Preliminary impacts of Climate Change on Carbon

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Acknowledgments

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Outline

- Why do we care?
- Projected changes
- Impacts on carbon
- How can we improve?
- Implications for managers

Why do we care?

- Our climate is changing, including an increase in global average temperatures since the mid-20th century.
- This change is caused by human activities creating greenhouse gases.
- The effects of this change will worsen if no action is taken to reduce our overall greenhouse gas emissions.
- These climate changes will have significant and damaging impacts on human society, industry, and our natural environment.

IPCC 2007

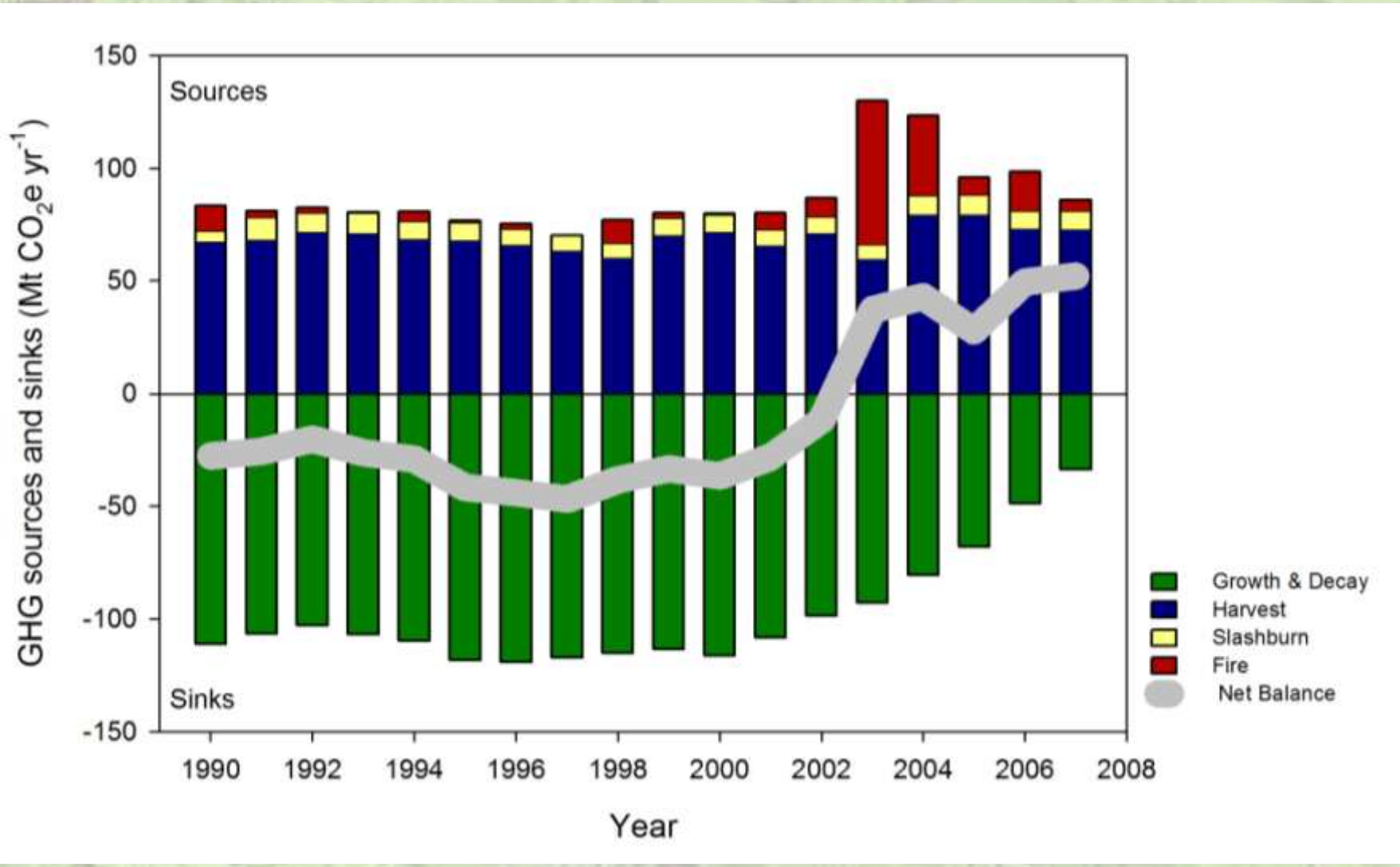
Bottom Line

- Balance of evidence points to a need to consider the forecasts of a changing climate seriously
  - Mitigation + adaptation

- Society's views of the situation are changing
  - Increased willingness to change behaviour
  - Changing social license for the forestry and agriculture sectors
  - New policies
  - New economics (e.g. consumer choice, offsets)

Snowman
- B. Bouton

Forest ecosystem of British Columbia



Source: Environment Canada, MoE

What will the future bring?

