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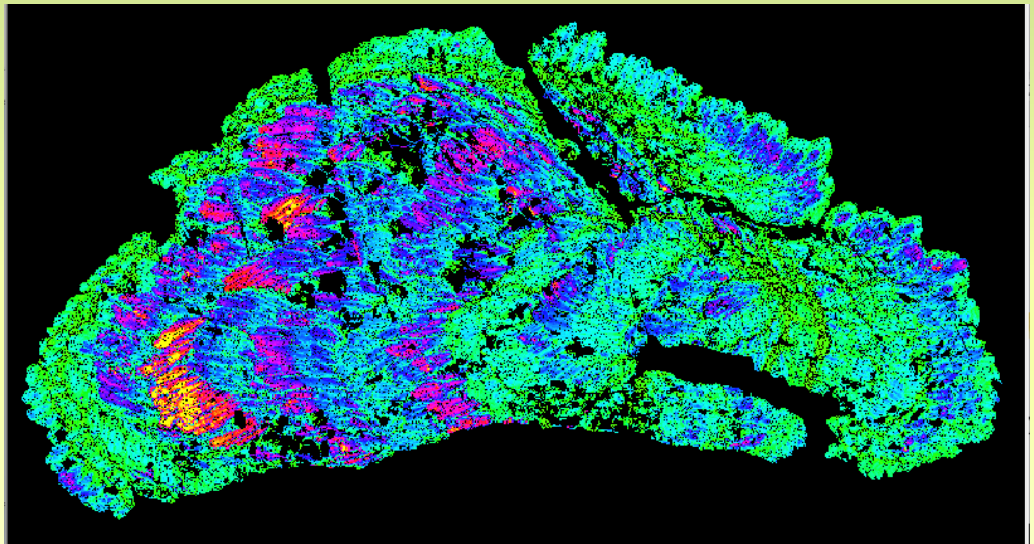
Single-fire outputs

Burn rate of spread

green: slower

blue/purple: faster



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Broad-scale analysis: focal area

Lakes Timber Supply Area (TSA)
buffered by 100km
(to reduce edge effects)

Fires can ignite anywhere in buffered area, but reporting only in Lakes TSA

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Outputs: Landscape Fire Hazard

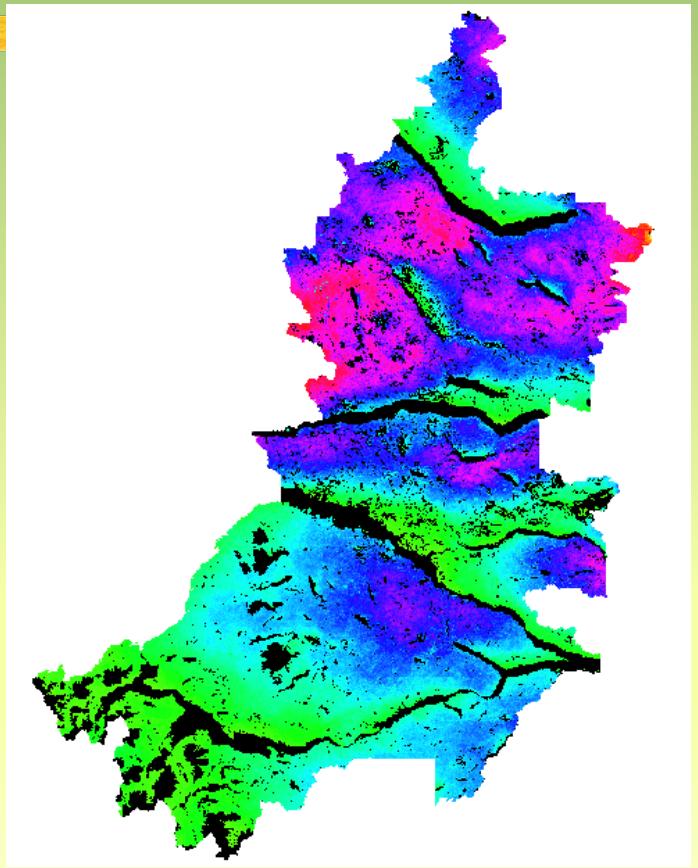
Combine results from multiple runs

Count Times Burned

Preliminary results

Num runs: 10,000

Max (blue/purple/red/yellow): 150



Experiment: Buffer around Burns Lake

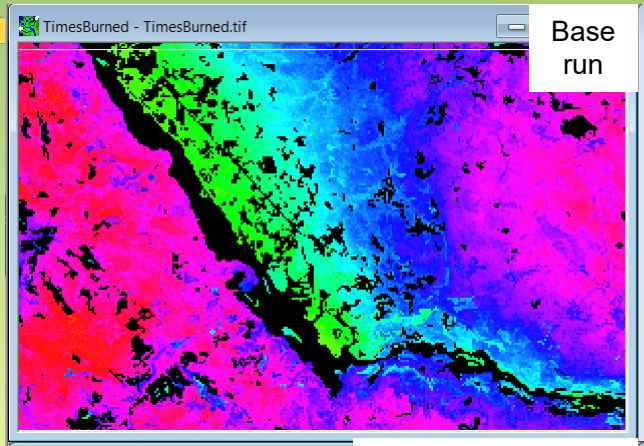
Landscape Fire Hazard (Times Burned)

