

ARE CLIMATE MODEL PROJECTIONS RELIABLE ENOUGH FOR CLIMATE POLICY?

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The ongoing debate on the global warming and climate change highlights the possibility of increased incidences of extreme weather events world-wide, as the earth's mean temperature is expected to rise steadily in the next 100 years according to most climate model projections. The recent IPCC (Intergovernmental Panel on Climate Change) document (IPCC, 2001) categorically states: *The globally average surface temperature is projected to increase by 1.4C to 5.8C over the period 1990 to 2100. The projected warming is much larger than the observed changes during the twentieth century and is very likely to be without precedent during at least the last 10,000 years.* The Climate Change document also summarizes various extreme weather events and their observed and projected changes based on model simulations. Among the extreme weather events summarized by IPCC are: *Higher maximum temperature and more hot days over nearly all land areas; increase of heat index over land areas; more intense precipitation events and increased summer continental drying and associated risk of drought.* Besides these weather events, the Climate change document also makes projections of major climatic events and states: *El Niño events may show small increase in amplitude but its impact in terms of droughts and floods will increase. The warming associated with increasing greenhouse gas concentration will cause an increase of Asian summer monsoon variability.*

A number of recent papers appearing in peer-reviewed literature have questioned many of the IPCC projections on future warming of the earth's surface and associated increase in extreme weather events. It is important to briefly review these recent studies and make an assessment of present status of the global warming science. Such an assessment is essential for developing a Climate Policy consistent with the emerging view of the state of science. In this viewpoint, some of the climate model projections are briefly assessed in the light of recent studies.

PROJECTIONS OF FUTURE WARMING

Several recent articles have suggested that the future warming of the earth's surface will only be moderate and may not be as catastrophic as projected by IPCC documents

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and climate model projections. Two papers are worth examining here: A paper by Michaels et al (2002) makes revised projection of warming in the 21st century, using a more realistic future growth of CO₂ based on recent 25 year period and an adjustment to climate sensitivity resulting from the 'adaptive iris effect' due to changing cloud cover as suggested by Lindzen et al (2001). Michaels et al obtain a range of warming from 1.0C to 3.0C with a central value of 1.8C for the next one hundred years. In another paper by Sun and Hansen (2003), the NASA/Goddard climate model is integrated with an improved scheme for sequestering of heat by global oceans. Sun and Hansen obtain warming in the next fifty years of only about 0.5C or so, if an alternative climate forcing of 1.1 W/m² is used between 2000 and 2050. Even with a Business As Usual (BAU) scenario, Sun and Hansen obtain a warming of about 1.2C in the next fifty years, less than what IPCC has projected. Further, most climate model projections are based on emission scenarios from the IPCC Special Report on Emission Scenarios (SRES). In a recent paper by Castles and Henderson (2002), these SRES have been closely examined and it is argued that many of these scenarios are not realistic in terms of future growth of world economies. Thus, future growth of CO₂ and other greenhouse gases is expected to be significantly lower than IPCC projections and this in turn would lead to reduced warming.

GLOBAL WARMING AND EXTREME WEATHER

The possible link between global warming and extreme weather events has been extensively referred to in many informal articles and news stories on worldwide extreme weather events. Worldwide incidences of extreme weather events and their impacts on the society are reported in news and print media more often at present than they were reported ten or twenty years ago. According to Unger (1999), television viewers in the USA are three times more likely to see a story on severe weather today than they were only 30 years ago. In Canada, news items re: release of regional or national reports on climate change (including release of IPCC 2001 documents) have received front-page coverage and bold headlines in the last six years. Improved satellite and information technology have also helped in producing instant coverage of many extreme weather events which would have gone unnoticed, just a few years ago. The increased worldwide coverage of extreme weather events has created a perception of global warming/extreme weather link.

When closely analyzed, the global warming/extreme weather link is more perception than reality. Many studies referred in the IPCC documents when carefully analyzed, reveal that the warming/extreme weather link is tenuous at best at this point in time. In a report on *Trends and Changes in Extreme Weather Events* published by the Government of Alberta (western Canada), I have concluded that extreme weather events like heat waves, thunderstorms/tornadoes, rainstorms etc. are not increasing anywhere in Canada at this point in time (Khandekar, 2002). Based on a careful analysis of available Canadian data, I have further concluded that the likelihood of increased incidences of extreme weather events in the next ten to twenty-five years remains very small at this time. A recent special issue of *Natural Hazards* (June 2003, Vol.29, No.3) has several papers dealing with the issue of global warming and extreme weather and most of the papers do not suggest any definite link at this point in time.

