

## Global Warming (GW) & Extreme Weather (EW) Link: Are Cold Extremes On The Rise?

Madhav Khandekar<sup>1</sup> and Ray Garnett<sup>2</sup>

Consulting Meteorologist, Unionville, Ontario, Toronto Canada

### Corresponding author

Madhav Khandekar is a former research scientist from Environment, 52 Montrose Crescent, Unionville, Toronto, Canada

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### Introduction

The ongoing debate on the GW/EW link continues unabated; media and environmentalists have linked the warming of the earth's climate (due to human-CO<sub>2</sub> emissions) as being responsible for more extreme weather (EW) events in recent years. The IPCC (Intergovernmental Panel on Climate Change, a UN Climate Body) has identified several EW events (e.g., heat waves, droughts, floods) as being linked to the warming of the climate [1, 2, 3].

The annual COP (Committee of Parties) meetings of the IPCC (most recent COP meeting was held in Madrid Spain, November 2019) have been emphasizing the need to reduce worldwide CO<sub>2</sub> emissions, so as to minimize future adverse impacts of EW on world humanity. What is the reality? It is important to note at the outset that EW events are part of natural climate variability and have always occurred in the earth's climate [4, 5]. Even when the earth's climate was cooling down during the 1945-77 period there were as many EW events as there are now; however, the media and the climate science community paid very little attention to many those EW events [3, 4]. For example: A tropical cyclone named Bhola struck East Pakistan (now Bangladesh) on October 12-13 1970, and killed an estimated one quarter of a million people; this was possibly the largest human fatality due to a single weather event. Sadly, however, most of the media in North America at the time provided only scanty details on this tragic event. Several other EW events with regional, national or worldwide impacts occurred during the period 1945-77, when the earth's climate cooled by about 0.25°C [5, 6].

Again, most of the media did not bother to report many of these events, as they were not considered newsworthy. Fast forward 50 years and today we see a plethora of news items on EW: There is now growing interest in the media in promoting the GW/EW link and its deleterious impacts on humanity. As a recent example: the bush fires in southeast Australia during November-December 2019 captured headlines in the global media's, with long commentaries on "How such bush fires are devastating Australia's forestry and that only a drastic reduction in worldwide CO<sub>2</sub> emissions would bring these bush fires under control". Despite the media obsession on reporting extreme weather today, it is worth noting that EW events are not on the rise; It is more perception than reality [5].

### Cold Extremes

Interestingly, recent years have seen increasing cold weather extremes (extreme low temperatures, heavy snowfalls & longer winter seasons) in many parts of the world, especially over the Northern Hemisphere [5, 7]. These cold extremes are inflicting increasing economic damage in many major cities and townships over North America and Europe. A recent paper lists 25 cold extreme and associated economic impacts [8]. The winter season of 2013/14 over North America, was one of the longest, coldest and snowiest and inflicted an economic impact of about US\$100 to 150 billion dollars on USA and Canada (combined). The winter season of 2014/15 witnessed the heaviest snowfall accumulation in the city of Boston (US) in over 125 years; the same winter saw heavy snow avalanches in Afghanistan where over 250 people perished in February 2015. In December 2016, the city of Vancouver on the west coast of Canada received over 60 cm of snow inflicting economic damage of over two billion [8]. The most recent winter (2019/20) saw a massive blizzard over Newfoundland (eastern Canada) with snowfall of over 75 cm over a large area of Newfoundland; the city of St John's was 'cut-off' from the rest of Canada for over 36 hours, as a consequence of heavy snow accumulation. Figure 1 below shows that Newfoundland's 2019/20 winter season was not over as of March 20.



**Figure 1:** Newfoundland and Labrador farmers seriously hampered by historically harsh winter. Source: google search on Electroverse, March 19, 2020

These increasing cold extremes appear to be at odds with IPCC projections which categorically stated (IPCC 2007) that ‘winters in future would be milder and snow may disappear from land areas of the earth in a few decades’. Further, there is a new twist in the reporting of such cold extremes of recent years, namely that “the cold extremes are due to the warming of the earth’s climate”! To illustrate this point, it may be noted that just a few weeks/months ago (mid-January 2020), an extreme cold spell over North America produced wind-chill values of -50°C and lower, in some mid-western US States and in western Canada. Most of the media reported such cold extremes as being caused by Global Warming! This explanation is simplistic and lacks scientific credibility.