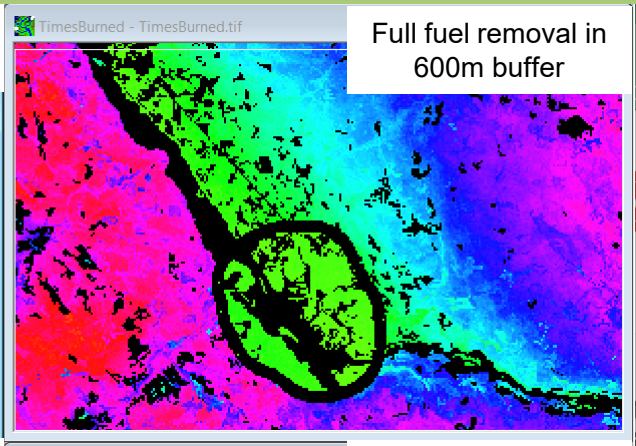
Preliminary results

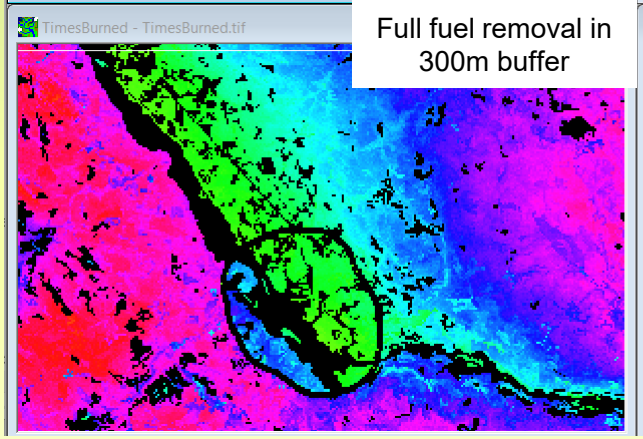
Num runs: 5,800

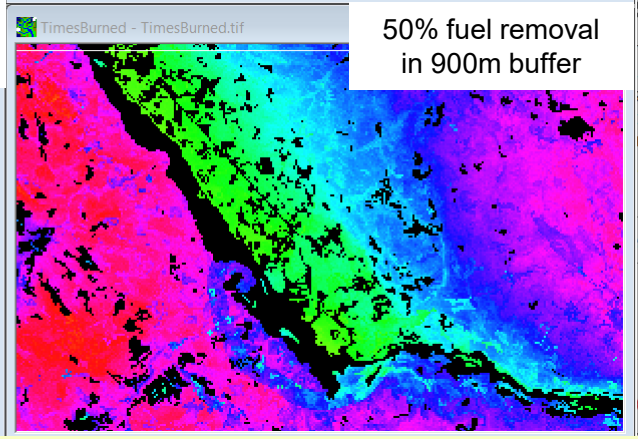
Base run and buffer (up to 100% fuel removal)

Max (blue/purple/red): 400









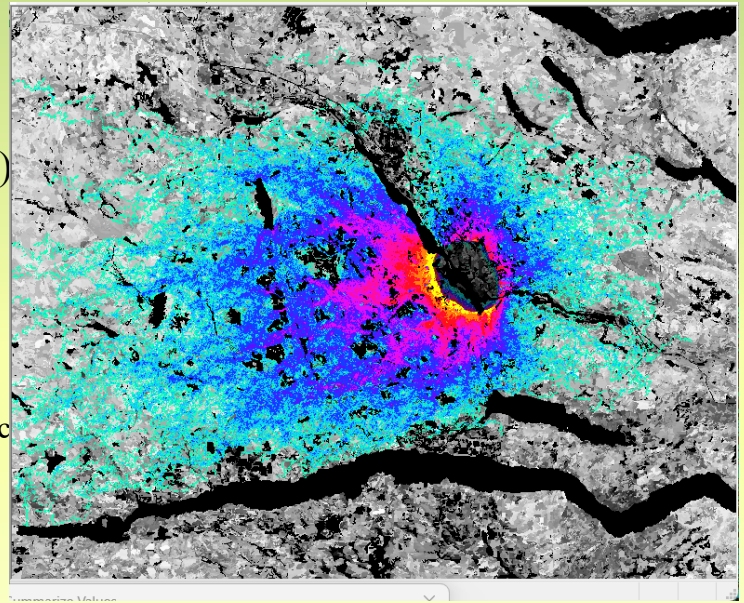
Outputs: Fire Pathways

Wildfire hazard to identified areas (e.g. communities, rare ecosystems)

- Assessment of directions with relatively higher likelihood of hazard (community firesheds and fire pathways)

  Similar to Wang et al. 2024

- Example: Burns Lake
  - Pathways of modelled fires that reach munic boundary



Benefits and Potential Uses

Flexible, empirical basis and relatively low data requirements

Potential to adapt model or use modified input conditions, e.g.:

- Assess potential effects of climate change on fire spread and duration
  - e.g. to help identify climate refugia
- Assess potential effects of management actions (broad scale or more focused)
  - e.g. to help identify fire-sheds or other management zones