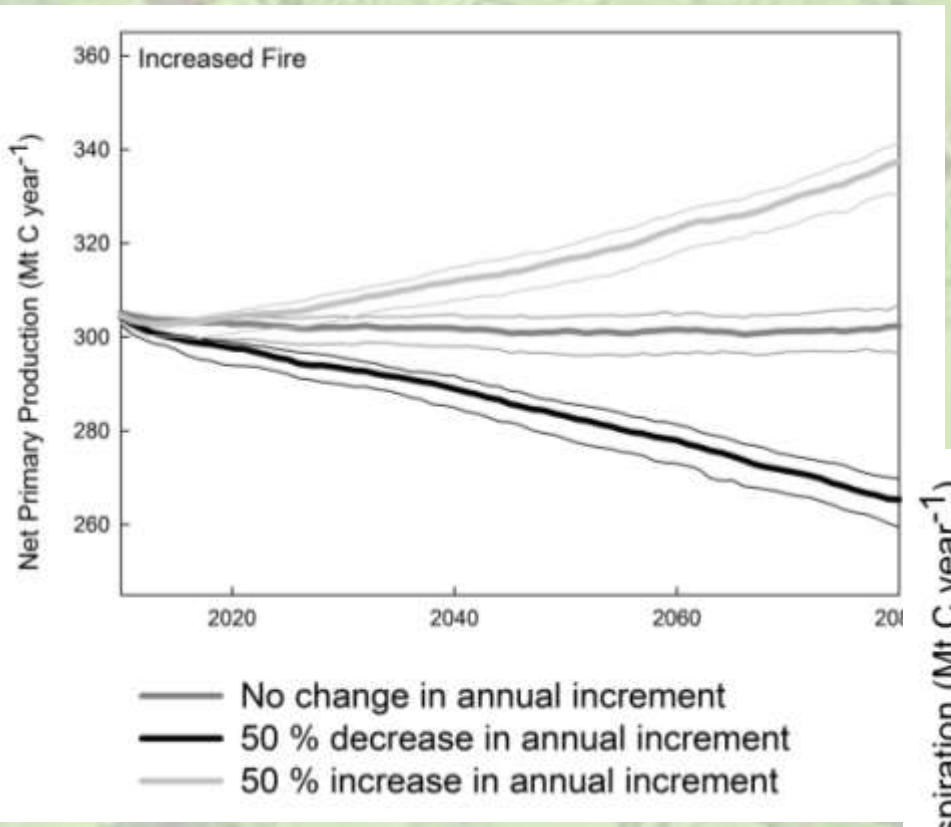
- Intention was only to define the range of possible future outcomes.
- Can not describe likelihood
- All are within the realm of the possible

