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HONG KONG OBSERVATORY

Reprint 707

Climate Change - Meteorologists in Action

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International Conference on Climate Change,

Hong Kong, China, 29-31 May 2007

CLIMATE CHANGE – METEOROLOGISTS IN ACTION

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Summary

Meteorologists were the first group of people to sound the alarm about global climate change attributable to human beings. This paper describes a number of events in the past three decades, to illustrate how the international meteorological community under the championship of the World Meteorological Organization (WMO) responded to the emerging signs of human-induced climate change, both in a rational approach to understand the phenomenon and in an active way to engage a wide spectrum of partners and stakeholders. The work of Hong Kong Observatory (HKO), as an example of the meteorological services which constitute the WMO, in studying the regional impact of global climate change and in reaching out to the community to motivate them to take actions in the face of climate change is also described.

Keywords

Climate change, meteorologists, WMO, meteorological services

1. Introduction

The climate on Earth has always been changing, associated with various natural causes such as orbital changes, moving continents, evolving biological composition, fluctuating solar radiation output, etc. The rate of such changes would be very gradual and almost imperceptible at the time scale of decades. However, in the early 1970s, the occurrence of climatic extremes such as rain and drought persisting for months or even years led to speculations that a major climatic change might be occurring on a global scale. Much debate arose as to whether the observed phenomena were part of the “natural” short-term variability of climate or whether they were due to climate change resulting from human activities. In this connection, the WMO set up a specialist panel to study the subject, which marked the beginning of a long chain of events, eventually leading to the much publicized 4th *Assessment Report* of the Inter-governmental Panel on Climate Change (IPCC), which is scheduled to be published in 2007. This paper looks back at the events, to appreciate how meteorologists, working together at the international level and coordinated by the WMO, applied the rational approach to understand the phenomenon and how they actively engaged a wide spectrum of partners and stakeholders to deal with the multi-faceted impacts of climate change.

To avert human-induced climate change hazardous to the human race itself, human societies have to change their way of living, particularly regarding the use of energy and material. This is a mammoth task requiring major attitude changes among other things. Meteorologists have to help the community understand how human beings have brought about the recent observed climate change, its adverse impacts and what people could do both to adapt to inevitable changes as well as to prevent even more harmful changes in the future. It requires meteorologists to reach out to the community, to teach and to preach. The work of Hong Kong Observatory, the meteorological service in Hong Kong Special Administrative Region of China, is described to illustrate the activities involved.

2. World Meteorological Organization (WMO)

2.1 The first WMO statement on climate change

At the international level and within the UN system, meteorologists were the first group of people to sound the alarm about global climate change attributable to human beings. In 1976, the Executive Committee of WMO issued the first statement on the accumulation of carbon dioxide in the atmosphere and the potential impacts on climate [WMO, 1976]. To give it a historical perspective, it might be noted that the carbon dioxide level in 1976 was about 330 ppm, midway between the pre-industrial revolution level of 280 ppm and the present level of 380 ppm (fig. 1).

Limited by the little data and understanding then prevailing, the statement could not rule out “climate variability” as the cause of weather extremes but did go as far as saying that “the possible change of climate resulting from man’s activities is at least of equal concern”. It also specifically pinpointed “burning of oil and coal” as the source of increasing carbon dioxide in the atmosphere and said that “this could produce a long-term warming and, as a consequence, large-scale changes in rainfall distribution”.

The statement further recognized that climate change could “seriously disrupt urban communities, interfere with agriculture, industry and commerce, and hamper economic and social development”, specifically mentioning food as a key issue. Thus, right at the outset, it was recognized that climate change was not purely a subject of scientific interest but rather would be a phenomenon which would impact on practically all sectors of human activities and was intimately linked to the sustainable development of human communities. This dictated that WMO would have to work with many partners to cope with the multi-disciplinary nature of the subject.