Potential to link outputs with other tools and decision processes, e.g.:

- Forest carbon stocks (e.g. inputs to CBM-CFS3)
- Wildfire resilience/risk assessment (e.g. Forest Landscape Planning)
- Assess potential long-term effects on forest values (e.g. input to SELES STSM)

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Potential Applications

Community Wildfire Risk Assessment

- To support assessment of fire buffers

PODs

- To support design and assessment of PODs

Timber supply analysis

- To develop inputs that may be used in timber supply assessment

Forest Landscape Planning / Forest Landscape Modelling (FLM)

- To provide modelled wildfires for use by optimization-based FLMs
- To assess effect of 10-year plans on fire hazard (input to TEF)
- To assess interactions of 10-year plans and wildfire

Watershed Stewardship Plans

- To support Nation led planning

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Questions

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LUNCH, back at 1:00 PM

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Explore Solutions

Explore the solution space by looking at two aspects of wildfire:

1. landscape-scale wildfire hazard
2. Wildfire Resilience

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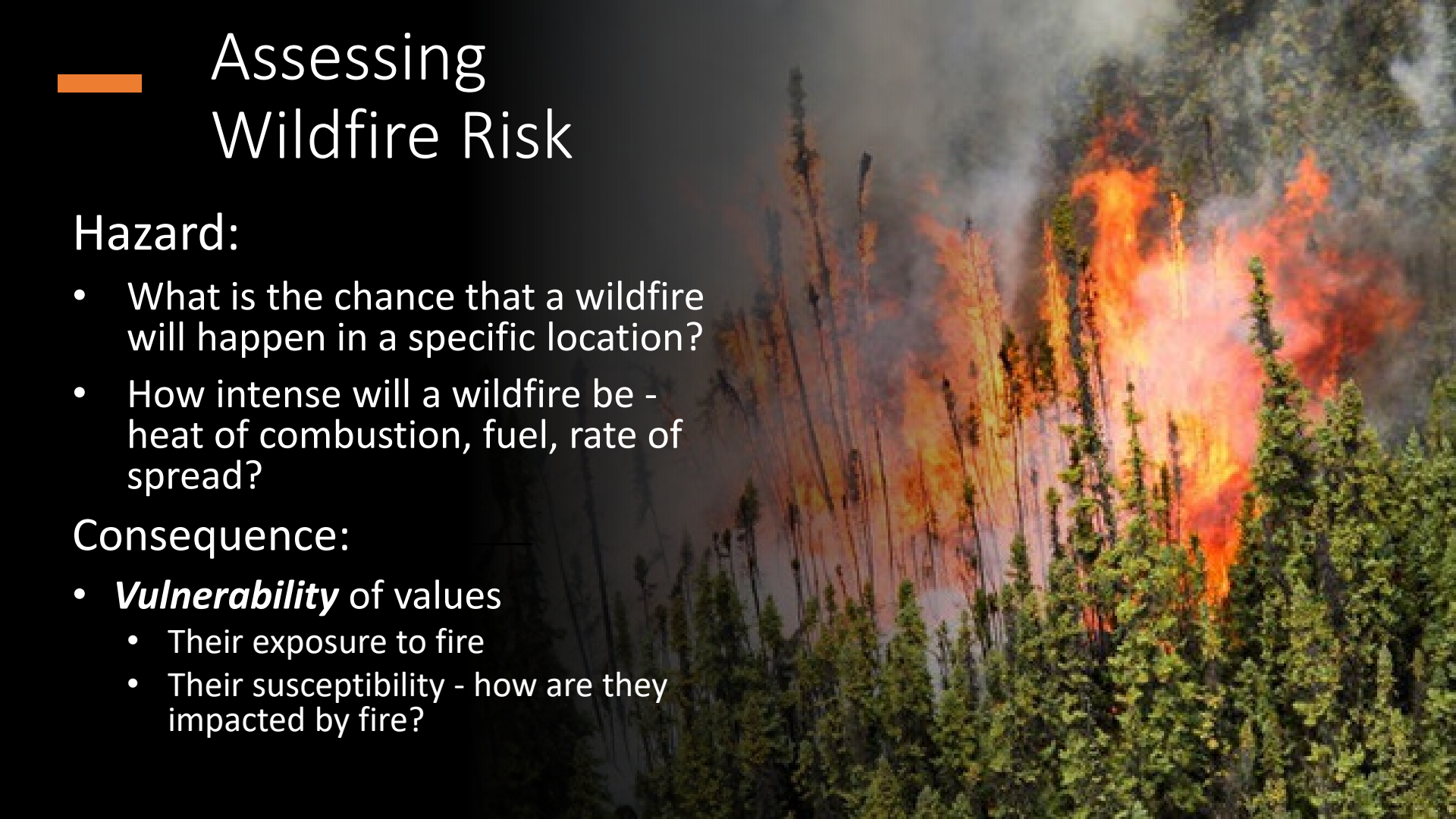
Assessing Wildfire Risk



