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Dynamical modeling of tick-borne encephalitis transmission with climate projection

We introduce a mathematical model for retroactive analysis of weather fluctuation on tick-borne encephalitis (TBE) prevalence in Hungary. The model couples a TBE virus transmission dynamics among ticks with multiple development stages, animal hosts and humans, with the stochastic observation process of human TBE reporting given infection. By fitting human incidence data in Hungary to the model, we estimate key parameters relevant to the tick-host interaction and tick-human transmission. Then we compute the basic reproduction number which determines the long-term behaviors of the periodic system of integro-differential equations - the TBE transmission dynamics. We then show that the developed model provides an effective tool for projecting TBE virus transmission risk in the enzootic cycle by integrating climate projection with emerging knowledge about the region-specific tick ecological and pathogen epidemiological processes.