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IGES-WHO Joint International Symposium on Climate Change, Environment and Health, 2 March 2009

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## Climate change and emerging risks to human health and well-being: response options and the role of public and private sectors



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IGES-WHO International Symposium FY2008
on
Climate Change, Environment and Health

Climate change and emerging risks to human health and well-being:
response options and the role of public and private sectors

The first to suffer the effects of environmental disruptions such as climate change are people who live amid weak social infrastructures and depleted ecosystems. Barely a day has passed in recent years without the words "global warming" or "climate change" being mentioned in the mass media. The G8 Environment Ministers meeting was held in Kobe, further raising awareness of the importance of environmental issues. At the subsequent G8 Toyako Summit in Hokkaido, environmental issues were high on the agenda, signalling the beginning of the quest for a low-carbon society.

The fourth report of the Intergovernmental Panel for Climate Change (IPCC), stated that "the warming of the climate system is unequivocal". Therefore, while stabilization of greenhouse gases such as Carbon dioxide is the first step, a multifaceted approach is necessary to ensure future reductions. Similarly, to minimize the unavoidable impact of climate change, adaptation policies are essential at every level. For now, policies that need to be enforced immediately are indicated in the IGES White Paper, published by the Institute for Global Environmental Strategies (IGES).

This symposium, under the theme of "Climate change and emerging risks to human health and well-being: response options and the role of public and private sectors", aimed for recognition of the direct threat to health posed by climate change and sought policy recommendations for social development measures that are climate-friendly. It was organized jointly by the IGES Kansai Research Centre, which deals with environmental problems under the theme of "Business and the environment", and the WHO Centre for Health Development, a leader in international health issues. Hyogo Prefecture hosted the event at Hyogo House, Kobe.

## Symposium Programme

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| **13:30-13:50** | **Opening Remarks** |
| | - **Prof Yutaka Suzuki**, Director, IGES Kansai Research Centre, Vice President of University of Hyogo Prefecture<br>- **Dr Shin Young-Soo**, Regional Director, WHO Regional Office for the Western Pacific<br>- **Mr Toshizo Ido**, Hyogo Prefectural Governor<br>- **Mr Kazuhiko Takemoto**, Vice-Minister for Global Environmental Affairs, Ministry of the Environment Japan |
| **13:50-14:20** | **Keynote Speech: Climate Change and Alien Invasive Species: Risks to Human Health, Well-being and Welfare** |
| | - **Prof Nay Htun**, Stony Brook Southampton, State University of New York, Former UN. Asst. Sec-Gen. UNDP, UNEP |
| **14:20-14:50** | **Keynote Speech: Heat disorders in Japan - Current situation and the countermeasure for prevention -** |
| | - **Dr Masaji Ono**, National Institute for Environmental Studies |
| 14:50-15:00 | Coffee Break |
| **15:00-17:00** | **Panel Discussion** |

**Coordinator:**
- Prof Hironori Hamanaka, Chair, IGES Board of Directors

**Panelists:**
- Dr Shuzo Nishioka, Senior Research Adviser, IGES
- Dr Jacob Kumaresan, Director, WHO Centre for Health Development (WHO Kobe Centre)
- Prof Xinbiao Guo, Professor and Chair, Department of Occupational and Environmental Health Sciences, School of Public Health, Peking University
- Dr Hideo Shinozaki, Emeritus President, National Institute of Public Health
- Mr Harumi Yashiro, Tokio Marine & Nichido Risk Consulting Co., Ltd.

## KEYNOTE SPEAKERS

**Prof Nay Htun**
**Stony Brook Southampton, State University of New York,**
**Former UN Assistant Secretary-General UNDP, UNEP**

Prof Nay Htun received his PhD degree in Chemical Engineering from Imperial College London. He served in the UN for over 25 years where he held the rank of UN Assistant-Secretary General at the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). He was seconded to the UNCED Secretariat, Geneva, Switzerland as the Programme Director supervising the drafting of Agenda 21, generally referred to as the blueprint for sustainable development, and helped organize the 1992 Rio Earth Summit. In addition to his current post, Prof Nay Htun is a Fellow and Visiting Professor of International Environmental Policies, Center for Environmental Policies, Imperial College London, and is Visiting Professor or Advisor to institutions in Sweden, Thailand and China. He has also authored or co-authored a large number of books on the environment and sustainable development.

**Dr Masaji Ono**
**National Institute for Environmental Studies**

Dr Masaji Ono graduated and later obtained a Doctorate of Health Sciences from University of Tokyo. He joined the National Institute for Environmental Studies (NIES), Tsukuba, Japan in April 1978 and currently works as Chief of the Integrated Health Risk Assessment Section for the Institute's Environmental Health Sciences Division. Dr Ono's main research areas and interests are the health effects of global warming, air pollution and ultraviolet radiation. He serves as a member of the committee for health surveillance and health impact of regional pollution as well as the ozone layer protection committee, both organized by the Ministry of the Environment, Japan. Furthermore, he has taken roles as chairman of the Society of Indoor Environment, Japan, as an executive board member of the Japan Society for Atmospheric Environment and as a board member of the Japan Epidemiological Association.

## PANEL DISCUSSION COORDINATOR

**Prof Hironori Hamanaka**
**Chair of the Board of Directors, IGES/ Professor, Faculty of Environmental Information, Keio University**

Prior to his current position, Prof Hironori Hamanaka was the Vice-Minister for Global Environmental Affairs at the Ministry of the Environment, Japan. He has been serving with the Government of Japan for more than 35 years, mostly in the field of environmental policies. In particular, he has devoted his administrative career to inter-governmental negotiations in areas including the Kyoto Protocol and its rules of implementation, as well as major agreements in the field of sustainable development.

## PANELISTS

**Dr Shuzo Nishioka**
**Senior Research Advisor, Institute for Global Environmental Strategies (IGES)Senior Research Fellow, National Institute for Environmental Studies (NIES)**

Dr Shuzo Nishioka graduated from the University of Tokyo (Mechanical Engineering) and started his career at Asahi Chemical Co., before engaging with the NIES as a Senior Researcher on environmental system research areas such as urban transportation, nature conservation and climate change. He joined the Intergovernmental Panel on Climate Change (IPCC) in 1988, and was also leader of IGES Climate Policy Project for six years. He was a professor at the Tokyo Institute of Technology and Keio University (Global Environmental Policy). From 2001 to 2008, he worked as Executive Director of NIES. He leads the "Japan Low Carbon Society 2050" project under Global Environmental Research Program of the Ministry of Environment, and "Kakushin climate modeling" project under the Ministry of Education and Science.

**Dr Jacob Kumaresan**
**Director, WHO Centre for Health Development (WHO Kobe Centre)**

Dr Jacob Kumaresan graduated from Kilpauk Medical College, University of Madras, India in 1978, practicing in hospitals in Tamilnadu before taking up the post of Government Medical Officer with the Ministry of Health of Zimbabwe in 1981. He furthered his studies at Tulane University, New Orleans, gaining a Masters in Public Health and Tropical Medicine, then a Doctorate in Public Health. Returning to Africa, Dr Kumaresan took up postings with the Ministries of Health in Zimbabwe and later in Botswana. In 1992, Dr Kumaresan joined WHO as Medical Officer for its Global Tuberculosis Programme, later becoming Senior Adviser to the Stop TB Initiative. In 2003, Dr Kumaresan was president of the International Trachoma Initiative, a US non-profit organization. In the year prior to his appointment at the WHO Kobe Centre in Kobe, he served as Coordinator at the WHO Office for the UN in New York.

**Prof Xinbiao Guo**
**Professor and Chair, Department of Occupational and Environmental Health Sciences, School of Public Health, Peking University**

Prof Xinbiao Guo received his Ph.D. in Preventive Medicine at University of Tokyo, Japan in 1990 and his M.D. at Beijing Medical College (now Peking University Health Science Center), China in 1984. He was a visiting researcher in National Institute of Health Sciences, Japan from 1990 to 1993 and in School of Medicine, Juntendo University, Japan from 1997 to 1998. He was also visiting professor of the School of Medicine, Kobe University, Japan. He is now the professor and chair of the Department of Occupational & Environmental Health Sciences, School of Public Health, Peking University Health Science Center, China. Prof Guo's recent research focuses on the health effects of air pollutants, environmental health risk assessment and environmental health promotion. He currently serves on the Board of Directors, Chinese Society of Environmental Science, is the vice-president of Chinese

Society of Environmental Health, and the deputy chair of the Environmental and Ecological Toxicology Committee, Chinese Society of Toxicology. He is also the chair of the Environmental Health Committee, Beijing Preventive Medicine Association..

**Dr Hideo Shinozaki**
**Emeritus President, National Institute of Public Health**

Dr Hideo Shinozaki is currently Emeritus President of the National Institute of Public Health (NIPH), Ministry of Health, Labour and Welfare, Japan. He received an M.Sc. from the Graduate School of Science, Engineering, and Medicine at the University of Manchester after obtaining his Ph.D. from the Keio Graduate School of Medicine. Dr Shinozaki joined the Ministry of Health, Labour and Welfare (former Ministry of Health) in 1974 and assumed various posts before eventually taking on the role of Director-General of the Health Policy Bureau (Chief Medical Officer). Dr Shinozaki first served World Health Organization (WHO) as an Adviser for the WHO Regional Office for the Western Pacific from 1978 to 1980. He also has been a member of the Executive Board of the WHO since 2005, to which he was appointed for the first time from 2000 to 2003. He is also a member of the Advisory Council on Health Research of WHO as well as an Advisory Committee member of the WHO Centre for Health Development since 2003.

**Dr Harumi Yashiro**
**Tokio Marine & Nichido Risk Consulting Co., Ltd.**

Dr Harumi Yashiro graduated with a Masters degree from Waseda University before becoming an assistant in the Faculty of Science and Engineering. He then joined Tokio Marine and Fire Insurance Co., where his current work includes research on natural disaster insurance, risk management, securitization methods, and risk communication related to environmental issues. He also works with Nagoya University using life cycle assessment (LCA) to analyse natural disaster and environmental risks to companies and local governments, and is researching the change in natural disaster risk due to global warming and the impact on insurance firms. In addition, he is a member of the Ministry of Internal Affairs and Communications IT Security Committee and the Ministry of Land, Infrastructure, Transport and Tourism.

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# Opening Remarks

*Professor Yutaka Suzuki*
*Director*
*Institute for Global Environmental Strategies (IGES)*
*Kansai Research Center (KRC)*

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Good afternoon, ladies and gentlemen. On behalf of my organization, the IGES Kansai Research Center, together with WHO Kobe Centre, both in HAT Kobe, and Hyogo Prefecture, welcome to this international symposium. I would like to express my sincere appreciation to all the support and cooperation from the Ministry of the Environment, Kobe City, the Hyogo Earthquake Memorial 21st Century Research Institute, as well as the other organizations.

IGES and our Kansai Research Center were established in 2001. From the beginning, together with the international and domestic network of IGES, and local companies who have a strong interest in environment, we have developed research activities based upon the key theme of industry and the environment. Research outcomes have been transmitted and disseminated by publications such as policy briefs and IGES white papers, and we make an effort to disseminate to the rest of the Asia in the form of the international conferences and policy recommendations. For today's international symposium, the main focus is going to be climate change, the environment and health.

Rapid economic development and rapid population growth are joined by increasing environmental burden. These are major and urgent issues that all Asian nations are facing. The impact of climate change on the environment and health is a big potential risk for the future in Asia. So today, we are able to invite quite a few specialists who are tackling these environment and health issues. It is a very important discussion, in view of the environment and health policy in Asia. Therefore, we really hope that this symposium is going to draw public attention. Our Center, with the support of Hyogo Prefecture and local companies and organizations, is continuing to transmit the outcomes of our business and environment projects. So once again I would like to ask for your cooperation and support.

I would like to close my remarks with my sincere wishes for the success of today's event. Thank you very much.

# Opening Remarks

*Dr Shin Yong-soo*
*Regional Director*
*WHO Regional Office for the Western Pacific*

Good afternoon. Professor Hironori Hamanaka, Board of Directors of the Institute of Global Environment Strategies, and Professor Yutaka Suzuki, Director of IGES, Kansai Research Center, and Vice-President of University of Hyogo; Mr Toshizo Ido, Governor of Hyogo Prefecture, and Mr Kazuhiko Takemoto, Vice-Minister of Global Environmental Affairs, Ministry of Environment, Japan; distinguished guests, ladies and gentlemen, I am very pleased to welcome you to this opening session of the IGES-WHO Joint International Symposium on Climate Change, Environment and Health. It is quite fitting that this, my first speech in the region as new WHO Regional Director for the Western Pacific, comes at a symposium that addresses one of my four priority areas, which is responding to public health emergencies and risks including climate change.

As we all know, climate change affects the availability and quality of our fresh water, and quality of air we breathe, production and safety of our foods, all major determinants of our health and quality of life. Climate change also increases the frequency of extreme weather events, such as heat waves, floods, and droughts, and storms, as well as their intensities.

In 2000, the Western Pacific was the first WHO region to address climate change and its impact on health in small island countries when we conducted a regional workshop for Pacific Island countries. Similar activities for the countries in the Caribbean and the Indian Ocean followed, leading to the 2005 WHO publication, *Climate variability and change and their health effects in small island states*. More recently, the WHO Regional Office for the Western Pacific, in collaboration with the Regional Office for South-East Asia, held two consultations with Member States to develop a regional framework for action to protect human health from effects of climate change in the Asia-Pacific region. This regional framework focuses on three areas: first, it aims to increase awareness of the health consequences of climate change, and secondly, it is intended to strengthen the capacity of health systems to provide protection from climate-related risks and substantially reduce greenhouse gas emissions generated by the health sector. Finally, it hopes to ensure that health concerns are addressed in decisions to reduce risks from climate change in other sectors.

The WHO Regional Committee for the Western Pacific, our regional governing body, discussed and endorsed the framework in September last year, and similar plans were developed in other regions, and the WHO global workplan on climate change and health was endorsed by the WHO Executive Board in January 2009. Currently, our regional office, working with the mandate of Member States, and in collaboration with other WHO offices, is developing guidelines for member states on health vulnerability and adaptation assessments. We are also preparing training modules on climate change and health. We are supporting this year Cambodia, Mongolia and Samoa in their effects to assess health vulnerability and develop national plan for health sector adaptation to climate change.

The WHO Kobe Centre was established in the aftermath of the 17 January 1995 Great Hanshin-Awaji Earthquake that claimed nearly 6500 lives. Ever since that horrifying day, disaster management has been close to the hearts of the citizens of Kobe City and Hyogo

Prefecture. In fact, just a month after the December 2004 Asian tsunami in the Indian Ocean, Kobe hosted the United Nations World Conference on Disaster Reduction, producing the Hyogo Framework for Action, 2005-2015. The key action areas included in the Hyogo Framework have become more relevant as extreme weather disasters caused by climate change become more frequent and evident. Disaster management has been a backbone of the WHO Kobe Centre's programs. In 2007, the Kobe Centre developed a training manual for cities in the region, with a focus on managing the health impacts of disasters, such as heat waves, floods, and events related to the climate change. In addition, the Centre convened a workshop in November 2008 to identify the research and action agenda for climate change and health in urban settings. For many years, the Japanese government has been a leader in advocating a human security approach for global health, and it has supported the United Nations Trust Fund for Human Security.

The human security approaches go beyond the traditional focus on the security of nation to include concerns for the security of individuals and communities. It focuses not only on protecting individuals and their health, but strives to empower them through health system strengthening. Human security also is an important concept in dealing with the health effects of climate change. Japan has been a strong advocate for strengthening the response to climate change, and the Ministry of Environment has played a key role in developing policies and programs to reduce greenhouse gas emissions, and adapt to the effects of climate change. Japan was active in negotiations under the United Nations Framework Convention on Climate Change (UNFCCC) and demonstrated leadership at the Hokkaido-Toyako G8 Summit last July looking at climate change mitigation issues.

In closing, I would like to thank IGES for providing us with the opportunity to join you in organizing the symposium. I look forward to the active participation of all of you in discussions on this important global issue. Thank you.

# Opening Remarks

*Mr Toshizo Ido*
*Governor*
*Hyogo Prefecture*

Good afternoon, ladies and gentlemen. Welcome to this joint international symposium. from the Institute of Global Environmental Strategies, Kansai Research Center and WHO Kobe Centre. We are very pleased to have this symposium. The topic is on environment and health, especially climate change - one of the issues that we actually face is a very risky situation, so in that sense, I think this topic is a very critical subject, kind of a life-threatening subject, and also as introduced now, we have Dr Shin all the way from the Philippines, and also the Professor Nay Htun, actually from New York, to deliver the keynote speech. So I am sure that we are going to have a wonderful panel discussion.

Well, last year here in Kobe, at the end of May, the G8 Environment Ministers Conference was held in the lead-up to the Toyako G8 Summit. I am sure that it was a great success in that it prepared the way for the environmental framework determined by the G8 summit. And what I felt at that time was, China, India and Brazil and Mexico, the so-called “BRIC” nations, together with those nations like the United States which already escaped from the Kyoto Protocol, have announced to join the activities toward the post-Kyoto Protocol framework, and we are very pleased hearing that news. Looking at the future global environment, it is not an issue that just one particular country or region can tackle. We have to make a concerted effort, all of us together, every region and country, and we have to deal with this situation as one common theme. So in that sense, various case studies have been developed in many different parts of the world. If we have these kinds of opportunities to publish those research results so that the general public can access the information, I am sure that we will be able to develop a good framework for the future. So in that sense, this symposium is going to give us a good footprint for future activities. This is my wish.

We have been making an effort to develop a good environment for a long time. The Inland Sea, called *Seto Naikai*, borders Hyogo Prefecture and 40 years ago, it was called the Dead Sea, because along with the various industrial activities, there was a high pollution inflow which deteriorated the level of the water quality. So we established the Inland Sea environmental security law, to try to cope with any source of the pollution by regulating its sources. We were able to clean it up. On the corporate level, I think that we can improve this situation by imposing rules. However, in terms of water use by each individual household, how do we tackle those issues? Well, we needed to focus on the sewage system. We had great difficulties in improving those sewage utilization rate. The rate here in Hyogo Prefecture is actually reaching 96%. Tokyo and I think Kanagawa are first and second in Japan for developing the sewage system, but we are third. In the past 15 years, we had a strategy to try to improve the individual household sewage utilization to 98%. So we now have a very beautiful sea, but a major industry of the Inland Sea is seaweed cultivation. So for the growth of the seaweed, it requires a certain level of the organic substance. If you have seawater that is too clean, it may be reducing some nutrients, slowing the growth of the seaweed. So therefore, how to keep a good balance between the growth of the seaweed and the level of the nutrient? This is also a challenge that we are going to face in the future. So maintaining a good ecosystem is a critical but difficult challenge for all of us.

Two years ago, I visited the headquarters of the EU and I had a chance to talk to the director of the environmental section, and he said the problem was the gap between the fishing interests of member states and the regulation framework of the EU. Each member country tries to maintain or secure its own rights, but for the EU, certain rules must be implemented in order to maintain a good level of the environment, and he said it is very difficult to maintain a good balance between these two issues. And when I asked which country he was talking about, he said France. When I met the environment minister in France, I explained this to him and he said that the EU actually tries to set up these sorts of the rules all the time, but the effort or difficulties in implementing those regulations is on countries' shoulders. So I understand that in every region of the world, there is a conflict of interests. But anyhow, there are many challenges about the environment, and also of implementing rules to protect the environment. It is very important, but at the same time it is very difficult to implement environmental measures. That is my message.

But anyhow, when I move around Kobe City, I use the small compact electric car which we borrowed from the Ministry of the Environment. The performance is rather poor at this moment, and its range is only up to 80 kilometers, so I just can use it in a very small vicinity, but a lot of people show very strong interest in that type of car. For transportation I think that either electric vehicles or hydrogen cars are going to be the option for the future. And I myself, I should not disclose any particular name of the manufacturer, but I had experience in driving a hydrogen car developed by BMW, with a performance very close to a car running on gasoline. They have a research institute in Kagoshima Prefecture, and they developed a hydrogen car. Last year, during the G8 summit, the car was driven all the way up to Hokkaido, and there I had the luxury of using it. One of those is actually able to bring you up to the summit of the Mount Rokko, so in that sense, there are the new areas for development and good areas for the future investment to meet those needs of the people.

Regarding health, my major concern is that the world is susceptible to more insects, especially mosquitoes. If mosquitoes carrying malaria spread from Amami Oshima island to the mainland, it would be very troublesome. I will probably be dead before then but this is just one of the examples.

Along with climate change, there are other concerns. For example, at the moment we have a lot of cedar pollen in the air, and yesterday I had red eyes because of it. Such damage or the impact on health by the pollen might have something to do with climate change. These trees may release more pollen or seeds as a result. So again, how to adopt our lifestyle and environment to environmental change is one of the topics that we have to think about for the future. We have a certain responsibility for the future of the planet, so I hope that this symposium is going to give us the good instructive information. Lastly, I would like to express my sincere appreciation to all the parties concerned, and the success of this international symposium. Thank you very much.

# Opening Remarks

*Mr Kazuhiko Takemoto*
*Vice-Minister for Global Environmental Affairs*
*Ministry of the Environment, Japan*

Hello, everybody. My greetings to you on the occasion of the opening of this international symposium. Climate change, as the Governor has already mentioned, is making an impact on health issues, biodiversity, water issues, disasters, and is closely related to environmental changes. During this symposium, we are going to focus on health issues which is in our strong interest, and we are going to have a discussion and presentations from leading figures in the field. This symposium is organized by IGES and the WHO Kobe Centre, and under the leadership of Governor Ido, Hyogo Prefecture is quite active on the environment. As mentioned, last May we had the G8 environment ministerial meeting, and in organizing that event, I sincerely appreciate the great support of Hyogo Prefecture and Kobe City.

The Ministry of Environment, is now working toward the establishment of a green economy and society and a low-carbon society. We are conducting research and also trying to raise awareness for policy change. Therefore, we are trying to cooperate with Hyogo Prefecture and we are hoping that we are going to deepen our relationship and cooperation with IGES and WHO, to further implement activities in the field of the climate change. Last but not least, at the opening of this symposium, I sincerely appreciate the great effort contributed by everyone to this symposium, and I sincerely wish for its success. With these words, I would like to conclude my remarks. Thank you very much for your invitation.

# Keynote Speech 1: Climate change and alien invasive species: risks to human health, well-being and welfare

*Professor Nay Htun*
*Stony Brook Southampton*
*State University of New York*

Thank you very much for inviting me and giving me the opportunity to share some views with you. I would also like to thank and congratulate the organizers of this joint symposium, and the many sponsors. Clearly, this shows the increasing and widening interests of the interface and intersection of the environment, specifically climate change, and human health.

In today's presentation, I would like to focus not only on human health, but human health and well-being. I would like to specifically focus attention on the role of invasive microorganisms, or alien invasive species.

We clearly know how climate change is so central to destruction, disaster and deprivation – depriving people of dwellings, food, clothing, jobs, which in turn leads to diseases. And these are all closely inter-related, and when that happens, more and more people are displaced, within the country and out of the country. If we are going to count the number of people displaced in their own country, whether it is a recent fire in Australia, or the Katrina event, or the fires and earthquake or the tsunami which has been mentioned, we are talking about a huge number of people.

The 2008 Inter-governmental Panel on Climate Change (IPCC) synthesis report for policy-makers clearly stated that for health, and climate change, there will be an increasing burden from malnutrition, diarrhea, cardio-respiratory, and infectious diseases. There will be increased morbidity, mortality from heat waves, floods and droughts, changed distribution of some diseases, global warming, changes in ecosystems, and an increasing range and spread of vectors and microorganisms.

As I said earlier on, I would like to focus on the role of invasive species, particularly invasive species and microorganisms, when climate change takes place. Right at the very top, I put the melting of the permafrost. I have a slide here which shows the permafrost, as we can see, covers a very huge area, almost 23 million square miles, or 24% of the exposed land surface. It is estimated now from the satellite pictures of NOAA and others that probably by the middle of this century, and some scientists say even well before that, anything from 20-25% of the permafrost could be melted. So when this permafrost melts, it is not only methane gas which is released. Today's Japan Times has a half page about permafrost melting and the release of significant amounts of methane gas, and methane is a greenhouse gas. But here, I want to focus on what happens when the ice melts and the soil is exposed. When the soil is exposed, the potential – and it is more than potential, there is beginning to be evidence – that microorganisms which have been dormant are released. Not only in the bacteria and viruses, but fungi and molds, and these get transported across continents. So when we have a very large area of land, of soil, which has been covered by ice, by the permafrost for a long time, and now it is exposed, we can expect more microorganisms to be exposed and to be transported.

We all know about sea level rise, and what it does to coral, mangroves, changing precipitation patterns, changing the ecosystem, and habitats.

One of the greenhouse gases which have not received much attention is water vapor and humidity. As a matter of fact, it is not in the Kyoto Protocol. As we know, the Earth's surface is nearly three-quarters water and as the climate becomes warmer, the oceans will evaporate more and humidity is increasing. Increase in humidity and temperature is very favorable to the growth of microorganisms, bacteria, viruses and the like, and helps alien, invasive microorganisms to spread.

There is also a phenomenon called the atmospheric brown cloud. We used to call it "dust storms", the "yellow cloud", etc., but this phenomena is a bit different. It is not only dust, but carbon particles from coal burning, forest fires, and indeed from pulverized rubber. As we urbanize, the car population increases, and we construct more and more highways which are made not out of bitumen, out of tar, but out of concrete. Cars drive faster, at a higher speed, more cars, with more erosion of tires, and these particles of fine rubber get up to the atmosphere, right up to the upper atmosphere, and together with the carbon particles, remain there a long, long time. This has implications, but there is also beginning to be evidence that this atmospheric brown cloud, the "ABC", that is hovering up there, is also a transport mechanism for microorganisms that can then move from continent to continent.

The interaction and correlation between climate change, diseases, health, and well-being is beginning to be recognized, and it is going to get more and more attention. Professor Shin of the WHO Regional Office for the Western Pacific said that as far back as 2000, they were already working with the countries on it. But I think more has got to be done, and there is not yet enough attention and not yet enough knowledge on the linkages between climate change, diseases, health, and well-being. The melting of glaciers, flooding, droughts, these are happening and as we have said, there are direct and indirect consequences for life support systems, human welfare and health and well-being, and as Professor Shin has said, it compromises human security.

