NUS National University of Singapore | Saw Swee Hock School of Public Health

CERM Centre for Epidemic Research & Modelling

Dengue in the urban environment

What role can modelling and analytics play in our public health response?

Alex R Cook Associate Professor Vice Dean (Research)

Dengue epidemiology 101

Aedes aegpyti

Friendly, loves people
(ie Anthropophilic)

Adapted to urban environment
Lives around our homes

Highly competent dengue vector

Aedes albopictus

Loves green areas, gets along with all animals

Generally less frequent around homes

Less competent dengue vector

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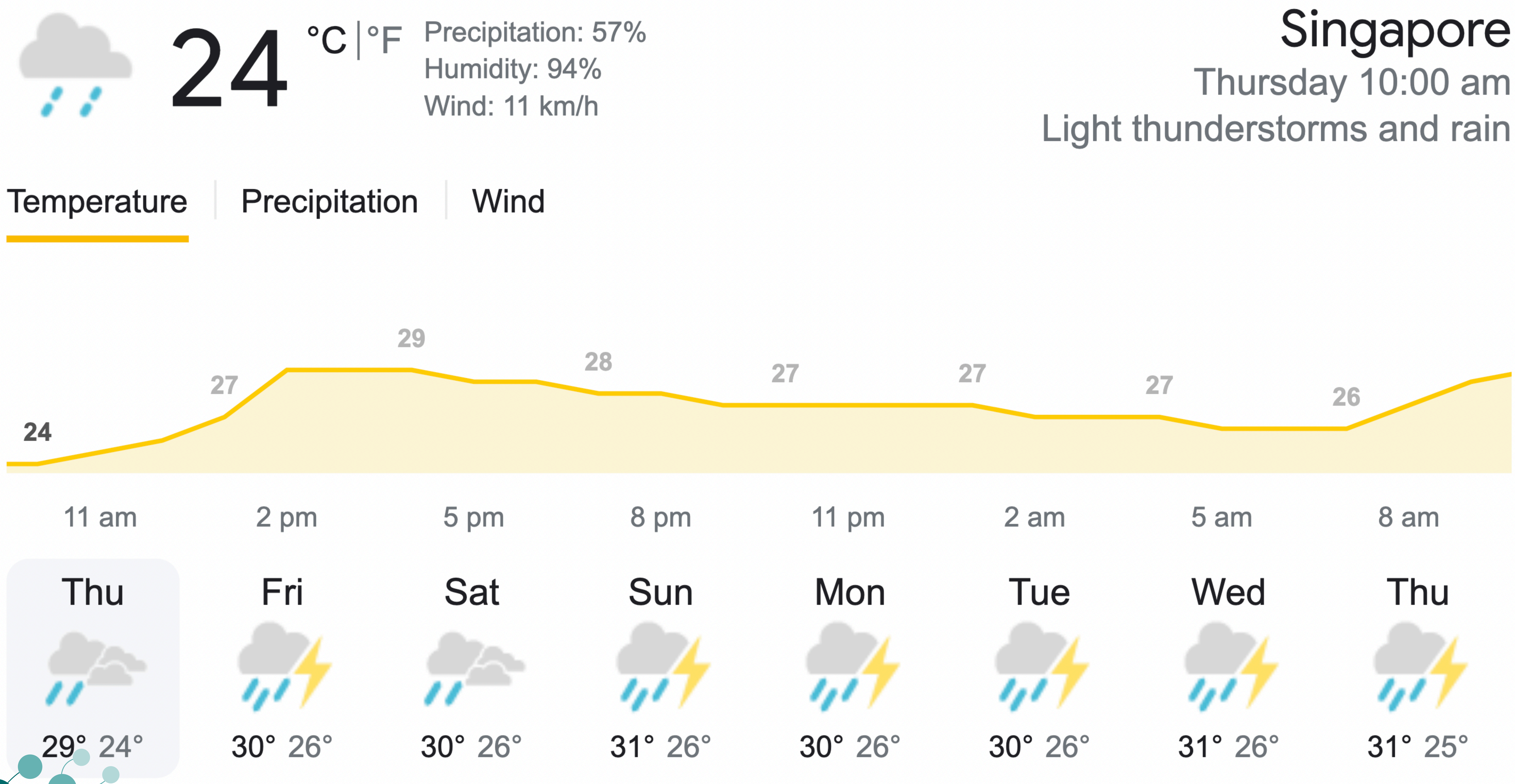
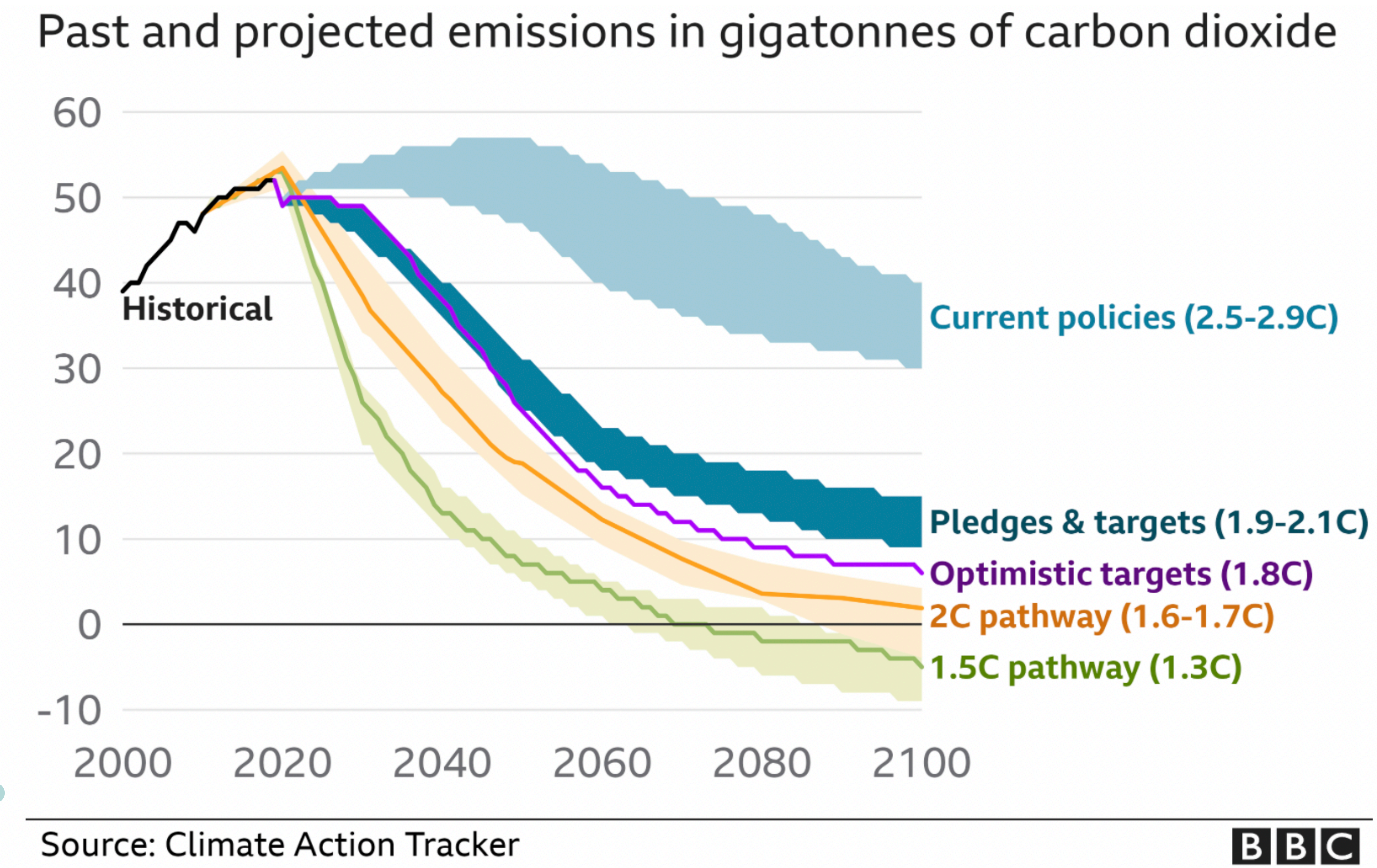
How can modelling and analytics contribute?

