Assessing the exposure of low productivity forests to different fire risks with two indicators of vulnerability

Sylvie Gauthier **Frédéric Raulier**
Héloïse Le Goff **Rija Rapanoela**
Yves Bergeron

Ressources naturelles Canada
Natural Resources Canada

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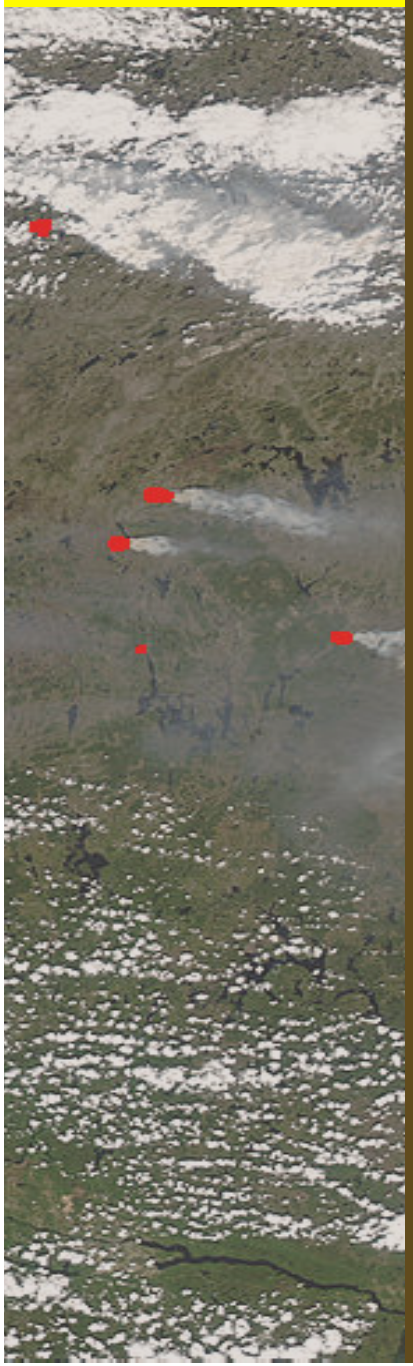
Canada



Fire and harvesting

What we know for sure:

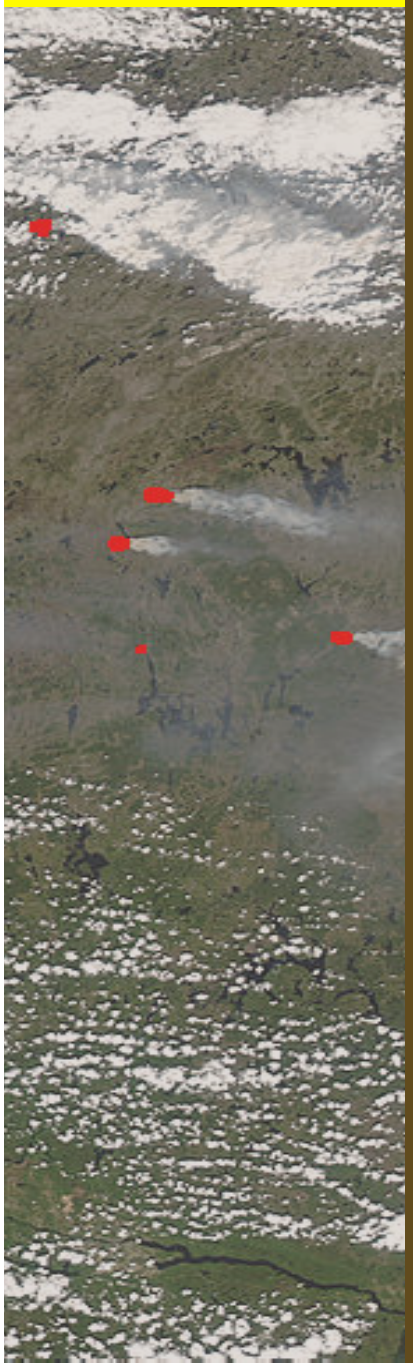
- A proportion of the boreal forest will burn within the next decade.

What we don't know:

- Where, when and what surface area?

Way forward:

- Fire risk can be integrated in AAC calculation (c.f. Leduc et al., Martell et al., Van Wagner, etc).

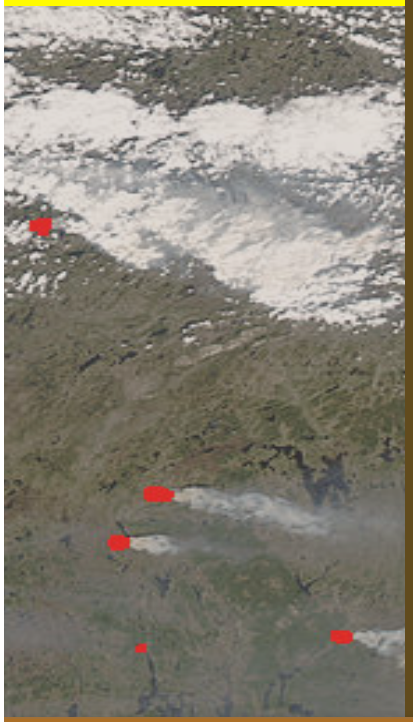


However

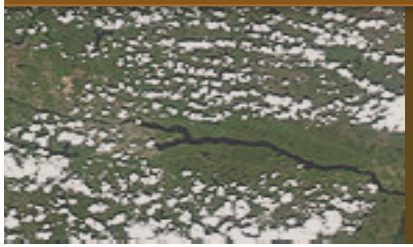
- Industries and jurisdictions are hesitant to include fire risk *a priori* because :
  - Fire risk can be taken into account *a posteriori* by recalculating AAC regularly;
  - It results into a significant decrease in current harvesting volumes if one considers future fire events.

Martell et Savage 2010

Introduction



Important fluctuations in harvest if fire risk is not considered into planning



However

- Industries and insurance companies are hesitant to include fire risk a *priori* because :
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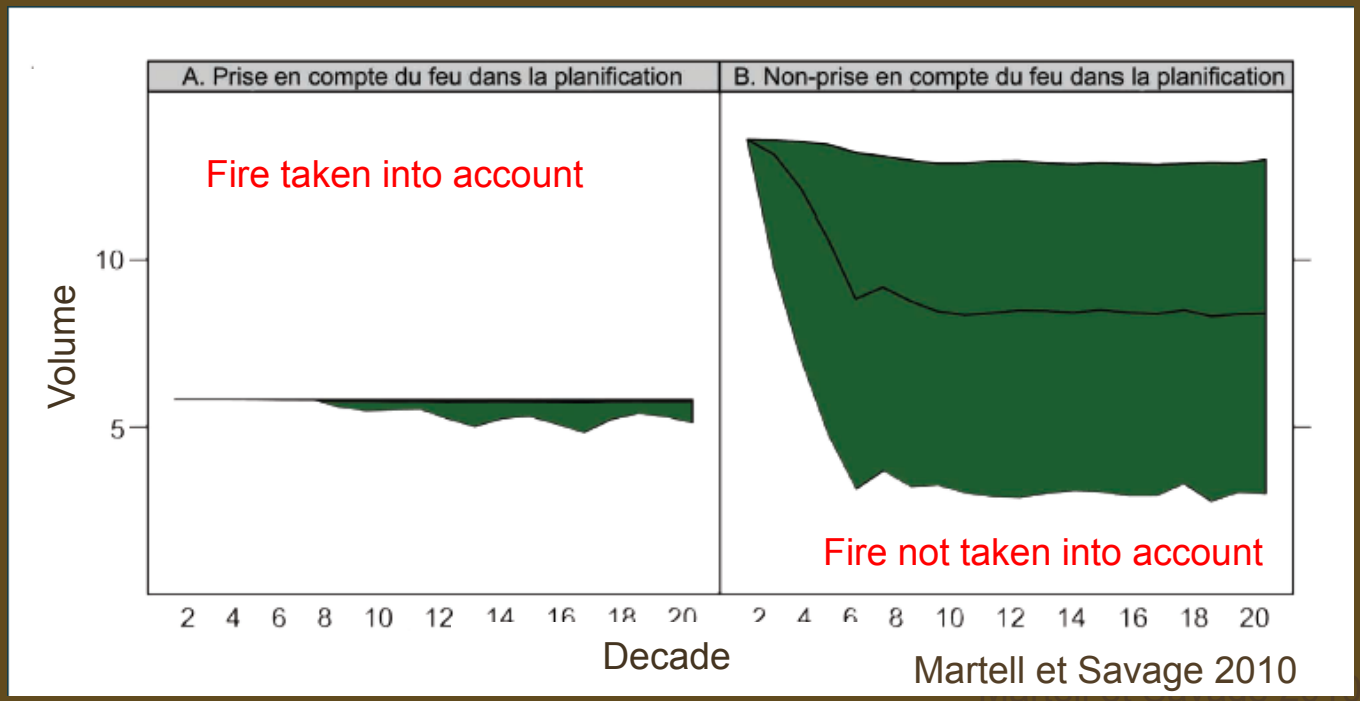


Martell et Savage 2010

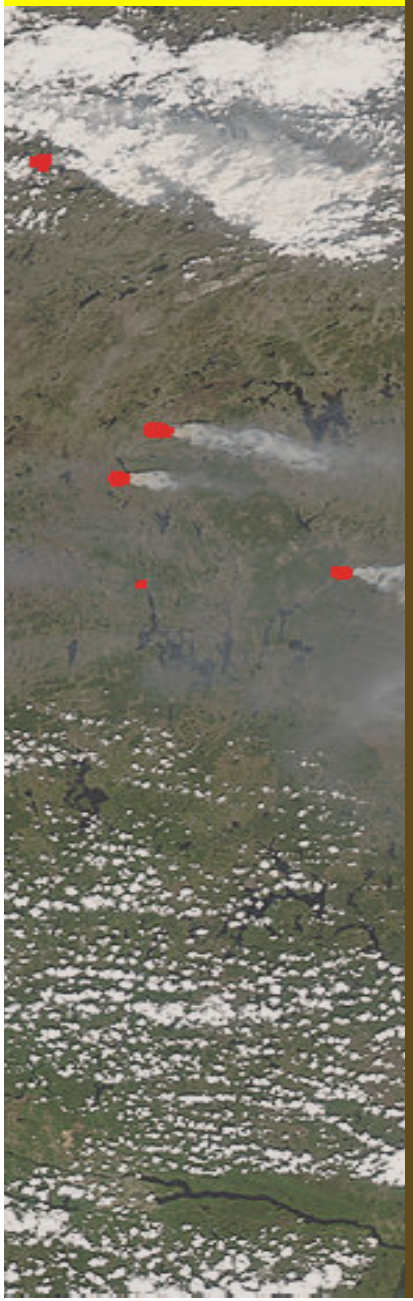
Research question

Can stand productivity be included in assessing forest vulnerablity in the face of fire?

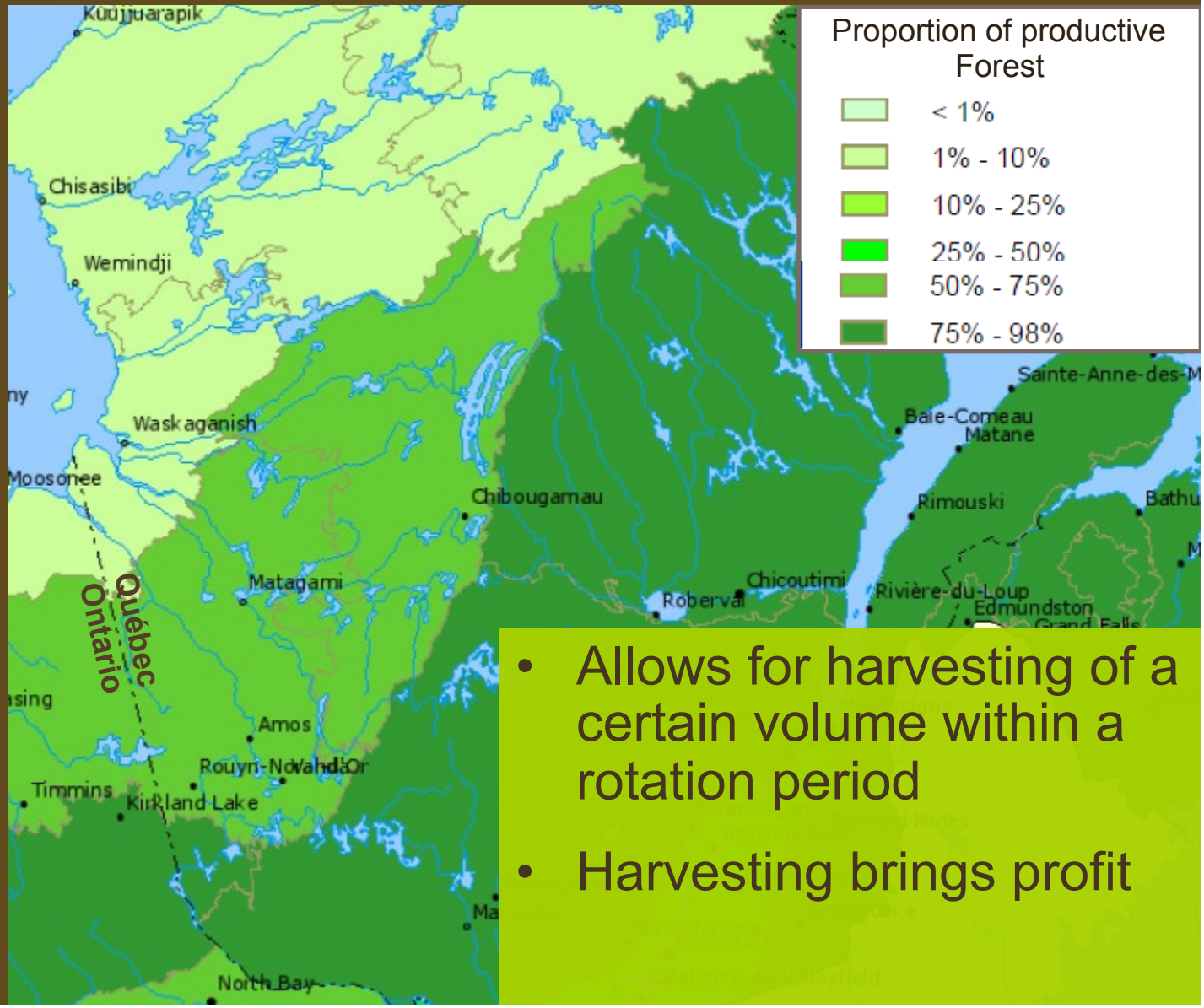
Are production goals adjustable when fire risk is taken into account?

