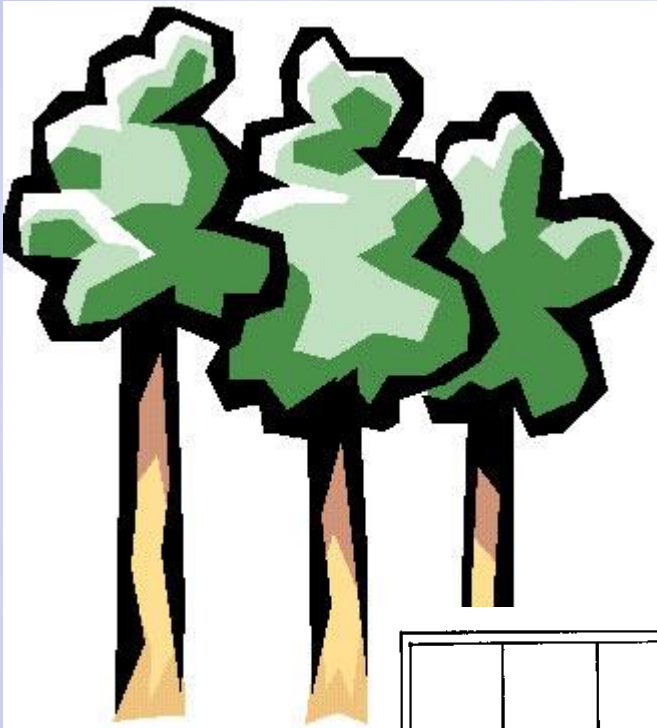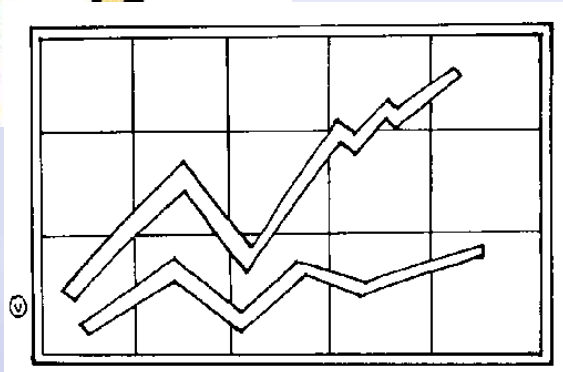Ministry of **Forests, Lands** and Natural Resource Operations

Managed Stand Growth and Yield Models:

- TASS,TIPSY and what they can do for you

Winter SISCO Jan. 30 - Feb. 1, 2017, Kamloops, B.C.

OUTLINE

- Introduction: Terms and Definitions
- TASS II
- TIPSY
- TASS III
- Recommendations for model use

Introduction

Managed stand growth and yield models

- Growth and yield :
  - study of tree growth over time, and prediction of product yields and forest structural characteristics

- Managed stands:
  - second growth
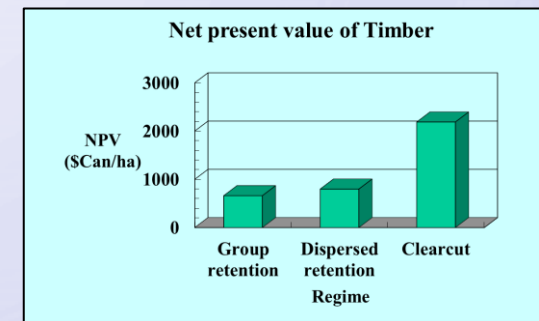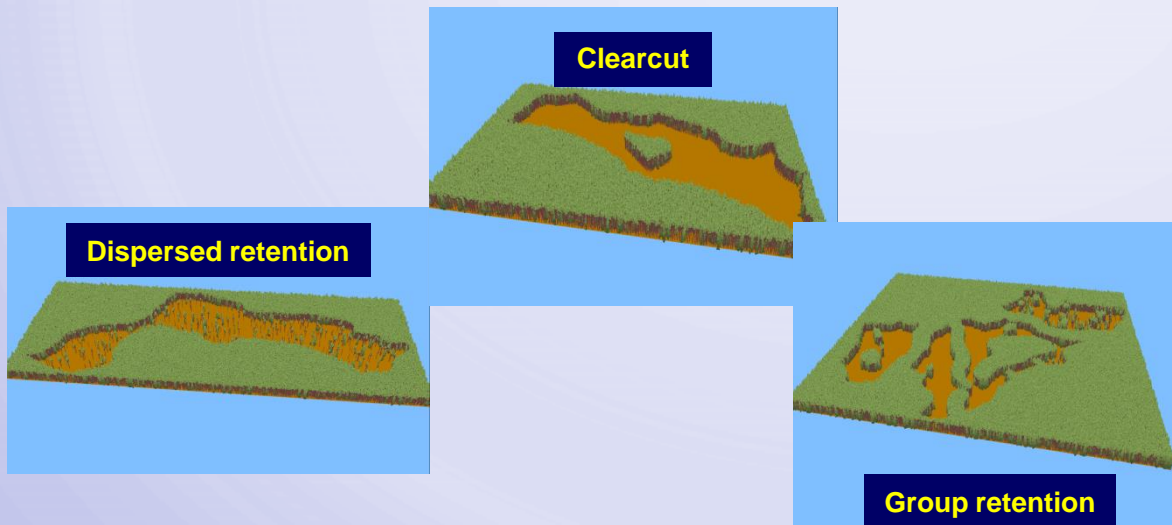 - subject to silvicultural controls

