Extreme weather and climate events and public health responses

Report on a WHO meeting
Bratislava, Slovakia
09–10 February 2004

European Environment Agency

EUROPE

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ABSTRACT

This expert meeting was organized by the WHO Regional Office for Europe and the European Environment Agency and hosted by the Ministry of Health of the Slovak Republic to exchange information and develop recommendations on public health and environmental responses to weather and climate extremes, specifically floods, heat-waves and cold spells. The 54 participants included representatives of 20 countries from the European Region, as well as of the European Commission, European Environment Agency, Red Cross, World Meteorological Organization, World Health Organization and scientists from around the world.

The discussion on health effects in different countries of the heat-wave and of the cold-waves occurred in 2003, as well as of the flooding in 2002, can be summarized as follows: 1) During the severe heat-wave that affected much of western Europe in summer 2003, women 75 years of age and older were at highest risk. 2) Winter mortality is still higher than summer mortality. While some of this wintertime excess relates to hypothermia, the greatest component is due to respiratory and cardiovascular diseases. 3)Flooding in 2002 caused serious re-organization of health care services and required advice on hygiene and immunization by health authorities. A review of the health effects showed that fatalities are often caused by entrapment in automobiles and behaviours that clearly disregard dangers. Other health effects included gastrointestinal infections due to contamination of food and water, and psychological effects.

The meeting developed the following recommendations:

- emphasis must shift from post-disaster intervention to pre-disaster planning;
- identifying and protecting vulnerable groups is particularly important;
- meteorological agencies, health departments and civil protection agencies must work together to develop early warning, surveillance mechanisms, intervention plans and crisis management tools.

This meeting contributed to the preparatory process for the Fourth Ministerial Conference on Environment and Health (Budapest, June 2004). Its recommendations, providing actions addressing public health and environmental responses to weather and climate, were submitted to Member States as an input to a policy document and to the Conference declaration.

Keywords
CLIMATE
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HEAT STROKE - prevention and control
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The meeting was kindly hosted by the Ministry of Health of the Slovak Republic and was cosponsored by the European Environment Agency.

Introduction

Over the past few years, severe floods, windstorms, heat waves and cold spells in Europe have caused dramatic political, social, environmental and health consequences. In response to these events, Ministries of Health and other public health authorities, along with national and international meteorological services and organizations and civil defence authorities have focused increased attention on the development of appropriate strategies and measures to prevent future health effects from extreme weather and climate events. Efforts are underway to understand the lessons learned from recent events, to evaluate the effectiveness of measures and early warning systems that were in place and to use the knowledge gained to target future activities. In addition, these events have also increased concern as to whether the intensity and frequency of future extreme weather and climate events can be expected to change as a consequence of the changing climate.

In June 2004, the fourth Ministerial Conference on Environment and Health will be held in Budapest, Hungary. The Conference aims: to adopt the "Children Environment and Health Action Plan for Europe" (CEHAPE); to develop a platform for sharing evidence and information to facilitate decision-making; and to address public health and environmental responses to newly emerging issues.

At the recent meeting of the European Environment and Health Committee (EEHC), which is acting as the Steering Committee of the Budapest Conference, it was agreed that at the 4th Intergovernmental Preparatory Meeting to be held in Malta, March 2004, actions necessary to address public health and environmental responses to weather and climate extremes will be discussed as an input to the Budapest Conference. The meeting was kindly hosted by the Ministry of Health of the Slovak Republic and co-organized with the European Environment Agency.

Objectives of the meeting

The aim of this meeting was to:

- exchange information and develop recommendations on public health and environmental responses to weather and climate extremes

The recommendations developed will be submitted to the European Member States at the 4th Intergovernmental Preparatory Meeting in Malta. There were 54 participants from 25 countries, the World Meteorological Organization (WMO), the European Environment Agency (EEA) and the International Federation of Red Cross. The meeting was organized into five sessions. Session one dealt with climate variability and extremes in Europe; Session two with the human health impacts of temperature extremes; Session three with responses to temperature extremes; Session four with the human health impacts of flooding and Session five with national case studies on health care system responses to extreme weather events. Participants then worked in small groups on the elaboration of recommendations, which were agreed to in a group discussion. These recommendations include proposed text for the Declaration of the 4th Ministerial Conference on Environment and Health; a set of recommendations for the Policy Document to accompany the declaration text; and specific recommendations at international, national and local levels to respond to the risk of floods, heat-waves and cold spells.

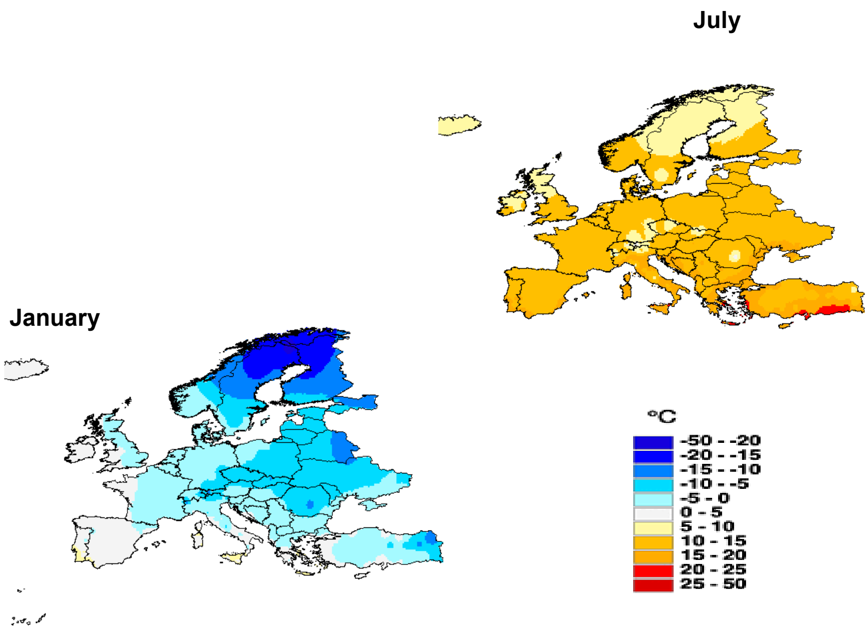
Session 1: Climate Variability and Extremes in Europe

The climate dilemma

(Antonio Navarra)

Although much of Europe lies in the northern latitudes, the relatively warm seas that border the continent give most of Central and Western Europe a temperate climate, with mild winters and summers. In the Mediterranean area, the summer months are usually hot and dry, with almost all rainfall occurring in winter. In Eastern Europe (from central Poland eastward), moderating drier conditions prevail, accompanied by greater amplitude of annual variation of temperatures, i.e. hot summers and cold winters. Northwestern Europe is characterized by relatively mild winters with abundant precipitation along the Norwegian coast and mountains and much colder winters and generally drier conditions in Sweden and Finland.

Figure 1: Climatological Minimum Temperatures (Source: WMO)



There are natural oscillations within the climate systems, such as the North Atlantic Oscillation (NAO)[1] and the El Niño Southern Oscillation (ENSO)[2], that affect interannual variability. ENSO is a prominent influence on weather patterns in much of the world but has only weak effects in Europe. The NAO is characterized by changes in ocean circulation in the Atlantic and is a weak determinant of interdecadal and interannual variability in Europe.

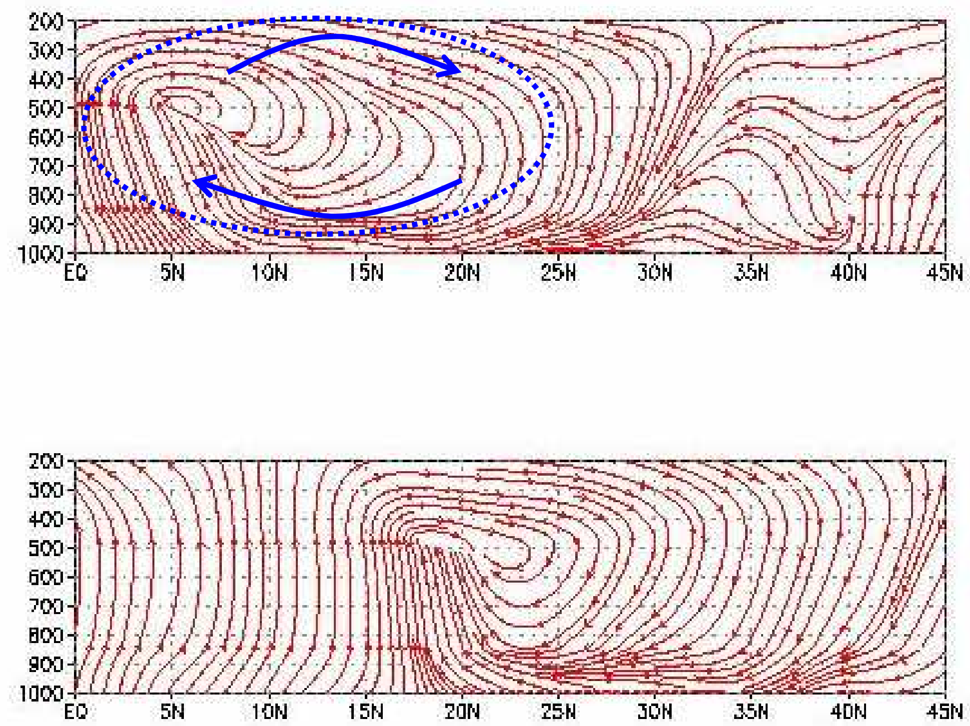
Regional climates are governed by the general circulation systems (air movements). The Mediterranean region has basically two climates. In the dry season (summer), the tropical zone of the Hadley cell expands and covers southern Europe, giving a tropical climate (warm and dry). In the wet season (winter), the mid-latitude cell expands and covers southern Europe, giving a

[1] NAO is indice difference of pressure in iceland and the azore islands

[2] ENSO/El Nino in its original sense it is a warm water current that periodically flows along the costs of Ecuador and Peru. It is associated with a fluctuation of the intertropical surface pressure patterns and circulations in the Indian and Pacific oceans called the Souther Oscillation. It monitored through an index represented by the sea surface temperature anomalies in a certain place in the central pacific region..

wet, moist and temperate climate. With climate change, this balance between the expansion and contraction of different circulation cells could change and become more complicated.

Figure 2: Mean Meridial Circulation (Navarra, personal communication)



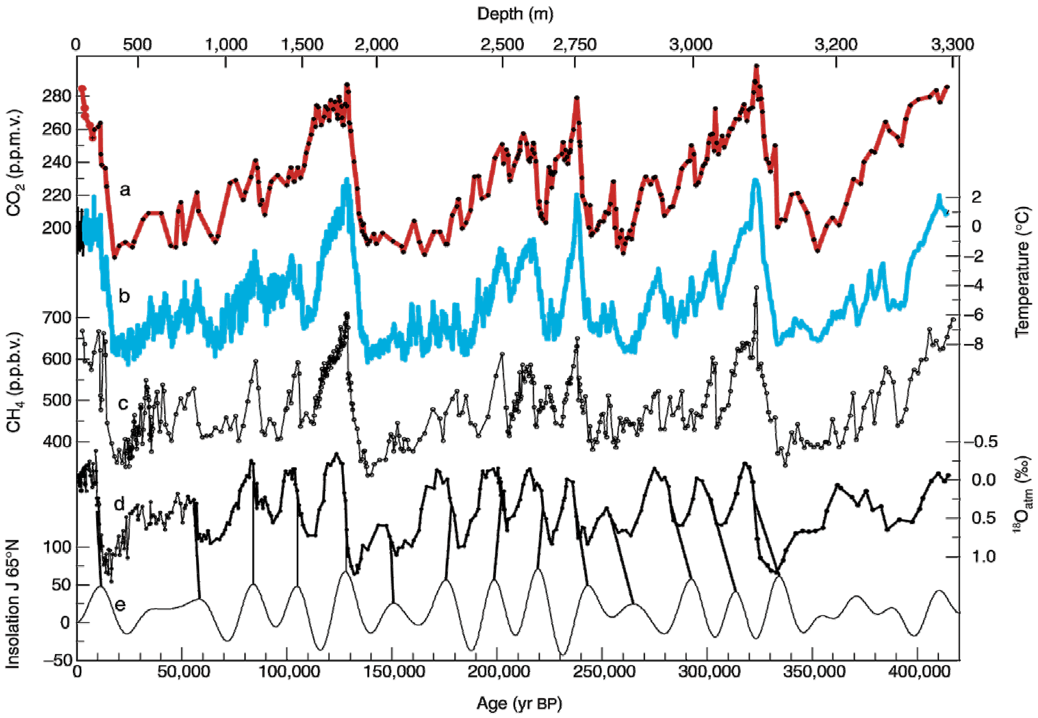
The water cycle is the main mechanism governing our weather and climate. Solar radiation drives the water cycle. The earth re-radiates some of the solar radiation that it receives. If solar radiation were the only mechanism that determined our climate, the earth would be in equilibrium at an average temperature of minus 20ºC. However, our atmosphere absorbs and re-emits some of the radiation from the earth; this is the "greenhouse effect". The greenhouse effect increases the temperature of the earth at equilibrium to an average of +10ºC.

