

Health and climate change

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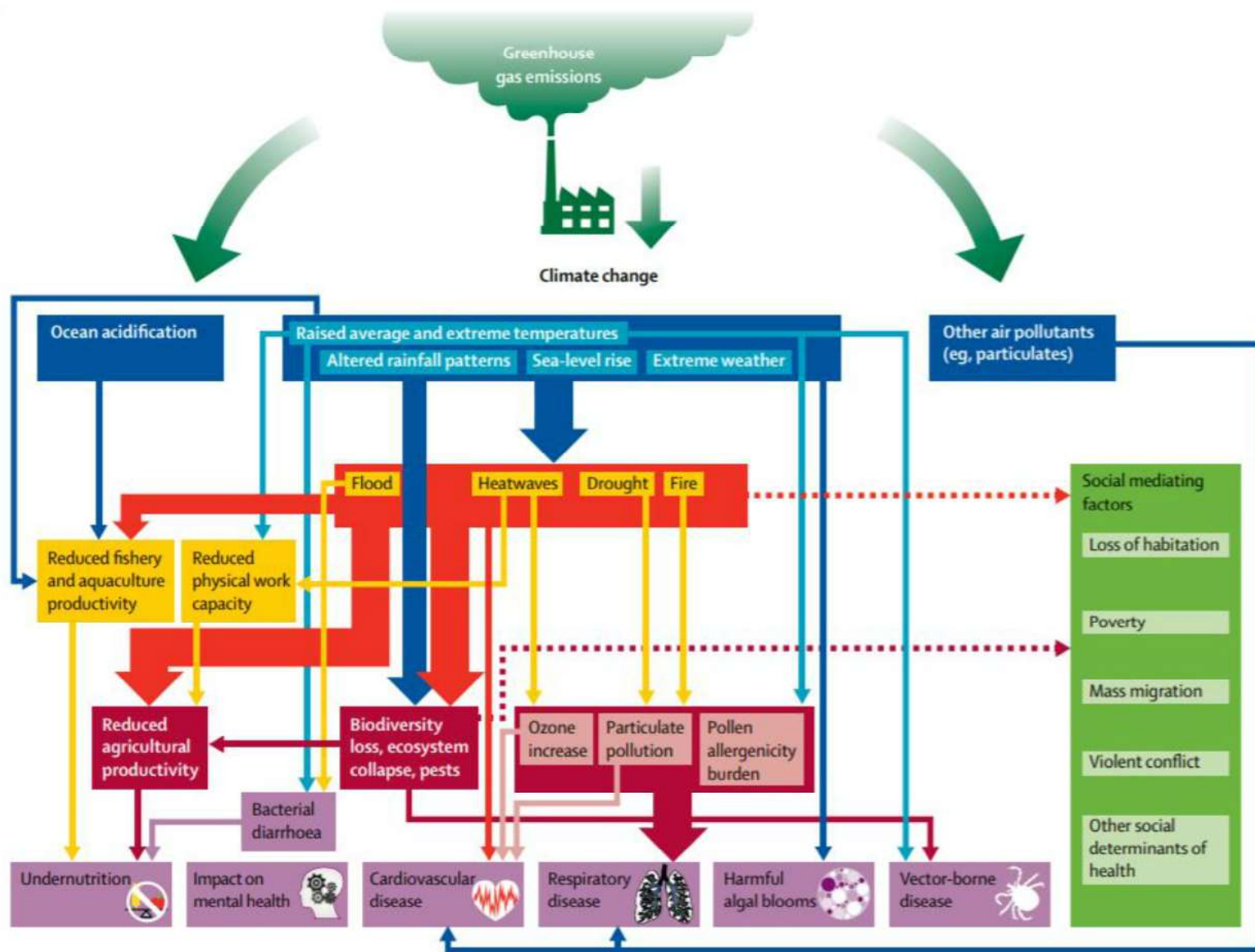
Département Santé Travail - Environnement

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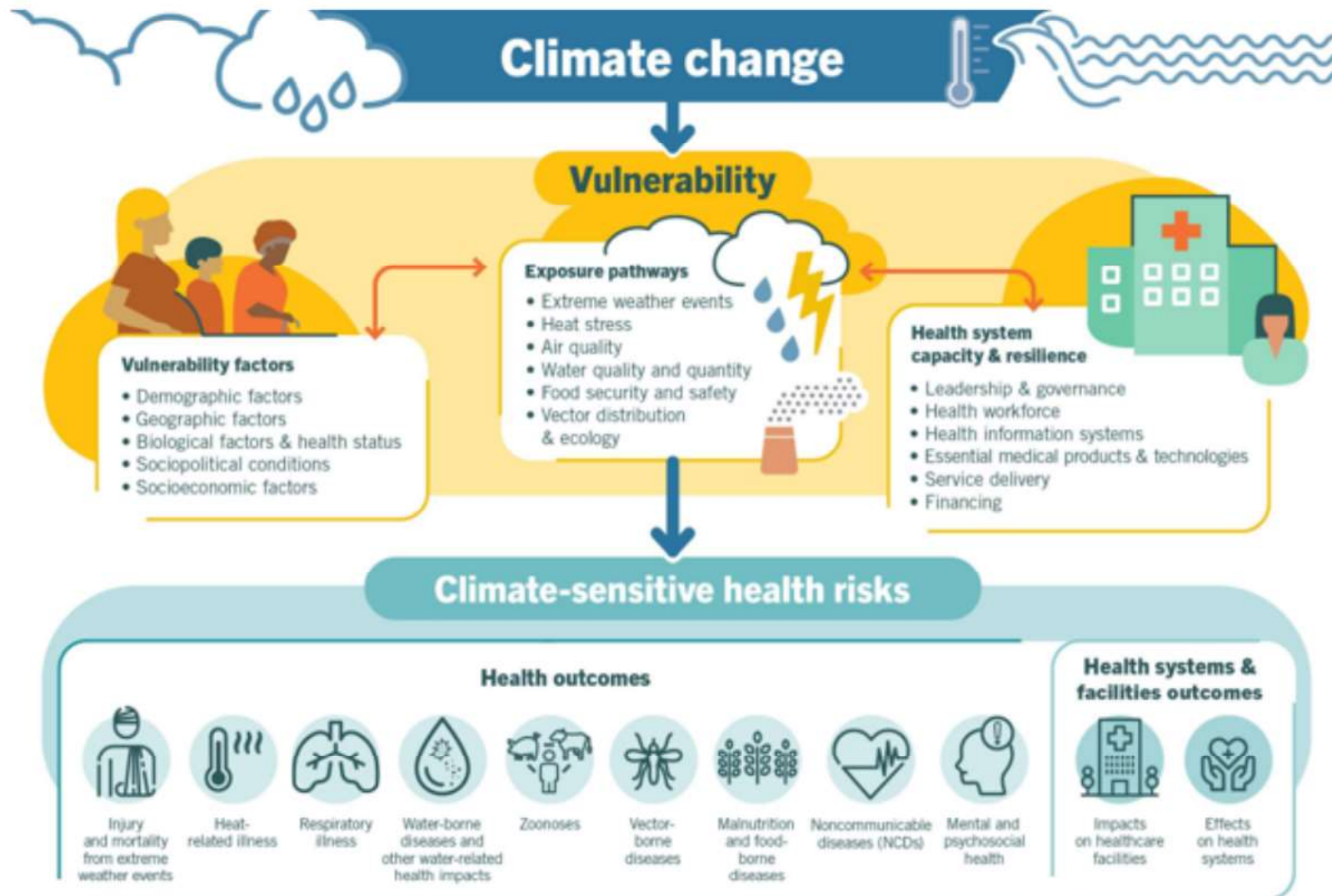
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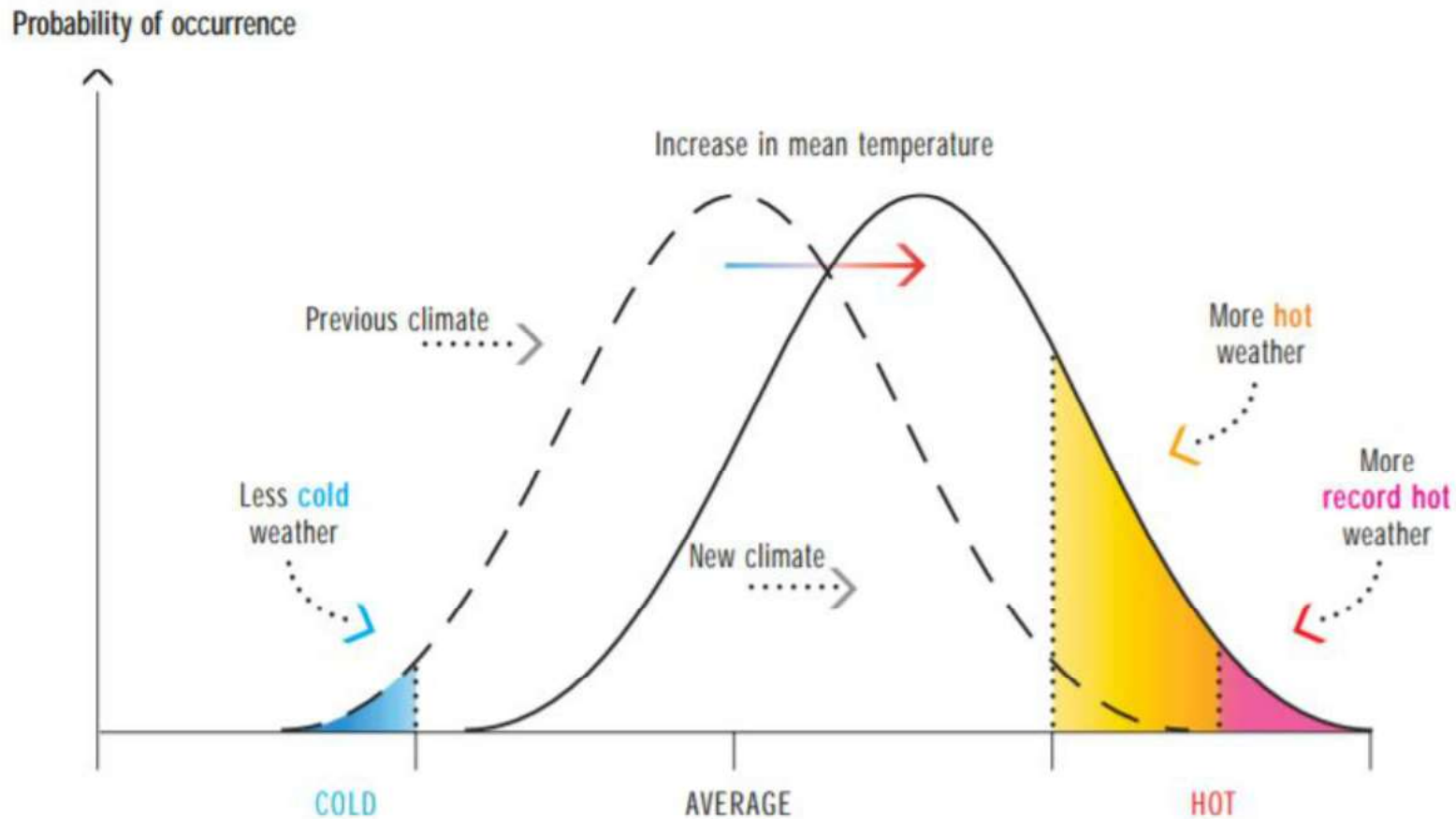
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Lancet Countdown report 2018



