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Growth-climate relations of Larix decidua and Pinus cembra in an inner-alpine dry valley

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Due to climate change, increasing temperatures and decreasing precipitation are expected for the southern part of the Alps. To estimate possible effects on growth conditions in mountain forests we investigated climate to tree growth relations along an elevation gradient in one of the driest regions in the Alps, the LTSER site Matsch/Mazia in South Tyrol, Italy. Besides Picea abies (27%), Larix decidua (42%) and Pinus cembra (25%) are the two most abundant tree species in the study area. While Pinus cembra is restricted to the sub-alpine zone, Larix decidua is ranging from the lowest parts of the study area up to the tree line, especially at lower elevations also due to reforestation efforts of heavily eroding pastures in the past 120 years and traditional silvopastural systems which promote Larch. The reaction of the two species to changing climatic conditions during the last 150 years were analyzed by relating tree ring width of Larix decidua from 8 sites at elevations from 1070 to 2430 m a.s.l. and of Pinus cembra from 5 sites ranging from 2030 to 2430 m a.s.l. at SE- and NW-exposed slopes to temperature and precipitation records from the nearby station at Marienberg (1310 m a.s.l.) dating back to 1860. Overall, basal area increment was highest at sites at about 2000 m a.s.l and decreased at higher and for Larch at lower sites. At lower elevations up to 1750 m a.s.l. growth rates of Larix decidua generally decreased during the last 15 years, especially during and after the 2003 heat wave, after increasing from the 1950s to the 1980s . On the contrary, at elevations of more than 2000 m a.s.l., growth of both Larch and Pinus cembra increased since the 1990s. Growth-climate correlations and extreme year analysis show a similar results: at low-elevation sites, growth was correlated positively to precipitation and reacted positively to wet and cold years and negatively to hot and dry years. On the other hand, growth was positively correlated to temperature at the forest line. In general, sensitivity was higher for Larix decidua and at extreme sites at the forest line and at low elevation and lower for Pinus cembra and at sites around 2000 m. At a regional level, higher elevation site chronologies were correlated quite closely to more humid sites in South Tyrol, the low sites were comparable to the specifically xeric Tschirgant site in North Tyrol. Overall, our results indicate that climate change might negatively affect Larix decidua at low elevation but have a positive affect at the forest line even in a dry part of the Alps.