Problem 1: forecasting



Problem 2: what-if scenarios



Both are important

- Long-term forecasting allows policy decisions to be 'data' driven
- Nowcasts and short-term projections allow resources to be allocated more

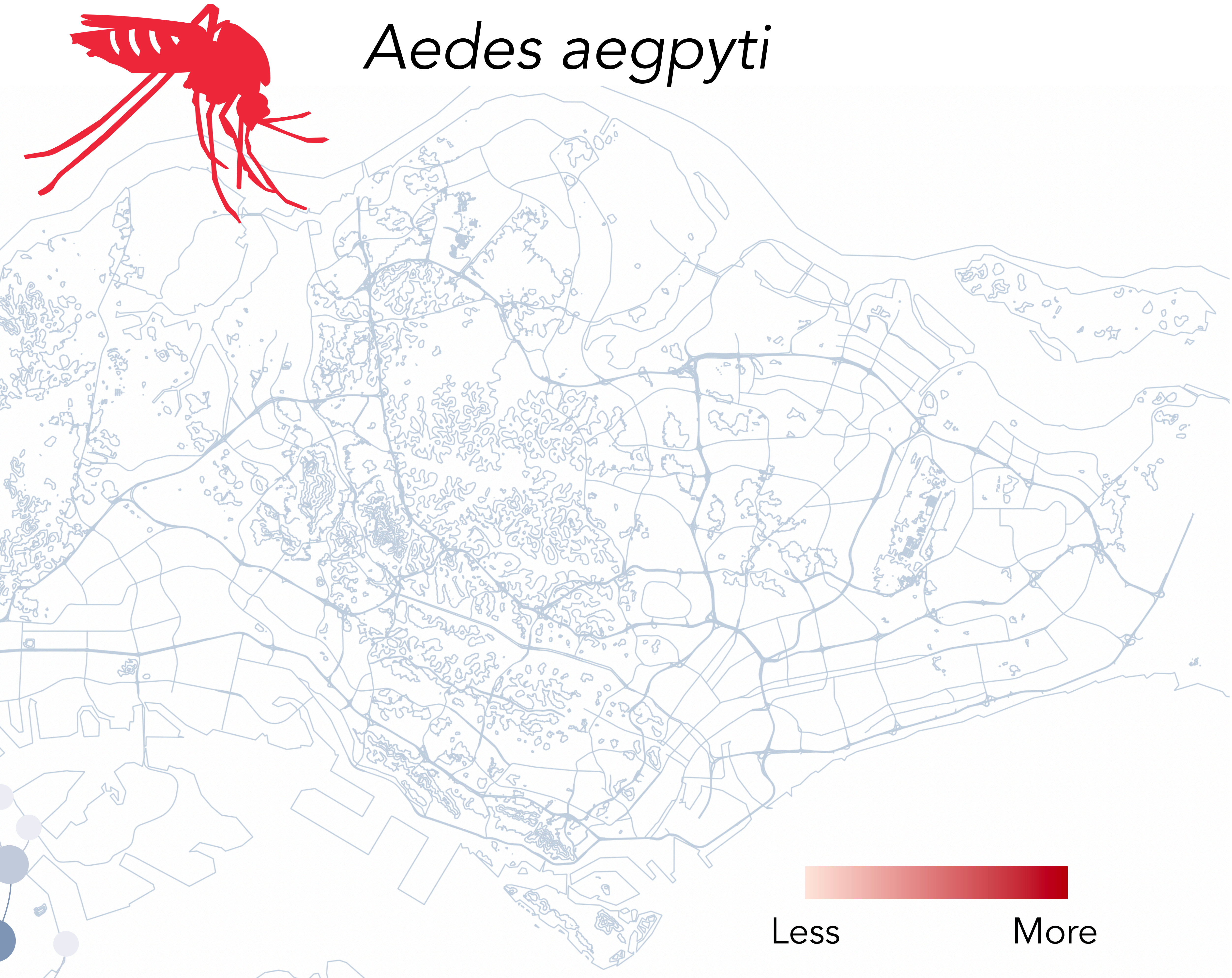
Spatial determinants of mosquito breeding

Gravitraps

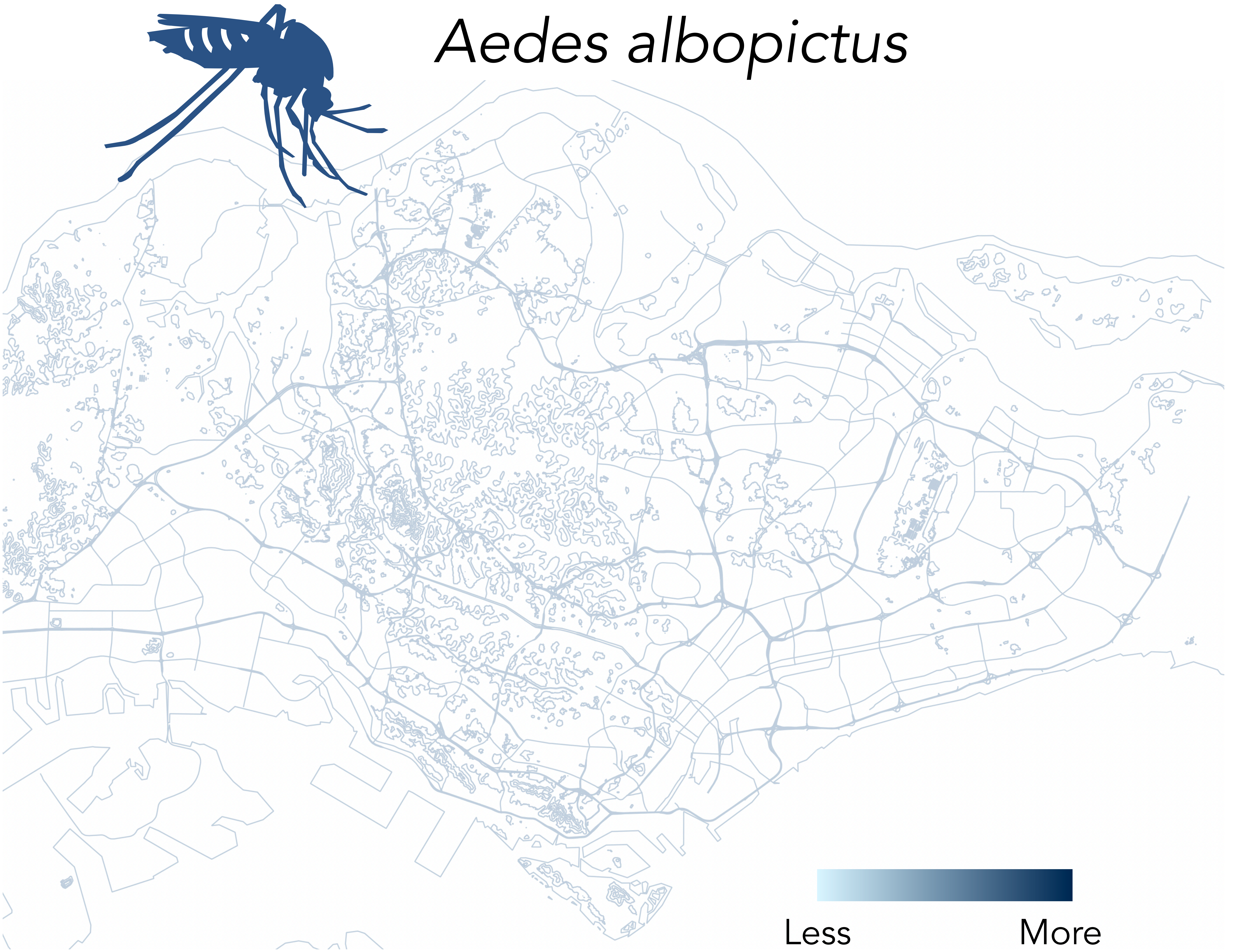
- Mosquitoes **attracted by scent** and **availability of water** to oviposit
- They then stick to the sides, reducing the adult population
- Eggs that hatch cannot emerge because of the mesh
- Placed at all HDB blocks
- Used for **surveillance** and to **reduce vector population**

