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**Climate and Health**  
*Health and climate change*

*David Vernez*

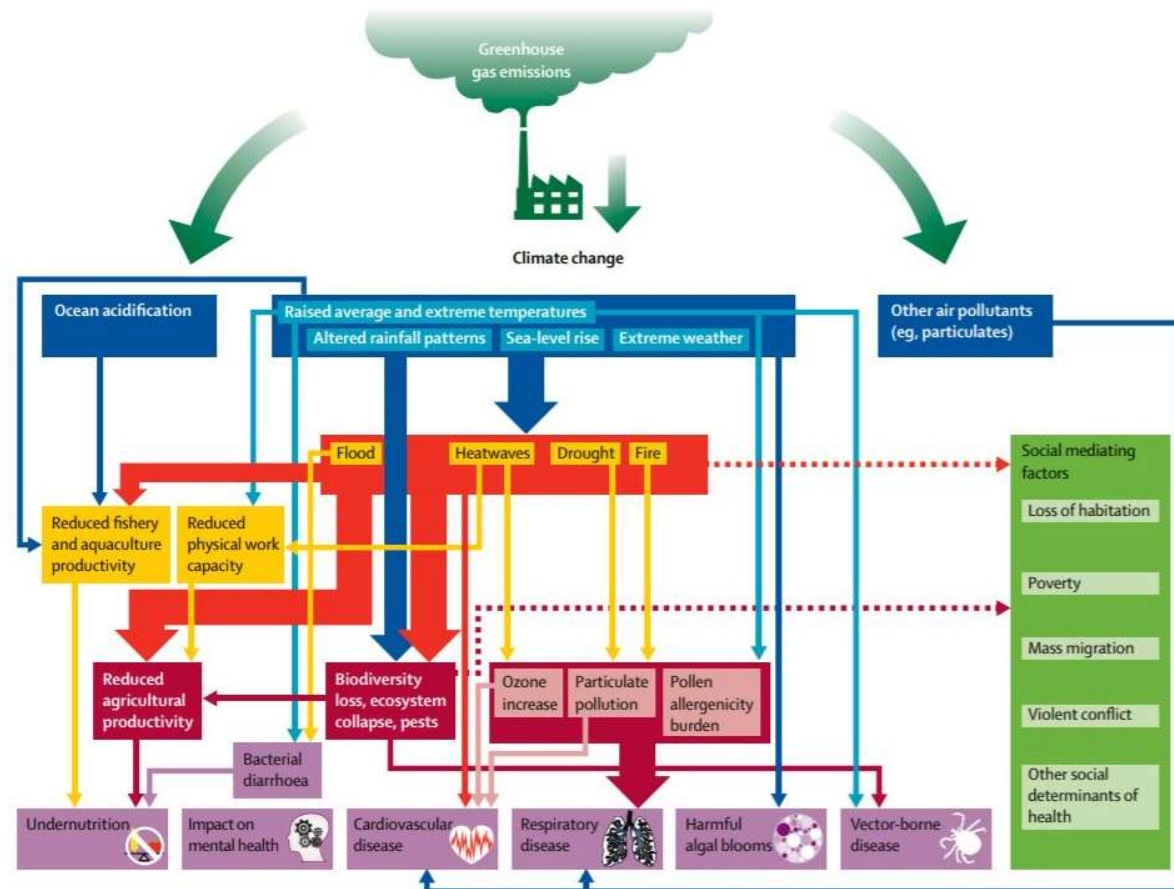


# Climate and Health

## Overview

### Health determinants

- Complex relationships
- Indirect health effects
- Socioeconomic impacts



# Case study

## Mental health and climate

Mental health problems are one of the possible consequences of climate change.

### Question (5.a)

What phenomenon(s) do you think could explain this hypothesis?



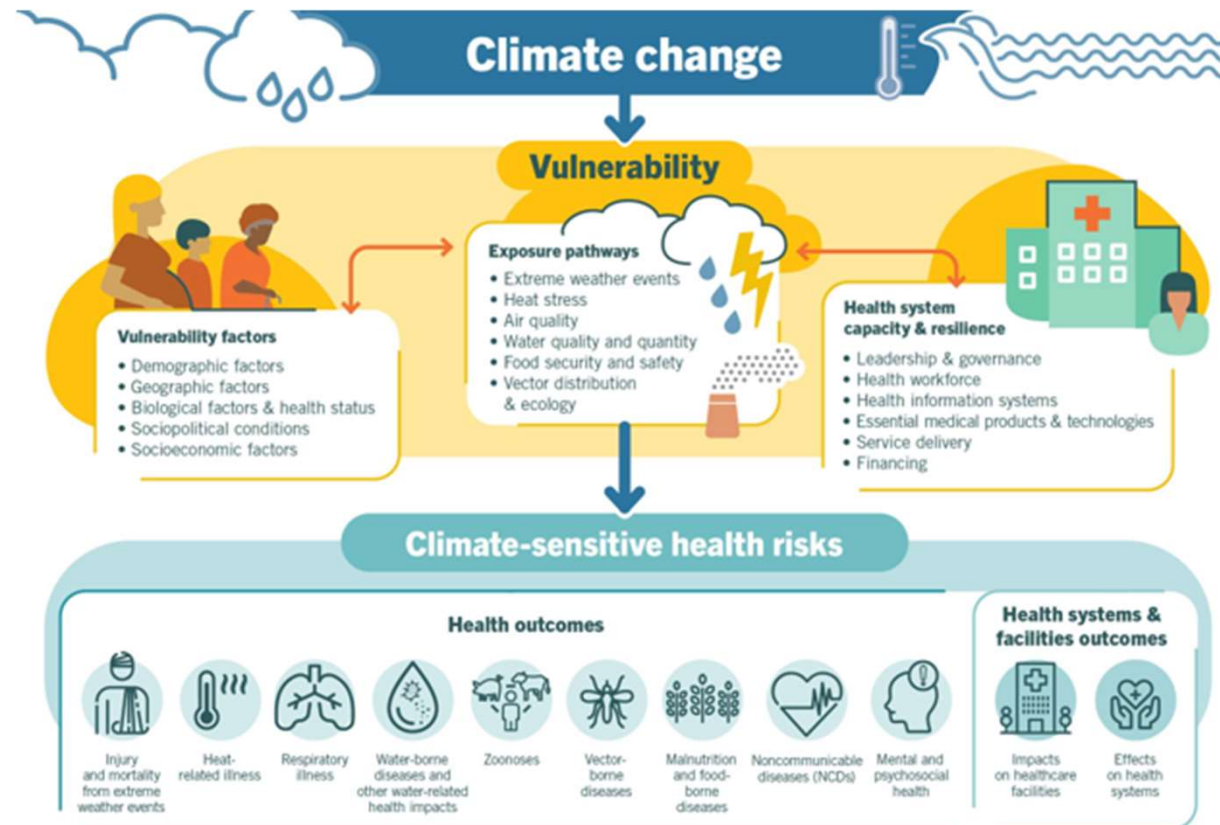
*Hopkins Bloomberg Public Health*

# Climate and Health

## Overview

Pathways and mediating factors

- Vulnerabilities
- Systemic factors
- Impact on (and from) the healthcare system



