CLIMATE CHANGE AND HEALTH – CHALLENGES FOR HUNGARY

ZMIANY KLIMATU A ZDROWIE – WYZWANIA DLA WĘGIER

Anna Paldy and Janos Bobvos

National Institute of Environmental Health, Budapest, Hungary

Abstract

In Hungary detailed research work has been carried out since several years to help the process of getting prepared and adapted to the impacts of climate change. The research activities concerned mainly the health impacts of heat waves (excess mortality). Based on the results of the time series statistical analysis of weather variables and daily mortality of Budapest, it was found that a 5°C increase of the daily mean temperature increases of the risk of all cause mortality by 10%; and the risk of death due to cardio-vascular diseases by 12%.

The frequency of heat waves has been increasing since the nineties. The most extreme heat wave hit the country in 2007 with an excess mortality around 1100 cases. A three level heat health warning system was launched in 2005 as an action to support adaptation.

A significant association was found between global radiation and the increase of melanoma cases. The incidence of melanoma morbidity increased between 2003–2008, the number of new cases changed from 1854 to 2610.

The data of the previous years support that there is an increasing risk of vector borne diseases, as the continuous increase of the incidence of Lyme diseases (15% per year) showed it. Although tick-borne encephalitis is present in the country, the incidence of the disease does not show a strong correlation with climate variability. Diseases like West Nile virus and Hanta virus infection appeared and showed an increasing tendency. The vector of Leishmaniasis also appeared in Hungary.

Another consequence of climate change is the temporal and spatial change of allergenic plant species. New, invasive plants will appear, the length of pollination has been increasing.

Key words: *climate change, heat waves, excess mortality, melanoma, cataract, vector borne diseases, allergenic plants*

Streszczenie

Na Węgrzech od wielu lat realizowane są szczegółowe prace badawcze, aby wspomóc proces przygotowania i dostosowania się do skutków zmian klimatu. Prace badawcze dotyczą głównie zdrowotnych skutków fal upałów (wzrost umieralności).

Na podstawie wyników analizy statystycznej szeregów czasowych zmiennych pogodowych i śmiertelności dziennej w Budapeszcie, stwierdzono, że wzrost dziennej średniej temperatury o 5° C zwiększa ryzyko zgonu z powodu wszystkich chorób o 10%, a ryzyko zgonu z powodu chorób układu krążenia o 12%.

Nadesłano: 15.12.2009
Zatwierdzono do druku: 10.01.2010

Częstotliwość fal upałów rośnie od lat dziewięćdziesiątych. Najbardziej ekstremalne upały nawiedziły Węgry w 2007 r. co spowodowało wzrost umieralności o około 1100 przypadków. Dla ułatwienia adaptacji, w 2005r. ogłoszono system ostrzegawczy uwzględniający trzy poziomy gorąca.Stwierdzono istotny związek między globalnym promieniowaniem a wzrostem zachorowań na czerniaka złośliwego. Zachorowalność na ten nowotwór wzrosła w latach 2003-2008, liczba nowych przypadków zmieniła się z 1854 na 2610. Dane z poprzednich lat wskazują, że istnieje coraz większe ryzyko chorób przenoszonych przez nosicieli, jak widać na przykładzie stałego wzrostu zachorowań na chorobę z Lyme (15% rocznie). Chociaż obserwuje się w kraju przypadki kleszczowego zapalenia mózgu, częstość występowania tej choroby nie wykazuje silnego związku ze zmiennością klimatu. Pojawiają się choroby zakaźne takie jak wirus Zachodniego Nilu czy Hanta wirus i wykazują tendencję wzrostową. Zaobserwowano na Węgrzech także wektor leiszmaniozy. Inną konsekwencją zmian klimatu są czasowe i przestrzenne zmiany dotyczące alergizujących gatunków roślin. Pojawią się nowe, inwazyjne rośliny, długość pylenia wzrasta.

Słowa kluczowe: *zmiany klimatyczne, fale upałów, nadmierna śmiertelność, czerniak złośliwy, zaćma, choroby przenoszone przez wektory, rośliny alergizujące*

Global concerns

In the early 1990-ies the health-deteriorating impacts of climate change was not of a major concern, as it was reflected in the first report of the UN/IPCC (Intergovernmental Panel for Climate Change) in 1991. This situation has been changed. The second report of UN/IPCC devoted a whole chapter to the harmful health effects of climate change. In the declaration of the Third Conference of European Ministers of Environment and Health (London, 1999) [1] the chapter dealing with the early health impacts of climate change and the decrease of the ozone in the stratosphere in Europe, had five paragraphs (39–43) that summarised the proposals. In the declaration of the Conference the ministers acknowledged the need for studying the global climate system and the health hazards of the changes of the ozone layer of the stratosphere, along with the potential unfavourable impacts on economic development and economic-social stability.

