Ancient interglacials as analogues of the present: reconstructing the past variability for understanding and modelling the future climate

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Why past interglacials?

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Thousands of years BP

Holocene

Reconstruction of Holocene

Thousands of years

Lisieki and Raymo, 2005
Why past interglacials?

Past interglacials are “natural experiments”, with different climate boundary conditions.

Insights into present and future climate

Paleoclimate parameters for the last 800 ka (modified from Tzedakis et al., 2009 Ngeo)
Reconstruction of past interglacials variability

- Understand the sensitivity of the Earth system to different forcings
- Explore the background of natural variability in which human-induced changes operate
- Clarify where we are in the natural progression of events

High resolution, well dated and globally representative paleoclimatic records are required
Our case studies: high resolution, multiproxy records from caves and lakes of central Mediterranean sites covering past interglacial periods.
Continental carbonates are powerful climatic archives. Many properties sensitive to hydrological and environmental variability.
Oxygen isotopes provide one of the best tracers of the Mediterranean hydrological cycle particularly sensitive to variations in the amount of rainfall.
The Last Interglacial period (129-110 ka):

Global average warming of ~1 to 2°C relative to pre-industrial (2 to 4°C in high northern latitudes)

Paleoclimate records from the North Atlantic and the Mediterranean show millennial-scale events of climate instability.

A good context in which to study the interactions occurring in the Earth System during warmer-than-present conditions.
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These events can be also tracked in marine proxies from the same core and appear to correspond to perturbations in surface hydrography and in deep water ventilation.
Comparison with northern North Atlantic records

The same events are present also in marine records from the Northern North Atlantic.

The multi-centennial mid-to-high latitude North Atlantic surface coolings point to significant reorganizations (weakening) of North Atlantic circulation (AMOC).
CONCLUSION:


The spatial and temporal fingerprints of these changes indicate a reorganization of ocean surface circulation, consistent with low-intensity disruptions of AMOC.

Climate numerical simulations suggest that episodic Greenland ice melt and runoff, as a result of excess warmth, may have contributed to short-term AMOC weakening and increased climate instability throughout the Last Interglacial.

This implies that a high warming of the high latitudes increases the possibility of occurrence of abrupt climatic changes, with "chain" effects that propagate at the hemispheric level and can also affect precipitation in the Mediterranean area.
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