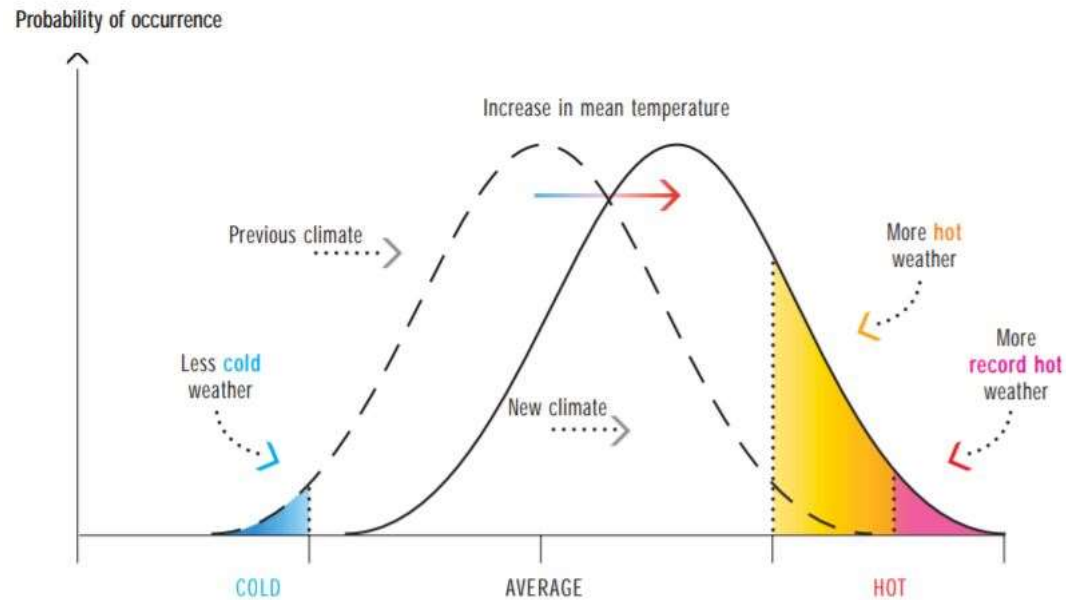
# Climate and health – heat



## Extreme weather events

Displacement of the weather distribution

- Average increase in temperature
- Increase in frequency of extreme weather conditions



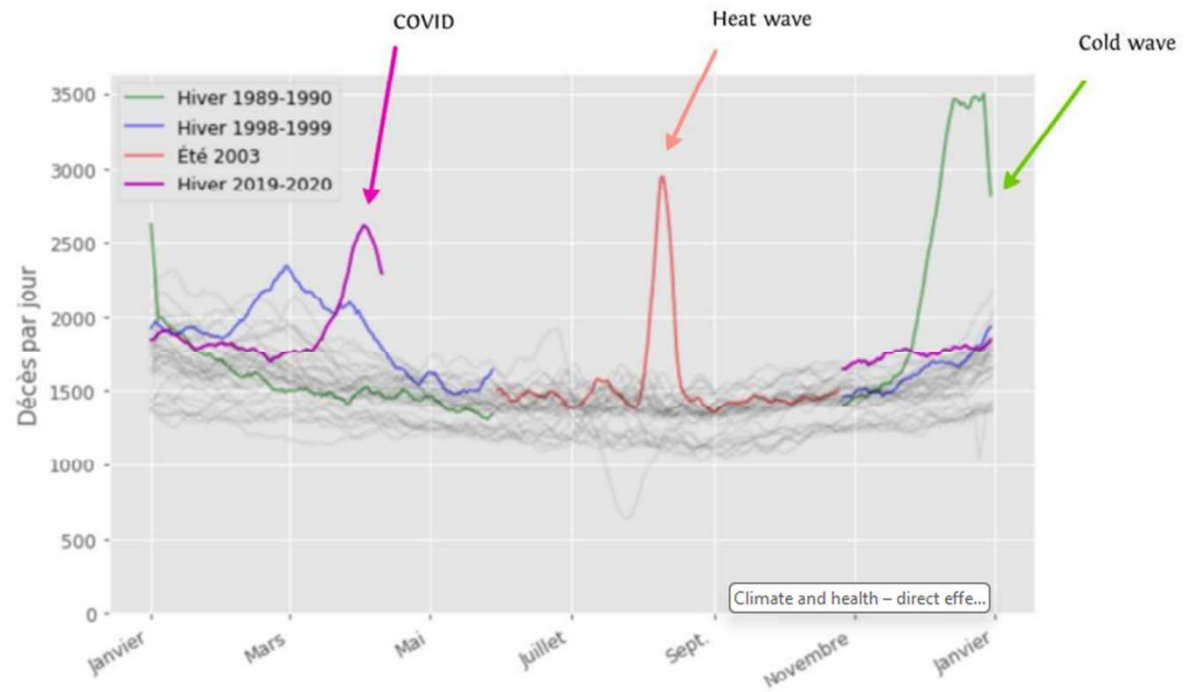
# Climate and health – heat



## Extreme weather events

### Thermal events and excess mortality

- Seasonal mortality in France
- Influence of extreme events



# Climate and health – heat



## Heat Waves and Heat stress

### General population

#### Situation

- Lasting elevated temperatures

#### Effects

- Exhaustion, dehydration
- Overmortality in vulnerable populations

#### Criteria

- Elevated daily and nocturnal temperature
- Several days
- Ambient temperature

### Workers

#### Situation

- Acute elevated temperature
- At risk activities

#### Effects

- Heat stroke, exhaustion, dehydration
- Exhaustion, heat stroke
- At risk workplaces

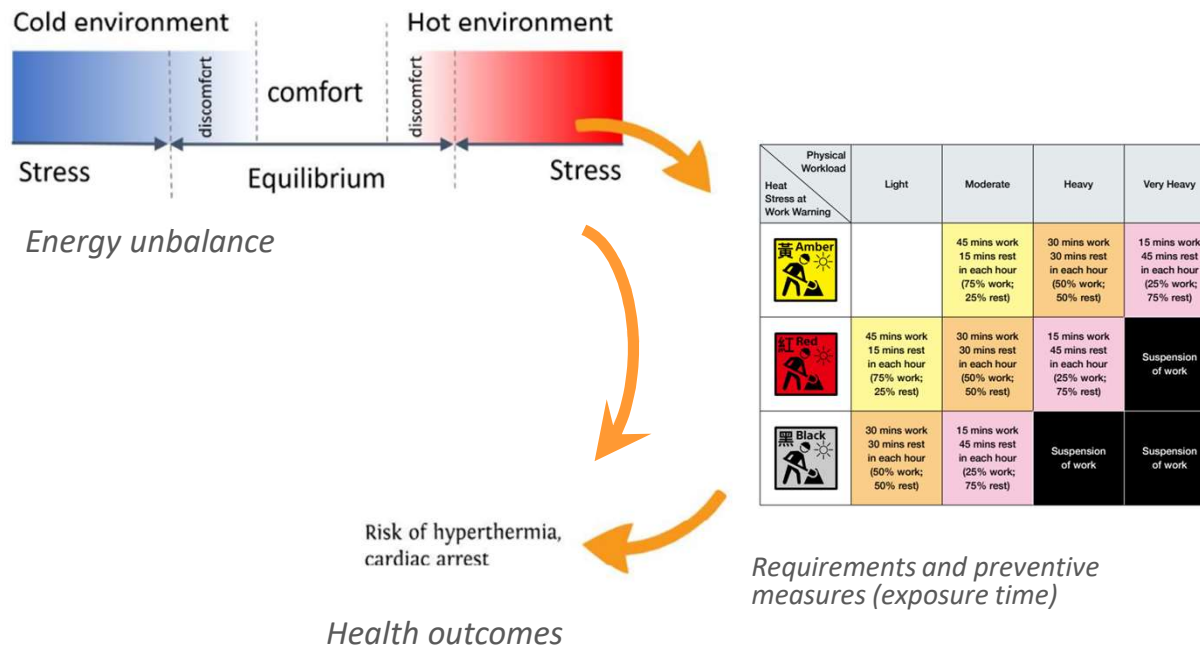
#### Criteria

- Heat strain (WBGT Temp.)
- Metabolic activity
- clothing..

