Conference Proceedings

# Workshop on public health surveillance and climate change

## 25-26 March 2010

**Saint-Maurice, France**

FRENCH INSTITUTE FOR PUBLIC HEALTH SURVEILLANCE

# Contents

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### Saint-Maurice, France

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# Abbreviations

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| **Anses** | French Agency for Food, Environmental and Occupational Health Safety |
| **BMU** | Federal Ministry for the Environment, Nature Conservation and Nuclear Safety |
| **CDC** | Centers for Disease Control and Prevention |
| **CNRS** | National Center for Scientific Research |
| **DAS** | German Adaptation Strategy |
| **DGS** | French General Department of Health |
| **E3** | European Environment and Epidemiology Network |
| **ECDC** | European Center for Disease Control |
| **ED** | Emergency Department |
| **EDEN** | Emerging Diseases in a changing European Environment |
| **GHG** | Greenhouse Gas |
| **HPA** | Health Protection Agency |
| **InVS** | French Institute for Public Health Surveillance |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **NGO** | Non-governmental Organization |
| **OSCOUR®** | Coordinated Health Surveillance of Emergency Departments |
| **TBE** | Tick-borne encephalitis |
| **UK** | United Kingdom |
| **USA** | United States |
| **UV** | Ultraviolet |
| **WHO** | World Health Organization |

# Objectives



Protecting health from climate change is the main endpoint of any adaptation and attenuation strategies. Adaptive capacity of a human system can be defined as "the capacity of any human system from the individual to humankind to increase or at least maintain the quality of life of its individual members in a given environment or range of environments" [1]. In 2010, 18 European countries have developed adaptation strategies; 12 countries have included health in their national multisectoral adaptation plan, and 8 countries are developing health sector-specific adaptation plans to climate change in the World Health Organization (WHO) European Region. In Parma, at the 5th Ministerial WHO Euro Conference on Environment and Health – Protecting children's health in a changing environment, a regional framework was proposed by WHO Euro around five strategic objectives [2]:

- to ensure that all current and future mitigation and adaptation climate change measures, policies and strategies integrate health issues at all levels;
- to strengthen health, social and environmental systems and services to improve their capacity to prevent, prepare for, and cope with climate change;
- to raise awareness to encourage healthy mitigation and adaptation policies in all sectors;
- to increase the health and environment sectors' contribution to reducing greenhouse gas (GHG) emissions;
- to share best practices, research, data, information, technology and tools at all levels on climate change, environment and health.

Public health surveillance is "the ongoing, systematic collection, analysis, and interpretation of health-related data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those responsible for prevention and control" [3]. It will be essential to identify climate change impacts, to detect new trends, risk factors or vulnerable populations, to test hypothesis or to evaluate intervention measures. As such, surveillance has been identified as one priority to develop in a perspective of climate change [4]. The French High Committee on Public Health recommended in 2009 "to implement or reinforce the surveillance of health and environmental factors that could be modified by climate change".

This 1.5 days workshop on public health surveillance and climate change was organised by the French Institute for Public Health Surveillance (InVS) to share experiences on health surveillance and climate change, and to initiate a sustainable network to support one another when facing complex issues. Main issues discussed were:

- main risks and priorities identified by the different countries;
- role of surveillance systems toward climate change;
- research, surveillance and health impact assessment of climate change;
- organization of expertise;
- communication on the health risks risen by climate change.

This workshop has been the opportunity to define a framework to integrate a climate change perspective into public health surveillance. Its conclusions will be used to orientate future work on climate change and health surveillance.

This report presents the main conclusions of the workshop, and a summary of the presentations given during the workshop.

The main ultimate objective of public health surveillance is the implementation of relevant public health policies and measures. Its purpose is not to evaluate climate change impacts, or to attribute current events to climate change. These issues must be tackled through research studies.

The main objective of public health surveillance being to monitor the health status in order to implement relevant public health interventions, it is foreseen to have several uses to support adaptation to climate change and mitigation:

- to contribute to the scientific evidence of the health impacts of climate change;
- to identify and prioritize the risks;
- to provide early warnings;
- to contribute to evaluate interventions.

## Contribution to the scientific evidence of the health impacts of climate change

The fact that climate change can have public health impact is a major argument used by scientists and activists to push public health authorities to give the issue more importance on the political agenda. There is a need to produce data and knowledge in order to communicate science-based advices and positions, and to propose recommendations to reduce the impacts.

Since the first Intergovernmental Panel on Climate Change (IPCC) report, observations and models allow an increased understanding of climate change and of its impacts on the environment, the society, and on human health [5-7]. Health risks sensitive to climate and commonly identified for European countries are numerous. They can be classified into three categories:

- primary (direct impacts); e.g. heat, extreme events;
- secondary (indirect impacts through the environment); e.g. air quality, water accessibility…;
- tertiary (indirect impacts through global disruptions); e.g. environmental refuges.

These risks are sensitive to environmental and social changes wider than climate change. It would thus be valuable to speak of the "the health impacts of environmental changes" in general, rather than of the more restrictive "health impacts of climate change". Indeed, by putting too much attention on climate change, we may dismiss the importance of other factors, like e.g. land use, behaviours… A broader environmental health approach that includes climate is likely to be a more efficient intervention for prevention.

Most studies try to catch a global view of the impacts of these environmental changes. Now, there is an urgent need for studies focusing on narrower issues, with clear solvable questions, investigating specific health effects in well-defined areas and periods. On a first step, these studies may work on the direct and indirect impacts through the environment. Too few studies are available on the impacts

of climate change on environmental health, occupational health or chronic diseases. As for secondary and tertiary impacts (e.g. modifications of water supply or impacts on mental health), which might be the most important in terms of public health impact, the tools to understand them are not yet available, and need to be further developed by researchers.

In that perspective, surveillance data can be useful to identify trends of climate sensitive diseases. Although climate change has been observed since several decades, with impacts observed on ecosystems for instance, it is still difficult to identify trends in climate sensitive diseases. These difficulties can be explained by the variety of the determinants of health, most of them not being directly impacted by climate change, and by the complexity of the climate and health relationship, even for direct impacts such as heat waves. Limits are also created by the lack of routine health data with sufficient quality over long time periods. Syndromic surveillance systems give access to extensive datasets, but the question of data quality over time may reduce its ability to capture long-term trends.

