15TH INTERNATIONAL CONGRESS OF BIOMETEOROLOGY & INTERNATIONAL CONFERENCE ON URBAN CLIMATOLOGY

"BIOMETEOROLOGY AND URBAN CLIMATOLOGY

AT THE TURN OF THE MILLENNIUM"

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Abstract

Weather and climate conditions affect significantly the health and well-being of life on the planet Earth. Human beings, animals and plants respond physiologically to a number of atmospheric conditions including temperature, precipitation, humidity, wind, solar radiation and air pollution. Although ecosystems have a great capacity to adapt to variations in climate and environmental conditions, stress beyond tolerable limits can be very destructive. For instance, extremely high air temperatures can cause heat stroke and death. Recent studies provide evidence that the relationship between human mortality and thermal stress is stronger than expected with deaths rising by more than 50% above the normal baseline levels during unusually hot episodes. Mortality resulting from heat stress in urban areas is expected to increase substantially over the next few decades. Extreme climate stress also arises from natural disasters such as tropical cyclones, droughts and floods. Natural disasters are also often linked, directly or indirectly, to health problems. They often create conditions that are favourable for certain diseases such as malaria, cholera and diarrhoea. Droughts can also trigger mass migration, hunger and malnutrition and may engender diseases that are linked to lack of food and clean water.

The world's largest scientific forum on biometeorology and urban climatology, the 15th International Congress of Biometeorology (ICB) and the International Conference on Urban Climatology (ICUC), was held jointly for the first time in Sydney, from 8 – 12th November, 1999, with the participation of leading scientists, meteorologists and academics from all five continents. Coordinated by the World Meteorological Organization (WMO) and the International Society of Biometeorology (ISB), the two scientific meetings held joint working sessions to break the walls between various disciplines. Over 400 papers, submitted by a large number of scientists, researchers, universities and specialized institutes, dealt with

the topics varying from genetic adaptation and animal biometeorology to satellite and remote sensing of urban climates. Experts from ICB and ICUC were able to exchange views and draw up some common strategies in addressing those issues. In addition to minimizing the duplication of efforts, this approach also provided opportunities for developing synergies in fields that can significantly contribute to the welfare of humans. The Congress and Conference examined the impacts of urban climates on human health, ecosystems, energy utilization in buildings, energy resource efficiency and urban design. They also explored issues such as the impacts of global warming, El Niño and the Antarctic ozone hole on the levels of morbidity and mortality as well as on the indoor climate and air quality, climate changes and decision-making. Linkages with other branches of social and natural sciences were discussed. Strategies and programs for human adaptation to significant changes in the climate over the next 100 years and the development of appropriate international, national and community responses to worsening natural disasters were also high on the agenda. The major scientific themes (sessions) and key topics addressed by the 15th International Conference on Biometeorology and International Conference on Urban Climatology are discussed in the contribution.

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Weather and climate conditions have significant effects on health and the well-being of life on planet Earth. Human beings, animals and plants respond physiologically to a number of atmospheric conditions, including those of temperature, precipitation, humidity wind, solar radiation and air pollution. Although ecosystems have a great capacity to adapt to variations in climate and environmental conditions, stress beyond tolerable limits can be very destructive. For instance, extremely high air temperatures can cause heat stroke and death. Recent studies provide evidence that the relationship between human mortality and thermal stress is stronger than expected with deaths during unusually hot episodes rising over 50% above normal baseline levels. Mortality resulting from heat stress in urban areas is expected to increase substantially over the next few decades. Extreme climate stress also arises from natural disasters such as tropical cyclones, droughts and floods. Natural disasters are also often linked directly or indirectly to health problems. They often create conditions that are favourable for certain diseases such as malaria, cholera and diarrhoea. Droughts can also

trigger mass migration, hunger and malnutrition and may engender diseases that are linked to lack of food and clean water.

The Intergovernmental Panel on Climate Change (IPCC) concluded some years ago that human-induced activities could lead to changes in the mean global temperatures of between 1 to 3.5^{o}C. Such changes may cause zones with suitable habitat for species to move. Significant reduction of soil water availability could lead to forest decline. There could also be indirect problems such as more floods and greater erosion caused by more intense rainfall. Lakes, streams and wetlands will be influenced by altered water temperatures, flow regimes and water levels. The degradation of the savanna ecosystems will have further implications for animals and migratory birds. Deserts are likely to become hotter and not wetter. Altered rainfall amount, seasonality and increased evapotranspiration will lead to major alterations in productivity and species composition in tropical rangelands. In a warmer climate, general circulation models project that between one-third and one-half of existing mountain glacier mass could disappear over the next 100 years.

