JITMM2018

JOINT INTERNATIONAL TROPICAL MEDICINE MEETING 2018

12-14 December 2018, Bangkok, Thailand

Amari Watergate Bangkok

Planetary Health: challenges for health forecasting

FutureHealthSEA project

K. Chaisiri, S. Hinjoy, A. Karnchanabanthoeng, C. Lajaunie, P. Mazzega, S. Morand

cnrs dépasser les frontières

cirad

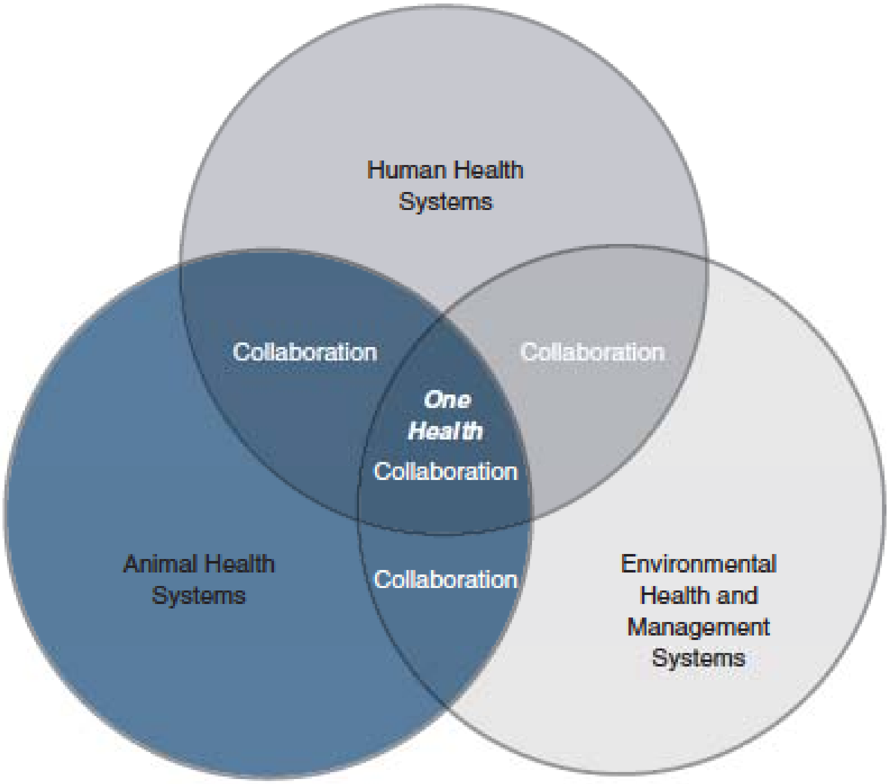
มหาวิทยาลัยเกษตรศาสตร์ KASETSART UNIVERSITY

MAHIDOL UNIVERSITY Wisdom of the Land Faculty of Tropical Medicine

One Health
Planetary Health

Investing in One Health

A concerted approach to address shared risks to humans, animals, and the environment



The One Health concept recognizes **the connections between humans, animals, and the environment** and promotes coordination to better understand and manage risks.

By improving understanding of animals and/or ecology, it informs risk management and can **prevent disease threats**. Its application can also reinforce other **health objectives**, such as maternal and child health, food and nutrition security, pollution management, and sanitation.

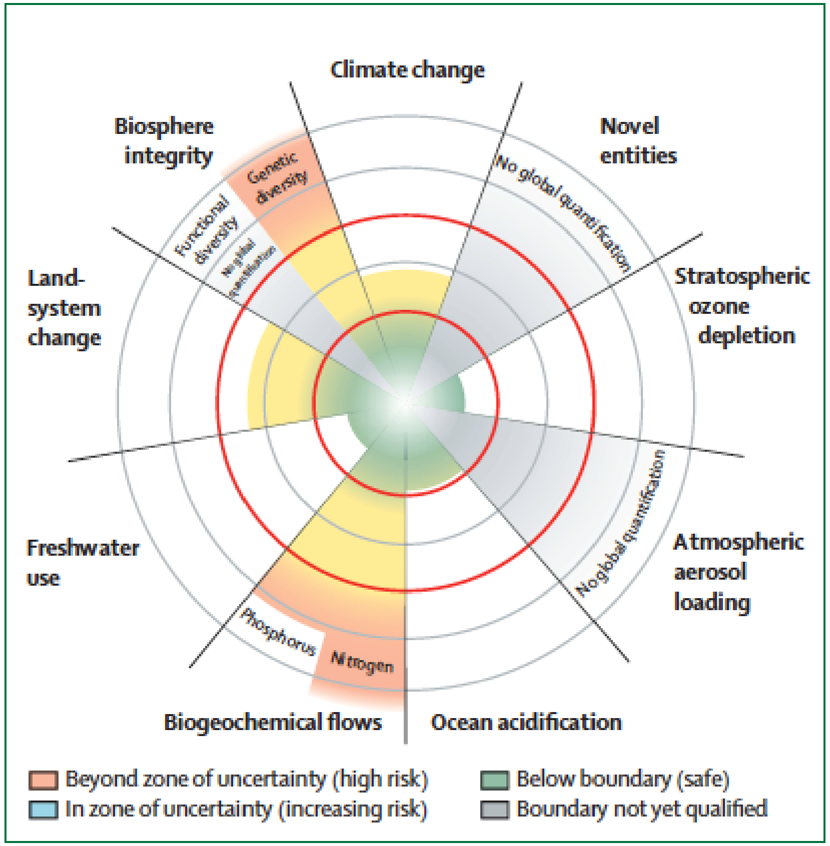
An increasing number of countries are taking measures to develop One Health coordination mechanisms to support **multi-sectoral surveillance**, laboratories, risk assessment, communication, and policy development activities.

The Rockefeller Foundation–*Lancet* Commission on planetary health

Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–*Lancet* Commission on planetary health

The concept of planetary health is based on the understanding that human health and human civilisation depend on flourishing natural systems and the wise stewardship of those natural systems

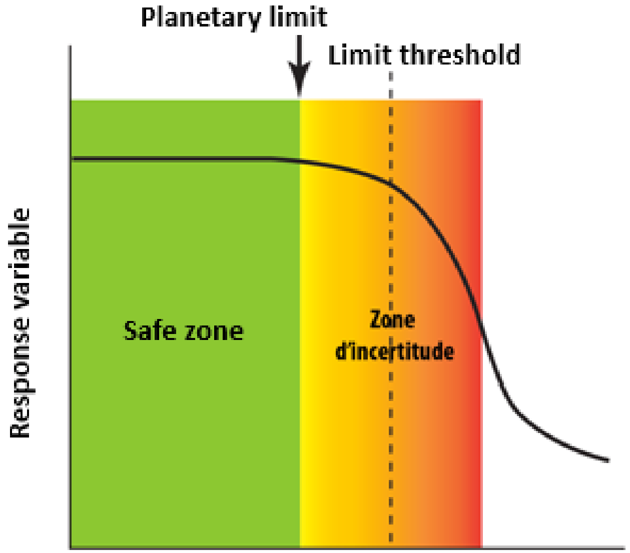
Solutions lie within reach and should be based on the redefinition of prosperity to focus on the enhancement of quality of life and delivery of improved health for all, together with respect for the integrity of natural systems

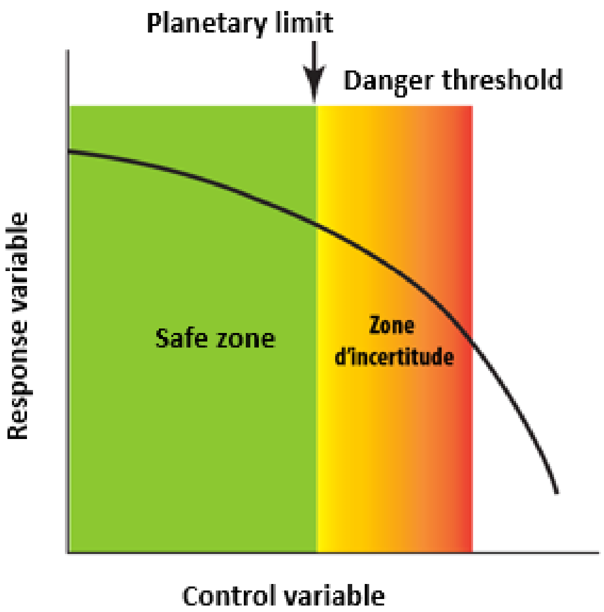


A safe operating space
For humanity

The present systems of governance and organisa
of human knowledge are
inadequate to address the threats to planetary health

Planetary Boundaries: Exploring the Safe Operating Space for Humanity





Scale of planetary limit processes	Processes with global limit thresholds	Slow process without limit threshold
Systemic process at planetary scale	Climate change	
	Acidification of oceans	
	Stratospheric ozone	Stratospheric ozone
Aggregated process at local and regional scales	Nitrogen and phosphorus cycles	Nitrogen and phosphorus cycles
	Atmospheric aerosols	Atmospheric aerosols
	Use of freshwater	Use of freshwater
	Use of land	Use of land
		Loss of biodiversity
		Chemical pollution

After Rockström et al. 2009

A safe operating space for humanity

Identifying and quantifying planetary boundaries that must not be transgressed could help prevent human activities from causing unacceptable environmental change, argue **Johan Rockström** and colleagues.

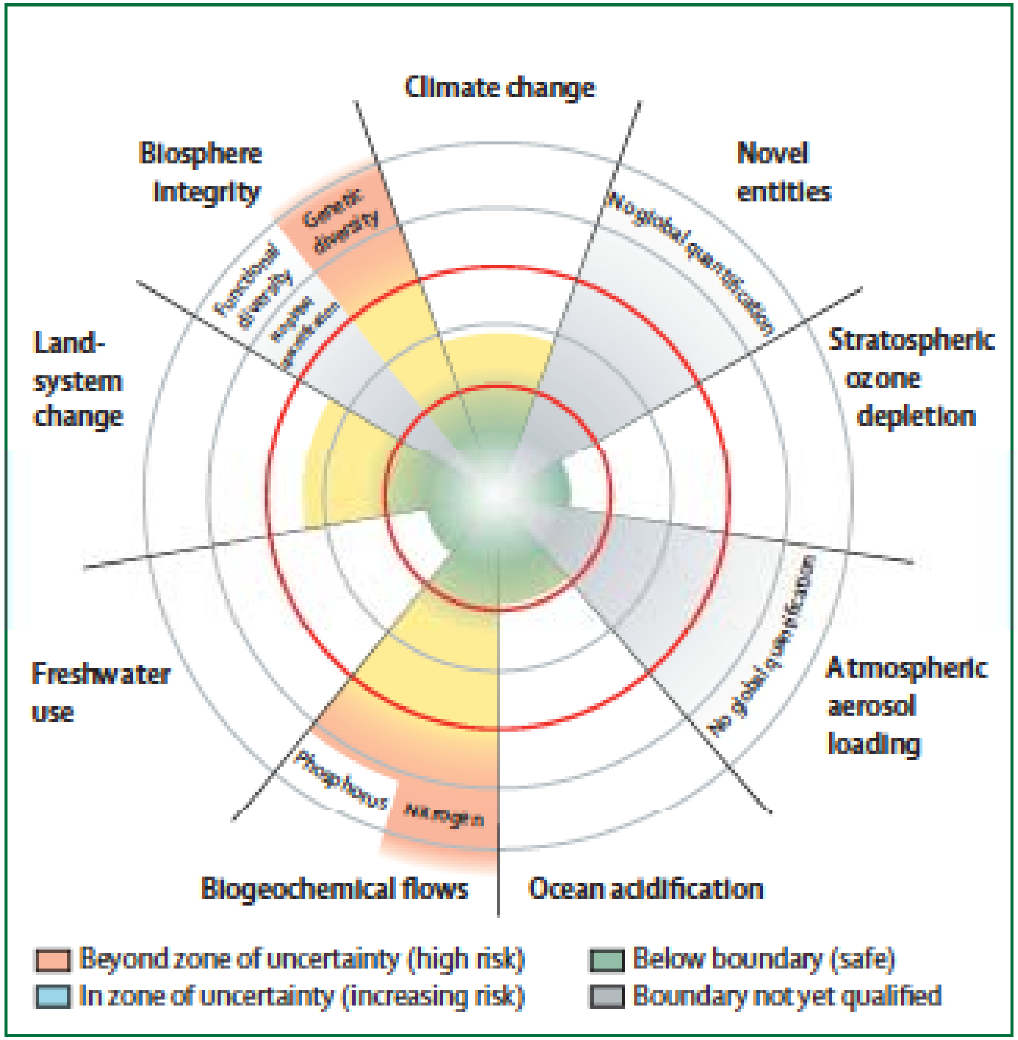


Figure 4: The present status of the control variables for seven of the nine planetary boundaries

