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Review Article

Climate Change & Cold Weather Extremes an Overlooked Issue in The Present Climate Debate

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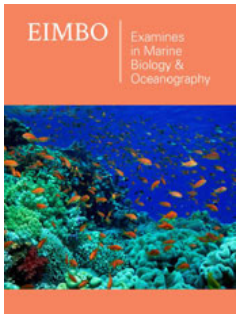

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Abstract

The debate on warming of the earth's climate due to rising levels of atmospheric CO_2 and associated climate change has gone on for over 40 years. Environmentalists and news media continue to point out increasing incidences of extreme weather events (e.g., heat waves, droughts/floods) and their harmful impacts on human societies. There is mounting evidence of increase in cold weather extremes which is at odds with the pervasive view of a warming climate. This paper deals with this overlooked but important issue of climate change and cold weather extremes. A brief overview of the global warming science as espoused by the UN climate body; IPCC (Intergovernmental Panel on Climate Change) is presented. Several examples of cold extremes since the new millennium are provided and briefly discussed. Short comments on the perceived "Climate Catastrophe" and the 'net-zero-by-2050' theme are provided in the end.

Introduction

The ongoing debate on the warming of the earth's climate (due to human-CO_2 emissions) and its impact on worldwide humanity continues unabated. Most news media in Canada and elsewhere continue pointing out recent extreme weather events and its possible linkage to the warming of the climate in about the last 50 years or about. Among the extreme examples cited in 2021:

- Extreme high temperatures: (ex: in Lytton, British Columbia (BC) Canada, a high temperature of 49.5^{0}C reported on June 29, 2021: parts of Greece recorded very high temperatures-over 40C, resulting in widespread forest fire activity).
- Droughts over the Canadian Prairies
- Very heavy rains with extensive flooding in the BC (Canada) interior during October-November 2021.

Many other warm weather extremes, Ex: summer floods in Germany were also cited by various media to suggest how present warming of the earth's climate will produce such extreme weather events in the future causing substantial economic damage on a global scale. At the COP26 (Committee of Parties) Meeting of the IPCC held in Glasgow, UK in November 2021, many environmentalists as well as the UN Secretary General Antonio Guterres made passionate appeals to world leaders to stem the growth of CO_2 and keep future warming of the earth's temperature below 1.5ºC. to avoid a "Climate Catastrophe (CC)". Many young climate activists present at the Glasgow meeting also re-iterated the theme of impending CC and urged the IPCC to help keep future climate stable and livable and avoiding catastrophic warming of the climate. Several weather & climate Agencies (e.g. NOAA & NASA in the US) have compiled a long list of extreme weather events and their deleterious impacts on humans living in large cities and rural areas of the world. This current media hype about Increasing Warm Weather Extremes (WWE) makes no mention of extreme cold events which appear to be on the rise in recent years. In recent years, various regions of the world are witnessing Cold Weather Extremes (CWE) accompanied with heavy snowfall which has been disrupting transportation and having an economic impact. These CWE are mostly ignored by the media and often lumped

with WWE as part of climate change impacts. Increasing incidences of cold extremes appear to be the new reality of climate change. This is an important and an overlooked issue in the present debate on climate change.

This paper provides a brief overview of the science of Global Warming (GW) and Climate Change as espoused by the IPCC: it further provides examples of recent cold extremes from various regions of the earth, where cold extremes have been reported since the new millennium. A possible linkage between worldwide CWE-Cold weather extremes and the approaching solar grand minimum is made in the concluding remarks.

The Global Warming Science Espoused by the IPCC

The IPCC was established in 1988 with a mandate to provide a summary of the earth's climate on a periodic basis. In its 1996 assessment report the IPCC made an important sacramental statement: "There is a discernable human influence on the earth's climate". This statement was meant to suggest that the human-CO_2 emissions of world nations was impacting the earth's climate by making the climate warmer. This hypothesized warming of the climate by human-CO_2 emissions has now come to be identified as GW-Global Warming, which is now morphed into the more popular and frequently used term Climate change. It is of interest to note here that the IPCC has never thoroughly established a definitive linkage between the modest (0.8C or about) warming of the earth's climate since about 1978 and the rising levels of CO_2. Furthermore, since the new millennium, there has been no additional significant warming of the earth's climate and this lack of warming is often referred to a 'warming hiatus' in climate model simulations. As such, this debate on the linkage between warming of the climate and rising levels of CO_2 emissions has continued to generate interest in scientific community and news media.

