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# Climate change and Emerging risks

Communicable diseases Dengue Fever case study

Karachi Apr. 9 ~11, 2017

# Summary

- What is the Dengue Fever
- Knowing the vector of Dengue virus
- Climate change: What impact on Dengue fever ?
- Countries at risk
- Case Study of Malaysia
- Case study of Sri Lanka
- Possible developments

# What is the Dengue Fever (DF, DHF, DSS)

**INFECTIOUS AGENT :** Dengue Virus is an arbovirus of the Flaviviridae family

**VECTOR :** Transmitted to humans by the bite of infected *Aedes aegypti* and *Aedes albopictus* mosquitoes

**CLINICAL SIGNS:** Dengue fever include influenza type symptoms, fever, rash, myalgias and arthralgias, with a febrile period lasting between 2 and 10 days.

**INCUBATION PERIOD:** Humans have an average incubation period of 4-7 days (range of 3-15 days).

**IMMUNIZATION:** No vaccine is presently licensed.

**SEVERE FORMS:** Dengue hemorrhagic fever (DHF) and Dengue shock syndrome (DSS) which if not cared can resulting in death within 12 to 36 h.

**REGION:** Tropical disease

# Knowing the vector



*Aedes aegypti* (the yellow fever mosquito) is a mosquito that can spread dengue fever, chikungunya, Zika fever, Mayaro and yellow fever viruses, and other diseases.

Only the female bites for blood, which she needs to mature her eggs

Eggs are laid over a period of several days, are resistant to desiccation and can survive for periods of six or more months. When rain floods the eggs with water, the larvae hatch.

The entire immature or aquatic cycle (i.e., from egg to adult) can occur in as little as 7-10 days.

## Knowing the vector



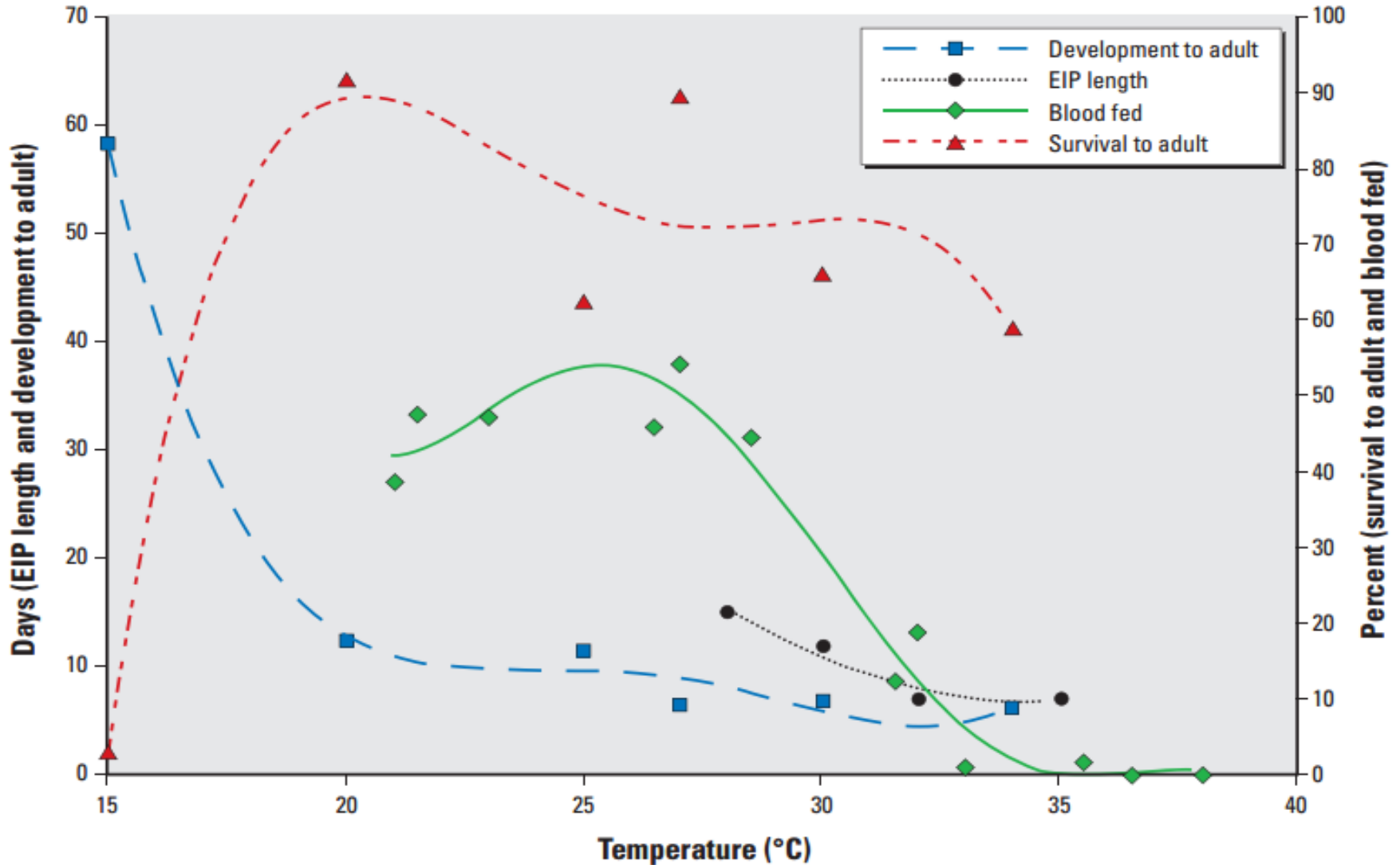
The lifespan for adult mosquitoes is around three weeks (21 days).

