



About past interglacials as analogues to the Holocene and Anthropocene

Andre Berger and Qiuzhen Yin

George Lemaitre Centre for Earth and Climate Research, Earth and Life Institute, Université Catholique de Louvain, Louvain-la-Neuve, Belgium

To understand better our current interglacial and its future, we have investigated the response of the climate system to insolation and CO₂ at the peaks of the interglacials over the past 800,000 years using both LOVECLIM and CCSM3. If we identify these peaks with NH summer at perihelion, MIS-1, MIS-11 and MIS-19 show a pretty similar latitudinal and seasonal distribution of the incoming solar radiation, which leads to similar climate response to insolation. However, differences exist. When compared to the average of the last 9 interglacials, a warming over the Southern Ocean in austral winter occurs during MIS-1 and MIS-19 due to the summer remnant effect of insolation. However, this does not happen in MIS-11 because the large global cooling during this season is dominating the remnant effect of the austral summer. This leads to MIS-11 being a cool insolation-induced interglacial and thus not as good an analogue of MIS-1 as MIS-19, at least as far as insolation is concerned. The CO₂ equivalent concentration is practically the same for MIS-1 and MIS-19 but is larger for MIS-11. The lower CO₂ during MIS-1 and MIS-19 cools the Earth, reinforcing the insolation-induced cooling during boreal summer and moderating the warming during boreal winter. The reverse happens for MIS-11 for which its higher CO₂ allows it to be finally classified among the warm interglacials. The interglacials MIS-9 and MIS-5 are the warmest over the last 800 ka and, as such, are considered as analogues for our CO₂-induced future warm interglacial. However, their astronomical forcings are largely different from MIS-1 and its future, leading to a completely different seasonal and regional climate response compared to the simulated future climate. The best analogue to MIS-1 depends therefore upon the criteria used to select such an analogue. The climate simulated with insolation when NH summer at perihelion will be compared to climate resulting from other insolation scenario.

If we look for analogues of the whole Holocene and its future, it must be stressed that the next minimum of eccentricity at the 400-ka time scale is approaching. With this and a CO₂ concentration at the interglacial level, and even larger under human influence, our interglacial was predicted to be exceptionally long. The same happened during MIS-11. According to the sensitivity experiments of Berger et al. (1999), moderate values of CO₂ sustained for sufficiently long might have led to an interglacial MIS-19 even much longer than MIS-11 and MIS-1.