→ The results are published in Raulier et al. 2012. Introducing two indicators for fire risk consideration in the management of boreal forests. Ecol. Indic., doi: 10.1016/j.ecolind.2012.07.23

Research question

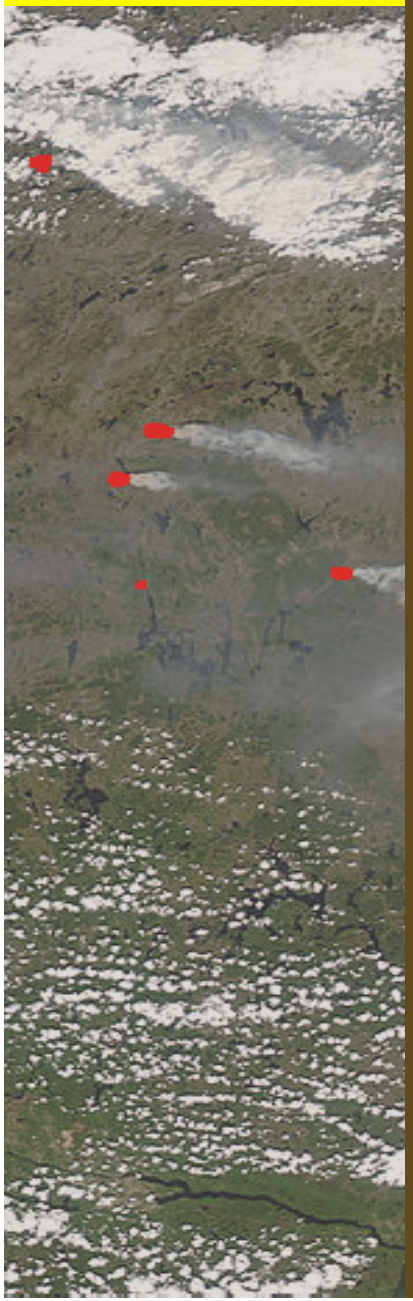


Defining a productive forest?

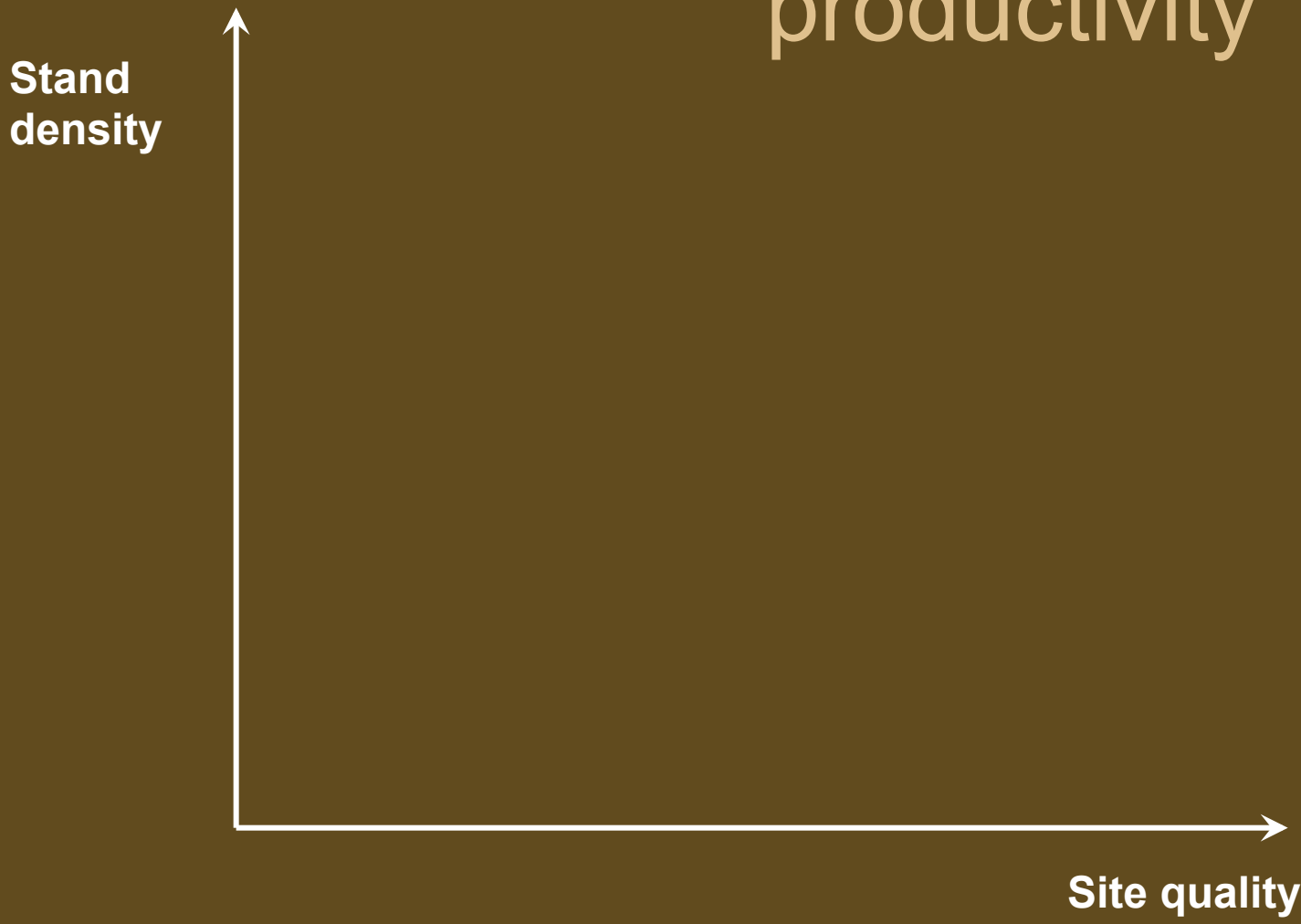


- Allows for harvesting of a certain volume within a rotation period
- Harvesting brings profit

Research question



Double threshold to define productivity



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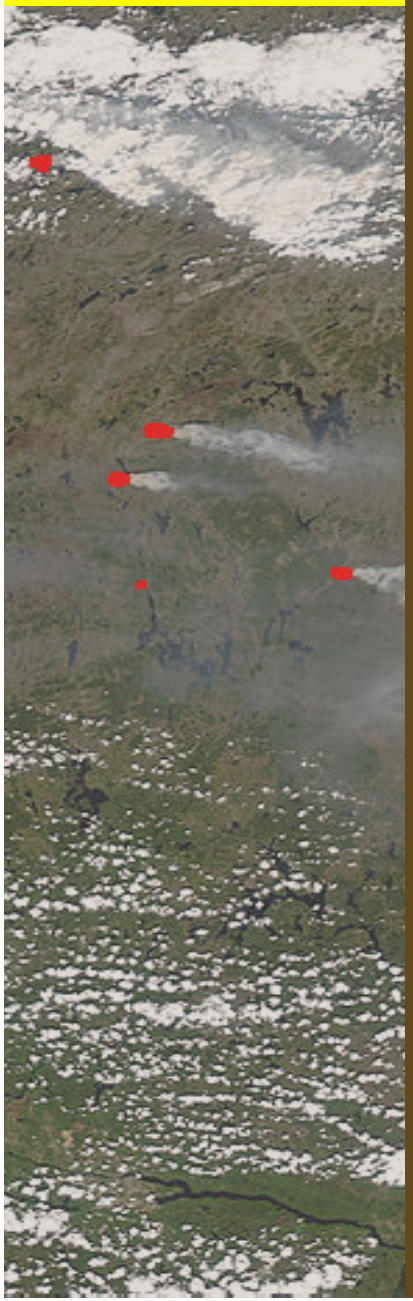

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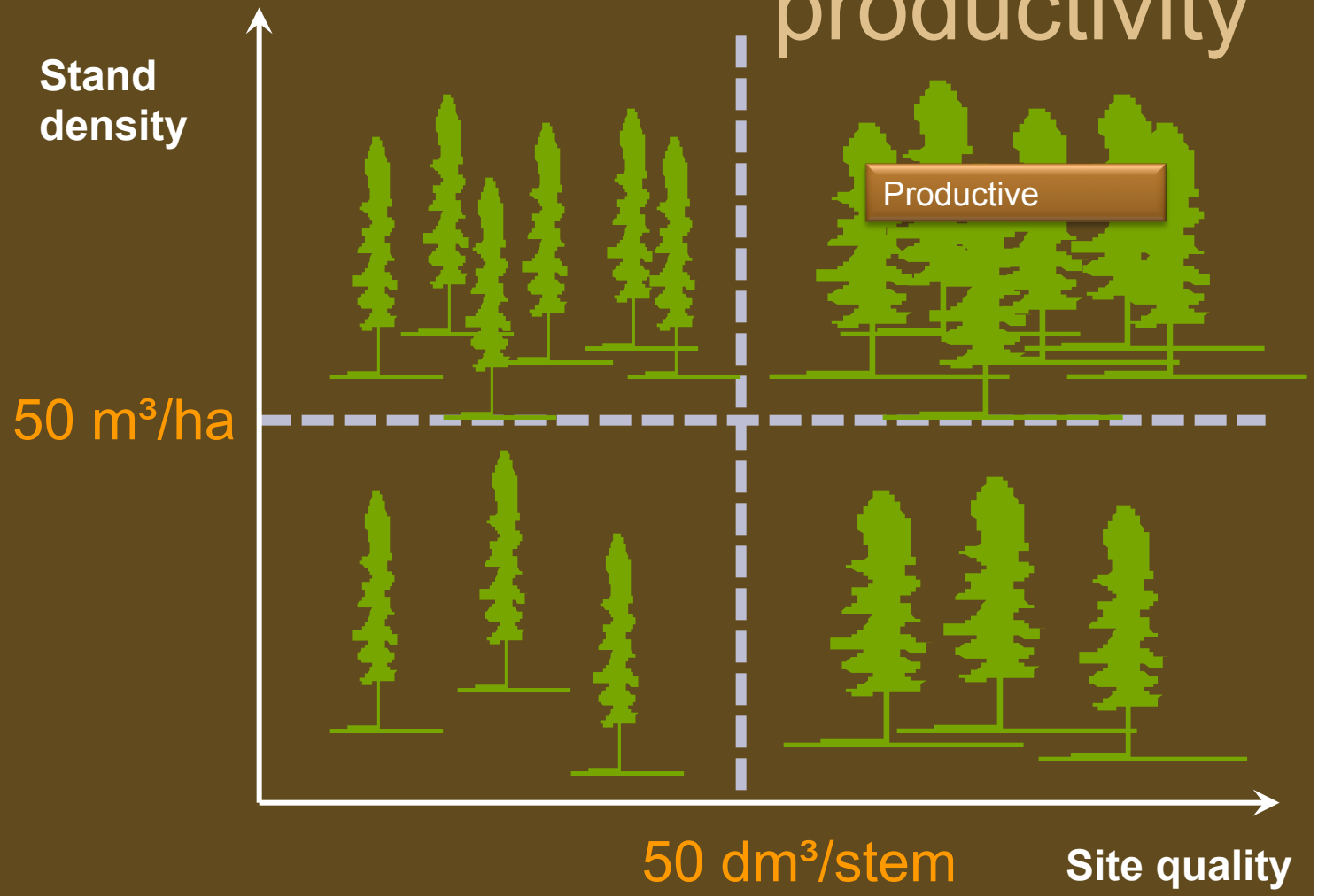