Breeding across residential Singapore

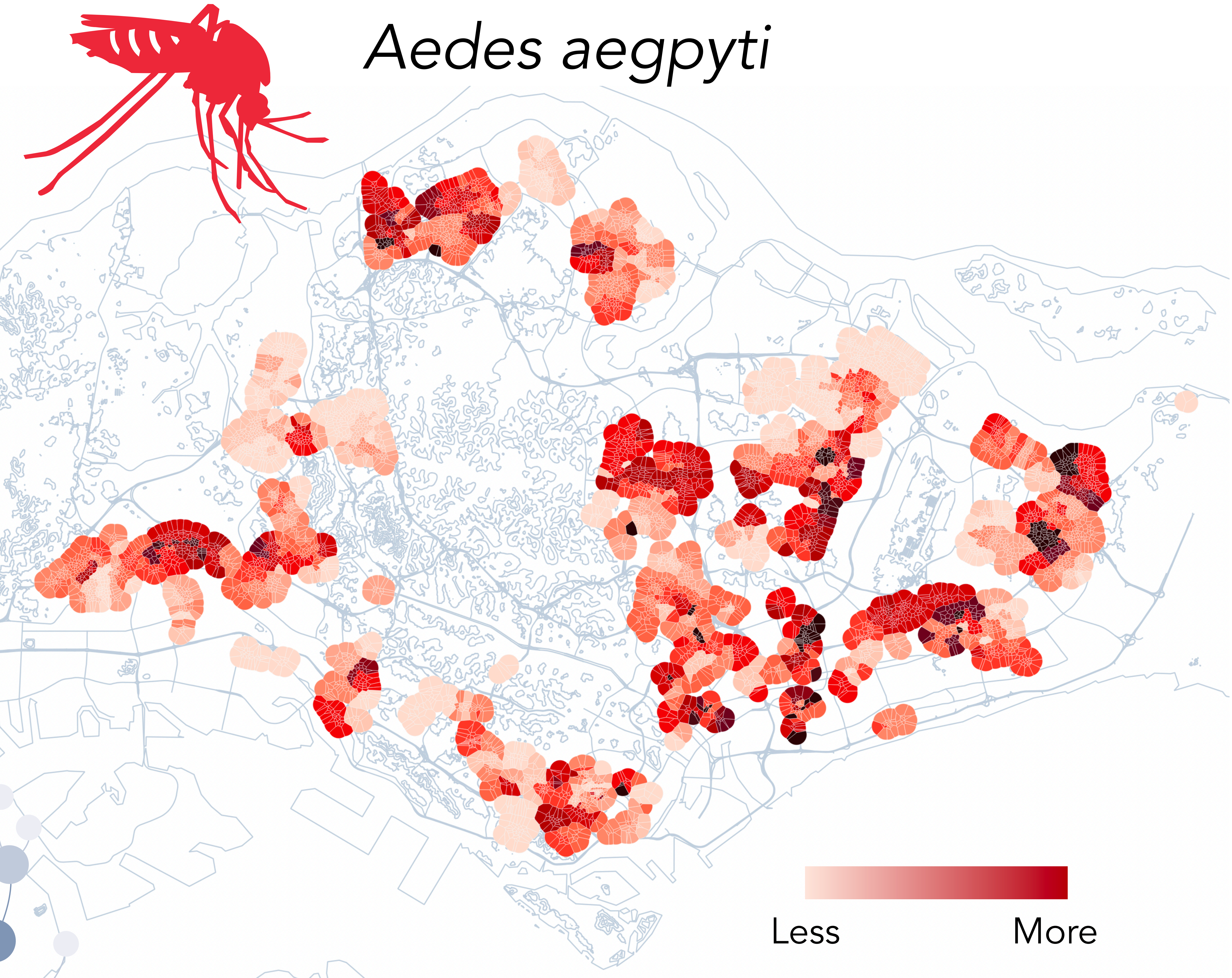
Aedes aegpyti

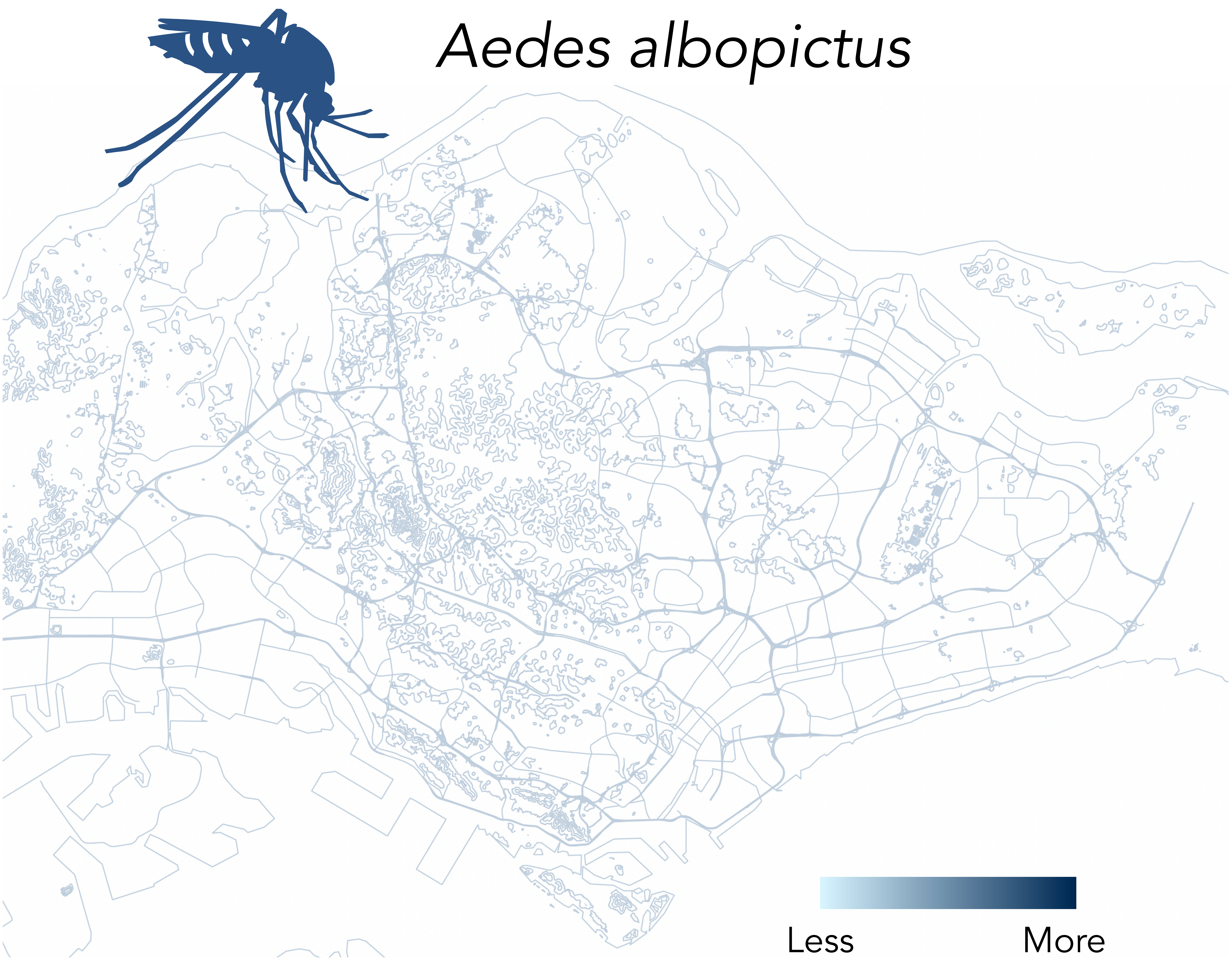


Aedes albopictus



Breeding across residential Singapore





Breeding across residential Singapore

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