TASS III: The Next Generation...

of a Growth & Yield Model for Complex Stands

TASS Trek - we're going where few have gone before....

Jim Goudie, Research Leader Stand Development Modelling Group Research and Knowledge Management Branch



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The star ship TASS crew

- Ken Mitchell (scientist emeritus, Captain Kirk)
- Jim Goudie (SDMG research leader, Captain Picard)
- Catherine Bealle Statland (complex stand development, Counselor Deanna Troi)
- Mario Di Lucca (G&Y applications specialist, Lt. Commander Data)
- Roberta Parish (Quantitative population biology, Dr. Beverly Crusher)
- Ken Polsson (programmer/analyst, Geordi La Forge)
- Shelley Grout (software application specialist TIPSY, Lt. Tasha Yar, security)
- George Harper (hardwoods) (Q)
- Ian Cameron (Azura Formetrics; biometrics/modelling, Commander Riker)
- Stephen Stearns-Smith (SSS and Assoc.;extension specialist Worf)
- Past member: Albert Nussbaum









Ken "Captain Kirk" Mitchell Circa 1975 COLUMBIA



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- About TASS
- TASS I II III history
- TASS III modifications
 - o tRAYci light model
 - o Crown profiles
 - o Crown competition
 - o Mortality
- TASS Graphical User Interface
- PLOTSY



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TASS – Tree And Stand Simulator

 \triangleright



40+ years and still exploring space

(because it is spatial)

TASS and TIPSY provides managed stand yield tables for use in:

- Timber Supply Review (AACs)
- Silvicultural prescriptions and strategies
 - Predictions of non-timber forest values





TASS I:

1963-1968

Dr. Ken Mitchell, UBC grad and Yale PhD (1968) (Yale Bulletin No. 75)

Two-dimensional crown modelling









TASS II:

1968 – present 1975 For. Sci. Monograph 17









T<mark>ass III</mark>

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1996 – present

Three-dimensional crown modelling and light model (tRAYci)





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TASS II Key Components

- •Height Growth = f(potential, light)
- Crown morphology (branch extension)
- Competition
- Mortality
- Ring characteristics
 - size, juvenile-mature wood, relative density, strength, cell characteristics









Crown Growin

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Competition - Mortality





Bole Increment



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April 7, 2010: 6:00pm

South

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North

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Latitude 50° N

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Relative height growth

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Crown Profiles

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Crown profile samples

Spacios	No troos	No Branches		
Species	110. 11665	Radius	Total	
Hwc	154	1619	8307	
Fdc	150	1302	3751	
Ва	63	510	1121	
Ss	96	504	2006	
Si	60	863	2763	
PI	115	1106	1761	
Total:	638	5904	19709	

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Crown - columns of growing space

Allows only <u>one</u> live canopy layer per grid column – Overtopped canopy layers die

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Supports <u>multiple</u> live canopy layers per grid column -Light governs understory growth and mortality

noiiiieqmo2 - nwor2

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- About TASS
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 - o Mortality (our nemesis, the Borg)
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- PLOTSY

Mortality steps

- Collected all stem-mapped PSPs
- Input tree list and x-y coordinates into TASS
- Estimated the PACL of each tree at each measurement
- Used this derived PACL and other variables to predict the probability of death (or survival).
- Tried several approaches but now,

Classification And Regression Trees (CART)

- *Classification* for categorical variables (i.e. live or dead) or *Regression* for continuous variables
- Random forests is the most well known software
- While similar in concept to principle components analysis (which creates linear combinations of variables), this routine is non-paramentric (no assumptions necessary about the underlying distribution) and uses if-then-else logic.
- Results are fairly straightforward to interpret, however, the algorithms are very complex
- Need to decide:
 - The criteria for predictive accuracy
 - When to stop splitting
 - What is the "right-sized" tree (i.e., over fitting can be a problem)

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Classification And Regression Trees (CART)

Leaf Label is node number and probability of survival

Lives/Dies label is simply based on probability of survival: e.g., at node 2 < 0.979 → Dies

Individuals will live or die based on probabilities and random draws, not the Lives/Dies label.

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Moving through the Tree - If the test statement is True, go left

We have coded in the CART mortality algorithm for testing purposes. When satisfied that it is working "correctly" (i.e., passes test of reasonableness), then we use the information (e.g., variables, interactions) to conduct logistic regression.....

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Logistic Regression

- generic tool for fitting a dichotomous dependent variable (e.g. Live-Dead) to categorical and continuous independent variables.

$$P_s = \left(\frac{1}{1 + e^{\beta X}}\right)^L$$

 $\beta X = b_0 + b_1 C_1 + b_2 C_2 \dots + b_n C_n + b_{12} C_1 C_2 + \dots + b_{nm} C_n C_m$

with individual covariates (C_i) and possible interaction terms that are selected in part from the CART results.

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TASS Graphical User Interface (the holodeck) PLOTSY

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About TASS III

OK

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Version 2.0.4 alpha

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Developed by Research Branch, Ministry of Forests and Range, Victoria BC.

TASS III - Tree And Stand Simulator

Distributed free of charge at the discretion of the ministry.

Acknowledgements...

TASS Graphical User Interface (the holodeck)

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TASS Graphical User Interface

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Merch Volume & Juvenile Wood Volume

TASS III

Underlying philosophy unchanged:

Advancing the prediction of stand growth and yield by focusing on the spatial dynamics of individual tree crowns, the biological engine of tree growth.

TASS is a framework for synthesis of world-wide research on tree growth and stand development, with a focus on treatment response.

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Thank you for your attention

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