# Climate change and Health

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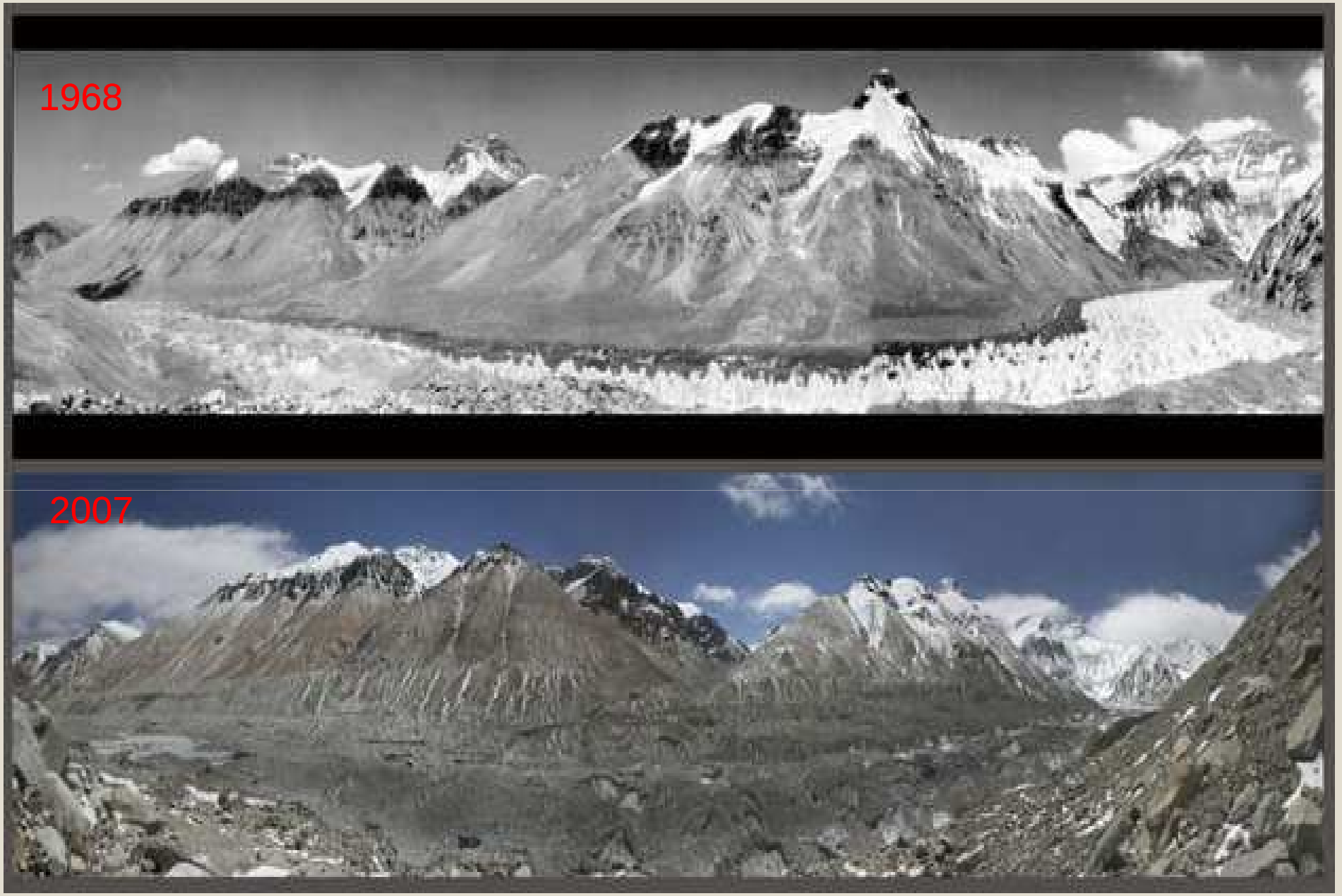



Himalaia

# The facts

Latest (2007) InterGovernal Panel Climate Change report:

- 'Warming of the climate system is unequivocal…'
- Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely* [over 90% certainty] due to the observed increase in anthropogenic greenhouse gas concentrations

# Climate change…

- In 1896, the Swedish scientist Svante Arrhenius suggested that human activity could substantially warm the earth by adding CO2 to the atmosphere
- Temperature increase of 0.74ºC in last 100 years
- 11 of last 12 years have been the warmest on record
- Warming of oceans
- Faster than average warming in Arctic

# What is more…

- Temperatures to rise by about 3°C by 2100 *(range:* 2 to 4.5°C ).
- 2°C rise = 'dangerous climate change'
- We're already 'committed' to 1°C rise even if we stop producing any more GHGs right now.
- We need to achieve 80% not 60% cuts by 2050
- Europe seem not meeting the $CO_2$ reduction targets
- Will EU meet its 2012 Kyoto target (8% cut)?