So climate change is changing habitats, and with changing habitats, there is increasing movement of people and goods, and also the discharge of ballast water. A large amount of water is being discharged from ships all over the world in the transportation of goods and crude oil from temperate regions to tropical regions, tropical regions back to temperate regions. So every time a ship goes back to its port of origin, it takes back ballast water, and the ballast water is discharged. In the ballast water, there are all forms of microorganisms. The marine environment is very mixed up now. This has significant potential in Asia to affect marine organisms, fisheries, etc. Not all invasive species do harm. Some have good impacts. Some have benefits. But some also have significant ecological and economic impacts.

The point I want to make here is that we do not have enough knowledge or information about what are the "good guys", and what are the "bad guys". And if we do not have enough knowledge/information, it is difficult for us to manage it. So it behooves us to have better knowledge, and I will come back to this towards the end.

In my presentation today, I will attempt to connect up these dots from different parts of the world, and in a very preliminary manner,. If we are to look at one dot at a time, perhaps we are not quite aware of what the potential consequences are. Like we see one part of a jigsaw puzzle in a picture, we are not sure of what the big picture is. But if we begin to put some of these jigsaw pieces together, perhaps a picture is beginning to form. Perhaps, and we are now having more and more of these jigsaw puzzles, and we can begin to put them together and see what can be emerging. In Senegal, there is an invasive plant, which has out-competed native plants in many parts of the delta, and is spreading beyond Senegal. It is

obstructing access to water and encouraging the proliferation of weaverbirds, which feed on grains. And when it feeds on grains, there is not enough food for human beings. And when there's not enough food, malnutrition, health and well-being are compromised. A habitat is also provided for vectors of water-borne diseases, and there is an explosion of mosquito and snail populations, and malaria and bilharzias have reached epidemic proportions in the region.

Here is the conclusion of a regional training program sponsored by the World Bank in December 2007. It's called a "mile a minute" weed, it grows so fast. Originally from Central America and South America, it was taken to India to plant around airfields during the second world war,: the weed grows so fast, it could camouflage the airfields so they would not be bombed. It had its purpose, but this weed has grown so fast in the South Asian subcontinent, is now found even up to semi-temperate regions like Nepal, Thailand, Philippines, Malaysia, Indonesia, Papua New Guinea, and is even found in Australia. This weed grows extremely fast. It affects and smothers agro-forestry, natural forest ecosystems, as well as many crops and plantations. In South Asia, it particularly affects tea plantations. When it affects food and tea plantations as crops, we can begin to see how it affects food security and the well-being of the people.

The zebra mussel is clogging up the great lakes between North America and Canada. It is proliferating. Although about $140 million per year is spent fighting it, it is not a winning proposition.

The long-horned beetle, found in many parts of the United States, is spreading now, costing at least $175 million a year. Just in the United States, invasive species are estimated to cost $140 billion per year.

So these phenomena, due to ecosystem and environmental changes, are having an impact on food. I'll just use three examples here. One is the collapse of the beehives, colony collapse syndrome, happening in the United States and spreading to many countries in Europe. The next is ranavirus, which is affecting Pacific salmon, frog populations, and in yesterday's Japan Times, there was a front-page article on research from a university in Kanagawa Prefecture which conclusively found that 10 000 frogs were found dead in a pond due to a ranavirus. The ranavirus and chytrid are major causes of worldwide reduction of amphibian species, particularly frogs. It has devastated Central America, Costa Rica, and many other places, causing near extinction. So far, there is no cure. Fortunately it is not contagious to human beings, but it is affecting the frog population. As it affects the frog population, there is more and more multiplication of insects, because the frogs are very good predators. So we will very soon have to use more insecticides, chemical pesticides and insecticides. That has implications.

So you can see the cycle and the inter-relationship of what is happening, and in all these examples, it is a combination of environmental factors: warming, more stresses, excessive use of chemicals, but also mites and fungi and viruses. It is a combination that is weakening us, with significant implications for food and in turn, human health and well-being.

So we can see all these, now, food security, water stress, water quality, heat, allergies, which are increasing, respiratory infectious diseases. Hopefully we will not move to more widespread zoonoses and disasters.

Now to focus more on infectious diseases. I am not downplaying health stresses, they are important, but there are at least three direct effects of climate change: on pathogen replication rate, pathogen dissemination, and movement and replication of vectors and

abundance of animal hosts. Indirectly, it affects ecosystems, increasing habitats and breeding sites, and human behavior. The vicious cycle continues.

Examples of diseases influenced by environmental conditions, whether it is warm, cold, dry, wet, some diseases are favored and there is increasing evidence that this is happening.

Three years ago, at the St. Petersburg G8 summit, the second paragraph of the communiqué said, “A vigorous response to the threat of infectious diseases, the leading cause of deaths worldwide, is essential to global development and to the well-being of the world’s population. Major diseases, such as HIV and AIDS, TB, malaria, and measles, continue to exact a heavy toll on economies and societies around the world, particularly in developing countries, impeding achievement of the Millennium Development Goals. Clean water, sanitation, and the emergence of highly pathogenic avian flu demand our immediate attention.

The UK Foresight Report is excellent report, which you can download free on the website, and one of the conclusions is that climate change could favor increases in vector-borne infectious diseases, affecting human beings, livestock, and crops.

WHO reported in 2006 that 24% of the global disease burden and 23% of all deaths can be attributed to environmental factors. Of the 102 major diseases, environmental risk factors contribute to disease burden in 85 categories. And children are particularly vulnerable. We see the re-emergence of malaria, nearly 1 million deaths a year, and 500 million becoming severely ill. Warming affects and extreme weather events would precipitate large outbreaks, since because of warming, the range of mosquitoes will spread. It is re-emerging in Northeast Asia and we are beginning to find it re-emerging in the temperate, semi-temperate zones of Northeast Asia, China, Korea, Japan, and Hokkaido.

West Nile virus is re-emerging, affecting human species, horses, and over 130 species of birds. Warm weather and drought play a role in amplifying this. Dengue fever: a current outbreak in the Asia/Pacific is attributed to climate change and global warming. Asthma: in the US, its prevalence has quadrupled since 1980 and I understand it is happening in Japan, too. The new drivers of asthma include increased levels of $CO_2$, which increases plant pollens, soil fungi, fine particles, and micro-organisms.

The IPCC 2007 synthesis report summarized that the adaptation option and strategy are very important. Human health action plans, emergency medical services, improved climate sensitive surveillance, and control are needed. And the underlying policy framework should be public health policies that recognize climate risk, strengthen health services, and region and international cooperation are so important.

Japan, as the Governor and the Vice-Minister said, played an extremely important role in last year’s G8, started here in Kobe with the environment minister’s meeting, continuing to Hokkaido where the leaders met. Japan’s leadership, starting here, resulted in adoption by the G8 of a “move towards a low-carbon society.” Because of this leadership role, the G8 has agreed to designate IGES as the secretariat for the G8 Low-Carbon Society Research Network. Here at Kobe, we have two very important organizations that look into health, environment, environmental health, with the strong support from Hyogo Prefecture, where IGES Kansai Research Center and the WHO Kobe Centre are located. The very fact that this symposium has been organized with the support of the sponsors shows not only the recognition but the will to cooperate between the health and the environmental community, and I believe it is extremely important and needed, together with the support and recognition of the central and the local governments. All of us are affected. Private and public sectors, we all have a role.

I come back to one of the first slides I showed, but here I have added the word “carbon.” Carbon is so central to climate change, and this is why the G8 agreed to move towards a low-carbon society, to focus on carbon, because we can measure it, and by being able to measure it, we can manage it better. Talking about generalities and “reducing greenhouse gases” does not focus at the heart of the problem, which is energy, which is carbon. We can measure it, and I think this is very, very good progress.

For a low-carbon society, energy conservation and efficiency, renewables and carbon capture are all important in many ways. But what is extremely important is transformational change, not only more of the same business as usual, but really a paradigm change, in governments, business, industry, research universities, people and society. Local governments are at the frontline of health outcomes. They are the first to bear it. We need early warning systems for new and re-emerging diseases, and better surveillance systems of what these new and emerging diseases are. We need information exchange, preparedness for new and emerging diseases, response procedures, and particularly for the elderly, the children, and the disabled, who are going to be most affected by global warming in terms of health outcomes. For the private sector and the Japanese government, we all know the three Rs: reduce, re-use, recycle, and I know Japanese industry is doing a fantastic job in putting the three Rs into practice. What we would like to suggest is also to have a fourth R: rethink. Transformational thinking. We need to rethink everything we do. Can we use energy more efficiently? Can we lower the level of carbon, materials, the water that we use, can we reduce it more, can we recycle? Health, what are the new outcomes in our production systems?

And finally, all of us, public and society, are affected directly and indirectly. It is in a symposium like this, through the central government, through the Prefectural government, through the universities, that we must keep on increasing the awareness of the inextricable linkages between the environment and human health. As we become aware, we can begin to make the transformational changes in our consumption patterns and our lifestyles. We cannot go on with our current lifestyles. We all need to change - in our consumption, our production systems, and our lifestyles. That will be the way to move toward a low-carbon society, so that there will be less impact on human health, on diseases, on environments and on food safety.

Thank you very much for your attention.

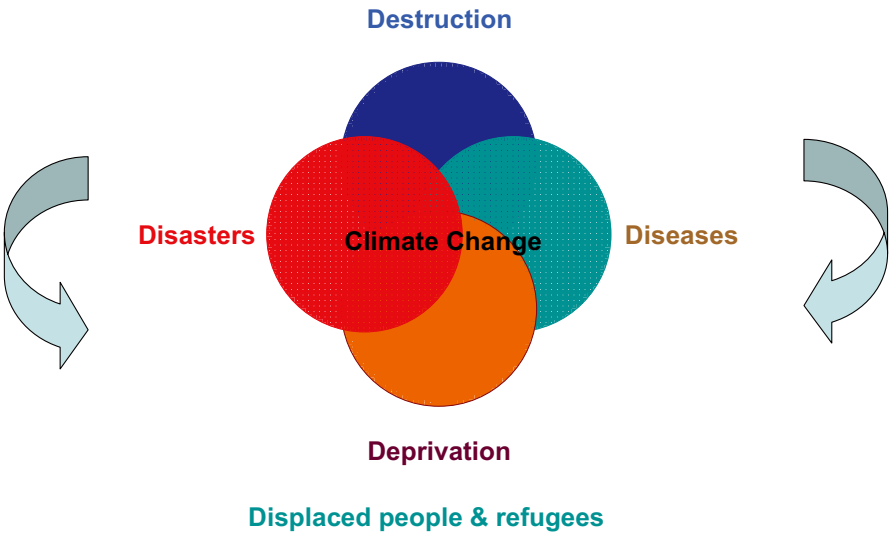
# CLIMATE CHANGE, ALIEN INVASIVE SPECIES: RISKS TO HUMAN HEALTH & WELL BEING

## Keynote Speech

**Nay Htun, PhD; FIC**
**Research Professor, Stony Brook University, State University of New York**

## IGES-WHO Symposium

**Climate Change, Environment & Health**
**Kobe, Japan, 2 March 2009**




Nay Htun, State University of New York, Stony Brook 2008

## IPCC 2007 SYNTHESIS REPORT SUMMARY FOR POLICY-MAKERS

- **HEALTH:**
  * **"Increasing burden from malnutrition, diarrhoeal, cardio-respiratory and infectious diseases"**
  * **"Increased morbidity and mortality from heat waves, floods, droughts"**
  * **"Changed distribution of some diseases"**
- **ECOSYSTEM:**
  * **Increasing species range shift**

## CLIMATE CHANGE – ENVIRONMENT- ECOSYSTEM INVASIVE SPECIES

- PERMAFROST, GLACIERS AND GREENLAND MELTING, EXPOSING SOIL (releasing methane)
- SEA LEVEL RISING, FLOODING COASTAL AREAS, AFFECTING HABITATS, HUMAN SETTLEMENTS, CORALS, MANGROVES
- CHANGING PRECIPITATION PATTERNS (changing ecosystems & habitats)
- HUMIDITY INCREASING (Water vapor is a greenhouse gas, but receives little attention)
- MORE FAVOURABLE FOR INSECT, BACTERIA, VIRUS, MOLD, FUNGUS
- INCREASING ALIEN INVASIVE SPECIES
- ATMOSPHERIC BROWN CLOUD HOVERING OVER CONTINENTS (global dimming, decreasing photosynthesis, fine particles increase health risks. ABC transport mechanism for invasive species)

**Permafrost regions occupy approximately 22.79 million km$^2$ - about 24% of the exposed land surface of the Northern Hemisphere.**

**By mid-21$^{st}$ century, a 20-35% decline is predicted.**

## CLIMATE CHANGE – DISEASES, HEALTH & WELL BEING

- Insufficient attention to the linkages and implications of global warming, sea level rise, melting of glacial and Arctic ice, Antarctica, flooding and droughts, and ecosystem changes
- These have dirct and indirect consequences on life support systems, human welfare, health and well being
- HUMAN SECURITY IS COMPROMISED

- **Climate change is changing habitats**
- **Increased movement of people and goods, ballast water discharge accelerating the introduction of alien invasive species**
- **Some alien species are beneficial**
- **But some have significant ecological, economic and health impacts.**
- **Much more attention and knowledge needed on microbial risks and threats**

**"In Senegal, *Typhaaustralis*, an invasive plant, has out-competed native plants in many parts of the delta.**

**It is obstructing access to water, encouraging the proliferation of weaverbirds which feed on grains, provide habitat for vectors of waterborne diseases.**

**An explosion of mosquito and snail populations has brought malaria and bilharzia to epidemic proportions in the Senegal Delta region."**

***Global Invasive Species Training Programme, Senegal, Dec 2007***

***Mikania micrantha,*** **mile-a-minute weed, native to Central and South America, was planted in India to camouflage airfields in WW2 .**

**It has since has become an important, invasive weed within the moist tropical zones of South and South East Asia in India, Bangladesh, Sri Lanka, Nepal, Thailand, the Philippines, Malaysia, Indonesia, Papua New Guinea and many of the Pacific islands.**

**It affects and smothers both agro-forestry and natural forest ecosystems, as well as many crops and plantation production systems; tea plantations particularly severely affected.**

➢**Zebra mussels, native to Black Sea clogging up North America's Great Lakes and choking water intake pipes, ship rudders.**

➢**Costing US and Canada US$ 140 million per year.**

❖**Longhorn Beetle in New York, New Jersey, Illinois costs US$ 175 million per year.**

✓**Invasive species in US estimated to cost US $ 140 billion per year.**

## DISEASES & FOOD SECURITY

SOME EXAMPLES:

- **COLONY COLLAPSE DISORDER** among honey bees affecting US$ 14 billion per year of US agriculture, attributed to pesticides, mites, fungus, virus and environmental changes.
- **PACIFIC SALMON** heavy losses and extinction in Western Canada and US, caused by sea lice breeding on farmed salmon.
- **FROG POPULATIONS** severely affected , extinct, due to increase of chytrid disease caused by fungus ***Batrachochytrium dendrobatidis***

## SOME LINKED & CONVERGING IMPLICATIONS FOR HEALTH & WELL-BEING

- FOOD SECURITY
- WATER STRESS
- WATER QUALITY
- HEAT STRESS
- ALLERGY
- RESPIRATORY, INFECTIOUS & NEW DISEASES
- ZOONOSES
- DISASTERS

## DIRECT & INDIRECT EFFECTS OF CLIMATE AND INFECTIOUS DISEASES

### DIRECT

- Pathogen replication rate (*vector borne-diseases of warm-blooded animals, due to exposure of pathogens to ambient weather conditions for part of their life cycle*)
- Pathogen dissemination (*when floods contaminate drinking water reservoirs resulting in diarrheal diseases; soil born pathogens distributed by atmospheric aerosols and fine particles*)
- Movement & replication of vectors and abundance of animal hosts (*migratory birds that carry influenza; transportation of goods and passengers*)

### INDIRECT

- Effects on ecosystems (*increasing habitats and breeding sites*), and human behavior (*drought prompt people to store water in open containers)*

## EXAMPLES OF DISEASES INFLUENCED BY ENVIRONMENTAL CONDITIONS

**(Source: US. National Research Council, 2001)**

| Environmental Conditions | Diseases favored | Evidence |
|---|---|---|
| Warm | Malaria, Dengue | Primarily tropical distribution, seasonal transmission pattern |
| Cold | Influenza | Seasonal transmission pattern |
| Dry | Meningococcal meningitis, coccidioidomycosis | Associated with arid conditions, dust storms |
| Wet | Cryptosporidiosis, Rift Valley fever | Associated with flooding |

## INFECTIOUS DISEASES

- G8 SUMMIT, ST. PETERSBURG 2006

" A vigorous response to the threat of infectious diseases, the leading cause of deaths world wide, is essential to global development and to the well-being of the world's population. major diseases such as hiv/aids, tuberculosis, malaria and measles continue to exact a heavy toll on economies and societies aroud the world, particularly in developing countries, impeding achievements of the millennium development goals"

"Clean water, sanitation, emergence of highly pathogenic avian influenza with the accompanying possibility of human pandemic, demands our immediate attention"

## UK FORESIGHT REPORT (2006)

*Infectious diseases: preparing for the future*

< www.foresight.gov.uk >

"Climate change could favor increases in vector-borne infectious diseases affecting human beings, livestock and crops"

## WHO REPORT (2006)

*Preventing Disease through Healthy Environments—Towards an estimate of the environmental burden of disease*

- "24% of global disease burdens and 23% of all deaths can be attributed to environmental factors. Of the 102 major diseases…environmental risk factors contributed to disease burdens in 85 categories"
- "Among children 0–14 yrs of age, the proportion of deaths attributed to the environment was as high as 36%"

## MALARIA

- Yearly one million deaths and 500 million severely ill
- Warming effects and extreme weather events would precipitate large outbreaks
- Increased range of mosquitoes which spread malaria re-emerging in NE Asia

## WEST NILE

- Affects humans, horses and over 130 species of birds
- Warm weather and droughts play role in amplifying virus

## DENGUE

Current outbreak in Asia-Pacific attributed to climate change and global warming

## ASTHMA

- In US, prevalence has quadrupled since 1980
- New drivers include increased levels of CO2, which increase plant pollens, soil fungi, fine particles, micro-organisms

## MITIGATION

- **REDUCING ECOLOGICAL AND CARBON FOOTPRINT**
- **Increasing conservation of resources and energy; improving efficiencies**
- **Carbon capture and storage**
- **Reforestation**
- **Bioenergy**
- **Renewables**

## PROTECTING AND IMPROVING HUMAN HEALTH & WELL BEING

- **Disease surveillance & monitoring**
- **Improved diagnostics for new and emerging diseases**
- **Speedy sharing and reporting of disease outbreak**
- **Public health education**

## IPCC 2007 SYNTHESIS REPORT SUMMARY FOR POLICY MAKERS

- **ADAPTATION OPTION/STRATEGY**

**"Human health action plans, emergency medical services, improved climate sensitive surveillance and control"**

- **UNDERLYING POLICY FRAMEWORK**

**"Public health policies that recognize climate risk, strengthened health service, regional and international cooperation"**

## "MOVE TOWARDS A LOW CARBON SOCIETY"

G8 Toyako Summit 2008

**G8 Low Carbon Society Research Network -- Secretariat is IGES**

**Close collaboration between IGES and WHO Centre for Health Development, Kobe**

**Very important for mitigating and adapting to climate change and health outcomes**

***PRIVATE & PUBLIC SECTORS AS WELL AS INDIVDUALLY -- ALL HAVE ROLES***

# Keynote Speech 2: Heat disorders in Japan

*Dr Masaji Ono*
*National Institute for Environmental Studies*

Thank you very much for giving me this opportunity to deliver the keynote speech, for which I am grateful to Hyogo Prefecture, IGES Kansai Center, and WHO Kobe Centre.

Now, Professor Nay Thun has given us a very extensive view of the health issues related to global warming, including infectious disease issues. I am going to focus on heatstroke in Japan. I am sure that you heard a lot about this during the summer of 2007. In 2007, we had a very hot summer, so I would like to look are the major governmental approaches, both locally and centrally, to the issue of heatstroke.

Our research project is financed by the "Global Environmental Research Fund", organized by the Ministry of Environment.

First of all, let me briefly explain about global warming. The Ministry of the Environment prepared a brochure for the public based on the Fourth Report of the IPCC, and the website has detailed information, so just let me highlight some of the points. The IPCC, as you know, operates on a continuous basis, and issues a report every four years. The latest report was issued in 2007, saying that there is "no doubt" about global warming.

Therefore, everybody agrees that global warming has already started. And then there are a couple of phenomena that we have to pay attention to, as evidence of global warming. Global warming is an upward curve getting steeper in recent years. For the past 150 years, on average, the temperature has risen by 0.04ºC every 10 years, over the past 100 years by 0.74ºC, by 0.0128 in the last 50 years and over the past 25 years, 0.117ºC. With this, we have the problems of the sea level rise and snow melt. The various impacts have been observed in different parts of the world. There was Hurricane Katrina in the States, and just recently in Australia there were big bushfires because of a series of droughts. In 2003 in Europe, a heat wave claimed several tens of thousands of lives. So these could be omens of future global warming.

There are many controversies regarding global warming – some people say that it could be the result of natural changes and the long history of the globe. This shows the actual change of the temperature in each continent. This phenomenon cannot be explained only by natural factors, it is based on the both natural and anthropogenic factors, especially $CO_2$ emissions. If you incorporate this information from every region of the world, then you can explain what is going on with global warming. Clearly, human activities have a lot to do with it. The prediction is for a 1.8–4ºC increase, and the variation will depend on how to deal with our lifestyles, and how we carry out economic activities. Will we try to be a little bit more patient, more friendly to the Earth? If we only seek more convenience, and continue the current status of living, then it will make a big impact on life in the future. Also, this is only the average temperature of the globe. Depending on the region, there might be some areas which are more susceptible to warming, like the Antarctic. It is very difficult to foresee the impact in every area, and so in some places you will see the impact immediately, in others there will be some effect only after the average temperature rises by 2ºC. But in general, along with the increase of the global warming, we would foresee many impacts in different regions. Let me talk about heatstroke then.

This is the heat wave in Europe in 2003. This blue line represents the daily mean temperature in August averaged 1999–2002, but from the beginning of August to mid-August 2003, daily mean temperature (red line) rose to 10ºC above the 1999-2002 average. The heat wave lasted for 10 days. Along with this increase, there is higher mortality. The blue bar and red bar show the average mortality for 1999-2002 and 2003, respectively. In 2003, when the temperature went beyond 30ºC, mortality increased to as much as 10 times the average. This is the case of Paris, but across France as a whole, more than 15,000 people died than the normal year, and 35,000 to 40,000 more in Europe as a whole. Aged people were more affected. In the younger generation, excess deaths were 20-30% higher than normal years, but among aged people over 75, excess deaths were 75–100% higher.

This is the case of Europe, but in Japan, fortunately, we have not experienced such an extreme event. In 2007, we experienced a very hot summer, but it was only 2-3ºC hotter than a normal year. In the case of France and Europe, the temperature was 10ºC higher than normal. This is the equivalent of Sapporo and Sendai seeing temperatures as high as Osaka and Kobe, and for more than 10 days. A heat wave like this would be the worst scenario for heatstroke in Japan.

The National Institute for Environmental Studies is conducting research on heatstroke and has obtained the numbers of heatstroke cases transported by ambulance in the largest cities in Japan, from Sapporo in Hokkaido to Fukuoka in Kyushu, since 2000. This graph shows the number of heatstroke cases by city and year. Patient numbers show a consistent increase with small exceptions, for example in 2003 when we had a cool summer.

This graph shows the relationship between temperature and the number of heatstroke patients. When the temperature goes beyond 30ºC, we see an onset of problems. So for Tokyo and Osaka, July and August are the most dangerous seasons. Of course, this may vary too. For example, in 2007, July was very cool, so we hardly see any patients, but in August, we had very severe heat and so all of a sudden, there was a rapid increase in the number of patients. This is 2008, a fairly average year. We see many patients in both July and August.

Looking at 2007, two-thirds of the patients are male. Concerning the age, in the case of males patients came from almost all age groups, especially adults: 19-39, 40-64 and 65 years or older. However, in the case of the women, more than half the patients are over 65 years old. This is because young men are doing hard work outdoors.

In a little bit more detail, the blue and red bars are the number of patients by age group for males and females, respectively. In the case of males, there are three peaks: in the aged around the 60s, in young men at the prime of life, and at the age of junior and high school. In women, we only find a peak for the aged – there is no peak for younger women. Among aged people, we see the same situation for both male and female; as people get older, there is a higher risk. Daytime is the riskiest time, but even at night there is a chance of onset of heatstroke.

One more thing is the severity. When the patients are young, the symptoms are rather mild. As they get older, the symptoms are more serious, due to physical weakness. Another reason is that ageing makes people less sensitive to temperature and heat. Therefore, they have to pay attention, especially if they live alone. Further, if they feel uncomfortable at night, they may only be found needing help the following morning. In cases of heatstroke found at a later stage, the symptoms can be more serious. Aged patients found in the early morning show worse symptoms than those patients found in the daytime or at night.

This is the place of events occurring. High school kids are suffering during exercise, and the elderly are affected at home, and working age people are suffering at the worksite, so they all reflect their life pattern.

This graph shows the relationship between daily maximum temperature and the number of patients. We can find a strong correlation: when the temperature exceeds 30ºC the patients increase, but there are some exceptions with many cases on a day of relatively low temperature and few cases on a hot day.

This is where we come to another heat index called Wet-Bulb Globe Temperature (WBGT). This is an index for heatstroke and includes humidity and solar radiation as factors. This is the example of Tokyo in August 2007. There are three days above 35ºC. Within those days, on one day the number of patients exceeds 100, but on other days it is half. The temperature is about the same on all those days, but the relative humidity differs a lot. The day when more than 100 patients were reported shows higher humidity than the other days.