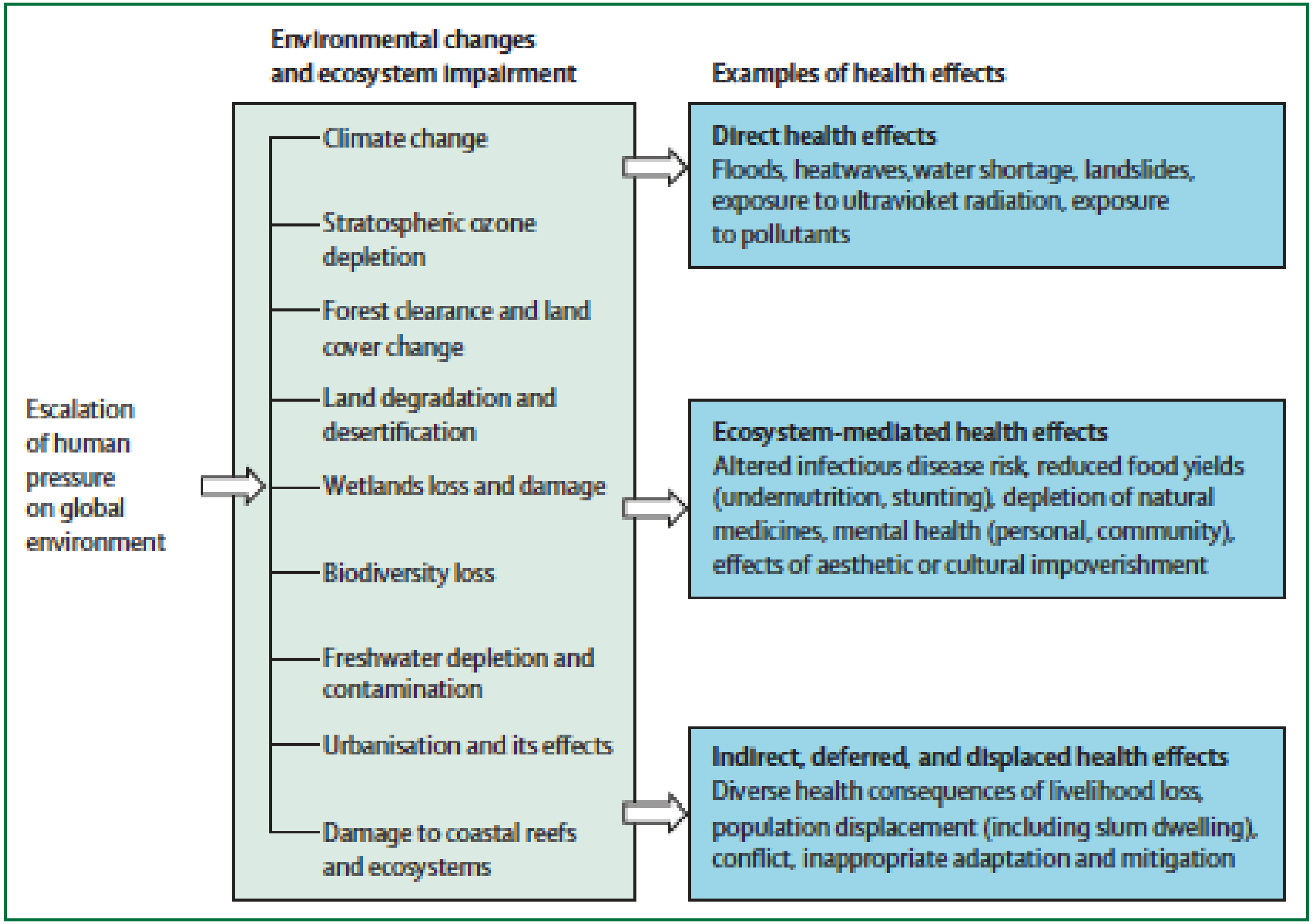


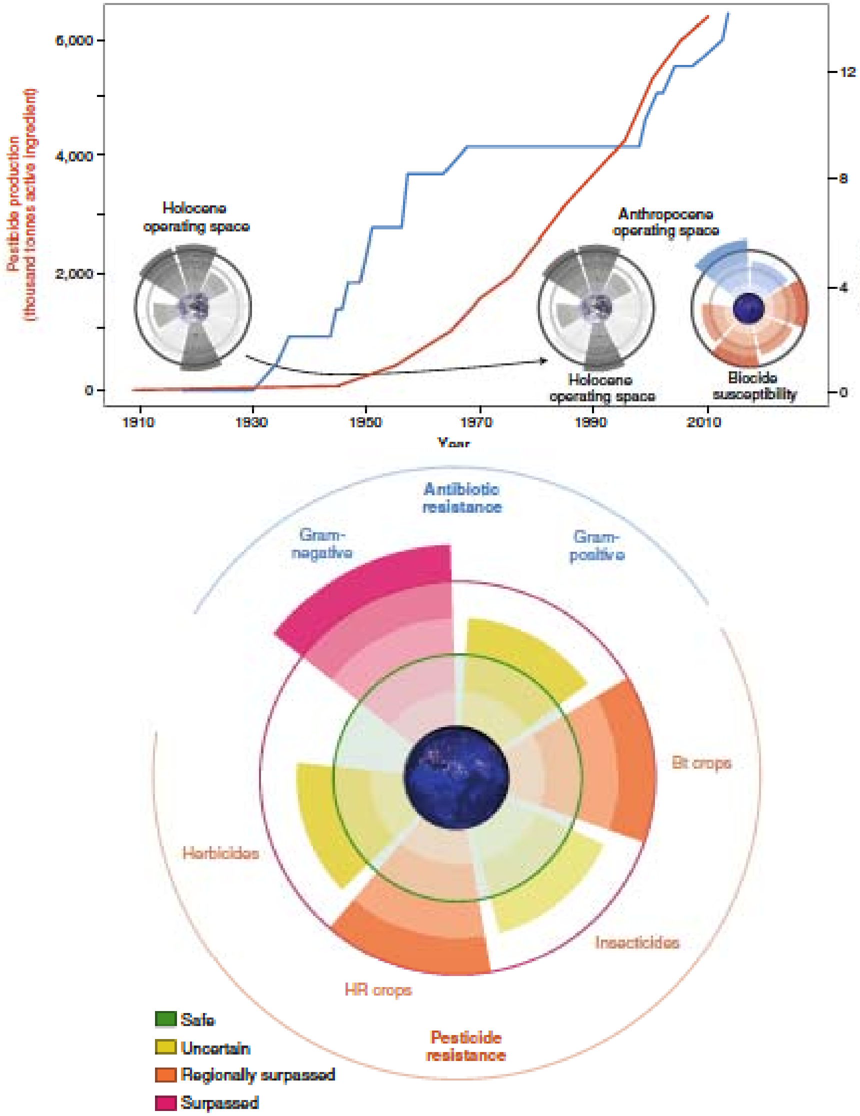
Figure 3: Mechanisms by which the harmful effects of ecosystem change can affect human health

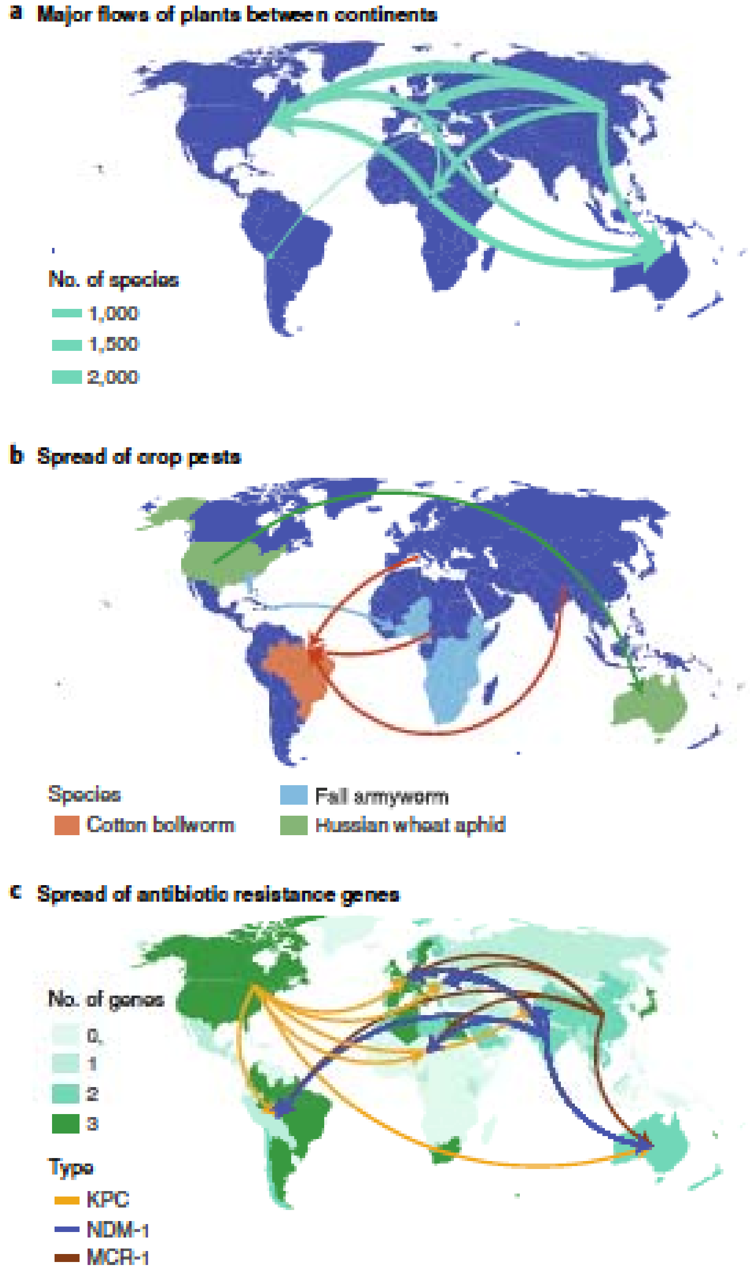
Reproduced from Millennium Ecosystem Assessment,[3] by permission of WHO.

Biocides

Antibiotic and pesticide susceptibility and the Anthropocene operating space

Living with Resistance project[1]

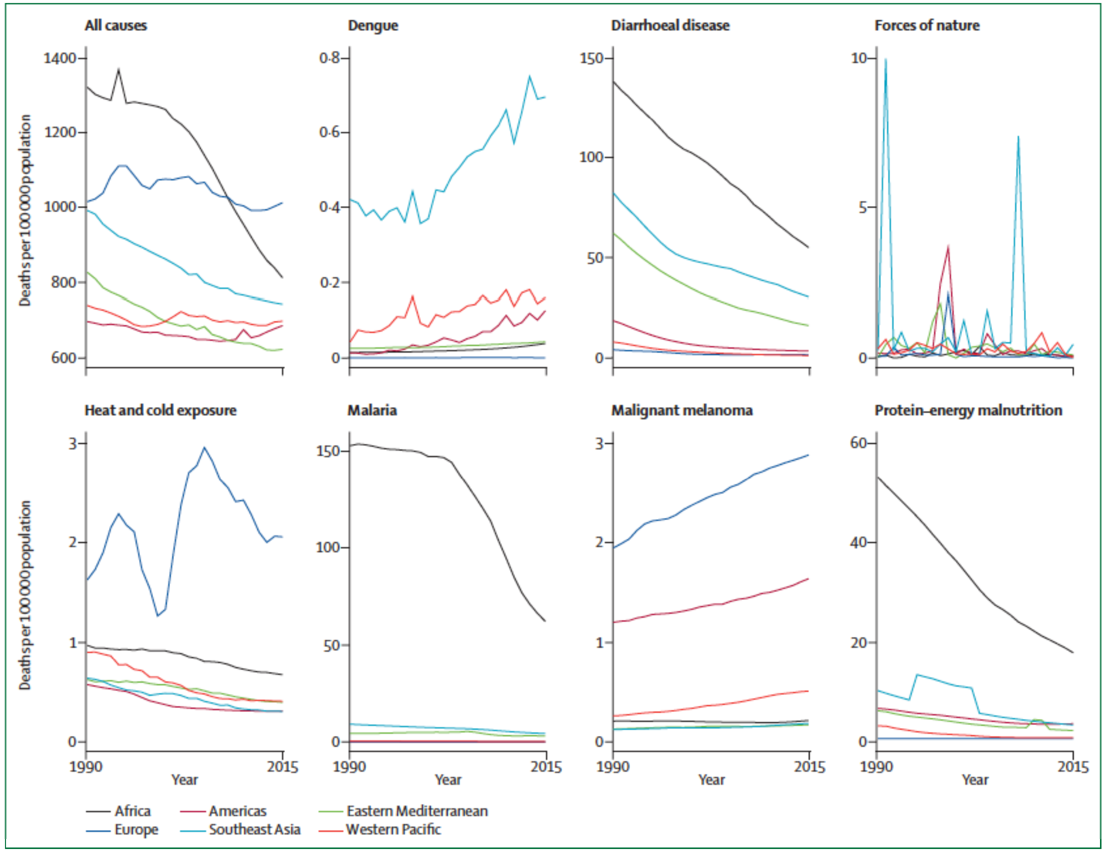




Climate change and climate variability

www.thelancet.com Published online October 30, 2017 http://dx.doi.org/10.1016/S0140-6736(17)32464-9

The *Lancet* Countdown on health and climate change: from 25 years of inaction to a global transformation for public health

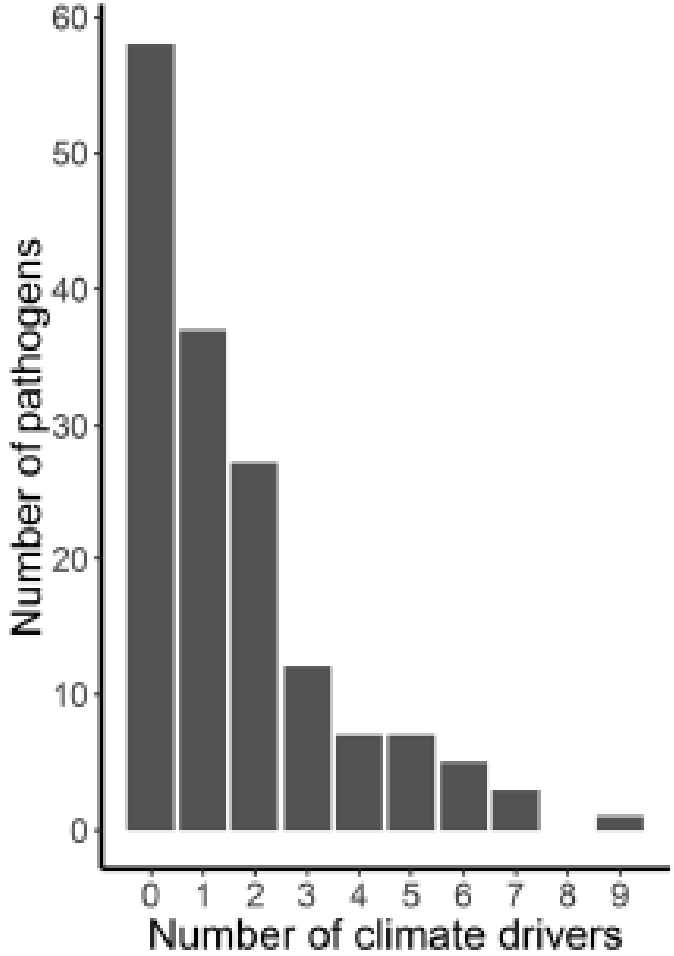


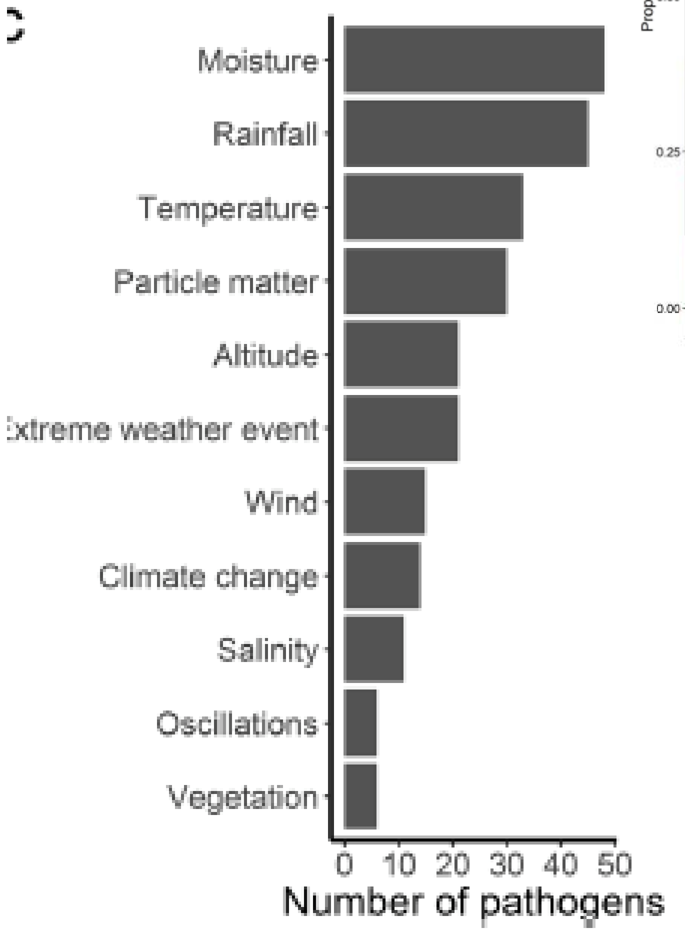
Trends in mortality from selected causes of death, as estimated by the Global Burden of Disease Study 2015, by WHO region

