# COST STSM REPORT

***Period:*** From 22nd of July to 11th of August 2014

***STSM Applicant:*** Dr. Dejan Stojanović, Institute of Lowland Forestry and Environment, Novi Sad, Serbia (dejan.stojanovic@uns.ac.rs)

***STSM Topic:*** “Reconstruction of climate change impact on marginal/ peripheral European beech populations in Serbia in purpose of developing adaptive management strategies“

***Host:*** Dr. Tom Levanič, Slovenian Forestry Institute, Slovenia

# 1. Purpose

## a. Background

European beech (Fagus sylvatica L.) is the main constituent of deciduous forests in Europe. It is widely distributed in Central and Western Europe while its range boundaries are extended to Sweden in the north and to the Balkan and Italian Peninsula in the south (von Wuehlisch, 2008). Beech is the most dominating tree species in terms of potential natural vegetation in Central Europe (Ellenberg, 1988). Numerous publications studied the distribution of European beech forests in Europe (Bolte et al., 2007, Mátyás et al., 2009, Rasztovits, 2011), some of them used tree-ring data to make relation between growth and ecological factors in other parts of Europe (Lebourgeois, et al., 2005; Čufar et al., 2008) but not the single one used the full power of dendroecological methods for evaluation of the present and past of marginal beech populations in the southeast Europe.

Beech is also the most abundant, the most important and economically the most significant tree species in Serbia (Banković et al., 2009). Although, recent studies showed that it could be highly vulnerable to climate change. Some researches stated that before the end of the century more than 90% of beech forests in Serbia will be outside their normal niches, while 50% will be in the zone in which the mass mortality of beech is noticed today (Stojanović et al., 2013).

## b. Aim of the STSM

Aim of this STSM was firstly to determine climate-growth response of European beech in Serbia.

Secondly, to determine the differences in response of various beech populations along elevation gradient, putting focus on marginal populations.

## 2. Description of the work carried out during the STSM

Marginal population from the upper limit (*Fagetum subalpinum*) from the locality Stara planina (long: 22.61˚, lat: 43.37 ˚) was evaluated in deep. Twenty-five cores from dominant beech trees were glued to the wooden holders. Later, samples were sanded with belt sander (Speer, 2010) with progressively finer sand paper until their surface become extremely smooth (Figure 1).

Figure 1 Sanded European beech samples

After, scanning with ATRICS system was performed (Levanič, 2007) (Figure 2).

Figure 2 ATRICS system for scanning of wooden cores

Measurements were conducted in the resolution 0.01mm with WinDendro software (Figure 3).

