Te Marunga Forest, East Coast Region, North Island: Comparison of PhotoMARVL data and TreeBLOSSIM Predictions

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NOTE : Confidential to participants of the Stand Growth Modelling Cooperative.
: This is an unpublished report and must not be cited as a literature reference.

EXECUTIVE SUMMARY

Twenty-two radiata pine trees, representative of the range of "tree types' found in Te Marunga Forest (East Coast Region, North Island) were PhotoMARVLed during 2000. Branch diameters, extracted from these images, were compared with TreeBLOSSIM predictions of branch diameter for a permanent sample plot that was considered to be representative of the forest.

Comparison of the PhotoMARVL data with TreeBLOSSIM predictions suggested that the position of the tree within the stand (e.g. typical forest situation versus road edge) had influenced the tree mean value of $BD_{\max}$, where $BD_{\max}$ is the diameter of the largest branch in a cluster.

It is suggested that the affect of growing space on branch diameter be investigated further.

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Introduction

In 2000, Hikurangi Forest Farms commissioned Forest Research to take PhotoMARVL images of selected 20-year-old trees in Te Marunga Forest. These trees were not in a permanent sample plot, but were selected throughout the forest and represented the range of “tree types” found in the forest.

These 22 images were made available to the Stand Growth Modelling Cooperative in 2003 to determine how well TreeBLOSSIM could predict the branching characteristics of trees in Te Marunga forest. This is one of several studies to determine how well TreeBLOSSIM predicts branching charcateristics of radiata pine throughout New Zealand.

Previously, comparisons of PhotoMARVL data with TreeBLOSSIM predictions have been made by:

- taking images of specific trees within a permanent sample plot (PSP),
- running TreeBLOSSIM for the specific PSP,
- comparing PhotoMARVL data and TreeBLOSSIM predictions for the specific trees.

As the trees PhotoMARVLed in Te Marunga forest were not in a PSP, a new comparison procedure was required.

Methods and Results

Step 1. **Analysis of PhotoMARVL data.**

For each PhotoMARVL tree, a graph was plotted showing the relationship between the diameter of the largest branch in a cluster and the height to the base of the cluster. The correlation between these two variables was also calculated. The correlation was significantly different from zero for only 6 of the 22 trees (Table 1).

Table 1. Trees where the correlation between diameter of the largest branch in a cluster and cluster height was significantly different from zero ($p< 0.05$).

Tree	Tree DBH (cm)	Correlation	Comment
14	32.0	-0.60	
11	46.5	-0.52	
10	56.5	0.49	
13	59.5	0.45	
4	60.5	0.44	
17	61.0	0.51	One of the adjacent trees had lost its top.

Based on knowledge gained from developing TreeBLOSSIM, it is suggested that a significant correlation indicates that the tree's growing space has changed though time. In the absence of any silvicultural treatment, a negative correlation would indicate a tree has suffered from suppression, whilst a positive correlation would indicate that a tree has been able to take advantage of local gaps in the canopy.

To define limits for the TreeBLOSIM data (see Step 2), the lowest and highest cluster measured on the PhotoMARVL images was determined.

- The height to the lowest cluster measured was 5.56 m.
- The height to the highest cluster measured was 19.06 m.

Step 2. Running TreeBLOSSIM.

Hikurangi Forest Farms provided PSP data for a plot that was considered representative of the trees PhotoMARVLed. This plot, HF1201/0 14/0, was last measured in August 2000 when the trees were 20.2 years old. Data from this measurement, together with the silvicultural history (Table 2) were imported into TreeBLOSSIM. TreeBLOSSIM then predicted the branching pattern for the whole tree at 20 years, the age at which the trees were PhotoMARVLed.