So with the WBGT index, we can say that one of the three days is the most uncomfortable, and that is related to the higher onset of heatstroke. Japan Sports Association (JASA) made guidelines for school exercise using WBGT. The guidelines, JASA recommends avoiding heatstroke during sport as follows: if the WBGT exceeds more than 31, exercise should be forbidden, and if it is more than 28, we have to be cautious during exercise, and so on. At schools, this is helping heatstroke prevention.

We also have to watch out for the elderly. This is the temperature dependent incidence rate of heatstroke by age. The incidence rate is standardized (the incidence rate at 30-34ºC = 1.0). At an extremely hot day, for example at 37ºC, incidence rate of the younger generation is higher, but the increase rate is 5 or 6-fold. But in the case of the elderly, the increase rate is more than 10-fold. So the elderly are more sensitive to rising heat.

Those of working age can adjust themselves better. For instance, if it is too hot, they can postpone work they had planned or cancel their golf round. But on the other hand, most of the elderly are not working so even if the weather is too hot, they do not change their lifestyle. And if they cannot adjust their room temperature, then the temperature directly impacts them.

This is the penetration rate of air conditioners in Japan. As shown here, once the apparent temperature increases, the rate of usage increases. By region, more than 80% of households in the western and southern part of Japan (regions west or southwest from Kanto, the Tokyo area) are equipped with airconditioning. However, in the north the penetration rate is low, for example 50% in Tohoku and less than 20% in Hokkaido. So, if heat wave like Europe occurs in Hokkaido or Tohoku, people cannot control their room temperature because they don't have the air conditioners. In New York last year, a similar situation occurred. Public spaces were provided and people were forced to flee to those areas. So if such a heat wave were to attack Japan in the future, we would have to consider such public support.

This shows the number of heatstroke deaths. Viewing the number of the deaths by age group, we can find several peaks. For male, there are three peaks for the young, the elderly and the middle-aged. In the case of women, there is one peak for the elderly. The peak for middle-aged men represents outdoor workers. And even though heatstroke is decreasing among children, there are still some cases where they get left in the car on a hot day. So we have to call attention to these issues.

This is an extreme example: Okinawa Prefecture. Here, 80% of the patients are due to the outside work, much more than in other major cities in Japan. From June to August, the temperature exceeds 30ºC every day. In the other cities, if the temperature exceeds 30ºC,

then they can postpone outdoor work. However in Okinawa, they cannot do that. And therefore, many workers are suffering on construction sites or other outdoor work sites. This is the number of the patients in Okinawa by age. For males, most of the cases occur during work among the middle-aged, and during exercise among schoolchildren. These cannot be controlled by workers and children themselves, so social intervention has to be considered.

Now, this is the number of the hot days in Tokyo in 2003 and 2007, showing a big increase and therefore, more patients every day. With global warming, the curve would continue to rise, and the number of the patients will increase.

Lastly, I would like to talk about the current situation of countermeasures in Japan. The Ministry of Environment has looked at heat disorder prevention and created a manual that has been distributed to the health offices and municipalities, so that they can distribute to the public. And you can access their website as well. Regarding research, various studies have been conducted by the Ministry of Environment and local governments, including the material that I showed today.

Our institute is collaborating with activities to provide a kind of weather forecast with a heat index estimate on a website, enabling warnings to be given, and you can access this even from the mobile telephone. But for elderly people, it is difficult to utilize this kind of service, so different measures have to be considered.

There are various websites on heatstroke, and local governments are conducting various programs. Kusatsu City in Shiga Prefecture gives heatstroke warnings and has established regulations. Once the day exceeds a certain temperature, the mayor gives a warning, and various measures are suggested. The mayor decided to establish the regulations because more than 10 high school students were affected by the heatstroke at a sports event. Other examples are Kumagaya City, Saitama and Tajimi City, Gifu; both cities are famous for their heat, and they give warnings over the radio or via other services. Saga Prefecture has a website as well as email services. They are also trying to come up with some guidelines for the private sector, schools and industries. For major companies, they are establishing a system of occupational physicians, and work places (construction sites and factories) are admitting these kinds of services. I would like to suggest for local communities and especially for elderly that information about heat be provided through daycare services or the support system of the elderly, and also by utilizing the home visit or neighborhood associations. It is necessary to support each other and pay attention to issues related to the heat among the elderly.

# Heat disorders in Japan

**Masaji Ono**
National Institute for Environmental Studies, Japan

**IGES-WHO International Symposium on Climate Change and Health**
**02 March 2009, Kobe, Japan**


Global Environmental Research Fund, Ministry of Environment

Comprehensive assessment of climate change impacts to determine the dangerous level of global warming and to determine an appropriate stabilization target for atmospheric GHG concentration（FY2005-2009）

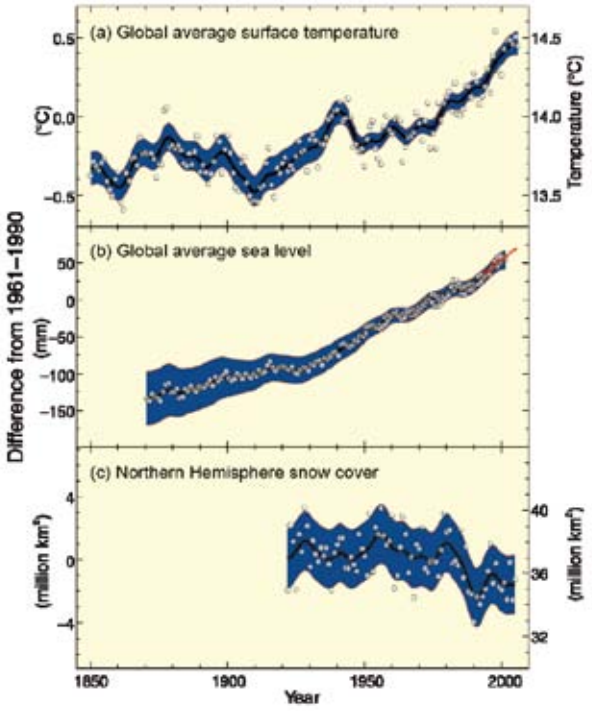
A study to improve ability to predict the future effects of climate change and economical evaluation from a health perspective

## Changes in temperature, sea level and Northern Hemisphere snow cover

Observed changes in
(a) global average surface temperature;
(b) global average sea level from tide gauge (blue) and satellite (red) data and
(c) Northern Hemisphere snow cover for March-April.

All differences are relative to corresponding averages for the period 1961-1990.

Smoothed curves represent decadal averaged values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties.



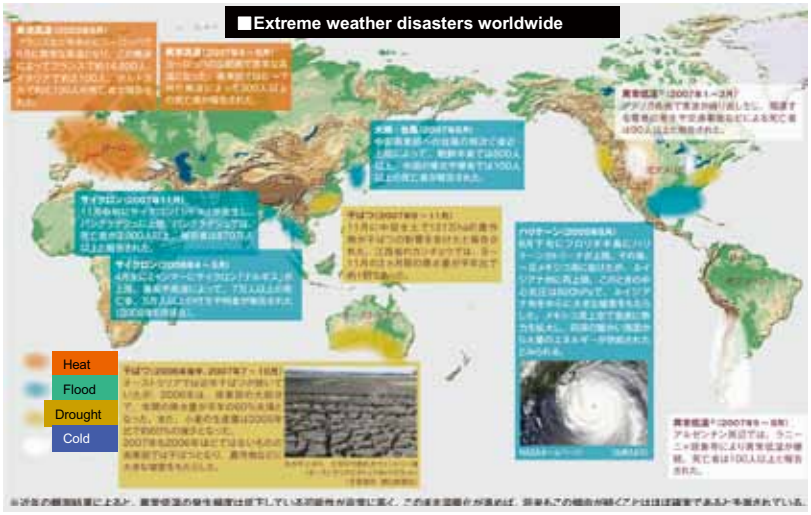

# More frequent extreme weather is affecting societies

### Extreme weather events around the world

In every corner of the globe, extreme weather events such as hurricanes, cyclones and typhoons, droughts and heat waves are on the increase. Hurricane Katrina in 2005 killed over 1800 people, and drove 1.2 million from their homes. The European heat wave of 2003 killed over 20 000. In Australia, the drought has lasted more than six years with regional variations over time.

Cyclone Nargis caused massive destruction in April 2008. In Myanmar, over 70 000 lost their lives, and over 50 000 are still reported as missing, a total of 120-130 000 (as of June 2008).

We cannot say with certainty that global warming is contributing to these disasters, but many have indicated the potential for climate change to make them more frequent.

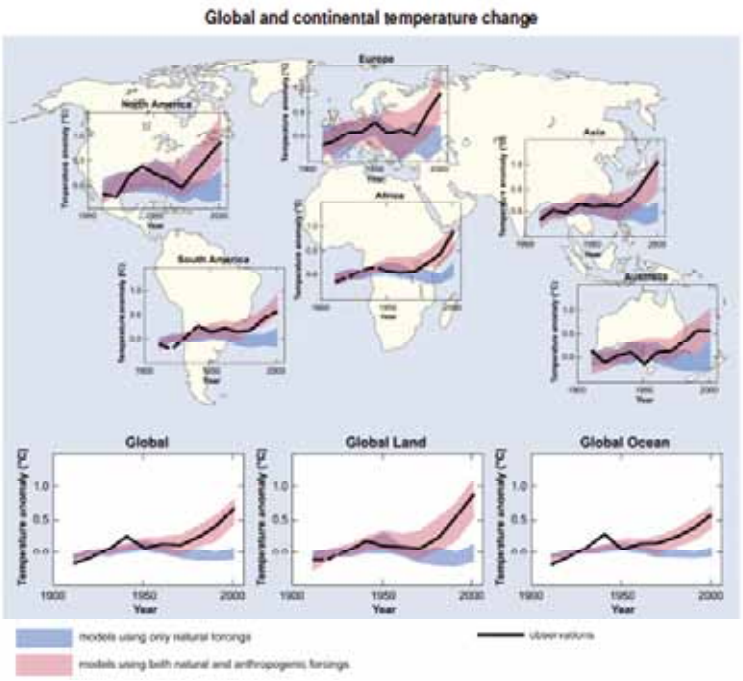


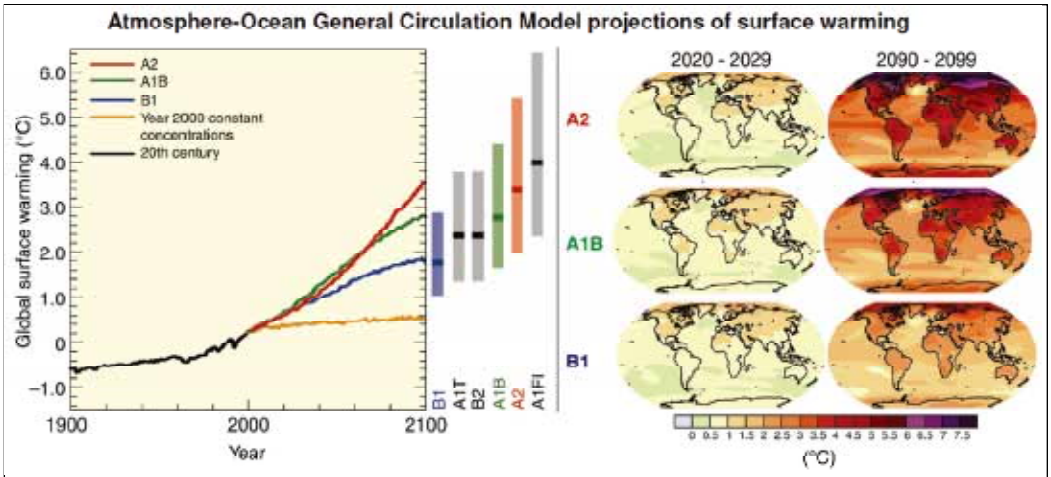
Comparison of observed continental- and global-scale changes in surface temperature with results simulated by climate models using either natural or both natural and anthropogenic forcings.

Decadal averages of observations are shown for the period 1906-2005 (black line) plotted against the centre of the decade and relative to the corresponding average for the period 1901-1950. Lines are dashed where spatial coverage is less than 50%.

Blue shaded bands show the 5-95% range for 19 simulations from 5 climate models using only the natural forcings due to solar activity and volcanoes.

Red shaded bands show the 5-95% range for 58 simulations from 14 climate models using both natural and anthropogenic forcings.

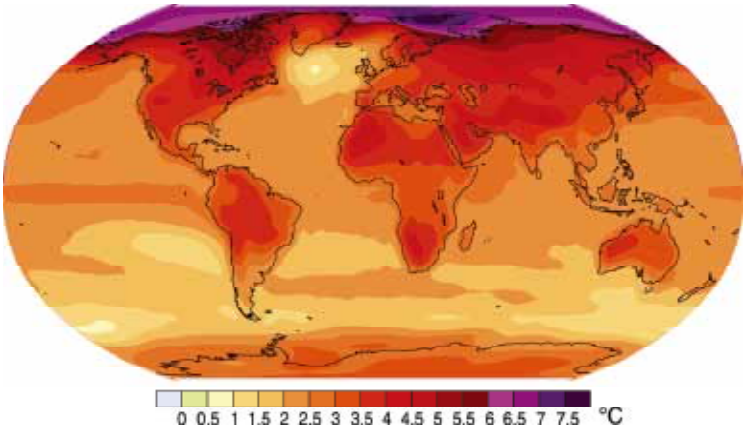



**Left panel:** Solid lines are multi-model global averages of surface warming (relative to 1980-1999) for the SRES scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. The orange line is for the experiment where concentrations were held constant at year 2000 values. The bars in the middle of the figure indicate the best estimate (solid line within each bar) and the *likely* range assessed for the six SRES marker scenarios at 2090-2999 relative to 1980-1999. The assessment of the best estimate and *likely* ranges in the bars includes the Atmosphere-Ocean General Circulation Models (AOGCMs) in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints.

**Right panels:** Projected surface temperature changes for the early and late 21st century relative to the period 1980-1999. The panels show the multi- AOGCM average projections for the A2 (top), A1B (middle) and B1 (bottom) SRES scenarios averaged over decades 2020-2029 (left) and 2090-2099 (right).

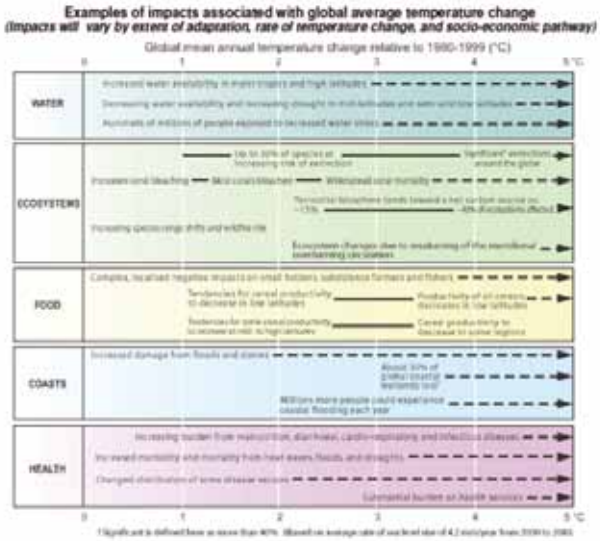
# Global average temperature increase 1.8～4.0℃ in 2100



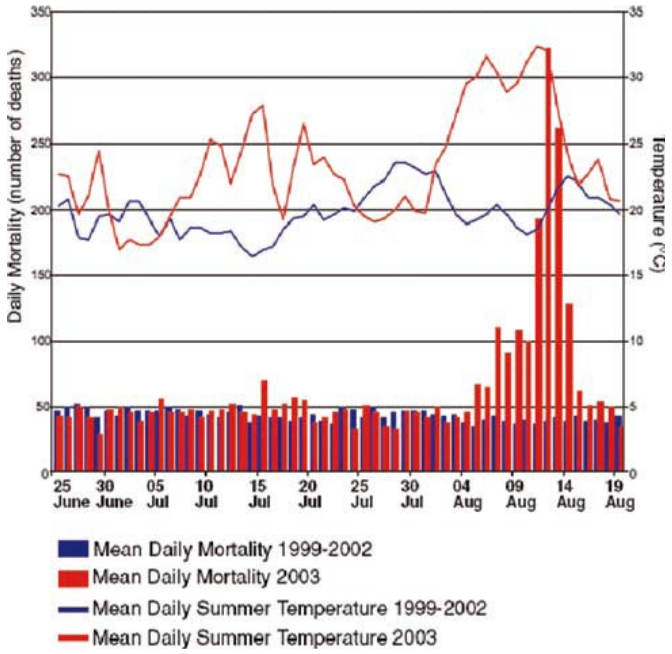

Projected surface temperature changes for the late 21st century (2090-2099). The map shows the multi-AOGCM average projection for the A1B SRES scenario. All temperatures are relative to the period 1980-1999.

**Examples of impacts associated with global average temperature change.**

Illustrative examples of global impacts projected for climate changes (and sea level and atmospheric CO2 where relevant) associated with different amounts of increase in global average surface temperature in the 21st century.
The black lines link impacts; broken-line arrows indicate impacts continuing with increasing temperature. Entries are placed so that the left hand side of text indicates the approximate level of warming that is associated with the onset of a given impact. Quantitative entries for water scarcity and flooding represent the additional impacts of climate change relative to the conditions projected across the range of SRES scenarios A1FI, A2, B1 and B2. Adaptation to climate change is not included in these estimations. Confidence levels for all statements are *high*.



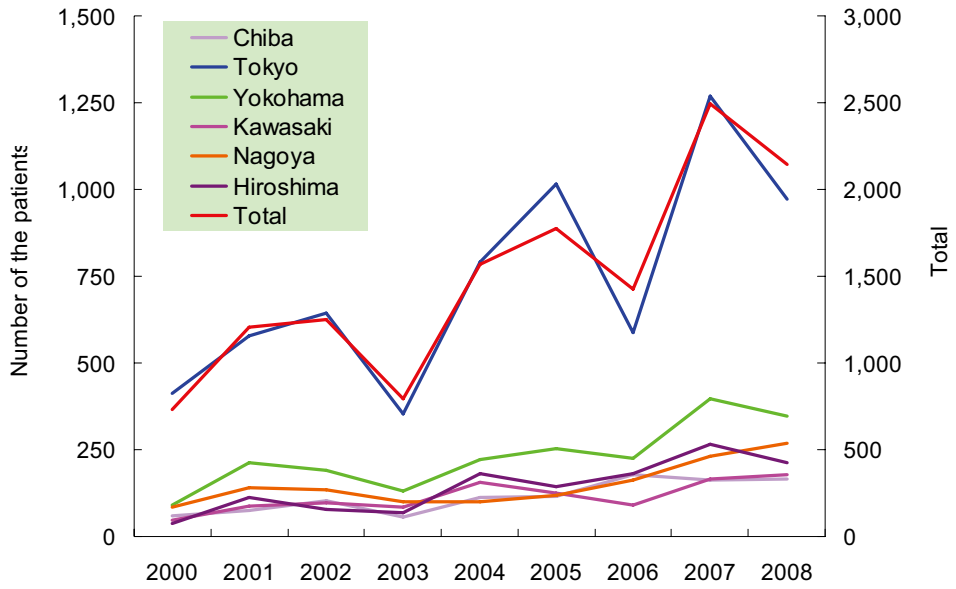
# Mortality in heat wave 2003, Europe



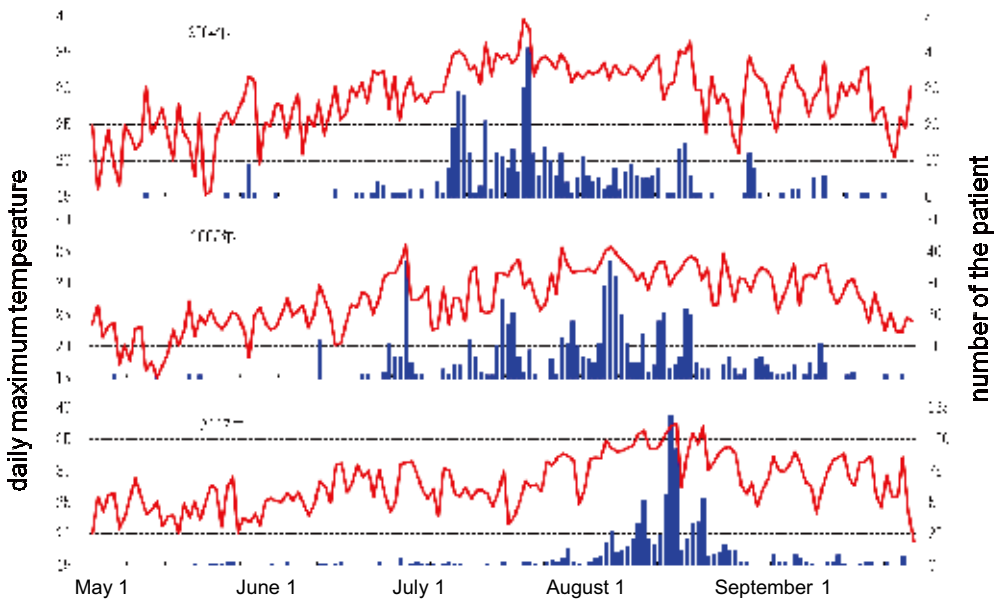

## Number of the heatstroke patients - transported by ambulance -

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|
| Sapporo | | | | | | 29 | 68 | 95 | 39 |
| Sendai | | | 66 | 18 | 54 | 54 | 37 | 115 | 67 |
| Saitama | | | | | | 176 | 164 | 350 | 219 |
| Chiba * | 59 | 74 | 104 | 56 | 114 | 115 | 178 | 164 | 167 |
| Tokyo (1) * | 269 | 393 | 416 | 207 | 521 | 642 | 363 | 879 | 648 |
| Tokyo (2) * | 143 | 186 | 227 | 147 | 271 | 373 | 225 | 389 | 324 |
| Yokohama * | 92 | 212 | 190 | 131 | 221 | 253 | 226 | 398 | 346 |
| Kawasaki * | 47 | 88 | 98 | 85 | 157 | 126 | 90 | 166 | 179 |
| Niigata | | | | | | | | 119 | 95 |
| Shizuoka | | | | | | | | 158 | 81 |
| Hamamatsu | | | | | | | | 115 | 134 |
| Nagoya * | 85 | 140 | 134 | 100 | 101 | 119 | 163 | 231 | 268 |
| Kyoto | | | | | 199 | 252 | 211 | 407 | 379 |
| Osaka | | | 184 | 126 | 201 | 172 | 240 | 339 | 413 |
| Sakai・Takaishi | | | | | | 79 | 96 | 173 | 154 |
| Kobe | | | | 114 | 134 | 140 | 176 | 262 | 253 |
| Hiroshima * | 39 | 112 | 79 | 69 | 182 | 145 | 180 | 267 | 213 |
| Kitakyushu | | | | 104 | 178 | 124 | 200 | 205 | 225 |
| Fukuoka | | | | | | 136 | 280 | 270 | 253 |
| Okinawa | | | | | | | | 576 | 444 |
| Total | 734 | 1,205 | 1,498 | 1,157 | 2,333 | 2,935 | 2,897 | 5,678 | 4,457 |
| Sub total | 734 | 1,205 | 1,248 | 795 | 1,567 | 1,773 | 1,425 | 2,494 | 2,145 |

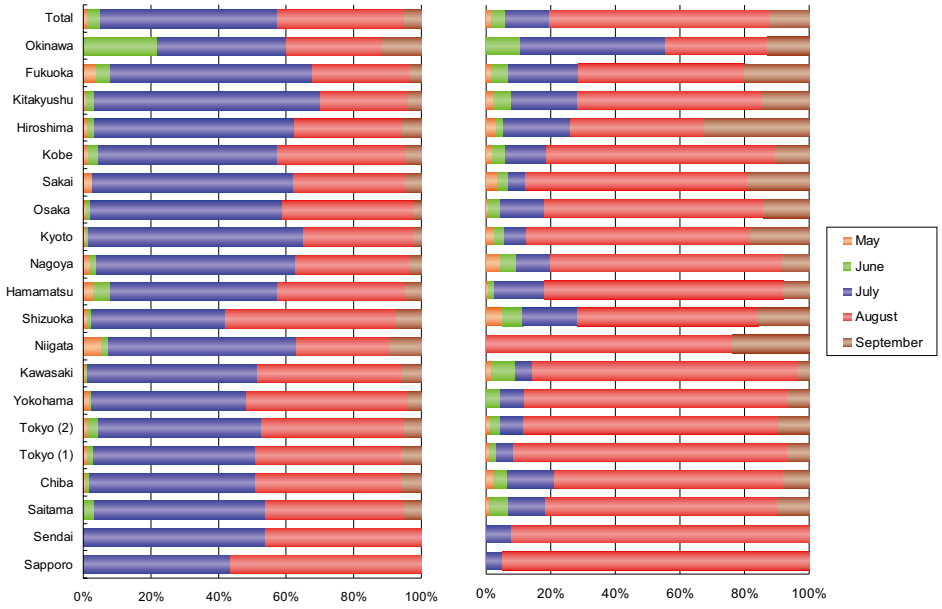
* Cities available 2000-2008




Time trend of the number of heatstroke patients (person)