Climate change and heat waves

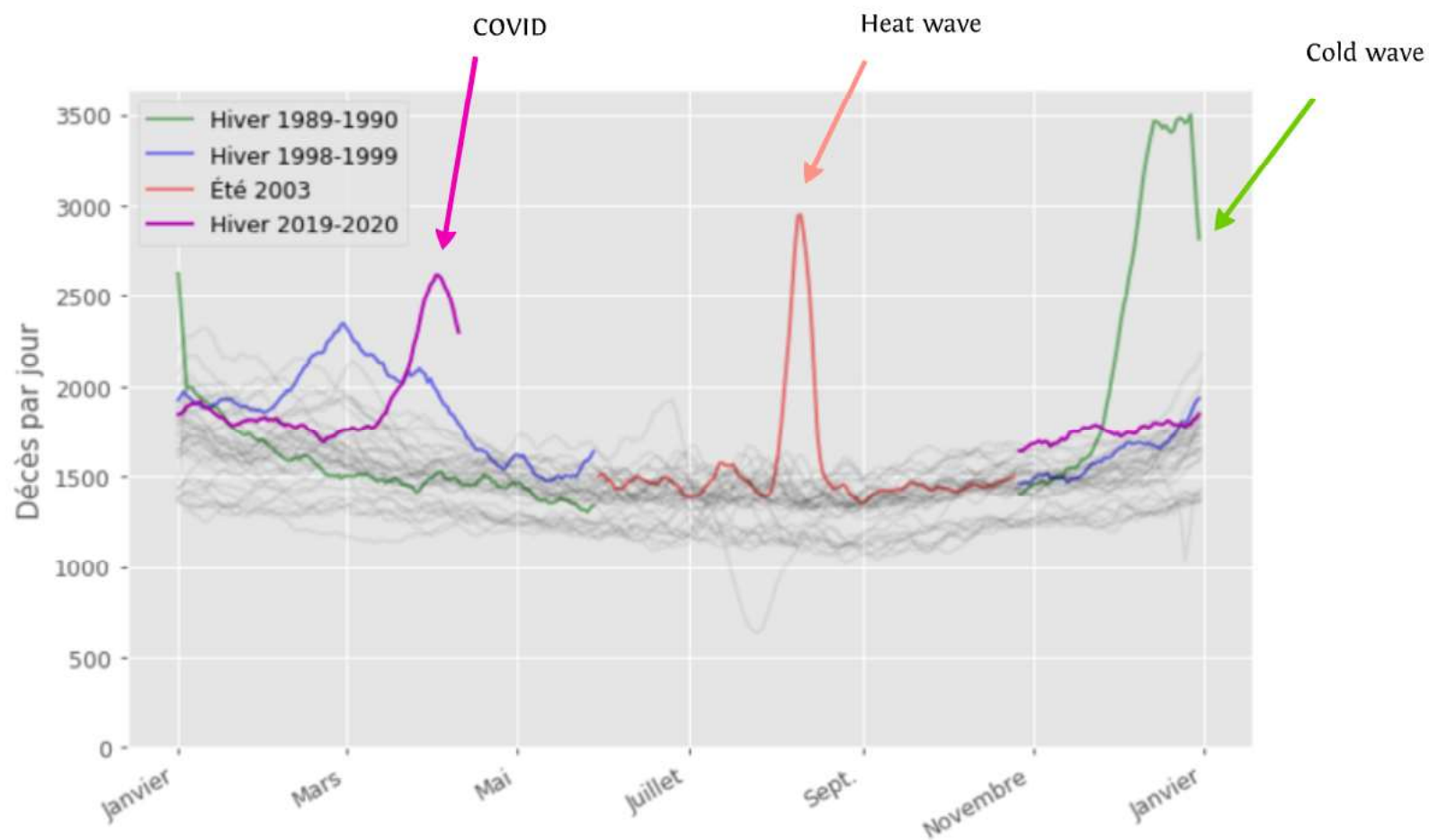


Houghton, 2001

Thermal events and excess mortality



Seasonal mortality in France





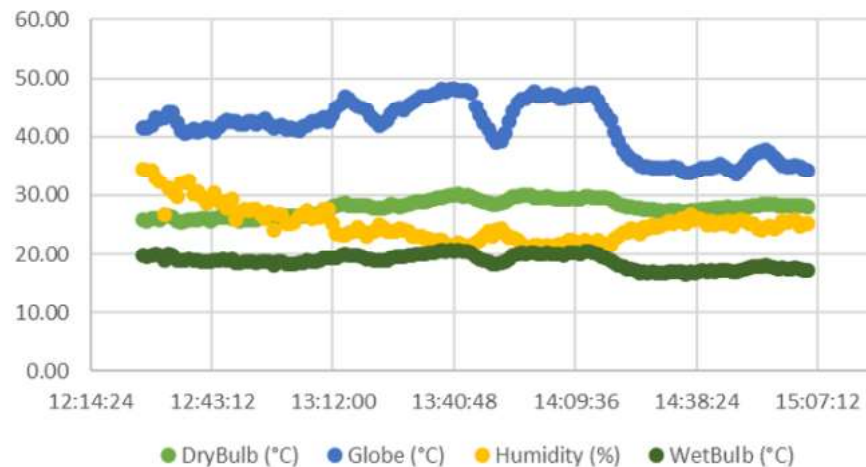
Heat waves and heat stress

Heat stress situations during heat waves

- Increased ambient air Temperature
- Increased radiant temperature (without shade)



Increased Heat Stress





Heat waves and heat stress

General population

Situation

- Lasting elevated temperatures

Effects

- Exhaustion, deshydration
- Overmortality in vulnerable populations

Criteria

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

Workers

Situation

- Acute elevated temperature
- At risk activities

Effects

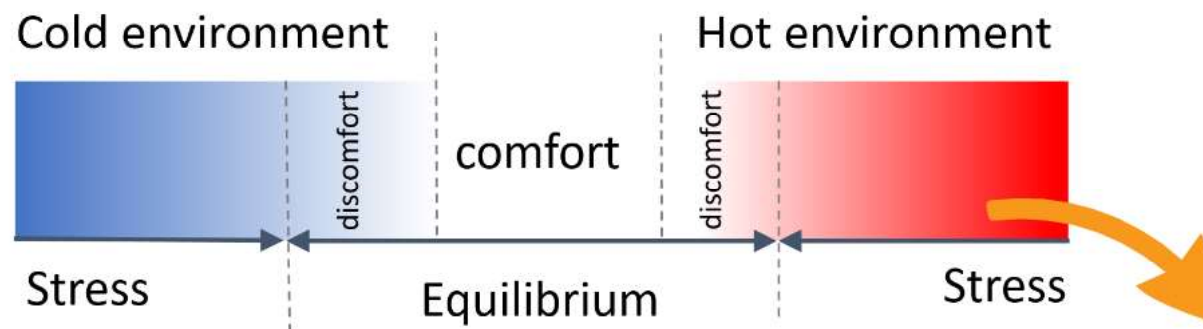
- Heat stroke, exhaustion, deshydration
- Exhaustion, heat stroke
- At risk workplaces

Criteria

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

Assessing global impact of heat stress

Unbalanced energy balance



Requirements in terms of exposure time (% of activity, breaks, hydration...)

Extreme outcomes are rare,
assessment based on the
requested rest time

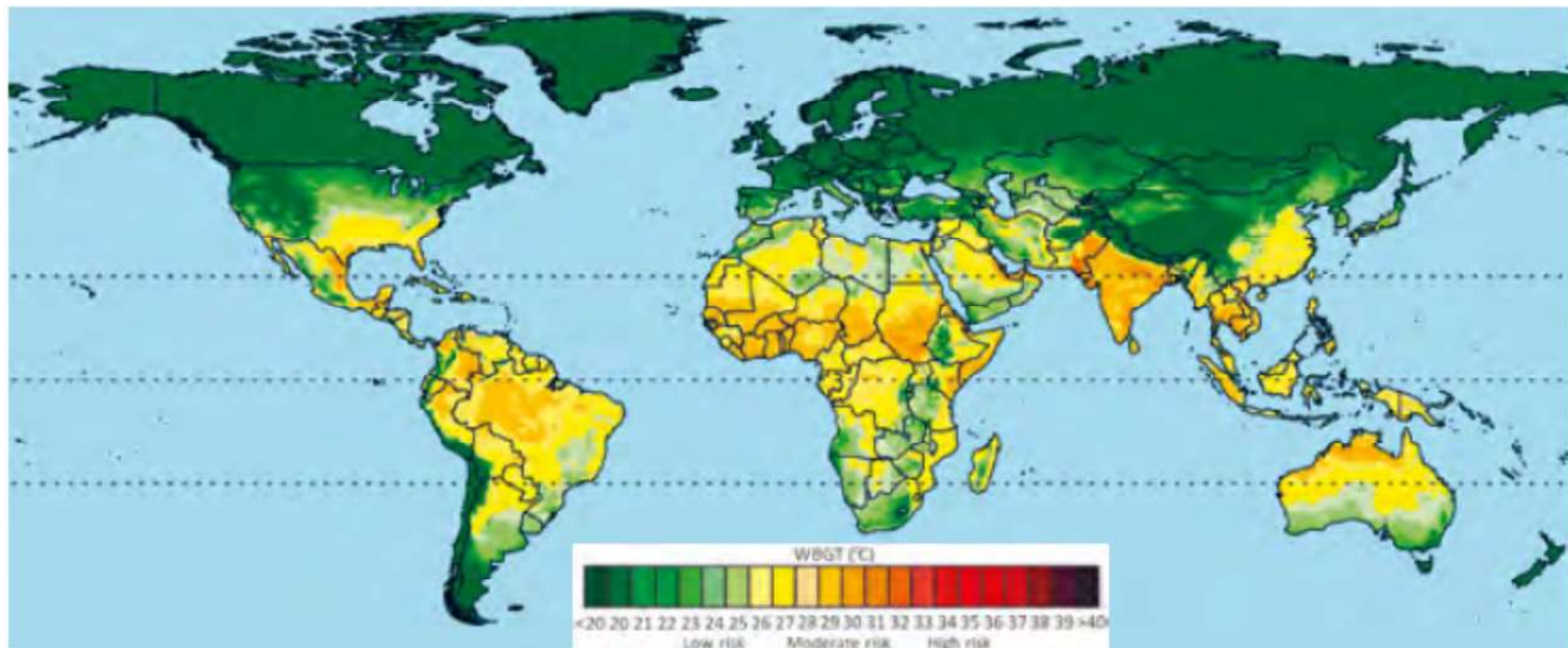
Physical Workload / Heat Stress at Work Warning	Light	Moderate	Heavy	Very Heavy
		45 mins work 15 mins rest in each hour (75% work; 25% rest)	30 mins work 30 mins rest in each hour (50% work; 50% rest)	15 mins work 45 mins rest in each hour (25% work; 75% rest)
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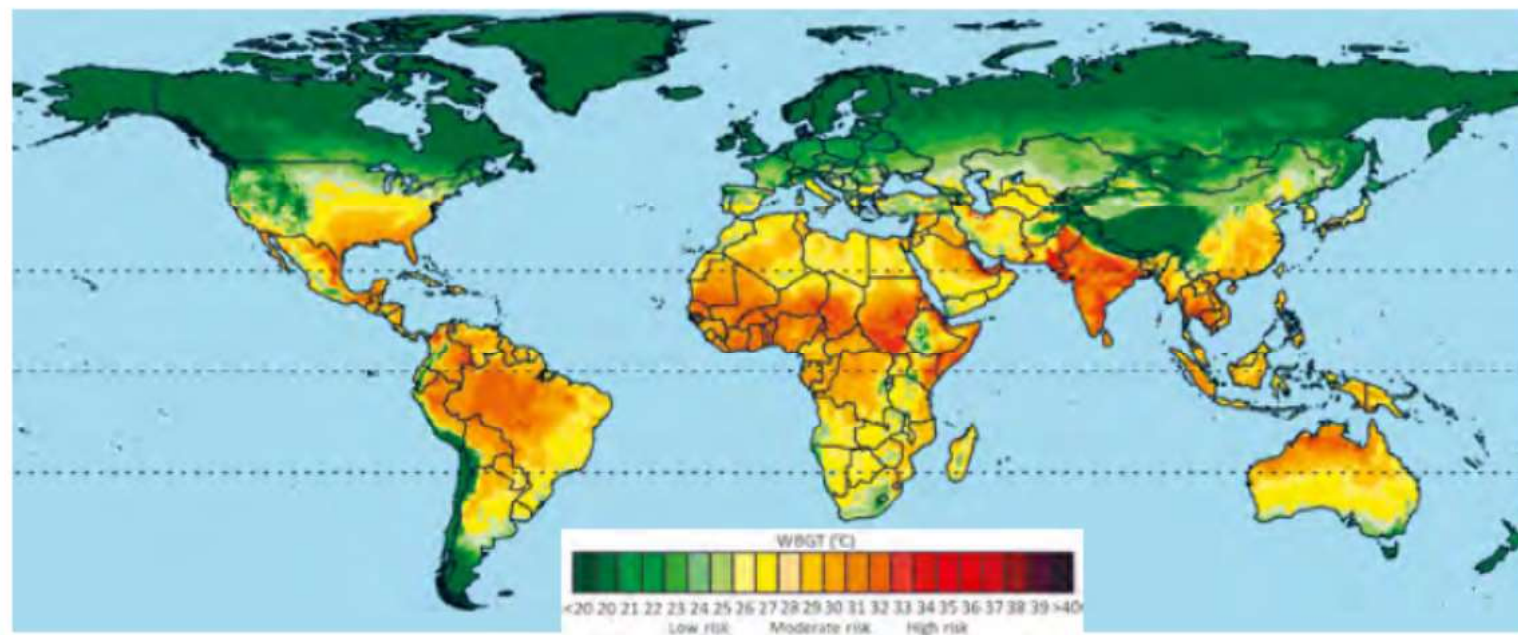
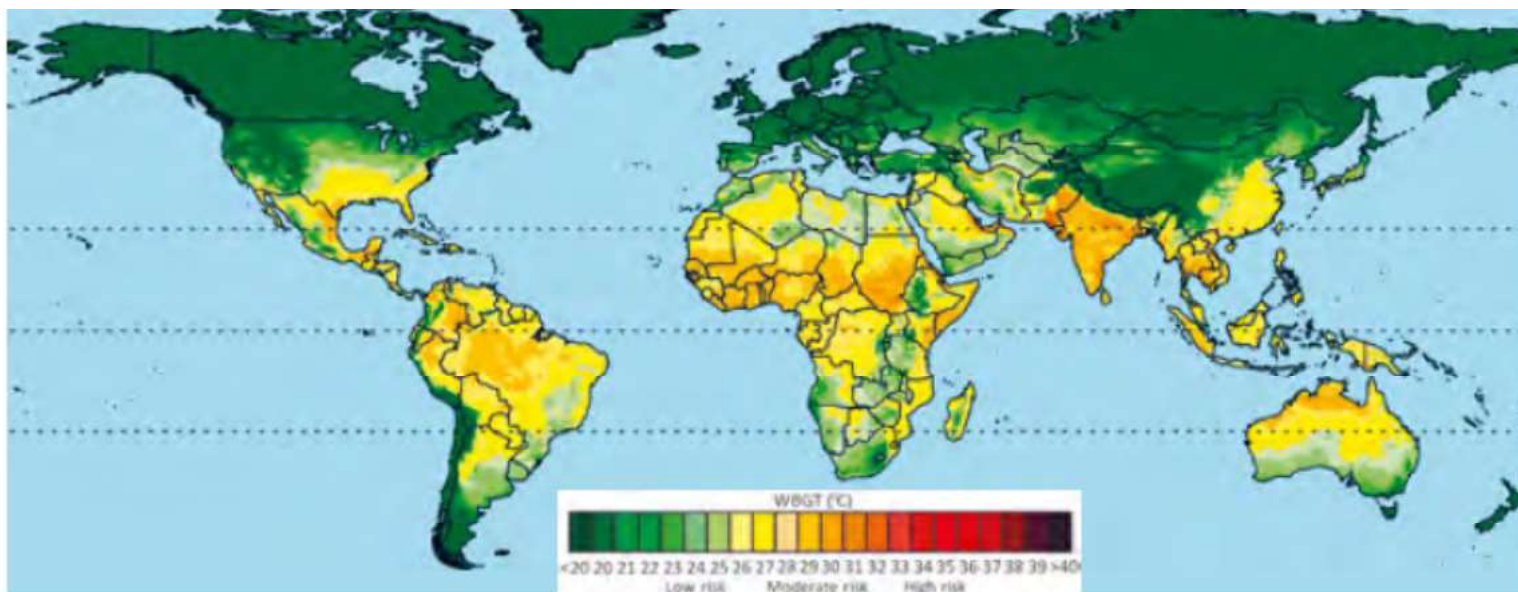
Risk of hyperthermia,
cardiac arrest

