

Chaos and Noise in Population Biology: mathematical modelling, data analysis and intervention methods in dengue fever epidemiology, a case study

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Keywords : Bifurcations, positive Lyapunov exponents, multi-strain dynamics, dengue fever vaccines, parameter estimation, Bayesian analysis

Target Session(s): Epidemiology;

Abstract

We investigate epidemiological models describing the difference between primary and secondary infection in dengue fever, which show complex dynamics, like Hopf and torus bifurcations into chaotic dynamics with positive Lyapunov exponents, in wide parameter regions.

These models describe surprisingly well long term empirical time series of dengue hospitalized cases, e.g. from Thailand, Brasil and Indonesia. Statistical methods for such complex dynamics are developed, including parameter estimation via iterated filtering and Bayesian model comparison.

We finally investigate some recent advances in control measures, namely the newly licensed first dengue vaccine and its distinctive efficacy and relative risk for seronegative versus seropositive hosts, via Bayesian analysis. This ties in well into the initial modeling assumptions of differences in primary and secondary infection as empirical confirmation.

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