# Defining terms

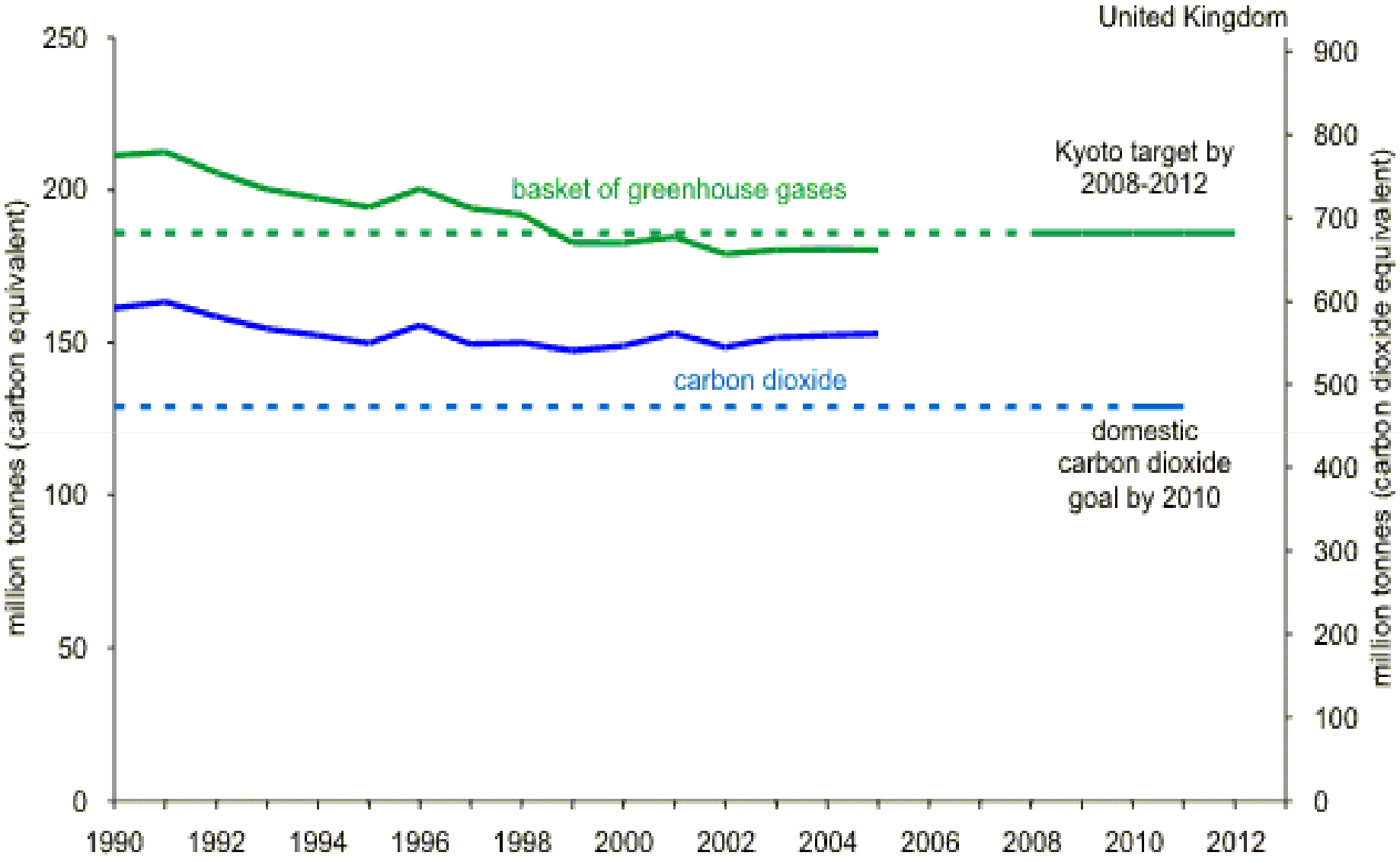
GHGs = greenhouse gas emissions

$CO_2$ the main GHG but…

…others also important (especially for food safety)

- Methane 23 x greater global warming potential than $CO_2$
- Nitrous oxide 296 x greater global warming potential than $CO_2$
- Refrigerant gases thousands of times greater than $CO_2$

Figure 5: Emissions of greenhouse gases: 1990-2012




Note: Estimates for 2005 are provisional. Updated Aug 2006

Source: netcen, Defra

## Figure 2.2 EU-15 GHG emissions 1990–2004 compared with target for 2008–2012 (excl. LULUCF)

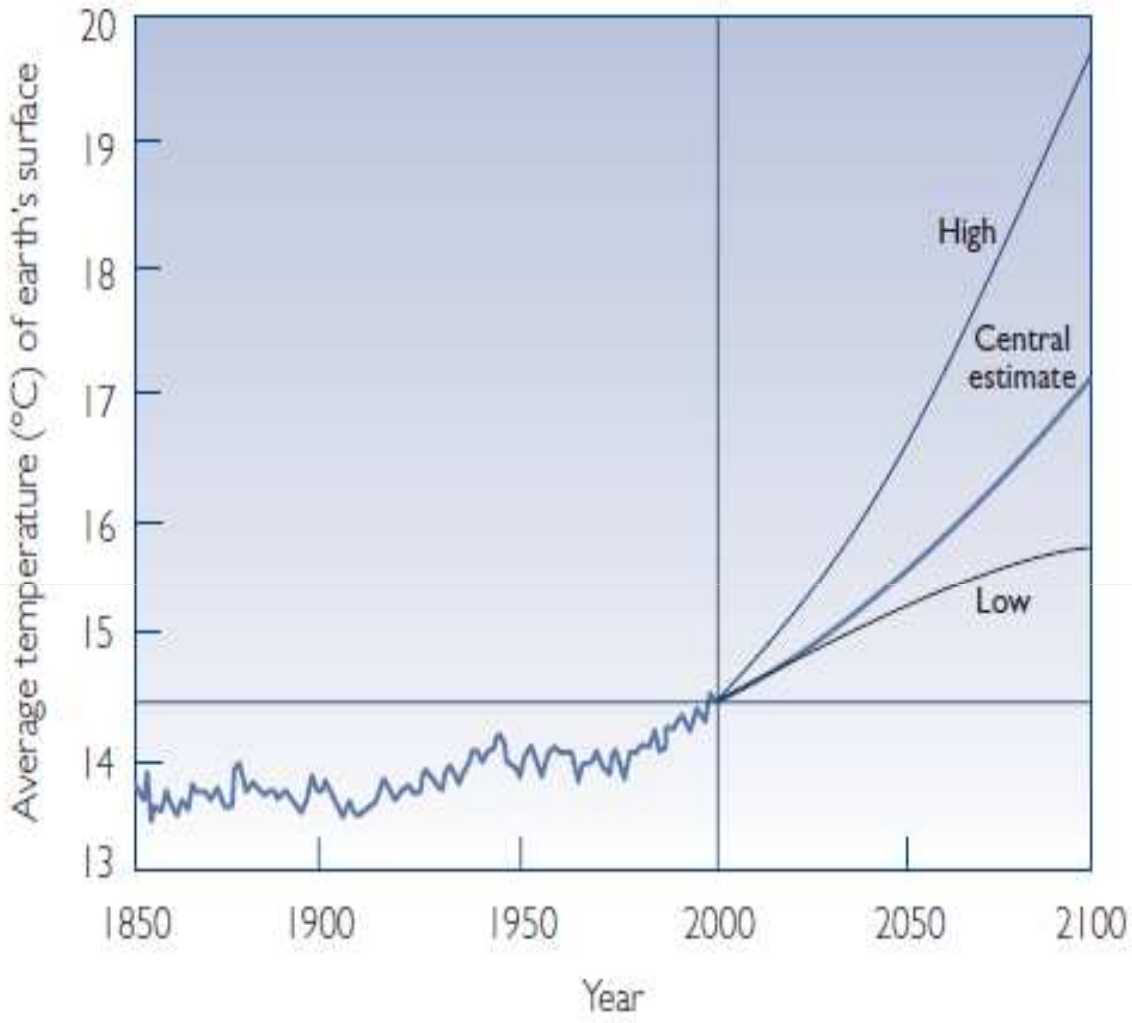



**FIGURE 1.1 Global temperature record, since instrumental recording began in 1860, and projection for coming century, according to Intergovernmental Panel on Climate Change** (*3*). The wide range around the projection reflects uncertainties about aspects of the climate system and future human economic activity and technology choices. World temperature has increased by around 0.4 °C since the 1970s and now exceeds the upper limit of natural (historical) variability. Climatologists consider around five-sixths of that recent increase to be due to human influence.

