

Project 2.07 | Australian Woody Vegetation Landscape Feature Generation

Project Leaders

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Research Team

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Project Participants

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Objectives

- To use remote sensing data to derive spatial layers of relevant descriptors of Australian woody vegetation
- To use those descriptor layers to create landscape features characterising large area woody vegetation systems

Outcomes

The project team will deliver a set of tools ready to be applied by Australian state agencies to create landscape features describing woody vegetation. The tools will be developed using open source language and adapted to be applied at a large area scale.

Introduction

With the onset of climate change there is an increasing need to monitor and assess the environment. Remote sensing data such as satellite imagery are the only means in which this can be achieved synoptically. Highly accurate and traceable measurements beyond the current state-of-the-art are required for climate forecasting and monitoring of trends. Computer modelling of highly detailed and accurate reconstructed natural environments is an attractive and affordable method to quantify retrieval method uncertainty and traceability of essential climate variables derived from remotely sensed data. It can be used to simulate ground-, air- and space-borne sensors in an almost unlimited number of scenarios. This is made possible using the known truth as a benchmark in the reconstructed computer modelling environment.

Study Site

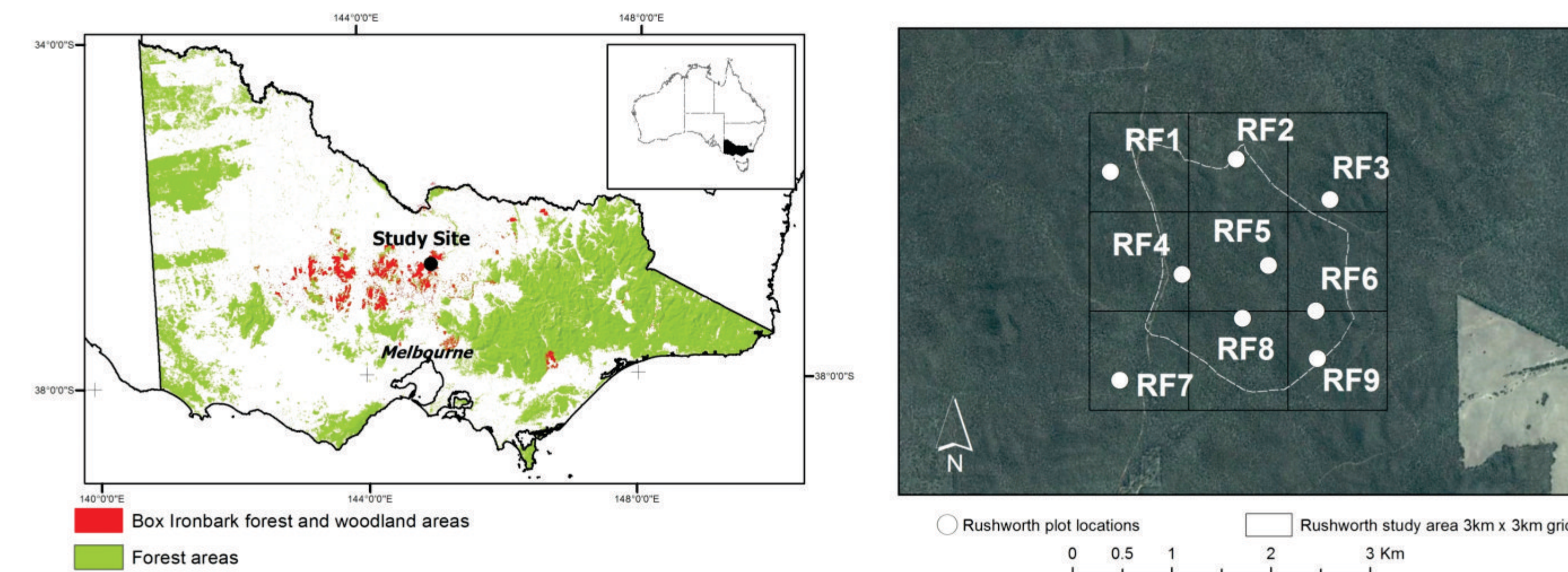


Figure 1 left: Map of Victoria displaying forest (green) and Box Ironbark forest (red), map of Australia (inset); right: Rushworth study area with location of forest plots

Method

Create a library of 51 deterministic 3D trees representative of a forest site



Figure 2 Four tree models reconstructed from field data. Reconstructed tree model structure (left); reference field photo (right)