Incidence of heat stress

Maximum daily WBGT value (30-year average, 1981-2010)

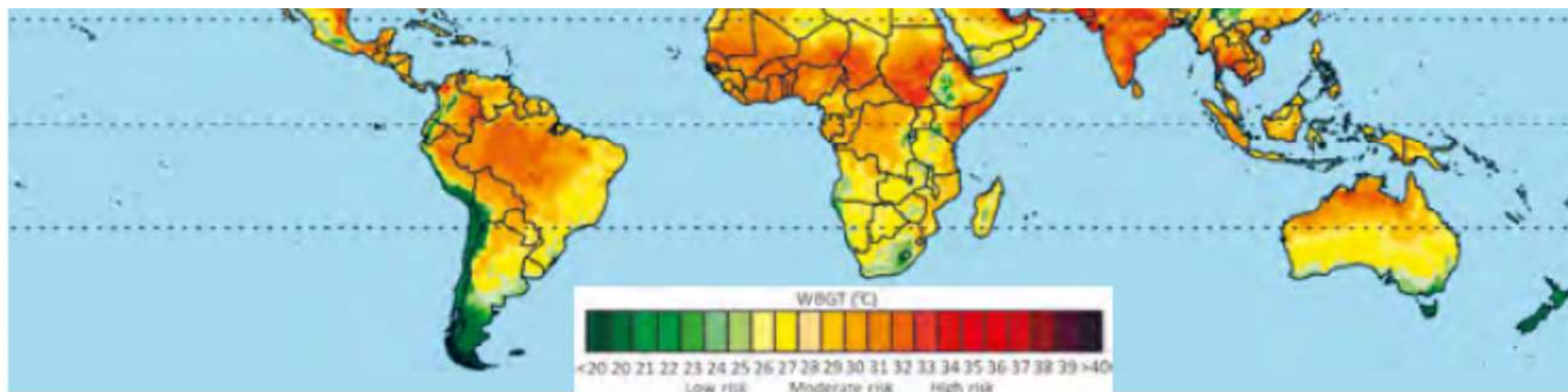
Figure 2.1 Estimated incidence of heat stress worldwide in 1995





ILO, 2019

Maximum daily WBGT value (forecast 2085)



Maximum daily WBGT value (forecast 2085)

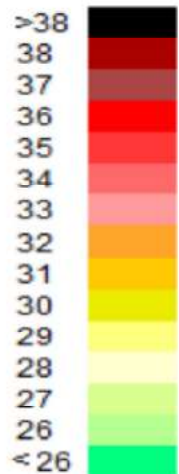
Situation in Europe

- Weakly affected by productivity loss
 - low % of workers in primary sectors
 - low increase in WBGT
- Increased direct effects
 - population and work organization poorly acclimatized
 - particularly exposed work situations

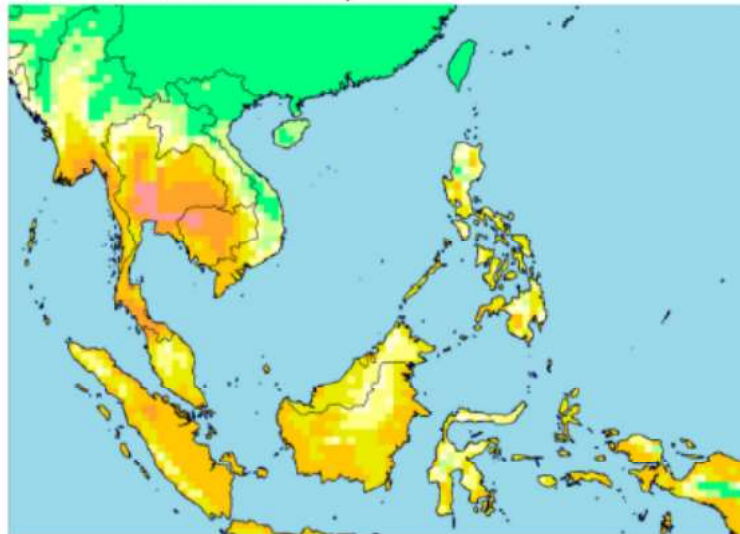
WBGT and climate

Progressive increase of WBGT with climate

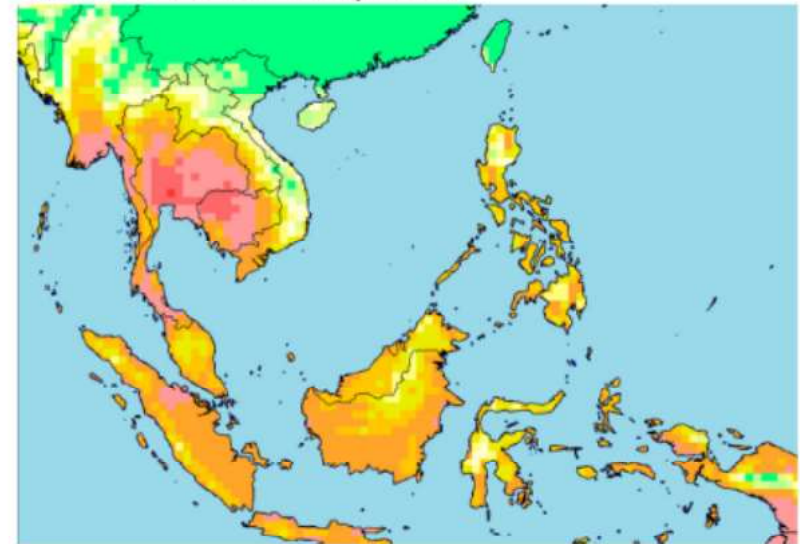
: WBGT
colour code



WBGT in the sun, 1975



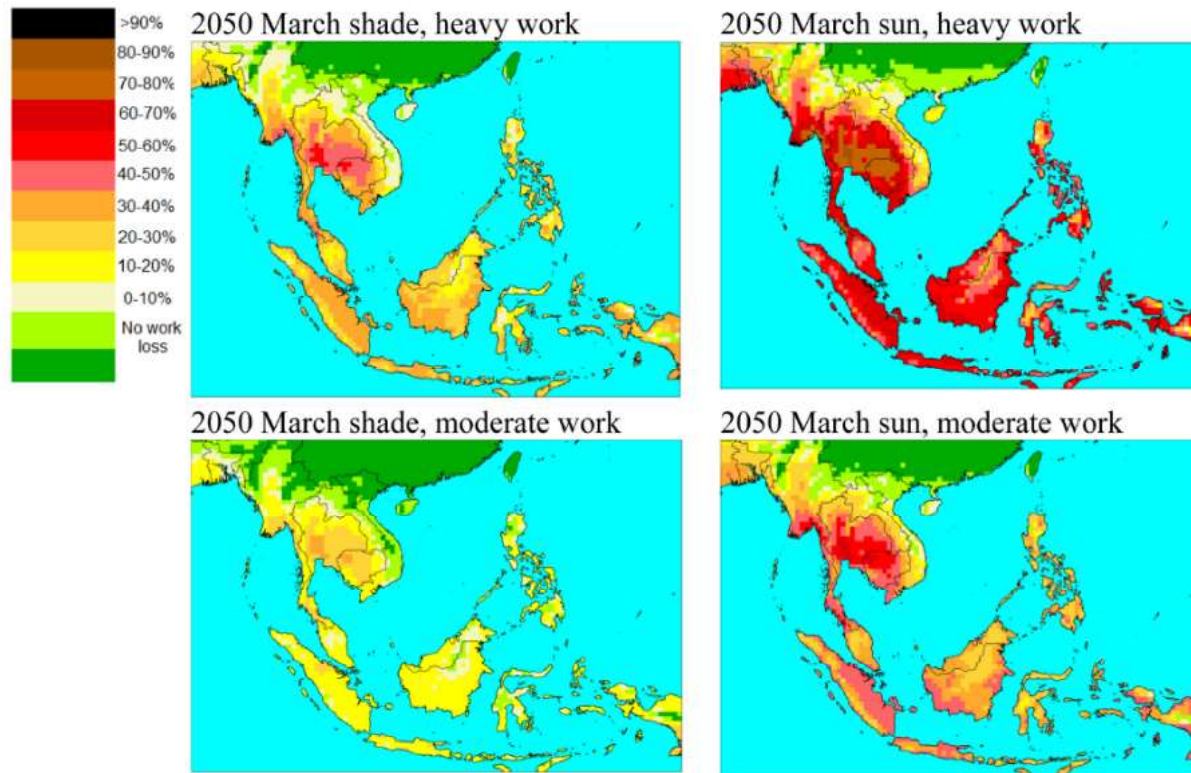
WBGT in the sun, 2050



Kjellstrom et al., 2013. environment, 2019

Projections of lost work time

Loss of work related to the need for rest time (% of afternoon lost), projection 2050.