The 4th Assessment Report of the IPCC [2] stated, that emerging evidence of climate change effects on human health shows that climate change has

- altered the distribution of some infectious disease vectors (medium confidence)
- altered the seasonal distribution of some allergenic pollen species (high confidence)
- increased heat wave related deaths (medium confidence)

In Hungary the investigations concerning the health impacts of climate change started in the year 2000. The programme, carried out within the National Environmental Health Action Programme, focussed primarily at investigating the health-deteriorating effects of heat waves due to climate changes. Within the action programme the association of daily mortality and meteorological variables of Budapest – the capital of Hungary – was carried out for the period of 1970–2000. The impact of temperature on emergency ambulance calls was also studied in Budapest for the period of 1998–2004 [3, 4, 5] (Fig. 1).

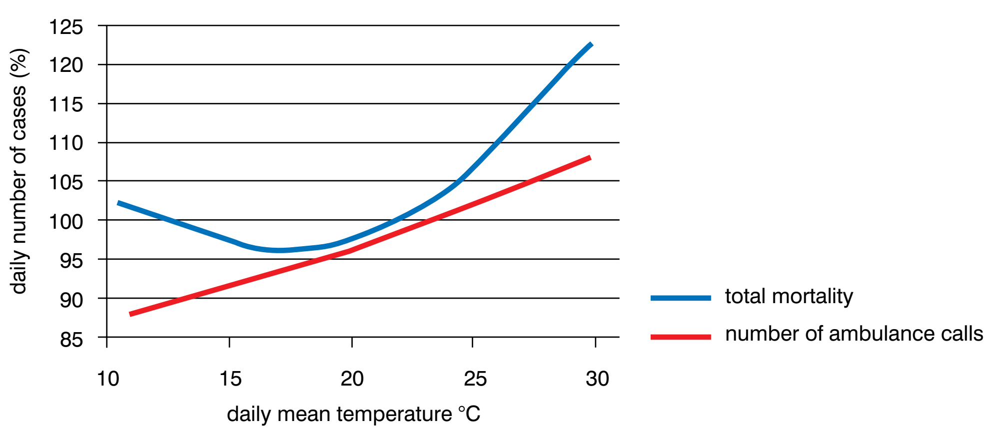

Figure 1. Association of daily mortality and emergency ambulance calls and daily mean temperature in Budapest

Rycina 1. Śmiertelność dzienna, liczba wezwań pogotowia a średnia temperatura dnia

The results of the statistical analysis of weather variables, daily mortality and daily emergency ambulance calls can be summarized as follows. It was found that a 5°C increase of the daily average temperature results in:

- 10% increase of the risk of mortality due to all causes;
- 12% increase of the risk of mortality due to cardio-vascular diseases;
- 15% increase of the number of emergency ambulance calls for heart complains and “general complains”.

Study of heat waves and related features in Budapest in 1992–2007

There is no generally accepted definition for ’heat wave’ in the relevant literature. For Budapest the criteria of heat-wave was defined on the basis of analysing the meteorological and mortality data of the period 1970-2000. Namely, a heat-wave was defined when the daily mean temperature (26.5° C) exceeded the 98% probability during at least three subsequent days. According to this definition there were 6 heat-waves in Budapest in the period 1992–2000 [4]. Excess mortality occurred as follows:

Table I. Excess mortality in Budapest, during the heat waves of 1994–2000
Tabela I. Nadmierna śmiertelność w Budapeszcie w okresie upałów 1994–2000

Age group		1994 August	1994 August	1998 August	1998 August	2000 July	2000 August
Cardio-vascular	15–64	– 4	2	– 1	– 1	8	0
	65–74	14	6	14	– 4	8	0
	75+	51	36	22	25	39	27
	total	61	44	35	20	55	27
Due to all causes	15–64	11	32	2	3	31	–3
	65–74	10	12	18	– 4	14	8
	75+	49	50	48	33	57	33
	total	70	94	68	32	102	38

In the period of 2001–2007 there were 13 further heat waves in Budapest with the total duration of 80 days [6].

Table II. Heat waves in Hungary, 2001–2007
Tabela II. Fale upałów na Węgrzech, 2001–2007

	2001	2002	2003	2004	2005	2006	2007
Number of heat waves	1	2	2	1	1	5	3
Number of days with heat wave	3	8	11	4	5	30	19

In 2007 – in the most extreme summer so far experienced – there were three heat waves in Hungary. During the period of the first and third heat wave excess mortality was less than 5%. In the second and most severe heat wave record breaking daily mean temperatures of higher than 30 °C were measured for five days in the period 16–24 July (Fig. 2). The unfavourable impact of high temperatures on the daily mortality could be unambiguously determined and this impact was even larger among hospitalized patients. The excess mortality rate (33%) of the ten-day heat wave was lower in the Central Region of Hungary than in France during the heat wave of 2003 [7]. Nevertheless, during the five hottest days the excess mortality was 57%. At a national scale the estimated total excess death cases were calculated by the respective relationships as likely falling into the range of 800–1000.