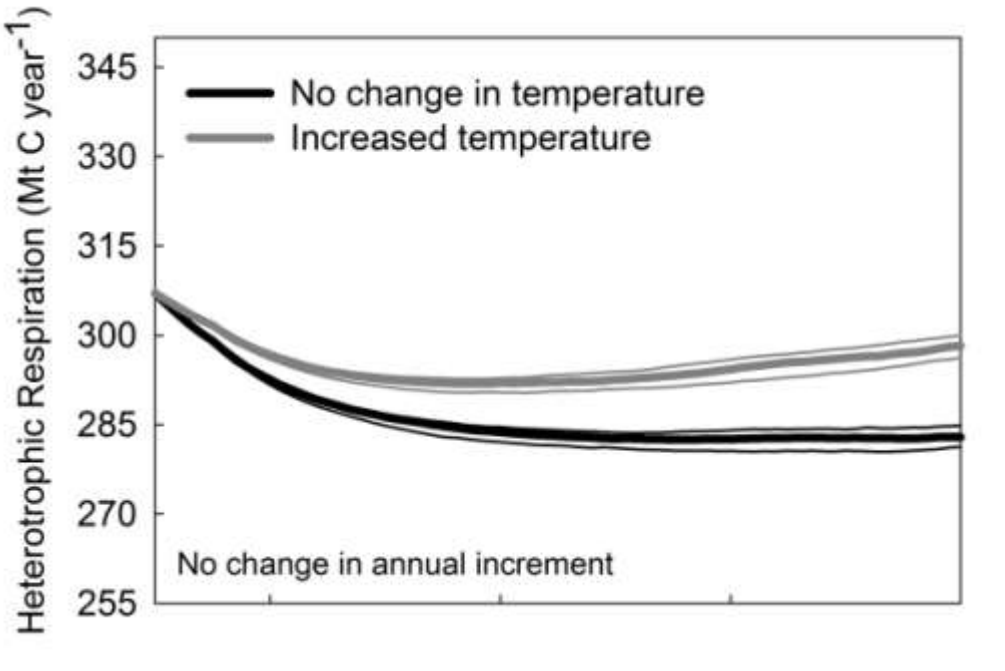
Methods

- Aggregation of BC's forest inventory and yield curves
- Recent fire history data used to parameterize annual area burned function.
- Recent temperature data drives decay rates
- One mountain pine beetle future
- One future harvest

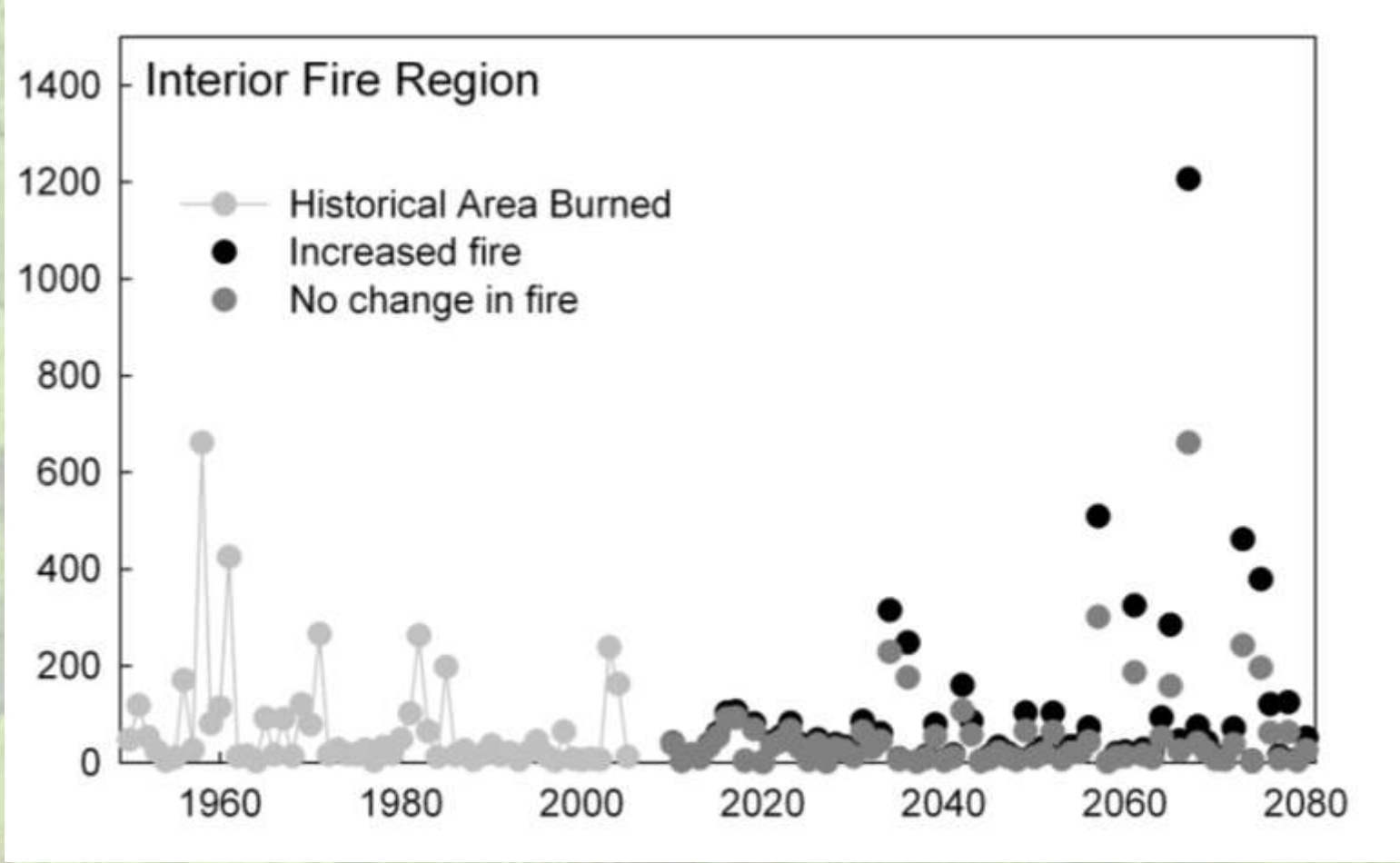
- 12 climate change scenarios
- Growth rate recent, decreasing or increasing
- Decay rate recent or increasing with forecast temperature
- Annual area burned recent or increasing x 100 random futures