Climate change and its potential impact on health challenges current epidemiological methods. The different time-scales involves in climate change and climate change adaptation complexifies the issue. Classical epidemiological methods can be efficiently used, for instance, case-control studies to confirm hypothesis, and cohorts to follow up long-term impacts, e.g. floods. A coupling of these approaches with social sciences studies could help formulating and testing hypothesis, to propose innovative prevention. There is also a need for new methods to be developed. The challenge for a public health surveillance institute is to maintain existing systems and to ensure the quality of the data over time, and to develop relevant partnerships for analysis with innovative methods and to interpret in terms of public health the trends that are observed.

## Contribution to the prioritisation of risks

Surveillance data could provide useful information for policy-makers to help them set priorities. Initiatives like the environmental burden of disease (EBoDE Project), to develop comparative methods for the assessment of health impacts estimated as Disability-Adjusted Life Years (DALYs) lost from environmental stressors, could be applied to climate-sensitive diseases. Economic evaluation of potential damages to health of climate change may be used to assess timely adaptation and mitigation strategies.

Another specific role for surveillance is the follow-up of the psychosocial dimension of the problem. Decision-makers are reluctant to take actions when the risks are uncertain and the impact of the decision is important. In that case, public opinion can be a major driver of policy, and it might be useful to monitor with reproductive appropriate methods the perception of the topic by the public.

Polls can provide a snapshot but scientific surveillance of trends of perceptions and expectations would be helpful, for example using validated KABP (Knowledge, Attitude, Belief and Practice surveys).

## Early warnings

In addition to specific surveillance and warning systems (e.g, heat waves…), syndromic surveillance is a powerful tool to detect and/or monitor in real time the impact of unexpected events, providing that the capacity to interpret the data exists. This capacity implies pooling of expertise, collaborating with many partners; specialists of environmental and health surveillance systems, and researchers. We may also consider environmental monitoring systems as early warning systems for human health. This would allow to anticipate health risks and to promote immediate preventive actions to reduce the exposure. Heat warning systems using meteorological forecasts are an illustration of such systems.

## Evaluation of interventions

Evaluation of actual adaptation and mitigation policies would allow to identify best practices and to avoid the risks of adaptation or mitigation's negative impacts.

Climate change must be seen as an opportunity for surveillance to feed local policies, e.g. transport, urbanisation… Surveillance of the health impacts of adaptation measures implemented in some countries, regions or cities could provide valuable information for others. An observatory of adaptation practises could be developed, as it was done for example for heat prevention within the EuroHeat Project [8].

The main sectors contributing to GHG emissions are generating services, but also risks for human health. Mitigation strategies targeted toward these sectors are expected to have an impact on health and on society and should be tackled with concerted actions [9,10].

In all cases, the health impacts or benefits should not be isolated from other benefits, but integrated in a broader cost-benefit analysis.

## Major challenges and ways forward

### The importance of sustainable surveillance systems

The risk of facing financial cutbacks in current surveillance systems because of the economic crisis may question their maintenance in the long-term and the extension of the surveillance coverage. However, long-term surveillance data will be essential to understand and follow up the impacts of climate change and it is necessary to find new ways of doing surveillance. The opportunity of doing case-finding surveillance, i.e. focusing on regions where most impacts are expected, and developing *ad hoc* studies to gain knowledge should be investigated.

This concept could be extended to an international perspective, as it could make sense to select regions of the world where specific changes are expected, and to implement regional, specific surveillance systems. The organization of a network of pilot regions in Europe to focus public health surveillance on sensitive areas and share experiences could be a way to move forward.

### The development of integrated systems and the building of interdisciplinarity

Another challenge is to integrate different surveillance systems from different domains. Besides technical obstacles for data sharing and data linkage, a cultural barrier limits sharing information collected by different organizations (ministries, public health agencies, research organization, the private sector…) with different objectives and constraints. Initiatives are needed to make a better use of all the available knowledge and most importantly data. Organizations like public health agencies should advocate the benefits of consistent and reliable focused surveillance systems. These systems should include health data, pollutants data, but also other environmental data such as biodiversity indicators, maps of infrastructures possibly affected by climate change and key for public health, e.g. water treatment plants, roads, hospitals and other health care facilities and social and demographic information.

Integration of disciplines, or interdisciplinarity, should be the next step. Unfortunately, it is recognized that it is difficult to make climate scientists, public health scientists and decision makers work together, even if they need each other. Climate scientists need to work with epidemiologists to define scenariis of downscaling models relevant for impact studies. Epidemiologists need to support decision-making, not only relying on climate parameters but also taking into account the impacts of other determinants of health. Collaboration is also required to define the appropriate area and period of studies. Climate parameters can show a vast heterogeneity depending on the geographical scale, and an inappropriate geographical scale can lead to wrong conclusions.

## Sharing information

Strengthen comparability and share evidence-based targeted information for key audiences available through a rapid enquiry facility would be extremely valuable to support different stakeholders groups (public health agencies, decisions makers, Non-governmental Organization (NGOs), professional associations...). This would cooperate with and support the European agencies and Commission, and the WHO regional office in the development of a mechanism of exchange of information, share of best practice and scientific advices. It could include:

- existing tools and experiences in countries and organizations on:
  - horizon scanning (literature review),
  - prioritisation of risks,
  - prioritisation of actions,
  - guidance and guidelines,
  - raising awareness;
- on-going discussions on indicators to be included in adaptation/action plans;
- existing solutions – good practices on:
  - research,
  - surveillance and expertise,
  - economic valuation,
  - policy/strategy/adaptation,
  - policy evaluation,
  - involvement of stakeholders and partnerships,
  - use cross-sectional entries like urban planning,
  - modalities to develop interdisciplinarity instead of multidisciplinarity,
  - innovative use and adaptation of available systems.

# Summary of presentations

# Surveillance systems and climate change

**Mathilde Pascal, French Institute for Public Health Surveillance (InVS), France**

InVS missions are to monitor the population's health status, detect trends, risks factors, identify vulnerable populations, in order to support decision making and provide public health warnings. In the context of climate change, the High Committee on Public Health recommended in 2009 "to implement or reinforce the surveillance of health and environmental factors that could be modified by climate change". Based on the literature and on its expertise, the InVS attempted to assess available knowledge for each risk, describe existing surveillance and alert systems concerned by climate-related risks, and identify issues raised by climate change in terms of knowledge and surveillance.

