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Modelling hydro-climatic controls on seasonal malaria dynamics

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Climate plays a critical role in determining malaria geographical distribution and its seasonal dynamics. In particular, temperature, rainfall and soil moisture influence both malaria agent (*Plasmodium*) and vectors (*Anopheles* female mosquitoes). Careful analysis of malaria monthly data coupled with daily and monthly meteorological data in three South African provinces showed different responses of malaria evolution to temperature and rainfall. Temperature extremes constrain the development of the disease vectors, whereas rainfall had a twofold effect: moderate-to-high rainfall rates had a favourable but delayed affect on malaria growth, while very intense rainfall tended to directly reduce malaria incidence. We attributed the former rainfall effect to increased water availability (soil moisture and puddles) for mosquito breeding sites, and the latter to habitat destruction by heavy rainfall and, possibly, associated winds and low temperatures. We modelled these dynamics by means of a differential equation model, at the monthly timescale, coupling soil moisture and malaria evolution and using empirical functions describing the above-mentioned effects of temperature and rainfall. The preliminary results show that the model explains the main seasonal components of malaria dynamics in at least two provinces. In one of the series, the interannual variability possibly due to other non-climatic factors is explained by means of time-varying parameter values. Future efforts will be directed toward the use of daily hydro-meteorological data to improve the results especially in terms of temporal intermittency.