ECOMORE II

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

IRD Institut de Recherche pour le Développement FRANCE

ESTIMATING LEPTOSPIROSIS BURDEN IN SOUTHEAST ASIA AND ITS FUTURE EVOLUTION BASED ON CLIMATE AND ENVIRONMENTAL DETERMINANTS

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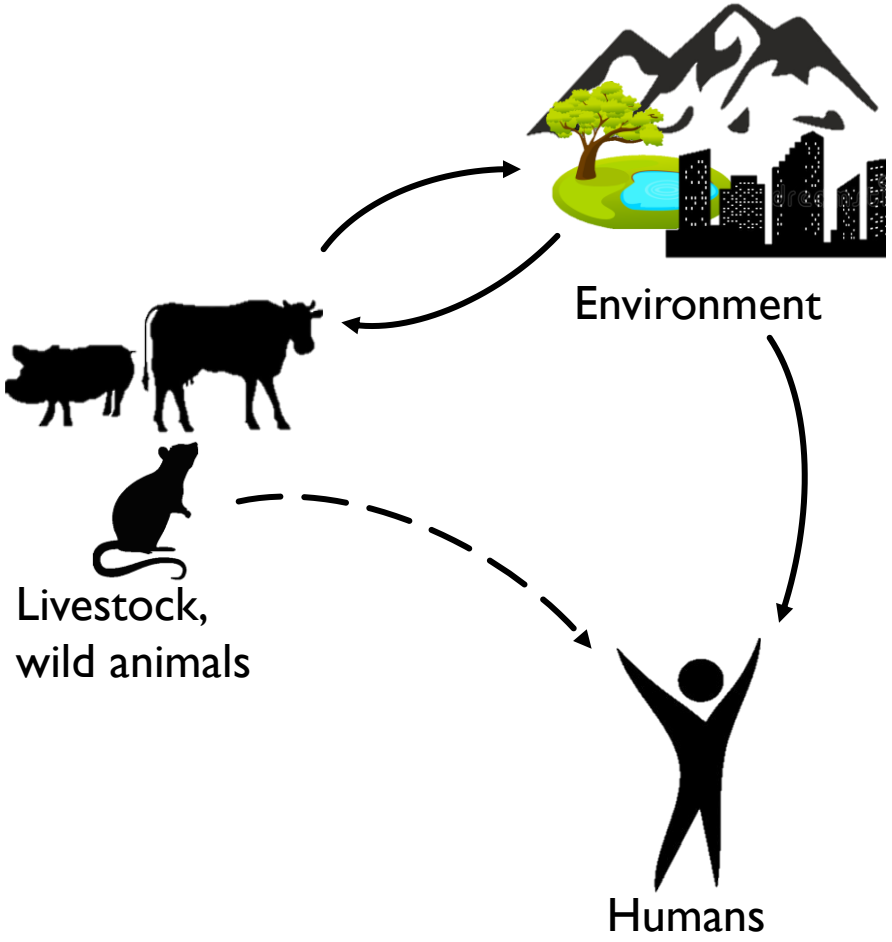
GeoOneHealth 2022 symposium, the 5th of December

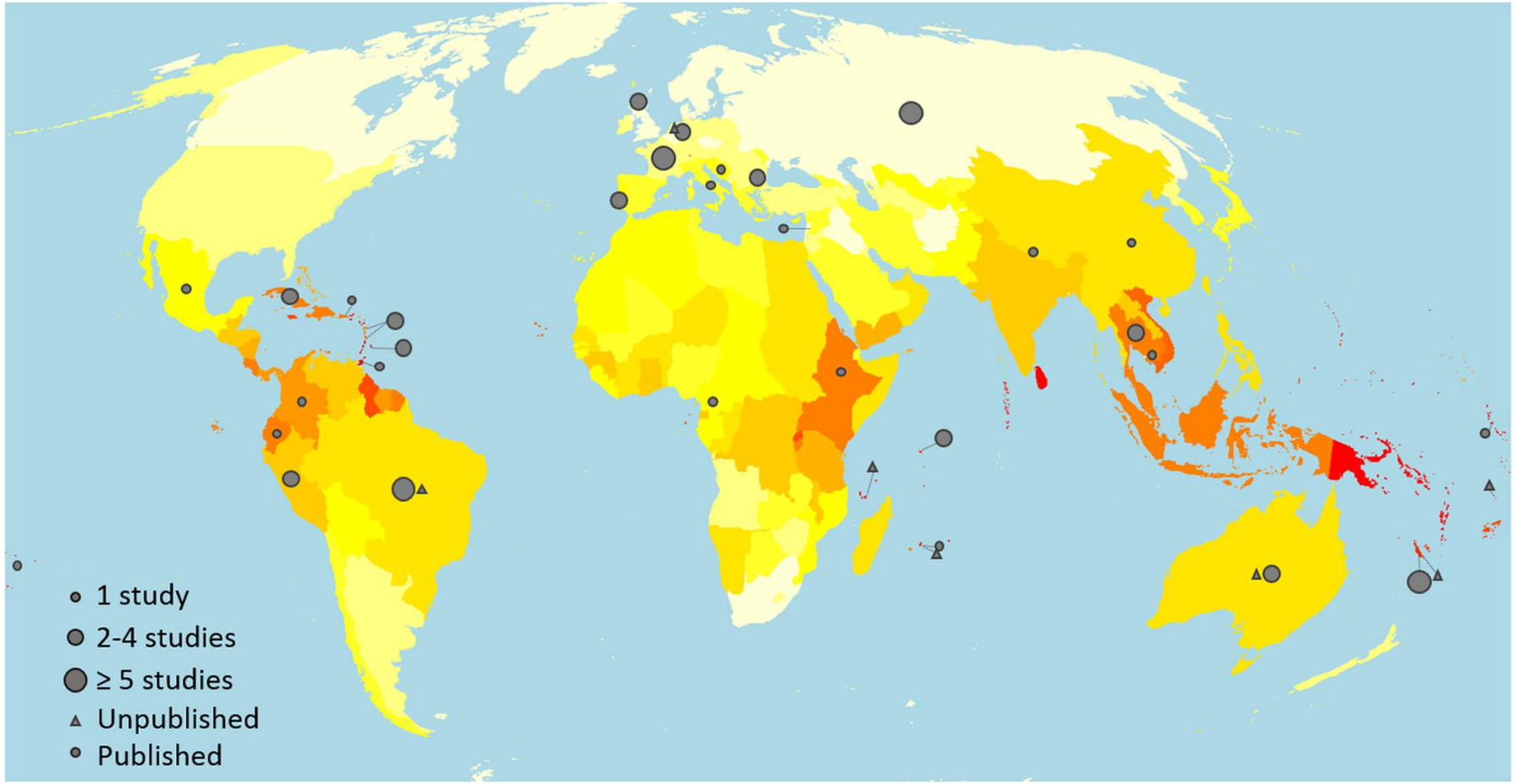
CONTEXT : Leptospirosis, a zoonotic disease



Caused by **pathogenic leptospires** (bacteria)

- Grow in the in the kidney tubules of animals that act as **reservoir**
- **Shed into the environment** through urine
- **Survive in water and soil** for weeks to months
- **Human infection mostly occurs through contaminated environment**

