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Comparison among Proxy System Models (“PSM-MIPs”)

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In recent years, there has been a surge in the development of proxy system models to describe all known processes by which climate data is emplaced and extracted from a paleoclimate archive. Such models vary widely in terms of the level of complexity (from bivariate linear to multivariate nonlinear) and number of processes that are modeled explicitly or parameterized from empirical relations. These choices in turn have major ramifications for their modularity across sites and their utility in the data assimilation framework. For example, multivariate PSMs that explicitly model all of the physical, biological, and/or chemical processes by which climate is recorded in an archive may be highly parameterized to the dynamics of a local site, leading to large uncertainties when the model is applied at other sites. Similarly, many of the climate variables needed to run complex PSMs may not be standard output from climate model simulations, limiting their utility in paleoclimate data assimilation. In contrast, simple models may parameterize key processes or fail to model them entirely. As part of the Data Assimilation and Proxy System Modeling PAGES working group, we aim to compare the performance of existing PSMs to identify gaps in our understanding, limitations of published PSMs, and ultimately make recommendations to the community for a unified PSM toolbox for a range of paleoclimate archives. Here I present an example of one such PSM intercomparison (“PSM-MIP”) for stable oxygen isotope records developed from marine carbonates (corals, coralline algae, bivalves, and sclerosponges)—δ18Ocarb-PSM-MIP—assessing the utility of these models for capturing observed δ18Ocarb variability. This PSM-MIP also highlights remaining uncertainties and opportunities for future model development.