# Climate and health – heat



## Assessing the global impact of heat stress



- Rare extreme outcomes
- Statistics are not reliable (causality)
- Indirect metric (requested rest time)

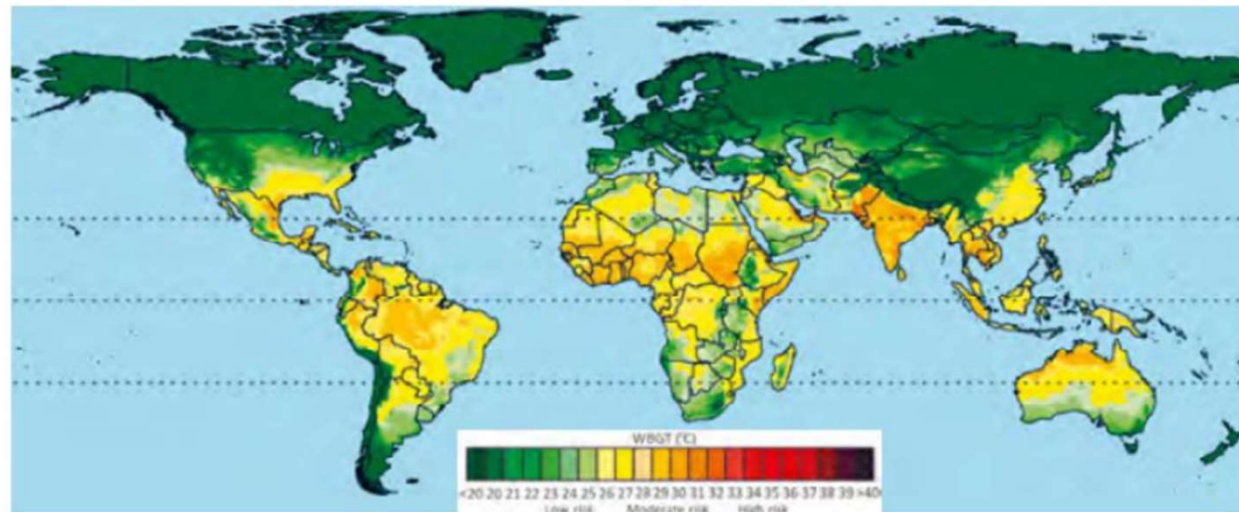
# Climate and health – heat



## WBGT climatology

Maximum daily  
WBGT values

- 30 yr average
- 1981-2010
- Heat stress in 1996



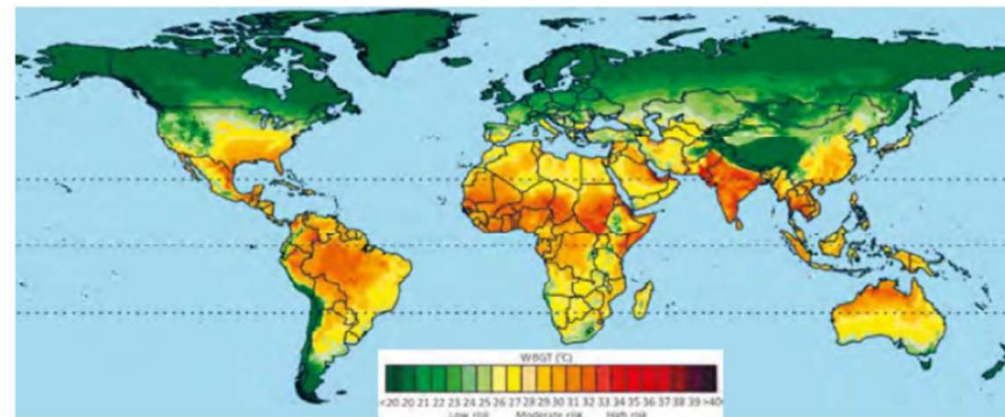
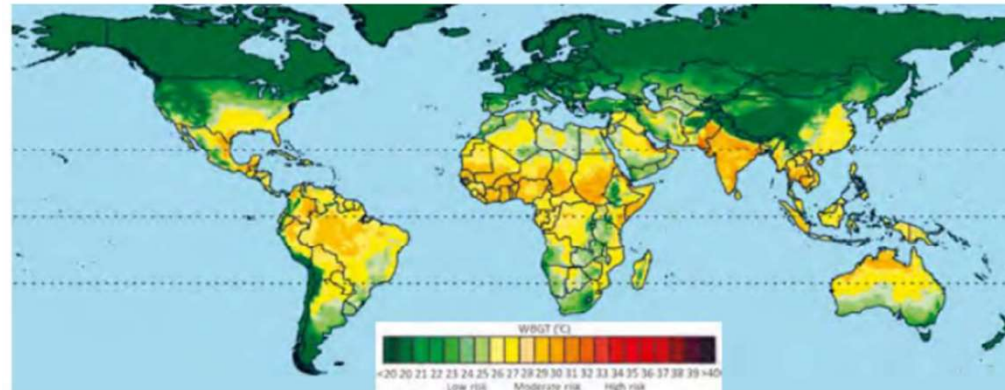
# Climate and health – heat



## WBGT forecast

Maximum daily  
WBGT values

- situation 1996 vs
- Forecast 2085



ILO 2019

# Climate and health – heat



## WBGT – Forecast in Europe

### Weak effect on productivity loss

- Low % of workers in primary sectors
- Low global increase in WBGT

### Increased direct effects for:

- Populations and work organization poorly acclimatized
- Particularly exposed work situations

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**UNIA**

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«Workers: the Climate Canaries». *Am J. of Pubic Health* 2014

# Climate and health – heat

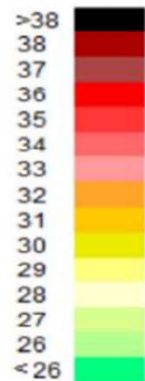


## Extreme situations in south-east Asia

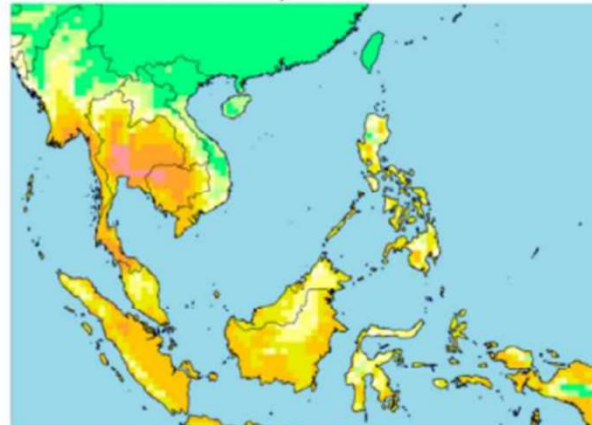
Progressive increase of WBGT with climate

- Worker productivity drops by 2–3% for every degree above 20°C.

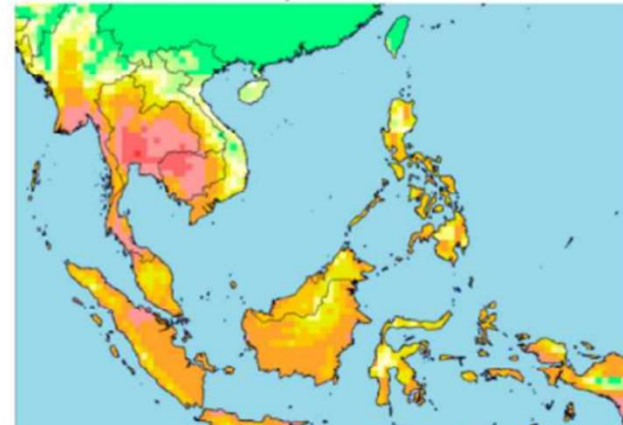
WBGT  
colour code



WBGT in the sun, 1975



WBGT in the sun, 2050



# Climate and health – heat



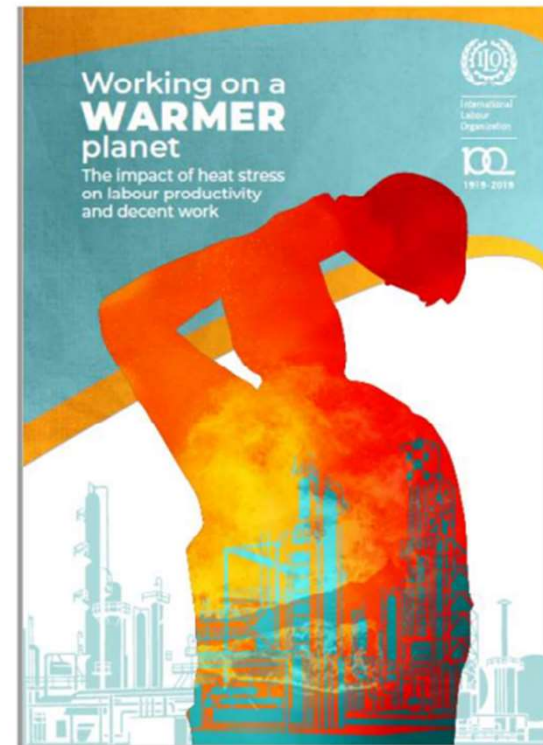
## Extreme weather events – indirect effects