Table 2. Silviculture input into TreeBLOSSIM

Thinning History		Pruning History	
Age (years)	Stems/ha remaining	Age (years)	Height to crown (m)
0	1650	6	3.3
5	500	7	5.6
8	240	8	7.5

To be able to compare TreeBLOSSIM predictions with the PhotoMARVL trees all clusters lower than 5.56 m or higher than 19.06 m were deleted from the dataset.

For each tree in the PSP, a graph was plotted showing the relationship between the predicted diameter of the largest branch in a cluster and the height to the base of the cluster. The correlation between these two variables was calculated for each tree, and was non-significant for each tree.
The TreeBLOSSIM prediction of the relationship between diameter of the largest branch in a cluster and height to base of the cluster was generally consistent with that obtained from the PhotoMARVL images.

Step 3. Comparison of TreeBLOSSIM predictions with PhotoMARVL data (1)

As the correlation between diameter of the largest branch in a cluster and height to the base of the cluster was only significant for a few PhotoMARVL trees, it was considered that a tree average branching variable could be used in further analyses. The mean and variance of BD_{max} was calculated for each tree, where BD_{max} is the diameter of the largest branch in a cluster. The mean and variance were plotted against tree DBH (Figure 1 and Figure 2).

There was a group of trees where the PhotoMARVL and TreeBLOSSIM relationship between mean BD_{max} and DBH were similar. However there were also a number of trees where the PhotoMARVL value of mean BD_{max} was larger (Figure 1). The same was true for the variance of BD_{max} (Figure 2).

Step 4. Comparison of TreeBLOSSIM predictions with PhotoMARVL data (2)

To determine if there were any reasons for these patterns, the surroundings of the PhotoMARVL trees were assessed using the photographic images. From these notes, the trees were allocated to one of four classes:

- forest – tree in a forest situation
- track edge – tree by a narrow track, less open situation than those classified as road edge
- road edge – tree by a road edge
- open – 3 trees were assigned to this class, a road edge tree in a very open situation , a tree in an open situation, a tree in a low-stocked area where a neighbour had lost its top

Figures 1 and 2 were re-plotted (Figures 3 and 4) with the PhotoMARVL trees labelled according to the above classification.

Figure 3 is quite revealing. The between-tree variability in mean BD_{max} can be explained by the situation of the tree within the forest. The trees in the most open situation had the largest mean BD_{max} with respect to tree diameter. The trees close to a road-edge tended to have larger mean BD_{max} than the trees beside a narrow track or in a forest situation. For the trees classified as 'forest', the trend with DBH was similar to the TreeBLOSSIM predictions.

A similar situation is revealed when Figure 4 is examined. The variance of BD_{max} was largest for the trees in the most open situation, and tended to be least for the trees in the forest situation. The variance for the trees in the forest situation was similar to that predicted by TreeBLOSSIM.

Discussion

In this study TreeBLOSSIM predictions of branching within Te Marunga forest have been compared with data from PhotoMARVL images.

This study highlighted the benefits of having a permanent PhotoMARVL image of sample trees. We were able to go back to the images and classify the trees according to their situation in the forest.

The analyses indicated that the situation of the tree (in the forest, track-edge, road-edge, or open) influenced the tree mean and variance of BD_{max} for a given DBH. The mean and variance were largest in the open situation and smallest in the forest situation. In the forest situation, the means and variances were similar to the TreeBLOSSIM predictions, suggesting that TreeBLOSSIM predictions are reasonable in this situation.

Given that the PhotoMARVL trees were not located within the PSP, a more detailed comparison of the data is not justified. However, the study has provided some interesting insights into branching patterns. Trees on road edges and more open situations tended to have larger branches for a comparable DBH compared to a forest situation. One possible explanation is that the local stocking for a tree influences stem diameter growth, whereas the local stocking in the direction of the largest gap influences the diameter of the largest branch in a cluster.

The positions of neighbouring trees have been recorded for the trees that have been destructively sampled during the development of TreeBLOSSIM. These data will be used to explore the hypothesis outlined above, i.e. that gaps influence branch diameters more than tree DBH.