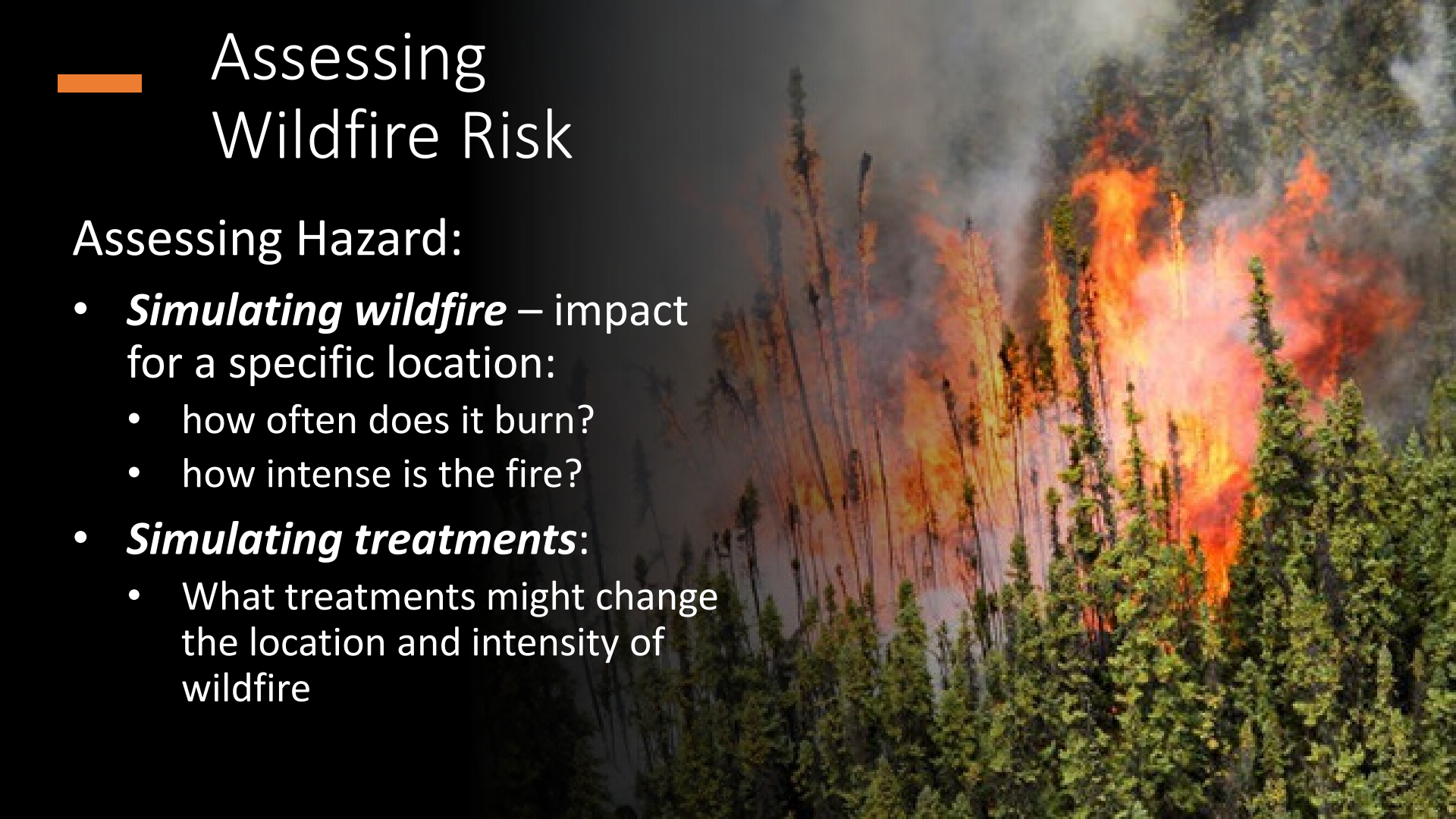
Hazard:

- What is the chance that a wildfire will happen in a specific location?
- How intense will a wildfire be - heat of combustion, fuel, rate of spread?

Consequence:

- ***Vulnerability*** of values
  - Their exposure to fire
  - Their susceptibility - how are they impacted by fire?