*Aedes aegypti* do not remain alive through the winter in the egg stage in colder climates.

They prefer to bite indoors and primarily bite humans mainly early in the morning and in the evening at dusk.

Artificial or natural water containers (water storage containers, flower pots, discarded tires, plates under potted plants, cemetery vases, flower pots, buckets, tin cans, clogged rain gutters, ornamental fountains, drums, water bowls for pets, birdbaths, etc.) that are within or close to places where humans live are ideally larval habitats for this mosquito.

## Temperature and Life cycle of Aedes Aegypti



Source : Morin, Comrie & Ernst – Climate and Dengue transmission: Evidence and implications

## In other words ?

Change in temperature means:

- Boosting the speed of development of mosquitoes larva to adult stage;
- Females bite more frequently;
- Increasing the survival period;
- Warmer winters enable mosquitoes to survive in area formerly too cold;
- Increase of the number of mosquitoes;
- Shortening the time it takes for the virus inside the mosquito to develop and becoming infective;

While changes in precipitation/evaporation is regulating the mosquitoes population

# Climate change: What impact on Dengue fever

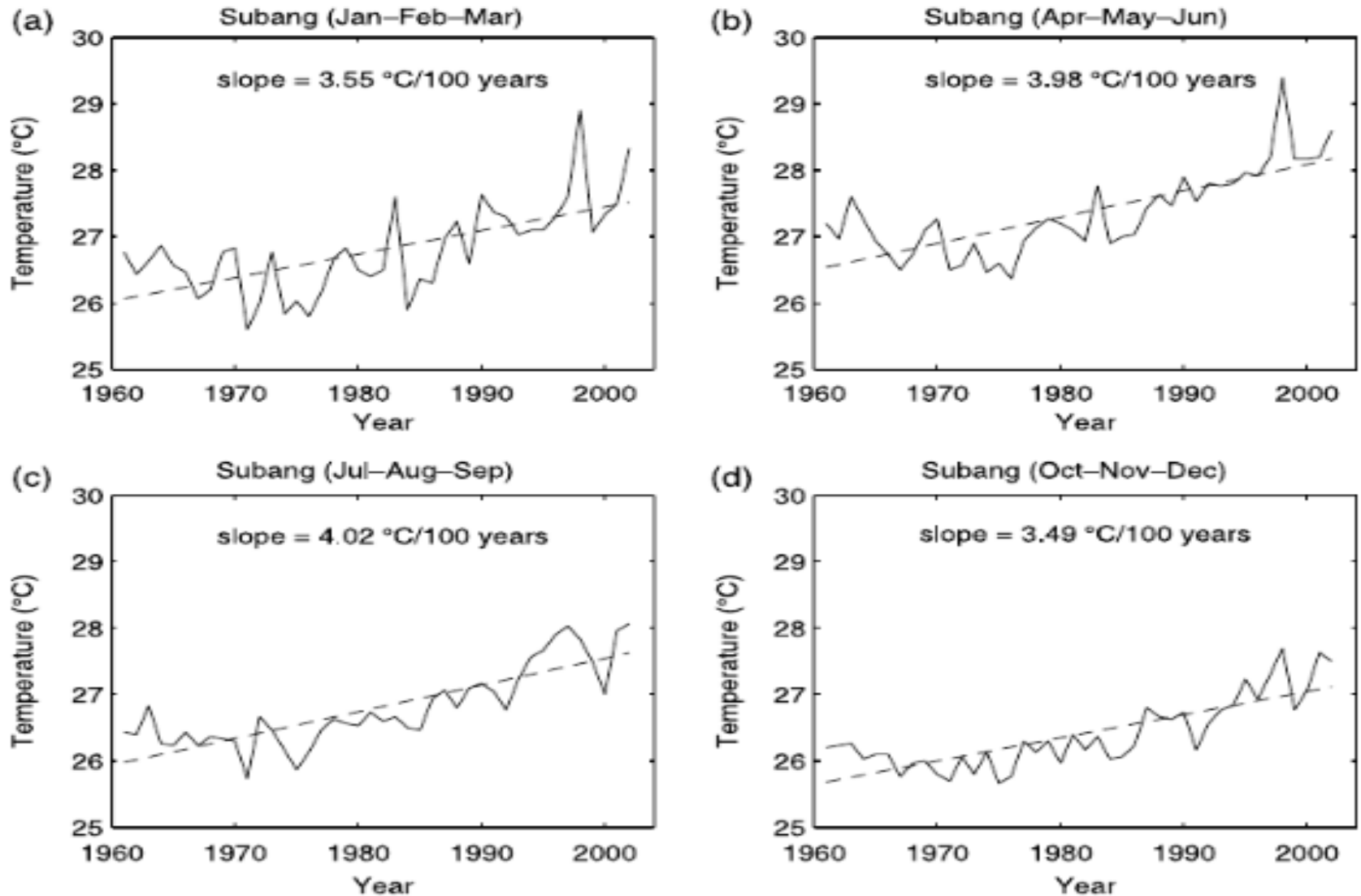
## Studies identifying relationships between climate variables and DF cases

Source	Location	Study type/model	Identified climate predictors/associations
Amarakoon et al. 2008	Caribbean	Time-series analysis, correlation	ENSO, temperature
Arcari et al. 2007	Indonesia	Multivariate regression, correlation	Temperature, rainfall
Barrera et al. 2011	Puerto Rico	Longitudinal study	Rainfall
Brunkard et al. 2008	Mexico	Time-series analysis, autoregressive model	Temperature, rainfall, sea surface temperature
Cazelles et al. 2005	Thailand	Wavelet analysis	ENSO
Chadee et al. 2007	Trinidad	Correlation	Precipitation
Chen et al. 2010	Thailand	Correlation, Poisson regression	Minimum temperature, rainfall, relative humidity