Another interesting question whether the relationship between tree mean value of $BD_{\max}$ and DBH has any influence on the stem wood properties.

Acknowledgement

Thanks are due to Ross Wade of Hikurangi Forest Farms for allowing the PhotoMARVL data to be used for this analysis, and to be reported to the Stand Growth Modelling Cooperative.

Figure 1. Tree average values for diameter of the largest branch in a cluster ($BD_{\max}$).

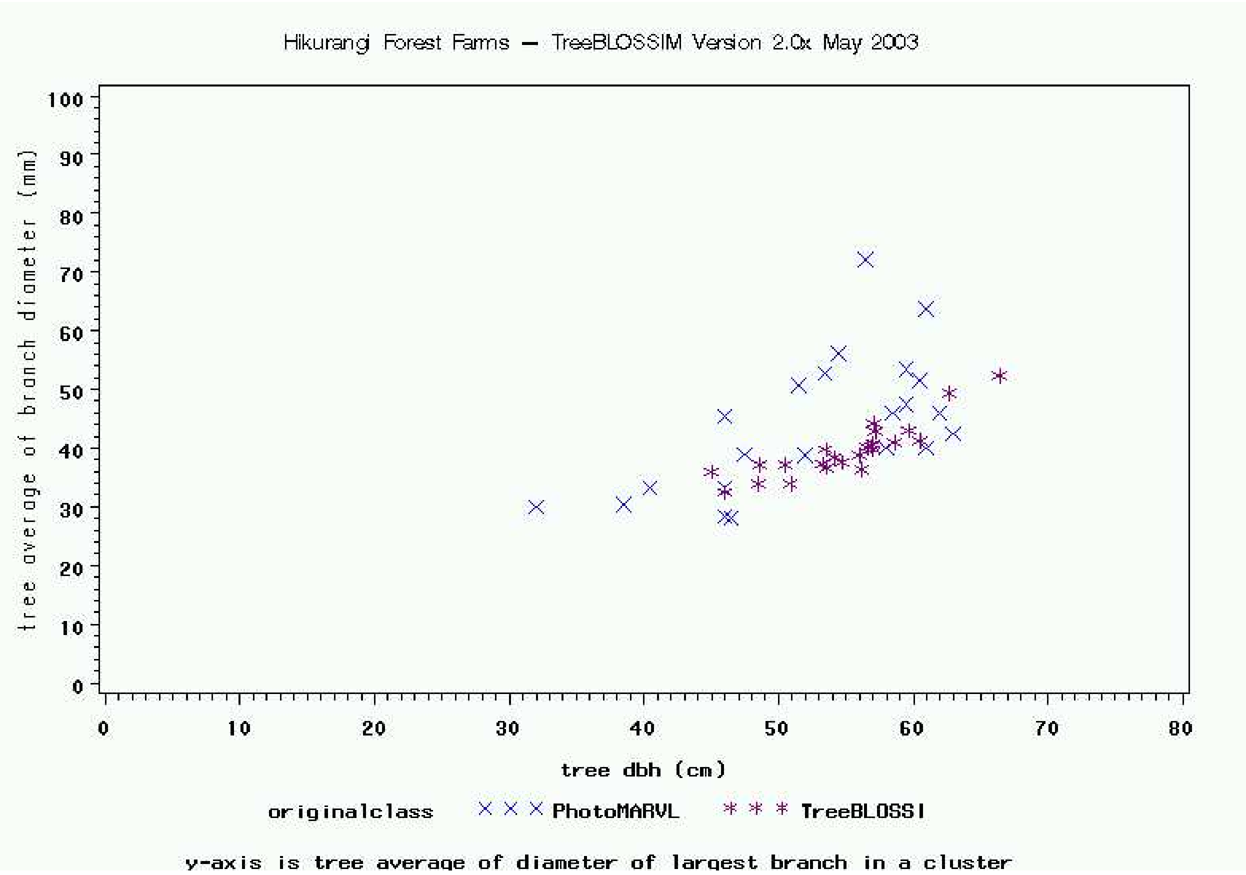

Figure 2. Tree variance for diameter of the largest branch in a cluster ($BD_{\max}$).