**Tropical Noel caused flooding in the 80% of the Dominical Republic in October 2007. Flooding affected the most of the south part water system**

**Typhoon Mitch in Ondoura and Nikaragoua hit in 1998 killing more than 17 .000 people and living more than 3 million homeless**

Nigeria: Up to 2030, temperature rise and changes in water because of climate change may endanger 90 million

Temperature rise affects the circulation of natural substances (e.g. pollen) which are considered as the main cause of asthma. About 300 million suffer from asthma in 2005. Deaths from asthma may increase about 20 % in the next 10 years.

Uganda : 40% of roads have been destructed. 40% of the population can not use natural clean water sources

Katrina typhoon destroyed New Orleane in 2005.
600000 deaths universally as a result of climate change in 1990,
95% in developing countries

Pakistan.: water for several uses
Gastroenteritis kill about .2 εκ.
Each year in developing countries.

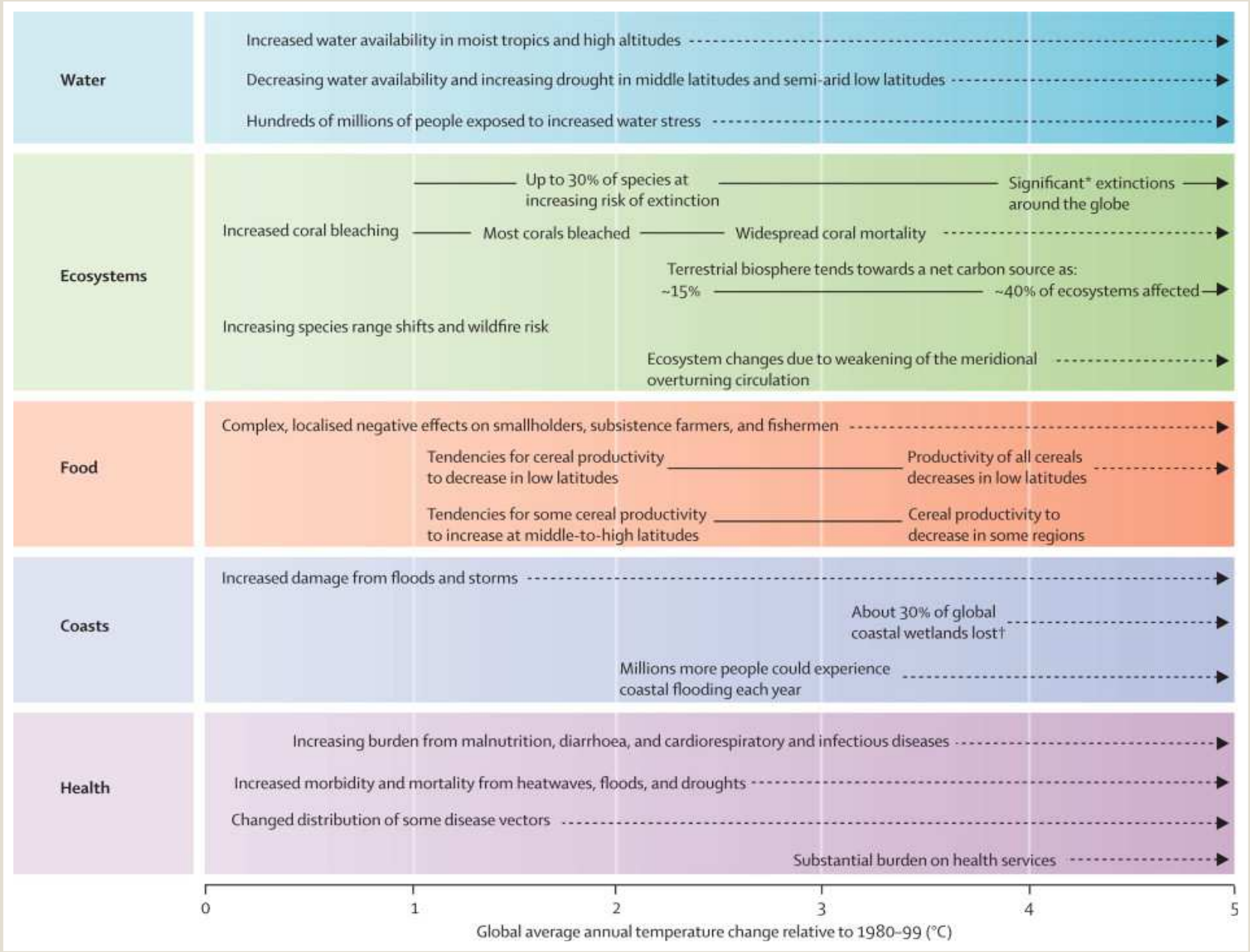
Sea level rise increases flooding danger and may cause population migration. Some of the most sensitive areas are Nile in Egypt , Bangladesh, and some small islands in Malvides.  Flooding may cause injuries and deaths as well as vector infections are increased

Freshwater production will be affected by change in rainfall .
The lack of water already affects 4 in 10 inhabitants.
The lack of water forces people to move from in big distances and to store water in their houses .

Table 5.1. Numbers of extreme climatic/weather events, people killed and affected, by region of the world, in the 1980s and 1990s

| | 1980s | | | 1990s | | |
|---|---|---|---|---|---|---|
| | Events | Killed (thousands) | Affected (millions) | Events | Killed (thousands) | Affected (millions) |
| Africa | 243 | 417 | 137.8 | 247 | 10 | 104.3 |
| Eastern Europe | 66 | 2 | 0.1 | 150 | 5 | 12.4 |
| Eastern Mediterranean | 94 | 162 | 17.8 | 139 | 14 | 36.1 |
| Latin America and Caribbean | 265 | 12 | 54.1 | 298 | 59 | 30.7 |
| South East Asia | 242 | 54 | 850.5 | 286 | 458 | 427.4 |
| Western Pacific | 375 | 36 | 273.1 | 381 | 48 | 1,199.8 |
| Developed | 563 | 10 | 2.8 | 577 | 6 | 40.8 |
| Total | 1,848 | 692 | 1,336 | 2,078 | 601 | 1,851 |

# Effects of global average temperature



# Climate change – Understanding the future risk

For example , temperature and sea level rises. Summers have higher temperatures, winters become more wet.

- What is this for Europe?
- What does that mean for Public Health?
- How diseases are affected by climate change?

# Environmental factors affect health

Our health is affected by several different physical mechanisms:

- Source of food,
- Water source,
- Climate
- Ecology of pets and/or microorganisms, or vectors causing diseases.