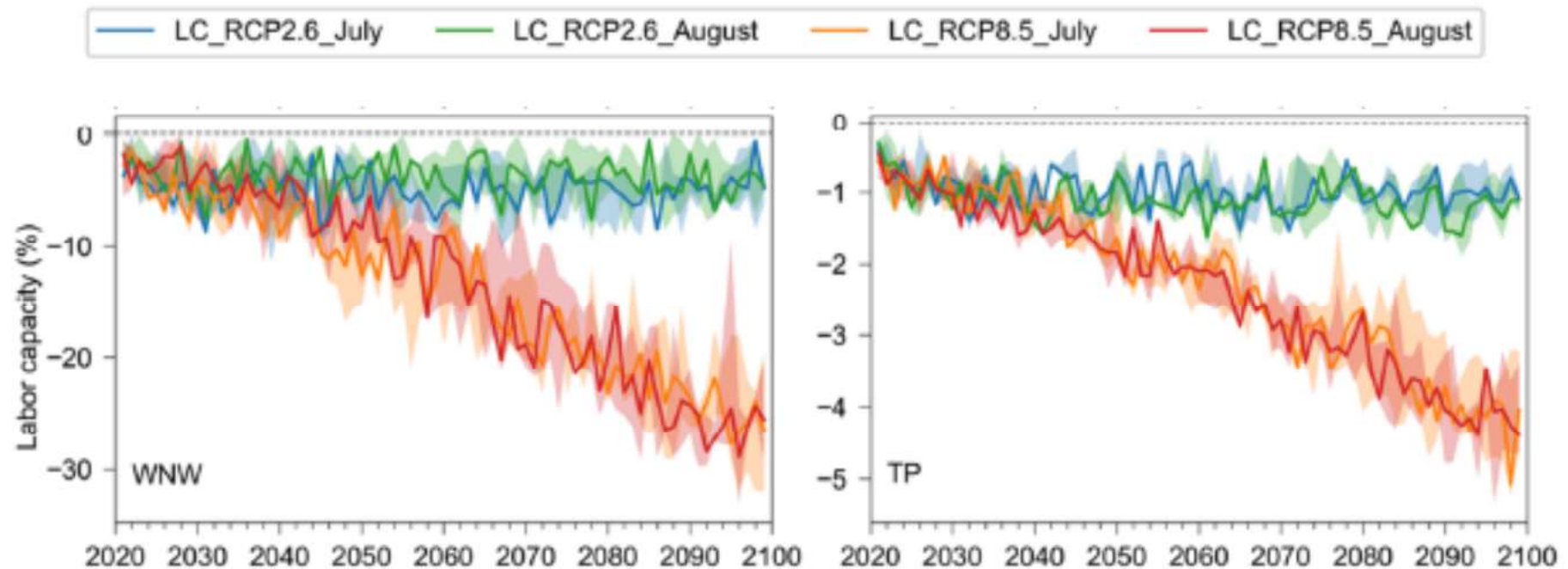


Kjellstrom et al., 2013. environment, 2019

Highly sensitive to the type of work performed

Loss of working time

Loss of work in two provinces in China (projection 2099)



Xingcai, IJERPH, 2020

High sensitivity to climate change scenario

Indirect effects of heat stress

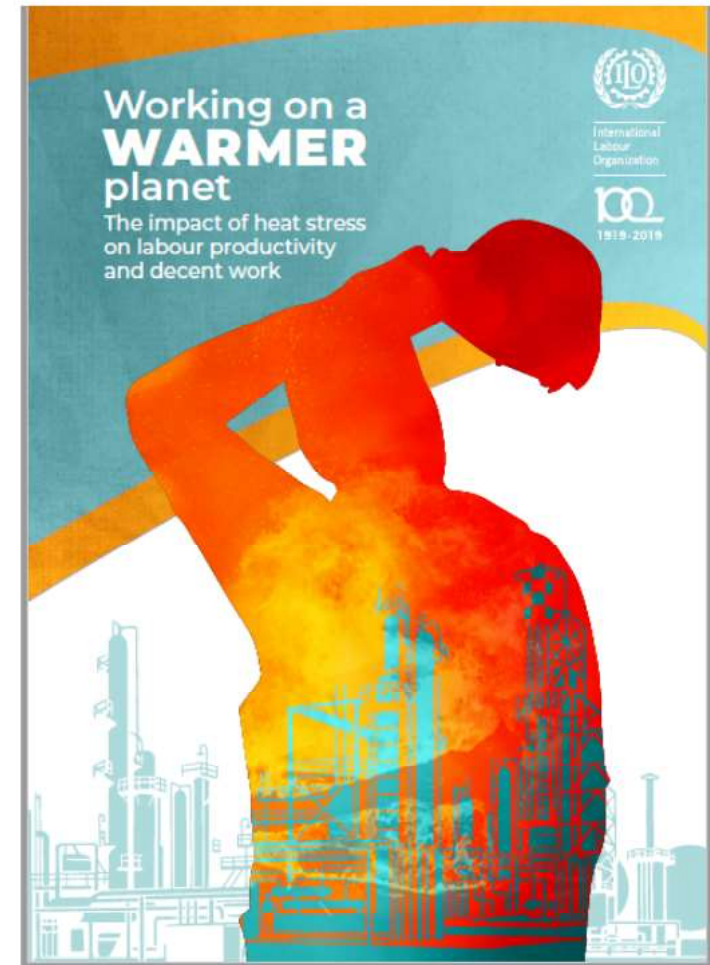


Loss of productivity

- Slower pace of work, need to increase rest time

Increased risk of accidents

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

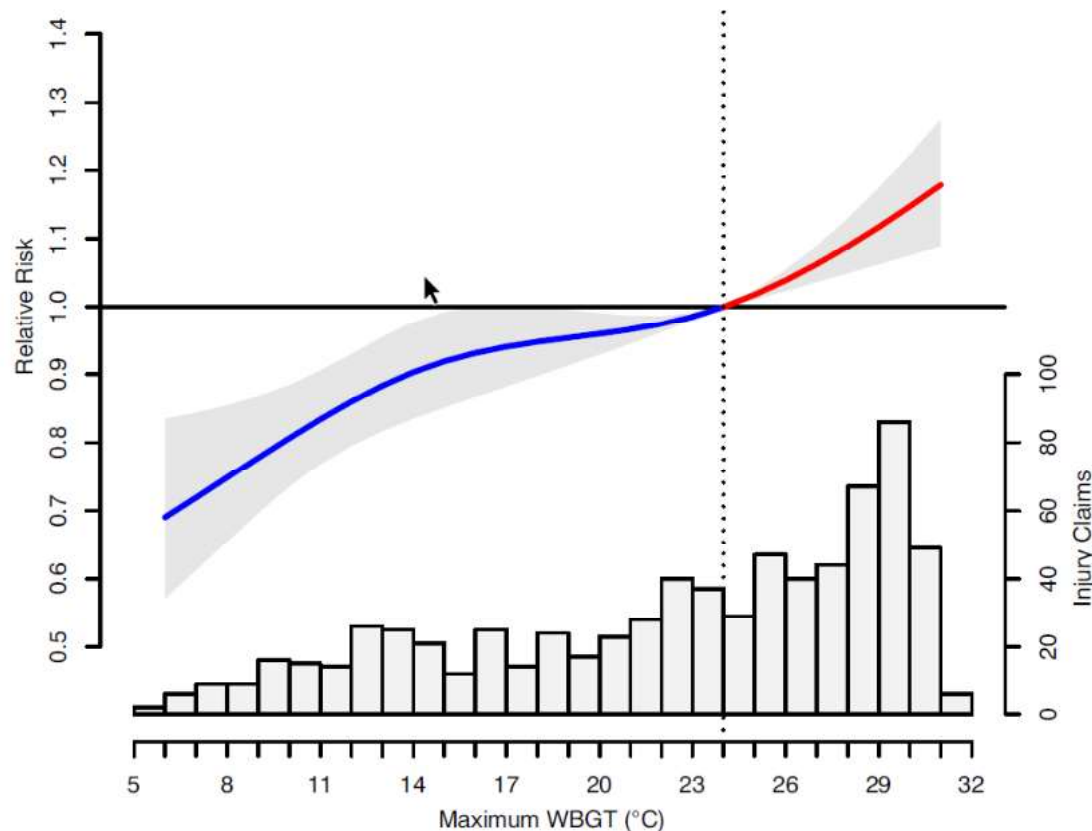


ILO, 2019

Thermal stress and work accidents



Effects other than heat stroke: work accidents, loss of productivity, absenteeism



Correlation between the increase in daily WBGT max and the number of occupational accidents cases reported

4.8% of occupational injuries attributable to heat stress

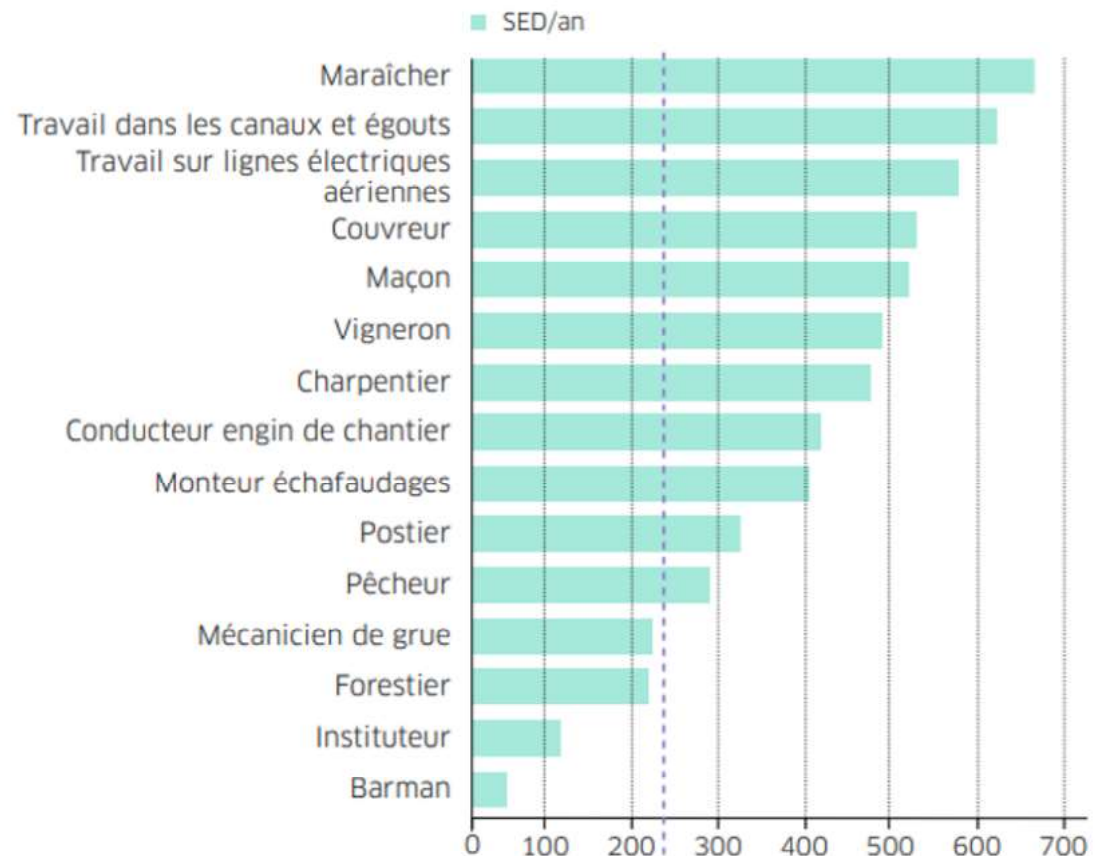
Climate change and UV light



More sunny days

- Increase in UV light exposure
- Incidence of skin cancer

Current average UV doses in various outdoor occupations (Genesis 2022)