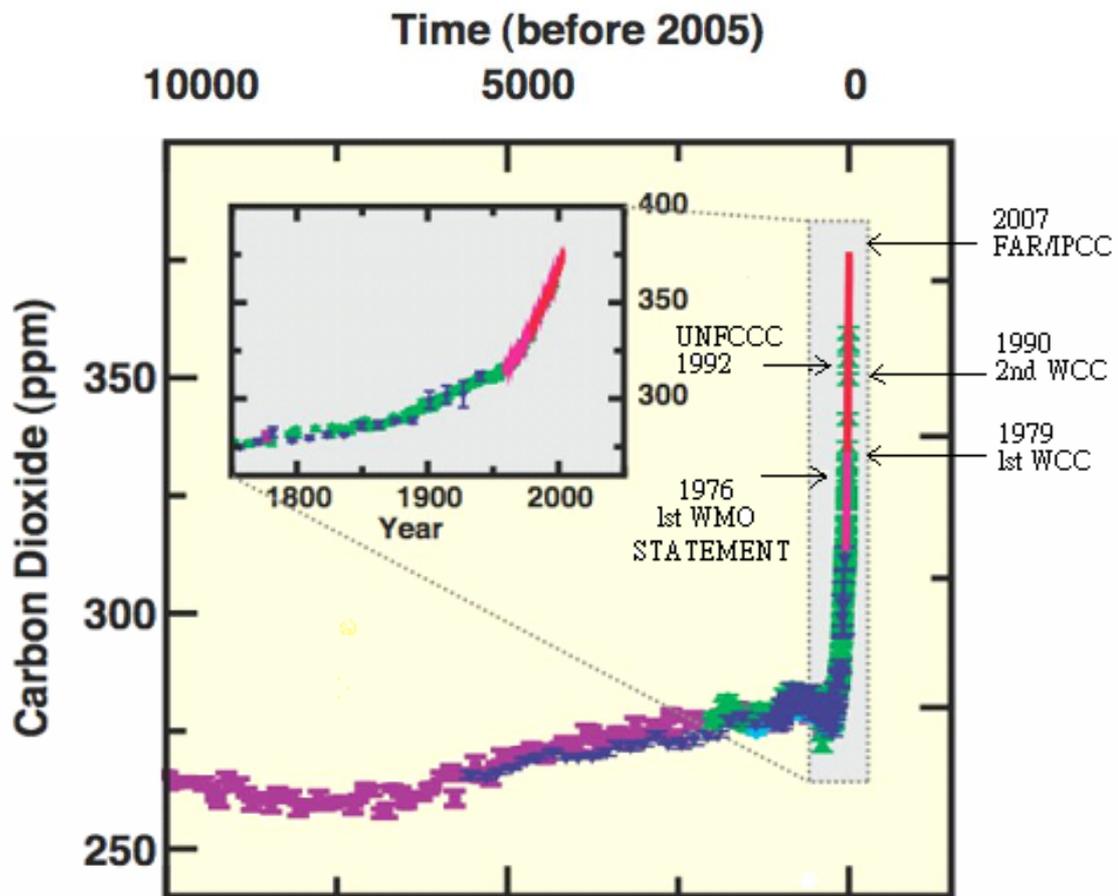


Fig. 1 Events related to climate change relative to the carbon dioxide content in the atmosphere; see text for the acronyms (background figure after IPCC, 2007)

2.2 The 1st World Climate Conferences 1979

The WMO has spearheaded the campaign to engage the world's governments in appreciating and responding to climate change. It convened the 1st World Weather Conference (WCC) in 1979, with the support of the UN Environment Programme (UNEP), the Food and Agriculture Organization (FAO), the UN Educational, Scientific and Cultural Organization (UNESCO), the World Health Organization (WHO), etc. The programme covered the physical basis of climate change, global ecology, human influence, impacts on water resources, human health, agriculture, forestry, fisheries and world economy, as well as public policy. A Declaration appealing for urgent actions by the nations was issued by the Conference, focusing on the need to improve significantly the knowledge about climate change and "to foresee and to prevent potential man-made changes in climate that might be adverse to the well-being of humanity" [WMO, 1979].

The Declaration was able to state "with some confidence" that the burning of fossil fuels, deforestation,

and changes of land use had increased the amount of carbon dioxide in the atmosphere by about 15 per cent during the last century, etc. But the state of art constrained it to the use of the words “appears plausible” when talking about “a gradual warming of the lower atmosphere”. It frankly admitted that the details of future changes in climate patterns were “still poorly understood”. However, it made certain visionary predictions viz. “It is possible that some effects on a regional and global scale may be detectable before the end of this century and become significant before the middle of the next century”. It is surprisingly accurate according to the latest IPCC assessments [IPCC, 2001 & 2007].

To approach the subject rationally, one must first understand the phenomenon of climate change *per se*. To react to climate change, all sectors have to join in. The WMO subsequently set up the World Climate Programme and later the IPCC, in collaboration with other international bodies.

2.3 World Climate Programme and IPCC

The World Climate Programme (WCP) was established by the 8th WMO Congress in 1979, shortly after the 1st WCC. It consisted of four components viz. data, applications, research and impacts on human activities. The concept of partnership has prevailed in these endeavours, with the involvement and collaboration of multiple international partners.