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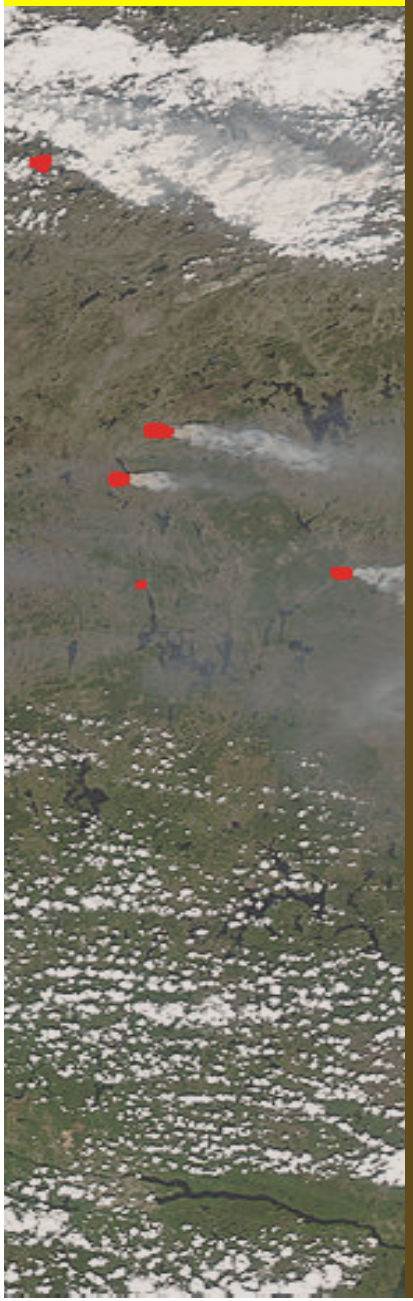

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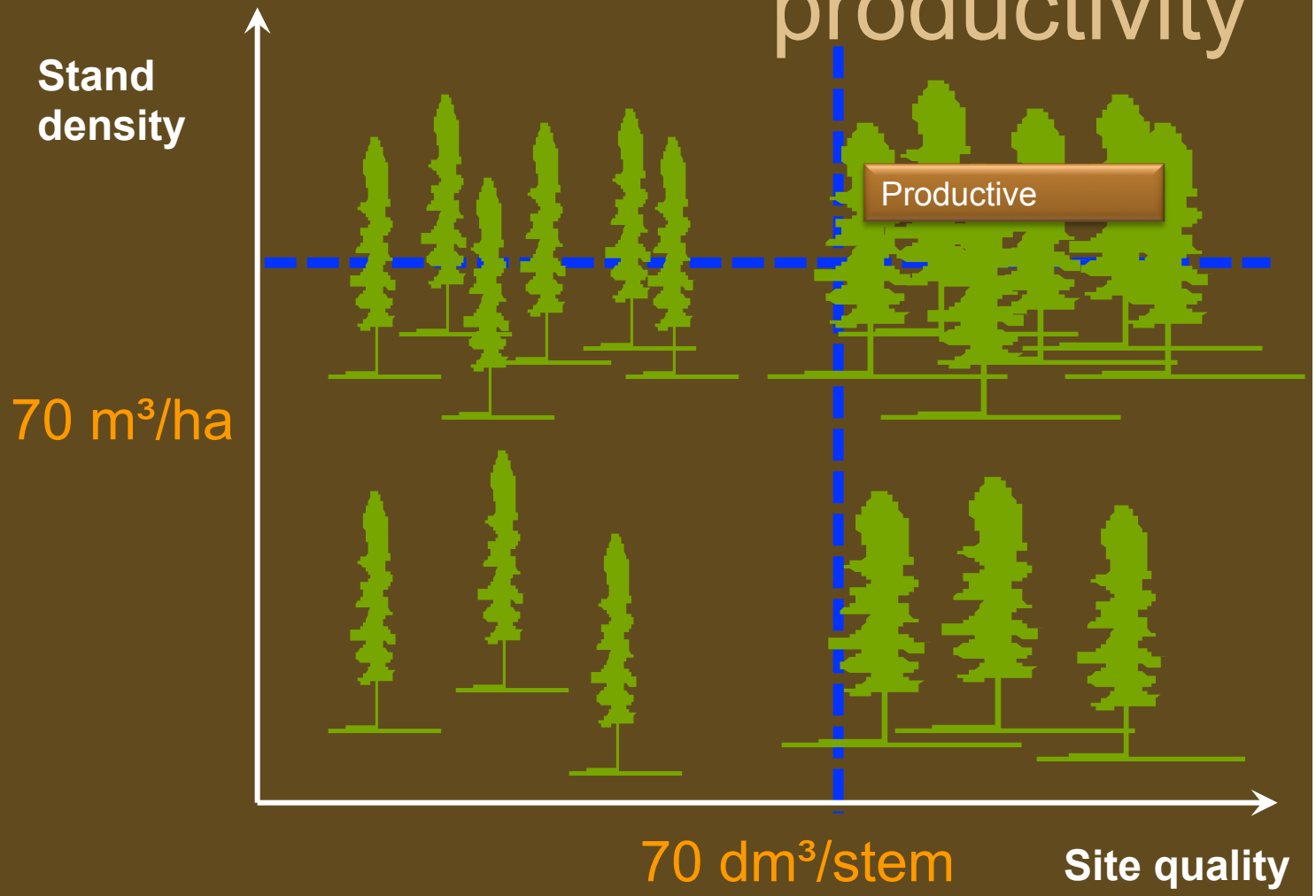
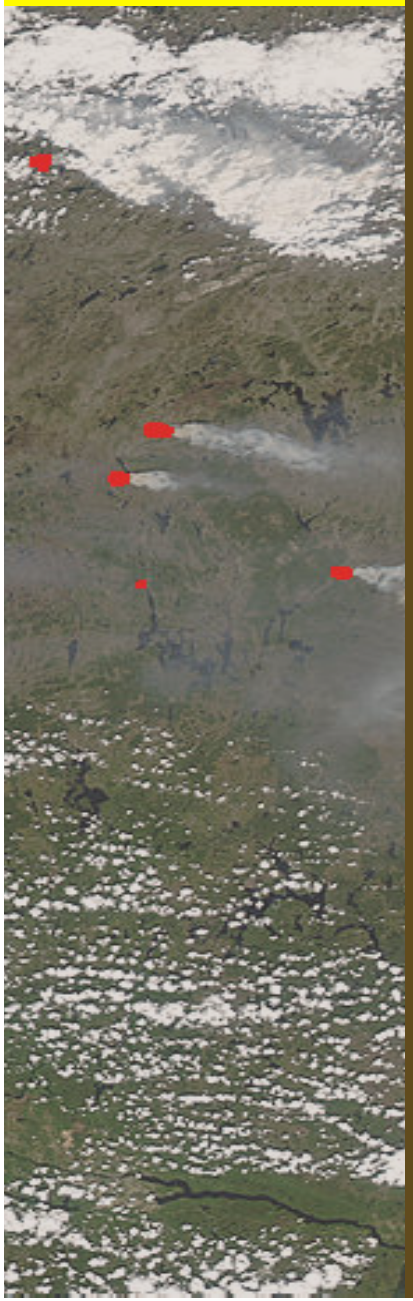


50-50 = low profitability
70-70 = higher profitability

Research question



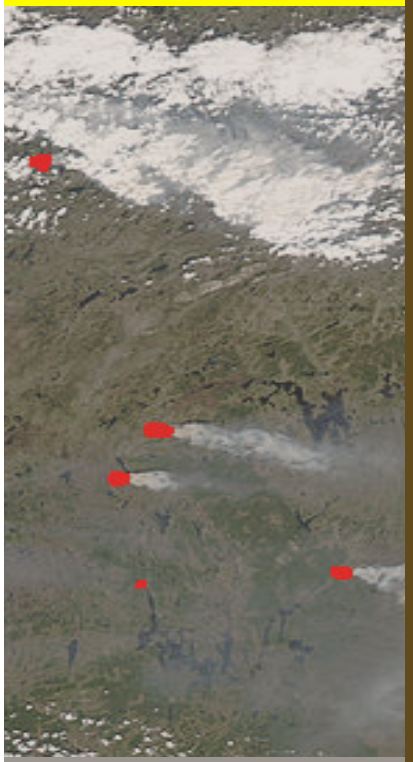
Stand vulnerability to fire depends on its productivity

- Vulnerability : probability of being burned before reaching the minimal harvesting age (depends on production goals)

  - A low productivity stand is longer exposed to fire risk compared to a high productivity stand

Too high to be considered ?

Research question



High risk of not finding the expected wood volume due to fire damage

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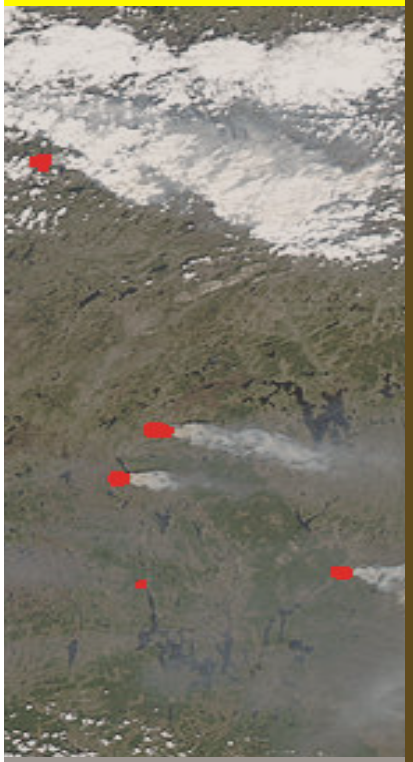


High risk of not finding the expected wood volume due to fire damage

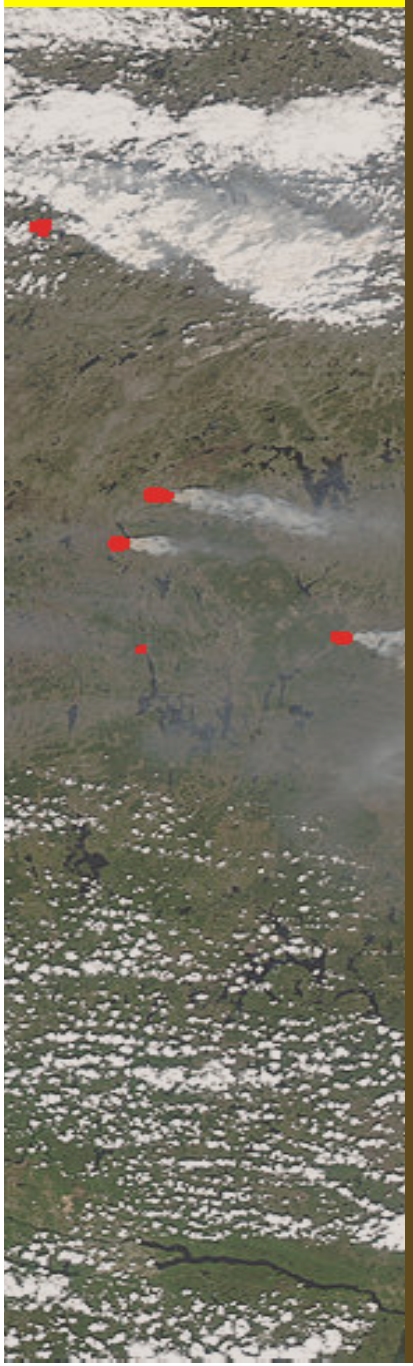
Stand vulnerability to fire risk depends on its productivity

- Vulnerability : probability of being burned before reaching the size to be harvested

  - A low productivity stand is longer exposed to fire risk compared to a high productivity stands

Should we therefore exclude low productivity stands from the AAC calculation?

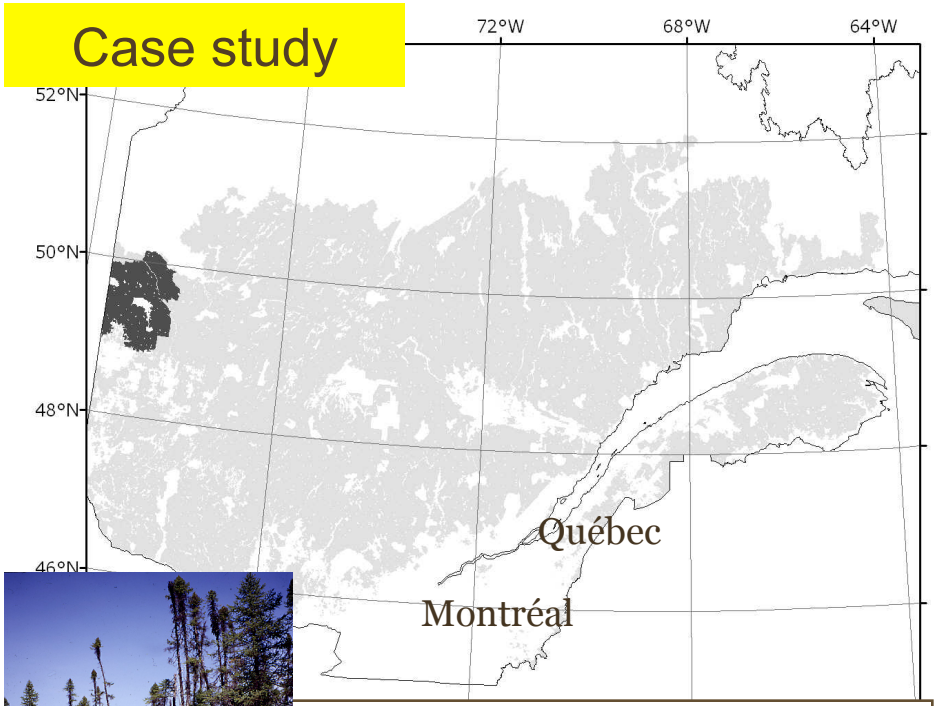
Approach

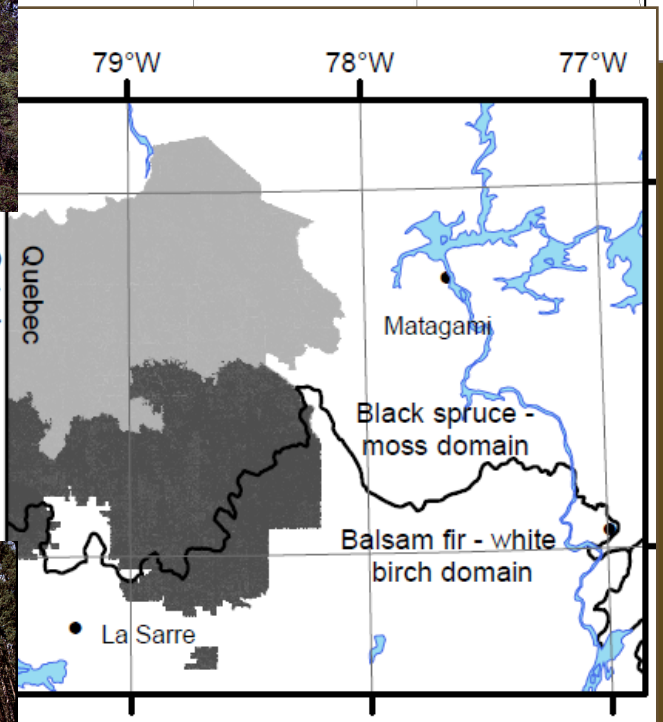


Linking productivity, production goals and fire risk

1. Proportion of stands meeting the production goals (50 m^3-50 dm^3, 70 m^3-70 dm^3 & 90 m^3-90 dm^3);
2. Time required to meet the goals;
3. Probability of reaching goals considering fire risk;
4. Assessing vulnerability of management units

Case study





- Species ➲ black spruce
- Two FMU's in northwestern Quebec
  - south ➲ high productivity
  - north ➲ low productivity
- Each FMU is subdivided into ≈ 50 operating areas

Current fire cyle: around 400 yrs

200 yrs

100 yrs

Research question

Can stand productivity be included in assessing forest vulnerablity in the face of fire?