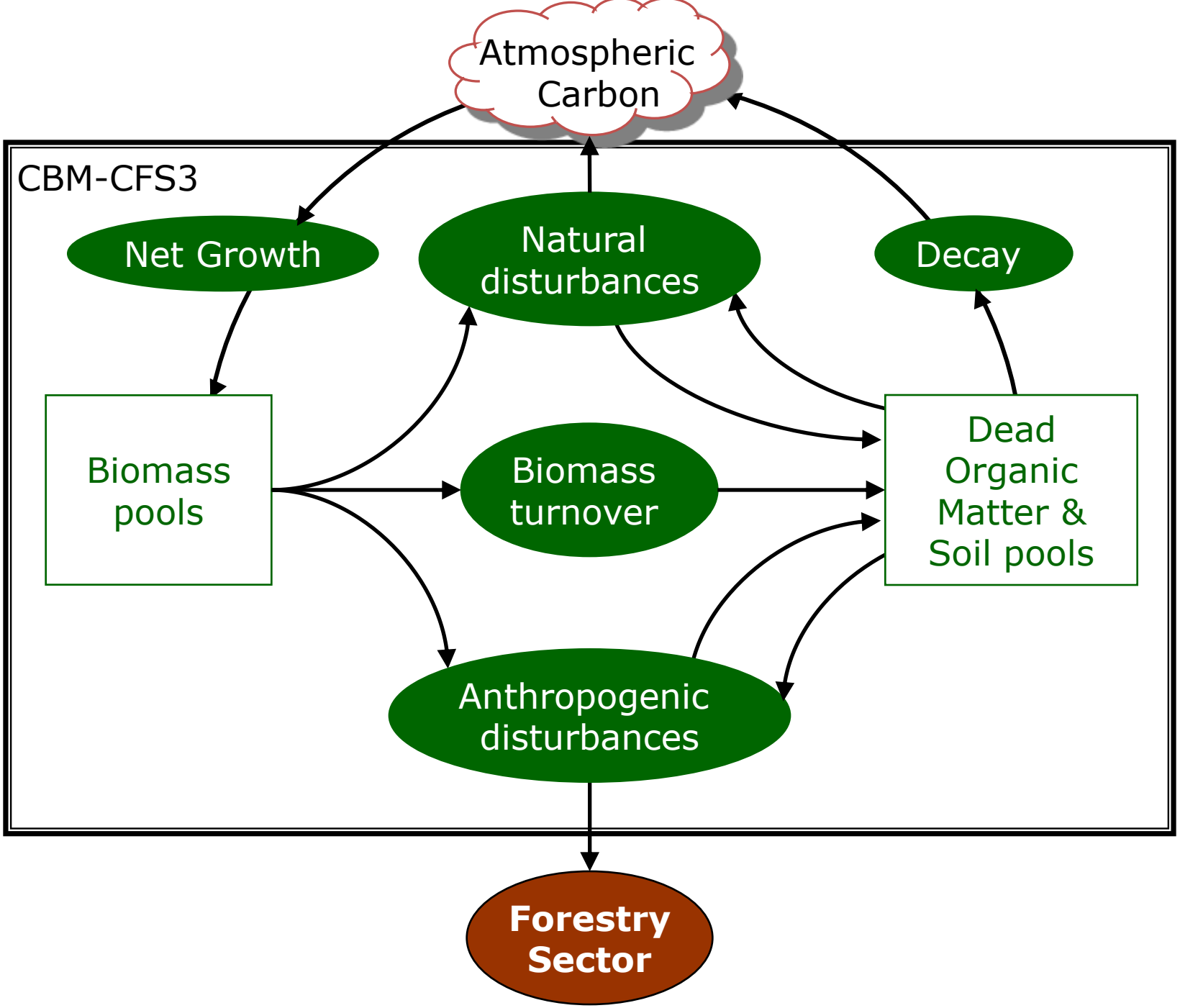
Changes


Increased Fire
Net Primary Production (Mt C year-1)
360
340
320
300
280
260
2020
2040
2060
No change in annual increment
50 % decrease in annual increment
50 % increase in annual increment


Heterotrophic Respiration (Mt C year-1)
345
330
315
300
285
270
255
No change in temperature
Increased temperature
No change in annual increment