Assessing Wildfire Risk



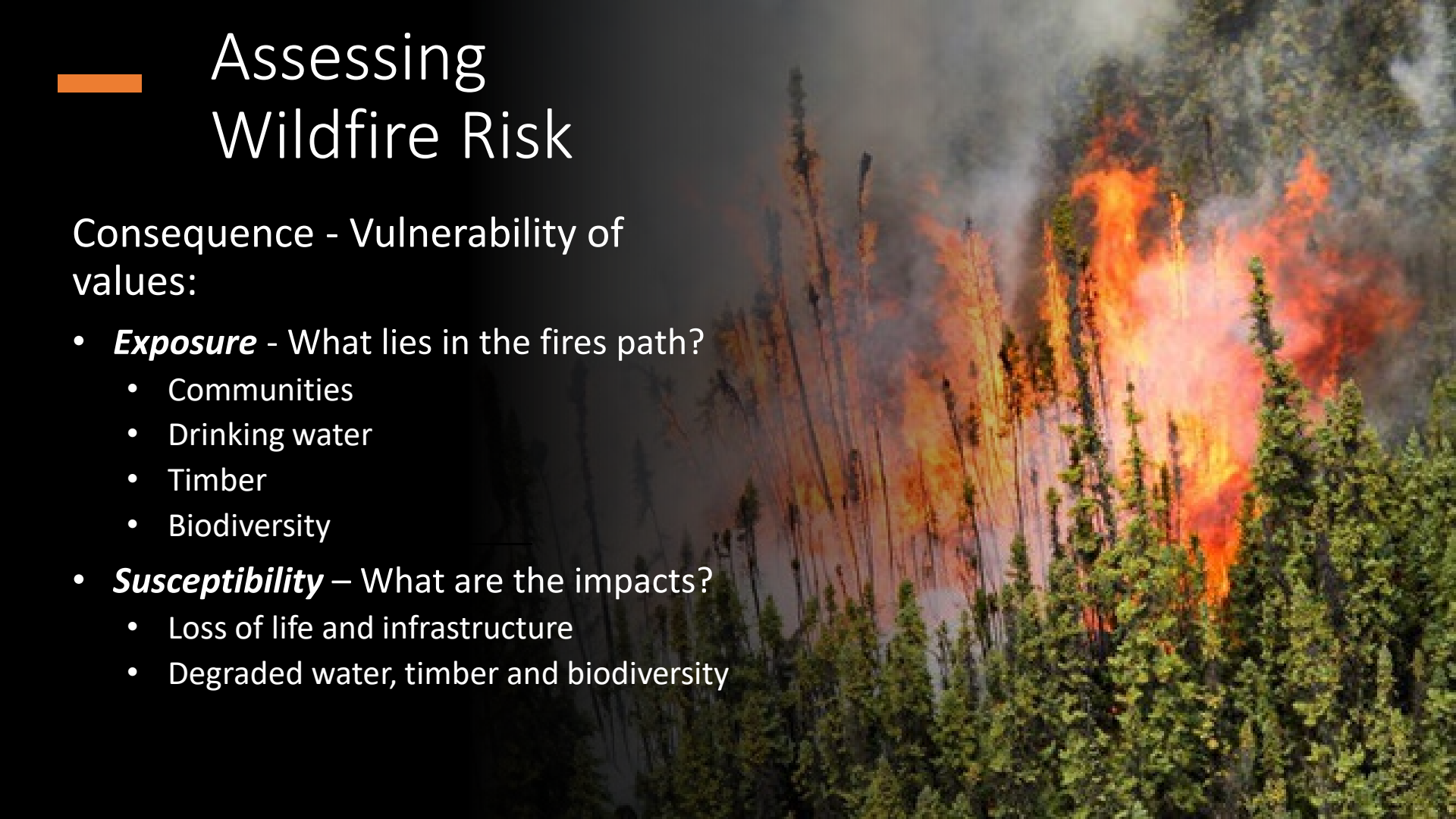
Assessing Hazard:

- ***Simulating wildfire*** – impact for a specific location:
  - how often does it burn?
  - how intense is the fire?
- ***Simulating treatments***:
  - What treatments might change the location and intensity of wildfire

Assessing Wildfire Risk

Consequence - Vulnerability of values:

- ***Exposure*** - What lies in the fires path?
  - Communities
  - Drinking water
  - Timber
  - Biodiversity
- ***Susceptibility*** – What are the impacts?
  - Loss of life and infrastructure
  - Degraded water, timber and biodiversity



Assessing Wildfire Risk

Where and how much of the landscape can be treated to mitigate wildfire?

- ***Specific treatments*** – reduce exposure and susceptibility for a specific value
- ***General treatments*** – reduce overall landscape wildfire hazard

Small Group Discussion (30 minutes)

At each table, discuss landscape-level hazard

Questions:

How can stand-level treatments be configured to have a landscape effect?
When might they get "swamped"?
What would be stand-level / landscape-scale treatments?

Report out – 5 minutes

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Forest Resilience to Wildfire

Resistant:

- Wet sites
- Aspen (moist leaves)
- Low understory fuel load (little in-stand disturbance)

Resilient:

- Serotinous cones
- Root sprouting/suckering
- Moist sites

(stand composition and structure)

Stand-scale Resilience (e.g.,)

Resilience is the ability to bounce back from exposure to wildfire.