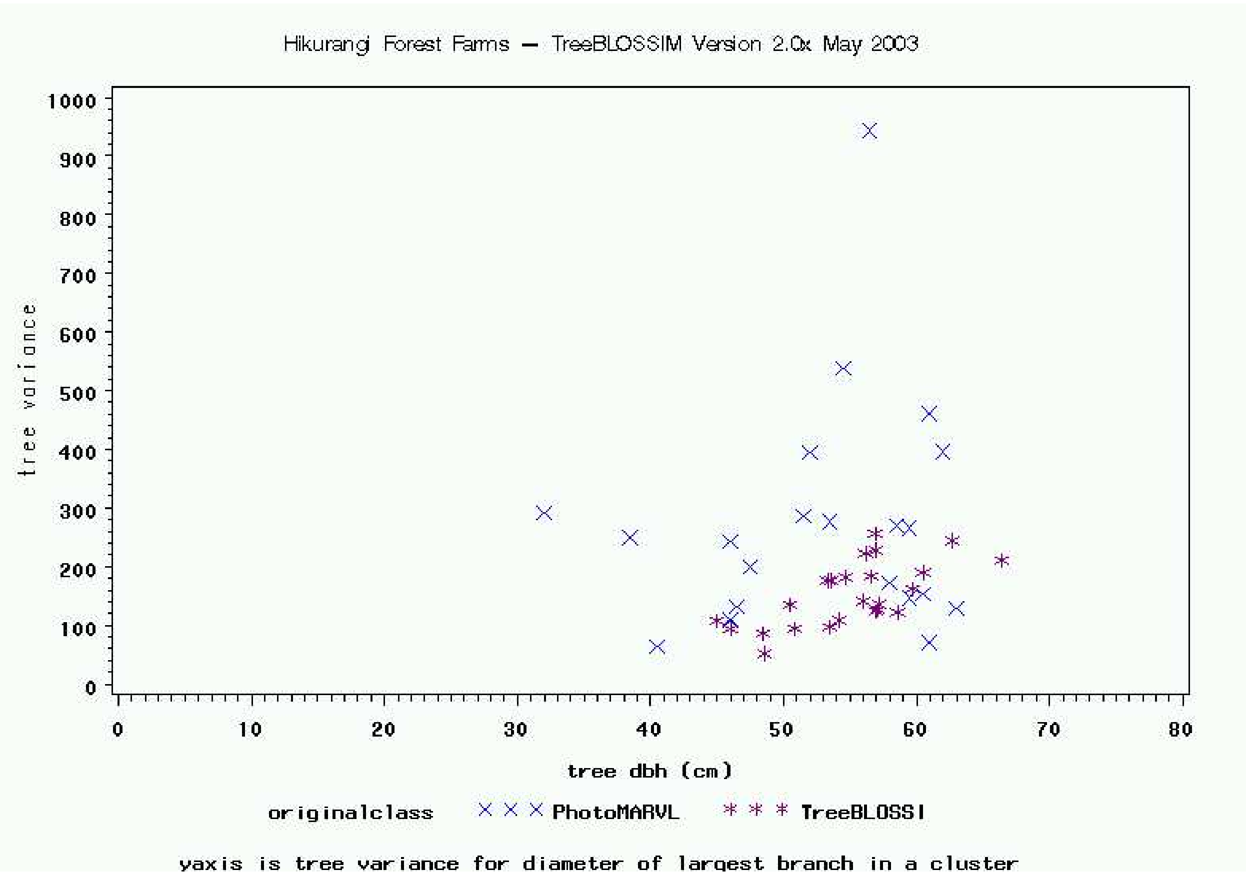

Figure 3. Tree average values for diameter of the largest branch in a cluster (BD_{max}).

