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Relative contributions of model parameter setting, driving climate and initial condition errors to uncertainty in malaria simulations in the highlands of Kenya

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Understanding sources of uncertainty in the development of climate driven disease forecasts is useful as it it helps decision-makers understand where, when and why forecasts may be more or less robust and allows the prioritization of error reduction. Experiments are conducted to gauge the relative importance of model, initial condition, and driving climate uncertainty for simulations of malaria transmission at a highland plantation in Kericho, Kenya. A genetic algorithm calibrates each of these three factors within their assessed prior uncertainty in turn to see which allows the best fit to a timeseries of confirmed cases. It is shown that for high altitude locations close to the threshold for transmission, the spatial representativeness uncertainty for climate, in particular temperature, dominates the uncertainty due to model parameter settings. Initial condition uncertainty plays little role after the first two years, and is thus important in the early warning system context, but negligible for decadal and climate change investigations. Thus, while reducing uncertainty in the model parameters would improve the quality of the simulations, the uncertainty in the temperature driving data is critical. It is emphasized that this result is a function of the mean climate of the location itself, and it is shown that model uncertainty would be relatively more important at warmer, lower altitude locations.