Climate change affects human health in parallel with other changes such as:

- Urbanization
- Damage to the environment
- Population growth and migration
- Technological/Scientific changes

**Climate change may have :**

1. Direct effects, caused by climate itself
2. Indirect effects
   a. Environmental changes and ecological
   b. Infections
   c. Diet effects
   d. Psychological effects because of the migration of the populations

# Links of climate change to health

1. Changing patterns of disease and mortality,
2. Extreme events,
3. Food,
4. Water,
5. Shelter
6. Population-migration.

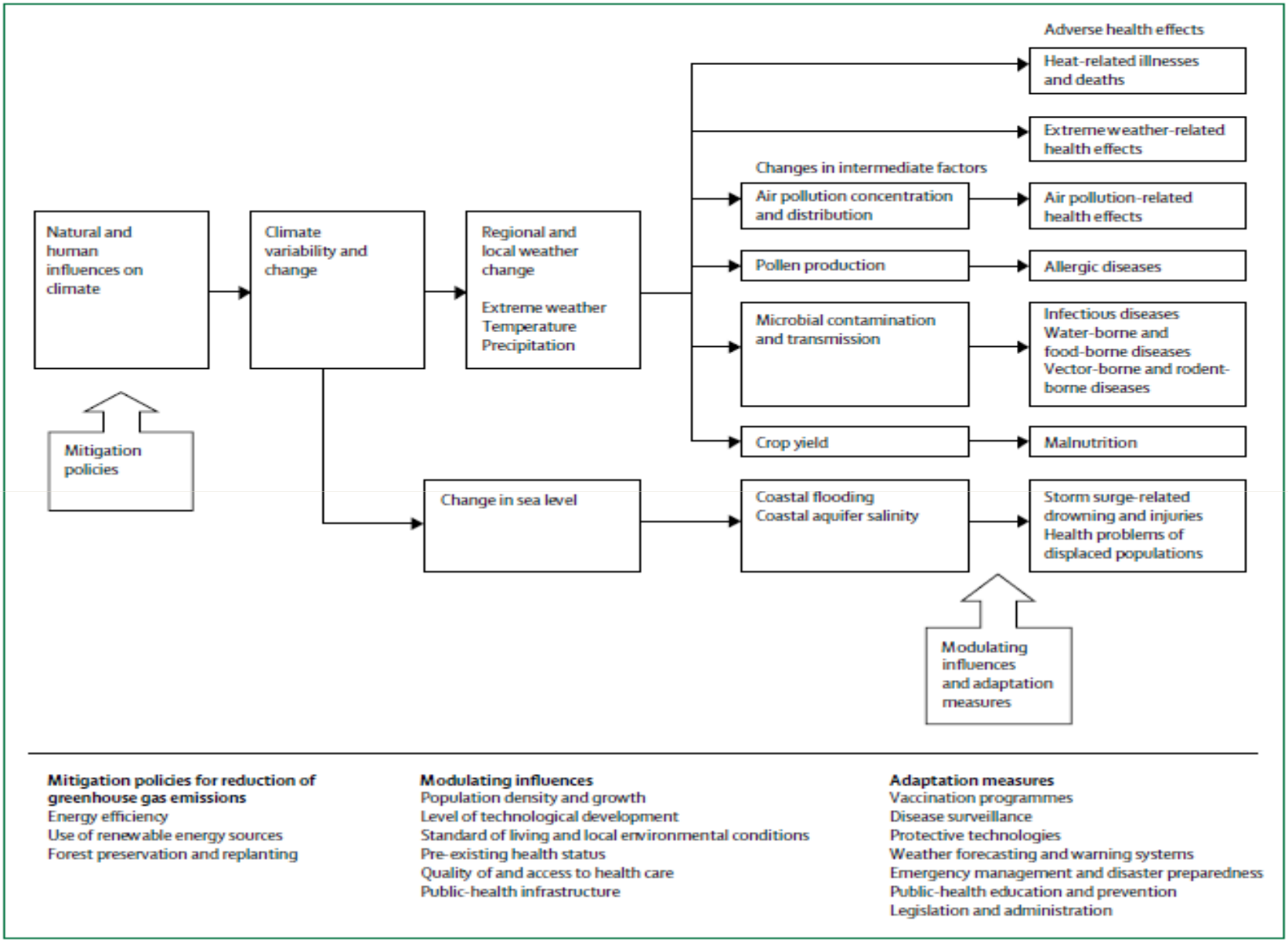



***Figure 1*: Potential health effects of climate variability and change**

# Examples of how diverse environmental changes affect the occurrence of various infectious diseases in humans.

| Environmental changes | Example diseases | Pathway of effect |
|---|---|---|
| Dams, canals, irrigation | Schistosomiasis | ▲ Snail host habitat, human contact |
| | Malaria | ▲ Breeding sites for mosquitoes |
| | Helminthiasies | ▲ Larval contact due to moist soil |
| | River blindness | ▼ Blackfly breeding, ▼ disease |
| Agricultural intensification | Malaria | Crop insecticides and ▲ vector resistance |
| | Venezuelan haemorraghic fever | ▲ rodent abundance, contact |
| Urbanization, urban crowding | Cholera | ▼ sanitation, hygiene; ▲ water contamination |
| | Dengue | Water-collecting trash, ▲ *Aedes aegypti* mosquito breeding sites |
| | Cutaneous leishmaniasis | ▲ proximity, sandfly vectors |
| Deforestation and new habitation | Malaria | ▲ Breeding sites and vectors, immigration of susceptible people |
| | Oropouche | ▲ contact, breeding of vectors |
| | Visceral leishmaniasis | ▲ contact with sandfly vectors |
| Reforestation | Lyme disease | ▲ tick hosts, outdoor exposure |
| Ocean warming | Red tide | ▲ Toxic algal blooms |
| Elevated precipitation | Rift valley fever | ▲ Pools for mosquito breeding |
| | Hantavirus pulmonary syndrome | ▲ Rodent food, habitat, abundance |

▲ increase ▼ reduction

# 1.Changing patterns of disease and mortality

- Climate change will affect health directly through a complex set of interdependent interactions.
- Regional weather changes in temperature, sea level, precipitation, and extreme weather events will cause downstream effects on the environment that lead to adverse health effects.
- The epidemiological outcome of climate change on disease patterns worldwide will be profound, especially in developing countries where existing vulnerabilities to poor health remain.
- The added pressure of climate change to the environment will worsen this burden and pose challenging questions for public and global health.