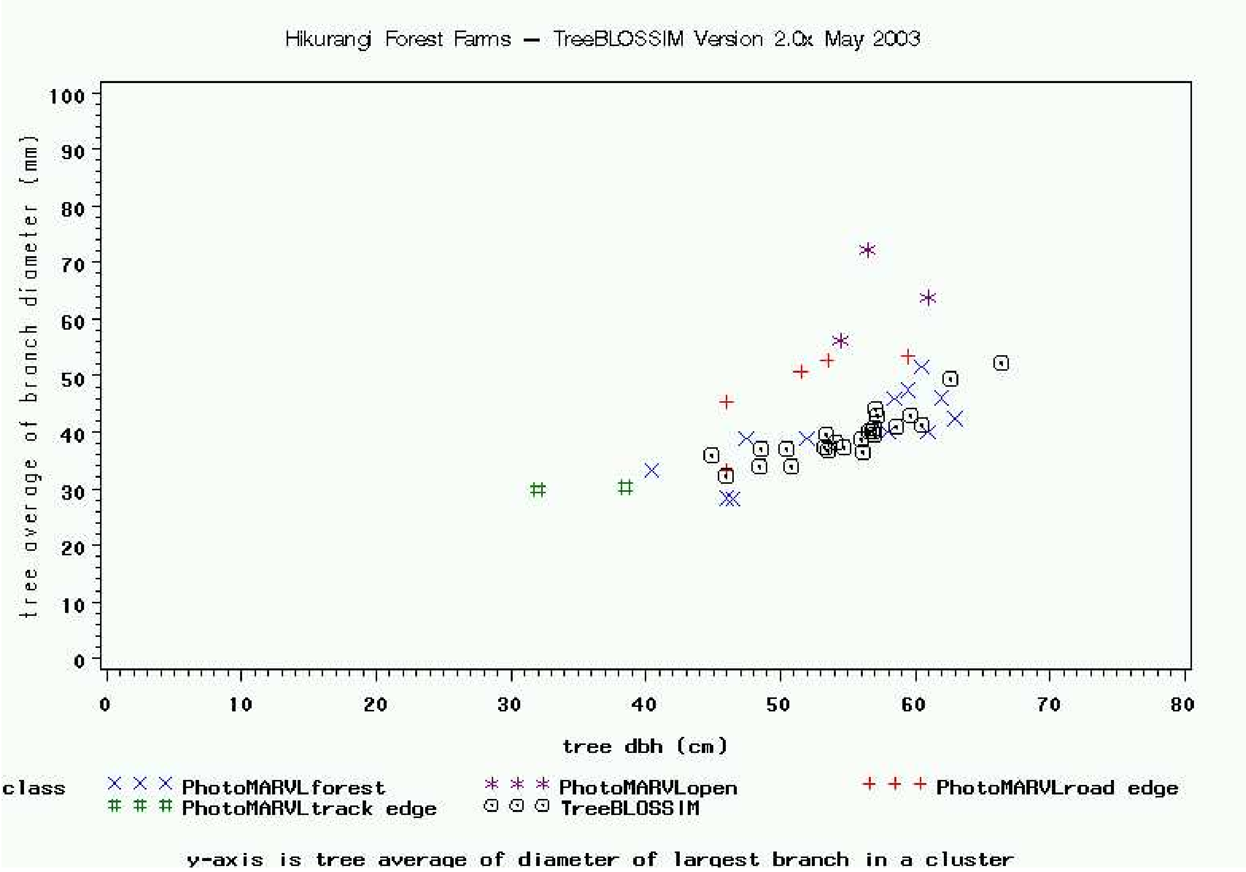

Figure 4. Tree variance for diameter of the largest branch in a cluster (BD_{max}).