Forest vulnerability to climate change: example of the silver fir-beech community forest at its southern Alps margin. Abstract

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Forest growth in Mediterranean mountains is limited by two major factors: summer drought at low elevation and low temperatures at high altitude (Korner 2007). As a consequence of climate change, observed trends would be the consequence of the contradictory effects of reduced frost and increased drought (Badeck et al. 2004; Jump et al. 2006). We chose a model ecosystem where both warming and drought trends will be measurable: the silver fir-beech community (*Abieto-Fagetum*) forest at its southern Alps margin. Using dendroclimatological data, growth differences along an altitudinal gradient, recent growth trends, and analysis of the spatial variability of the tree health, the objective of our works is to better understand the effects of climate change on the growth and the resistance of co-occurring trees.

Climate-growth relationships show that silver fir is more sensitive to summer drought than beech, which is confirmed by a growth optimum at higher altitude. Common beech is more sensitive to climate events (2003 heat-wave and late frost), due to the non-persistence of its leaves. Forest productivity is positively affected by global change. But with the recent warming (0.6°C to 0.7°C by decade since 1960 in South-eastern France) and accumulation of summer drought, an upward shift in altitude of growth optima is already noticed and is higher for silver fir than for common beech. In the study area, rising temperatures and decreasing rainfalls (4-27%) are predicted (IPCC 2007). These growth trends would logically go on.

At low elevation silver fir is declining with a high spatial variability which depends on tree characteristics (age, height, climatic sensitivity, past growth...), abiotic conditions (superficial and deep soil, stand composition, microclimate, and altitude) and biotic factors (pathogens). Beech vitality should be less affected except if heat-waves increase in intensity and frequency as expected (Meehl and Tebaldi 2004).

At high elevation, the upward shift of beech would be limited by late frosts damage contrary to silver fir which would take advantage of higher carbon assimilation due to rising temperature and lengthening of the growing season.

To conclude the decline / resistance of forest to climate change is a complex process which depends on species-specific effects, and on site characteristics, and which needs an interdisciplinary approach to be understood. It also shows that the frequency and intensity of extreme events must be taken into account, because of their effects differ between co-occurring species.