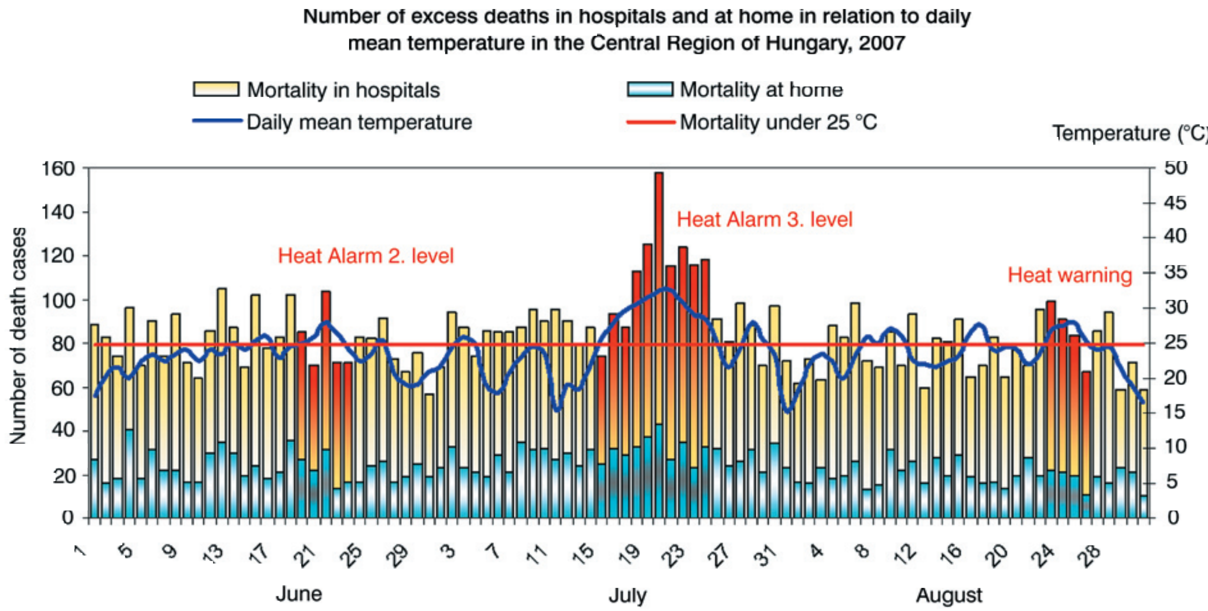

Figure 2. Daily in/out of hospital death counts and daily mean temperature in the Central Hungarian Region 01.06–31.08.2007

Rycina 2. Liczba dzienna zgonów w szpitalu (żółte słupki), w domu (niebieskie słupki), a średnia temperatura dnia w centralnym regionie Węgier, 1.06–31.08.2007

Establishment of the heat alert and warning system

In developing the system of heat warning the results and practices established within the *PHEWE*[1] programme supported by the European Union, launched in 2004, has been utilised. The professional principles of heat-warning were developed firstly for Budapest and then for the whole country [8]. The action plans of heat wave periods were defined for the National Public Health and Medical Officers' Service, on the basis of the EU supported *EuroHEAT*[2] programme and making use of the proposal of the of WHO/ECEH – Rome Office, by the National Institute for Environmental Health. Level 3 (Third Grade) heat warning was released in July 2007 for the first time, while in the earlier years the daily average temperature reached the second level.

[1] European Union 6th Framework project Quality of life and management of living resources: key action: environment and health contract no QLK4-ct-2001-00152): Asessment and prevention of acute health effects of weather conditions in Europe (PHEWE) 2002–2005

[2] EU New Public Health Programme: Improving Public Health Responses to Extreme weather/Heat-Waves – EURO HEAT) N°: 2004322 (2005–2007)

The levels of heat warning are defined on the basis of the weather forecasts of the National Meteorological Service in the following way:

Level 1: when forecasts indicate that the daily mean temperature exceeds 25° C for one day. The internal information system of the Service of Medical Officers is involved.

Level 2: when forecasts indicate that the daily mean temperature exceeds 25° C for at least for 3 days. The National Chief Medical Officer alerts the health institutions, the emergency ambulance service, the local governments and the population through the regional chief medical officers and orders the performing of preventive actions to protect the health of the population.