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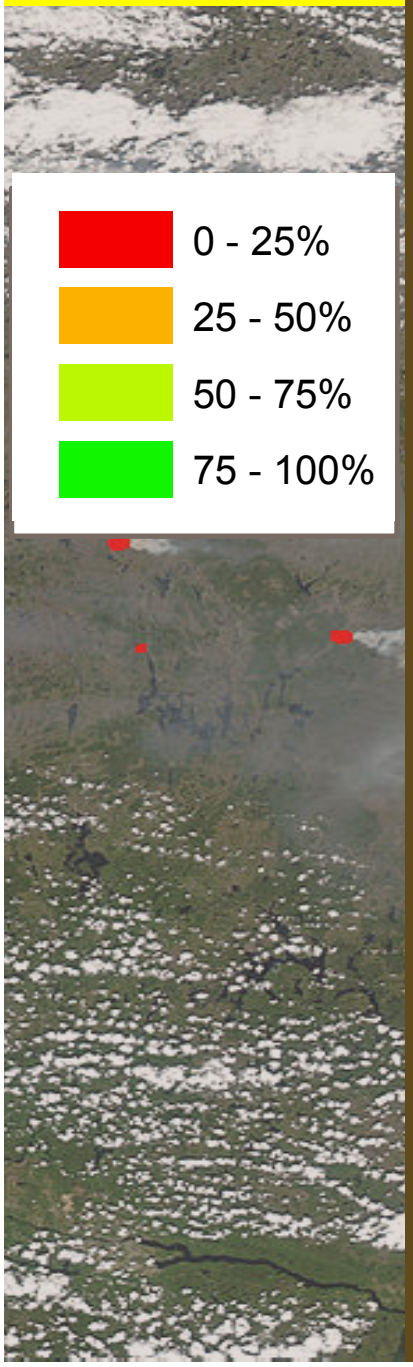
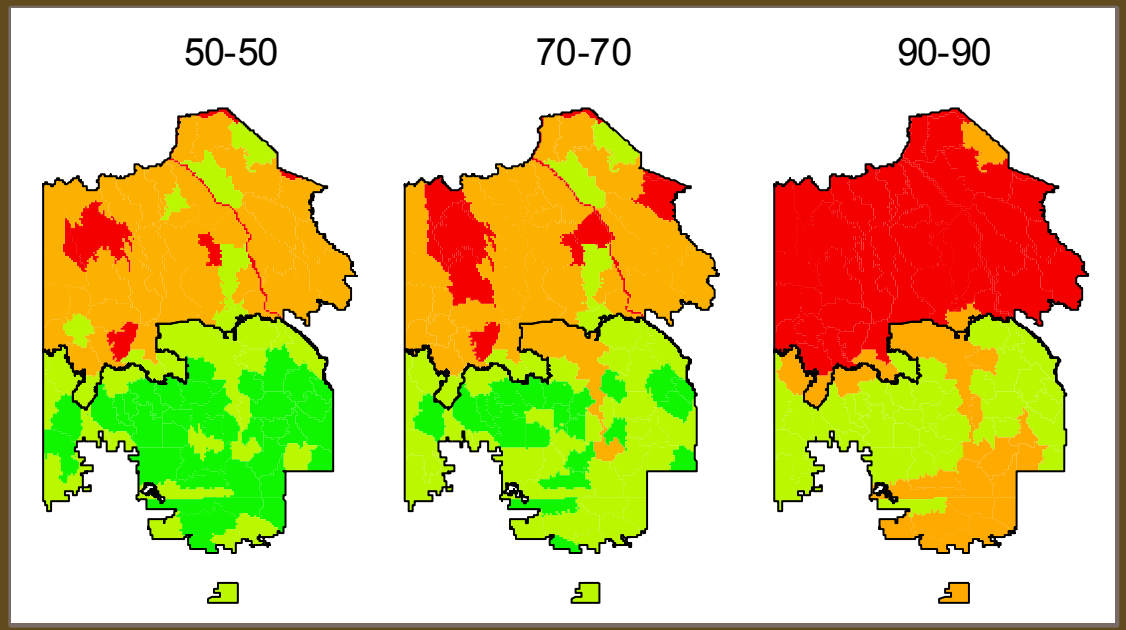
Results

1. Proportion of stands meeting production goals



Zone	50-50	70-70	90-90
Low productivity	Occasional	Occasional	Rare
High productivity	Abundant	Common	Common



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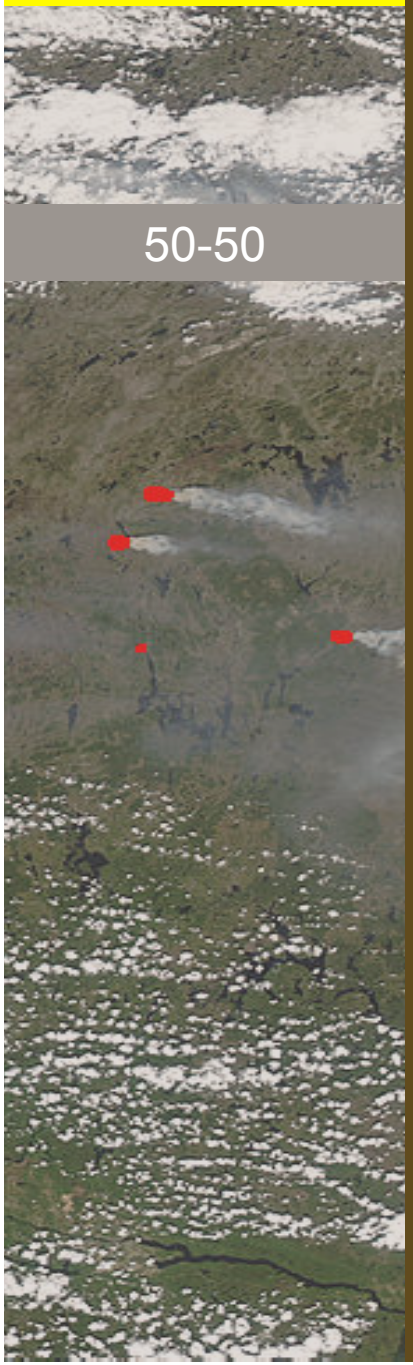
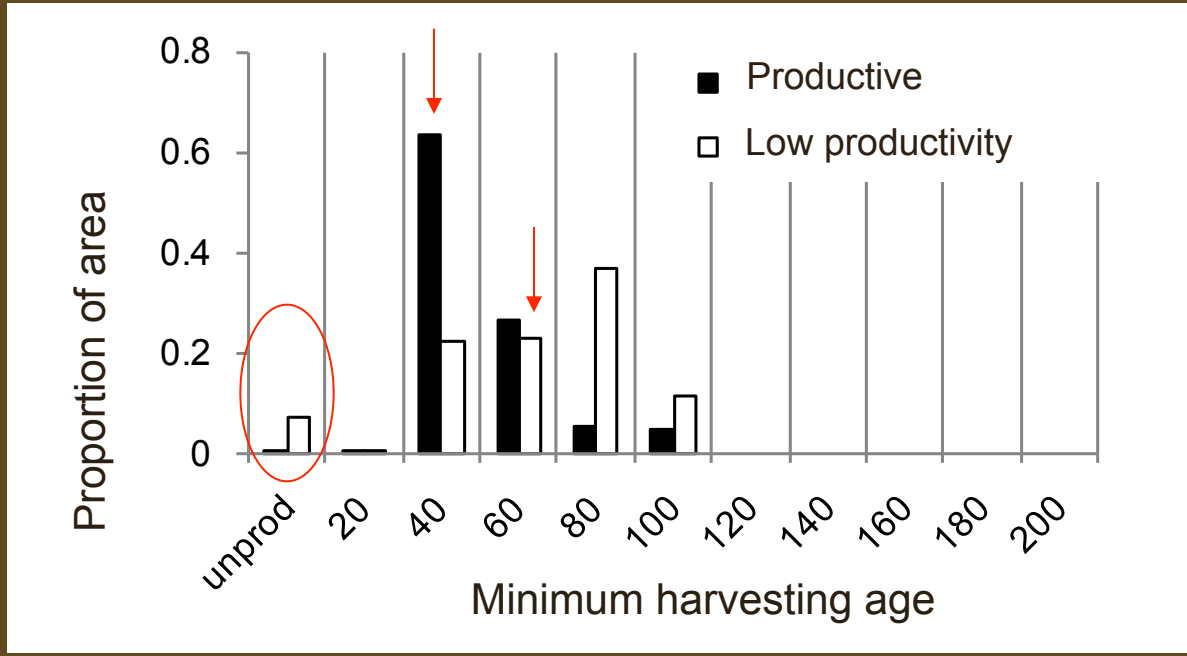


2. Time required to meet the production goals



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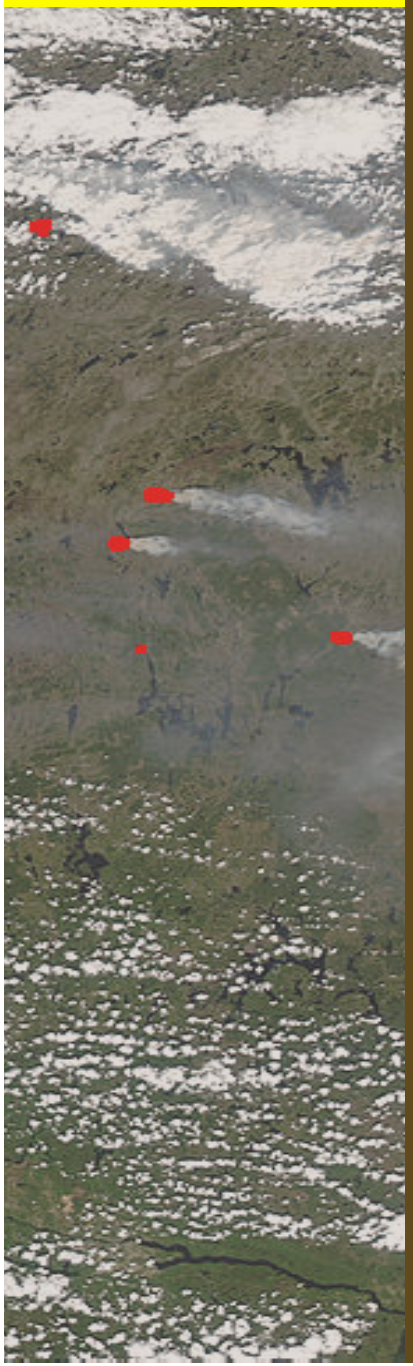