Potential uses of surveillance regarding climate change have been identified:
- to detect trends in epidemiologic patterns, unexpected events and emerging events;
- to identify vulnerable populations, risks factors;
- to propose and evaluate adaptation measures;
- to evaluate the health impacts of adaptation and mitigation strategies.

Existing surveillance and alert systems should be strengthened. It is essential to ensure data sustainability, quality and accessibility. A better linkage and consistency between health and environmental monitoring systems is necessary to reach integrated and relevant environmental health surveillance. Currently, exposure surveillance is often limited to monitoring environmental contamination. However, climate and environmental changes could lead to changes in determinants of exposure. This implies the need for improving the characterization of exposure and health impacts, as well as taking into account determinants of exposure, which would contribute to better understand potential impacts, and target prevention efforts. Examples of the role of behavioral changes can be found in the exposure to chlorination by-products. Climate and hydrology changes can increase the number of extreme events (runoffs, turbid spates, drought or low water), resulting in an increase of the organic matter content. A higher concentration of chlorine is then needed in the water. In addition, some behavioral changes have been reported; saving distributed water, resulting in an increased residence time of water in the distribution network, and rising use of tap water for drinking. All can result in a higher exposure to chlorination by-products.

Besides, climate change may lead to new and unknown situations, like the 2003 heat wave, where specific monitoring systems may not be adapted. Real-time non specific surveillance (syndromic surveillance) provides then useful information for crisis management and detection of unexpected events. It also generates routine epidemiological data that can be processed through traditional monitoring systems to better understand long-term impacts.

Another important issue for public health is to take into account the current health impacts of policies implemented to mitigate aerosols and GHG emissions. These gases are emitted by human activities that generate services and risks for human health. It is necessary to develop methods that provide decision makers with information on co-benefits enabling them to adopt policies with the best records in the short and long terms.

In a broader and integrated risk management scope, interdisciplinary partnerships are needed to explore complex systems and put health impacts of environmental, social and economic changes into perspective. For InVS, this implies the implementation of multi-disciplinary working groups, as well as the development of definitions shared by different specialties. The need for interdisciplinarity is also reflected in the interaction with research. In many areas, the lack of knowledge on the interactions between climate variability, environment and health does not allow to rule on the actual risks and their likely developments. In particular, it is important to encourage data acquisition at scales of time and space suitable for the development of public health policies.

Last but not least, the importance of international collaborations should be highlighted, both to encourage the sharing of knowledge and experiences, in particular by taking advantage of the concept of "similar countries", countries that are experiencing a climate similar to the one projected in the years to come, but also to ensure that international negotiations and decisions take greater account of health impacts of climate change.

**Conclusion:** the expected impact of climate change does not justify the development of new surveillance systems. However, existing systems should be strengthened through:

- the implementation of systematic and standardized studies on the health impact of extreme events in the short, medium and long terms. This requires defining health and social impact indicators relevant to public health efforts. A major concern is to better understand the impacts of these events on mental health. The resiliency of a society to simultaneous or repeated events is also questionable;
- the quantification of interactions between air pollution and temperature;
- the integration of the population and habitat dimension;
- the development of tools able to integrate the impact of air, housing, and urban pollution in the evaluation of policies to reduce greenhouse gas emissions;
- the promotion of research programmes (in the area of water, ultraviolet (UV) exposure, chemicals), related to changes in exposure modes, societal and environmental changes.

A detailed report [11] is available on: www.invs.sante.fr/publications/2010/impact_sanitaire_changement_climatique/index.html.

# Climate change and health activities at the US Centres for Disease Control and Prevention

George Luber, Centres for Disease Control and Prevention (CDC), United States (USA)

The CDC's climate change program was developed out of an informal working group formed in 2006 to provide a forum for intra-agency discussion and collaboration on climate change impacts. It was formally constituted as a program in March 2009 with a congressional appropriation. The CDC has developed a set of priority health actions that emerged from recommendations to the CDC Climate Change Workgroup held in January 2007 with representatives from various stakeholder groups and public health officials from all levels of government. These priority actions serve as the cornerstone of CDC's policy on climate change: www.cdc.gov/nceh/climatechange/.

## Priority health actions for climate change

1) Communication: serve as a credible source of information on the health consequences of climate change for the United States population and globally. Three channel have been identified; communication for the public, integration of health in all policies for policy makers and research for the scientific community.
2) Surveillance: track data on environmental conditions, disease risks, and disease occurrence related to climate change. This will require enhancement and expansion of national disease surveillance systems and the integration of infectious and environmental disease information systems.
3) Expand capacity for modelling and forecasting health effects that may be climate-related, with an urgent need for "downscaled" regional and even urban models.
4) Enhance the science base to better understand the relationship between climate change and health outcomes. 17 intramural research awards and 7 extramural research grants were awarded. Examples included:
   - response to climate change induced drought: assessing public health impacts of decentralized water reuse as a non-potable water supply;
   - linkage of two National Center for Health Statistics Data Systems to Climate Indices;
   - measuring the role of the built environment as an effect modifier of climate change and mortality in US cities;
   - development of a climate change module to track predictors, responses and public health consequences of climate change;
   - impact of climate reponses design on heat related morbidity and mortality in Los Angeles.
5) Identify locations and population groups at greatest risk for specific health threats, such as heat waves, through epidemiologic investigations and vulnerability mapping, e.g. impact of heat waves at the census block level.
6) Communicate the health-related aspects of climate change, including risks and ways to reduce them, to the public, decision makers, and healthcare providers. An example is the development of education materials for preventing heat-related illness in student-athletes.

7) Develop partnerships with other government agencies, the private sector, NGOs, universities, and international organizations to more effectively address US and global health aspects of climate change.
8) Provide leadership to state and local governments, community leaders, healthcare professionals, non-governmental organizations, the faith-based communities, the private sector and the public, domestically and internationally, regarding health protection from climate change effects.
9) Develop and implement preparedness and response plans for health threats such as heat waves, severe weather events, and infectious diseases.
10) Provide technical advice and support to state and local health departments, the private sector, and others in implementing national and global preparedness measures related to the health effects of climate change.
11) Promote workforce development by helping to ensure the training of a new generation of competent, experienced public health staff to respond to the health threats posed by climate change (e.g. the collegiate leaders in environmental health: www.cdc.gov/nceh/cleh/).

**Conclusion:** CDC draws from a variety of disciplines to create a comprehensive public health response to climate change. CDC's expertise and programs in environmental health, infectious disease, and other fields form the foundation of public health efforts in preparedness for climate change.