Level 3: when forecasts indicate that the daily mean temperature exceeds 27° C at least for 3 days. It involves the strict control of the actions and measures of level 2. The National Chief Medical Officer notifies the Secretariat of the Central Co-ordinating Committee, requesting the taking over of the co-ordination of actions and measures of the various economic sectors, when so required.

The flow of information of heat warning is shown in Fig. 3 on the basis of the experiences in the year 2007.

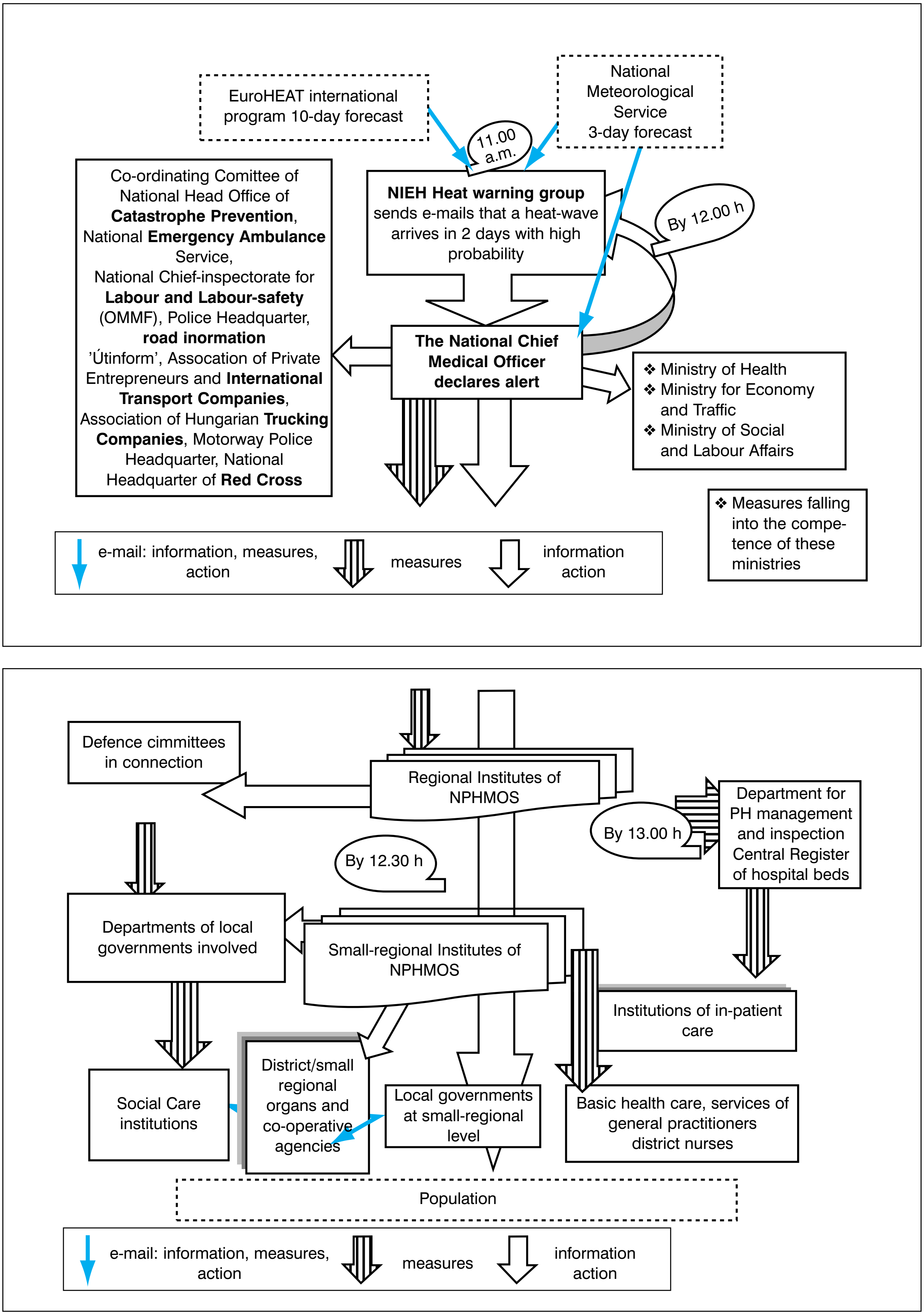

Figure 3. The flow of information of heat warning
Rycina 3. Przepływ informacji ostrzegającej przed falą upału

Ultraviolet radiation and health

Greenhouse-induced cooling of the stratosphere is expected to prolong the effect of ozone-depleting gases, which will increase levels of UVR reaching some parts of the Earth's surface. Climate change will alter human exposure to UVR exposure in several ways. [9]. Solar ultraviolet radiation (UVR) exposure causes a range of health impacts. The greatest burdens result from UVR-induced cortical cataracts and malignant melanoma of the skin [10].