Introduction

Managed stand growth and yield models

- Simulate the physical development of <u>treated</u> forests and report quantitative units familiar to forest professionals responsible for implementing and assessing both basic and intensive forestry practices.

Clearcut

Dispersed retention

Group retention

Net present value of Timber

Managed stand growth and yield models

Year	Age Estab years	Number Alive #/ha	Top Height m	Crown Closur %	Volume Total m³/ha	DBH QMean cm
2011	2	1156	0.00	1	0.0	0.00
2012	3	1156	0.00	3	0.0	0.00
2013	4	1156	0.00	8	0.0	0.00
2014	5	1156	1.60	18	0.0	0.03
2015	6	1156	2.34	31	0.2	0.57
2016	7	1156	3.07	48	0.5	1.30
2017	8	1156	3.84	66	1.2	2.20
2018	9	1156	4.66	82	2.5	3.26
2019	10	1156	5.52	92	4.9	4.47
2020	11	1156	6.41	97	8.5	5.77
2021	12	1156	7.29	99	13.8	7.10
2022	13	1156	8.19	100	20.9	8.37
2023	14	1156	9.05	100	29.8	9.57
2024	15	1156	9.95	100	40.6	10.70
2025	16	1152	10.84	100	52.8	11.75

- Growth and yield information for managed stands first assembled from early B.C. field study plot data into yield tables.

- Gradually, the usefulness of computer modelling and simulation was applied to the task.
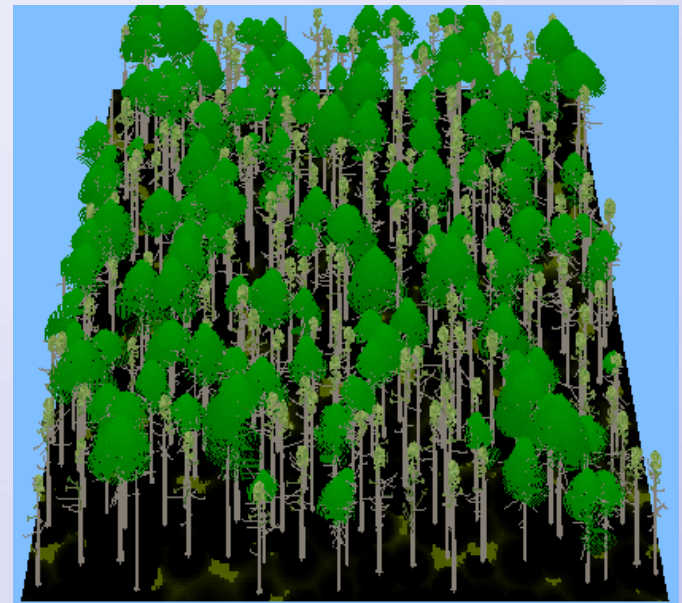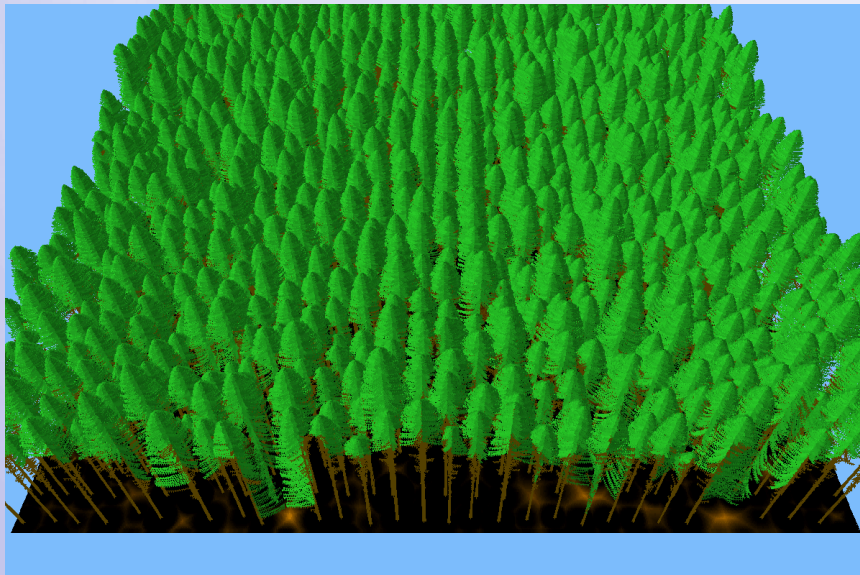
Tree **a**nd **S**tand **S**imulator (TASS)