In subsequent IPCC reports several additional statements were made, in particular: extreme weather events & their linkages to rising levels of CO_2. The IPCC continued its theme of that extreme weather (specifically WWE-Warm Weather Extremes) would be on the rise, as the climate continues to warm further [1]. The IPCC never made any reference to CWE-Cold Weather Extremes, in any of their various documents published since its inception in 1988. In the 2007 climate reports [2], the IPCC once again re-iterated its theme of a warming climate and added a categorical statement that "In future, the earth's climate will see fewer frost days and milder winters; snow may disappear from land areas of the earth in a decade or two". This pivotal but contentious statement is the focus of this paper. The discussion below shows that the IPCC projection is at odds with the reality of the climate. CWE are being reported with increasing frequency since the new millennium and in last five years.

The Cold Reality of Present Climate Change

It is noteworthy that cold extremes in various parts of the world have been reported in various news media since the new millennium; however, these events were either identified as part of natural climate variability or would often be identified as manifestation of 'climate change impact'. The first decade of the new millennium saw four winters-2002,2005,2007&2008- which were quite severe over Europe and North America. The severity of 2002/03 winter was felt as far south as Vietnam and Bangladesh, where several hundred people died of a month-long exposure to colder weather [3,4]. The winter of 2005 was especially harsh and severe over most of Europe and over eastern Europe.

The year 2008 was one of the coldest years according to Plimer, [4] who identified several cold extremes in China and parts of south Asia. The unusually colder winter month of February 2008 destroyed 40% of rice crop in Vietnam and killed several thousand head of livestock; elsewhere, extreme low temperatures (ranging from -37C to -40C) were recorded in several North American locales. The winter 2008/09 was once again severe and snowier over most of North America. The winter of 2013/14 was possibly one of the longest, coldest, and snowiest over most of Canada and the conterminous US. Several thousand flights were cancelled at major airports in US and Canada. According to the OECD (Organization of Economic Cooperation & Development, Paris) the winter severity of 2013/14 led to an economic drawdown by 2% or more over Canada and the US [5].

Figure 1 below, which is along the lines of our 2018 publication shows almost one M km^2 (2%) increase in Northern Hemispheric (N.H.) snow cover for the period 1980-2021. The increase is clear since 2000 when 8 of the last 21 winters experienced above trend snow cover. Five of the 15 years since 2007 have been above the 42-year trend. Where is the disappearing snow cover extent and milder winters that the IPPC predicted in 2007? The spike in N.H snow cover in 2009 and 2010 coincided with the deepest solar minimum since 1913. The years 2007-2010 saw less than 15 sunspots a month. The impact of sun on the earth's weather & climate anomalies has also been identified by several researchers in recent years (ex; van Geel B et al. [6]). Apart from Europe and North America, winter severity was also felt in parts of South America- Argentina and Chile in particular. Snow fell in Buenos Aires in July 2007 for the first time after 1918 and a locale in Argentina reported a low temperature of -25ºC. In 2010 July, several dozen people died of extreme cold in Chile and July 2013 saw snow in southern Brazil, hanging from palm trees! Besides Europe and the Americas, cold extremes have also been reported in various other regions: Northeast China, Japan, & the Middle East. In Northwest India & the foothills of the Himalayas in the Kashmir valley, heavy snowfalls have occurred with increasing frequency in last ten years. The winter severity during December 2011-January 2012 led to several dozen deaths in parts of northern India, mostly elderly people living in poorly built houses with no insulation or heating. Numerous other examples of CWE, over North America, Europe, Japan, China and elsewhere are listed in the enclosed references [3,5,7].

