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Editorial

Climate Changes and Forests

The impact on worldwide climate of long-term anthropogenic emissions of greenhouse gases is now well-established on scientific grounds. According to the Intergovernmental Panel on Climate Change (IPCC) report (Christensen et al., 2007), the European continent will be severely affected by increases in annual mean temperatures that exceed the global mean during the period 2071 to 2100. The greatest warming in northern Europe is likely to come in winter. Recent observational studies have provided evidence that increasing greenhouse gas concentrations are also likely to increase variability in summer temperatures in Europe (Barriopedro et al., 2011; Schär et al., 2004). Changes in average climate variables such as temperature and rainfall will be important, but major socio-economic and environmental effects of climate change will be driven by changes in the frequency and intensity of extreme events, such as heatwaves, windstorms and heavy rainfall events (Liberato et al., 2011; Trigo et al., 2005).

The impacts of climate variability and change on vegetation dynamics, agricultural production (Gouveia et al., 2011) and on forest ecosystems are complex and still unclear (Serengil et al., 2011; Paoletti and Tuovinen, 2011). Warmer temperatures might be expected to increase drought stress on trees but this oversimplifies the problem. For instance, weather affects more than just the water physiology of trees; warmer winter temperatures may play a role in supporting higher populations of forest insects such as mountain pine beetles, with major impacts (and legacies) on forest ecosystems (Binkley, 2010). On the other hand one cannot disregard land-atmosphere interactions and the intricate dynamic feedbacks involved which play an important role in climate and climate change dynamics over a wide range of spatial and temporal scales. Europe's severe heatwave in 2003 provides a good example; the carbon sequestration that occurred in the previous five years was annihilated in just a few days of extreme weather conditions. Droughts and heatwaves may modify the health and productivity of ecosystems and transform, albeit for a short period, carbon sinks into sources, contributing to a short-term positive carbon-climate feedback (Ciais et al., 2005).

Mediterranean ecosystems are particularly vulnerable to extreme weather events (Trigo et al., 2002; Trigo et al., 2006a; Garcia-Herrera et al., 2007). Changes that are likely to occur on frequency and intensity of such extreme events may pose serious threats to environmental systems either because of the effect of drought episodes on vegetation stress (Gouveia et al., 2009) or as a result of an increased likelihood of occurrence of weather patterns favoring the occurrence of severe wildfires (Trigo et al., 2006b; Dury et al., 2011). Mediterranean Europe is in fact one of the regions of the world most affected by large wildfires, burning thousands of hectares of vegetation cover every year, causing extensive economic and ecological damage (Pereira et al., 1997; Miranda et al., 2009) and representing an important disturbance to land-based ecosystems (Ichoku et al., 2008). For instance, Northwestern Iberia contributes to about 50% of the total number of fires in Europe, followed by Southern Italy and Greece (European Commission, 1996, 1998).

The context of changing climate and sensitivity of Mediterranean forests led to a special on "Changes and Forests" in the IUFRO conference *Mixed and Pure Forests in a Changing World 2010*. This international conference took place on October 2010, at the University of Trás-os-Montes e Alto Douro (UTAD) in Vila Real, Portugal, and was devoted to various aspects of research on pure and mixed forests in a context of global changes. The scientific programme of the 3 day conference included four sessions: *Mixed Stands*, *Carbon and Biomass Modeling*, *Sustainability of Forest Stands*, *Changes and Forests* and a field day. Each session had a keynote presentation followed by 6 oral communications and a total of 81 posters have been presented on the four poster sessions organized.

Considerable effort has been spent in the last years to better understand the regime of wildfires in the Mediterranean region. As pointed out in the leading oral presentation by DaCamara, remote-sensed observations play a key role in the process of understanding the ways land and atmosphere affect vegetation stress and wildfire activity (Gouveia et al., 2008; Libonati et al., 2006). In this particular, the importance of the reflectance of the middle-infrared (MIR) spectral band (around 3.5–3.9 μm) is worth being emphasized because of its ability for discriminating among different types of vegetation, estimating total and leaf biomass of several forest ecosystems, monitoring intra- and inter-annual climate-induced changes in vegetation and efficiently detecting burned areas (BAs) in a wide variety of ecosystems (Libonati et al., 2010, 2011a). Retrieval of MIR reflectance is however a difficult task since it implies solving the problem of separating MIR reflectance from the total signal (Libonati et al., 2011b). The oral presentation by Gouveia focused on the key role played by remote-sensing in assessing the drought impact on vegetation dynamics in Portugal. For instance, fire regimes depend on the type of land-use and land-cover, some of them leading to preferential spatial patterns of fire occurrence; fire events may in turn lead to reduced vegetation growth and to a decrease of fire events. On the other hand, temperature and precipitation regimes during the spring that precedes the fire season may induce stress conditions in vegetation cover (Gouveia et al., 2009) making it prone to burn, especially if, during the fire season, there is the establishment of atmospheric circulation patterns which induce extremely hot and dry spells over western Iberia

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(even of short duration) that favor the ignition and spreading of fires (DaCamara et al., 2007). Because of their capability to provide data at sub-hourly resolution, geostationary satellites appear as an especially appropriate means to obtain information on fire activity (Amraoui et al., 2008) and therefore to assess the impact of meteorological factors on the fire regime. This aspect was focused by Amraoui in his oral presentation devoted to applications of the so-called Fire Detection and Monitoring (FD&M) product (Amraoui et al., 2010) which is based on information provided by the SEVERI instrument, on-board Meteosat-8, the first geostationary satellite of Meteosat Second Generation (MSG). The FD&M product is currently being generated on an operational basis within the framework of the Land Surface Analysis Satellite Application Facility (LSA SAF), a specialized development and processing centre, which is part of the distributed Applications Ground Segment of EUMETSAT, the European Organization for the Exploitation of Meteorological Satellites (Trigo et al., 2011).

Fire regimes appear therefore as resulting from a number of interacting factors, with spatio-temporal scales of their own. Disentangling the roles of land and atmosphere in fire regimes is a very complex task that is far from being completed. However such complexity ought to be viewed as characteristic of most problems involving Forest Ecology and Management under present or future scenario conditions. Several of such aspects have been gathered in this special issue encompassing original management techniques and possible adaptation measures on climate change conditions. The technical aspects to enhance soil carbon sequestration by means of forest conversion and changing tree species composition on Mediterranean mountain forests are discussed in an experimental study performed in Central Spain by Díaz-Pinés et al. (2011). Another experimental study, in a newly installed mixed forest stand in Northeast Portugal, is presented by Fonseca et al. (2011), where the effect of several site preparation techniques on plant survival and growth is tested. The use of thinning as an adaptation measure to minimize the impact of insufficient precipitation in a young Scots pine stand in Central Europe is confirmed in an experimental study conducted by Slodicak et al. (2011). An assessment is made by Tatarinov et al. (2011) on the effect of climate change on central-European forests through a regional-scale simulation of forest production under current management practices and different environmental scenarios. This assessment is performed using the known process-based model BIOME-BGC previously parameterized for the main Central-European tree species (spruce, pine, beech and oak) and adapted to include forest management practices. Finally, Carvalho (2011) presents a study on tree species diversity and structure of different natural mixed-oak forests in Portugal, through the analysis of their composition and structural elements providing a better understanding of mixed-oak forests diversity and valuable information for forest management.

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