Risk quantification of arthropod-borne disease in link with meteorological data

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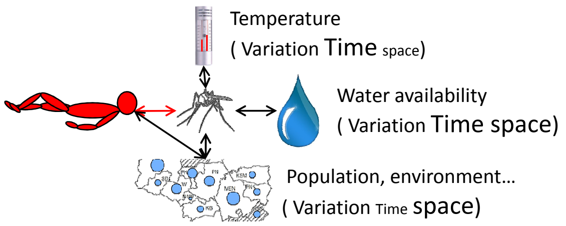
Problematic

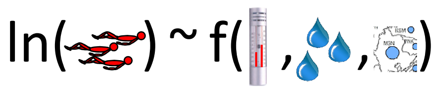
By the presence of the arthropod vector and its biology, the Arthropod-Borne Diseases are linked, to the environmental conditions and more particularly to the meteorological data. Using the reported cases of a mosquito borne disease in the time and in the space, and the environmental, meteorological and population data, it is possible to obtain a model estimating the risk of a mosquito born disease.

Furthermore, the climate can no more considered stable. Numerous proves exist on the global change. There are also results of different climatic models used by Inter-governmental Panel on Climate Change, IPCC giving a change not only on the temperature but also on the rainfall repartition. Using results of the climate change according the emission scenario A1B; it is possible to quantify the risk of a mosquito borne disease according an increase of temperature and modification of the rainfall repartition.

Methodology and application to dengue



1. Smoothing the occurrence : population size, random time and space, spatial autocorrelation
2. Generalized linear model :



3. Taking into account Climate Change (IPCC)

Results for Sakon Nakhon Province(Northeast of Thailand)

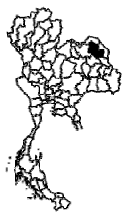
Now (2005-2007)

smoothed dengue occurrence per district per month

monthly average Tmin

2 – Month Cumulated Rainfall per district

district parameter as population size and socioeconomic indicators

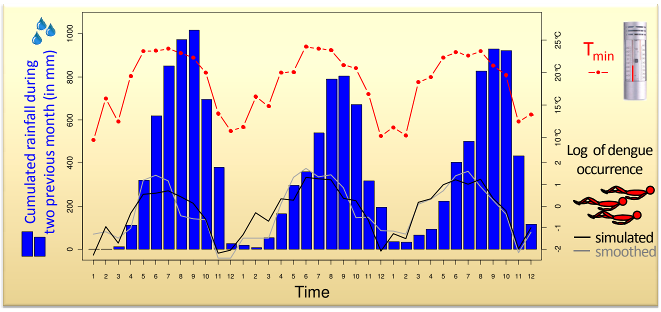


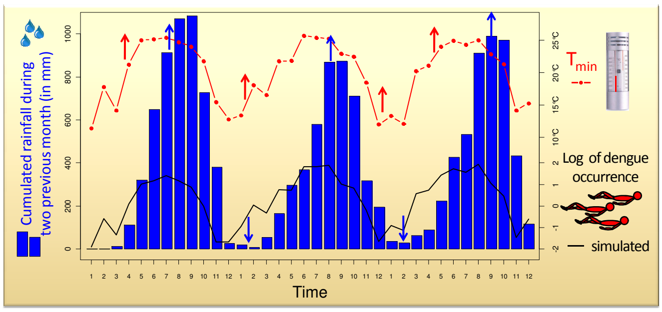
IPCC Scenario A1B for 2090-2100

Temperature: 1.75°C ↑

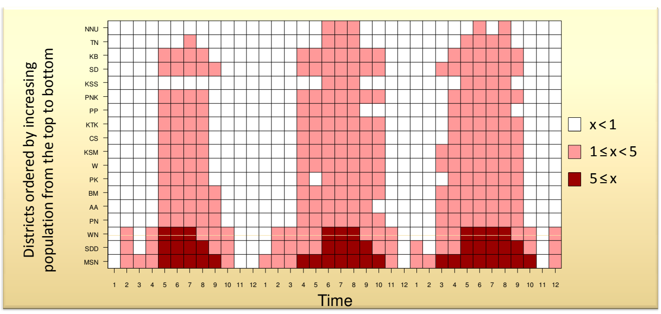
Rainfall: 10% ↑ summer; 10% ↓ winter

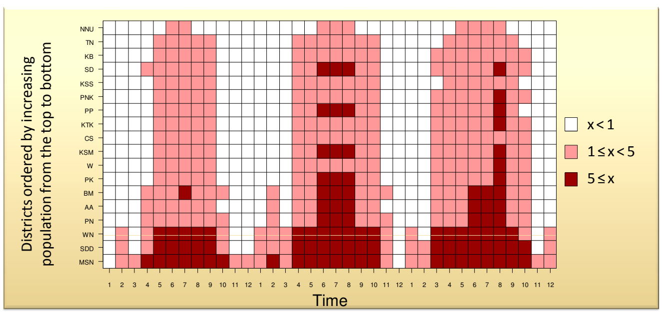
Province level





District level





Dengue occurrence simulated per district and per month (x)

Number of simulated cases of the mosquito borne disease for 3 years. At the left, the minimal temperature and the rainfall repartition is not changed. At the right, the minimal temperature is increased by 1.75°C and the rainfall is 10% decreased in the winter an 10 % increased in the summer as it is simulated in the climatic models for north-east of the Thailand for the end of the 21th century.

White, pink and dark red correspond respectively to a number of cases by district and by month n<1, 1<n<5, n>5.

Conclusion

Globally, in this studied case, the number of the mosquitoes borne disease case is mainly positively linked with the minimal temperature. The impact of the rainfall repartition acts lighter than that of minimal temperature but also synergistically with the increase of the minimal temperature. Increase of risk period and risk area is observed even with moderate increase of temperature and change of rainfall. This method can be adapted to a lot of vector born diseases.

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Ref.: Bicout DJ, Carvalho R, Chalvet-Monfray K & al Distribution of equine infectious anemia in horses in the north of Minas Gerais State, Brazil. J Vet Diagn Invest 2006; 18: 479-82.