Chowell et al. 2011	Peru	Time-series analysis, spatial analysis	Mean temperature
Chowell and Sanchez 2006	Mexico	Correlation, multiple linear regression	Maximum temperature, evaporation, precipitation
Colón-González et al. 2011	Mexico	Multiple linear regression	Minimum temperature, ENSO
Descloux et al. 2012	Australia	Multivariate nonlinear model	Temperature, relative humidity, precipitation
Fuller et al. 2009	Costa Rica	Statistical model	ENSO
Gharbi et al. 2011	Guadeloupe	Seasonal autoregressive integrated moving average model	Relative humidity, mean temperature, minimum temperature
Hii et al. 2009	Singapore	Time-series analysis, Poisson regression	Mean temperature, precipitation
Hsieh and Chen 2009	Taiwan	Correlation, multiphase Richards model	Temperature, rainfall
Hurtado-Diaz et al. 2007	Mexico	Time-series analysis, autoregressive model	Sea surface temperature, minimum temperature, rainfall
Johansson et al. 2009a	Mexico, Puerto Rico, Thailand	Wavelet analysis	ENSO, temperature, precipitation (not uniformly)
Johansson et al. 2009b	Puerto Rico	Regression model	Temperature, precipitation
Jury 2008	Puerto Rico	Multiple statistics	Temperature, precipitation
Keating 2001	Puerto Rico	Multivariate linear regression	Temperature
Lu et al. 2009	China	Time-series analysis, Poisson regression	Minimum temperature, minimum humidity, wind velocity
Pinto et al. 2011	Singapore	Correlation, Poisson regression	Minimum and maximum temperature
Schreiber 2001	Puerto Rico	Multivariate regression	Temperature, energy, moisture variables
Su 2008	Philippines	Correlation, regression	Precipitation
Thai et al. 2010	Vietnam	Wavelet analysis	ENSO
Tipayamongkholgul et al. 2009	Thailand	Poisson autoregressive model	ENSO
Wu et al. 2007	Taiwan	Time-series analysis, autoregressive integrated moving average models	Monthly temperature variation, relative humidity
Wu et al. 2009	Taiwan	Spatial analysis, GIS	Temperature
Yu et al. 2011	Taiwan	Spatiotemporal analysis, stochastic Bayesian maximum entropy analysis	Multiple climate variables



