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## Climate, culture and population size

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Human history is full of examples documenting that cultural innovations played a key role in reducing the impact of environmental stress on early populations. Over the past 1 million years this type of adaptation (e.g., clothing, shelter, hunting techniques, social behaviour) likely also increased human population size. Humans are cumulative cultural learners, who can integrate knowledge and culture from one generation to the next. The larger the number of interacting people, the faster the rate of innovation. Here we introduce a stochastic consumer-resource modeling framework, that simulates the dynamics of cultural transmission, learning, and innovation, population size, and resource depletion in a changing environment. Culture is introduced as a booster to carrying capacity. A zero-dimensional version of the model simulates nonlinear phase-synchronization between culture, population and external climate forcings. We will also present the first results of the model in 2 dimensions with full global resolution and 3 interacting hominin species to assess which role differences in cultural innovation played in the extinction of Neanderthals and Denisovans.