Compare reconstructed model metrics with measured structural metrics

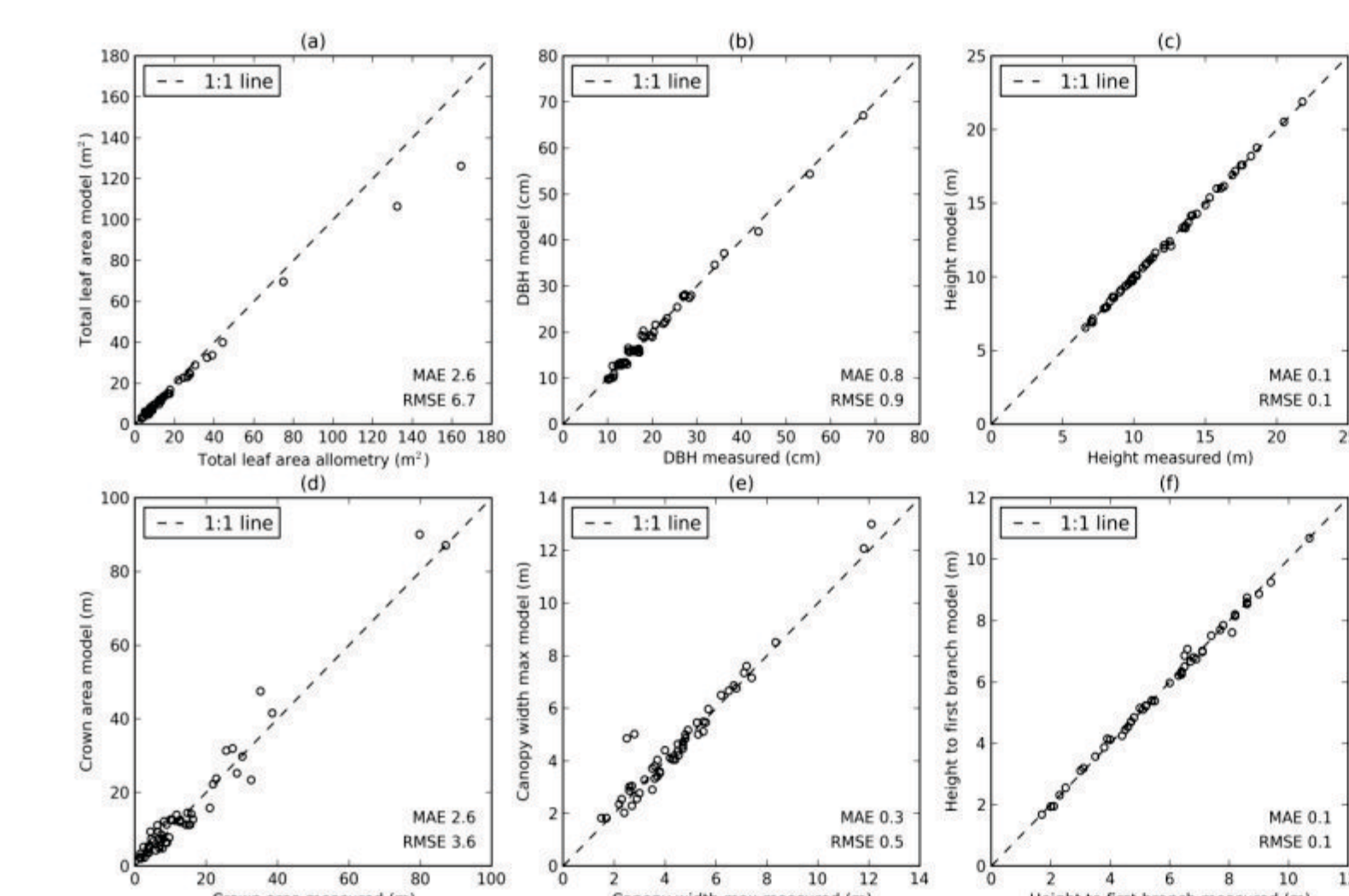


Figure 3 Comparison of structural parameters as measured or estimated in the field with the reconstructed model value for all 51 trees; (a) total leaf area per tree, (b) stem diameter at breast height, (c) tree height, (d) crown area, (e) maximum horizontal canopy width, and (f) height to first branch

