Last millennium climate reconstruction by data assimilation using proxies

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Paleoclimate reconstruction enables us to analyze long-term climate change. Understanding climate change is the key to improving climate prediction. However long-term climate data is insufficient. Observation is limited spatiotemporally, and climate models cannot reproduce the real situations very well. Data assimilation can ease these problems. We can obtain most likely values by combination of observation values and model's estimates. Recently data assimilation has been introduced into paleoclimate reconstruction. Multiple proxies can be used simultaneously, so it is possible to reconstruct the past climate fields which are consistent with each proxy’ s data. In most cases, before assimilation, isotope ratio derived from proxies is converted into temperature, etc., with empirical formula. However, various factors influence isotope fractionation, so information recorded in proxies could not be used fully. In addition, there is uncertainty in the empirical formula to convert isotope ratio because it is based on the present climate state. Okazaki and Yoshimura (2017) incorporated isotope fractionation process into climate model (MIROC), and assimilates isotope ratio directly. In the period from 1871 to 2007, the effect of proxy data assimilation is examined, and results shows that it is effective for paleoclimate reconstruction to assimilate isotopic information from proxy data directly. In this study, we try to reconstruct climate fields for the past 1000 years based on the method of previous study (Okazaki and Yoshimura, 2017). Annual variations will be reconstructed by using oxygen isotopic data of ice cores, corals, and tree-ring cellulose. We use proxies’ data archived by the National Oceanic Atmospheric Administration (NOAA), and assimilate through ensemble square root filter.

Keywords: paleoclimate, proxy, stable water isotope, data assimilation