In terms of data, the initial WMO effort was based on the Global Observing System (GOS) and Global Atmospheric Watch (GAW). The GOS consists of the global network of observing stations operated by national meteorological services while the GAW is a specialized network coordinated by WMO with a focus on atmospheric composition. In 1992, the Global Climate Observing System (GCOS) was established, co-sponsored by the WMO, Inter-governmental Oceanographic Commission (IOC) of UNESCO, UNEP and the International Council for Science (ICSU). It builds upon existing and developing observing systems such as the GOS and GAW, Global Ocean Observing System and the Global Terrestrial Observing System. It addresses the total climate system including physical, chemical and biological properties, and atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes. The multi-disciplinary nature of the work is abundantly clear. The data collected by this joint effort provided a solid foundation for the objective assessment of climate change. By 2006, three decades after the 1st WMO statement, the coordinated observations confirmed a further addition of 50 ppm of carbon dioxide to the atmosphere, which constituted half of that added to the atmosphere since the industrial revolution in late 18th century. The observations also confirmed a range of other trends such as a rise of 0.74°C in the global temperature in the last 100 years.

The World Climate Research Programme (WCRP), established in 1985, was another multi-agency effort, co-sponsored by WMO, ICSU and IOC-UNESCO. It encompasses studies of the global atmosphere, oceans, ice cover, the biosphere and the land surface, which together constitute the Earth’s climate system. The WCRP adopts a multi-disciplinary approach and organizes large-scale

observational and modeling projects too large and complex to be undertaken by individual countries or institutions. Taken as a whole, the scientific studies have added enormously to our knowledge of the predictability of climate and the effect of human activities on climate. The data from GCOS and the research under WCRP underpin the needs of the 1992 UN Framework Convention on Climate Change (UNFCCC) and the authoritative assessment reports of the IPCC, of which more is said below.

The IPCC was co-established by WMO and UN Environment Programme in 1988, to assess the state of the climate, potential impacts of climate change and policy options in response. By 2001 when IPCC issued the Third Assessment Report, it was able to say that “most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentration” [IPCC, 2001]. Climate variability could by then be safely discounted.

Seven years into the new century, Working Group I of IPCC was able to confirm in its contribution to the Fourth Assessment Report (FAR) [IPCC, 2007] that the “warming of the climate system is **unequivocal**” and that the observed change is “**very likely** due to the observed increase in anthropogenic greenhouse gas concentrations” (mostly carbon dioxide). It was widely reported in the press and accepted by most as an authoritative statement in defining the problem. Thus, a problem first brought up by the WMO statement three decades ago was at last understood to an extent sufficient to convince most if not all to take action. But now the carbon dioxide level has reached 380 ppm (fig. 1).

2.4 2nd World Climate Conference and UNFCCC

The 2nd World Climate Conference was initiated by WMO and co-sponsored by WMO, UNEP, UNESCO, IOC, FAO and ICSU. It took place in 1990 shortly after IPCC published its first assessment report. The Conference consisted of multi-disciplinary scientific sessions as well ministerial sessions, the latter reflecting the increasing engagement of governments at the senior level in the collective global effort to deal with the problem. It also turned out to be the UN-sponsored environmental conference in Geneva getting the largest-ever media coverage.

The scientific programme included, apart from climate change *per se*, remote sensing, ocean circulation, water cycle, paleoclimate, agriculture and food, water and drought, fisheries, energy, transport, land use and urban planning, health and diseases, population and attitudes, ecosystems and species, economy, risk management, etc. This list is indeed a very good indication of climate change as being part of a much bigger array of disciplines and human issues.

At the time of the 2nd WCC, the carbon dioxide level was around 350 ppm, 20 ppm more than 1976 (fig. 1). The Ministerial Declaration recognized the unprecedented rate of climate change predicted by IPCC and its association with greenhouse gases produced by human activities [JÄGER and

FERGUSON, 1991]. It called for negotiations without delay following UN General Assembly deliberations, which later led to the UNFCCC which was established at the UN Conference on Environment and Development in 1992. Thus for the first time in human history climate change becomes a policy issue at the highest level in governments. The rest is history.

The Ministerial Declaration of the 2nd WCC also emphasized that a well-informed public would be essential for addressing and coping with a complex issue like climate change. This has to be achieved at the international, national and regional level. In the connection, at the international level, WMO, as the leading UN agency on climate matters, has been issuing Annual Statements on the Status of the Global Climate for the last 13 years. Regional Climate Outlook Forums facilitated by WMO have also provided a mechanism for capacity building at the regional level, especially in developing countries. To reach out to the community at the local level, it falls upon the meteorological services to work on it at the front-line.