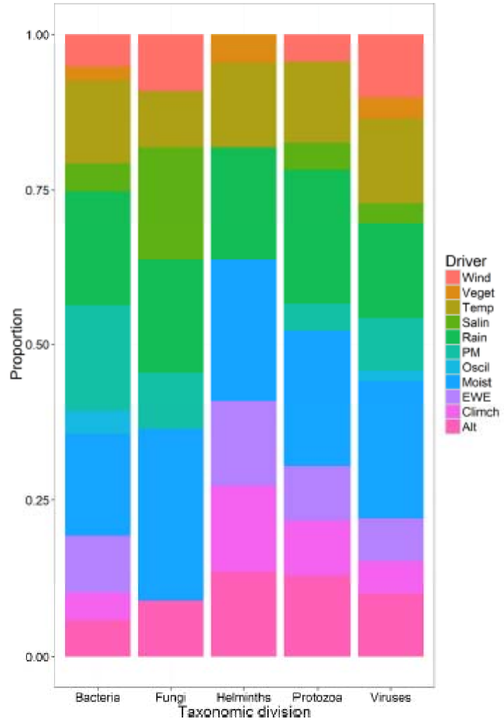
Systematic Assessment of the Climate Sensitivity of Important Human and Domestic Animals Pathogens in Europe

SCIENTIFIC REPORTS

K. Marie McIntyre[1,2], Christian Setzkorn[1], Philip J. Hepworth[1], Serge Morand[3,4], Andrew P. Morse[2,5] & Matthew Baylis[1,2]







Climate variability and outbreaks of infectious diseases in Europe

SCIENTIFIC REPORTS

Serge Morand[1,2], Katharine A. Owers[1], Agnes Waret-Szkuta[2], K. Marie McIntyre[3] & Matthew Baylis[3]

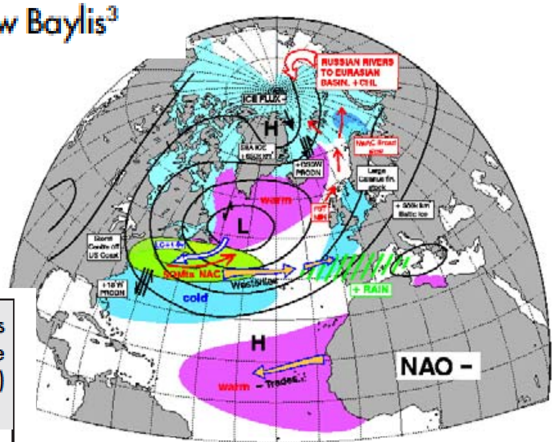
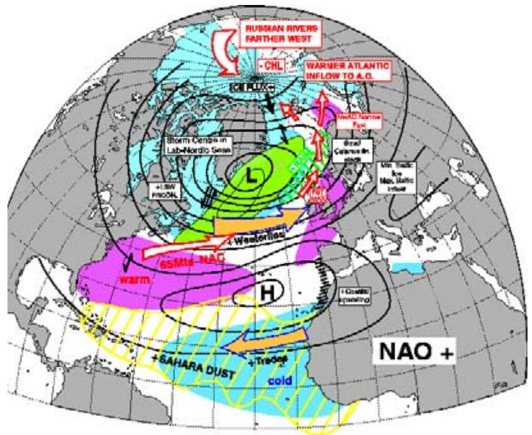
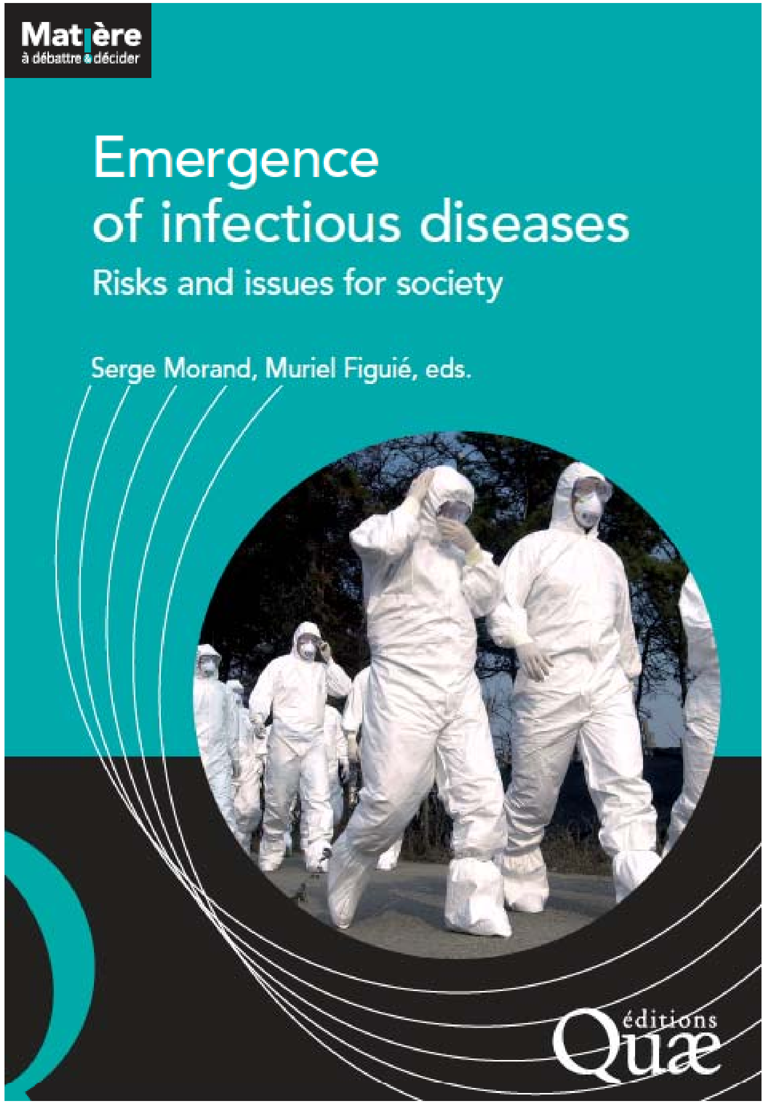


Table 2 | Results of generalized linear regression analyses on detrended infectious disease outbreaks in relation to detrended monthly values of the NAO (North Atlantic Oscillation) (from NAO1: January to NAO12: December) of each year or with one year lag. Best models were selected using a backward-stepwise procedure using AIC and Bonferroni corrections, with only significant, or close to significant ($p < 0.08$) explicative variables indicated

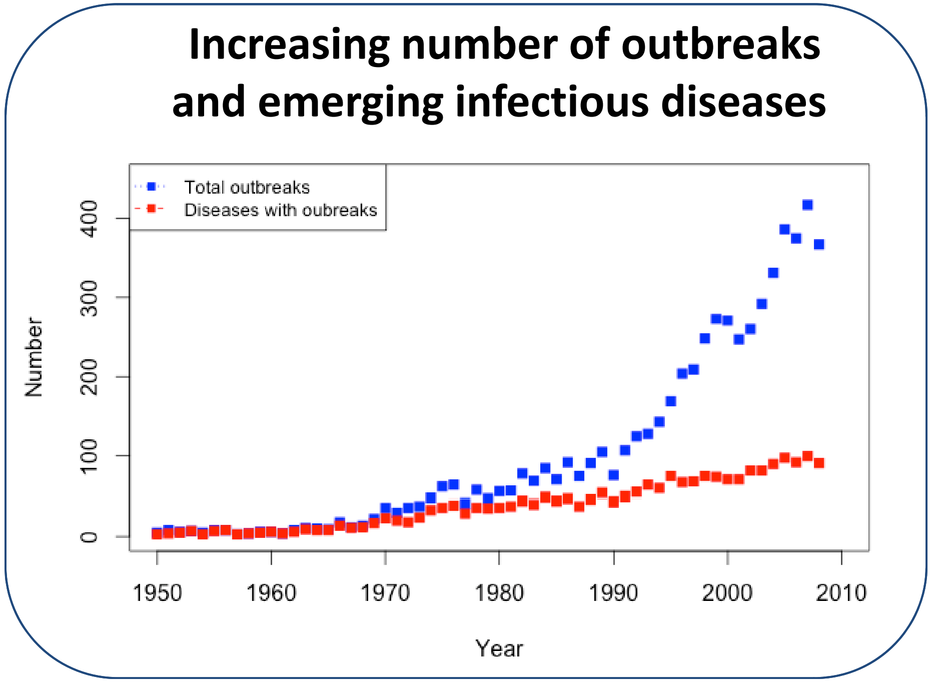
Diseases	Location	Independent variable	Deviance	Sign (P)
Adenovirus	Northern	NAO11	0.76	+0.1 (0.06)
Measles	Northern	NAO8	2.13	+0.3 (0.05)
	Southern	NAO10	0.98	−0.1 (0.03)
Aseptic viral Meningitis	Northern	NAO10	3.82	+0.3 (0.03)
Q fever	Northern	NAO7 (year lag)	<0.01	+0.001 (0.05)
	Southern	NAO12 (year lag)	2.19	−0.2 (0.02)
Tuberculosis				
Enterovirus infection	Northern	NAO6 (year lag)	0.61	+0.1 (0.01)
Gastroenteritis	Northern	NAO9 (year lag)	1.94	+0.02 (0.06)
	Southern	NAO12 (year lag)	1.38	−0. 3 (0.03)
Shigellosis	Northern	NAO11 (year lag)	2.42	+0.2 (0.009)
	Southern	NAO5 (year lag)	1.64	−0.2 (0.03)
Typhoid fever	Northern	NAO6 (year lag)	17.15	−0.6 (0.003)
	Southern	NAO12 (year lag)	0.76	+0.2 (0.01)
Hantavirus infection	Northern	NAO12 (year lag)	<0.01	−0.001 (0.005)
	Southern	NAO12 (year lag)	1.27	+0.3 (0.08)
Tularaemia	Northern	NAO3 (year lag)	1.51	−0.2 (0.04)
Hepatitis A	Northern	NAO7 (year lag)	5.41	−0.4 (0.06)
	Southern	NAO9 (year lag)	2.56	−0.2 (0.03)
Trichinosis	Northern	NAO1	<0.01	−0.001 (0.06)

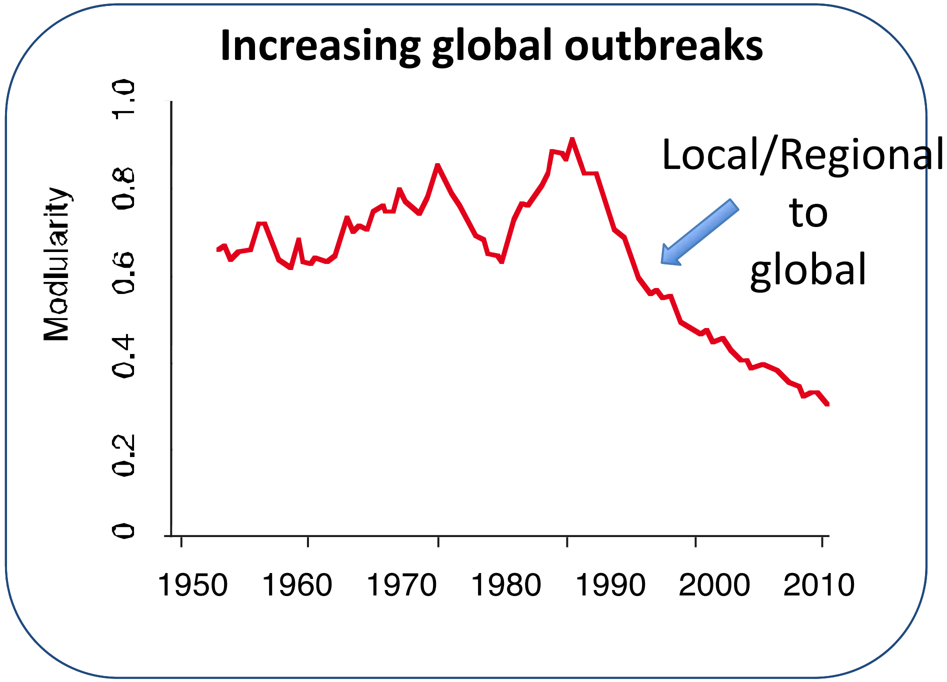


Biodiversity

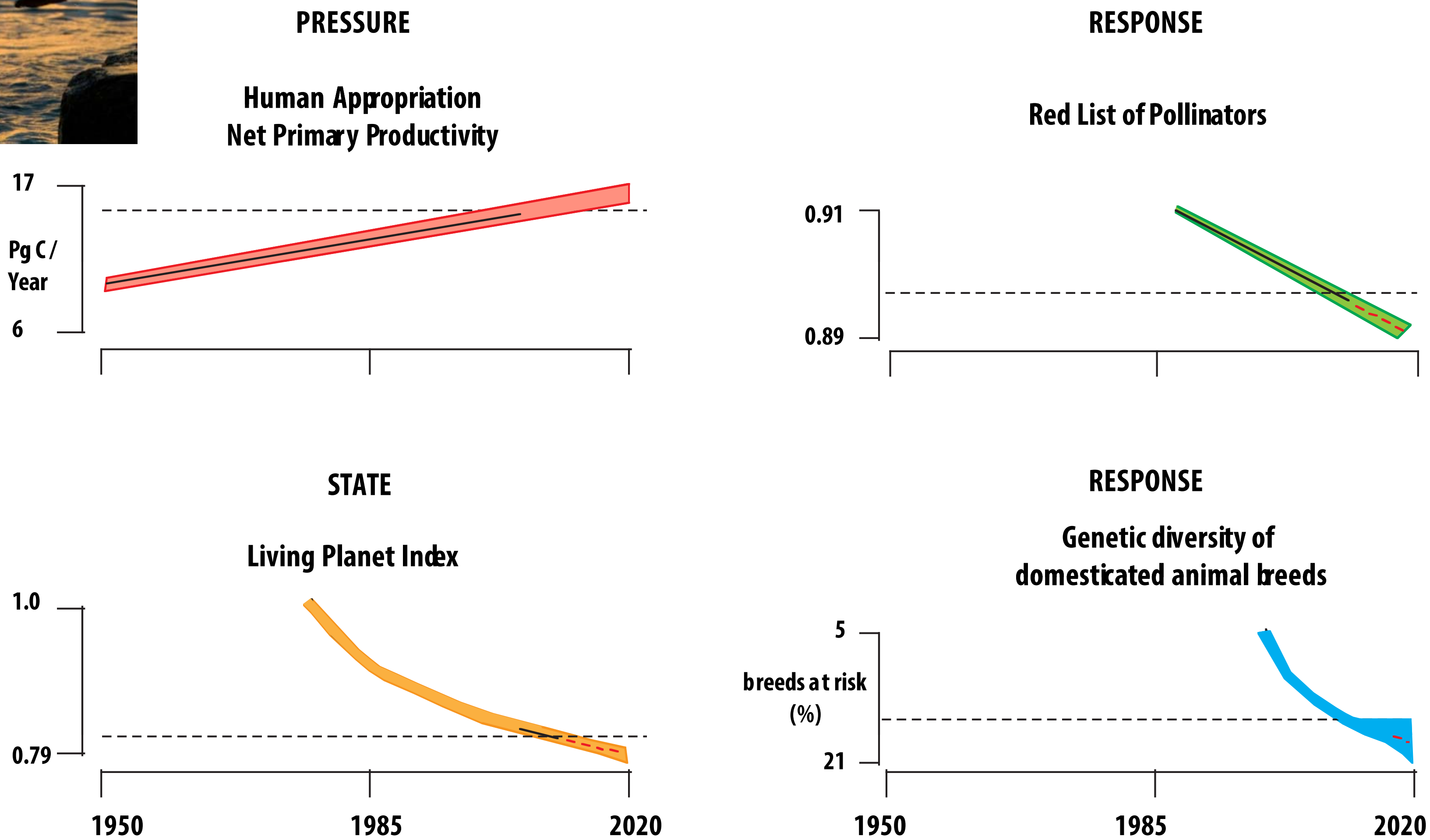


Morand & Figuié 2018



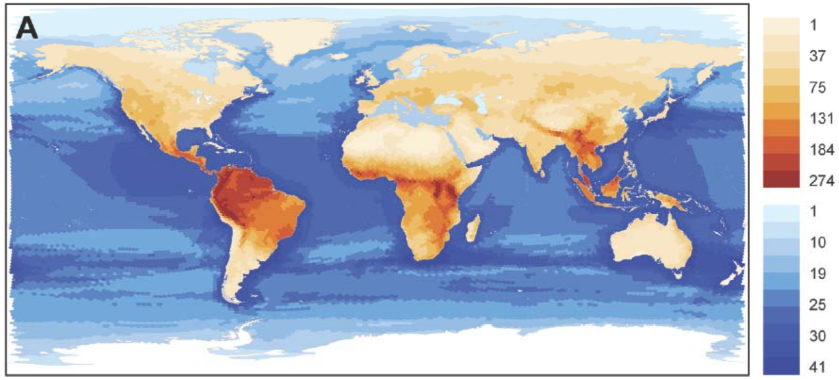


Increasing human appropriation of the biological productivity is leading to a major biodiversity crisis