3D Modelling

Simulation of different scenarios



Figure 5 Upward looking hemi photo simulations of three tree densities (increasing density left-right)

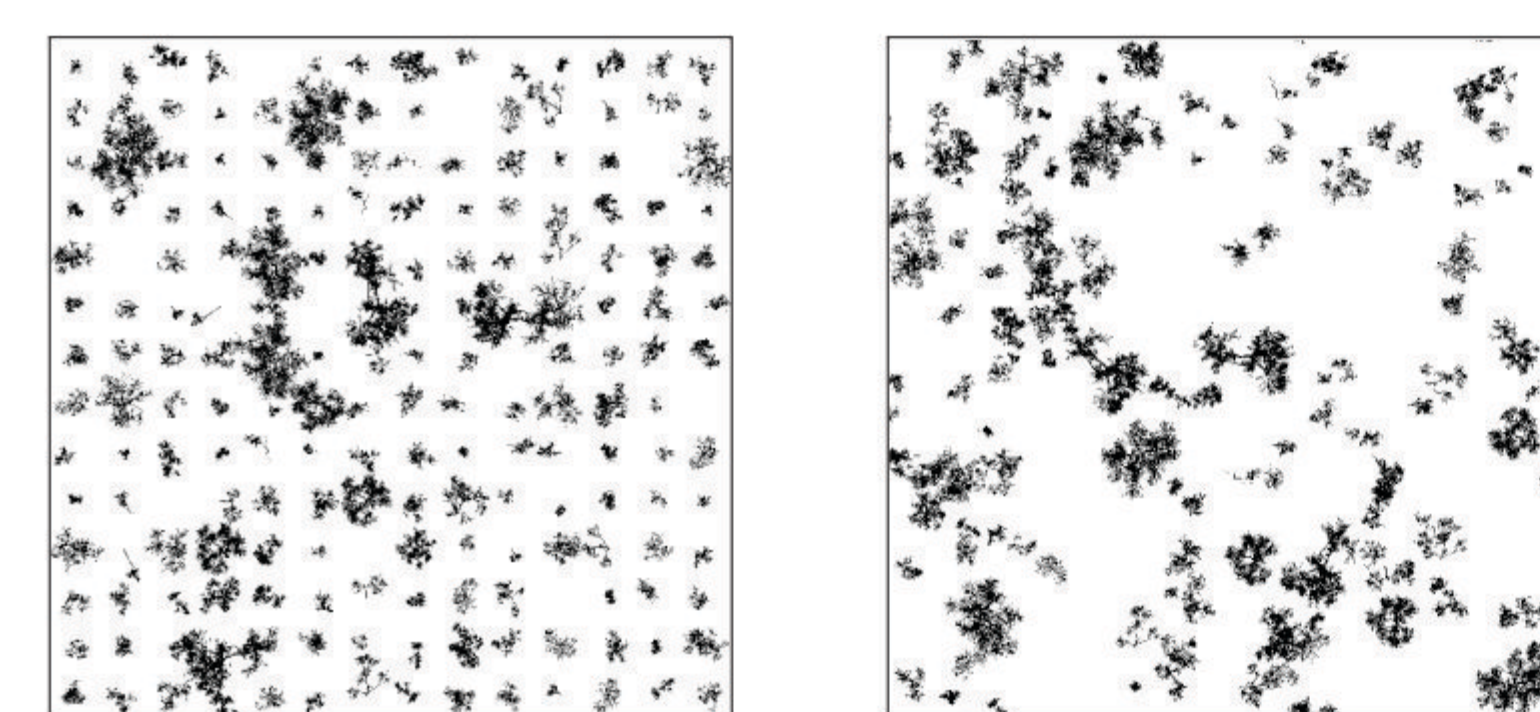


Figure 4 Three scenarios of element projected cover simulations for a single tree at a view zenith angle of 0 degrees (top-down)

Figure 6 Top-down simulations of two different stem distributions. Left: regular/plantation; right: clumped natural stand

Determination of LAI retrieval accuracy and uncertainty

Figure 7 Plant Area Index (PAI) or Leaf Area Index (LAI) error proportion when ignoring the angular distribution of wood. The error is shown for planophile (red), extremophile (green), and erectophile (black) leaf angle distributions at the Rushworth study site