Human activities are also known to deplete the atmospheric ozone that protects life on planet Earth from dangerous UV radiation from the Sun. Such dangerous radiation has been associated with health problems such as sunburn, suppression of the immune system, skin cancer and eye damage, as well as with adverse effects on plants.

According to UN estimates, world population reached the six billion mark in October, 1999, and is estimated to be about 8 billion by the year 2025 and 10 billion in the year 2050. Already about ½ of the world's population lives in urban areas and predictions for the year 2025 shows that 2/3 of the world's population will be city dwellers. Urban areas are particularly vulnerable to changes in environmental conditions. Unplanned settlements and urban centers are particularly sensitive to natural disasters, since 1/3 of the urban populations lives in sub-standard housing and 40% do not have access to save drinking water or adequate sanitation. Furthermore, the urban population is increasingly subjected to an environment which is often polluted by metals, pollen and fungal spores, as well as toxic emissions and gases. Such pollutants are produced from burning of fossil fuels, urban water waste discharge, factories, offices and residential area. Some of these pollutants have been associated with acid rain and dry toxic deposits, which continue to contaminate farmlands, forests, water sources and fish stocks, in many parts of the world. Local effects from pollutants such as smog and low-level ozone concentrations, as well as the presence in the air of certain pollens, have also been linked to acute attacks of asthma and other respiratory diseases.

It is also well known that urbanization and other land use activities can change the climate on a local level and create heat island and urban-rural wind effects that have far-reaching implications for pollution transmission. The health of populations in distant areas can therefore be affected by pollutants transported from a distant point source such as a small number of factories in urban areas. However, in large cities, the combination of urban wind, temperature, rainfall, humidity and air quality can make the urban populations more vulnerable than their rural counterparts.

The world's largest scientific fora on biometeorology and urban climatology, the 15th International Congress of Biometeorology (ICB) and the International Conference on Urban Climatology (ICUC), was held jointly for the first time in Sydney from 8 - 12 November 1999 with the participation leading scientists, meteorologists and academics from all five continents. Coordinated by the World Meteorological Organization (WMO) and the International Society of Biometeorology (ISB), the two scientific meetings held joint working sessions to break walls between various disciplines. The conferences were also sponsored by the United Nations Environment Programme, the World Health Organization (WHO), the Australian Bureau of Meteorology, Macquarie University, the German Meteorological Society (DMG) and the University of New South Wales (UNSW).

In an opening address underlining the importance of the event, Prof. Godwin Obasi, Secretary-General of WMO, invited the participating scientists to explore new ways of modifying the biological impacts of climate change, including urbanization policies, within the framework of the Climate Agenda. Prof. Obasi also called for the initiation of services such as, UV and sunburn forecasts, thermal advisories and bioclimatic maps to alleviate the impacts of excessive heat stress, air pollution and high pollen and dust counts throughout the world. He pointed that in view of the growing concern regarding the continued growth in the world’s population especially in urban areas, the degradation of the environment, the dwindling water resources and the projected impact of climate change on sustainable development, the joint scientific event was timely, and it was appropriate that it would deal with topics related to the interactions between atmosphere and the biosphere as well as those related to urban atmosphere and the hydrosphere.

Over 400 working papers submitted by a large number of scientists, researchers, universities and specialized institutes dealt with topics varying from genetic adaptation and animal biometeorology to satellite and remote sensing of urban climates. Experts from ICB and ICUC were able to exchange views and draw up some common strategies in addressing

those issues. In addition to minimizing duplication of efforts, this approach also provided opportunities for developing synergies in fields that can significantly contribute to the welfare of humanity. The Congress and Conference examined the impacts of urban climates on human health, ecosystems, energy utilization in buildings, energy resource efficiency and urban design. They also explored issues such as the impacts of global warming, El Niño and the Antarctic ozone hole on the levels of morbidity and mortality, as well as indoor climate and air quality, and climate change and decision-making. Linkages with other branches of social and natural sciences were discussed. Strategies and programs for human adaptation to significant changes in climate over the next 100 years and the development of appropriate international, national and community responses to worsening natural disasters were also high on the agenda. Following were the major scientific themes (sessions) and key topics addressed by the two scientific meetings.

15th International Conference on Biometeorology

Medical, health, adaptation: Topics related to climate change and variability were discussed. In specific, impacts of heat waves and cold spells on mortality, indirect influence on infectious diseases, spores, pollutants, and evolutionary perspectives were described. Health effects of climate variability and ENSO on diseases such malaria, as well as on respiratory and neural problems were stressed. UV radiation impacts were pointed out by several examples such as facial exposure and protection strategies. Further, forecast models and modeling approaches of UV radiation within canopies were proposed. Other topics were related to advices and maps of heat stress related to human biometeorology. New heat health warning systems and heat waves-case studies were also presented.

