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CLIMCONG: A framework-tool for assessing CLIMate CONGruency

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It is widely accepted that the anticipated elevational and latitudinal shifting of climate forces living organisms (including humans) to track these changes in space over a certain time. Due to the complexity of climate change, prediction of consequent migrations is a difficult procedure afflicted with many uncertainties. To simplify climate complexity and ease respective attempts, various approaches aimed at classifying global climates. For instance, the frequently used Köppen-Geiger climate classification (Köppen, 1900) has been applied to predict the shift of climate zones throughout the 21st century (Rubel and Kottek, 2010). Another – more objective but also more complex – classification approach has recently been presented by Metzger et al. (2013).
Though being comprehensive, classifications have certain drawbacks, as I) often focusing on few variables, II) having discrete borders at the margins of classes, and III) subjective selection of an arbitrary number of classes. Ecological theory suggests that when only considering temperature and precipitation (such as Köppen, 1900) particular climate features – e.g. radiation and plant water availability – may not be represented with sufficient precision. Furthermore, sharp boundaries among homogeneous classes do not reflect natural gradients. To overcome the aforementioned drawbacks, we here present CLIMCONG – a framework-tool for assessing climate congruency for quantitatively describing climate similarity through continua in space and time.
CLIMCONG allows users to individually select variables for calculation of climate congruency. By this, particular foci can be specified, depending on actual research questions posed towards climate change. For instance, while ecologists focus on a multitude of parameters driving net ecosystem productivity, water managers may only be interested in variables related to drought extremes and water availability. Based on the chosen parameters CLIMCONG determines congruency of climates using Manhattan distances among locations. First applications of CLIMCONG were to I) globally cluster congruent eco-climates resulting in a classification being more objective than Köppen (1900) but at comparable complexity, II) successfully model MODIS average annual net primary productivity globally (R^2 = 0.69), and III) identify recent climates (with foci varying from eco-climates over water availability to extreme events) most similar to the predicted (RCP-scenarios) climate of given locations worldwide without being restricted to classifications. Using CLIMCONG it thereby becomes possible to track the 'migration' of local climate conditions throughout the 20th and 21st century. Further applications are planned and a CLIMCONG 'R'-package is under preparation.

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