CONTEXT : Leptospirosis in Southeast Asia

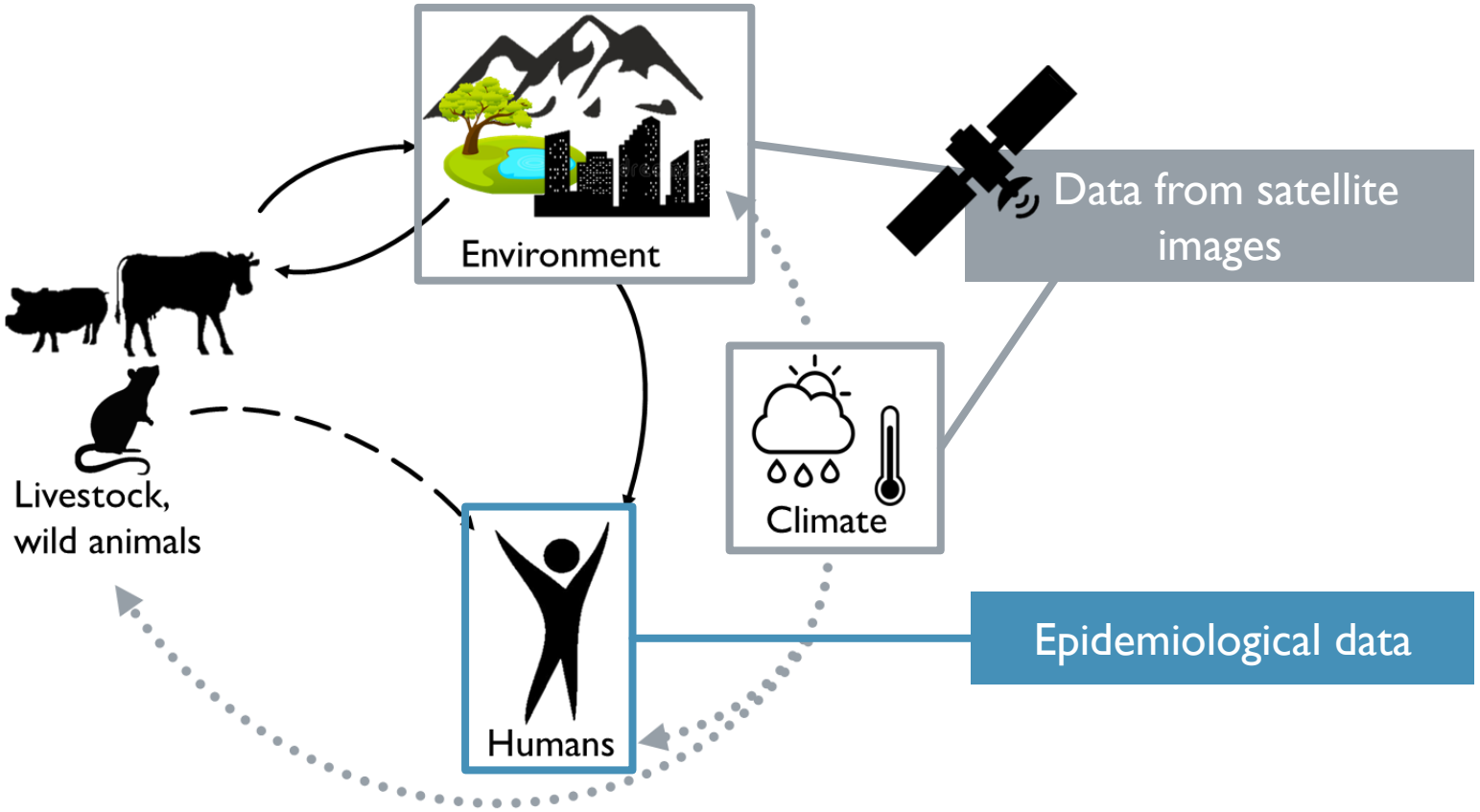


Estimated annual morbidity of leptospirosis by country or territory. Annual disease incidence is represented as an exponential colour gradient from white (0–3), yellow (7–10), orange (20–25) to red (over 100), in cases per 100,000 population. (source: Costa et al., 2015)

In Southeast Asia :

- Endemic with estimated high incidence
- Mainly occupational
- Remains under-reported and poorly documented
- Favorable environment and climate for leptospirosis outbreaks

CONTEXT:
Using remote sensing to inform on the environmental risk of leptospirosis



Climate and environment impact :

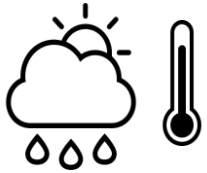
- the survival of the leptospires
- the behaviors of reservoirs animals and human populations
- the exposure of human populations

Data from satellites images are promising tools to study leptospirosis burden

OBJECTIVES

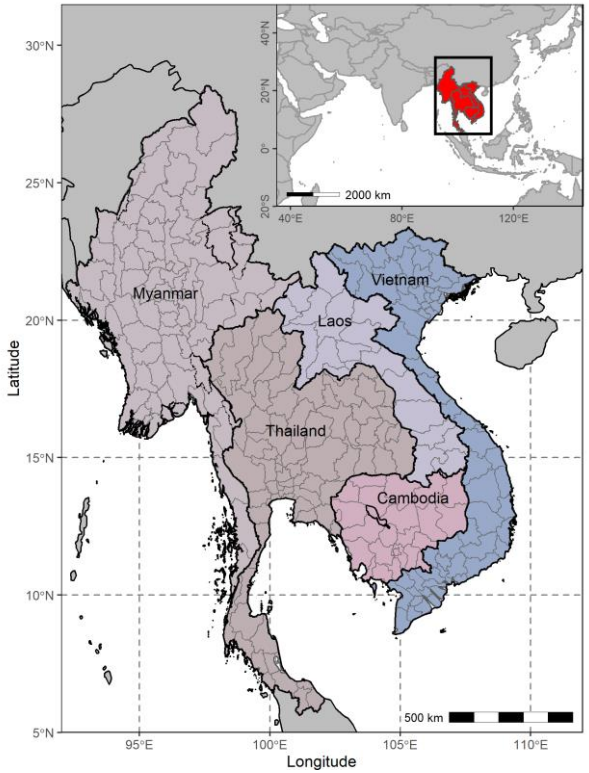
1. Identify environmental and climate determinants of leptospirosis in Southeast Asia