# 1.Changing patterns of disease and mortality

- Poor areas as well as developing countries will be mainly affected
- Health effects will result by temperature rise, flooding, drought.
- The temperature decrease in winter and temperature rise in summer affects mortality  in a few European countries
- Climate changes may affect the air pollution level
- Increased temperature of air and water increases the survival and growth of several pathogens (e.g. Vibrio cholerae)

## Diseases transmitted through vectors or water

- Survival of vector and reproduction
- Frequency of bite
- Incubation period of pathogen inside the vector

### Factors affecting

Temperature

Rainfall

Sea level, wind

Duration of the daylight

### Exposure to waterborne infections

Contact with contaminated water of food

## Effects on the infectious diseases

- Small arthropods are sensitive to temperature
- Some of them have travelled north (Sweden)
- Extreme climate effects have been connected to “clusters” of diseases
- Drowning conditions reduce predators of *Anopheles mosqito (malaria vector)*
- Although, heavy rainfalls will affect food – this fact will increase rodents and help to the growth of malaria

## The Impact on the transmission of infectious diseases

- The occurrence of pneumonia caused by waterborne contaminants, such as Legionella are influenced by climatic change and especially the rainfall. The Legionellosis occur during the warm months and the risk seems to increase with the wet and rainy weather
- Worldwide, waterborne enteric diseases are more likely to increase the incidence of cholera. The risk increases with the increase in water temperature

# Impact on the transmission of infectious diseases

- A study in Thailand indicated a statistically significant correlation between rainfall and enteroviruses infections associated with consumption of contaminated drinking water.
  It indicated statistically significant correlation between the rate of rainfall and infections with enteroviruses. The probability was greater than 50% of precipitation > 31 mm/h
  The enteroviruses can be found in ground water after heavy rainfall

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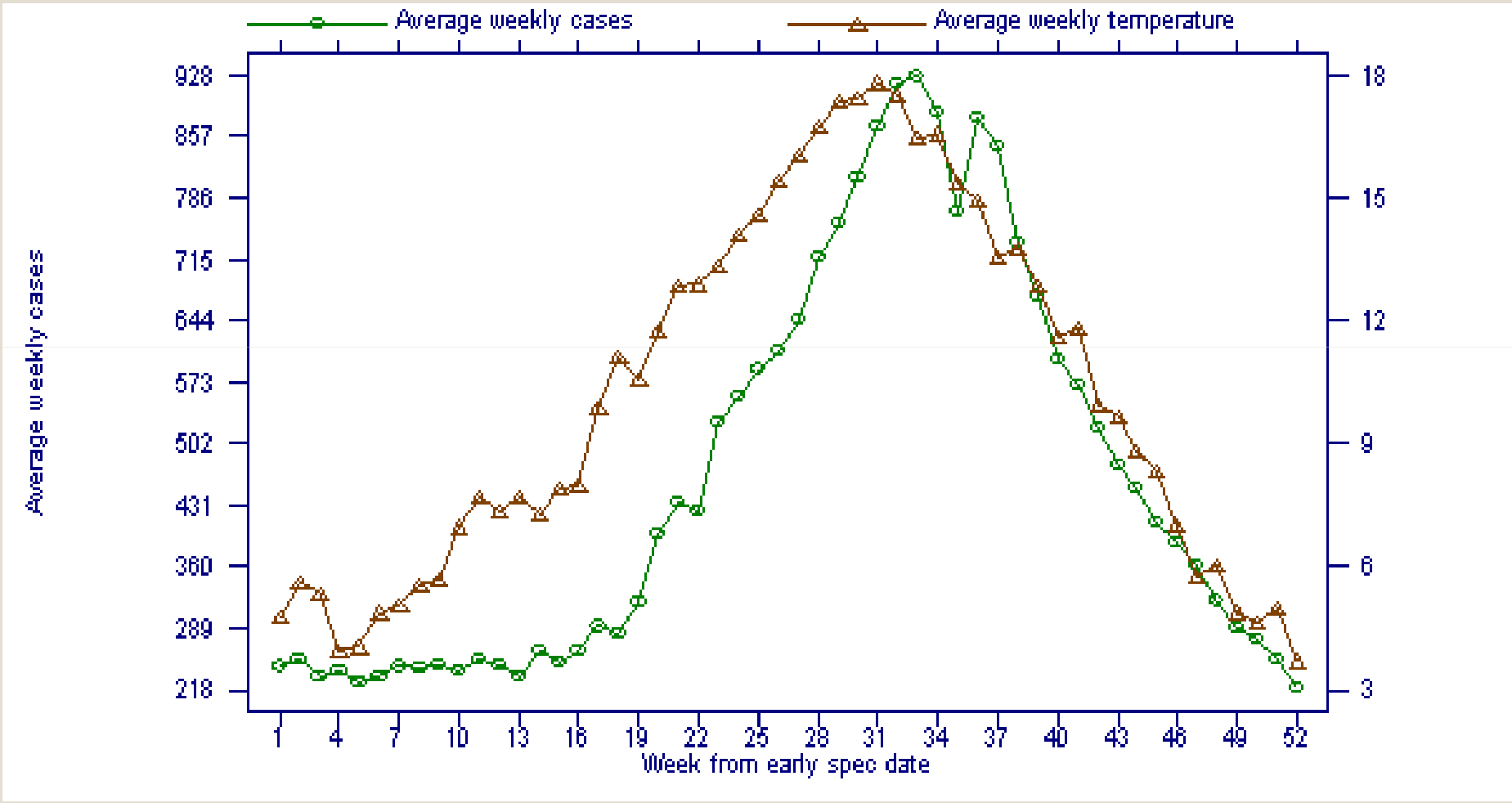
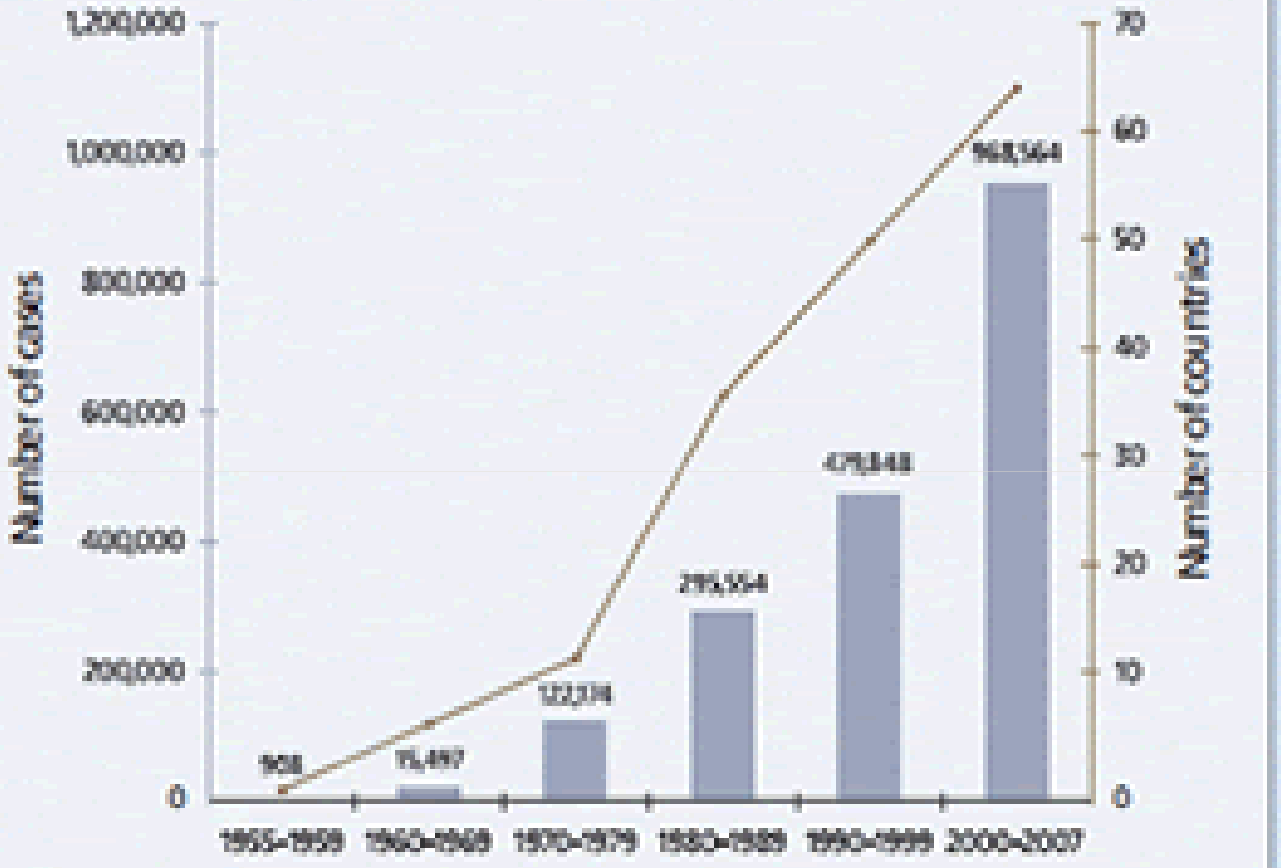
# Seasonal Distribution of salmonellosis with temperature

