A millennium-length temperature reconstruction for the eastern Mediterranean

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The Mediterranean has been identified as particularly vulnerable to climate change, yet a high-resolution temperature reconstruction extending back into the Medieval Warm Period is still lacking. Here we present such a record from a high-elevation site on Mt. Smolikas in northern Greece, where some of Europe's oldest trees provide evidence of warm season temperature variability back to 730 CE. The reconstruction is derived from 192 annually resolved, latewood density series from ancient living and relict Pinus heldreichii trees calibrating at $r_{1911-2015} = 0.73$ against regional July-September (JAS) temperatures. Although the recent 1985-2014 period was the warmest 30-year interval (JAS $T_{\text{wrt.1961-90}} = +0.71°C$) since the 11th century, temperatures during the 9-10th centuries were even warmer, including the warmest reconstructed 30-year period from 876-905 (+0.78°C). These differences between warm periods are statistically insignificant though. Several distinct cold episodes punctuate the Little Ice Age, albeit the coldest 30-year period is centered during high medieval times from 997-1026 (-1.63°C). Comparison with reconstructions from the Alps and Scandinavia shows that a similar cold episode occurred in central Europe but was absent at northern latitudes. The reconstructions also reveal different millennial-scale temperature trends (NEur = -0.73°C/1000 years, CEur = -0.13 °C, SEur = +0.23°C) potentially triggered by latitudinal changes in summer insolation due to orbital forcing. These features, the opposing millennial-scale temperature trends and the medieval multi-decadal cooling recorded in Central Europe and the Mediterranean, are not well captured in state-of-the-art climate model simulations.