# Case study of Malaysia

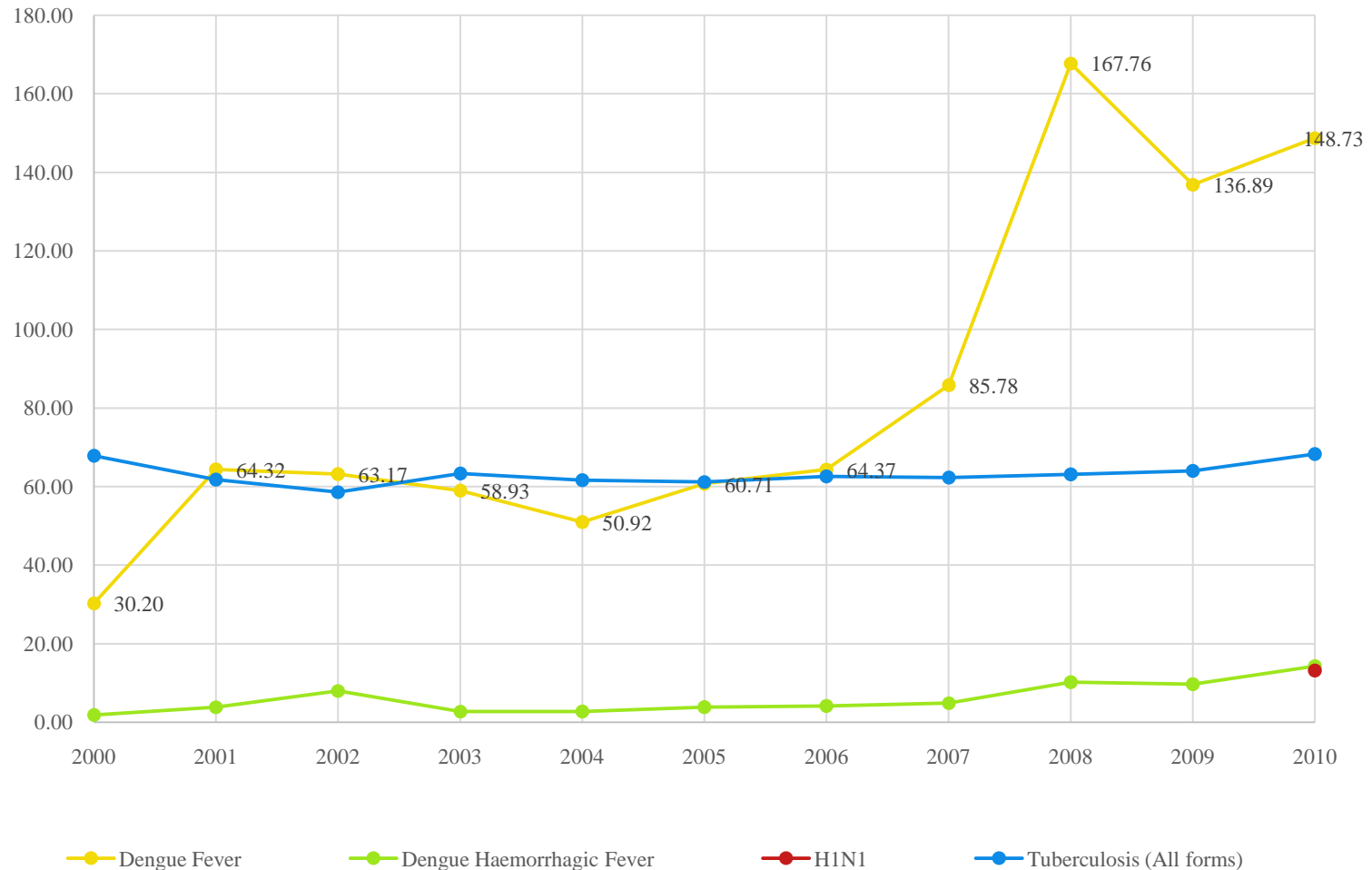
## Trend and interannual variability of temperature in Malaysia