3. Hong Kong Observatory

3.1 Studying the problem

The Hong Kong Observatory (HKO) as the meteorological service in Hong Kong carries the responsibility of detecting, attributing and projecting climate change locally. Following the publication of the IPCC Third Assessment report in 2001, HKO recognized that climate change was emerging as a major concern both for the world and for Hong Kong itself. Subsequently, HKO has analyzed local data since 1884 to evaluate observed climate trends in Hong Kong [LEUNG et al., 2004a]. On top of the global warming in the background, it has also looked at the added effect of urbanization [LAM, 2006]. To project into the future, HKO has downscaled the outputs of global numerical climate models run by advanced centres into local projections of temperature and rainfall for Hong Kong in the 21st century [LEUNG et al. 2004b, WU et al. 2005].

3.2 Outreach

While the above scientific studies were going on, it became increasingly clear that they alone would not stop the gradual shift of climate to a state potentially harmful to human beings. HKO as a meteorological service also has to help all sectors of the public, both public and private, appreciate the climate change taking place and understand the basic scientific causes. Only then would they be motivated and be able to choose and adopt response actions which would ameliorate rather than aggravate climate change. Therefore the results of the scientific studies were converted into projected scenarios which could be related to the day-to-day experience of ordinary people.

For example, the prediction of a 3.5°C rise in temperature by the end of the 21st century did not ring a bell with most people, since the temperature varies more than this amount within a day on most days. But when we re-phrased it to become “there will be no winter by the end of the century”, on the basis that the estimated number of days with temperature falling below 12°C would drop on average to less than one per winter (fig. 2), it became a message which everyone would understand. Looking back, the very prominent reporting of this particular point in the press in August 2004 (fig. 3) probably marked a turning point in the public appreciation of climate change as an important issue in Hong Kong itself. Before then, “climate change” was to most people a vague and remote “global” concept. From that point onwards, it became, at least to some, a subject relevant to Hong Kong, something which could be felt by and something to be concerned about by the ordinary man in the street.

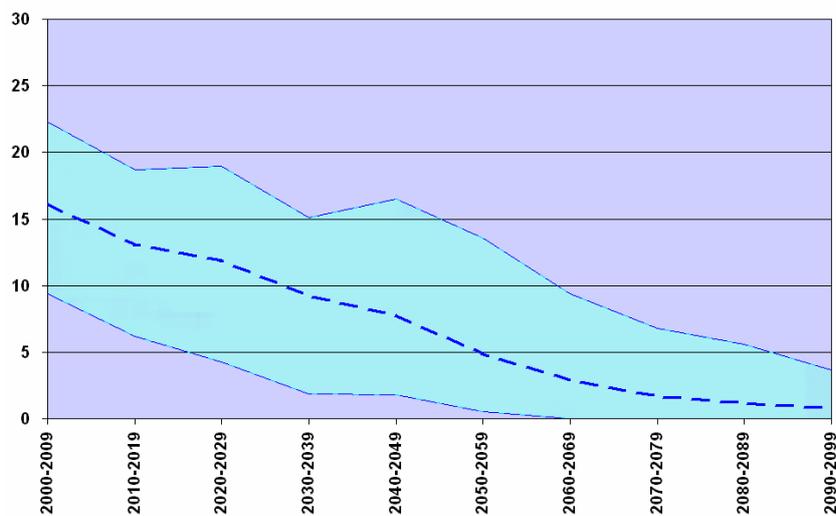


Fig. 2 Projected number of days in winter with temperature falling below 12°C



Fig. 3 Press cuttings on the “absence of winter” at the end of the 21st century

In the following year, we announced the projected rainfall situation in the 21st century. Instead of presenting purely a trend, we evaluated the probabilities of years having extreme high or low rainfall amounts. We succeeded in conveying the message that climate would become unstable and that rainfall extremes would become more frequent in the future. It too resulted in prominent reporting in the press after the press conference. The potential that droughts as serious as that in 1963, when water supply was restricted to four hours once every four days, could recur three times in the century switched on the attention of many people who went through that experience themselves. The key again was to relate the scientific findings to the real-life experience of people.

