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High Resolution European Climate Reconstruction during the Holocene: An Off-line Data Assimilation with COSMO-CLM 5.00 Model

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Recent paleoclimate studies using data assimilation (DA) have mostly performed low or intermediate resolution global simulations. For paleo-data assimilation, the proxy time resolution is often too long for the dynamical models and the forecast state usually has no skill. In contrast to the "online" DA, in an “off-line” approach, the re-initialization cycle is completely removed after the assimilation step. We conducted a set of offline DA experiments using the static Ensemble Kalman Filter (EnKF) and precomputed COSMO-CLM 5.00 simulations. In order to test the approach, we first assimilated yearly pseudo-observations into an ensemble of COSMO-CLM high-resolution regional climate model (RCM) simulations over Europe, where the ensemble members slightly differ in boundary and initial conditions (by domain shifting of RCM model). We tested the sensitivity of the DA method to the noise levels of pseudo-observations. Furthermore, the effect of correlation between the observations is studied to set an optimal correlation length in the scheme. The impact of the domain selection for RCM on the forecast skill is addressed. The experiments were conducted for summer and winter averaged values. Finally, the real yearly-averaged observations of Holocene (pollen-based reconstructions) are assimilated into the RCM time-slice simulations (6 different time-slices during the Holocene) and the performance is evaluated. For evaluation of the results, a set of independent reconstructions dataset is chosen. We conclude that for the paleoclimate studies the DA set-up is a promising tool for creating high-resolution analysis quantities.