England and Wales Health Protection Agency Communicable Disease Surveillance Centre (2002)



## Dengue since 1955: more cases, more places




In the wake of rapid urbanization and heightened global travel since World War II, the number of both dengue cases and countries reporting infection has climbed precipitously.

Source: WHO; http://www.who.int/csr/disease/dengue/impact/en/index.html

# 2.Extreme events

- Major disasters caused by extreme natural events and health are directly linked, especially in relation to weather-related disasters, which can be expected to increase in number and severity in a warmer planet.
- Associated health problems can arise from the loss or contamination of potable water leading to disease, destruction of crops resulting in food shortages, poor nutrition, and malnutrition.
- Health problems are compounded by general infrastructure breakdown, notably with respect to water supply, sanitation, and drainage. In the long term, mental health conditions after a disaster, such as depression and anxiety, can also present serious problems.

# Climate change effects

- The increased temperature and the heavy raining  is predicted to increase the frequency of waterborne and foodborne diseases.
- Temperature rise and changes in the pattern of rainfall may increase the vectors diseases
- Flooding provide the best environment for vectors, helping them to their geographical distribution and increasing the frequency of outbreaks that cause

## Flooding, insects, diseases

- Increased Risk for the appearance of malaria
- Climate change may affect the disease distribution which are caused by insect bites in Europe
- The rise of the sea level is very important
- About 12 million have been affected in Europe from flooding or drowning last decade
- 2000 deaths from flooding about 0.5% of all deaths

# 3.Food

- In 2008, Josette Sheeran, director of the World Food Programme, wrote that :

  “in the fight against hunger we could now be facing a perfect storm of challenges, including climate change and increasingly severe droughts and floods, soaring food prices and the tightest supplies in recent history, declining levels of food aid, and HIV/AIDS, which also aggravates food insecurity”.

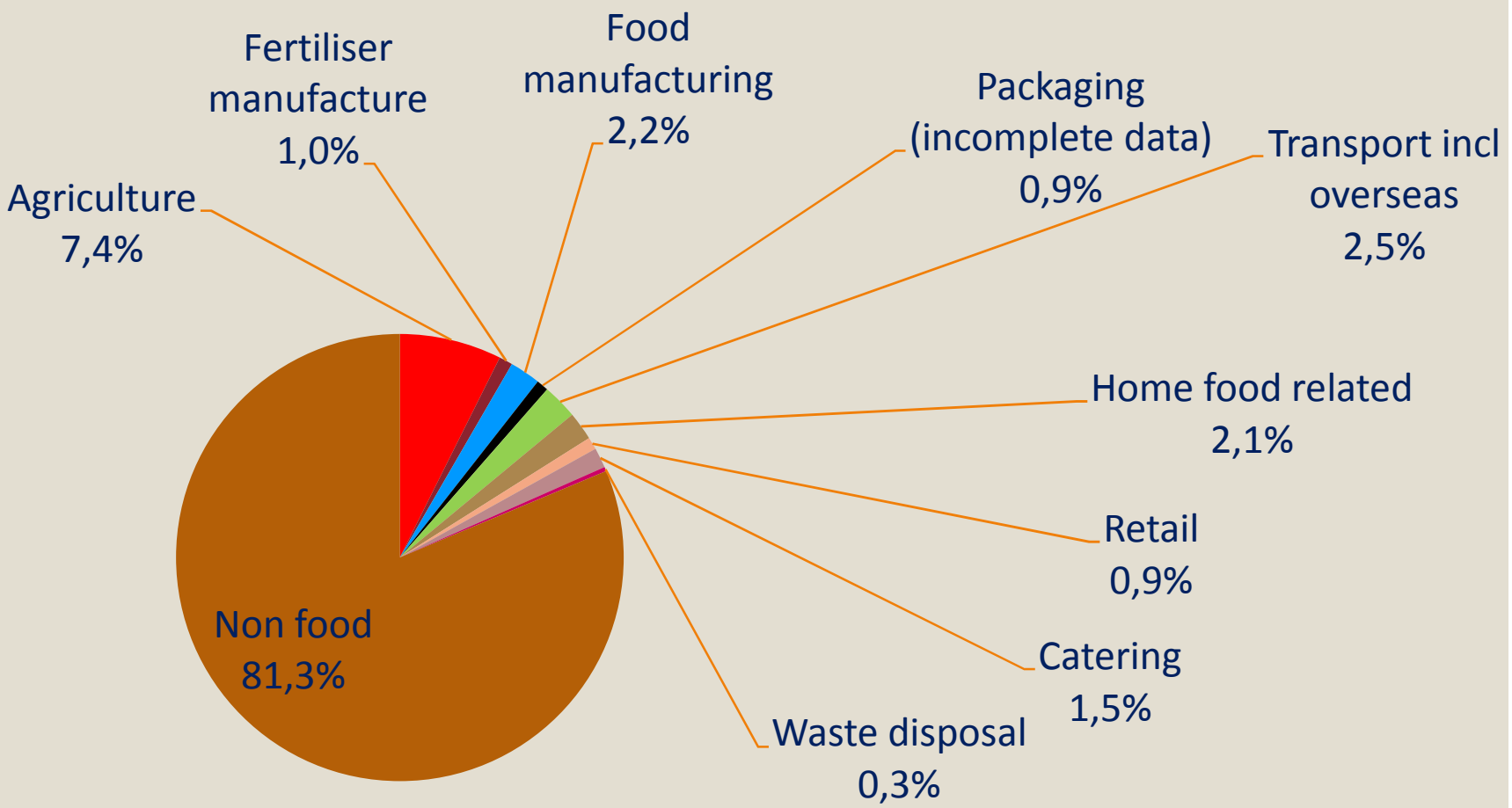
# Need to consider emissions at all stages

