STSM Report

Dendro approaches to consolidate knowledge of Scots Pine dieback in Mediterranean areas (Switzerland-Spain-Turkey-Italy).

COST Action: FP1106

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Introduction

Future drought is projected to occur under warmer temperature conditions as a progress of climate change. Tree growth strongly depends on soil water availability, able to compensate the transpiring requirement of leaves via root absorption and xylem transport in a tension-driven hydraulic continuum (Poyatos *et al* 2013). Measurable changes in tree stem are useful indicators of variations in plant water status. Analyzing physiological and structural responses to fluctuations in water availability in decaying trees could constitute a useful tool in understanding tree-adaptive mechanisms under severe drought-related stress. During short-term drought conditions, stomatal closure regulates the decrease in leaf water potential, in order to prevent the impairment of xylem transport; under long-term drought conditions some tree species reduce their leaf area so that they can maintain moderate transpiration rates without increasing tension in the xylem. However by coupling thickness variations of xylem and inner bark with respect to the elastic properties of the tissues (Sevanto et al 2002, 2003) it will be possible to test whether hydraulic capacity maintains its integrity and its ability at recovering in presence of severe drought stress.

Purpose of the STSM

The main purpose of this STSM was to connect and compare *dendro*-data sets in order to harmonize and synthesize Scots Pine dieback knowledge in Mediterranean areas. The STSM proposed to integrate active research sites in Spain (Tarragona) and Swiss (Rhone Valley) with new data from Turkey (Central Anatolia) and marginal relic populations in Italy.

Concurrent to the *dendro* approaches, still ongoing within study sites considered (Italy and Turkey sites will be sampled in the summer of 2014), we started analyzing coexisting measurements of change in the bark and xylem diameters in trees that experienced severe drought-induced defoliation carried out in the same sites that were sampled for *dendro*. Those analyses were carried out in Spain in 2012, are ongoing in Switzerland and will be carried out in Turkey in the summer of 2014. Therefore we believe that analyzing those observations timely and will constitute a precious added value to our initial project.

Description of the work carried out during the STSM

During my STSM we surveyed the study areas, finalized the technical elements for new measurements in Switzerland and started analyzing data from concurrent measurements of change in the bark and xylem diameters in trees that experienced severe drought-induced defoliation.

Study was conducted at the Poblet nature reserve (Prades Mountain, Spain), on Scots Pine population 150 years old that has remained unmanaged for the past 30 years (Heres et al. 2012). Here Scots Pine diffusion increased at the lowest of its distribution earliest in XX century, within deciduous oak stands. The reserve remained unmanaged for several years and the area appears now with a very dense structure; within the whole reserve it is possible to observe decaying trees, mostly on south-facing hillsides. The stands of studied Scots Pine suffered severe drought episodes since the 1990 (Martinez-Vilalta & Pinol 2002). Here permanent plots for continuous data acquisition were defined: meteorological variables, soil moisture and sap flow were recorded every 30-15 minutes respectively. Three Scots Pine trees were selected for continuous monitoring through a fix measurement system constituted by two pair of linear transducers placed at two eights of trees (*i.e.* 1.5 mt, 7 mt). Measurements on trees were collected every 15 min continuously from 11/08/2011 to 30/11/2012, for 11months.

