

Translating Climate Futures into Management Guidance: making practical decisions in the face of tremendous uncertainty

Harry Nelson

Forest Resources Management, UBC



Future Forest Ecosystems Scientific Council
Seminar Series

Victoria, BC

November 6, 2012



THE RESEARCH TEAM

2

- Dr. Harry Nelson (Univ of BC) – Project Co-Lead
- Ken Zielke RPF (Symmetree Consulting) – Project Co-Lead
- David Perez (Univ of BC) – Project facilitation, extension and support
- Dr Brad Seely (Univ of BC) – Stand modeling
- Dr Clive Welham (Univ of BC) – Stand modeling
- Dr Craig Nitschke (Univ of BC, Univ of Melbourne) – Regeneration modeling
- Reg Davis RPF (Forsite Consulting) – Landscape modeling
- Michael Gerzon (Univ of BC) – Landscape modeling
- Bryce Bancroft RPBio (Symmetree Consulting) – Forest Management Specialist
- Laurie Kremsater RPF, RPBio (consultant) – Conservation and Habitat Specialist
- Cam Brown RPF (Forsite Consulting) – Forest Management Specialist
- Dr Stewart Cohen (Univ of BC, Environment Canada) – Climate Change Specialist
- Cindy Pearce RPF (consultant) – Community Dialogue Specialist

Overview

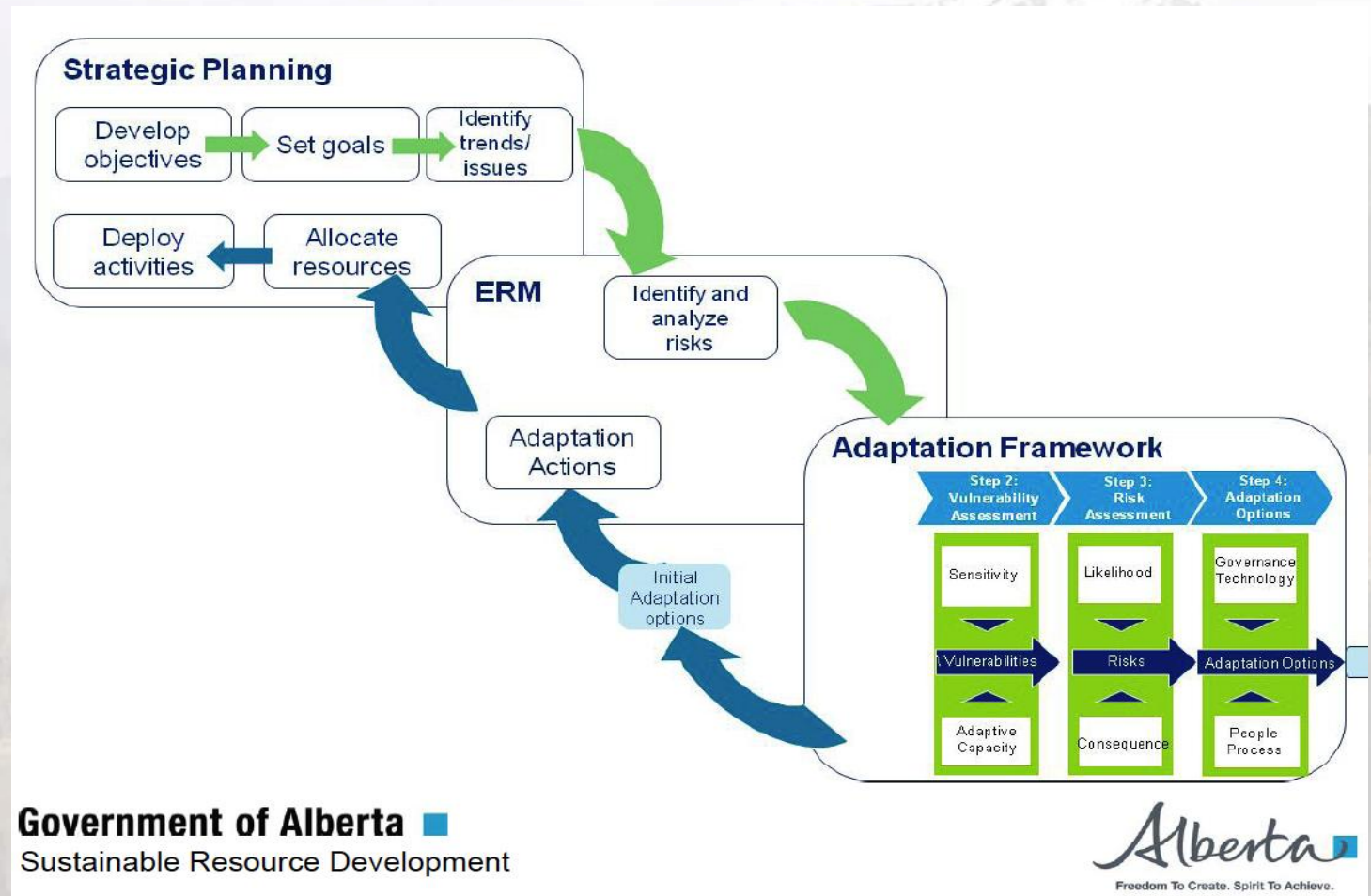
*Translating Climate Futures into
Management guidance: making
practical decisions in the face of
tremendous uncertainty*

- How Can Academics + Research + Climate Futures = Practical Results?
- The Approach – Models, Expert Judgement + Practitioners
- How We Arrived at Management Guidance:
 - Recommended actions
 - Addressing uncertainty
 - Ongoing evaluation
- Concluding Remarks

Value of Science to Managers

- How can science/models help resource managers around adaptation?
 - Vulnerability assessments that help prioritize risks
 - Assist managers in understanding potential tradeoffs
 - Relate actions to outcomes

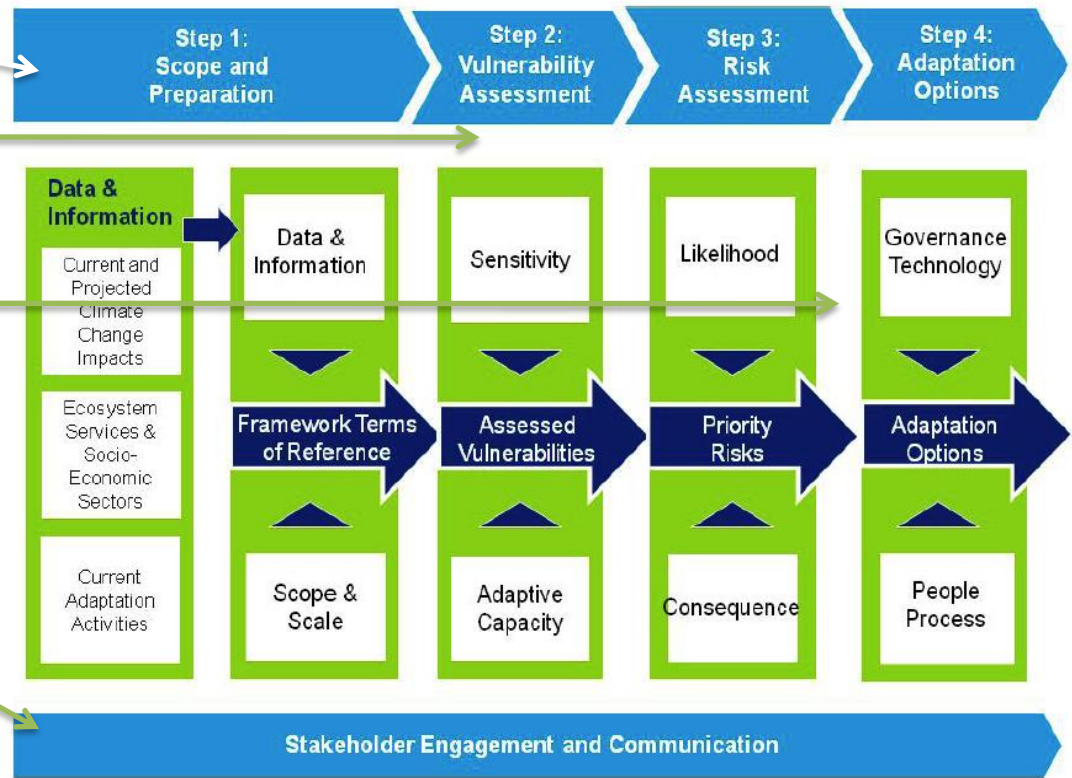
Example: SRD (Alberta) Climate Change Adaptation Framework



Where science/models can support framework

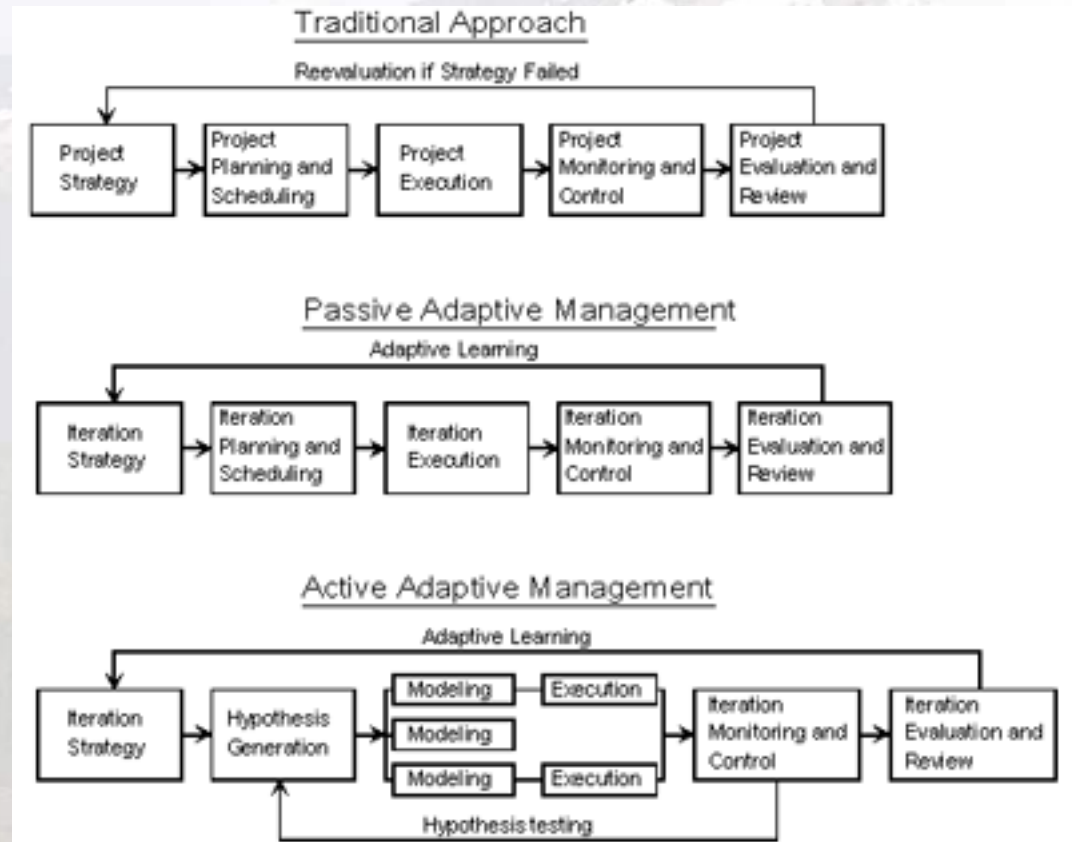
- Models can provide support for structured decision-making in developing the framework:
- can assist in vulnerability assessment and risk, helping prioritize risks; and
- for adaptation options can assist in evaluation (how do they affect outcomes) and offer opportunity of monitoring of indicators; and
- can also provide a platform for stakeholder engagement and communication

SRD Climate Change Adaptation Framework



Enabling Adaptive Management

- Proactive versus BAU management
- Models offer link between action, monitoring, evaluation and adjustment



How Modeling Helps Answer Management Questions

- It allows us to “fast forward” through time and simulate under different scenarios future outcomes

2009



Modelling suite

A.K.A.