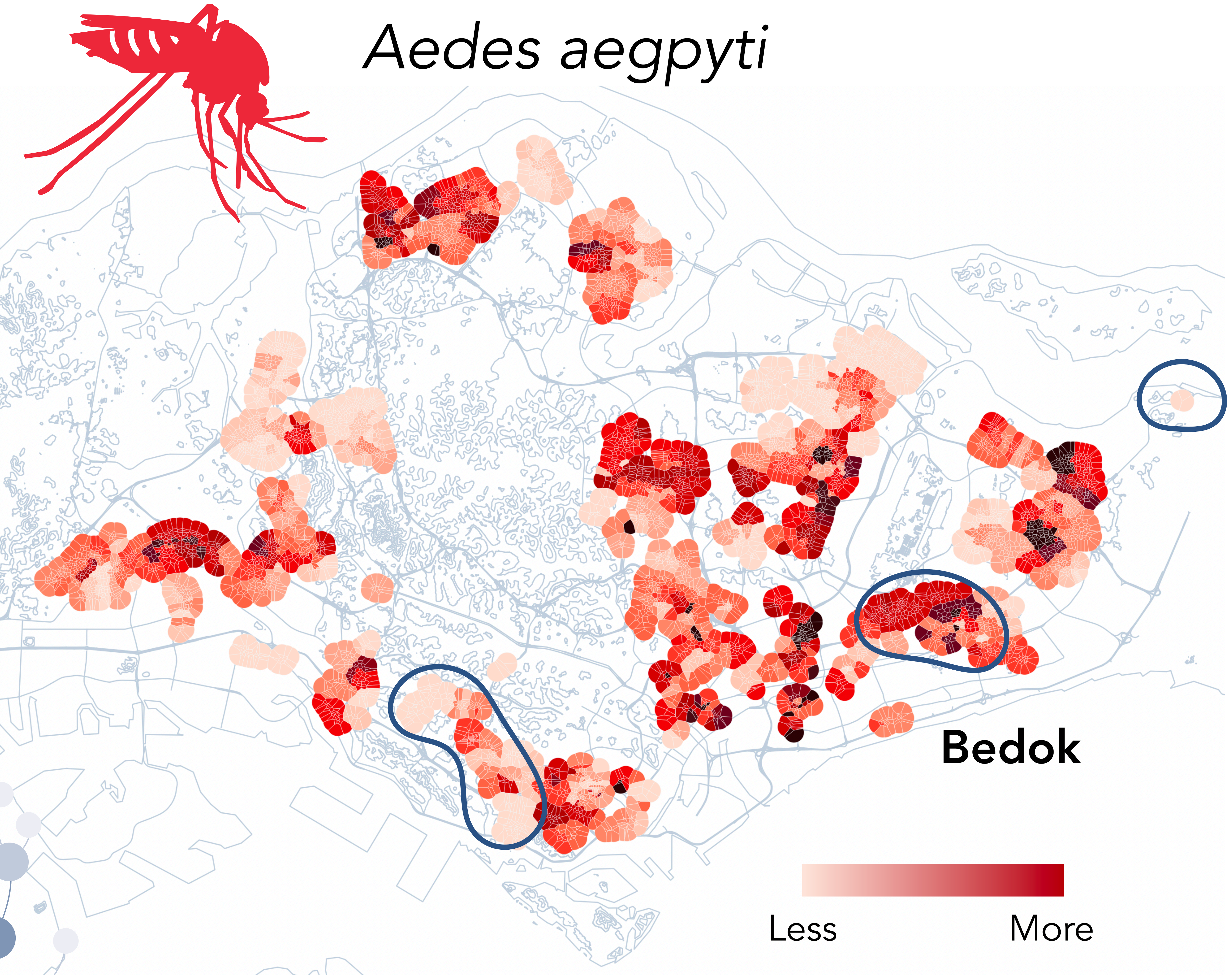
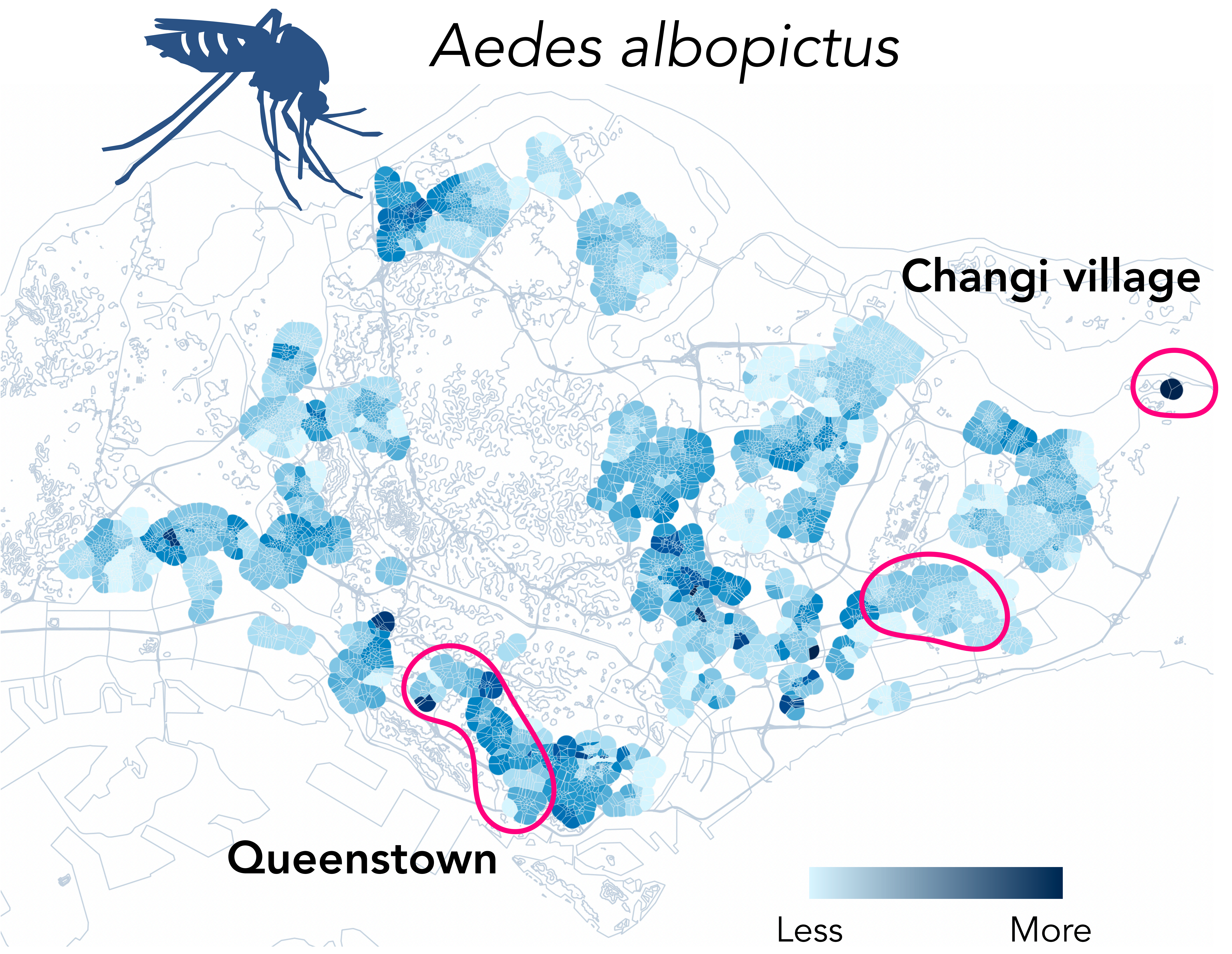
Aedes aegpyti



Aedes albopictus



Weather vs urban environment

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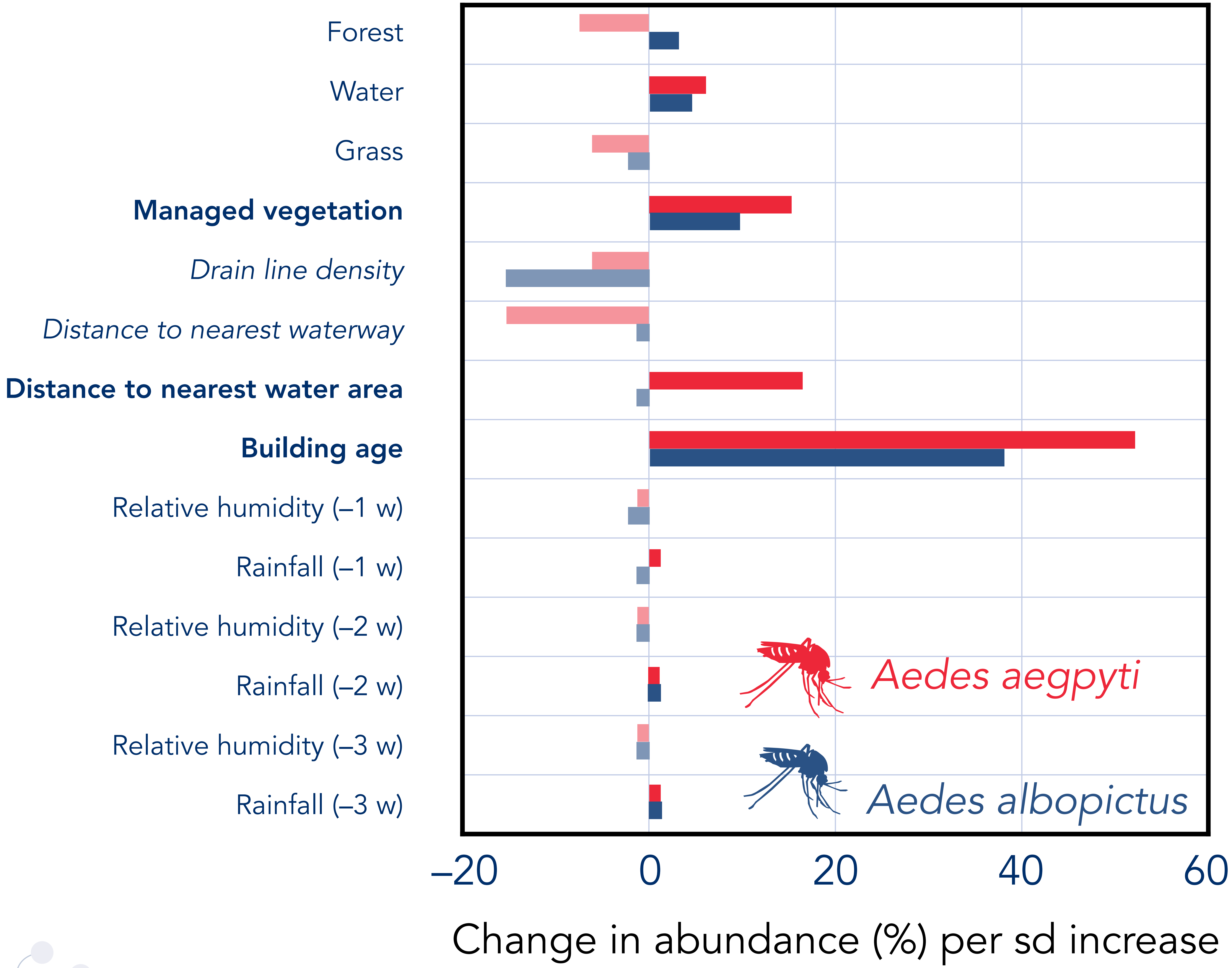
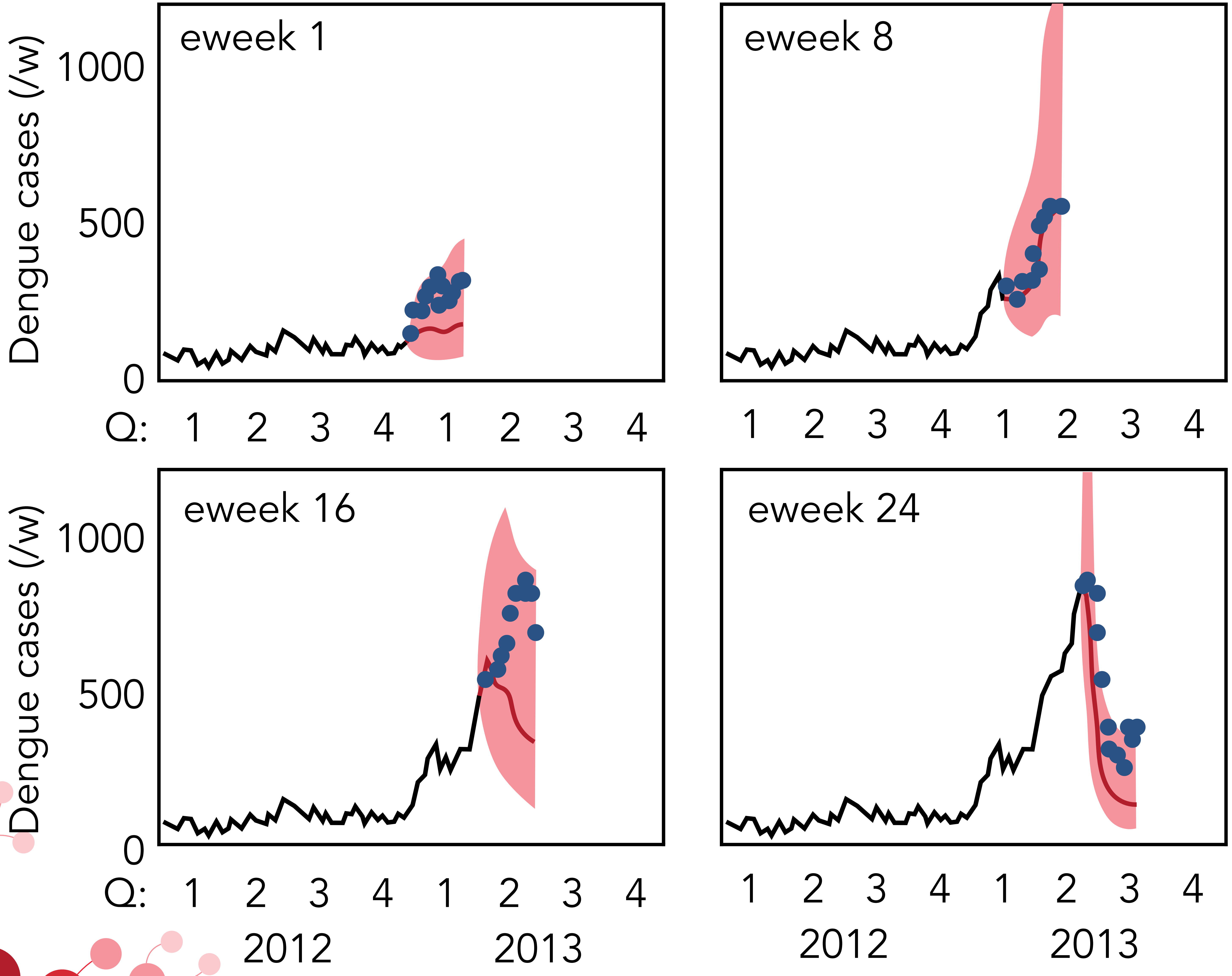