Environment

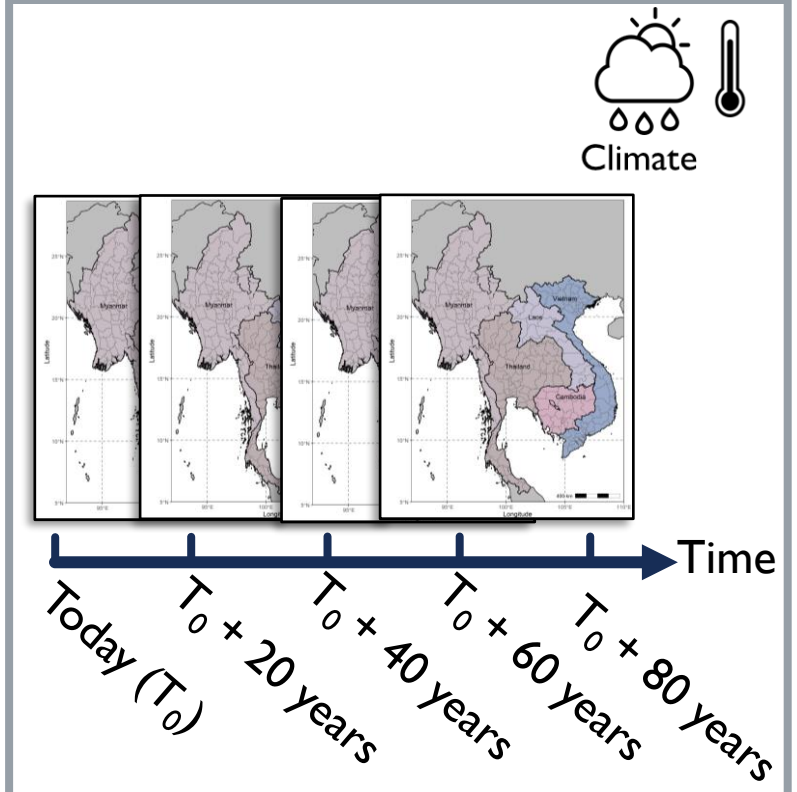


Climate

2. Estimate leptospirosis burden in Southeast Asia

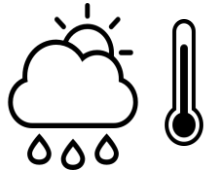


3.Predict its evolution along with climate change



METHODS

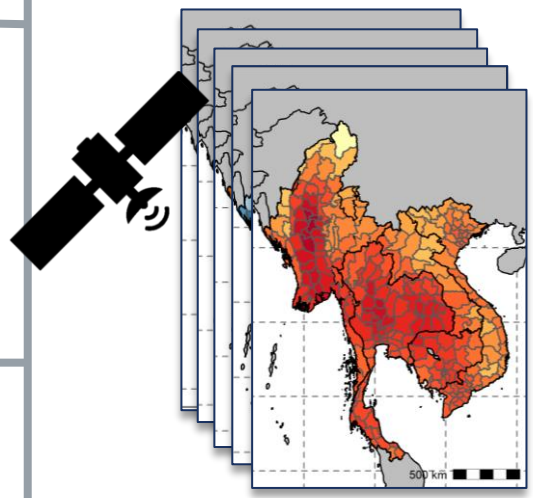
Environment



Climate

Humans

Data from satellites images



Epidemiological data

Median of yearly incidence between 2003 and 2019 for each Thai provinces

Machine Learning (Support Vector Machine)

Modèle validation

cross-validation

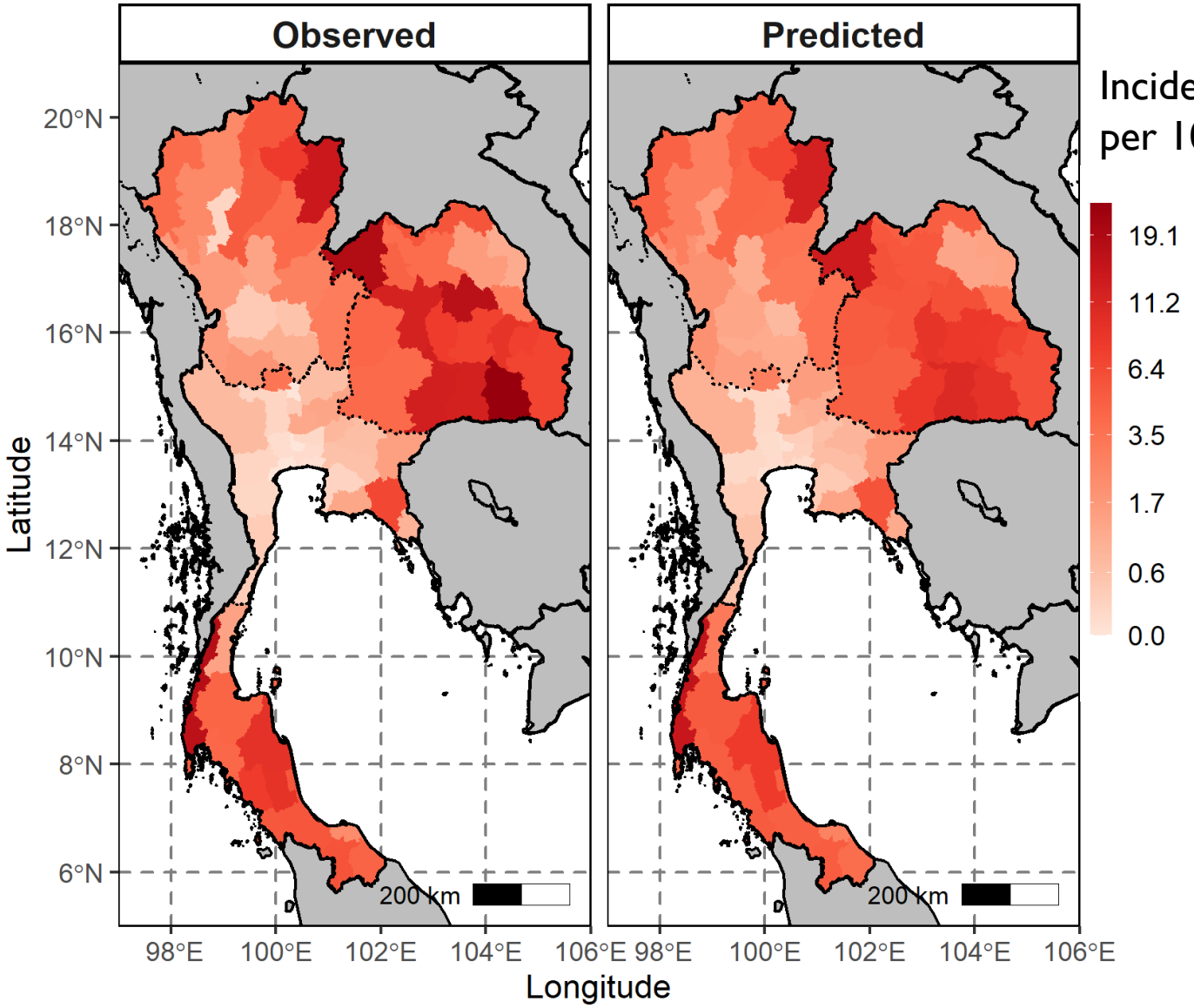
Model extrapolation to Myanmar, Cambodia, Laos and Vietnam

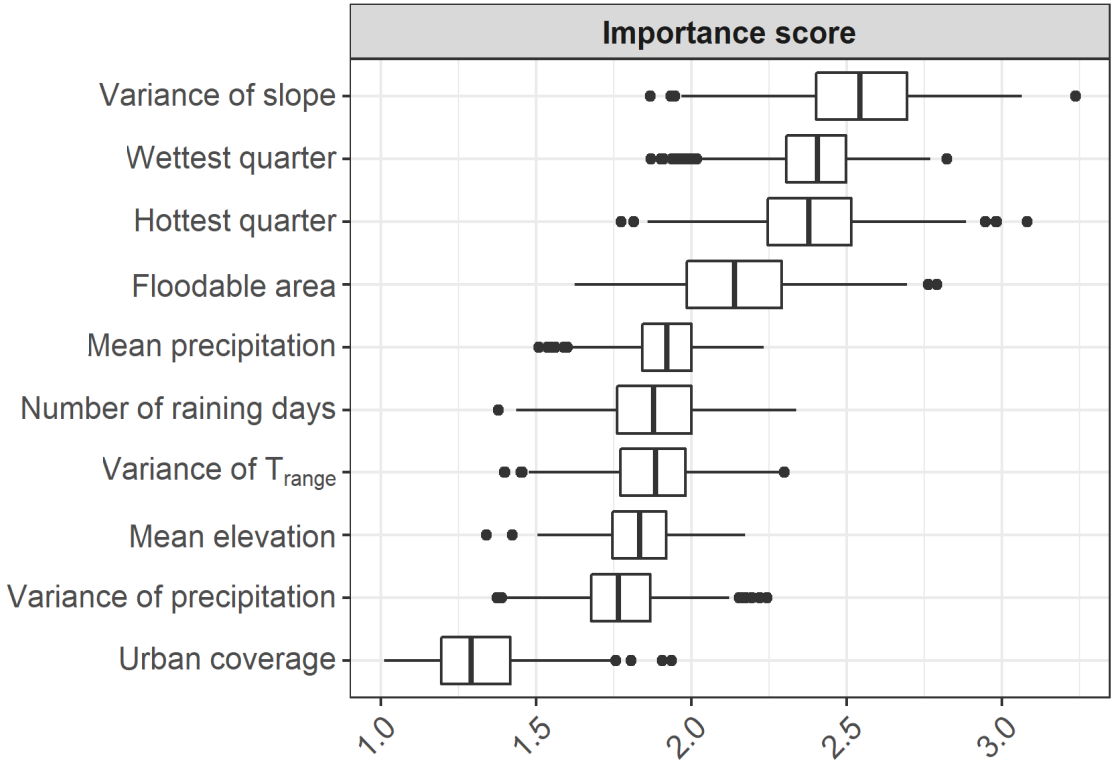
CMIP6 climate projections (Eyring et al., 2016)