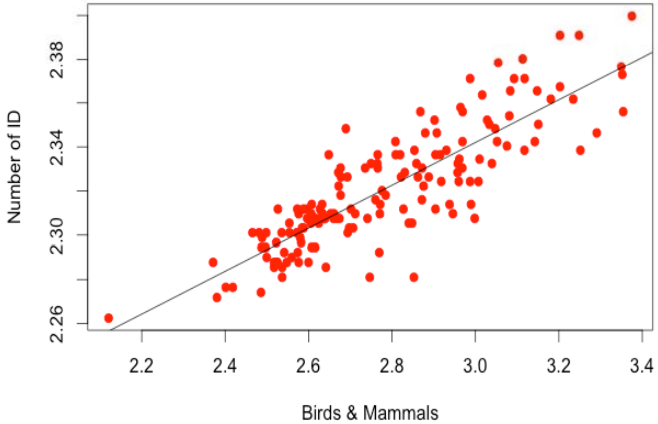


Biodiversity, loss and zoonotic diseases

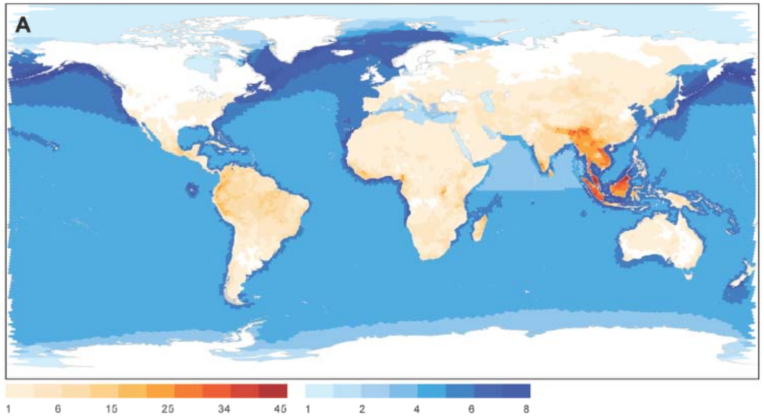
high biodiversity ⇨ **high number of infectious diseases in a country**



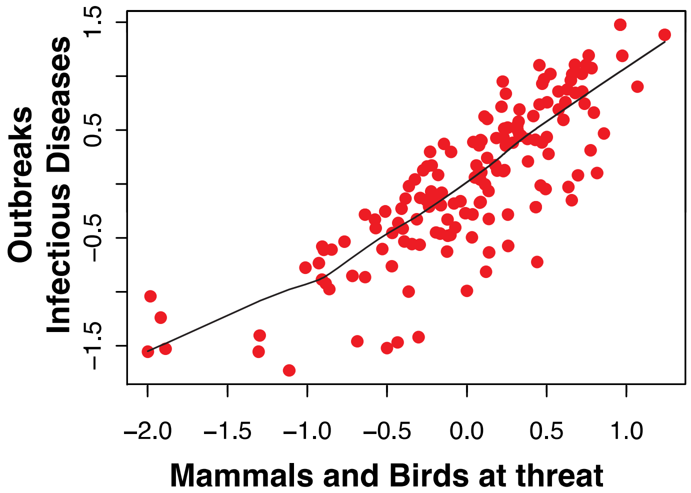
Mammal Species richness



high biodiversity at threat ⇨ **high number of ID outbreaks**



Mammal Species at threat



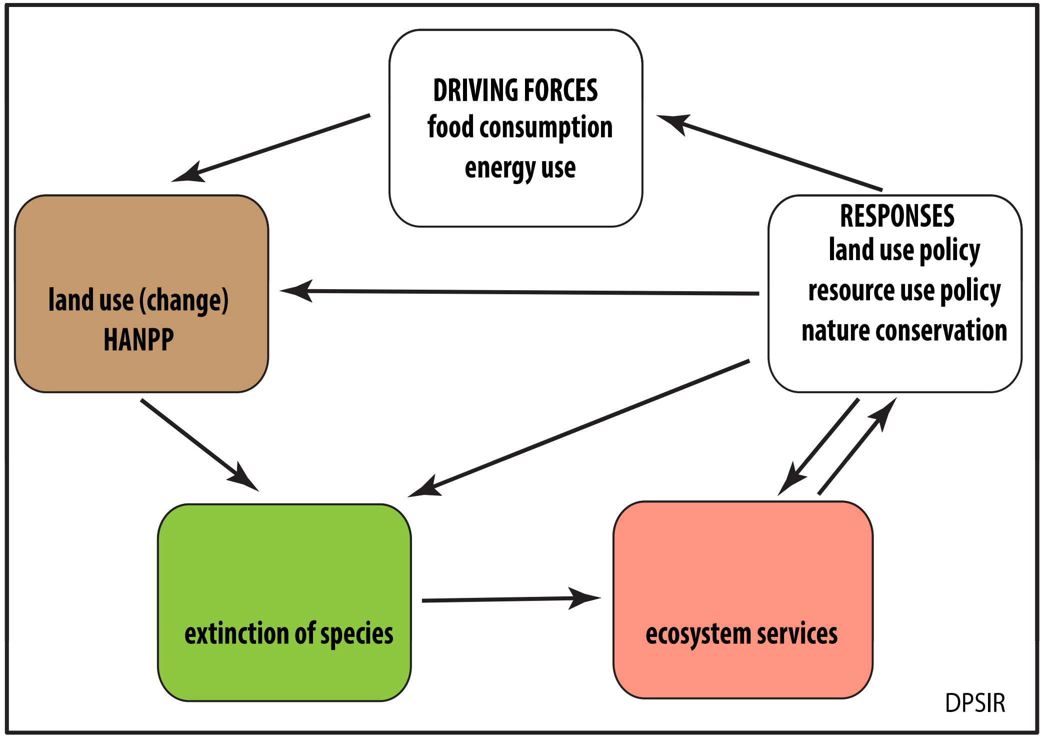
(Schipper et al. 2011)

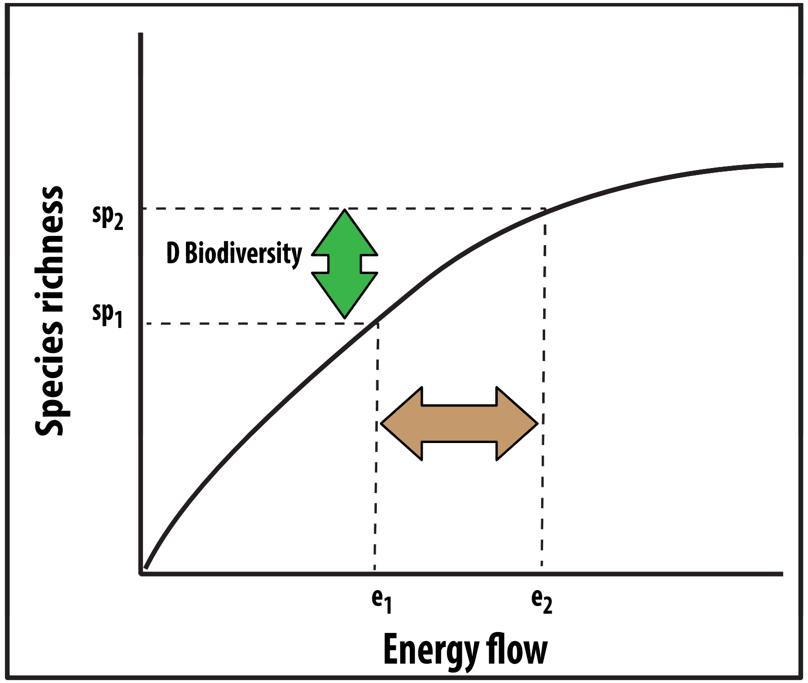
(Morand & Lajaunie 2017)

Social-ecological mechanisms

Socio-ecological approach and ecological law

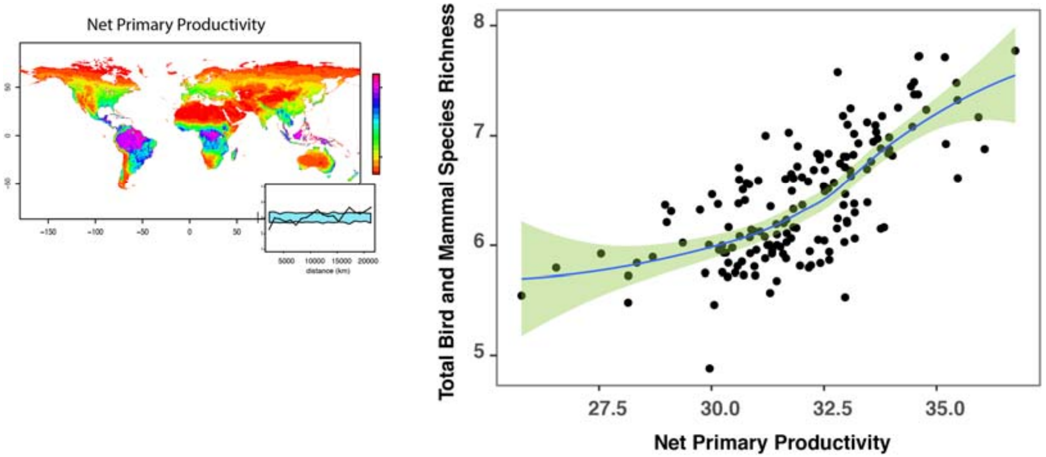
linking ecological-biological metabolism with social metabolism





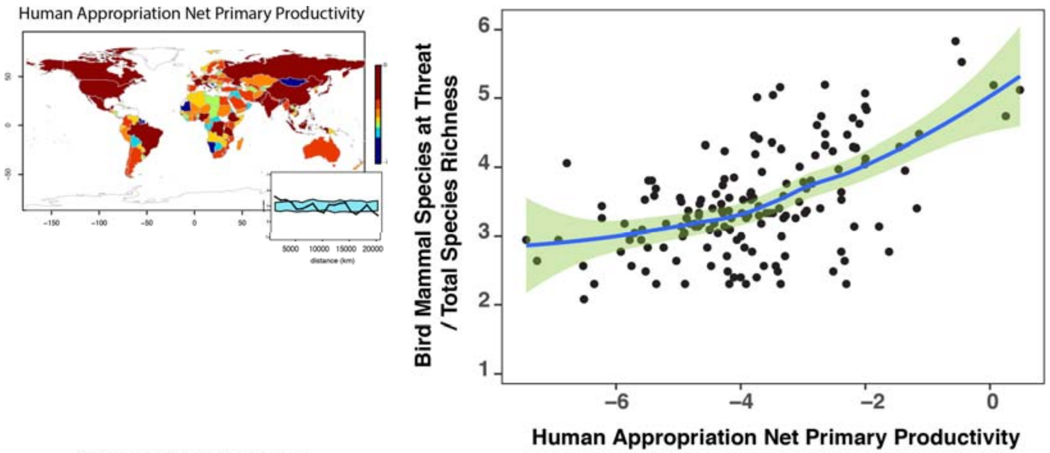
Haberl et al. 2007
Fischer-Kowalski & Weisz 2016