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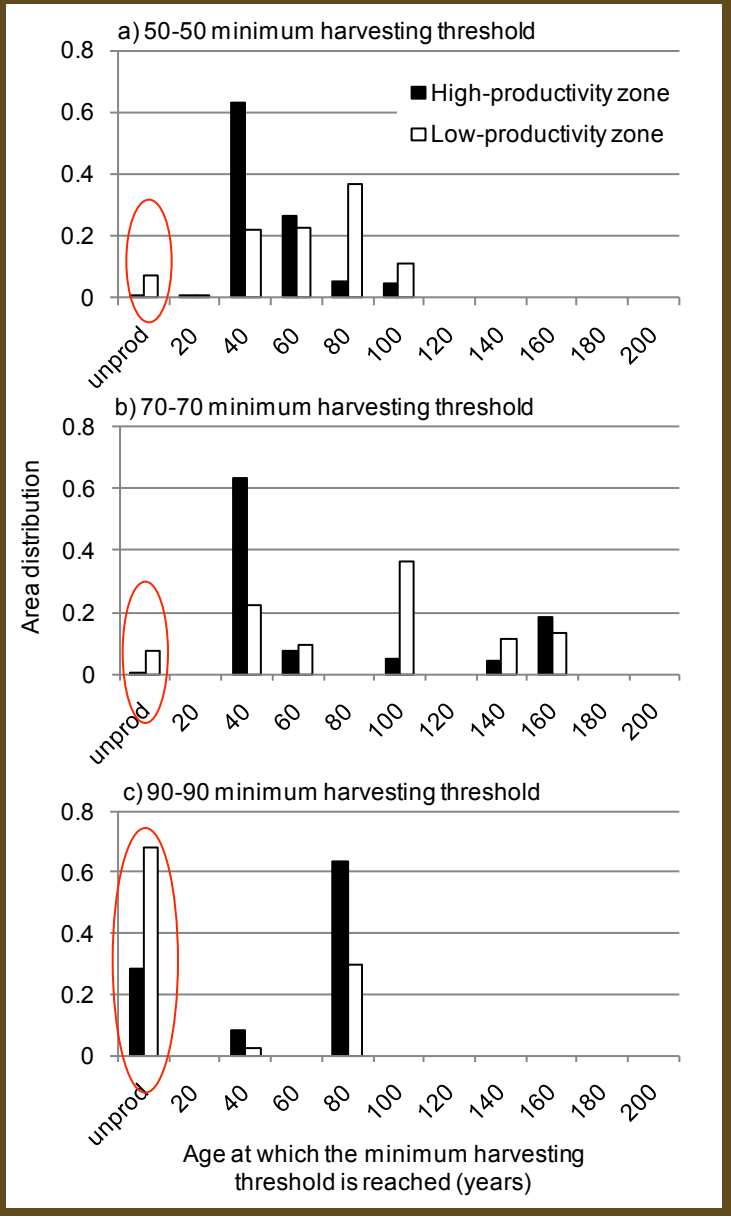


Results

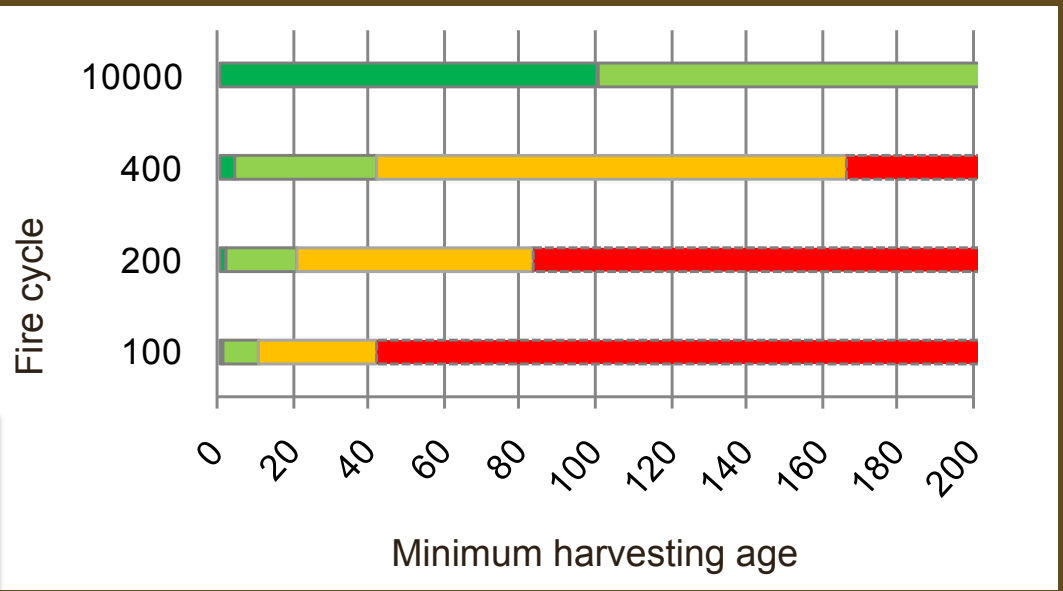
3. Assessing fire risk

50-50

Prob. reaching harvesting age

- p > 0.99 : very certain
- p > 0.90 : certain
- p > 0.66 : probable
- p < 0.66 : equally probable as improbable

- p < 0.66 :
  - These stands are considered vulnerable



Vulnerable stands should be eliminated from the productive area

Results

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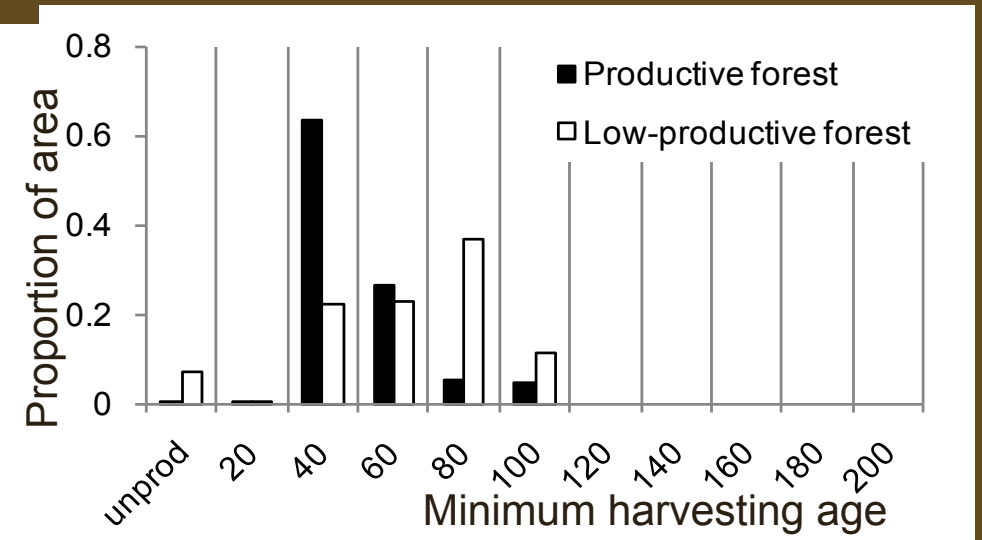

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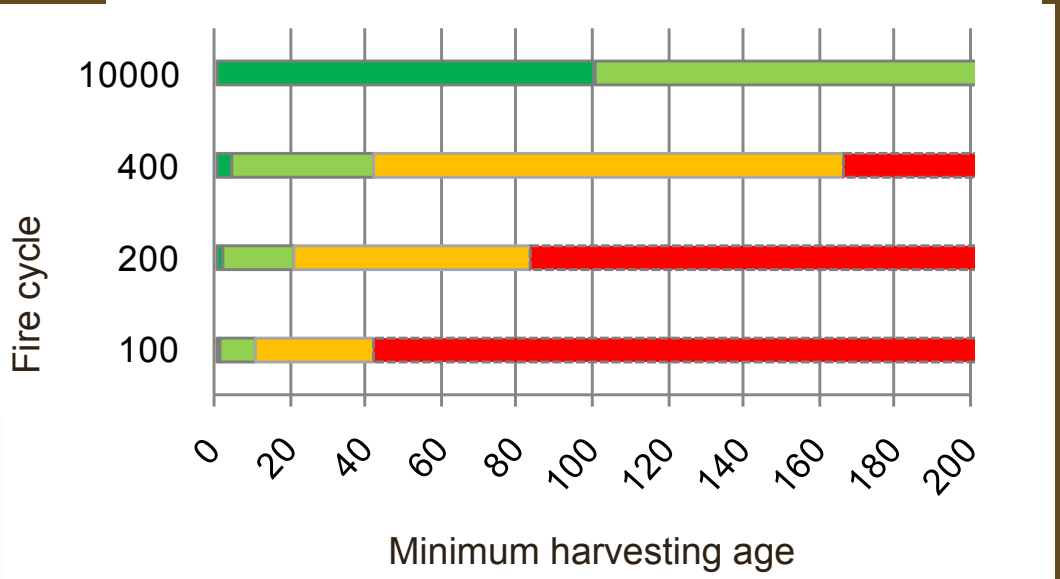
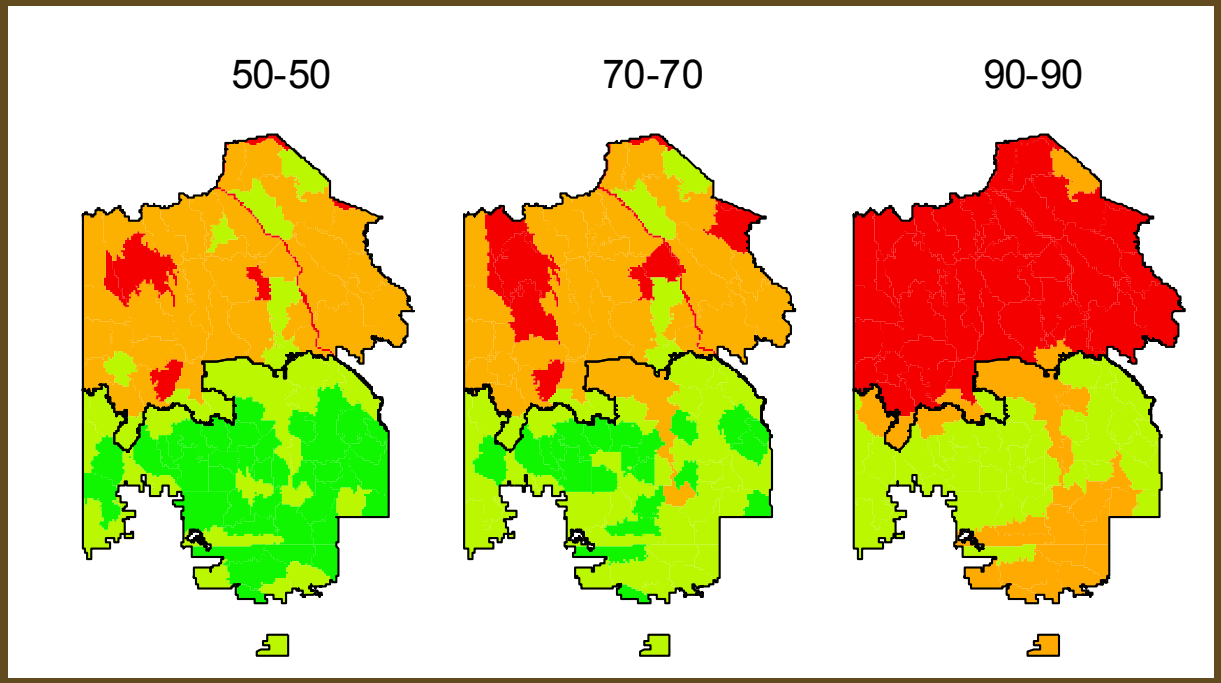


Vulnerable stands should be eliminated from the productive area

Results

4. Zone vulnerability

% of productive stands without considering fire risk



Results

4. Zone vulnerability

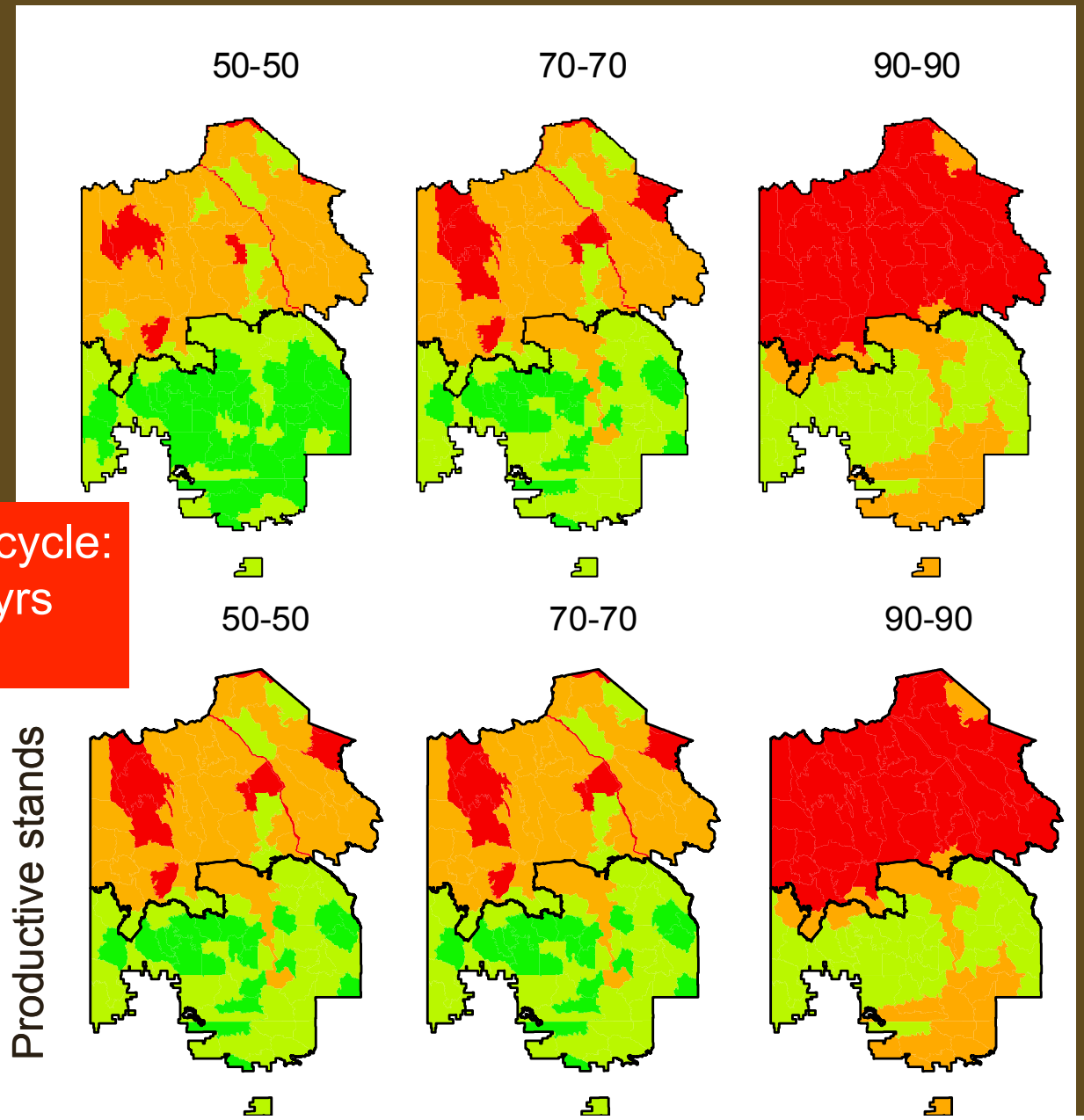
% of productive stands without considering fire risk