- The premier managed stand growth and yield model used in B.C. forest management

Tree and Stand Simulator (TASS)

- An individual tree
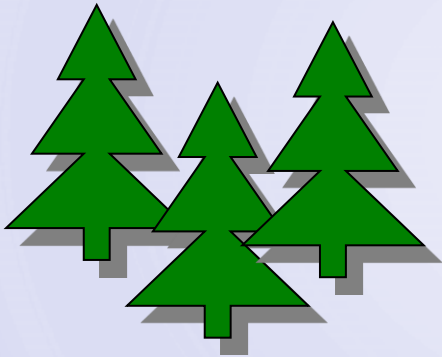
- spatial
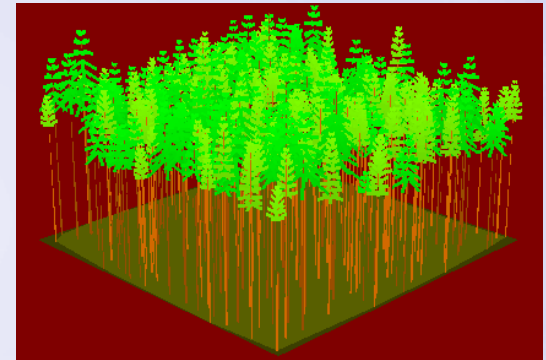
- crown model
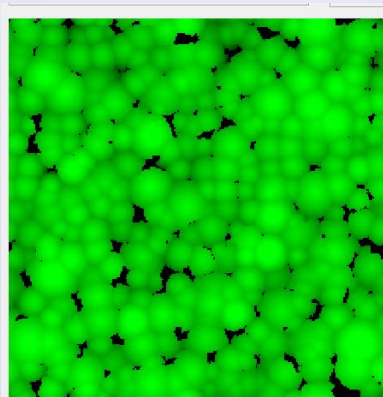
TASS Growth Simulation Process
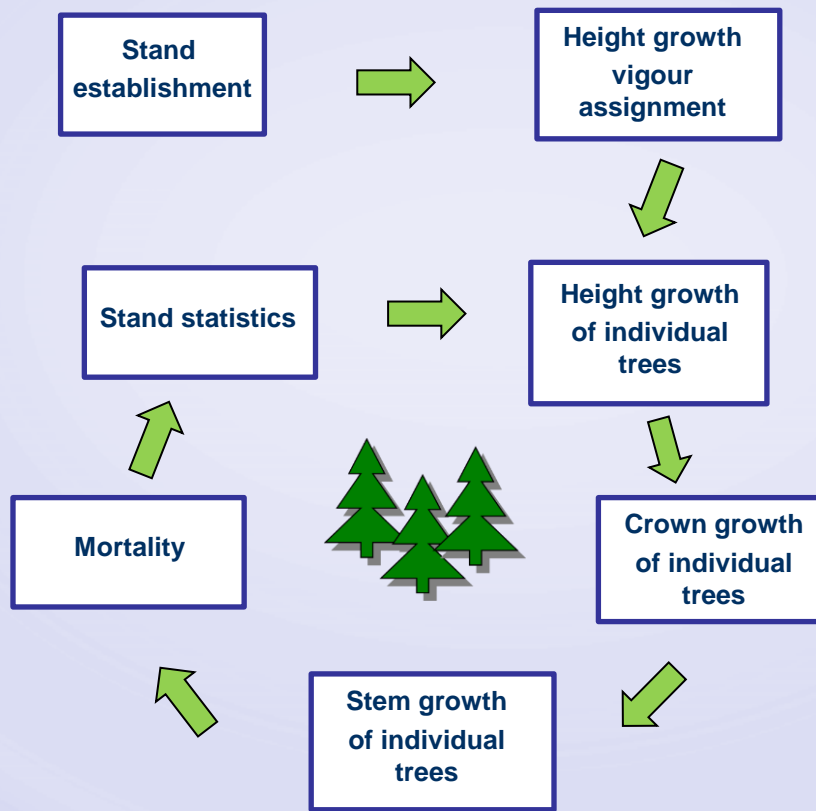
```
┌──────────────┐              ┌──────────────┐
│    Stand     │   ──▶        │ Height growth│
│establishment │              │    vigour    │
│              │              │  assignment  │
└──────────────┘              └──────────────┘
                                     │
                                     ▼
┌──────────────┐              ┌──────────────┐
│Stand statistics│  ──▶       │ Height growth│
│              │              │of individual │
│              │              │    trees     │
└──────────────┘              └──────────────┘
     ▲                               │
     │                               ▼
┌──────────────┐              ┌──────────────┐
│  Mortality   │              │ Crown growth │
│              │              │of individual │
│              │              │    trees     │
└──────────────┘              └──────────────┘
     ▲                               │
     │                               ▼
          ┌──────────────┐
          │  Stem growth │
          │of individual │
          │    trees     │
          └──────────────┘
```