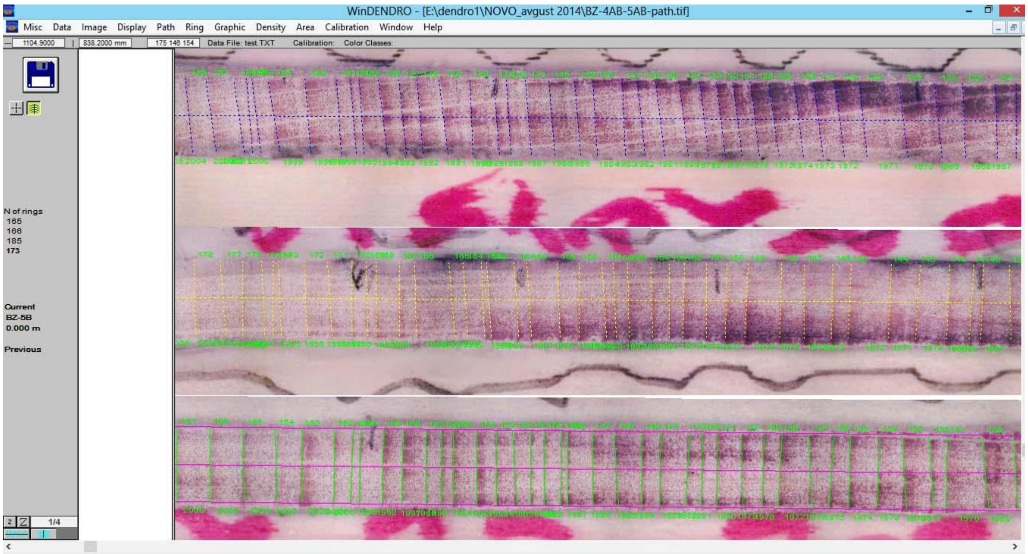
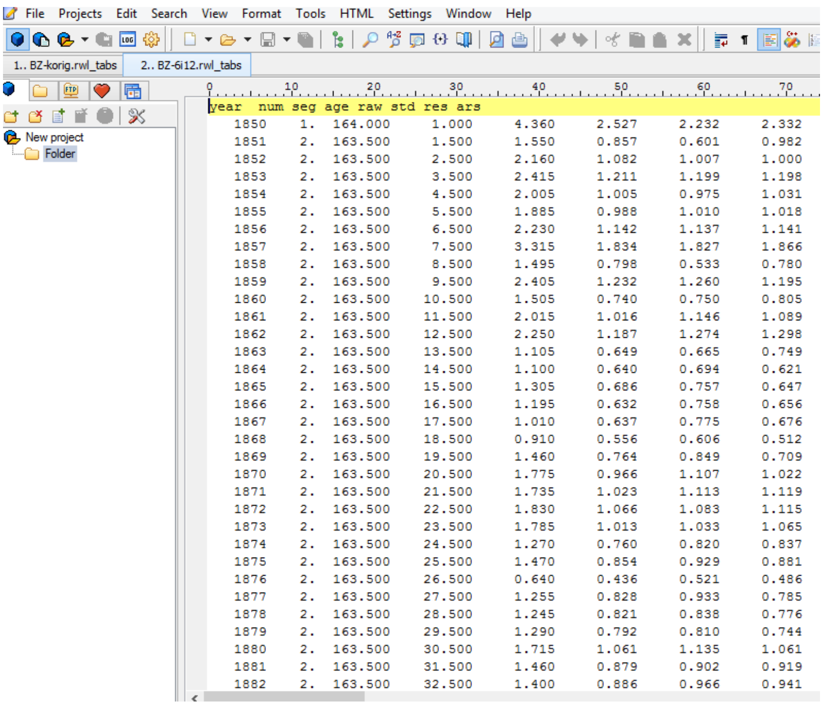



Figure 3 Screechot of European beech samples from Stara planina measured with WinDendro software obtained during this STSM

Measurements were analysed using several different software: PAST, COFECHA, ARSTAN (Figure 4) and R statistical package.