Currently, carbon dioxide averages around 370 parts per million (ppmv) in the atmosphere; pre-industrial concentrations were about 280 ppmv. CO_2 concentrations have not been this high in the past 400,000 years. If CO_2 concentrations continue to increase, average surface temperatures must increase for the "balance" of the earth to be maintained.

Although there are many confounding factors, most of the alternative explanations for our changing climate have been ruled out, with the exception that increasing concentrations of CO_2 are leading to increasing temperatures and other changes in the climate system.

Using global climate models, climate change scenarios have been developed of what could happen under different atmospheric concentrations of CO_2. In general, temperatures will increase over land; the exact amount is not known.

Figure 3: Carbon dioxide and methane concentration in ice scores since 400,000 years until now[3].



There will also be changes in precipitation. In Europe, there will be less precipitation in the southern areas and increased precipitation in the northern areas. Projections at national, regional, and local levels are uncertain. Included in the range of projections for this century are thawing of the permafrost and an ice-free Arctic.

Projected changes in extreme weather and climate events in Europe

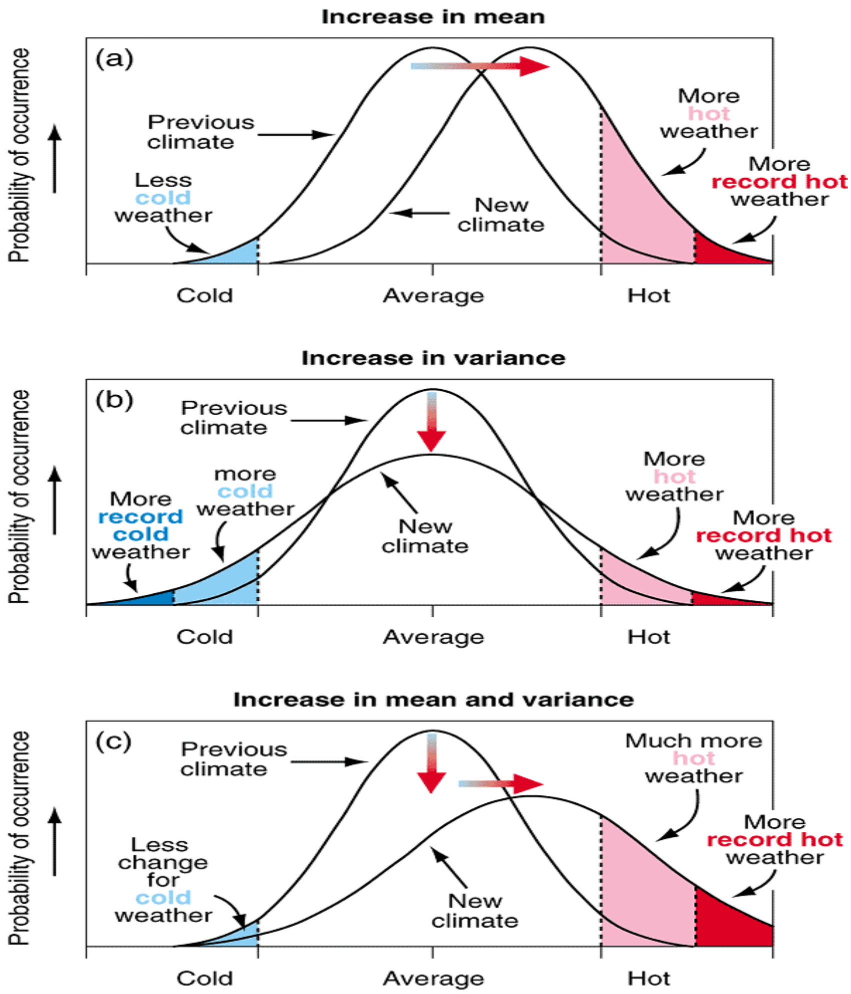
(Glenn McGregor)

Statistically, extreme events are defined as possessing a low probability of occurrence. From a societal point of view, extreme events are those events that society is susceptible to or unable to cope with. There is a need to differentiate between extreme weather and climate events. Extreme weather events are events that are rare within its statistical reference distribution at a particular place. Definitions of "rare" vary, but an extreme weather event would normally be as rare or rare than the 10th or 90th percentile. Extreme climate events are the average of a number of weather events over a certain period, which is itself extreme (e.g. rainfall over a season).

Extreme events may be simple or complex and are usually defined using derived climate indices. One such index is the total of the number of days crossing a threshold defined by either an absolute (fixed threshold) or percentile (variable) value. Extreme events have a number of attributes that make them multifaceted phenomena. These include their rate (frequency), intensity, volatility (shape) and dependence (clustering in space or time). Conceptually, with a change of climate to warmer and drier/wetter conditions than present, the nature and occurrence of extreme weather and climate events could change.

[3] Petit et al (1999). Climate and atmospheric history of the past 420 years from the Vlostock icescores Antarctica. Nature 399, 1999, pag 429 - 3636

Figure 4: Change in mean and variance of extreme weather events (Houghton et al, 2001[4])



A range of hypotheses exists concerning how extreme events might alter with climate change. These include the "no change", "mean effect" (increase in mean but not variability), "variance effect" (increase in range) and "structural change" (increase in mean and skew of low probability events) hypotheses.

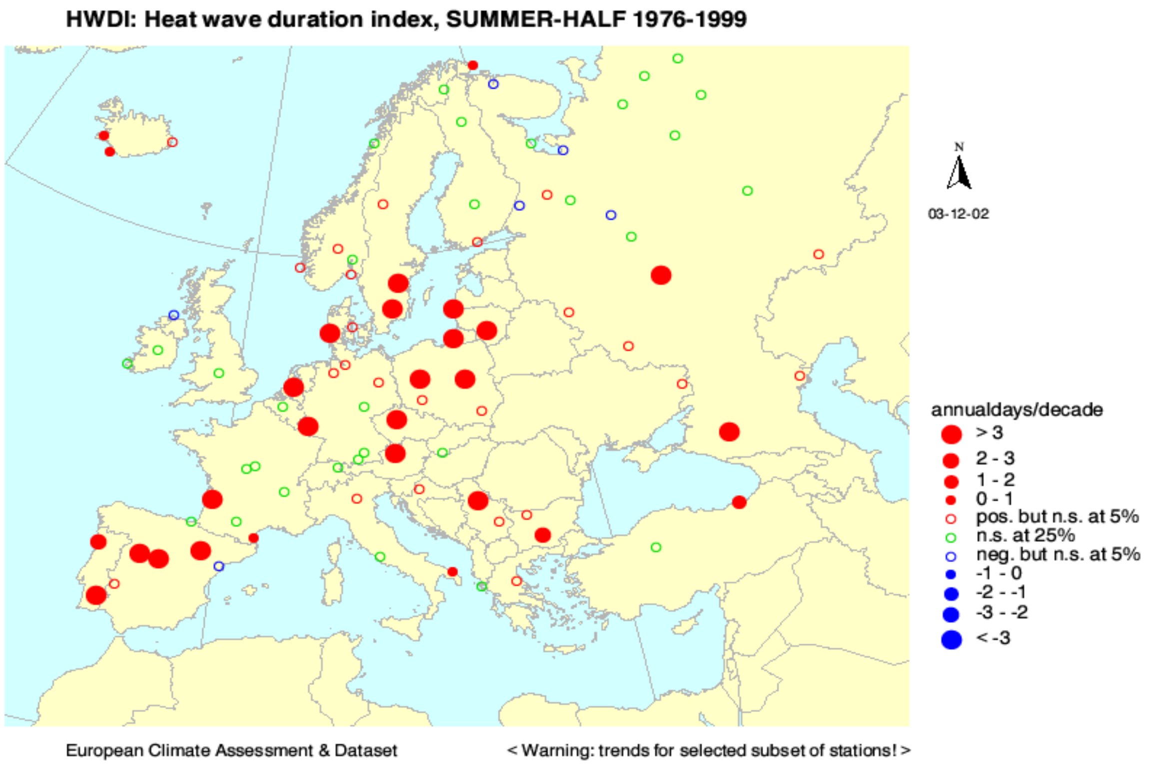
Two broad approaches are taken to assess these hypotheses: statistical modelling using extreme value theory and modelling using General Circulation Models (GCMs) or Regional Climate Models (RCMs). Both approaches have projected the following outcomes for Europe, which in terms of scientific confidence are rated as likely to very likely:

(1) more frequent extreme high temperatures and less frequent extreme low temperatures, with an associated increase (decrease) in cooling (heating) degree days;
(2) an increase in daily minimum temperatures in many regions that will exceed the increases for daytime maximum temperatures;
(3) daily temperature variability will decrease in winter but increase in summer;
(4) there will be a general drying of mid-continental areas during summer; and
(5) there will be an increase in precipitation intensity in some regions.

[4] Houghton JT et al., eds. (2001). Climate change 2001: the scientific basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, Cambridge University Press.

Confidence in such projections exists because trends in observed weather and climate extremes for Europe in many ways match the expected outcomes of climate change; the heat-wave of August 2003 is a possible harbinger of the future.

Figure 5: Heat-wave duration index. Klein Tank et al, 2002[5]



Alteration of the frequency and/or intensity of extreme weather and climate events have a number of implications for health if appropriate response strategies are not formulated, including

- possible increases in heat-related mortality especially amongst sectors of the population that are unable to protect themselves against heat stress, such as the elderly and the urban poor;
- increase in food security risk because of summer dryness and an elevated incidence of drought;
- extension of the range of some pest and disease vectors;
- decrease in water quantity (because of summer drought and increased runoff) and quality (because of soil erosion during intense rainfall periods); and
- increase in floods.

[5] Klein Tank A, Wijngaard J, van Engelen A (2002). *Climate of Europe: assessment of observed daily temperature and precipitation extremes*. De Bilt, the Netherlands, Royal Dutch Meteorological Institute.

Are the frequency and intensity of flooding changing in Europe?
(Zbigniew W. Kundzewicz)

Floods have recently become more destructive and projections show that this trend may become more pronounced. The global costs of extreme weather events exhibit a rapid upward trend: yearly economic losses from weather extremes increased, in inflation adjusted dollars, tenfold over four decades. Part of this trend is linked to socio-economic factors, but a portion of the flood growth is linked to climate.

Changes in annual stream flow are usually strongly associated with changes in total precipitation. However, no uniform greenhouse gas signature has been found in studies of flood flows. Kundzewicz et al. (2004)[6] examined a long time series of annual maximum daily river flow in Europe and found that the 1961-2000 maxima occurred more frequently in the later sub-period, 1981-2000, than in the earlier sub-period, 1961-1980.

Flood hazard and vulnerability tend to increase over time in many areas, due to a range of climatic and non-climatic impacts. The latter include impacts of changes in terrestrial systems (hydrological systems and ecosystems), and economic and social systems. Land-use changes, which induce land-cover changes, control the rainfall-runoff relationship. Deforestation, urbanization and reduction of wetlands, impoverish the available water storage capacity and increase the runoff coefficient, leading to growth in flood amplitude and reduction of the time-to-peak. Urbanization has adversely influenced flood hazard by increasing the portion of impervious areas. The urbanized area in the former West Germany has grown from 7.4% in 1951 to 12.2% in 1989, while in the European Union, 2% of agricultural lands have been lost to urbanization per decade.

Humans have been encroaching into unsafe and flood-endangered areas, thereby increasing the damage potential. An important factor influencing the flood hazard is an unjustified belief in absolute safety of structural defences. When a dike breaks, the damage may be higher than it would have been in a levee-free case.

Vulnerability to floods can be regarded as a function of exposure, sensitivity and adaptive capacity. Because, in many areas, exposure grows faster than adaptive capacity, vulnerability also increases. Counter-intuitively, vulnerability of societies may grow even as they become wealthier, because technology helps populate and develop more "difficult" areas so that societies may become more exposed. High investment into maladapted infrastructure does not reduce vulnerability.

