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Numerical model for the dispersal of modern humans: Combining palaeoclimate model results with archaeological site distributions

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Numerical models based on Fisher's equation have been used in the past to estimate the dispersal of hunter-gatherers and the spread of farming, utilizing radiocarbon dates and recently palaeoclimatic data. These models use diffusion for a linear and isotropic movement. However, migration of humans seems to be anisotropic and following routes characterized by preferential environmental conditions.
In this study, we present a numerical model for the dispersal of humans based on an advection-diffusion equation. In an interdisciplinary approach, we combine palaeoclimate model results with archaeological site distribution in a species distribution model to estimate human suitability scores. These scores serve as a driver for directed dispersal (advection) in addition to isotropic (diffusion) migration. Population dynamics are estimated through a logistic growth function. The model can be applied to global and continental scales for which population densities are of interest. For smaller scales, the dispersal is modeled in a rapid and stepwise expansion by prohibiting advection until a population threshold is reached. Sensibility tests of the model and the used parameters are delineated and discussed critically.