Changes

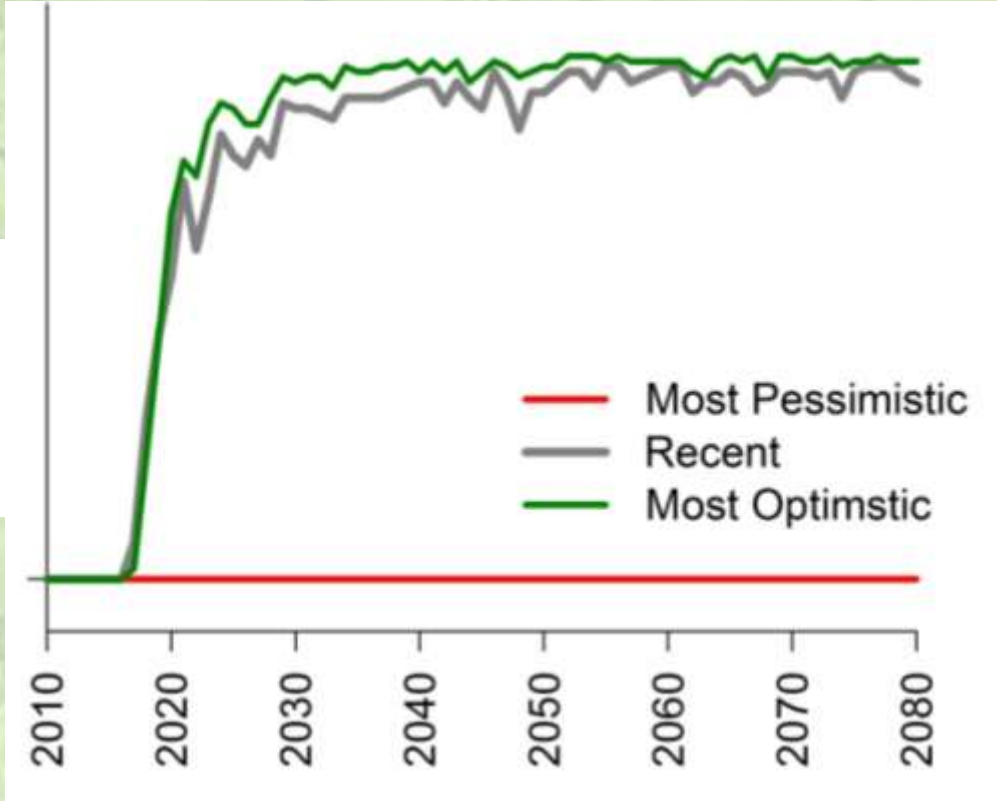

Interior Fire Region
Historical Area Burned
Increased fire
No change in fire
1400
1200
1000
800
600
400
200
0
1960
1980
2000
2020
2040
2060
2080


Atmospheric Carbon
CBM-CFS3
Net Growth
Natural disturbances
Decay
Biomass pools
Biomass turnover
Dead Organic Matter & Soil pools
Anthropogenic disturbances
Forestry Sector

