



## **Tree-ring responses to climate and to seasonal changes in water levels of an ice-contact lake in the Western Italian Alps**

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Tree rings are a valuable tool for reconstructing past climatic and environmental information at the yearly scale. They have been widely applied for studying glacier fluctuations and history, and more recently the recent dynamics, confirming their usefulness for collecting also environmental data. In the presented research, responses to climate and to changes in glacial hydrological discharge were analyzed for five sites close to an Alpine ice-contact lake near the most representative Italian debris-covered glacier (Miage Glacier, Mt. Blanc Massif, Western Italian Alps). Water level changes in this lake are rapid and follow seasonal periods of filling in and emptying out, according to glacier melting phases. Tree vegetation is present near the lake banks including plants permanently submerged by water. Most of the trees around the lake are still alive but those growing in the water present symptoms of water stress at the root level, and some of them are dead. Two sampling sites were selected with trees very frequently and frequently affected by water-level changes and one control site close to the first two sites but far from water lake. Others two sites are located far from the lake and on opposite facing slope of the Veny Valley (on the Mt. Blanc flanks and at the treeline on the N-facing slope). Tree-ring growth at the two sites close to the lake (and especially at the most affected site), show different growth patterns than the control sites, thus potentially providing information on past years with high water levels. Moreover, several trees at the most hydrologically disturbed site show abrupt growth changes with dropping growth rates. At this site and at one control site stable isotopes ( $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ ) in the tree rings were analyzed with the aim to detect years of high water levels in the lake. Tree-ring responses to climate were assessed for the control site at the treeline and showed a good correlation with summer temperatures. This study proposes an integrated approach on tree rings for reconstructing past hydrological changes in the Alpine glacial environment. In particular, the reconstruction of past glacial meltwater-level changes in an ice-contact lake was performed in order to investigate in detail the past glacier dynamics, introducing another application of dendrochronology to hydrological and glaciological studies.