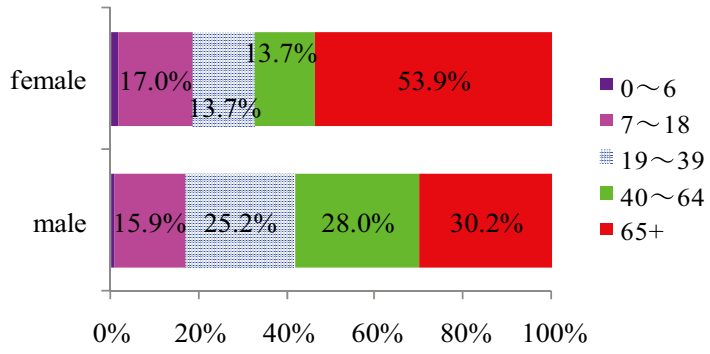

Time series of the number of patients in Tokyo

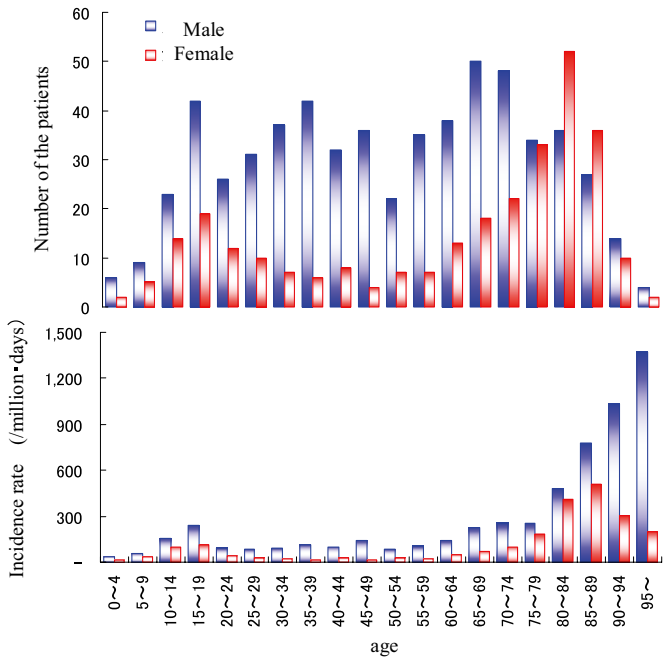



# Number of patients by month

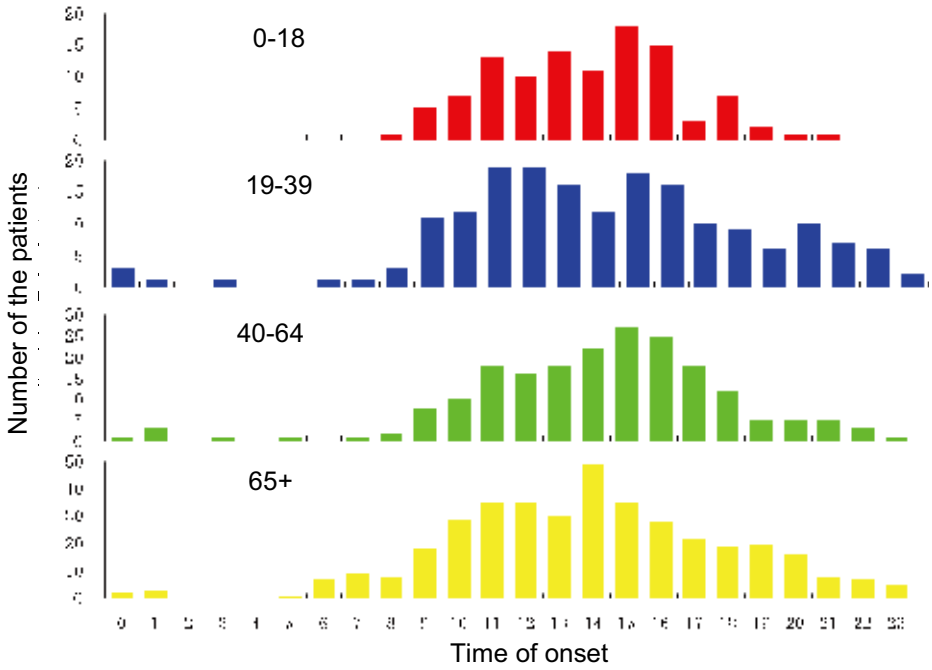
## Number of patients by sex and age (2007)

| age | male | female | total |
|---|---|---|---|
| 0～6 | 29 | 25 | 54 |
| 7～18 | 560 | 268 | 828 |
| 19～39 | 889 | 216 | 1,105 |
| 40～64 | 987 | 215 | 1,202 |
| 65+ | 1,065 | 848 | 1,913 |
| Total | 3,530 | 1,572 | 5,102 |

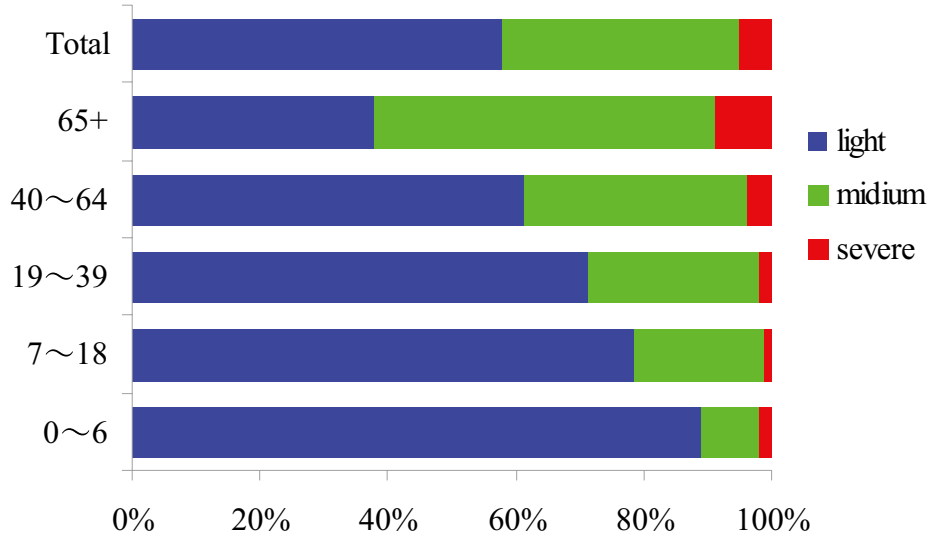




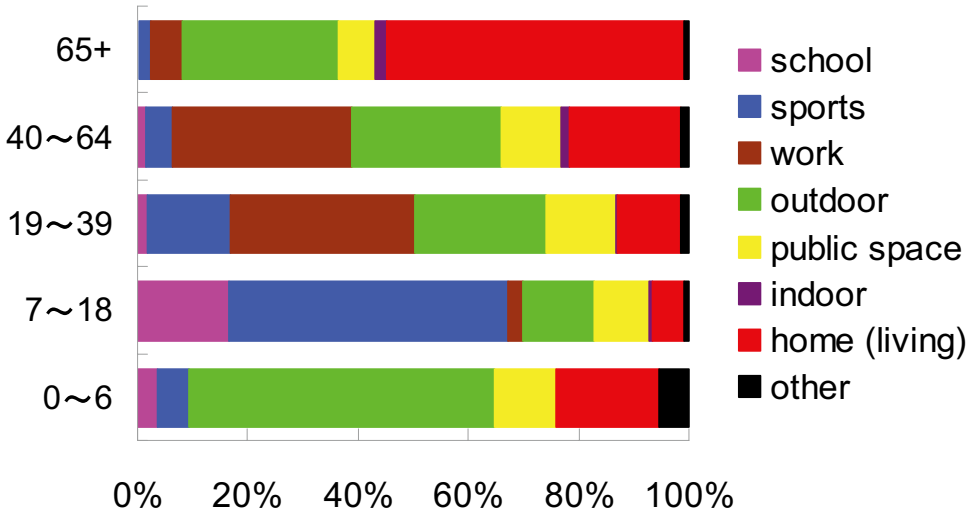

Number of heatstroke patients
(upper: number, lower: incidence rate)




Number of patients by time of onset (Tokyo, 2007)

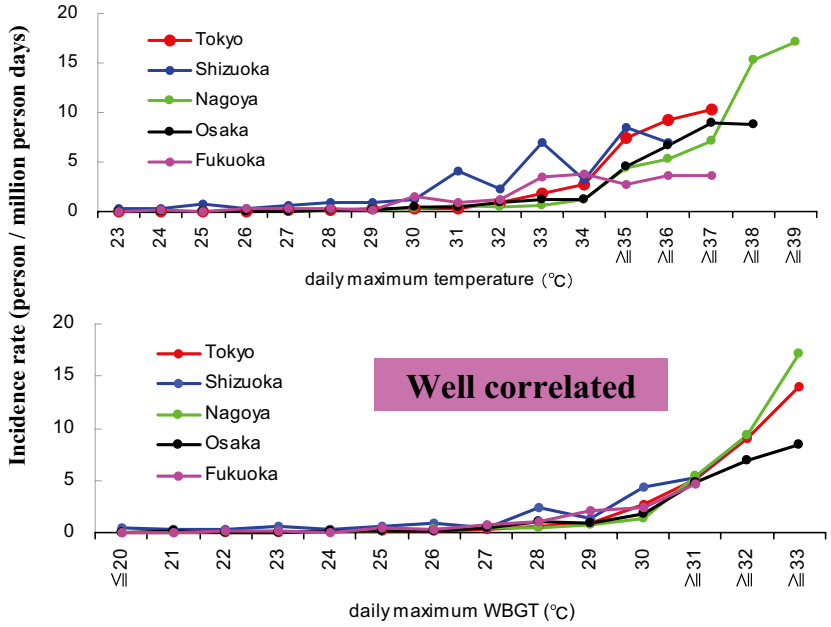



Proportion of patients by sex and severity class（2007）

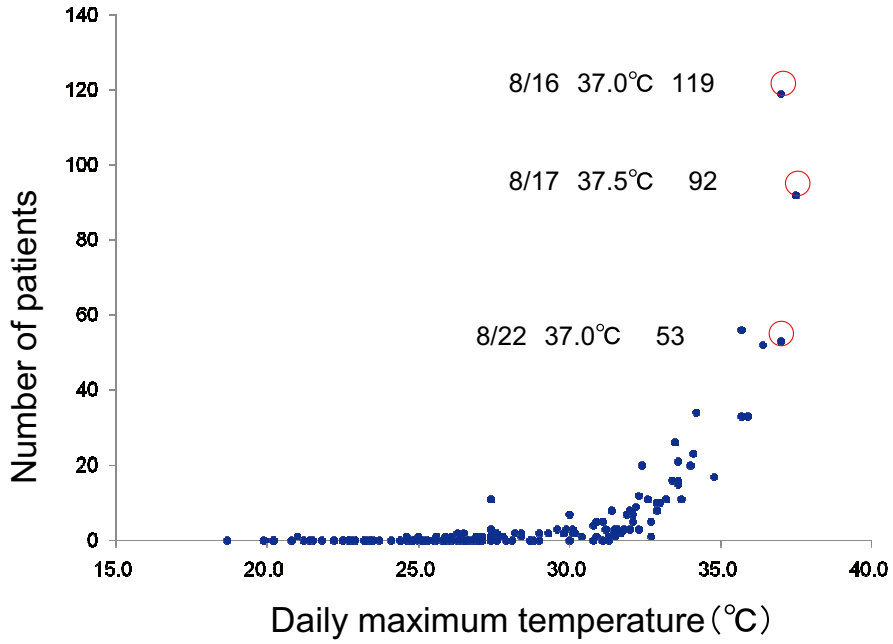


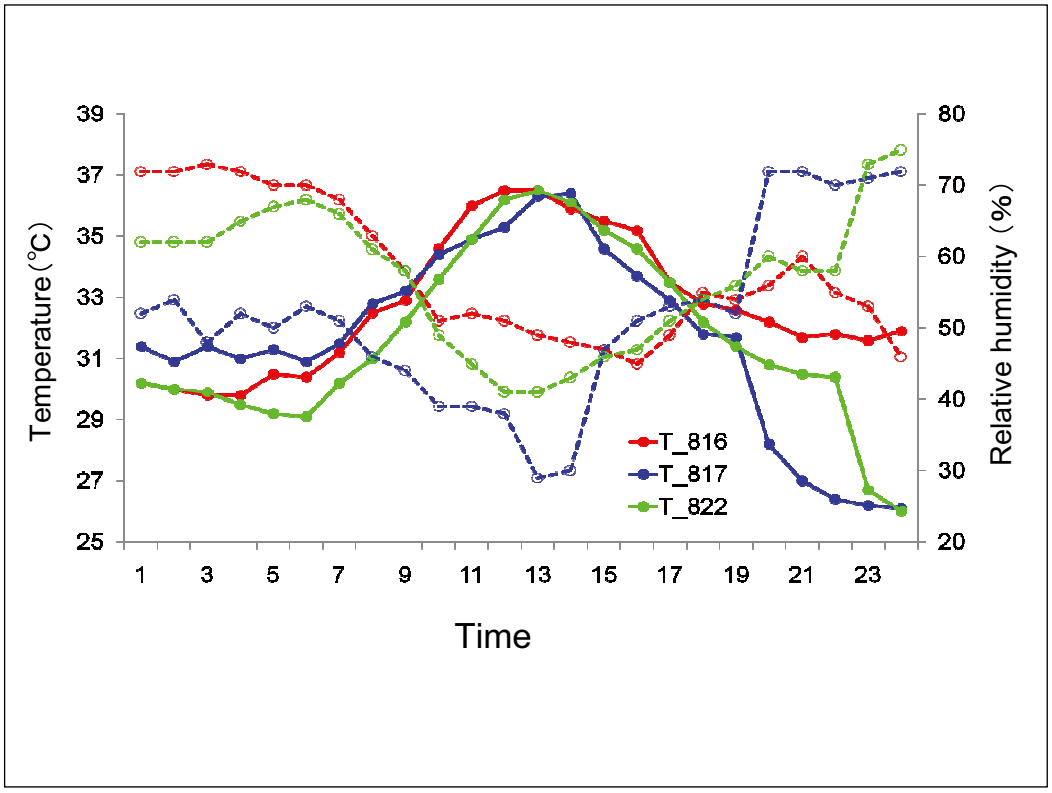

Proportion of the place of the events occurred by age
- 2007, all areas -

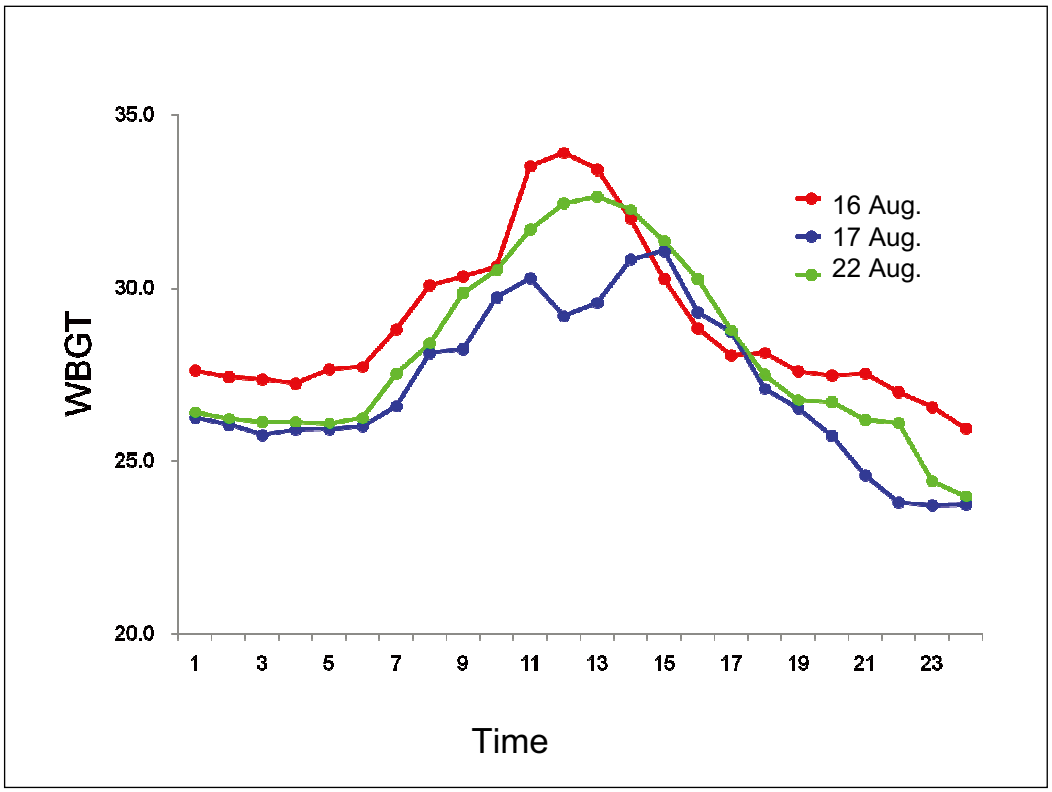
## Incidence rate versus daily maximum temperature by city




## Number of the patients versus daily maximum temperature




Temperature (℃)
Relative humidity (%)
Time
T_816
T_817
T_822
39
37
35
33
31
29
27
25
80
70
60
50
40
30
20
1
3
5
7
9
11
13
15
17
19
21
23


WBGT
Time
16 Aug.
17 Aug.
22 Aug.
35.0
30.0
25.0
20.0
1
3
5
7
9
11
13
15
17
19
21
23

WBGT = 0.7 × wet-bulb temperature

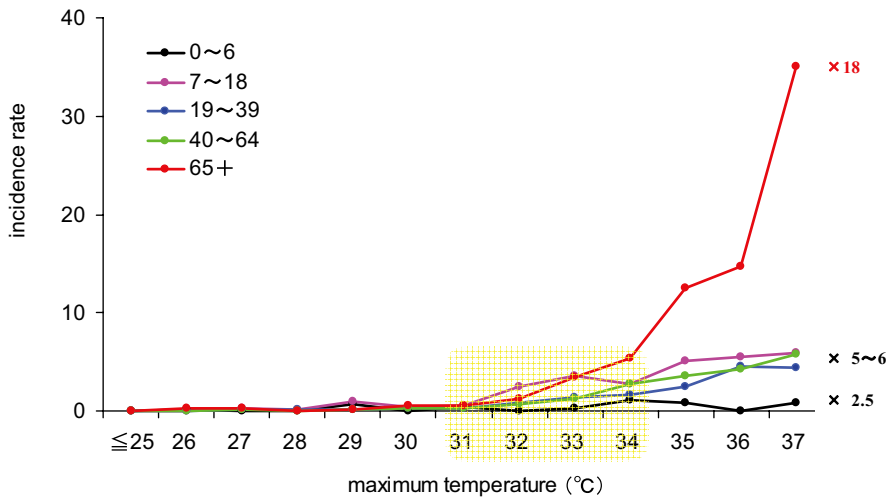
+ 0.2 × globe temperature

+ 0.1 × dry-bulb temperature


## Guidelines for exercise

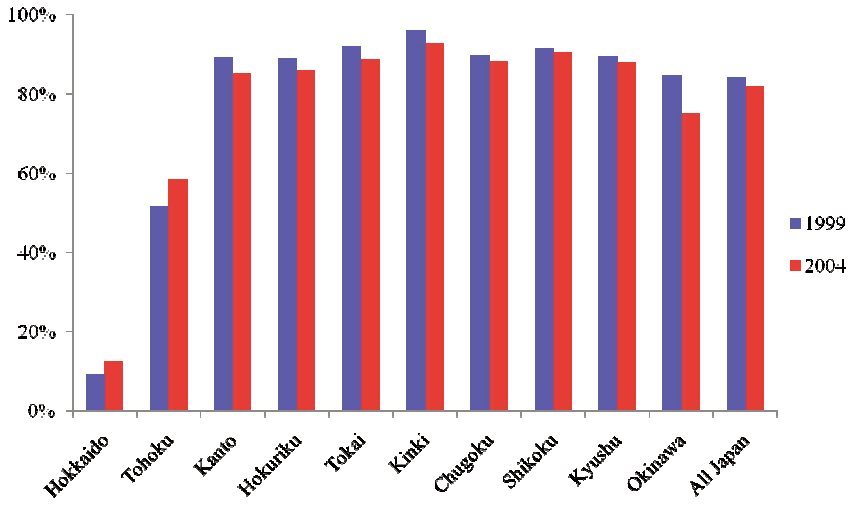
| WBGT | dry-bulb temp. | Guideline |
|---|---|---|
| ≧31 | ≧35 | Exercise prohibited |
| ≧28 | ≧31 | Severe warnig |
| ≧25 | ≧28 | Warning |
| ≧21 | ≧24 | Caution |
| <21 | <24 | Almost safe |

(Japan Sports Association)