- Rare
- Occasional
- Common
- Abundant

Fire cycle: 400 yrs

% of productive stands (excluding vulnerable ones)

- Rare
- Occasional
- Common
- Abundant



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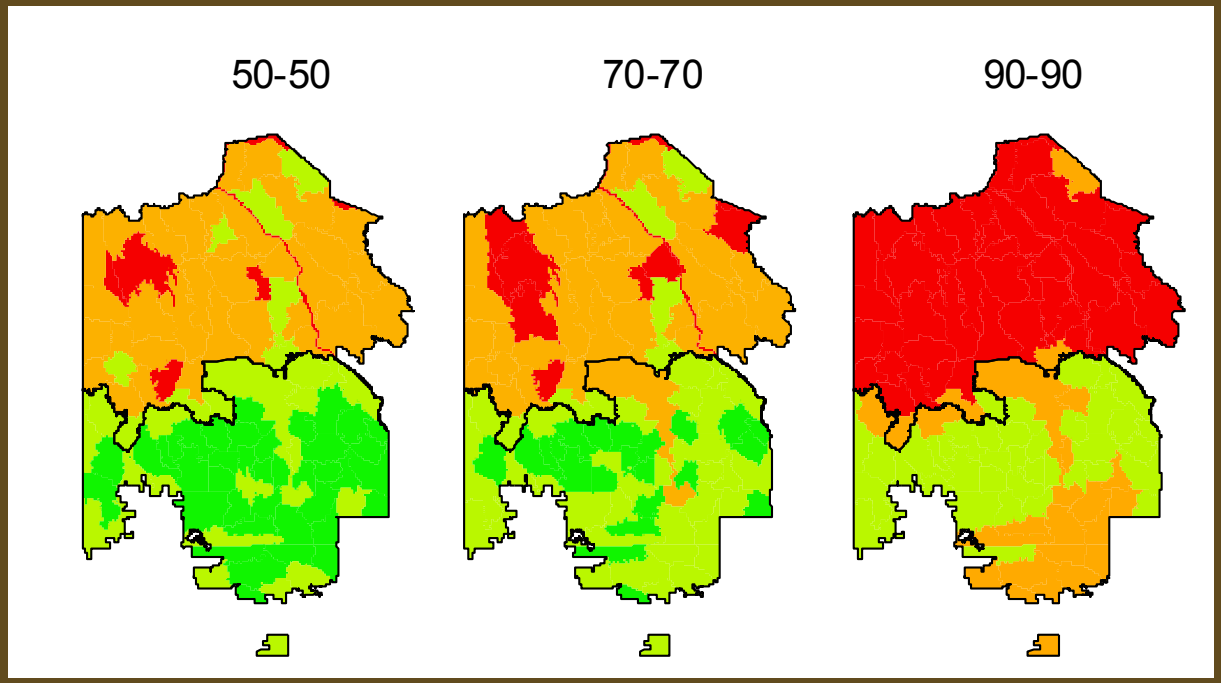

Results

4. Zone vulnerability

% of productive stands without considering fire risk

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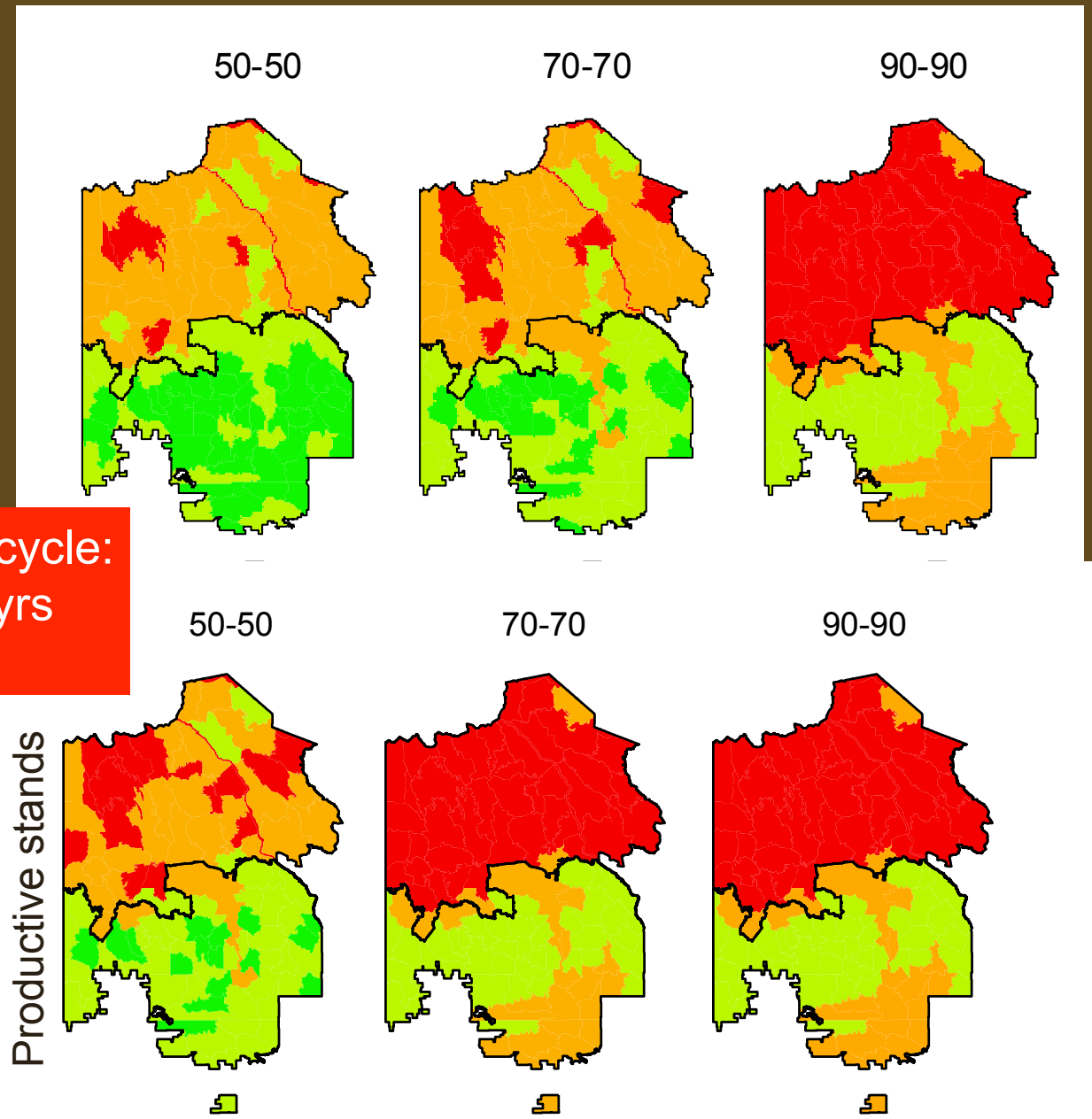
Fire cycle: 200 yrs

% of productive stands (excluding vulnerable ones)

- Rare
- Occasional
- Common
- Abundant

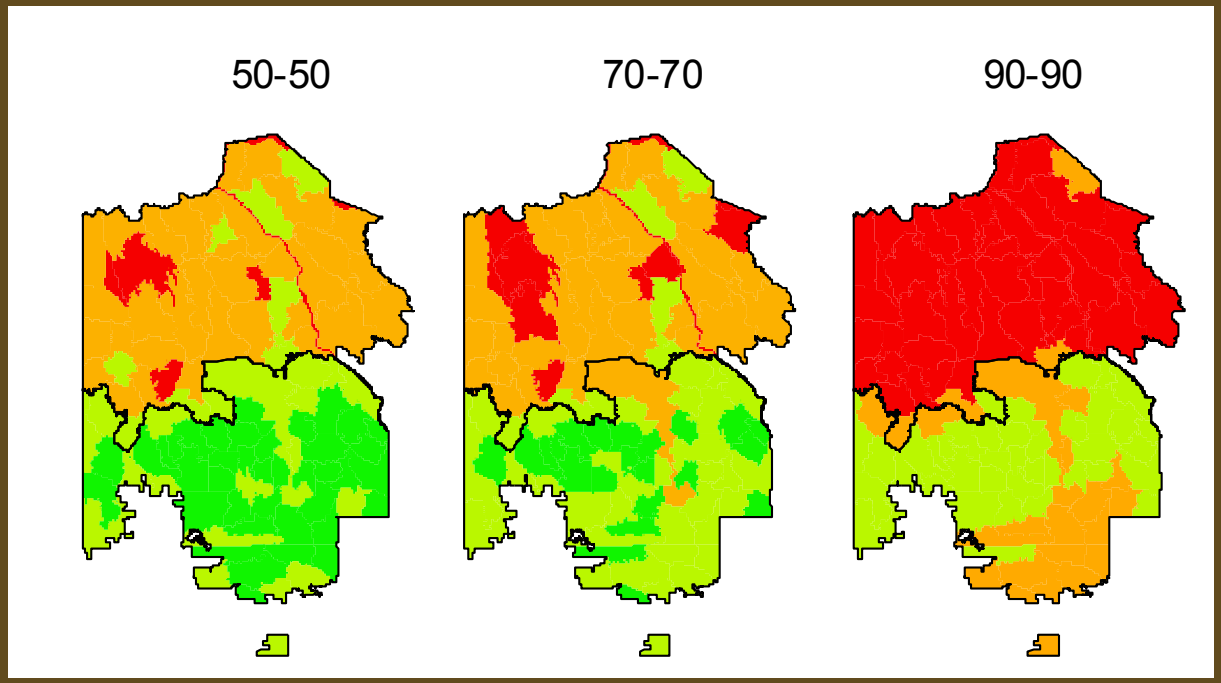


Results

% of productive stands without considering fire risk

Rare
Occasional
Common
Abundant

4. Zone vulnerability



Results

4. Zone vulnerability

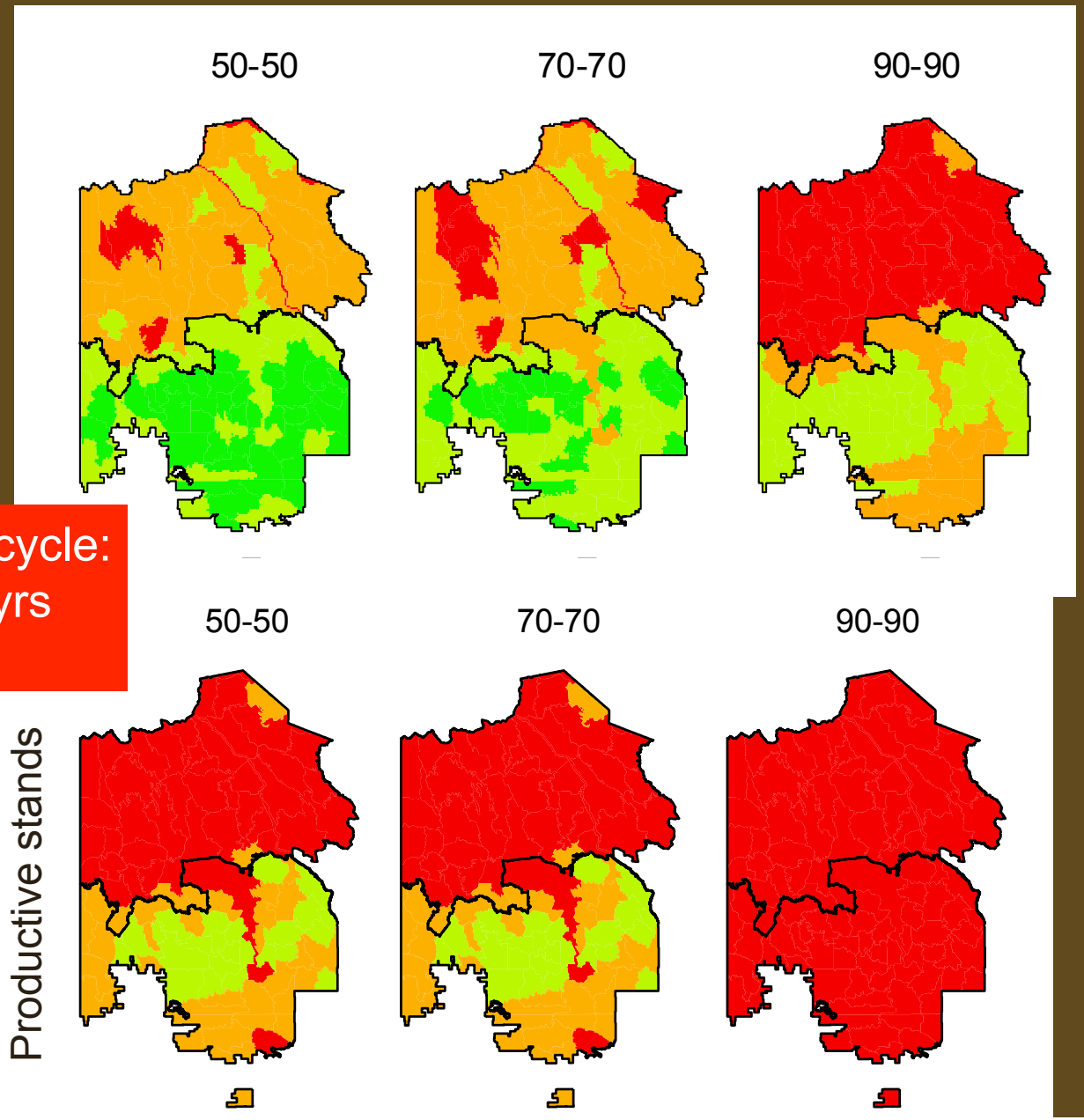
% of productive stands without considering fire risk