| year | num | seg | age | raw | std | res | ars |
|---|---|---|---|---|---|---|---|
| 1850 | 1. | 164.000 | 1.000 | 4.360 | 2.527 | 2.232 | 2.332 |
| 1851 | 2. | 163.500 | 1.500 | 1.550 | 0.857 | 0.601 | 0.982 |
| 1852 | 2. | 163.500 | 2.500 | 2.160 | 1.082 | 1.007 | 1.000 |
| 1853 | 2. | 163.500 | 3.500 | 2.415 | 1.211 | 1.199 | 1.198 |
| 1854 | 2. | 163.500 | 4.500 | 2.005 | 1.005 | 0.975 | 1.031 |
| 1855 | 2. | 163.500 | 5.500 | 1.885 | 0.988 | 1.010 | 1.018 |
| 1856 | 2. | 163.500 | 6.500 | 2.230 | 1.142 | 1.137 | 1.141 |
| 1857 | 2. | 163.500 | 7.500 | 3.315 | 1.834 | 1.827 | 1.866 |
| 1858 | 2. | 163.500 | 8.500 | 1.495 | 0.798 | 0.533 | 0.780 |
| 1859 | 2. | 163.500 | 9.500 | 2.405 | 1.232 | 1.260 | 1.195 |
| 1860 | 2. | 163.500 | 10.500 | 1.505 | 0.740 | 0.750 | 0.805 |
| 1861 | 2. | 163.500 | 11.500 | 2.015 | 1.016 | 1.146 | 1.089 |
| 1862 | 2. | 163.500 | 12.500 | 2.250 | 1.187 | 1.274 | 1.298 |
| 1863 | 2. | 163.500 | 13.500 | 1.105 | 0.649 | 0.665 | 0.749 |
| 1864 | 2. | 163.500 | 14.500 | 1.100 | 0.640 | 0.694 | 0.621 |
| 1865 | 2. | 163.500 | 15.500 | 1.305 | 0.686 | 0.757 | 0.647 |
| 1866 | 2. | 163.500 | 16.500 | 1.195 | 0.632 | 0.758 | 0.656 |
| 1867 | 2. | 163.500 | 17.500 | 1.010 | 0.637 | 0.775 | 0.676 |
| 1868 | 2. | 163.500 | 18.500 | 0.910 | 0.556 | 0.606 | 0.512 |
| 1869 | 2. | 163.500 | 19.500 | 1.460 | 0.764 | 0.849 | 0.709 |
| 1870 | 2. | 163.500 | 20.500 | 1.775 | 0.966 | 1.107 | 1.022 |
| 1871 | 2. | 163.500 | 21.500 | 1.735 | 1.023 | 1.113 | 1.119 |
| 1872 | 2. | 163.500 | 22.500 | 1.830 | 1.066 | 1.083 | 1.115 |
| 1873 | 2. | 163.500 | 23.500 | 1.785 | 1.013 | 1.033 | 1.065 |
| 1874 | 2. | 163.500 | 24.500 | 1.270 | 0.760 | 0.820 | 0.837 |
| 1875 | 2. | 163.500 | 25.500 | 1.470 | 0.854 | 0.929 | 0.881 |
| 1876 | 2. | 163.500 | 26.500 | 0.640 | 0.436 | 0.521 | 0.486 |
| 1877 | 2. | 163.500 | 27.500 | 1.255 | 0.828 | 0.933 | 0.785 |
| 1878 | 2. | 163.500 | 28.500 | 1.245 | 0.821 | 0.838 | 0.776 |
| 1879 | 2. | 163.500 | 29.500 | 1.290 | 0.792 | 0.810 | 0.744 |
| 1880 | 2. | 163.500 | 30.500 | 1.715 | 1.061 | 1.135 | 1.061 |
| 1881 | 2. | 163.500 | 31.500 | 1.460 | 0.879 | 0.902 | 0.919 |
| 1882 | 2. | 163.500 | 32.500 | 1.400 | 0.886 | 0.966 | 0.941 |

Figure 4 Screenshot of output file from ARSTAN obtained during this STSM

## 3. Description of the main results obtained

By analyzing available dendrochronological samples we found decline in past several years (Figure 5), which could be result of extensive drought conditions during 2011 and 2012 (Figure 6 and Figure 7). Also, Pedunculate and Turkey oak showed the same growing pattern (and same decline) and a very high radial growth synchronicity among two tree species.

