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Long-term climatic variations in the highlands of Western China, as evidenced by a 4650-year-long chronology based on tree-ring cores from Qilian junipers (Juniperus przewalskii Kom)

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In order to create a reliable chronology of long-term tree-growth variations that may be due to climate variations, we apply eigenanalysis to a large dataset of tree-ring width records (1263 records sampled from Qilian junipers [Juniperus przewalskii Kom]), a species endemic to the highlands of Western China. In order to exclude the so-called growth rate/life span association effect, and to give the possibility of applying the eigenanalysis, tree-ring width records were sorted into six subsets, based on the life spans of the trees sampled: 200–400, 400–600, 600–800, 800–1000, 1000–1500 years old, and trees older than 1500 years. Pairs of partial chronologies were created, pairing the set of all trees (living, dead, archaeological remains) with the living trees belonging to each subset. We compute the contours of tree-growth variations (on both 100-year and longer time scales) for each subset, ending with six pairs of partial subset chronologies. Two sums of all these partial chronologies thus give us a reliable record of tree-growth variations over a period ranging from 2627 BCE up to 2012 CE.
These variations are most likely climate-induced. Some of the variations seen over the last two millennia are attributed to effects of the 178-year-long cycle of the Sun rotation around the barycentre of the Solar system, leading to the well-known diminished solar activity events of Oort, Wolf, Spoerer, Maunder, and Dalton. One variation seen early in this long chronology deserves mention: a prolonged (approximately 400 years in length) damping of tree growth, perhaps due to the drought known as the 4.2 kiloyear event (sometimes blamed for the collapse of the Egyptian Old Kingdom, 2500–2100 BCE). The chronology of the only living Qilian junipers also provides a clear picture of the response of these trees to the current period of global climate change. Tree growth seems to have been spurred by rising temperatures until 1998, after which rising global surface air temperatures were associated with a slowdown in growth.