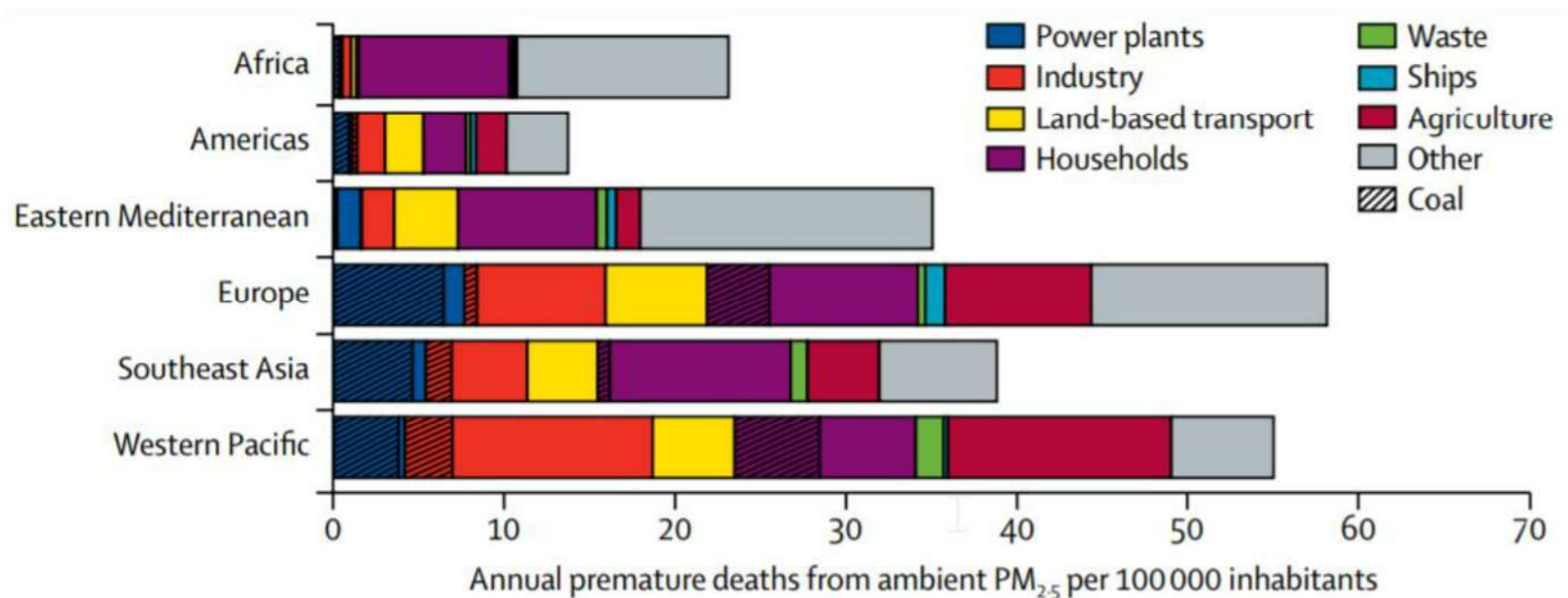


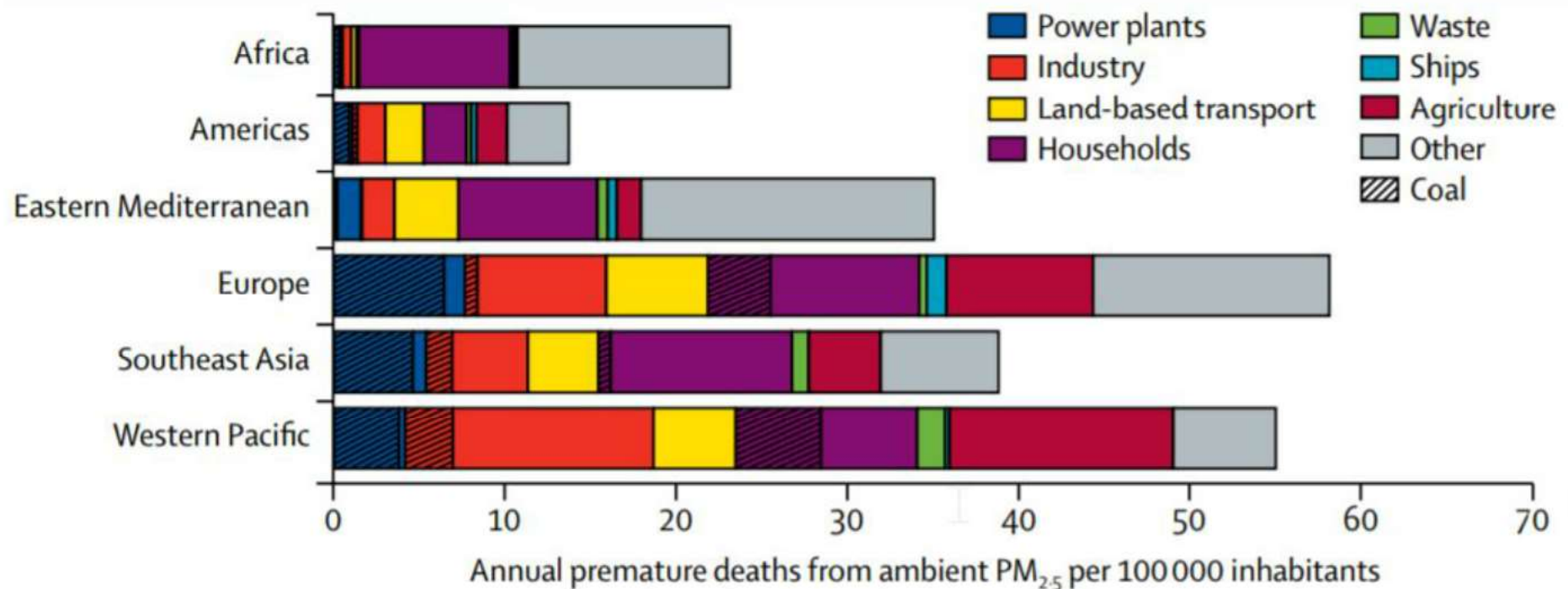
Air Pollution and Health



Particulate pollution, ozone, pollens

- cardiovascular risks, chronic respiratory diseases, asthma
- 4.2 Mio. deaths/year due to environmental pollution





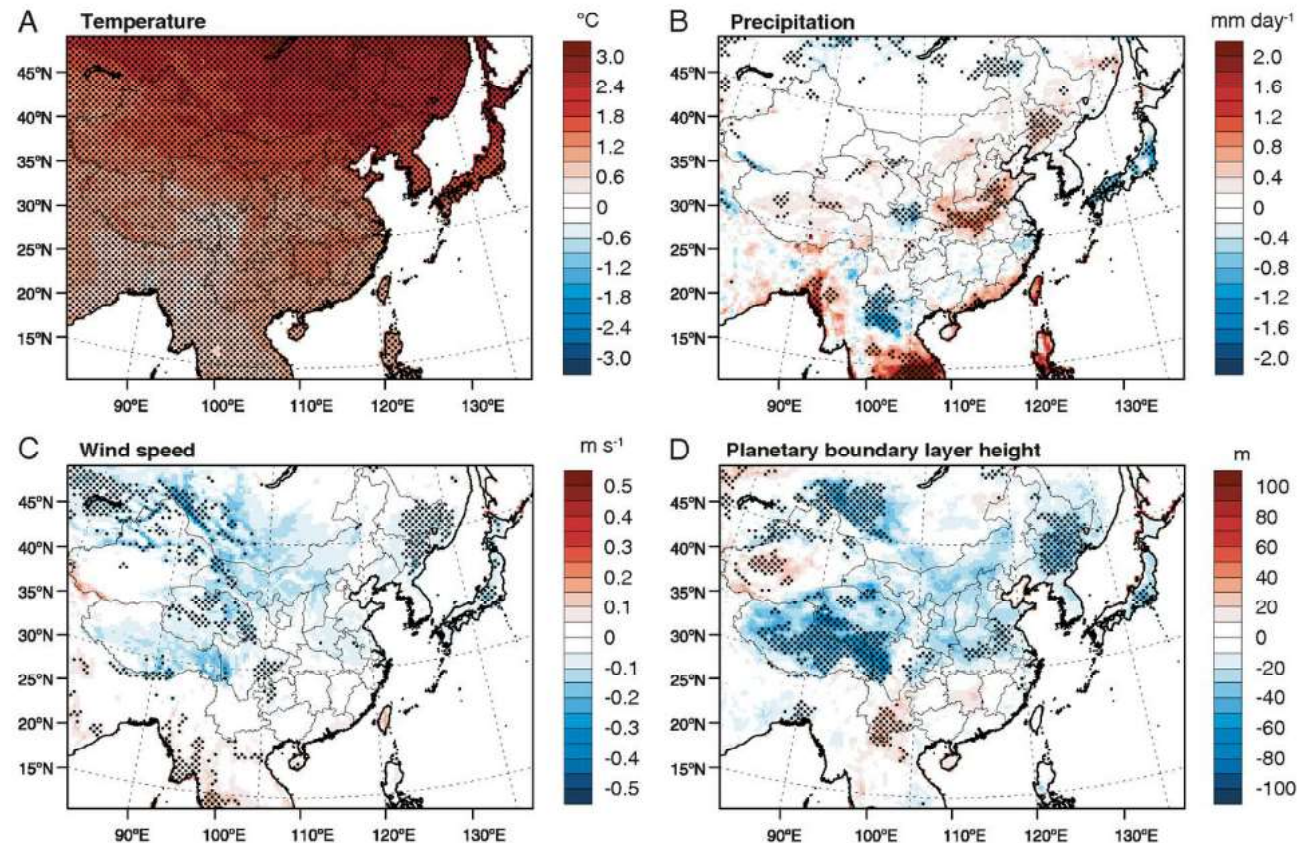
- PM₁₀ and PM_{2.5} penetrate the thoracic and breathing zone, respectively
- Evidence of health effects during short-term exposure for PM₁₀
- Evidence of health effects on respiratory health and mortality for long-term exposure to PM_{2.5}
- Mortality increases by 6 to 13% per 10 µg/m³ of PM_{2.5}
- Vulnerable groups: pre-existing lung or heart disease, elderly, children
- 3% of cardiopulmonary deaths and 5% of lung cancers are attributable to PM
- Particulate pollution causes 3.1 Mio deaths/year (2010)
- 90% of cities have particulate concentrations > WHO recommendation (10 µg/m³ PM_{2.5})

Air Pollution and Health



Particulate pollution, ozone, pollens

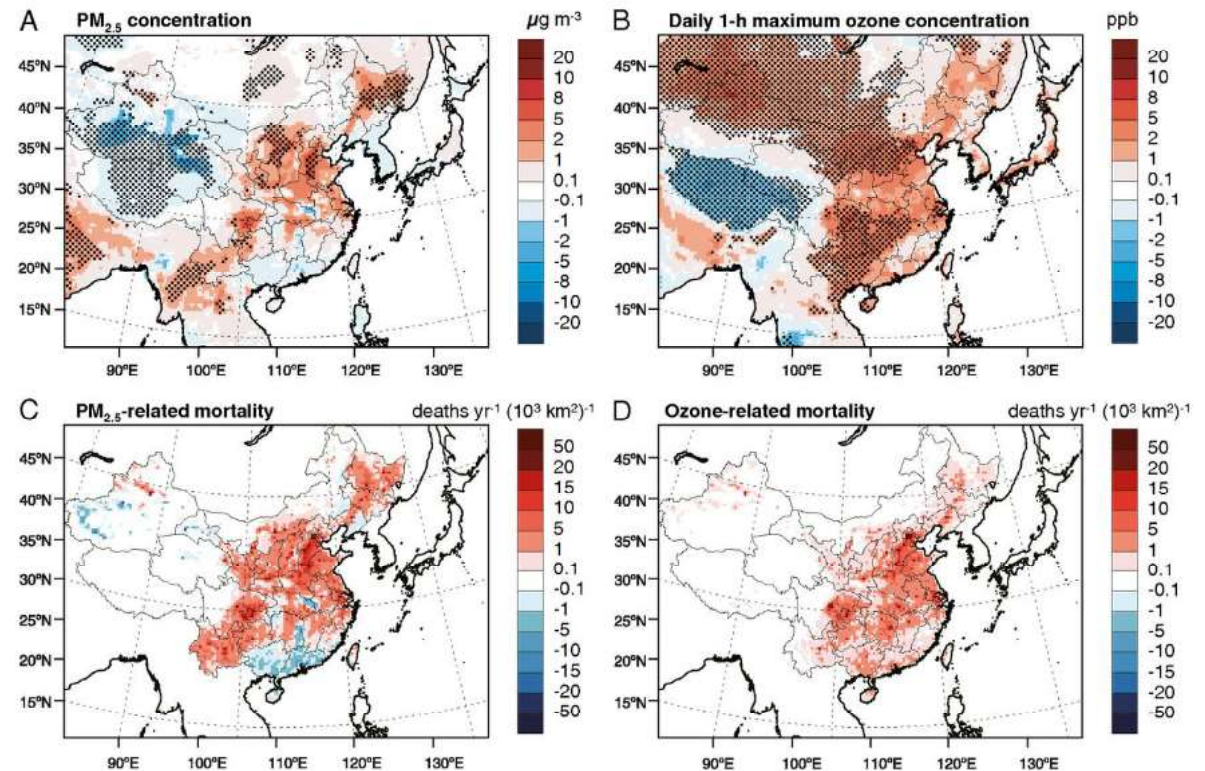
- Increased ozone-related mortality
- Less obvious for PM
- Variation in average conditions (precipitation, humidity...)
- Increase of extreme events (heat waves, atmospheric stagnation....)