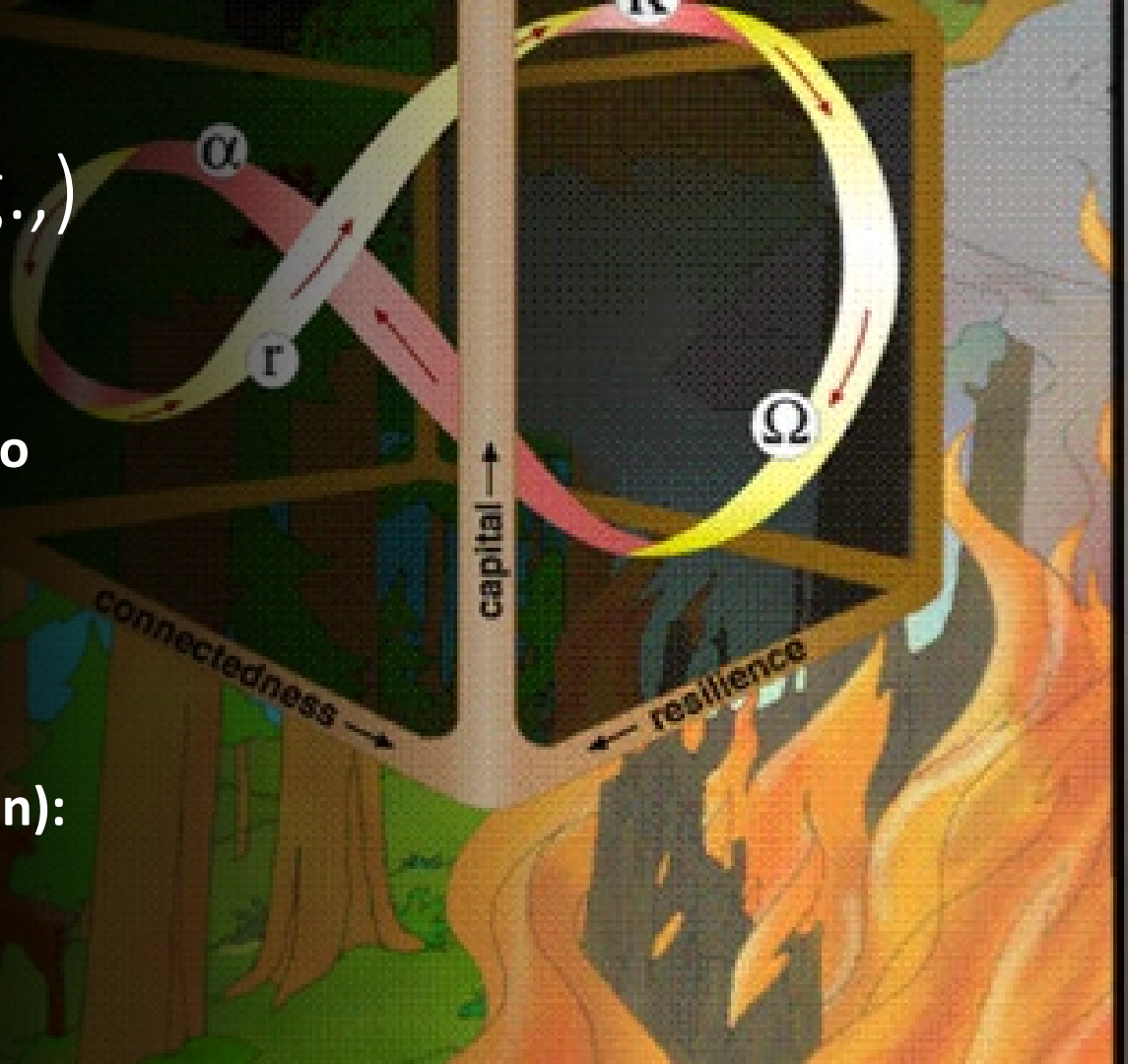
Resist/absorb:

Less likely to burn badly

Resilient (recovery, adaptation):

Likely to return as functioning forest

Even when fire is big and hot



Forest-scale Resilience (e.g.,)

Landscape Diversity (patches)

- Age, species and stand structure
- Disturbance history
- Patch size

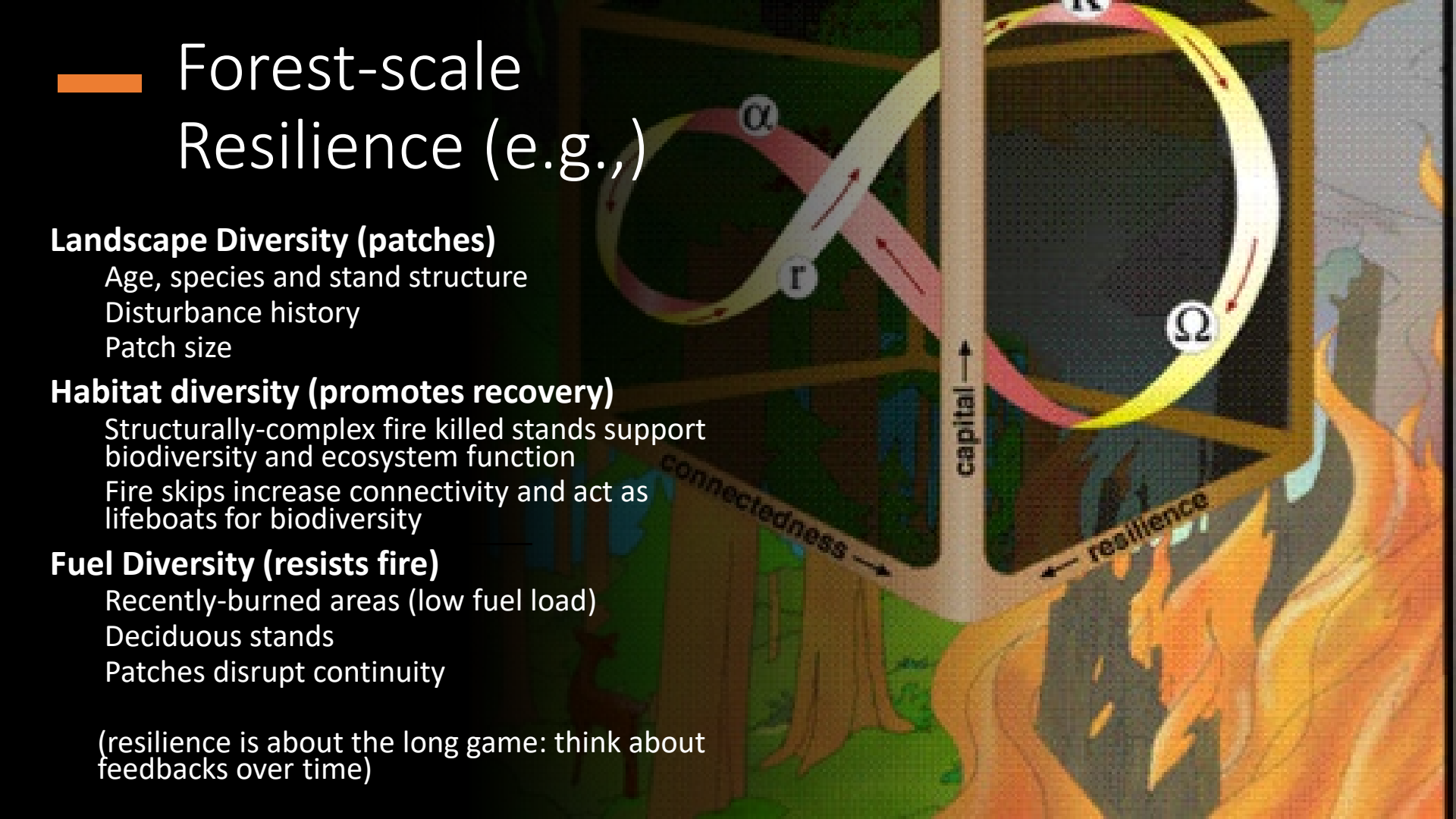
Habitat diversity (promotes recovery)

