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Establishing the skill of precipitation reconstructions through PPE

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This study aims at assessing the skill of several climate field reconstruction techniques (CFR) to reconstruct past precipitation over continental Europe and the Mediterranean at seasonal time scales over the last two millennia from proxy records. A number of pseudoproxy experiments are performed within the virtual reality of a regional paleoclimate simulation at 45 km resolution to analyse different aspects of reconstruction skill. Canonical Correlation Analysis (CCA), two versions of an Analog Method (AM) and Bayesian hierarchical modeling (BHM) are applied to reconstruct precipitation from a synthetic network of pseudoproxies that are contaminated with various types of noise. The skill of the derived reconstructions is assessed through comparison with precipitation simulated by the regional climate model. Unlike BHM, CCA systematically underestimates the variance. The AM can be adjusted to overcome this shortcoming, presenting an intermediate behaviour between the two aforementioned techniques. However, a trade-off between reconstruction-target correlations and reconstructed variance is the drawback of all CFR techniques. CCA (BHM) presents the largest (lowest) skill in preserving the temporal evolution, whereas the AM can be tuned to reproduce better correlation at the expense of losing variance. While BHM has been shown to perform well for temperatures, it relies heavily on prescribed spatial correlation lengths. While this assumption is valid for temperature, it is hardly warranted for precipitation. In general, none of the methods outperforms the other. All experiments agree that a dense and regularly distributed proxy network is required to reconstruct precipitation accurately, reflecting its high spatial and temporal variability. This is especially true in summer, when a specifically short de-correlation distance from the proxy location is caused by localised summertime convective precipitation events.