### Loss of productivity

- Slower pace of work
- Need to increase rest time

### Increased risk of accidents

- Fatigue, decrease in reasoning ability, difficulties in wearing protective equipment



ILO, 2019

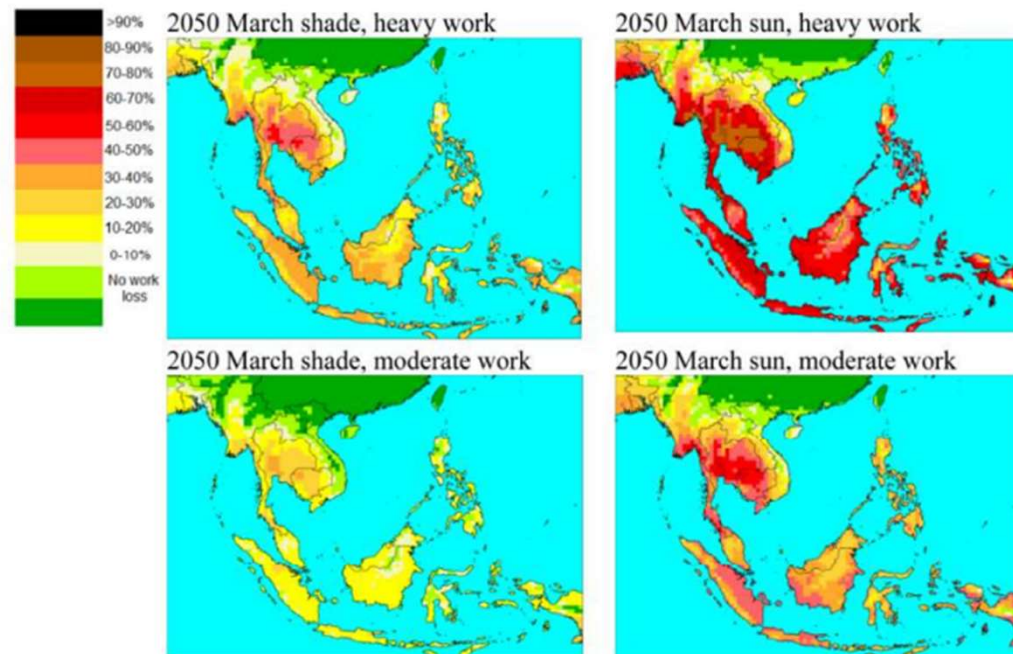
# Climate and health – heat



## Loss of working time

Loss of work related to the need for rest time

- [%] of afternoon time lost
- Projection 2050
- Highly sensitive to the work performed



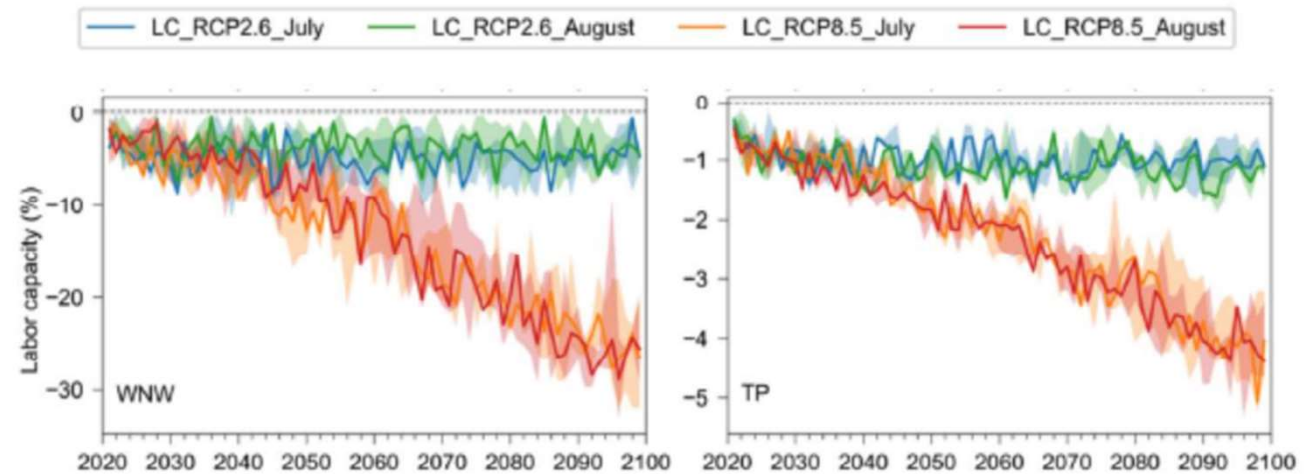
# Climate and health – heat



## Loss of working time

Loss of work in two provinces in China

- Labor capacity [%]
- Projection 2099
- High sensitivity to climate change scenario



Xincai, IJERPH, 2020

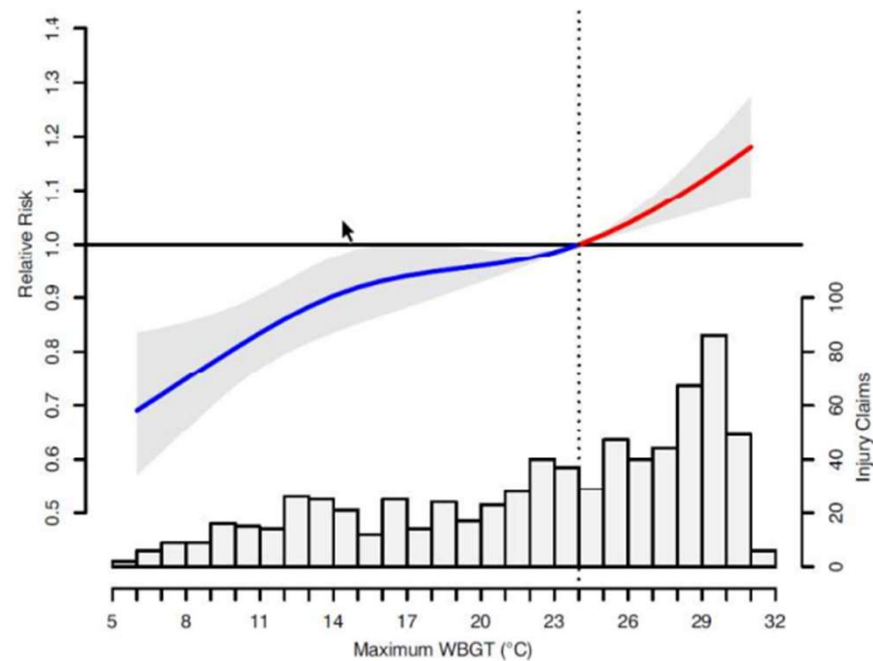
# Climate and health – heat



## Thermal stress and work accidents

Effects other than heat stroke: work accidents, absenteeism

- Correlation between the increase in daily WBGT max and accident cases reported
- 4.8% of occupational injuries attributable to heat stress