Impacts on carbon

- Assumed that half the harvested wood is stored and the remaining emitted,
- The most optimistic scenario has a high proportion of simulations as an annual sink in 2020 and beyond.
- The most pessimistic does not estimate an annual sink by 2080

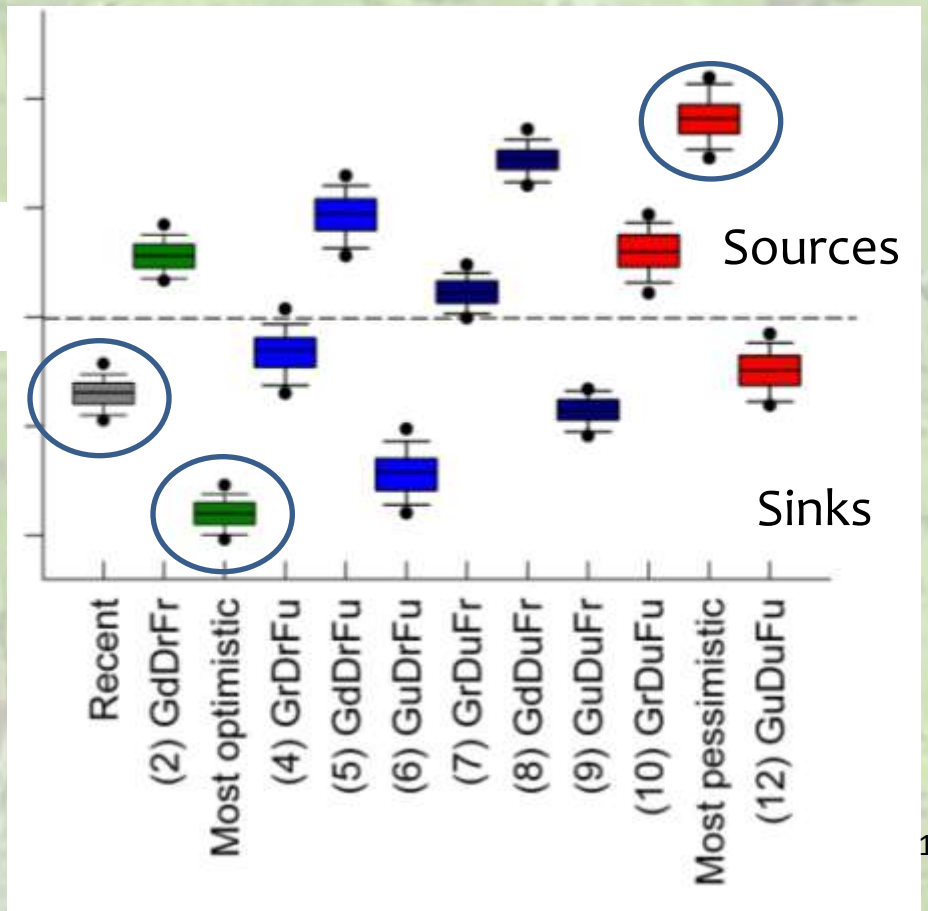
Proportion of random fire simulations with a C sink



Impacts on carbon

- Assumed that half the harvested wood is stored and the rest emitted,
- A future based on the past is estimated to be a cumulative sink
- Scenarios with increased growth are estimated as sinks
- Increased decay alone was enough to move estimate to source