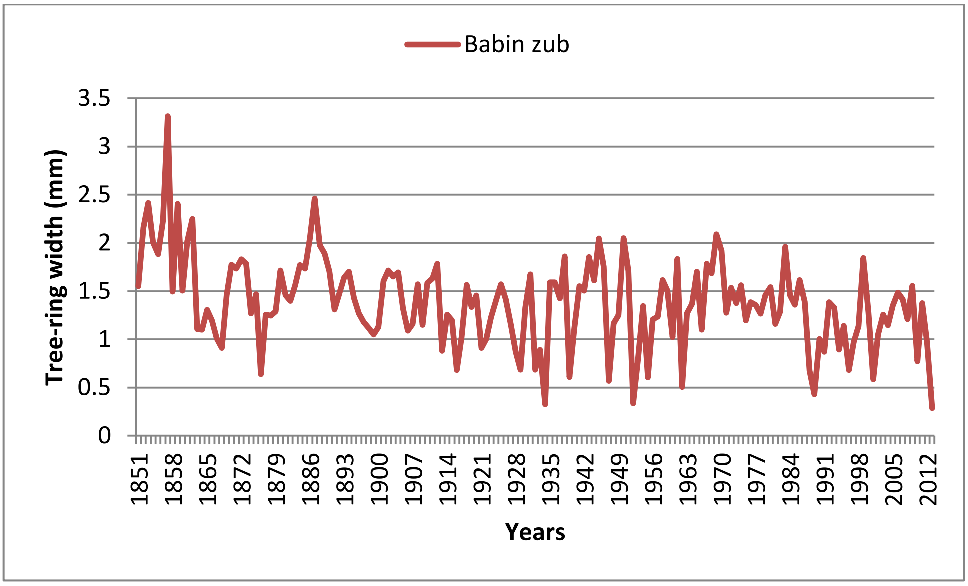



Figure 5 Tree-ring widths of European beech at Stara planina (locality Babin zub)

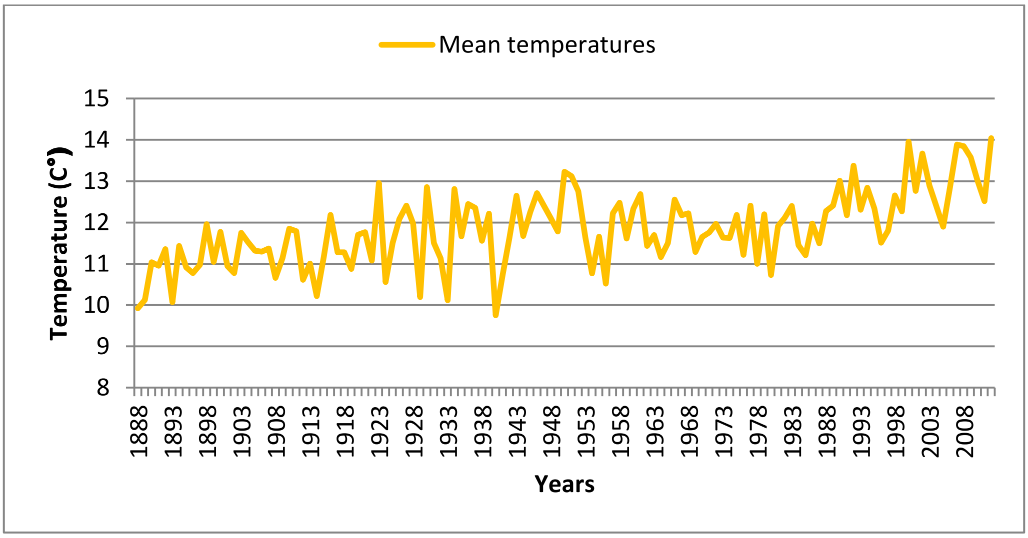



Figure 6 Mean annual temperatures (Belgrade)

