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Statistical and mathematical modeling of the nonstationary spatio-temporal dynamics of dengue in Thailand

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ABSTRACT

Dengue is the most important arboviral disease worldwide and a major public health problem in the tropics and the subtropics. The dengue vector and virus are extremely sensitive to environmental conditions such as temperature, humidity and precipitation that influence mosquito biology, abundance, habitat and the virus replication. Then these climatic factors must have significant influences on dengue propagation in the population.
To better understand the role of climate in dengue epidemics we have analyzed the relationship between dengue cases and local climatic variable using wavelet decomposition, in the 76 Thailand provinces. Wavelet clustering has been applied to the coherences between dengue incidence and local climatic variables to define five main "dynamical regions". Then a classical 2-strain dengue stochastic model has been fitted to each of these five "dynamical regions" but using time-varying transmission parameters. Exact inference was conducted using recent algorithms as the particle MCMC coupled with an initial exploration of the likelihood surface with the extended Kalman filter.
The preliminary results have shown that climatic variables were found to have a statistically significant relationship with the time-varying transmission parameters in these five "dynamical regions". Therefore, one can expect that forecast climate information has potential utility in a dengue decision support system. Taking advantage of lead times of several months provided by climate forecasts, public health officials may be able to efficiently allocate intervention measures well ahead of an imminent dengue epidemic.

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