**Our “time
machine”**



2050



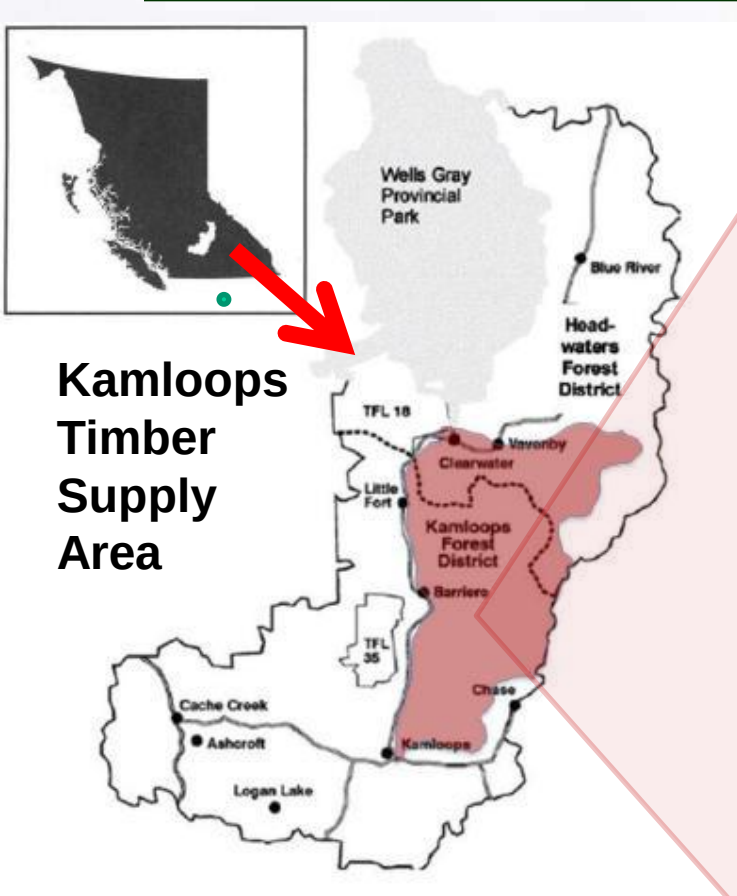
Conceptual model

- Climate >growth>management
- Impact of climate on forest renewal (**regeneration**)
- Impact on growth (**productivity**)
- Impact on mortality (**disturbance**)

To Offer Management Guidance

- We need to be able to tailor model to regional characteristics and conditions
- We need to allow for diverse responses
- And ideally we should be able to offer integrated assessments across different resource values

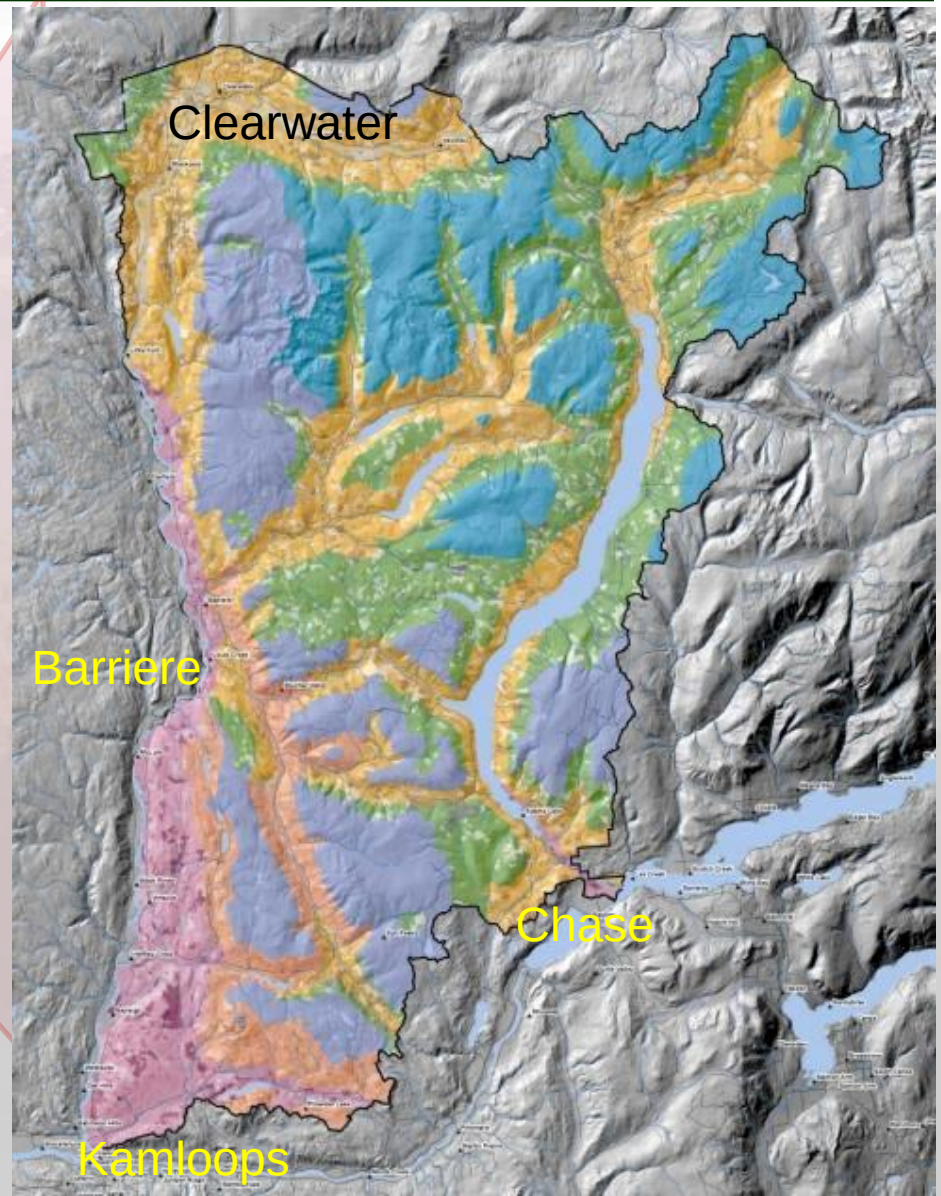
Case Study Area



**Kamloops
Timber
Supply
Area**

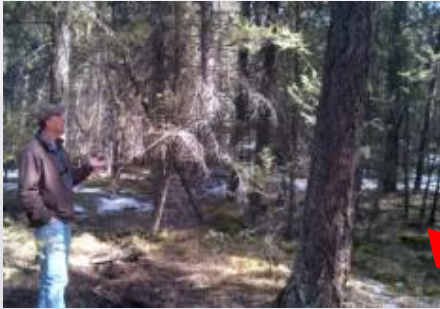
CASE STUDY AREA

- 900,000 ha (2.2 million acres)
- Six Broad Eco-units



Case Study area - Six Ecological Landscapes

And 21 stand units



**Dry Douglas-fir /
Ponderosa pine (4%)**



**Dry Lodgepole pine
and Douglas-fir(6%)**



**Wet High Elev
Spruce/Fir (17%)**



**Moist Transition
(28%)**

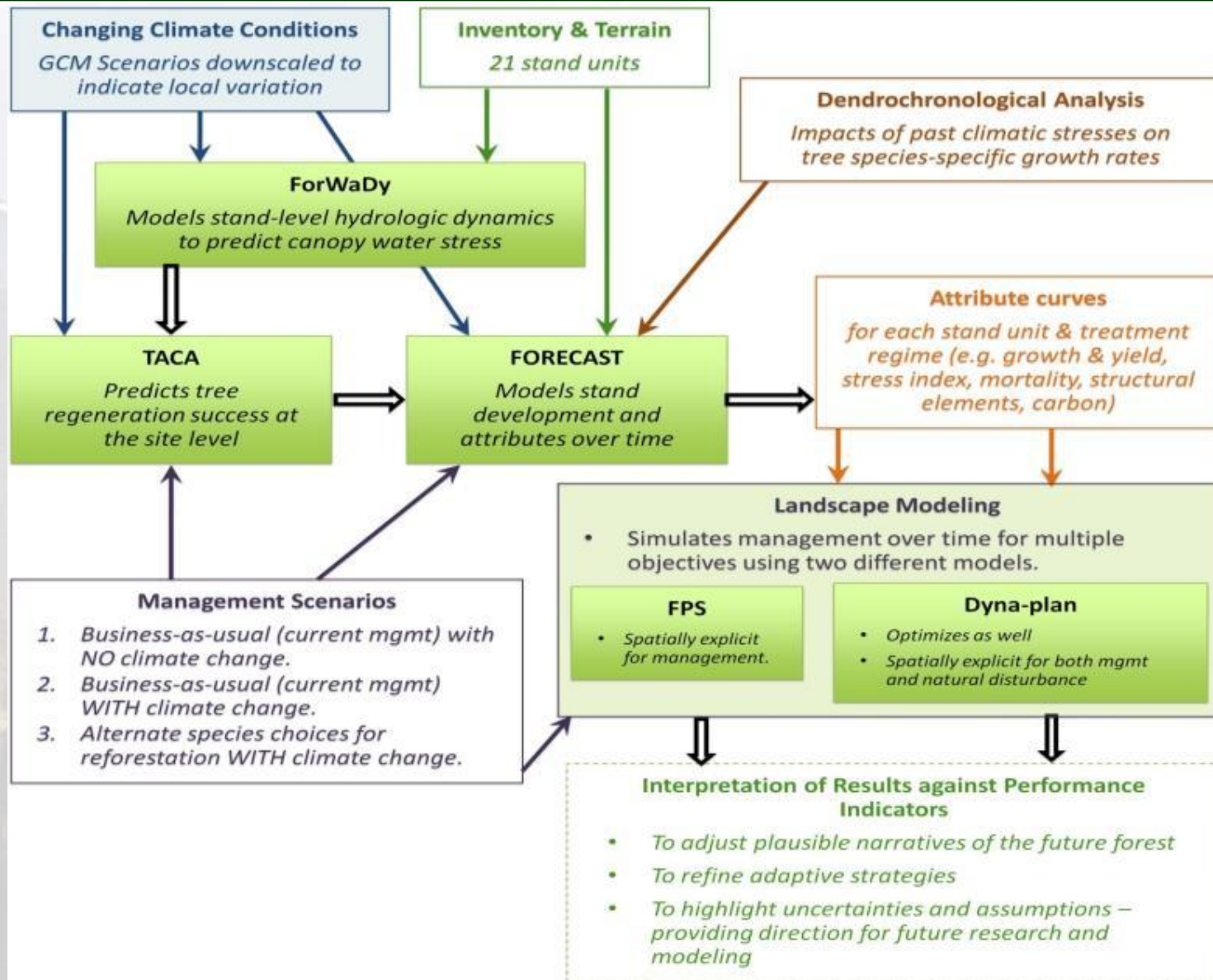


Plateau (21%)



