



Helping the world cope with health impacts of severe heat waves

A heat wave is a period of unusually hot weather which lasts from a few days to a few weeks. Human discomfort can be increased when the prolonged anomalous heat is accompanied by high humidity during both day and night, and can be somewhat alleviated if the air is very dry. Detailed definitions of heat waves based on meteorological thresholds (e.g. for temperature) vary by location. With the observed trends and future projections in the overall climate patterns in all parts of the world involving increasing temperatures and extremes, heat is more and more recognized as a major issue with serious health consequences in developed as well as developing countries.

'Because they lack the spectacular and sudden violence of say, a tropical cyclone, and because the related death tolls are not always obvious at first, heat waves rarely received adequate attention in the past; however, heat waves are amongst the most dangerous of natural hazards', said Dr Michel Jarraud, WMO Secretary-General during the fifteenth World Meteorological Congress held in May 2007.

During the 2007 pre-monsoon hot weather season (April-May), more than a hundred people died and several hundreds were treated throughout India for heat-related ailments as temperatures soared above 40°C, sometimes reaching as high as 48°C. Memories of the deadly heat wave in 2003 are still fresh in people's minds, when at least 35,000 people died as a result of the record heat wave that scorched Europe in the month of August. France alone suffered a loss of 14,802 people after temperatures soared to over 40°C for two weeks.

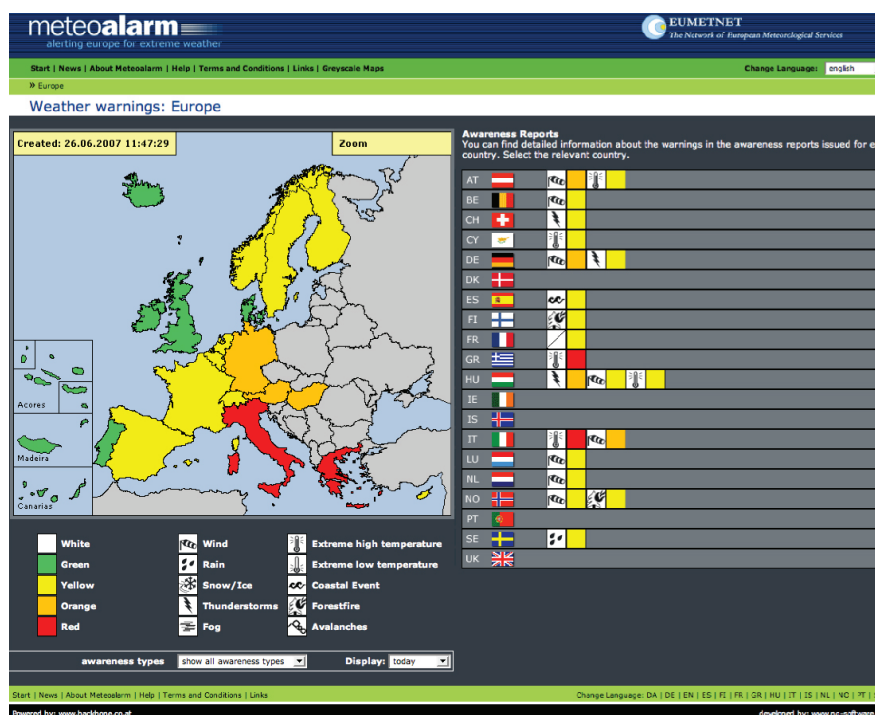
The danger of the 2003 European heat wave was not the extreme day-time temperature as such, but that the nights brought no relief,

noted Dr Lisa Alexander, in the 2006 paper on 'Global observed changes in daily climate extremes of temperature and precipitation'. Heat waves take the greatest human toll in cities, where the area of dark heat-absorbing roofs and pavements exceeds the area covered by cooling vegetation. Cities preserve the heat, and night-time temperatures can be up to several degrees higher compared to the countryside.

According to the 2007-published Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), frequencies of hot days, hot nights and heat waves have increased over the last 50 years. The IPCC AR4 also projects more such extreme events ahead of us in some parts of the world, and warns that more heat stress may be expected during the 21st century. These conclusions are largely based on global analyses coordinated by experts from the World Meteorological Organization (WMO) and the World Climate Research Programme (WCRP).

Recently, there has been recognition that heat-related risks can be reduced through early warning systems which alert decision makers and the general public to impending dangerous hot weather. Such warning systems can also serve as sources of advice on how to avoid negative health outcomes associated with hot weather extremes.

WMO's World Climate Applications and Services Programme, with the support of experts from the WMO Commission for Climatology and the World Health Organization (WHO), is at an advanced stage of preparing a joint Guidance on *Development of Warning Systems for Heat Waves and Health*. The goals of the Guidance are to outline, for national meteorological and health services, the issues surrounding the threat of heat waves; to show how an understanding of the biometeorology, epidemiology, public health and risk communication aspects of



The Meteoalarm websites display daily updates on weather warnings (including extreme high/extreme low atmospheric temperatures) for all European countries and their provinces. People planning their vacations somewhere in Europe are highly recommended to consult this website to better prepare for meteorological hazards (www.meteoalarm.eu).

heat as a hazard needs to be integrated within early warning systems for heat waves; and to describe how key players from climate, health, emergency response agencies, decision-makers as well as the media and general public can work together for effective management of heat as a health hazard. This Guidance is being developed under the leadership of Professor Glenn McGregor, lead expert for the Commission for Climatology's Expert Team on Climate and Health, and Chief Editor of the International Journal of Climatology. Editors of the WMO-WHO Guidance are Professor McGregor, Dr Kris Ebi (ESS, LLC, USA), Dr Bettina Menne (World Health Organization Regional Office for Europe), and Mr Pierre Bessemoulin, President of the WMO Commission for Climatology.