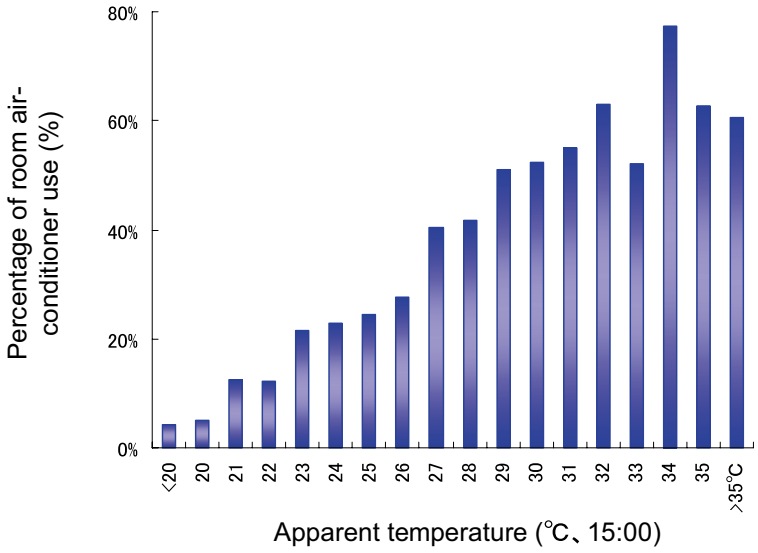


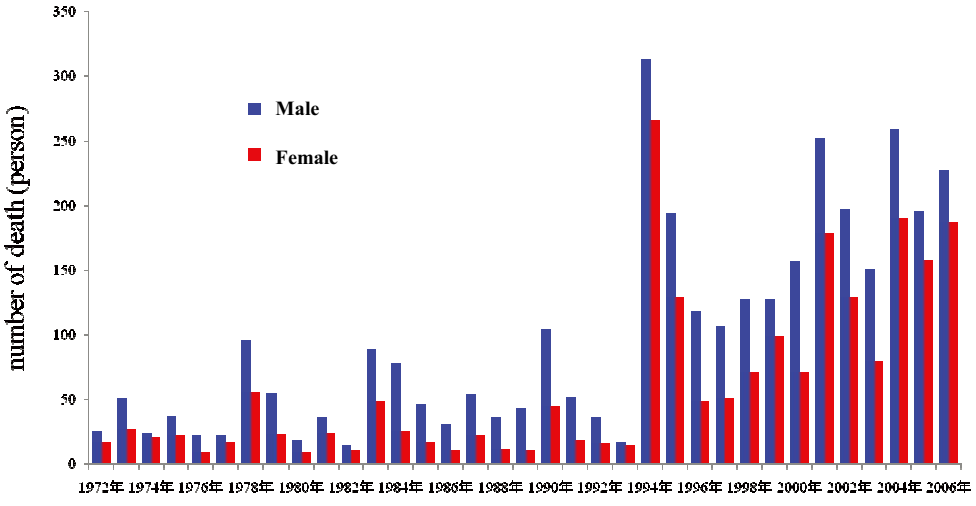

**Incidence rate versus daily maximum temperature by age group (2007, Tokyo)**

## Percentage of households with air conditioning by area

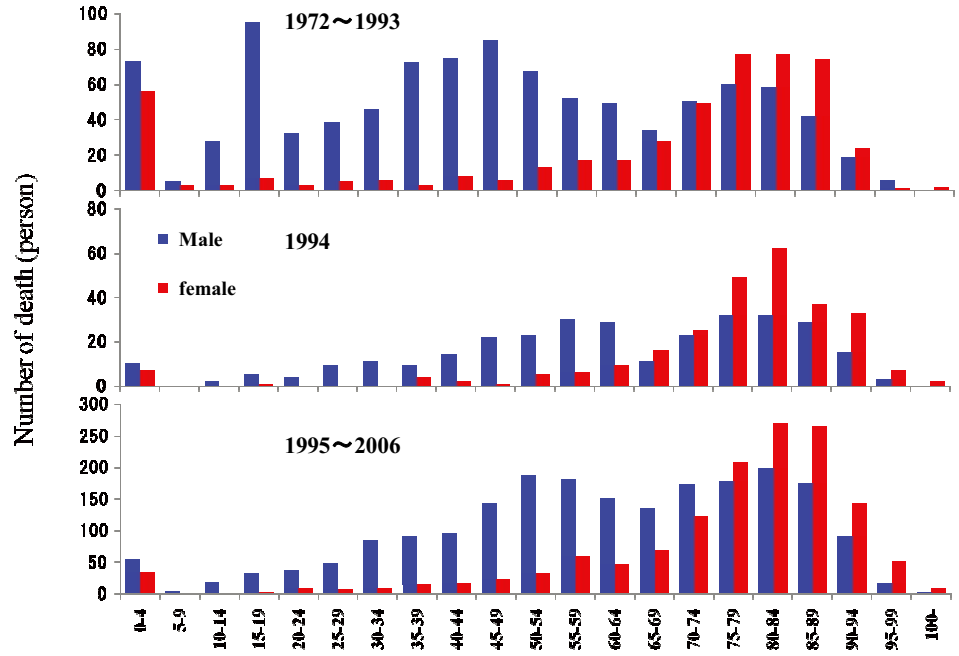


## Percentage of the room air-conditioner use versus temperature

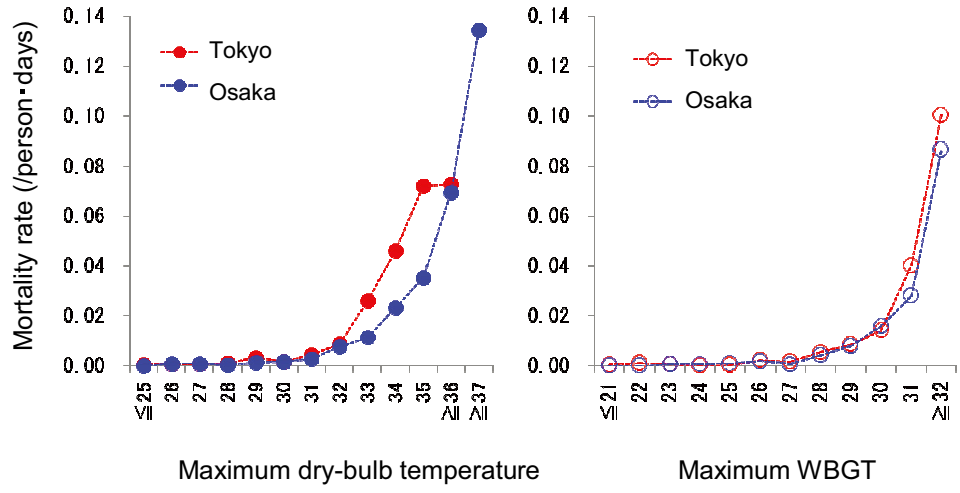


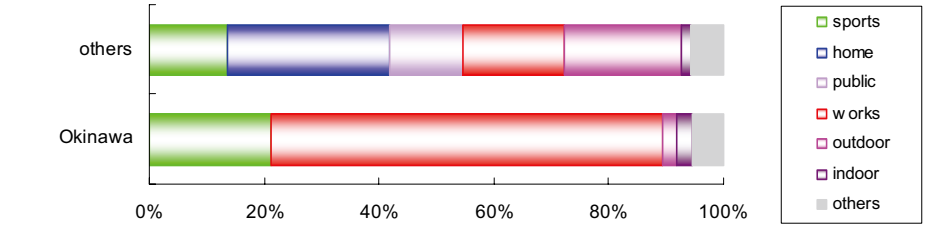

## Time trend of number of deaths by sex



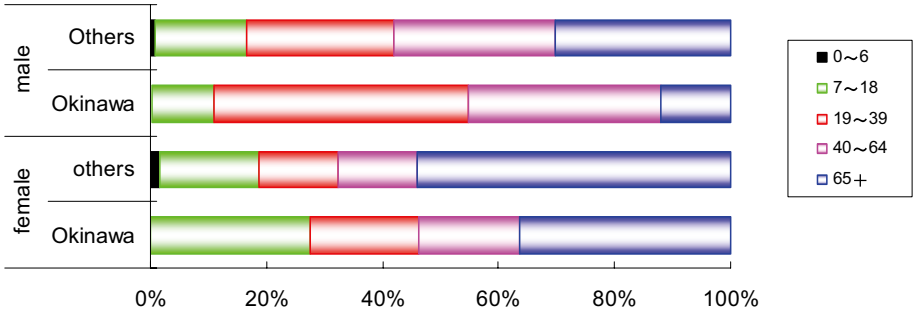

Number of deaths by year, sex and age



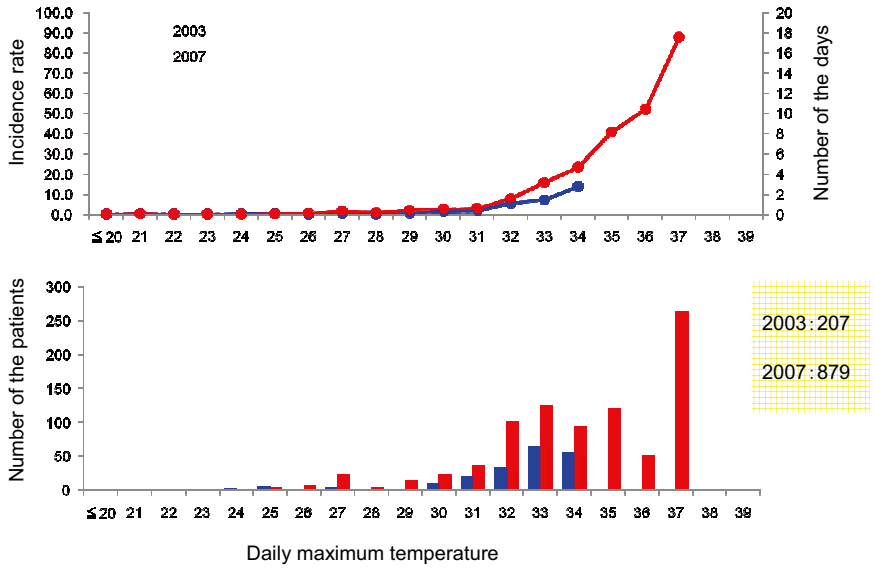

Mortality rate versus daily maximum temperature




Percentage of patients by location of heatstroke




Percentage of patients by sex and age




Number of the patients and
daily maximum temperature (Tokyo)

## Characteristics of heat warning system of local governments

| City name | Target | WBGT (wet bulb globe temperature) measurement | Media for instruction |
|---|---|---|---|
| Kusatsu | all residents | at elementary schools | e-mail |
| Kumagaya | all residents | at 30 elementary schools and city government building | e-mail,<br>Leaflet for elderly living alone |
| Tajimi | all residents | at a kindergarten | e-mail,<br>bulletin board,<br>FM radio |
| Saga | all residents | Health information including heat index | Web, e-mail |
| Machida | children | at all the elementary and junior high schools | manual |

## Ministry of the Environment action on climate change and health

Action plan: Preparation and distribution of a manual for heatstroke and posters to raise awareness

•Research plan: Research project for Climate Change Impact Evaluation and Adaptation (Global Environmental Research Fund)

•Website for heat warning system: Providing forecast of heat index (WBGT), collaboration with National Institute for Environmental Studies

•Organizing several special committees on climate change and health impacts

### Useful websites

Ministry of Environment Japan: forecast of wet-bulb globe temperature (WBGT) for today and next day's WBGT for every 3 hours with levels of heat disorder risk.

National Institute for Environmental Studies: information on new heatstroke patients in 18 major cities all around Japan.

National Institute for Environmental Studies

Tokyo Fire Department

Japan Sports Association

Weather Association

# Panel Discussion

Professor Hironori Hamanaka, Chair, IGES Board of Directors: It is my pleasure to welcome such a big audience today. Thank you for joining this symposium. So far, we have heard about global warming and the fourth report of the IPCC issued in the autumn of 2007. Dr Masaji Ono mentioned that there is no doubt about the evidence of the global warming, it is due to the human activities, and that has been clarified by this report. And as the Governor Ido mentioned, last year we had the G8 environmental ministers' meeting, the G8 Toyako Summit, and in December this year, the great post-Kyoto Protocol meeting will be held in Copenhagen, Denmark to succeed the Kyoto Protocol, to discuss the framework of environment related issues. $CO_2$ is one of the reasons for global warming, and the problem should not be reduced only to the United States. The newly emerging economies China, Brazil, and India are trying to strengthen their control. That is very important, but on the other hand, even though we are trying to give them the best account measures, we cannot avoid global warming completely. So we have to consider how we can predict global warming and be prepared. As Dr Ono mentioned, heatstroke is one of the challenges that we are facing.


Now, we are going to have a discussion among the five panelists. First we are going to ask for their presentations, and then we are going to have a panel discussion to deepen our understanding. Now, I would like to ask Dr Nishioka to start his presentation.

Professor Shuzo Nishioka, IGES: Today, I'm going to talk about the need for adaptation to climate change in Japan. The IPCC quite often refers to global examples but climate change actually does have a clear impact on Japan. This is from the Ministry of the Environment last year, and they have summed up their study on how to adapt ourselves to climate change in an internal report. There are frequent natural events, which could be caused by global warming, and we scientists have to be very cautious. If, for example, yesterday was a very hot day and people ask whether it is because of global warming, then we cannot immediately say yes or no. Of course, we can easily imagine that it is partly because of the global warming, and since the year 2000 onward in Japan, we have seen a decrease in alpine plants such as beech, and there is also a change in the retained circulation of water. Take Lake Biwa, for example, If the surface of the water is cold, then the surface water sinks and

you can expect a good circulation of water. However, circulation is hampered when the surface is warm, leading to a shortage of the oxygen at the bottom, and this takes its toll on the fish and other life at the bottom of the lake. We see this situation here and there.

The increase of heatstroke patients has already been mentioned. Great damage has also been wrought by torrential rains and flood damage, in Kobe too. Regarding the impact on agriculture, the Ministry of Agriculture conducted a national survey in 2005, and were very surprised by the results. For example, farmers in 100% of prefectures had found that there was something wrong with their fruits. Ninety percent found changes to vegetables and 70% were having issues with rice. Especially hard hit were fruit, with very poor color and a timing gap between the coloring and ripening – temperature needs to be controlled in order to color the skin. This brochure from the Environment Ministry has some pictures. For example, this thick skin of the citrus is caused by hot temperature and high humidity.

In the case of rice, we have a very serious situation. After the seeding, there is a shortening of the period until harvest, meaning the rice is immature. This phenomenon is observed quite often in Kyushu, but in Hokkaido, they still have good, tasty rice. So in total, Japan as a whole still enjoys a good rice harvest, but the quality varies depending on the area. And this is not anything unique to Japan. In Australia, there is a drought, and it affects the price of food due to the lower production volume. Back in Japan, pears have been afflicted with so-called sleeping disease, and other pathogens are moving towards the north of Japan. Actually the seasons have shifted northward, so by the year 2060, the apples will be harvested mostly in the north, for example in Hokkaido where apples do not currently grow. Fisheries are moving northward.

Your handout shows the impact we may see, for example the damage due to a tidal surge, such as the strong impact on the seashore of Kochi Prefecture during Typhoon 23. It caused a surge, and at Itsukushima Shrine, on an island off Hiroshima, there was an increase in the rate of submergence of the shrine, and there was torrential rain and damage to the northern part of Kyushu.

At the other extreme, if you have a good big dam and a mountain, then you see high water level, and during summertime that level of water goes down but you can maintain that certain level of water. However, in the future, if you do not have a dam or just a small one, then in the very early spring, you will have a flow of the water, but storage may run out during the harvesting time or the seeding time, and you would have to change those seasonal activities. But if you have a large dam, it will be full of water from the inflow of early spring, so it will be there when you need the water. So you have to increase the capacity of dams. But even if you have a dam, you cannot be fully secured from a long drought.

And then what about adaptation? Even if we maintain the current level of greenhouse gas emissions, the temperature would still be up 0.2ºC in 20 years, and we will have to take certain measures. We cannot just wait and see. This is the famous example of the Himalayan lake that formed because of the ice melting, and it may harm the village at the foot of the mountain. In Canada, when they built a new bridge they already incorporated an increase in the height of the bridge by one meter.

Here you can see that we have developed a new type of the eggplant which is stronger against such changes. And here is a building where greenery has been grown on the roof, providing shade against the sun and heat. Another measure would be to absorb the solar energy falling on the residency to create power.

Coastal megacities are particularly vulnerable, but there are various options for them. First is the technological option, like redeveloping the water drainage system, to change or modify

the flow of the water, not just the hardware but also the hazard map, which is also very important and is already available, especially for earthquakes. These provide information about where to escape, and also the monitoring system, long-term monitoring or the real-time monitoring. All these help us to plan for what we should do when something happens in real time. Another option is to shift houses to safer areas, and for this you have to take action as early as possible, in a well-planned manner. Another very important point that I'm sure the people living in Kobe know quite well is training and education about how to cope with a disaster. What IPCC and UN do in the beginning is that they come up with a policy option, which is less costly, but which can be implemented by the community as a whole, and they try to initiate a sort of training session. Megacities also have the socioeconomic option, that is, by utilizing insurance, subsidiary tax and other incentives, can take action quickly.

Let us beware of bad adaptation, however. What I mean is that without good information, if you only increase the height of the levee, then it may alter the flow of the sand along with the water, and end up flooding the coastal area. Therefore, we have to think about what sort of modifications should be made, and then we have to adapt ourselves. This is important for policy as well: if private homes use a lot of air conditioning, then the outside temperature goes up in the urban setting. Therefore, we have to be very cautious in adaptation, so as to achieve good adaptation. At any rate, we should avoid causing any further global warming. This is all. Thank you very much for your attention. (Please *see slides on pages 61–66).*


Prof Hamanaka: Thank you very much. Dr Nishioka talked about the kind of impact we will have with global warming and generally summarized how we have to respond, Today's symposium is co-organized by the Kansai Research Center of IGES, and by the WHO Kobe Centre. So it is by these two institutes. So allow me to present the WHO Kobe Centre Director, Dr Jacob Kumaresan.

Dr Jacob Kumaresan, Director, WHO Kobe Centre: Thank you, Professor Hamanaka. It is a joy and pleasure to be with you this afternoon to address you on this topic. We all talk about collaboration between different sectors, but I'm very pleased that Professor Hamanaka and Professor Suzuki have actually made this happen, and I'm glad that WHO and IGES can join together in this effort.

I want to show you in this slide how climate change actually has health impacts. Climate change can have an impact in three areas. One is the environmental conditions. The second is the socioeconomic conditions, and the third is on the health system itself. And it does so by modifying in three different aspects. One is through direct exposure, and this is through heat stress, and we saw a wonderful presentation earlier on that. The second is through indirect exposures, which means through waterborne diseases or through vector-borne diseases like mosquitoes, and we also saw examples of that. The third, which is more subtle, is through the human aspects of psychology. So if someone is affected, has a loss of property or a loss of income, that individual may sink into depression, and that will have some impacts on health as well.

Now this slide is specific to a particular disease, and I am taking the example of diarrhea, which is a water-borne disease. Now, independent of any effect of temperature, diarrhea will increase in populations which do not have access to safe water and sanitation. Now imagine a population which does not have access to safe water and sanitation, and add an effect of temperature on that, or humidity, or precipitation: these are environmental factors. So what it does in that particular scenario is that it will affect the survival and replication of pathogens. In other words, if temperature increases or humidity increases, it will have an effect upon the pathogen, the viral protozoan or bacterial organism, and then it will cause replication of that pathogen, and it contaminates the water. Now this will eventually mean, if there is an increase in the pathogen, it will increase the number of diarrhea cases as well as the mortality. So it's a very straightforward progression from temperature through a proximal effect, increasing the number of pathogens and therefore causing disease.

You heard this about the mosquitoes which are increasing their range. I would just like to show you that currently, the population which is exposed to dengue fever, is in this area, the red portion. At this point in time, one-third of the world population is exposed to dengue fever. However, in the future, if climate change has its effect, it will increase to a much larger scale, but in the same populations. So you can see the amount of red actually increases. And this is the projection for the year 2085, which is 75 years from now – half of the population will be exposed to dengue. And that's a significant amount of people who will be living in areas which have an opportunity to be bitten by a mosquito.

Climate change will not affect everybody in the same way. Everybody is vulnerable to climate change effects, but the people who are most vulnerable, again, as we saw this afternoon, will be the children. We saw a very good example of heat stress in children. And in the same way, it will be the older people who are affected, as they have less adaptation capacity. There are also people who are living in coastal areas, people who are living in water stressed areas, people who are living in megacities and mountain areas who will be affected by climate change and I'll show you an example of that.

I wanted to talk a little bit about urbanization, because this is a phenomenon which is happening today, and it's going to expand in a rapid way. These are the trends of people coming to live in urban areas, partly due to migration, but also partly due to urban areas expanding and going beyond what was normally the city or the municipality in the past. So as of 2007, half of the world's population is living in urban areas. That means one out of two people are living in urban areas. And that trend is increasing, and it will increase in the next 20 years to a situation where 2 out of 3 people will be living in urban areas. And by the year 2050, 70% of the population will be living in urban areas. And this is significantly different from the 1950s. So one has to adapt and see how people can be ready to cope with this challenge.

What does it mean? Let's look at some city examples. This is data from Shanghai, China starting from 1971 and the normal trend has been that there are nine hot days per year in

Shanghai when the temperature is more than 35ºC. But as you can see here in this graph, the trend is increasing. And in 2003, when you saw the heat wave in Europe, at the same time, there were 40 hot days in Shanghai. As you can see here, the trend is increasing much faster than what was happening in the last three decades.

What does it mean in terms of impact? In the 1998 heat wave, the average mortality in Shanghai increased by 300%. That is remarkable, but at the same time, we have cold waves, and in the last, the number of excess deaths was about 2500. Now you can see the impact that climate has on human populations.

Now I would like to talk about climate change when it doesn't kill people, but affects their ability to work and be productive. Some work commissioned by our Centre looked at work ability outdoors. And there are two aspects here. May is the hottest month in India where temperatures go beyond 45ºC for significant amounts of time. So the work output here, this is on the left side you find the graph about heavy labor. When you look at heavy labor, there is 100% loss in the ability of a person to work from the time of 10am to about 4pm. That means somebody who is doing heavy labor is not able to do that at all. If you look at light work, which is indoor work, it has a lesser effect, with about 80% loss in work ability but in some cases it can go from 1–2 hours to 100%. Now you can imagine, being in a city and experiencing a heat wave and the amount of stress it puts on human beings. This is a significant loss of productivity, and in terms of adaptation one needs to take into consideration whether we need to change the policies to have people to work later in the evening or earlier in the morning. This is where we need to make policy decisions if we are to adapt to climate change.

Now this is another wonderful example of the per-capita emission due to transport in large cities. This is data from 84 cities, and look at the left extreme, the emission of carbon dioxide due to transport. Atlanta and Houston are way up here, as compared to Beijing and Hong Kong. This means that people are using more cars there and traveling without public transport or there is a lack of public transport in these places, but there needs to be policies like those introduced in London and Singapore which allow people not to use private transport and encourage them to use public transport.

Now I want to show you data about what it means to the health of an individual. This is information from the United States, and look at the levels of obesity. If somebody is using a car all the time, there is no opportunity to walk, no opportunity to use the bicycle, and you can look at the rates of obesity going up. Now this is a wonderful graph (please refer to PPt) which shows that these are rates which are at about 10-15% of obesity in this part of the United States. Now 20 years later look at this graph. This is Atlanta here, and Houston here, where the rate is more than 30%. So the levels of obesity here are going higher in these places, and we can obviously see the link of people relying on private transport. The point I'm trying to make here is that all these things are interconnected. If you want to reduce carbon emissions and have a low-carbon society, you need to introduce transport policies, and allow people to do more walking and so on, you will have an impact upon health. You have to do more studies on this to show the actual impact in the future.

I'd like to conclude now by saying what should we do. Our Centre is doing research to make this more apparent and take it to policy-makers. We need to find champions who understand this as we seek a low-carbon society. We need to inform the public so that they can understand and take their own simple measures to use bicycles and walk more and so on. And we need to support the local government initiatives like those taken in Hyogo Prefecture to make this more apparent. It is wonderful to see the Governor taking an interest in environmental issues, and we need to support that. I'll stop here, but I'll just say that our Centre is doing more research on these aspects, and we do it not for the sake of doing

research, but so that we can have policy changes. We want to bring this information to policy-makers and to the public so that we can all work towards a carbon-free society. Thank you very much. *(Please see slides on pages 67–72).*

Prof Hamanaka: Thank you very much, Dr Kumaresan. I think that this was a very comprehensive presentation about the issues of global warming and its impact on the environment. Now the next presentation is from Professor Guo Xinbiao of Beijing University.

Professor Guo Xinbiao, Beijing University School of Public Health: Good afternoon. Since I studied in Japan, and most of you are Japanese, let me talk in Japanese. First of all, my special appreciation goes to the organizers, so Hyogo Prefecture, IGES and the WHO Kobe Centre. I'm very pleased to be given this opportunity to inform you about the Chinese situation. For China, climate change and environmental health are very important challenges, and we must take this issue into very seriously into consideration. First, I think let me talk about the features of the environmental health problem in China, which is quite different from Japan. We have a big population in China, so there are more people exposed to different environmental factors. In addition, the population is aging. Well, Japan is the most advanced nation in aging, and actually climate change does have the strongest impact on the aged, as mentioned by Dr Ono when he told us about heatstroke.

In China, our population is also aging at accelerated speed. We have the one child per household policy. We have had that policy for decades, and over-65s account for 8% of the population, but in Shanghai and Beijing, the ratio is double. That means that some 100 million people are over 65 years old. And the social insurance system is not well developed, and the medical insurance system is also not so well developed, and living standards are not ideal yet either. Therefore, it is very difficult to adapt ourselves not only to climate change, but also in other ways. There is a big difference in terms of the lifestyle between the urban and the rural areas. You quite often have a chance to see how the people are living in Beijing and Shanghai, and actually we have everything in Shanghai and Beijing that you have in Japan – especially after the Beijing Olympics, I think that the level of living in Shanghai and those urban areas is quite similar to that of Japan. For example, in a very urban area, we have also the problem of the car pollution and heat island issues, we face along with

urbanization. But in rural areas in China, we have problems attaining safe drinking water and sewage systems, such as was the case of Japan maybe 100-200 years ago. In Japan, we are told that the rate of sewage development is very high, but in China, that rate is still quite low. There are also emerging health problems such as climate change, so there is a sort of the difference between the traditional issues and emerging new issues.

In short I would say that in China, we face those environmental health problems which is sort of a mirror on the past for developed nations. We have the problems which Japan faced in the past, pollution problems and so forth, and also car-related environmental problems and traffic congestion. If you visit Beijing, you will probably understand what I mean.

Today, I am going to talk about the climate change. In the past 50 years, when we look at the climate average, in Shanghai, for example from 1951 to 2006, this period shows a very clear increase of average temperature. This morning on TV they said that you had a very warm winter. We did in China as well and for 110 days, we did not have any rain at all. No snow and rain, but just recently we had snow, with the aid of the rocket. No, I'm just joking. But anyway during the Olympic Games, we used rockets to try to get rid of the clouds.

So climate change brings various impacts on the health. In China we also face those problems. There are some similar problems, and some that are different from Japan. For example, here are the dirty dozen, including agrochemicals and dioxins, a list of pollutants, and then when we look at the climate change, there is a very close linkage between pollutants and climate change, as well as infectious disease – you also have the deadly dozen diseases. While that list of diseases may not be so relevant to the case of Japan, some are becoming a big issue in China.

This is the incidence rate of 37 infectious diseases in China in 2007, including tuberculosis, malaria, Schistosomiasis, dengue fever, and cholera. China, like Japan, has a tuberculosis problem, and malaria has become a big issue. Here is the incidence rate of Schistosomiasis. Considering the population in China, there is a big public health burden.

This shows the area of high possibility of Schistosomiasis epidemic in future, a prediction based on global climate change. The green area is year 2050, and red is the situation in 2100. Blue represents the current situation, which is gradually increasing. This northern range is only two hours from Beijing, although this is only a prediction, but we do see some tendency for the northward movement of these communicable diseases. E

China is now tackling climate change as a first priority issue. We have a lot of greenhouse gas emissions and we get pressure from the international community, so therefore the academic field and national government work closely together.

In 2004, the web-based real time reporting system for infectious disease outbreak started. We developed this system in 2004, building on the lessons learned from SARS. We continue to use it, but we would like to expand the utilization of this system to the other diseases and conditions such as heatstroke. Climate change and health will be very important issues, so we would like to use this system for those areas as well. Moreover, China issued a national environmental health action plan under the support and the instruction of WHO, in 2007, a joint initiative of the Ministry of Health and the Ministry of Environmental Protection, together with 16 other ministries or agencies. Climate change and health is reported to be a very important critical issue in this plan. This is the first time for 18 different sections to work together, and there are 18 different seals on the report. It is very rare.

China has announced a national assessment record of climate change and a national adaptation plan for climate change, meaning it has become a very big issue, and some

related forums and symposium are being held. So this is the national assessment report of climate change, although no seals or stamps are attached here.

This is the WHO's 60th anniversary symposium in Beijing, where climate change and how to protect the humans' health was held on 8 July 2008. It was also discussed at the 30th anniversary of the China Environmental Science Association. In this way the administration and academia are working together in China to cope with the problem. But we have so many challenges or the issues that we need to tackle, including the development of technology and economic issues.

For example, many speakers already mentioned that we must adapt ourselves to climate change. However, what about our ability to adapt? We need to improve the level of assessment, and how good we are at adapting ourselves. At the university graduate school, we try to collect more information on climate change and its health impact as a baseline. In terms of surveillance of the human health impact of the climate change, heatstroke is monitored in Japan as mentioned by Dr Ono but in China, the government tried to set up such a system but it is not yet operating. Without the basic data, prediction of incidence may not work. Of course I understand the importance of such surveillance, but we have to push further.

The third point is the need to enlighten and educate the general public. Like today's symposium, we need to disseminate information and knowledge, but actually in China we do not have such activities at all, so it is an area that we have to make further effort, otherwise we cannot expect any improvement on the individual level.

Thank you very much for your attention. *(Please see slides on pages 73–77).*

Prof Hamanaka: Professor Guo, thank you very much for your presentation, and we do understand what kind of activities have been already started, and also the remaining challenges, especially of the health impact surveillance collection, it would be possible from now on. Now, Dr Shinozaki.

Dr Hideo Shinozaki, National Institute of Public Health: Dr Kumaresan, Director of WHO Kobe Centre, invited me to participate to this seminar. I have been serving as an advisor to the WHO Kobe Centre for a long time. WHO is involved in the health aspects of climate change. Dr Shin Yong-soo was selected as the Regional Director starting from 1 February 2009. For WHO, this is the Regional Office for the Western Pacific (WHO WPRO), and it consists of the 34 countries including China, Korea, and Japan, and other southern countries. Australia and New Zealand, are also member states together with the South Pacific island countries. One of them is Tuvalu, the submerging island that has already been mentioned and for historic reasons, the UK, the United States, and France are regarded as players in the Region. So politically, it has impact in the field of climate change.

Today we have a representative of the Ministry of Environment Japan and I believe that WPRO can collaborate with the Ministry to come up with good countermeasures. Now let me talk about the health sector. Dr Kumaresan presented the WHO program activities and is most knowledgeable about the factors involved, the health effects and temperature-related illness and death. We have seen comments about heatstroke, extreme weather-related health effects such as flooding or heavy rain, air pollution-related health effects, water and food-borne diseases, vector-borne diseases from rats and insects. Malaria is one of the examples of that. Food and water shortages due to drought, mental aspects and infectious and non-infectious diseases are also included. It is in this category that WHO is responding to climate change. This is not an issue of a particular country or a particular region but a

global issue. So as international organizations, the United Nations – WHO, UNEP, WMO and the other stakeholders – have to be involved.