Wright 1983



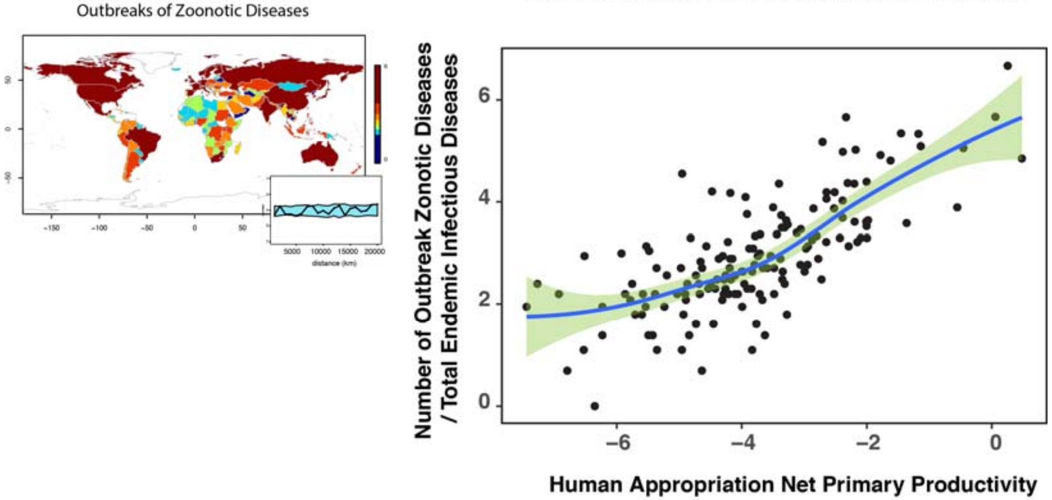
1

Confirmation of the energy flow (NPP) / species relationship



2

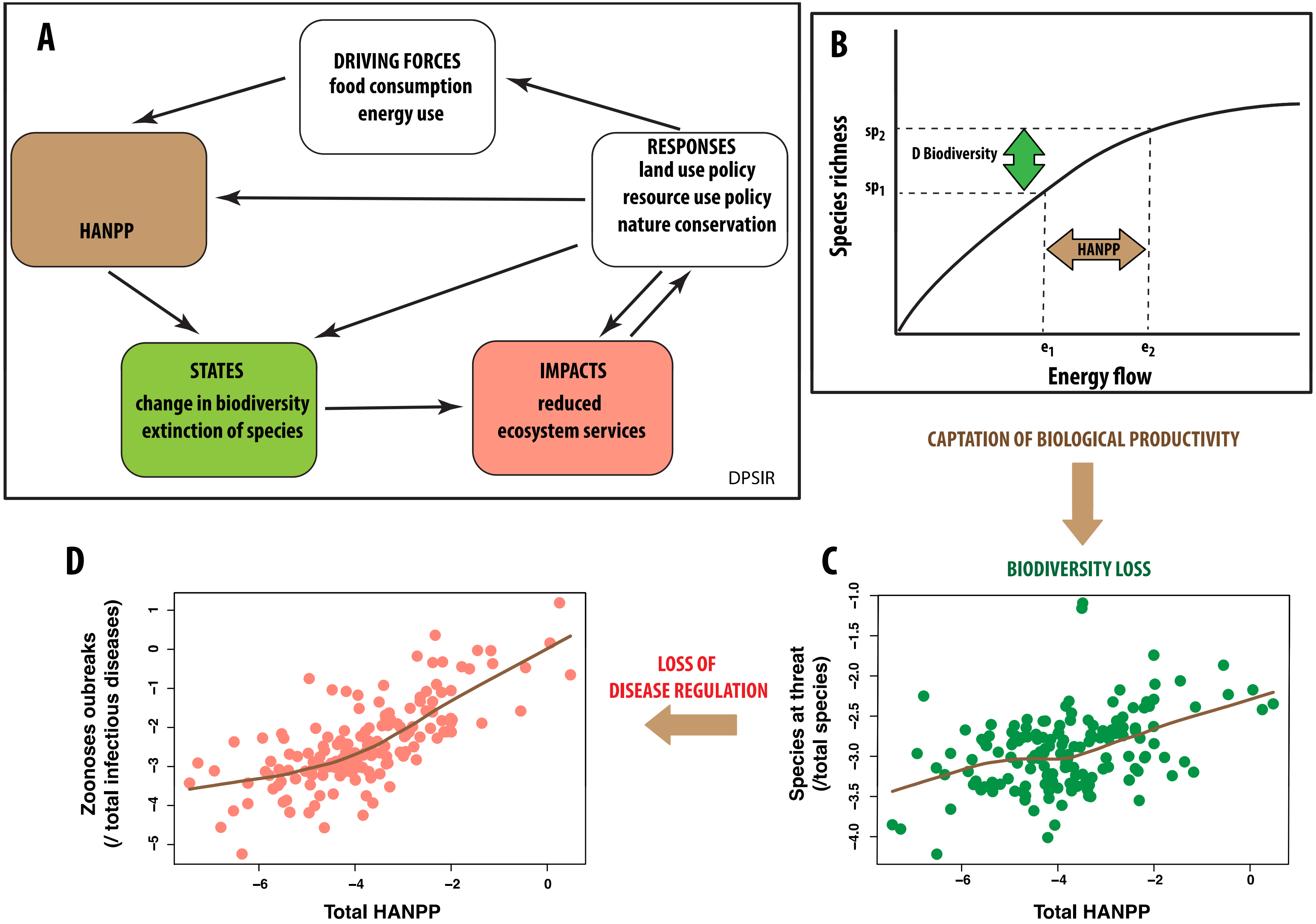
Loss of biodiversity linked to the Human Appropriation of the Net Primary Productivity (HANPP)



3

Increasing Zoonotic Diseases outbreaks with the Human Appropriation of the Net Primary Productivity (HANPP)

Human Appropriation of the Net Primary Productivity and loss of zoonotic diseases regulation



Anticipating future:
The need of scenarios

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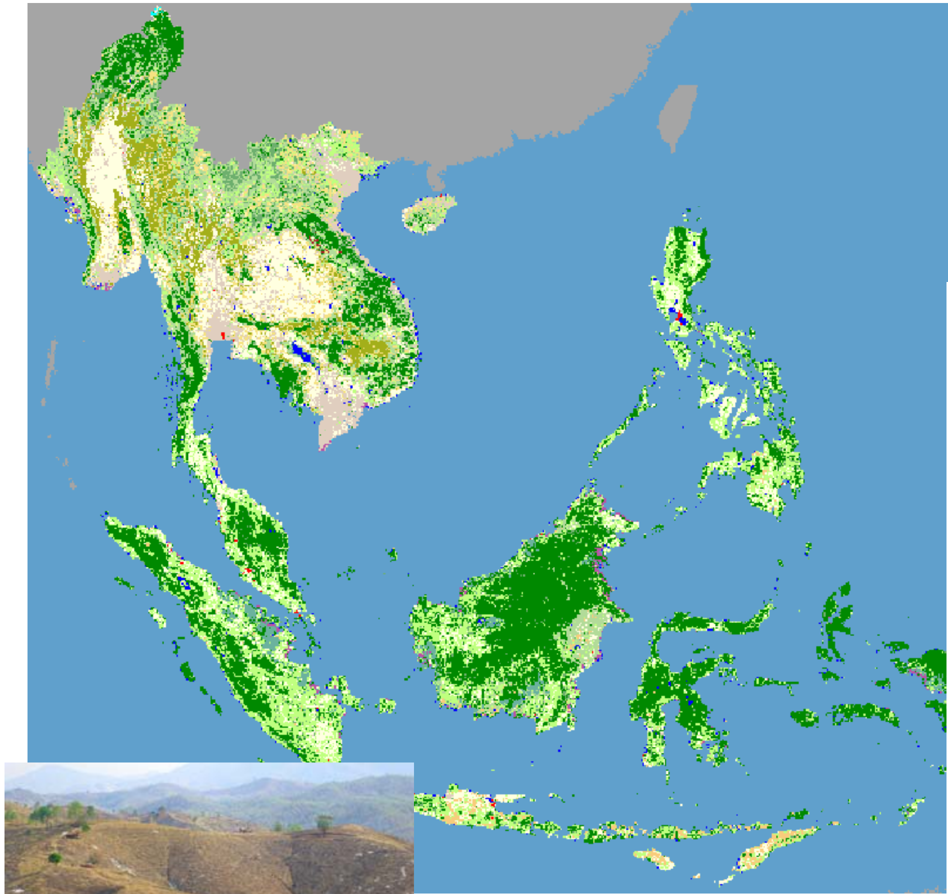
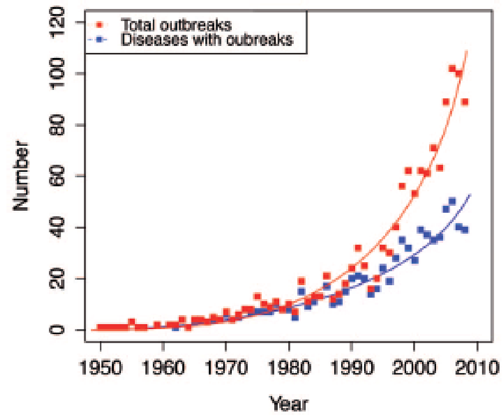
Infectious Diseases and Their Outbreaks in Asia-Pacific: Biodiversity and Its Regulation Loss Matter

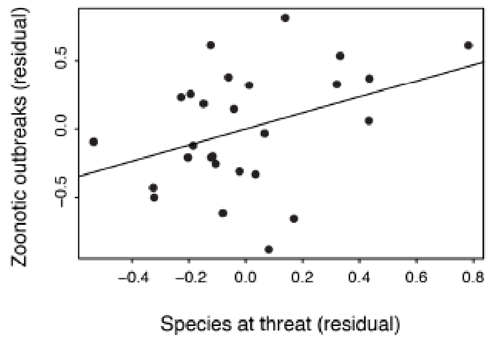
Serge Morand[1,2,3]*, Sathaporn Jittapalapong[4,5], Yupin Suputtamongkol[6], Mohd Tajuddin Abdullah[7], Tan Boon Huan[8]



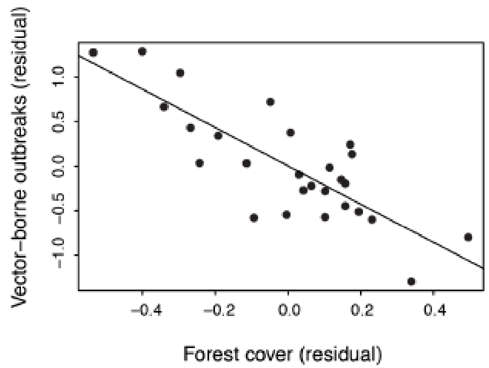
An increasing number of outbreak events

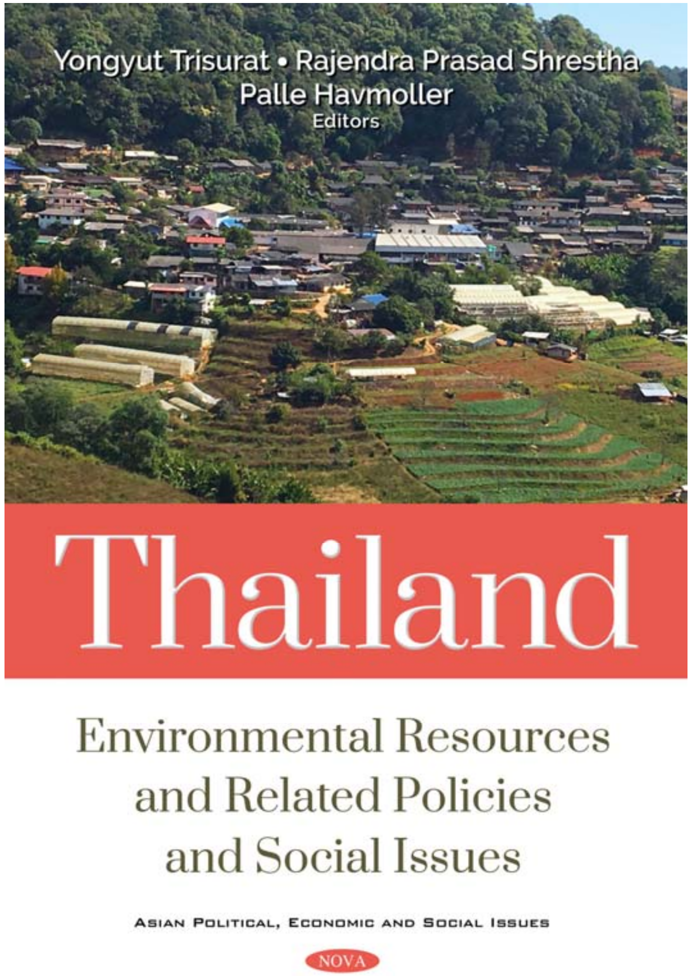


Zoonotic outbreaks linked with biodiversity at threat



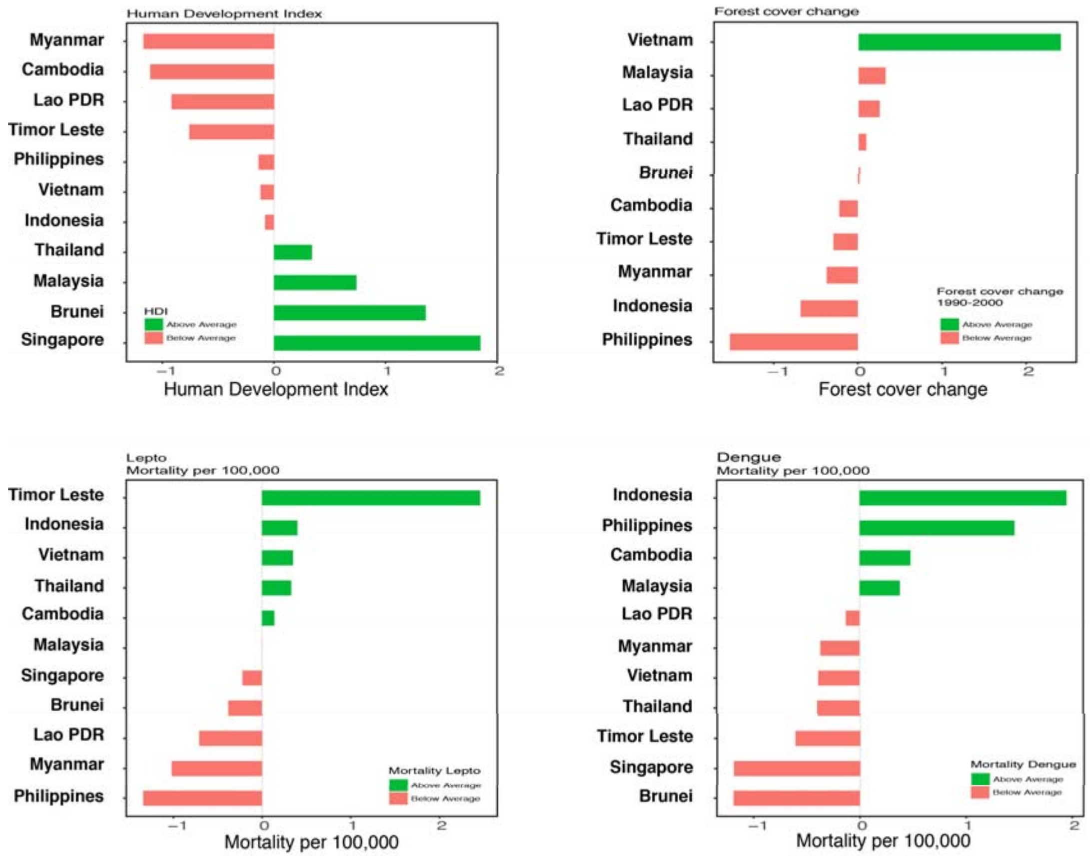
Vector-borne disease outbreaks linked with low forest cover