Model Fitting

Bole Measurements
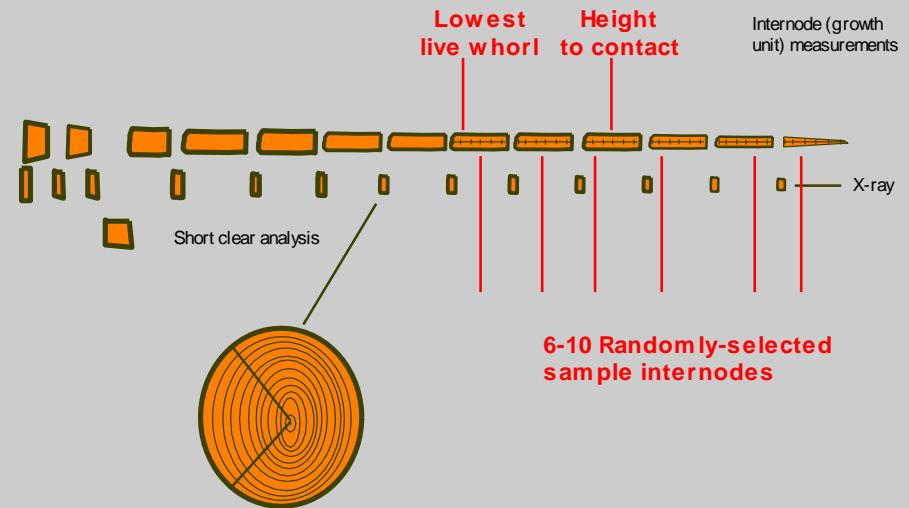
Lowest live whorl · Height to contact · Internode (growth unit) measurements