The Hungarian studies detected a significant association between global radiation and the increase of melanoma (ICD10–C43) cases. The health impact was studied by using the geographical information system (GIS) based on morbidity data from 1997 to 2001. The results showed a significantly higher incidence of cataract (ICD-10: H25) and malignant melanoma of skin with higher global solar radiation (Figs. 4–5). Similar tendency of melanoma incidence was also detected in the country between 2003–2008, the number of new cases increased from 1854 to 2610.

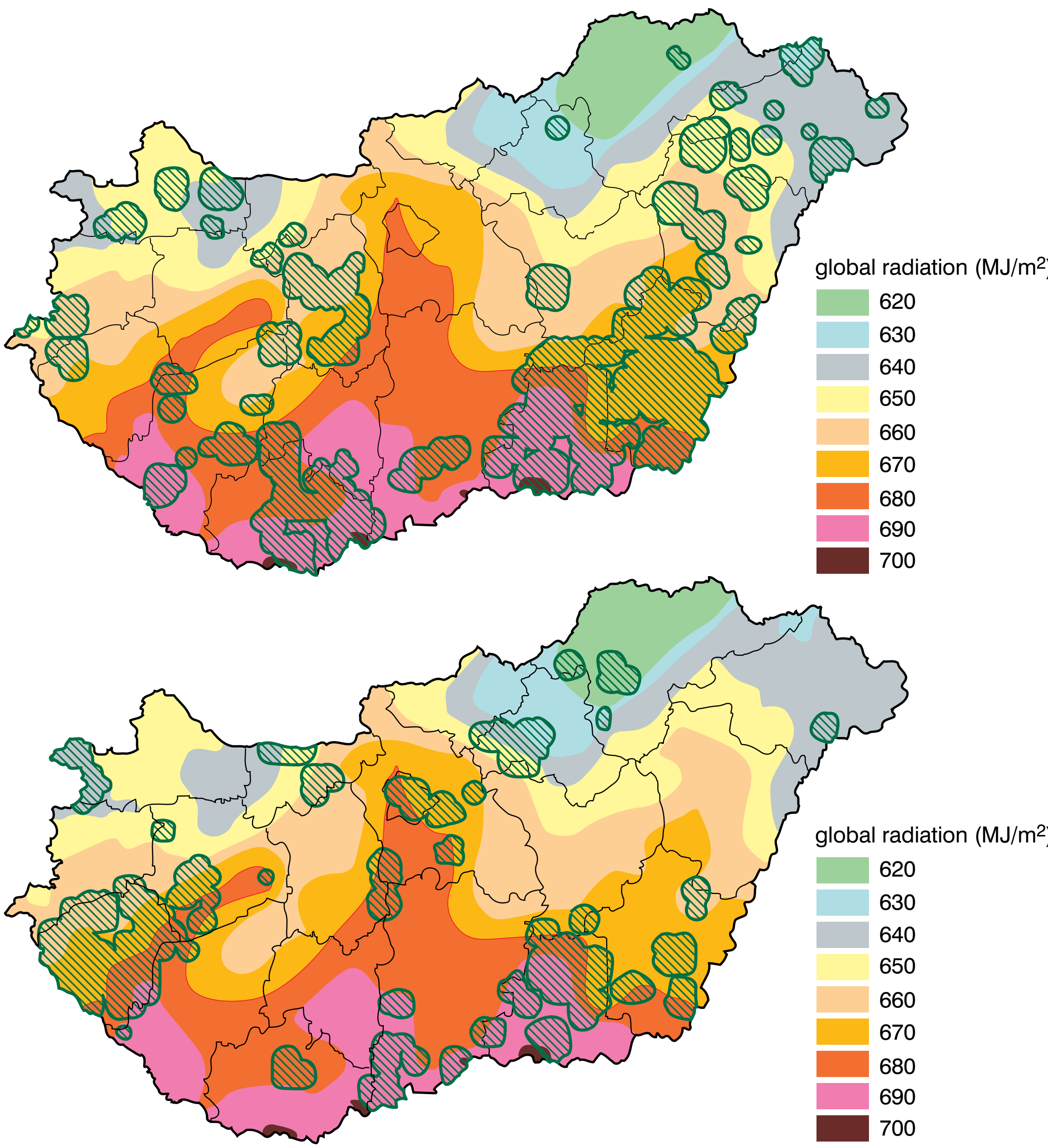

Figure 4–5. Association between global irradiation and the morbidity of malignant melanoma of the skin (ICD10-C43) and cataract of the eyes (ICD-10: H25) in the Hungarian population, 1997–2001

Rycina 4–5. Całkowite naświetlenie słoneczne a zachorowalność na czerniaka złośliwego skóry (ICD10-C43) i zaćmę soczewek (ICD-10: H25) w populacji węgierskiej, 1997–2001

Climate change and vector borne diseases

Vector-borne diseases are among the best studied of the diseases associated with climate change due to their widespread occurrence and sensitivity to climatic factors. There is some evidence of climate change related shifts in the distribution of tick vectors of disease, of some (non-malarial) mosquito vectors in Europe [1].

