



A Robust Reconstruction of Precipitation Variations of China Over Both a Short-term Scale and the Last Two Millennia

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Composite-plus-scale (CPS) and covariance-based climate field reconstruction (CFR) are the most popular statistical approaches to reconstruct past climate variations, many of which are hemispheric mean surface temperature. Though CPS works well for single time series and is easy to use, CFR is preferred over CPS due to its freedom of restrictive assumption of locality on the proxy data. However poor estimation arises in CFR when the proxy series outnumber the observations. Therefore CFR has to be largely modified by complex mathematic tools if the reconstruction is based on multiple proxies and a short time interval. This study proposes robust principle component regression (RPCR) not only to simplify reconstruction over a short period but also to provide satisfactory reconstruction on millennial scale. The proposed method allows the number of variables to exceed the number of observations. Moreover, it applies to reconstruct past records of climate variables of a wider range, such as precipitation. Large spatial variation and less accurate measurement of the precipitation indicators lead to more and larger statistical noises. Thanks to its good tolerance of noises, the robust regression offers a good fit to the bulk of data. The performance of RPCR is evaluated against the existing four top statistical methods applied in climate reconstructions. Precipitation variation reconstruction in China is illustrated as an example, over both short and long time scales. A pilot study has shown that RPCR performs satisfactorily well at short-term scale. The long-term performance of RPCR is still under investigation and the comparison results should be ready in February 2012. Although this study focuses its major contribution on the breakthrough in methodology, the reconstruction of China's precipitation variability over the past two millennia is a valuable byproduct to which great attention should also be paid. Such a reconstruction is unprecedented in China because it adopts a multiple-proxy approach. The centennial variability of precipitation observed from the reconstruction is critically needed for our knowledge of Asian monsoon modeling, and prediction.