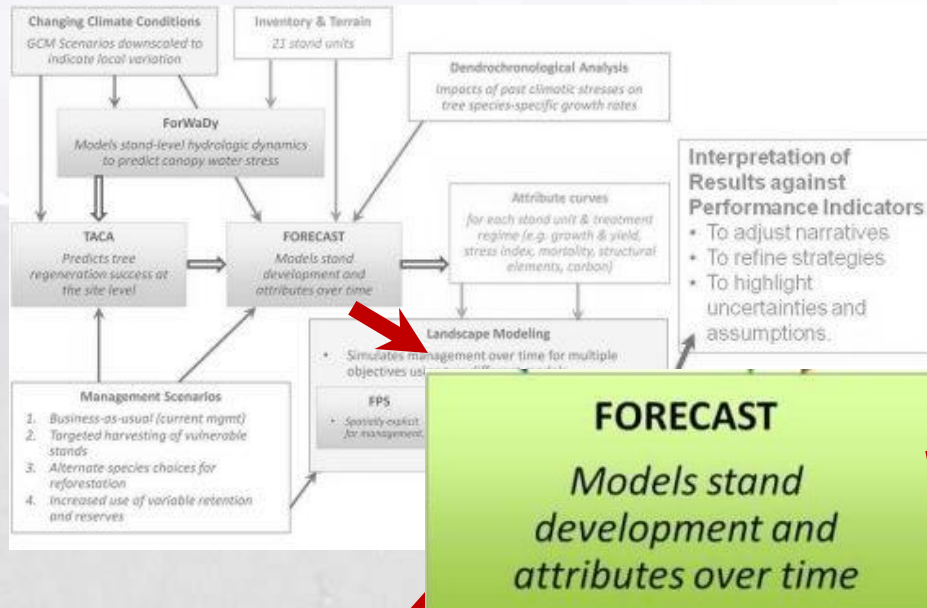
**Dry Transition
(24%)**

Modeling Suite and Approach

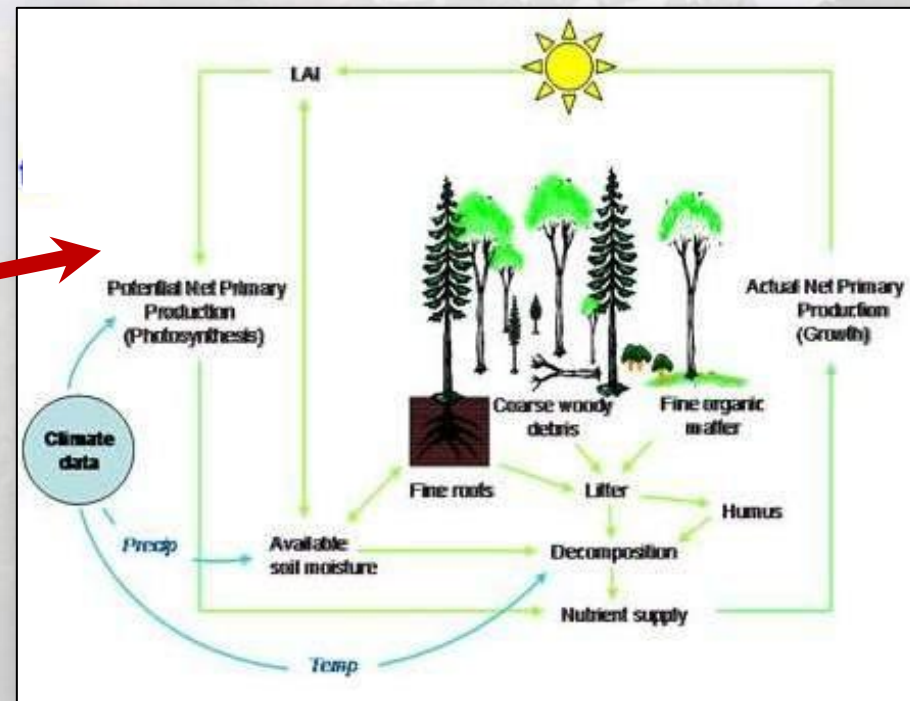


STAND (ECOSYSTEM) SIMULATION:

FORECAST-Climate Ecosystem Process Model



Dr Brad Seely, Dept of Forest Mgmt, UBC



Describes changing stand attributes over time by simulating in various stand layers:

- Harvesting and silviculture
- Climatic and biophysical variables
- Competition, evapotranspiration
- Decomposition

Calibrating Growth Response to Climate

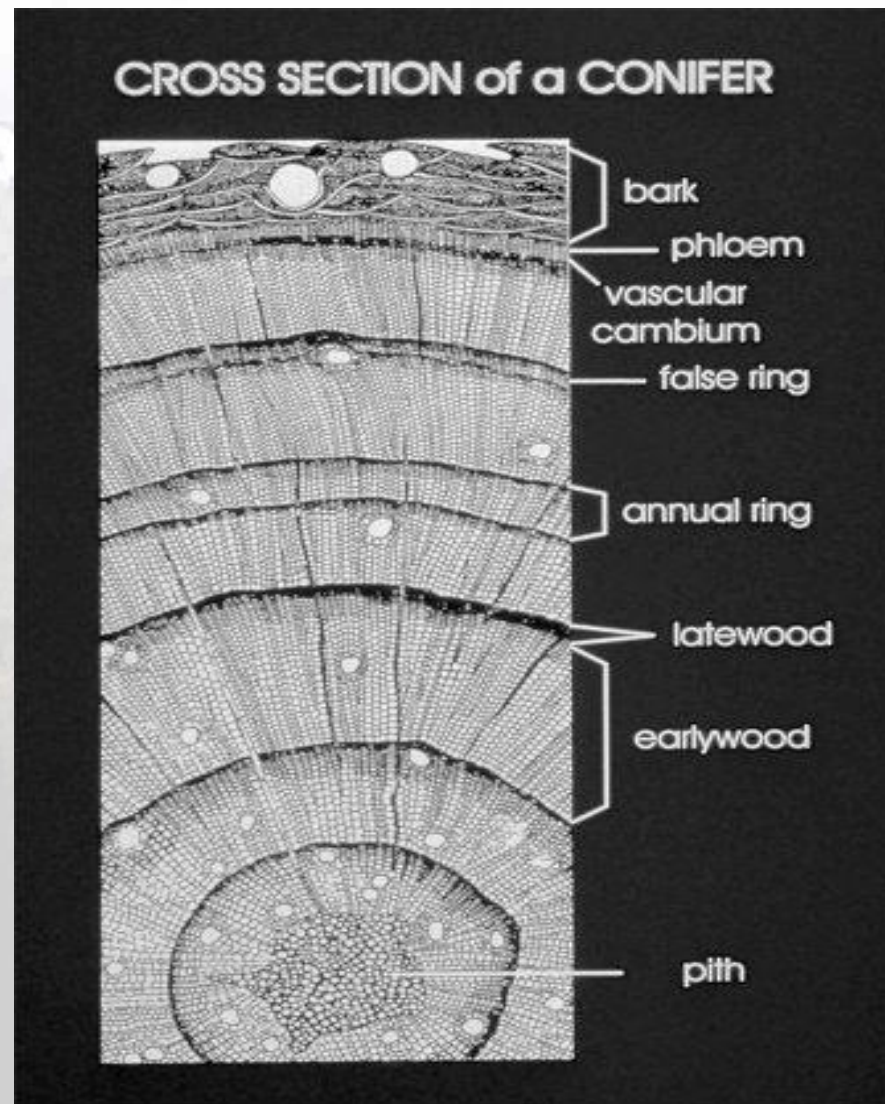
Dendroclimatology: A bioassay of climate impacts on tree growth

Data sources:

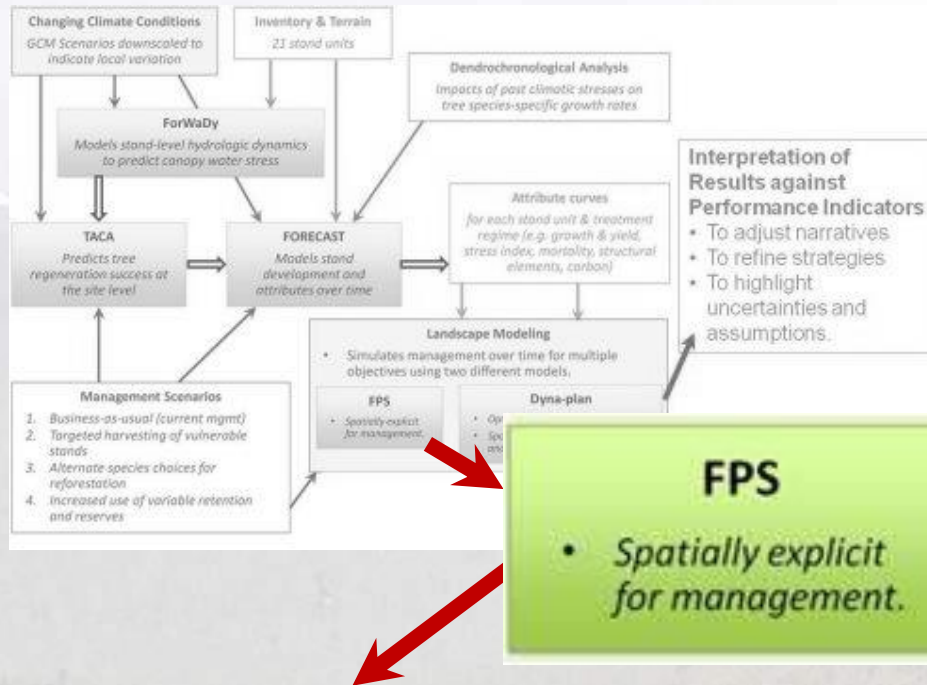
- NOAA tree ring datasets
- Local field sampling (Dendro study)