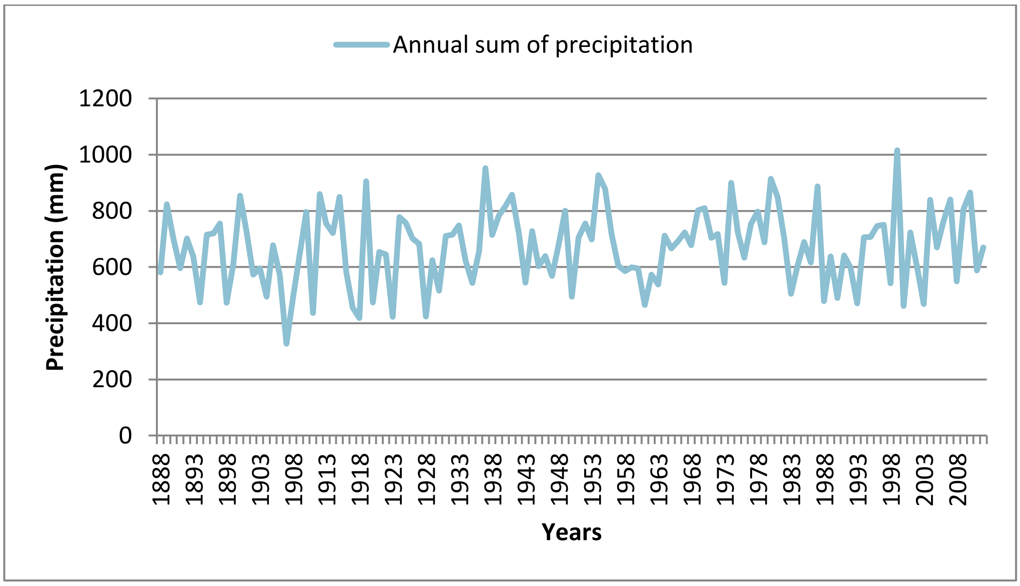



Figure 7 Annual sum of precipitation (Belgrade)

Preliminary results showed that there is negative correlation between temperature in July and beech growth (Figure 8).

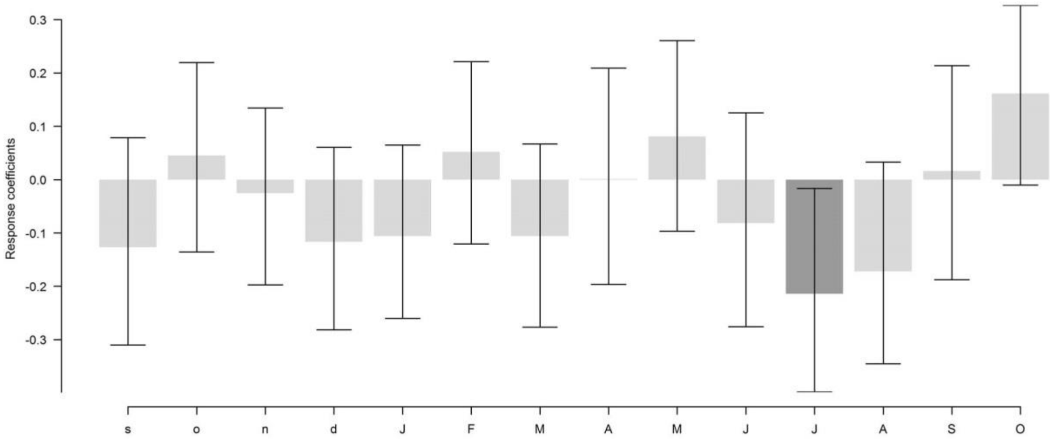



Figure 8 Response coefficients for tree growth and average temperatures of particular months (eight months of the year of growth and four months of the previous year) for the period 1888-2012. Dark colour represents significant correlation

Correlation analysis showed that there is significant correlation between growth of beech marginal population at Stara planina and average temperature in July for the period 1888-2012.

When dendrochronological analysis of other marginal populations will be finished, it would be possible to give more comprehensive conclusions about response of beech along elevation gradient. Since the trend of temperature change shows increase, it could be assumed that this change won’t have positive impact on growth and fitness of marginal beech populations in Serbia.

## 4. Future collaboration with the host institution:

Cooperation between Slovenian Forestry Institute and Institute of Lowland Forestry and Environment from Novi Sad will be continued in order to process all samples and provide answers about response of marginal beech populations to various climate conditions.

## 5. Foreseen publications/articles resulting from the STSM :

These results will help in understanding what is the future of marginal beech populations and what can be adaptation measures for forest management in that sense. We are considering publication of these results during 2015.

## 6. References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Sincerely yours,

Dejan Stojanović, PhD

Novi Sad, 22th of August, 2014