X-ray

Short clear analysis

6-10 Randomly-selected sample internodes

Model Calibration
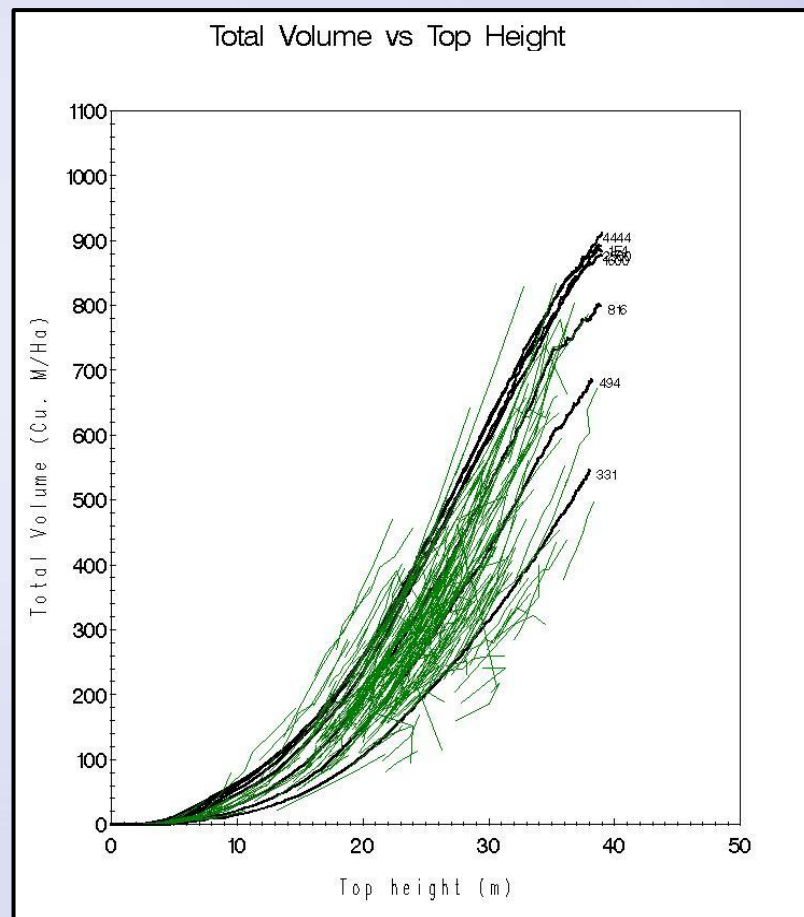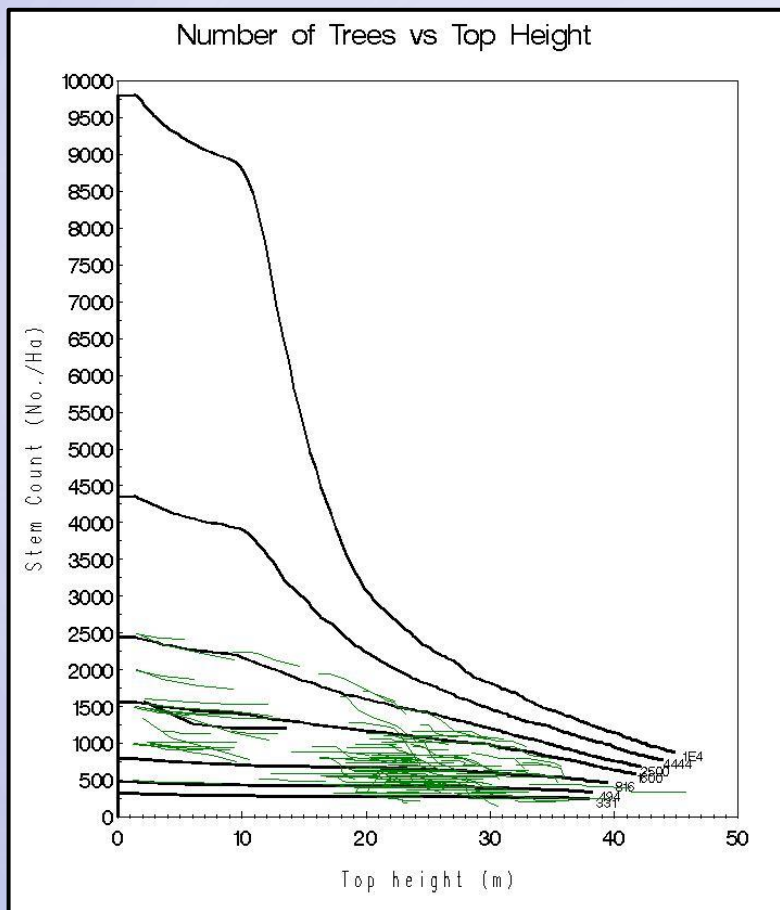
Great tool, but….

- The full TASS model is not (yet) in general distribution
- Possible TASS variables, scenarios and outputs is large:

    Species x spatial arrangement x initial density x silvicultural treatments x genetic worth x product specifications x etc. = ∞

Enter "TIPSY"

- <u>T</u>able <u>I</u>nterpolation <u>P</u>rogram for <u>S</u>tand <u>Y</u>ield (TIPSY)

- A "meta-model" software program giving electronic access to a vast database of yield tables produced by TASS.

