Studying Tree Responses to extreme Events: a SynthesiS

Short Term Scientific Mission Report

Quantitative wood anatomy using ROXAS

COST Action: FP1106
Reference code: COST-STSM-ECOST-STSM-FP1106-220314-039539
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Period: 22/03/2014 to 29/03/2014

Introduction

Xylem is a complex tissue with multiple functions. Contrasting demands of these functions involve trade-offs in terms of invested resources and room devoted to different tissue elements (Chave et al. 2009, Poorter et al. 2010). Although xylem anatomy shows a strong phylogenetic control (Sperry 2003, Willson et al. 2008), endogenous (*e.g.* age or size) and exogenous factors (*e.g.* climate or competition) also play a key role in final xylem configuration (Domec & Gartner 2002, Martínez-Cabrera et al. 2009, von Arx et al. 2012). Understanding how tree species modify xylem anatomical configuration along climatic gradients is critical to predict tree response to ongoing climatic change, but such analyses require measurements of large number of anatomical parameters (xylem quantitative anatomy). Without adequate software this may become a strenuous task, thus it is necessary to acquire the basic ability in any of the existing programs.

Purpose of the STSM

The aim of the STSM was to learn about automatic image analysis with ROXAS program under the supervision of its designer, Dr. Georg von Arx, taking advantage of this to start the analysis of available images of anatomical preparations of several tree species from Chilean Patagonia, and to discuss the science of the related project.

Description of the work carried out during the STSM

During the week I stayed in WSL-Birmensdorf I started the analysis of material from the common joint study introduced before while I learned how ROXAS worked. The study is based on the analysis of two generalist angiosperm *Embothrium coccineum* (Proteaceae) and *Nothofagus antarctica* (Nothofagaceae) xylem characteristics along an environmental gradient ranging from 600 to 2500 mm rainfall in South Chile, and six specialist species adapted to dry, mesic and wet areas.

G. von Arx first introduced me to the basics of the image analysis tool ROXAS (version 1.6.0.0. Pro, © G. von Arx, Birmensdorf, Switzerland, www.wsl.ch/roxas; von Arx & Dietz 2005) and its relation with the commercial software Image-Pro Plus (version 6.1 for Windows 7; Media Cybernetics, Inc., Silverspring, MD, USA), for which it was developed. I learned how to calibrate images to have measurements in microns instead of pixels, the way to manage high numbers of images belonging to the same study, the tools to perform automatic vessel analysis and manual editing, the way to calculate outputs and summarize results and how to program analysis to be run automatically by the computer. G. von Arx adjusted tailored ROXAS configurations for the two generalist species, and I started the analysis of several images of these two species under supervision of G. von Arx. Towards the end of the stay G. von Arx taught me how to configure ROXAS for new species and showed me several advanced tricks to increase efficiency in manual editing.

Description of the main results obtained

At the end of the week I was ready to use ROXAS as a “power” user and next steps in the data analysis were clarified. More specifically, ROXAS configurations for the two generalist species and for three of the six specialist species were created. I finished with the manual editing of six images of the generalist species, three of *Embothrium coccineum* and three of *Nothofagus Antarctica* (Fig. 1). For all of them, anatomical parameters included vessel cross-sectional area, but also vessel grouping patterns, whose measurement has been recently implemented in ROXAS capabilities (von Arx et al. 2013). The analysis of the very preliminary and low-replicated results confirmed the potential of the selected approach for future analysis.

Description about how the results contribute to the Action aims

This STSM is part of a broader study including Wood anatomy and Ecophysiology. Although it will be developed on forests of southern Chile, it can contribute to the Action FP1106 aim of generating a basic understanding of short to long-term physiological responses of tree species under a wide range of climate conditions. Studying the response of spatial patterns in vessel configuration to rainfall availability and in its coordination with leaf characteristics is crucial to

understand responses to environmental stress, and results of this study could be extrapolated ultimately to understand the impact of anatomical traits in plant function.

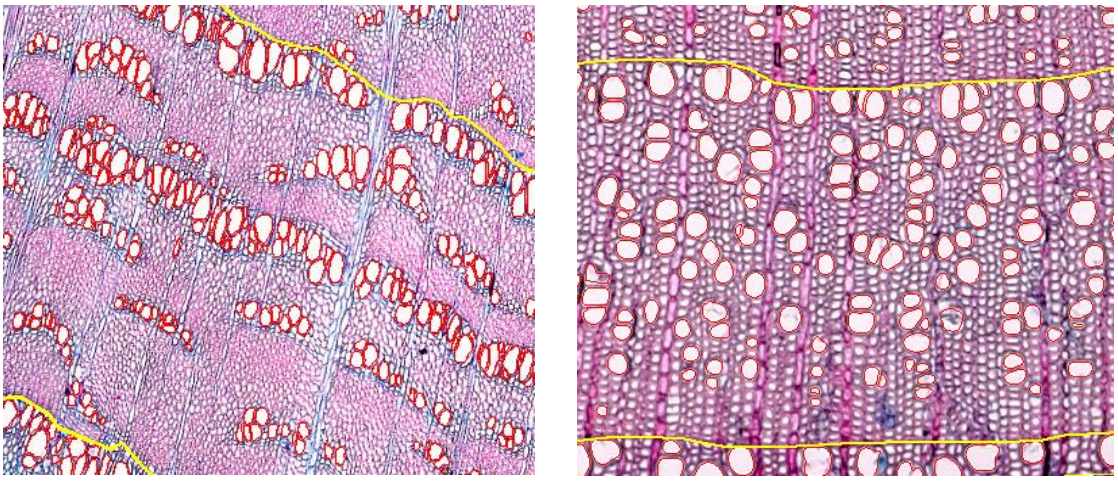

Figure 1. Processed images of 2013 growth ring for an *Embothrium coccineum* (left) and a *Norhofagus antarctica* (right) individuals.

This report may be posted on the Action website.

Confirmation by the host institution of the successful execution of the STSM can be found in the attachment.

References

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