



Late Holocene climate swings recorded in Italian speleothems and cultural changes

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Late Holocene climate swings are reconstructed from stable isotope values and growth rates of stalagmites along a North to South traverse across Italy. Stalagmite SV1 from Grotta Savi near Trieste (NE Italy) shows predominant temperature forcing of the $\delta^{18}\text{O}$ values in the Late Holocene. Based on calibration with instrumental and historical data we suggest that the warmest temperatures in the Late Holocene were probably reached between circa 400 BC and circa 0 AD (Roman Warm Period, RWP), and in the past 100 years. In the RWP temperatures were similar to those of today. In the Middle Ages, a cool phase from circa 450 AD to circa 700 AD recorded the coldest spell in the decades about the year 600 AD. For that period *Pauli Diaconi Historia Langobardorum* reported extremely cold winters and famine. This was followed by warming from circa 700 AD to circa 850 AD, coinciding with the Carolingian Empire. A second Medieval Cold Period was recorded from circa 900 AD to 1100 AD, with the spell occurring in the two to three decades after the year 1000 AD, coinciding with several years when the crops failed and a terrible famine in Europe as described by Rodulfus Glaber. A second warming occurred from circa 1150 AD to circa 1400 AD during which temperatures seem to have been similar to those of today. SV1 records the coldest period of the past 2000 years from 1450 to 1800 AD, and the decade centred at 1840 AD is the last of the coldest phases of the LIA. In the past 100 years temperatures rose sharply and follow the reconstructed Northern Hemisphere temperature trend. The years from 600 AD to 1000 AD are marked by severe cold spells in other stalagmites from Northern Italy. The year 1000 AD seems to mark also a change in hydrology as seen in a Sicilian stalagmite, which is particularly sensitive to evapotranspiration balance.

The Italian stalagmites record a change from internally forced to solar-forced climate

between the Early and Mid Holocene as already recognized in stalagmites from Oman. The Late Holocene climate swings appear to be related to solar forcing mainly.