Press conferences announcing the results of the HKO scientific studies constitute only the “official” side of outreach activities. It is supplemented by HKO officers giving feature interviews in newspapers and on radio/TV programmes as well as delivering talks to schools and giving popular science lectures on other public occasions. Briefings were also provided occasionally for concerned NGOs and the academia.

While HKO put in a fair amount of effort to publicize climate change and managed to generate feature reports in the press from time to time, the level of interest in the subject remained fairly low relative to other social issues in Hong Kong, such as labour, transport and food safety. These other issues are all perceived to be “immediate” and “close”, in contrast with climate change which is slow and invisible and which is felt to be far away in the sense of both time and space.

When a TV documentary series of HKO was broadcast in 2005, the episode on “global climate change” got the lowest audience rating, sharing the fate of many other TV documentaries which carried a “global” label. Most people do not appreciate the relevance of the issue to the welfare of Hong Kong. Many of them further think that the city being so small, there is nothing which its people could do about any issue which is “global”. This is a psychological obstacle which we must work hard to remove.

3.3 More to be done

By the institutional nature of HKO, it is confined to scientific work and at most the communication of information to the population. Its portfolio does not include policy. It is therefore not in a position to develop policies or lead action programmes. Within these confines, HKO will continue to organize activities to enable the public to know more about climate change such as current trend, potential impacts, the basic causes of climate change and what people could do based on this knowledge. It will have to impress upon the people of Hong Kong that they constitute 0.1% of the world’s populations. They therefore have one vote in a thousand to determine the future of the human race under the threat of climate change. This is not at all a small responsibility.

In the near future, HKO will step up its climate-related publicity programme. It will produce a cartoon book and a video, both to introduce the concept of climate change to young children and to advocate the adoption of a life style which would use less energy and hence emit less carbon dioxide. Together with other information material, an education package will be developed to enable teachers to teach their students and to lead them doing project work relevant to climate change.

One key message which HKO will be emphasizing is that everyone contributes to climate change and so it falls upon all to take action at the individual level to reduce the damage to the atmosphere. HKO will also engage various sectors of the society, to broaden the reach of its publicity campaign together with partners such as green groups and to motivate technological innovations by scientists and engineers to reduce carbon dioxide emission or even to reverse the trend.

4. Meteorologists must act

Meteorologists must act to prevent anthropogenic climate change from escalating beyond control and becoming harmful to the human race. Meteorologists are often perceived as purely scientists. This is not good enough. Meteorologists must reach out and convey the message about climate change in a clear and easily understood language. Only then would they be truly able to trigger and sustain the total global human effort comprising a wide range of technological, regulatory and behavioural changes needed to stop harmful climate change from occurring and amplifying. In this endeavour, meteorologists must be bold in engaging a wide range of partners and must not be frightened that they might trespass into the territory of other disciplines. Climate change is by nature a multi-disciplinary subject. If everyone stays in his mental silo, it would mean the Earth heading aimlessly into a state in which human beings could not survive. People have to work together. A lot remains to be done.

References

IPCC, 2001, *Climate Change 2001: The Scientific Basis*. Cambridge U. P.

IPCC, 2007, Summary for Policy Makers, *Climate Change 2007: The Physical Science Basis*. IPCC (issued in Paris, 2 February 2007).

JÄGER, J., and FERGUSON, H.L. (eds.), 1991, *Climate Change: Science, Impacts and Policy – Proceedings of the Second World Climate Conference*. Cambridge U.P.

LAM, C.Y., 2006, On Climate Changes Bought About By Urban Living, *Proc. PGBC Symp. 2006 on Urban Climate + Urban Greenery*: p. 14-17. Professional Green Building Council, Hong Kong.

LEUNG, Y.K., YEUNG, K.H., GINN E.W.L. and LEUNG, W.M., 2004, Climate Change in Hong Kong, *Tech. Note No. 107*. Hong Kong Observatory.

LEUNG, Y.K., GINN, E.W.L., WU, M.C., YEUNG, K.H. and CHANG, W.L., 2004, Temperature Projections for Hong Kong in the 21st century, *Bulletin HK Met Soc*, Vol. 14, p. 21-48.

WMO, 1976, Resolution 12 – Climate Change, *Abridged Report with Resolutions, 28th session of the Executive Committee*: 108-110. WMO.

WMO, 1979, *Proceedings of the World Climate Conference, Geneva, 12-23 February 1979*. WMO.

WU, M.C., LEUNG, Y.K. and YEUNG, K.H., 2005, Projected Change in Hong Kong's Rainfall In The 21st Century, *Bulletin HK Met Soc*, Vol. 15, p. 40-53.