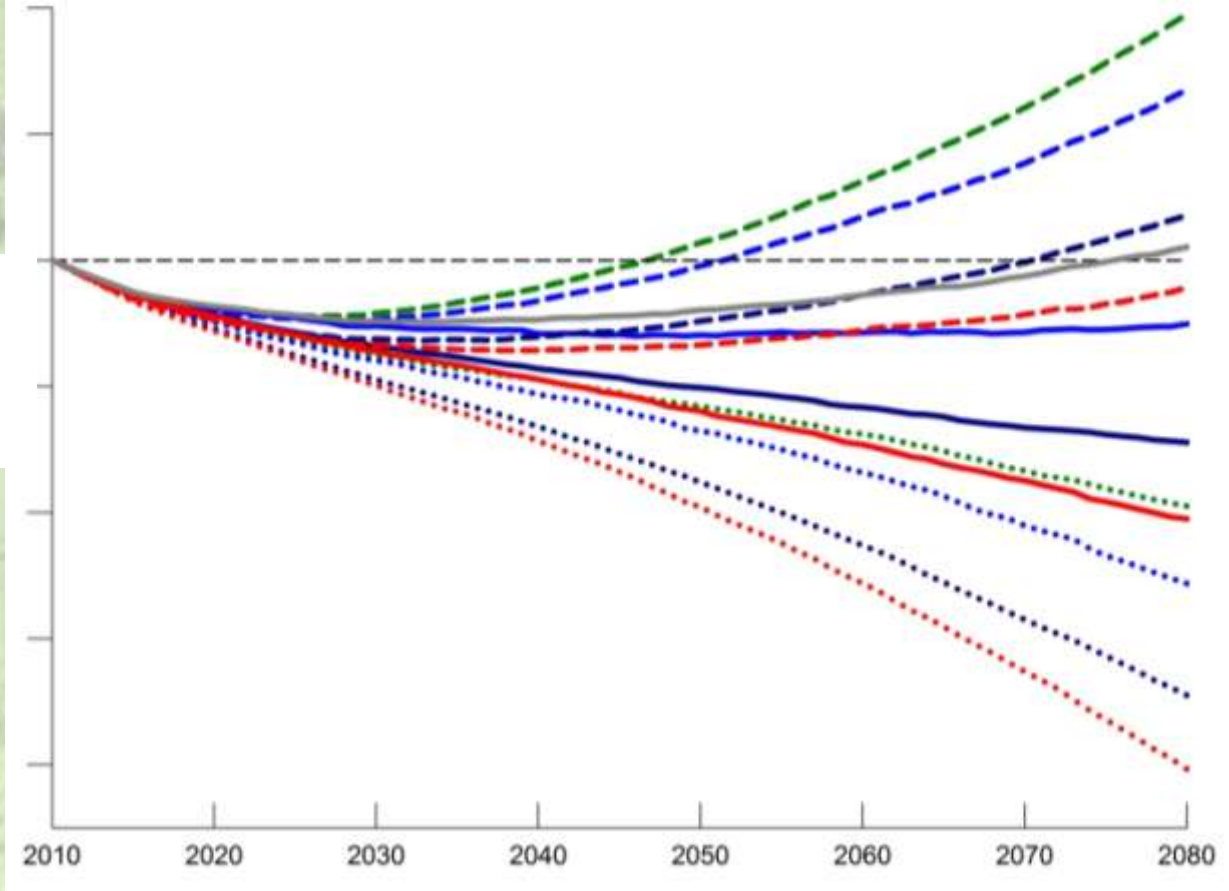
Cumulative 2010-2080 C flux



Impacts on carbon

- Range of future ecosystem stocks 2010 level is large
- Most scenarios show a decrease
- Urgent need to improve our understanding

