Modeling at the Landscape Level

DYNA-PLAN

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Landscape Level Models

► Mathematical models designed to explore issues relevant at the landscape level (multiple stands):
  ▪ Wildlife Habitat / Biodiversity
  ▪ Wood Supply
  ▪ Watershed Health, etc.
Use Landscape level models:

► when we cannot conduct real-life experiments
  - E.g. results take too long to obtain

► when tradeoffs evaluation becomes complex
  - Counter-intuitive
  - E.g. wood vs wildlife habitat
    Maybe harvesting less could increase fire risk and eventually result in a younger landscape under drier warmer climate.
Landscape Level Modeling: an exploratory tool

► Allows different scenarios to be explored:
  ▪ Alternative future forest conditions
  ▪ Alternative management responses

► Outcomes tracked with consistent indicators

► Role: Project forest harvesting, growth, and natural disturbances at the landscape level in order to predict impacts from climate change on timber supply, wildlife habitat, biodiversity, forest cover (to feed into the hydrological model)
DYNA-PLAN Model

- Fully spatially explicit (raster cells)
  - Unique in how it considers neighborhood relationships (cells try to be like neighbours)
DYNA-PLAN Model

- Stand can have multiple treatment options
- Economics can be considered (including roads)
- Model’s job is to select treatment options and timing for each stand to meet local and global objectives (goal seeking).
DYNA-PLAN

Able to simulate natural disturbances (MPB, fires, etc) while also optimizing harvest schedules.

Plan for what we know and then update as things change.
DYNA-PLAN’s Recursive Approach

► Period 1
- Simulate natural disturbances in P1
- Search for optimal harvest schedule for all future periods (make a plan)

► Period 2
- Simulate natural disturbance in P2
- Reoptimize from P2 forward (update the plan)

► Period 3
- Continue ..... Until all periods are completed.
What DYNA-PLAN Needs

► Landbase definition (THLB/NonTHLB)
► Stand attribute data (e.g. age, species mix)
► Stands grouped into similar ecosystems or ‘units’
► Eligible treatment regimes for each stand unit
► Attribute development curves for each stand unit/treatment regime
► Landscape/forest level objectives
  - Harvest flow, old growth, habitats, etc
  - Economics (revenue flow, stand values, costs, road network)
► Natural disturbance parameters
How is Climate Change Reflected?

- **Landbase Changes** (input to model)
  - Marginal stands fall out of THLB?

- **Loss of Existing Stands** (input to model)
  - From climate stress?
  - From increased natural disturbance?

- **Productivity Changes** (input to model)
  - Stand attribute curves altered?

- **Management Changes** (input to model)
  - Alternative regeneration / silviculture approaches?
  - Proactive harvesting of at risk stands?
What DYNA-PLAN Provides

► For each Scenario:
   Management actions for each raster cell over the planning horizon.
   Future landscape conditions resulting from these management actions - and disturbances.
   Forest outputs ($’s, harvest volume, habitat, spatial location)

► Each modeled scenario will reflect only one climate condition (i.e. Hadley A1F1 in 2050) and is assumed constant during the planning horizon.
end
Landscape Level Modeling

- Inputs from stand level models are used to assign attributes to each stand in the forest
  - Typically simplified to stand/ecosystem units with common attributes.

CLIMATE CONDITIONS

INVENTORY (Stand Units)

TREATMENT REGIMES

ForWaDy (Predict Moisture Stress)

TACA (Predict Regeneration Success)

FORECAST (Stand Level attributes over time)

Attribute Curves for each Stand Unit / Treatment Regime

DYNA-PLAN
Landscape Level Modeling
- Natural disturbance regimes
- Landscape level objectives for timber and non-timber values.
Neighbours

- Neighbours influence a stand’s future more than what is going on far away (e.g. fire, fragmentation)
- In DYNA-PLAN, each stand has its own decision function that considers neighbourhood context and the suitability of the stand to a given management action.
Finding a Solution

► Stand level decisions are made:
  - for each time period of the planning horizon
  - given local characteristics and constraints,
  - given potential development options through time,
  - given neighbors' decisions and
  - the level of satisfaction of forest constraints.

► Stand decisions co-evolve until the forest as a whole has improved objectives