A paper by Balling and Cerveny (2003) appearing in the special issue makes a survey of extreme weather events in the USA and concludes no increase in severity of any of the weather events mentioned in IPCC list of extreme weather. Further, increasing economic losses in the conterminous USA in recent years is due to societal change and not due to global warming, according to another survey paper by Changnon (2003) appearing in the same issue.

The IPCC table of extreme weather events refers primarily to summer season extreme weather events like thunderstorms/tornadoes, rainstorms, heat waves and increased heat index etc. Several extreme weather events, normally associated with winter season, have been reported with increasing frequency in recent years. For example, the consecutive winter season of 2002/03 and 2003/04 were unusually severe and longer in eastern Canada and USA and also in parts of Europe. The unusually long and cold winter of 2003 was felt as far south as Vietnam and Bangladesh where several hundred people died of exposure to a month-long cold weather. The seaboard states of eastern USA have been experiencing increased snow accumulation in recent years. During a heavy snow storm in February 2003, some locals in Baltimore/Washington region recorded snowfall of close to 100 cm in 24 hours! The recent winter (2003/04) saw a major winter storm in New York city and vicinity when an all-time record breaking snow accumulation (~50 cm) occurred at the earliest date (December 5, 2003). In eastern Canada, St. John's, Newfoundland recorded highest ever snow accumulation in one season, almost 650 cm from November 2000 through May 2001! In February 2004, the city of Halifax in eastern Canada received a record-breaking 100 cm of snow in a 24-hour period! The winter season of 1995/96 was one of the longest and coldest in western Canada when the city of Winnipeg set a new record of consecutive number of days of snow on the ground – a whopping 156 days! Many other winter weather extremes have been reported in recent years. Interestingly, neither the IPCC document nor any of the climate models make any reference to changes in winter extreme weather events in future climate projections.

VARIABILITY IN EL NIÑO AND ASIAN MONSOON

The long and unusual El Niño event of 1990–95 prompted a couple of studies (Trenberth and Hoar, 1996; Trenberth, 1998) with a suggestion that climatic events like El Niño may become more pronounced and/or more frequent in a warmer world. However, Rajgopalan et al (1997) have examined the suggestion by Trenberth and others and have shown using a non-parametric statistical technique that the 1990–95 El Niño could have occurred through natural climate variation. Since the 1997/98 El Niño event (probably the strongest El Niño event in 100 years), the ENSO (El Niño-Southern Oscillation) cycle has been in a cold (La Nina) phase for the past four years and the present ENSO phase indicates only a mild El Niño to occur by the end of 2004. The Asian Monsoon variability has been examined in a recent paper by Kriplani et al (2003) using a 130-year long IMR (Indian Monsoon Rainfall) series. The authors (Kriplani et al) conclude that the strength and variability of IMR does not show any change in recent years due to global warming. Another paper (Chase et al, 2003) on changes in observed global Monsoon circulation document that since 1950 global Monsoon circulation has significantly diminished in four important tropical Monsoon

regions. The findings of Chase et al are contrary to the IPCC projection of intensification of global hydrological cycle in a warmer world.

There are several other issues re: global warming /climate change science that are being debated at present. A pivotal issue that *the recent warming of the earth's surface is likely to have been the largest of any century during the past 1000 years* (IPCC, 2001) is being vigorously discussed through peer-reviewed studies at present. A recent paper by McIntyre and McKittrick (2003) reconstructs the temperature history using all available proxy data (tree-rings) and finds that the twentieth century warming is unexceptional when compared to the warming of the MWP (Medieval Warm Period). Another recent study (Esper et al, 2004) shows that the amplitude of the warming during the MWP could be larger than the recent warming.

CONCLUDING REMARKS

Several other studies, not referenced here, have questioned many other climate model projections. A few other studies have questioned the precise cause of the recent warming, whether the warming is due to anthropogenic CO₂ increase or due to human activity on ground (urbanization etc.). There is a definite need to reassess the present state of the global warming science. A Climate Policy like Kyoto ratification and implementation must be based on a thorough understanding of the cause and consequence of global warming.

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