Predictions along with climate change

RESULTS

Environmental determinants



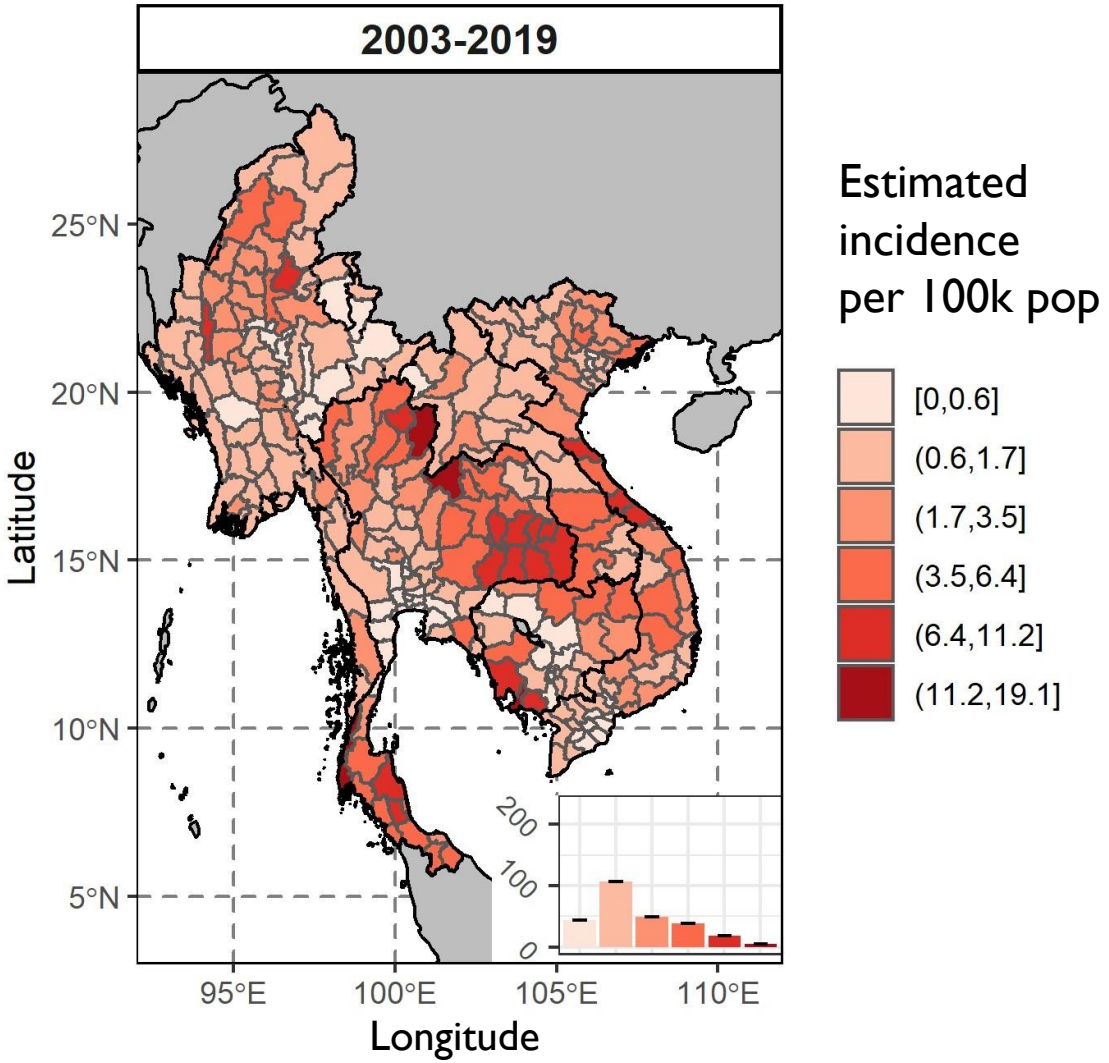


Observed and predicted incidence for the actual period (2003-2019)

RESULTS

Environmental determinants

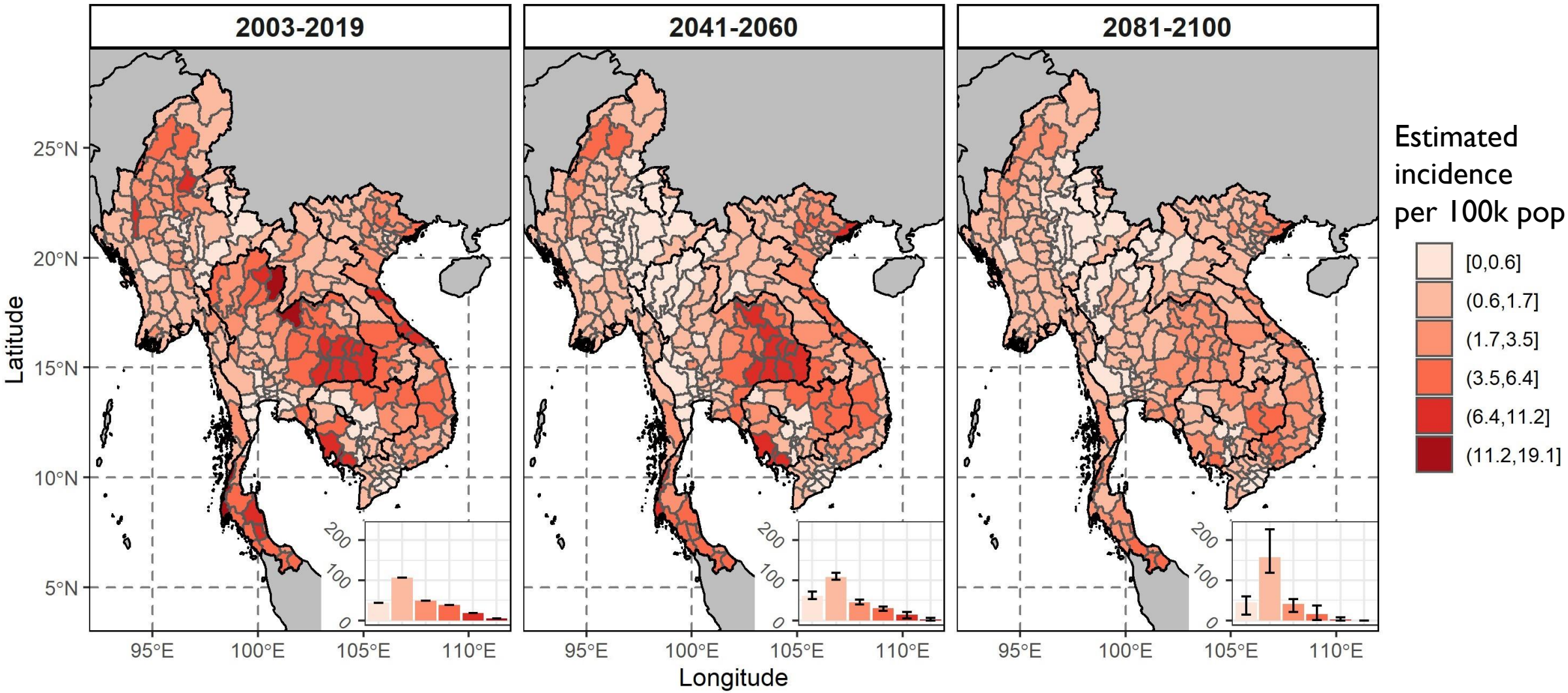
Estimating leptospirosis burden



Distribution of leptospirosis in Southeast Asia.