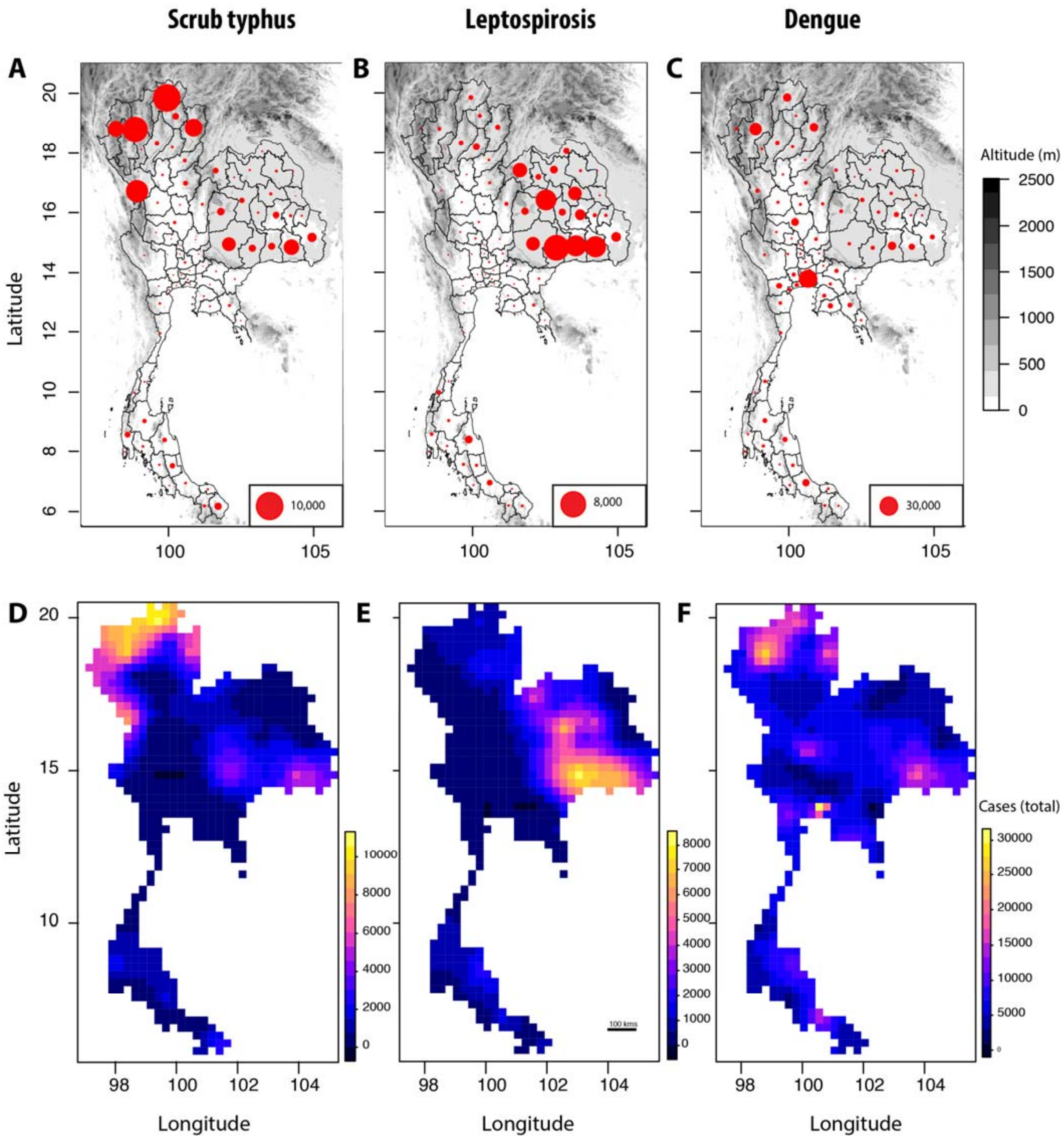




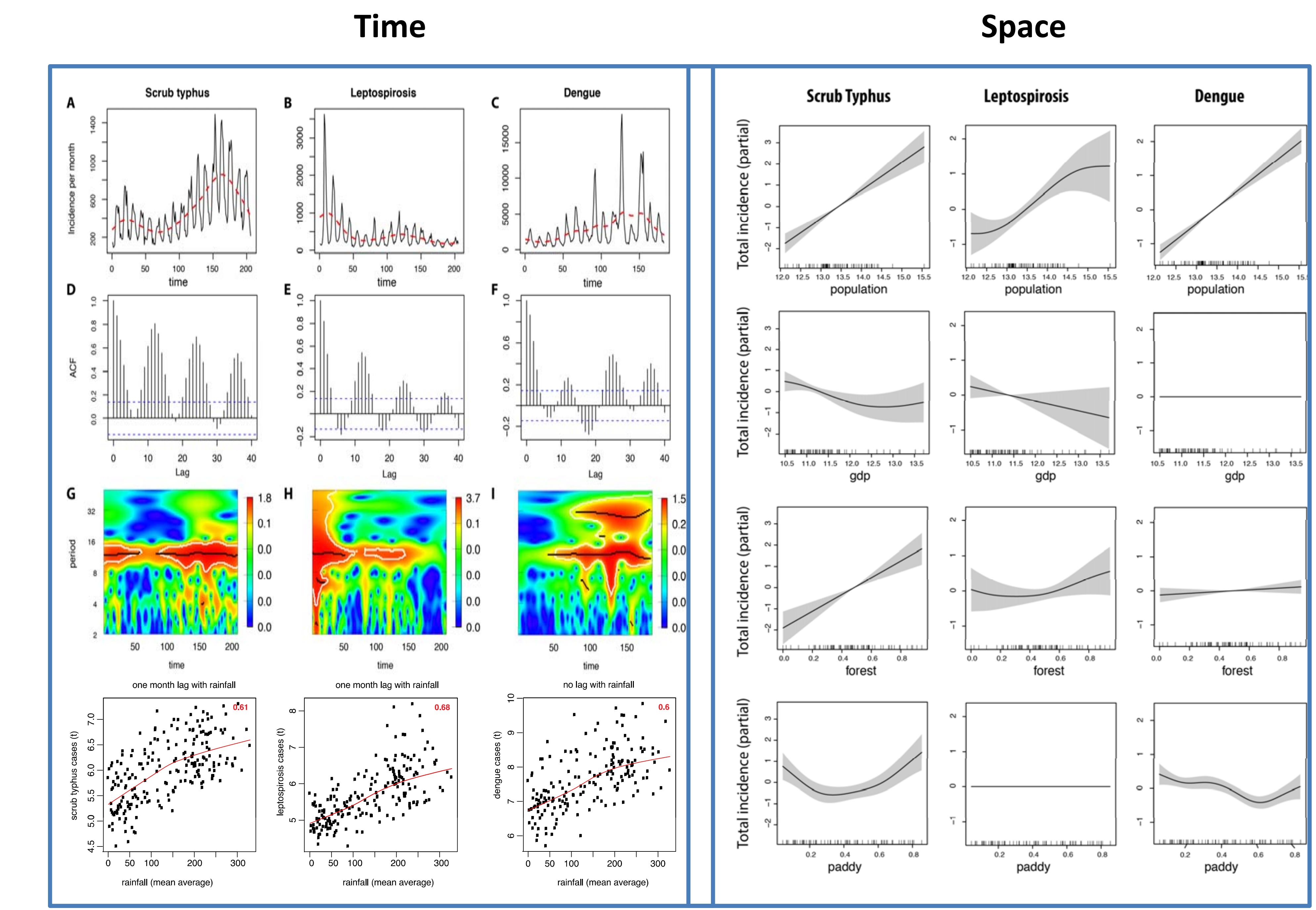
Environment and Health in Thailand: Investigating Epidemiological Trends of Three Infectious Diseases to Infer Scenarios

Serge Morand[1,2,], Kittipong Chaisiri[3],*
Anamika Karnchanabanthoeng[2] and Soawapak Hinjoy[4]





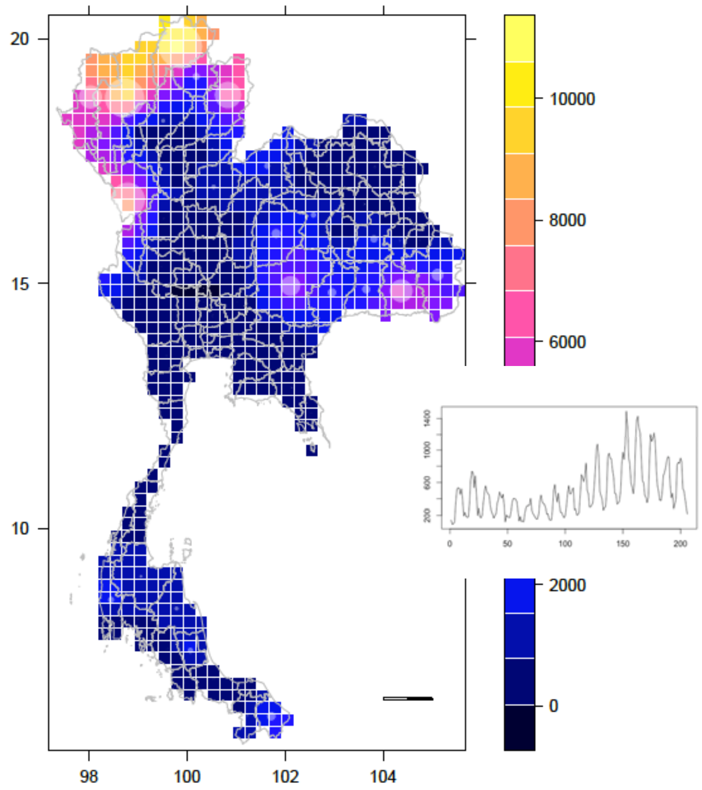
Scrub typhus
Leptospirosis
Dengue
A
B
C
D
E
F
Latitude
Longitude
10,000
8,000
30,000
Altitude (m)
2500
2000
1500
1000
500
0
Cases (total)
100 kms



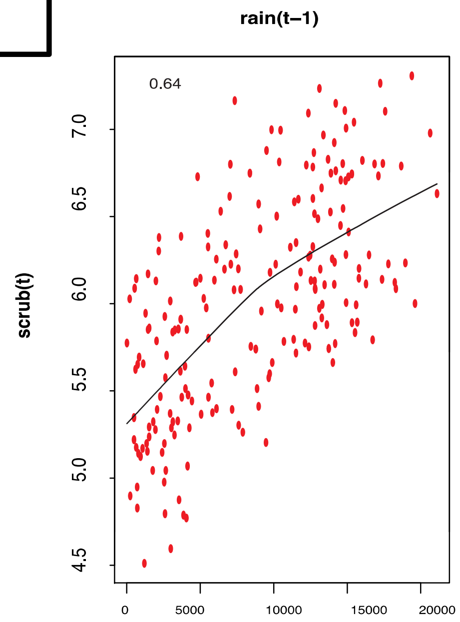
Time
Space
Scrub typhus
Leptospirosis
Dengue
A
B
C
D
E
F
G
H
I
Incidence per month
time
ACF
Lag
period
one month lag with rainfall
no lag with rainfall
scrub typhus cases (t)
leptospirosis cases (t)
dengue cases (t)
rainfall (mean average)
0.61
0.68
0.6
Scrub Typhus
Total incidence (partial)
population
gdp
forest
paddy

Climate variability and scrub typhus incidence 2000-2017 in Thailand

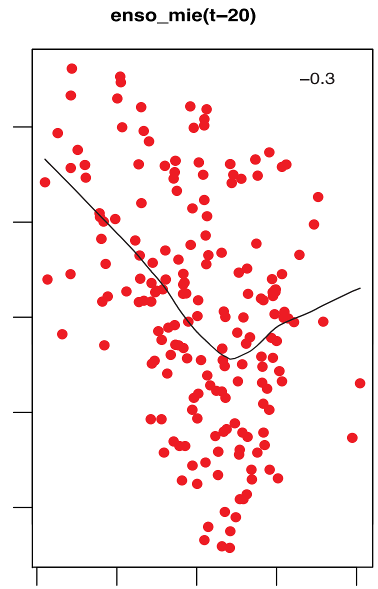
Climate variability: ENSO from NOAA
Scrub incidence 2000-2017
Bureau of Epidemiology, Thai Ministry of Health
Rainfall data
Thai Meteorological Department

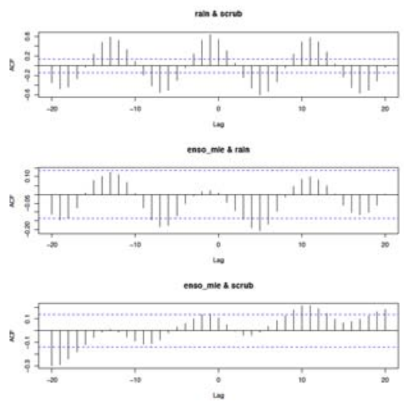


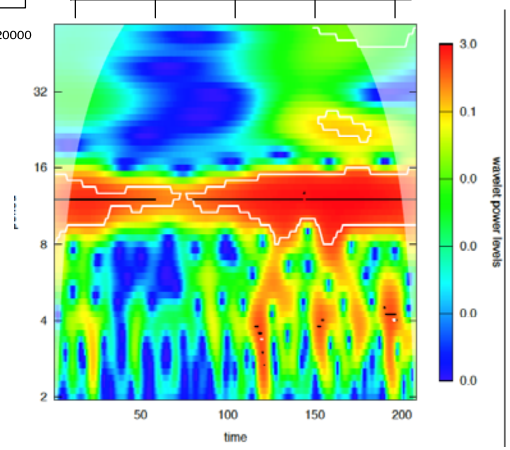
Rainfall Scrub
(1 month lag)



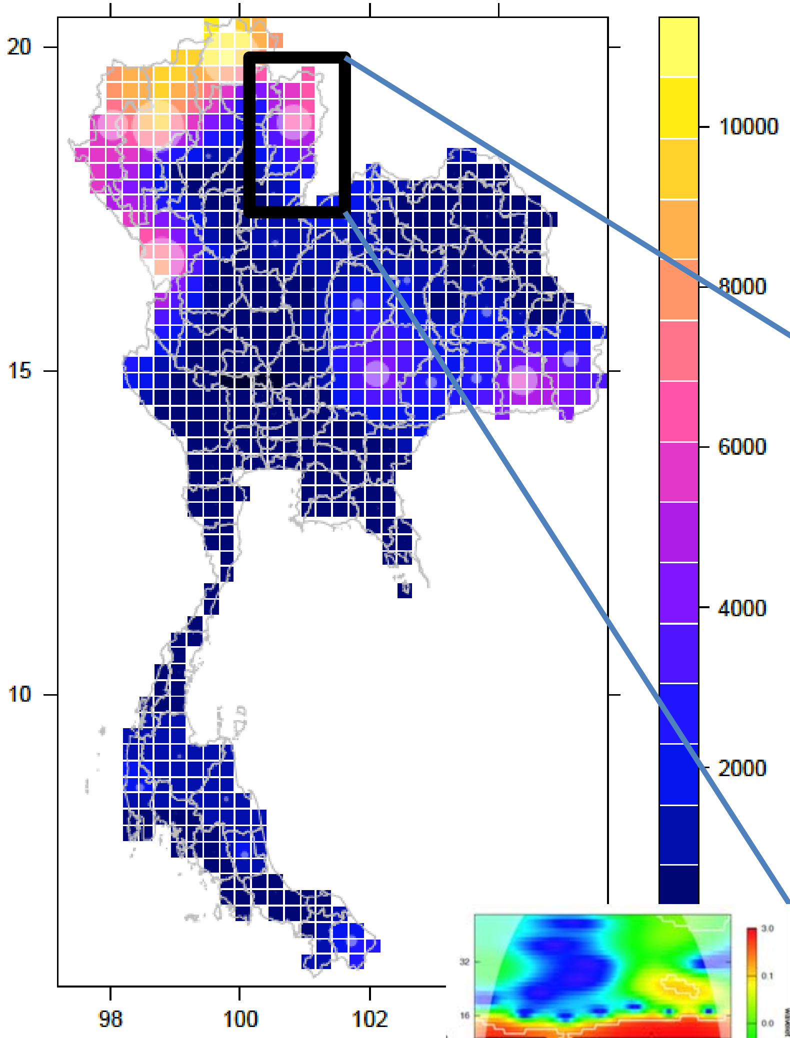
ENSO Scrub
(10 months lag)

