Project Proposal

Impact of Relative Humidity on Dengue cases in Thailand

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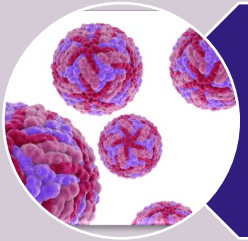
Dengue fever

Viral Vector:

Aedes aegypti; Aedes albopictus

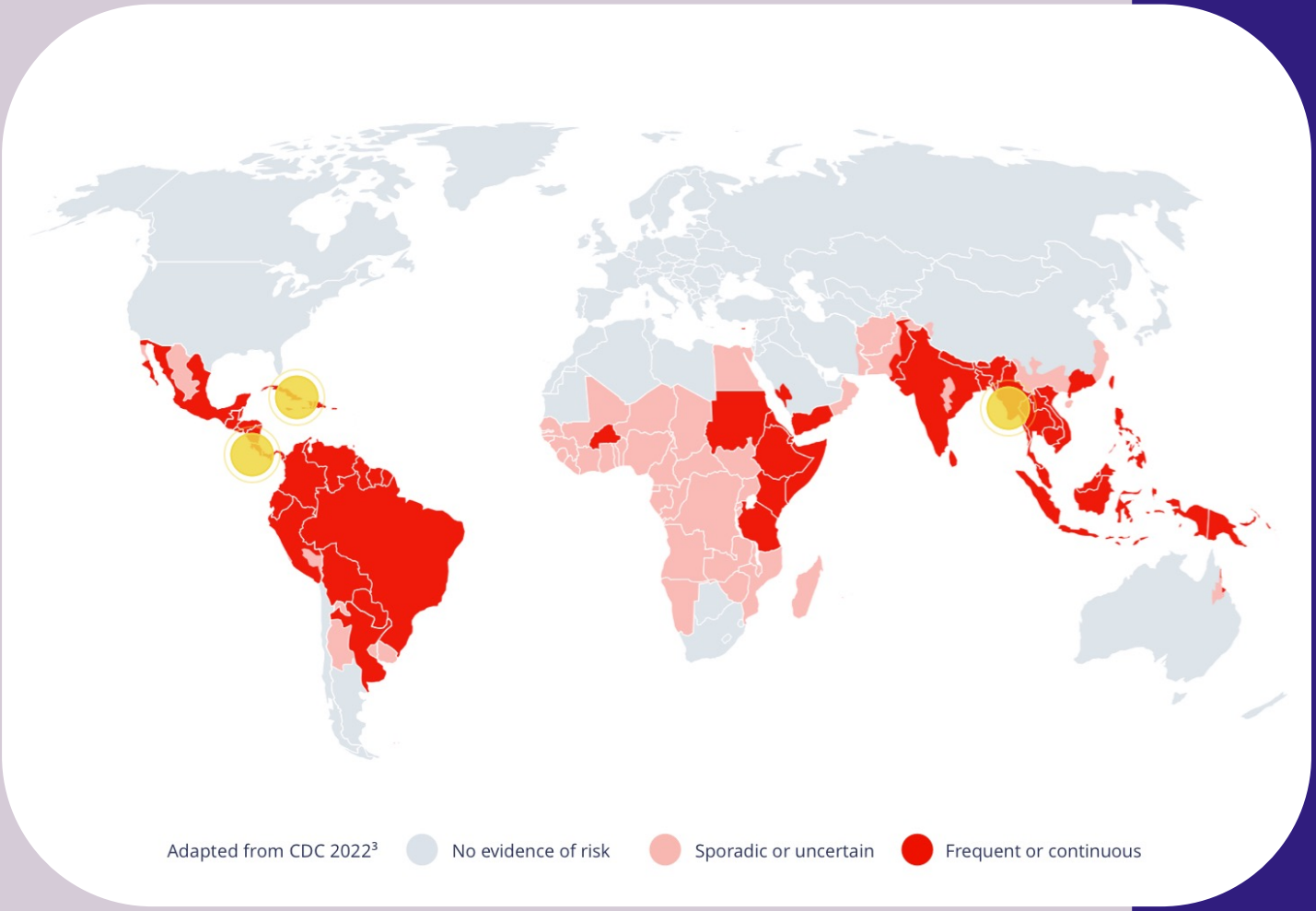


Four serotypes (DENV 1-4) of ssRNA virus of the genus Flavivirus

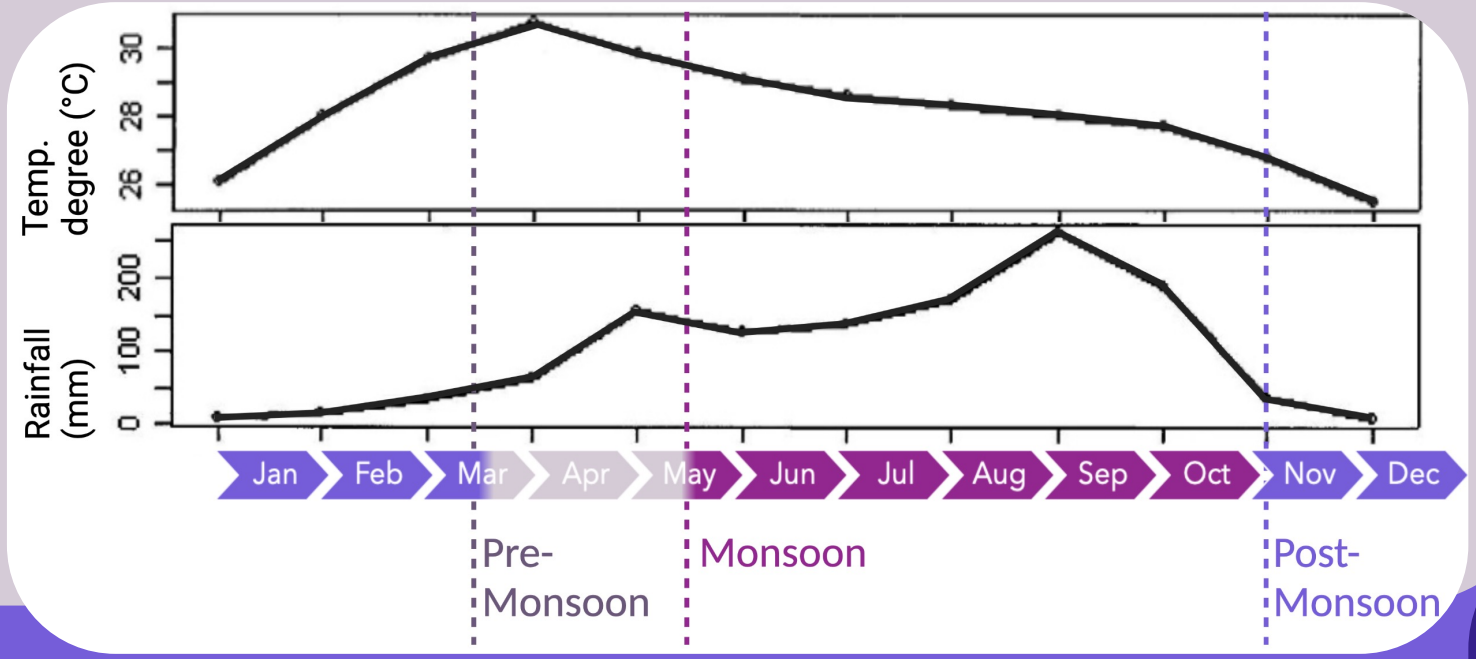
Symptoms:

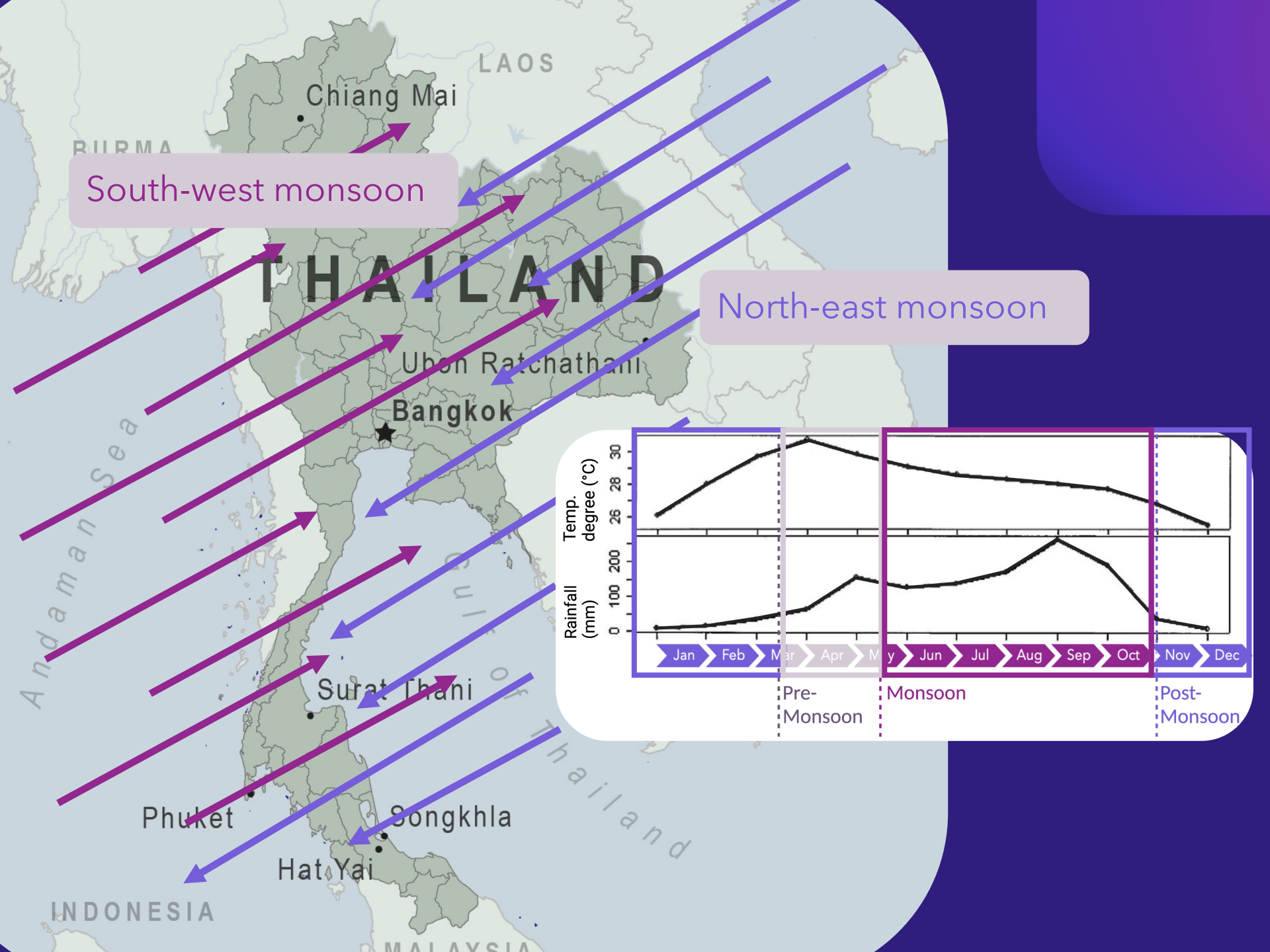
High fever, severe headaches, nausea, skin rash, joint pain etc.