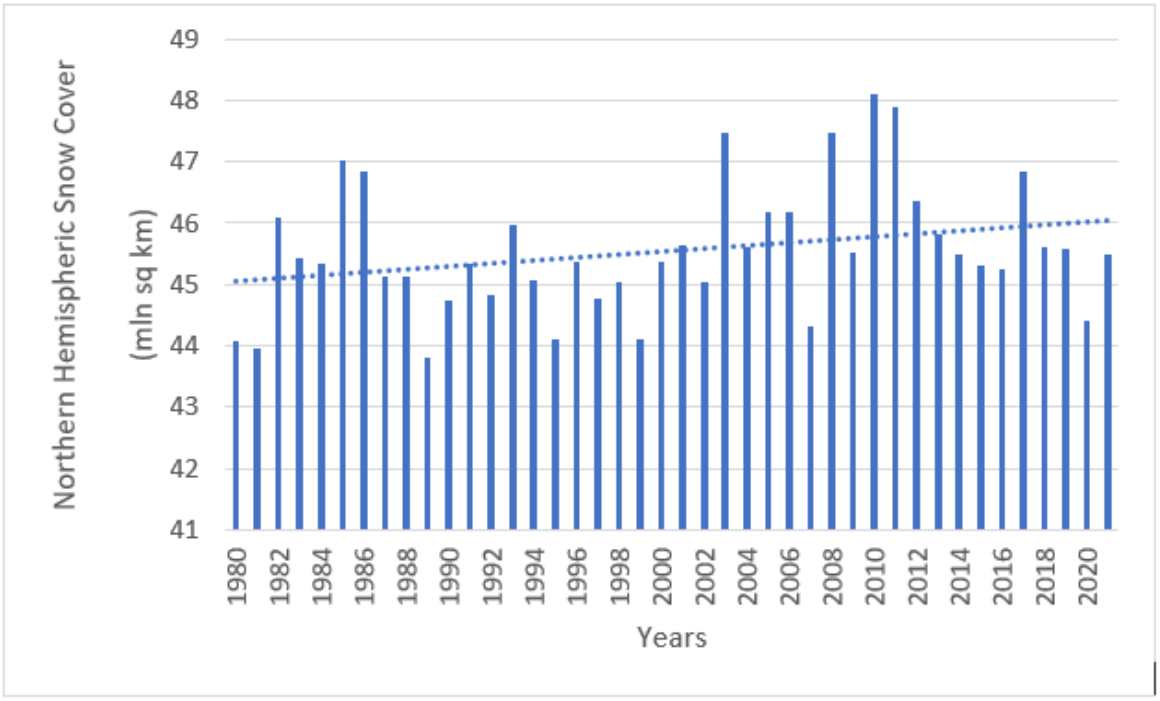

Figure 1: Winter N.H. snow cover extent 1980-2021.
Source: Rutgers University Snow Lab US.

A Suggested Mechanism

Most media and popular scientific magazines generally provide only scanty details on cold extremes, lumping these events with warm extremes. Cold extremes are governed by a totally different mechanism than warm extremes; it is scientifically incorrect to simply combine cold and warm extremes together using a simplistic 'climate change' argument. Among the possible factors favoring cold extremes are large-scale circulation patterns, like PDO- Pacific Decadal Oscillation and NAO-North Atlantic Oscillation: Solar variability & the approaching solar grand minimum. Let us analyze these factors in brief:

a. PDO: This large-scale oscillation, which encompasses the ENSO (El Nino-Southern Oscillation) cycle is an important large-scale atmosphere-ocean oscillation dominating the equatorial Pacific surface temperature structure from the west coast of South America to Indonesia. An El Nino (warmer sea surface temperature in the equatorial eastern Pacific) generally produces warmer winters for most of western Canada and large part of the conterminous US. A La Nina phase on the other hand, produces colder winters for most of western Canada and parts of southeastern US. The change-over from an El Nino phase to a La Nina phase is irregular with a timeframe of three to seven years [8]. Currently, the PDO is in a La Nina phase and this cold phase of the ENSO cycle seems to be exacerbating winters over North America and elsewhere in the US and possibly over parts of Europe as well. Several global temperature data sets provide excellent graphs on El Nino/La Nina events of last 40 years or so (ex: "Climate4U" Prof Ole Humlum Norway)

b. NAO: This oscillation pattern, dominates the weather & climate anomalies over most of northeast US and Canada and most of western Europe. A positive phase of NAO brings in warmer winters, while a negative phase produces much colder winters for western Europe and for the Atlantic Canadian Provinces and parts of northeast US [9].

c. Solar variability: A commonly used index to measure solar variability is the sunspot numbers. With more sunspots, the sun becomes very active, while fewer sunspots mean a weak sun. At present, the sun is approaching a Grand Solar Minimum (GSM), which means a weak sun and low TSI-Total Solar Irradiance at the top of the atmosphere. According to Khandekar et al. [10], a weak sun impacts global atmospheric flow patterns leading to increasing cold extremes in various regions. During the LIA-Little Ice Age, the sun was in a minimum phase called the Maunder Minimum. This minimum phase of the sun was likely responsible for extreme cold winters over most of Europe and elsewhere, from approximately 1650 till about 1850 or so; this period now identified as the LIA [11].

It is proposed here that a combination of the above factors provides a plausible mechanism for a colder phase of the earth's climate at present. This colder phase appears to trigger cold weather extremes worldwide.

Concluding Remarks

Increasing cold weather extremes on a global scale is a reality. This aspect of changing climate has been sorely overlooked by the media and by the climate science community. The earth's climate appears to be in a change-over phase at present and may be entering a colder phase soon. Will cold weather extremes continue to increase in future? Is the earth's climate becoming colder at present? There is no definitive answer at present except to point out the observed satellite-based temperature trend in the global atmosphere suggesting global cooling in the past 18 months. (Figure 2) Finally, the currently pervasive issue of CC-Climate Catastrophe continues to gather steam with the 'net-zero by 2050' theme in full swing. Among many questions for the global leaders and the climate science community are: Is there a Climate Catastrophe? What is the criterion? Is there a need to reduce worldwide CO_2 emissions?

Many other important issues remain unresolved in the ongoing debate on this most important scientific issue of our time.