# Syndromic surveillance and climate change: a possible use?

Loïc Josseran, French Institute for Public Health Surveillance (InVS), France

All health effects of climate change are not clearly identified at the current time but the need of a surveillance of those effects is a key element for the coming years. InVS undertook a study on the possible use of syndromic surveillance for climate change. The objective was to evaluate the ability of the French syndromic surveillance system to monitor or identify the health impact of climate change based on already recorded data that is matched with weather events or situations representing aspects of climate change.

Two data sources were used. The first was emergency department (ED) data (Coordinated Health Surveillance of Emergency Departments (OSCOUR®) network). This individual data is collected daily and includes information such as date of birth, gender, discharge diagnosis (ICD10), and zip code. In total, there are 240 ED in the OSCOUR® network accounts for 47% of the national emergency activity in France with 19,000 visits/day. The second data source was mortality data, which is collected *via* death certificates from municipal city officials. Information collected includes age, date and place of death. In total 1,042 cities provide death certificates which accounts for 70% of the daily mortality in France (1,000 deaths/day).

In France, indicators easily accessible and useful to follow up a possible expression of climate change have been identified including:

- the 2006 heat wave: e.g. following the number of ED visits per day with a diagnosis linked to hot weather;
- air pollution; e.g. number of cases per day of asthma in Paris area, idenfying peaks associated to a combination of air pollution, pollens, storm and heavy rain;
- food poisoning outbreaks; e.g.;
- 2005-2006 Chikungunya outbreak in Réunion Island;
- insect bite; e.g. numbers of ED visits per day with a diagnosis linked to insect bites, Paris area.

**Conclusion:** syndromic surveillance does not cover all the needs in health surveillance in the context of climate change but it has an important role to play by avoiding the need to develop specific surveillance systems for each climate change effect. Syndromic surveillance presents several advantages for monitoring the health effects of climate change including:

- ongoing surveillance with valid and available historical dataset;
- follow-up of events in real time;
- follow-up possible by diseases or syndromes;
- good flexibility for monitoring several diseases or syndromes;
- good stability of data transmission even during crisis;
- good coverage of France and overseas departments.

Close cooperation is necessary between institutions in charge of syndromic surveillance, weather forecast and air pollution in order to develop an effective surveillance of health effects due to climate change.

# Tackling climate change: European Centre for Diseases Control's action plans



**Jan Semenza, European Centre for Disease Control (ECDC), Sweden**

The predicament of climate change calls for concerted public health action. In Europe, the incidence, prevalence and distribution of vector-, rodent-, water-, and food-borne infections are expected to shift in a changing environment. Due to the high level of uncertainty on the rate and speed of climate change and its impact on infectious diseases, the ECDC, a new public health agency in Europe, has mounted a proactive adaptation strategy by building an integrated network for environmental and epidemiological data. The blueprint of such a European Environment and Epidemiology network (E3) has been designed and integrated into the IT landscape of ECDC. It will be connected with the mandatory surveillance system of 49 diseases and with epidemic intelligence that monitors threats and outbreaks in Europe and beyond. The E3 network will have the capacity to connect epidemic intelligence and infectious disease surveillance with meteorological, entomological, water quality, remote sensing, or other data, for multivariate analyses and long-term projections. It would have to be pilot-tested and validated but could be a distributed, secure, web-based network that would provide timely access to climatic/environmental and infectious disease surveillance data that are collected by a variety sources. The hub could serve as a repository and would support data exchanges and sustained collaborations between member states, researchers, and other authorized users across geographic and political boundaries. Merging, integrating, and analyzing such environmental and epidemiological data will advance our understanding of the relationship between climate change and infectious diseases in Europe and inform public health action.

ECDC has also developed an handbook to encourage planning activities that anticipate and address the possible impact of climate change on communicable disease spread. This technical [12] is available on: www.ecdc.europa.eu/en/publications/Publications/1003_TED_handbook_climatechange.pdf.

# Climate change and health: lessons learned from the Swedish vulnerability, impact, and adaptation assessment

Elisabet Lindgren, Karolinska Institute, Sweden

Due to severe storms in Sweden in 2005, the Swedish government established a transdisciplinary Commission on Climate and Adaption. Two questions:

1) what are the costs if we do nothing?
2) what are the costs if we invest in adaptation?

Between 2005-2007, the Commission looked at eight different sections: infrastructure, housing and construction, physical planning, agriculture, forestry, fisheries, tourism, nature conservation, water and sanitation, and health sector (human and veterinary medicine). The Health section (human and veterinary medicine) looked at a number of issues including health effects of extreme temperatures, outdoor and indoor air quality, health effects of floods, landslides and storms, water and food quality, health effects of ecosystem changes and risk evaluations of climate-sensitive infections. The main concerns were heat waves and infectious diseases including vector, water and food borne.

**Heat waves:** this was the most pressing issue due to the fact that buildings in Sweden are currently designed for cold climates and as such have multiple windows, which has the effect of making the homes greenhouses during a heat wave. It is estimated that in Stockholm between the years 2071-2100, there will be a 35% decrease in heating needs and a 10-fold increase in the number of days with cooling needs (based only on outdoor temperature). The commission made a number of recommendations concerning heat waves including:

- that cooling systems need to be installed in intensive and coronary care units in hospitals;
- an evaluation is needed for sun shields/cooling systems in primary health care, homes of the elderly, work places etc.;
- at the community, level there needs to be an identification and record keeping of persons who are at risk;
- information needs to be diffused to the public.

**Drinking water:** another major concern in Sweden is drinking water as the majority of the population drinks tap water and the concern is when there is a threat to this water system. In addition, there is an increased risk of epidemics from floods and changes in water flows (incl. spread from animal keeping). The water-borne pathogens of most concern include *Cryptosporidium, Guardia, Campylobacter, Calicivirus*, and *E. coli* VTEC (EHEC). There is also a concern with recreational waters in that people enjoy swimming and there has been an increase in problems with toxic algae growth and cases caused by *Vibrio vulnificus* and *Vibrio cholerae* non-O1 or non-O139 during the summer months.

**Water-borne diseases recommendations:** the commission made a number of recommendations including adapting water plants and pipes to increases in water flows, locating and registering old deposits of hazardous materials in areas prone to landslides and floods, and to target information to various stakeholders.