Dengue fever Prevalence



Climate in Thailand

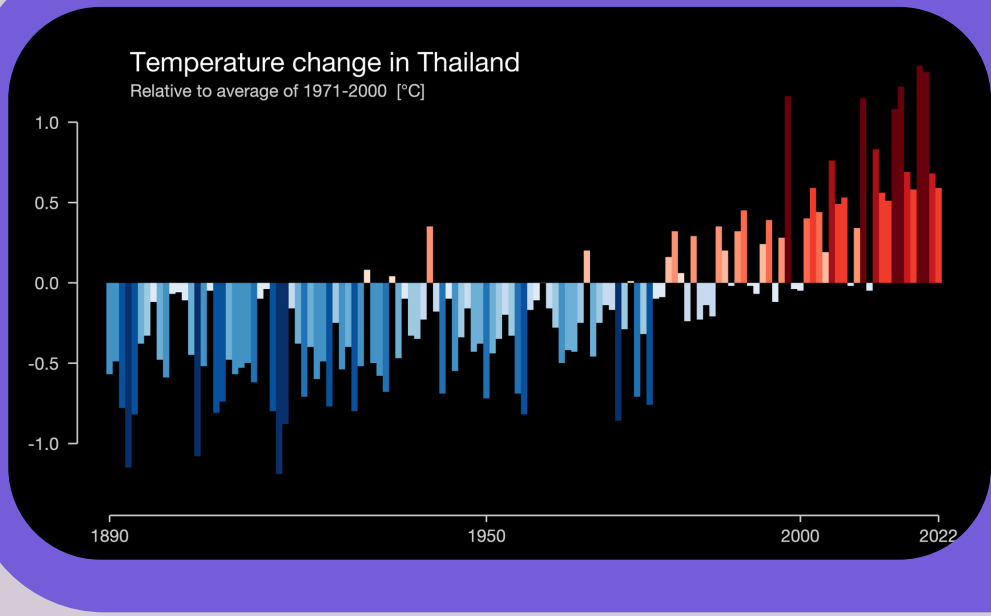



LAOS
Chiang Mai
BURMA
South-west monsoon
THAILAND
North-east monsoon
Ubon Ratchathani
Bangkok
Andaman Sea
Gulf of Thailand
Surat Thani
Phuket
Songkhla
Hat Yai
INDONESIA
MALAYSIA
Temp. degree (°C)
26
28
30
Rainfall (mm)
0
100
200
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Pre-Monsoon
Monsoon
Post-Monsoon

Relevance

Climate change in Thailand is creating favourable conditions for dengue transmissions:

→ increase of 1.0-3.8°C in mean temperature until 2099 is expected
→ Dengue is a high socioeconomic burden



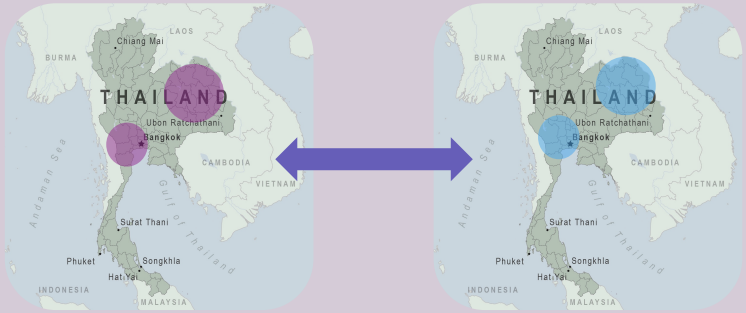
→ Warning systems and predictions are vital to recognize outbreaks early on, to react accordingly and distribute limited resources

Hypothesis

Relative humidity has a positive impact on dengue fever cases in Thailand between the years 2006-2020

1. Can we define geographical and temporal Clusters for Dengue cases and humidity?
2. Can we find relations between the dengue and humidity clusters?
    a) geographically
    b) Yearly
    c) Monthly (Pre-, Post- and Inter-monsoon)
3. What is the relationship between population density and dengue cases?