Lodgepole and Douglas-fir

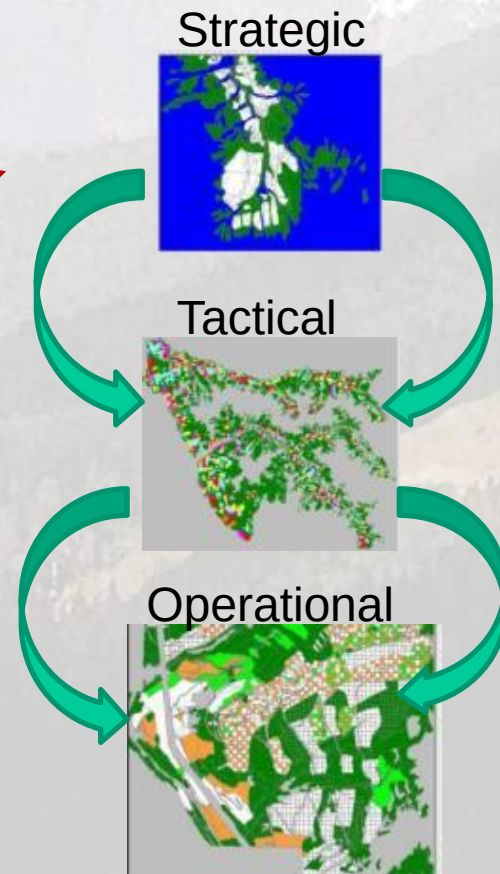
- *Other literature sources*



LANDSCAPE SIMULATION: Forest Planning Studio (FPS)



*Cam Brown and Reg Davis,
Forsite Consulting*



Uses inputs (attribute curves) from stand modeling to spatially report on landscape indicators:

- Harvesting and growing stock
- Species and age class composition
- Stand level moisture stress
- Dead and down trees

Landscape Simulation:

Dyna-plan (new landscape model)

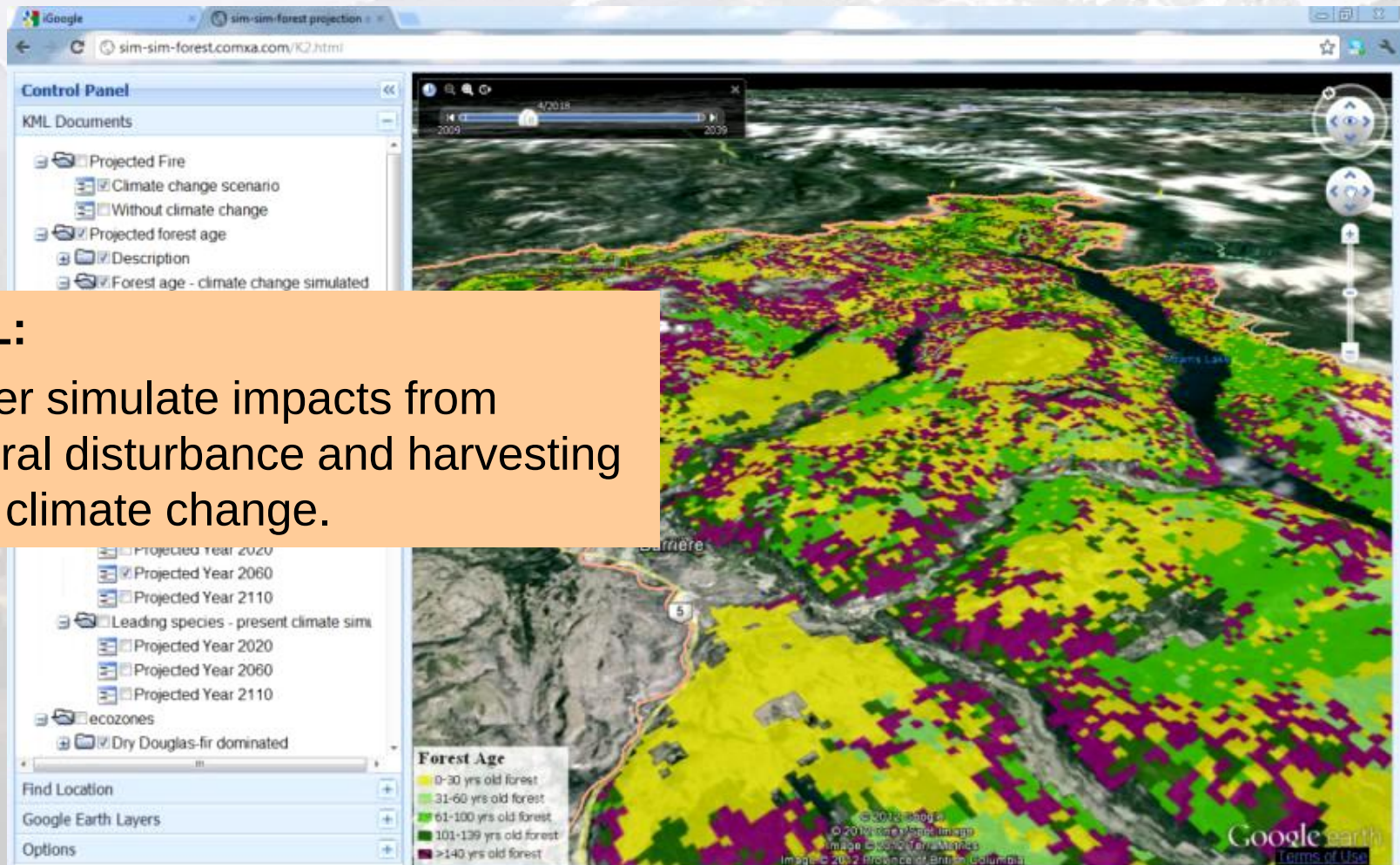
Is BOTH:

Michael Gerzon, Forest Sciences, UBC

- A spatially explicit simulation, AND optimization model

GOAL:

- Better simulate impacts from natural disturbance and harvesting with climate change.



Regeneration Success:

1. Over time some tree species will not regenerate in the open on some sites.

TACA RESULTS:

Dry Transition :

Lodgepole pine regeneration



Site Type

Very dry
Dry
Slightly dry
Moist
Moist-wet
Wet

IDFmw			
Curr	2020s	2050s	2080s
A	A	A	A
VF	A	A	A
VF	F	A	A
VF	VF	VF	VF
VF	VF	VF	VF
F	F	F	F

Douglas-fir regeneration



Site Type

Very dry
Dry
Slightly dry
Moist
Moist-wet
Wet

IDFmw			
Curr	2020s	2050s	2080s
VF	INF	A	A
VF	VF	F	A
VF	VF	VF	F
VF	VF	VF	VF
VF	VF	VF	VF
INF	F	F	INF

A	- Absent
INF	- Infrequent
F	- Frequent
VF	- Very Frequent

FORECAST CLIMATE Stand Level Lessons:

Stand Level Productivity & Mortality

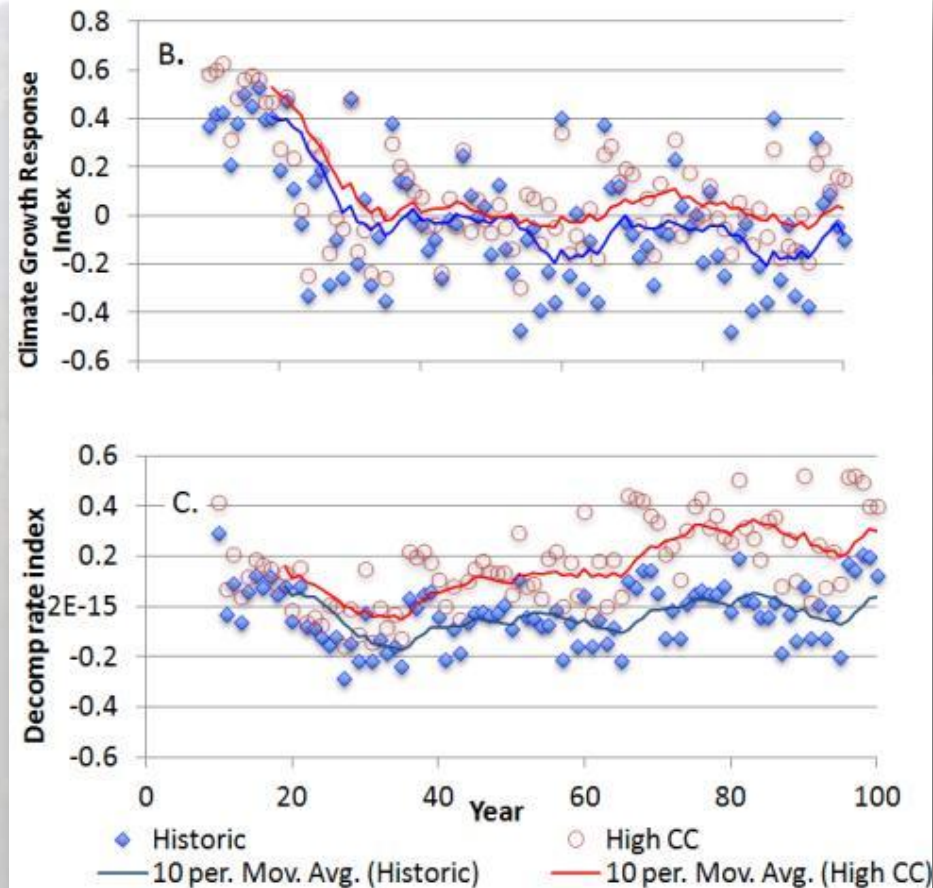
BOTH POSITIVE AND NEGATIVE IMPACTS:

2. Climate warming:

- lengthened the growing season,
- increased decomposition,
- increased productivity.

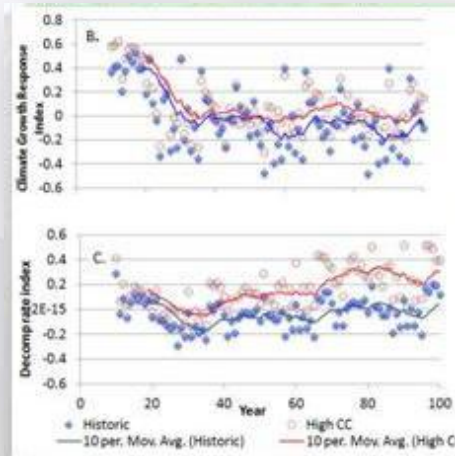
Same DRY TRANSITION:

Doug-fir stand unit

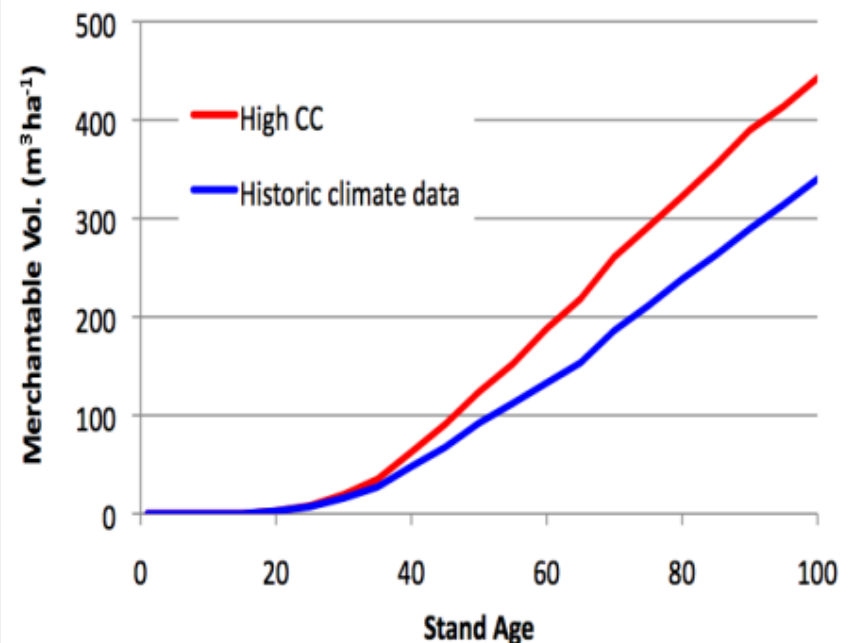


FORECAST Stand Level Lessons:

