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Understanding north-western Mediterranean climate variability: a multi-proxy and multi-sequence approach based on wavelet analysis.

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Forcings and physical mechanisms underlying Holocene climate variability still remain poorly understood. Comparison of different paleoclimatic reconstructions using spectral analysis allows to investigate their common periodicities and helps to understand the causes of past climate changes. Wavelet analysis applied on several proxy time series from the Atlantic domain already revealed the first key-issues on the origin of Holocene climate variability. However the differences in duration, resolution and variance between the time-series are important issues for comparing paleoclimatic sequences in the frequency domain.
This work compiles 7 paleoclimatic proxy records from 4 time-series from the north-western Mediterranean all ranging from 7000 to 1000 yrs cal BP:
-pollen and clay mineral contents from the lagoonal sediment core PB06 recovered in southern France,
-Sea Surface Temperatures (SST) derived from alkenones, concentration of terrestrial alkanes and their average chain length (ACL) from core KSGC-31_GolHo-1B recovered in the Gulf of Lion inner-shelf,
- δ18O record from speleothems recovered in the Asiul Cave in north-western Spain,
-grain size record from the deep basin sediment drift core MD99-2343 north of Minorca island.
A comparison of their frequency content is proposed using wavelet analysis and cluster analysis of wavelet power spectra. Common cyclicities are assessed using cross-wavelet analysis. In addition, a new algorithm is used in order to propagate the age model errors within wavelet power spectra.
Results are consistents with a non-stationnary Holocene climate variability. The Halstatt cycles (2000-2500 years) depicted in many proxies (ACL, errestrial alkanes and SSTs) demonstrate solar activity influence in the north-western Mediterranean climate. Cluster analysis shows that pollen and ACL proxies, both indicating changes in aridity, are clearly distinct from other proxies and share significant common periodicities around 1000 and 600 years, since the mid-Holocene. The $\sim$1000 years period is also evidenced in terrestrial alkanes and Minorca sediment drift grain size, which respectively indicate changes in the Rhône hydrology and changes in the north-western Mediterranean deep water formation. These findings suggests that an original climate driver influences the Gulf of Lion area. Finally, both clay mineral content from PB06, indicative of past storminess and δ18O record from the north western Iberia, related to precipitations, record the well known 1500 years period since the middle Holocene. The presence of this period, widely encountered in the Atlantic, highlights the link between the north-western Mediterranean and the Atlantic climate variability.