Projections of extreme events under future climate scenarios are highly uncertain. There are large quantitative differences between scenarios and models. However, global average water vapour concentration and precipitation are expected to increase further during the 21st century, with precipitation extremes projected to grow. Adverse consequences include increased risks of floods, landslides, avalanches and mudslides; increased soil erosion; and increased pressure on flood insurance systems and disaster relief.

[6] Kundzewicz, Z. W., Ulbrich, U., Brücher, T., Leckenbusch, G., Menzel, L., Przymusińska, I., Radziejewski, M. & Szwed, M. (2004) Summer floods in Central Europe - climate change track, *Natural Hazards* (submitted).

Wetter winters are projected throughout Europe. The modelling results of Palmer & Räisänen (2002)[7] indicate that the probability of wet boreal winters will considerably increase over large areas of Europe. For example, an over five-fold increase is projected over Scotland, Ireland and much of the Baltic Sea basin and a more than seven-fold increase for parts of Russia.

The project Modeling the Impact of Climate Extremes (MICE) within the 5th Framework Programme of the European Union examines changes in precipitation between the control period, 1961-1990 and 2070-2099 using climate models. It is projected that, for the A2a SRES[8] scenario, intense precipitation will increase over most of Europe, even over vast areas where mean precipitation is expected to decrease. Climate change is likely to cause an increase in the risk of riverine flooding across much of Europe. However, changes in flood frequency depend on the generating mechanism: floods that are the result of heavy rainfall may increase while those generated by spring snowmelt and ice-jams may decrease.

Menzel et al. (2003)[9] examined flood frequency for the river Mosel at Cochem, comparing two thirty-year periods: 1961-1990 and 2061-2090. For a specific discharge, the return interval was considerably lower under future climate scenarios; this means that floods are projected to become more frequent. Model-based analyses for the Severn and Thames rivers for 2050s show an increase in both the frequency and magnitude of flooding. Reynard et al. also showed less flooding in some rivers in the U.K due to less summer rainfall.

The exceptional meteorological conditions in summer 2003 in Europe

(Tanja Cegnar)

Most of the time, people are well adapted to average climatic conditions but vulnerable to extremes. Even in developed countries, extremes cause damage and casualties. Among the major challenges for the meteorological and hydrological community is improved protection of life and property. This should be achieved through a reduction of the adverse social and economic impacts of natural disasters and of extreme weather and climate events, as well as through increased awareness and preparedness of individuals and societies to face such events.

The influence of weather and climate on human well-being and the environment were evident in several events past year. Summer 2003 in Europe was a globally significant anomaly characterized by severe drought, forest fires, more rapid glacier melting and a historic heat-wave with significant and prolonged temperature anomalies and record temperature. The 2003 heat-wave was clearly an outlier; there was no way to predict its intensity and duration from historical data. Seasonal forecasts failed to predict it months in advance; but national meteorological services provided good short and medium range forecasts.

Air temperature is measured 2 m above the ground under highly standardized conditions (meteorological shelter, above grass, etc.). Urban areas can have quite different conditions than

[7] Palmer, T. N. & Räisänen, J. (2002) Quantifying the risk of extreme seasonal precipitation events in a changing climate, Nature, 415, 512-514.

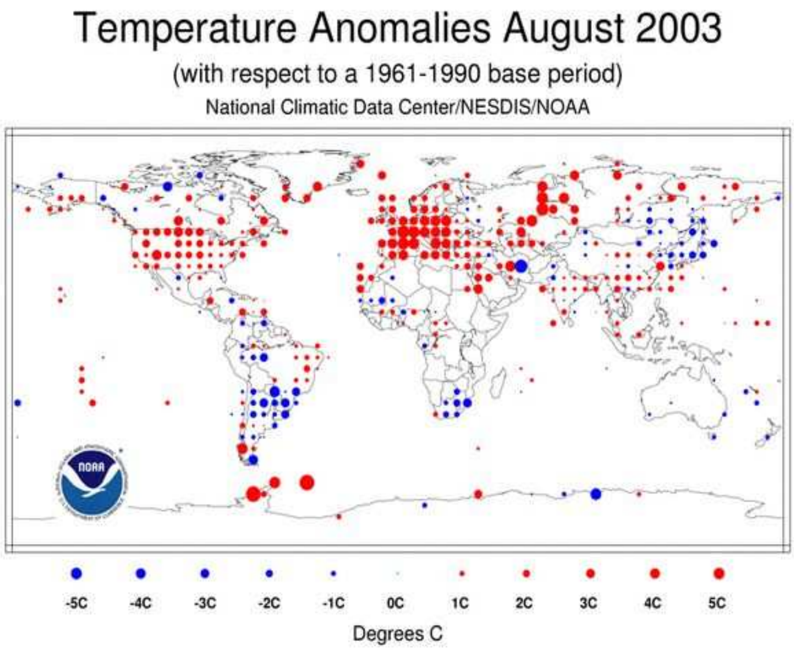
[8] SRES = Special Report on emission scenarios. IPCC, 2001

[9] Menzel, L., Thieken, A.H., Schwandt, D., Bürger, G. (2003) Impact of climate change scenarios on the regional hydrology – Modelling studies in the German Rhine catchment. Natural Hazards (in print).

rural areas because of heat island effects. Air pollution (Particulate Matter (PM), ozone, Nitro oxides (Nox)) also could play an important role during heat-waves.

Much of Europe was affected by heat-waves during the summer (June, July and August) of 2003. Nationwide seasonal temperatures were the warmest on record in Germany, Switzerland, France, and Spain. The heat-wave resulted from a zone of strong high pressure over Western Europe related to a marked ridge of high pressure in the large-scale upper atmospheric wind flow. Such "blocking highs" that persist for many days are not rare in Europe during summer. They usually bring warm and sunny weather. However, in this situation heated air from the south reinforced the strength and persistence of the heat-wave. The lack of precipitation contributed to the heating (positive feedback), as nearly all radiation from the sun was converted to heat because of the soil.

Figure 6: Temperature anomalies in August 2003.



and vegetation dryness. At many locations, temperatures rose above 40°C. Summer as a whole surpassed all current records.

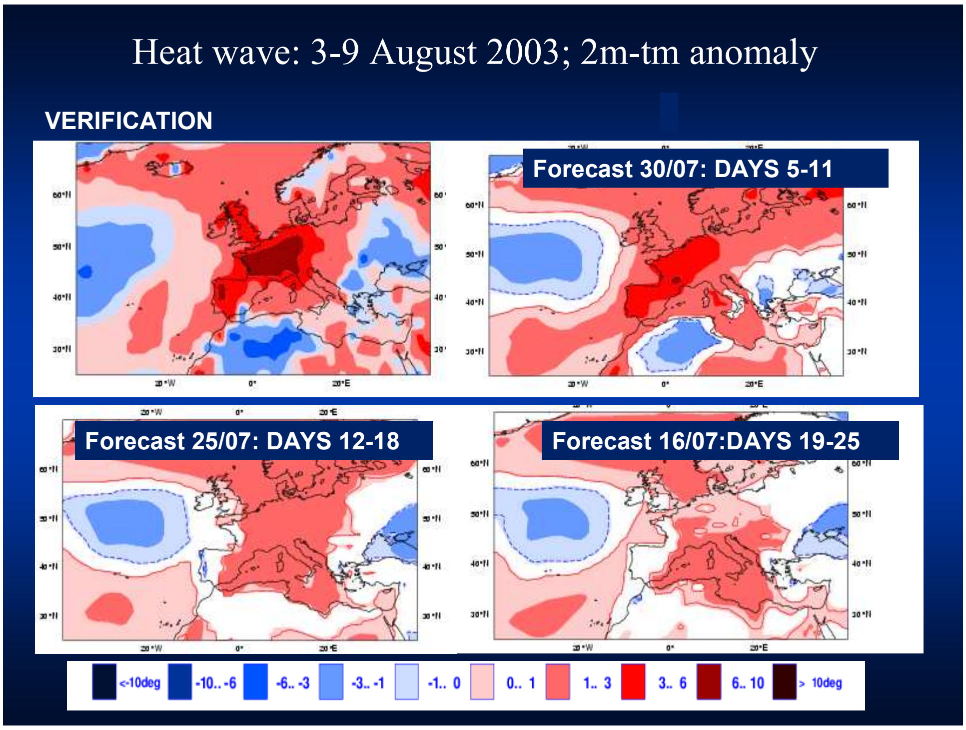
In Germany, summer 2003 surpassed even the hot, dry and sunny summer of 1947 in heat and intensity. In the second half of July and the first half of August, the heat-wave peaked, particularly in the south and the southwest of Germany. The heat-wave was less pronounced in northern Germany. Over large areas the temperature anomaly exceeded 5ºC. France was probably the most affected country with the largest number of excess deaths. The heat-wave in west Europe ended in the second half of August.

In Austria, temperatures in June and August were 3.5 to 5.5ºC above the long-term average. July was not so exceptional, but still well above normal. Like many other countries, Slovenia was the warmest ever recorded, with many absolute temperature extremes and a record number of hot days. The first heat-wave happened in June, but the worst heat-wave was in August. Bright sunshine duration was well above the 1961–1990 normal.

National Meteorological and Hydrological Services (NMHSs) provide short-range forecasts (including physiologically relevant parameters like heat load and cold stress estimation, pollen concentration, bio-weather forecasts, UV index, relationship between weather types and air pollution and others). They use several tools to forecast extreme weather events; these are being continuously improved. Monthly and seasonal forecasts in Europe are still in a research phase, but in some parts of the world seasonal forecast have been demonstrated to be of great benefit to many economic sectors and society as a whole. NMHSs tend to have well-established mechanisms for cooperation with emergency services and to have well-developed and operational links with media. The media are highly efficient in spreading warnings when necessary. NMHSs also have experts on specific microclimates and are familiar with existing regional and local differences in heat load and cold stress.

Heat-waves usually spread over large areas, and international harmonization of methods to assess heat load is recommended. Because people are acclimatized to their local climate, thresholds for heat-waves should take into account the local baseline climate.

Figure 7: Forecasts between 5-25 days and accuracy. (Source: WMO)



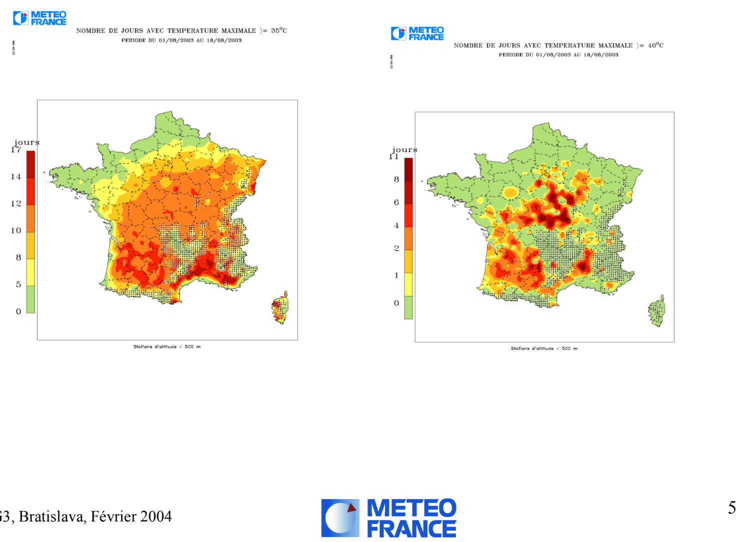
The World Meteorological Organization (WMO) has a long tradition of studying weather and climate impacts on human health. Two Expert Teams have been established within the Climate Change Index (CCI) Open Area Programme Group 3 (OPAG 3) on Climate Applications, Information and Prediction Services to focus on heat/health and related climate issues. The most important activities within WMO related to interdisciplinary tasks are concentrated under the umbrella of the project named CLIPS (Climate Information and Prediction Services). CLIPS results from past and ongoing monitoring and research on the climate system and experience acquired by NMHSs in applying climate knowledge to socio-economic activities. The aim of the CLIPS project is to provide the framework for comprehensive multidisciplinary applications of climate information and prediction to enable governments and other users to take decisions in support of national sustainable development.