**Vector-borne diseases:** vector-borne diseases are an area of major concern for both human and veterinary medicine. There have been major changes in geographical distribution of tick vectors, in seasonality, and in incidence in tick-borne diseases over this century in Sweden, and a high risk of introduction of new species/diseases from other countries.

**Conclusion:** early adaptation is important. The Swedish plan this includes up-dated flood and disaster preparedness plans, adaption of the building environment and housing, information and education of health personnel and other stakeholders and relevant surveillance.

# Surveillance of extreme events in the United Kingdom

Giovanni Leonardi, Health Protection Agency (HPA), United Kingdom (UK)

The HPA in the UK is responsible for environmental and infectious diseases and is governed by the Health Protection Act 2004, the Civil Contingencies Act 2004 and numerous other public health acts and international health regulations.

In the UK, the health effects of climate change include:
- by 2012, there is a 1 in 40 chance that South-Eastern England will have experienced a serious heat wave;
- periods of very cold weather will become less common, while periods of very hot weather will become more common;
- flooding is an increasing risk;
- tick-borne diseases are likely to become more common in the UK, but this is more likely to be due to changes in land-use and leisure activities, than to climate change;
- increased exposure to sunshine and to ultraviolet light will lead to an increase in skin cancers;
- the UK population seems to be adapting to increasingly warm conditions.

The HPA Agency undertakes work on natural hazards/climate change including:
- **heat waves:** contribution to the UK heat wave plan, surveillance, epidemiology, risk assessment including air pollution effects, and evaluation of interventions;
- **flooding:** contribution to overall response, risk assessment of infectious, chemical and psychological aspects, advice about safe use of water, and evaluation of interventions and ongoing effects;
- **climate-related infections:** epidemiology, surveillance, and risk assessment;
- **increased levels of UV radiation:** risk assessment and screening of feasible interventions;
- **overall:** contribution to UK report on overall health impacts, training and education.

The UK also has an Advisory Group on natural disaster reduction, which has tried to link with the United Nations work on disaster reduction. In addition, HPA has undertaken a number of studies with the London School of Economics on the long-term health impacts of flooding in England and Wales. The conclusions thus far on flooding epidemiology has shown that in the UK, high-resolution geo-coded mortality and other routine health datasets provide the possibility of examining the long-term health effects of floods. Nevertheless, interpretations are limited by uncertainties about recording of the place of death (e.g. with temporary displacement). The preliminary results do not suggest floods in England have been associated with a rise in mortality in the year after flooding, but further research is needed to address methodological uncertainties and perhaps a different approach (cohort) is needed.

**Conclusion:** primary care surveillance is used in the UK for a range of hazards including extreme weather events. Hazard reduction in relation to extreme events is increasingly seen as a requirement for adequate response and flooding responses and plans are being reviewed by HPA along with WHO. In addition, numerous studies on the long-term impacts of flooding are ongoing, the cohort approach should be better used and population displacement needs to be captured better.

# The national adaptation strategy process in Germany



**Bjorn Ingendahl, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Germany**

In December 2008, the German Adaptation Strategy (DAS) was adopted by the Federal Cabinet. Germany considers adaptation a process including all society and all government. DAS gives a national framework and assesses the current knowledge on climate parameters changes for Germany. At regional scale, it screens potential consequences of climate change for various sectors, identifies fields of action, sketches first options for action and outlines the future strategic process.

DAS aims at reducing the vulnerability to climate change impacts and sustaining/enhancing the adaptive capacity of natural, societal and economic systems. For successful adaptation, what is needed is an integrated, cross-sectoral approach, establishment of networks, solutions on a regional level as well as participation and cooperation by all stakeholders. In the scope of DAS, the following fields of action are considered:

- public health;
- agriculture;
- forestry;
- fisheries;
- water management/flood protection;
- industry/commerce;
- finance/insurance;
- housing/construction;
- energy supply;
- biodiversity;
- transport;
- tourism;
- soil.

**Public health within the adaption strategy:** health cannot be considered as an isolated field within the adaptation strategy. There are interdependencies to other fields within the strategy. Some examples are:

- flood prevention; by taking appropriate actions against flooding serious hazards for human health can be reduced;
- civil protection – by setting up emergency plans early action can prevent death or injury;
- architecture – by including the effects of heat waves and extreme weather events into the planning of buildings health threats can be reduced.

There are three main considered subjects on climate change and health in Germany including infectious diseases, extreme weather events and non-communicable diseases. The next step is to develop an adaptation action plan until 2011 together with the Federal Länder and stakeholders. The aim of the 2011 Action Plan and the further advancement of DAS will be to:

- describe upcoming sectoral, regional and international activities;
- further improve the knowledge base and climate services;
- raise public awareness, to enhance a broad dialogue and communication process, to foster participation and to stimulate individual contributions;
- support stakeholders by providing a solid information base for decision-making, procure decision-support.

A detailed report [13] is available on: www.bmu.de/files/pdfs/allgemein/application/pdf/broschuere_dem_klimawandel_begegnen_en.pdf.

Communication is an important process in the DAS. Within the last six months, the Federal Ministry for the Environment (in cooperation with the Federal Ministry of Health) established a broad communication process within the scientific community. The main objective is to establish a communication platform on climate change and health composed of experts from all relevant fields and to define the most urgent activities to become part of the adaptation action plan from 2011 onwards. The communication process with the scientific community includes establishing effective structures for communication and exchange of experience among experts. These experts pointed out the need for more research to define the most urgent activities. Several technical meetings have also been organised including a symposium on the Asian tiger mosquito [14], workshop on thermophilous harmful organism and an international extreme weather conference (scheduled for November 2010).

A major goal of the German communication process is to raise the awareness of both the public and health professionals. Since 2006, the public is informed about the possible health effects of climate change by press releases and brochures published by the Federal Government. In 2010, a broader awareness raising campaign focussing on specials groups within the population such as children and elderly will be implemented and will be done in collaboration with the Federal Ministry of Health who is responsible for raising the awareness and training of health professionals.

BMU is also supporting projects in collaboration with the WHO on health-related adaptation to climate change in Albania, Kazakhstan, Kyrgyzstan, Macedonia, Russia, Tajikistan and Uzbekistan. Activities to address the expected health effects of climate change are country specific, reflecting different priorities and needs. Each country has identified health adaptation actions such as disease surveillance, disaster preparedness, primary health care and training of health professionals, control of air pollution, water and food safety, and communication and advocacy. Communication and advocacy activities aim to raise public awareness of climate change-related health risks and what can be done by policymakers and individuals.