Stand Level Productivity & Mortality



DRY TRANSITION :
merch volume over time



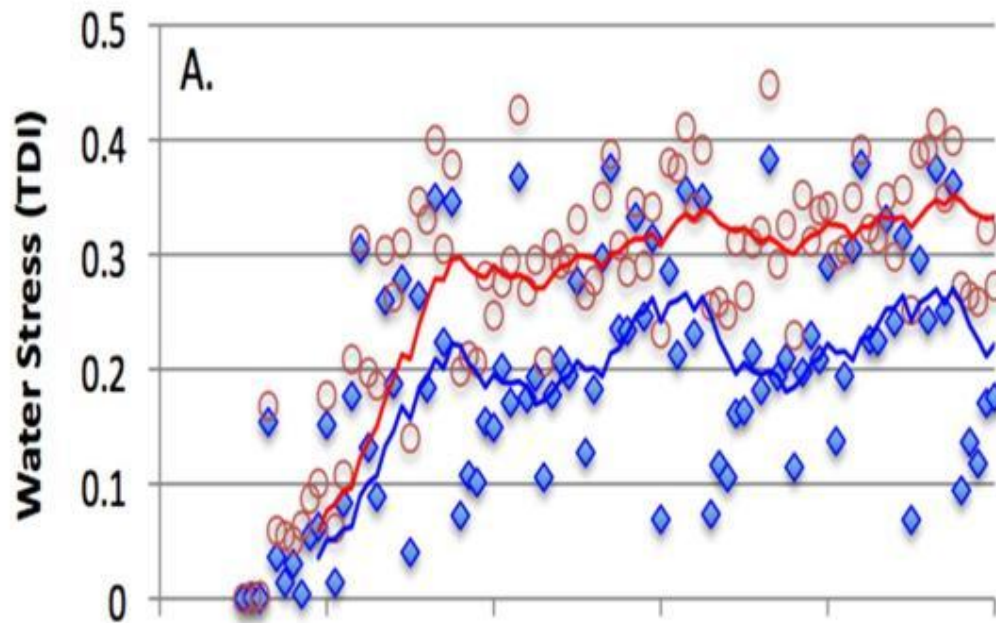
- may lead to more merchantable timber production – BUT...

FORECAST Stand Level Lessons:

Stand Level Productivity & Mortality

BOTH POSITIVE AND NEGATIVE IMPACTS:

3. Climate change consistently led to increase in mid-growing season water stress

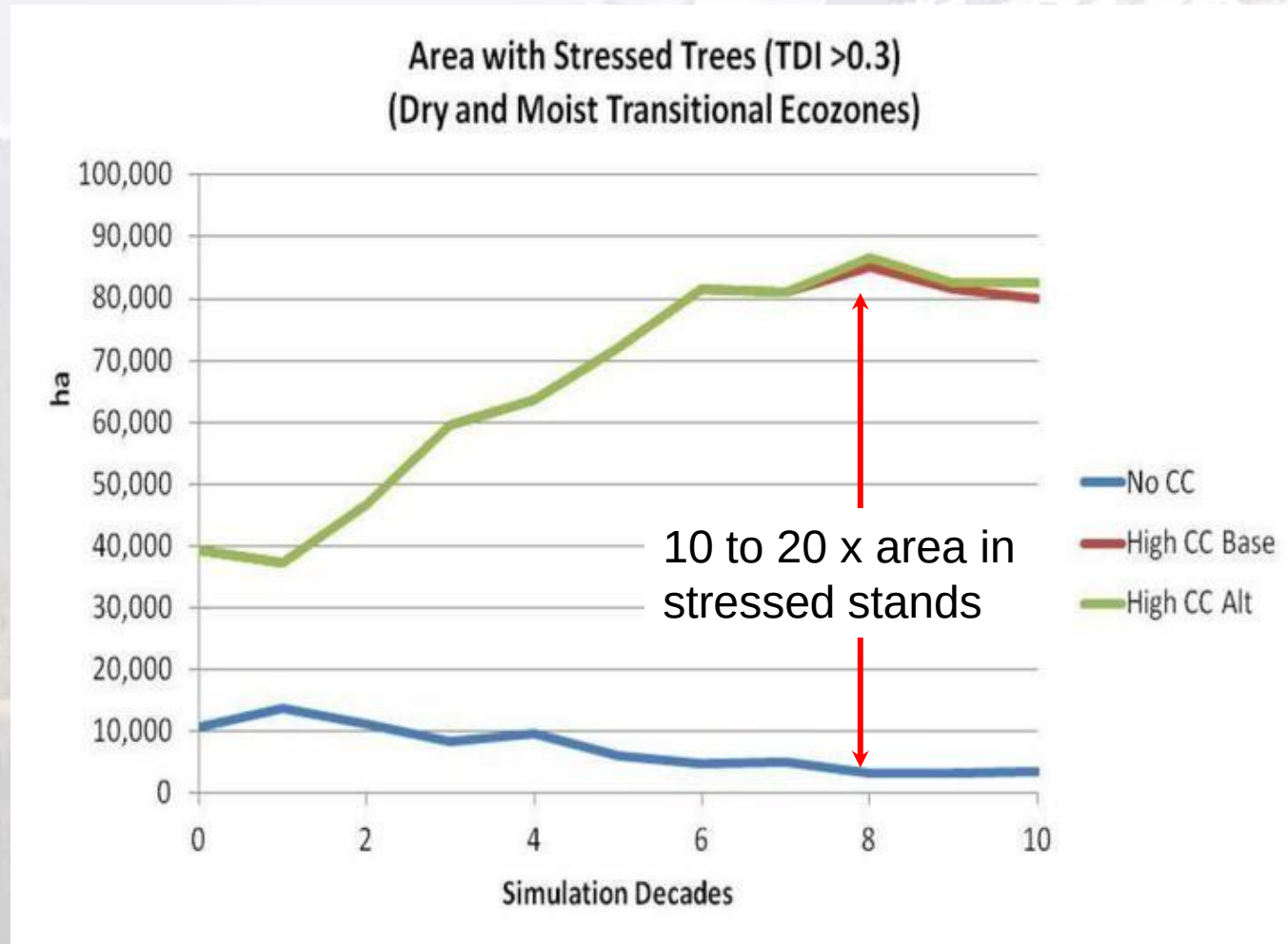


Dry Transition: Doug-fir stand unit

- Average annual transpirational deficit index over 100 yr simulation.

Projected area in Moisture-stressed Stands

NET IMPACT DEPENDS ON SPECIES, ECOZONE AND SITE:



Developing Management Guidance

- Experts and practitioners in project both helped adjust models
- And then used model results to inform guidance

Management Insights

- Planting guidelines
- Strategic Planning
 - OGMA loss of function
 - Where THLB will be at risk over time period
 - Which ecozones and stand types are at highest risk

Resulting Management Guidance

Guidance to Adapt Forest Management for Climate Change in the Kamloops TSA.

FIRST APPROXIMATION (June 7, 2012) which should be viewed as a continuous work in progress.

Based on:

Validating Impacts, Exploring Vulnerabilities, and Developing Robust Adaptive Strategies under the Kamloops Future Forest Strategy (K2-2011) – Future Forest Ecosystems Scientific Council (FFESC) Interdisciplinary Climate Change Adaptation Research for Forest and Rangeland Ecosystems.

And

Adapting Forest Management in the Kamloops TSA to Address Climate Change – The Kamloops Future Forest Strategy (K1 – 2009)



Forest Resources Management
University of British Columbia,
Symmetree Consulting Group Ltd.,
Forsite Consultants Ltd.

Ecological Landscape (Ecozones)	Associated BEC subzones	Guidance	Details
Plateau	Transitional to higher elevations (e.g. MSdm, SBS mm ESSFdc)	Avoid conversion of Douglas-fir or Spruce leading stands to Pli leading stands	Manage for a majority of Fd, Py, Lw, Pw and other appropriate non-pine species. Restrict Pli to 20-30% of stocking or restrict to "acceptable" stocking status in silvicultural surveys.
		Encourage species diversity across the landscape.	On average across the landscape, maintain species diversity at natural / historic levels. Target warm lower elevation sites for increased amounts of Douglas-fir (e.g. 20-35%) where it is ecologically feasible.
Plateau (cont)	Transitional to higher elevations (e.g. MSdm, SBS mm ESSFdc)	Maintain presence of At on landscape for habitat and species diversity	Avoid removal of aspen (where concentrated) through brushing and other activities. Make strategic use of stratification and free-growing stocking standards.
Wet ESSF	e.g. ESSFwk	Encourage tree species diversity as much as possible across the landscape	Spruce is still a good choice for regeneration – monitor carefully for increased weevil damage at lower elevations, where redcedar should be gradually mixed in.

Harvesting:

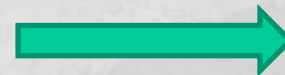
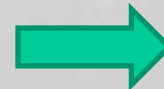
The harvesting guidance below is strategic in nature and as such requires thoughtful strategic planning directing well-coordinated tactical plans. Work will be necessary to identify the vulnerable stand types and make appropriate decisions regarding economics and timing of treatment. Incentive and other mechanisms not yet in place may be needed.

Ecological Landscape (Ecozones)	Associated BEC subzones	Guidance	Details
Dry Fdi (Py)	IDF and PP subzones too dry for Pli	Reduce fuels with commercial thinning and/or juvenile spacing	With well designed fire management strategies encourage vigor and health and reduce fire risk by significantly reducing stand stocking densities.
Dry subzones with Pli	IDF with Pli (e.g. IDFdk) and very dry MS (e.g. MSdk)	Targeted harvesting to address high risk stands.	Target stands more vulnerable to fire (with climate change) as a priority for harvesting, retaining those stands that are less vulnerable for future passes and other objectives.