The observed meteorological changes in summer 2003

(Jean-Claude Cohen)

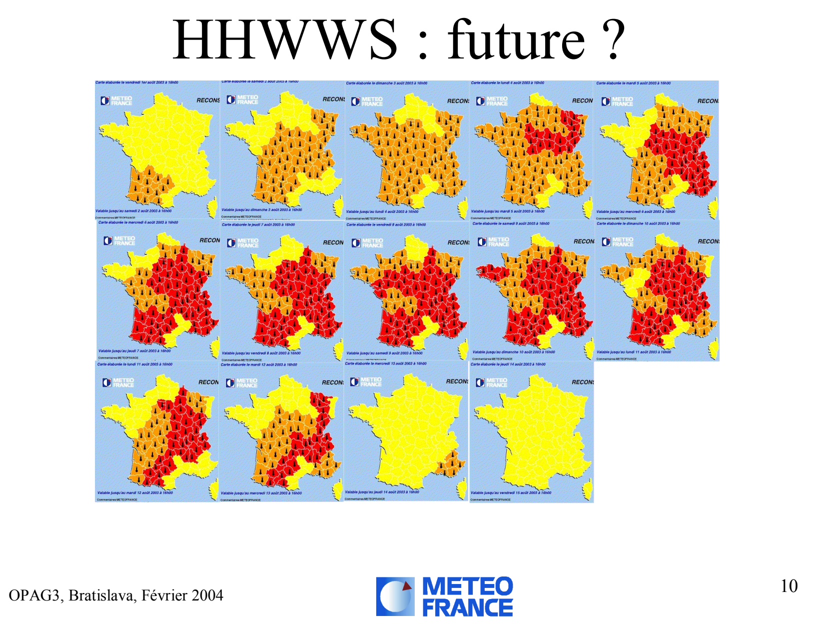
Summer 2003 in France included the hottest heat-wave in the past 50 years. The heat-wave lasted two weeks, with absolute temperature records in 70 out of 180 stations. Temperatures over 35ºC were recorded in two-thirds of stations and temperatures over 40ºC were recorded in 15% of stations. Daily mean temperature had been recorded in Paris since 1873. Seven of the eight hottest records occurred in 2003 (the sixth occurred during a heat-wave in July 1947). The 2003 heat-wave occurred after a 6-month drought. France, Andalusia and Portugal were the areas most affected by the heat-wave. Meteo France issued a press release on 1 August that a heat-wave was settling over the country. On 4 August, Meteo France offered simple health advice. Figure 8 shows daily mean temperatures over Paris since 1873: among the 8 hottest records, 7 occurred in 2003 (only the sixth occurred on the 28/7/1947)

Figure 8: Daily mean temperatures over Paris since 1873



Further, a press release on 7 August included a health warning, particularly for elderly persons. On 13 August, Meteo France announced the progressive ending of the heat-wave. This heat-wave is consistent with climate change projections. In response to the heat-wave, an early warning system is being established for heat-waves and cold spells that will include a first announcement forecast for health professionals 3 to 7 days before the event, a warning forecast 1 to 3 days before the event for media and the general public and an enhanced warning in case of pollution, humidity, strong winds, etc. There is consideration of including other bio meteorological warnings, such as UV index and pollen concentrations. Figure 9 shows the elaboration of a potential heat warning system in France.

Figure 9: Heat-wave forecasting: the future?



Discussion

There is growing recognition that climate variability and change are causing serious risks to human health. Changes in climate may be experienced as gradual changes in mean meteorological variables, such as linear increases in minimum temperature or average precipitation; as changes in the variance, such that extreme events become more or less common; as changes in both the mean and variance; or as a fundamental shift in the climate.

How much climate variability may increase over the next decades is highly uncertain. Changes in extreme events may be experienced as changes in the rate or frequency of events and/or as changes in their intensity or magnitude. Spatial and temporal clustering of events may become more common. For example, heat-waves may increase in both frequency and duration in coming decades; see http://www.unifr.ch/geoscience/geographie/personal/mb/mb.html, which shows that the maximum temperatures recorded in 2003 for Basel, Switzerland match the projected temperature distribution for 2071-2100. Projections for cold spells are more uncertain. What is certain is that increasing climate variability will challenge public health systems.

These possible changes require policy makers at all levels to take a proactive, anticipatory approach to designing strategies, policies and measures to reduce current and future burdens of climate-sensitive diseases. There is a need to increase collaboration and coordination between the health and meteorological communities, including the use of meteorological indicators by the health community.

Session 2: The Human Health Impacts of Temperature Extremes

Cold extremes and their impacts on health

(Juhani Hassi)

Exposure to environmental cold temperatures can result in numerous negative health consequences, including death, disease, injury, other health complaints, degradation of different qualities of performance and degradation of motivation. Hypothermic deaths may be seen at an environmental temperature of 0°C, with risk of death strongly related to lack of awareness of hypothermia and protection against cold. For example, hospital treated frostbite has been reported to be more common in metropolitan areas than in other regions (Juopperi et al 2003). Air-connected frostbite has its onset at an environmental temperature of -11°C. Wind, high altitude and wet clothing can decrease the temperature at which frostbite occurs. The rate of frostbite increases from -15°C down.

In most European countries, death rates in winter are higher than deaths rates in summer. Winter-related mortality is most often due to ischemic heart disease, cerebrovascular disease and respiratory disease (Keatinge et al 2002)[10]. The burden of cold-related health effects varies between countries. Increases in mortality due to cold are less in cold regions in Europe than in warmer ones. It is likely that better protection occurs in European cold regions from infrastructure and the use of protective clothing, at a given level of outdoor cold.

Cold spells currently have serious health impacts in Northern Europe, mountainous regions in more southern countries, Russia, Canada and Alaska. Cold-related morbidity and mortality also is a risk for warmer regions when cold spells occur in conjunction with ecological disturbances, catastrophes, or societal conflicts (such as the war in Bosnia).

Figure 10: Average daily incidence of frostbite requiring hospital treatment per 100,000 inhabitants by temperature and region in Finland (Juopperi, 2002)

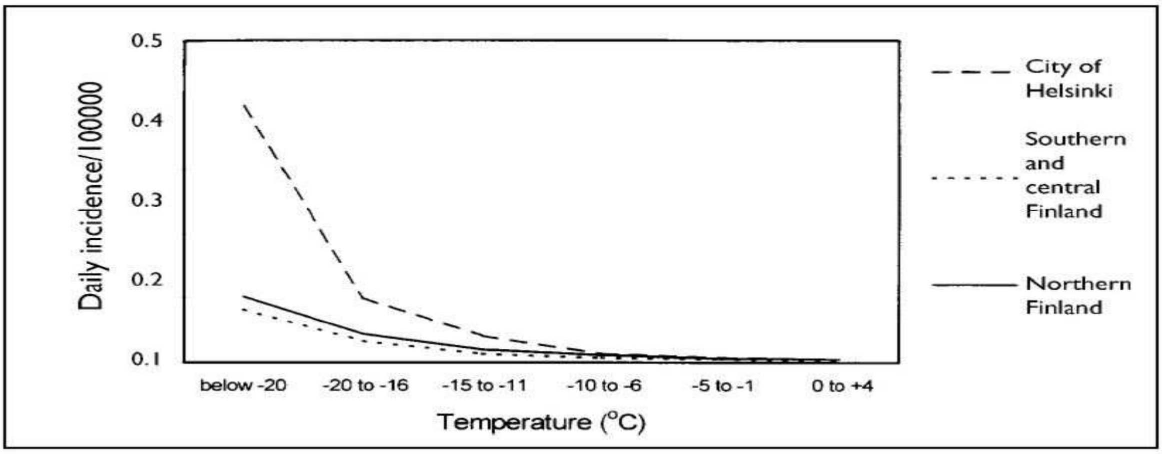


Fig. 5.
Average daily incidence of frostbite requiring hospital treatment per 100,000 inhabitants by temperature and region in Finland.

Juopperi et al.Int J Circumpolar Health 2002;62(4):352-362.

[10] Keatinge WR (2002) Winter mortality and its causes. Int J Circumpolar Health 61(4):292-299

Finland has developed practical methods and tools for recognition of environmental cold risks and for the evaluation of individual health risks related to cold exposure. Increased scientific information over the last decade about both cold-related health impacts and their prevention can be used to develop countrywide strategies to protect against the potential consequences of occasional or repeated extreme cold.

Cold spells could increase with the projected increase in climate variability that may accompany global climate change. In the longer term is the risk of rapid climate change, which could result in the collapse of the thermohaline[11] circulation. This would lead to a strong decrease in annual temperatures in western and northern Europe.

Health impacts of the 2003 heat-wave in France

(Pascal Empereur-Bissonnet)

A heat-wave struck France in early August 2003. June had been warm with temperatures 4 - 5°C above seasonal averages. Temperatures in July were closer to normal, except for high heat during the last two weeks. The period from August 4th to 12th broke all historical records (since 1873) for Paris, in terms of minimum, maximum and average temperatures and in terms of duration. The heat-wave was associated with high levels of air pollution. An excess of mortality that started early and rose quickly accompanied this unprecedented heat-wave: 300 excess deaths on the 4th of August, 1,200 on the 8th and 2,200 on the 12th. There were 14,802 excess deaths between August 1st and 20th, compared with the average daily mortality for the same period in 2000-2002. This represents an increase of 60% in mortality from all causes (41,621 observed versus 26,819 expected). Individuals 75 years of age or more experienced a 70% increase in mortality. Individuals 45-74 years of age experienced an increase of 30%. In all age groups, mortality in women was 15-20% higher than in men.

Figure 11: Gender and age

Age	Female		Male		Total	
	Ratio of mortality (O/E)	Excess of deaths (O-E)	Ratio of mortality (O/E)	Excess of deaths (O-E)	Ratio of mortality (O/E)	Excess of deaths (O-E)
<44	1.0	-9	1.1	151	1.1	142
45-74	1.4	1 044	1.2	1 406	1.3	2 450
>75	1.9	8 475	1.6	3 735	1.7	12 210
Total	1.7	9 510	1.4	5 292	1.6	14 802

Source: INSERM (**O** = number of deaths **Observed** ; **E** = number of deaths **Expected**)

[11] thermohaline circulation: Large-scale density driven in the ocean, caused by differences in temperature and salinity

Figure 12: Place of death

Place	<75 years old	>75 years old	Total
	Ratio of mortality (O/E)	Ratio of mortality (O/E)	Ratio of mortality (O/E)
Home	**1.4**	**1.9**	**1.7**
Hospital	**1.2**	**1.6**	**1.5**
Private Clinic	**1.0**	**1.3**	**1.2**
Retirement Home	**1.8**	**2.0**	**2.0**
Outside	**1.0**	**1.0**	**1.1**

Source: INSERM (**O** = number of deaths **Observed** ; **E** = number of deaths **Expected**)

Excess mortality was experienced throughout most of the country. There were regional variations in excess mortality, from a 20% increase in Languedoc-Roussillon (South) to a 130% increase in Ile-de-France (Paris and Suburbs). Excess mortality clearly increased with the duration of extreme temperatures. In Paris, increased mortality began a few days after the beginning of the heat-wave and was particularly high because the maximum temperature exceeded 35°C for as long as 10 days. Mortality rates were highest in nursing homes, where twice as many deaths occurred as was expected.

Descriptive studies were carried out immediately after the heat-wave. Two ongoing case-control studies are designed to identify risk factors for the elderly living at home and those residing in a nursing home. In addition, a study will try to calculate the fraction of the health impacts observed during the heat-wave 2003 that could be attributable to air pollution. These results could be used to develop profiles of vulnerable individuals for the future Heat-Wave Action Plan. This plan will include a provisional Heat Watch Warning System (HWWS) for 2004, based on a predictive model of mortality developed from a historical dataset of daily mortality and meteorological indicators in 13 French cities. Another HWWS, developed by the European project PHEWE (Assessment and Prevention of Acute Health Effects of Weather Conditions in Europe), will also be tested in Paris next summer.

Heat-waves in Portugal

(Rui Calado)

Since 1999, the district of Lisbon has had an operational heat warning system – the ICARO Surveillance System. It operates each year from 15 May to 30 September. Warnings are issued when the ICARO index exceeds a particular threshold. These warnings are communicated to the Civil Protection Agency and the General Directorate of Health, which communicates with 5 Regional Health Authorities and the Health Authorities Network. A free telephone number for heat advice is also activated; 1466 calls were received in 2003. An official report is drafted when a warning is issued.

Portugal was severely affected by the heat-wave of summer of 2003. From 27th July to 15th August, almost all Portuguese districts had weekly maximum temperatures above 32ºC and 13 of those districts had weekly mean maximum temperatures above 35ºC. The ICARO Surveillance System detected the heat-wave early, with a special warning issued on the 30th July. From 28th July to 14th August, the predicted ICARO Index for the following 3 days was above zero. On 11 of those days, the ICARO index was above the warning threshold. Higher index values were predicted on 1, 12 and 13 August. The predicted peaks of the ICARO index correlated well with observed temperature and mortality peaks.

The preliminary estimate of the excess mortality during the heat-wave (1 to 30 August) is 2099 deaths (all ages), with 2026 deaths (47% excess) in the over 75-age group. Work is in progress to assess the full effect of this heat-wave.