RESULTS

Environmental determinants → Estimating leptospirosis burden → Response to climate change



Distribution of leptospirosis in Southeast Asia and its predicted evolution under the no-climate policy scenario (SSP5-8.5) of climate change.

DISCUSSION

A robust model of leptospirosis distribution

- Accurately estimate Leptospirosis in Thailand
- Rely on **landscape and climate data available at large extent**
- Highlights the **importance of climate** on the disease distribution

DISCUSSION

A robust model of leptospirosis distribution

Unravelling leptospirosis distribution in Southeast Asia

- First estimates of **leptospirosis burden at local scale** encompassing 5 countries of Southeast Asia
- **Neglect behavioral and socio-economics aspects** shown to impact leptospirosis incidence
- True burden **likely underestimated** in countries less informed than Thailand

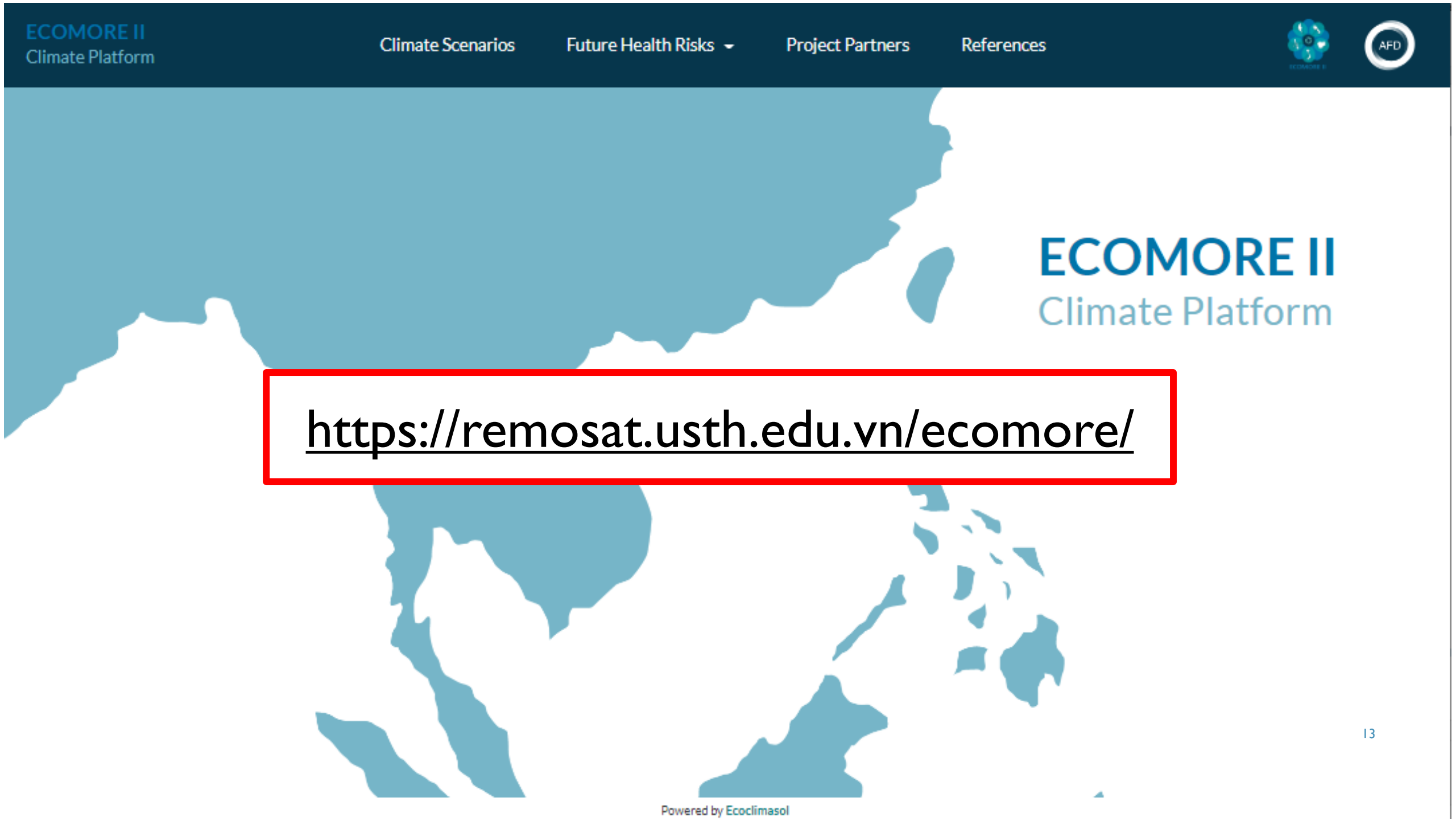
DISCUSSION

A robust model of leptospirosis distribution

Unravelling leptospirosis distribution in Southeast Asia

Predict the evolution of the distribution along with climate change

- Leptospirosis globally decreases with climate change
- Spatio-temporal aggregation likely **hide localized extreme climate event** in the future that would trigger outbreaks
- Climate projections globally **agree on the temperature trend but not for precipitation trends**
- Models predictions are only driven by climate projections but **modification of the landscape and development of the countries** could also impact the distribution