To Reduce Tree/Stand Vulnerabilities:

1. PLANT RESILIENT SPECIES AND DIVERSIFY AT BOTH LANDSCAPE AND STAND LEVEL:

- More PONDEROSA PINE in Drier ecozones
- More DOUGLAS-FIR in moister ecozones
 - Moist Transition / Plateau
- Use the FULL MIX OF SERAL SPECIES in Moist Transition ecozone



Strategic Planning Implications:

STAND CONVERSIONS TO LODGEPOLE PINE INCREASE RISK ON THE LANDSCAPE:

- *Especially in drier subzones*
- *and/or on drier sites.*



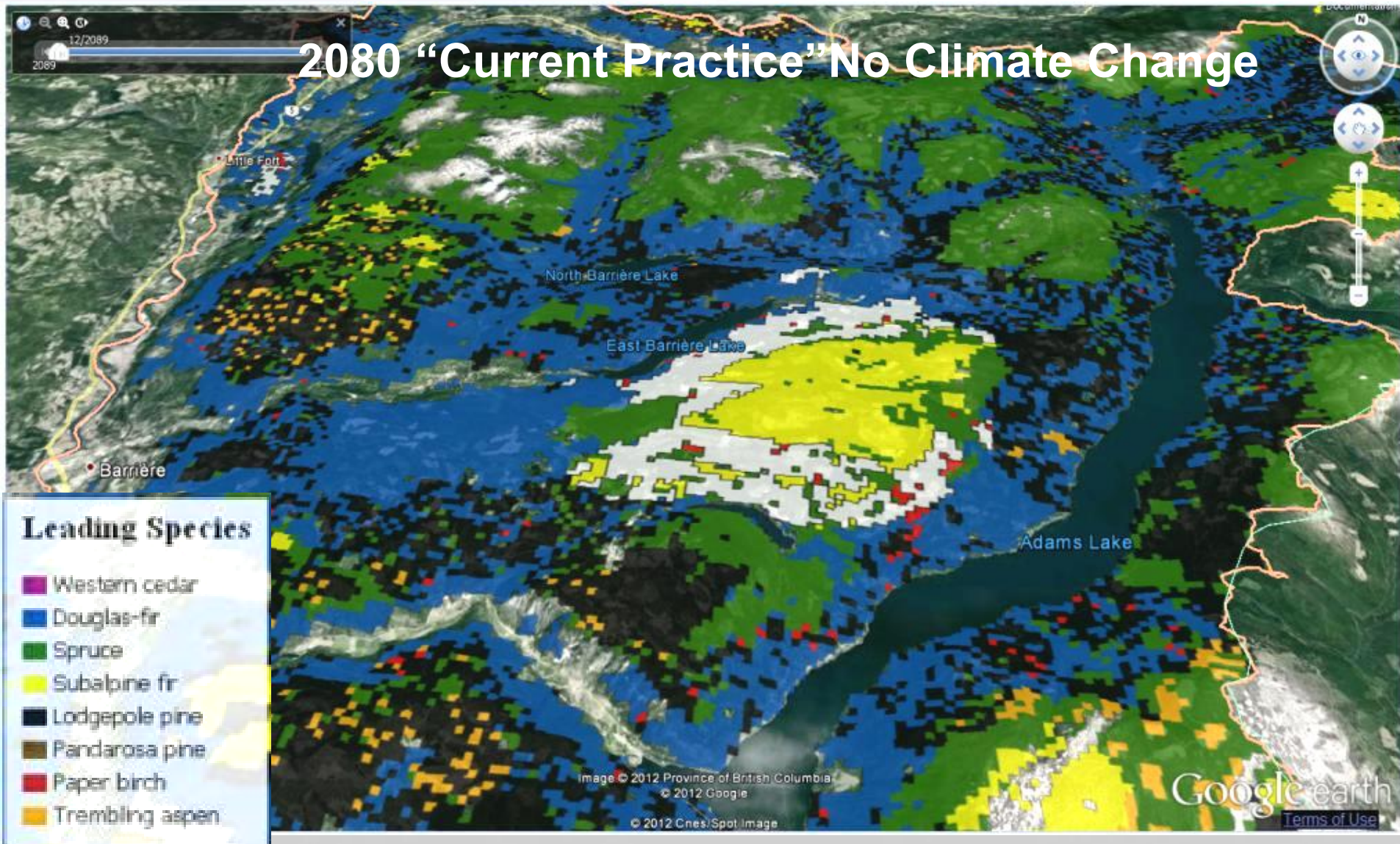
Reducing Vulnerability – Dyna-plan Simulation:

The “current” problem with pine conversions:



Reducing Vulnerability – Dyna-plan Simulation:

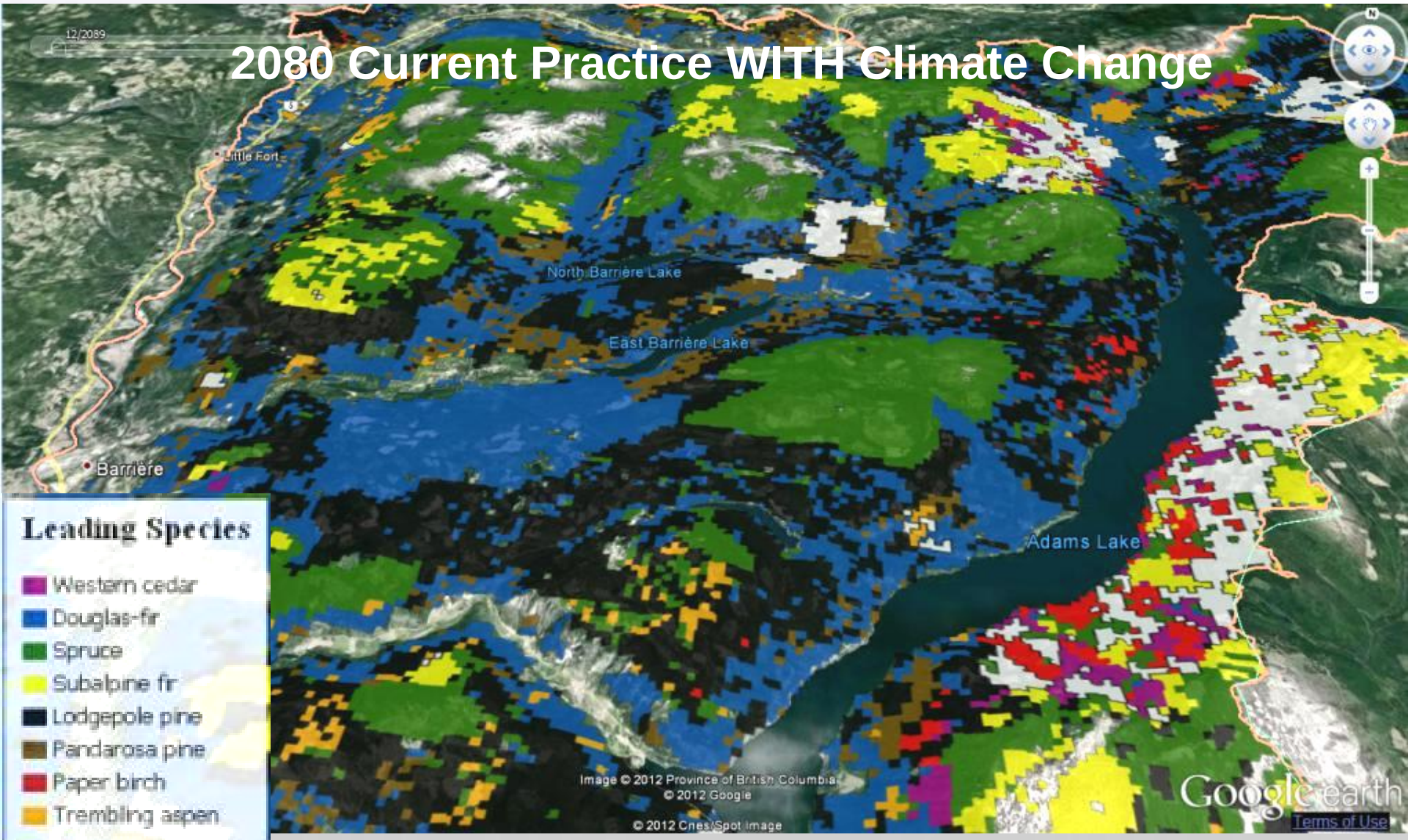
The “current” problem with pine conversions:



Reducing Vulnerability – Dyna-plan Simulation:

The “current” problem with pine conversions:

2080 Current Practice WITH Climate Change



TRENDS

Area burned (wildfires) projected to DOUBLE

Spatial simulation – at 2060-2070

- 10 year area burned by stand replacing fires.