Source : Tangang & Juneng – Trend and interannual variability of temperature in Malaysia: 1961–2002

# Case study of Malaysia

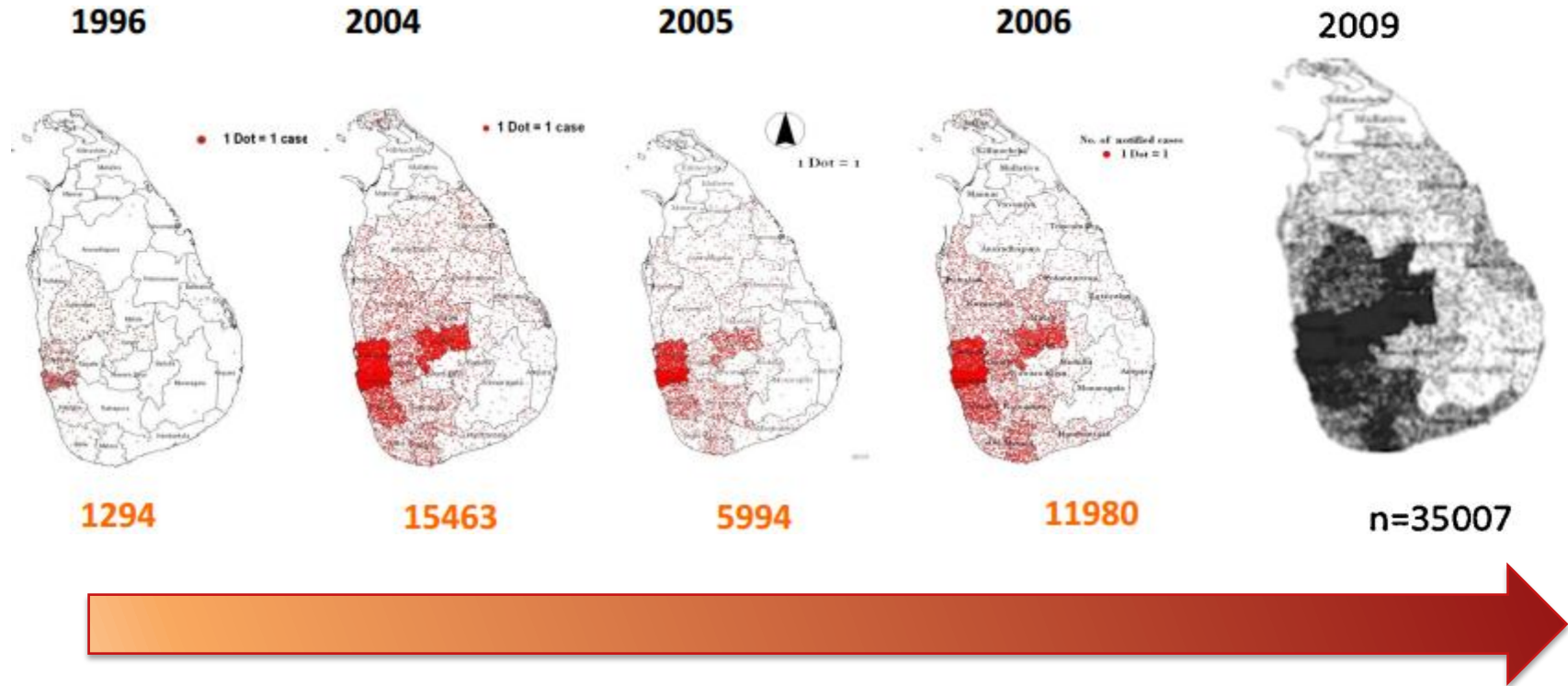
## INCIDENCE RATES OF DF / DHF IN MALAYSIA