Dengue cases



humidity

Relation between climate and mosquito

Temperatur Increase

- Decreased Incubation Rate
- Increased Biting Rate

Higher Precipipitation Rate

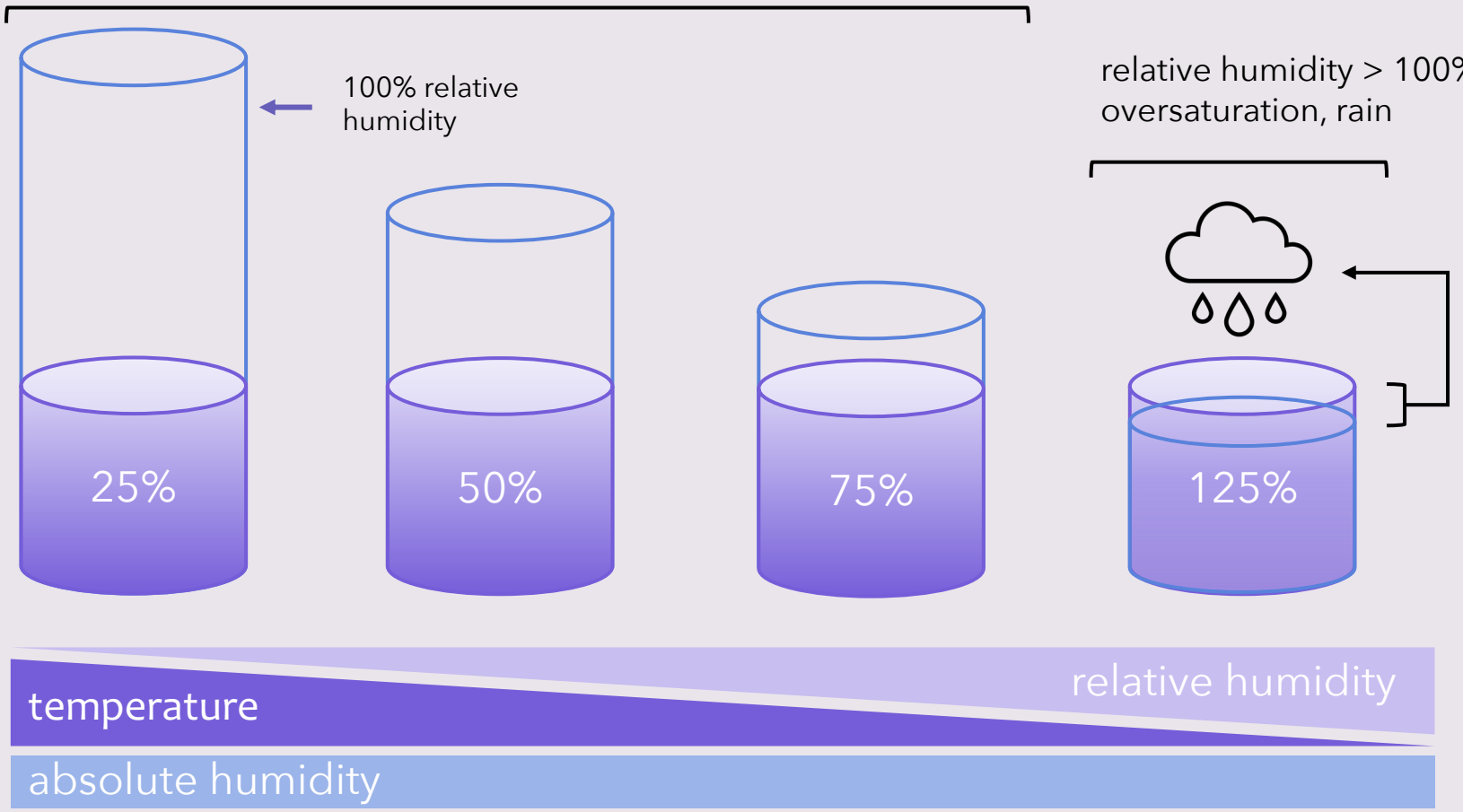
- Destroyed Larvea by heavy Rainfall
- More Breeding Possibilities

