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A Metaheuristic approach to select Representative Measuring Points for Temperature Field Reconstruction

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The assessment of past climate relies on natural and documentary proxies. These may be combined in different forms to characterize the average time evolution of meteorological variables for a given region or even for the globe. These procedures have several problems since the distribution of proxies is irregular, their time resolution varies and their availability decreases back in time. In particular, as natural proxies may be clustered around a given ecosystem (i.e. tree rings), discerning their representativeness may be problematic. Here we show how soft computing techniques can be applied to identify the most representative points from a given dataset. This has been formulated as an optimization problem which can be solved through biologically-inspired operators. Specifically, the Coral Reef Optimization (CRO) algorithm has provided efficient solutions to the Representative Selection problem, outperforming other well-known methodologies. Here, we combine the CRO algorithm with the widely-used Analog Method in order to identify the most representative set of monthly average temperature time series for Europe from gridded (ERA Interim) and un-gridded (ECA) datasets. The best solutions obtained with this methodology are climatologically consistent, and include points from Scandinavia, Central and Southern Europe, Eastern Europe and the Black Sea. Interestingly, once the number of selected locations reaches a certain threshold, the improvement in the temperature reconstruction is achieved by adding points near the previously-identified zones and not by reshaping the selected sub-regions. Therefore, a reduced subset of points over key areas is enough to capture the climate variability of the entire region. Furthermore, our method excels by reducing the reconstruction misfit up to 28% when compared with other metaheuristic procedures, such as the greedy algorithm, based on individual selections. These results provide a clear guide to identify the best set of proxy locations for field reconstructions.