The National Institute of Public Health is under the control of the Ministry of Labour Health and Welfare and trains about 4000 people per year. With regard to climate change, we have a training program for urban environmental health inspectors, who work in municipal public health offices. There are about 6000 environmental health inspectors throughout Japan. Important to this is the Building Sanitation Law established in 1970. As far as I know, only Japan and Korea have a law specifying building sanitation, but once the population is concentrated in cities and high-rises are built, the role of such a law becomes very important. In this room, there are no windows and all the air is ventilated by air conditioner, so all sanitation countermeasures including control of the air inside the building, water supply, drainage, pests, insect control have to comply with the Building Sanitation Law. I was talking with the municipal health office and they told me that if the building size is more than 3000 square meters, then they have to assign a building sanitation engineer. These engineers are qualified under national exams, and the sick building phenomenon is not occurring in Japan because of this regulation.

There are 18 departments in our institute and 300 researchers, including support staff. The Department of Environmental Health and the Department of Architectural Hygiene and Housing are the two departments dealing with climate change-related research.

I read in a recent newspaper article that the Japanese government is to decide on a new mid-term target for carbon emissions by June. This kind of meeting is very important for that discussion, and global warming-related articles are reported daily.

This is a baby penguin in the Antarctic, covered in dirt because the ice has melted.


The South Pacific island of Tuvalu has population of about 10,000. It is a beautiful island, but it is severely eroded these days. With an altitude of about 2 or 3 meters, sea level rise is on its way to submerging the nation.

This is a scene of Tokyo high-rises and maintaining the health of these buildings is a challenge for our department.

This is a building or house. Air is coming from the outside through the window or the air conditioner, and the indoor air pollution can be very high. Mites and molds are part of the problem. Moreover, insects and small animals are not dying during the wintertime because of the air conditioning. They are surviving. Meanwhile, hot weather worsens the noxious photochemical smog, and the ozone effect can also be seen. So indoor pollution would worsen with a hotter climate.

This is the predicted area is of low rainfall, and the green area is the heavy rainfall.

The heavy rain is expected to increase during the summer, and this explains how it would increase in all regions. If one is the current status, then it would increase to more than one – this is case for Hokkaido and Tohoku.

This looks at flood safety, and here the outer side is safer. The red line shows 100-year floods. Rivers without any system are quite risky.

In this slide is the simple device under development at our institute. It measures carbon and the ozone levels.

Here, we see how the yellow dust from China affects Japan, even as far away as Tokyo.

While Dr Nay Htun mentioned the four Rs, consider the three Cs: collaboration, cooperation, and combination. Health sectors and the other sectors, private and public, have to collaborate and cooperate and combine together in response to climate change.

That is all for me. Thank you. *(Please see slides on pages 78–83)*

Prof Hamanaka: Thank you very much, Dr Shinozaki. NIPH has conducted extensive research on environmental health and building sanitation, and they provide a lot of training.

Mr Harumi Yashiro, Natural Disaster Risk Group Leader, Tokio Marine and Nichido Risk Consulting Company Limited: Today, the global environment and insurance business is my topic. Coping with global issues is part of the insurance business, or any business. The business environment is something that you cannot ignore since it entails risk. And you have to come up with countermeasures.

But regarding the global environment, business has started corporate social responsibility (CSR), but a more realistic approach is needed from each company. Voluntary targets have been set by the business federation and industries in general but I think that each company needs to think about what it can do.

So, what sort of activities are the private sector and insurers involved in? Let me touch upon that issue. The insurance business, and the financial industry in general, do not manufacture any physical products, so in that way our environmental impact is rather limited. However, we

have to take certain measures against the global warming, through our insurance service so that we can reduce the environmental load that we generate. Since we deal with natural disasters, floods are a risk for us so we have to think about what sort of contribution we can make. And actually, most of the products we offer are dealing with the environment.

For example, we provide a discount on car insurance for environmentally friendly vehicles like hybrid cars. We may also give some discount if regenerated parts are used in accident repair. Another measure is greenery insurance, that is, if a house is burnt down, as well as trees surrounding the house, not only the house itself is covered by the insurance but we may provide some insurance to replace the greenery. If an incident occurs, we may add some money as the insurance if environmentally-friendly materials are used, on the condition that the ecology is brought back to the original state. If an environmental assessment is done, we may also offer some additional insurance.

We also offer financing for wind turbines and other environmentally-friendly projects, as well as for venture companies whose businesses are related to the environment. In principle we are trying not to give any financial support to companies that have a bad impact on the environment. And if we do, we consider raising the interest rate, to encourage them to change their actions and plans.

We also offer insurance for damage from climate change. For example, in order to promote wind power generation, if the wind velocity goes below a certain level, then we compensate their profit, since generation level varies depending on wind velocity. And we offer some compensation measures for abnormal weather, such as unusual rainfall causing an amusement park lose profit.

This from UNEP shows the economic damage of disasters. Recently, this disaster damage has worsened. Of course, the insurance coverage has also grown.

This is the payment of insurance money in Japan. This is Typhoon 18 or 19, showing the increase of insurance coverage, and how much insurance is paid out in the case of a typhoon. In 1991, 500 billion yen was paid out after Typhoon 19. If the typhoon is very big, then 100-200 billion yen of the money is paid as insurance, if a very wide area is damaged. In the case of an earthquake, it's much less. The premiums for earthquake insurance are actually very small.

And what about wind disasters? Each household may have fire insurance, but once the typhoon hits an area then we pay this amount of money to the whole area. This is the amount of money paid out for earthquakes. So therefore, the prediction of typhoons is a very big issue for insurance companies. Heavier rainfall or stronger typhoons are things we can predict for the future. The meteorological agency offers data from the last 60 years and 60 years ahead. But what's going to happen 100 or 200 years ahead?

Actually we cannot process all the data to make such future predictions, so we have to come up with a typhoon simulation model. This is how we prepare the simulation model, to see the distribution of the damage from wind speed. What's going to be the future of the typhoon? There are various ways to evaluate. Generally speaking, the number of typhoons is expected to go down by 30%, but the size of typhoons is growing. The frequency of tropical cyclones is expected to drop by 14%.

This is the 50-year and 100-year simulation distribution of maximum velocity. With fewer, bigger typhoons, Kanto and Tohoku might suffer worse damage.

One hundred years ahead, probably Hokkaido will be more severely damaged. And Kanto will have higher maximum velocity in the future.

What about the actual damage? The increase of the damage in 25 years would be 5%, and 11% after 100 years. And there are many opinions about this, but considering these factors for the future, insurance premiums might need to rise.

We are the insurance business. I refer simply to typhoons, but if you have more rainfall, we may also see more flood damage. What's going to happen in the future? We have to quantify for the sake of insurance coverage and premiums. We must prepare the more realistic figures based upon more quantitative data. But as an industry and business in general, global warming will have a very strong impact in the future. In the current economic situation, you cannot only depend on CSR but tackle it as a main pillar of business management. It involves not just risk but opportunities as well. That's going to be something we have to think about for the future. Thank you very much for your attention. *(Please see slides on pages 84–93).*

Prof Hamanaka: Mr Yashiro, thank you very much for your presentation from the perspective of the insurance industry, which has a very important role. He talked about global warming, whether typhoons' impact is increasing, how insurance payouts will increase, and if it is so, premiums will have to be increased as otherwise they can't survive. As for business, they cannot risk being unprepared for global warming. So they do not only see the risks, but the business opportunities as well, which is quite interesting. Thank you.

The remaining time is about 30 minutes. The panelists have voiced various opinions. We have also received questions from the floor. So I would like to invite our two keynote speakers for their comments after listening to the five presentations given by the panelists, and I believe that they have already been informed about the questions received from the floor, so I would like them to include the response to those questions as well.

One of the questions that I received from the floor was in relation to heatstroke and climate change. Air conditioners are a countermeasure and can be promoted, but once air conditioners are used, then $CO_2$ emissions increase. So in Japan, the air conditioners are not to be promoted. Sure, it might be easier to let the Japanese public use them, and from the global perspective, it may be possible to equip people in developing countries with air conditioners, but what do we do if we are aiming to be a low carbon society? And another question is that for global warming preparedness, we also have to consider food shortages. The maximum population that the planet can stand would be 12 billion. So how to control the population? These are the questions received from the floor. So if is possible, Dr Htun, would you respond to these questions, as well as commenting on what you've heard from the panelists?

Dr Htun: In view of the shortage of time, I'd like to have the panelists respond to it. I have one very brief comment, but if I may, two questions, one to Dr Nishioka, and another one to Mr Yashiro. The comment is that I was very impressed with all five presentations, with how much awareness and how much work is being undertaken, taking into account the challenges of climate change to health, property and disasters. This really shows a significant amount of interest and work in this part of the world. My two questions are these: first, to Dr Nishioka, I was very interested to see the work being done on the effects of climate change on citrus fruit, oranges, and rice. Is there also work on the cost of these impacts?

The other question is to Mr Yashiro: in your work, do you see more and more the private sector incorporating climate change risk into their business plans? If there is an increase, what business sector in particular is taking the lead role? Thank you very much.

Prof Hamanaka: Thank you very much, so the two questions from Professor Htun.

Prof Nishioka: As for the cost of the agricultural impact, I'm sorry I don't have information about that. But the first survey was conducted in 2005 and the methodology was not developed for proper calculation, therefore the changes to agricultural crops were not well grasped. These are rumors for now. So we have to think about the costs, especially with the rice quality dropping, but we haven't seen a clear picture yet.

Prof Hamanaka: So regarding the environmental impact on rice and the other crops, I understand that you don't' have enough information yet. Then what about Mr Yashiro?

Mr Yashiro: Well, in the case of Japan, we are trying to do our best to minimize the $CO_2$ level. However, we have not taken action yet to switch the risk to a business chance. In the supermarket for example, you will see advertising for products which are environmentally friendly, or you may see an advertisement for eco-friendly housing. People are very interested in those things, so I think that there is more public awareness now. Even if it costs a lot, people still show much interest. So I think that business is moving toward more environmentally-friendly products.

Prof Hamanaka: Thank you very much. Now, Dr Ono, do you have any comments or questions to each panelist, and also if possible, there is a question from the floor regarding heatstroke: what are the symptoms?

Dr Ono: Thank you very much for your presentations, panelists. It was very interesting. Dr Guo, you mentioned the Chinese government situation, and you mentioned that activity has just started, and that expectations towards China from the world are very high. I do hope that you continue to be involved in this process. I have a question to Dr Nishioka. International frameworks and negotiations are taking place for the reduction of $CO_2$ emissions,. Now, what is happening within Japan, between cities, between industries? They would make trade-offs among themselves, so what is the current status? In what way will it be happening, or has it already started? Schedule-wise, how much have we done? And regarding the symptoms of the heatstroke, I do have a leaflet so if you are interested, please contact me.

Prof Hamanaka: Thank you. Now, Prof Guo, what is the Chinese situation?

Prof Guo: There was a request for further strengthening of activities. As you know, the American regime has changed and now President Obama is very active in tackling this climate change issue. As the mass media says, China has so far sat back to watch how things will change, but we have to take a more proactive approach. In China, we have environmental ministry and a public health ministry, and we try to have very close communication, and climate change may become a very big issue among all these departments. This is because of the pressure from outside China, but domestically we feel that we must take an action in terms of technological innovation as well as social change.

The economic condition is not favorable, because of the economic crisis. This makes it difficult for new graduates to enter companies and for example, in the case of university, , we try to give a sort of the room for them to study further after they graduate. We have a post-doctorate program, and we also have programs for graduates who have just finished their bachelors. This is one of the measures we are considering. So for young people who cannot

find jobs, we try to provide more education opportunities. Of course it's a kind of challenge but it is a good opportunity to disseminate information and knowledge.

Regarding emissions, there are a couple of reforms needed. First of all, economic reform. We need an antenna or mechanism, and then we have to make sure that effort to reduce carbon is rewarded. That's the ideal society we need to develop. Then, how? Economically there are two major factors. If the carbon tax is imposed on every citizen, then people may try to save energy and $CO_2$ emissions. The other method is just to allocate credits to everyone. Say the emission level for each individual is 10 tons,. We could target half that, fives tons per individual, then if you can reduce it, say down to two tons, you are going to sell the rest. If you are rich and you have enough money, then you buy it. That is a trading system. This system is what we are now achieving worldwide, especially in Europe, and the United States may follow. China has also shown some interest.

What about Japan? Last October, the government took an initiative and tried to go to this system. 300 companies claimed they were interested. But the target is not the five tons allocated by the government, they have their own voluntary targets. So it's not as stringent as it's supposed to be, but anyhow, the worldwide effort has been made. Then if there is a criticism that no reduction has been observed, and you want to make money, then you probably make an effort to reduce. A system is also being developed related to technological innovation.,

Prof Hamanaka: Thank you very much. In response to the questions received from the floor, the assumption is that temperatures are rising, and air conditioning use will spread – that is certainly the direction in Japan. But what about the other countries? Do you think that air conditioners will increase around the world, worsening $CO_2$ emissions? What should we do? That's a question. So can I invite comments from the panelists, either Dr Htun or Dr Ono, or the five panelists. Dr Nishioka, please.

Prof Nishioka: Well, two methods have been suggested. One is the technology-oriented approach. Our houses are not insulated properly yet, so during the cold season we have to turn up the heaters, and that warmed air is released to the outside. If we had an appropriate insulation system, then one-hour operation of the air conditioner in the morning would be enough to maintain temperature until nightfall, but you can't have this because of economic conditions. But once insulation does penetrate, I think that it can be one of the solutions, and this is the technology-oriented approach. The other one is suggested by MD Robinson. In the Kyushu and Okinawa regions, house structures allow very good breezes and ventilation. Without an air conditioner, the houses in these subtropical areas can utilize the breeze from outside, and you can spot such kind of houses in Okinawa and tropical countries in the region. So maybe we can learn from that. As a country, we can copy some of the architecture and it would be a way to reduce $CO_2$. So we have the two approaches, and we have to pursue these two directions. Thank you.

Prof Hamanaka: So, in your explanation, Dr Nishioka, insulation materials in the ceiling of houses and also ventilation, are important points. Dr Shinozaki spoke about the Building Sanitation Law, and in installing insulation, we have to consider the sanitation aspect. Actually, we have one more question about China.

Prof Guo: This is quite a big question. In terms of the environment, when can China become a developed country? And what about the awareness of the public in China? I would like to talk about the latter point. I'm involved in the Environment Ministry and one of their projects is to promote knowledge, behavior and the action on climate change and health. We conducted a survey in four cities. Generally, there is very high awareness of environment issues, and if we provide more opportunities for education we can expect a high level of knowledge among

the public. But another important point is action, and the level is not so high. Even though people have knowledge and understanding, it is not linked to action yet. Another point is that we have started to see some limits and regulations on environmental pollution in China, especially in the east coast urban setting. The region is well developed and the environmental code is well prepared, but this is not yet the case in undeveloped western China. That is why corporations are transferring production from the east coast to other sites where the regulation is not so strict. Now it is necessary to improve the environment in the villages and rural areas more than in the urban areas. In the old days, the rural people enjoyed a beautiful environment, but the environment has deteriorated because of factories invading their area. So these two issues explain the Chinese condition.

Prof Hamanaka: Well, thank you very much for your help, Dr Guo. For the first part of this question, Dr Nay Htun or any others, do you have any comment? Well, then here is another question.

Audience member: What sort of negotiation has each country had to with the United States to get it to sign up to the post-Kyoto Protocol discussion? The first promising signs came this year so schedule-wise it might be difficult, but the post-Kyoto Protocol negotiations have started, and what is the role to be played by the United States? If possible, I would like to ask Professor Htun.

Dr Htun: Very good question. I want to make it very clear that these are my own personal views. I don't represent any official views of the United States. That being said, my own personal view is that I believe the prospects for the United States to take a very proactive role in post-Kyoto are very good. At the highest political level, there is good commitment right throughout. The Department of Energy is now headed up by a Nobel laureate, Steven Chu, who himself is very committed to renewable energy, very committed to lowering greenhouse gases, so throughout the administration and by the President Obama itself, we see there is very broad awareness of political support.

Over at the legislative branch – Congress – the chairman of the Foreign Relations Committee is Senator John Kerry, and he is very committed to the environment and climate change too.

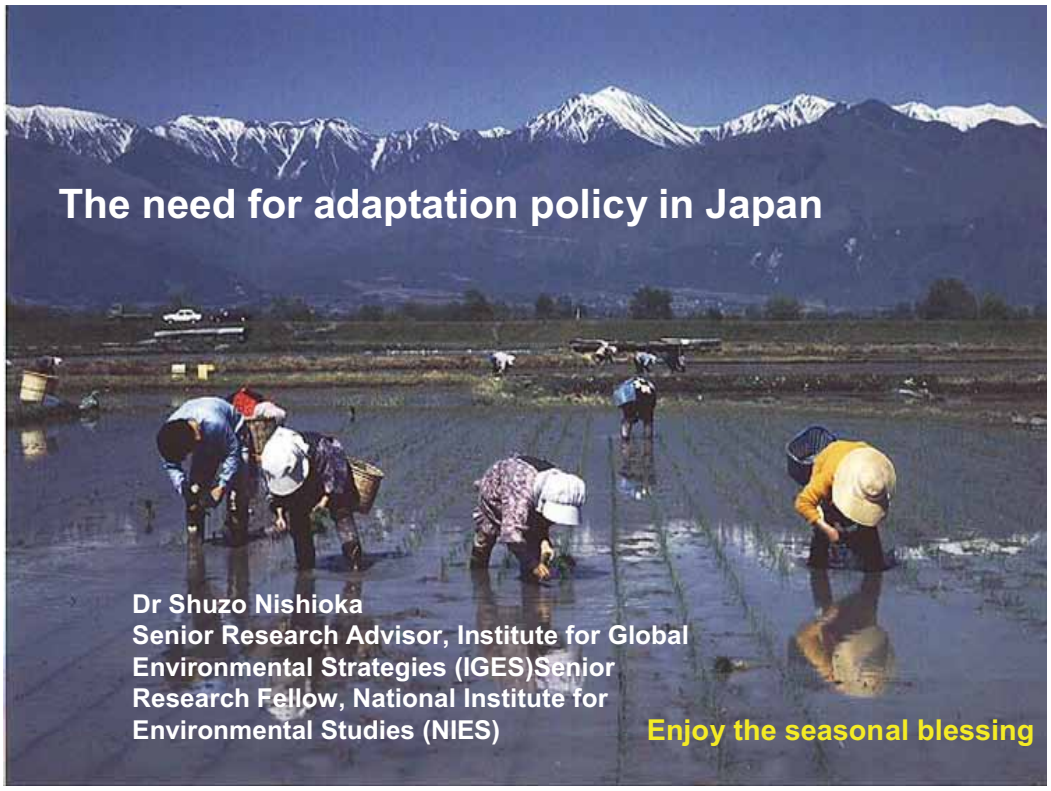
In the judiciary branch, one of the three branches of government, a very important decision was made by the Supreme Court justices in April 2007, where after many months of deliberation, they agreed with 17 states, ruling that $CO_2$ is a pollutant. Therefore, the Clean Air Act has a responsibility to regulate $CO_2$.

So now we have three branches of the government, plus tremendous support and awareness by the general public and by the universities and think-tanks in the United States. I think this will have very good support. The only concern at the moment for all of us, including the United States, is how the economic situation is going to affect economics, how is it going to affect jobs. But we need to take this economic crisis as an opportunity to find new jobs, to find new ways of development, and I hope this will be the case. So the bottom line is this: on a personal basis, observing the situation, I am much more hopeful this time. Thank you.

Prof Hamanaka: Dr Htun, thank you very much for your comment. Well, we are behind schedule now. I couldn't cover all the questions received from the floor, but in spite of that, thank you very much for your active participation in raising questions and I do hope that this is very productive to all of you.

On climate change issues, first of all, we have to identify the root cause of emissions and for that purpose, each nation is in negotiation right now. But at the same time, we have to consider what to do even though we are making the best effort, as global warming will be going ahead regardless. As a result, serious impacts are coming. So the impacts of our actions are going beyond the borders of nations and regions, which is a great change for human beings. It will impact agricultural products, with floods or drought, and heatstroke and other health issues such as infectious diseases. We have to identify that impact and make the assessment. For the example of the impact on agriculture, we haven't identified what would be the financial impact given from that, so the information is not sufficient yet.

In sum, regardless of our positions, who we are or where we are, we have to be seriously involved in solving the issues. Thank you very much for your contributions today, for your discussion, and for your participation. With this, I would like to conclude the panel discussion. Thank you very much.




## The impact of warming on Japan is dramatic

- Events caused by warming are frequent.
- Worldwide: heatwaves, hurricanes/cyclones, floods, droughts
- Japan since 2000:
  - Lower quality and volume of produce from high temperatures
  - Decline in beech and other high-altitude plants
  - Biological changes in lakes due to less thermal circulation
  - Reduced range of cold freshwater fish species
  - More heatstroke patients
  - Increased range of insect vectors
  - Water cut off due to record dry spells
  - Damage from high tides during typhoons
  - Flood damage due to record heavy rains

# The impact of climate change on Japanese agriculture has begun

**Prefectures showing impacts**

**Trees: 100%, Vegetables: 90%, Rice paddies: 70%, Wheat/soy/livestock: 40%**

- **Fruit trees: poor colouring (reasonably low temperatures required for good colour). High temperatures lead to early flowering, then crops mature in hot conditions, failing to take on good colour**
- **Hot year in 2007 led to many problems in fruit such as thick skin and disease in nashi pears and peaches. Greenhouse nashi failed to bud in spring because of lack of cold in autumn/winter. The tropical Asian citrus disease *Huanglongbing* has now reached southern Kyushu and cannot be treated**
- **Immature rice due to shortened time between seeding and harvest – originally a problem in Kyushu, now spread as far north as Hokuriku and Tohoku**
- **Earlier harvesting times disrupt the usual patterns – price volatility**
- **Cabbages and lettuces too loose**
- **Chickens getting heatstroke, big livestock too hot in summer, cows cannot produce much milk**

**(2005 survey of agricultural research organizations)**

## Impact on people's lives

**Expected future impact**

- **The impact on lives is expected to be broad, in terms of safety, economics and higher level of psychological stress. The effect will depend on where people live (country or city) and who they are.**

- **Some major expected impacts:**
  - **Loss of life, assets (e.g. house) due to unusual weather, loss of workplace**
  - **Effect on transport and communication links due to unusual weather**
  - **More heatwave mortality, more hay fever**
  - **Higher household expenses due to more expensive food and more A/C use**
  - **More stress and discomfort in daily life from hot days and nights**
  - **Effect on recreation and tourism through habitat change – less mountain forest, disappearing beaches, shrinking marshland**
  - **Effect on sports industry through lack of snowfall, later flower season leading to cultural impact on communities, and loss of seasonal change**

## Disaster damage: coasts, big cities

**Forecast impact so far:**

- Effects are storm surges on the coast and flooding and landslides along rivers. There is little clear evidence of the impact of climate change so far, but the probability of such disasters occurring is likely to grow. Recently, annual rainfall variation has increased. A trend to lower rainfall is accompanied by more frequent short, intense rains.
  - ・Damage caused by storm surge during the 2004 Typhoon 23 on Nabae coast, Kochi Prefecture
  - ・Floods more frequent at the Itsukushima Shrine
  - ・Underground areas damaged in northern Kyushu by record rainfall seeping in
  - ・More frequent intense, localized downpours


Growing frequency of intense downpours (50mm/hr+) seen from 1978-2007 (annual average)

## Future effects (coasts, cities)

- **On the coast, damage is expected to increase as rising sea levels bring more surges, and shores and beaches are predicted to wash away. The effect of higher water and debris volumes flowing down rivers on inland flooding is still being researched. It is also possible that changes in traditional typhoon tracks will result in storm damage in normally unaffected places.**

**Major predicted effects**

**More powerful typhoons**

**Changed typhoons tracks leading to storm damage in SE-facing bays**

**More wind and wave damage**

**Coastal erosion as rising sea level leads to more waves reaching over defenses**

**Washing away of beaches (1m of sea level rise will take out 90% of beaches)**

**Less safe flood control measures in all waterways, more landslides due to snowmelt**

## Some adaptation policy options (coasts, cities)

- **Technology**
  - New building standards・Better coastal defences and stormwater systems・Super-levees・Better use/extended life of existing defences・Comprehensive management of sand and soil on rivers and coasts・Dam rebuilding
- **Information/knowledge**
  - Creation and distribution of hazard maps (using web); Stronger monitoring systems (long-term monitoring, real-time monitoring)
- **Policy options**
  - Change land use and regulations to prevent disaster (move houses, prohibit or restrict building in unsafe areas)・Impose comprehensive coastal management, disaster training and education
- **Economic/social options**
  - Establish autonomous disaster prevention groups; create a flooding insurance scheme for residents; establish a fund or subsidies for disaster recovery

## Global warming risk management: policies needed now

- Hope: Set the hazard level and clarify by when the risk will be controlled
- Attitude: Precautionary principle (act now, despite lack of certainty because risk is so great)
- Roadmap: Medium-term measures with timelines
  - No-regret measures: Strengthen social systems, etc.
  - Preparation for impact which scientifically is basically certain
- Urgent: Address current damage, assess weaknesses, developing countries, Japan…
- Compliance: Policy mechanisms, forecasting ability that allow rapid feedback in forecasting, changes and damage prevention measures

## Effective and efficient response to climate change

**Global Warming Response Research Committee, Ministry of Environment, June 2008**

- **Process**
  1. **Local weakness assessments**
  2. **Consider diverse policy options**
  3. **Consider prevention early and come up with a flexible, responsive system**
  4. **Create public consensus, involve related ministries/agencies, and ensure that the priorities are included in the planning of disaster planners, land use planners, urban planners, agriculture policy, nature conservation policy, local government environment policy.**
  5. **Based on "adaptation planning", establish a PROPOSAL-PLAN-IMPLEMENT-ASSESS-KAIZEN cycle.**

- **Address the issues wisely in view of local conditions such as ageing and depopulation. This may change the way of doing things and open up new solutions to other problems at the same time. The aim of the Committee is safer, better living in Japan, from a comprehensive, long-term perspective.**

## Major adaption options

- **Generally, there are many options for adaptation measures. Choices have to be made, although patchwork of measures may also work.**

- **Technology options**
  - **Technology and information/knowledge options promote development and use of special technologies, as well as technology related to overall planning. Other such options are monitoring, early warning systems and databases.**
- **Policy options**
  - **Legal system and human resource options**
  - **Legal options include laws, ordinances, system changes and can assist in promoting techno and social/economic options at the same time. Human resource options include increasing expert capacity, and awareness raising among decision-makers and the public.**
- **Social/economic options**
  - **Economic and social system options.**
  - **Economic options include insurance, subsidies, taxes and other incentives. Social options are encouraging the creation or changes to customs, culture or other aspects of social fabric.**

## Evaluation list for good adaptation

- Technology
  - Are diverse options considered/applied?
  - Are forecasts considered, even if there is uncertainty?
  - Is some redundancy allowed in the policy to account for uncertainty of forecasts?
  - Are monitoring, human resource development and other necessary aspects included?
- Policy
  - Are coordination and cooperation networks established between relevant groups?
  - Are long-term and short-term perspectives accounted for?
  - Is it mainstreamed (integrated into existing plans, etc.)?
  - Are unexpected impacts of climate change accounted for (systems for warning in place, etc.)
- Social/economic
  - Are local areas able to take action on their own behalf?
  - Are local weakness assessments taken into account? Are compensation and other appropriate economic measures prepared?