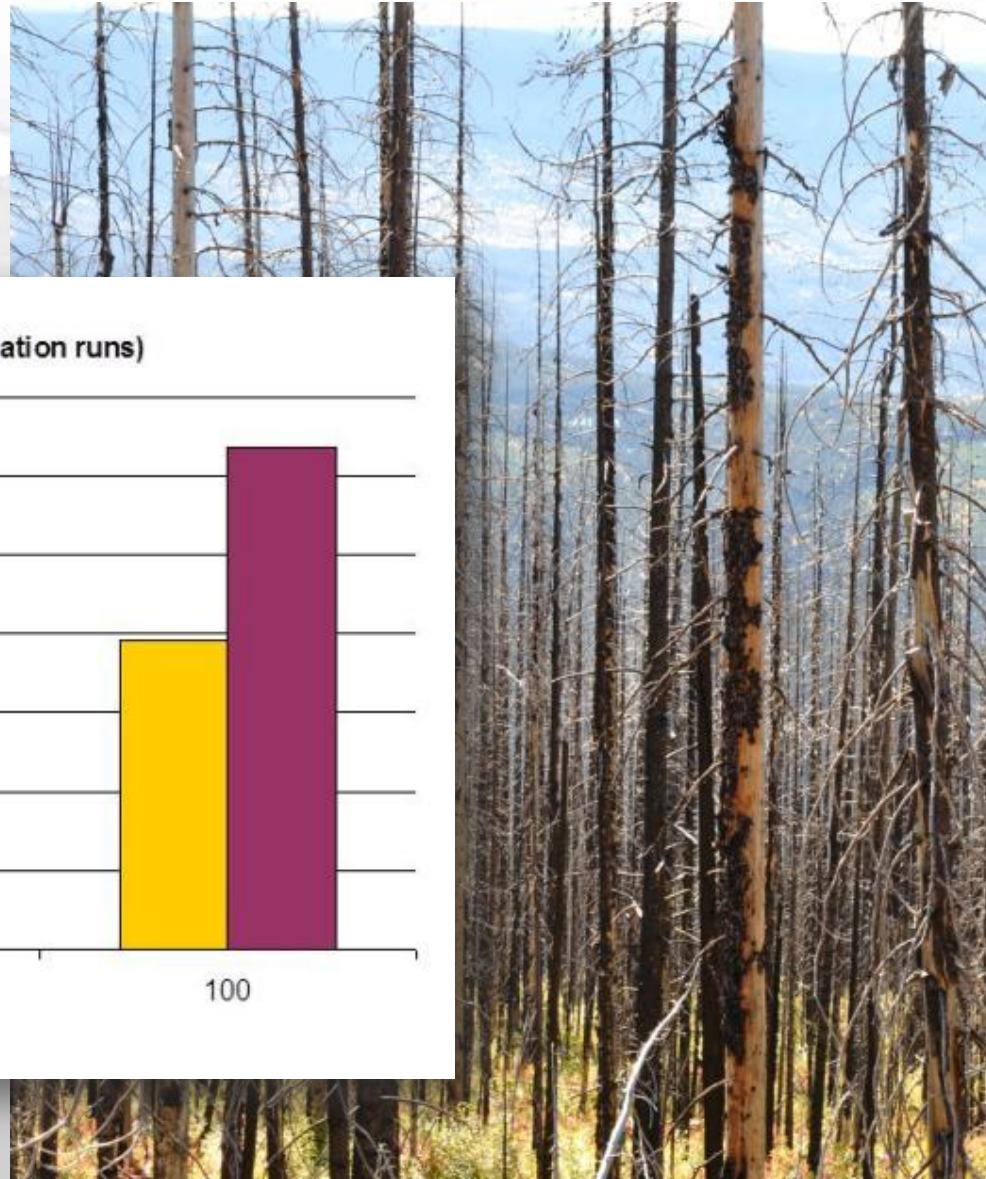
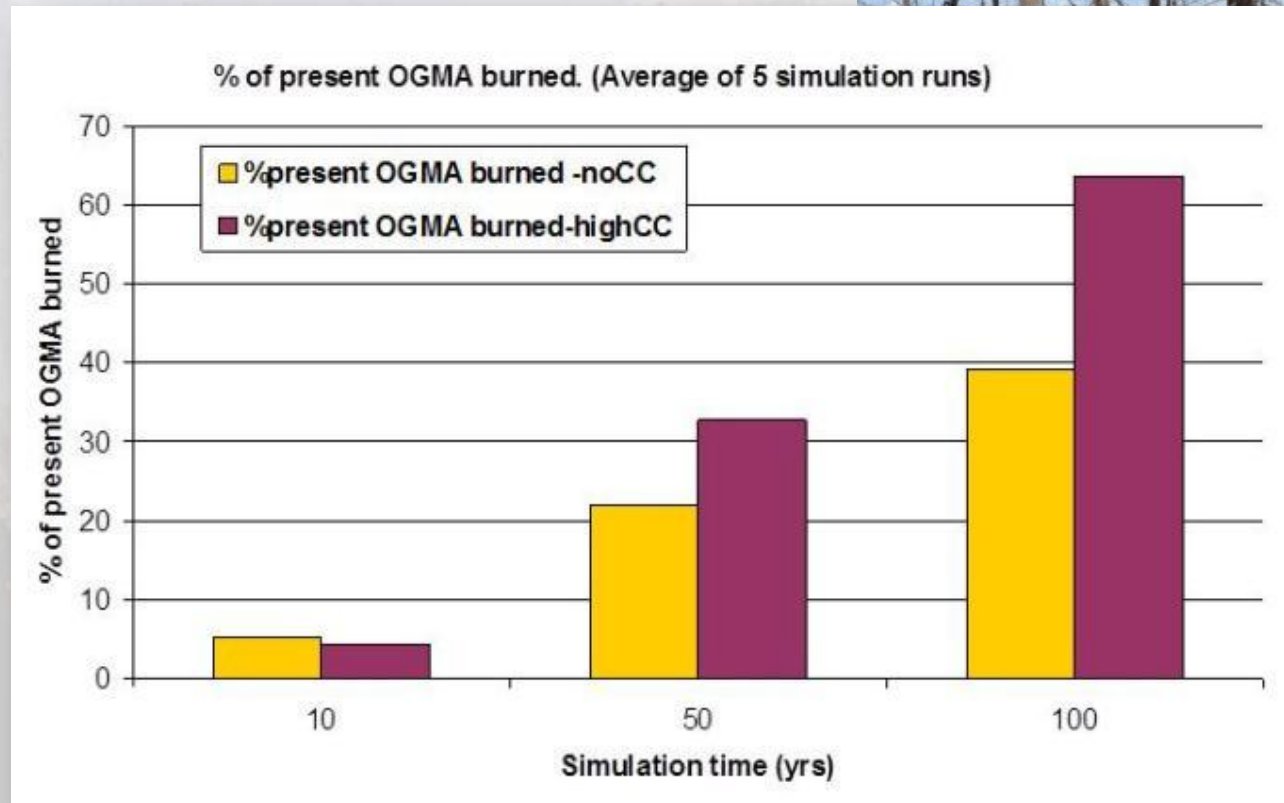


TRENDS

Biodiversity – Old Growth Reserves:

Dyna-plan spatial simulation:

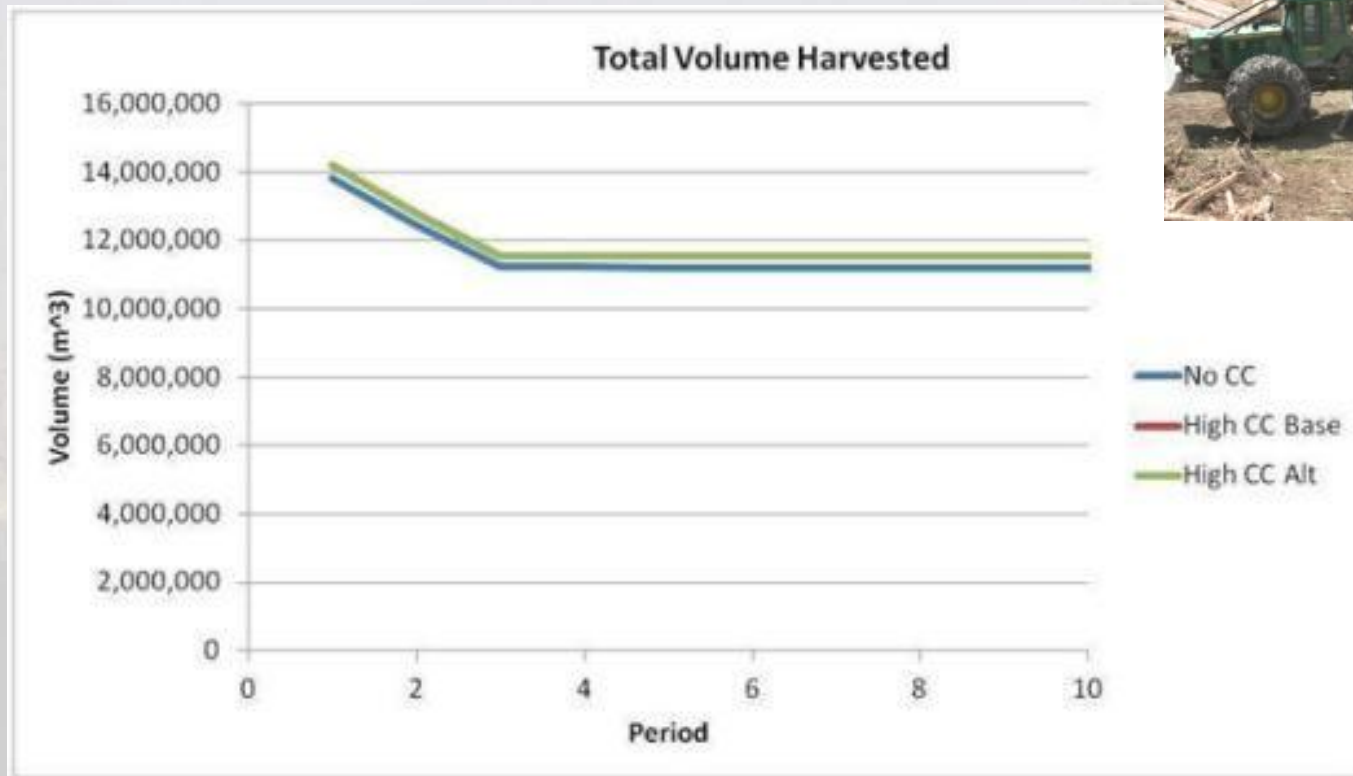
- Old Growth Reserves burned with climate change.



TRENDS

Timber Flows over the 100 year simulation:

- Harvest levels can be maintained over the 100 yr simulation period...BUT

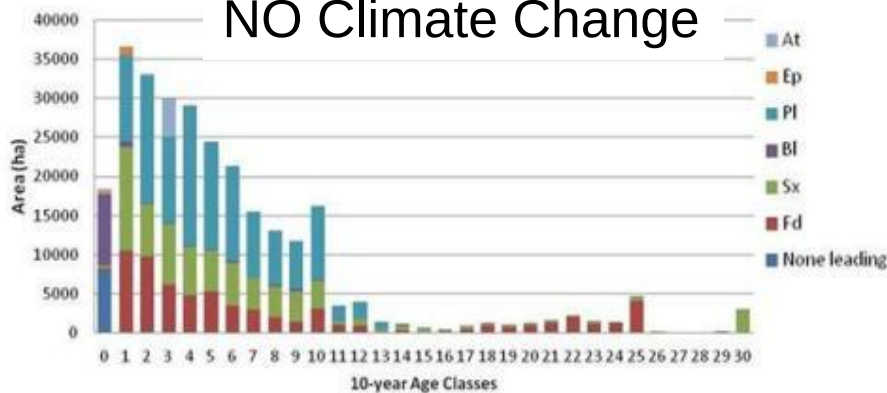


TRENDS

Timber Flows **BEYOND** the 100 year simulation:

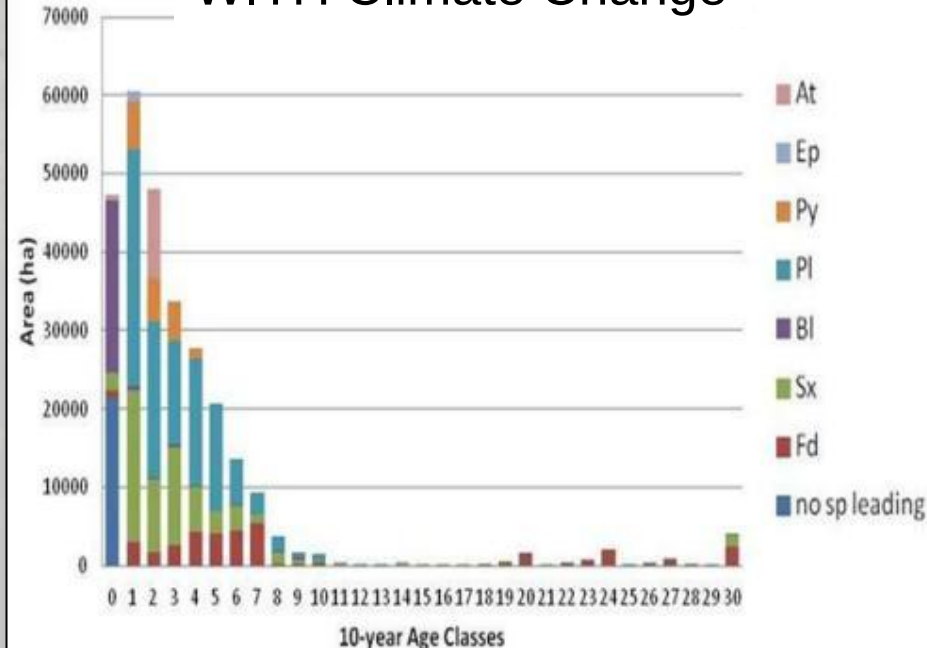
- Could be headed for a big falldown in harvestable timber.