Overall, the ICARO's Surveillance System performed well and accurately predicted the effects that occurred. Difficulties encountered included that partners in the ICARO system had some problems in conveying warning messages to the population late in the heat stress period when the media were more interested in reporting forest fires. It was concluded that passive systems, such as using the media to spread messages of interest during heat stress periods, are not reliable especially in a very long heat-wave. Therefore, active ways must be sought to actively convey information to the population.

Heat-waves in Budapest

(Anna Paldy)

The population of Budapest is exposed to recurrent heat-waves. In 2000, a severe heat-wave affected many countries in the Balkans. The impacts of variations in daily temperature and of individual heat-wave episodes were investigated in relation to mortality in this population.

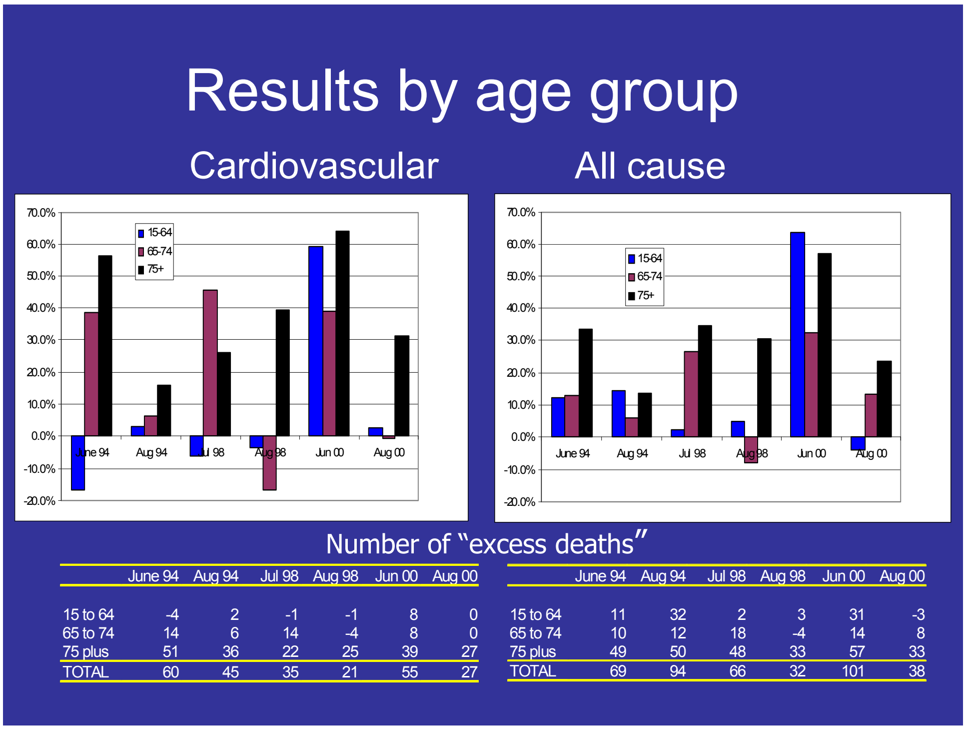
A time-series analysis was conducted of the short-term effect of meteorological variables on daily mortality in Budapest during the period 1970-2000. Standardized daily total and cause specific mortality decreased over the period. The mean, minimum and maximum daily temperature increased significantly, as did the number of hot days and weather variability. Urbanization, as well as warming due to global climate change, is likely to be responsible for this trend. Relative humidity showed a deceasing trend.

A 5ºC increase in daily mean temperature significantly increased the risk of mortality [total mortality or TM RR= 1.106 (96% CI: 1.097, 1.14); cardiovascular disease mortality or CM RR: 1.18 (96% CI: 1.106, 1.29); and respiratory disease mortality or RM RR= 1.088 (96% CI: 1.054, 1.123)]. A 5ºC increase from the previous 15-day mean temperature had a significant impact on mortality: TM RR= 1.063 (96% CI: 1.056, 1.07). Humidity had a slight, but significant positive effect on total mortality [TM: RR= 1.002 (96% CI: 1.000, 1.003]) while barometric pressure had a negative effect [TM: RR= 0.995 (96% CI: 0.991, 0.999].

Six heat-waves were identified: 28 June to 1 July 1994 (4 days); 30 July to 8 August 1994 (10 days); 22 July to 25 July 1988 (4 days); 3 to 5 August 1998 (3 days); 13 to 15 June 2000 (3 days); and 20 to 22 August 2000 (3 days). During the heat-waves, daily maximum temperatures reached, on average, 34ºC. During the hottest event (August 2000), daily maximum temperatures reached 38ºC. Excess mortality (all cause) was observed during all heat-waves: 22% (June 94), 12% (Aug 94), 24% (Jul 98), 26% (Aug 98), 52% (Jun 00), and 14% (Aug

2000). During each episode, excess mortality was greatest in the elderly (75 years or more of age), except during the June heat-wave in 2000, when excess mortality was greatest in adults.

Figure 13: Heat-wave episodes by age groups



Heat-waves contributed a significant burden of mortality in Budapest, particularly during events that occurred early in summer. The impact of subsequent heat-waves was likely to have been diminished by both the loss of susceptible individuals and the increased acclimatization of the population to hotter weather. There is a need to improve public health advice in order to reduce the burden of heat-waves on human health in Hungary.

Heat-waves in Italy: cause-specific mortality and susceptible sub-groups

(Paola Michelozzi)

During the summer of 2003 record high temperatures were observed in most of Europe. Italy, France and Germany were hardest hit in terms of morbidity and mortality. In Italy, the Italian National Institute of Health produced a crude estimate of excess mortality for all Italian provinces comparing the mortality data of summer 2003 with summer 2002. A more detailed analysis was conducted for Rome, Milan and Turin. The analysis aimed to characterize susceptible populations through: the analysis of daily mortality by gender, age and cause of death (ICD IX); the analysis of the prevalence of specific risk factors (co-morbidities) in subjects who died during the heat-waves; and the analysis of the risk associated with lower socio-economic status. Weather variables included mean, maximum and minimum temperatures (6-hourly), maximum apparent temperature for Rome and the Humidex index for Turin and Milan during the period June 1st – August 31st.

Daily expected mortality was computed using a smoothed daily average from a reference mortality time series. A Poisson regression model was adopted to evaluate risk of mortality by age, gender and cause of death. In addition, in Milan the association between mortality and hospital admissions in the three months before death was assessed to analyze the prevalence of co-morbidities among patients who died during the heat-waves of 2003 versus the reference period.

The results of the analyses carried out for each city indicated record excess mortality during the heat-wave periods in summer 2003. A strong association between daily mortality and temperature was observed, with peaks in mortality corresponding to peaks in temperature. In Rome, excess mortality was observed throughout the summer, while in the northern cities (Milan and Turin) the excess was concentrated in the first part of August. The heat-waves recorded between June and August 2003 was associated with significant health effects; a total of 1094 excess deaths were observed in Rome (+20%), 598 in Milan (+23%) and 502 in Turin (+33%). The northeast of Italy was hard hit by the heat-wave due to the more extreme weather conditions.

When subdivided by age, excess mortality increased dramatically with age. The greatest impact was observed in the over-85 age group (+46% in Rome, +40% in Milan). When stratified by gender, the increase in mortality appeared to be greater among females (+33 in Milan and +32% in Rome). Risk of mortality was highest in the lowest socio-economic level.

Excess mortality was highest for the central nervous system, cardiovascular, respiratory and circulatory diseases and metabolic\endocrine gland disorders. In Milan a study on co-morbidities illustrated the increased mortality risk for individuals suffering from cardiac arrhythmia (OR = 2.00), cardio-pulmonary disease (OR = 2.33), blood disorders (coagulopathy OR= 1.82, anemia OR=1.50, and electrolyte disorders 0R= 2.21).

Results will aid identification of susceptible populations and the development of prevention programs. In Italy, the possible effects of global warming could make susceptible subgroups more vulnerable and together with the increasing proportion of elderly people, may enhance heat-related mortality.

The follow-up programme on the influence of meteorological changes upon cardiac patients

(Inge Heim)

It has generally been assumed that for many diseases and pathological conditions, their onset, course and outcome depend to a significant extent on weather and climatic conditions. Our objective is to find out how weather changes affect heart patients. To do so, a five-year program was initiated in February 1999 in our Polyclinic. The program is carried out in collaboration with the Croatian Institute of Hydrometeorology. The target population is the population of Zagreb, the capital of Croatia. The study sample includes patients who visited our Polyclinic for coronary heart diseases and those with risk factors for atherosclerosis. Subjective symptoms (physical fitness, sense of fatigue, stenocardia, a typical chest pain, palpitations, vertigo, nausea, loss of consciousness, headache and mental functions) and objective health status parameters (heart rhythm and frequency, ECG changes and arterial blood pressure) are recorded. Medical data are correlated with meteorological parameters such as air temperature, relative humidity, etc. It is expected that the correlation between the medical data obtained for all study subjects and meteorological changes will be a valuable contribution to the initiative being developed to inform not only the patients but the entire population about the impacts of weather changes on human health. More than 10 000 subjects have so far been interviewed. Twice a week, after the weather forecast for the Zagreb area, a team of experts provides health tips to patients with chronic diseases (heart, rheumatic and pulmonary diseases) depending on weather conditions.

Discussion

The discussion sessions focused on descriptions of similarities and differences between countries and on research needs. For example, death rates in the south of France and northern Italy were similar, offering the opportunity to explore non-heat-related factors associated with mortality. Also, the over-all mortality rates were similar in France and Portugal.

Heat-waves were associated with an increase in all causes of death, not just heat stroke. In France, an excess of mortality was observed for all causes of deaths. The highest increases were observed for causes directly linked to the heat-wave; hyperthermia and dehydration (28.9% of the 2003 heat-wave total mortality was attributable to the heat-wave). Mortality due to respiratory diseases and genitourinary diseases also showed a significant increase. However, a bias exists in the description of the causes of deaths, as some cardiovascular diseases have been reported as respiratory diseases (pulmonary oedema) and some hyperthermia have been reported as infections.

Based on analyses to date, there is no evidence that mortality displacement occurred during the heat-waves this past summer. There was no decrease in total mortality in France and Italy following the heat-waves. However, it is possible that lower than usual mortality during winter 2002-2003 may have meant that more susceptible individuals were at risk than usual as the 2003 summer heat-waves arrived.

Knowledge gaps exist: in characterizing the relationship between heat exposure and a range of health outcomes. Research is needed on the morbidity associated with heat-waves. Little information has been published. In France, the patterns of the 2003 epidemic curves of the deaths notified by the Birth and Death Registrar Office and by the hospitals were similar. 42% of the excess deaths occurred in hospitals, 35% at home, 19% in retirement pensions and 3% in private hospitals. Eventually, the number of deaths occurring in hospitals was twice the usual value. The number of hospitals admissions has not been investigated into details.

Further research is also needed in understanding interactions between harmful air pollutants and extreme weather and climate events as well as on analysis of the health-threatening characteristics of heat wave episodes as opposed to the more general assessment of the overall relationship between temperature and health.

Research also is needed on what information is needed and how that information should be communicated, to motivate appropriate changes in behaviour during heat-waves. People perceive risks differently and have different responses to perceived risks. More information is needed on to how to effect appropriate behavioural changes in vulnerable populations. Finally, criteria need to be developed for how to identify regions with more vulnerable populations.

Session 3: Responses to Temperature Extremes

Lessons learned from the 2003 heat-wave in France and actions taken to limit the effects of future heat-waves

(Thierry Michelon)

France, a country endowed with an efficient and up-to-date public health system, was hit by a severe heat-wave in August 2003. The heat-wave had catastrophic health consequences (an imputed 14,800 deaths). This health crisis was unforeseen, was only detected belatedly and brought to the fore several deficiencies in the French public health system: a limited number of experts working in this area; an inadequate exchange of information between several public organisations who were understaffed because of the summer holidays and whose responsibilities were not clearly defined in this particular area; health authorities overwhelmed by the influx of patients; crematoria/cemeteries unable to deal with the influx of bodies; retirement homes under-equipped with air-conditioning and with inadequate manpower for the crisis ; and a large number of elderly people living alone without a support system and without proper guidelines to protect themselves from the heat.

This health crisis, without precedent since the Second World War, has had serious repercussions and has led the French government to take several steps in order to limit the effects on public health of any future heat-waves.

