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Anomalies during the Present and Last interglacial periods - A proxy comparison

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The stability of the Earth's climate is strongly linked to the amount and spatial distribution of energy by atmospheric/oceanic processes from low to high latitudes. Past periods of relatively stable climate have been interrupted by sharp events, once a critical point has been passed and positive triggers and feedbacks propel change toward a contrasting mode. Additional mechanisms amplify or sustain climate changes that are already under way. High-resolution proxy archives are useful tools for characterizing these events and modes in the past, both in time and space, in order to assess the likelihood of sudden shifts, in particular within warm climate behaviour.

In this respect, the PIG2LIG-4FUTURE database (Geophysical Research Abstracts Vol. 14, EGU2012-13825) contains alkenone-derived sea surface temperatures (117 marine sediment profiles) and stable oxygen isotope ratios (measured in ice cores and speleothems; 29 and 88 records respectively) with sufficient temporal resolution to understand global abrupt climate processes throughout the present interglacial (PIG) and the last interglacial (LIG), together with their deglaciations (d1 and d2). Records have been selected according to their inclusion of both the PIG and LIG intervals for the same location (no more than 45% of the sites), tight chronological control and calibration revised criteria. Data have been compiled into 200-year bins for regional stacks to help in identifying trends, transitions, boundary conditions, latitudinal temperature gradients, polar amplification and reorganisation of monsoon systems. The LIG relative to PIG anomalies are larger at mid latitudes (up to 6ºC around 40N and 40S) than those for the tropics (less than 2ºC from 20N to 20S). The amplitude of variation during the PIG is found to be no more than 2ºC (few exceptions up to 4ºC at northern sub-polar specific locations). Latitudinal distribution of anomalies appears connected to temperature seasonal contrast. The same response is not seen everywhere, particularly evident when climate is changing to a different state (e.g. deglaciation or glacial inception). Results show an apparent homogenous LIG-scenario of global cooling after full interglacial conditions, while the equivalent interval within the PIG is heterogeneous, e.g. a cooling trend is persistent in the northern Atlantic latitudes whereas a warming progression is evident at a number of tropical locations. These spatial differences give clues about mechanisms, location of forcings and sustainers. LIG snapshots at approximately 129 ka, 125 ka, 121 ka and 115 ka BP are compared with PIG results at 12 ka, 8 ka, 5 ka, and 3 ka BP, respectively. These snapshots illustrate how climate occasionally flip to contrasting states. Unlike gradual trends, they seem to be largely unpredictable in detail (intensity and rate of change) and could pose a significant challenge to quantifying the impact of climate changes. This sort of rapid variability may well be the response to an internal non-linear rhythmic throbbing of the climatic system, persistently repeated and manifested depending on regional particularities and specific global environmental conditions prior to the beginning of any transition.