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

Effects on PM and health

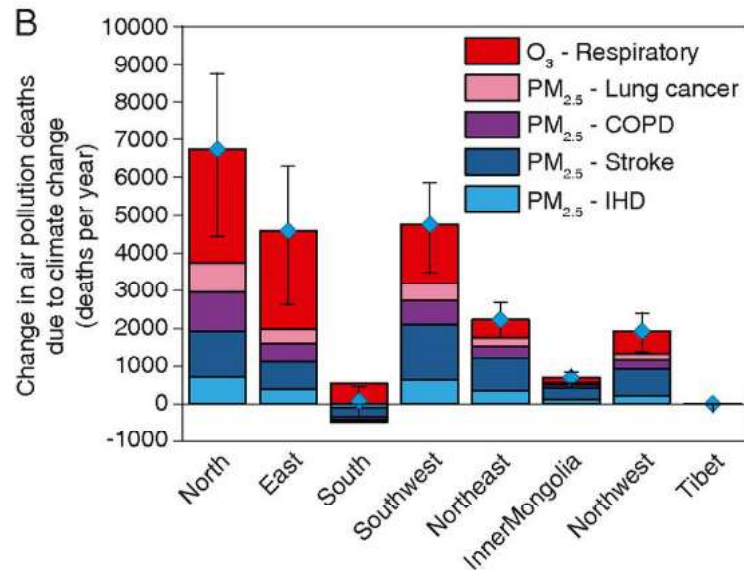
- Average PM_{2.5} increase to 9 $\mu\text{g}/\text{m}^3$
- Pollution-related deaths increase in all provinces



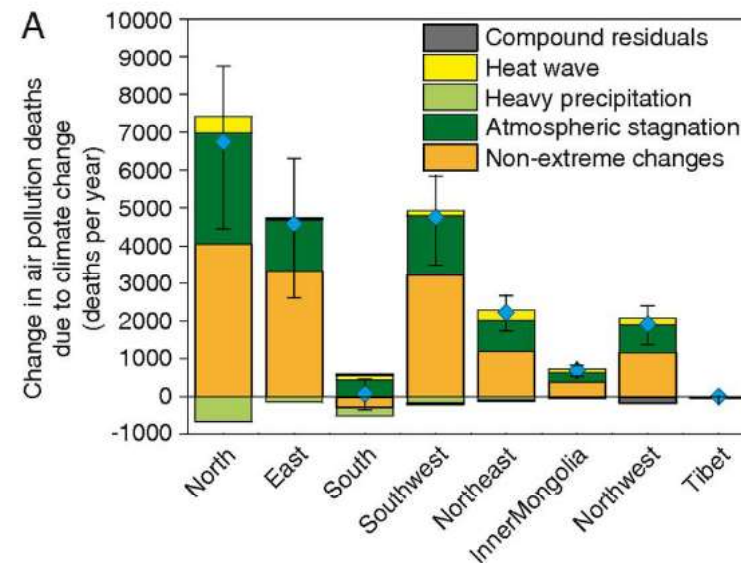
Expected changes in air pollutants and mortality between 2010 and 2050 (RCP4.5)

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

Expected mortality



- By type of pathology (in China)



- By factor (in China)

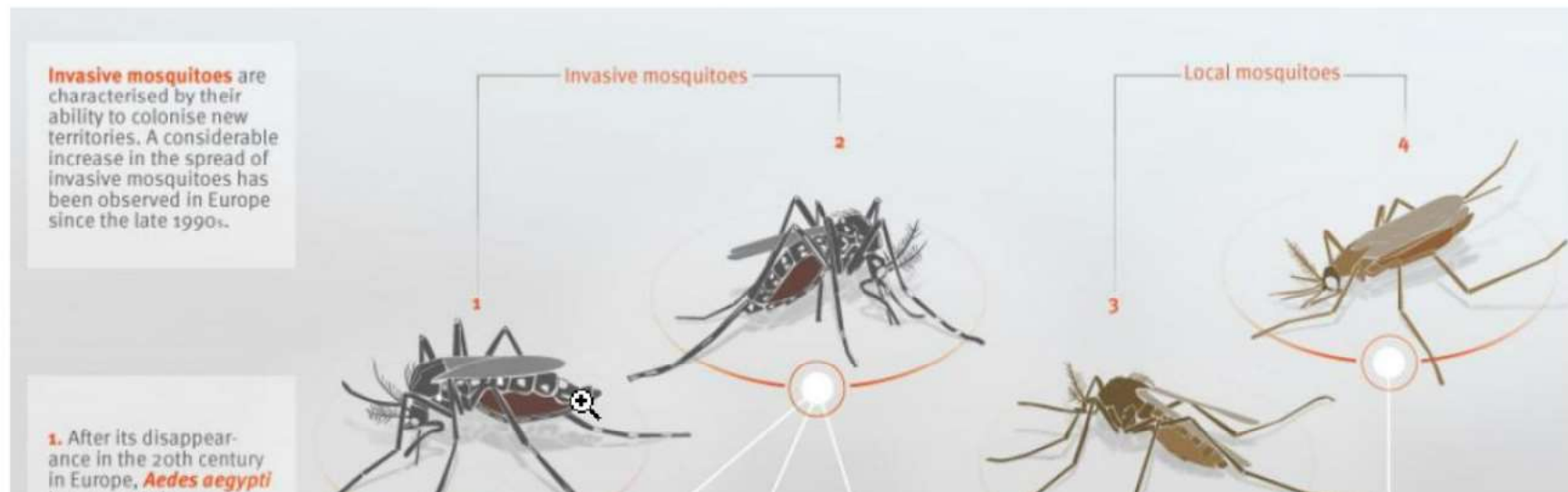
Climate-dependent infectious diseases

Movement and proliferation of vectors



- Dengue, Malaria, Nile fever, Encephalitis, Lyme disease, Chikungunya, bacteria in water
- Favourable environmental conditions, proliferation of vectors in more northern or high altitude regions

Mosquitoes



Mosquitoes

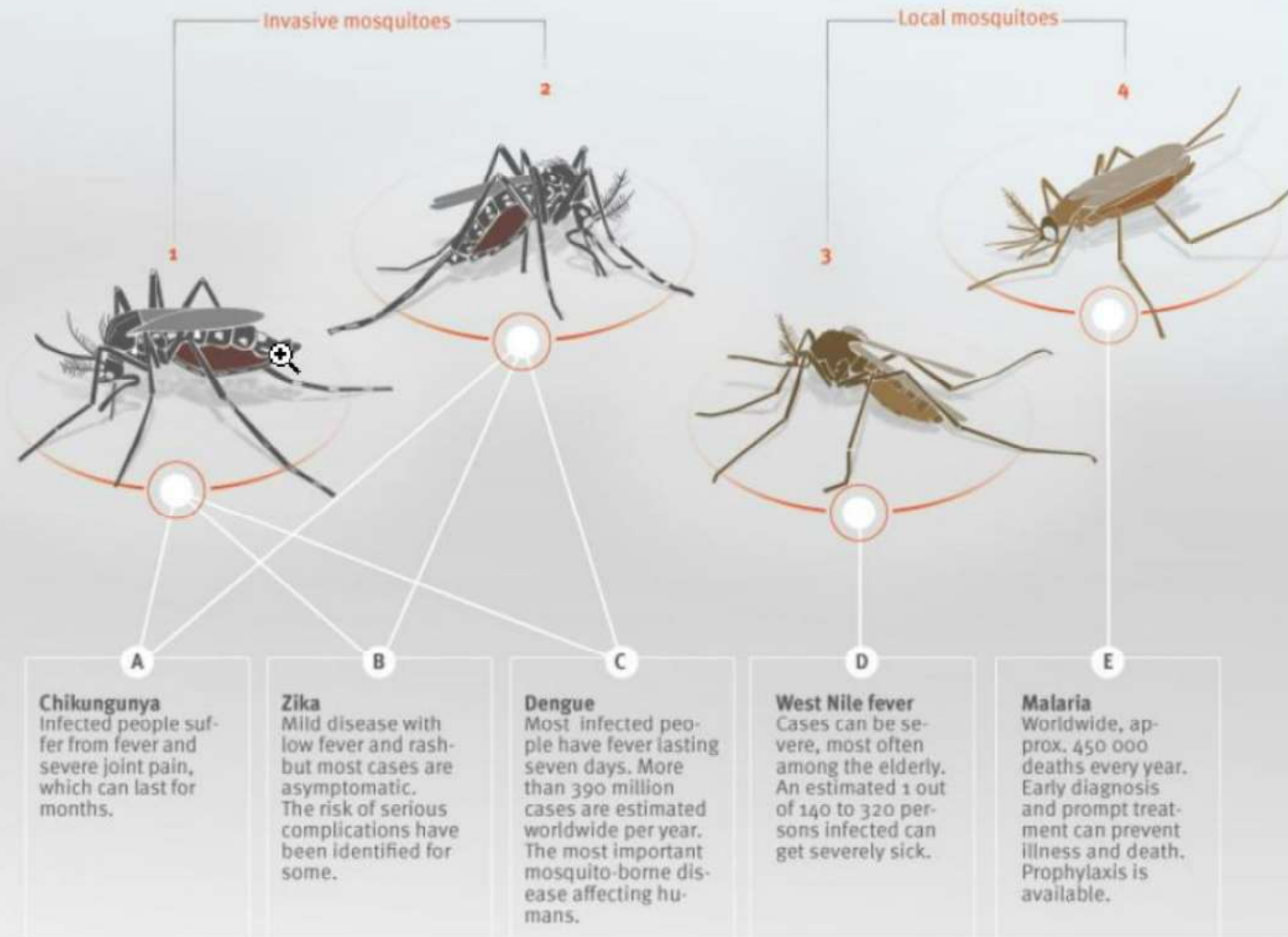
Invasive mosquitoes are characterised by their ability to colonise new territories. A considerable increase in the spread of invasive mosquitoes has been observed in Europe since the late 1990s.

1. After its disappearance in the 20th century in Europe, *Aedes aegypti* has recently become established in Madeira. It is also present in some areas around the Black Sea coast.

2. *Aedes albopictus* is considered to be the most invasive mosquito species in the world. It is present in much of southern Europe.

3. *Culex pipiens* is the most widespread mosquito in Europe.

4. The *Anopheles* mosquito can be found from south-eastern Sweden to Portugal.

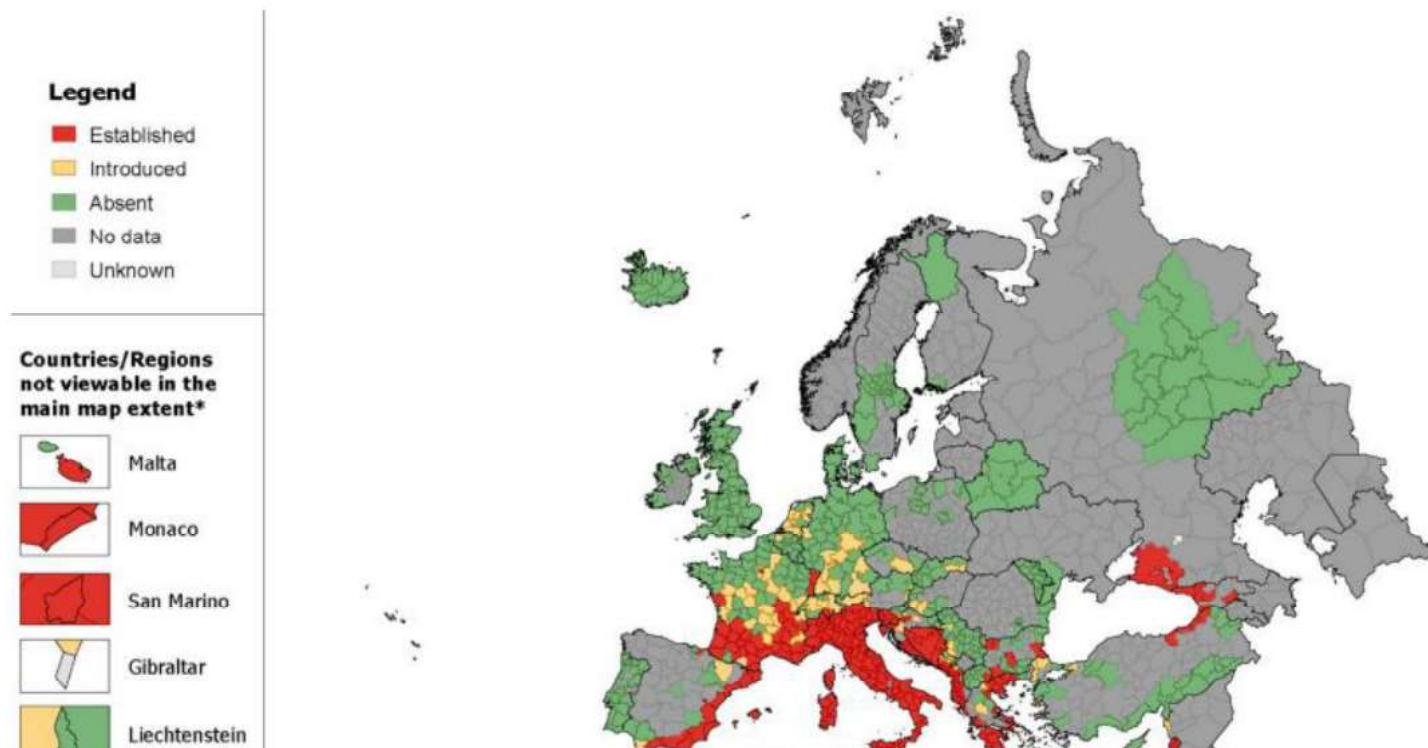


Infectious diseases (mosquitoes)