- Structurally-complex fire killed stands support biodiversity and ecosystem function
- Fire skips increase connectivity and act as lifeboats for biodiversity

Fuel Diversity (resists fire)

- Recently-burned areas (low fuel load)
- Deciduous stands
- Patches disrupt continuity

(resilience is about the long game: think about feedbacks over time)



Community Resilience to Wildfire

Resistant:

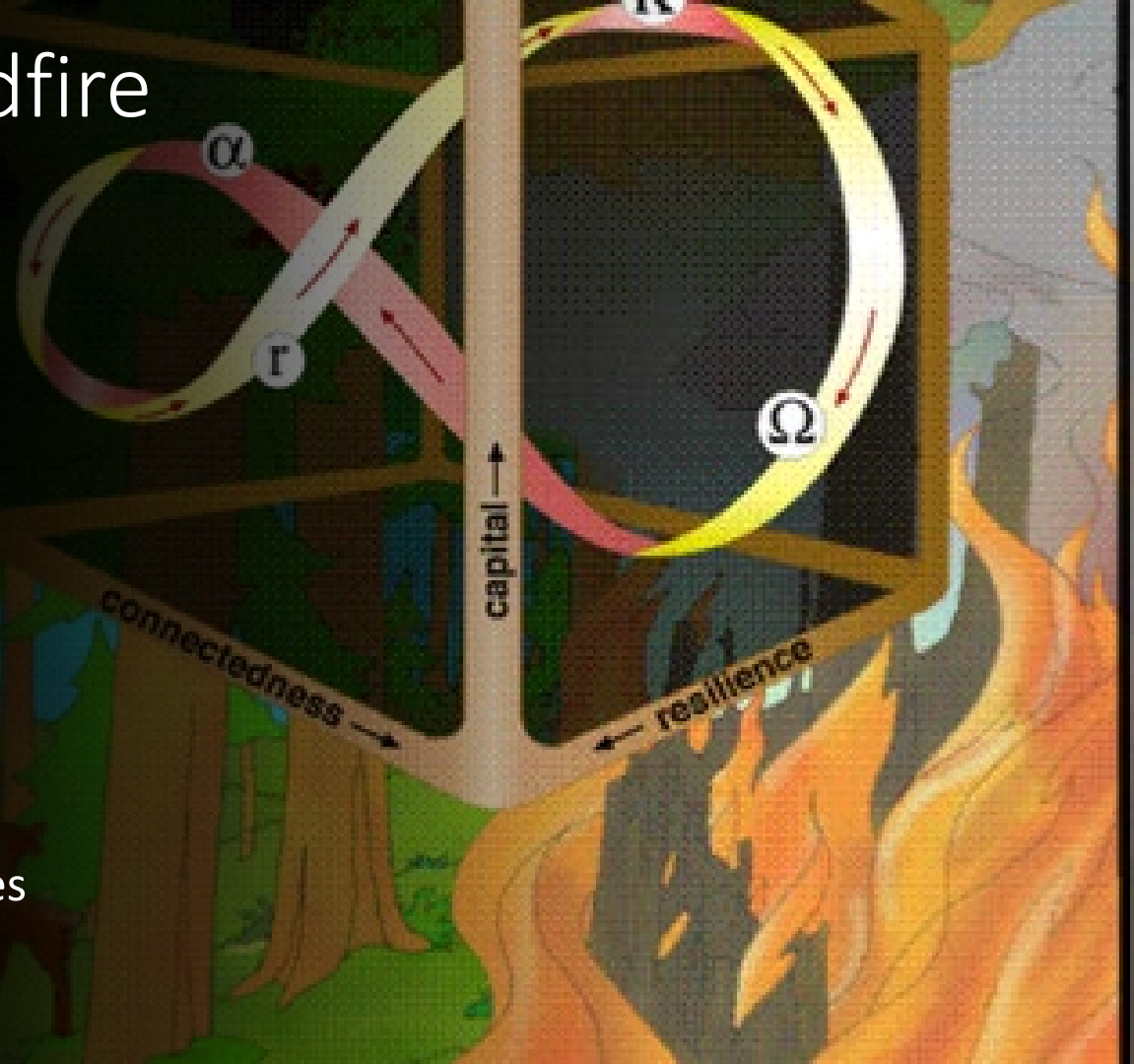
- Fire Smart and fire fighting (90%)
- WUI
- Depends on community knowledge, skills and economic and cultural support