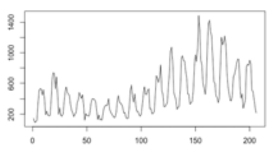


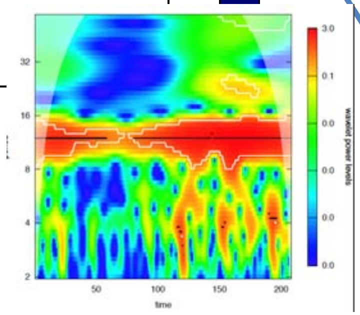




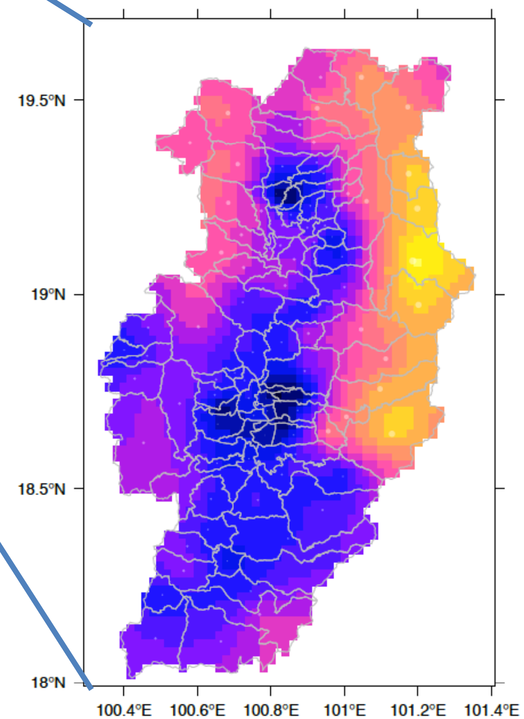
Modeling
the incidence of scrub typhus

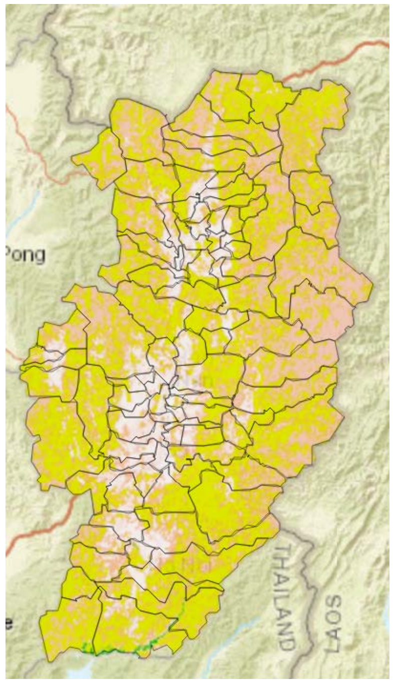




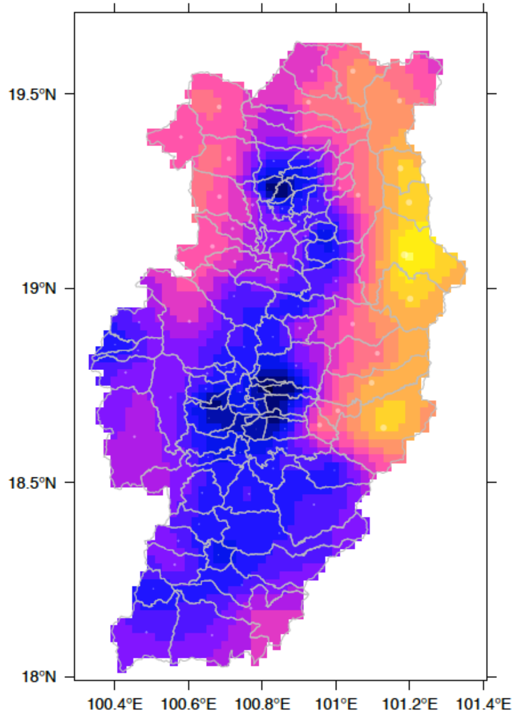


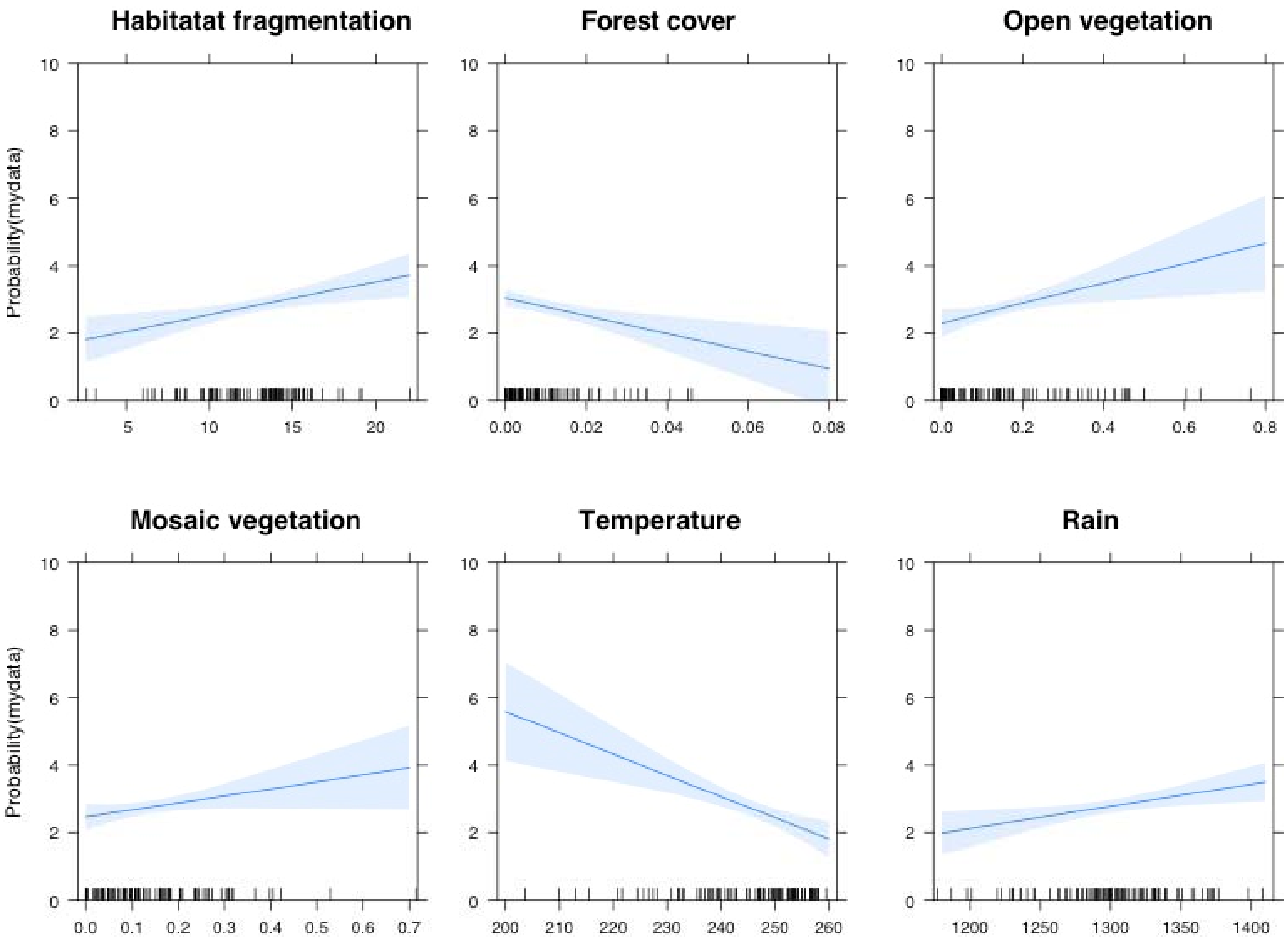
Land Use (Global Land Use)
Population
Elevation
Climate factors





Modeling
the incidence of scrub typhus
General Additive Modeling





Anticipating future:
The need of scenarios

Ecology Letters, (2018)

Pathogen spillover during land conversion

Christina L. Faust,[1,2,3]*
Hamish I. McCallum,[4]
Laura S. P. Bloomfield,[5]
Nicole L. Gottdenker,[6]
Thomas R. Gillespie,[7]
Colin J. Torney,[8]
Andrew P. Dobson[2] and
Raina K. Plowright[1]

$$\frac{dS_c}{dt} = b_c N_c\left(1 - \frac{N_c}{(1-\phi)K_c}\right) - \left(\frac{\beta_c S_c I_c}{N_c^{\kappa}} + \frac{\varepsilon[\phi]\psi\beta_m S_c I_m}{(N_c + \varepsilon[\phi]N_m)^{\kappa}}\right) - d_c$$

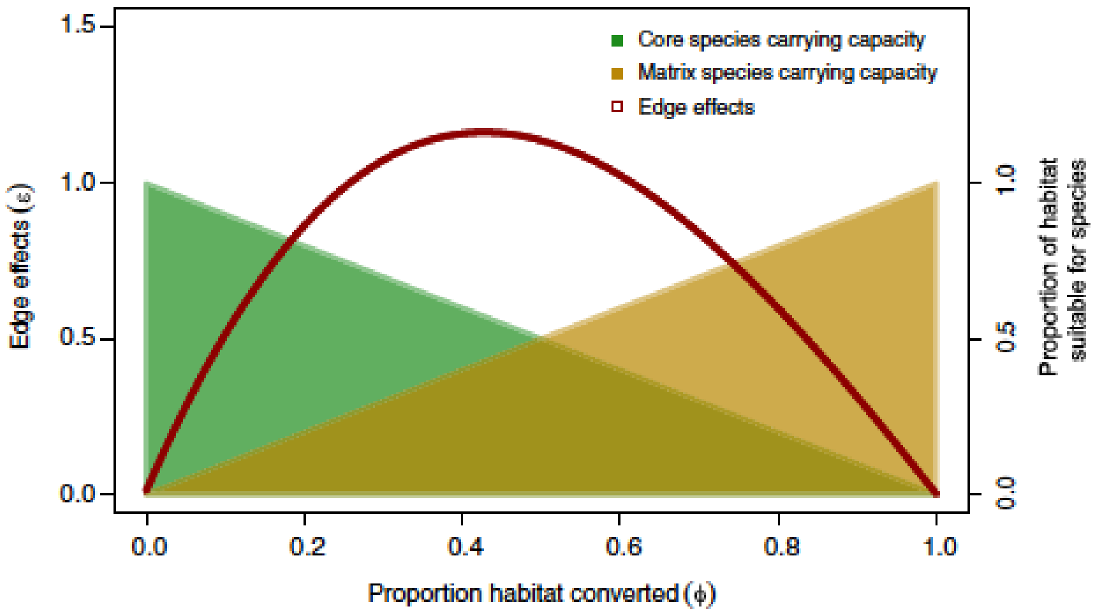
$$\frac{dI_c}{dt} = \frac{\beta_c S_c I_c}{N_c^{\kappa}} + \frac{\varepsilon[\phi]\beta_m S_c I_m}{(N_c + \varepsilon[\phi]N_m)^{\kappa}} - (d_c + \alpha_c + \gamma_c)I_c$$

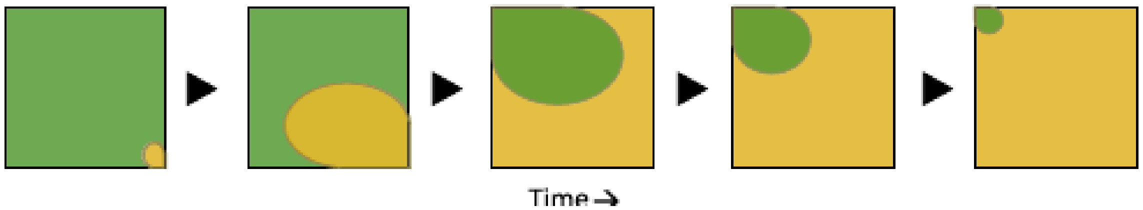
$$\frac{dR_c}{dt} = \gamma_c I_c - d_c R_c$$

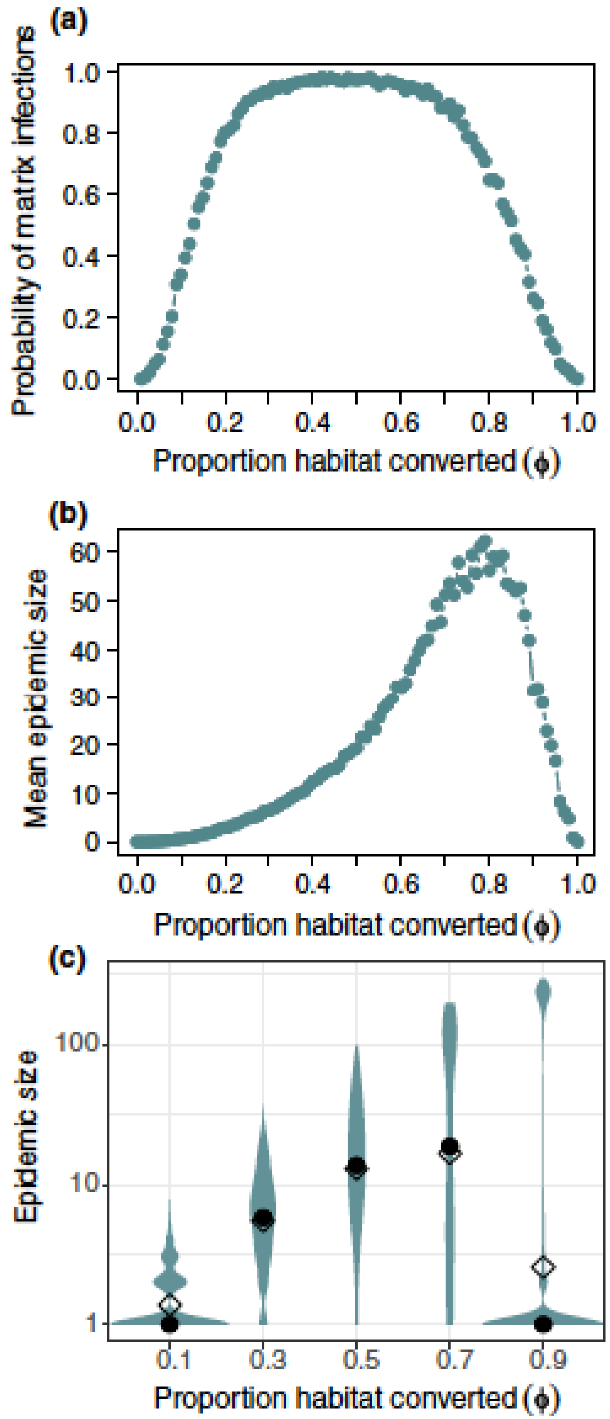
$$\frac{dS_m}{dt} = b_m N_m\left(1 - \frac{N_m}{\phi K_m}\right) - \left(\frac{\beta_m S_m I_m}{N_m^{\kappa}} + \frac{\varepsilon[\phi]\psi\beta_c S_m I_c}{(N_m + \varepsilon[\phi]N_c)^{\kappa}}\right) - d_m$$

$$\frac{dI_c}{dt} = \frac{\beta_m S_m I_m}{N_m^{\kappa}} + \frac{\varepsilon[\phi]\psi\beta_c S_m I_c}{(N_m + \varepsilon[\phi]N_c)^{\kappa}} - (d_m + \alpha_m + \gamma_m)I_m$$