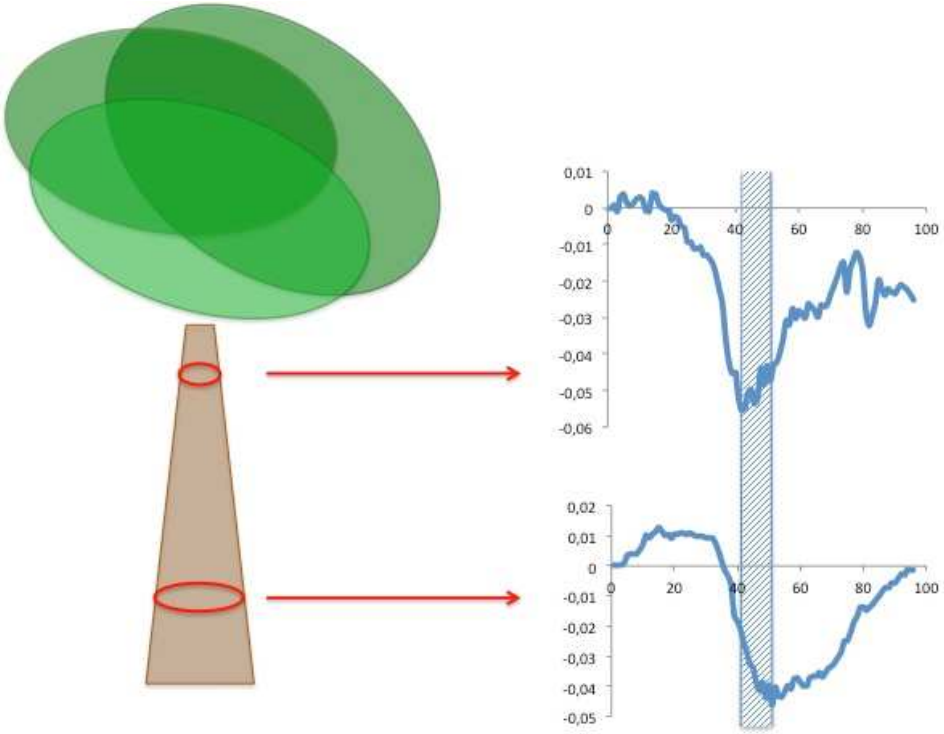
All the statistics were performed using ‘R’ software.

Description of the main results obtained

Our goal was to analyze changing in stem fluctuations with respect to environmental conditions in order to evaluate whether time lags between fluxes recorded at two different tree heights could be used as proxy of tree capacitance.

In general data revealed dissimilar behavior within trees, likely attributable to their different degree of defoliation.

Therefore we started analyzing time lags between the recorded fluxes by evaluating the time interval that elapses between the maximum/minimun values recorded at the top of the tree and the maximum/minimum value recorded at the bottom of tree.



We evaluated our observation with respect to the soil water content and climatic variables. At this early stage data exploration showed significant differences between daily shrinkage versus daily soil water content and precipitation values. Evaluations will follow by evaluating evapotranspiration rate and eddy-covariance observations. Furthermore we're evaluating the possibility to use collected data set for validating the latest model of Mencuccini *et al.* (2013).

Other comments

In parallel to the work carried out and described above, we planned activities in order to finalize our common *dendro*-research topics. Furthermore we discussed about other project and research proposal that will be carried out within the 2013. Therefore the STSM consolidate the collaboration between the University of Basilicata and the Universitad Autonoma de Barcellona, and further collaborations have already been planned to occur.

Foreseen publications/articles resulting or to result from the STSM

The results obtained during the study carried out within this STSM will be part of at least one publication. Further scientific papers are expected once the collection of *dendro* data sets will be completed.

Description about how the results contribute to the Action aims

Once current data set will be analyzed and tree-cores samples will be completed, this STSM will strongly contribute to the Action FP1106: in particular we will harmonize data sets of Scots Pine dieback in Mediterranean areas, in order to evaluate and compare *i)* temporal changing in influence of climatic factors on the tree growth of SP, *ii)* changes in wood anatomy properties at changing climatic conditions; *iii)* the susceptibility of SP to climate related stress conditions, in Mediterranean areas. Furthermore we already started analyzing evidences, from the same Scots Pine provenances, in shrinkage and swelling changing with the respect to the water availability. In addition, the collected data and the collaborative research carried out within this STSM will contribute through scientific papers to the progress of COST Action FP1106.

In attachment the confirmation letter by the host institution of the successful execution of the STSM.

We authorize to post this report at the Action website.

References

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