First, several studies are in progress investigating the risk factors associated with the heat-wave (housing, people living in isolation, atmospheric pollution, medication and others). These studies should lead to definitions of action levels for given meteorological parameters. Second, mechanisms for health surveillance (checks on the number of admissions to emergency wards) and environmental surveillance (meteorological data) will be put in place. Finally, national and local action plans are to be drawn up and implemented before June 2004. They will define precisely those public organisations with responsibility for heat-wave issues, their roles and actions to be taken at each level.

The management of retirement homes and hospitals will be improved by creating air-conditioned areas and by recruiting 13,200 care workers for retirement homes by 2007. The district councils will also be responsible for creating a list of vulnerable elderly and handicapped people in order to facilitate regular contact, particularly in case of heat-waves.

By and large these steps are aimed at reducing the impacts of any future heat-wave. According to climatologists, it is highly likely that France and Europe will have future occurrences due to climate change. The final toll in health terms of the August 2003 heat-wave was particularly heavy, but it could have been exacerbated by other related and highly probable, events such as electric power failures, drought and others. This justifies public authorities devoting funds and drawing up contingency plans in order to deal with such eventualities.

Rapid elaboration of information: the summer 2003 heat-wave experience in Italy

(Susanna Conti)

Following the unusually hot 2003 summer, together with the dramatic news from neighbouring countries such as France, it was decided to investigate whether there had been an excess of deaths in Italy, with a particular focus on changes in mortality in the elderly population. To that end, the Minister of Health requested the Istituto Superiore di Sanità's Office of Statistics in the National Centre for Epidemiology, Surveillance and Disease Prevention to undertake an epidemiologic study of mortality in Italy during summer 2003. Local surveys on excess mortality were also carried out (in Turin, Milan, Genoa, Venice, Bologna and Rome) after the national investigation.

Estimation of the effects of the thermal environment on mortality is sensitive to the epidemiologic method used. In many studies, attributable or excess mortality was estimated by subtracting the expected mortality from the observed mortality; the expected mortality was calculated using a variety of measures, including moving averages and averages of similar time periods in previous years. Another commonly used method compares mortality counts or rates during a heat-wave with figures during the same time period in the previous year; this method was used because data collection is rapid. In these studies, excess mortality was estimated using expected mortality, calculated on the basis of a multiple-year period. The excesses estimated by local and national investigations were very similar.

The first phase of the study began on August 22nd. The results were available the first week of September. Communal offices, which maintain vital statistics, were asked for the number of deaths among residents who were registered during the period June 1 - August 31, 2003 and during the same period in 2002 for each of the 21 capitals of the Italian regions. In order to obtain stable and known denominators, we analyzed data on residents who died in their own city. Morality data were collected for the last fifteen days of August. Within the framework of a collaboration with the Italian Central Office for Agriecology (UCEA), meteorological data (minimum and maximum temperature, humidity) were obtained for the 2002 and 2003 time periods in order to calculate discomfort indexes, such as the Humidex.

Compared with the previous year, during the summer months of June, July and August, there were 3,134 additional deaths in 2003 (from 20,564 in 2002 to 23,698 in 2003). The greatest increase was in the elderly; 2876 deaths (92%) occurred among people 75 years of age and older.

The increase in mortality was greatest in the cities in the Northwest of the country (31.5%), followed by the South (17.8%), the Northeast (16.4%,) and the Centre (16.3%). With respect to each city, the greatest increases were observed in Turin (45%), where deaths more than doubled during the first fifteen days of August, Milan (30.6%), and Genoa (22.2%). It is noteworthy that some cities in the South experienced their highest increase in mortality during the last period of August. In Bari, the overall excess mortality was 33.8%, but the excess in the last part of August reached 137%. In these cities, the relationship between mortality and climatic indexes (maximum temperature and Humidex) was investigated and a clear correlation was observed. The Italian Minister of Health has started programs in Milan, Turin and Genoa to identify the elderly at risk and to provide measures to protect their health during the summer.

Canadian urban heat-wave response plans

(Tom Kosatsky)

During the last five years, Canadian cities have begun to develop formal programs to protect the public's health from the effects of summertime heat. Toronto's (Ontario) first program was developed in response to recommendations from advisory committees for seniors and for the homeless. Under an interim policy, heat alerts were to be called if the next day's maximum forecast Humidex (a perceived temperature index) was over 40°C. Ironically, the public health department was confronted with a rainstorm on the first day that it issued a heat alert (in 1999). Toronto has since instituted a two-level alert and emergency response program based largely on the estimation of mortality impacts through a synoptic model developed at the University of Delaware. A heat information line and emergency cooling centres support the response arm of the heat watch program. Mitigation measures are coordinated with a 'clean air' coalition of non-governmental organizations and include promotion of green roofs and urban parks.

Montreal (Quebec) continues to issue public advisories based on an apparent temperature threshold, but both synoptic and time series based research projects have been initiated to better inform the choice of thresholds for heat and heat plus pollutant warnings and for the institution of emergency measures. Civil defence authorities, advised by the city's health department, coordinate an emergency heat response plan based on the mobilization of existing services.

Montreal has instituted a program of research and action designed to identify and reduce population vulnerability to the health effects of heat. Interventions include recommendations on air cooling and dehumidification for hospitals and chronic care facilities, the provision of cooling rooms in all seniors' facilities, advice to physicians and pharmacists on how to tailor medications, therapeutic fluid restriction and exercise prescriptions to summertime conditions. Research includes the assessment of air conditioning, medications and fluids as determinants of hot day deaths in nursing homes; the evaluation of knowledge, attitudes and practices with respect to ambient heat among the elderly; and the development of a an information system to characterize both the out and indoor distribution of summertime heat as well as the location of persons at high risk for death or hospitalization due to heat exposure based on medical frailty, age, poverty, lack of air conditioning and social isolation. An expanded surveillance project based on ambulance records and emergency room visits is being piloted in 2004 in order to detect early evidence of health effects related to heat.

A National system for the prevention of heat health effects in Italy

(Paola Michelozzi and Paulo Noguiera)

In 2003, an Italian network was established for the prevention of the health effects of heat-waves, coordinated and financed by the National Department of Civil Protection at the national level. This department, in collaboration with a centralized data elaboration centre, coordinates a network of experts from epidemiological departments, local health authorities and regional agencies of the environment and civil protection. At the municipal level, local centres coordinate the workload. The phases of implementation of the system include: the development of a forecasting model based on weather conditions and historical mortality data; the definition of a set of intervention plans for each city; the identification of the network of organizations/services involved; and the evaluation of the effectiveness of the system in preventing excess mortality.

The heat/health watch/warning system (HHWWS) is based on a synoptic climatological procedure that classifies each day into meteorologically homogeneous groups (air masses) and identifies "oppressive" conditions associated with an increase in mortality. Meteorological forecast data are then applied to the system to predict air masses and the related excess mortality three days in advance. In 2003, HHWWS were activated in four pilot cities: Rome, Milan, Turin and Bologna. The systems will be extended to other cities in 2004.

Weather forecast data for each city are transmitted daily from the Italian Air Force Meteorological Service to the centralized data centre and elaborated. A warning bulletin, graded by the severity of the conditions, is then transmitted to the National Department for Civil Protection and published on their website. At the same time, the data elaboration centre transmits a city-specific bulletin to the local coordinating centre that is responsible for the local dissemination of the warning. During "alarm" conditions, the local centre is responsible for the activation of a city-specific prevention program, based on guidelines developed by the National Institute. Information regarding the warning is transmitted to local health authorities and social services, public and private hospitals, nursing homes, general practitioners, social centres for the elderly and the general public via the media.

Preventive measures especially aimed at the elderly and other susceptible groups include a telephone help-line, a network of social services, volunteers, street units trained for emergency situations and a campaign to inform the population of air conditioned public facilities. Air conditioning facilities are extended to health care services, social centres and hospitals. Furthermore, hospitals are urged to provide air conditioning for patients at risk, postpone non-emergency surgeries and increase medical care staff on alarm days. The Association for General Practitioners draws up specific guidelines for the general population and for patients suffering from specific diseases that are distributed at the beginning of the season to local pharmacies and physicians.

During the summer of 2003, the HHWWS in Rome called an alarm on 23 (25%) days and an emergency on 20 (22%) days, compared to a mean of 9 alarm\emergency days in the reference period 2000-2002. During the summer of 2003, high temperatures persisted and record excess mortality was observed during three heat-wave periods (June 10th–July 3rd, July 11-31st, August 4-14th). There was a strong association between temperature and daily mortality. The system was efficient in predicting major peaks in mortality, but during heat-wave periods it underestimated the total number of excess mortality. This can be attributable to the underestimation of forecast temperatures. In addition, the extreme meteorological conditions recorded during the heat-waves were not accounted for in the meteorological time series used to construct the model.

To improve the accuracy of the model, meteorological forecast data will be corrected to better represent the local meteorological conditions of the urban area; the time series in the model will be extended with 2003 data included to account for more extreme conditions; and a temperature-based model will be integrated in the HHWWS air mass-based model. Further developments include the expansion of warning systems to other Italian cities and the implementation of city-specific prevention programs focused on high-risk sub-groups.

Decisions under uncertainty: extreme weather events. Lessons from the heat-wave epidemic in France

(Lucien Abenhaim)

Public health is faced with both epidemics and crises. A crisis arises whenever trust is at stake. Epidemics can occur without a crisis, such as an outbreak of influenza. Crises can occur without epidemics, such as CJD in France. The August 2003 heat-wave in France is an example of an epidemic and a crisis. Features of health crises include: surprise; lack of alert; uncertainty on danger and risk; lack of efficient mitigating measures; deficiencies in communication; and distrust in political decision makers. The August heat-wave took public authorities by surprise, partly because of the extremely short risk period. It was difficult to obtain information quickly enough from health surveillance systems to understand the dimensions of the problem. A retrospective assessment determined there had been about 3900 deaths at the time when 10 deaths had been reported. Part of the problem was that the fire department had been ordered not to disclose information on the deaths. There were insufficient alerts: when the meteorological service issued warnings on risk, not on an epidemic, approximately 2000 deaths had already occurred. Public health has efficient alert systems for infectious diseases, new diseases and usual or rare diseases. Alert systems are not efficient for known and otherwise endemic diseases. Emergency services are known to be crowded during the summer. The number of emergency interventions in August (1900 visits) was not higher than usual (2100 visits in 2000). There was a lack of efficient mitigating measures and a lack of model for action. Air conditioning may have saved some lives, but is generally not available, particularly for the populations at highest risk, such as the elderly in nursing homes. The dimension of the problem was another issue: 6 million people were at risk, of which 1 million were at very high risk. There were 500,000 at very high risk and isolated. Field interventions have not been designed to address a problem of this magnitude. The tendency of individuals responsible for communication is to first provide reassurance, minimize the figures and deny there is much of a problem. This contributed to distrust in political decision makers. Lessons learned from this heat-wave include that it is important to share uncertainty with the media and the public and to inform the media and the public of every step taken. Other lessons learned include the importance of reinforcing health surveillance systems and public health services.

Discussion

The assessment of the environmental and health consequences of heat-waves highlighted a number of knowledge gaps and problems in public health responses. To date, heat-waves have not been considered a serious risk to human health with "epidemic" potential in the European Region. Decision makers must be convinced that heat-waves and cold spells are as much emergencies as earthquakes and floods. In order to reduce the health impacts of future heat-waves, fundamental questions need to be addressed, such as can a heat-wave be predicted, can it be detected, can it be prevented and what can be done.

The problem of excess summertime mortality is made worse under conditions of increasing climate variability. Future crises appear likely. Preventing them requires a coordinated approach, which will need new methods to assess vulnerabilities, tools to lessen them and new measures to persuade populations to adopt health-protective behaviour. Both long-term actions to avoid risks and short-term measures to manage them are necessary. Resources must be sought for both.

A fundamental issue is the definition of a heat wave. While it has often been stated that high humidity is an important co-factor with heat, the summer of 2003 was extremely dry in Paris. On the other hand, the high night-time temperatures, which occurred, allowed for little cooling over the string of hot days. In France, it was observed that there was little excess mortality outside of urban areas, suggesting that either heat gain by city buildings or traffic patterns may influence heat-wave mortality.

The situation was somewhat different in Portugal where many deaths occurred among the elderly in small towns and villages. Social and personal characteristics seem, along with meteorological variables, to be important predictors of mortality during heat-waves: these include social isolation and pre-existing illnesses. This was of particular concern in France where the August 2003 heat-wave was coincident with a national summer vacation period, compounding problems for the homebound elderly.