Need to consider emissions at all stages in the food chain:

- Agriculture
- Manufacturing
- Refrigeration
- Transport
- Packaging
- Retail
- Home
- Waste

They all affect one another

# UK GHG emissions – how does food contribute?



# 4. Water

- Changing rainfall and temperature over the next decades are likely to make provision of clean water, good sanitation, and drainage even more complicated than it is now.
- Average annual rainfall is forecast to decrease in some regions and increase in others, and droughts and floods are likely to become more frequent and intense.
- Regional temporal patterns of rainfall might also be altered: the problem is not simply sustained drought, but also severe rainfall all at once followed by less rainfall, thus annual rainfall might rise, but still cause drought.

## …Water

- Rainfalls affect water availability as well as water quality
- Heavy rainfalls and flooding  help the rapid movement of pathogens in water
- The population movement because of flooding and environmental conditions  is connected with the increased risk of waterborne and foodborne diseases
- Transfer faster toxic chemical substances and/or microorganisms (such as *E. Coli, Cryptosporidium,* and *Vibrio cholerae).*
- Create land for the growth of mosquitos,

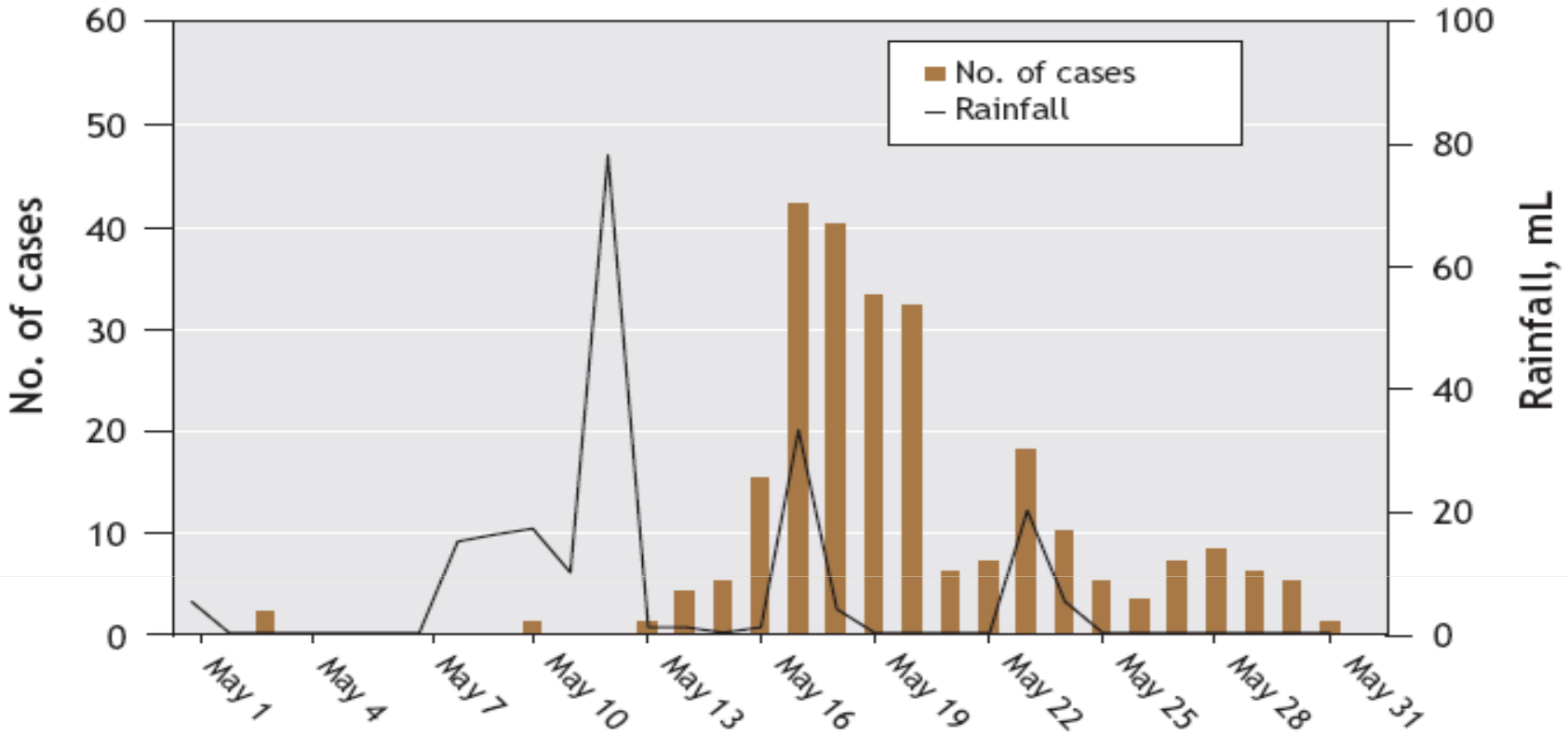



**Figure 3:** Association between precipitation and water-borne disease outbreaks. The graph shows the relation between unusually heavy rainfall and the number of confirmed cases of verotoxigenic *Escherichia coli* infection that occurred during a massive enteric disease outbreak in Walkerton, Ontario, in May 2000. The incubation period for verotoxigenic *E. coli* is usually 3–4 days, which is consistent with the lag between extreme precipitation events and surges in the number of cases. The figure is based on data published by Auld et al[36] and data published in *Report of the Walkerton Inquiry: the events of May 2000 and related issues. Part one*.[50]

# Shelter

- The management of health effects of climate change related to shelter and human settlements requires not only secure emergency shelter for those displaced or affected by climate variability events, but also human settlements prepared for the future climate-changed environment.
- The process of urbanization in the developing world is structurally linked to increased environmental vulnerability, with a high percentage of the urban population exposed to climate-related hazards, such as floods and landslides, as well as to related health problems, such as disease and injury.
- Climate change increases this vulnerability, especially for the poorest and most powerless groups in society, as they often have not been given opportunities to adapt.
- Poverty reduction needs to be placed at the forefront of the debate on adapting human settlements to climate change.