Data on tick-borne encephalitis (TBE) between 1989–2008 showed a decreasing tendency. A characteristic spatial distribution of the diseases cases can be observed: it accumulates in the Western and Northern part of the country where the surface is covered by forests [6] (Fig. 6). Although tick-borne encephalitis is continuously present in the country, the incidence of the disease does not show a strong correlation with climate variability.

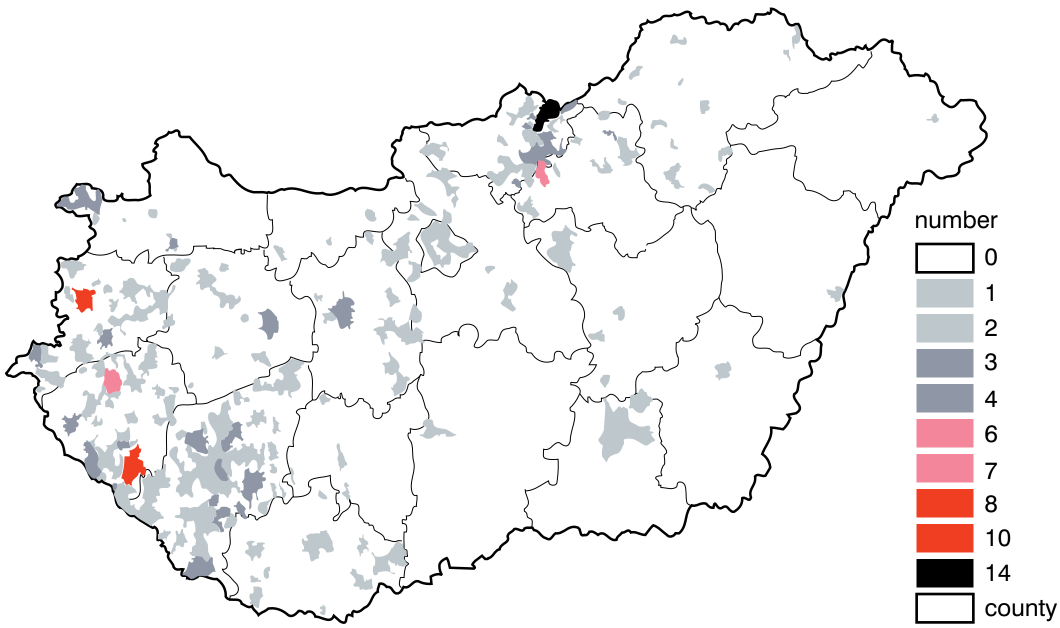

Figure 6. Spatial distribution of tick borne encephalitis cases in Hungary, 1996–1999
Rycina 6. Rozprzestrzenienie wirusowego kleszczowego zapalenia mózgu na Węgrzech, 1996–1999

Another important tick borne disease is Lyme borreliosis caused by the bacterium *Borrelia burgdorferi*. The reporting of Lyme disease has been mandatory since 1998. In the recent years we can observe an increase of the incidence (Fig. 7). The spatial distribution of the disease is similar to that of TBE, although its occurrence covers a greater area.

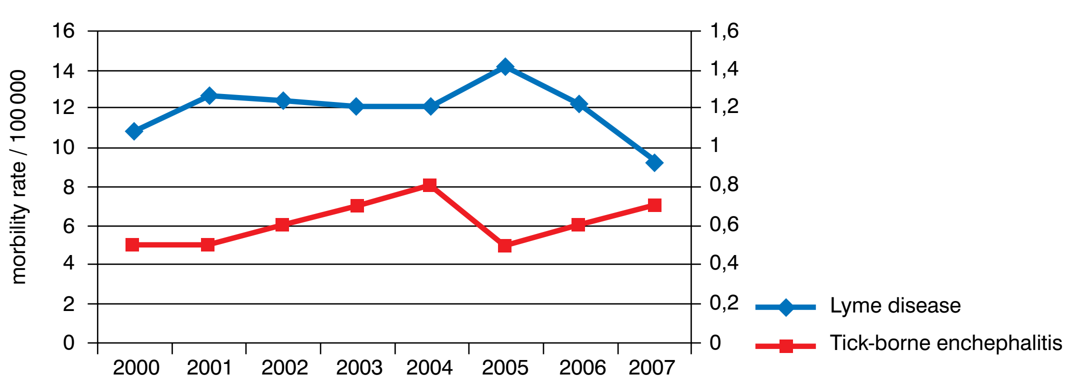

Figure 7. Incidence of tick-borne encephalitis and Lyme disease in Hungary, 2000–2007
Rycina 7. Występowanie wirusowego kleszczowego zapalenia mózgu oraz Choroby z Lyme na Węgrzech, 2000–2007