- Does not simulate stand growth, but retrieves, customizes and displays information from the database.

- Output readily transferred to a graphing program (PLOTSY) and an financial analysis program (FAN$IER).

Example: Lodgepole pine, site index = 20 m
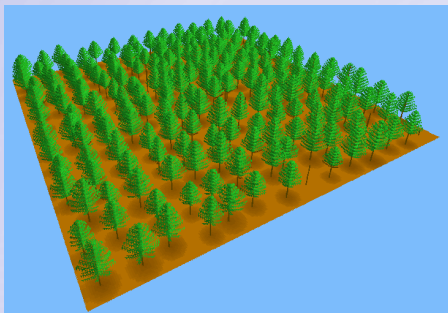
- **Planted, square spacing 800 trees ha^{-1}**
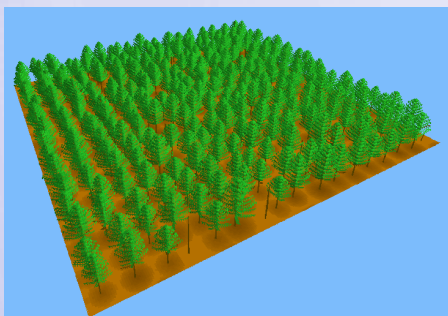
- **1200 trees ha^{-1}**
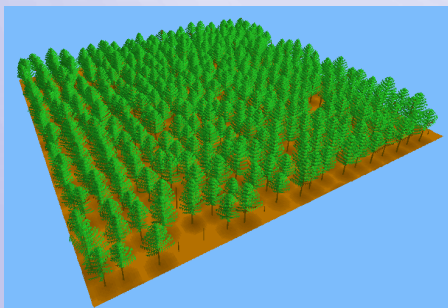
- **1600 trees ha^{-1}**

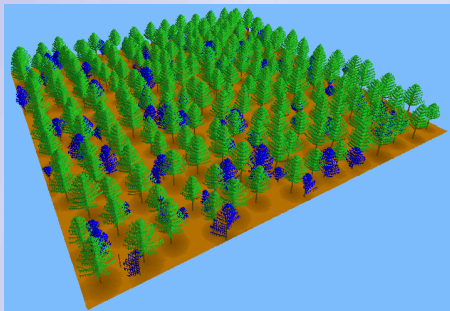**Merchantable Vol. Yield to 100 Years**
TIPSY 4.3.2
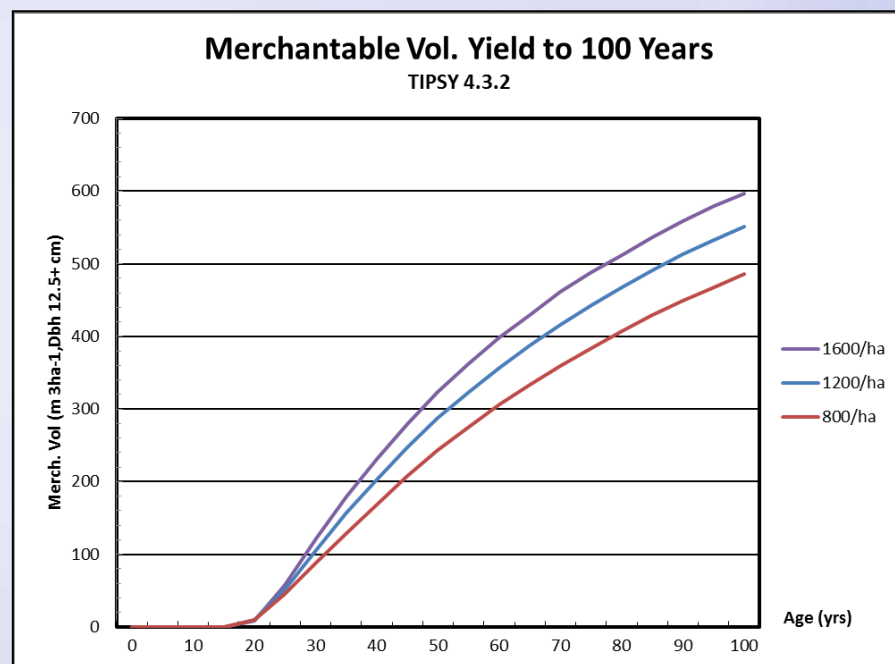
Limits to TIPSY