- Rare
- Occasional
- Common
- Abundant

Fire cycle: 100 yrs

% of productive stands (excluding vulnerable ones)

- Rare
- Occasional
- Common
- Abundant

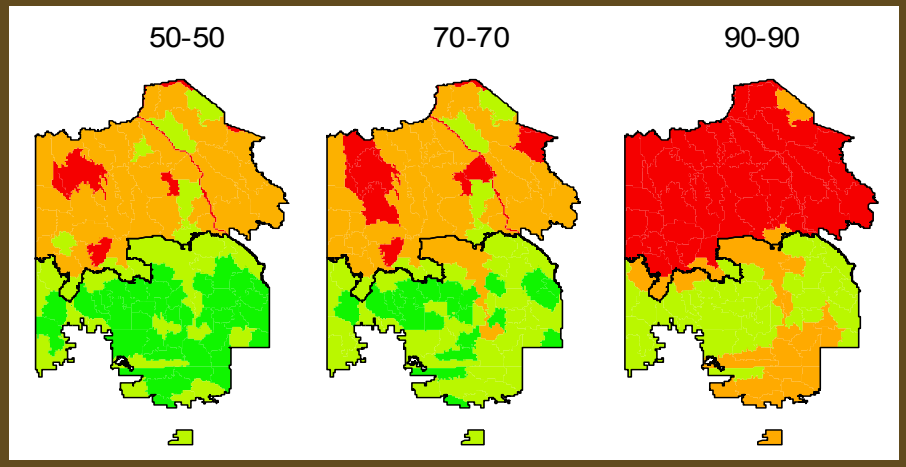


Results

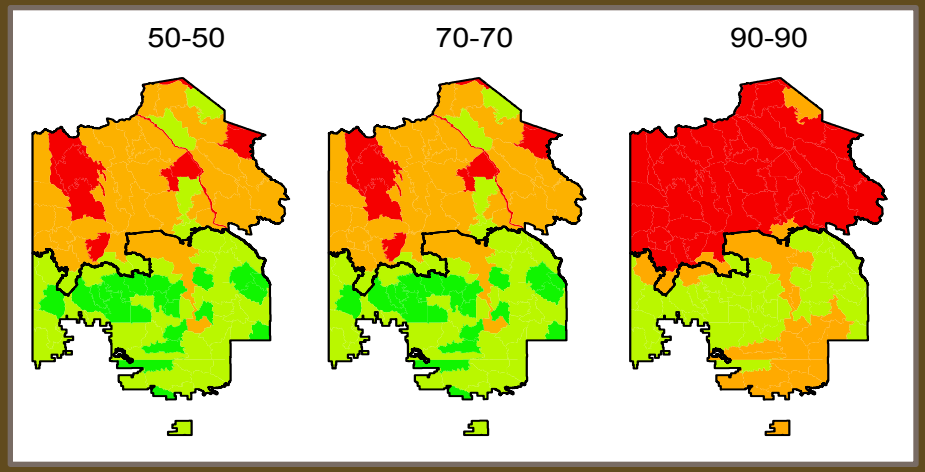
4. Zone vulnerability

0 - 25%
25 - 50%
50 - 75%
75 - 100%

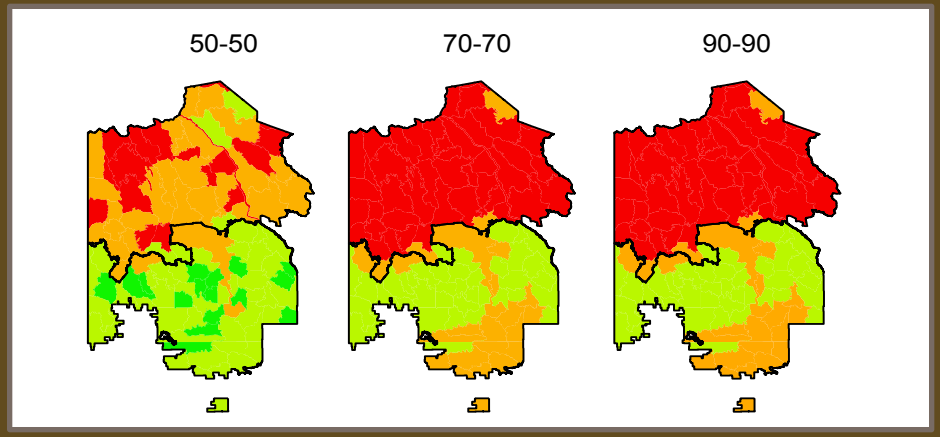
Without fire



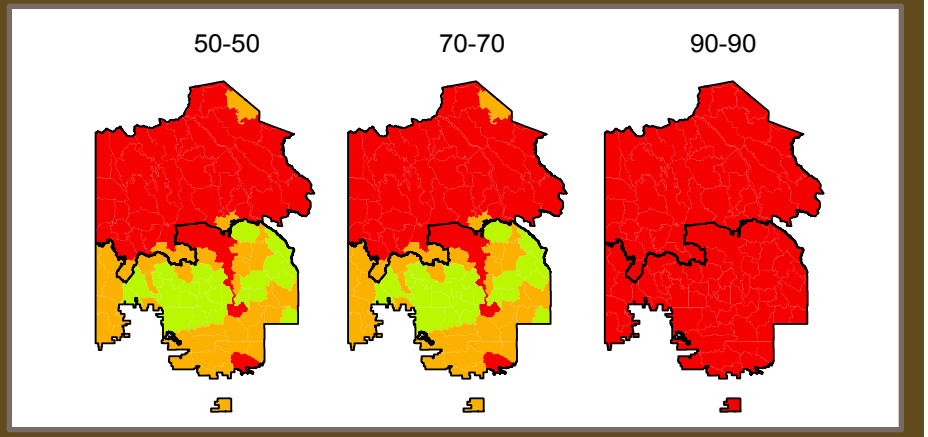
400 yrs



200 yrs



100 yrs



Results

Is the vulnerability threshold value subjective?

- Why < 66 % ?

Prob. reaching harvesting age

- p > 0.99 : very certain
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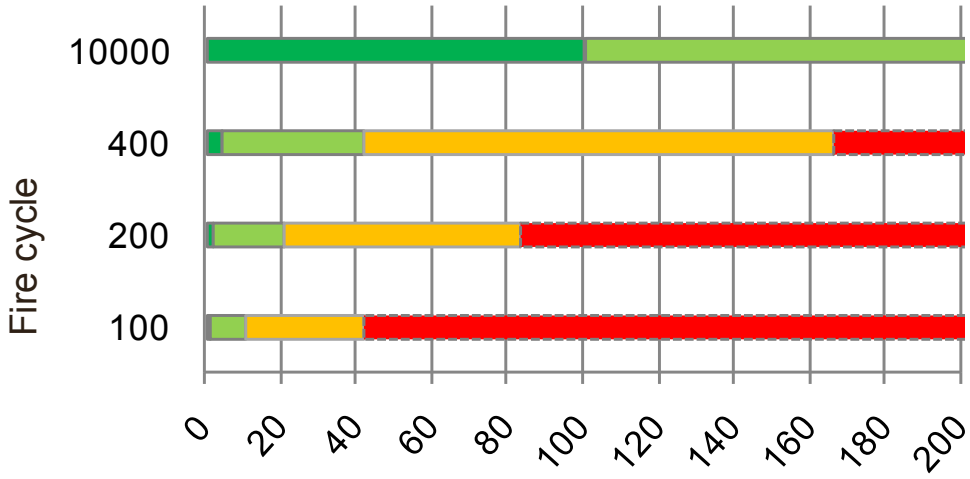


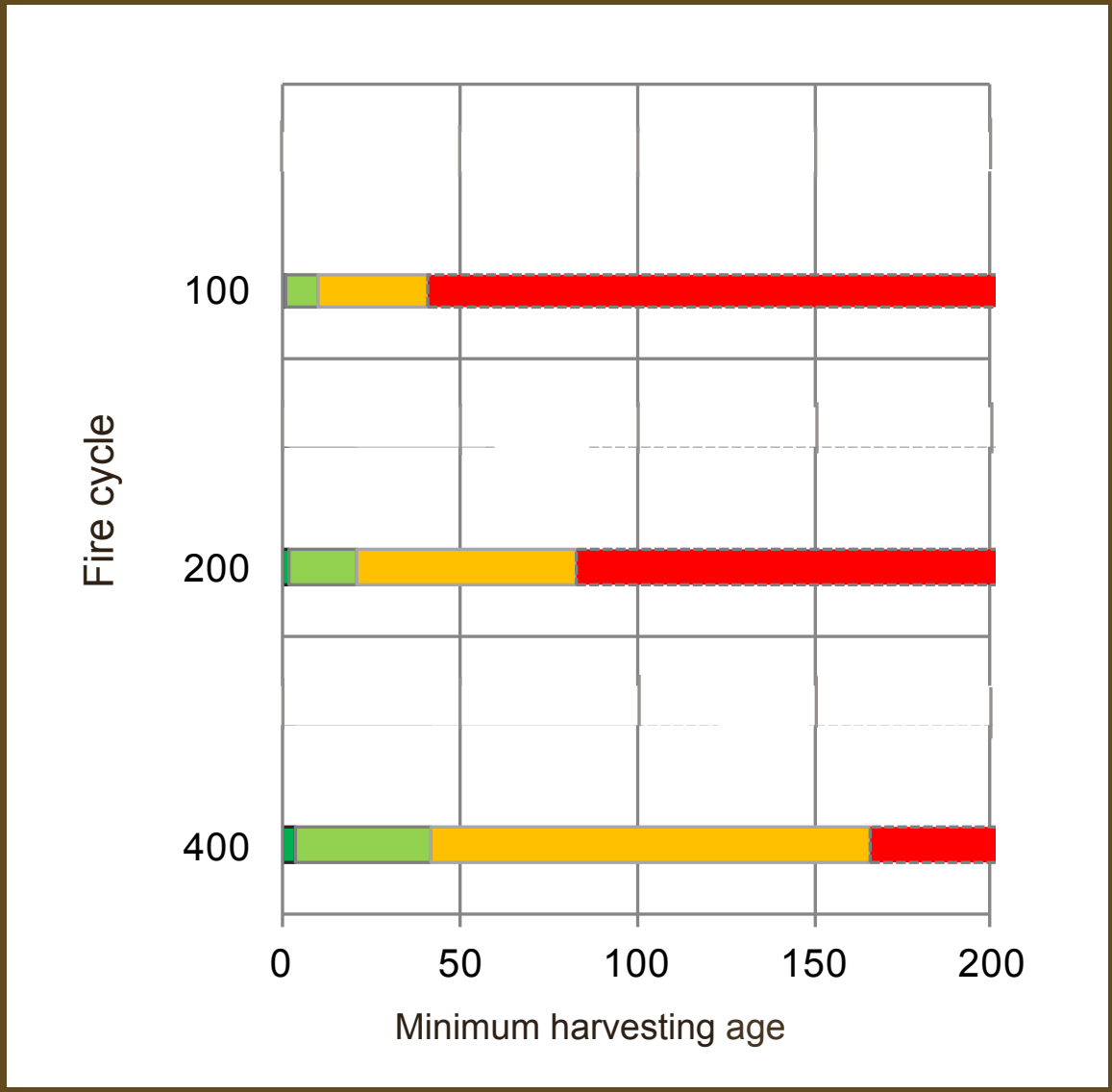
Results

Vulnerability can be further linked to the investment risk (i.e. finding an acceptable interest rate of retunr considering risk)