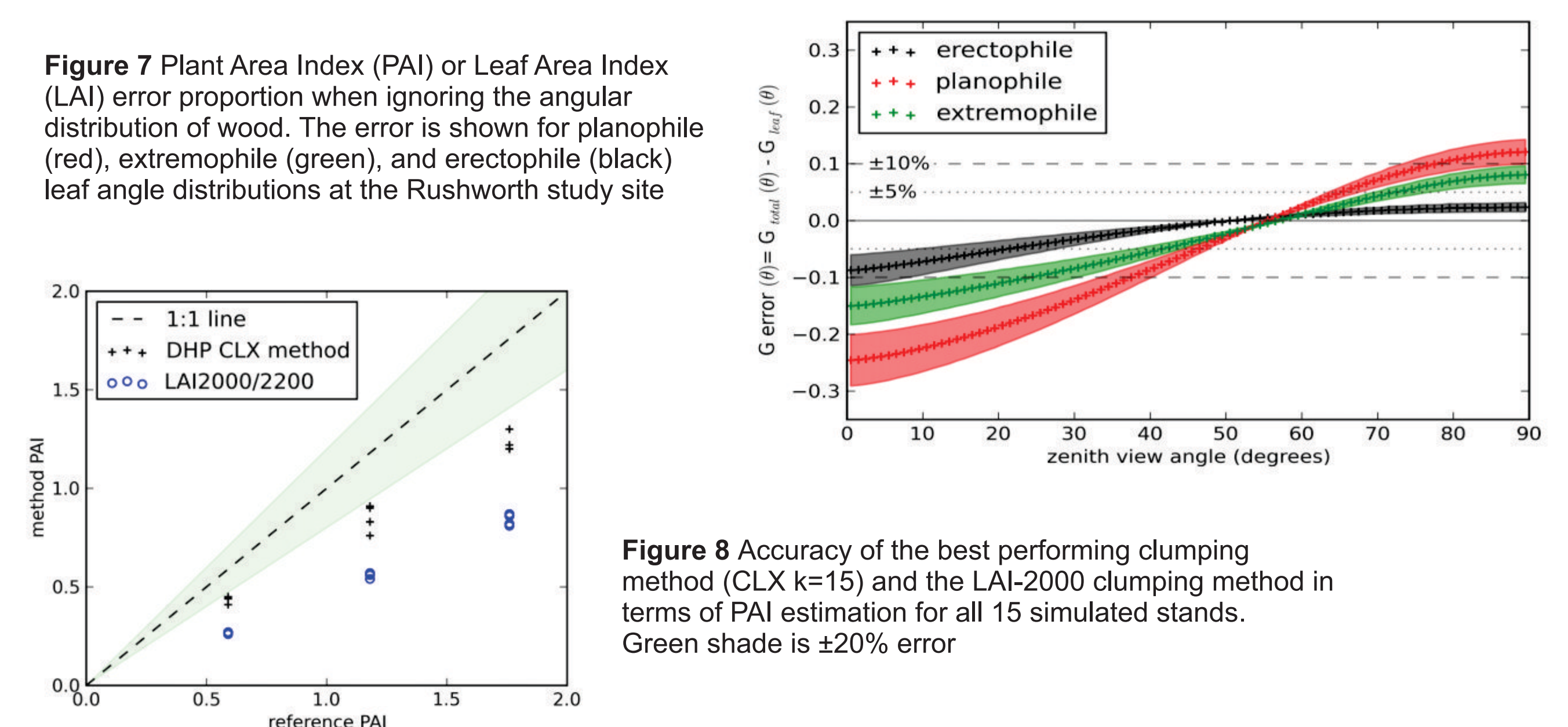


Figure 8 Accuracy of the best performing clumping method (CLX k=15) and the LAI-2000 clumping method in terms of PAI estimation for all 15 simulated stands. Green shade is $\pm 20\%$ error

Conclusions & Future Work

- 3D reconstructed forest stands in a ray tracing computer model offer a method to quantify retrieval method uncertainty and traceability of essential climate variables in ways unachievable using fieldwork
- Ignoring the angular distribution of wood can have up to 30% error in LAI/PAI estimation at a 0 degree view angle
- The current state-of-the-art clumping methods from DHP have around 35% error for the Rushworth study site
- Many different sensors (e.g. TLS/ALS, hyperspectral imagery etc.) and climate variables (FAPAR, albedo) can be investigated in the modelling environment.

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