# Protecting health in an environment challenged by climate change: information systems – European Framework for Action



**Bettina Menne, World Health Organization Regional Office for Europe, a.i. Programme manager climate change, sustainable development and green health services**

Climate change has been dealt with in the European Office since 1989 when the Charter of the first Ministerial Conference on Environment and Health acknowledged global changes as a threat to the European population. In 1997, a working group was set up to provide input on early human health effects of climate change and their recommendations were endorsed in the 3rd Ministerial Conference and they recommended setting up an interagency network to assess, monitor and advocate adaptation and mitigation measures. After the severe weather events in 2002 and 2003, climate change was put on the agenda of the fourth Ministerial Conference. In addition, the World Health Day 2008 was dedicated to protecting health from climate change which not only highlighted the health impacts of climate change but in particular stimulated action in the prevention of health effects such as through walking and cycling. Numerous research projects were coordinated by the WHO EURO and lead to the coordination of the IPCC work on human health. In 2008, the World Health Assembly approved a resolution on climate change and health and later in 2008 the EB endorsed the WHO workplan on climate change and health.

As a response, the European Framework for Action has been developed by the European Climate Change and Health Task Force, chaired by the UK and Serbia with the participation of Belgium, the Czech Republic, Denmark, Finland, Germany, Hungary, Italy, the Netherlands, the European Commission, the European Environment Agency, the European Centre for Disease Prevention and Control, the Health and Environment Alliance, the Regional Environment Centre and the secretarial assistance of the WHO Regional Office for Europe. The overall goal of the framework is to protect health, promote health equity and security, and provide healthy environments in a changing climate in the WHO European Region. The framework objectives are to:

1) raise awareness to encourage healthy mitigation and adaptation policies in all sectors;
2) ensure that all current and future mitigation and adaptation climate change measures, policies and strategies integrate health issues at all levels;
3) strengthen health, social and environmental systems and services to improve their capacity to prevent, prepare for, and cope with climate change;
4) increase the health and environment sectors' contribution to reducing greenhouse gas emissions;
5) share best practices, research, data, information, technology and tools at all levels on climate change, environment and health.

The framework includes a request to agencies to discuss the development of an information platform by 2014, building on the available tools and information gathering processes. Member States in the WHO European Region are called on to contribute and support the provision of regular information to the platform.

The essential elements to protect health from climate change include:
1) carrying out systematic health impact assessments of climate change and associated policies;
2) developing national adaptation strategies including health;
3) promoting health benefits of a number of measures to reduce GHG emissions;
4) leading by example in reducing GHG emissions.

In addition, the information needs to be solution oriented. Health systems and services can strengthen a number of activities including capacity building for preparedness and response to extreme weather events through better early warning and weather specific response plans such as the development of heat health action plans. Similar developments are necessary for flood and drought prevention. In 2009, the European Commission published its White Paper "Adapting to climate change: towards a European Framework for Action" which suggests ensuring adequate epidemiological surveillance and the control of communicable diseases. Climate proofed health care infrastructure, cool enough in summer time, flood proofed and warm enough in wintertime is another example of action. Strengthened public health services and primary health care will further contribute to safe lives. We also need to lead by example. Health systems have started to demonstrate their leadership and responsibility by reducing their own carbon footprint. By working to reduce GHG emissions in their own institutions and facilities, they can save money and improve health. Financial savings result from spending less on energy and waste disposal, from improved staff morale and productivity, from a healthier local population (active, well fed and gainfully employed), and from faster patient recovery rates in the health care.

There are very different balance of drivers and facilitating factors in different european countries. Key drivers for adaption policies include extreme weather events/impacts, european policies, economic costs of inaction, scientific research, NGO advocacy, the media, and private sector interests. Key facilitating factors include political will, co-operation between ministries, active expertise lead participation, compatibility with other policies, sufficient human and other resources available, suitable timing and sufficient knowledge available. There is also a need for economic evaluation and stimulation of economic studies. A number of indicators (developed in the framework of the European Environment and Health Information System Project) are also being testing in member states and include:
- outdoor air ozone;
- selected allergen flowering;
- selected pollen episodes;
- ragweed;
- floods;
- respiratory mortality (monthly);
- respiratory morbidity (proxy);
- excess health wave related mortality;
- *Lyme borreliosis* incidence;
- *Salmonellosis* (changes with temperature);
- *Cryptosporidiosis* (per rainfall);

- heat health action plans;
- prevent infectious diseases;
- secure water safety.

**Conclusion:** all countries in the WHO European Region can successfully contribute to the implementation of the Regional Framework, by taken action in their own countries and by sharing lessons learnt, data and information within the region. The European information platform would be an important target of the French activities and could be supported in its developments.

# Climate change and health: a challenge for research

**Chantal Pacteau, Sylvie Joussaume, National Center for Scientific Research (CNRS), Paris Consortium "Climate-Environment-Health", France**

Set up in 2007, Paris Consortium "Climate-Environment-Health" aims to foster integrative research on the evolution of eco-anthroposystems facing climate change, one of the crucial drivers of global change. The consortium relies on the research capacity of 15 laboratories in the Paris area working mainly in the fields of climatology, hydrology, ecology, health and social sciences. Four major areas of research have been defined, which are:

- global climate, energy policies and economic development;
- climate extremes analyses and vulnerable regions;
- climate change, ecosystems, water resources and land use;
- climate change impacts on health.

A special concern on adaptation to climate change is crossing these four areas.

The schematic framework of anthropogenic climate change drivers, impacts and responses proposed by IPCC [15] can help to build integrative research on health (figure 1). Health appears both in the box "Impacts and vulnerability" and the box "Socio-economic development": health – human, animal and vegetal – is impacted by climate change and impacts economic and social life. Impacts of climate change are either direct (*via* solar radiation or temperature, for example) or indirect changes: water, food quantity and quality, vector ecology, ecosystems, agriculture, industry, settlements, and social and economic disruption. Conversely, a state of bad health impacts all these domains.

The aim of this presentation is two-fold:

- running projects supported by the Paris Consortium are evocated;
- a framework for studying (re)emergent diseases is proposed.

## On-going projects

The aim of the Pollen, Allergy and Climate Project is to develop a platform for modelling the atmospheric concentrations of a series of allergenic pollens in different climate conditions. The planned platform will attempt to simulate pollen release, transport and depositing. Following this initial stage it will be possible to study the link between the simulated pollen concentrations and their medical impact, based on hospital admission statistics and doctor's appointments for respiratory problems.

