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Medieval climate anomaly and little ice age as recorded in speleothem and tree-ring data from the Middle Atlas in Morocco

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Progress has recently been made in assessing the spatial extend and timing of the Medieval Climate Anomaly (MCA) and the Little Ice Age (LIA) on hemispheric and global scales (Graham et al. 2011). Uncertainties still exist, however, since the transition from the MCA into the LIA seems to be diachronous, and in many cases, reconstructions are based on single climate archives (e.g., speleothems, tree-rings, or pollen data). In Morocco, cedar trees from the Middle and High Atlas have been used to reconstruct the Palmer Drought Severity Index (PDSI) back to 1049 AD (Esper et al., 2007), a metric integrating the evaporation-precipitation balance and soil properties. According to Graham et al. (2011), the MCA/LIA transition recorded in Moroccan tree rings occurred rather late (around 1400 AD) in comparison to the reconstructed winter temperature in the European Alps (e.g., Mangini et al., 2005), which show substantial changes about 50 years earlier. Here we compare precisely dated speleothem δ^{13}C and trace element records from the Middle Atlas with an updated version of the tree-ring based PDSI reconstruction from Esper et al. (2007). Both stalagmite δ^{13}C and strontium records support the prevalence of exceptionally dry conditions during the MCA and relatively wet conditions during the LIA. These changes have formerly been suggested to be related to persistent positive and negative phases of the North Atlantic Oscillation (Trouet et al., 2009). The speleothem based reconstruction extends back to 700 AD and, thus, provides insight on the precise timing of the driest period during the MCA in the Moroccan Middle Atlas.

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