Phenology: Increasing importance of phenological gardens for global change studies was specified. Methods of remote sensing and examples, as well as biodiversity studies were presented.

Vegetation and agriculture: New measurement techniques and systems related to micrometeorological problems such as footprints, energy balance closure gaps, forest evaporation, crop water loss and Bowen's ratio and canopy temperatures were presented. Scaling problems such as linking remote sensing to local climate models were also discussed. Several lectures were related to climate change and variability, e.g. desertification and climate change, water use and CO_2. Crop related research studies included weather and yield components, weather generators for crop modeling, disease algorithms, plant water stress in SVAT models. At the session related to the microclimate of forests modeling approaches of

transpiration of trees, surface conductivity and turbulent exchange in forests were described. It was pointed out by several scientists that knowledge from forest microclimatic studies can have some significance for urban canyon climate studies.

Thermal stress and comfort: Several indexes were discussed as well as a model for outdoor thermal comfort index. Other topics were mean radiation temperature and solar radiation and thermal physiology in man. Several papers covered index applications such as recreation climate assessments. Adaptations to thermal stress and comfort were stressed (effect of hill slides in cities, heat adaptation of humans, ventilation effects). Indoor climate studies were presented, especially focused on thermal comfort in schools.

Animal biometeorology: Modeling climate in livestock buildings and their ventilation, heat stress effects on cattle and predicting their body temperatures were specified.

Physical processes and models: Distinctive related problems were presented (estimation of land surface fluxes, use of remote sensing data for SVAT models, disease algorithms, greenhouse climate models, tourists and cave climate, assessments of uncertainty in climate models by land surface representation, structure of cold air drainage layer on slopes)

International Conference on Urban Climatology

Urban boundary layer models: Methods of modeling of urban heat island, linking different special scales and mesoscale models, and the introduction of local canyon geometry in the models were proposed.

Urban climate trends: The effect of urban fringe and urban heat index (UHI) variability were presented within some case studies.

Urban canopy layer: The calculation methods of sensible heat exchanges in urban canyons were discussed as a significant problem. The problems of urban ‘standard’ stations and the need for standards, wind flow models, mesoscale development, street canyon models and road climate studies were further specified.

Urban climate: Several case studies on urban climate mostly from sub- and tropical cities were presented at this session. Specific effects of sea-land air circulation and topographical aspects were especially addressed.

Building design and human comfort: Natural ventilation studies in buildings were presented.

Urban hydroclimates: Problems related to evapotranspiration at different scales, urban dew modelling, impact on diseases, urban humidity island studies were covered.

Urban planning, human environment & sustainability: Strategies to improve urban climate and planning programs were stressed.

Methods: Estimating "universal results" was pointed out and a method of wind comfort measurements by infrared techniques was proposed.

Urban heat islands: The often investigated heat island problem was stressed. Studies such as multi-temporal remote sensing of UHI, comparisons of rural-urban areas, UHI and city size, case studies, monitoring and modelling methods were discussed. Also a case study on urban cold island was presented.

Health and thermal comfort in cities: Assessments of human thermal climate and case studies such as trends in mortality were presented.

Radiation & remote sensing: The radiation climate plays a major role in urban climates. This problem was therefore addressed in this scientific session, where studies on solar radiation in urban areas, spatial/temporal radiation receipt in urban areas, urban surface sensible heat fluxes, surface temperatures, modelling and measurements, mapping methods were presented and discussed.

Urban design and climate: Studies on urban dayligth climate, impact of urban spaces and mapping temperature variations in cities using GIS were discussed

Local flows: Local flows can change urban climate patterns considerably. Cold air flows in cities, urban air temperatures and wind field, impact of spatial resolution of methods estimating urban ventilation and some case studies of local flow patterns were especially addressed.

Urban boundary layer structures: Urban boundary layer structures were investigated by use of some case and modeling studies.

Air quality: Dispersion models and effect of aerosolos on urban climate were presented at this session.

Urban climate and vegetation: Urban vegetation impacts were presented in several lectures (climatic effects of trees in street canyons, shading effects of trees and housing, modelling the effects of urban vegetation and spaces, reducing UHI by roof gardens, park climate and urban air quality, nocturnal cooling by urban tree canopies).

Urban micro-environments: Such kind of environments were investigated for subway stations and air conditioning studies.

Turbulent transfer: Papers regarding scintillometry in urban areas, fluxes and resistances for cities, heat flux over flat roof building were presented.

Energy use and climate: Finally, a few reports on urban warming and artificial energy use were also presented.

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