- TIPSY carries only a subset of the potential TASS simulations.
- TIPSY has no tables for:
  - scenarios combining planted plus natural ingress
  - mixed species
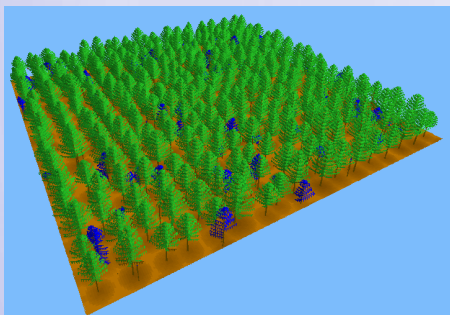- For these regimes, we must return to TASS:

TASS II Example: Lodgepole pine (site 20), with ingress

- Planted, square spacing 800 trees ha^{-1}, 500 trees ha^{-1} ingress

- 1200 trees ha^{-1}, 500 ha^{-1} ingress

- 1600 trees ha^{-1}, 500 ha^{-1} ingress

Merchantable Vol. Yield to 100 Years
TIPSY 4.3.2

Legend:
- 1600/ha
- 1200/ha
- 800/ha
- 820+500/ha
- 1200+500/ha
- 1600+500/ha
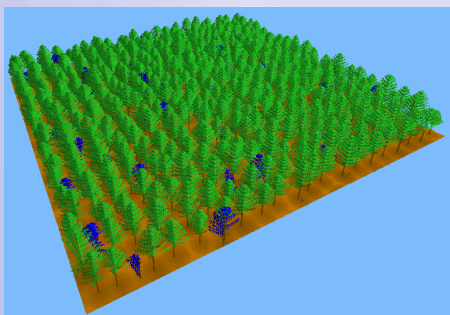
Y-axis: Merch. Vol (m 3ha-1,Dbh 12.5+ cm)
X-axis: Age (yrs)
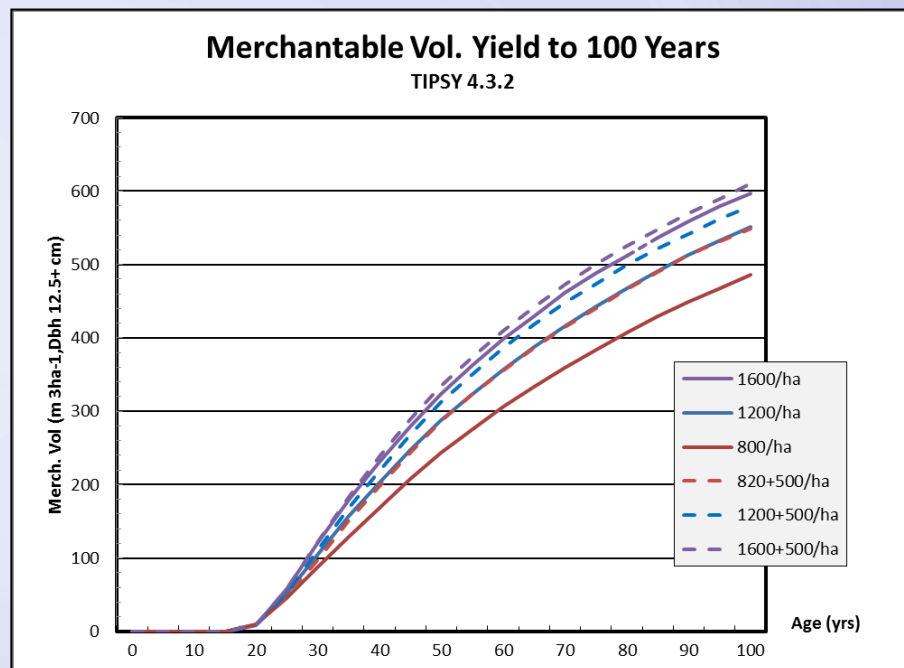
Limits to TASS II

- All over-topped trees die.
- Limited ability to simulate multi-layered canopies.
- Severely limits fidelity in simulating complex stands.

Enter TASS III

- A light model (tRAYci) simulates relative light levels within the canopy.