Climate Change

- Geographical Shift

Relative Humidity

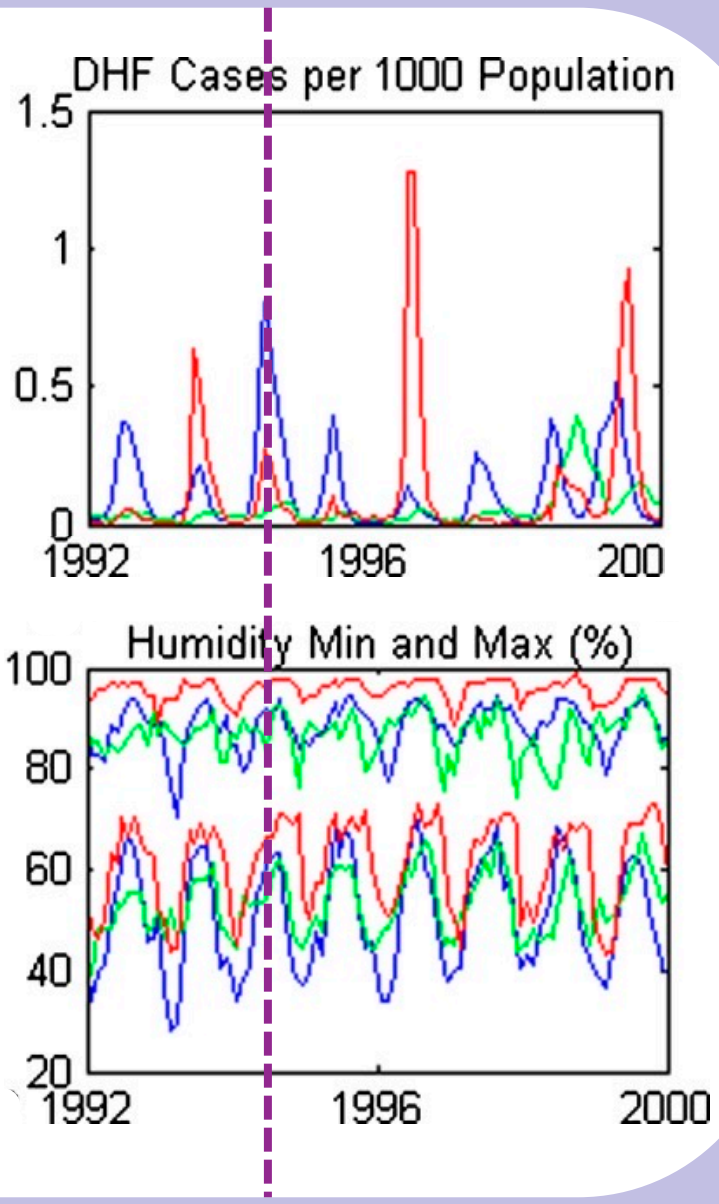
= the amount of water vapor in the air at a given temperature as a percentage of the amount needed for saturation



Inspired by: https://ibidi.com/content/371-humidity-and-evaporation

Relative Humidity

Blue: Udon Thani (northeast)
Green: Bankok (south-central)
Red: Trang (south)

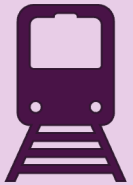


Campbell KM, Lin DC, Iamsirithaworn S, Scott TW. The complex relationship between weather and dengue virus transmission in Tailand. Am J Trop Med Hyg. 2013 Dec;89(6):1066-1080.doi: 10.4269/ajtmh.13-0321.Epub 2013 Aug 19. PMID: 23958906; PMCID: PMC3854883.

Aspect of population

Larger Populations improves breeding environemt for Aedes mosquito

Strongly connected provinces show higher correlation of dengue cases than weaker connected provinces



Challenge: different characteristics of provinces influence which analysis model is best suited

Data

Dengue cases in each province per month from 2006 to 2020,extracted from yearly reports

Reported cases by Province and by Month, Thailand,

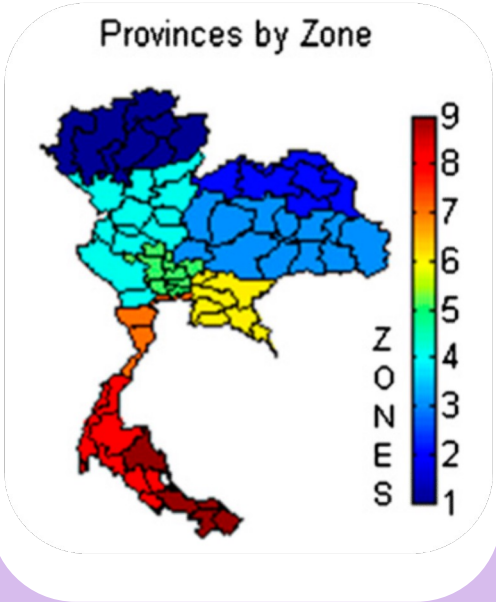
Reporting areas	Total	Jan	Feb	Mar
Total	**89626**	**3323**	**3141**	**3831**
Central Region	**43883**	**1960**	**1933**	**2323**
Bangkok	11009	601	550	605
Zone:1	**6079**	**259**	**293**	**415**
Nonthaburi	2479	89	79	132
P.Nakhon S.Ayutthaya	1476	85	124	161
Pathum Thani	1344	69	59	85
Saraburi	780	16	31	37