Primary effect is variability in the urban environment: building age and the presence of managed vegetation, of water ways and areas (*Ae aegypti*) and drains (*Ae albopictus*)

Much smaller effect due to recent rainfall or humidity

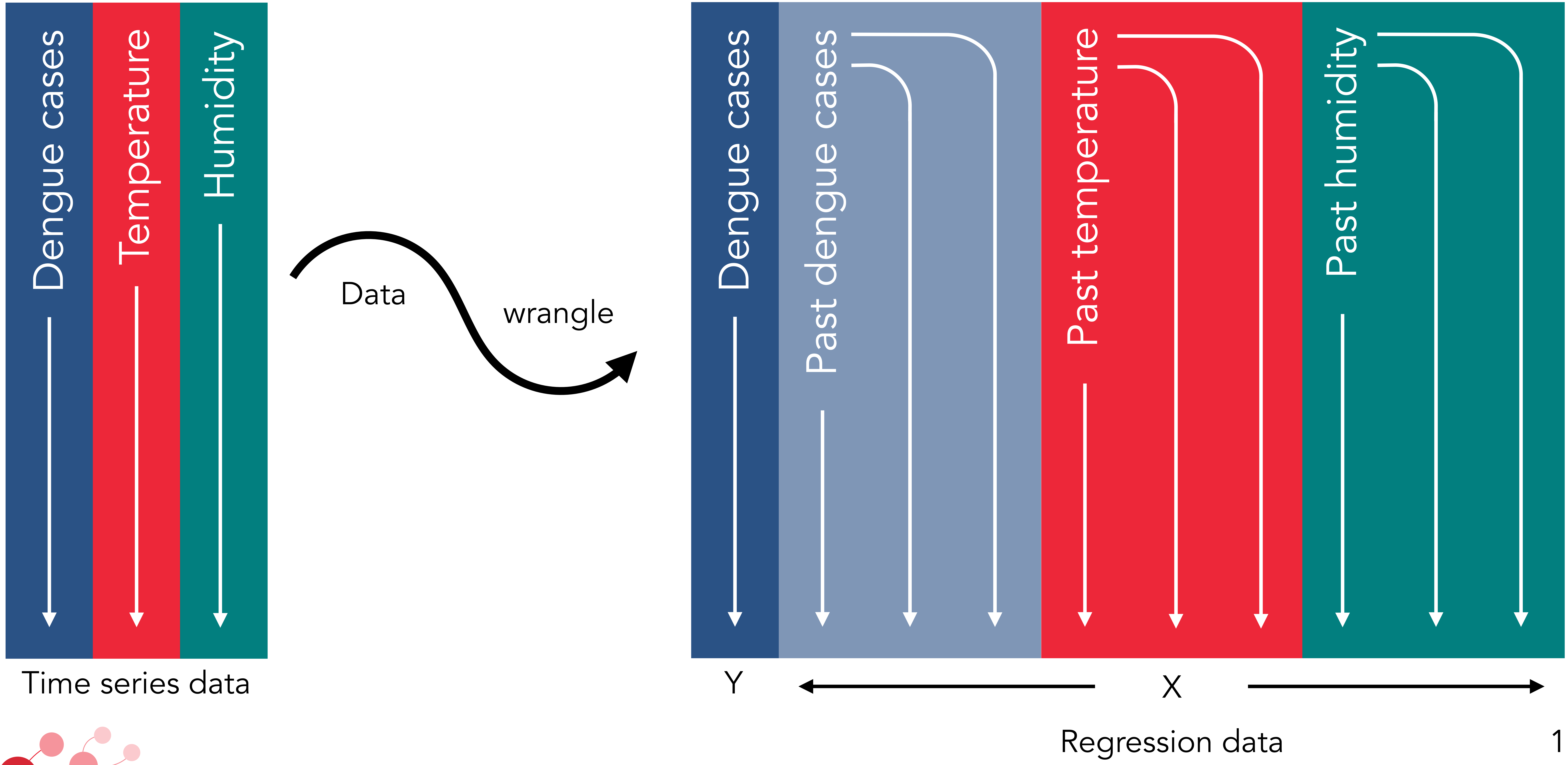
Creating dynamic risk maps

Dengue forecasting

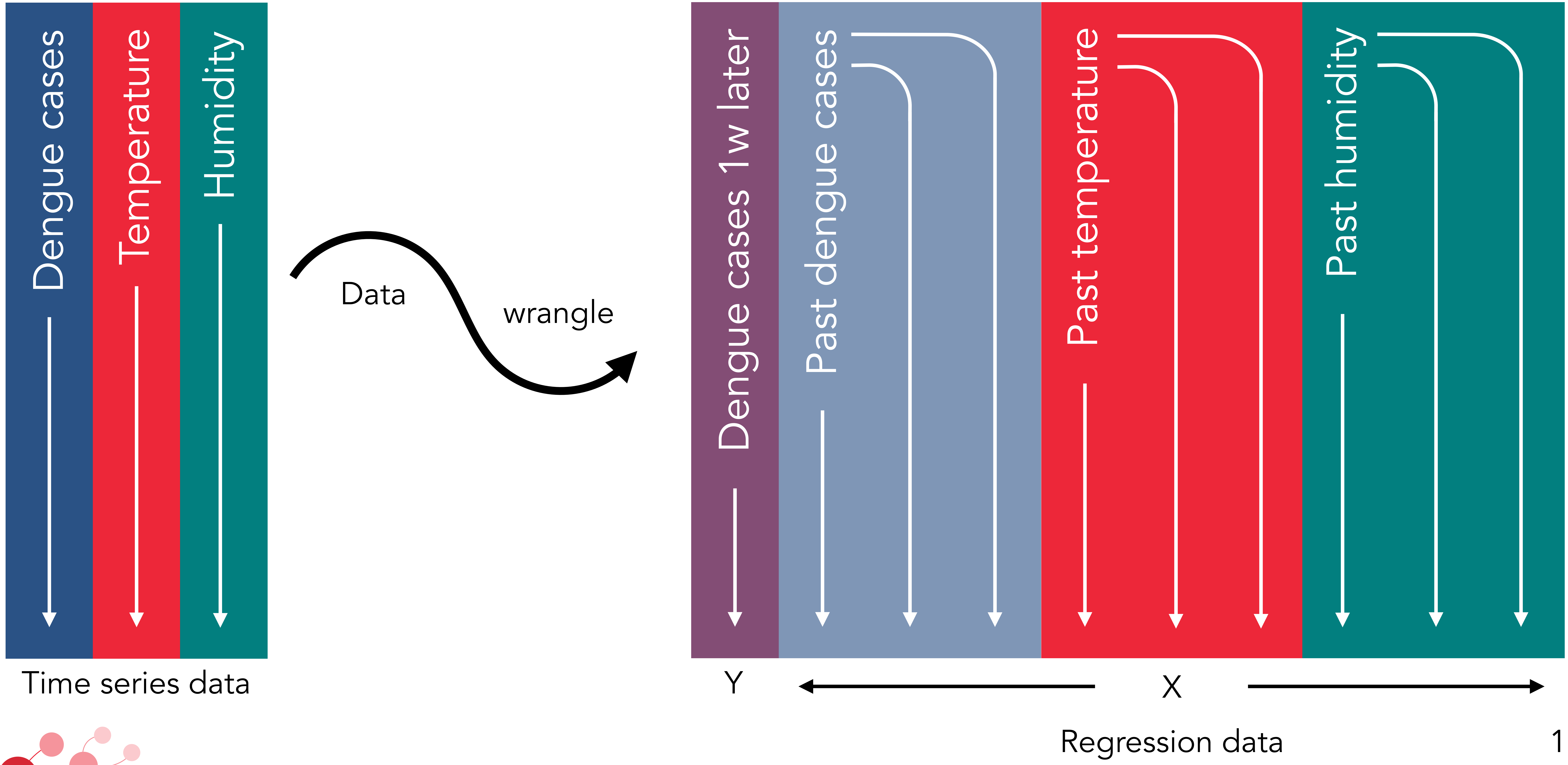


- For about a decade, NEA and NUS have had a dengue forecast algorithm to forewarn of looming epidemics
- **Successfully predicted the then record breaking 2013 outbreak**

