Geophysical Research Abstracts
Vol. 20, EGU2018-19100, 2018
EGU General Assembly 2018

The DAPS data assimilation intercomparison experiment

Martin Widmann (1), Jörg Franke (2), Hugues Goosse (3), Greg Hakim (4), and Nathan Steiger (5)

(1) School of Geography, Earth and Environmental Sciences, University of Birmingham, UK (m.widmann@bham.ac.uk), (2) Institute of Geography, University of Bern, Switzerland, (3) Centre de recherches sur la terre et le climat Georges Lemaître, Université catholique de Louvain, Louvain-la-Neuve. Belgium , (4) Department of Atmospheric Sciences, University of Washington, Seattle (WA), US, (5) Lamont-Doherty Earth Observatory, Palisades (NY), US

Various approaches for data assimilation for paleoclimatic state estimation have been implemented over the past years. They differ with respect to the assimilation setup and method, the dynamical models, and the type of assimilated information. The setups comprise online approaches, where the background states depend on the outcome of the previous assimilation step, transient offline approaches, where the background states are independent of the previous assimilation step but vary in time due to the influence of climatic forcings, as well as stationary offline approaches, which use the same background states in each assimilation timestep. The main data assimilation methods used in paleoclimate modelling are Particle Filters, where the analysis is given by a weighted version of the background ensemble, and Kalman Filters, where the background ensemble states are changed through the Kalman Gain; variational methods have also been explored. Dynamical models that are used include General Circulation Models, Earth System Models of Intermediate Complexity, and linear models. The empirical information is incorporated either in the form of local or regionally averaged climate variables derived by inverse models from proxy data, or directly as proxy information (currently only used for oxygen isotopes) using forward models.

The potential advantages and disadvantages of the different approaches are not well understood. For instance online approaches allow for information propagation in time, but it is not clear whether there is actually any substantial information propagation for the annual or longer time steps used in paleo data assimilation. If information propagation is not relevant, offline approaches would be sufficient and easier to implement, and in particular the stationary offline approach allows for using very large background ensembles. The relative performance of Particle and Kalman Filters depends on the ensemble size, and there may also be differences with respect to physical consistency. Assimilating local climate reconstructions allows to constrain small-scale structures in the climatic states, whereas using regional reconstructions can be expected to be influenced less by non-climatic noise in the proxies. Directly assimilating proxies avoids problems related to proxy-based, statistical climate reconstructions, but requires good forward models and small climate model biases.

In the DAPS (PAGES working group on paleoclimate reanalyses, Data Assimilation and Proxy System modeling) data assimilation intercomparison experiment we will apply the different approaches in a pseudo-proxy set-up for the Northern Hemisphere for the period 1900 – 2017 CE to systematically validate the analyses against a reasonably well-known estimate for the true climatic state. We will assimilate local temperature pseudo-proxies over land with annual resolution, constructed by adding white noise to the HadCRUT4 gridded temperature observations. They will be given at the locations of the PAGES2k proxy network at 1500 CE. The analyses will be comprehensively validated against the HadCRUT4 gridded temperature observations and the HadSLP gridded sea level pressure data sets.

The poster will present the details of the assimilation and validation set-up, and some preliminary results. The intercomparison has just started and we are inviting contributions from any groups working on paleoclimate data assimilation.