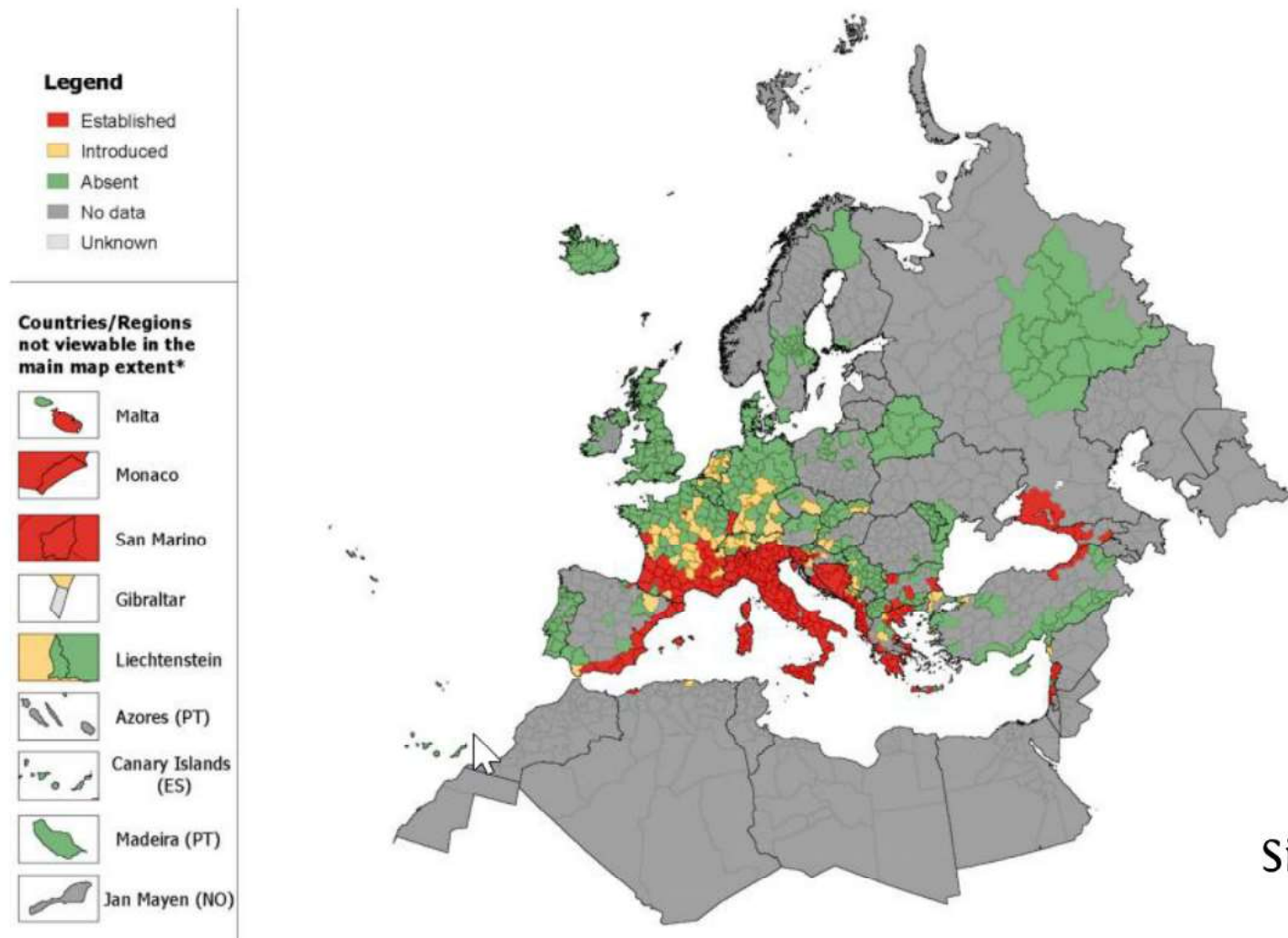


The tiger mosquito (*Aedes Albopictus*, 2017)

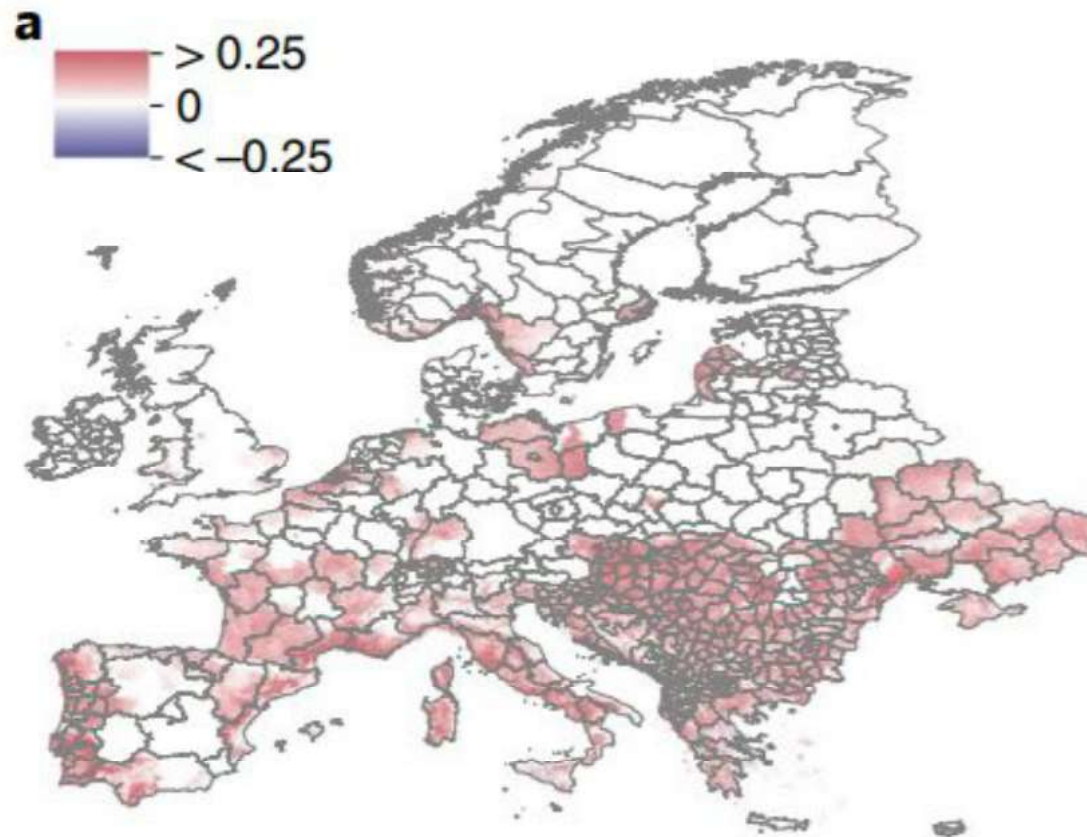
- Vector of Dengue, Zika and Chikungunya
- Arrival in Italy in 1990
- Appearance of Chikungunya and Dengue clusters in the EU



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Situation in 2017



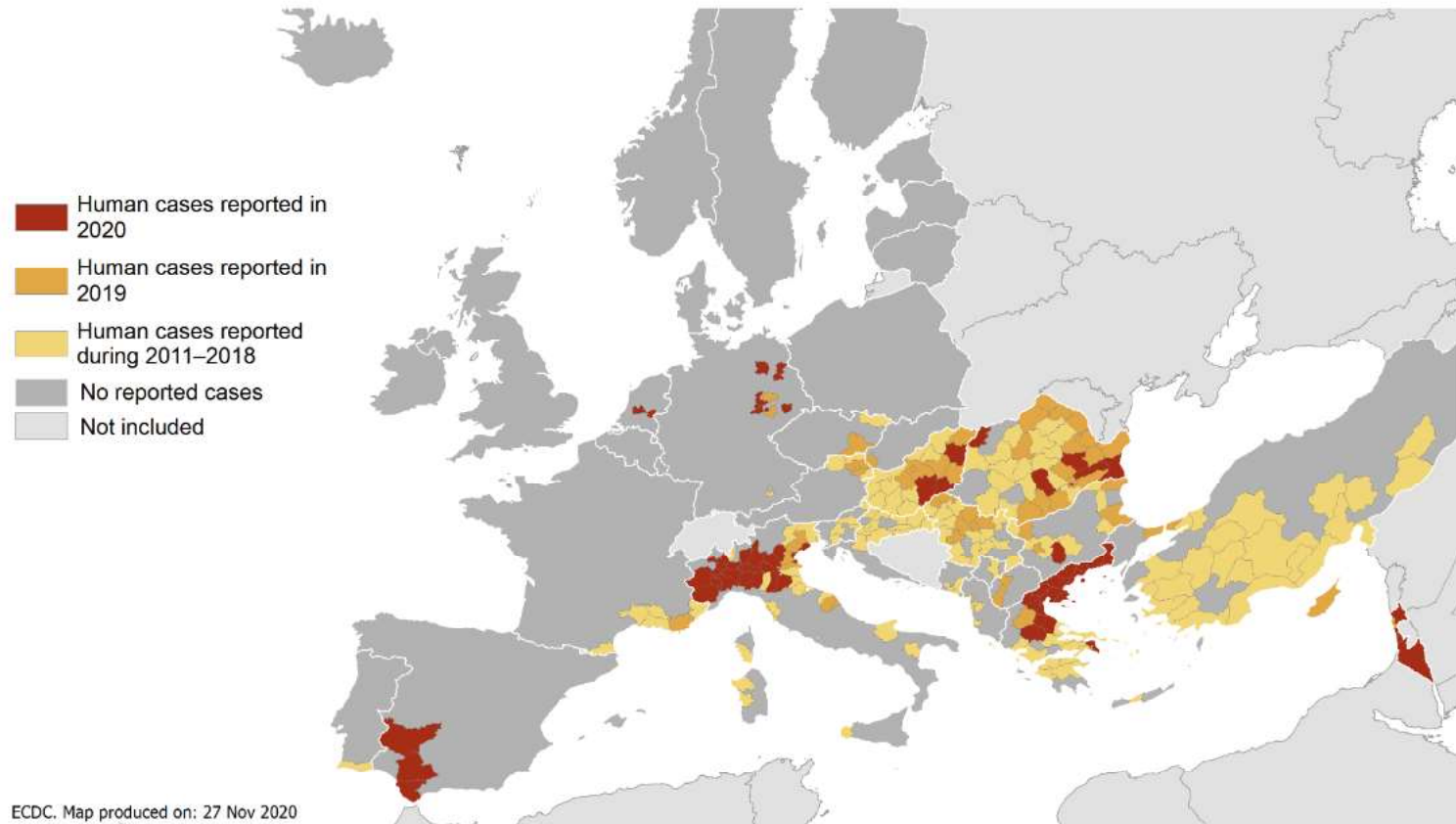
Predicted spread by
2080, medium
climate scenario
RCP 6.0

Infectious diseases (mosquitoes)

