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Assessment of six dissimilarity metrics for climate analogues

Patrick Grenier (1), Annie-Claude Parent (2), David Huard (1), François Anctil (2), and Diane Chaumont (1)
(1) Ouranos, Montreal, Canada (grenier.patrick@ouranos.ca), (2) Université Laval, Civil and Water Engineering Department, Quebec, Canada

Spatial analogue techniques consist in identifying locations whose recent-past climate is similar in some aspects to the future climate anticipated at a reference location. When identifying analogues, one key step is the quantification of the dissimilarity between two climates separated in time and space, which involves the choice of a metric. In this communication, spatial analogues and their usefulness are briefly discussed. Next, six metrics are presented (the standardized Euclidean distance, the Kolmogorov-Smirnov statistic, the nearest-neighbor distance, the Zech-Aslan energy statistic, the Friedman-Rafsky runs statistic and the Kullback-Leibler divergence), along with a set of criteria used for their assessment. The related case study involves the use of numerical simulations performed with the Canadian Regional Climate Model (CRCM-v4.2.3), from which three annual indicators (total precipitation, heating degree-days and cooling degree-days) are calculated over 30-year periods (1971-2000 and 2041-2070). Results indicate that the six metrics identify comparable analogue regions at a relatively large scale, but best analogues may differ substantially. For best analogues, it is also shown that the uncertainty stemming from the metric choice does generally not exceed that stemming from the simulation or model choice. A synthesis of the advantages and drawbacks of each metric is finally presented, in which the Zech-Aslan energy statistic stands out as the most recommended metric for analogue studies, whereas the Friedman-Rafsky runs statistic is the least recommended, based on this case study.