$$\frac{dR_c}{dt} = \gamma_m I_m - d_m R_m$$

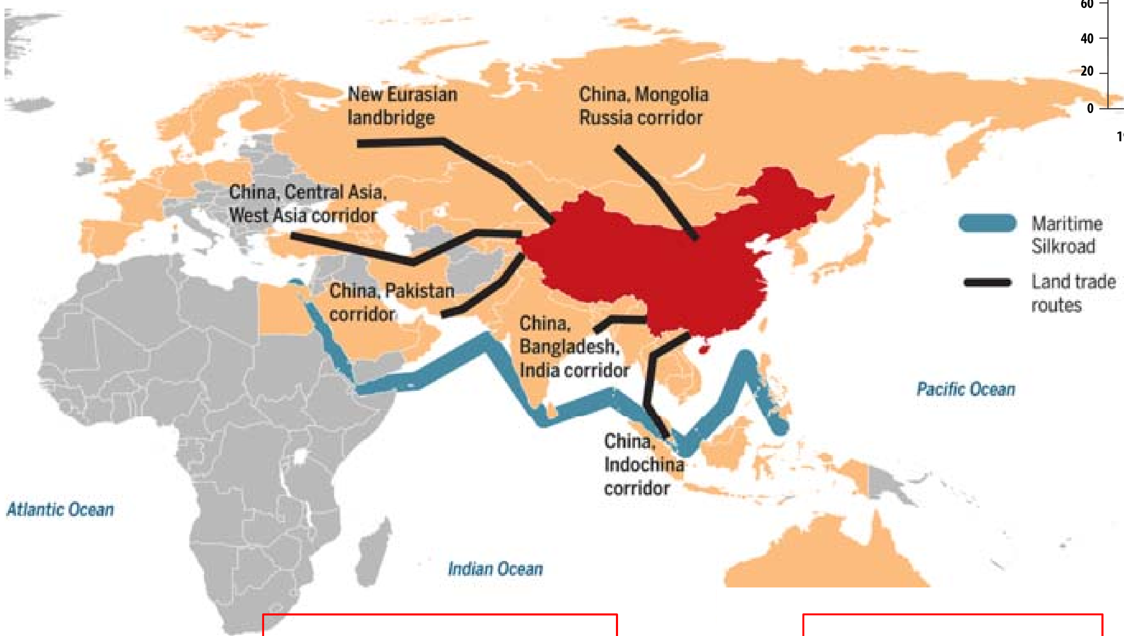


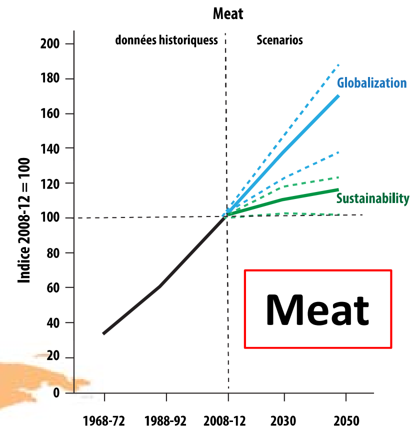


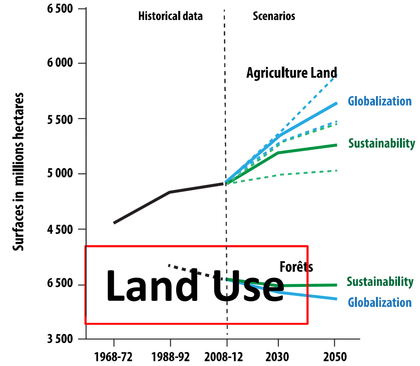


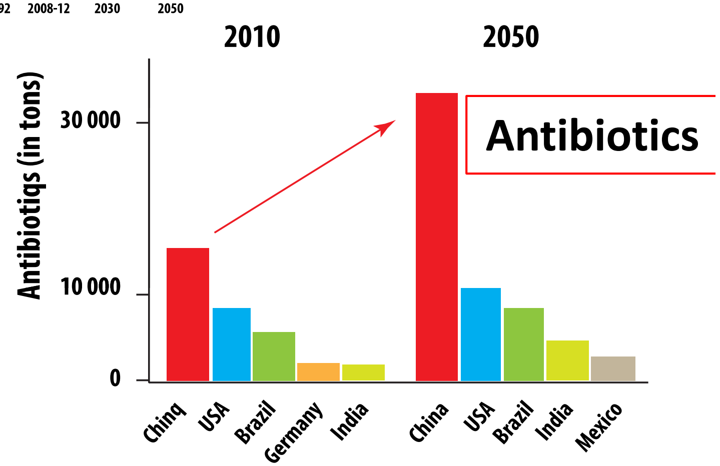
FUTURE

Economic Corridors

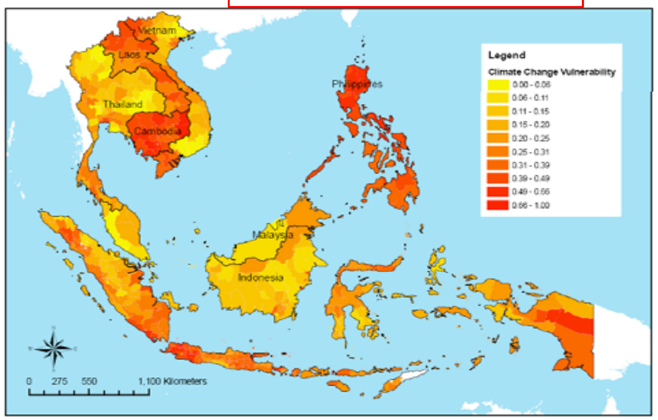




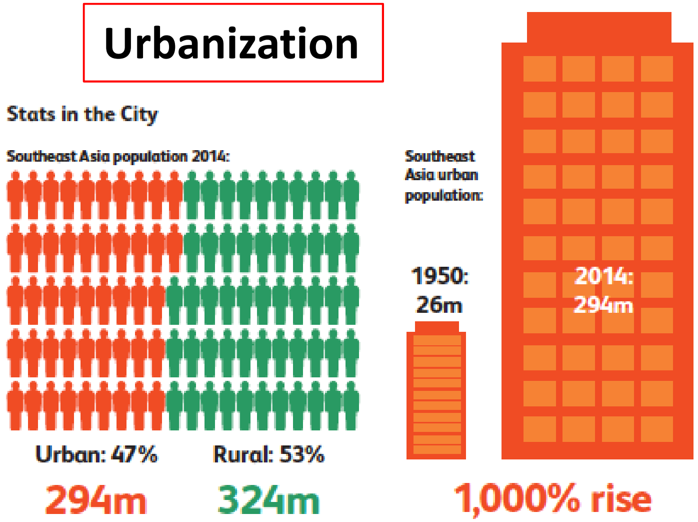




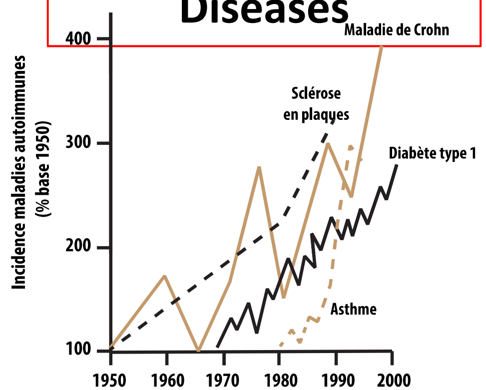
Climate Change



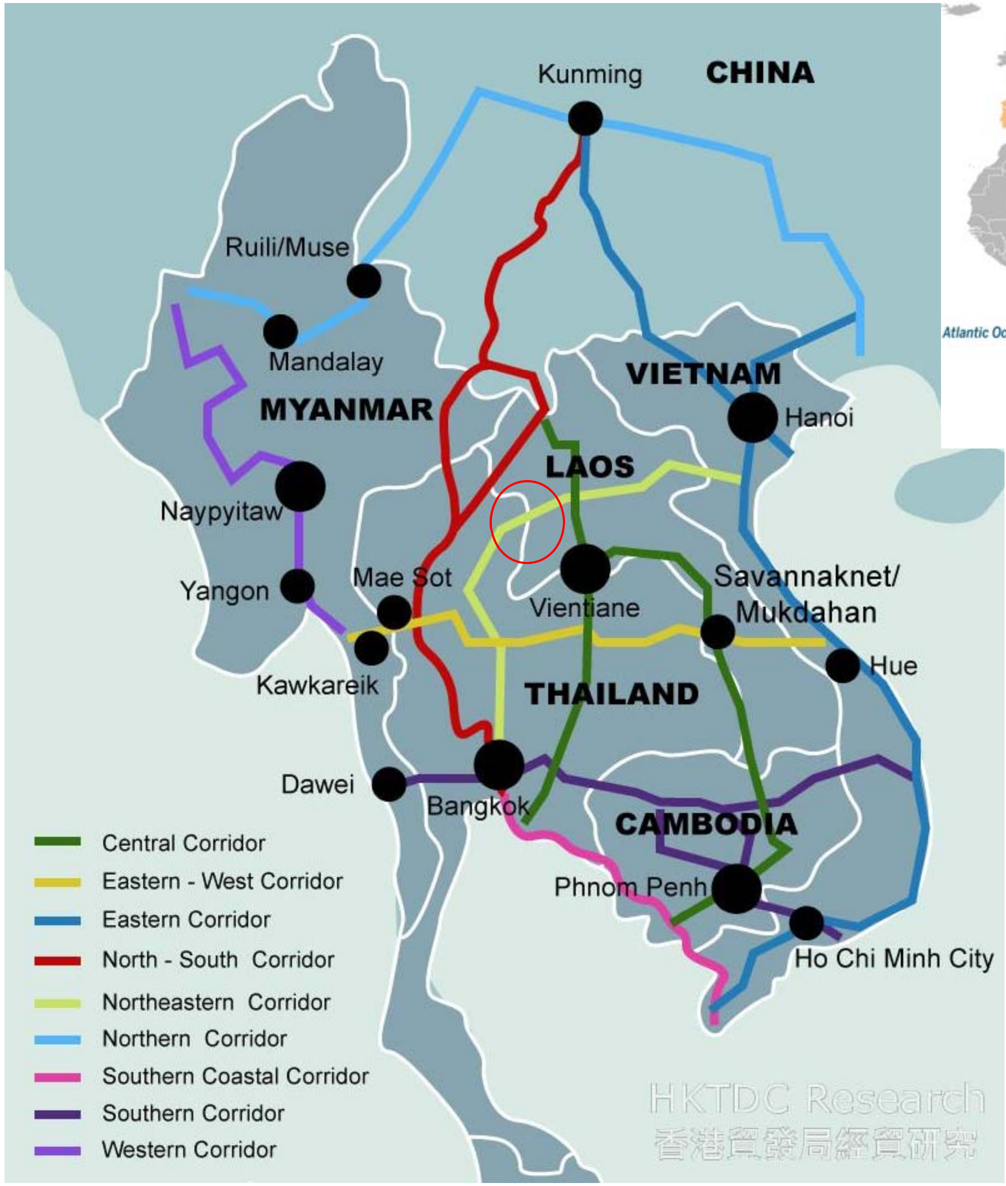
Urbanization

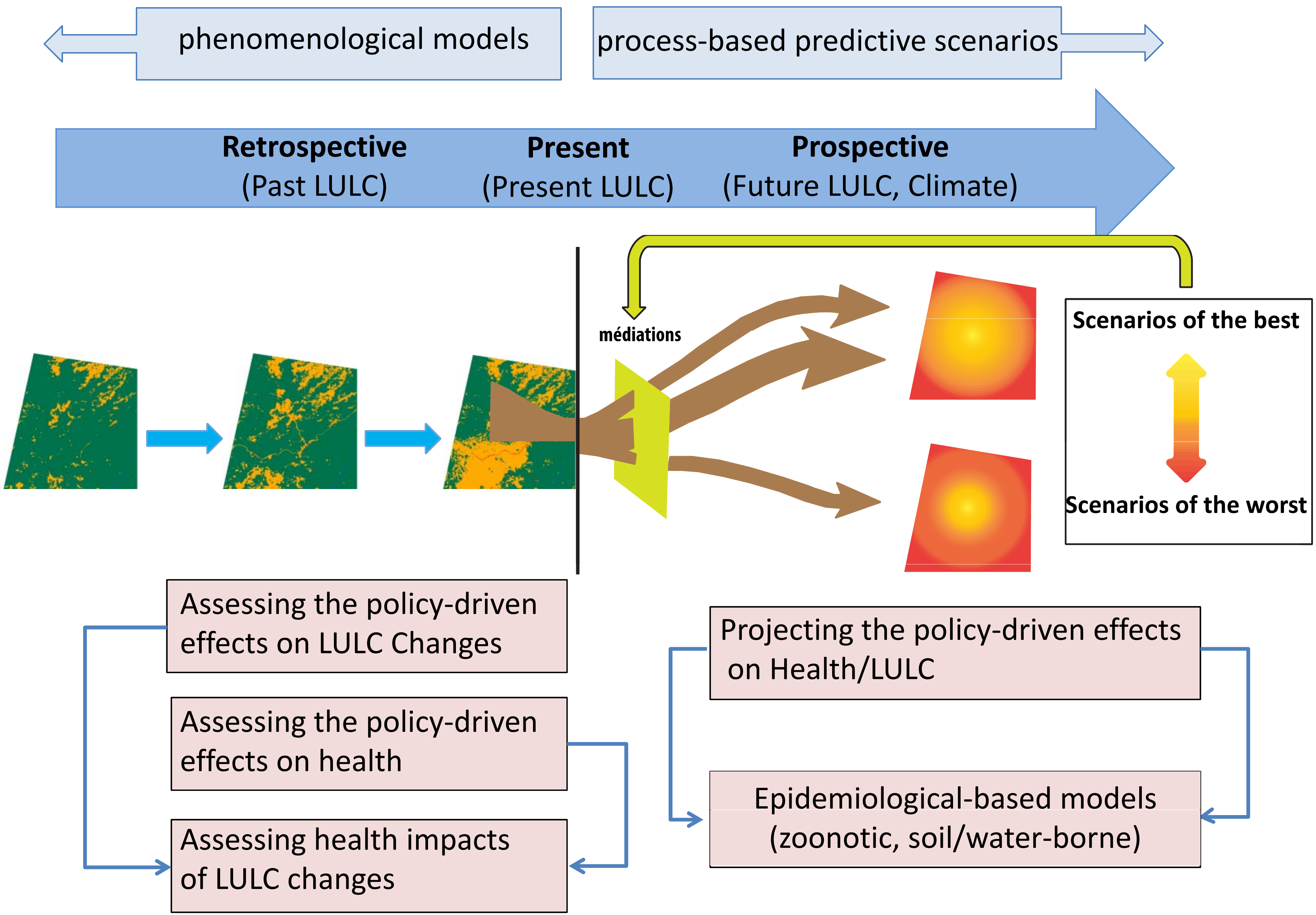


Non-communicable Diseases



One Belt One Road Initiative




phenomenological models
process-based predictive scenarios
Retrospective
(Past LULC)
Present
(Present LULC)
Prospective
(Future LULC, Climate)
médiations
Scenarios of the best
Scenarios of the worst
Assessing the policy-driven effects on LULC Changes
Assessing the policy-driven effects on health
Assessing health impacts of LULC changes
Projecting the policy-driven effects on Health/LULC
Epidemiological-based models (zoonotic, soil/water-borne)

TICA

AGENCE NATIONALE DE LA RECHERCHE

ANR

This will be a next story …

Thank you