West Nile virus



- 316 cases (including 37 deaths) EU (2020)

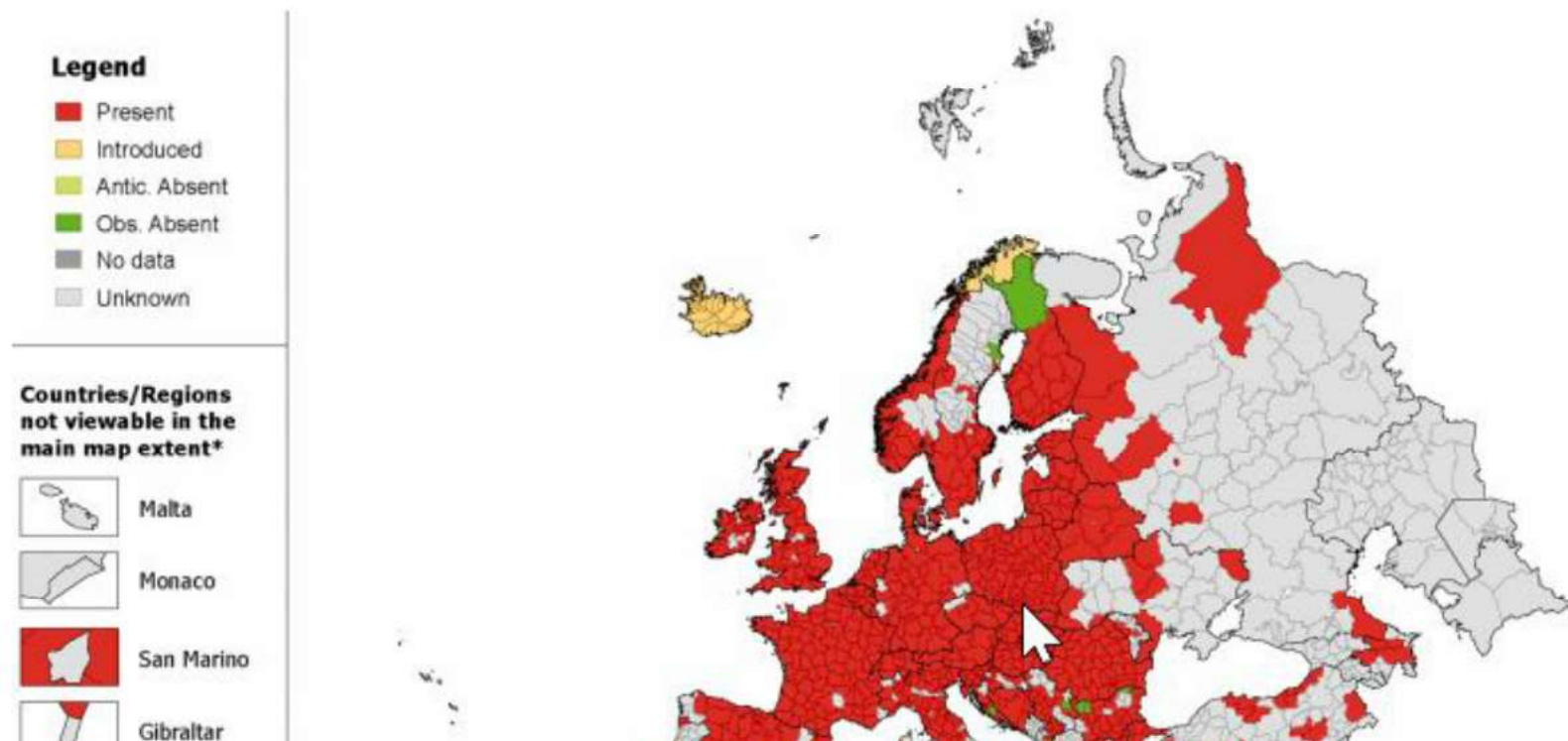


Infectious diseases (ticks)

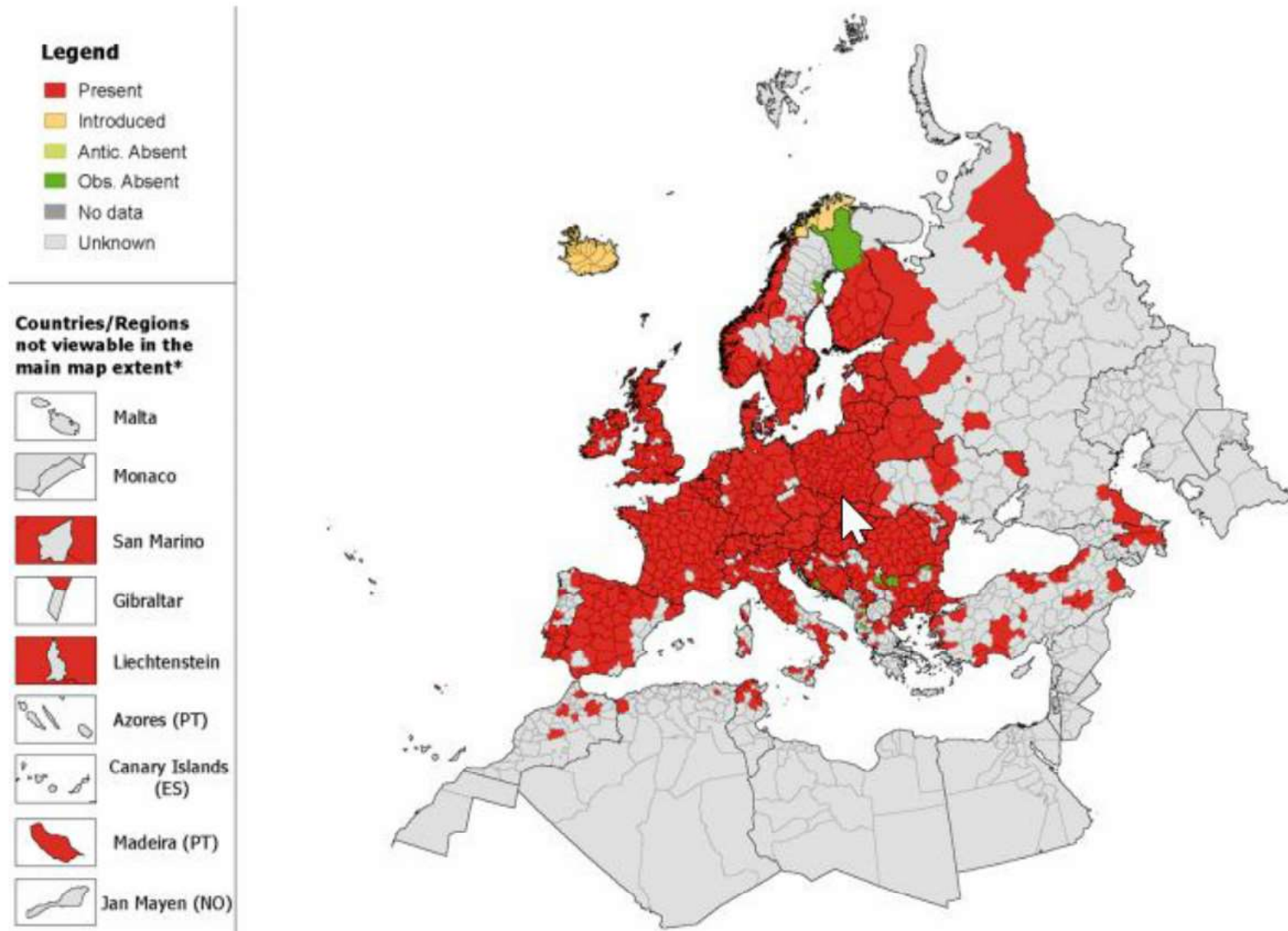
Ticks in EU (in 2017)



- Lyme disease 65'000 cases/year EU
- Tick-borne encephalitis ~2000 cases/year
- 400% increase in 30 years
- 3.8% increase in habitat projected for 2030-2060



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- 400% increase in 30 years
- 3.8% increase in habitat projected for 2030-2060



Indoor air quality (IAQ)



- 85-90% of our time spent in indoor spaces
- IAQ is a strong health determinant
- Where does the pollutants come from ?

Human activities:
CO₂, water, PM,
virus, VOCs,
cosmetics,...

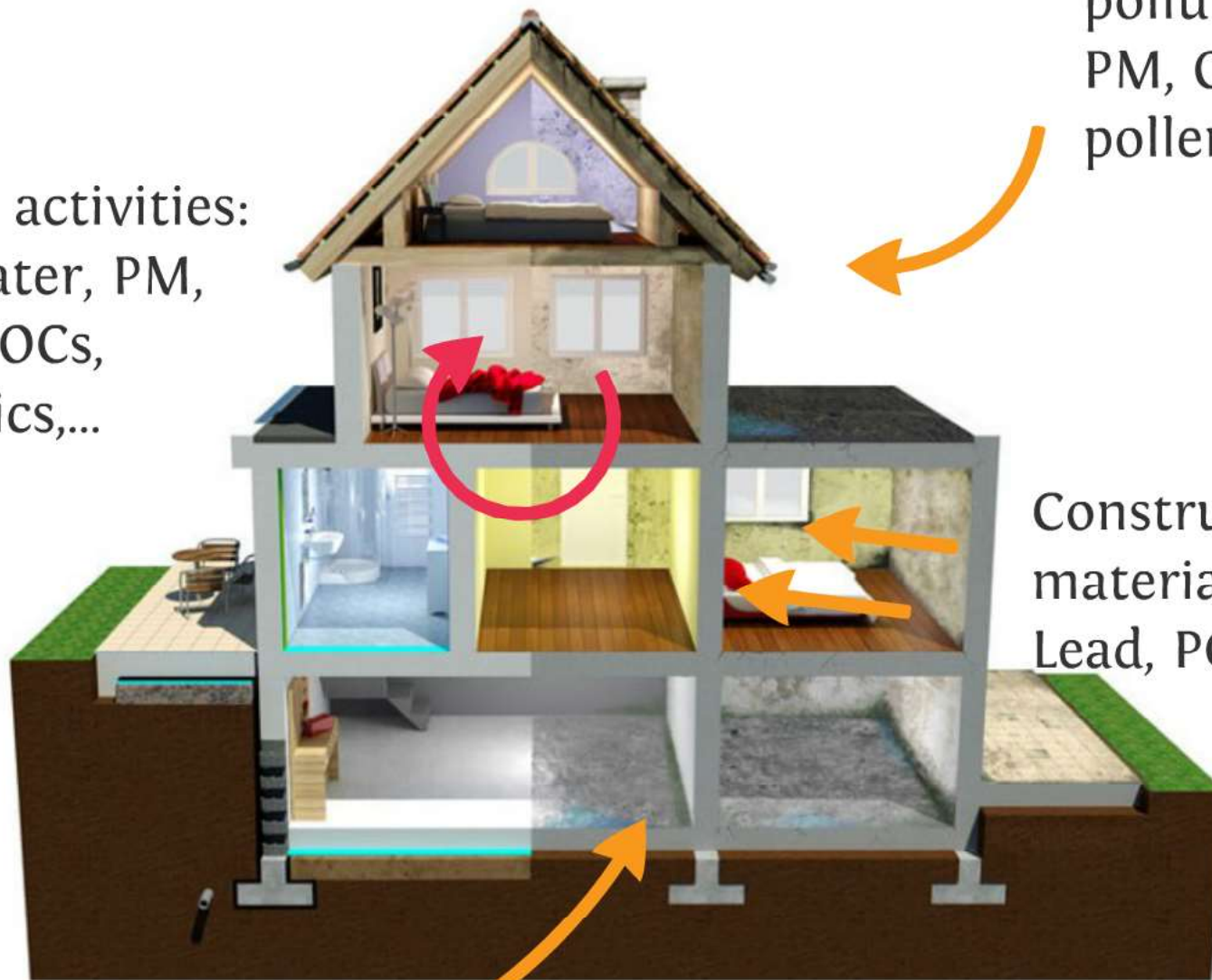


Outdoor
pollutants:
PM, Ozon, VOCs,
pollens...

Construction

Human activities:
CO₂, water, PM,
virus, VOCs,
cosmetics,...

pollutants:
PM, Ozon, VOCs,
pollens...



Construction
material: Asbest,
Lead, PCBs, VOCs

Radon

IAQ and climate changes (?)

- What are the expected effects of increased ambient temperatures on IAQ:
 - Molds ?
 - VOCs ?
 - Radon ?
 - PMs ?

Visible mould in a dwelling