The PREMAPOL Project (air pollution and risk of premature births) aims to assess the effects of atmospheric pollution and meteorological conditions on a population of pregnant women, to test the hypothesis of potential effects of meteorological conditions and atmospheric pollution, such as preterm birth, low birth weight, congenital malformations or even intellectual disorders.

The RISC-UV Project (impact of climate change on ultraviolet radiation and risks for health) aims to determine whether there is a link between the observed increase in skin cancer incidence rates and the variation in UV radiation caused by environmental changes in the atmosphere, and to assess the relative weights of behavioural and environmental factors in this rise in skin cancer.

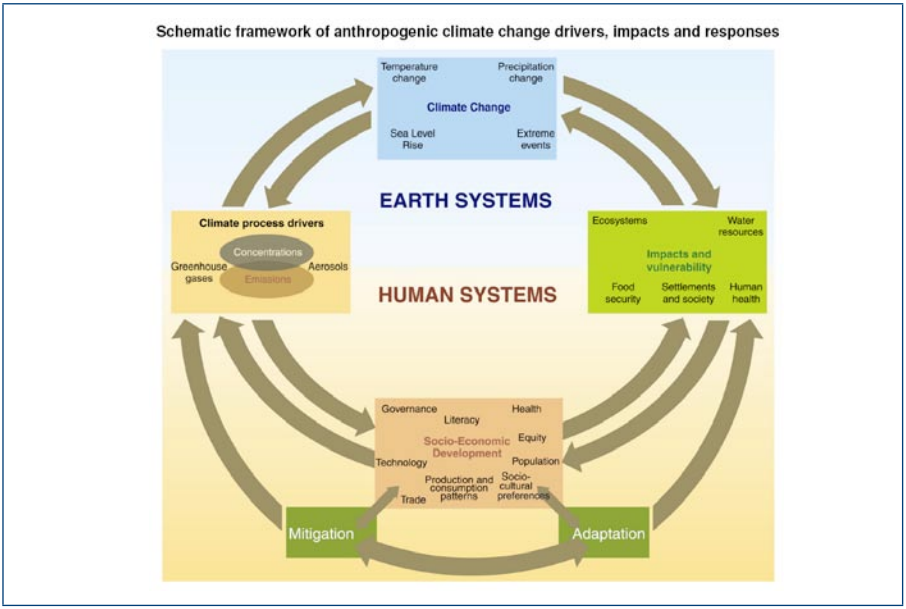
## Developing an ecology of health

As discussed by S. Morand and J.-F. Guégan [16], changes in biodiversity at all levels (genetic, population and community) affect ecosystem functioning and, in particular, host-pathogen interactions, with major consequences in health ecology (emergence and re-emergence, the evolution of virulence and resistance). Thus, "sciences of biodiversity, ecology and evolution are all central to the study of zoonotic diseases under climate change. It is undeniable that climate and climate variability are key factors in pathogen transmission. However, they also work in synergy with other determinants of global change, such as changes in land use, habitat fragmentation, bioinvasion and loss of biodiversity."

This integrative perspective of health is part of the Paris Consortium map road.

| Figure 1 |

**Schematic framework representing anthropogenic drivers, impacts of and responses to climate change, and their linkages [15]**



# Epidemiological research on climate change and health

Jouni Jaakkola, University of Oulu Institute of Public Health, Finland

The presentation addressed the following questions:
- do hypothesized health effects of climate change belong to the domain of epidemiology?
- if yes, are the contemporary epidemiologic methods suitable for studying these effects?
- if yes, what kind of evolution of epidemiologic methods is anticipated in the future?

Epidemiology has been defined by International Epidemiological Association (1993) as "the study of the distribution and determinants of health-related states and events in specified populations, and the application of this study to control of health problems." Climate change is among the potential influences of public health and fits under the umbrella of epidemiological research.

The speaker undertook a systematic non-exhaustive review of global warming and public health. The earliest paper found was by John Last and Tee Guidotti: "implications for human health of global ecological changes" [17]. A landmark paper was published later published by Anthony McMichael: "global environmental change and human population health: a conceptual and scientific challenge for epidemiology" [18]. Some of the main points A. McMichael made was that he tried to characterise the different types of possible adverse effects upon health due to global environmental change and he expanded the scope to various types of population health effects due to various scenarios. He claimed that epidemiologist must adopt an ecological model to identify, study, and to quantify the health effects of ecological disturbances. He claimed that thus rather than empirical evidence, interdisciplinary research, using modelling and forecasting to assess health effects, is needed to provide decision makers with the best available estimates.

In a systematic Pubmed search conducted on 15 August 2009 the key words climate change, human health and epidemiological methods were combined. In total, there were 593 hits. Furthermore, when he undertook an assessment of the last 100 had qualitative assessment published papers, the results were that there were 27 empirical studies, 26 reviews, 20 were classified as others and 27 were irrelevant. The speaker further noted that it is worth looking at the empirical studies and the results showed that the study design was cross-sectional studies: n=10, cohort studies: n=3, case-crossover study: n=1, time-series analyses: n=6 and other: n=7.

Some questions to consider is how epidemiologic ideas evolved, how are they applied currently, and how they will they evolve in the future. According to Alfredo Morabia (2004), current epidemiologic concepts have evolved since the 18$^{th}$ century in a series of well-defined steps to constitute an integrated theory based on two essential principles: population thinking and group comparison. The integration of these two principles is the unique contribution of epidemiology.

John E Gordon (1950) has written that "the study of disease as a mass phenomenon differs from the study of disease in the individual primarily in respect to the unit of investigation. It is early appreciated that the herd, the crowd or the community is not a simple aggregate of the persons comprising that

grouped population, but that each universe of people is an entity, a composite that possesses as much individuality as does a person." Looking at populations is one of the main trends of epidemiology and is essential to climate change. Group comparison is looking at the contrast of what is observed in the presence of exposure to what would have occurred had the group of interest not been exposed to the postulated cause. This is the central principal of epidemiology and is reflected in all aspects including: study design, measures of disease occurrence, measures of association and effect, issues of validity and chance and issues of causal inference.