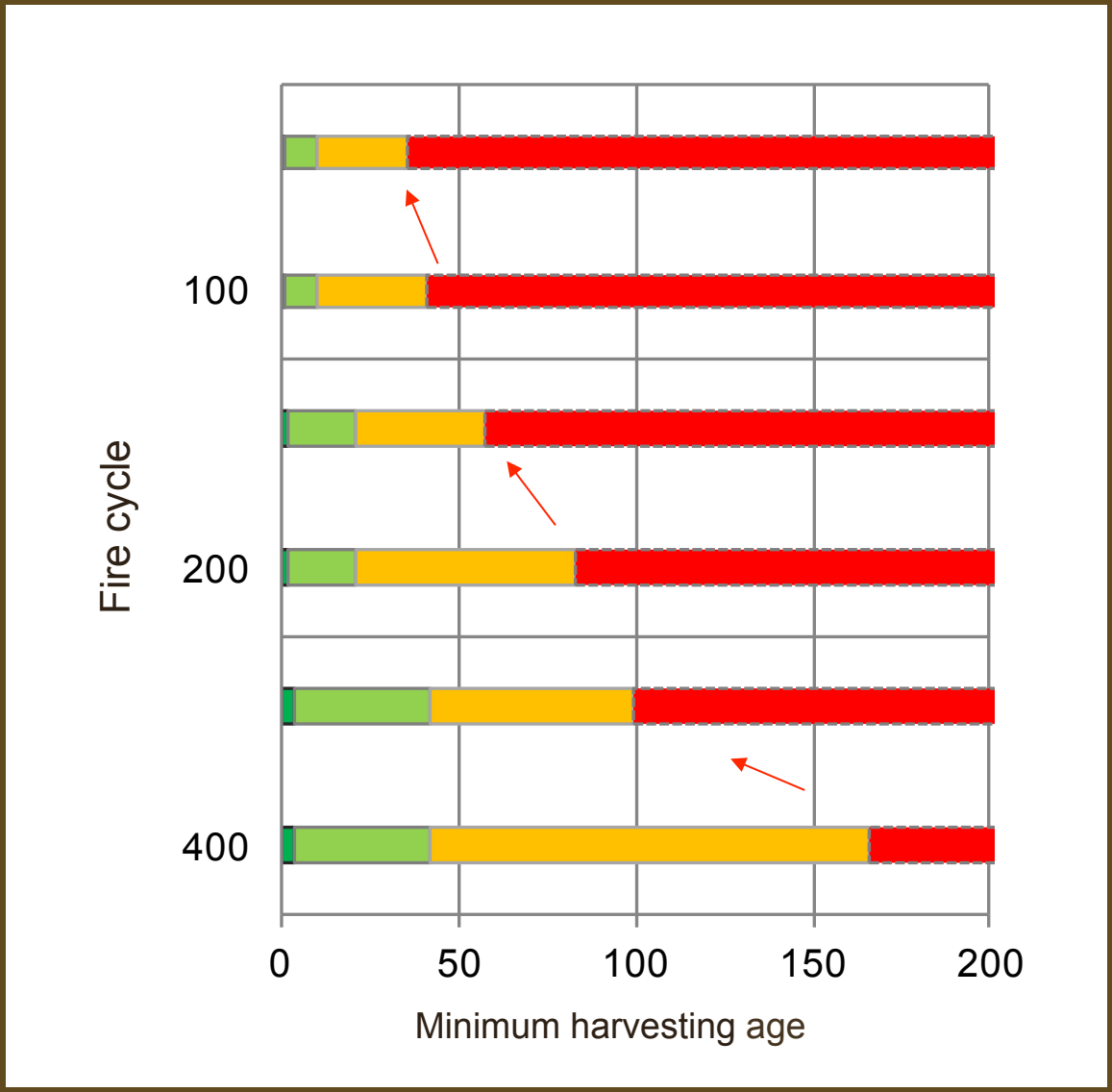
This allowed to evaluate the probability required to have enough profit

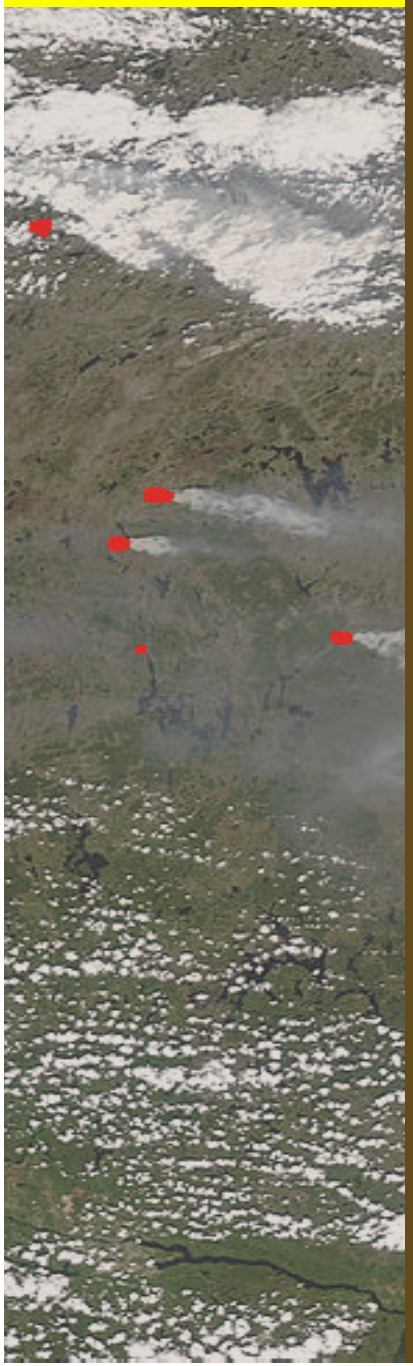
Cycle (yrs)	Probability of reaching minimum harvesting age (%)
400	**78**
200	**75**
100	**70**

- Using a probability of < 66 %



- When probability is based on the alternative rate

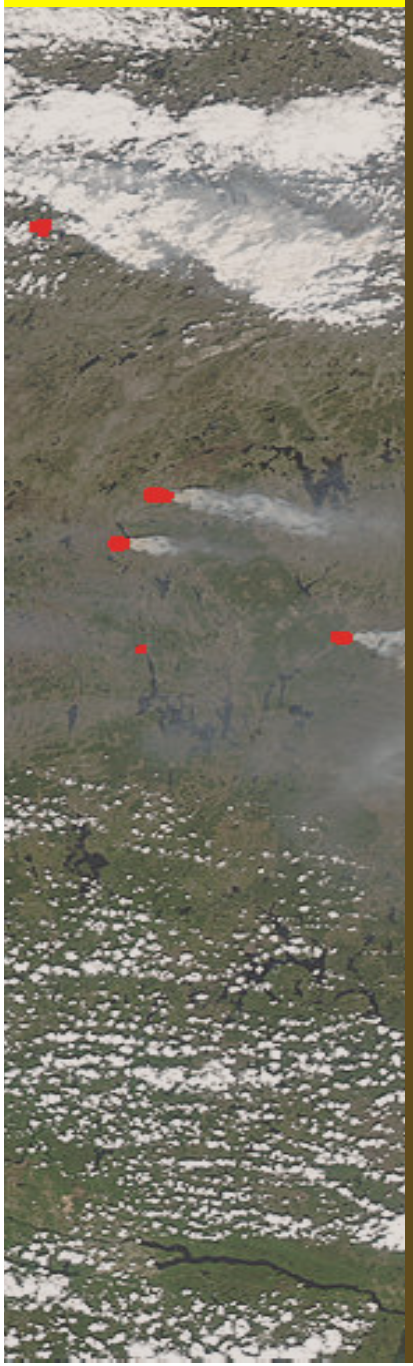




Messages (1)

- Without taking fire into account, both forest zones will be considered productive as long as the production goals remain below 90 m^3 and 90 dm^3.
- The current fire cycle (400 yrs) does not really affect our assessment of productivity of both zones
- Future fire cycles will likely be shorter implying that the less productive zone might be vulnerable even with modest production goals.

Discussion



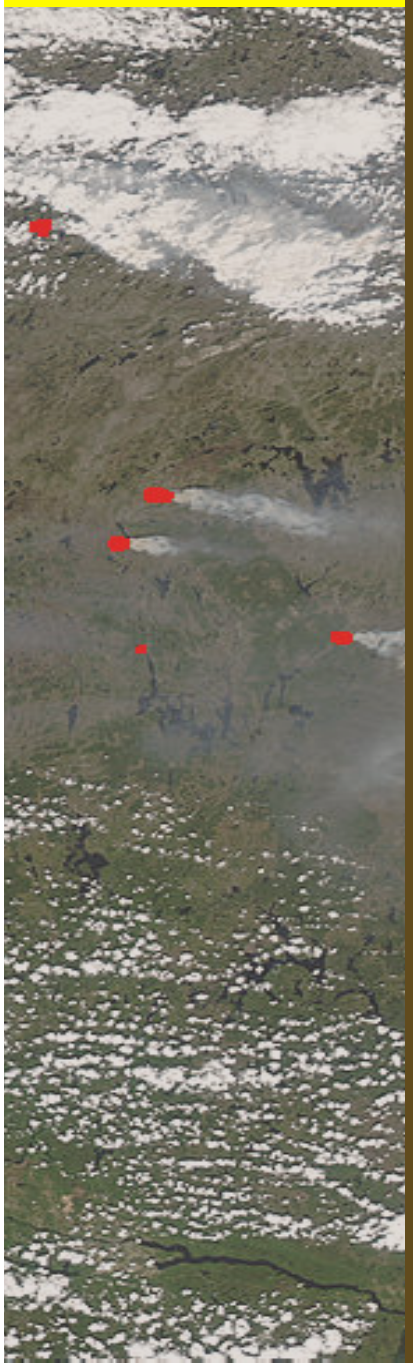
Messages (2)

The approach allows for evaluating production goals while taking fire into account

It is complementary to other type of assessment of fire vulnerability:

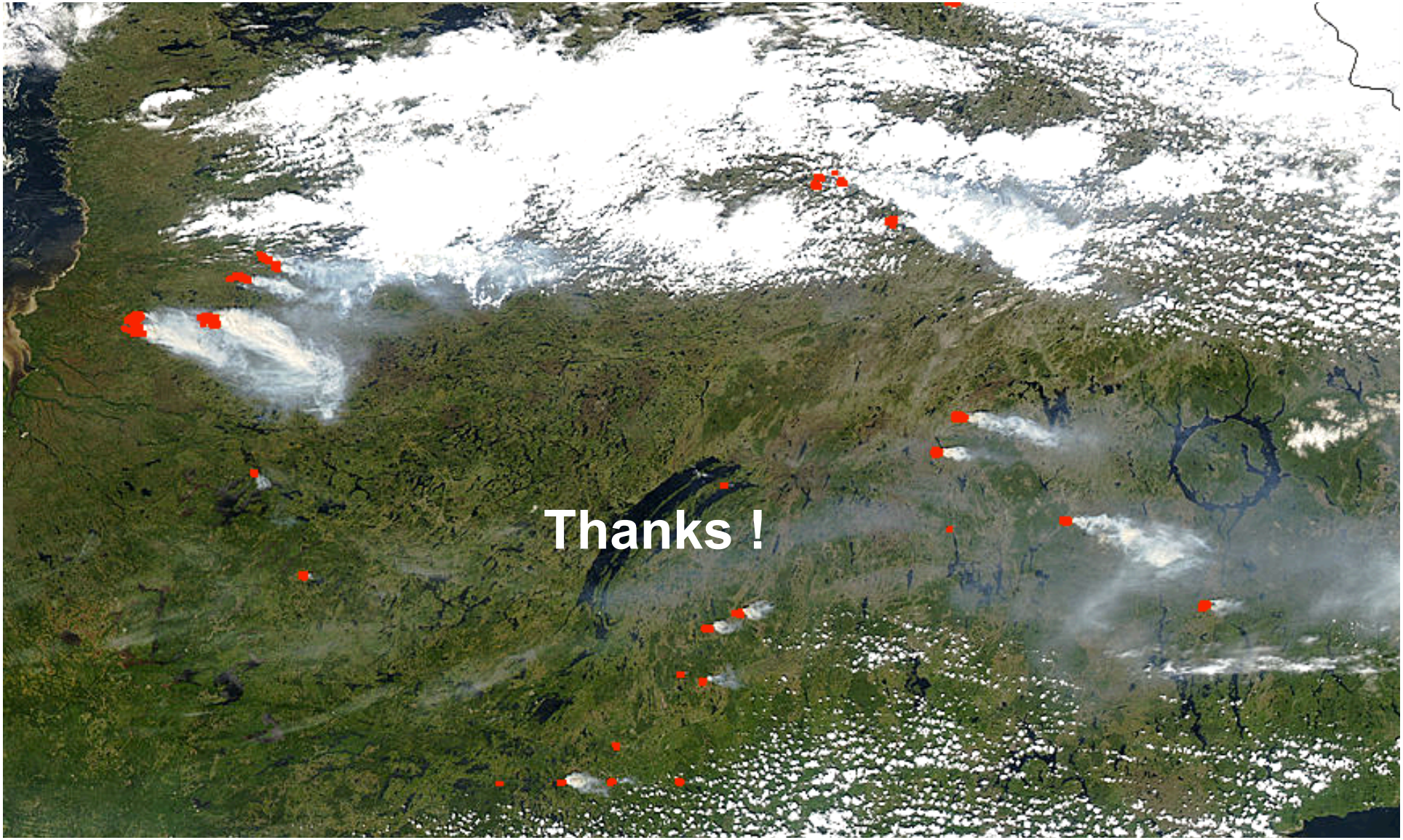
- insurance policies' approaches
- a reduction in AAC in accord to volume losses due to fire

It has the advantage of requiring much less information than usual AAC calculation



Perspectives

- The approach is useful when new potential territories are considered for timber production and to evaluate fire vulnerability in a changing fire regime.
- We are developing it for other tree species.



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