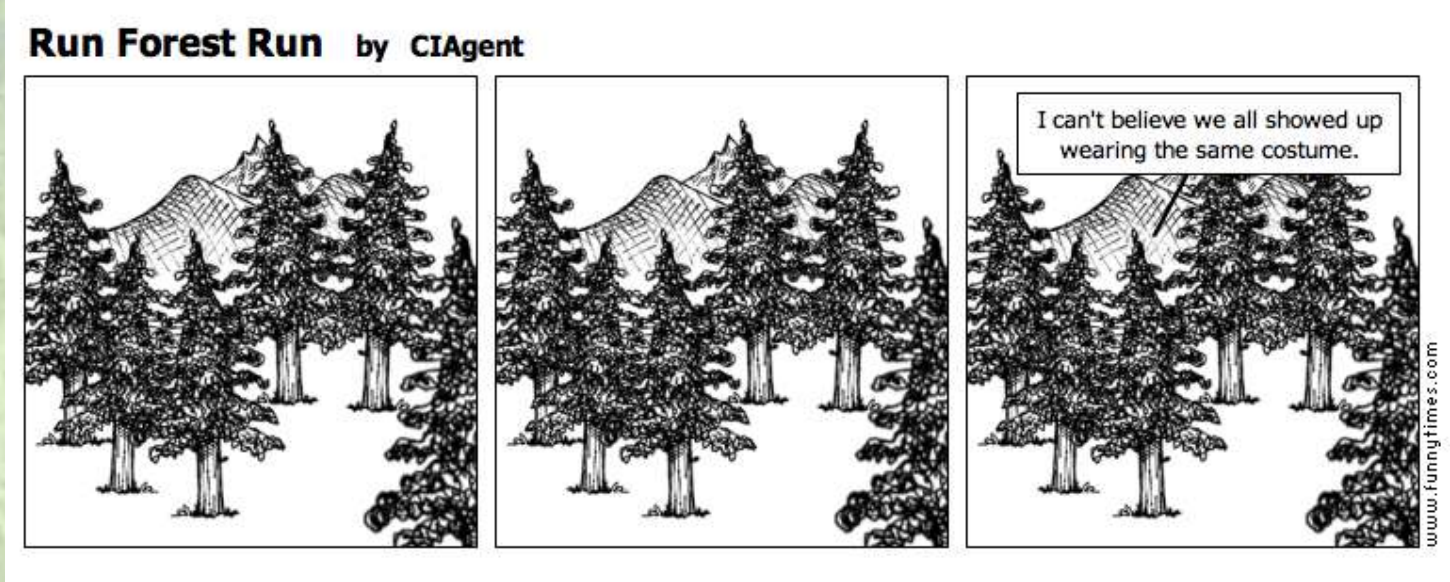
Proportion of carbon stocks relative to 2010



Recent

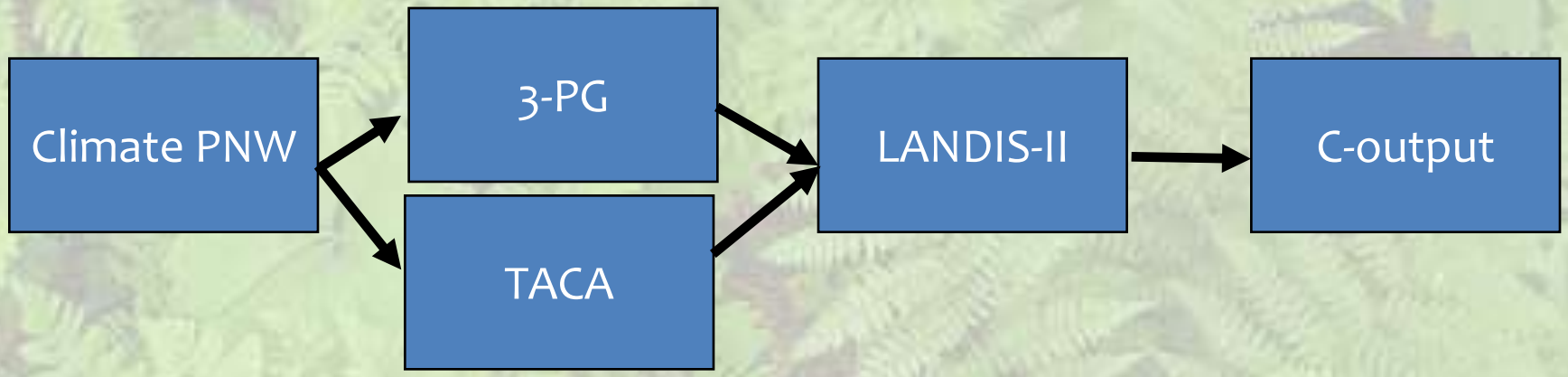
How can we improve on the modelling?

- Focus on a landscape
- Reduce range of changes on growth and fire by using more process-based models
- Incorporate spatial-dependencies



How can we improve on the modelling?

- Processed-based growth model: 3-PG
- Climate based model of natural regeneration success
- LANDIS-II
  - Climate based model of fire
  - Includes harvesting
  - New C-model based on CBM-CFS3



Implications for managers

- Can't assume there's going to be a sink with any degree of certainty.
- Adaptation to maintain or improve growth rates
- Remember that we may not be able to shift the forests from a source to a sink, but we can improve on what would naturally occur

Thanks!

- Extension Note 92
- http://www.for.gov.bc.ca/hre/topics/climate/Misconceptions.htm
- Carbon.cfs.nrcan.gc.ca