Casual webs were developed in social sciences and are now used in epidemiology. There are different routes of how changes in greenhouse effect influence global warming. We can use epidemiological methods to study many of the singular relations as has been done by the method to deal with causal webs are insufficient. Things become more complicated if we take a time perspective if we start to look at what is the impact of adaptation or mitigation is no longer unique directional. If we want to assess the overall balance, the current epidemiological methods are not sufficient. Therefore, the question is what type of causality are we are talking about and the different types of causality that are being applied include:

- probabilistic causation – chance;
- counterfactual theories;
- manipulation theories – experimental evidence;
- causality in biology and medicine (e.g. Bradford Hill's criteria);
- causality in physic (laws of nature – deterministic effects of fundamental forces);
- causality in psychology;
- causality in history;
- causality in religions.

If we think of climate change and the effect on population health, it is a historical process. We have to adapt different approaches to casualty.

Environmental epidemiology has put pressure on the development of epidemiological methods. The type of problems we are facing in climate change adds to this problem. Recent developments in epidemiologic methods are being applied to issues of climate change:

- time-series analysis: effects of short-term exposure in relations with short induction period;
- case-crossover design: effects of short-term exposure in relations with short induction period – modification by individual characteristics;
- exposure assessment: modelling of exposures over time and space (Geographic Information System), prediction of relevant exposures;
- meteorological models: past, current, future;
- development in causal inference: directed acyclic graphs: marginal structural models as alternatives for ordinary regression models.

New challenges will put pressure on existing scientific methods and approaches. Questions of the health effects of climate change fit well in the domain of substantive epidemiology (i.e. knowledge about determinants of health and related events) but if we look at the traditional epidemiologic methods, they are insufficient to address some of the complex problems in assessing (predicting) effects of climate change. Epidemiology faces a problem of demarcation *vs* evolution. We need to demarcate the methods or let them evolve.

**Conclusion:** response to global environmental change will radically change theoretical epidemiology and one issue is the expansion of the classical population thinking to global population thinking. Epidemiology will need to move from group comparisons to strengthened counterfactual inference. There is also a need for evaluation of broad scale multilevel interventions. There will need to be conceptual development of causal models and development of suitable statistical methods. In addition, there needs to be interdisciplinary collaboration and exchange of ideas and a contribution of epidemiology to environmental health impact assessment.

# Climate-TRAP Project: an example of a climate change project



Hanns Moshammer, University of Vienna, Austria

There is a growing realisation that climate change is one of the biggest environmental concerns facing the world today. With rising temperatures, changing sea levels and extreme weather patterns, it presents a major threat to public health. Climate change is expected to have consequences on economic development, food production, access to water, migration patterns and has the potential to affect transmission patterns of communicable diseases. Europe's citizens are concerned about the impact that climate change can have on their health and expect policy makers to act. Climate-TRAP directly addresses Public Health organizations, which must be prepared for changes in population's health needs due to climate change. The project is expected to play a pivotal role in assisting the process of strengthening the implementation of existing warning systems and plans and in strengthening the Health Sector in its preparedness in facing the health impact of climate change. The project will look into the existing best available surveillance or early warning systems and will write guidelines to improve implementation and to prepare the Public Health Sector to face health effects and problems related to climate change. The results of the impact assessment and predictions on public health capacity needs will be linked to the compilation of the implemented surveillance and early warning systems in order to assure that these results can be used. After an impact and capacity assessment of public administration, these guidelines will be tested to assure that they can be implemented in all member states. Training sessions addressing both the public health professionals and first responders will be developed, in order to teach them how to be prepared for changes in public health that emerge due to possible climate change effects (Project website description assessed April 8, 2010: www.climatetrap.eu/).

Main focus is on climate change related health effects (heat stress, cold stress, flooding/disasters, atopic diseases and vector-borne diseases) in all countries and regions in Europe and effects in different time spans (e.g. 5, 10, 20 years). The project will look at adaption methodologies and see what is already being done and is interested in spontaneous and planned adaptation.

**Methodology I:** an inventory of early warning and surveillance systems i.e. Lyme's disease, influenza, pollen in all european member states (minimum 15) and is in line with WHO grant agreement on Climate, Environment and Health (2007).

**Methodology II:** an impact and capacity assessment that will use models for the progress on various health conditions (RAINS, IMAGE) and will be specified for countries/regions and timescales. It will presumably look at heat wave and ozone related mortality and morbidity.

**Methodology III:** is a combined analysis of early warning and surveillance systems, and assessment outcome. It will use output scenarios to gather insight into what has to be expected from the public health sector. It will also develop guidelines for policy makers.

**Methodology IV:** involves the implementation of guidelines of preparedness aimed at stakeholders at ministries. There will be three workshops (South, Central/East, North/West Europe) held.

**Methodology V:** involves the training of public health professionals "training of trainers" and three pilot trainings. Training modules will be available in six languages and will be distributed to all members.

Sarah E Randolph, Oxford University, United Kingdom (UK)

EDEN (Emerging Diseases in a changing European Environment) is a project of the European Commission that aims to identify and catalogue those European ecosystems and environmental conditions which can influence the spatial and temporal distribution and dynamics of human pathogenic agents. The project develops and co-coordinates a set of generic methods, tools and skills such as data archiving, predictive models and monitoring tools, which can be used by decision makers for risk assessment, decision support for intervention and public health policies. EDEN integrates research in 48 leading institutes from 24 countries (Information from project website accessed April 8, 2010: www.eden-fp6project.net/).

There are 6 subprojects focusing on different vector-borne diseases. This presentation was on tick-borne diseases. The results illustrate the complexity that needs to be addressed if discussing the impact of environmental change on complex systems such as vector-borne diseases. The focus was on tick-borne encephalitis (TBE) because it has been a well-recorded disease for the last 40 years, giving very good data.

**Climate change alone cannot explain TBE epidemiology:**
- need to explore alternative factors;
- multivariate factors differing in force in time and space;
- will inevitably generate heterogeneous pattern.

## Observed changes in TBE epidemiology across the full geographical spectrum

Along distributional boundaries, limited by climate:
- northward latitudinal shifts:
  - Sweden – ticks (but not TBE) recorded further north in 1990s;
- upward altitudinal shifts:
  - ticks and TBE cases recently recorded in Austrian, Slovak and Czech mountains.

Within the core endemic risk areas:
- western Europe:
  - gradual rise in TBD cases,
  - predominant effects of increasing deer densities,
  - increasing recreation associated with wealth and retirement;
- central and eastern Europe:
  - abrupt changes in human conditions precipitated by politics,
  - increases in both poverty and wealth.

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| Vautard | Robert | CNRS (France) |
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