## Difficulty of adaptation: not keeping up with climate change

- Local environments: stable climate values?
- Policy cannot be appropriate forever.
- Climate change is an unpredictable foe: Hard to fight back
  - Unknown quantity: hard to make pinpoint predictions
  - The value of what will be lost is unclear until it is lost
  - Hard to keep up: the pace of change is too rapid
  - Inertia of society makes agreement difficult
  - Unbelievable things may happen: abrupt change
  - No end in sight. No guarantee warming will stop. Even with a continued adaptation response, this may not lead to a stable world. How long will we have to take action on this?

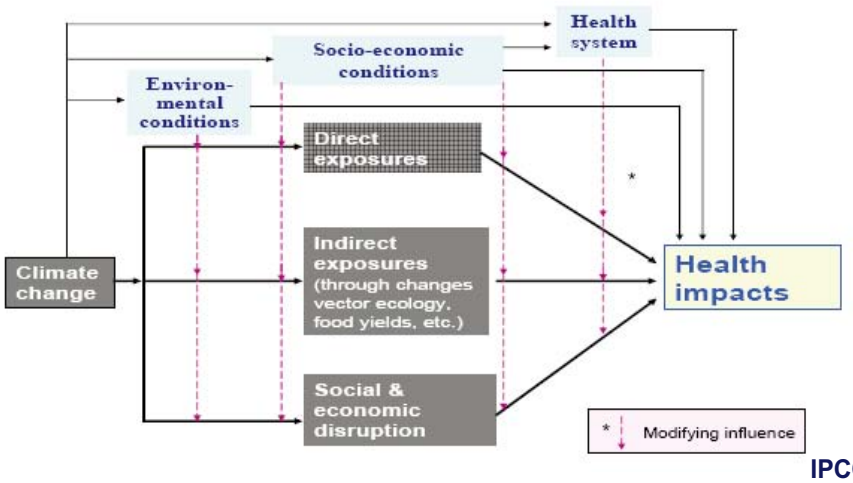
# Public health and climate change

IGES-WHO International Symposium on Climate Change
2 March 2009, Kobe, Japan

Dr Jacob Kumaresan
Director

World Health Organization
Centre for Health Development

## Climate change and health impacts




IPCC, 2007



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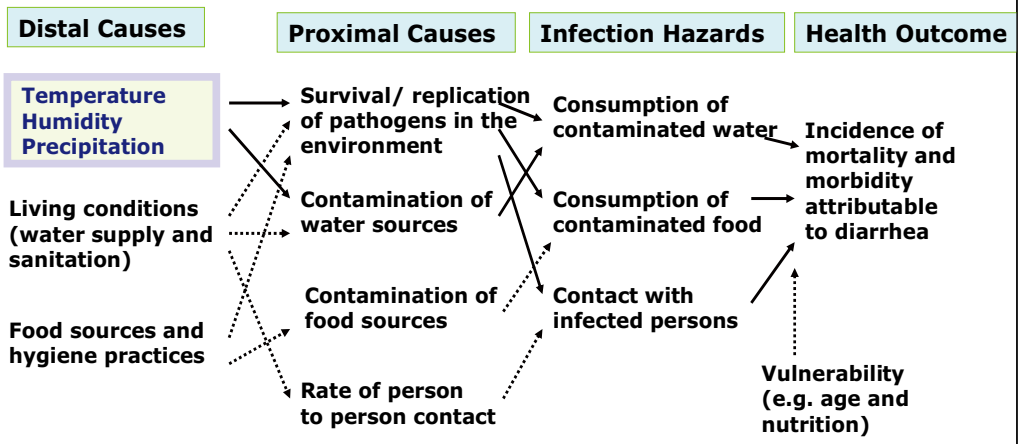
# Climate change increases health vulnerability

## Example: Diarrheal Disease



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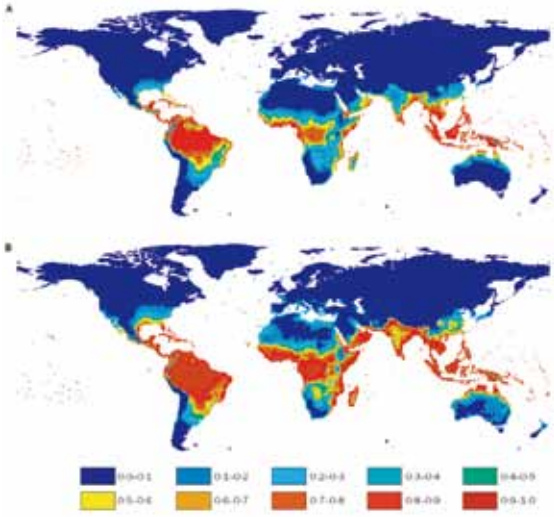
# Climate change and dengue



If other conditions hold constant, climate change is expected to increase the proportion of the global population exposed to dengue from about 35% (upper figure), to 50-60% (lower figure), by 2085.

Hales et al, *Lancet* 2002



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# Climate change will affect everybody but not in the same way

## Populations differ in vulnerability

- Children are most at risk from the effects of climate change.
- Heat primarily affects older people.
- Emergency service providers and labourers in outdoor environments are especially affected by extreme weather events.

Photo: Istockphoto



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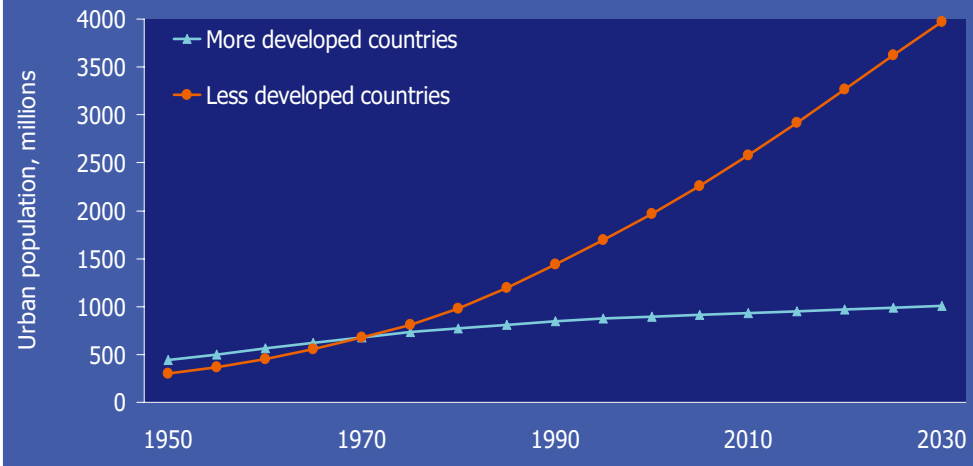
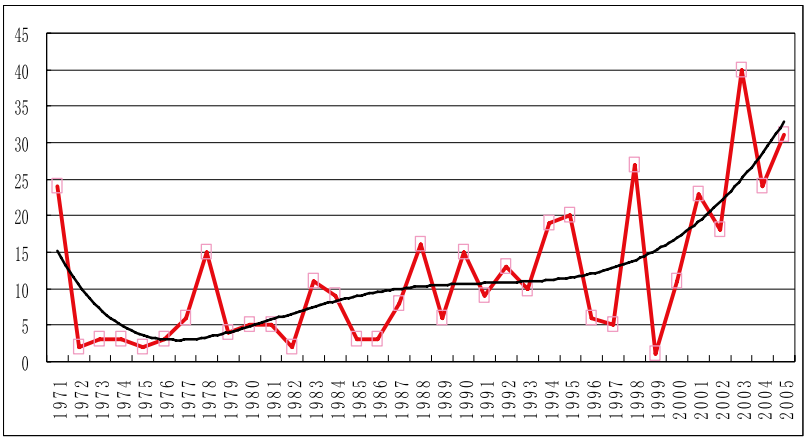
# Urbanization trends and projections




Source: *World Urbanization Prospects: the 2001 Revision.* New York, United Nations, 2002.

# Hot days in Shanghai, China




Source: Yuan, Shanghai CDC



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# Heat waves and extreme cold in Shanghai

- I998 Heat wave (8-16 August 1998):
  Average daily mortality increased by 300%
- 2008 Cold current:
  Number of excess deaths = 2,641

Source: Yuan, Shanghai CDC



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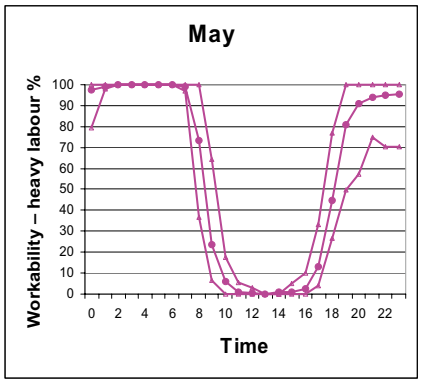
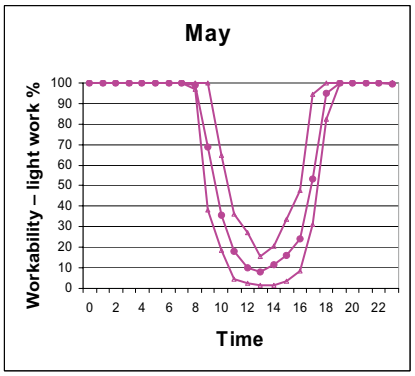
# Work ability outdoors
# New Delhi, India



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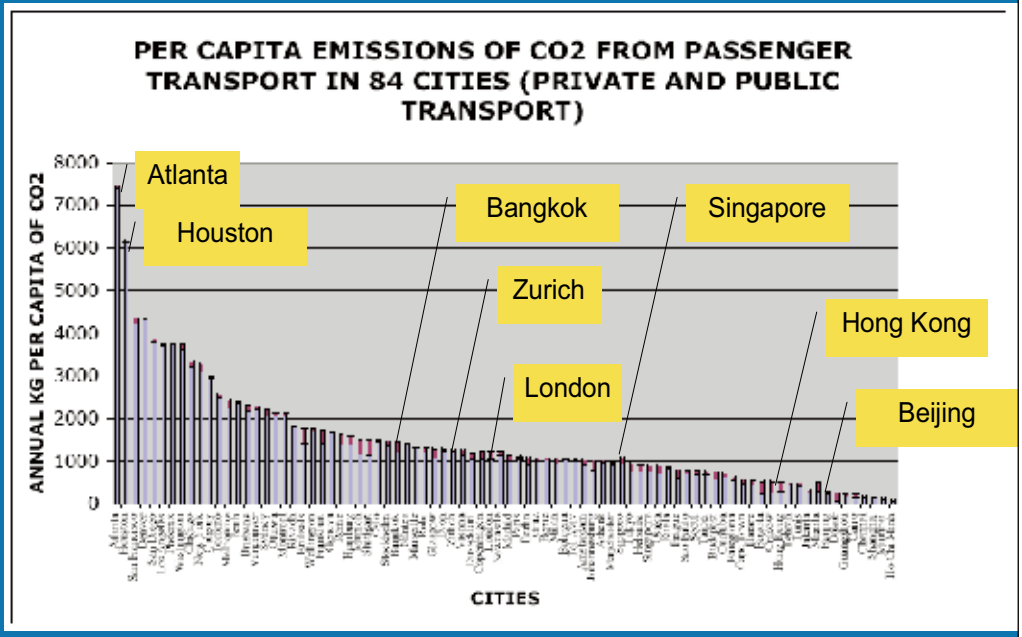
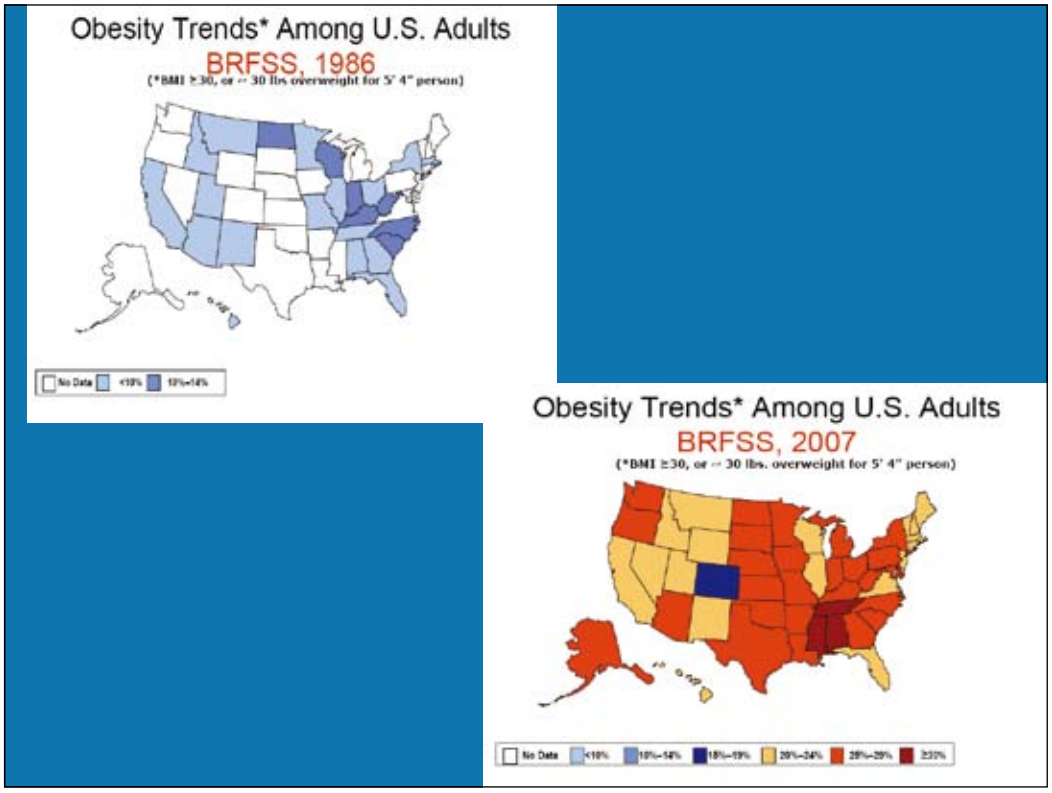
# Reducing emissions - cobenefits




Kenworthy, 2003




# WHO Centre for Health Development
# Kobe, Japan

## Raise awareness on health impacts:

- Mobilize champions
- Inform public and community
- Support local governments

## Research/evidence for policy making:

- Heat health impact assessment
- Health co-benefits research
- City health systems preparedness – vector borne diseases attributable to climate change



World Health Organization
Centre for Health Development

# Climate Change and Environmental Health: New Challenge to China

GUO Xinbiao
Peking University School of Public Health

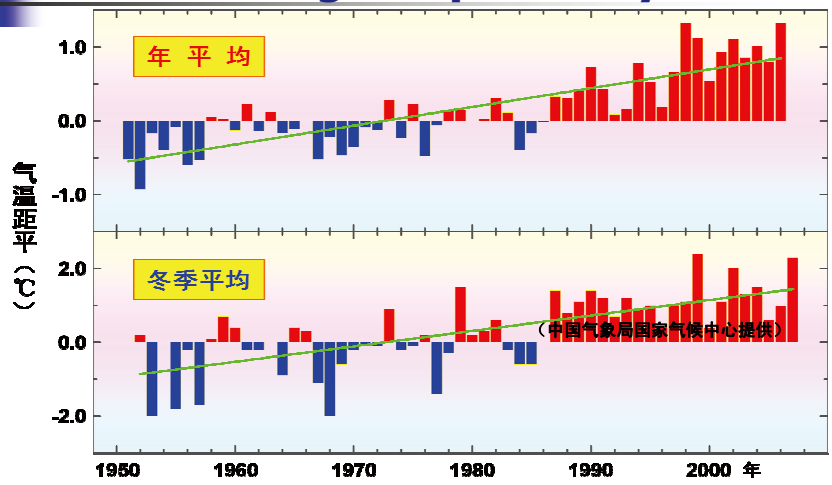
Translated by Secretariat

## Features of environmental health problems in China

- The exposed population is huge
- Population aging is accelerated
- The spectra of health effects are quite different between urban and rural areas
- Traditional and emerging health effects coexist

## Environmental health problem in China: the mirror of past, present and future pictures in developed countries.

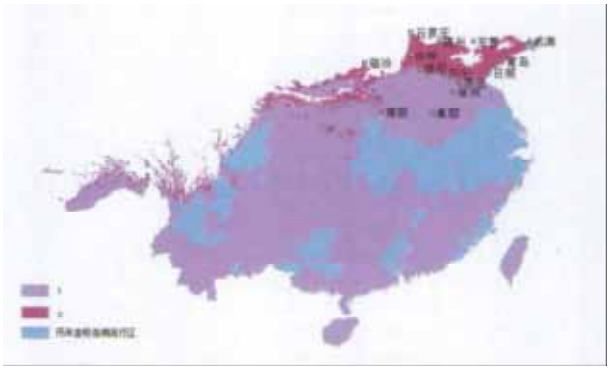
## Transition of average temperature in China during the past 50 years




Difference of the each year's (1951-2006) average temperature from the average temperature of 1961-1990

| Dirty Dozen (persistent organic pollutants) | Deadly Dozen |
|---|---|
| DDT, Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, Hexachlorobenzene(HCB), Mirex, Toxaphene, Polychlorinated Biphenyls(PCB), Polychlorinated dibenzo-p-dioxins and dibenzofurans(PCDD/PCDF) | Lyme disease, Yellow fever, plague, Bird flu, Babesiosis, Cholera, Ebola hemorrhagic fever, parasites, red tides, Rift valley fever, Sleeping sickness, T.B. |

## Predicted area of high possibility of schistosomiasis epidemic



**1: By 2050; 2: By 2100 (Peng W, et al., 2006)**

# National actions

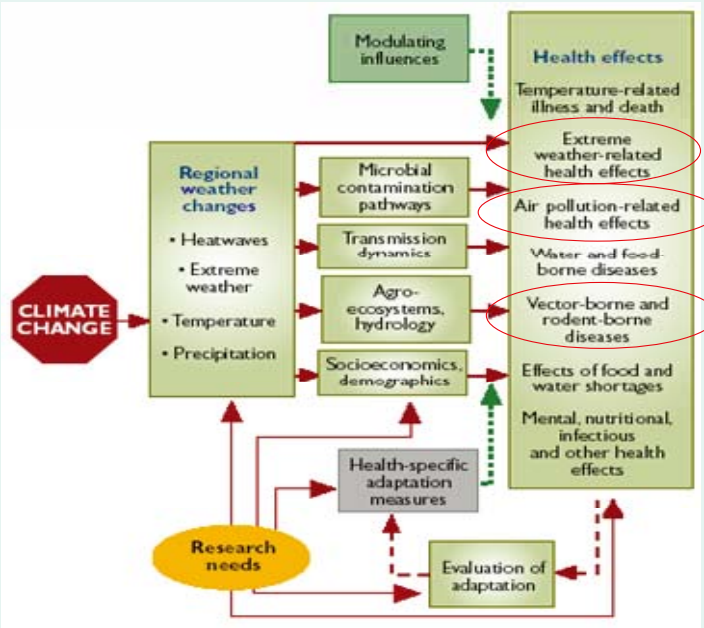
- In 2004, the web-based, real time reporting system for infectious disease outbreak started. It will be covering non-infectious diseases in the future.
- In Nov 2007, jointly led by the Ministry of Health and the Ministry of Environmental Protection, with 16 other ministries and agencies, China issued the "National Environmental Health Action Plan (2007-2015)"
- "National assessment report of climate change" and "National adaptation plan for climate change" were announced
- Several forums and symposia related to climate change were held




## Awaiting solution

- Increased adaptation capacity and its assessment
- Research and surveillance of health impact of climate change
- Related health education and promotion


## WHO climate change and health programme activities

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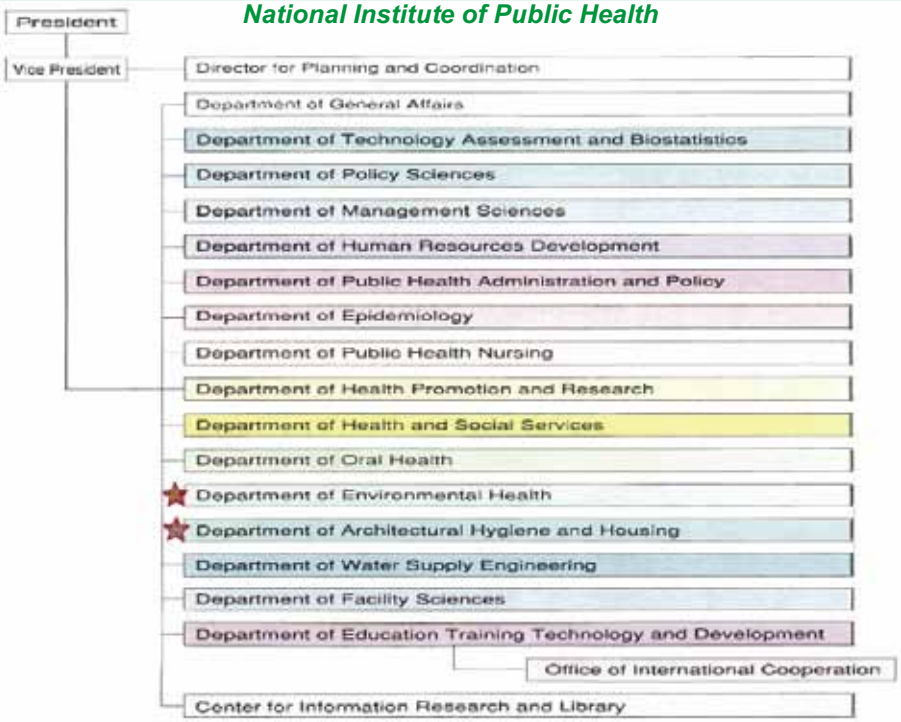
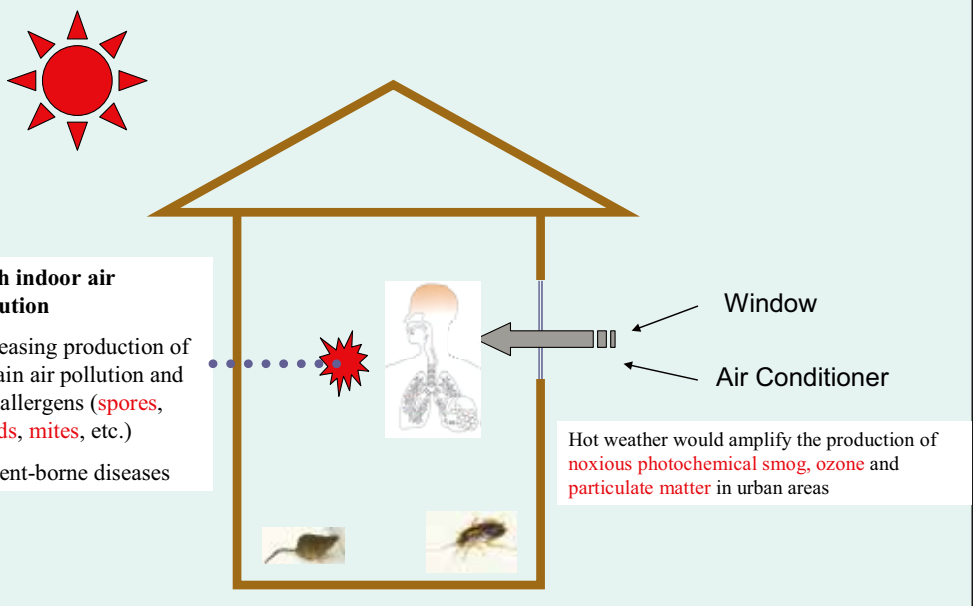
## National Institute of Public Health




**High indoor air pollution**

Increasing production of certain air pollution and aeroallergens (spores, molds, mites, etc.)

Rodent-borne diseases

Hot weather would amplify the production of noxious photochemical smog, ozone and particulate matter in urban areas

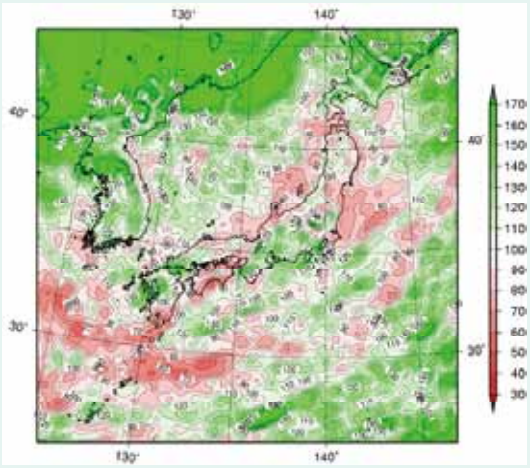
**Warm temperatures can increase indoor air pollution, which in turn harms human health.**

7

7

Tennozu Isle buildings, Tokyo

## Torrential downpours on the rise (increase of maximum rainfall )




Rate of change of maximum daily rainfall (%)
＝(average in 2081-2100) / (average in 1981-2000)

Reference :
http://www.data.kishou.go.jp/climate/cpdinfo/GWP/Vol6/pdf/gwp6_1.pdf
地球温暖化予測情報：気象庁：H17.3

Increase of regional maximum daily rainfall is predicted by global simulations, up 50% in 100 years.