Diseases like Hanta virus and West Nile virus (WNV) infection appeared and showed an increasing tendency. Between 2000–2007 three to five cases were reported yearly, however 12 new cases of WNV were identified in 2008 during three months [11]. The vector of Leishmaniasis was also detected in Hungary. A 2° C increase of yearly mean temperature will increase the risk of appearance of sand fly in the Carpathian Basin by 100 percent (Fig. 8). The appearance of the tiger mosquito (*Aedes albopictus*) is also predicted for the Carpathian Basin by the different climate scenarios. There is a potential threat that diseases like chikungunya fever can also appear in our country.

Figure 8. The dissemination of cutan Leishmaniasis in Europe [12]
Rycina 8. Rozprzestrzenienie leiszmaniozy skórnej w Europie [12]

Climate change and pollen production

Climate change has caused an earlier onset of the spring pollen season in Europe. There is limited evidence that the length of the pollen season has also increased for some species [13].

The temperature increase forecast for Hungary will trigger the earlier appearance of all early spring wind-borne pollen allergens, and an increase in the pollen quantity of some of these allergens »(e.g. birch (*Betula.*)« as was found in 10 years of data. This effect can worsen the symptoms of patients suffering from hay fever and bring them on in early spring. Significant increases were observed in the concentration of every single aeroallergen monitored over the last 10 years by the Aerobiological Network. In Budapest an average annual increase of 52 pollen grains/m^3 was registered for all monitored species. As to amentaceous trees (willows, birches, and oaks) the annual increase was 28 pollen grains/m^3 and in case of summer weeds the annual rise was 25 pollen grains/m^3. The timelines of aerobiological pollutants in Budapest were also analysed on the basis of 10-year database. The flowering season for trees has started earlier and earlier and with the variation being as much as 2 months, in keeping with changes in daily maximum temperature (Fig. 9). There is less fluctuation of the onset of flowering of summer weeds (e.g. *Ambrosia* and mugwort) than among trees flowering during early spring (Fig. 10), so prevention measures (weed control, actions, early initiation of drug treatment) can be prepared more effectively.

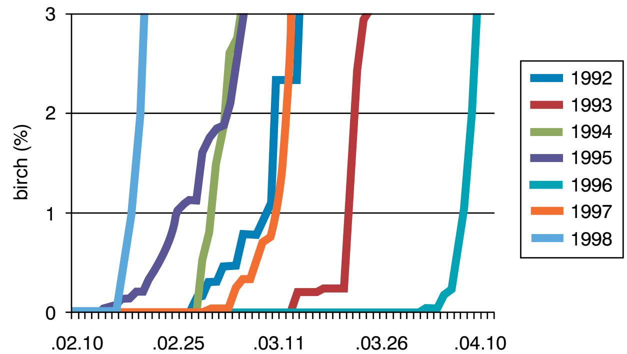

Figure 9. The onset of pollination of birch (Betula) in Budapest, 1992–1998
Rycina 9. Początek pylenia brzozy w Budapeszcie, 1992–1998

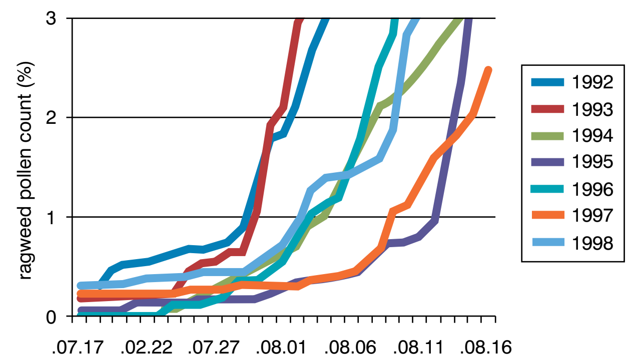

Figure 10. The onset of pollination of ragweed (Ambrosia) in Budapest, 1992–1998
Rycina 10. Początek pylenia ambrozji w Budapeszcie, 1992–1998

In the future new, invasive plants like common pellitory (Parietaria) and golden rod (Solidago) (Figs. 11–12) will appear, the length of pollination will increase, and the sensitisation pattern of allergic patients will change, the season of the major allergen in the Carpathian basin, Ambrosia will increase.