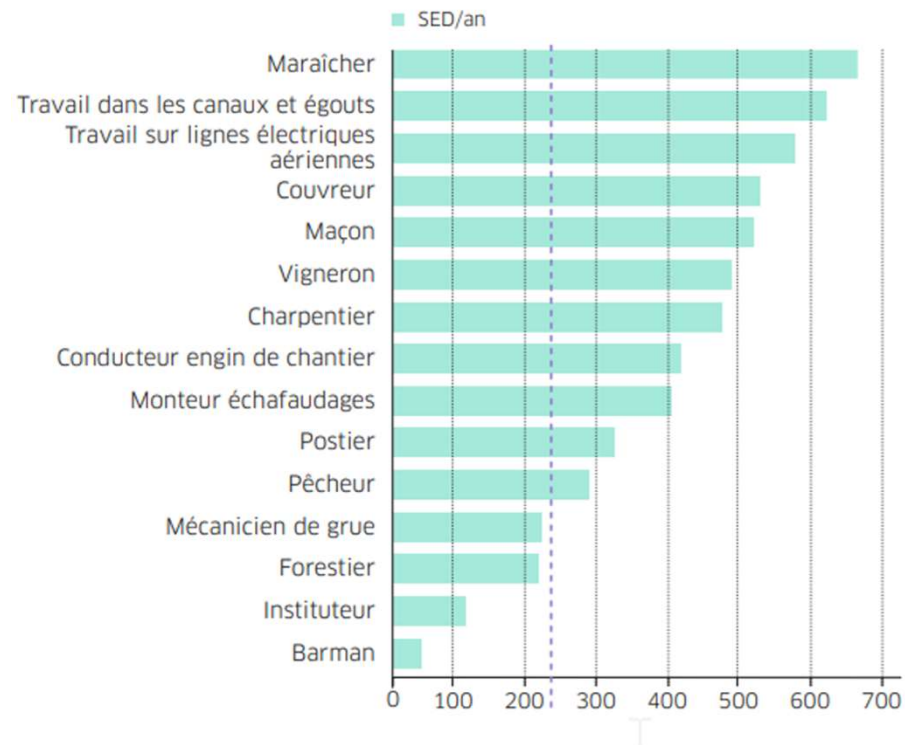
Ma et al. Science of the Tot. Env. 2019

# Climate and health – UV light



## More sunny days

- Increase in UV light exposure
- Incidence of skin cancer
- Average UV doses in outdoor occupations



Genesis, 2022

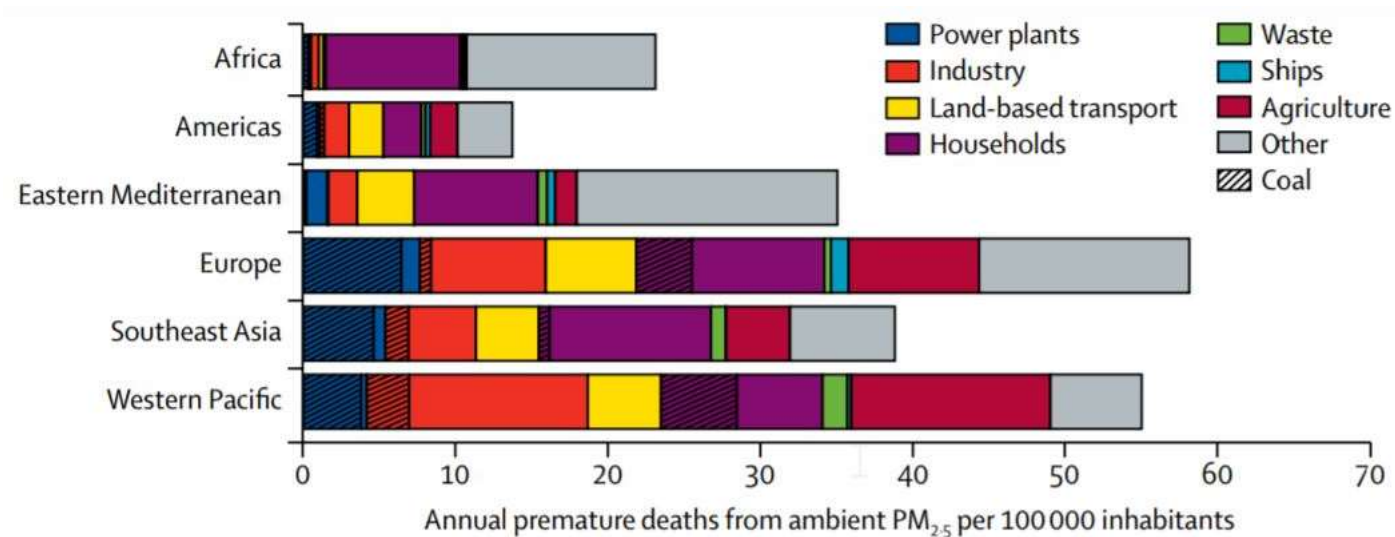
# Climate and health – Air pollution



## Particulate pollution, ozone pollutants

Increase in atmospheric pollution

- Cardiovascular risks, chronic respiratory diseases, asthma
- 4.2 Mio death/year due to environmental pollution



# Climate and health – Air pollution



## Particulate pollution, ozone pollens

- 3% of cardiopulmonary death and 5% of lung cancers are attributable to PM
- Particulate pollution causes 3.1 Mio death/year (2010)
- PM<sub>10</sub> and PM<sub>2.5</sub> penetrate the thoracic and respiratory zone, respectively
  - Evidence of health effects from short-term exposures to PM<sub>10</sub>
  - Evidence of effects on respiratory health and mortality from chronic exposure to PM<sub>2.5</sub>
  - Mortality increases by 6-13% per 10 µg/m<sup>3</sup> of PM<sub>2.5</sub>
- Vulnerable groups: pre-existing lung or heart disease, elderly, children
- 90% of cities have particulate concentrations > WHO recommendation (10 µg/m<sup>3</sup> of PM<sub>2.5</sub> )

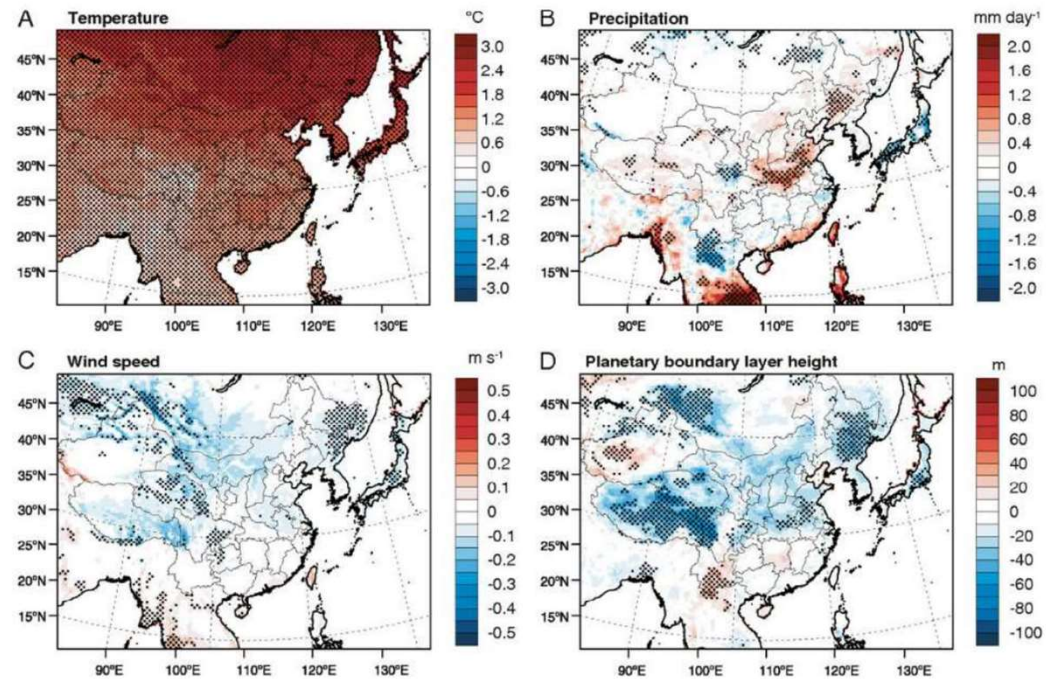
# Climate and health – Air pollution



## Particulate pollution, ozone pollens

### Climate forecast in China

- Increased temperature and ozone
- Variation in average conditions (precipitation, humidity)
- Increase of extreme events (heat waves, atmospheric stagnation...)