ECOMORE II
Climate Platform
Climate Scenarios
Future Health Risks
Project Partners
References
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Climate Platform
https://remosat.usth.edu.vn/ecomore/
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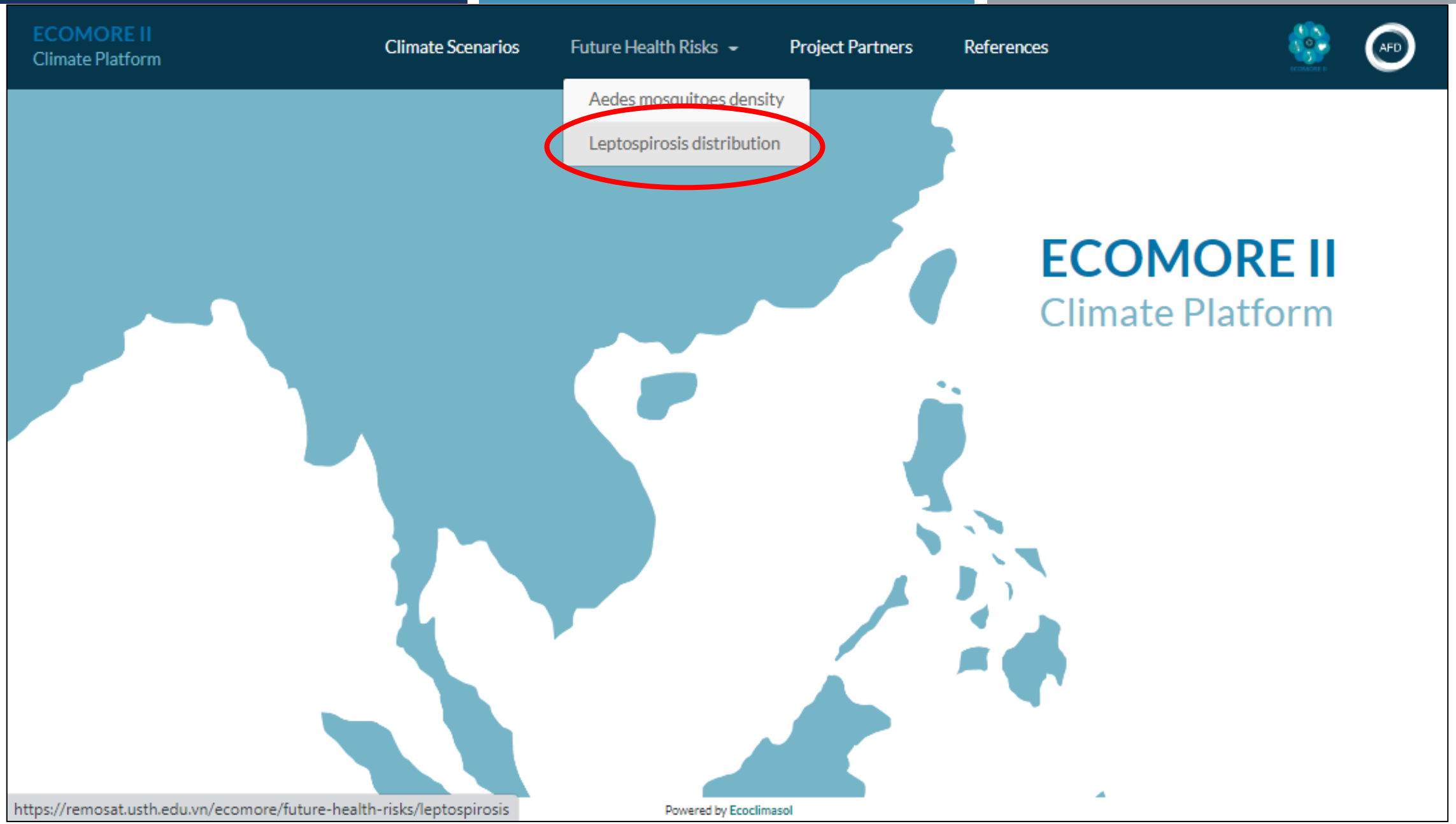

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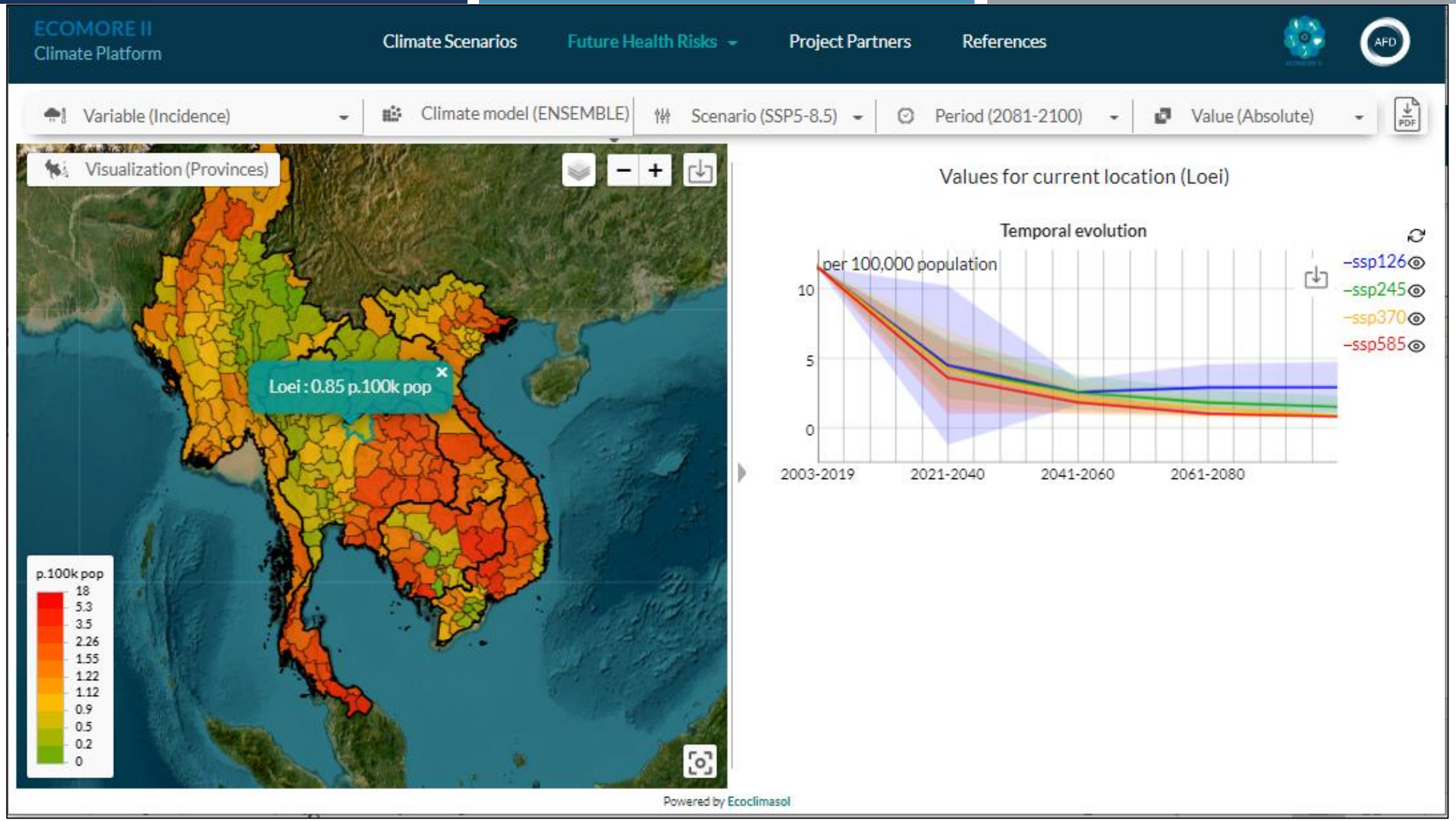