Source : MOH Malaysia – Health Facts 2000 - 2010

# Case study of Sri Lanka

## Temporal and Spatial spread of Dengue fever



Serologically confirm in 1962; first outbreak in 1965

1<sup>st</sup> major epidemic in 1989 ; Notifiable disease in 1996

Cyclical epidemics in 2002, 2004, 2006, 2009, ...

Increase of the number of reported case per year and extension to almost the whole country

Since 2009 incidence rate is having a positive trend and is in average 164.31 per 100,000 inhabitants

# Case study of Sri Lanka – Insurance wise

## Incidence rate and Inpatient Cost related to DF (experience based on medical portfolio)

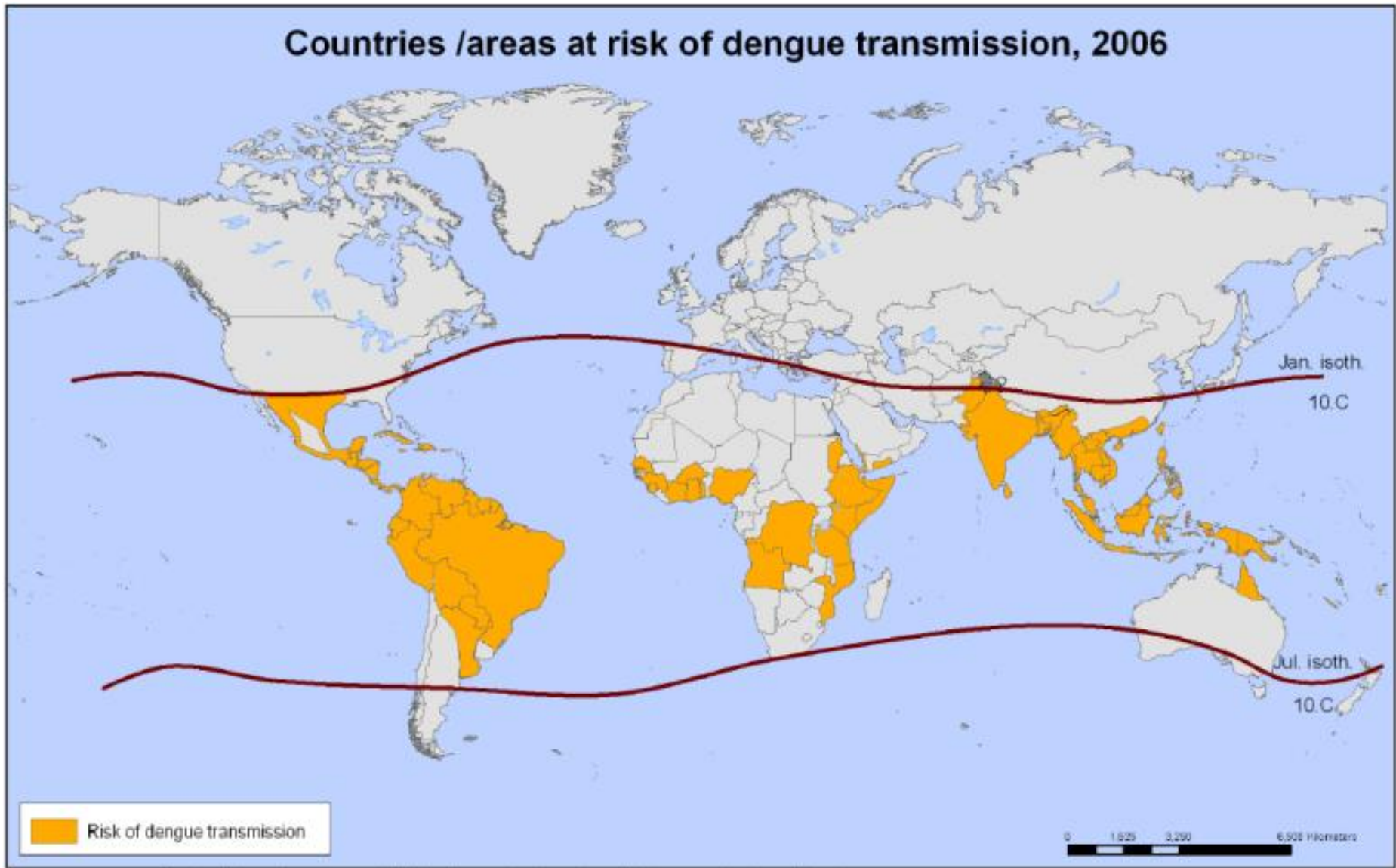
Year	Incidence rate (Per 100,000)		Av. Cost of In Patient	
	Portfolio wise	Country wise	Non Dengue	Dengue
2013	344.59	145.40	19,697	58,679
2014	339.31	133.04	30,673	65,323
2015	468.03	213.78	26,924	69,290

