



Interglacial Durations

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In the context of future global warming induced by human activities, it is essential to assess the role of natural climatic variations. Precise knowledge of the duration of past interglacial periods is fundamental to the understanding of the potential future evolution of the Holocene. Past ice age cycles provide a natural laboratory for exploring the progression and duration of interglacial climate. Palaeorecords from ice, land and oceans extend over the last 800 ka, revealing eight glacial-interglacial cycles, with a range of insolation and greenhouse gas influences. The interglacials display a correspondingly large variety of intensity and duration, thus providing an opportunity for major insights into the mechanisms involved in the behaviour of interglacial climates.

A comparison of the duration of these interglacials, however, is often difficult, as the definition of an interglacial depends on the archive that is considered. Therefore, to compare interglacial length and climate conditions from different archives, a consistent definition of interglacial conditions is required, ideally one that is not bound to the method nor to the archive under consideration. Here we present a method to identify interglacials and to calculate their length by means of a simple statistical approach. We based our method on ~ 400 ka windows of time to determine mean climatic conditions while allowing for the possibility of long term evolution of the climatic baseline. For our study of interglacials of the past 800 ka, we used two windows that largely align with the pre-(800-430 ka ago) and post- (430-0 ka ago) mid-Brunhes event (MBE), although the resulting conclusions are not sensitive to this particular division.

We applied this method to the last 800 ka of a few palaeoclimate records: the deuterium ice core (EDC) record as a climatic proxy, the benthic $\delta^{18}\text{O}$ stack (LR04) as a proxy for sea level/ice volume, ice core (Vostok, EDC) atmospheric CO_2 and additional records. Although each climatic parameter has its own interglacial duration in this approach, important overall patterns emerge for individual interglacials. Interglacial conditions during the last interglacial, marine isotope stage (MIS) 5, as well as most pre-MBE interglacials persisted somewhat longer than the elapsed duration of the Holocene, while MIS 7 was shorter, and MIS 9 and MIS 19 were similar in duration. The longest interglacial durations overall characterized MIS 11, a frequent candidate as a potential Holocene and near future analogue because of similar orbital configurations (similarity shared also with MIS 19). Our study also reveals that interglacial high CO_2 levels on the whole are within the duration range of the other paleoclimatic proxies and similar in length with the deuterium EDC record. This suggests that CO_2 essentially plays a role of feedback when contributing to interglacial's duration.

This exercise highlights the stability and variability in duration of the different interglacials as recorded in various proxy records under natural climate conditions. It may help identify past interglacial periods with conditions similar to those observed in the Holocene thus far, thereby allowing improved understanding of the human impact on climate.