Harmonic responses to climate cycles

T.Laepple, G.Lohmann

Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
(thomas.laepple@awi.de)

In the annual cycle of the insolation recorded in modern climatologies as well as in recordings of the precessional cycle in proxy data, harmonics of the fundamental frequencies are visible in the frequency spectrum. The reason for their occurrence is a nonlinear response of the record on the forcing occurring either in the climate system or in the recording system. By parameterizing the response function as a simple clipping or rectification function, one can derive the parameters of the response function from the observed amplitudes of the fundamental frequency and its harmonics. In the presented paper we apply this technique to the annual cycle and investigate the similarities to paleoclimate records in which the fundamental frequencies are given by the orbital forcing. Spatial resolved maps of the response function show that for the annual cycle strong nonlinear responses exist in the subtropical and polar latitudes. Transferring this climate response to paleo timescales proposes that the harmonics of the Milankovich forcing like the observed semiprecessional cycle do not have to originate from the tropics but could also originate from other nonlinear responses.