- Height growth and other driving functions are responsive to relative light levels.
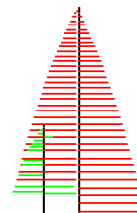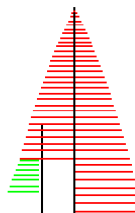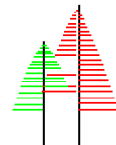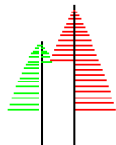

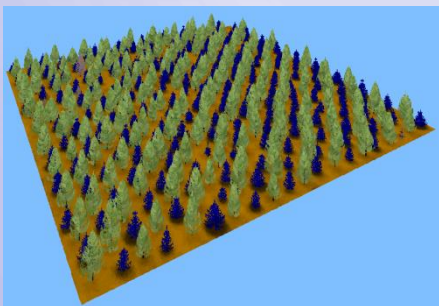| Age 30 | TASS II | TASS III |
| Age 50 | | |
| Age 80 | | |

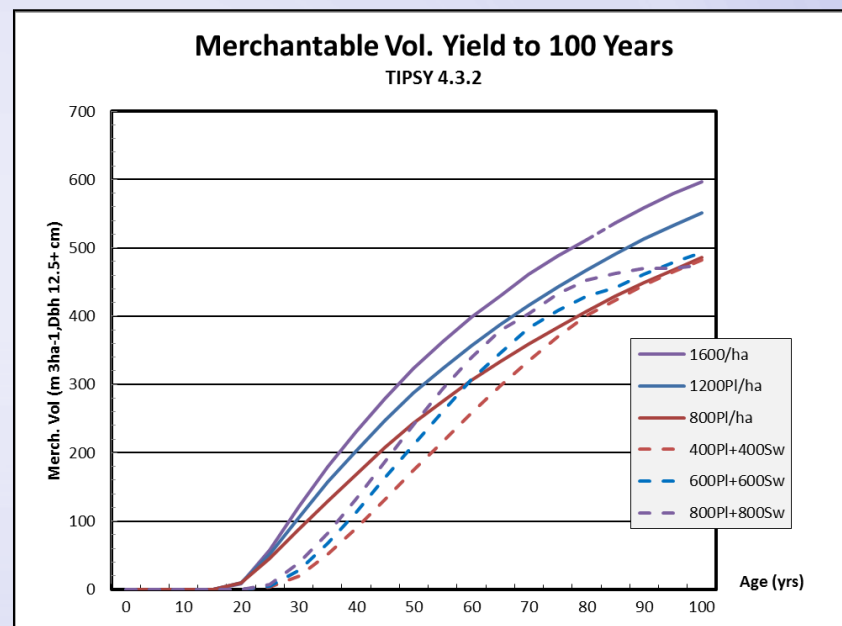# TASS III Example: 50:50 Mix of Lodgepole Pine and White Spruce
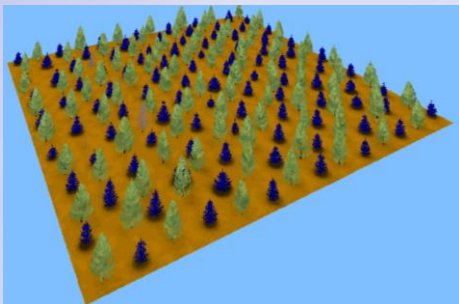
- **Planted, square spacing 400 Pl trees ha^{-1}, 400 Sx trees ha^{-1}**
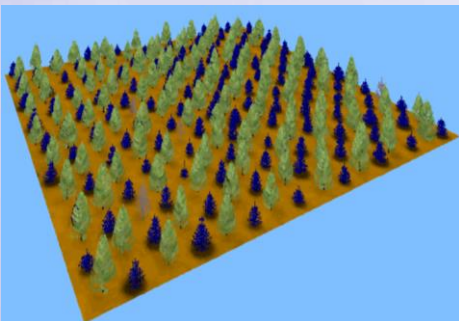
- **600 Pl trees ha^{-1}, 600 Sw ha^{-1}**

- **800 Pl trees ha^{-1}, 800 Sw ha^{-1}**

TASS III Example: 50:50 Mix of Lodgepole Pine and White Spruce

Here is what this looks like:

plsw3.mp4

Recommendations

- TIPSY is suitable for a very wide range of applications.

- Contact Forest Analysis and Inventory Branch for custom TASS runs, if needed.

- Confine scenario comparisons to only one of these models.

THANK YOU!

- Acknowledgements
  - Ken Polsson
  - Jim Goudie, RPF
  - Mario di Lucca, RPF
  - Ian Cameron, RPF
  - Ken Mitchell, PhD, RPF