That deaths are associated with summertime heat every year and not just with heat-waves was pointed out. However, the heat health function varies between centres and does not clearly display a linear trend. Participants felt that heat-related deaths in general merited efforts at prevention, but pointed out that the level of action is a political decision. Concerning long-term measures, it was felt that public health authorities should encourage and support improvements in building design and city plans to diminish the build-up of heat. While some participants encouraged measures to make air conditioning more accessible to the ill and elderly and all felt that limited air cooling of hospitals and long-term care institutions was important, the effect that air conditioning might have in producing waste heat, in increasing greenhouse gas emissions, and in making cities vulnerable to power blackouts was stressed. The need for improved warning and surveillance systems is clear. Systems need to be both as sensitive and specific enough. It was felt essential that pertinent meterological information be communicated to public heath authorities, which must themselves develop tools to predict risks associated with heat. Simple tools based on the heat-health research described above are a priority. The tools must be both sensitive and specific, triggering public health action when lives can be protected, but avoiding emergency calls when risk is limited. Because heat waves are rare events, sharing methods and results between cities should strengthen the predictive capacity of these tools. Given the climatic and social realities of Europe, a regional approach to assessing the relationship between heat and excess mortality was advised. WHO was looked to as supporting these analysis.

Session 4: The Human Health Impacts of Flooding

Lessons learnt from the 2002 floods in Dresden, Germany

(Wilhelm Kirch)

In July 2002, Dresden and its neighbouring areas experienced unusually intense rain and violent thunderstorms, causing small mountain rivers to collapse and water reservoirs to overflow. These huge amounts of water caused destruction from mountain villages to the cities located in the valley of the river Elbe. Following the 15th of August, a second, more silent but nevertheless detrimental flood wave passed through the cities of Prague, Pirna, Dresden and Meißen and affected all the regions located along the river *Elbe* in the following weeks. The historical city centre of Dresden was totally flooded for several days.

Two public health issues had to be immediately addressed in Dresden: (1) public hygiene; and (2) problems involved in evacuating whole hospitals. The Ministry of Health and Social Affairs for Saxony and Saxony-Anhalt issued recommendations to the public designed to maintain hygiene, including boil water alerts. A more severe problem was the evacuation of Dresden's four hospitals.

Lessons learned from the flood include: (1) the public health community needs to be prepared to address potential public hygiene issues; (2) it is important for hospital equipment to be assembled in a waterproof manner; and (3) for general crisis management, it is important that a decision hierarchy between hospitals and administrative authorities be established before an extreme event.

Health and floods: impacts and recommendations

(Edmund Penning-Rowsell and Sue Tapsell)

Floods cause some deterioration in the health of those affected. Whilst some classic research by Bennett in Bristol, UK, in 1969 showed the mortality effects of severe floods, less systematic information is available on morbidity effects.

The physical health impacts and the mental health impacts of flood victims have been studied in longitudinal research since 1998. The physical effects affected about two-thirds of the vulnerable people in the sample we studied, whereas the mental/psychological effects affected more than three-quarters of this sample. The physical effects lasted just over twelve months, on average, whereas the psychological impacts lasted more than twice as long.

In this respect, hazards such as floods should be regarded as potentially multi-strike stressors whose components are: the event itself; the disruption and problems of the recovery period; and the worry or anxiety about the risk of a reoccurrence of the event. Factors affecting this perceived risk of reoccurrence could include a perceived failure on the part of relevant institutions to alleviate flood risk or to provide adequate warnings of that risk. Loss of confidence in the relevant authorities and attendant loss of security in the home can therefore exacerbate the existing stress and anxiety experienced by victims from a flood event through a fear that the authorities will also fail to protect them or warn them about any future event.

This research shows that this additional stress and anxiety, along with the event stress itself, the stress associated with recovery and pre-existing health conditions, can have significant impacts upon the overall health and well-being of flood victims. Mediating factors between stress and health may include flood warning, coping strategies and social support; however, where flooding is unexpected, sudden and without warning, these mediating factors may be weakly developed or non-existent in their effect.

The recommendations from this research are:

- Provide better information on those especially vulnerable to suffer health impacts in floods, so that they can be (a) located and (b) targeted for assistance. This includes the elderly; those with prior-event health problems; the poor; and those with dependents (especially children). Taking note of and acting on these recommendations should be the responsibility of local authority social services departments and national census departments.
- Provide better warnings of floods before the events occur and better arrangements for response to these flood warnings. This includes longer warning lead times; more accurate warnings; more advisory warning messages (not just facts, but advice as to what to do); and better warnings for agencies. Taking note of and acting on these recommendations should be the responsibility of meteorological and water/basin agencies; local authorities; and emergency services (police; fire; etc).
- Provide better post-event social care for those who have been affected, even those who appear at first sight to not be affected. This includes visits to identify problems; assistance with recovery work phases; financial assistance and advice; and medical/social advice. Taking note of and acting on these recommendations should be the responsibility of: medical authorities; local authority social services departments; insurance and related organizations; etc.

Learning from experience: evolving responses to flooding events in the UK

(Merylyn Mckenzie Hedger)

Experience from flooding events in the UK has driven action since the catastrophic East Coast flooding event in 1953. Several recent events, combined with increased understanding about climate change, have added momentum to the development of responses. Loss of life with the 1953 coastal flooding was significantly less than the Netherlands (under 300), but the trauma of human misery and property loss alerted the Government to the potential dangers. A radical rethink was instituted which led to major new flood defence infrastructure being built and eventually the commissioning of the Thames Barrier in 1987. The reference context was gradual subsidence of the east and south coasts of the UK due to isostatic readjustment after the last glaciation.

The first major IPCC Assessment (1991) changed approaches to coastal planning throughout the UK, with an allowance for climate change built into all new coastal flooding infrastructure. It was not, however, until subsequent major fluvial flooding events in 1998 and 2000 that it was proposed that a sensitivity test allowing for an increase in flows of 20% be overlaid on existing flood defence appraisal. This guidance has been increasingly formalized in advance of improved scientific assessments that are currently underway, using improved climate models. Increased understanding of climate change has also meant that it is recognized that the design life of the Thames Barrier now needs to be extended after 2030, so that a major re-assessment is underway with the intention of further investment to extend the life of the barrier to 2100.

Actual experiences of flooding events in 1998, 2000 and 2002 have accelerated action. Whilst not driven by concerns for major loss of life, there has been evident major disruption to lives with a general perception of increased problems with well-being and health. Property loss has also been a major driver. Failure to warn adequately for the 1998 flooding in particular led to management change at the highest level in the responsible (Environment) Agency and new flood warning systems being adopted. The new measures proved successful at the time of the 2000 floods, but the potential for improvement was identified and put into effect. Government significantly increased funding. Subsequently, a major new approach to planning for flood risk has been established for new investment. A coherent new approach to flood warning is now in place that is incrementally building on increased public understanding over time and with the aim to ensure people take action to protect themselves. A National Flood Forum has been established to integrate flood responses and improve communication. Based on a 2003 public awareness program, 72% of those at risk of flooding are now aware that they are at risk. 96% are aware of at least one action they can take to reduce their flood risk, but only 10% have actually taken any action. Materials included in the public awareness program included advertising in pubs and local newspapers, development of a flooded house model (on CD) and creation of a telephone Flood-line.

In the UK, flooding has been an insurable risk for over 20 years. However, the insurance industry itself is now a powerful force behind change. It is demanding improved flood risk mapping as the price for its continued coverage. Some homeowners are already faced with very significant premium increases.

Discussion

Distinctions should be made between the three types of floods (flash, riverine and storm surges). Different plans of action may be required in different regions depending on flood type, local infrastructure and organizations, etc.

The health sector should be included in national and international emergency planning for floods, and in flood vulnerability risk mapping. The health sector should be more pro-active in planning for and providing post-flood event assistance.

Major flooding occurred in Poland in 1997, with many health-related impacts. There were 55 fatalities, with about the same number in the Czech Republic. Gastrointestinal health events were common. The event was beyond the imagination of most people. A lack of awareness of appropriate behaviour during and following a flood resulted in deaths when people underestimated the risks of their actions (returning to home to rescue pet, making photos from rubber boat, homeless people drown when the bridge they lived under flooded, etc.). About one-half of flood victims were trapped in their cars.

With better information, the emphasis in disaster management could shift from post-disaster improvisation to pre-disaster planning. A comprehensive, risk-based emergency management programme of preparedness, response and recovery has the potential to reduce the adverse health effects of floods.

Session 5: National Case-Studies on Health Care System Responses to Extreme Weather Events

Extreme weather events in the republic of Bulgaria for the period 2001-2003 and responses to address them

(R Chakurova and L Ivanov, presented by Lyubomir Ivanov)

A number of disasters occurred during the period 2001-2003. The extreme weather events posed significant environmental and population risks, with extensive material damage (BGN 106,457,720 for 2000). These events included storms, hurricanes, snow-drifts, ice formation, dry spells, fires, etc. The timely intervention of the specialist squads of Civil Protection and other agencies reduced the environmental risks and population casualties.

A year of calamities: the Romanian experience

(Anca Cristea)

Several major abnormal weather phenomena occurred in Romania in 2002. Although perhaps less harmful then in the rest of the continent and although manifested locally or only in limited regions, due to their unusual frequency and rapacity, these phenomena justified local people to consider 2002 as a year of calamities. The most spectacular of all was the first-ever registered tornado in Romanian history. It hit on August 12th in a small area in the South of the country, with damage to infrastructure, injuries and some deaths. In response to the extreme weather events, local Disasters Defence Committees have been formed to minimize losses, to rehabilitate water and sewerage pipes, to recover from electricity faults, to repair roads, bridges and railways, but mainly to help local people with living supplies, medicines, safe drinking water and hospitalization.

General health measures for disasters can be classified as in-place (for areas under urgency or in those with displaced population) and in-hospital. Specific measures include provision of safe drinking water, water and sewer infrastructure and protection from chemical hazards. Two important educational problems have been identified: inappropriate behaviour of the population during and immediately following a disaster and the rather poor efficiency of medical personnel in case of disasters.

Lessons learnt from a country that is living with extreme weather conditions: medical service organization of Uzbekistan in cases of natural catastrophes

(Elena Borisova)

Uzbekistan has a sharp continental climate, with long hot summers that lead to an excess thermal force on humans. Methods of protecting against the heat include consuming liquids such as green tea and horse milk; wearing national clothes that protect against the heat; and spending time in cooler micro-climates such as natural water reservoirs, gardens and ventilated buildings. Another environmental problem is the Aral Sea, where salts from the drying of the Aral Sea are blown more than 1000 km. As a consequence, the incidence of skin disease in the Aral region is 938/10 000, which is twice the national rate. Uzbekistan experienced a flood with mudflow in August 1998 that destroyed houses, bridges and electricity lines. 109 people died and thousands of people were left without shelter. The activities of the medical teams responding to this disaster were not coordinated, which lead to the development of an Emergency Medical System. The system is designed to provide emergency assistance to victims of disasters, to cooperate with other services in the disaster area and to coordinate evacuations when needed. The system includes 39 mobile medical teams, 182 emergency medical aid teams based in hospitals and 483 local emergency medical specialized teams.

Moscow smog of summer 2002

(Victor Kislitsin)

A long-lasting anticyclone caused an extreme weather condition in Moscow from July until mid September 2002. Weather conditions were characterized by: high temperatures (up to 33ºC); low precipitation (for the period May-September 2002, there was 150 mm of precipitation compared with the usual 350 mm); many calm days; and low humidity (40-65%). These conditions caused a vast area of forest and peat bog to burn (350 hectares). The long-lasting burning, industrial emissions and vehicle exhausts caused high concentration of toxic air pollutants in Moscow. The pollutants of concern were PM10 and PM2.5, ozone, sulphur dioxide, carbon monoxide and nitrogen dioxide. The concentration of PM2.5 increased from a yearly mean of 70 цg/m3 to a maximum value during the smog period of 680 цg/m3. Concentrations of nitrogen dioxide increased 9-fold, concentrations of carbon monoxide more than doubled and ozone concentrations more than tripled.

Due to the lack of data on health outcomes associated with the smog, the Ministry of Health of the Russian Federation asked experts of our institute, together with the Moscow Government's Health Department, to evaluate possible adverse health effects caused by the smog. Health risk assessment methods were used to determine the number of deaths due to the smog event. 107 deaths were attributed to carbon monoxide (including 20 due to acute myocardial infarction); 67 deaths were attributed to ozone (including 30 due to cardiovascular disease); 104 deaths were attributed to nitrogen dioxide (including 44 due to cardiovascular disease); 196 deaths were attributed to PM2.5; and 112 deaths were attributed to PM10.

