

EGU22-3684

<https://doi.org/10.5194/egusphere-egu22-3684>

EGU General Assembly 2022

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PTBox, a toolbox to facilitate palaeoclimate model-data analyses

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Recent progress in modelling the Earth system has made it possible to produce transient climate simulations longer than 10.000 years with comprehensive ESMs. These simulations improve our understanding of slow climatic feedbacks, climate state transitions, and abrupt climate changes. However, assessing the quality and reliability of such paleoclimate simulations is particularly challenging due to the inherent characteristic differences between model data and the climate reconstructions used to validate them.

Here, we present a collection of software packages for inter-model and model-data comparisons called Palaeo ToolBox (PTBox). Its first intent is to evaluate transient simulations of the PalMod project (deglaciation, glacial inception, MIS3) using several proxy data syntheses. Various variables are evaluated (including temperature, precipitation, oxygen isotopes, vegetation, carbon storages and fluxes), across a range of timescales (from decadal to multi-millennial). PTBox provides integrated model-data workflows, from data pre-processing to visualisations, organised into a series of (mostly R) packages. So far, PTBox includes 1) tools for pre-processing simulations and proxy data, 2) ensemble and pseudo-proxy methods to bridge the gap between simulations and proxies and to quantify uncertainties, 3) spectral methods to analyse timescale-dependent climate variability, and 4) newly developed metrics for spatio-temporal model-data comparisons.

Finally, PTBox is accompanied by a website (<http://palmodapp.cloud.dkrz.de/>) with examples on how to use PTBox and interactive visualisations of the datasets produced in the PalMod project.