Monthly mean values of relative humidity, temperature and rainfall in each province 2006 to 2020 (ERA5)

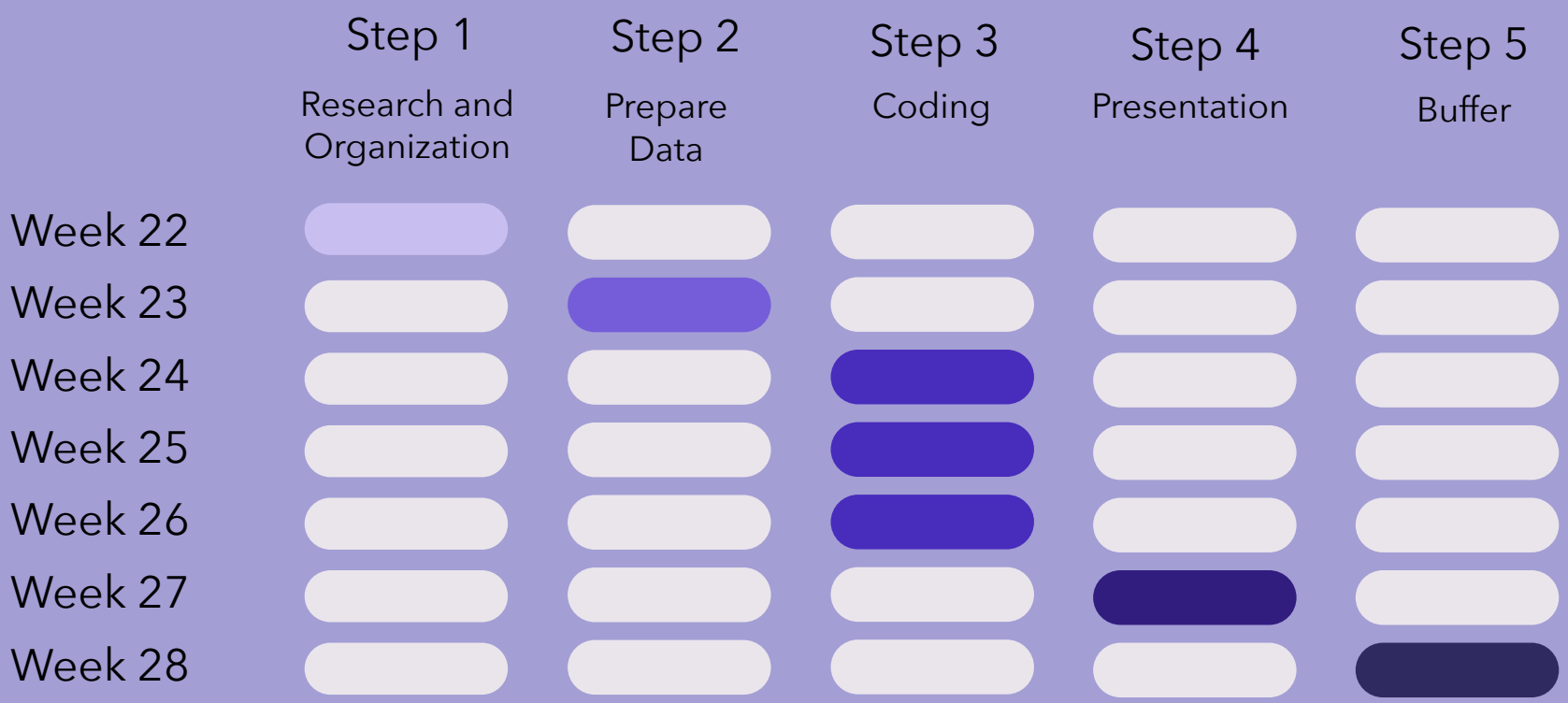
Provinces	Spatial information		Monthly data from 2006-2020		
ADM1_EN	Longitude	Latitude	2006.01.	2006.02.	2006.03.
Bangkok	100.6	13.8	68.46	72.41	70.94
Samut Prakan	100.7	13.6	69.24	72.64	72.45
Nonthaburi	100.4	13.9	65.04	70.59	68.19
Pathum Thani	100.7	14.1	67.24	70.85	69.40
Phra Nakhon Si Ayutthaya	100.5	14.3	62.49	66.32	65.76
Ang Thong	100.3	14.6	57.88	61.62	61.58
Lop Buri	100.9	15.1	58.63	60.96	64.15