During the smog period, Moscow medical authorities exerted efforts to help people overcome by the conditions. The number of serviced medical emergency calls during August and September increased by 10%. Moscow TV and radio reported instructions on how people should behave to avoid health damage. In order to alleviate any adverse health effects of future emergency ecological situations, a regulation was developed for interaction among the environmental organizations, medical organizations and authorities, including stipulation for data exchange.

Session 6: Workshop Recommendations

During the working group sessions, three sets of recommendations were developed, discussed and endorsed:

- A set of recommendations to be included in the Draft declaration for the 4th Ministerial Conference for Environment and Health for further discussion in Malta at the 3rd intergovernmental meeting;

- A set of more detailed recommendations, to be further developed in the policy document, for the 4th Ministerial Conference for Environment and Health for further discussion in Malta at the 3rd intergovernmental meeting;
- A set of recommendations specifically for actions on heat-waves, floods and cold spells.

Recommendations for the draft declaration for the 4th Ministerial conference on environment and health

The participants to the meeting suggested that Ministries for Environment and Health, should:

- recognize the increasing evidence, as addressed in the European Climate Assessment and the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), regarding the role of human activities in contributing to climate change and we recognize the increasing short-term and long-term hazards posed to human health. Progress has been made since the London Conference on the basis of the Conference Declaration on the early human health effects of climate change and stratospheric ozone depletion in the exchange of information, research and capacity building. We acknowledge the contributions of the WHO European Centre for Environment and Health in this regard. However, significant work remains to be done in our efforts to identify, mitigate and adapt to the health impacts of climate change and other global environmental changes to the largest extent possible.
- recognize that climate is already changing and that the intensity and frequency of extreme weather events, such as floods, heat-waves and cold spells, may change in the future. Extreme weather events caused recent problems in Europe, particularly in urban areas. These events will continue to pose additional challenges to health risk management and to the reliability of the power supply and other infrastructure. This demands a pro-active and multi-disciplinary approach by governments, agencies and international organizations, such as the World Health Organization, the World Meteorological Organization, [the European Commission, the European Environment Agency and the International Federation of the Red Cross] and improved interaction on all levels from local to international.
- take actions to reduce the current burden of disease due to extreme weather and climate events. We call on the World Health Organization, through its European Centre for Environment and Health, in collaboration with the World Meteorological Organization, the European Environment Agency and other relevant organizations, to support these commitments and to coordinate international activities to this end. We agree to report on progress achieved at the intergovernmental meeting in 2007.

Recommendations to be further developed for the policy document to support the declaration for the 4th Ministerial conference on environment and health

The participants recognized that

- The political, social, environmental and health consequences of extreme weather events have increased in Europe in recent years. We recognize that the climate is already changing and that the intensity and frequency of extreme weather events, such as floods, heat-waves and cold spells, may change in the future. These events will continue to pose additional challenges to current and future populations, health risk management and to the reliability of infrastructures such as health services, power supply and others.

- There is a need for Ministries of Health and [other Ministries] to recognize that actions must be taken to reduce the current and future burden of disease due to extreme weather and climate events and to include the prevention of health effects due to weather and climate extremes among national health priorities.

The participants suggested to urge:

- Ministries of Health and [other Ministries] as well as research institutions to improve the understanding of the regional and national burden of disease due to weather and climate extremes and of effective and efficient interventions, such as early warning systems, surveillance mechanisms and crisis management.
- effective and timely coordination and collaboration among public health authorities, meteorological services and agencies (national and international), emergency response agencies and civil societies to develop local, regional and national monitoring/surveillance systems for rapid detection of extreme weather events and their effects on the public's health; to develop civil emergency and intervention plans, including activities to prevent morbidity and mortality due to weather and climate extremes; and to improve public awareness of extreme weather events, including actions that can be taken at individual, local, national and international levels to reduce impacts.

The participants requested:

- the World Health Organization, through its European Centre for Environment and Health, in collaboration with the World Meteorological Organization, The European Commission, the European Environment Agency and other relevant organizations, to support these commitments and to coordinate international activities to this end. In particular, there is a need to develop guidelines to estimate the burden of disease due to weather and climate extremes; develop indicators for inter-country and intra-country comparison and monitoring of progress; coordinate the development of new methods, including sentinel monitoring/surveillance systems, to provide timely information on the health impacts of weather and climate extremes at the European level; develop and evaluate more effective and efficient interventions, such as early warning systems, to reduce negative impacts; and harmonize interventions across regions and countries to facilitate sharing of data and lessons learned.

Two working groups were established to further investigate actions and research needs to respond to and prevent the health effects of floods, heat-waves and cold spells.

Recommendations on research, methods and interventions to respond to and prevent the health effects of floods:

1. Develop more and better quantitative data on the health impacts associated with all categories of flooding (flash, riverine, storm surge). This includes centralized and systematic national reporting of deaths and injuries from floods using standardized methods and the follow-up of long-term health and mental health impacts
    a. WHO should coordinate the development of standard reporting indicators of the health, social and environmental consequences of flooding events
2. Ministries of Health coordinate and collaborate with meteorological agencies, emergency response agencies and civil society to develop national plans of action for flooding events, including the development of vulnerability risk maps

a. National plans of action should include the transboundary health impacts of floods, such as chemical pollution and disease;
b. Develop programs of event management training for the key actors [fire brigade, health services, civil protection, etc.] in catchments with flood risks
   i. Ensure the provision of post-flood assistance with regard to health

Recommendations on research, methods and interventions to respond to and prevent the health effects of heat-waves:

1. Develop more and better data on morbidity and mortality associated with high temperature episodes, including the identification of individual risk factors in relation to housing, institutional care and social support networks. Specific research needs include:
   a. Better characterization of the relationship between exposure and a range of cause-specific health outcomes; and
   b. Better understanding of the mechanisms underlying heat-related morbidity and mortality.
      i. Use standard approaches to assess lessons learned from the 2003 heat-wave and other recent events, including health impacts and public health responses
      ii. Review interventions and evaluate their effectiveness. Develop evaluation methods as needed.
2. Ministries of Health, in collaboration with WHO, WMO and national meteorological agencies, support the development of heat health warning systems at the local or national level, particularly the identification of community-based interventions that focus on the protection of vulnerable individuals
      i. Develop real-time monitoring systems for heat-related morbidity and mortality
      ii. Facilitate the development of selective space cooling to protect the most vulnerable individuals, particularly in hospitals, nursing homes and senior centres. An expert group should investigate the broader issue of the introduction of air conditioning systems, especially retrofitting, with respect to potential costs and benefits and also the negative impact increased air conditioner use will have on the urban heat island as well as on global climate change
      iii. Facilitate the local identification of high risk groups to better target interventions
      iv. Facilitate the development of active community-based activities that support the social and medical welfare of the elderly to reduce their vulnerability to temperature extremes
   c. Develop longer-term strategies to reduce morbidity and mortality due to heat-waves, such as improved housing design and measures designed to reduce urban heat islands.
   d. Investigate interactions between harmful air pollutants and extreme weather events
      i. Integrate heat health warning systems with pollution warning networks
      ii. Investigate the role of air pollution in increasing the health impacts of urban heat islands
      iii. Investigate the role of air pollution (particularly ozone) in increasing health impacts in rural areas

Cold spells related recommendations:

1. Develop effective interventions to prevent cold-related morbidity and mortality, particularly among vulnerable populations such as the homeless
    a. Ministries of Health coordinate with responsible companies and agencies to develop regional and national plans of action to ensure maintenance of the energy and water supply infrastructure during cold spells

Future steps

1. For the World Health Organization:

The WHO Global change and health unit will be preparing the Working document to be submitted to the Malta Preministerial meeting, March, 2004. Further on the WHO ensures the recommendations to be included following discussions with Member States into the Budapest Declaration. Based on the Budapest 4th Ministerial Conference for Environment and Health, actions will be taken by the WHO. These actions would be concerning:

- Collaboration with the World Meteorological Organization, the European Commission, the EEA and other relevant organizations,
    - to develop guidelines for estimating the burden of disease due to weather and climate extremes;
    - to map activities and impacts with regard to extreme weather events;
    - to develop indicators for intercountry and intracountry comparison and monitoring of progress;
    - to coordinate the development of new methods, including sentinel monitoring and surveillance systems,
    - to provide timely information on the health impacts of weather and climate extremes at the European level;
    - to develop and evaluate more effective and efficient interventions, such as early warning systems, to reduce negative impacts;
    - and to harmonize interventions across regions and countries to facilitate the sharing of data and lessons learnt.
    - To identify funds to organize a follow-up meeting in 2006, to discuss the lessons learnt on implementing intervention strategies and plans, to be submit as an input into the 2007 intergovernmental meeting.

2. The European Public health Association:

The European Public Health Association offered to coordinate, in collaboration with WHO the development of the book on this meeting, and ensured the process. The book would be a joint EUPHA WHO publication and should be made available by the end of 2004, depending on the timely delivery of the manuscripts, the publisher and the WHO approval process.

3. For the participants of the meeting

- To ensure that their Ministries are informed about the outcome and progress of the meeting and to keep the participants and the organizer updated on any progress on this issue within their respective countries.
- To provide the manuscript of the presentation to Professor Kirch of the EUPHA.
- To notify to the organizers any potential hot topics on extreme weather and climate events, and to report and inform the WHO about measures, policies and practices.
- To report back on impacts and actions at European, national and sub national level at the intergovernmental meeting planned for 2007.

Annex 1:

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Annex 2:

List of papers

5036794/01	Provisional list of working papers
5036794/02	Scope and purpose
5036794/03	Provisional agenda
5036794/04	Provisional programme
5036794/05	Provisional list of participants
5036794/06	Projected changes in Extreme Weather and Climate Events in Europe
5036794/07	Cold Extremes and Impact on Health
5036794/08	Health Impact of the 2003 Heat-wave in France
5036794/09	Heat-waves in Budapest
5036794/10	Epidemiologic Study of Mortality during Summer 2003 in Italy
5036794/11	Lisbon heat health warning system – Summer of 2003
5036794/12	The follow-up program on the influence of Meteorological changes upon cardiac patients
5036794/13	Lessons learnt from the 2003 Heat-wave in France and actions taken to limit the effects of new heat-wave
5036794/14	Moscow smog of summer 2002: Evaluation of adverse health effects
5036794/15	Extreme Weather Events in the Republic of Bulgaria for the period 2001 – 2003 and responses to address them
5036794/16	Is the frequency and intensity of flooding changing in Europe?
5036794/17	The Human Health Consequences of flooding in Europe and the implications for public health: a review of the evidence
5036794/18	Lessons to be learnt from the 2002 Floods in Dresden, Germany
5036794/19	2002, A year of calamities: the Romanian experience
5036794/20	Floods: Climate change and adaptation strategies for human health
5036794/21	Political Recommendations for flood risk mitigation for European Public
5036794/22	Comparative analysis of risk management regulations in the member states of the Council of Europe’s EUR-OPA Major Hazards Agreement
5036794/23	Provisional Recommendation points

Extreme weather and climate events and public health responses

This expert meeting was organized by the WHO Regional Office for Europe and the European Environment Agency and hosted by the Ministry of Health of the Slovak Republic to exchange information and develop recommendations on public health and environmental responses to weather and climate extremes, specifically floods, heat-waves and cold spells. The 54 participants included representatives of 20 countries from the European Region, as well as of the European Commission, European Environment Agency, Red Cross, World Meteorological Organization, World Health Organization and scientists from around the world.

The discussion on health effects in different countries of the heat-wave and of the cold-waves occurred in 2003, as well as of the flooding in 2002, can be summarized as follows:
During the severe heat-wave that affected much of western Europe in summer 2003, women 75 years of age and older were at highest risk.
Winter mortality is still higher than summer mortality. While some of this wintertime excess relates to hypothermia, the greatest component is due to respiratory and cardiovascular diseases.
Flooding in 2002 caused serious re-organization of health care services and required advice on hygiene and immunization by health authorities. A review of the health effects showed that fatalities are often caused by entrapment in automobiles and behaviours that clearly disregard dangers. Other health effects included gastrointestinal infections due to contamination of food and water, and psychological effects.

The meeting developed the following recommendations:

- emphasis must shift from post-disaster intervention to pre-disaster planning;
- identifying and protecting vulnerable groups is particularly important;
- meteorological agencies, health departments and civil protection agencies must work together to develop early warning, surveillance mechanisms, intervention plans and crisis management tools.

This meeting contributed to the preparatory process for the Fourth Ministerial Conference on Environment and Health (Budapest, June 2004). Its recommendations, providing actions addressing public health and environmental responses to weather and climate, were submitted to Member States as an input to a policy document and to the Conference declaration.

The WHO Regional Office for Europe

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

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