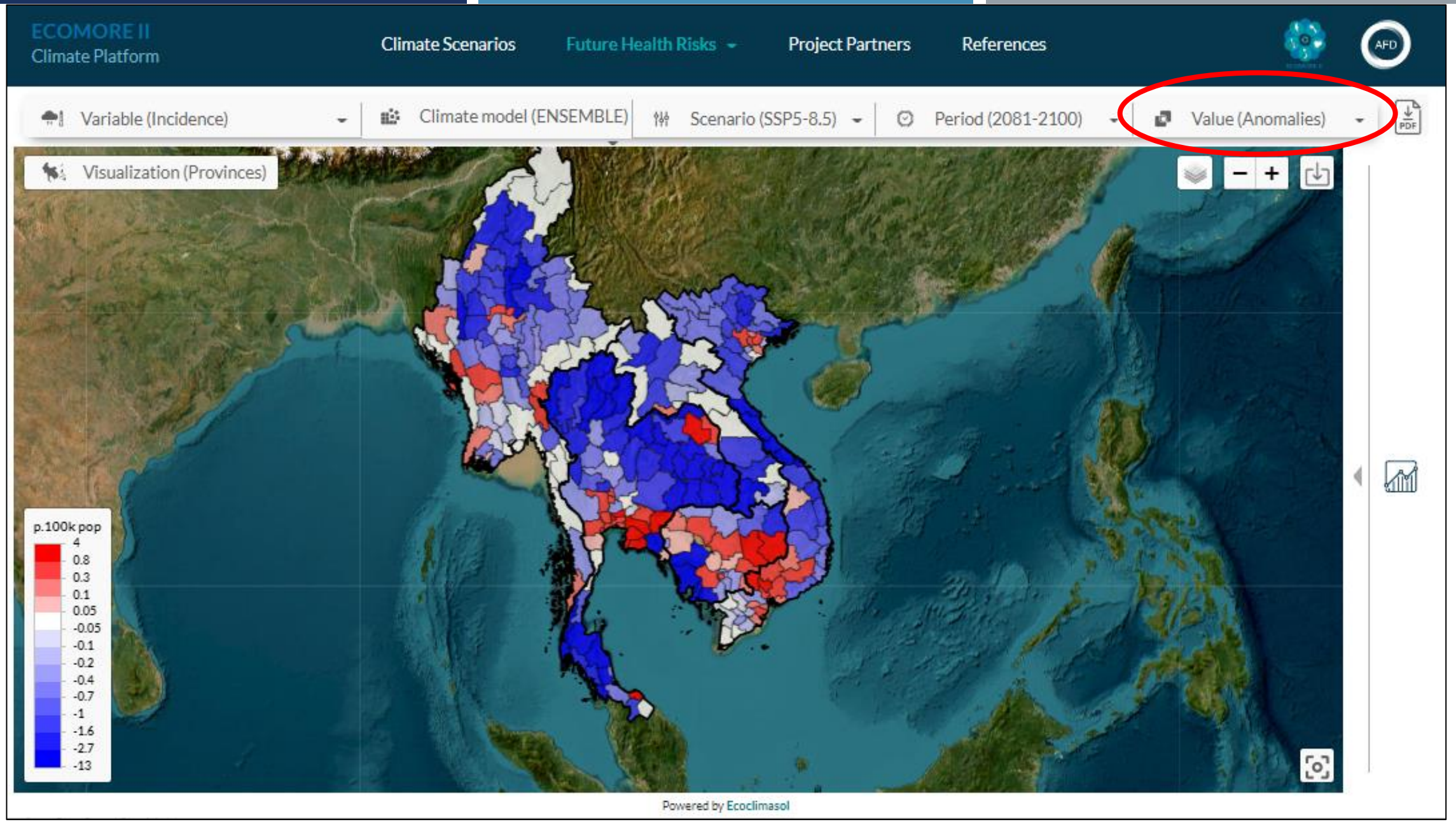
ECOMORE II
Climate Platform
Climate Scenarios
Future Health Risks
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References
AFD
Variable (Incidence)
Climate model (ENSEMBLE)
Scenario (SSP5-8.5)
Period (2081-2100)
Value (Anomalies)
PDF
Visualization (Provinces)
p.100k pop
4
0.8
0.3
0.1
0.05
-0.05
-0.1
-0.2
-0.4
-0.7
-1
-1.6
-2.7
-13
Powered by Ecoclimasol

ACKNOWLEDGMENTS

Bureau of Epidemiology of the Ministry of Public Health of Thailand for providing leptospirosis surveillance data