Figure 11. Common pellitory (*Parietaria*)
Rycina 11. Pomurnik lekarski (*Parietaria*)

Figure 12. Golden rod (*Solidago*)
Rycina 12. Nawłoć pospolita (*Solidago*)

The way forward

The impacts of climate change is high on the agenda of the European Union. The European Commission issued a White Paper [14] entitled: Adapting to climate change: Towards a European framework for action. The objective of this Adaptation Framework is to improve the European Union's ability to deal with the impact of climate change.

Since 2005, climate change related issues have been high on the political agenda in Hungary and in 2008 the National Climate Strategy was unanimously adopted by the Parliament.

Within the frames of this strategy a 'Climate-health Preventive Strategy' was elaborated with the following goals:

- to create the climate-health network;
- to identify the options of avoiding and preventing climate-change related illnesses;
- to prioritise prevention, along with priorities of rescue, health-care and rehabilitation;
- to raise awareness of health impacts of climate change among politicians, experts, population, especially vulnerable groups and other stakeholders;

The implementation of this national Climate-health Preventive Strategy would require 7–10 years. It can only be realized if it is based on one hand on extensive intersectorial co-operation at national level, and on the other hand on the close co-operation with all international partners, like the World Health Organization, or institutions of the European Union.

Acknowledgement

The results are partly based on the project "Preparation for Climate Change" – supported by the Hungarian Academy of Science-BCE Study Group (2006TKI246).

Literature

1. Confalonieri, U., Menne, B., Akhtar, R. et al.: Human health. Climate Change: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 2007; 391-431.
2. Declaration of the Third Conference of European Ministers of Environment and Health (London, 1999) http://www.euro.who.int/Document/E69046.pdf
3. Páldy A., Erdei E., Bobvos J. et al.: A klímaváltozás egészségi hatásai (Climate change and its health impacts), AGRO 21 Füzetek., 2003; 32, 62-77.
4. Páldy A, Bobvos J, Vámos A, et al: The effect of temperature and heat waves on daily mortality in Budapest, Hungary, 1970-2000 In: Kirch, W., Menne, B., Bertollini, R.: Extreme weather events and public health responses, WHO, Springer-Verlag Berlin Heidelberg 2005; pp 99-108.
5. Páldy A., Bobvos J., Vámos A., et al: Effect of Elevated Temperature on Daily Emergency Ambulance Calls: A Time Series Analysis in Budapest, Hungary 1998-2004. Central European Journal of Occupational and Environmental Medicine 2007; 13, 159-169.
6. Páldy A, Bobvos J.: A 2007. évi magyarországi höhullámok egészségi hatásainak elemzése – elözmények és tapasztalatok. (Assessment of the health impacts of the heat waves of 2007 – background and experiences) Klíma21 Füzetek 2008; 52, 3-15.
7. Pirard, P., Vandentorren, S., Pascal, M., et al: Summary of the mortaltiy impact assessment of the 2003 heat wave in France, Euro Surveill. 2005; 10,153-6.
8. Bujdosó L. Páldy A: Az ÁNTSZ feladatai a klímaváltozás egészségi hatásainak megelŒzése érdekében (Tasks of the National Service for Public Health and Medical Officers in preventing the harmful health impacts of climate change) AGRO21 füzetek, 2006; 48. 60-67
9. de Gruijl, F., Longstreth, J., Norval, C.A. et al: Health effects from stratospheric ozone depletion and interactions with climate change. Photochem. Photobio. 2003; S2, 16-28.
10. El Ghissassi, F., Baan, R., Straif, K.,et al: on behalf of the WHO International Agency for Research on Cancer Monograph Working Group International Agency for Research on Cancer, Lyon, France: A review of human carcinogens – Part D: radiation 2009; 10, 751-752.
11. Ferenczi E., Bán E., Petrányi G. et al: Újonnan megjelenö vírusfertözések (Newly emerging viral infections) Háziorvos Továbbképzö Szemle 2006; 11, 24-28.
12. Menne, B., Ebi, K.: Climate Change and Adaptation Strategies for Human Health. Springer Steinkopff Verlag Darmstadt 2006.
13. Emberlin, J., Detandt, M., Gehrig, R., Jaeger, S. et al: Responses in the start of Betula (birch) pollen seasons to recent changes in spring temperatures across Europe. Int. J. Biometeorol., 2002; 46, 159-170.
14. COMMISSION OF THE EUROPEAN COMMUNITIES Brussels, 1.4.2009 COM(2009) 147 final. WHITE PAPER Adapting to climate change: Towards a European framework for action

Contact details:
Anna Paldy, MD, PhD
Deputy director
National Institute of Environmental Health
Gyáli ut 2-6.
Budapest 1097
Tel./fax: +36-1-476-1215
E-mail: paldy.anna@oki.antsz.hu