

Discussion

Between-stand growth

The mean beech growth from 1960 to 2007 was highest in stand B4, mainly due to higher soil fertility (Robin, 1993). However, beech growth appeared to be sensitive to the same climatic variables and SWD indices between stands. This lack of differences in close stands within a forest was also observed at a larger scale using the French network RENECOFOR from 1949 to 1994 (Lebourgeois, 2006). Probably due to the most constraining soil conditions being observed at this site (i.e., low fertility and AWC), the interannual growth variations in B12 over 48 years were better predicted by both the climatic and bioclimatic models than the growth in B4 and B9.

The mean oak growth was lowest in stand O3, mainly due to lower soil fertility and a larger overstory basal area. The growth in O3 was also the more sensitive to the maximum temperatures, precipitation and I_s of the current growing season and less sensitive to the climate of the previous year than that in O4 and O19. This climate sensitivity of O3 could be due to the lower soil fertility and low thinning rate at this stand compared to O4 and O19 because thinning partially buffers the tree-ring response to climate (Martín-Benito et al., 2010). This led to an exceptional ability of the climatic and bioclimatic models to predict the interannual growth variations in O3 from 1960 to 2007.

The mean pine growth was the lowest in P13, which could be explained by its exhibiting the lowest soil fertility, highest understory proportion and oldest trees among the pine stands. Martinez-Vilalta et al. (2007) reported a large growth efficiency decrease of approximately 50% between 25-year-old and 75-year-old Scots pine in the Scottish Highlands. The between-stand difference in response to climate and SWD was greater for pine than for beech and oak. The low AWC in P8 could explain the higher growth vulnerability to maximal temperatures and precipitation over the current June to August observed at this site, leading to the best ability of the bioclimatic model for P8 to make growth predictions. Most likely due to the highest AWC and the oldest trees being found at this site, the growth in P13 was the less sensitive to the I_s value of the growing season, both over 47 years and when considering only the pointer years. For all species, ring width measurements in the stands with the lowest AWC and the lowest fertility seemed to provide the best climatic signal for paleoclimatic reconstitutions.

Between-species response to climate

Investigation of the growth response to climate and SWD for the pointer years of each species allowed highlighting differences in the species' vulnerability. Differing frequencies of pointer years were observed among species. This is consistent with the results of a previous analysis of a large tree