ring database showing that species are the first source of differences in the frequency of pointer years, before the bioclimatic context (Bréda & Badeau, 2008). Beech was very sensitive to the climate of the current year, with more pronounced interannual growth variations being observed than for the other species. The high suitability of beech tree-rings for dendrological analysis has been reported at many European sites (Dittmar et al., 2003). Generally, the beech budburst is earlier (Suzuki et al., 1996) than the initiation of radial growth because of a close correspondence between leaf unfolding and the reactivation of the cambium (Cufar et al., 2008). Radial growth in this species is therefore mainly dependent on climatic variations and leaf photosynthesis. As beech is a diffuse porous-species, the reactivation of its growth is less sensitive to winter embolism and consequently less dependent on stored reserves which could explain the weak influence of the climate of the previous year on this species (Barbaroux & Bréda, 2002). The observed interannual growth variations were negatively correlated with the maximum temperatures in June and, especially, in July and positively correlated with precipitation from May to July. Previous European studies have shown similar results as under Atlantic climate in Belgium or in 10 sites of central Europe under continental climate (reviewed in Lebourgeois, 2005). The observed beech growth response to the intensity of SWD in July and August and SWD duration underlined the key role of soil water depletion during the summer.

During the pointer years, the total ring growth of oak was more sensitive to the climate of the previous year compared to beech and pine. Oak growth was sensitive to cold temperatures and low precipitation in the previous autumn and December, as described at other French sites by Lebourgeois (2006). The temporal dynamics of soil water recharge for recovering field capacity appears to be a water balance pattern pre-conditioning the next ring. Large earlywood vessels of oak are sensitive to embolism generated by winter frosts (Hacke & Sauter, 1996). Therefore, the production of new earlywood before leaf expansion for the spring recovery of hydraulic conductivity largely depends on the use of carbon reserves. Dry autumnal conditions could affect carbon reserve storage because the accumulation of non-structural carbohydrates in temperate sessile oak continues after growth cessation until leaf fall (Barbaroux & Bréda, 2002, Hoch et al., 2003). Carbohydrate depletion could explain long term consequences of climate on oak growth, such as observed from 1972 to 1978 with a time lag of more than one year (Becker et al., 1994). As for beech, oak growth was positively correlated with the precipitation of the growing season, but the months with the strongest climatic impact were June and July. The June-July period corresponded to latewood formation was found to be the ring component that most influenced the total ring width variations. The growth response to I_s in June and July highlighted the vulnerability of oak growth to SWD during this period.

Pine was the only evergreen species included in our study, and its growth increased in the case of warm temperatures in winter and, particularly, in the previous December. Warm winter conditions could improve carbohydrate storage because photosynthesis occurs in conifers during mild winters and could increase the mycorrhizal activity and root growth (Guehl, 1985, Lebourgeois et al., 2010). These factors, in combination with abundant precipitation in the previous December, which increases