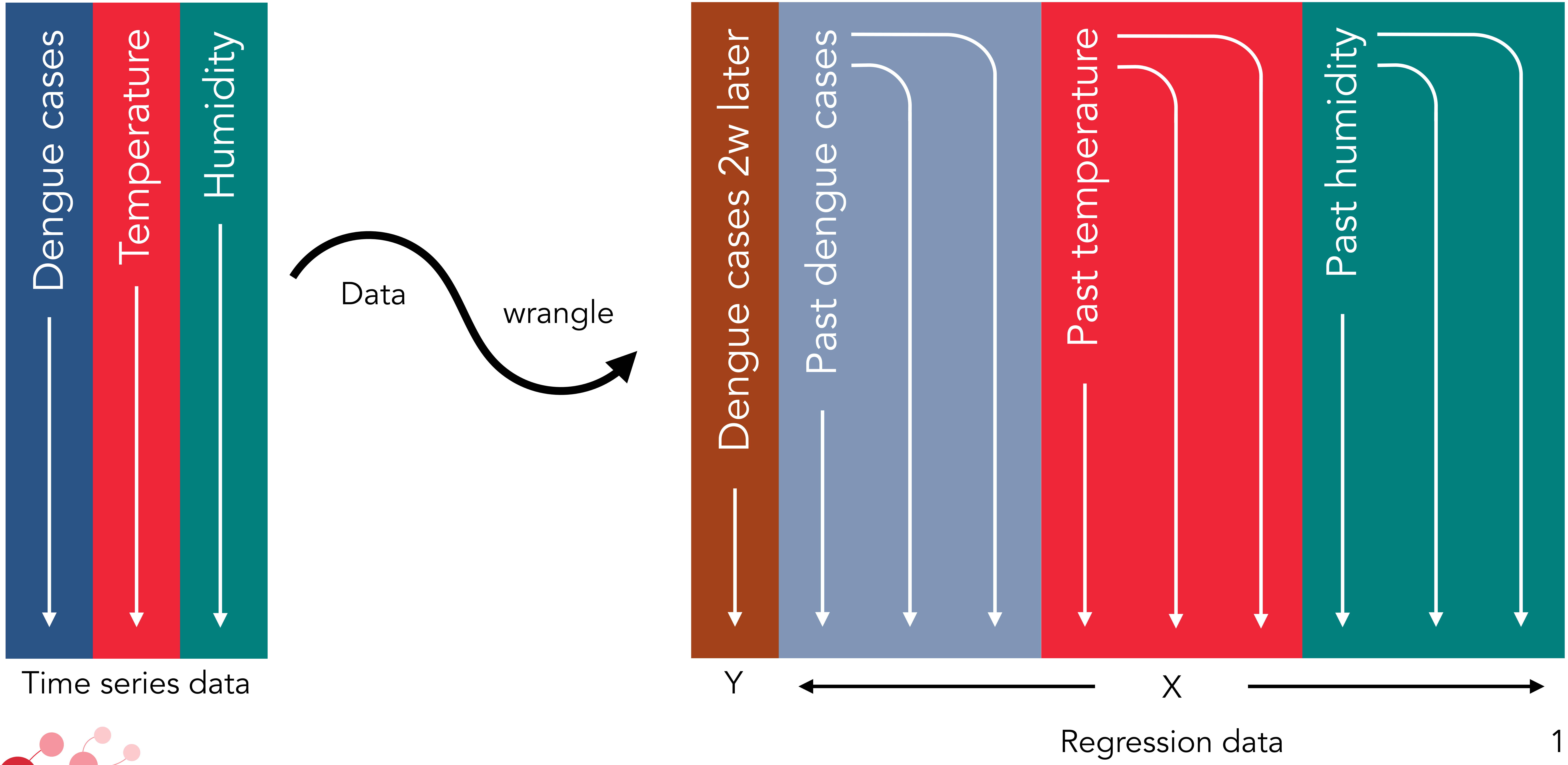
General approach



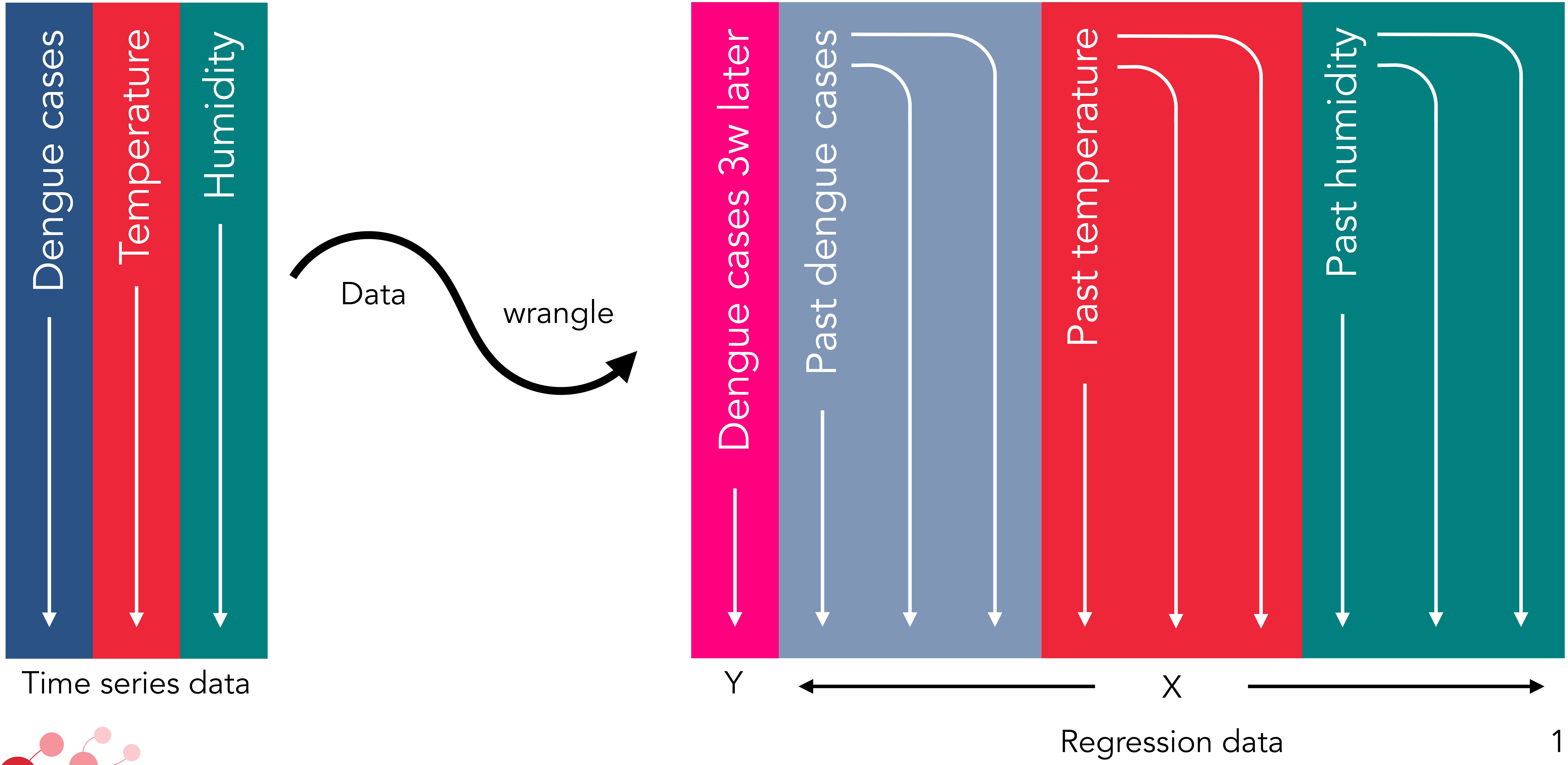
General approach



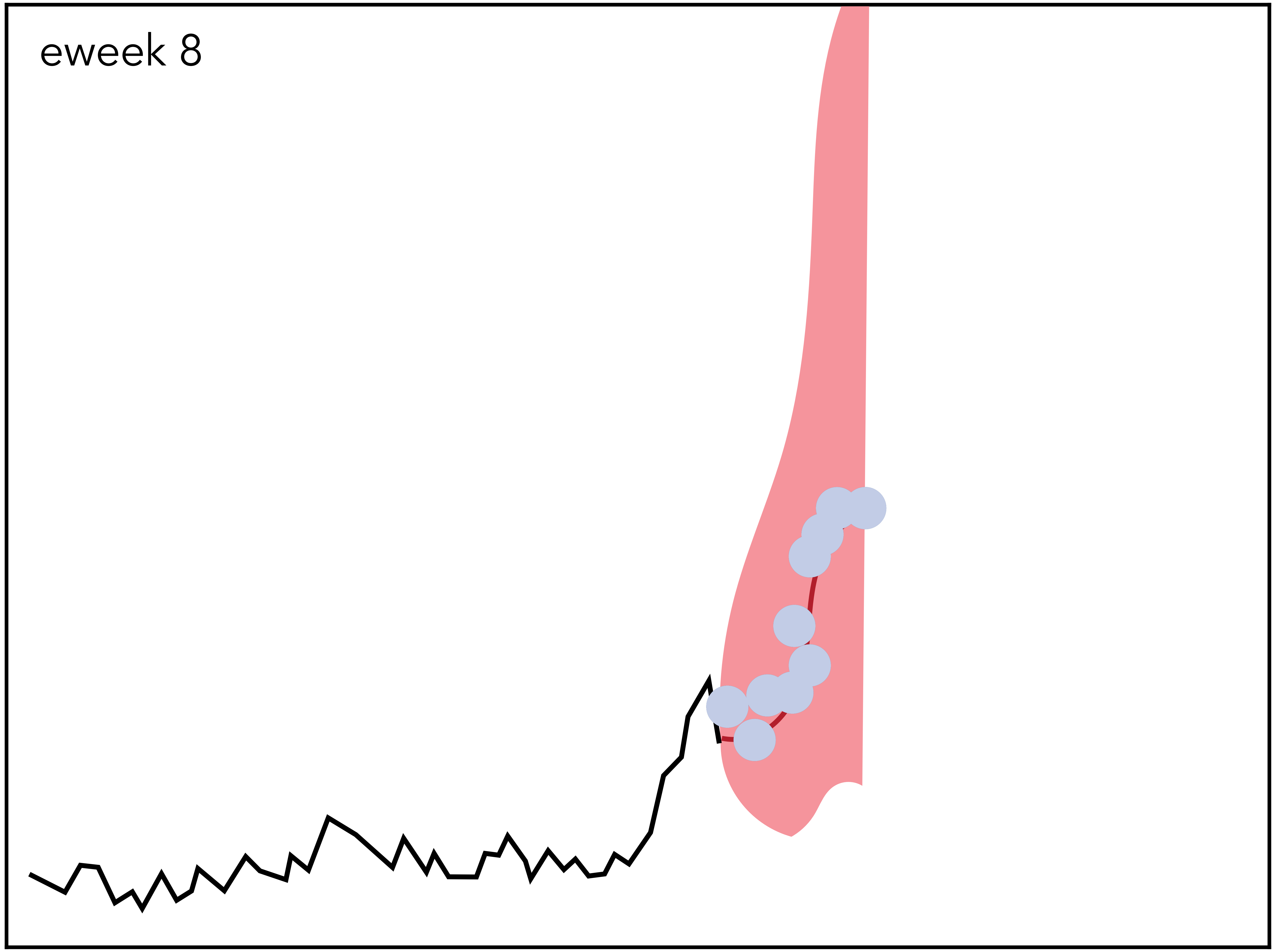
General approach



General approach



Forecasting as sleight of hand



Forecasting as sleight of hand

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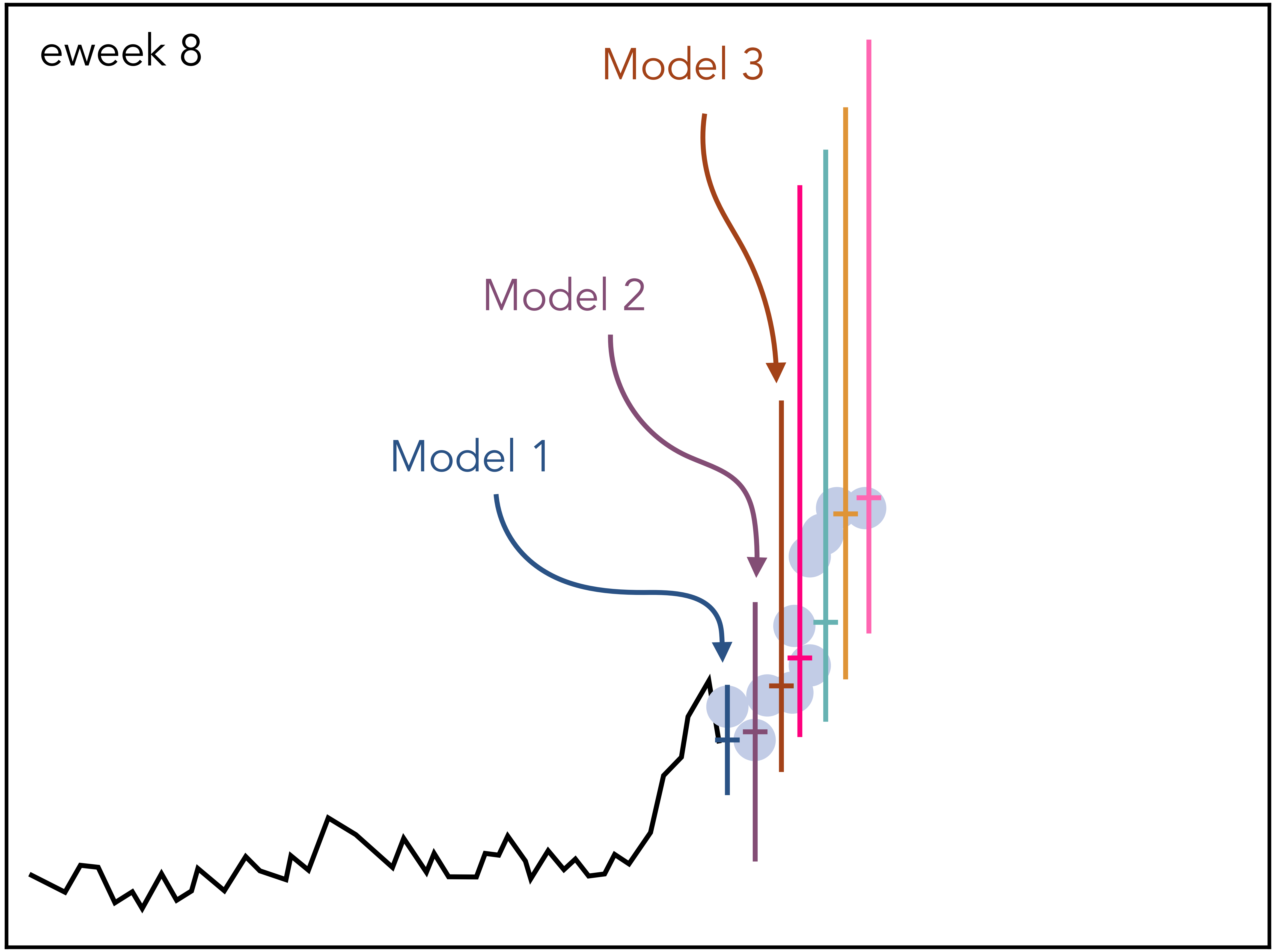
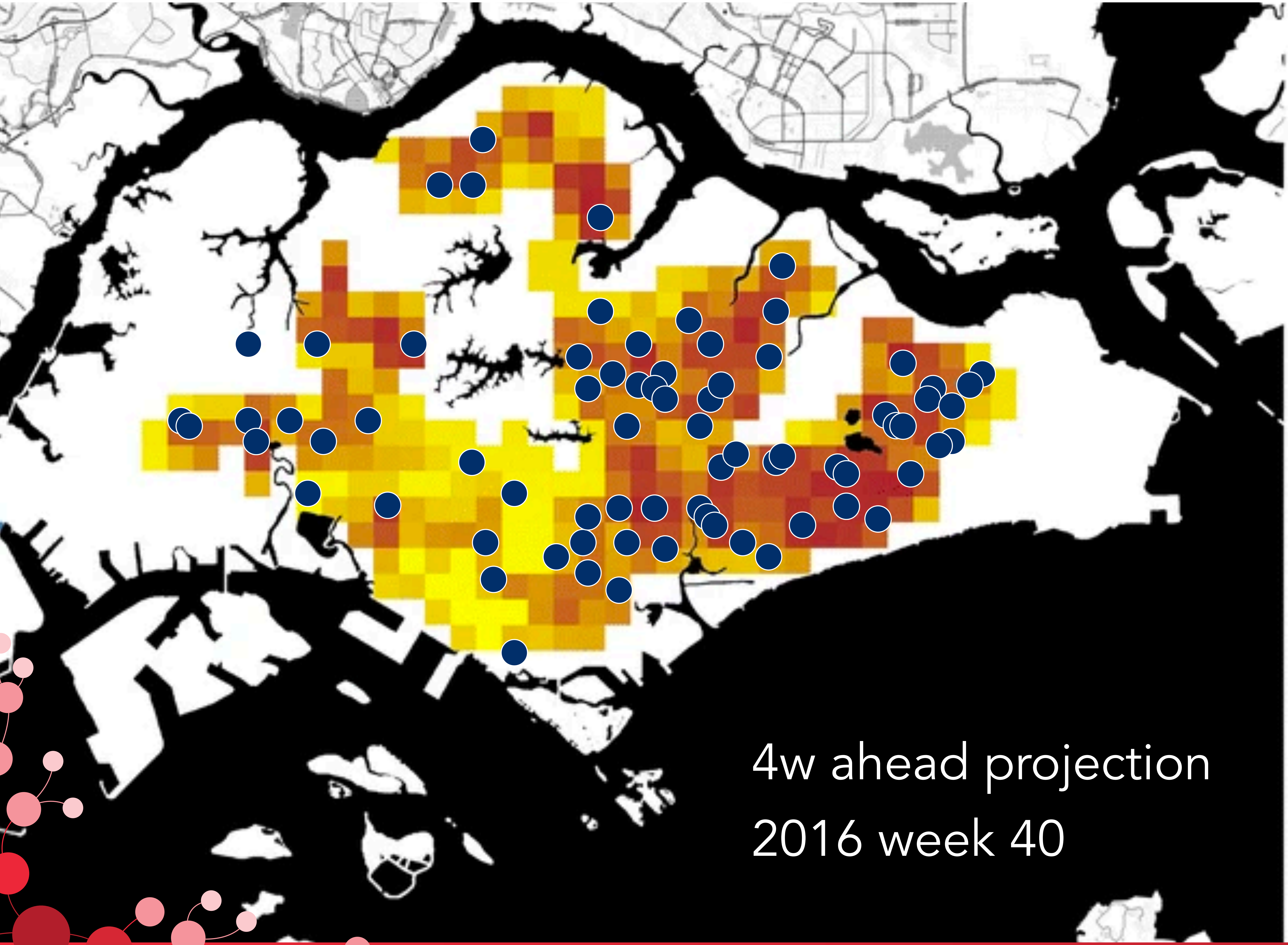


Spatiotemporal projections