Incidence rate is 2.2 to 2.6 higher than Population wise

Claim amount for Dengue are 2.1 to 3.0 higher than non Dengue claim

For an Insurance Company, Dengue can lead to increase in frequency and in severity

# Countries at risk

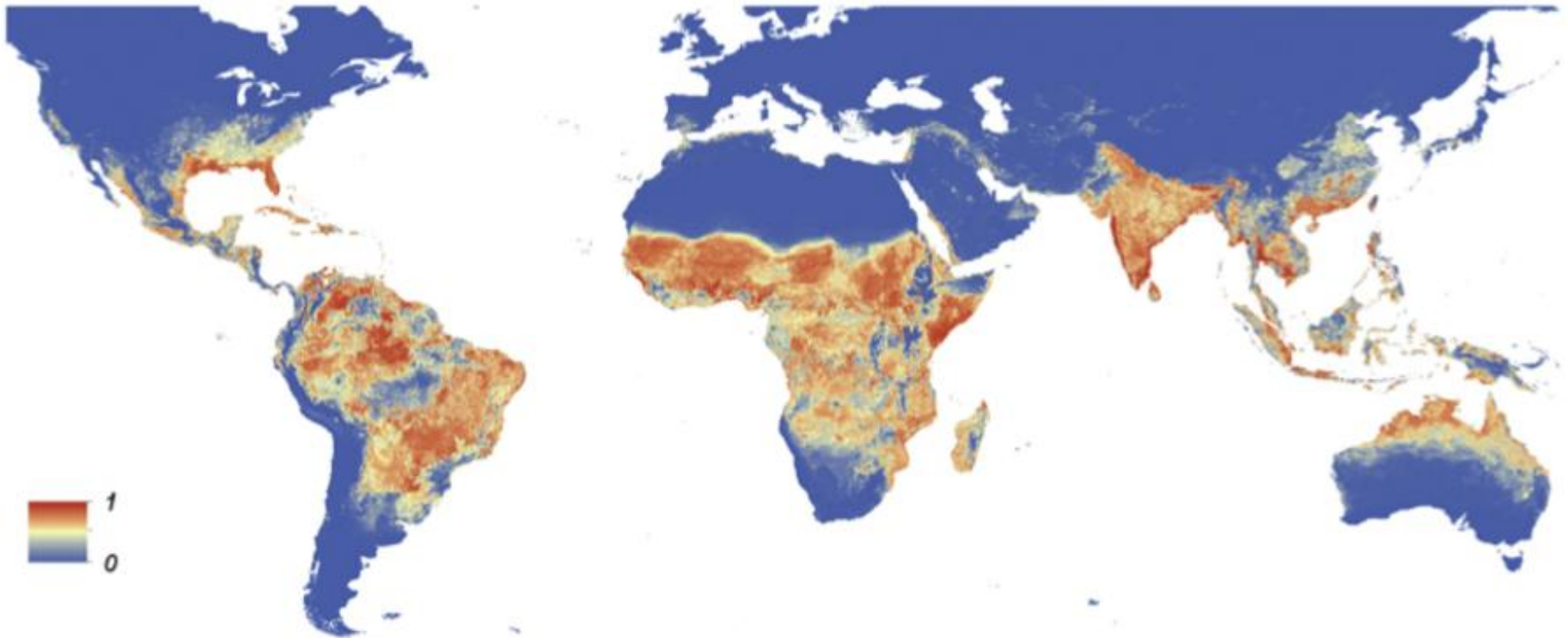


Source : WHO

# Possible developments

Global warming => Redesigning the tropical and sub-tropical zone  
Leading to occurrence of communicable disease in new region of the world