# Population-migration

- Although it is impossible to predict with any certainty what climate change will mean for human population migration, the number of climate-change-related migrants that could exist by 2050 is estimated to be in the hundreds of millions.

The population will be affected depending on the following factors:

- Population density,
- Level of financial growth,
- Food supplies,
- Socioeconomic level
- Local environmental habits
- The health status of the population
- The situation, quality and availability of public health programmes.

# For example

A) In risk: socially isolated citizens, elder people, poor people

B ) Populations living in areas close to areas with malaria dengue fever, which do not have effective public health systems will be more sensitive to climate change

# In general some major concerns

- 9 billion people on planet in 2050
- Increase in numbers in absolute poverty AND growing wealth in many parts of developing world
- The poor will suffer most from climate change
- An 80%+ cut in developed world GHGs needed
- Tackle problems in isolation or as a whole - atomised vs synthetic approach?

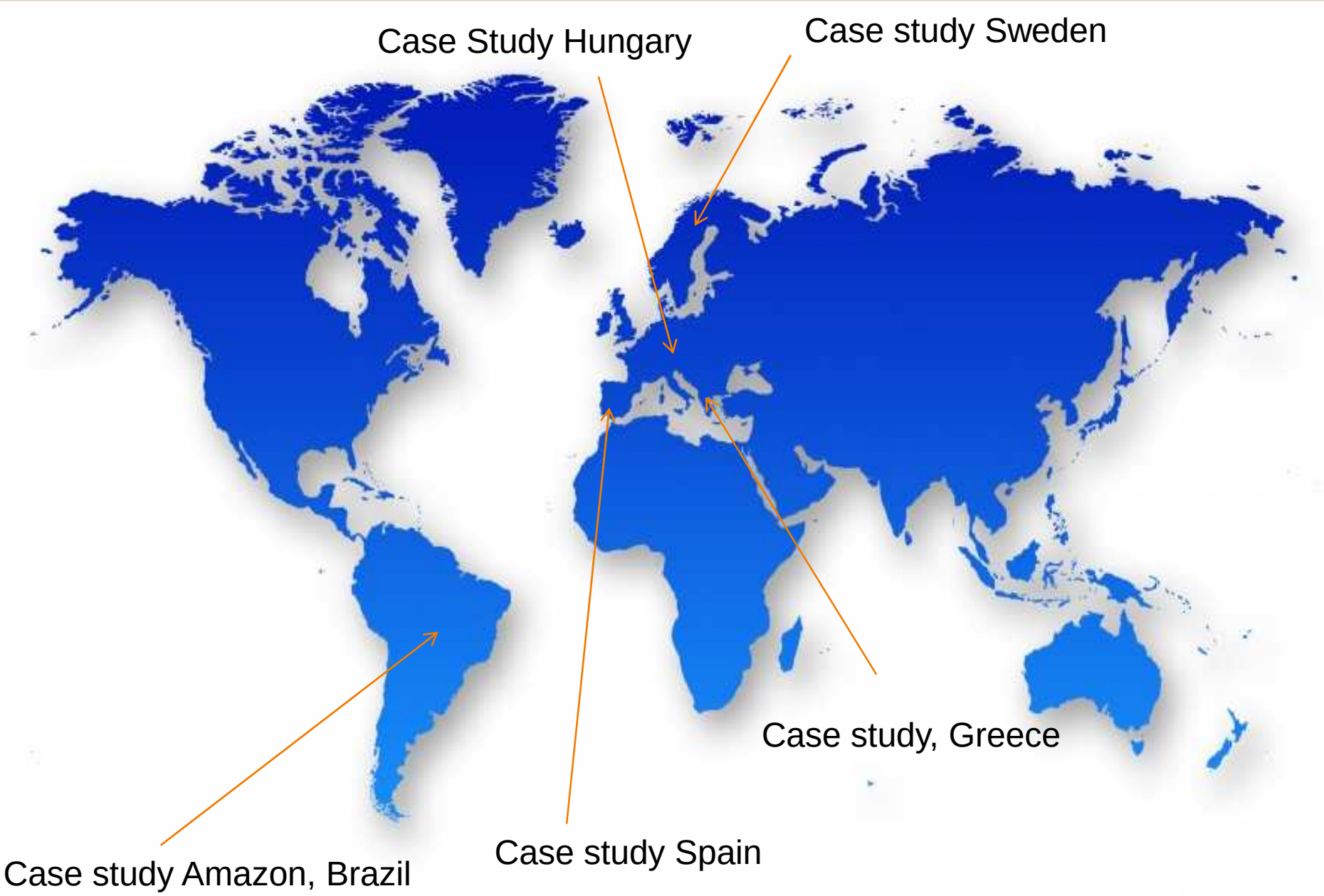
Viroclime

# Impact of climate change on the transport, fate, and risk management of viral pathogens in water

- ABERYSTWYTH UNIVERSITY (AU) , UK
- UNIVERSITAT DE BARCELONA (UB), Spain
- VELINDRE NATIONAL HEALTH SERVICE TRUST (NPHS)
- UNIVERSITY OF PATRAS (UPA) , Greece
- UMEA UNIVERSITET (UMU) , Sweden
- FUNDACAO OSWALDO CRUZ (FIOCRUZ), Brazil
- ORSZAGOS KORNYEZETEGESZSEGUGYI INTEZET (NIEH), Hungary
- FUNDACIÓ PRIVADA INSTITUT CATALÀ DE CIÈNCIES DEL CLIMA (IC3), Spain

**VIROCLIME Principal Project Objectives**

1. To report on the performance characterization of methods developed in EU, International Cooperation Partner Countries (ICPC) and US laboratories for the detection of waterborne human pathogenic viruses in environmental 'hot-spots'.
2. To report on the performance characterisation of methods developed in EU, ICPC and US laboratories for the concentration of human pathogenic viruses in aquatic environments in environmental 'hot-spots'.
3. To report on the development of **improved virological tools for microbial source tracking**
4. To produce **an operational model forced by environmental and water management changes** at the target sites which may be calibrated to show changes in virus levels and to facilitate changes in water management strategies.
5. To provide a report on **18-months surveillance Case Studies of emergent potentially pathogenic viruses at five environmentally sensitive sites** in Spain, Hungary, Sweden, Greece and Brazil
6. To report on any relationships linking target virus incidence with that of the current faecal indicators *Escherichia coli (EC)* and intestinal enterococci (IE) and to **assess the suitability of current faecal indicators in the face of changing climate scenarios**.


Case Study Hungary
Case study Sweden
Case study, Greece
Case study Spain
Case study Amazon, Brazil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# Thank you