Expected changes between 2010 and 2050 (RCP4.5), Hong 2019

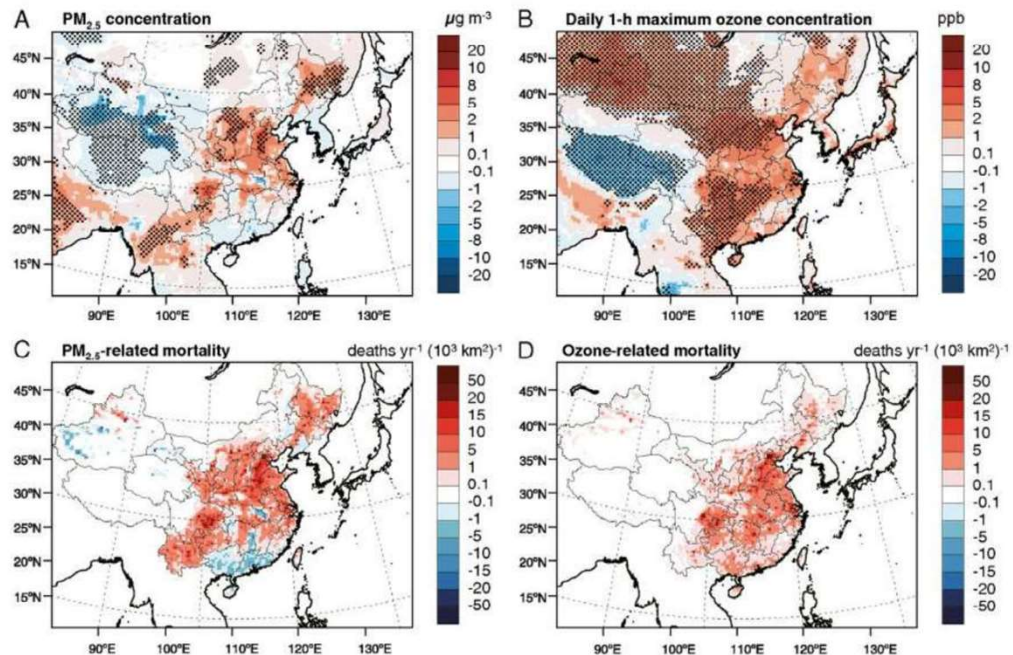
# Climate and health – Air pollution



## Particulate pollution, ozone pollens

### Health forecast in China

- Increased ozone-related mortality
- Average PM<sub>2.5</sub> increases to  $\mu\text{g}/\text{m}^3$
- Pollution-related death increase in almost all provinces



Expected changes in air pollutants and mortality between 2010 and 2050 (RCP4.5)

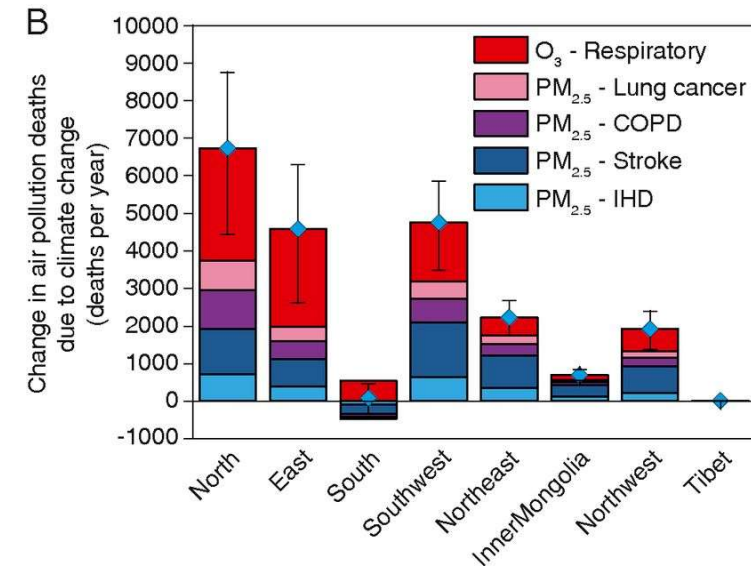
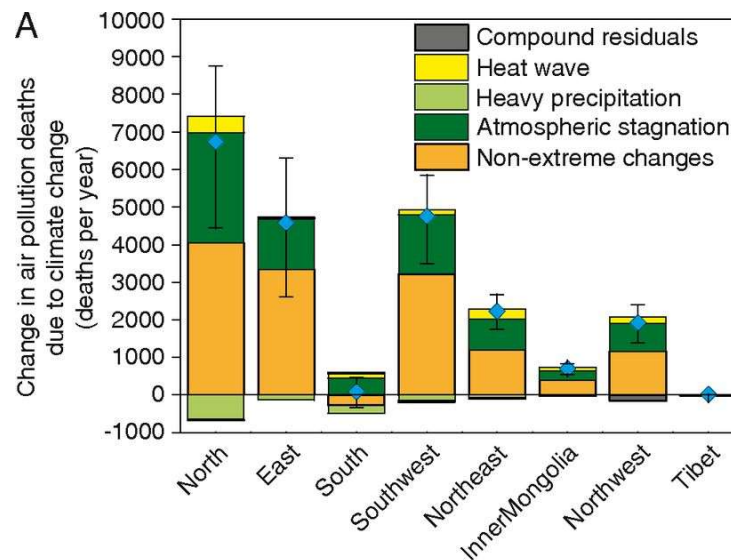
# Climate and health – Air pollution



## Expected mortality

Health forecast in China, variation in health outcomes

- By factor (A)
- By pathology (B)

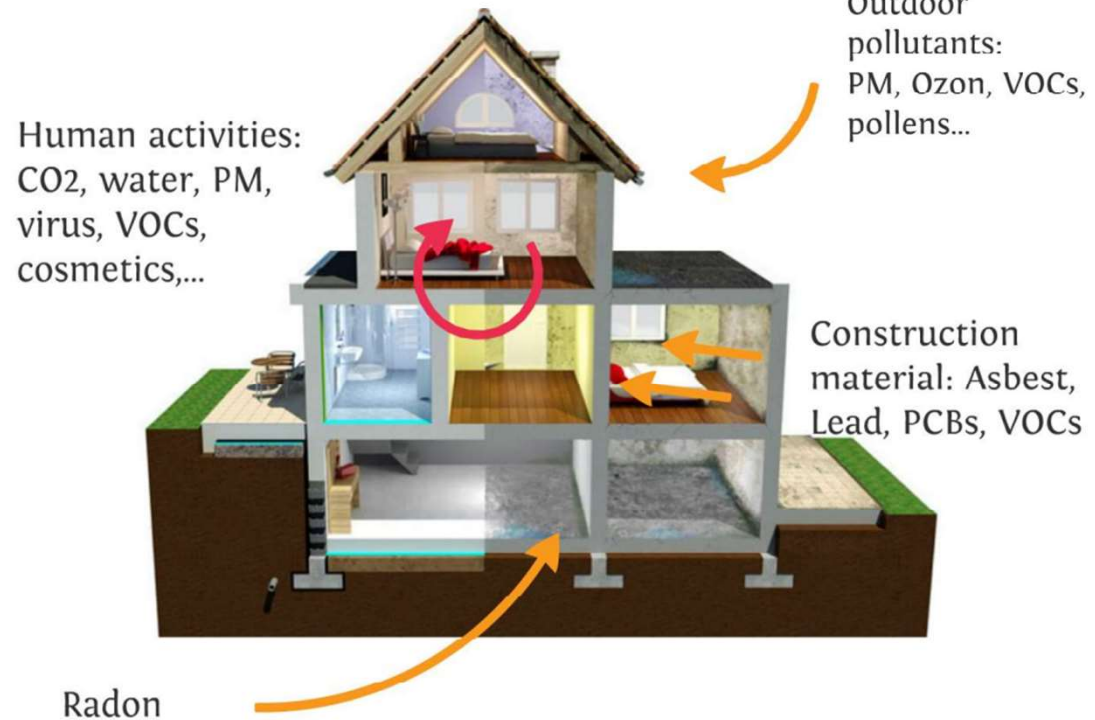


# Climate and health –IAQ



## Indoor air quality (IAQ)

- 85-90% of our time spent in indoor spaces
- IAQ is a strong health determinant
- Multiple sources of pollution
- Increase in pollution [ ] favored by low air renewal