Methods

- Descriptive Analysis
  - Time series analysis
  - spatial-temporal-analysis
  - Correlation analysis
  - Clustering
- Regression analysis
  - Poisson modelling
  - ARIMA or GAM



timeline



- get familiar with the Data
- brainstorming project ideas
- Project Proposal

- Prepare Data for further Coding

- Code for Tasks and Subtasks
- running experiments and models
- finalizing and Evaluating results

- writing and designing our final presentation

Sources

Title : Spatiotemporal Dynamics of Dengue Epidemics, Southern Vietnam; Personal Author(s) : Cuong, Hoang Quoc;Vu, Nguyen Thanh;Cazelles, Bernard;Boni, Maciej F.;Thai, Khoa T.D.;Rabaa, Maia A.;Quang, Luong Chan;Simmons, Cameron P.;Huu, Tran Ngoc;Anders, Katherine L.; Published Date : Jun 2013; Source : Emerg Infect Dis. 19(6):945-953.URL : https://stacks.cdc.gov/view/cdc/18983

Do, T.T.T., Martens, P., Luu, N.H. *et al.* Climatic-driven seasonality of emerging dengue fever in Hanoi, Vietnam. *BMC Public Health* **14**, 1078 (2014). https://doi.org/10.1186/1471-2458-14-1078

Pumijumnong, N., Eckstein, D. Reconstruction of pre-monsoon weather conditions in northwestern Thailand from the tree-ring widths of *Pinus merkusii* and *Pinus kesiya* . *Trees***25**, 125–132 (2011). https://doi.org/10.1007/s00468-010-0528-4

https://science.howstuffworks.com/nature/climate-weather/atmospheric/question651.htm

https://www.vaisala.com/en/expert-article/relative-humidity-how-is-it-defined-and-calculated

Campbell KM, Lin CD, Iamsirithaworn S, Scott TW. The complex relationship between weather and dengue virus transmission in Thailand. Am J Trop Med Hyg. 2013 Dec;89(6):1066-1080. doi: 10.4269/ajtmh.13-0321. Epub 2013 Aug 19. PMID: 23958906; PMCID: PMC3854883.

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Climatic Factors Affecting Dengue Haemorrhagic Fever Incidence in Southern Thailand S. Promprou, M. Jaroensutasinee! and K. Jaroensutasinee Institute of Science, Walailak University, 222 Thaiburi, Thasala District, Nakhonsrithammarat 80160, Thailand

https://www.thaizer.com/the-effects-of-the-monsoon-on-thailands-weather/

https://education.nationalgeographic.org/resource/monsoon/

https://scijinks.gov/what-is-a-monsoon/#:~:text=A%20monsoon%20is%20caused%20by,blow%20from%20cold%20to%20warm

https://www.thaizer.com/the-effects-of-the-monsoon-on-thailands-weather/

Schaefer TJ, Panda PK, Wolford RW. Dengue Fever. [Updated 2022 Nov 14]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK430732/

Dengue Fever | NIH: National Institute of Allergy and Infectious Diseases

https://www.leicestermercury.co.uk/news/uk-world-news/symptoms-dengue-fever-watch-amid-8351403