Some of the earlier studies of vital importance to the development of the Guidance were the European cCASHh (climate Change and Adaptation Strategy for Human health) and PHEWE (Assessment and Prevention of acute HEalth effects of Weather conditions in Europe) projects. Within the cCASHh project, which was coordinated by the WHO Regional Office for Europe in collaboration with many European

national meteorological services, knowledge about heat and health was gathered from all parts of Europe. cCASHh was a combination of impact and adaptation assessment. The project provided basic findings on the capacity of the population to adapt to extreme thermal conditions and identified several strategies for reducing vulnerability. In the EU-funded PHEWE project a prototype of a Heat/Health Watch Warning System was developed in selected European cities (Rome, Barcelona, Paris, London, Budapest) to predict and alert cities' residents of potentially oppressive weather conditions including heat.

Most recently, the World Health Organisation Regional Office for Europe has led a detailed study on heat as a health issue for all of Europe. The results of the EuroHEAT study project are in review, pending publication. EuroHEAT is a multi-year project, co-funded by the European Commission to improve public health responses to weather extremes and in particular to use the heat-wave as a case study for improving public health responses. The final report will assist countries in developing actions in reducing heat effects; provide guidance on core elements of

heat plans; and assist countries in evaluating actions taken.

Populations at mid and high latitudes are affected by heat in a different way compared to populations living near the equator, given the greater exposure to higher temperatures in the tropics. Local environmental factors including housing design and materials, the siting of homes and communities with respect to coastlines and elevation and within urban environments and the general local climate play important roles, in the effect of heat on the human population.

While heat waves affect all humans, the elderly, the very young or the chronically ill are the most vulnerable. In addition to age and state of health, tolerance to thermal extremes can also be influenced by fitness, gender, lifestyle, work environment, standard of living and by level of acclimatization.

Some degree of acclimatization or adaptation to local climate can be achieved by physical and social mechanisms regulating exposure to high temperatures. Behavioural factors such as time spent outdoors, clothing, use of fans or air conditioning; social/cultural adaptation techniques including the traditional afternoon 'siesta' in Southern Europe; and the physical environment, including thermal properties of buildings and cities (such as building insulation, size of windows, density of buildings, trees and green spaces), can all influence our vulnerability to heat. Indeed, the concept of using indigenous knowledge and traditional coping strategies for dealing with heat waves is experiencing a renewal in some countries, with a fresh look at courtyard-style houses; work days that accommodate a rest period in the highest heat of the day; and even closure of some facilities in the most dangerous conditions.

Warning systems for heat and health are in place in a number of countries around the world. WMO, WHO and the United Nations Environment Programme (UNEP) ran two successful showcase projects in Rome, Italy, and in Shanghai, China, in 1999 to 2001, to demonstrate and test a prediction system based on a synoptic climatological procedure

that identifies 'oppressive' air masses that have historically been associated with increased human mortality. Air mass occurrence can be predicted several days in advance, and such systems are in widespread use in the United States of America and in parts of Italy. Many countries in Europe have developed prediction models based on temperature, or on some combination of temperature, humidity and wind speed. Germany relies on a heat budget model, which takes into account the heat exchanged between the human body and its immediate environment (which is described in terms of air temperature, water vapour pressure, wind velocity, and mean radiant temperature). In all cases, the forecast information is used by health professionals to implement educational and efficient intervention measures during the dangerous weather to reduce adverse health effects.

In order to assist WMO Member countries around the world choose and implement models as part of comprehensive warning systems for heat and health, WMO is planning a project for intercomparison of a number of currently used techniques, in a variety of climate and social settings, including in Shanghai, China, and Toulouse, France. Volunteer hosts are being sought to participate in this effort, and tentative interest has been expressed from India, Morocco, Canada and South Africa. The goal is to produce implementation guidance, with descriptions (including evaluations and, if possible, implementable code) of various forecast systems, for use in Meteorological Services. This project is being run in conjunction with three broad-scale demonstration projects (France, India and China) of WMO's Disaster Risk Reduction Programme, on multi-hazard early warning systems, in which heat-health warnings are an integral component.

For the longer term, WMO, through its World Weather Research Programme and its World Climate Research Programme, is committed to increasing the skill and lead time of weather and climate prediction, especially for extremes including heatwaves, to better understand and forecast extreme heat events in conjunction with prevailing air pollution levels and to survey

the occurrence of heat islands in megacities to better understand their influence on patterns of heat stress. Through its observing programmes, WMO is also striving to continually improve the collection and use of data relevant to health outcomes. The World Climate Programme will continue to build effective interaction and collaboration with the health sector at all levels for continual development of these warning systems, and will also facilitate integration of research advances into operational climate services in Member countries. [*c arndt*]

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