# Climate and health –IAQ



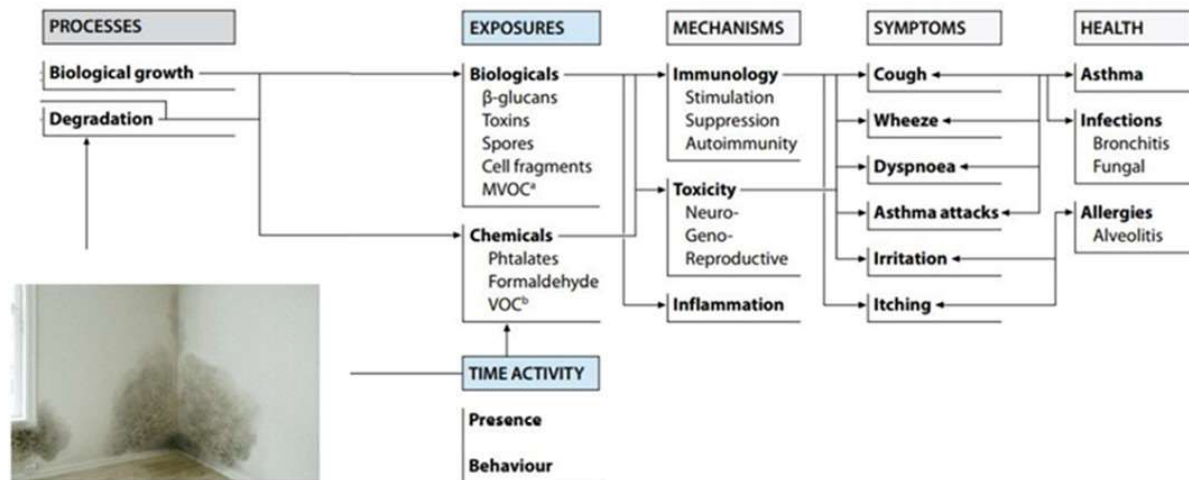
## Indoor air quality (IAQ)

### Molds in buildings

- Natural origin, growth promoted by humidity and temperature
- Risk factor for asthma, lung infections, and allergies

### Mesqualair study (French-speaking Switzerland)

- Mold measurement in 149 homes
- Visible mold in 18% of homes



# Case study

## Molds in housing

Molds in housing are associated with a number of respiratory problems, most particularly in children.

### Question (5.b)

What are the arguments (pros and cons) for an increase of mold issues in buildings due to climate change?

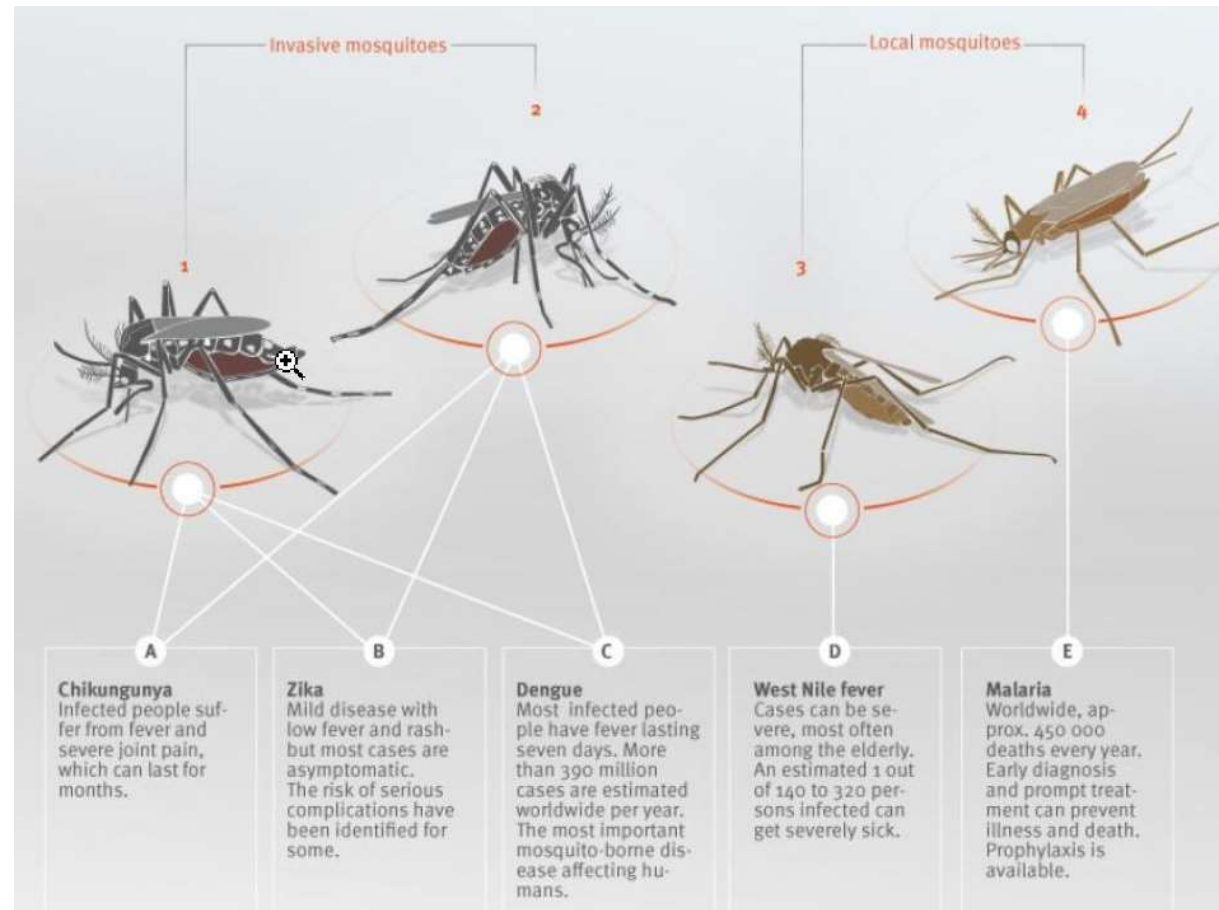


# Climate and health – infectious diseases



## Movement and proliferation of vectors

- Favorable environmental conditions, proliferation in northern or altitude regions