NO Climate Change

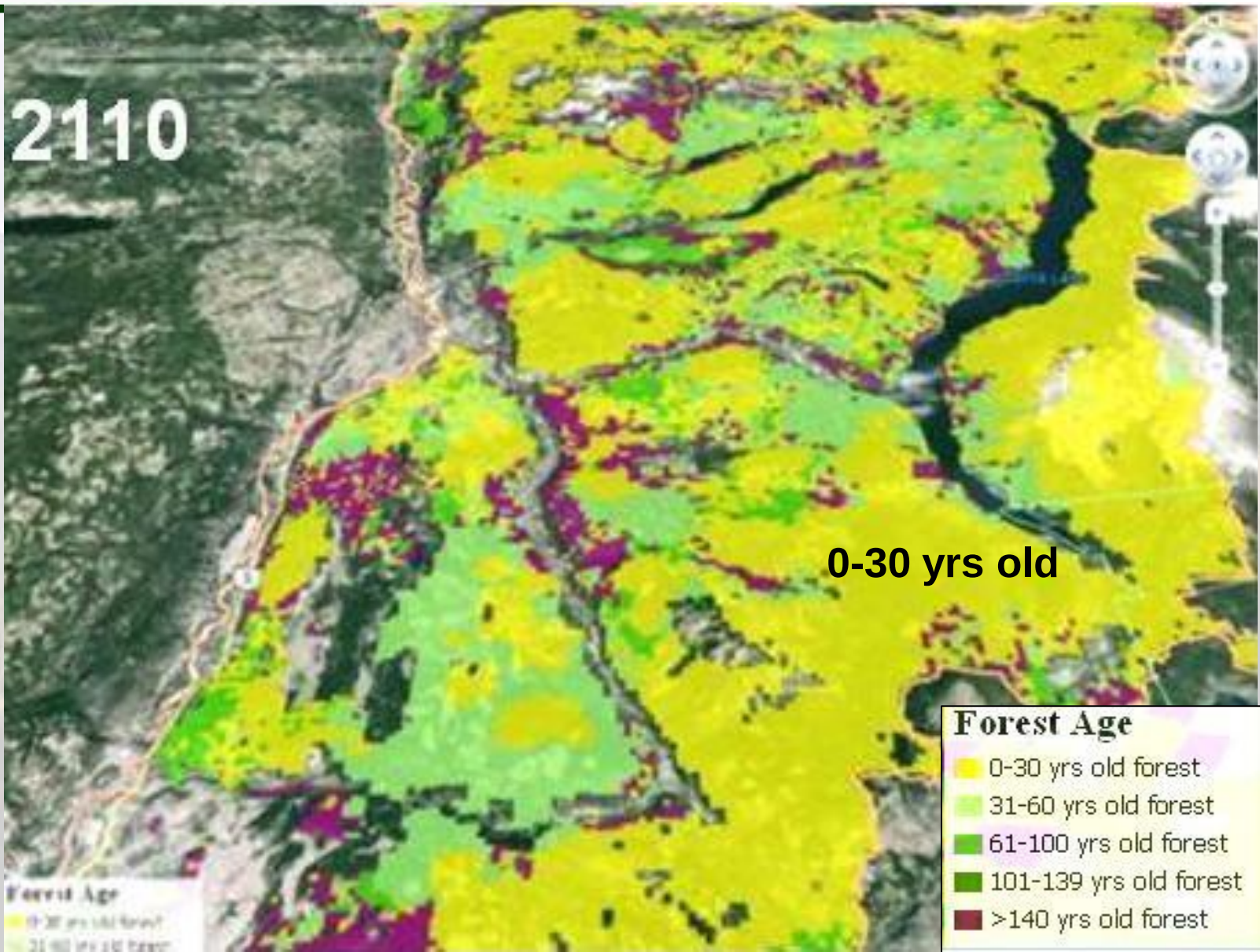


2110

WITH Climate Change



Visualization of Age Classes with Climate Change...



We Turn to the Issue of Uncertainty...

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Plateau (cont)	Transitional to higher elevations (e.g. M50m, SBS, rtm ESSFw)	Encourage species diversity across the landscape.	On average across the landscape, maintain species diversity at natural / historic levels. Target lower elevations sites for increased amounts of Douglas-fir (e.g. 20-35%) where it is ecologically feasible.
Wet ESSF	e.g. ESSFw	Maintain presence of As on landscape for habitat and species diversity.	Avoid removal of aspen (where concentrated) through logging and other activities. Make strategic use of stratification and free-growing stocking standards.
		Encourage tree species diversity as much as possible across the landscape.	Spruce is still a good choice for regeneration – monitor carefully for increased weevil damage at lower elevations, where necessary should be gradually moved in.

Harvesting:

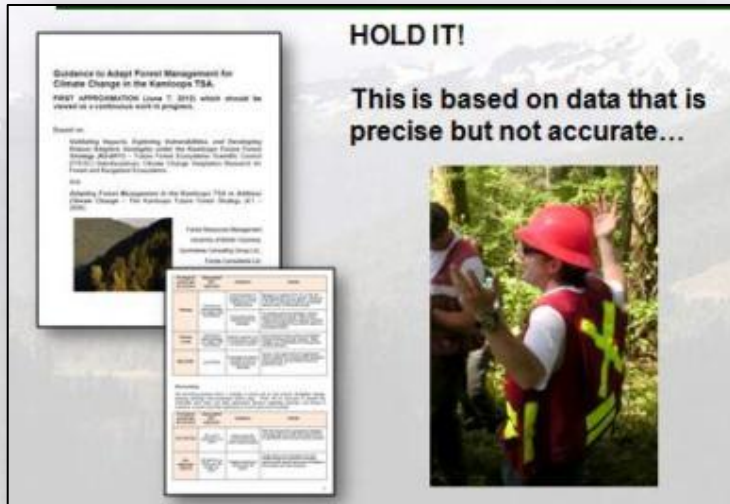
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Dry Fd (Py)	DF and RP subzones too dry for PI	Reduce fuels with commercial thinning and/or juvenile spacing	With well designed fire management strategies, encourage vigor and health and reduce the risk by significantly reducing stand stocking densities.
Dry subzones with PI	DF with PI (e.g. DFd) and very dry MD (e.g. MDd)	Targeted harvesting to address high risk stands.	Target stands more vulnerable to fire (with climate change) as a priority for harvesting, retaining those stands that are less vulnerable to future stresses and other objectives.

This guidance is based on data that is precise but not accurate...



Models Can Allow for Probing of Uncertainty...



We can vary parameters and assumptions in models to assess robustness of results:

- Precision allows for useful comparisons within these different scenarios.
- But Important to Recognize Uncertainty by Continually:
 - Questioning assumptions, and
 - Revisiting modeling and management.
 - Through monitoring and research

Why Adaptive Management Might Not be Embraced

- Inconsistency
- Sunk costs
- Indecisiveness

Climate change adds

- Uncertainty
- Additional complexity
- Unfamiliarity

There is only one living species in the world that often actively resists adaptation – humans.*

<http://www.projecttimes.com/articles/adaptive-project-management.html>

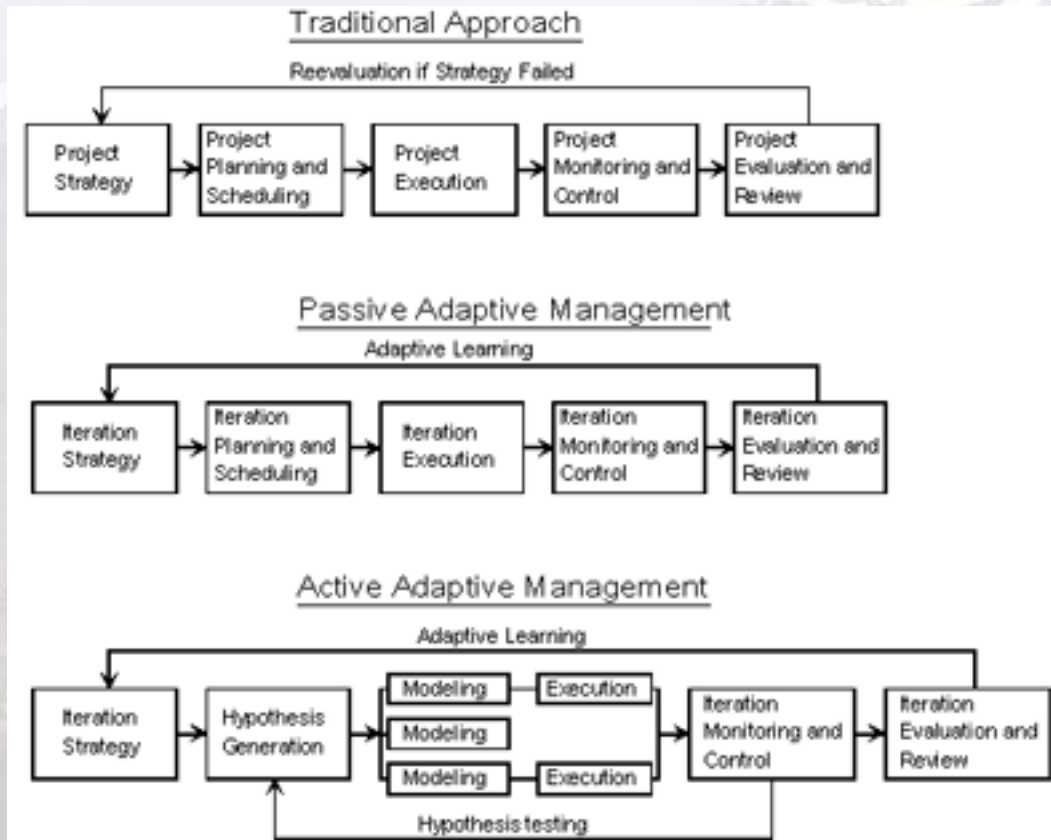
Source: Viner; also own author

How Quantitative Approach Can Address Barriers

- Inconsistency
- Sunk costs
- Indecisiveness
- Complexity
- Uncertainty
- unfamiliarity
- Future is changing-it's ok to change too!
- Current practices may result in magnified risks
- Allows opportunity for structured evaluation of decisions “by the gut”
- Scenarios and process-based models offer ways to explore how complex relationships might change and how things might evolve over time and space
- Tools (models) offers an alternative to existing approaches, plus giving people opportunity to examine how their tools may need to be modified

But need to recognize it brings its own set of barriers-technical expertise, cost...

Enabling Adaptive Management



We live forward, but
understand backward
Søren Kierkegaard (not
a forester)

Researchers



KAMLOOPS FUTURE FOREST STRATEGY II

Validating Impacts, Exploring Vulnerabilities, and Developing Robust Adaptive Strategies

 Search

Feeds:  Posts  Comments



Photo: Courtesy of Dave Dobl

The Kamloops Future Forest Strategy II (K2) home page

Adapting Forest Management Under Climate Change

These pages serve as a portal to promote an ongoing dialogue between the Kamloops clients (government agencies, forest licensees, communities, First Nations, and other stakeholders) and the K2 Research Team in a joint effort to understand how the changing climate will affect the forest ecosystems and management of the Kamloops Timber Supply Area (TSA) in British Columbia, Canada.

In the following pages you'll be able to learn about how K2 has been developing,

K2 PAGES

- Background
- K2 Introduction
- Kamloops TSA & Study Area
- K2 Research Team
- The Models:
 - TACA
 - ForWaDy
 - FORECAST
 - FPS
 - DYNA-PLAN

For more information please visit www.K2KamloopsTSA.com