Resilient:

- Capacity to provide short-term shelter
- Capacity to rebuild (better)

Assessing Wildfire Resilience

- Measuring Resilience:
  - Landscape fire metrics:
    - frequency
    - size distribution
    - location
  - Fire intensity metrics:
    - Fire severity
    - Fire skips, spotting
    - Suppression opportunities



Small Group Discussion (30 minutes)

At each table, discuss the ecological elements of wildfire resilience

Questions/Discussion points:

How is wildfire resilience defined?
Attributes of resilience - frequency, size and severity
How does the model inform the attributes of future fire regime

Report out – 5 minutes

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BREAK– 20 minutes

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Building Blocks for BuMo Model

What has been heard, and what questions the model should address

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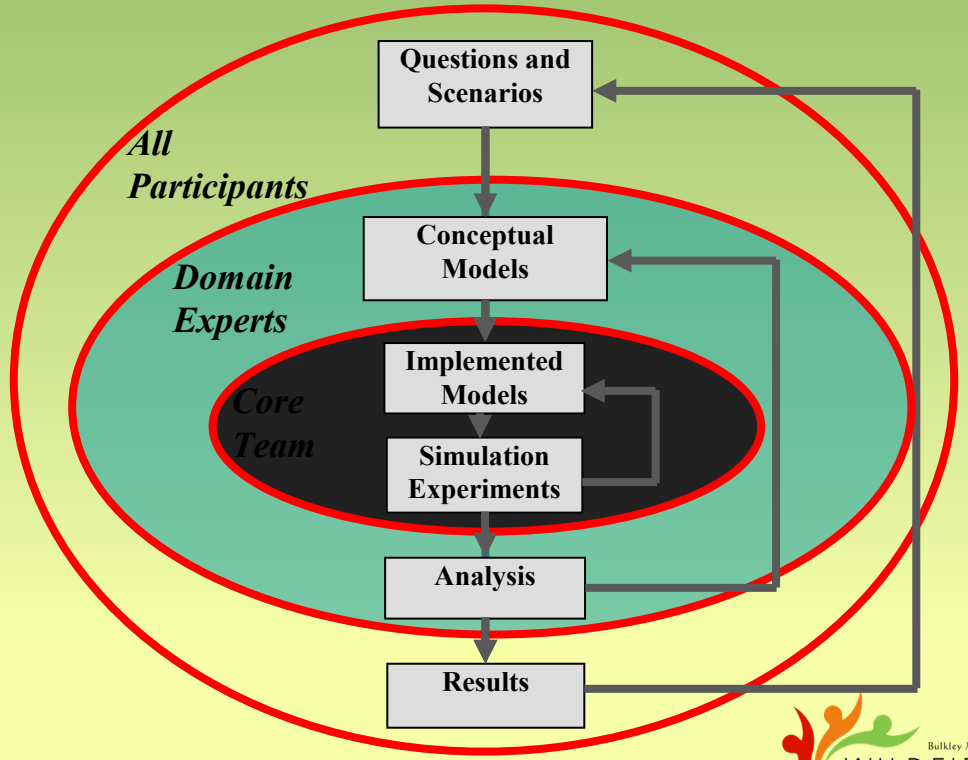
What the Decision-Support Team Needs

- Overall Guidance
  - What experiments
  - What scenarios
- Key Values
  - Specifically targeted with treatments
  - Generally impacted by wildfire
- Issue Identification
  - Community concern
  - External factors – eg climate change
- Data
  - Location of values
  - Culturally important places



Steering Committee Direction

A roundtable to hear from each participant (3 min ea):

What are your key learnings from today?
What areas of uncertainty do you see?
What are your hopes for what this project can deliver?

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Decision Support Next Steps

- Building out the TEF model for the Bulkley Morice
- Modelling stand and landscape wildfire treatments under different fire weather
- Modelling the hazard and consequence of wildfire on values (e.g. Community, Biodiversity, Timber, Water)
- Fall 2025 steering committee progress check-ins

- Late fall 2025 Workshop
- Steering committee direction for modelling treatment combination scenarios and impact assessments
    - Evaluating the effectiveness of treatments under different fire weather
    - Evaluating wildfire resilience under different treatment combinations