Extended the idea to create **dynamic forecast maps**, projecting how many cases in the weeks ahead in each neighbourhood

Despatialising spatiotemporal data

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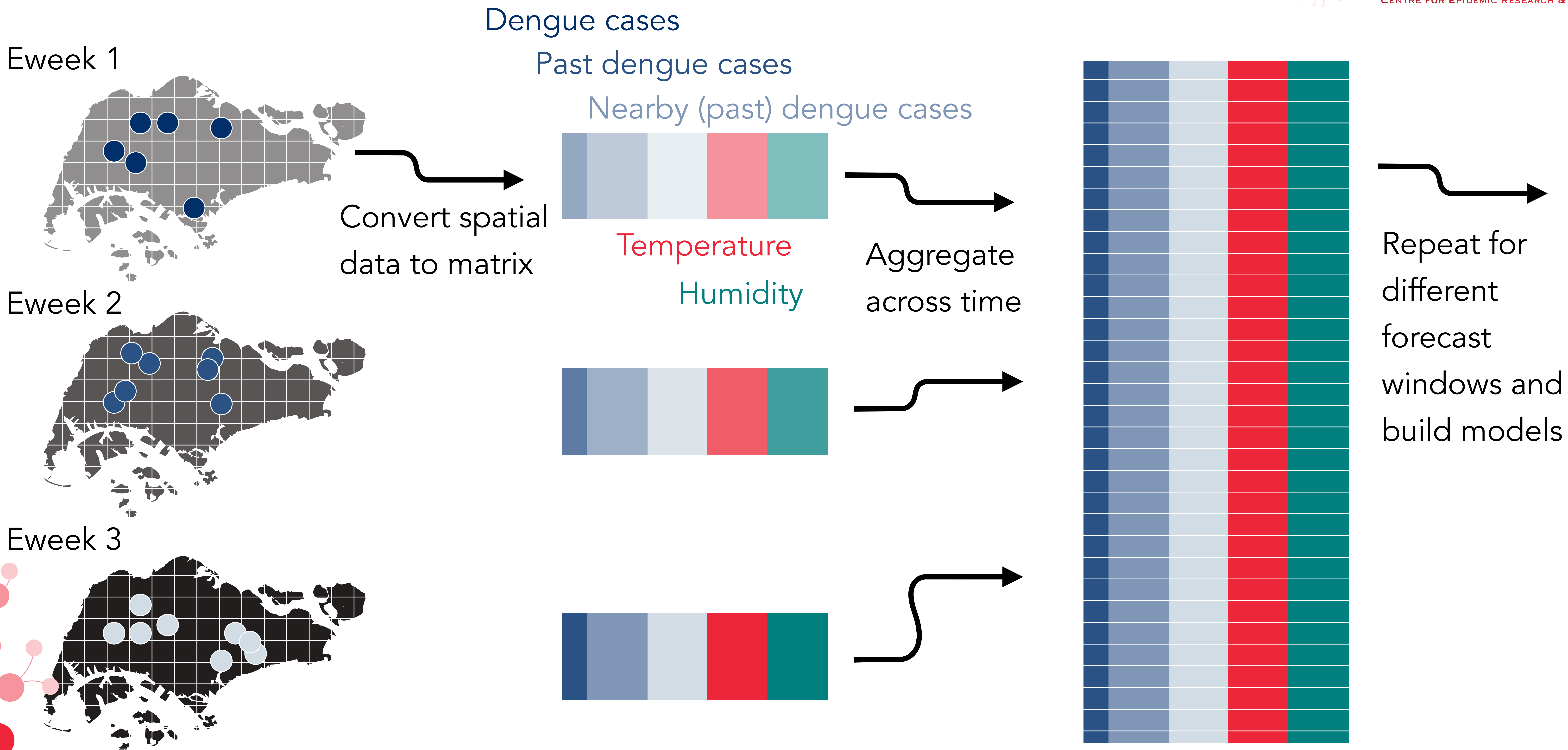

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The future of dengue analytics

Future adaptations

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- **Approach is agnostic to data types:** spatiotemporal model uses spatiotemporal, spatial and temporal data:
  - Incidence, mosquito breeding, weather, age of estates
  - Seroprevalence? Serotypes? Population flux?
- **If the model is right it's wrong:** identifying priority areas hopefully means the targeted areas have less dengue

Ongoing work	Use modelling to evaluate the impact of novel forms of control (eg Wolbachia) and inform optimal deployment

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