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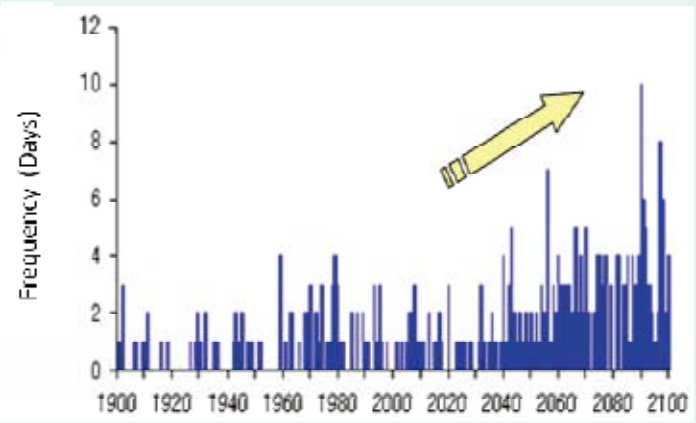
# More torrential rains expected in summer



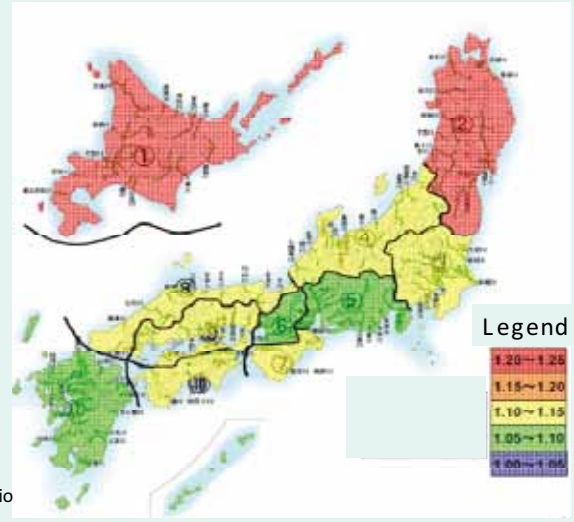

Number of days with more than 100mm rainfall increases from 3 to 10.

Reference: 東京大学等合同研究チームによる報道発表(2004.9)、
国土交通省国土交通審議会・河川部会資料

9

# Regional deterioration of flood safety caused by global warming (Rate of annual max. daily rainfall increase)

| | | |
|---|---|---|
| 1 | Hokkaido | 1.24% |
| 2 | Tohoku | 1.22 |
| 3 | Kanto | 1.11 |
| 4 | Hokuriku | 1.14 |
| 5 | Chubu | 1.06 |
| 6 | Kinki | 1.07 |
| 7 | South-Kii | 1.13 |
| 8 | San-in | 1.11 |
| 9 | Seto-uchi | 1.10 |
| 10 | South-Shikoku | 1.11 |
| 11 | Kyushu | 1.07 |




Rate of annual maximum daily rainfall increase

$$= \frac{\text{(average in 2080-2099)}}{\text{(average in 1979-1998)}}$$

Simulated by GCM20 using A1B scenario

Reference:
http://www.mlit.go.jp/river/basic_info/jigyo_keikaku/gaiyou/kikouhendou/pdf/080601_shiryo_08_11.pdf

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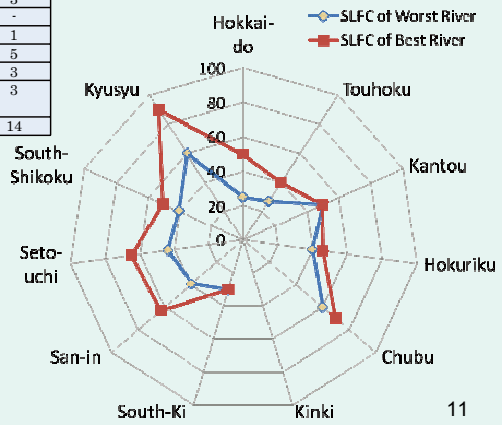
# Regional deterioration of flood safety caused by GW (Deterioration of Safety Level of Flood Control*)

| | Region | Predicted Change of Safety Level of Flood Control (SLFC) | | # of river system investi-gated |
|---|---|---|---|---|
| | | Predicted Rate of max daily rainfall Increase | Change of Safety Level in 100years (Return Period) | |
| 1 | Hokkaido | 1.24 | 1/25 - 1/50 | 8 |
| 2 | Tohoku | 1.22 | 1/27 - 1/40 | 5 |
| 3 | Kanto | 1.11 | 1/50 | 1 |
| 4 | Hokuriku | 1.14 | 1/40 - 1/46 | 4 |
| 5 | Chubu | 1.06 | 1/60 - 1/70 | 3 |
| 6 | Kinki | 1.07 | - | - |
| 7 | South-Kii | 1.13 | 1/30 | 1 |
| 8 | San-in | 1.11 | 1/39 - 1/63 | 5 |
| 9 | Seto-uchi | 1.10 | 1/44 - 1/65 | 3 |
| 10 | South-Shikoku | 1.11 | 1/41 - 1/51 | 3 |
| 11 | Kyushu | 1.07 | 1/60 - 1/90 | 14 |

1/100 (present plan)

*SLFC: Safety level of Flood Control
= Inverse number of Return period [-/year]

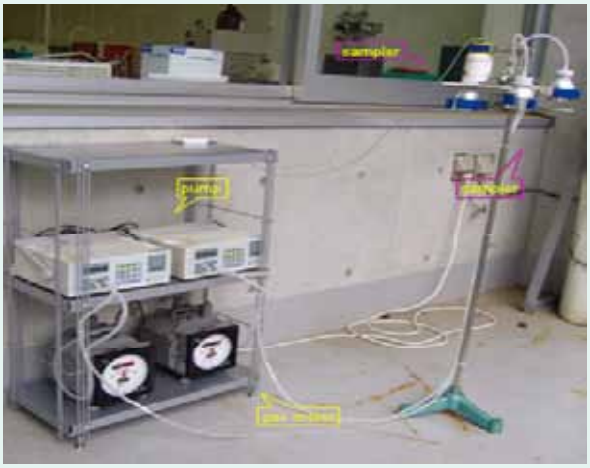


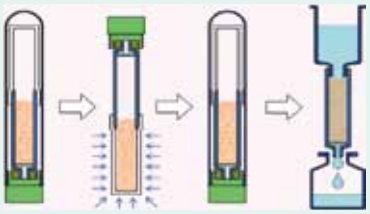

11

## Development of a diffusive sampling device for measurement of ozone in ambient air

Uchiyama, S.; Inaba, Y.; Matsumoto, M.; Suzuki, G. (National Institute of Public Health)

**Measuring ozone using the DSD-OZONE device**



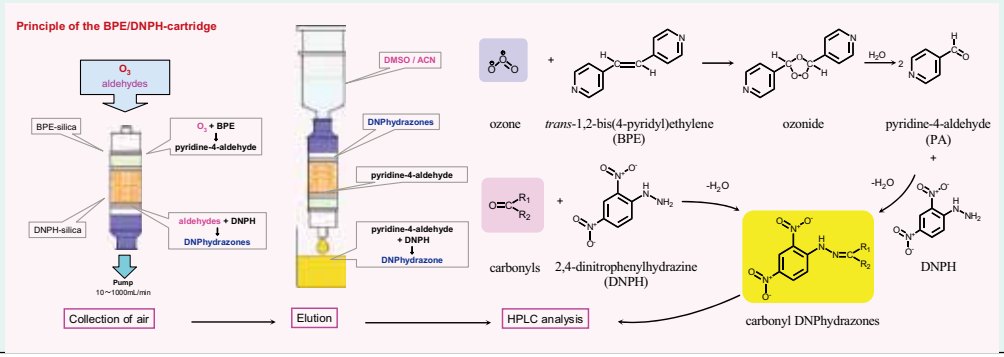
Parallel sampling with diffusive and active sampling

12

Simultaneous Determination of Ozone and
Carbonyls Using *trans*-1,2-Bis(4-pyridyl)ethyleneas an Ozone **Scrubber**
for 2,4-Dinitrophenylhydrazine-Impregnated Silica Cartridge

Uchiyama, S.; Inaba, Y.; Matsumoto, M.; Suzuki, G. (National Institute of Public Health)

**A new method for the simultaneous determination ozone and carbonyls in air using a two-bed cartridge system has been developed. Each bed consists of reagent-impregnated silica particles. The first contains *trans*-1,2-bis-(4-pyridyl) ethylene (BPE) while the second contains 2,4-dinitrophenylhydrazine (DNPH). Air samples are drawn through the cartridge first through the BPE and then through the DNPH. Ozone in the air sample is trapped in the first bed by the BPE-coated silica particles and produce pyridine-4-aldehyde.**




# Global air pollution

Particulate and gaseous contaminants which adhere to Aeolian Dust are transported even to a distant place

Reference
NASA Goddard Institute for Space Studies
Asahi Shimbun, Apr. 19, 2001

14


## Background

- Kyoto Protocol entered into force Feb 2005
- From 2008 to 1012 Japan has a legally binding commitment to reduce its greenhouse gas emissions by 6% below 1990 level
- The impact of global warming on business is growing, and can no longer be ignored
- It is essential for management to grasp the risks and map out a strategy

2

## Environmental strategy for insurance industry

Insurance is an industry with a light ecological footprint,
yet it has been ahead of most of the finance sector

- Through insurance services
- Reduces its business activity ecological footprint and contributes to environmental awareness-raising

3

## "Green" insurance products

- Discounted car insurance for environment-friendly cars
- Insurance for greenery – to replace trees and shrubs lost by fire or other incident
- Eco-insurance

  e.g. cover to pay for added cost of eco-friendly materials in construction

  cover to pay for surveys of pollution caused by accidents

4

## Environmental protection through project finance

- Financing for wind farms
- Financing for environmental ventures (recycling, energy conservation projects, biomass power generation, etc.)
- Environmental assessment for credit analysis (indirect method of restricting environmentally destructive activities by reducing credit to offending businesses)

5

## Insurance for damage from climate change

- Risk hedges against low wind (cover for wind farms in case of profit loss due to substantially weaker-than-expected wind speeds)
- Abnormal weather insurance
- Climate derivatives (irrespective of actual damage, these pay out in the case of certain weather conditions such as typhoon, rain or temperature)

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## A typhoon wind damage evaluation that reflects global warming

- The IPCC report did not give enough weight to the influence of global warming on typhoons/hurricanes/cyclones
- According to UK insurers, an average 6% rise in typhoon wind speed would push up insurance claims 60%
- We will verify the difference between current and future wind speeds using a typhoon simulation model and global data on numbers and strength of typhoons
- We will assess how this wind speed change will affect insurance payouts

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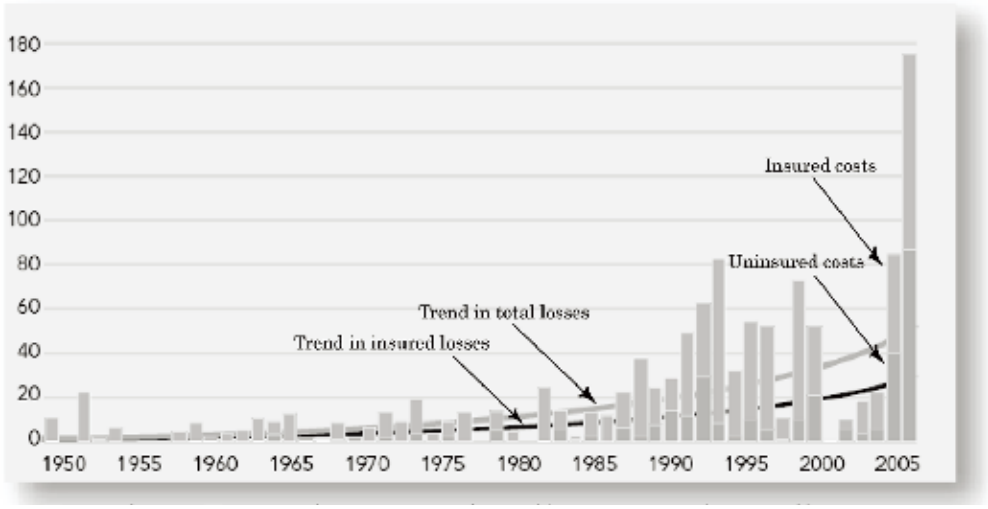
## Economic losses from disasters, US$bn (UNEP)

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## Method used to evaluate future typhoon activity

- Parameters: number of typhoons and central low pressure
- 30% less tropical depressions will strike in latter half of 21st century (Oouchi and Yoshimura)
- 14% deeper low pressure in latter half of 21st century (Knutson and Tuleya)
- In the following charts, the probability distribution of typhoon strikes and central pressure are based on 1932-1996 data

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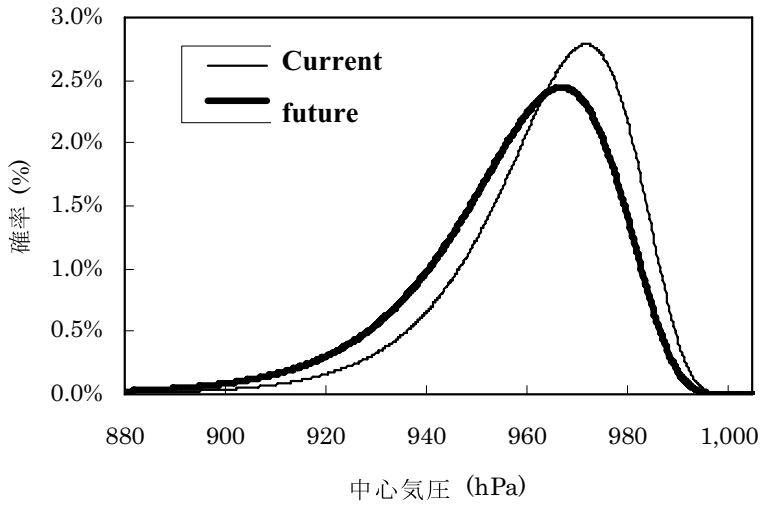
## Probability distribution of central low pressure of typhoon in one year

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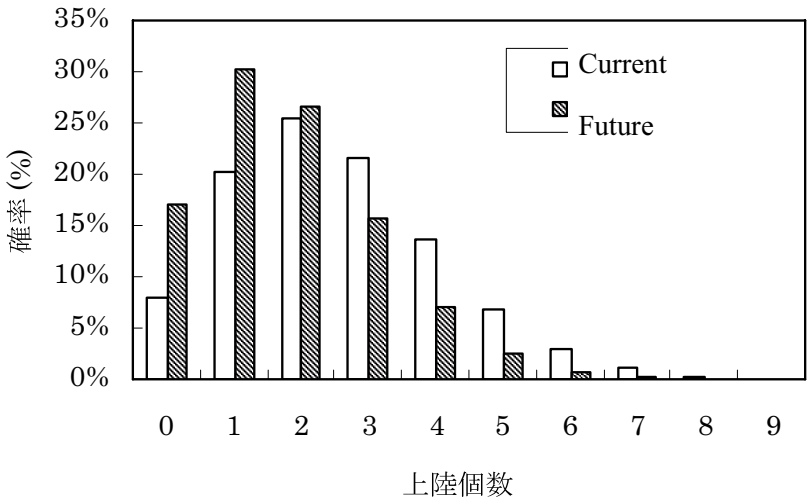
## Probability distribution of typhoon strikes on Japan mainland in one year

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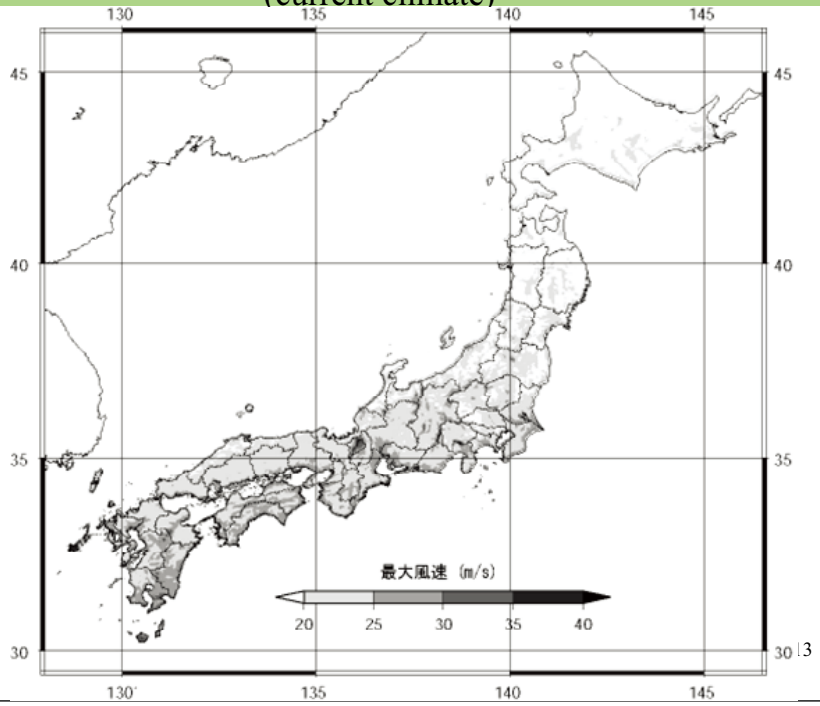
## Distribution of max wind speed over 100 years simulated (current climate)


12

## Distribution of max wind speed over 50 years simulated (current climate)

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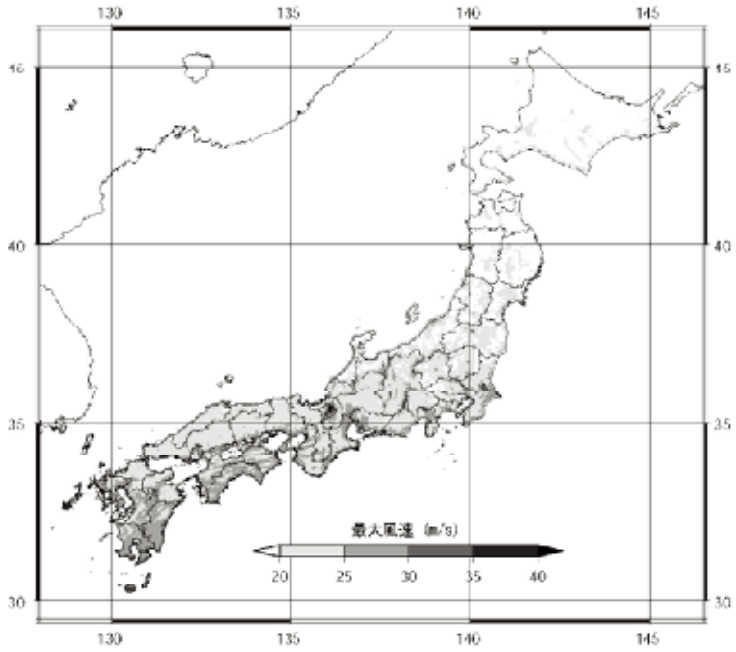
## Distribution of max wind speed in 50 years simulated

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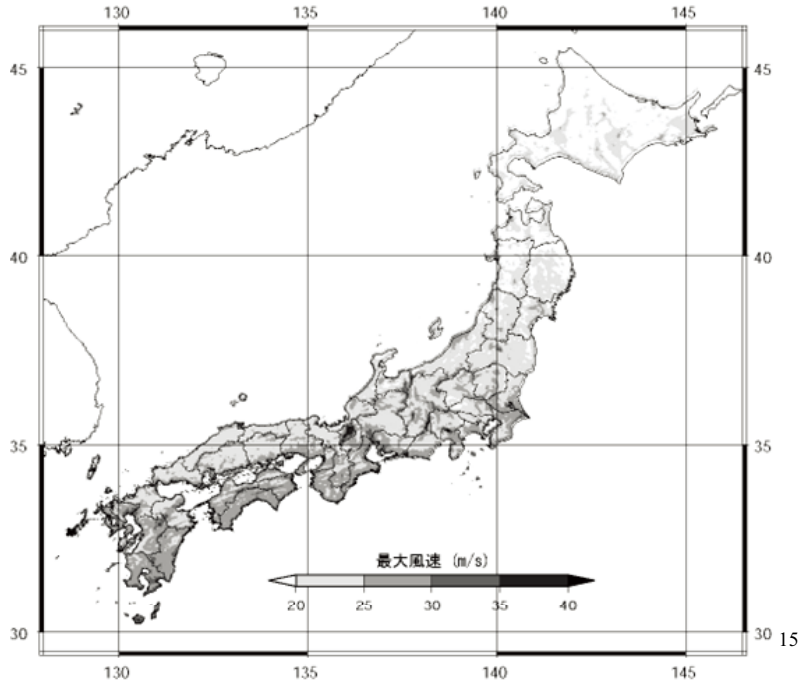
## Distribution of max wind speed in 100 years simulated

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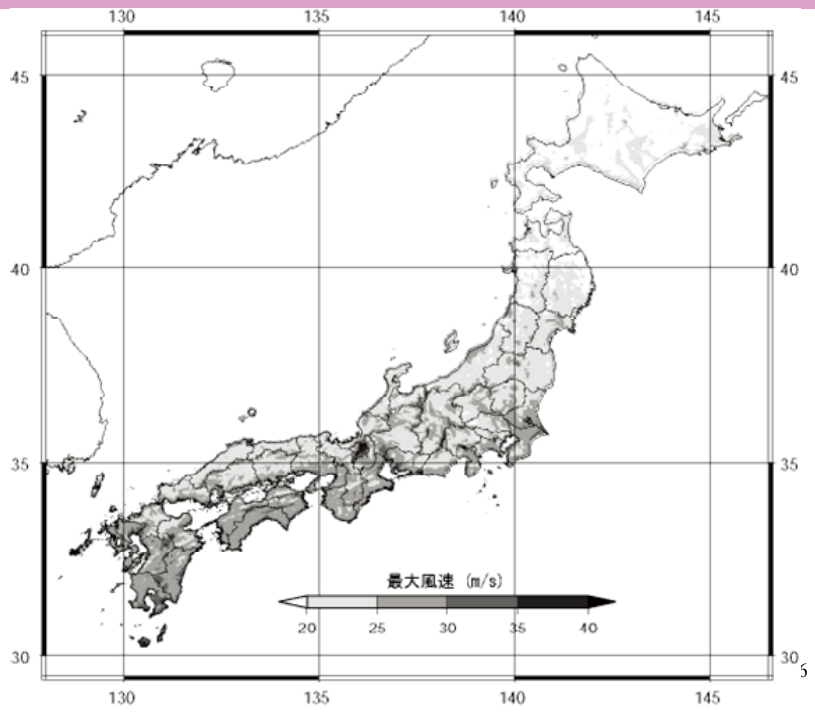
## Rate of increase of max wind speed over 50 years simulation to current situation

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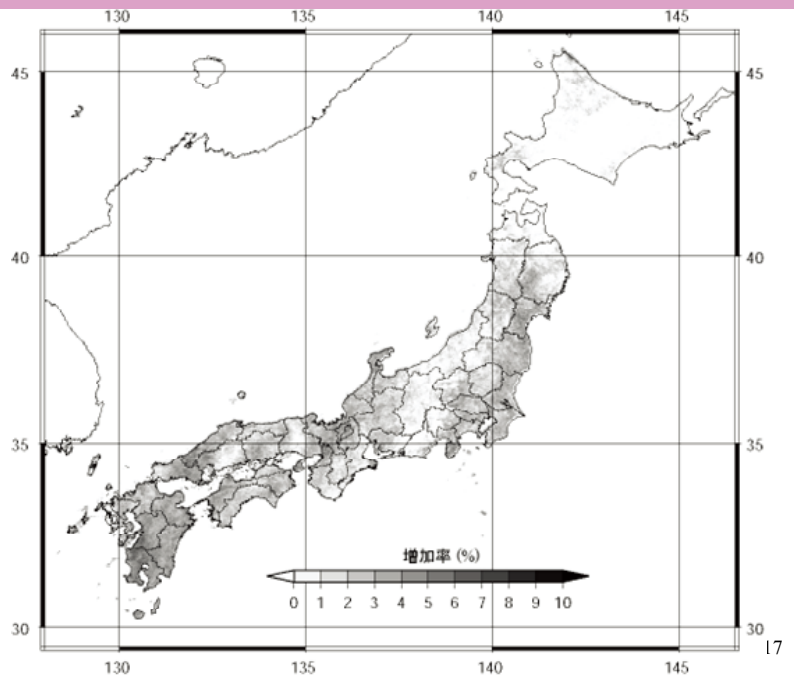
Increasing rate of max wind speed over 100 years simulation to current situation

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## Simulation of future wind speeds

- Over 50 years, the rate of maximum wind speed is simulated to increase in Kyushu and the rest of western Japan, and the Pacific coast in eastern Honshu. The rate would decrease for Hokkaido.
- Over 100 years, the same result is seen, but the increase is observed further north in Miyagi and Iwate Prefecture.
- Our simulation for 50 years and 100 years shows that maximum wind speed under future climate conditions will be greater in western Japan and the Kanto area.
- However this simulation didn't alter the standard variation, which would greatly affect to the result. To evaluate the standard variation under future climate conditions, a simulation using a high resolution global model is needed.

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## **Typhoon damage under future climate conditions** (quantitative evaluation)

- We calculated typhoon damage under future climate conditions for each simulated period.
- Over 7 years and 10 years, the future climate shows less damage. However over 25 years or more, there is more typhoon damage under future climate conditions.
- Therefore, insurance payouts will be smaller for weak typhoons than today, but in the rare case of a more intense typhoon, they will be more than now.

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## Conclusion

- Global warming is certain to affect insurance and all other business sectors.
- Global warming should not just be seen as a risk but importantly, as a business opportunity.

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**Disclaimer**

This meeting report contains the views of the presenters at the IGES-WHO Joint International Symposium on Climate Change, Environment and Health, 2 March 2009 and does not necessarily represent the decisions or the stated policy of the World Health Organization.