The increasing cold extremes of recent years in many parts of the world (especially over the Northern Hemisphere) appear to be the present reality of a changing climate. The Northern Hemisphere has witnessed five severe winters since the new millennium (e.g., 2002/03, 2005/06, 2009/10, 2011/12 and 2013/14) and the brunt of winter severity has been borne by Western Europe in particular. The winter of 2012/13 was extremely cold and snowy in parts of France, Germany, Belgium and Poland, with the city of Berlin experiencing its coldest winter in 100 years. Many more examples of extreme cold and heavy snow accumulation over Europe, North America and even in parts of northern India are provided in the “Extreme Weather” Chapter of the comprehensive Volume “Climate Change Reconsidered II: Physical Science” [9].

How do we explain such cold extremes in a warming world? Climate models provide no mechanism to explain these cold extremes. Recent studies have linked the extremely cold winters over Europe & North America, to the weakening of the sun and associated ‘low solar activity’ [10, 11]. Could this (a weakening sun) be the main reason for increasing cold extremes of recent years? The current period of low solar activity (sunspot cycles 24 and 25) has been named the Eddy Solar Minimum which is depicted in Figure 2. Sunspot cycle #24 is the last one shown [12]. This “Eddy Minimum” (see Figure 2) appears consistent with the De Vries-Suess cycle of about 210 years described by various scientists [13, 14, 15]. The period 1814-1823 in the Dalton (solar) minimum brought severe economic depression to northern Europe associated with extremely cold weather [16]. Between 1814 and 1823 there was an average of 22 sunspots per month with a peak of 46 sunspots in 1816. Recent years (2018, 2019 and 2020) have seen an average of 11.6, 4.8 and 1.7 sunspots per month respectively (September to August). The average for the period 1985-2018 is 55.8 sunspots per month.

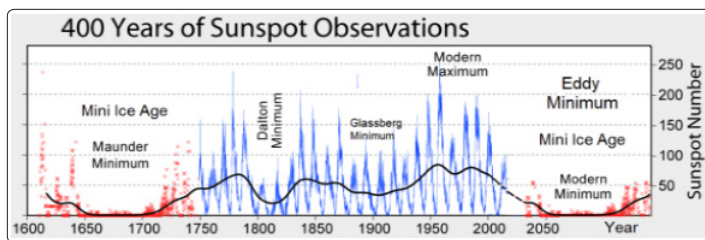


Figure 2: Source: Google search on Electoverse.

### Concluding Remarks

There is mounting evidence that CWE (Cold Weather Extremes) are on the rise in various regions of the world since the new millennium. The simple explanation by the media and in scientific literature that such cold extremes are a result of Global Warming (GW) is

misleading and without any scientific merit. Climate models and various IPCC documents do not provide any explanation of these cold extremes. It is tempting to link these CWE to the weakening of the sun and the approaching grand solar minimum as suggested in several recent studies [10, 17, 18, 19]. According to Morner and Landscheidt the sun may enter into a grand solar minimum by about 2030-2040 that could usher in a ‘colder phase’ of the earth’s climate with a distinct possibility of more CWE in coming years. Among the parameters responsible for ushering a colder phase of the climate are: variation in TSI-Total Solar Irradiance, solar wind and global cloud cover changes [20].

Selected examples of cold weather extremes with accompanying snow accumulation are given in the text above. Many more examples of cold extremes are provided in several references listed below. When taken together, these cold extremes appear as an anomaly and a puzzle. What is driving these cold extremes? We have hypothesized a ‘weak sun’ as a possible link to these cold extremes. More exploratory work on the “Sun-Climate” relationship will hopefully provide definitive answers in the near future.

It is important to differentiate between “Warm Weather Extremes (WWE)” (e.g., heat waves floods/droughts etc) as defined by the IPCC and recent “Cold Weather Extremes (CWE)” as described above. These two weather extremes are often lumped together as a ‘manifestation of the Global Warming impact’. This is false. The WWE and CWE are driven by different physical mechanisms and require different adaptation or mitigation strategies. Finally, are Cold Weather Extremes –CWE-- on the rise in the next decade? Only time will tell!

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We wish to dedicate this commentary to the memory of our friend, (late) Dr Tad Murty, former Editor of the Natural Hazards (Kluwer, Netherlands); Tad has inspired large number of scientists and students with his life-long dedication to the science of climate change, extreme weather and their impact on human societies.

1. Madhav Khandekar is a former research scientist from Environment Canada and was an Expert Reviewer for the IPCC 2007 climate change and documents. Khandekar is on the editorial board of the international Journal Natural Hazards NHAZ (Kluwer, Netherlands) since 2000.
2. Ray Garnett, formerly of the Canadian Wheat Board, currently operates a home-based business Agro-Climatic Consulting (ACC).

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