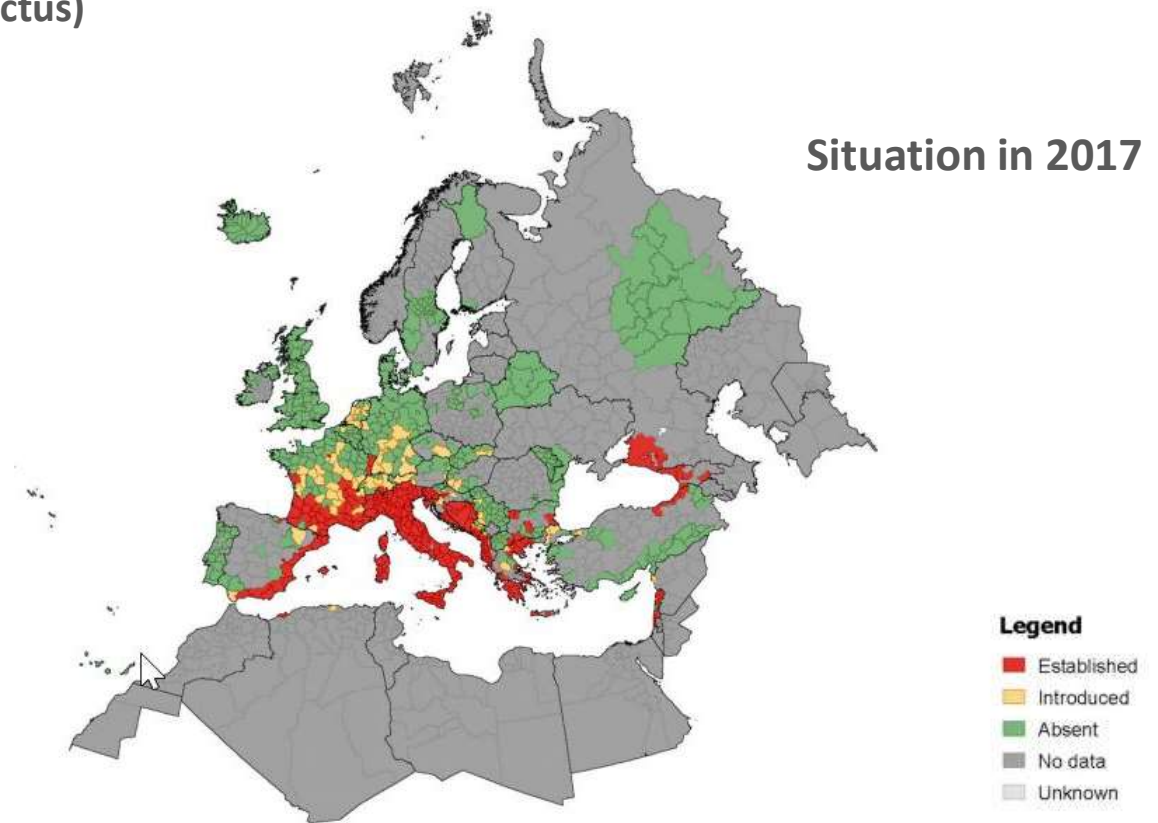


# Climate and health – infectious diseases



## Tiger Mosquito (*Aedes Albopictus*)

- Vector of Dengue, Zika and Chikungunya
- Arrival in Italy in 1990
- Appearance of Chikungunya and Dengue clusters in Europe

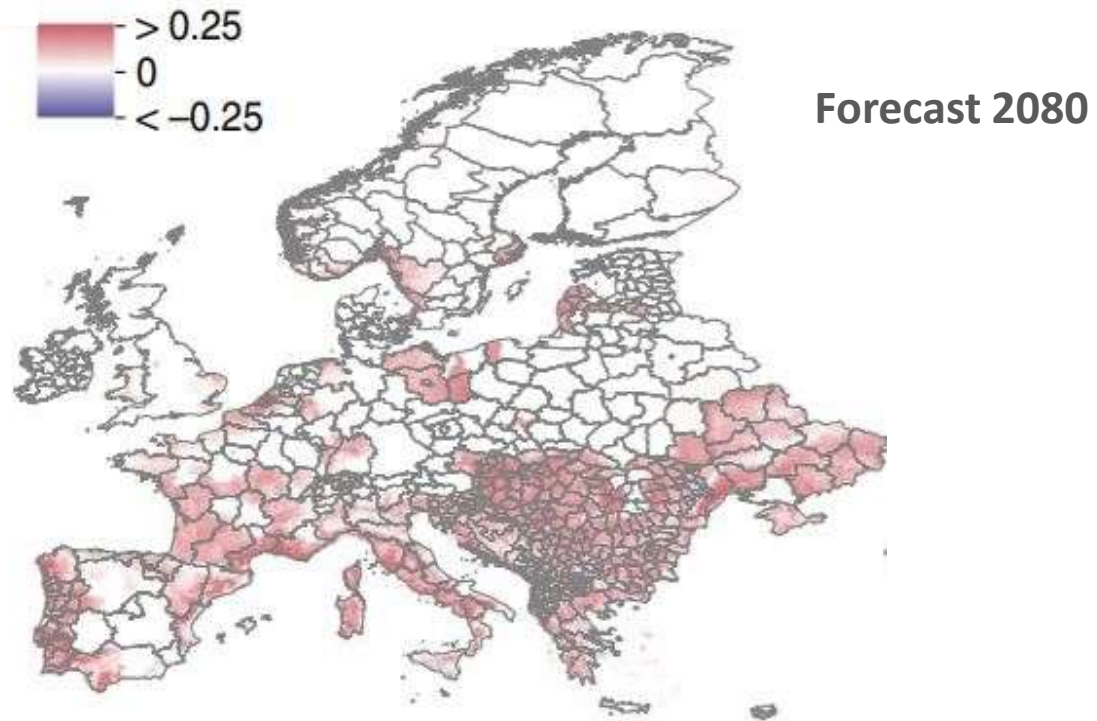


# Climate and health – infectious diseases



## Tiger Mosquito (*Aedes Albopictus*)

- Predicted increase/decrease by 2080
- Medium climate scenario RCP 6.0

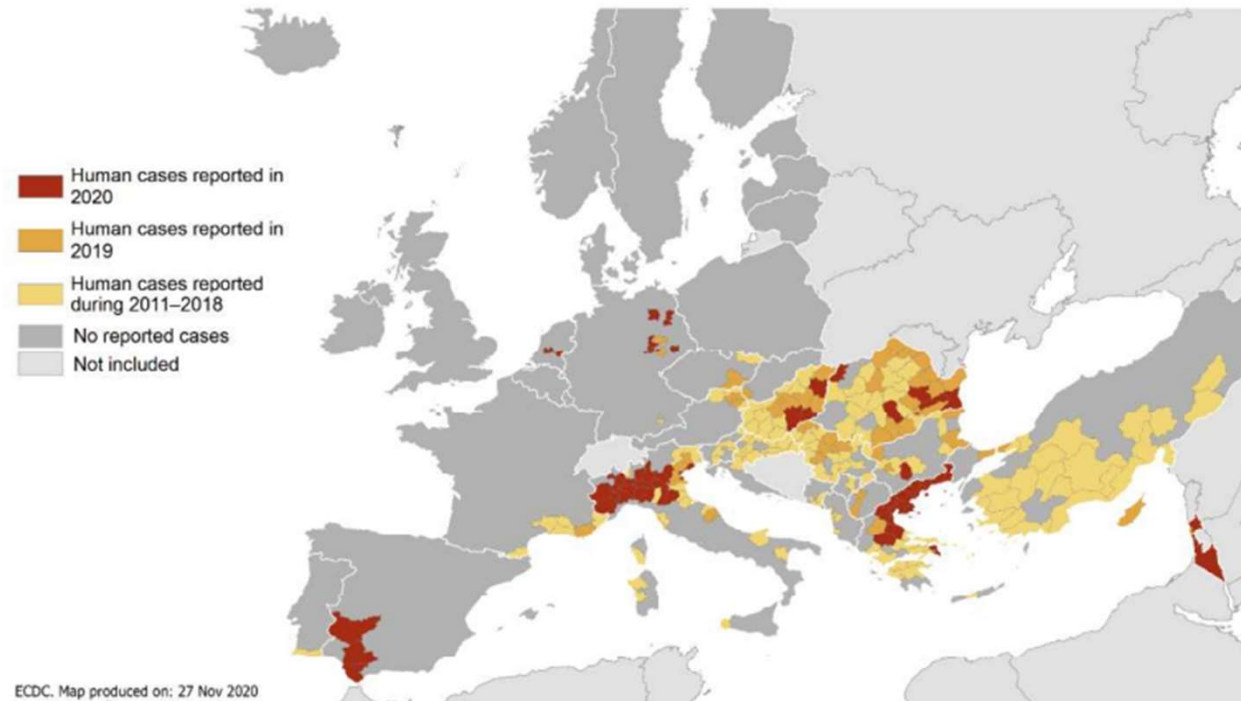


# Climate and health – infectious diseases



## West Niles virus

- 316 cases (including 37 death) EU 2020



# Climate and health – infectious diseases



## Ticks

Tick in EU in 2017

- Lyme disease 65'000 cases/year EU
- Tick-borne encephalitis 2'000 cases/year
- 400% increase in 30 years
- 3.8% increase in habitat projected for 2030-2060