probability of occurrence of *Ae. Aegypti*

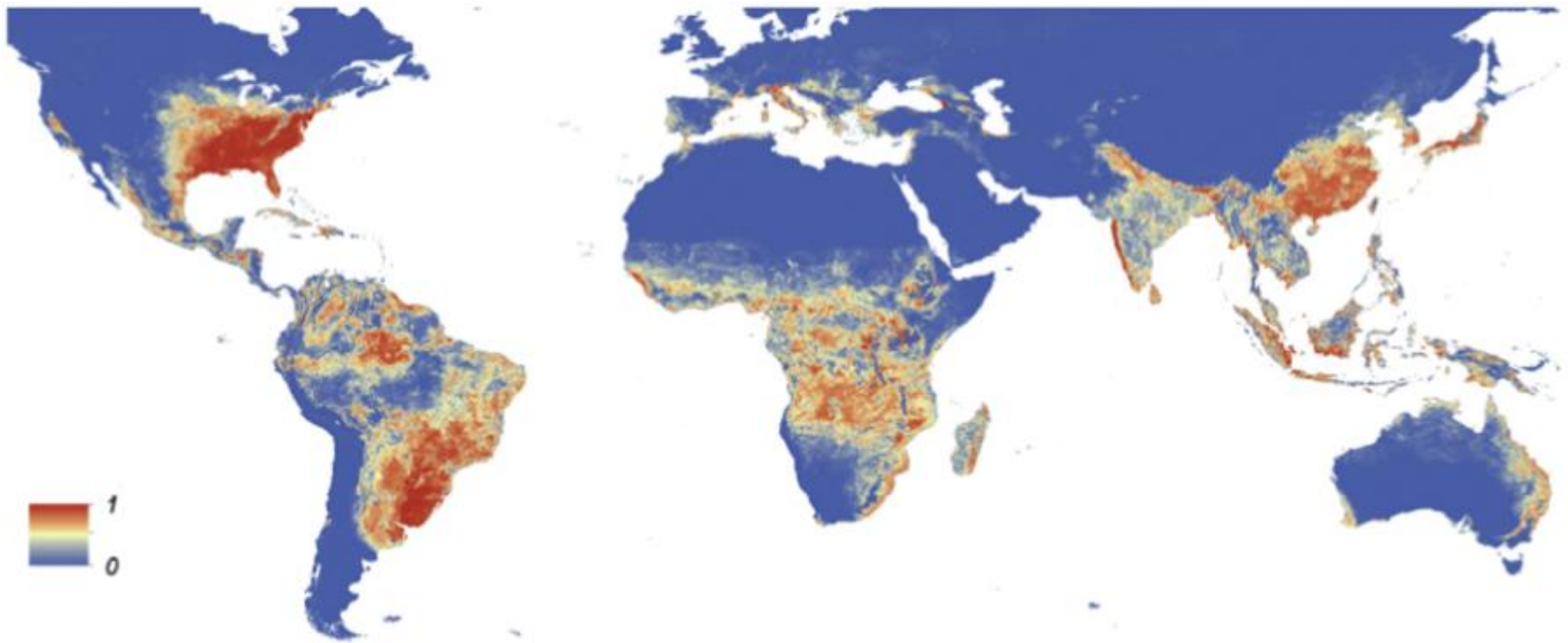


Source : Kristie L. Ebi & Joshua Nealon - Dengue in a changing climate

# Possible developments

Global warming => Redesigning the tropical and sub-tropical zone  
Leading to occurrence of communicable disease in new region of the world

probability of occurrence of *Ae. albopictus*



Source : Kristie L. Ebi & Joshua Nealon - Dengue in a changing climate

**THANK YOU**



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