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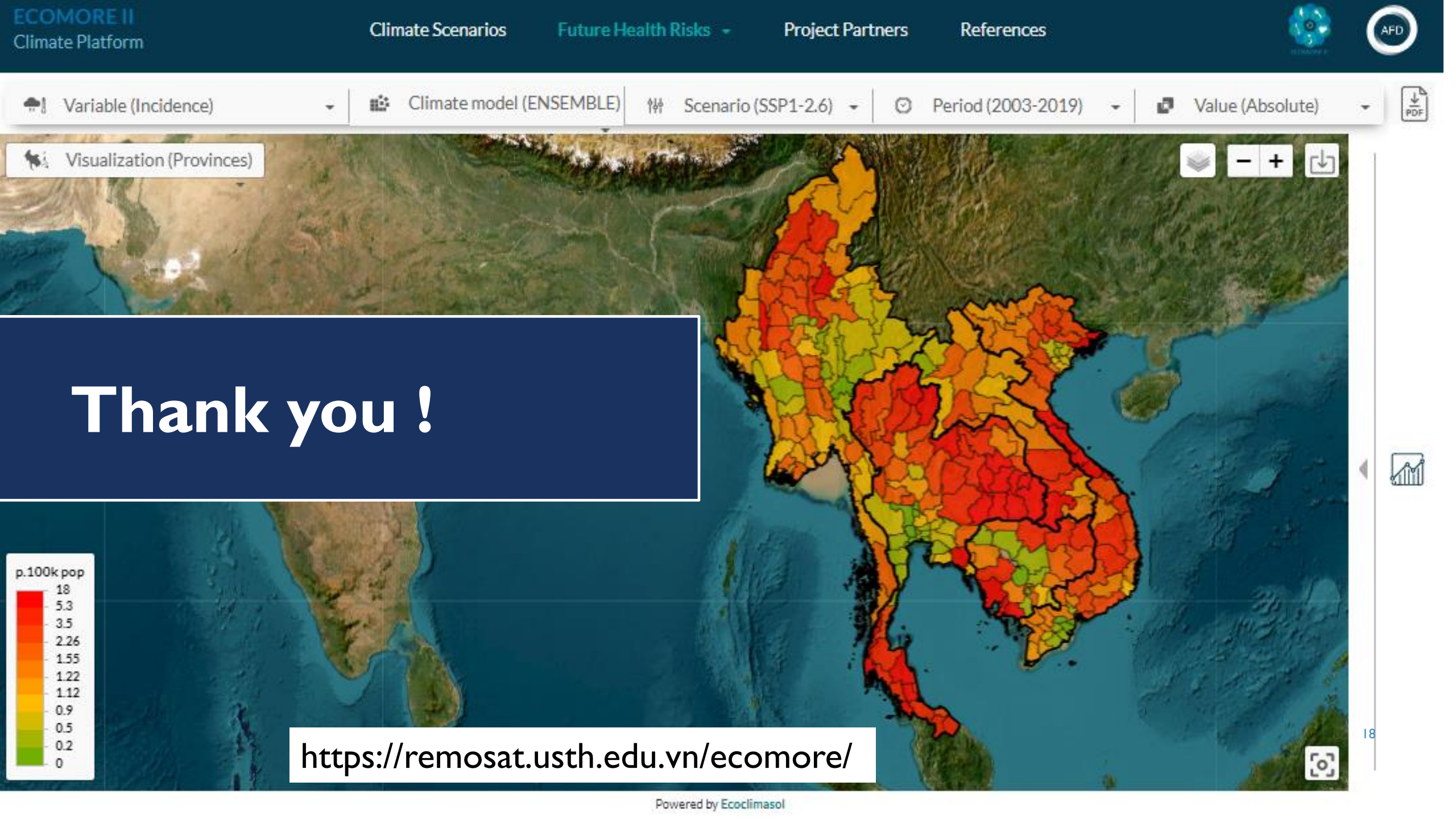
ECOMORE II
Climate Platform
Climate Scenarios
Future Health Risks
Project Partners
References
AFD
Variable (Incidence)
Climate model (ENSEMBLE)
Scenario (SSP1-2.6)
Period (2003-2019)
Value (Absolute)
PDF
Visualization (Provinces)
Thank you !
p.100k pop
18
5.3
3.5
2.26
1.55
1.22
1.12
0.9
0.5
0.2
0
https://remosat.usth.edu.vn/ecomore/
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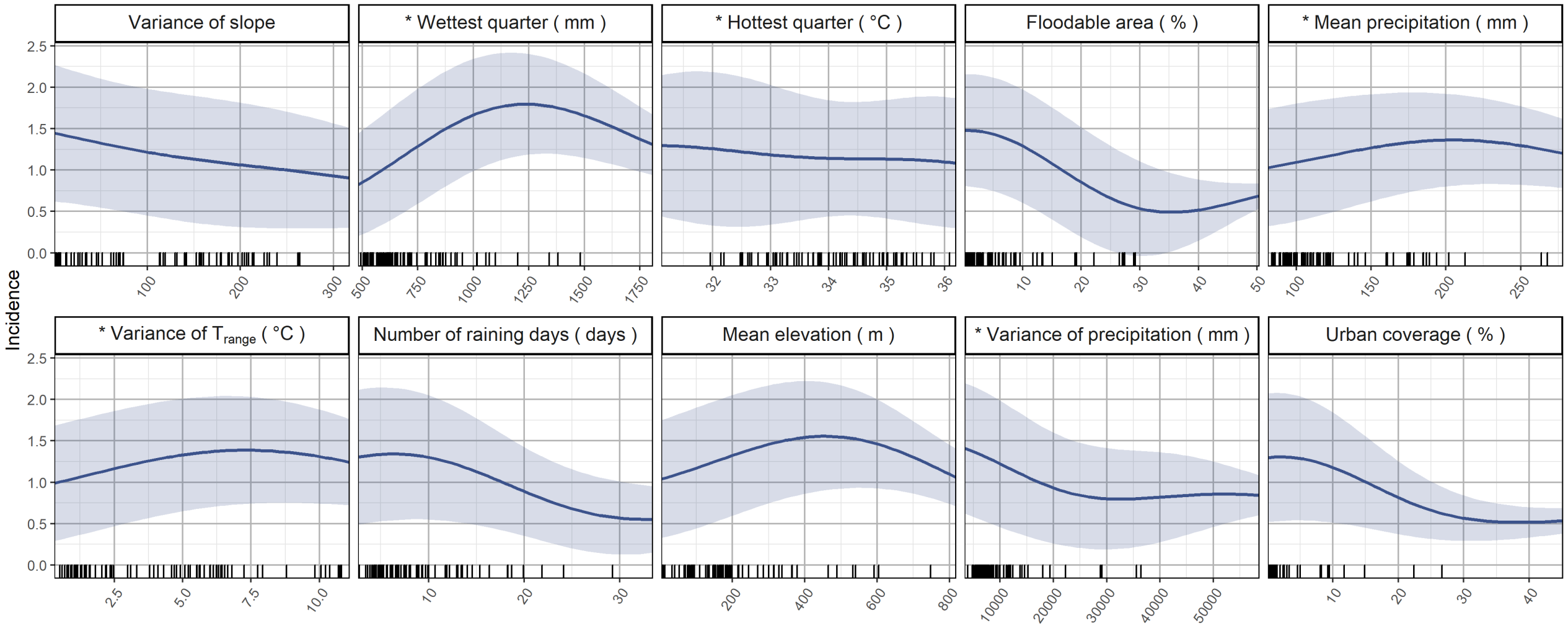
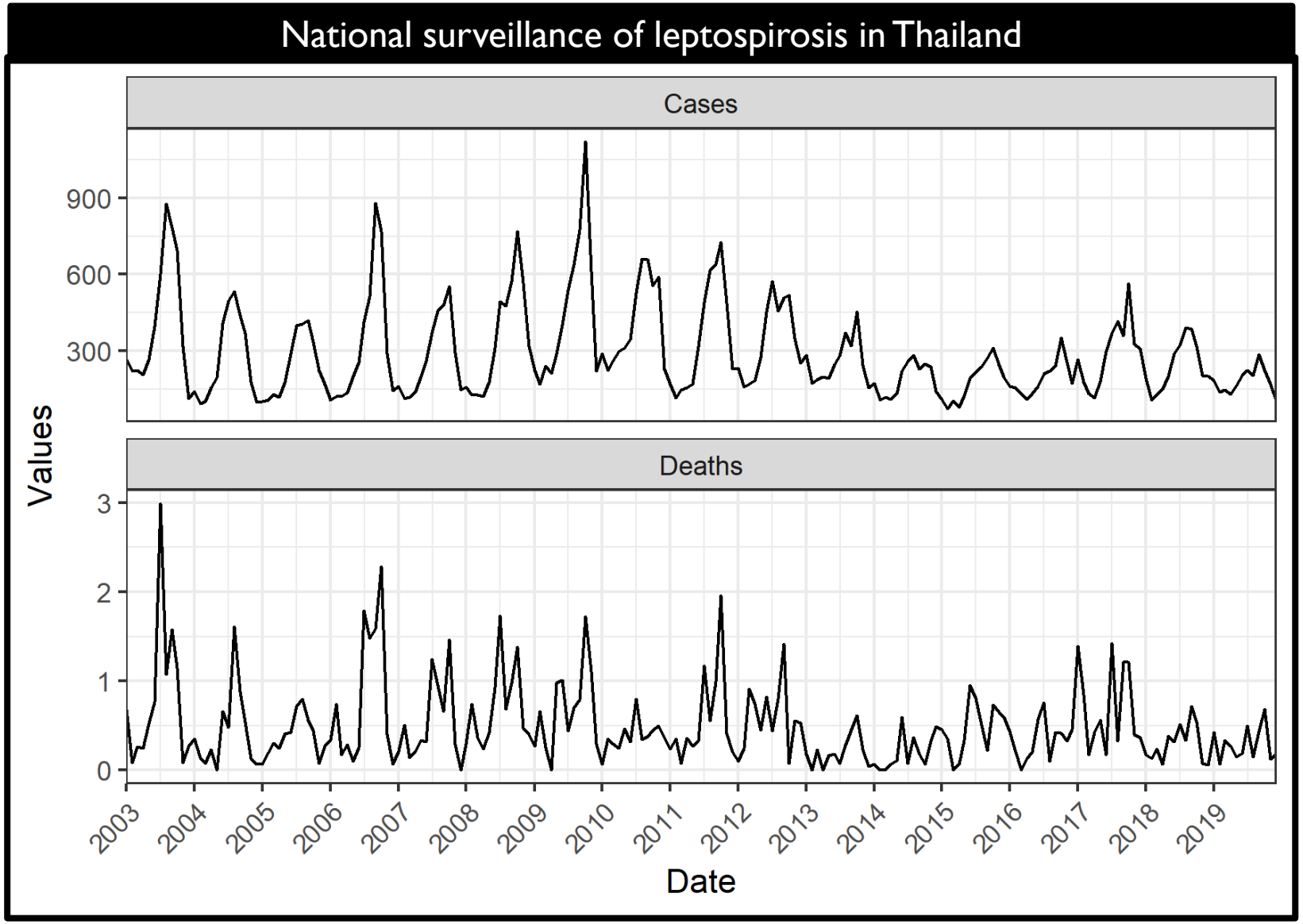

Variance of slope
* Wettest quarter (mm)
* Hottest quarter (°C)
Floodable area (%)
* Mean precipitation (mm)
* Variance of T_{range} (°C)
Number of raining days (days)
Mean elevation (m)
* Variance of precipitation (mm)
Urban coverage (%)
Incidence
Partial dependancy ± sd
Observed variables values
* CMIP6 Projected climate variables


National surveillance of leptospirosis in Thailand
Cases
Deaths
Values
900
600
300
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
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2019
Date