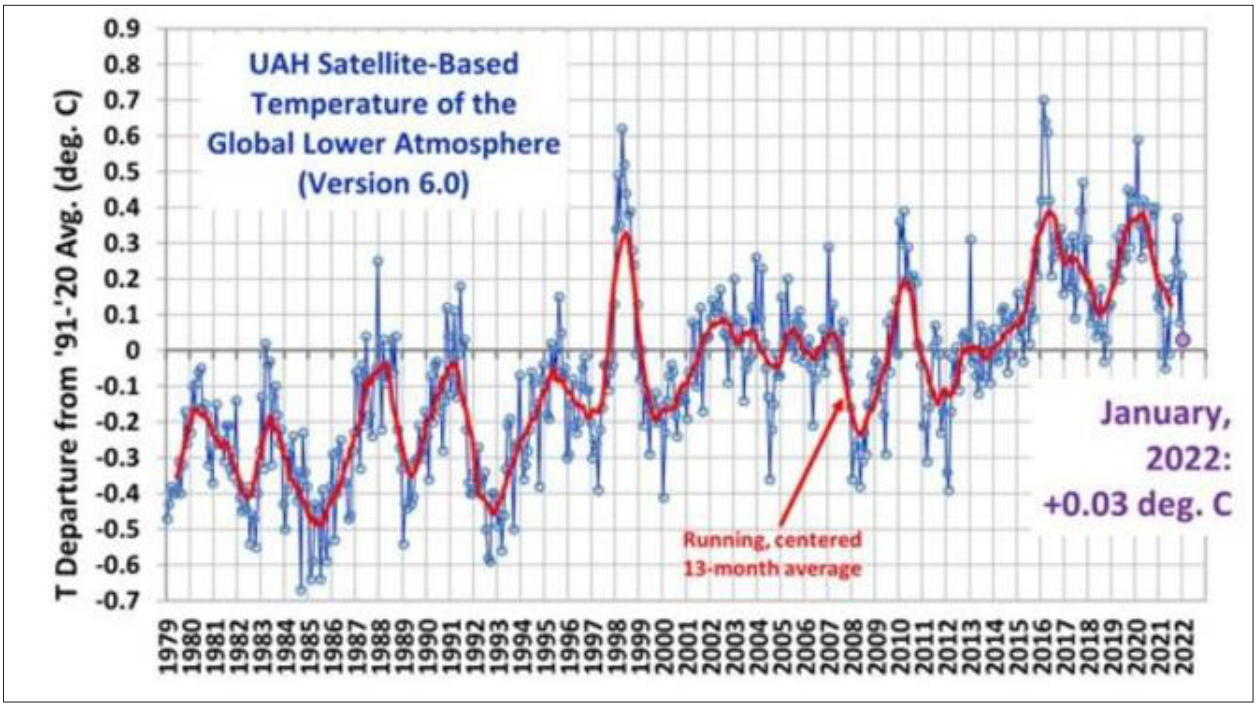

Figure 2: Courtesy of Roy Spenser, author, and former NASA scientist.

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Appendix

There have been numerous cold weather extremes, since the beginning of the new year 2022: From western Canada to southeastern US, to Greece to Turkey to Iraq. We have selected five examples of cold extremes with heavy snows, snarled traffic, and extreme low temperatures. At the time of writing this paper, a major nor-easter identified as a "weather bomb" was developing over northeast US and Canada. A winter blizzard was declared from New England to New Jersey (January 29-30, 2022) and up to two feet of snow was expected to be dumped over Boston and New York city. Another winter storm with dangerous conditions from Northeast US to Mid-West & further down to Texas developed in the first week of February: There were over 6000 flight cancellations at major US airports (February 3rd, 2022) and power outages were reported from Tennessee to Texas for close to half a million houses. The winter severity of this year is felt as far away as North-West India which was in the grip of a cold wave for most of January 2022 (For latest snowstorms - refer to the website Electroverse). See examples of snowstorms below in Figures 3-7 below.

Figure 3: Jan. 6, 2022, Record-breaking snowstorms snarl transport across U.S. shutter the federal government and bring Washington D.C to a standstill with close to 12 inches of snow. Source: Google search on Electroverse

Figure 4: January 21, 2022, Nashville, Tennessee, U.S. experiencing snowiest January since 1985. Source: Electroverse

Figure 5: January 24, 2022, Heavy snow in Athens Greece; Source: Electroverse

Figure 6: Jan. 25, 2022, Istanbul, Turkey Airport shut, cars banned with 1000s stranded in vehicles with largest power outage ever reported Source: Electroverse

Figure 7: January 18, 2022, Erbil, Iraq reports -15°C with risk of pipes freezing with inadequate infrastructure for such cold and snow. Source: Electroverse

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